10th ISC International Symposium on the Cretaceous

August 21–26

Vienna 2017

Benjamin Sames (Ed.)

ABSTRACTS

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BENJAMIN SAMES (Ed.)

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Benjamin Sames, Editor

Dr. Benjamin Sames, Universität Wien, Department for Geodynamics and Sedimentology, Center for Earth Sciences, Althanstraße 14, 1090 Vienna, Austria.

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10th ISC Logo: Benjamin Sames
The 10th ISC Logo is composed of selected elements of the Viennese skyline with, from left to right, the *Stephansdom* (St. Stephen's Cathedral), the *Wiener Rathaus* (city hall), the *Wiener Riesenrad* (big wheel) and the *Donauturm* (Danube Tower). The star-shaped nannofossil in the big wheel is the plan view of a large form of the Coniacian to Campanian coccolith *Lithastrinus grilli* STRADNER, 1962 (gen. et sp. nov.) in 'Upper Cretaceous stratigraphic color', used here in honor of the renowned Austrian micropaleontologist Herbert Stradner. The clouds comprise of elements of the suture of the Cenomanian to Turonian ammonite *Spathitoides sulcatus* WIEDMANN, 1960 (after KENNEDY, WRIGHT & HANCOCK, 1980). The text is in 'Lower Cretaceous stratigraphic color'.

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10th International Symposium on the Cretaceous, Vienna, August 21–26, 2017

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CONFERENCE MANAGEMENT

Eventmanagement
University of Vienna
Universitätsring 1
1010 Vienna
Austria

Contents

Programme

1.1. Preliminary Conference Programme and Talks I–X

1.2. Poster Programme XI–XIV

Address of Welcome XV

Tribute to Dr. Herbert Stradner XVII–XXVI

Egger, H.: To Herbert Stradner XVIII
Young, J.R.: Dr. Herbert Stradner XIX
Hay, W.W.: Dr. Herbert Stradner XX
Haq, B.U.: A personal Tribute to Herbert Stradner: a consummate discoverer and an incomparable scholar of the "inner space" XXI

Abstracts in Alphabetical Order of the First Authors 1–313

Alphabetical Index of Authors 314–320

Preliminary Program of the 10th International Symposium on the Cretaceous

Field Trips:	
17. - 20. August 2017	PRE-1: Upper Cretaceous and Paleogene at the northwestern Tethyan margin (Austria, S Germany): Boundaries, Events, Cycles and Sequences (4 days bus excursion)
19. August 2017	PRE-2: Lower to mid-Cretaceous of the Western Carpathians, Slovakia (1 day bus excursion)
20. August 2017	PRE-3: Cretaceous Building Stones of Vienna (1/2 day city walk)
25. August 2017	POST-3: Eustasy and sea-level changes in the footsteps of Eduard Suess (1 day bus excursion)

Sunday, 20. August	Ice Breaker Party at the Natural History Museum Vienna, starting at 19:00 (Doors open at 18:45)

Monday, 21. August - Events HS 8			Monday, 21. August - Stratigraphy HS 7		Monday, 21. August - Paleontology HS 5	
9:00-10:00	Opening					
	Coffee Break		Coffee Break		Coffee Break	
10:30-11:30	HS 8: Solemn Award Ceremony: Bestowal of the Eduard-Sueß-Medal of the Austrian Geological Society to Dr. Herbert Stradner					
	T3.E03 Deciphering Cretaceous environmental pertubations		T1.S16 Cretaceous sequence stratigraphy		T5.P00 Open Session on Cretaceous palaeontology	
11:30-11:45	Price	A high-resolution belemnite geochemical analysis of Early Cretaceous (Valanginian-Hauterivian) environmental and climatic perturbations	Kakabadze	New Data on the Upper Barremian–Aptian Bio- and Sequence Stratigraphy in the Racha Region (West Georgia)	Moreno	Aptian ammonite biostratigraphy of the Sierra del Patrón section, Durango State, Northeast Mexico
11:45-12:00	Schmitt	An integrated bio-chemostratigraphic framework for Lower Cretaceous (Barremian-Cenomanian) shallow-water carbonates of the Central Apennines (Italy)	Wilmsen	Early Late Cretaceous sea-level changes: new insights from Cenomanian-Turonian successions around the Mid-European Island	Krobicki	Early Cretaceous (Valanginian) unique polychelidean lobsters (Decapoda, Polychelidae) as autochthonous fauna of deep-sea flysch environments (Carpathians, Czech Republic)
12:00-12:15	Nuñez	Barremian-Turonian episodes of accelerated global change in Mexico	Algouti	Paleogeographic history of the Senonian in the High Western Atlas of Morocco	Pons	The taxonomic status of the rudist bivalve genus *Pironaea* Meneghini, 1868 amongst the multiple-fold hippuritids.
12:15-12:30	Socorro	Geochemical Characterization of the Basal El Pujal Section, Organyà Basin (NE Spain), in Relation to its Chronostratigraphic Position to OAE1a.	Mohamed	Sequence stratigraphy of the Raha Formation, Bakr Oil Field, Gulf of Suez, Egypt: Insights from electrical well log and palynological data	Pan	The original colours and the preservation potential of chitin from the cuticles of insects in Myanmar ambers
	Lunch Break		Lunch Break		Lunch Break	

	Monday, 21. August - Events HS 8		Monday, 21. August - Stratigraphy HS 7		Monday, 21. August - Paleontology HS 5	
13:30-14:30	Petrizzo	HS 8: PLENARY - Cretaceous stratigraphy – state of the art.				
			T1.S14 + S15 Early Cretaceous integrative methods in stratigraphy and climate changes			
14:30-14:45	Coimbra	Albian shallow-water sedimentary archives: elemental evidence of major perturbations?	Aguirre-Urreta	Biostratigraphy, cyclostratigraphy and radio-isotopic geochronology of the Agrio Formation (Argentine Andes): towards an intercalibration with the Tethys during the Valanginian-Hauterivian	Riahi	Late Barremian - Early Aptian Calcareous Algae and Benthic Foraminifera from, Western Kopet Dagh Basin (Tirgan Formation, North Eastern Iran).
					T6. CRETACEOUS HYDROCARBON AND MINERAL DEPOSITS	
14:45-15:00	Hennhoefer	The stable isotope record from the Albian to Turonian Shilaif Basin (United Arab Emirates) - Climatic perturbations from a palaeo-equatorial intra-shelf basin perspective	Kesjar	Integrated Lower Cretaceous stratigraphy from the Aisén Basin, Patagonia, Chile	Okay	Cretaceous geological evolution of the Central Pontides
15:00-15:15	Frijia	Paleo-temperature and C-isotopes records derived from bivalves shells across the OAE-2 in the shallow water carbonates of the Apennine Platform of Italy: Local or global signal?	Vickers	High Arctic record of Early Cretaceous climate and carbon-cycle perturbations: evidence from Spitsbergen, Svalbard	Tari	How is the opening of the Black Sea reflected in the Cretaceous sequence of the Bulgarian Moesian Platform?
15:15-15:30	Mahmudy-Gharaie	A multi-proxy chemostratigraphy of the Cenomanian/Turonian transition in Kopet-Dagh basin (NE Iran); implication for oceanic temperature and pCO_2 variations	Raisossadat	Ammonite biostratigraphy of Lower Aptian-Upper Albian deposits (Kazhdumi Formation) in Zagros Basin, SW Iran	Tari	The continuation of the Late Cretaceous volcanic arc of the Balkan orogen beneath the Black Sea: implications for hydrocarbon exploration plays
15:30-15:45	Koutsoukos	Late Cretaceous foraminifers and ammonities and palaeoceanographic events of northeastern Brazil – An overview	Mutterlose	An integrated stratigraphy of the Early Cretaceous (Valanginian - Albian) - implications for Boreal-Tethys correlation		
15:45-16:00	De Winter	Multi-proxy analysis and growth modelling of Late Cretaceous fossil bivalves: Disentangling seasonal parameters				
		Coffee Break		Coffee Break		Coffee Break
16:30-18:30		Poster Party		Poster Party		Poster Party
18:30-20:00				SKS Deutsche Kreide-Subkommission Raumnummer 2C315		

	Tuesday, 22. August - Stratigraphy HS 8		Tuesday, 22. August - Facies HS 7		Tuesday, 22. August - Paleontology HS 5	
	T1.S01 Jurassic/Cretaceous boundary and the Berriasian stage and substages		T2.F03 Cretaceous Carbonate platforms and shallow-water bioevents		T5.P07 Palaeobotany and Palynology	
8:30-8:45	Wimbledon	The Tithonian/Berriasian stage boundary and the base of the Cretaceous System	Császár	Comparison of the Darwin atoll and the Mecsek type reef	Golovneva	Early–middle Albian angiosperms from the Kolyma river basin, Northeastern Russia
8:45-9:00	Salazar	Tithonian – Berriasian Ammonites From The Lo Valdés Formation At Cruz De Piedra, Central Chile	Godet	The impact of early meteoric diagenesis on Urgonian platform carbonates: A case study from the western Swiss Jura	Dong	A new structurally preserved seed cones of *Pityostrobus* from the Lower Cretaceous of Northwestern China and its evolutionary significance
9:00-9:15	Fang	Sedimentary characteristics on the Jurassic/Cretaceous boundary in the Junggar Basin, Central Asia: Tectonic and climate implications	Michalik	Resedimented Cretaceous platform material in the Manín Unit, Western Carpathians.	Kvacek	Palaeoecology and palaeoclimate of Late Cretaceous of Central Europe based on fossil plants
9:15-9:30	López-Martínez	*Crassicollaria* and *Calpionella* zones in the Neuquén Basin (Argentine Andes): First approach to the correlation of the Tithonian/Berriasian boundary with western Tethys	Solak	Biostratigraphy and facies analysis of the Upper Cretaceous platform carbonates of the Anamas-Akseki Autochton in the Central Taurides, S Turkey	Leppe	Interpreting the Upper Cretaceous record of *Nothofagus* in Antarctica and Patagonia
			T2.F01 Cretaceous terrestrial/non-marine studies			
9:30-9:45	Matsuoka	Stratigraphic potential of radiolarians for determining the Jurassic/Cretaceous boundary: evidence from pelagic sequences in the Pacific and Tethys	Nasri	Aptian shallow marine carbonate platform and Lower Albian lacustrine and fan delta siliciclastic deposits of Jebel Koumine (Central Atlas Tunisia)	Huerta Vergara	Assembling coniferous plants from Mexico based on reproductive and vegetative organs
9:45-10:00					Cevallos Ferriz	Recognizing Lauraceae in Cretaceous assemblages from Mexico
	Coffee Break		Coffee Break		Coffee Break	
10:30-10:45	Vanková	Taxonomy and stratigraphy of the Lower Cretaceous belemnites from Štramberk (Czech Republic, Outer Western Carpathians)	Sha	Response in Late Mesozoic lake systems in East Asia to destruction of North China Craton	Alekseev	The Santonian-early Campanian biota from the Ola volcanic plateau (Magadan region, Russia)
10:45-11:00	Wimbledon	Magnetostratigraphy constrained by biostratigraphy: the lower Berriasian of the Theodosia coast of southern Ukraine			Nosova	Phoenicopsis (Leptostrobales) and Pseudotorellia (Ginkgoales) in the Cretaceous of the north of Eastern Siberia and Northeastern Russia
11:00-11:15	Baraboshkin E. Y.	New data on the Berriasian Stage of the Crimea	Sames	Testing cyclostratigraphy in the non-marine Lower Cretaceous by reinvestigating parts of the English Wealden (UK)	Herman	Turonian–Coniacian flora of the Okhotsk-Chukotka volcanogenic belt (North-eastern Russia)
11:15-11:30	Pruner	Integrated stratigraphy of the Jurassic-Cretaceous sequences of the Kurovice Quarry, Outer Western Carpathians: correlations and tectonic implications	Joeckel	Dynamic pedostratigraphy: Vertisol genesis and sedimentation in an Early Cretaceous (Neocomian–Aptian) fluvial-to-palustrine setting, Sevier foreland, Utah, USA	Moiseeva	Late Cretaceous Ayanka Flora and Plant Communities of the Okhotsk-Chukotka Volcanogenic Belt (Northereastern Russia)
11:30-11:45	Košťák	Stable isotope record ($\delta^{13}C$, $\delta^{18}O$), invertebrates and small vertebrate fauna from the Jurassic-Cretaceous transition of the Kurovice quarry (Czech Republic, Outer Western Carpathians)	Xi	Late Cretaceous (Santonian) lake anoxic events (LAEs) in the Songliao Basin, NE China	Afonin	Sequoioxylon (Cupressaceae s. l.) fossil woods from the Cretaceous deposits of Primorye and Sakhalin regions, Russian Far East

	Tuesday, 22. August - Stratigraphy HS 8		Tuesday, 22. August - Facies HS 7		Tuesday, 22. August - Paleontology HS 5	
11:45-12:00	Grabowski	New details of bio- and magnetostratigraphical correlations in the Jurassic/Cretaceous boundary interval: Lókút (Transdanubian Range, Hungary), Veliky Kamenets (Pieniny Klippen Belt, Ukraine), Barlya (Western Balkan, Bulgaria)	Li Liquin	Early Cretaceous paleoclimate and paleogeography in Tarim Basin, northwestern China: a palynological record	Li Y.	*Superiortrapa* (Lythraceae s.l.) from the Miocene of North China
12:00-12:15	Atasoy	A composite biostratigraphy (mainly calpionellids and foraminifera) of the Upper Jurassic - Lower Cretaceous Carbonates in Sivrihisar region (Pontides, NW Turkey): Delineation of the J-K boundary in a slope environment	Symons	Contextualizing newly discovered dinosaurian assemblage in the Mussentuchit Member of the Cedar Mountain Formation, Central Utah, USA: insights from the sedimentary record	Gnilovskaya	Early Fagaceae from the Late Cretaceous of the Northern Pacific
12:15-12:30			Hu	Microbial tetraether biomarker records in the Lower Cretaceous paleosols in Sichuan Basin, China		
	Lunch Break		Lunch Break		Lunch Break	
					T5.P06 Cretaceous vertebrates	
13:30-13:45	Michalik	Sedimentological and biological changes at the Jurassic Cretaceous transition (West Carpathian JK boundary type-section area)		Session break	Cifelli	Cretaceous Mammals of Eurasia and North America
13:45-14:00	Schnabl	Magnetostratigraphy and biostratigraphy of Jurassic-Cretaceous boundary sections in the Vocontian Basin, France				
14:00-14:15	Benzaggagh	Discussion on the calpionellid biozones and proposal of a homogeneous calpionellid scheme for the Tethyan Realm			Houla	Discovery of the first theropod dinosaur tracks in the Lower Albian lacustrine facies of Central Tunisian Atlas
	T1.S02 + S03 + S04 The Valanginian, Hauterivian and Barremian stages and substages					
14:15-14:30	Mutterlose	The Hauterivian stage boundary: state of the art			Amalfitano	A revision of the fishes from the Bonarelli Level (uppermost Cenomanian) of northeastern Italy
			T2.F01 Cretaceous terrestrial/non-marine studies (continued)		T5.P04 + P05 Cretaceous biodiversity (micropaleontology/macropaleontology)	
14:30-14:45	Premoli Silva	Planktonic Foraminiferal Distribution From Uppermost Hauterivian-Lower Barremian Strata At Arroyo Gilico (Betic Cordillera, Se Spain): An Update	Leslie	Revised age constraints for Late Cretaceous to early Paleocene strata from the Dawson Creek section, Big Bend National Park, west Texas	Choi	Taxonomic revision of *Cypridea* (Ostracoda: Cyprideidae) from the Lower Cretaceous Jinju Formation of the Gyeongsang Basin, South Korea
14:45-15:00	Company	The Barremian GSSP-state of the art	Teerarungsigul	Stratigraphy and Geology of the Sao Khau and Phu Phan Formations, Phu Khum Kao, Kalasin Province, Thailand	Fauth	Aptian integrated micropaleontological study from the Brazilian Equatorial Margin (Pará-Maranhão Basin): biostratigraphic and paleoecologic interpretation

	Tuesday, 22. August - Stratigraphy HS 8		Tuesday, 22. August - Facies HS 7		Tuesday, 22. August - Paleontology HS 5	
15:00-15:15	Maurasse	Towards a Chemostratigraphic Approach to Determine the Barremian-Aptian Boundary	Upchurch	Climate of southern Laramidia: A multi-proxy paleobotanical reconstruction for the upper Campanian Jose Creek Member, McRae Formation, south-central New Mexico, USA.	Vodrážka	The first hexactinellid sponge skeleton from the Cretaceous of Austria (Schrambach Formation, Northern Calcareous Alps)
15:15-15:30	Kelly	Biostratigraphy of the Barremian-Aptian (Early Cretaceous) of eastern Greenland	Suarez	Continental paleotemperatures from lacustrine carbonates in Asia and North America	Rantuch	Rhynchostreon oysterŽs beds from Orlové sandstones - New view for one of the most problematic palaeoecological queries of the Western CarpathianŽs Klippen Belt (Klape unit, Western Carpathians)
	T1.S05 + S06 The Aptian and Albian stages and substages					
15:30-15:45	Brovina	Barrem–Aptian plankton foraminiferal stratigraphy of the southern framing of the East European platform (Crimea and Ulyanovsk Volga region).	Ludvigson	Aptian–Albian Terrestrial Paleoclimatology of the North American Western Interior Basin	Gale	A microcrinoid zonation for the Late Cenomanian–Campanian interval – Chalk Group, Anglo-Paris Basin, and its potential for global correlation.
15:45-16:00	Karpuk	Late Barremian–Aptian Ostracod biostratigraphy in the Mountain Crimea	Heimhofer	Continental vegetation and climate dynamics during Oceanic Anoxic Event 2	Wiese	When the going gets tough, the tough gets going - Cretaceous deep sea atelostomate echinoids resist oceanic anoxic events
	Coffee Break		Coffee Break		Coffee Break	
	T1.S07 Cenomanian* and Turonian* stages and substages					
16:30-16:45	Tucker	Mid-Cretaceous development of the Eromanga Basin, Queensland, Australia; palaeoenvironmental and palaeobiogeographic context for newly discovered fossil assemblages	Li X	Mid-Cretaceous terrestrial environments and climates in Hengyang Basin, Hunan province, South China	Jagt	New stratigraphical and faunal data on the type Maastrichtian (uppermost Cretaceous; southeast Netherlands and northeast Belgium)
16:45-17:00	Falzoni	Reassessing planktonic foraminiferal biostratigraphy across the Cenomanian-Turonian boundary interval (middle Cretaceous)	Wang Y.	Ostracod biostratigraphy suggests no non-marine J/K boundary in the Dabeigou Formation or Dadianzi Formation, Luanping Basin, China	Perera	Late Cretaceous tp Paleoncene Nannofossil Assemblage Characteristics Conserved in Deccan intertrapean Sediments, Mannar Basin, Sri Lanka
	T1.S08 The Coniacian stage and substages					
17:00-17:15	Walaszczyk	Stratigraphic subdivision of the Coniacian Stage: State of the art	17:00 -18:30	Wimbledon: Berriasian Working Group Meeting		
17:15-17:30	Voigt	Reassessment of Salzgitter-Salder as potential stratotype for the Turonian-Coniacian Boundary				
17:30-17:45	Ifrim	The Rosario section, Coahuila, northeastern Mexico and its potential as Global Stratotype Section and Point for the Turonian-Coniacian boundary (Upper Cretaceous)				
17:45-18:00	Cech	The Turonian-Coniacian stage boundary in the Bohemian Cretaceous Basin (Czech Republic), correlated between nearshore and offshore facies				
18:00-18:15	Walaszczyk	The Coniacian stratigraphy in the Western Interior of North America: A Canadian perspective				
19:00	CONFERENCE DINNER AT 10ER MARIE		CONFERENCE DINNER AT 10ER MARIE		CONFERENCE DINNER AT 10ER MARIE	

	Wednesday, 23. August - Stratigraphy HS 8		Wednesday, 23. August - Events HS 7		Wednesday, 23. August - Greenhouse World HS 5	
	T1.S09 The Santonian* stage and substages		T3.E02 Cretaceous environmental perturbations - Anoxia, OAEs, oxic events, K/Pg boundary T3.E01 Mass extinctions, volcanism and impacts during the Cretaceous		T4.C07 Comparison between the marine and continental records during Cretaceous	
8:30-8:45			Föllmi	Early Cretaceous climate, anoxia and sea-level change	Wang Y.	Triassic to Cretaceous fossil wood studies of China: Diversity variations and paleoclimate implications
8:45-9:00	Petrizzo	Planktonic foraminiferal biostratigraphy across the Coniacian-Santonian boundary interval in Tanzania and its reproducibility in coeval settings	Charbonnier	Mercury enrichment indicates volcanic triggering of Valanginian environmental change	Liu	Paleoclimate Evolution Driven by Astronomical Forcing in the Early Cretaceous Songliao Basin, Northeast China
9:00-9:15	Summesberger	Ammonite stratigraphy of the Santonian (Upper Cretaceous) in the type area of the Gosau Group (Northern Calcareous Alps, Austria)	Pictet	Preludes of the Oceanic Anoxic Event 1a along the northern Tethyan margin : a progressive climatic destabilization from the latest Hauterivian (Early Cretaceous) onward	Wu	Intercalibration of astrochronologic and radioisotopic time scales for Late Cretaceous continental records in Songliao Basin, Northeastern China
9:15-9:30	Wagreich	Santonian calcareous nannofossil zonations	Thibault	Barremian to early Aptian environmental changes in the North Sea: new results from high-resolution carbon and oxygen stable isotopes, major and trace elements, and calcareous nannofossils	Tan	Late Cretaceous provenance change in the Jiaolai basin, East China: Evidences from detrital zircon U Pb ages from the Wangshi Group
	T1.S10 The Campanian stage and substages				T4.C06 Asia-Pacific Cretaceous Ecosystems (IGCP608)	
9:30-9:45	Gale	Towards a formally defined Campanian Stage: correlations, potential GSSPs and boundary markers.	Yilmaz	Cretaceous black shales (Oceanic Anoxic Events) in Turkey: collaboration of tectonics, sea level and oceanographic changes	Ando	Reconstruction of Cretaceous continental arc-trench system in Japanese Islands as a basis for Cretaceous paleoenvironmental studies
9:45-10:00	Ifrim	The Jimenez sections in Northeastern Mexico and their sedimentary record across the Santonian-Campanian boundary	Möller	Size variations of calcareous nannofossils – a good tool for understanding past ocean perturbations?	Li X.	Radiolarian assemblage of Barremian to Aptian interval in the Tethys and the influence of the oceanic anoxic event (OAE) 1a
	Coffee Break		Coffee Break		Coffee Break	
10:30-10:45	Dubicka	An integrated study (benthic and planktonic foraminifera, calcareous nannofossils, crinoids, stable carbon isotopes and magnetic polarities) across the Santonian/Campanian boundary at Bocieniec, southern Poland: A new GSSP Candidate for the Base of the Campanian Stage	Jarvis	Mid-Cenomanian Event I vs. the CTBE: geochemical and palaeoenvironmental contrasts between two major Late Cretaceous carbon isotope events	Sun	Early Cretaceous Fossil Plants from Huolinhe Basin of Inner Mongolia, China and their Geological Analysis
10:45-11:00	Wagreich	The Gosau Group of Austria - reference sections for the Santonian-Campanian boundary in the NW Tethys and the Broinsonia parca parca bioevent	Batenburg	Oceanography of the Western Interior Seaway during OAE 2 using Nd isotopes	Xi D.	Late Cretaceous- Early Paleogene ostracod biostratigraphy in the Songliao Basin, NE China

	Wednesday, 23. August - Stratigraphy HS 8		Wednesday, 23. August - Events HS 7		Wednesday, 23. August - Greenhouse World HS 5	
					T4.C04 Early Cretaceous climate variations and its impact on paleoecology and paleoenvironmental developments	
11:00-11:15	Wolfgring	The Santonian-Campanian boundary in the NW Tethys; magneto-, isotope- and biostratigraphy from the pelagic Postalm section (Northern Calcareous Alps, Austria).	Hasegawa	Response to Cretaceous Cenomanian/Turonian OAE2 in southern high latitude, Pacific	Rogov	Early Cretaceous climate and glendonites
11:15-11:30	Wolfgring	The Santonian Campanian boundary at Göynük, Northwestern Anatolia, Turkey	Danzelle	Oscillating redox state in Vocontian Basin (SE France) during the Cenomanian–Turonian Oceanic Anoxic Event (OAE 2)	Schneider S.	The Rollrock Section - the most comprehensive Jurassic-Cretaceous boundary section of the Canadian Arctic Islands
	T1.S11 The Maastrichtian* stage and substages and Cretaceous/Paleogene Boundary Stratigraphy					
11:30-11:45	Baraboshkin E. Yu.	Integrated study of Campanian / Maastrichtian boundary interval at Volga region (Russia) and Aktolagay Plateau (West Kazakhstan) of the Russian Platform	Arnaud-Vanneau	Scenario of an Announced Death: The Extinction of Large Benthic Formainifera during the Anoxic Episode OAE 2	Dai	Climate Records of Color and Magnetic Susceptibility of continental Sedimentary Rocks of the Lower Cretaceous in Jiuxi Basin, NW China
11:45-12:00	Salazar	Facies and Biostratigraphy of Late Cretaceous (Maastrichtian) in central Chile.	Hart	The 'Black Band': local expression of a global event	Brysch	Palaeoenvironmental and climatic changes in the uppermost Jurassic to lower Cretaceous in the southern Hemisphere (Central and southern Chile, Antarctica)
12:00-12:15	Gavtadze	The paleogeographic setting and biostratigraphy of the South-East part of Georgia at the boundary of the Cretaceous/Paleogene	Gavrilov	Diversity in the sedimentological and geochemical features of the late Cenomanian OAE2 in the different areas of the Crimea-Caucasus area	Zakharov	Isotope composition of Mesozoic molluscs from the Saratov-Samara region and main Early Cretaceous climate trends at the Russian Platform Caucasus area
12:15-12:30	Li S.	Charophytes from the Cretaceous-Paleocene boundary of the Songliao Basin (Northeastern China) and calibration of the Chinese charophyte biozonation to the Global Polarity Time Scale	Mousavi	The OAE2 and Late Cretaceous cooling across the Cenomanian-Campanian succession in the Kopet-Dagh Basin, NE of Iran (Eastern Tethyan Region)	Huck	Barremian-Aptian rudist shells record dramatic shallow-water sea-surface temperature changes in the subtropical Tethyan Ocean
	Lunch Break		Lunch Break		Lunch Break	
13:30-14:30	Weissert	HS 8: PLENARY - Mesozoic C-cycle perturbations and climate: evidence for increased resilience of the Cretaceous biosphere to greenhouse pulses.				
	T1.S12 Towards an astronomically calibrated time scale for the Cretaceous: Cyclostratigraphy					
14:30-14:45	Martinez	Synchronizing the astronomical time scales in the Valanginian–Hauterivian from the Neuquén Basin (Argentina) and the Tethyan area	Köberl	The Cretaceous-Paleogene Boundary Ejecta Layer and its Source Crater at Chicxulub	Carvalho	Late Aptian (Cretaceous) dry - wet cycles and their effects on vegetation in the South Atlantic: palynological evidences
14:45-15:00	Wolfgring	The Postalm section, Northern Calcareous Alps, Austria - towards an astrochronological solution for the Tethyan Campanian	Hart	Dinocyst stratigraphy and paleoenvironmental interpretation of the Cretaceous/Paleogene boundary at Stevns klint, Denmark	Trabelsi	Ostracod faunicycles in the Mid-Cretaceous carbonate platform from the Central Tunisian Atlas (North African margin): Biostratigraphic and paleoecologic implications

Wednesday, 23. August - Stratigraphy HS 8			Wednesday, 23. August - Events HS 7		Wednesday, 23. August - Greenhouse World HS 5	
	T4.C05 + C08 Climate-environmental deteriorations during greenhouse phases					
15:00-15:15	Vishnevskaya	Cretaceous Microplankton of the Russian Arctic and Pacific Rims: Superplume and Cooling during Supergreenhouse	Karabeyoglu	*Heterohelix* and *Guembelitria* blooms before the K-Pg boundary in Haymana Basin, Turkey	Niezgodzki	Late Cretaceous climate with different gateway configurations and CO_2 concentrations as simulated by the Earth System Model. Implications for the Arctic region.
15:15-15:30	Kopaevich	Late Cretaceous microfossils (Foraminifers and Radiolarians) as indicators of paleoclimate fluctuations (by xxample of Russian sector of eastern Europe)	Golovneva	Extinction of high latitude Kakanaut biota, North-East of Russia	Pohl	A better-ventilated ocean triggered by Late Cretaceous changes in continental configuration
15:30-15:45	Iakovishina	Maastrichtian paleotemperature changes in the Southern Russia	Adatte	Timing and tempo of Deccan volcanism relative to the KPg boundary, evidence from mercury anomalies	Bottini	Paleoenvironmental changes traced by calcareous nannofossils through the mid-Cretaceous
15:45-16:00					Falzoni	Climate change and planktonic foraminiferal evolution during the Late Cretaceous
	Coffee Break		Coffee Break		Coffee Break	
	T1.S00 Open Session on Cretaceous stratigraphy					
16:30-16:45	Bengtson	The mid-Cretaceous saga		Poster Party	Radmacher	Late Cretaceous climate change in the sub-Arctic region recorded by dinoflagellate cysts
16:45-17:00	Granier	Regional stages: What is the use of them – A case study in Lebanon			Leppe	Paleoclimatic estimations in the Upper Cretaceous of Magallanes Region, Southern South America.
17:00-17:15	Berensmeier	Drill-core analysis of Cenomanian–Coniacian sedimentary rocks deposited on the North German epicontinental shelf: An integrated stratigraphical, geophysical and geochemical approach			Wendler I.	The crux of interpreting oxygen isotope data with respect to Milankovitch-scale sea-level changes during greenhouse climates
17:15-17:30	Bragina	New radiolarian zonation of the Upper Albian – Santonian of the Tethyan regions of Eurasia				Poster Party
17:30-17:45	Packer	Cretaceous (Early Maastrichtian - Aptian) stratigraphy of the Shiranish Islam area, northern Iraq.				
17:45-18:00	Hadach	Sedimentology, biostratigraphy and palaeogeographic evolution of the lower Cretaceous of the Ait Ourir basins, High Western Atlas, Marocco	16:30 - 18:00	Mutterlose: Hauterivian Working Group Meeting Room number 2B204 (Eberhard Clar-Saal)		
18:00-18:15	Sariaslan	Planktonic Foraminifera Biostratigraphy of the Cenomanian - Campanian Succession in the Haymana - Polatli Basin (Ankara, Turkey)	18:00 - 19:30	Cretaceous Subcommission Meeting		
20:00	Benton	HS 8: PUBLIC LECTURE - DINOSAURS IN DECLINE				

	Thursday, 24. August - IGCP 609 HS 8		Thursday, 24. August - Geodynamics HS 7		Thursday, 24. August - Facies HS 5	
	T4.C05 + C08 Climate-environmental deteriorations during greenhouse phases		T7.CRETACEOUS GEODYNAMICS AND OROGENIES AND THE EVOLUTION OF THE TETHYAN REALM			
8:30-8:45	Sames	An overview on IGCP 609: Climate-environmental deteriorations during greenhouse phases: Causes and consequences of short-term Cretaceous sea-level changes	Okay	Crustal scale Upper Cretaceous mass flows northwest of Ankara related to the destruction of the forearc		
8:45-9:00			Roban	Provenance of Eastern Carpathian mid-Cretaceous clastic sediments: Implications for the evolution of Moldavides		
9:00-9:15	Huber	Was the late Albian–Santonian too warm to support ephemeral polar ice sheets? ^{18}O paleotemperature evidence from southern high latitudes	Xi D.	Late Cretaceous biostratigraphy and sea-level change in the northwest Tethys		
9:15-9:30	Ulicný	High-frequency, shallow marine clastic sequences across the Turonian - Coniacian boundary, correlated between the Bohemian Cretaceous and Western Canada basins	Hu	Cretaceous–Paleogene lithostratigraphic and tectonostratigraphic frameworks in southern Tibet: implication to the timing of the India-Asia collision		
9:30-9:45	Jiang	The discussion of the relationship between the phototropism and the plate motion	Li G.	Early Eocene Radiolarian Fauna from the Sangdanlin, Southern Tibet: Constraints on the Timing of Initial India-Asia Collision		
9:45-10:00						
	Coffee Break		Coffee Break		Coffee Break	
					T2.F00 Open Session on Cretaceous settings and facies	
10:30-10:45	Iqbal	Extreme greenhouse conditions: Mesozoic examples of palaeoclimatic fluctuations from the southwestern margin of the Neotethys in the Salt Range, Pakistan	Yang X.	The Late Mesozoic Plants from Northwest Lhasa of Tibet (Xizang), China	Yildiz	Platform-to-basin facies transition and tectono-sedimentary processes in the Late Jurrasic-Cretaceous deposits, Mescitli area (Gümüshane, NE Turkey)
10:45-11:00	Chen	Carbon isotope and ammonite biostratigraphy of the Early Aptian Oceanic Anoxic Event in Tethyan Himalaya of Southern Tibet	Wulff	Late Cretaceous Inversion Tectonics in Northern Germany deciphered by calcareous nannofossils	Benchaabane	New insights on the Aptian-Albian sedimentary record and age of the Serdj Formation (Central Tunisia): Impact on regional stratigraphic correlations
11:00-11:15	Yao	Bio-, carbon isotopic and cyclo-stratigraphy of the Albian-Cenomanian Boundary Event in Southern Tibet			Krobicki	The early Late Cretaceous transgression in the Busko Zdrój area (southern Poland) – facies development, syn-sedimentary tectonic events and palaeorelief of basement
11:15-11:30	Bąk	Reconstruction of palaeoceanographic changes during the Upper Albian OAE 1d event in the submerged Tatric Ridge, Central Western			Püttmann	Late Cretaceous (Cenomanian to Campanian) calcareous nannofossils from northern Germany as a record for shallow marine coastal dynamics

Thursday, 24. August - IGCP 609 HS 8			Thursday, 24. August - Geodynamics HS 7		Thursday, 24. August - Facies HS 5	
					T2.F05 Chalk facies and biota	
11:30-11:45	Yılmaz	Cyclic Carbonate Facies Changes on the Middle to Upper Cenomanian Arabian Carbonate Platform, Se Turkey: An Approach for the Causes of Short ans LongTerm Sea Level Change			Godet	Integrated stratigraphy of the Austin Chalk (Coniacian – early Campanian) in south Texas: unravelling tectonic control on depositional geometries
11:45-12:00	Melinte-Dobrinescu	Calcareous nannofossil extinction, survivorship and speciation during the OAE2 in the Tethys Realm			Engelke	Early Maastrichtian palaeoecology of the chalk at Kronsmoor (Saturn quarry, northern Germany): an integrated approach
12:00-12:15	Zorina	Episodes of anoxic ferruginous conditions in the Coniacian–Campanian on the Eastern Russian Platform			Linnert	Evidence for palaeoenvironmental stability during the earliest Maastrichtian – implications from benthic foraminiferal assemblages from North Germany
					T2.F06 Cretaceous Geoparks and World Heritage: Scientific Approach	
12:15-12:30	Wendler	Gains and pitfalls of proxies for the reconstruction of ocean-continent water transfer - testing aquifer eustasy			Jagt	The ENCI-HeidelbergCement Group quarry at Maastricht, the Netherlands – a latest Cretaceous mosasaur park from 2018 onwards?
		Lunch Break	Lunch Break		Lunch Break	
13:30-14:30	Suarez	HS 8: PLENARY - From paleosols to ancient lakes: Non-marine climate indicators and insights into the Cretaceous landscape.				
14:30-14:45	Yılmaz	The Upper Campanian Paleoceanographic and paleoclimatic records on the northern Arabian Platform, SE Turkey	Wang & Koutsoukos	Workshop on academic publishing and scholarly writing		
14:45-15:00	Fathy	Palaeoclimatic reconstruction of Maastrichtian oil shale deposition in the southern Tethyan realm, Egypt				
15:00-15:15	Mikadze	The Khrami Shallo`s Paleogeography In The Campanian-Maastrichian Stage				
15:15-15:30	Wagreich	Events in Earth history: The K/Pg impact versus the Anthropocene				
15:30-15:45						
15:45-16:00						
		Coffee Break	Coffee Break		Coffee Break	
16:30-18:30		Closing Ceremony				

Poster - 10th International Symposium on the Cretaceous System

Title	Last name	First name
T1. CRETACEOUS STRATIGRAPHY		
T1.S00 Open Session on Cretaceous stratigraphy		
Depositional Facies, Carbon and Oxygen Isotope Records and Sequence Stratigraphy of The Coniacian–Santonian Matulla Formation, West Central Sinai, Egypt	El Belasy	Ahmed
A Boreal high-resolution composite $\delta^{13}C_{carb}$ record of the Albian to Turonian interval from the North German Basin	Bornemann	André
Planktonic foraminiferal and nannofossil biostratigraphy of the Upper Cretaceous at Aurachtal-Herbstau and Nussdorf am Attersee (Helvetic units, Upper Austria)	Domanski	Hubert
The 6th international meeting of the IUGS Lower Cretaceous Ammonite Working Group, the « Kilian Group » (Vienna, Austria, 20th August 2017)	Lukeneder	Alexander
A revised integrated Cretaceous biostratigraphy of eastern Greenland	Kelly	Simon
Stratigraphy of the Lower-Middle Coniacian core section (NW-part of the Bohemian Cretaceous Basin): deciphering T-R history and linking offshore to proximal deposits	Nádaskay	Roland
Sedimentology and Magnetostratigraphy of the cretaceous formations in the Hamakoussou and Mayo Oulo-Lere bassins in the Northern Cameroon (Benue Through)	Ntsama Atangana	Jacqueline
Lithostratigraphy of Upper Cretaceous deposits of the southern Münsterland (Northwest Germany) – correlations of borehole lithostratigraphical, biostratigraphical and natural gamma radiation (GR) log data.	Dölling	Bettina
A new Lower Cretaceous ammonoid fauna from the Northern Calcareous Alps	Lukeneder	Alexander
T1.S01 Jurassic/Cretaceous boundary and the Berriasian stage and substages		
Micropaleontology of the Jurassic and Cretaceous boundary deep marine sediments	Skupien	Petr
Implications of changing the Jurassic-Cretaceous boundary on the chronostratigraphic correlation between marine and coastal–continental sequences: the example of the dinosaur-rich Villar del Arzobispo Fm (E Spain)	Alcalá	Luis
Jurassic – Cretaceous boundary in the Eastern Crimea	Arkadiev	Vladimir
Sedimentology and ichnoassamblages of the Jurassic / Cretaceous boundary interval of Feodosia region (SE Crimea)	Baraboshkin	Evgenij E.
Stratigraphy and paleoclimate of non-marine deposits of the Jurassic/Cretaceous boundary interval in northern Germany	Schneider	Anton C.
Morphological differentiation of loricas of *Calpionella alpina* and its significance for the J/K boundary interpretation	Kowal-Kasprzyk	Justyna
Calpionellid and nannofossil correlation across the Jurassic-Cretaceous boundary interval, Kurovice Quarry, Outer Western Carpathians	Svábenická	Lilian
New data on the Berriasian Stage of the Crimea	Baraboshkin	Evgenij Y.
Latest Volgian (earliest Berriasian) *Volgidiscus*-bearing beds of the European part of Russia and their significance for inter-regional correlation and palaeogeography	Rogov	Mikhail
T1.S02 + S03 + S04 The Valanginian, Hauterivian and Barremian stages and substages		
Orbital chronology of the Barremian Stage from the Eastern Subbetic (Spain)	O'Dogherty	Luis
T1.S05 + S06 The Aptian and Albian stages and substages		
Radiolarian stratigraphy of the proposed GSSP for the base of the Aptian Stage (Gorgo Cerbara, Umbria-Marche Apennines, Italy)	O'Dogherty	Luis
Paleoenvironment reconstitution of uppermost Albian deposits in Northern Tunisia inferred from foraminiferal and radiolarian assemblages	Zrida	Rim
Foraminifera across the Jurassic–Cretaceous transition at Kurovice section (Western Carpathians, Czech Republic)	Bubik	Miroslav
T1.S08 The Coniacian stage and substages		
Inoceramids and calcareous nanoplankton at the lower and middle Coniacian substage boundary in the Bohemian Cretaceous Basin	Čech	Stanislav
The Reverse polarity zone in the Turonian–Coniacian interval of the Lower Volga region	Guzhikov	Andrey
T1.S09 The Santonian* stage and substages		
Foraminiferal biostratigraphy and ecology of the Coniacian/Santonian boundary at the Stöckelwaldgraben section (Northern Calcareous Alps)	Bukenberger	Patrick
T1.S10 The Campanian stage and substages		
Upper Cretaceous planktonic stratigraphy of the Göynük composite section, western Tethys (Bolu province, Turkey)	Wolfgring	Erik

T1.S11 The Maastrichtian* stage and substages and Cretaceous/Paleogene Boundary Stratigraphy		
Shallow benthic environment at the Cretaceous/Paleogene (KPg) Boundary documented by abiotic and biotic data on the Pg Adria CP from NE Italy to South Dalmatia	Drobne	Katica
High-resolution chemostratigraphic calibration of the Campanian-Maastrichtian boundary interval at Kronsmoor (northern Germany): a Boreal reference section revisited	Wilmsen	Markus
Campanian to Maastrichtian planktic foraminifera of the Pálava Formation from the southern Waschberg-Ždánice-Unit, Lower Austria	Gebhardt	Holger
T1.S12 Towards an astronomically calibrated time scale for the Cretaceous: Cyclostratigraphy		
Sub-Milankovitch cycles in Upper Cretaceous pelagic successions along the active and passive continental margins of the NW Tethys	Wolfgring	Erik
Cyclostratigraphic, lithological-geochemical and paleoecological characteristics of the sedimentation within Mountainous Crimea in Maastrichtian age	Gabdullin	Ruslan
T1.S14 + S15 Early Cretaceous integrative methods in stratigraphy and climate changes		
Lower cretaceous formations and paleontology in southeast Mongolia	Ichinnorov	Niiden
Multi-proxy record of orbital-scale changes in climate and sedimentation during the Weissert Event in the Valanginian Bersek Marl Formation (Gerecse Mts., Hungary)	Martinez	Mathieu
Integrated stratigraphy and isotopic ages at the Berriasian/Valanginian boundary at Puebla State, eastern Mexico	Barragán-Manzo	Ricardo
T2. CRETACEOUS SETTINGS AND FACIES		
T2.F00 Open Session on Cretaceous settings and facies		
Enigmatic 3-meters long vertical structures in the Turonian deposits of Poland – biotic (paramoudra-like structures) versus abiotic origin	Remin	Zbyszek
Coniacian-Campanian epeiric carbonate platform system of the Haftoman Formation (northern Yazd Block, Central Iran)	Wilmsen	Markus
Integrated stratigraphy and facies analysis of the uppermost Albian-Cenomanian Glauconitic Limestone of Esfahan (Iran)	Wilmsen	Markus
Corrosion of heavy minerals in the middle Campanian siliciclastic deposits of SE Poland – environmental implications	Cyglicki	Michal
Upper Cretaceous depositional systems in the NE part of the Polish Basin (NE Poland) – new insight based on seismic data	Stachowska	Aleksandra
Facies analysis and facies model of proximal deposits of the Cenomanian to Coniacian epicontinental sea in SW Münsterland Cretaceous Basin (NW	Berensmeier	Michaela
Microfacies and depositional environment of Campanian (Cretaceous) deposits, Düzköy (Trabzon, NE Turkey)	Yildiz	Merve
T2.F01 Cretaceous terrestrial/non-marine studies		
Charophytes and ostracods as tool to detect key stratigraphic surfaces in Mid-Cretaceous strata from the Central Tunisian Atlas (North African margin)	Khaled	Trabelsi
The discontinuous Lower Cretaceous of Northeast Germany: Late Cimmerian Unconformity or Early Cretaceous pre-inversion?	Franke	Sandra
Understanding Valanginian continental climate using $\delta^{18}O$ as a proxy for precipitation	Sengupta	Ritwika
Paleosols and Paleoclimate of the Prince Creek Formation, Arctic Alaska, during the middle Maastrichtian global warming event	Salazar Jaramillo	Susana
Stratigraphy of the Lower Cretaceous Dabeigou Formation from Luanping Basin, North China: implications from non-marine ostracod biostratigraphy	Qin	Zuohuan
T2.F03 Cretaceous Carbonate platforms and shallow-water bioevents		
A Km-scale Cretaceous slope in western Sicily (Italy)	Randazzo	Vincenzo
T2.F05 Chalk facies and biota		
Provenance of the chalk grounds of the medieval icons from the National Museum in Kraków on the basis of their calcareous nannoplankton assemblages	Kedzierski	Mariusz
Multiproxy analysis of the nature and origin of carbonate and non-carbonate microparticles in siliceous chalk.	Jurkowska	Agata
T2.F06 Cretaceous Geoparks and World Heritage: Scientific Approach		
Disseminating Cretaceous palaeontology through a network of regional centres in Teruel (Spain)	Alcalá	Luis

T3. CRETACEOUS EVENTS		
T3.E02 Cretaceous environmental perturbations – Anoxia, OAEs, oxic events, K/Pg boundary		
The Cretaceous/Paleogene transition in the Brazilian Equatorial Margin (Pará-Maranhão Basin): a micropaleontological approach	Krahl	Guilherme
Taphocoenoses of the OAE2 interval as indicators of changing depositional and paleoecological conditions, Bohemian Cretaceous Basin	Sklenár	Jan
Constraining the carbon fluxes during the onset of OAE 1a via inverse modelling	Adloff	Markus
The Early Aptian Oceanic Anoxic Event 1a in western Iran (Garau Formation, Zagros Basin) – evidence from calcareous nannofossils	Mahanipour	Azam
Early Aptian anoxic basin of the Russian Plate as a response to OAE1a: $\delta^{13}C$ chemostratigraphy and palaeoecological changes of cephalopod communities	Rogov	Mikhail
T3.E01 Mass extinctions, volcanism and impacts during the Cretaceous		
Paleoenvironmental perturbation across the Cenomanian-Turonian boundary (OAE2) in the Kopet-Dagh basin inferred from benthic foraminiferal assemblages and geochemical anomalies	Mahmudy-Gharaie	Mohamad H.
T4 THE CRETACEOUS GREENHOUSE WORLD: CLIMATE AND SEA-LEVEL CHANGES		
T4.C01 Cretaceous paleoclimate: proxies and models		
Polar ice sheets during the warm Cretaceous? Insights from coupled numerical modelling.	Donnadieu	Yannick
Palaeo-circulation and paleogeographic changes in the Late Coniacian – Early Santonian (Late Cretaceous) of Europe, as based on ammonites and stable carbon and oxygen isotopes	Remin	Zbyszek
Orbital forcing of climate in the Mississippi Embayment during the Campanian	O'Connor	Lauren
Evolution of deep water exchange in the Atlantic Ocean during the latest Cretaceous - early Paleogene	Batenburg	Sietske J.
Evolution of the oceanic circulation on the southern Tethyan margin during the Late Cretaceous	Freslon	Nicolas
T4.C04 Early Cretaceous climate variations and its impact on paleoecology and paleoenvironmental		
Magnetic susceptibility and chemostratigraphy of the Tithonian – Berriasian succession in the Polish Basin	Ploch	Izabela
Lower Cretaceous microbialite and encrusters; implication for lagoon-sea level oscillations under Milankovitch effects in NE-Iran	Mahmudy-Gharaie	Mohamad H.
Middle Cretaceous climate and pCO2 estimates of Liupanshan Basin in the hinterland of China	Du	Baoxia
T4.C05 + C08 Climate-environmental deteriorations during greenhouse phases: Causes and consequences of short-term Cretaceous sea-level changes		
Clay mineralogy of a 10 Ma interval in the NW Tethyan Upper Cretaceous (Postalm, Austria)	Meszar	Maria
Palaeoenvironmental analyses of the Pleistocene and Holocene deposits of the Peshawar Basin, Pakistan - in search for the early Anthropocene	Bibi	Mehwish
Sedimentology and biostratigraphy of the Pabdeh Formation at the PETM interval, Paryab, Zagros Basin, SW- Iran: Implication for sea level fluctuations	Azami	Seyed Hamidreza
Geochemical Assessment of the Cabó Formation Section North of Organyà, Catalunya, Spain	Herdocia	Carlos
Records of paleoclimatic and palaeoenvironmental conditions inplatform to slope carbonates, lower Cretaceous, Ayralaksa Yayla (Trabzon, NE Turkey)	Yildiz	Merve
Valanginian Sea-Level Records on the Bilecik Carbonate Platform and Slope Environment, Western Sakarya Zone,Western Pontides	Yilmaz	Ismail Omer
Cenomanian-Coniacian Carbonate Sequence in the Northwestern Part of the Arabian Carbonate Platform (SE Turkey): Characteristics and Implications	Mulayim	Oguz
T4.C06 Asia-Pacific Cretaceous Ecosystems (IGCP608)		
Terrestrial biota and climate during Cretaceous greenhouse in NE China	Wan	Xiaoqiao
Late Campanian-Early Maastrichtian heteromorph dominated ammonite fauna of the Northwestern Pacific region: an example from the Nakaminato Group (Hitachinaka, central Honshu, Japan)	Masukawa	Genya
T4.C07 Comparison between the marine and continental records during Cretaceous greenhouse states		
Evolution of the Late Cretaceous clam shrimps in the Songliao Basin, northeastern China	Li	Gang
Cretaceous terrestrial deposits in China	Cao	Ke
Late Cretaceous terrestrial paleoclimate recorded by paleosols in the Songliao Basin, northeast China	Gao	Yuan
T5. CRETACEOUS PALAEONTOLOGY		
T5.P00 Open Session on Cretaceous palaeontology		
Evolution and palaeogeographical dispersion of the radiolitid rudist genus *Auroradiolites* (Bivalvia: Hippuritida), with descriptions of new material from Tibet and archived specimens from Afghanistan	Rao	Xin

Cretaceous fossils of Saxony, part 1 (Cenomanian-Coniacian Elbtal Group, Saxony, Germany)	Niebuhr	Birgit
Cretaceous fossils of Saxony, part 2 (Cenomanian-Coniacian Elbtal Group, Saxony, Germany)	Niebuhr	Birgit
Upper Cretaceous nautilids from the Elbtal Group (Cenomanian-Coniacian, Saxony, Germany)	Wilmsen	Markus
New insights into micro- and macrofaunal assemblages from the uppermost Hauterivian *Pseudothurmannia* beds of the Polomec hill (Western Carpathians, Slovakia)	Lukeneder	Alexander
T5.P02 Cretaceous Foraminiferal Micropalaeontology – The State of the Art		
Shell size measurements of the planktonic foraminiferal species *Rotalipora cushmani* and *Whiteinella brittonensis* across the Oceanic Anoxic Event 2 (middle Cretaceous)	Falzoni	Francesca
Keeled planktic foraminifera in the Lower to Middle Cenomanian of the Boreal Cretaceous, North German Basin	Erbacher	Jochen
Foraminifera biostratigraphy of Albian- Cenomanian deposits in southwest of Qayen, East of Iran	Raisossadat	Seyed N.
High-resolution foraminiferal stratigraphy of the Puez Formation (Dolomites, Austria): a reference section for definition of the Cretaceous stage boundaries	Soták	Ján
T5.P04 + P05 Cretaceous biodiversity (micropaleontology/macropaleontology)		
A peep into a private life of a Late Cretaceous burrowing shrimp: a case study from Muthmannsdorf, Austria	Summesberger	Herbert
T5.P06 Cretaceous vertebrates		
A new carpet shark from the Hell Creek Formation increases latest Cretaceous freshwater biodiversity	Gates	Terry
The chondrichthyan fauna from the Upper Cretaceous Scaglia Rossa of northeastern Italy: an overview	Amalfitano	Jacopo
Bony fish remains from the Upper Cretaceous Scaglia Rossa of Veneto region (northeastern Italy)	Amalfitano	Jacopo
T5.P07 Palaeobotany and Palynology		
An Early Cretaceous Ginkgo ovulate organ from the Inner Mongolia, China	Xu	Xiaohui
Plant megafossils and amber from the Upper Cretaceous of Vernasso (Friuli-Venezia Giulia, northeastern Italy)	Giusberti	Luca
Cretaceous seeds interpreted as insect eggs	Hermanová	Zuzana
T6. CRETACEOUS HYDROCARBON AND MINERAL DEPOSITS		
Outcrop based γ-ray measurements and detailed facies analyses of the Natih Fm in Jabel Akdhar area of Oman: a powerful tool for improving surface to sub-surface correlation	Frijia	Gianluca
Geochemical characteristics and origin of dolomite in Late Jurassic-Early Cretaceous platform carbonates, Ayralaksa Yayla (Trabzon, NE Turkey)	Yildiz	Merve
T7.CRETACEOUS GEODYNAMICS AND OROGENIES AND THE EVOLUTION OF THE TETHYAN REALM		
Stratigraphy and provenance of the Tauern Flysch (Penninic Unit, Austria)	Begusch	Christina
Evolution of weathering and erosion in the South Atlantic during the Late Cretaceous	Pucéat	E.
New Paleontological and Geochronological Data of Upper Cretaceous Volcanoedimentary Sequence form the Eastern Sakarya Zone, NE Turkey	Oguz	Simge
Late Cretaceous positive inversion tectonics and synsedimentary movements in the southern Münsterland (Northwest Germany)	Dölling	Manfred
Sedimentation on the northern Tethys margin during the Campanian–Maastrichtian Boundary Event: case study from the Skole Nappe of the Polish Carpathians	Kedzierski	Mariusz
Late Cretaceous cooling enhanced by continental weathering expressed by clay minerals in Campanian sediments	Chenot	Elise

Address of Welcome

Dear Participants and Guests!

We cordially welcome you to the 10th international Symposium on the Cretaceous, taking place on August 21–26 in Vienna, Austria!

Following a tradition of almost four decades now – starting with the 1st Cretaceous Symposium in Münster, Germany (1978), and succeeding the successful 9th Cretaceous Symposium in Ankara, Turkey (2013) – it is the second time now that we are pleased to welcome you to Vienna, where the 6th Cretaceous Symposium was held in 2000, then organised by Heinz Kollmann, Herbert Summesberger, Hans Egger and Michael Wagreich.

Against the background that we also celebrate the 10th anniversary of this meeting, we have made efforts to broaden the fields in Cretaceous research offered at the meeting, and to strengthen those fields sometimes underrepresented, such as, amongst others, non-marine/terrestrial studies, palaeobotany/palynology and vertebrate palaeontology. Moreover, the Cretaceous as an icon for today's global change – especially with regard to greenhouse climate shift and sea-level rise – is a topic of wide interest and significance, and interwoven with the UNESCO-IUGS IGCP (International Geoscience Programme) projects on the Cretaceous, also represented at the symposium.

We are especially delighted to celebrate the Austrian micropalaeontologist, nannofossil specialist, and pioneer in nannoplankton biostratigraphy Dr. Herbert Stradner on the occasion of the bestowal of the Eduard Suess-Medal 2017 (in German *Eduard Sueß Gedenkmünze*). The Eduard Suess-Medal is the highest award of the Austrian Geological Society (ÖGG) granted since 1918 for outstanding contributions and merits to the Geological Sciences. It is an award in memory of the famous Austrian Geologist Eduard Suess (1831–1914), who coined universal terms and concepts of modern geology such as Gondwana, Tethys, and eustatic sea-level changes. The Suess-Medal has been first awarded in 1918 to the Swiss Alpine geologist Albert Heim, and Herbert Stradner is the 28th awardee.

On this occasion, we dedicate the volume at hand to Dr. Herbert Stradner and included tributes to him from long-term colleagues and disciples. Furthermore, as you may have recognized, we embedded the Late Cretaceous index nannofossil species *Lithastrinus grilli* STRADNER, 1962 (gen. et sp. nov.) into the Symposium logo.

Finally, we would like to express our gratitude to all the many people who have contributed, and will contribute, to the successful organisation and realisation of this meeting. Our appreciation is extended to our funding organisations and institutions.

We hope that this meeting, just like its precursors, will be successful and enjoyable, that it will stimulate the interdisciplinary dialogue within our community, the outreach of our ideas and concepts to the broader public, and that all of you can make new friends, and take home new ideas and insights.

Sincerely,
Michael, Wagreich, Benjamin Sames, Veronika Koukal, Holger Gebhardt,
Alexander Lukeneder, and Erik Wolfgring

Tribute to DR. HERBERT STRADNER

in recognition of the bestowal of the

Eduard Suess-Medal

by the Austrian Geological Society, 2017

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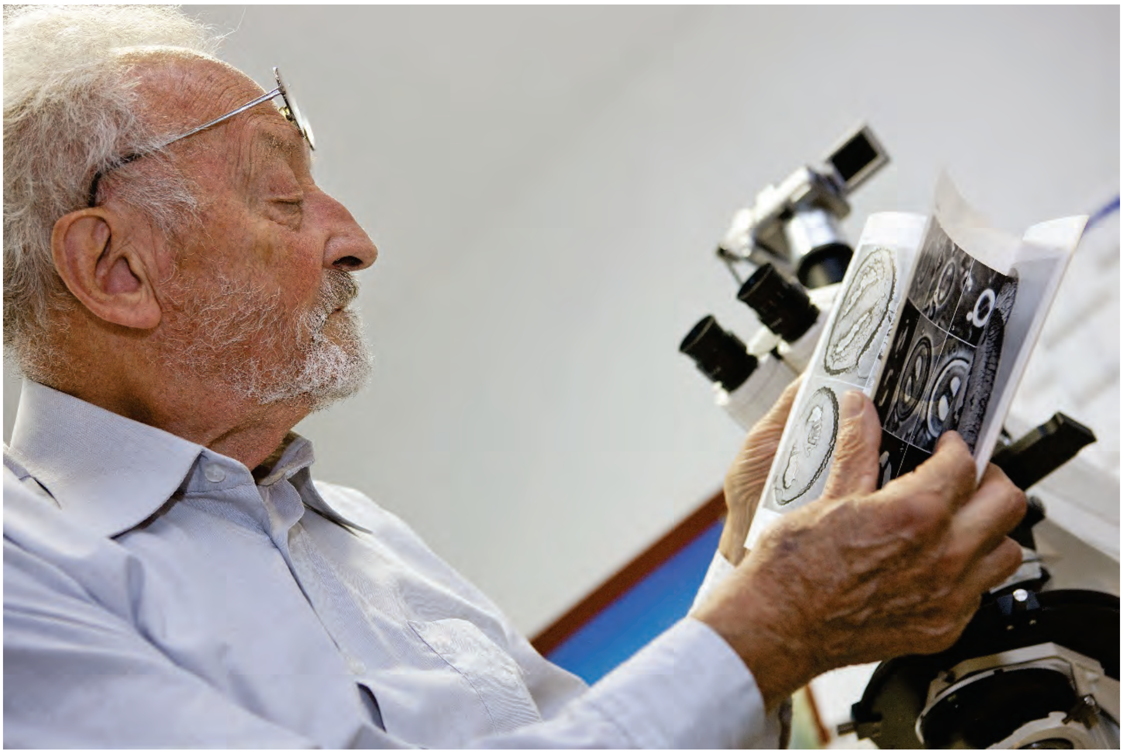

To Herbert Stradner

*By **Hans Egger***
Department of Paleontology and Stratigraphy, Geological Survey of Austria, Vienna

In 1980 Herbert Stradner gave a course on calcareous nannoplankton at Salzburg University. Me and the other students were impressed, not only by Herbert´s knowledge but also by his generous and kind personality. After the last lesson, Herbert was busy to travel to the US to join the ship party of the “Glomar Challenger” for LEGXXV in the Southern Atlantic. He was busy, nevertheless, he did not forget to send a picture postcard from California to each of his Salzburg students.

Later, calcareous nannofossils became an important tool for my thesis in Cretaceous and Paleogene deep-water deposits and Herbert did not hesitate to give me a deeper insight into nannoplankton stratigraphy. He is one of the pioneers in that field since he published the first paper on the stratigraphic value of discoasterids in 1959 at the 5th World Petroleum Congress. At the time of this publication, Herbert still worked as a teacher for the English language at a secondary school in Vienna and he had to take care for his growing family. So he could follow his scientific passion only in his spare leisure time.

Despite his tight schedule in the late 1950´s, Herbert contacted a local oil company and tried to convince them of the stratigraphic value of nannofossils. Actually, he got the chance to demonstrate this value by working on drill cores from the Matzen oil field north of Vienna and he was able to decipher the top of the Oligocene there for the first time. This was the begin of a consultant career, which continued also after his employment at the Geological Survey of Austria, where he was a member of the staff between 1960 and 1990.

In the newly established nannoplankton laboratory Herbert biostratigraphically analysed thousands of samples for the field geologists and by this contributed essentially to the understanding of the evolution of the Eastern Alps. The publication of many modern geological maps of alpine sedimentary units would not have been possible without the biostratigraphic framework given by Herbert. Besides he found time for over one hundred descriptions of new species (archaeomonadins, diatoms, calcareous nannofossils and silicoflagellates), many of them important stratigraphical markers. A revision of his taxonomic work on nannofossils was presented on the occasion of his 85th birthday in 2010, when he was honoured by a special volume by the Geological Survey of Austria. A revision of his work on silicoflagellates followed a few years later. Herbert contributed to both publications as one of the authors and we are very happy and grateful that Herbert is still coming to our department and helps with his advice.

On behalf of the department of Paleontology and Stratigraphy it is a great honour and pleasure for me to convey my best congratulations to my friend and mentor Herbert Stradner for being awarded the Eduard Suess Medal.

Hans Egger

Dr. Herbert Stradner

*By **Jeremy R. Young***
Department of Earth Sciences, University College London, UK

On behalf of the International Nannoplankton Association I am delighted and honoured to convey my congratulations to Dr. Herbert Stradner on the occasion of his being awarded the Eduard Suess-Medal. Nannofossil palaeontology is now one of the most commonly used tools in modern biostratigraphy with experts across the globe. In the late nineteen-fifties, however, when Herbert Stradner began his micropaleontological studies the subject hardly existed. Nonetheless, he rapidly recognised the potential of silicoflagellates, coccolithophores, discoasters and other nannofossils to solve biostratigraphic problems, and he became one of the pioneers of the field. He was especially active in nannofossil studies during the decade from 1959 to 1969, publishing some 25 papers and describing over a hundred taxa in this period. He also applied them in practical biostratigraphy both in Austria and internationally and this applied aspect increasingly dominated his work including participation in DSDP Legs to the Mediterranean, Caribbean and South Atlantic. In recognition of this a total of eight species and three genera of nannofossils have been named after him, by colleagues from seven different countries.

Herbert was one of the founding members of the International Nannoplankton Association, and I am pleased to share a photograph of him from the meeting in Rijswijk, the Netherlands, where it was initiated. Later, he helped Katharina von Salis with hosting of the first INA conference in Vienna in 1985 and he both co-lead the fieldtrip – which ended with a particularly memorable evening in a Heuriger – and co-edited the Proceedings. During his career Herbert has mentored, encouraged and co-published with numerous nannofossil workers and is universally remembered with respect and affection.

With all best wishes, Jeremy Young, President of the International Nannoplankton Association.

Herbert Stradner at the foundation of the International Nannoplankton Association in 1977, and rather more in his element during our first conference in Vienna 1985 (Photographs: Ben Prins and Shirley van Heck).

List of nannotaxa named in honour of Dr. Herbert Stradner

Genera: *Stradneria* REINHARDT (1964), *Stradnerius* HAQ (1968), *Stradnerlithus* BLACK (1971).

Species: *Cyclococcolithus stradneri* JAFAR (1975), *Discoaster stradneri* MARTINI (1961), *Haslingfieldia stradneri* BLACK (1973), *Lithastrinus? stradneri* PERCH-NIELSEN (1973), *Microrhabdulus stradneri* BRAMLETTE & MARTINI (1964), *Micrantholithus stradneri* CHANG (1969), *Tegumentum stradneri* THIERSTEIN in ROTH & THIERSTEIN (1972), *Vekshinella stradneri* ROOD, HAY & BARNARD (1971).

Dr. Herbert Stradner

*By **William W. Hay***
University of Colorado, Boulder, USA

I first met Herbert Stradner in 1959, while I was on a year of postdoctoral work at the University of Basel, Switzerland, sponsored by the US National Science Foundation. Through a special arrangement with Chevron Oil Company I had additional funds that allowed me to travel to collect samples for study and to meet with colleagues all over western Europe.

In Basel I had followed up on the idea of the possible significance of calcareous nannofossils as stratigraphic indicators suggested by Milton Bramlette and William Riedel at Scripps Institution of Oceanography in California in 1954. I had examined samples of the shale layers of the Schlierenflysch that had been collected by Hans Schaub, and discovered that the calcareous nannofossils were indeed valuable stratigraphic markers.

Professor Louis Vonderschmitt made me aware of recent papers by a young Austrian micropaleontologist, Herbert Stradner, in the Erdoel-Zeitschrift concerning Paleocene discoasterids and their potential for stratigraphic zonation. I resolved to visit him, his mentor, Adolf Papp, and the famous specialist on modern calcareous nannoplankton, Erwin Kamptner, in Vienna. We met for the first time in the spring of 1960. Herbert told me of his just completed work with Paul Brönnimann on using discoasterids and planktonic foraminifera as stratigraphic markers in Cuba and showing how they could be used for global correlation. After the visit in Vienna, I went on to collect samples from the stratigraphic sections in western Austria that Herbert had studied, and later used them for comparative purposes.

It was Herbert Stradner who first realised the significance of discoasters and other calcareous nannoplankton fossils as stratigraphic markers levels with a refinement equal to or greater than the planktonic foraminifera that were the standard of the time. He expanded these studies from the Paleogene to the Neogene over the next few years and demonstrated their importance in global correlations. In many ways, Herbert Stradner was the father of the stratigraphic use of calcareous nannoplankton.

Later I became intensively involved with the Deep Sea Drilling project, and was able to recommend enthusiastically that Herbert be invited as an onboard specialist describing the calcareous nannoplankton and their stratigraphic significance.

Over the years, we were able to meet a number of times, and I always enjoyed discussing the progress of his investigations. His studies of calcareous nannoplankton and the fossil silicoflagellates that had been the topic of his doctoral dissertation continued throughout the rest of his distinguished career.

William W. Hay

A personal Tribute to *Herbert Stradner:* a consummate discoverer and an incomparable scholar of the "inner space"

*By **Bilal U. Haq**,*
Sorbonne Universités, Pierre et Marie Curie, Paris, France

Herbert Stradner in 1977

I met my friend and mentor Herbert Stradner in 1965 in Vienna when I was a mere lad and attending a yearlong post-graduate research program sponsored by UNESCO and the Geologische Bundesanstalt (Geological Survey of Austria). Here I also met many other eminent Austrian geoscientists of that time, including Rudolf Grill, Heinrich Kuepper, Kuno Bruno Kuntz, Rudolf Oberhauser and Manfred Schmid, among others, all of who were great teachers for a young budding geologist. Initially, I worked with Rudolf Oberhauser and a distinguished Vienna University professor, Adolf Papp, on Miocene planktonic foraminifera from the Vienna Basin. However, later in the program, Herbert Stradner introduced me to the wonders of the "inner space" through the electron-microscopic world of calcareous nannoplankton (marine microplankton with an evolutionary history going back to the Triassic). Herbert was already mentoring another student (who was to become my life-long friend from Japan, Toshiaki Takayama), but he readily took me under his wing as well. I was immediately smitten with these nanno-critters and decided to study them for my thesis at the University of Stockholm where I had been invited by a Swedish professor, Ivar Hessland, on a PhD fellowship.

On my first meeting with Herbert, we immediately developed a great rapport. He was an imposing and striking figure with well-chiseled Viennese countenance and a most kindly disposition. In the short two months before my departure, he patiently taught me whatever he could so that upon arrival in Stockholm I could get started on my thesis without delay. This was a tremendous help. He accepted the role of being my mentor with enthusiasm, even though I was not officially assigned to him as a student and he encouraged me to pursue my newfound passion for the "inner space". At Stockholm University, Ivar Hessland generously provided me with my own electron microscope and I went wild exploring the "inner space" and the nanno-world beyond the power of ordinary light microscopes. During the next four years, I regularly consulted with Herbert and eventually defended my doctorate thesis in Stockholm in 1972 with Herbert as one of my external examiners (see above).


Two views of Herbert Stradner with the author in 1972, at the conclusion of the author's doctoral dissertation. Left: Herbert congratulating the author at the conclusion of the thesis defense, and right: Herbert and Ivar Hessland flanking the author at dinner that night in a Stockholm Gamla Stan (old city) restaurant.

Since that time, I have occasionally visited with Herbert in Vienna and met him in other places while attending scientific conferences, and throughout this time, my memories of Herbert have been very pleasant ones. He is amongst the most soft-spoken and kindest people I have ever met. My most recent visit with him was during the EGU annual meeting in 2012, when he invited me to visit the Albertina Museum, followed by lunch at his favorite restaurant in the center of city, with a typical Viennese meal of asparagus soup, followed by beef goulash, and downed with Krügels of Gösserbräu.


Left: Herbert Stradner teaching the author how to make a proper Wiener Schnitzel at his Klosterneuburg *home in 1977. Right: Sharing a nice Viennese meal in Herbert's favourite restaurant in the centre of Vienna in 2012. Notice how during this time Herbert has remained youthful and handsome as ever.*

Herbert Stradner's active career as one of the world's most eminent calcareous nannoplankton researchers spans over five decades, publishing nearly 70 research papers, predominantly on nannofossils, but also including other micro-fauna and flora. Three decades of this interval (1960s through 1980s), was a period of great discovery in nannofossil taxonomy and biostratigraphy and Herbert has a lion's share of discovering new taxa (nearly a 100 at the last count) and documenting their biostratigraphic utility. His passion for the discovery of new forms (new genera, species and subspecies) is demonstrated by the fact that he described new taxa in most of his published works since he started publishing in 1958.

Herbert's doctoral thesis at Vienna University was on the Tertiary silicoflagellates of Austria (1956). Soon thereafter, several papers of discovery (1958–1961) followed this, many of them first reports on the occurrence of nannofossils in basins in Europe and elsewhere. Most of these early papers had a special focus on the nannofossils that are restricted to the Tertiary, the Discoasters. This culminated in a profusely illustrated tome on Discoasters of Austria, Rumania, Italy and Mexico and their biostratigraphic significance (1961), published together with Adolf Papp. This volume, with beautifully hand-drawn figures by Herbert, became the must-have reference for all Tertiary nannofossil researchers and remains important to this day.

After the Tertiary, Herbert diverted his attention to the Mesozoic (1962–1963) while still continuing to discover new taxa in the Tertiary. Several papers reported on the nannoflora of the regional Tertiary stratotypes and neostratotype sections in Europe, e.g., Tortonian, Helvetian, Wemmelian, Biarritzian, Messinian, Ergerian and Sarmatian (1963–1980).

Herbert also participated in a number of Deep Sea Drilling Program legs, either as a shipboard nannofossil expert, or as shore-based contributor, starting with the all-important Leg 13 in Mediterranean (1970) that was first to document the Messinian Salinity Crisis and the desiccation of the Mediterranean Sea in latest Miocene. His expertise contributed to accurate biochronology of the basins that were drilled (DSDP Leg 13, Mediterranean; Leg 29, South Pacific; Leg 42, Aegean Basin; Leg 66, Middle America Trench; and Leg 75, Angola Basin) with his studies of nannofossils, Archaeomonadaceae, diatoms and silicoflagellates (1973–1984). He also contributed to the resolving of the controversy across the Cretaceous-Tertiary boundary with nannofloral evidence from sections in Austria (1987–1988).

Herbert has continued to be active since his retirement in the late 1980s, writing papers on nannofossils and silicoflagellates together with many well-known Austrian and international researchers and contributing with his special knowledge of stratigraphy of the European basins. Herbert has remained engaged with the pursuit of his passion for science well into his late 1980s, his most recent contributions having been in cataloguing the type specimens of nannoplankton, silicoflagellates and archaeomonids in the collections of the Geological Survey of Austria (2010–2014).

Herbert Stradner's bibliography clearly illustrates his standing as the indefatigable scholar of the "inner space" who has not only contributed a large body of basic scientific knowledge to micropaleontology, but has also inspired many young researchers to take up the same pursuit and develop a passion for the unravelling the hidden mysteries of nature.

Bilal U. Haq

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Timing and tempo of Deccan volcanism relative to the KPg boundary, evidence from mercury anomalies

Adatte, T.[1]***, Keller, G.***[2]***, Font, E.***[3]***, Mbabi Bitchong, A.***[4]***, Schoene, B.***[2]

1) Institute of Earth Sciences, Lausanne University, Lausanne, Switzerland, E-mail: thierry.adatte@unil.ch
2) Department of Geosciences, Princeton University, Princeton, USA
3) IDL-FCUL, Universidade de Lisboa, Lisbon, Portugal
4) Institute of Mines and Petroleum, Maroua University, Maroua, Cameroon

Mercury is a very toxic element, with a long residence time (1–2 years) and wide distribution by aerosols. Volcanic emissions and coal combustion are the two main natural sources of mercury. Several studies evaluated the relationship between Hg anomalies in sediments and LIP activity across mass extinction horizons. The bulk (80 %) of Deccan Trap eruptions occurred over a relatively short time interval in magnetic polarity C29r. U-Pb zircon geochronology reveals the onset of this main eruption phase 250 ky before the Cretaceous-Tertiary (KT) mass extinction and continued into the early Danian suggesting a cause-and-effect relationship (SCHOENE et al., 2015). In a related study, we investigate the mercury (Hg) contents of sections in France (Bidart), Spain (Zumaya, Caravaca, Agost), Denmark (Nye Klov), Austria (Gams), Italy (Gubbio), Tunisia (Elles, El Kef), Egypt (Sinai), Israel (Negev), India (Megalaya), Texas USA (Brazos River) and Mexico (La Parida). In all sections, results show Hg concentrations are more than 2 orders of magnitude greater during the last 100 ky of the Maastrichtian up to the early Danian P1a zone (first 380 ky of the Paleocene). These Hg anomalies are correlative with the main Deccan eruption phase. Hg anomalies generally show no correlation with clay or total organic carbon contents, suggesting that the mercury enrichments resulted from higher input of atmospheric Hg species into the marine realm, rather than organic matter scavenging and/or increased run-off. At Gams, Bidart, Elles and Caravaca, Hg anomalies correlate with high shell fragmentation and dissolution effects in planktic foraminifera indicating that paleoenvironmental and paleoclimate changes drastically affected marine biodiversity. These observations provide further support that Deccan volcanism played a key role in increasing atmospheric CO_2 and SO_2 levels that resulted in global warming and acidified oceans, increasing biotic stress that predisposed faunas to eventual extinction at the KTB.

SCHOENE, B. et al., 2015. Science, **347**/6218, 182–184.

Constraining the carbon fluxes during the onset of OAE 1a via inverse modelling

Adloff, M.[1,*], Greene, S.[2], Naafs, D.[1], Monteiro, F.[1], Ridgwell, A.[3], Lunt, D.[1], Hesselbo, S.[4]

*1) University of Bristol, Bristol, UK, *E-mail: ma16749@bristol.ac.uk*
2) University of Birmingham, Birmingham, UK
3) University of California, Riverside, Riverside, USA
4) University of Exeter, Camborne School of Mines, Penryn, Cornwall, UK

The Oceanic Anoxic Event (OAE) 1a during the early Aptian (~120 Ma) represents a major disruption of the global carbon cycle and is recorded in marine sediments from all major ocean basins. Stable carbon isotope ($\delta^{13}C$) records show a significant decrease during the onset of OAE 1a, followed by a broad positive excursion. The initial negative $\delta^{13}C$ excursion that might be coupled with an observed CO_2 increase, suggests an input of isotopically-depleted carbon into the Earth system at the onset of OAE 1a. However, estimates of the duration of the different stages of OAE 1a, particularly the negative $\delta^{13}C$ excursion, vary and complicate the interpretation of the geological record. To test the implications of the proposed OAE 1a timescales and their reconcilability with other proxy data, we will use the biogeochemical ocean model of intermediate complexity cGENIE. In a series of experiments, our model will be forced to follow the atmospheric CO_2 concentration and $\delta^{13}C$ evolution, obtained from proxy data, throughout the onset of the OAE using a variety of OAE 1a timescale assumptions. We will compare the results to proxy data from sediment cores, including the extend of anoxia. For each experiment, we will also extract the magnitude and $\delta^{13}C$ signature of carbon inputs required to reproduce the recorded $\delta^{13}C$ and pCO_2 development.

Sequoioxylon (Cupressaceae s. l.) fossil woods from the Cretaceous deposits of Primorye and Sakhalin regions, Russian Far East

Afonin, M.[1]

1) Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia, E-mail: afmaxim@inbox.ru

Fossil leaves and cones of Sequoioideae are common in the Cretaceous deposits of Russian Far East. They were reported from the Albian to the Maastrichtian of Chukotka, Kamchatka, Magadan, Amur, Primorye and Sakhalin regions. In Russian Far East, fossil woods of Sequoioideae were previously known only from the Upper Cretaceous deposits in the Amur Region (BLOKHINA et al., 2010; AFONIN, 2013). We described wood remains of Sequoioideae, under the generic name of *Sequoioxylon*, from the Cretaceous deposits of Primorye and Sakhalin regions. Fossil woods of Sequoioideae were found in the Cretaceous deposits of these regions for the first time. Moreover, *Sequoioxylon* fossil wood from Primorye represents the first record of this wood from the Lower Cretaceous deposits of Russia. In Primorye, fossil woods studied were collected from the Albian Galenki Formation on the De-Friz Peninsula, and in Sakhalin – from the Upper Turonian–Coniacian Middle Bykov Subformation on the right bank of the Nayba River. *Sequoioxylon* fossil wood species, described from Primorye and Sakhalin, are characterized by combination of wood anatomical features of the modern representatives of Sequoioideae (*Sequoia*, *Sequoiadendron* and *Metasequoia*). *Sequoioxylon* from Primorye shows the most similarity to the wood *S. dimyense* M. AFONIN (AFONIN, 2013). However, it differs from *S. dimyense* in the lower uniseriate rays, in the absence of bi-multiseriate rays, and uniseriate rays with triseriate parts. *Sequoioxylon* from Sakhalin most closely resembles that of wood *S. burejense* BLOKHINA & M. AFONIN (BLOKHINA et al., 2010), but it differs from the latter in the presence of tetraseriate pits on the radial tracheid walls, and the greater number of pits on the cross-fields, but the smaller number of pits in single horizontal row on the cross-field. Therefore, according to the literature data and our research, the first representatives of Sequoioideae appeared in the Russian Far East at the end of the Early Cretaceous. The representatives of Sequoioideae apparently played an important role as a component of woody vegetation in this territory at the middle-end of the Late Cretaceous.

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Orbital chronology of the Barremian Stage from the Eastern Subbetic (Spain)

Aguado, R.[1], Company, M.[2], Martinez, M.[3], Martínez-López, F.J.[4], O'Dogherty, L.[4,*], Sánchez-Bellón, Á.[4], Sandoval, J.[2]

1) Dpto. Geología, EPS-Linares, Universidad de Jaén, Linares, Spain
2) Dpto. Estratigrafía y Paleontología, Universidad de Granada, Granada, Spain
3) MARUM, Bremen, Germany
*4) Dpto. Ciencias de la Tierra, Universidad de Cádiz, Puerto Real, Spain, *E-mail: luis.odogherty@uca.es*

The basic purpose of this contribution is to estimate the accurate time span of the Barremian stage. To reach such objective we propose in this study the combination of basic chronostratigraphic tools (chemo-, magneto- and biostratigraphic) in an astronomical-calibrated framework through cyclostratigraphic approach in two pelagic sections from the Subbetic basin (SE Spain). Because Earth's climate is affected by cyclic modifications of its orbit, consequently the sedimentary record reflects a true and continuous evolution of palaeoclimatic proxies. The identification of Milankovitch cycles, deduced by means of magnetic susceptibility, calcium $CaCO_3$ and clay mineralogy, will provide the basis for a precise age-model of the Barremian stage.

In this sense, two pelagic successions from the Subbetic basin (Valentín, $X.V_1$: 74.80 m thick, and Barranco de Cavila, $X.Kv_2$: 67.70 m thick), well dated by ammonites, and encompassing the uppermost Hauterivian to lowermost Aptian interval were sampled for high-resolution stratigraphic studies. These will include magnetic susceptibility, carbon and oxygen isotope stratigraphy and clay mineralogy. The sampling interval was constant and as tight as 7 cm along the two sections, with a total of 2,027 samples (1,073 in $X.V_1$ and 954 in $X.Kv_2$) along the complete interval studied. Taking advantage of this high-resolution sampling, the first (FOs) and last occurrences (LOs) of several calcareous nannofossil markers, and calcareous nannofossil zonal boundaries along the study interval, were determined with a high precision. These include the LOs of *Lithraphidites bollii*, *Micrantholithus spinulentus*, and *Calcicalathina oblongata* and the FOs of *Flabellites oblongus*, *Lithraphidites houghtonii*, *Micrantholithus stellatus* and *Hayesites irregularis*. The boundaries between subzones NC5B/NC5C, NC5C/NC5D, NC5D/NC5E and zones NC5/NC6 were determined with precision. In addition, the uppermost Barremian event, known as 'nannoconid decline' or 'first nannoconid crisis' was recorded, and correlated with precision with respect to ammonite biostratigraphy (AGUADO et al., 2014).

AGUADO, R. et al., 2014. Cret. Res., **49**, 105–124.

Biostratigraphy, cyclostratigraphy and radio-isotopic geochronology of the Agrio Formation (Argentine Andes): towards an intercalibration with the Tethys during the Valanginian–Hauterivian

Aguirre-Urreta, B.[1,*]***, Schmitz, M.***[2]***, Martinez, M.***[3]***, Lescano, M.***[1]***, Omarini, J.***[4]***,***
Concheyro, A.[1]***, Tunik, M.***[4]***, Rawson, P.F.***[5]***, Ramos, V.***[1]

1) Instituto de Estudios Andinos, Departmento de Ciencias Geológicas, Buenos Aires, Argentina,
**E-mail: aguirre@gl.fcen.uba.ar*
2) Department of Geosciences, Boise State University, Idaho, USA
3) MARUM, Bremen, Germany
4) Instituto de Investigación en Paleobiología y Geología, General Roca, Argentina
5) Department of Earth Sciences, University College London, London, UK

The global 'standard' Early Cretaceous stages that are based on sections in the Mediterranean Tethys were defined by ammonite biostratigraphy and calcareous nannofossil bioevents calibrated with the M sequence of magnetic polarity chrons. Because of the scarcity of tuffs in the Tethys, the lack of precise radiometric ages has hindered the construction of an accurate geological time scale. In particular, the durations of the Valanginian and the Hauterivian stages are presently under much debate, with large discrepancies between the numerical ages of the Geological Time Scale 2016 (OGG et al., 2016) and biostratigraphic and radio-astrochronological studies performed recently, both in the Andes (AGUIRRE-URRETA et al., 2015) and in the Tethys (MARTINEZ et al., 2015). To deal with these issues we analyzed the Agrio Formation in the Neuquén Basin, a retro-arc basin developed at the foothills of the Andes. We have studied this unit for more than 20 years with bed-by-bed collection of fossils in many localities, recently sampling several tuff layers. We have selected a stratigraphic section at El Portón where this formation is composed of marl-limestone alternations, and have performed magnetic susceptibility measurements obtaining the first orbital time scale. Besides, there are two Chemical Abrasion-Isotope Dilution-Thermal Ionization Mass Spectrometry (CA-ID TIMS) U-Pb radio-isotopic ages in El Portón; the first one is 130.39 ± 0.16 Ma (early Hauterivian) and the second is 126.97 ± 0.15 Ma (latest Hauterivian–?early Barremian). Both are well constrained biostratigraphically by ammonites and calcareous nannofossils which correlate with the 'standard' sequence of the Tethys. Thus, we have obtained a robust combination of cyclostratigraphy, biostratigraphy and radio-isotopic ages for the Agrio Formation. This new data, together with two former U-Pb radio-isotopic ages from other localities have been used to correlate the results in the Neuquén Basin with those of the Tethys, including the candidates for the base of the Hauterivian (La Charce) and the base of the Barremian (Río Argos). Thus, a new geological time scale for the Valanginian–Hauterivian stages integrating astro-chronological, biostratigraphic and radiochronological data differs with the present official geological time scale which still maintains poorly constraint absolute ages for the Valanginian–Hauterivian interval.

AGUIRRE-URRETA, B. et al., 2015. Geol. Magazine, **152**/3, 557–564.
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Disseminating Cretaceous palaeontology through a network of regional centres in Teruel (Spain)

***Alcalá, L.**[1,*], Cobos, A.[1], Ayala, D.[1], Espílez, E.[1], González, A.[1], Mampel, L.[1], Royo-Torres, R.[1]*

1) Fundación Conjunto Paleontológico de Teruel-Dinópolis, Teruel, Spain,
**E mail: alcala@fundaciondinopolis.org*

The Province of Teruel in Spain is a worldwide significant area because of its museographic initiatives, which aim their attention at research, protection and dissemination of the palaeontological heritage. Thus, the Palaeontological Park of Dinópolis (composed of some large headquarters in the city of Teruel plus seven smaller satellite centres distributed throughout the Province) offers a varied palaeontological menu and constitutes the so-called "3D Handbook of Palaeontology". The exhibitions at the satellite centres introduce their local geological and palaeontological features as chapters of this "handbook". Four of them, the centres in the localities of Peñarroya de Tastavins, Galve, Castellote and Ariño focus on Cretaceous ecosystems, highlighting those with dinosaurs (while other Cretaceous fossils are also displayed in the main facilities in Teruel and in a Dinópolis-associated local exhibition in Mas de las Matas).

The Peñarroya de Tastavins centre (opened March 2003) concentrates on a Lower Cretaceous dinosaur site (Upper Barremian) where a new sauropod, *Tastavinsaurus sanzi*, was found. This exhibition's major theme is: *How is a dinosaur excavated?* And both the original fossils and a life-size replica of the skeleton are displayed in a spectacular bipedal posture.

In April 2003, the second satellite of Dinópolis was launched in Galve. Cretaceous fossils are represented by original fossils of *Iguanodon* (formerly identified as *Delapparentia*), ornithopod tracks, and by enlarged casts of Barremian mammalian teeth (such as *Galveodon*, *Lavocatia*, etc.). Also, the public can enjoy original bones, models and information about *Aragosaurus* – the first Spanish dinosaur described ever.

A centre in Castellote was opened in April, 2006 and it is mostly dedicated to palaeobotany. There, big fragments of trunks belonging to the species *Protaxodioxylon turolensis*, which were found in nearby coal mines, represent the flora of the continental Early Cretaceous (Albian). Furthermore, the different historical reconstructions of *Iguanodon* are also on display.

The Ariño centre (opened March 2015) shows the findings from open-pit mining activity and palaeontological prospecting carried out in the most important Albian dinosaur site identified in Europe. Almost ten thousand bones have already been recovered there. The main topic of the satellite deals with *Coal cool dinosaurs* and highlights the relevance of the outcrop and of the palaeontological record of this huge bonebed. So you can find the most complete armoured dinosaur in Europe, *Europelta carbonensis* (represented at the museum by its main anatomical characteristics and a life-size replica of this nodosaur), as well as the iguanodontian *Proa valdearinnoensis* (while a full original skeleton is showcased in Dinópolis-Teruel).

This network of facilities introduces "Cretaceous life" to the general public, and clarifies some ideas on vertebrate palaeontology to visitors, especially to all those who previously thought that dinosaurs are just protagonists of Jurassic parks!

This work was founded by the Aragón Government and Spanish Government (project CGL2013-41295-P DINOTUR).

The Santonian–early Campanian biota from the Ola volcanic plateau (Magadan region, Russia)

Alekseev, P.[1,*]***, Shczepetov, S.***[1]***, Golovneva, L.***[1]

*1) Komarov Botanical Institute RAS, St. Petersburg, Russia, *E-mail: palekseev@binran.ru*

During the Late Cretaceous, the northeastern margin of Asia was an area of intensive volcanic activity. During this time huge volumes of volcanic rocks were erupted and formed a massive mountain ridge, which extended up to 3000 km in longitudinal direction. This geological structure has been named as the Okhotsk-Chukotka volcanic belt. The Ola Formation is distributed near Magadan city and consists of ignimbrites and rhyolite tuffs and flows. Its age has been estimated as the Santonian–early Campanian on the base of isotope and paleomagnetic dating. This formation is overlain by basalts of the Mygdykit Formation, which forms the Ola volcanic plateau and protects the Ola Formation from erosion. The upper part of the Ola formation yielded several localities with abundant fossil insects, crustaceans and plants, that are preserved in lake sediments. The Ola flora contains cryptogam plants (club-mosses, horsetails and ferns), conifers, czekanowskialeans, cycadophytes, ginkgophytes and sparse angiosperms. The Late Cretaceous floras of nearest coastal lowlands were dominated by angiosperms. They are characterized by predominance of broad-leaved Platanaceae (*Pseudoprotophyllum, Paraprotophyllum, Arthollia*), Cercidiphyllaceae (*Trochodendroides*) and diverse Cupressaceae (*Sequoia, Metasequoia, Taxodium*).

The fossil plants from the Ola plateau localities are represented mostly by diverse Pinaceae and Cupressaceae with needle-shaped, falcate or squamiform leaves. Records of flowering plants are surprisingly scarce. Only the aquatic plant *Quereuxia* was a common component of floristic complexes. Except for this genus few small leaves of *Trochodendroides* and, possibly, leaves of two other extinct angiosperm genera were found. Animals and plants represent members of unusual mountain biota, which existed on the plateau between two stages of volcanic activity. This habitat was isolated from the coastal lowlands, and its vegetation was significantly different. In the Santonian–early Campanian the surface of the Ola volcanic plateau was covered by thermophilic conifer vegetation. Higher and drained places were occupied by pinaceous forest with *Taeniopteris* shrubs in undergrowth, whereas lake shores were covered by Cupressaceae forest with horsetails, ferns and a mixture of flowering plants. Lacustrine biota are represented by aquatic plants (*Quereuxia* and *Lokyma*), conchostracans and numerous larvae of insects. The late Campanian massive effusion of basalt lava flows dramatically finished the existence of these biota.

Paleogeographic history of the Senonian in the High Western Atlas of Morocco

Algouti, Ah.[1,*]***, Hadach, F.***[1]***, Algouti, Ab.***[1]***, Mourabit, Z.***[1]

1) Department of Geology, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco,
**E-mail: ahmedalgouti@gmail.com*

The study of the Senonian from the High Western Atlas of Marocco resulted in new biostratigraphic, lithostratigraphic and palaeogeographic data. The paleogeographic evolution during each stage was deduced from facies analysis and the reconstruction of depositional environments in space and time.

The Coniacian: During this period a major regression is reconstructed which resulted in emergence of the the eastern sector of the High Western Atlas. This regression is related to the pre-Senonian tectonic phase. However, in the study area, we could not detect any traces of tectonic activity between the Kasbah of Agadir Formation and the limestones and dolomitic marls of Anou-nfeg Formation except a significant paleogeographic change.

The Santonian is transgressive with a wide geographical extension. *The early Santonian* corresponds to a marine transgression resulting in a confined platform. At the end of this period, tectonic phase was accompanied in the north by halokinetic activity proven by the rise of a salt diapir in the Essaouira basin, which resembles those documented in the eastern Atlantic margin. *The late Santonian* corresponds to a regression, associated with thick evaporite series, deposited in a sabkha type environment, under a hot and arid climate, subjected to marine incursions marking minor and short transgressions.

The Campanian is absent from the northern slope of the Western High Atlas, indicating a major regression which exposed the eastern sector. This regression is related to a tectonic movement, as evidenced by an angular unconformity of 10° in Erguita, between the limestones and dolomitic marl of Ait Abbes Formation and the marls of Oued Lahouar Formation. In fact, during this period a slow convergence between Africa and Europe is evident from the western Mediterranean resulting in significant compression in Marocco, e.g. in the Central High Atlas (Toundout).

The Maastrichtian is marked by the return of the sea during a phase of major Atlantic transgression, encompassing the whole study area.

Upper Jurassic (Kimmeridgian)–Upper Cretaceous (Cenomanian) foraminifer assemblages within the sequence stratigraphic framework of subtidal to peritidal carbonate deposits controlled by a long-term lithospheric flexure (Western Taurides, Turkey)

Altiner, D.[1,*] ***and Yılmaz, İ.Ö.***[1]

*1) Middle East Technical University, Ankara, Turkey, *E-mail: demir@metu.edu.tr*

In the peritidal carbonate deposits of the Taurus carbonate platform, the boundaries of major second-order sequences consisting of several third-order sequences and numerous meter-scale cycles, coincide with important foraminiferal faunal extinctions, proliferations and changes. These boundaries, easily recognizable as distinct karst breccia levels in the field, correspond to the Kimmeridgian-Tithonian boundary, mid-Early Valanginian, mid-Early Aptian and mid-Cenomanian horizons. One of the foraminiferal faunal changes corresponds to the disappearance of some complex and large Textulariata (*Kurnubia plexus* including *Conicokurnubia, Neokilianina* and related forms) at the Kimmeridgian-Tithonian boundary. The overlying major second-order sequence, representing the Tithonian to lowermost Valanginian interval is characterized by the very rare occurrence of foraminifera which have probably been affected by the frequency of important sea level falls during this time interval. After the mid-Early Valanginian sea level fall foraminiferal fauna proliferated in the succeeding major second-order cycle, spanning the Early Valanginian–Early Aptian interval. This cycle is easily marked by the entry of several genera including *Montsalevia, Vercorsella, Campanellula* and *Voloshinoides*. Although they are not recorded from the western Taurides, orbitolinids sporadically invaded the peritidal domain in the eastern Taurides displaying their evolutionary trends for a short interval of time in the Early Aptian. A major crisis in the foraminiferal fauna occurred in the Aptian, coinciding with the mid-Early Aptian sea level fall. Several foraminiferal taxa including *Debarina, Vercorsella scarsellai, Voloshinoides murgensis* became extinct at this boundary. With the following sea level rise, the platform was again invaded, this time, by porcelaneous and agglutinated wall-bearing foraminifera belonging to miliolids, nezzazatids, cuneolines and chrysalidines typical for the recognition of the major second-order sequence deposited within the mid-Early Aptian–mid-Cenomanian interval.

Kimmeridigian–Cenomanian meter-scale cycles in the western Taurides consist mainly of four types. Subtidal cycles are distinguished as submerged subtidal and exposed subtidal cycles whereas peritidal cycles are recognized based on the presence of fenestrate limestones or tidal-flat laminites capping the cycle tops. When the distribution of dominant cycle types is documented their organization appears to follow in chronostratigraphic order within the Kimmeridgian–Cenomanian interval. Subtidal cycles occur dominantly in the Kimmeridgian–Tithonian, peritidal cycles in the Cretaceous. Peritidal cycles capped by laminites occur exclusively in the Upper Hauterivian–Cenomanian interval. The formation of such cycles could be explained by a long-term allocyclic, most probably a tectonic, event. A discrete flexure in the lithosphere should have caused the generation of peritidal cycles capped by stromatolites in the platform interior. Despite the long-term tectonic control on the structure of meter-scale cycles, vertical distribution of foraminiferal assemblages in the subtidal facies of cycles do not seem to have been controlled by any marked facies change.

Integrated Biostratigraphy of the Tithonian-Valanginian succession from the Northwest Anatolia, Turkey

Altiner, S. [1]

1) Middle East Technical University, Cankaya, Turkey, E-mail: altiner@metu.edu.tr

The analysis of Tithonian–Valanginian calcareous nannofossils and calpionellids have been investigated in order to improve the biostratigraphic resolution of this interval from the Northwest Anatolia, Turkey. The studied sections have been measured from the Tithonian–Valanginian deposits of the Yosunlukbayırı Formation and the Soğukçam Limestone. These formations are mainly characterised by calciturbidities and micritic limestones and marls with cherty and shaly levels.

Because of rareness and difficulties in extracting calcareous nannofossil species from these type of lithologies, nannoconids, the principal rock-forming consitutent of the Soğukçam Limestone, have been analysed from the very thin-thin sections. Nannofossil assemblages are dominated by *Conusphaera* spp., *Faviconus multicolumnatus*, *Watznaueria* spp. and *Nannoconus* spp. Five zones (*Conusphaera mexicana mexicana* Zone, *Microstaurus chiastius* Zone, *Nannoconus steinmannii steinmanii* Zone, *Retecapsa angustiforata* Zone, *Calcicalathina oblongata* Zone were recognized from Tithonian to Valanginian.

Successive distributions of calpionellids within the studied interval are evaluated to establish the biostratigraphic framework. Calpionellid zonation from bottom to top consists of *Chitinoidella boneti* Zone, *Praetintinnopsella* sp. Zone, *Crassicolaria* sp. Subzone, *Cr. intermedia* Subzone, *Cr. brevis* Subzone, *Calpionella alpina acme* Subzone, *Remaniella ferasini* Subzone, *Calpionella elliptica* Subzone, *Calpionellopsis simplex* Subzone, *Cs. oblonga* Subzone, *Lorenziella hungarica* Subzone, *Calpionellites darderi* Zone, *Tintinnopsella carpathica* Zone.

The co-occurrence of calpionellid and nannofossil events along the J/K boundary transition is typical as observed in other Tethyan sections. The Jurassic-Cretaceous boundary has been located at the base of Calpionella alpina acme zone. The acme of *C. alpina* is nearly synchronous with the last occurrence (LO) of *C. elliptalpina* and perfectly fits with LOs of some Late Tithonian *Crassicolaria* species including *C. intermedia* and *C. massutiana*. The Jurassic-Cretaceous boundary based on the calpionellids corresponds to the middle part of the *M. chiastius* Zone of nannofossils. Among nannoconids, one of the oldest species, *N. globulus minor* appears in the very Late Tithonian, close to the J/K boundary.

A revision of the fishes from the Bonarelli Level (uppermost Cenomanian) of northeastern Italy

***Amalfitano, J.*[1,*], Carnevale, G.[2], Fornaciari, E.[1], Giusberti, L.[1]**

*1) Department of Geosciences, University of Padova, Italy, *E-mail: jacopo.amalfitano@phd.unipd.it*
2) Department of Earth Sciences, University of Turin, Torino, Italy

The uppermost Cenomanian ichthyofauna from northeastern Italy, known since the 19th century, comes from the so-called Bonarelli Level (BL). This important marker bed is the lithological expression of the OAE2 event and consists of a black shale horizon (ranging from 30 cm to ca. 3 m in thickness) draping the hemipelagic rocks of the Scaglia Variegata Alpina Formation in the Southern Alps. The BL ichthyofauna from this area is practically unknown to the international scientific community. BASSANI (1880, 1882) first reported fossil fish remains from the BL, recovered near the village of Crespano (Treviso, Veneto), and consisting of three actinopterygian specimens. Most of the BL ichthyofauna was recovered from three main localities (Cinto Euganeo, Carcoselle quarry, Valdagno tunnel excavations) in northeastern Italy since the second half of the 20th century, and additional material derives from a number of minor localities. In particular, a relatively diverse fish assemblage was discovered at Cinto Euganeo. Excavations were undertaken at this locality in 1974 and 1975, and the fossils were subsequently described by SORBINI (1976).

Overall, the ichthyofauna includes mainly bony fishes, with lesser numbers of chondrichthyans (only several small isolated teeth referable to Lamniformes and Ptychodontidae, e.g., *Cretoxyrhina*, *Cretolamna*, *Squalicorax* and *Ptychodus*). The specimens are generally poorly preserved, with the exception of a few partially complete individuals of *Tselfatia formosa*. Some other fragmentary vertebrate remains (turtles and a reptile tooth) were recovered from the Carcoselle quarry and Valdagno tunnel excavations. Bony fish remains comprise mainly predatory teleosts, such as *Protosphyraena*, *Pachyrhizodus*, *Enchodus*, *Rharbichthys* and *Rhynchodercetis.* Other ray-finned fish genera present in the association are the formerly mentioned *Tselfatia*, plus *Thrissops*, *Holcolepis*, *Protelops*, *Ichthyotringa*, *Paravinciguerria*, *Protostomias*, *Clupavus* and *Omosoma*. Some pycnodontiforms (*Palaeobalistum*, *Coelodus* and *Nursallia?*) are also present. Considering the whole assemblage, the BL ichthyofauna from northeastern Italy is homogeneous and consistent with the coeval ones from Morocco, Sicily and Dinarides (ARAMBOURG, 1954; BASSANI, 1882; LEONARDI, 1965; SORBINI, 1976). What can be interpreted as meso-bathypelagic taxa are quite abundant, with rarer neritic fishes (Pycnodontiformes). The whole BL fish fauna from northeastern Italy is badly in need of a detailed revision, which is presently underway in the framework of a multidisciplinary project aimed at revising the stratigraphy and paleontology of Cretaceous *Fossil-Lagerstätten* from northeastern Italy.

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Bony fish remains from the Upper Cretaceous Scaglia Rossa of Veneto region (northeastern Italy)

***Amalfitano, J.*[1,*], Carnevale, G.[2], Fornaciari, E.[1], Giusberti, L.[1], Luciani, V.[3]**

*1) Department of Geosciences, University of Padova, Italy, *E-mail: jacopo.amalfitano@phd.unipd.it*
2) Department of Earth Sciences, University of Turin, Torino, Italy
3) Department of Physics and Earth Sciences, Univ. of Ferrara, Polo Scientifico Tecnologico, Ferrara, Italy

Vertebrate remains from the hemipelagic limestones of the Upper Cretaceous Scaglia Rossa Formation of Veneto region are usually rare. The fossil fauna includes mainly chondrichthyans, marine turtles and rare mosasaurs, mainly coming from the Turonian-Santonian "lastame" lithofacies (AMALFITANO et al., 2017). However, there are a few sporadic remains of bony fishes that add relevant information about this poorly known vertebrate assemblage. BASSANI (1886) reported isolated teeth referable to "*Lepidotes*" and a single tooth of *Protosphyraena ferox* from the "Pietra di Castellavazzo" lithofacies (near Belluno). D'ERASMO (1922) reported isolated teeth or tooth plates of Pycnodontiformes (*Coelodus*, *Acrotemnus*) from other sites. D'ERASMO (1922) ascribed also some partial pectoral-fin remains to *Protosphyraena,* that are in need of a revision. However, what appears to be the most important bony fish from the Scaglia Rossa Formation is a disarticulated cluster of bones, still undeterminated, coming from the "lastame" lithofacies. The bones are preserved on three slabs and have a rather large size. The general morphology is in some ways reminescent to dermal elements of the cranium of giant actinopterygians that inhabitated the Cretaceous open marine environments (e.g., *Bonnerichthys*, FRIEDMAN et al., 2010, 2013). The skeleton of these giant fishes was in general poorly ossified and its elements were loosely connected by cartilage. This fact could explain the poor preservation of the skeletal elements of the "lastame" specimen.

Despite the sparse and fragmentary record, the bony fish remains from the Scaglia Rossa Formation are extremely interesting in a broader context, as they augment the paleobiodiversity of Late Cretaceous Tethyan ichthyofaunas.

AMALFITANO, J. et al., 2017. Palaeogeogr. Palaeoclimatol. Palaeoecol., **469**, 104–121.
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The chondrichthyan fauna from the Upper Cretaceous Scaglia Rossa of northeastern Italy: an overview

***Amalfitano, J.**[1,*], Carnevale, G.[2], Fornaciari, E.[1], Giusberti, L.[1], Luciani, V.[3], Dalla Veccia, F.M.[4], Kriwet, J.[5], Roghi, G.[6]*

*1) Department of Geosciences, University of Padova, Italy, *E-mail: jacopo.amalfitano@phd.unipd.it*
2) Department of Earth Sciences, University of Turin, Torino, Italy
3) Dept. of Physics and Earth Sciences, University of Ferrara, Polo Scientifico Tecnologico, Ferrara, Italy
4) Soprintendenza per i Beni Archeologici del Friuli Venezia Giulia, Nucleo Operativo di Udine, Udine, Italy
5) Department of Paleontology, University of Vienna, Vienna, Austria
6) Institute of Geosciences and Earth Resources, CNR, Padova, Italy

Chondrichthyans are the most common vertebrates in the Turonian–Maastrichtian Scaglia Rossa Formation of northeastern Italy. Isolated lamniform and ptychodontid teeth have been found in several localities of the Veneto Region since the first half of the 19th century (e.g., BASSANI, 1877). Two specimens of the lamniform shark *Cretoxyrhina mantelli,* including articulated vertebrae and teeth, were recovered from the "Pietra di Castellavazzo" lithofacies near Belluno (BASSANI, 1888). Since the 1970s, chondrichthyan remains have been found during quarrying works in the "lastame" lithofacies near Sant'Anna d'Alfaedo (Lessini Mountains, Verona). These discoveries include a rather complete sclerorhynchid sawfish (*Onchosaurus pharao*; AMALFITANO et al., 2017a) and a large lamniform shark, *Cretodus* sp. that is closely associated with remains of a large marine turtle (AMALFITANO et al., 2017b). However, the most common lamniform is the ginsu shark, *Cretoxyrhina mantelli*, which is represented by at least three main specimens with associated vertebrae and teeth, and several others that are less complete. Some *Ptychodus* tooth sets were also found in the "lastame"; one specimen has well-preserved teeth associated with vertebrae and mineralized cartilage. *Ptychodus* remains from this lithofacies can be referred to at least three species: *P. decurrens*, *P. latissimus* and *P*. cf. *elevatus*.

In general, the chondrichthyan fauna of the Scaglia Rossa Formation is more diverse than previously assumed, including two large lamniform sharks (*Cretodus* and *Cretoxyrhina*) and a smaller one (*Scapanorhynchus*), a sawfish (*Onchosaurus*) and six ptychodontid species found in the whole Formation (*P. decurrens, P latissimus, P. mammillaris, P. mortoni, P. rugosus* and *P.* cf. *elevatus*). This fauna is typically cosmopolitan, comprising widespread genera from the Tethyan realm, and shares several similarities with other Late Cretaceous chondrichthyan faunas, especially those from the English Chalk, UK and the Niobrara Chalk, U.S.A. (e.g., EVERHART, 2005).

AMALFITANO, J. et al., 2017a. Cret. Res., **69**, 124–135.
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Reconstruction of Cretaceous continental arc-trench system in Japanese Islands as a basis for Cretaceous paleoenvironmental studies

***Ando, H.*[1,*] and Takahashi, M.[2]**

*1) Faculty of Science, Ibaraki University, Mito, Japan, *E-mail: hisao.ando.sci@vc.ibaraki.ac.jp*
2) Research Institute of Geology and Geoinformation, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan

As the Japanese Islands are situated in an active convergent margin, their geologic structure is very complicated in general. The distribution of their Cretaceous strata reflects the tectonic setting of the present four arc-trench systems: Kuril, Northeast (NE) and Southwest (SW) Japan, and Ryukyu. The tectonic configurations of the two main systems (NE and SW Japan) during the Cretaceous have not yet been resolved due to some epigenetical geologic processes. This is because the Cretaceous strata had been affected by post-Cretaceous tectonic movements, e.g. the Japan Sea opening, the subduction of Philippines Sea plate, the collision of the Izu-Ogasawara arc since the Early Miocene. Furthermore, the Cretaceous of Japan is widely eroded and covered by thick Neogene to Quaternary volcanics and sediments.

As a first premise we reconstructed the configuration of the NE and SW Japan arcs before the Japan Sea opening (ca. 25 Ma: Late Oligocene). A continuous distribution of Early Miocene volcanics parallel to a trench suggesting the volcanic front position at that time reminds us that the two major arcs formed a single straight continental arc (paleo-Japan arc). The distribution gap at their boundary zone, called Northern Fossa Magna region and Tonegawa Tectonic Line, was caused by right-lateral displacement of the paleo-Japan arc during the Early Miocene Japan Sea opening. Our reconstructed paleogeographic map indicates that the Outer Zone of SW Japan, the trench-side region of the Median Tectonic Line correlates in position to the offshore Pacific subsurface of NE Japan. The Cretaceous volcanic front inferred from the distribution of Cretaceous volcanics appears nearly in the same position as during the Early Miocene. This strongly suggests that the relative position of the continental arc during the Cretaceous was almost the same as during the Late Oligocene.

Mostly non-marine Lower Cretaceous strata are sporadically distributed in separated small intra- and back-arc basins around the volcanic arc, though they are also limited along the Pacific coast in NE Japan. On the other hand, mainly marine and subordinately fluvial strata are sporadically occurring but continuously distributed along the Pacific coast, offshore the Pacific subsurface in NE Japan, and along the southern end of the Inner Zone and the Chichibu Belt of the Outer Zone in SW Japan. Their stratigraphy and sedimentary environments are broadly correlated as forearc basin fills throughout the paleo-Japan arc. The stratigraphic ranges cover all of Cretaceous stages entirely, though the stratigraphic range and geographic distribution of each formation is limited.

These Cretaceous strata record a wide variety of sedimentary facies and biofacies changes from offshore to shallow-marine to continental, reflecting paleoenvironments and basin tectonic settings such as backarc/intra arc, forearc and trench slope-trench basins along the single continental arc-trench system between the Eurasian Plate and the subducting Paleo-Pacific oceanic plate.

Jurassic-Cretaceous boundary in the Eastern Crimea

Arkadiev, V.[1,*]***, Guzhikov, A.***[2]***, Baraboshkin, E.E.***[3]

*1) Saint Petersburg State University, Saint Petersburg, Russia, *E-mail: arkadievvv@mail.ru*
2) Saratov State University, Saratov, Russia
3) Lomonosov Moscow State University, Moscow, Russia

An integrated study of Jurassic-Cretaceous boundary interval study was carried out in the Crimea by geologists from Saint Petersburg, Saratov and Moscow over a long period of time. It includes bio- and magnetostigraphy, sedimentology and ichnology. Marine Upper Tithonian–Berriasian sediments are represented by carbonate flysh of Dvuyakornaya Formation in the Eastern Crimea (BARABOSHKIN et al., 2016). The age of the Formation is based on the ammonites, calpionellids and magnetostratigraphy. In the Feodosiya City region was interpreted as Late Tithonian *Microcanthum* and *Durangites* Zones and Early Berriasian *Jacobi* Zone (GUZHIKOV et al., 2012). The *Microcanthum* Zone was proven by *Oloriziceras* cf. *schneidi*, and the *Durangites* Zone – by *Paraulacosphinctes transitorius, P. cf. senoides*, and *Neoperisphinctes* cf. *falloti. Jacobi* Zone is subdivided into *Jacobi* and *Grandis* Subzones*.* Ammonite assemblage of *Jacobi* Subzone includes *B. chomeracensis, B.* sp., *Fauriella* cf. *floquinensis, Ptychophylloceras semisulcatum, Haploceras* sp. Ammonite assemblage of *Grandis* Subzone is represented by *Pseudosubplanuites grandis, P. ponticus, P. subrichteri, P. lorioli, P. combesi, P. crymensis, P. fasciculatus, D. crimensis, D. obtusenodosa, D. tresannensis, D. delphinensis, D. janus, D. pectinate, Berriasella berthei, B. oppeli, B. subcallisto, B. paramacilenta, Retowskiceras andrussowi, R. retowskyi, Spiticeras orientale, Negreliceras proteum, N. mirum, N.* ex gr. *negreli, Bochianites neocomiensis, B. goubechensis, B. crymensis* (ARKADIEV et al., 2012). Calpionellid assemblage is very poor, but three Zones were identified (PLATONOV et al., 2014): *Chitinoidella* (*Dobeni* and *Boneti* subzones, Tithonian), *Crassicollaria* (*Remanei* and *Massutiniana* subzones, Tithonian) and *Calpionella* (*Alpina* and *Elliptica* subzones, Berriasian).

The magnetic scale of GUZHIKOV et al., (2012) was revised after the fieldworks in 2016. Now it is interpreted as M20n-M17r Magnetic Chrons for the interval of Upper Tithonian Beds with *Oloriziceras cf. schneidi* to Lower Berriasian *Jacobi* Zone. The traditional J/K boundary based on ammonites must be located inside the magnetic Chron M19n in Crimea (GUZHIKOV et al., 2012), which is very similar to the Puerto Escano section (PRUNER et al., 2010). In our opinion, the base of the M18r magnetic chron is a good criterium for placement of the Jurassic-Cretaceous boundary, because the base of the M18r is close to the base of the Grandis Subzone, traced in sections of France, Spain, Bulgaria, Crimean Mountains and Caucusus more reliably than the base of the *Jacobi* Zone. The project is supported by grants of RBSF (16-05-00207a) and RHSF (15-37-10100).

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Scenario of an Announced Death: The Extinction of Large Benthic Foraminifera during the Anoxic Episode OAE 2

Arnaud-Vanneau, A.[1,*]***, Bomou, B.***[2]***, Adatte, T.***[3]

*1) Association Dolomieu, La Tronche, France, *E-mail: annie.arnaud@orange.fr*
2) Faculty of Sciences, University of Corsica Pasqual Paoli, Corte, France
3) Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland

The Cenomanian / Turonian boundary is marked by one of the greatest extinction of the large benthic foraminifers. These organisms were usually living in shallow and transparent waters of the photic zone, devoid or poor of nutrients, and can live with symbiotic green algae that are capable of photosynthesis. A detailed biological analysis was made by BOMOU et al. (2016) on two sections of the Morelos carbonate platform in Mexico. Planktonic foraminifer assemblages from the English type locality of Eastbourne, studied by KELLER et al. (2001), were compared to the benthic foraminifer assemblages in the mexican sections. A significant correlation based on δC^{13} can be established between the mexican sections and the reference section of Eastbourne allowing to outline the extinction scenatio linked with the OAE 2.

The studied interval starts above the Sb Ce5 sequence boundary located near the *R. cushmani* / *W. archaeacretacea* boundary, above the δC^{13} positive excursion and ends close to the Cenomanian / Turonian boundary. Sb Ce5 begins with a fall of sea level of around forty meters. This explains why the sedimentary record on platforms is not complete. In the mexican platform, below the sequence boundary Sb Ce5, the microfauna is well diversified with large benthic foraminifera as *P. chapianensis* and *P. dubia*, *C. parva*, *Dicyclina* sp., *C. gradata* and large miliolids. Then, this faunal association becomes less diversified due to more restricted environment ending with a karstic surface indicative of emersion of platform (Sb Ce5). Above and up to a maximum of deepening (mfs?), some large foraminifera such as *Dicyclina* sp. and *P. dubia* are still present. Extinction is complete above the mfs?, excepted for some rare *C. parva*. Then, very restricted environments, very badly oxygenated (anoxic/disoxic), settled almost permanently. The depositional environment is then dominated by high stress condition organisms including, *Istriloculina* sp., *?Decastronema* sp., *Thaumatoporella* sp. etc. Later, at the beginning of the Turonian, the carbonate platform returned to a more open and oxygenated environment marked by the reappearance of the pre-OAE microfauna, but without the large benthic foraminifera with the exception of *Cuneolina* sp. and *Dicyclina* sp.

Our detailed analyses of the OAE 2 interval show that anoxic conditions were variable and synchronous in both basin and carbonate platform environments. Planktonic (Eastbourne Basin) and benthic foraminifera assemblages (Mexican platforms) reflect alternating depleted and normal oxygen conditions even in very shallow water conditions. Low oxygen conditions are marked by the multiplication of *Heterohelix* species in the basin and coeval blooms of *?Decastronema*, *Thaumatoporella* and *Istriloculina* on platforms.

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BOMOU, B., ARNAUD-VANNEAU, A., ADATTE, T., FÖLLMI, K.B., FLEITMANN, D., Paleoenvironmental response to the Cenomanian-Turonian Oceanic Anoxic Event 2 in the Guerrero-Morelos carbonate platform, Mexico. (To be published)

A composite biostratigraphy (mainly calpionellids and foraminifera) of the Upper Jurassic–Lower Cretaceous Carbonates in Sivrihisar region (Pontides, NW Turkey): Delineation of the J-K boundary in a slope environment

Atasoy, S.G.[1,*] ***and Altiner, D.***[1]

*1) Middle East Technical University, Ankara, Turkey, *E-mail: sgatasoy@gmail.com*

A 748 m thick stratigraphical section was measured along the Upper Jurassic – Lower Cretaceous carbonate sequence exposed in a tectonic klippe of the Sakarya Zone (Pontides), north of Sivrihisar. According to the biozonation and microfacies types, two coeval but dissimiliar rock successions, separated by a thrust fault, have been detected. The lower succession displays a slope to basin facies and consists of the Kimmeridgian–Berriasian Yosunlukbayırı Formation and the overlying Valanginian Soğukçam Limestone. The deposits of this succession are characterized by the continuous pelagic background sedimentation with taxa including calpionelldis, *Saccocoma*, calcareous dinocysts and aptychi, intercalated with the calciturbidites containing platform derived clasts (benthic foraminifera, microencrusters, worm tubes etc.). The succession commences with pelagic deposits characterized by toe-of-slope type facies. There is an important increase in the amount of platform-derived clasts in the Tithonian, reflecting a calciturbiditic – slope type deposition in the succession. Latest Tithonian onward the background pelagic conditions dominate the deposition.

This facies evolution resulted in intervals dominated by neritic or pelagic taxa or characterized by mixed fauna. This types of bio-association gave rise to a composite biozonation that is based on both pelagic and benthic taxa, providing the link between slope and platform successions. This biozonation consists of the following biozones: *Globuligerina oxfordiana–Mohlerina basiliensis* Zone (Kimmeridgian), *Saccocoma* Zone (Lower Tithonian), *Protopeneroplis ultragranulata* Zone (Upper Tithonian), *Crassicollaria* (*massutiana* subzone) Zone (uppermost Tithonian), *Calpionella* (*alpina*, *Remaniella*, *elliptica* subzones) Zone (Lower Berriasian), *Calpionellopsis* (*simplex*, *oblonga* subzones) Zone (Upper Berriasian) and *Calpionellites* (*darderi* subzone) Zone (Lower Valanginian). Calciturbiditic deposits of the *P. ultragranulata* Zone are followed by pelagic deposits of the *massutiana* subzone in the latest Tithonian. The Jurassic-Cretaceous boundary is located at the base of the overlying *alpina* subzone defined by the acme of *Calpionella alpina*. The other observed calpionellid bioevents around the J-K boundary are the stepwise last occurences of *Crassicollaria intermedia* (below the boundary), *Calpionella elliptalpina* (at the boundary) and *Crassicollaria brevis* (at the boundary) and the marked decrease in the abundance of *Calpionella grandalpina* across the Tithonian-Berriasian boundary.

Sedimentology and biostratigraphy of the Pabdeh Formation, Paryab, Zagros Basin, SW-Iran, at the PETM interval: Implication for sea level fluctuations

***Azami, S.H.**[1,*]**, Wagreich, M.**[1]**, Mahmudy Gharaie, M.H.**[2]*

*1) Department of Geodynamics and Sedimentology, Center for Earth Sciences, University of Vienna, Vienna, Austria, *E-mail: mr.azami@yahoo.com*
2) Department of Geology, Ferdowsi University of Mashhad, Mashhad, Iran

The Paleocene–Eocene geologic record suggest a complex interplay between rising temperatures, sea-level fluctuations, plankton taxa extinction and diversification, and changes in the trophic resource regime for the PETM (Paleoecene–Eocene Thermal Maximum) interval. To investigate changing conditions during the PETM interval in a deep-water marine paleoenvironment of the Zagros Basin (W-Iran), a total of 394 samples has been taken from the predominantly 171 m thick shaly lower part of the Pabdeh Formation in a section at the village of Paryab. The cyclic limestone-marl successions of the Paleocene–lower Eocene Pabdeh Formation were deposited in a deeper-water marine environment in the (closing) oceanic area of the Neo-Tethys, and consist of deep-water pelagic to hemipelagic shale, marl(stone) and limestone. This project aims to identify and evaluate facies changes in this offshore environment, in particular around the Paleocene/Eocene boundary and the PETM interval.

Biostratigraphic age determination is based on calcareous nannoplankton using smear slides and 100x oil immersion light microscope. Nannofossil biostratigraphy indicates standard zones NP6 to NP15 and CNP8 to CNE8, respectively, for the whole section of the Pabdeh Formation at Paryab. The PETM interval is indicated by several nannofossil taxa starting at 69.1 m*:* *Rhomboaster* spp. (mainly *Rhomboaster cuspis*), *Discoaster araneus*, and the disappearance of the *Fasciculithus richardii* group. At the same level carbon isotope values ($d^{13}C$) fall from 1.5 to -0.2 per mill depicting the begin of the distinct negative carbon isotope excursion (CIE) of the PETM interval. Higher up-section, *Sphenolithus moriformis* and *Discoaster diastypus* appear, and $d^{13}C$ values increase again. *Tribrachiatus contortus* and *Tribrachiatus orthostylus* have their first occurrence at 75.6 m, followed by *Rhomboaster bramletteii*, *Discoaster barbadiensis*, *Sphenolithus* cf. *radians,* and *Discoaster binodosus*.

Paleoecological analyses of the nannoplankton assemblages allow the identification of the PETM interval (global warming and increased ocean-water temperature). This short-term marine warming was followed by a long-term cooling after the early Eocene. Though thermal variation from warmer ocean waters during the PETM to the cooler ocean water temperatures afterwards is likely to have decreased the effects of Milankovitch cyclicity on the sedimentation pattern, however a significant facies change from shales to shale-limestone cycles can be identified in the section after the PETM interval.

Multi-proxy record of orbital-scale changes in climate and sedimentation during the Weissert Event in the Valanginian Bersek Marl Formation (Gerecse Mts., Hungary)

Bajnai, D.[1], Pálfy, J.[2], Martinez, M.[3,*], Price, G.D.[4], Nyerges, A.[2], Főzy, I.[5]

1) J.W. Goethe-Universität, Frankfurt am Main, Germany
2) Eötvös Loránd University, Budapest, Hungary
*3) MARUM – Center for Marine Environmental Sciences, Bremen, Germany, *E-mail: mmartinez@marum.de*
4) Plymouth University, Plymouth, UK
5) Hungarian Natural History Museum, Budapest, Hungary

A multiproxy ($\delta^{18}O$, $\delta^{13}C$, magnetic susceptibility, gamma-ray spectroscopy) stratigraphy was developed from a 31.2-m-thick Upper Valanginian to lowermost Hauterivian section of the Bersek Marl Formation in Gerecse Mountains, Hungary, comprising alternating marlstone layers of varying clay and carbonate content. The aims of the study were to understand the mode of sedimentation in the Gerecse subbasin and establish a reliable correlation with other Cretaceous sections using the isotopic signature of the Weissert Event.

In the studied section, the bulk carbonate $\delta^{13}C$ signal shows sustained, elevated values (up to 2.7‰) up to 19.2 m, followed by a decreasing trend upsection. Together with biostratigraphic data, this suggests that the lower part of the section was deposited during the plateau phase of the Valanginian Weissert Event. Spectral analyses of the multiproxy dataset, including magnetic susceptibility measurements and gamma-ray spectroscopy on the lower part of the section, led to the identification of precession, obliquity, long and short eccentricity signals. A mean sedimentation rate of 14 m/Myr was calculated based on astronomical tuning. The cyclicity in the proxy signals reflects dilution cycles by detrital inputs in the basin, which supports a hypothesis that orbitally-forced humid-arid cycles controlled the pelagic alternating sedimentation during the Early Cretaceous throughout the Tethyan area.

Reconstruction of palaeoceanographic changes during the Upper Albian OAE 1d event in the submerged Tatric Ridge, Central Western Carpathians

Bąk, K.[1,*], ***Bąk, M.***[2], ***Fabianska, M.***[3], ***Misz-Kennan, M.***[3], ***Zielinska, M.***[3], ***Dulemba, P.***[1], ***Ciurej, A.***[1], ***Bryndal, T.***[1], ***Naglik, B.***[2]

*1) Faculty of Geography and Biology, Cracow Pedagogical University, Kraków, Poland, *E-mail: sgbak@cyf-kr.edu.pl*
2) Faculty of Geology, Geophysics and Environmental Protection, AGH University of Science and Technology, Kraków, Poland
3) Faculty of Earth Sciences, University of Silesia, Sosnowiec, Poland

Sea-level rise during Albian (HAQ, 2014) and tectonic movements in the Alpine–Carpathian microcontinent at the edge of the Penninic Ocean (Mediterranean Tethys) caused shallow-water carbonate sedimentation at intrabasinal Tatric Ridge during the *Parathalmanninella appenninica* Zone (late Albian). It was characterized by the deposition of echinoderm-foraminiferal limestones at outer neritic depths (BĄK, 2015), terminated by the formation of hardgrounds, phosphate pisolites and microstromatolites (KRAJEWSKI, 1981), replaced by hemipelagic dark-grey marls. These sediments belong to the youngest part of the High-Tatric Unit, outcropped in the Polish part of the Tatra Mountains, Central Western Carpathians.

Evaluation of microfacies, benthic foraminifers, calcareous dincysts, palynology, TOC, organic biomarkers, and carbon- and oxygen stable-isotope data enable a characterization of palaeocenographic changes related to the early and late phase of the Oceanic Anoxic Event 1d and the period immediately following. Successive sea-level rises and, most probably, climatic changes at that time induced stepwise changes in basin circulation leading to changes in sedimentation type at intrabasinal ridges (BĄK et al., 2016). Marine and land-derived organic matter (OM) was strongly degraded under the oxic conditions that pertained during the whole late Albian. High productivity in the surface water, induced by winddriven coastal upwelling, caused the particulate organic carbon fluxes across the unstratified water column to the sea bottom in the oldest phase of the OAE1d. Gradual sea-level rise associated with subsidence of the Tatric area and changes in wind direction from landward to seaward (downwelling) was characteristic of the final phase of the OAE1d. Organic matter accumulated at that time came from land wetlands. Their abundance stimulated the growth of phytoplankton, the consequent zooplankton activity, and the enhanced particulate organic carbon deposition. Bacterial decomposition of the OM, dominated by vascular plant remnants, spores of lake-derived green algae and particles of freshwater blue algae lead to decreasing oxygen concentrations in the lower part of the water, caused seasonal anoxia and water column stratification. A further change in the wind systems conjugated with changes in superficial water currents (HAY, 2008) caused the breakdown of the water stratification and renewal of the upwelling regime in the Tatric area.

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Sedimentology and ichnoassamblages of the Jurassic / Cretaceous boundary interval of Feodosia region (SE Crimea)

Baraboshkin, E.E.[1]

1) Lomonosov Moscow State University, Moscow, Russia, E-mail: baraboshkin-evgenij@yandex.ru

The Jurassic / Cretaceous boundary section of Feodosiya region is well-known due to good exposures and stratigraphic completeness. These outcrops were intensively studied during last years (GUZHIKOV et al., 2012; BARABOSHKIN et al., 2016, etc.). It was demonstrated the section was formed in the conditions of the deeper part of distally steepened ramp (GUZHIKOV et al., 2012). The recently collected material gives a possibility to detalise this model. The succession (~0,4–3 m) is represented by alternation of calciturbidites and hemiplegic deposits. Calciturbidites demonstrate Meischner-type cycles. Main and distributary channels, and interchannel facies are recognisible. The redeposited grains (pack-, grain- to rudnstones) were transported from the shallow ramp and contain microencrusters *Crescentiella morronensis*, and *Lithocodium-Baccinella* assemblage. Gradual reduction of thickness of envelop of *Crescentiella morronensis* in the resedimented grains from the base to the top of the section indicates shallowing of the carbonate ramp (FLÜGEL, 2010).

All hemipelagic carbonates are intensively bioturbated (BI=5-6: DROSER & BOTTJER, 1986), but the Titonian trace fossil association differs from the Berriassian one. Titonian ichnoassemblage contains *Zoophycos insignis*, *Z.* isp., *Flexorhaphe miocenica*, *Chondrites intricatus*, *Ch.* isp., *Planolites* isp., *?Petalloglyphus* isp., *Taenidium satanassi*, *T.* isp.; *Ophiomorpha annulata*, *O. rudis*, *Thalassinoides* isp. *Chondrites* is the most abundant trace fossil there. It is interpreted as deeper-water upper fan *Nereites* ichnofacies, *Ophiomorpha rudis* ichnosubfacies (UCHMAN, 2009). Berriassian ichnoasseblages are more diverse and represented by *Nereites missouriensis, N.* isp., *Chondrites intricatus*, *Ch.* isp., *Planolites isp*., *Rhizocorallium isp*., *?Glockerichnus parvula*; *Bergaueria perata*; *Belorhaphe zickzack* (Heer), *Cosmorhaphe lobata* (Seilacher); *Ophiomorpha annulata*. *Ophiomorpha* is primarily in the channel turbidites. In the same interval following structures were fixed: *Paleodictyon* isp.; worm burrows: *Taenidium* isp., *?Petaloglyphus* isp., *P. krimensis*, *?Stelloglyphus* isp., *Haentzschelinia* isp., *Spirorhaphe* isp., *Zoophycos* isp., feeding structures *Asterichnus* isp., *Rhizocorallium commune* (Schmid) *Alcyonidiopsis* isp., *Pilichnus* isp., *Phycosiphon incertum*, *Skolithos* isp. *Chondrites* traces are less abundant, in presence of other various traces. Berriassian ichnoassmablage is interpreted as shallow-water *Cruziana* ichnofacies. The changes in the trace-fossils confirm conclusion from the microfacies analysis on the shallowing of the Crimean carbonate ramp at the J/C boundary. The study was funded by RFBR (project 16-05-00207a) and RHSF (project 15-37-10100). Special thanks to «Total E&P Russie» for provision of fellowship.

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Integrated study of Campanian / Maastrichtian boundary interval at Volga region (Russia) and Aktolagay Plateau (West Kazakhstan) of the Russian Platform

Baraboshkin, E.Yu.[1,*]***, Benyamovski, V.N., Guzhikov, A.***[2]***, Aleksandrova, S.***[3]***, Pervushov, E.***[2]***, Selzer, V.B., Ovechkina, M.N.***[1]***, Kaljakin, E.A.***[2]***, Kopaevich, L.***[1]***, Vishnevskaya, V.S.***[1]***, Guzhikova, A.***[2]***, Pokrovsky, B.***[4]***, Baraboshkin, E.E.***[1]***, Iakovishina, E.V.***[1]

*1) Lomonosov Moscow State University, Moscow, Russia, *E-mail: Barabosh@geol.msu.ru*
2) Saratov State University, Saratov, Russia
3) Plovdiv University "Paisii Hilendarski", Plovdiv, Bulgaria
4) Geological Institute of RAS, Moscow, Russia

The problem of the recognition of Campanian / Maastrichtian boundary (C/M) at the Russian Platform (RP), appeared after its approval in the Tercis section (SW France) by the FAD of *Pachydiscus neubergicus* (ODIN & LAMAURELLA, 2001). This ammonite is not known from the RP, where the C/M was traditionally drawn at the base of *Belemnella lanceolata* Zone (OLFEREV & ALEKSEEV, 2005). An integrated study (macro- and microfossils, palynology, nanoplankton, stable isotopes, magnetostratigraphy) of the most complete C/M boundary sections of the RP was preformed in 2010-2014 (BENYAMOVSKIY et al., 2016).

C/M study in Volsk Town quarries (Volga River region) provides the following results. 1) Chrons 32n2, 32n1 and 31r have been identified. 2) Negative shift of δC^{13}, the boundary marker, was found at the middle of 32n2 Chron. 3) Both paleomagnetic and isotope markers are located within *Neoflabellina praereticulata–N. reticulata* benthic foraminifer Zone (BFZ) (LC19: BENYAMOVSKI, 2008). The FAD of *Belemnella lanceolata* falls into Upper Campanian *Angulogavelinella stellaria* BFZ (LC18). Study of the Aktolagay Plateau section (Emba River, Western Kazakhstan), demonstrated the following. 1) Base of *Belemnella lanceolata* Zone corresponds to the top of LC17. 2) The LAD of *Psudogavelinella clementiana laevigata* BF, corresponding to the top of Clementiana Biozone, the C/M marker, have been recognized in the middle of LC19. This is 40 m above the base of *Lanceolata* Zone. 5) C/M boundary falls in the middle of CC23a (or UC16) nannoplanktic Zone, which is close to BF data. 6) The base of dinocyst Beds with *Alterbidinium minus* in Aktolagay is near the C/M boundary, similar to Tercis section. 6) Analogue of magnetic Chrons 32n2 and the isotope shift are not obvious in Aktulagay. Top of supposed C32n2 is located in the middle of LC19 and in the upper part of *Belemnella lanceolata* Zone. Petromagnetic study demonstrated sea-level fall in the boundary interval. To summarise, the analogue of C/M GSSP is located inside the *Belemnella lanceolata* Zone, LC19, planktonic foraminifer Beds with *Rugolobigerina,* CC23a and UC16 nannoplakton Zones, dinocyst Beds with *Alterbidinium minus* and 32n2 magnetic Chrone.

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New data on the Berriasian Stage of the Crimea

***Baraboshkin, E.Yu.*[1,*], *Guzhikov, A.*[2], *Arkadiev, V.*[3], *Baraboshkin, E.E.*[1]**

*1) Lomonosov Moscow State University, Moscow, Russia, *E-mail: Barabosh@geol.msu.ru*
2) Saratov State University, Saratov, Russia
3) Saint Petersburg State University, Saint Petersburg, Russia

OTTO RETOWSKI (1893) described numerous ammonites *Hoplites occitanicus* (Pict.) from the Feodosia City region (Eastern Crimea), but their exact locality and stratigraphic position remained unknown. T.N. BOGDANOVA, E.D. KALACHEVA and I.I. SAY (1999) have been revised *Hoplites occitanicus* from the Retowski's collection. They described *Tirnovella occitanica* species and confirmed the presence of the *Occitanica* Zone in the Berriasian of Feodosia. Any attempt to find again *Tirnovella occitanica* in the Eastern Crimea was not successful. During the summer of 2016, E.YU. and E.E. BARABOSHKIN and A.Y. GUZHIKOV studied Berriassian section in "Zavodskaya Balka" quarry on the northern margin of Feodosia. As a result, the unknown part of the section was described. The studied section is of ~20 m in thickness of rhythmically alternated carbonate mudstones and muddy limestones, which are slightly deformed and shifted by faults. All rocks are intensively bioturbated (Bioturbation index=6) by *Chondrites, Planolites, Thalassinoides, Alcynidiopsis, Rhizocorallium* (BARABOSHKIN et al., 2016). It contains a number of ammonites, including large shells (D = 70-80 mm), which were identified as *Tirnovella occitanica*. The preservation style of these ammonites and their size suggest that *Hoplites occitanicus* were collected by O. RETOWSKI at the same locality in Feodosiya. The *Tirnovella occitanica* Zone assemblage contains also *Berriasella privasensis*, *Bochianites, Ptychophylloceras* and *Euphylloceras*.

The section was characterized by oriented paleomagnetic samples from 21 levels. Magnetic properties of these samples are very similar to ones from the overlying *Boissieri* Zone (ARKADIEV et al., 2015; GUZHIKOV et al., 2014). The characteristic components of NRM of reversal polarity are of good quality in all studied samples. Unfortunately, the section contains unexposed interval of indeterminable thickness between *Occitanica* and *Boissieri* Zones. Despite of this, a large magnetic zone of reversal polarity can be confidently identified as an analog M17r magnetic Chron.

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Integrated stratigraphy and isotopic ages at the Berriasian/Valanginian boundary at Puebla State, eastern Mexico

Barragán-Manzo, R.[1,*]***, López-Martínez, R.***[1]***, Bernal, J.P.***[2]***, Reháková, D.***[3]***, Gómez-Tuena, A.***[2]***, Martini, M.***[1]***, Ortega, C.***[2]

*1) Universidad Nacional Autónoma de México, Ciudad de México, Mexico. *E-mail: rbarra01@hotmail.com*
2) Universidad Nacional Autónoma de México, Querétaro, Mexico
3) Comenius University, Bratislava, Slovakia

The Berriasian–Valanginian time boundary is one of the least studied stratigraphic horizons in Mexico. From the biostratigraphical point of view it can be defined by the first occurrence of *Calpionellites darderi* (*Calpionellites* Zone) according with the proposal of BULOT (1996) and in agreement with the Valanginian Working group of the IUGS. This Zone is widely accepted and recognized by several authors who pointed to calpionellids as the main biostratigraphic markers of this boundary (REMANE, 1963, LE HÉGARAT & REMANE, 1968, ALLEMANN and REMANE, 1979, BLANC et al., 1994, BULOt, 1996, BLAU & GRÜN, 1997 and AGUADO et al., 2000).

In this work, the integration of calpionellid biostratigraphy, microfacies analysis, U-Pb geochronology, and strontium chemostratigraphy improves the definition of the Berriasian–Valanginian boundary in a section of Puebla State, and validates the age of calpionellid zones from eastern Mexico in this interval. An age of 139.85 Ma derived from $^{87}Sr/^{86}Sr$ ratio within the base of *Calpionellites* Zone defines the Berriasian–Valanginian boundary. Additionally, the 134.0 ± 0.5 Ma U-Pb age returned by zircon grains from a tuff level exposed at the top of the succession confirms the Valanginian age of the whole analyzed section. Microfacies analysis reveals sea level variations that can be coincident with the KVa1–KVa4 eustatic cycles. These new data suggest that calpionellid biostratigraphy represents the most useful tool for the definition of the Berriasian–Valanginian time boundary in eastern Mexico and its correlation with the rest of the Tethyan domain.

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Oceanography of the Western Interior Seaway during OAE 2 using Nd isotopes

***Batenburg, S.J.*[1,*], Dickson, A.J.[1], Kelsey, B.S.[1], Eldrett, J.S.[2], Robinson, S.A.[1], Ruhl, M.[1], Jenkyns, H.C.[1]**

*1) University of Oxford, Oxford, UK, *E-mail: sietske.batenburg@earth.ox.ac.uk*

2) Shell Projects and Technology, Rijswijk, The Netherlands

During the greenhouse climate of the mid-Cretaceous, the Western Interior Seaway (WIS) experienced semi-restricted conditions with poor water-column ventilation, leading to the accumulation of black organic-rich mudstones. In the Maverick Basin, the southernmost extent of the WIS, the main phase of organic matter deposition occurred in the early to late Cenomanian, before Oceanic Anoxic Event 2 (OAE 2). A sea-level rise prior to the event may have caused the basin to become better ventilated during the Cenomanian–Turonian transition, and ocean circulation likely played a major role on productivity and the preservation of organic matter. Widely different regimes of ocean circulation are suggested to have operated, with alternating incursions of water masses from both the north and the south. Foraminiferal assemblages suggest that during the early phase of OAE 2, Tethyan waters were drawn northward into the WIS (ELDERBAK & LECKIE, 2016), whereas dinocyst occurrences indicate an influx of boreal surface waters into the Maverick Basin (ELDRETT et al., 2014). This cooler episode correlates with the so-called Plenus Cold Event, recognized in northern Europe by southward invasion of boreal faunas.

Here we present neodymium-isotope records (ε_{Nd}) of fish teeth and bulk sediments from the Eagle Ford Formation that record the presence of distinct water masses at depth and allow testing of suggested mechanisms of ocean circulation. Mid- to late Cenomanian values of ε_{Nd} around -3 (this study) are unusually radiogenic compared to coeval open ocean ε_{Nd} records from the North Atlantic, where values typically lie between -4 and -10 (MARTIN et al., 2012, ROBINSON & VANCE, 2012) and may reflect a strong influence of regional volcanism close to the WIS and/or weathering of mafic volcanic rocks in the water-mass source area. Comparison of ε_{Nd} values from different depths within the Maverick Basin with records from further north in the WIS and from the Gulf of Mexico, will allow determination of the direction of watermass exchange in the southern WIS during the Cenomanian–Turonian transition. Deciphering the role of physical oceanography in organic-matter deposition and preservation will improve our understanding of ocean-climate dynamics influencing the Earth's carbon cycle.

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Evolution of deep water exchange in the Atlantic Ocean during the latest Cretaceous–early Paleogene

***Batenburg, S.J.**[1,*], Voigt, S.[2], Friedrich, O.[3], Klein, T.[4], Neu, C.[2], Osborne, A.[5], Frank, M.[5]*

*1) University of Oxford, Oxford, UK, *E-mail: sietske.batenburg@earth.ox.ac.uk*
2) Goethe-Universität Frankfurt, Frankfurt am Main, Germany
3) Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany
4) MARUM - Zentrum für Marine Umweltwissenschaften, Bremen, Germany
5) GEOMAR, Helmholtz-Zentrum für Ozeanforschung Kiel, Kiel, Germany

In the greenhouse world of the Late Cretaceous, the modes of deep- water formation and the extent of water-mass exchange are poorly constrained, whereas ocean circulation likely played a major role on the distribution of heat over the planet. Maastrichtian Nd-isotope records from the North and South Atlantic display a wide range of values (-2 to -17), whereas they are characterised by a similar trend towards more negative, less radiogenic values.

Two main hypotheses are brought forward: 1) Different processes of deep-water formation may have operated at the same time so that Nd-isotope signatures were strongly influenced by inputs from nearby continents. The parallel trends in neodymium values may reflect the exchange of surface waters and a common trend of decreasing volcanism; 2) A common water mass dominated at least at intermediate depths throughout the North and South Atlantic. Disparate Nd-isotope values observed near continental margins may reflect local overprinting of Nd-isotope signatures by continental inputs, boundary exchange processes, episodes of local volcanism or the occurrence of deep water formation with a limited geographic range.

To tests these hypotheses, Nd isotope data have been generated for a range of ocean drill Sites in the North and South Atlantic. Improved time constraints through cyclostratigraphy and the generation of carbon isotope stratigraphies allow confidently determining the timing of deep-water exchange between the North and South Atlantic. At 60 Ma, Nd-isotope values converge and an intensified mode of thermohaline circulation commenced.

Sedimentary cycles and pedogenesis in a Late Cretaceous fluvial system of the Bauru Basin, Southeastern Brazil

Batezelli, A.[1,*] ***and Ladeira, F.***[1]

*1) UNICAMP - Campinas State University, Campinas, Brazil, *E-mail: abatezelli@ige.unicamp.br*

There are many stratigraphic tools used in the study of the spatial and temporal evolution of continental alluvial sequences, particularly facies analysis, paleontology, and architectural elements. In the last three decades, the characterization of paleosol profiles has been used as an additional tool for the study of alluvial sequences, allowing the identification of specific features related to the non-depositional times (such as tectonic, climate, topography, and organisms). The Marilia Formation represents a distributive fluvial system stage of the Bauru Basin (Southeastern Brazil) that took place during the Maastrichtian, which is dominated by braided rivers deposits. Using the relationship between facies and paleosols of this unit, the present work purpose estimates the rate of sedimentation and pedogenesis to the Late Cretaceous of Southeast Brazil. By studying bi-dimensional sections, the facies associations that compose four architectural elements were identified: channels (CH), laminated sand sheet (LS), sand bars (SB) and overbank deposits (OF). The sedimentary dynamics are marked by the building and abandonment of channel complexes related to processes such as aggradation, calcrete generation, and vegetation growth within the channels. Fifteen paleosol profiles occur intercalated in the deposits and are characterized by horizons Bt, Btk, Bss, C, and Ck, which allows a possible general comparison with the present soil orders: Alfisols, Aridisols, Entisols, and Vertisols. The macro- and microscopic characteristics of these horizons indicate arid and semi-arid climatic conditions, with the minimum time of profile formation varying from 3740 to 5000 years. The genetic relationship between architectural elements and paleosols, as well as the piling pattern, suggest that the Marilia Formation was the product of a succession of high-frequency depositional events on the order of 10^3 to 10^4 years. This approach may allow the understanding of the sedimentary and pedogenesis processes in diferent portion of the distributive fluvial systems.

Stratigraphy and provenance of the Tauern Flysch (Penninic Unit, Austria)

Begusch, C.[1,*] ***and Wagreich, M.***[1]

1) Department. of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria.
**E mail: cbegus@gmx.at*

The provenance and the stratigraphic correlation of the metamorphic flysch-like sediments at the northern border of the Tauern Window (Penninic unit, Salzburg) represent an unsolved conundrum of the Eastern Alps. There are several models trying to explain the derivation of these deep water-mass flow-sediments. According to older models (FAUPL & WAGREICH, 2000) the Tauern Flysch may represent a northern Penninic deep-sea-trough, classifying these deposits equated to the non-metamorphic Rhenodanubian Flysch. More recent models consider an original position south of the Subpenninic units, and therefore a southern penninic or even austroalpine position (SCHMID et al., 2013). Provenance of the Tauernflysch may help to solve the question of its palaeogeographic and palaeotectonic derivation, mainly by making comparisons of heavy mineral associations and bulk geochemistry analysis data. Another research question is the degree of metamorphosis and how strong is the possible influence of the SEMP (Salzach–Ennstal–Mariazell–Puchberg) Fault.

Fieldwork included the sedimentological logging of 2 main profiles (one 780 m, two 400 m) and 18 single profiles in the area of the Wolfbachtal, southwest of Taxenbach, Salzburg. Almost continuous outcrops of metamorphic flysch deposits along forest roads and the Wolfbach streambed can be found, including meta-black shales, turbiditic meta-sandstones, meta-breccias and marbles. Analysis-methods used on the altogether 50 samples are petrographic microscope analysis, x-ray diffraction, heavy mineral associations, micro probe analysis of heavy minerals, rock bulk geochemistry analysis and principal component analysis. Microstructural microscope analysis indicates upper Green schist facies with temperatures around 450°C. Due to these conditions the results of the bulk geochemistry analysis are not fully reliable and do not give clear results. Nevertheless sedimentary structures, confirming the sedimentary nature of these meta-sediments, can be observed, due to the main deformation mechanism being pressure solution. Provenance analysis and geochemical classification are still in progress.

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New insights on the Aptian-Albian sedimentary record and age of the Serdj Formation (Central Tunisia): Impact on regional stratigraphic correlations

Benchaabane, N.[1,*], Robert, E.[2], Khemiri, F.[3], Soussi, M.[1]

*1) Université de Tunis El Manar, Tunis, Tunisia, *E-mail: najeh.geo.tun@live.fr*
2) Laboratoire de Géologie Terre, Planètes, Environnement (UMR CNRS 5276), Lyon, France
3) Entreprise Tunisienne d'Activités Pétrolières (ETAP), Tunis, Tunisia

New stratigraphic and sedimentologic investigations conducted in the Serj-Bargou (Central Tunisian Atlas) on the Aptian–Albian? succession allowed reinforcing previous biostratigraphic results and bringing new insights on the age of the uppermost part of the Serj Formation which is still subject of debates and controversies. In Jebel Serdj, these series comprise the Hamada and Serdj Formations. The first formation is composed of thick succession made up of transgressive *Orbitolina*-rich carbonates and deep marine shales and limestones. It extends from the uppermost Barremian to the lower Upper Aptian and includes the Oceanic Anoxic Event OAE1a covering the *Deshayesites weissi* to *Deshayesites deshayesi* ammonite zones. The overlying Serj Formation is made by moderate scale cycles composed of shallow marine carbonate units (Cu1 to Cu5) separated by four shaly, silty and rarely sandy intervals (T1 to T4) with mixed benthic and pelagic fauna from which have been collected new specimens of ammonites serving as complement data in refining the previous results of LEHMANN et al. (2009).

The first carbonate unit records *Tropaeum sp.* suggesting the *Epicheloniceras martini* Zone; while the overlying terrigenous interval (T1) encases *Acanthohoplites sp.*, *Parahoplites cf. nutfieldiensis* of the *Parahoplites melchioris* Zone. The third unit (Cu3) documents *Eodouvilleiceras sp.* of the *Hypacanthoplites jacobi* Zone. Within the T4 interval three ammonite specimens are collected (*Mellegueiceras sp., Mellegueiceras chiaouiae and Acanthohoplitinae indet.*). These ammonite specimens coupled with the presence of *Favusella washitensis, and Ticenella roberti* planktonic foraminifers and *Mesorbitolina gr. minuta-texana* within the Cu5 limestone strongly suggest a lower Albian age of the *Leymeriella tardefurcuta* Zone of the uppermost part of the Serdj Formation rather than uppermost Aptian as previously considered. Northward, in Cheirich area which corresponds to a platform-basin setting, the Cu5 comprises shelf margin barrier reefs with several horizons of cross bedded sandstones.The latter could be correlated with the lower Albian clastic events described in Hameima formation (Tejrouine area, Northern Tunisia) (CHIHAOUI, 2010). All these data support the new idea defended by TRABELSI et al. (2016) and considering that the upper Aptian-lower Albian sedimentary record is well preserved in several areas and does not correspond to a major Gap in overall central Tunisia as previously considered.

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The mid-Cretaceous saga

***Bengtson, P.*[1,*] *and Kakabadze, M.*[2]**

*1) Universität Heidelberg, Heidelberg, Germany, *E-mail: peter.bengtson@geow.uni-heidelberg.de*
2) Alexandre Janelidze Institute of Geology, Tbilisi, Georgia

Ever since its introduction in 1822, the Cretaceous System has been arbitrarily divided into two or three series, a situation that continues unabated today to the obvious detriment of clarity in stratigraphic communication. Contrary to common belief, the current two-fold division into lower and upper Cretaceous, separated at the base of the Cenomanian (Ogg et al., 2016), has never been formally defined and ratified; it is merely a widely adopted practice. Throughout the last four decades, in particular, the terms mid-Cretaceous and middle Cretaceous have been increasingly used in the literature. A Google internet search (February 2017) for “mid-Cretaceous” or “middle Cretaceous” with corresponding terms in German, French, Spanish, Portuguese and Russian yields nearly half a million hits – a clear evidence that they fulfil a need in stratigraphic nomenclature. However, as there is no agreement about the scope of the unit, the terms mean different things to different authors, from the entire Barremian–Santonian interval to solely the Cenomanian, although in the majority of cases the term is used loosely without explanation. This terminological “law of the jungle” leads to confusion, and voices have been raised for a formal (re)division of the Cretaceous System (e.g., SCOTT et al., 2005; OGG, 2007; GRADSTEIN et al., 2008; KAKABADZE & BENGTSON, 2009). During the nearly two hundred years since the Cretaceous System was introduced, a considerable amount of data has accumulated, providing a basis for ultimately settling the question of a two-fold vs. three-fold division. With its 80 million years, the Cretaceous is by far the longest of the Phanerozoic periods, and the informal [sic] early and late Cretaceous epochs even longer than the entire Silurian and Neogene periods. Most Phanerozoic systems are divided into three series, even though they may represent considerably shorter time spans than the Cretaceous.

Chronostratigraphic division is largely linked to palaeontological events manifested in the rock record. The historically and arguably still most important group for Cretaceous biostratigraphy and, by extension, chronostratigraphy are the ammonites. Major taxonomic turnover events, reflected at the family- and genus-group level, may indicate suitable boundaries between series/epochs. To produce a basis for a formal proposal for a division of the Cretaceous System/Period into series/epochs, the patterns of taxonomic turnovers among the key fossil groups, primarily ammonites, inoceramid bivalves and foraminifers, should be analysed in detail and integrated with data on palaeogeographic and palaeoclimatic events.

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Late Aptian (Cretaceous) dry – wet cycles and their effects on vegetation in the South Atlantic: palynological evidences

Bengtson, P.[1], Lana, C.[2], Carvalho, M.[3,*]

1) Universität Heidelberg, Heidelberg, Germany
2) CENPES/PETROBRAS, Rio de Janeiro, Brazil
3) Museu Nacional da Universidade Federal do Rio de Janeiro. Rio de Janeiro, Brazil,
**E-mail: mcarvalho@mn.ufrj.br*

The Cretaceous is generally conceived as one the warmest periods in Earth history. However, the climatic effects on vegetation are poorly documented. The link between warm climate and plant distribution is here highlighted on the basis of palynological analyses. An upper Aptian well section from the Sergipe Basin in north-eastern Brazil documents four cycles of dry–wet oscillations, based on palynological evidences. The cycles show a general trend of acceleration of the hydrological cycle. The dry periods are recorded mainly at the base of the section, with changes to more humid periods upwards. The dry periods are characterized by high to very high abundance of *Classopollis classoides*. Already in the wet periods a conspicuous change in vegetation is recorded, with an increase in ferns and mountain flora, in particular *Araucariacites australis*. The replacement of *Classopollis* by *Araucariacites* and ferns reflects a change from a dry to wet phase. The first dry–wet cycle (DWC-1) is recorded in the dominantly non-marine phase. At the base of this first cycle an intensive growth of anhydrite nodules is recorded. However, in beds overlying the evaporites, there is a conspicuous increase in the flora associated with humid condition (ferns and mountain flora). DWC-2 starts with a pronounced peak of dinoflagellate cysts, which decrease abruptly accompanied by an increase in xerophytic flora (e.g. *Classopollis classoides*). However, the abundance of xerophytic flora decreases upwards to give room for high abundances of fern spores, mountain flora (e.g. *Araucariacites australis*) and, in particular, dinoflagellate cysts. DWC-3 starts with a short interval containing a moderate abundance of xerophytes and a conspicuous wet flora and marine elements. With rising humidity, fern diversity also increased, suggesting that humidity was an important factor for the radiation of this group. DWC-4 records minor peaks of xerophytic flora and a dominance of fern spores and mountain flora. The change in flora may be the result of dislocation of the Intertropical Convergence Zone (ITCZ) and a relative sea-level rise.

Discussion on the calpionellid biozones and proposal of a homogeneous calpionellid scheme for the Tethyan Realm

***Benzaggagh, M.*[1]**

1) Department of Geology, Moulay Ismail University, Meknes, Morocco, E-mail: benzaggagh@gmail.com

Calpionellids constitute a group of planktonic microfosssils usually occurring in large numbers in pelagic deposits from the late Early Tithonian to Valanginian times, and showing a fairly uniform stratigraphic distribution all over the Tethyan Realm, from Mexico to, at least, eastern Iran. REMANE (1963, 1971) proposed a preliminary calpionellid scheme consisting of five zones and six subzones informally named: A (A1, A2, A3), B, C, D (D1, D2, D3) and E. This biozonal scheme based on specific associations, acme, and partial and/or total ranges, has constituted so far a valid zonal framework towards a homogeneous and universal calpionellid scheme, only requiring changes at the levels of subzones and lower subdivisions. Subsequently several works (e.g. POP, 1996, BLAU & GRÜN, 1997, REHAKOVA & MICHALIK, 1997) established new calpionellid frameworks that are often inconsistent and differing from one region to another. Such discrepancies noticeably hamper the purpose of calpionellids for biostratigraphy and for long-distance correlations. These discrepancies between local schemes originated from the misguided choice of zonal indices: actually quite a number of subzones were grounded on either rare species with short ranges and sporadic appearances (e.g. Bermudezi, Andrusovi, Remanei, Praetintinnopsella,…), rare and atypical forms (e.g. Catalanoi, Colomi, Doliphormis,…), or abundant of long-ranged taxa (Longa, Remaniella, Cadischiana, Ferasini) in some stratigraphic levels that also yield species with more reliable stratigraphic value. Consequently, further consistent stratigraphical use of this fossil group requires a homogeneous framework with unambiguous definition of zones and subzones, preferably based on associations of two or more taxons (except for species with a typical form and a short range). The retained subzones should correspond to stratigraphic intervals wide enough to be identifiable in the widest possible geographical area. Their boundaries must correspond to major events or noteworthy changes in the composition of calpionellid assemblages. Short-duration events should be restricted to lower subdivisions. Consequently, it makes sense to propose a coherent framework of 7 biozones, 15 subzones, and more than 5 horizons based upon the analysis of several dozens of sections from North Africa, France, and Iran, and the critical insights of former published works.

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Drill-core analysis of Cenomanian–Coniacian sedimentary rocks deposited on the North German epicontinental shelf: An integrated stratigraphical, geophysical and geochemical approach

***Berensmeier, M.*[1,*], Dölling, B.[2], Linnert, C.[3], Frijia, G.[4], Wilmsen, M.[1]**

*1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, *E-mail: michaela.berensmeier@web.de*
2) Geologischer Dienst NRW, Krefeld, Krefeld, Germany
3) Ruhr Universität Bochum, Bochum, Germany
4) Sultan Quaabos University, Muscat, Oman

Three drill cores of Cenomanian–Coniacian sedimentary rocks from the southwestern margin of the Münsterland Cretaceous Basin (MCB, NW Germany) have been logged in great detail and stratigraphically interpreted. The drilling sites (Essen and Gelsenkirchen) were part of a shallow marine epicontinental environment, where glauconitic sands, glauconitic (marly–sandy) lime muds, argillaceous-silty marls and spiculitic marly lime muds have been deposited during Late Cretaceous times. The resultant sedimentary rocks were lithostratigraphically assigned to the four lithostratigraphic formations: Essen Grünsand Formation, Büren Formation, Duisburg Formation and Emscher Formation.

The integrated approach of bio- (mainly calcareous nannofossils), chemo- and sequence stratigraphy as well as geophysical borehole data (gamma radiation) resulted in the calibration and correlation of the studied strata. The nannofossil biozones UC1–3 and UC6–10 have been recognised including a potential gap in the latest Cenomanian (UC4, 5). Furthermore, eight 3rd-order sequence bounding unconformities (SB) are present within the records: SB Cenomanian (Ce) 1/2?, SB Ce 3–5 and SB Turonian (Tu) 1–4, dividing the strata into depositional sequences (DS): DS Ce 1–5, DS Ce–Tu 1 and DS Tu 2–5 (sequence terminology after Janetschke et al., 2015). These depositional sequences are stacked into two 2nd-order cycles separated by SB Tu 1 in the lower–middle Turonian boundary interval. The carbon-stable isotope curve of one drill core has been correlated to the Cretaceous standard section for northwestern Europe (Dover) and the regional standard of the southern MCB (Werl/Anröchte). The major positive isotope excursion of the oceanic anoxic event 2 (OAE 2) has been recognised, along with some other subordinate Cenomanian–Turonian isotope events. The integrated stratigraphic analysis provides a better understanding of depositional environments and sedimentary dynamics at the southern margin of the late Cretaceous epicontinental sea in northwest Germany. Furthermore, the improved stratigraphic calibration allows a detailed correlation to the offshore areas of the MCB and into other Cretaceous basins.

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Facies analysis and facies model of proximal deposits of the Cenomanian to Coniacian epicontinental sea in SW Münsterland Cretaceous Basin (NW Germany)

Berensmeier, M.[1,*]***, Dölling, B.***[2]***, Frijia, G.***[3]***, Dölling, M.***[1]

*1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, *E-mail: michaela.berensmeier@web.de*
2) Geologischer Dienst NRW, Krefeld, Krefeld, Germany
3) Sultan Quaabos University, Muscat, Oman

Cenomanian–Coniacian sedimentary rocks have been drilled at the southwestern margin of the Münsterland Cretaceous Basin (MCB, NW Germany). These deposits correspond to the proximal facies zone of the epicontinental MCB that has been poorly known due to the lack of surface exposures. The strata have been related to four lithostratigraphical formations: Essen Grünsand Formation, Büren Formation, Duisburg Formation and Emscher Formation.

The integrated approach of litho-and biofacies analysis is based on detailed logging and careful description of the drill cores, supplemented by thin sections analysis of characteristic facies (BERENSMEIER et al., subm.). Three principal facies associations (FA) have been differentiated: transgression conglomerates (FA I), glauconitic sandstones (FA II) and spiculitic, silty-sandy marlstones (FA III). By identifying characteristic components and fabrics, nine subordinated facies types (FT) have been recognized (FT IA–B, FT II A–E, FT III A–B). The three principal FAs furnish evidence of the depositional environment associated with the inner shelf (FA I–II) and the proximal middle shelf (FA III). Five principal sediment sources are evident: (1) south-derived siliciclastic input (Rhenish Massif), (2) skeletal grains of calcareous macrobenthic organisms, (3) planktic carbonate (c-dinocysts, planktic foraminifera, calcareous nannofossils), (4) biogenic silica (mainly from siliceous sponges), and (5) autigenic glauconies. The latter source leads to deposition of in part very strongly glauconitic sediments, related to suitable chemical (e.g. diffusion of K^+ and Fe^{2+}) and physical conditions (e.g. permeability, porosity and tortuosity of sediment) of the depositional environment (MEUNIER & ALBANI, 2007). The integrated facies analysis results in the development of a depositional facies model and illustrates the strong impact of glaucony formation related to the sedimentary dynamics and warm-temperate to subtropical conditions at southern margin of the late Cretaceous epicontinental sea in NW Germany.

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Palaeoenvironmental analyses of the Pleistocene and Holocene deposits of the Peshawar Basin, Pakistan – in search for the early Anthropocene

Bibi, M.[1,*]***, Wagreich, M.***[1]***, Iqbal, S.***[1]

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: bibimehwish15@gmail.com*

The recognition of the relationship between geosphere, biosphere and humans led to introduction of the Anthropocene as a potential new epoch of Earth history. Since the introduction of the term, hot debates on the Anthropocene from both natural and social sciences arise proving the vividness and broad impact of the subject. Interestingly, the Earth Science-based research in this regard still lacks data. Today, the most important questions are IF and WHEN anthropogenic influence on geological processes and the Earth System as a whole started to dominate. A thick succession of interbedded lacustrine, channel margin and floodplain deposits of Indus and Kabul rivers and the overlying loess deposits represent the late Pleistocene and Holocene sedimentary archives in the Peshawar Basin, northwest Pakistan. At places erratic boulders in the strata represent the latest Pleistocene glaciation (LGM) in the area. The youngest basin fill therefore preserves an excellent record of the climatic variation and environmental conditions during and after the latest deglaciation (LGM) in the area. Geochemical methods are applied to identify natural and anthropogenic contributions. The Chemical Index of Alteration (CIA) displays a decrease in the chemical weathering near the start of latest Pleistocene glaciation, overall low values coinciding with the glaciation phase and gradual recovery, and an increase in the CIA after the glaciation. The A-CN-K plots display similar weathering trend supporting the CIA in all the studied sections. Geochemical plots for Cu, Pb and Zn reveal increase in the input of these elements versus relatively stable background values of Sc in the youngest parts of the basin fill. The preliminary results therefore support the anthropogenic role in the distribution of these elements and correlates with the Gandahara time mining activities (at 5000–2000 BP) in different parts of the area.

A Boreal high-resolution composite $\delta^{13}C_{carb}$ record of the Albian to Turonian interval from the North German Basin

***Bornemann, A.*[1,*], Erbacher, J.[1], Huck, S.[2], Heimhofer, U.[2]**

1) Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, Germany,
**E-mail: andre.bornemann@bgr.de*
2) Leibnitz Universität Hannover, Hannover, Germany

We present a potentially complete, six-hundred-meters-thick composite record of high-resolution bulk-rock $\delta^{13}C_{carb}$ data from northern Germany covering the topmost Lower Albian to Lower Turonian interval. The studied composite record consists of more than 1700 measurements analyzed from seven drill sites including the Kirchrode I and II cores (NEBE, 1999; FENNER, 2001), the Anderten I and II cores (BORNEMANN et al., 2017), two industrial cores Wunstorf 2011/2 and 2011/8 as well as the Wunstorf research core (VOIGT et al., 2008).

In the central North German Basin, the Albian is represented by a several hundred meters-thick succession of clays and clayey marls, whereas the Lower Cenomanian is characterized by the transition from clayey to chalky sedimentation. The latter prevailed during the remaining Cenomanian. The top of the studied succession is marked by the prominent black shales of the Cenomanian boundary event = CTBE). The generated isotope records show the $\delta^{13}C$ expression of the Oceanic Anoxic Events 1d and 2 as well as the Lower and Mid-Cenomanian Events (LCE, MCE). The applied integrated approach of high-resolution chemostratigraphy and revised biostratigraphy gives way for a substantial improvement of the Boreal Cretaceous stratigraphy.

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Paleoenvironmental changes traced by calcareous nannofossils through the mid-Cretaceous

Bottini, C.[1,*] ***and Erba, E.***[1]

1) Department of Earth Sciences, Università degli Studi di Milano, Milano, Italy,
**E-mail: cinzia.bottini@unimi.it*

Decades of multidisciplinary research focused on Mesozoic Oceanic Anoxic Events (OAEs) since they constitute ideal case-studies for the understanding of our planet's climate and environmental changes during perturbations of the carbon cycle. These perturbations were, in fact, characterized by excess CO_2, intense volcanism, and altered climate and oceanic chemistry. In particular, the Aptian–early Turonian time interval was marked by major environmental changes at regional to global scale. Specifically, it was a time of super-greenhouse conditions and the climate–ocean system experienced phases of stability perturbed by transient, sometimes prolonged, anomalies of the global carbon cycle. Several regional to global episodes occurred over this time interval: the early Aptian OAE 1a, the early Albian OAE 1b, the latest Albian OAE 1d, the Mid-Cenomanian Event (MCE I) and the Cenomanian–Turonian OAE 2. Most studies focused on these events and a complete record of long-term paleoenvironmental variations is not yet available. Here, we gathered new quantitative nannofossil data for the Tethys Ocean (Umbria Marche Basin, Italy) to derive climatic fluctuations and changes in ocean fertility during the late Albian–early Turonian in the Umbria-Marche Basin. Calcareous nannofossils are useful for reconstructing the marine ecosystem dynamics of the past, since calcareous nannoplankton is extremely sensitive to changes in surface water parameters like temperature and nutrient content, and interacts with the carbon cycle through biological processes and production of calcareous oozes. The new dataset has been integrated with the nannofossil data previously collected for the Aptian–early Albian time interval to provide a compilation of variations in temperature and surface water fertility over the long-term throughout the Aptian–early Turonian interval in the western Tethys.

New radiolarian zonation of the Upper Albian – Santonian of the Tethyan regions of Eurasia

Bragina, L.[1]

1) Geological Institute of Russian Academy of Sciences, Moscow, Russia, E-mail: l.g.bragina@mail.ru

A new detailed radiolarian zonation is proposed for the Upper Albian-Santonian of the Tethyan regions of Eurasia (Crimea, Caucasus, Turkey, Cyprus, Serbia) (BRAGINA, 2016): 1) The upper Albian *Crolanium triangulare Zone,* 2) the lower Cenomanian *Patellula spica* Zone, 3) the middle Cenomanian *Pseudoaulophacus lenticulatus* Zone, 4) the upper Cenomanian *Triactoma parva* Zone, 5) the lowermost Turonian *Acanthocircus tympanum* Zone, 6) the *Patellula selbukhraensis* Zone of the upper part of the lower Turonian, 7) the *Phaseliforma turovi* Zone (middle Turonian), 8) the *Actinomma* (?) *belbekense* Zone (upper part of the middle Turonian–upper Turonian), 9) the lower Coniacian *Alievium praegallowayi* Zone, 10) the upper Coniacian *Cyprodictyomitra longa* Zone, 11) the lower Santonian *Theocampe urna* Zone, 12) the middle-upper Santonian *Crucella robusta* Zone, and 13) the uppermost Santonian *Afens perapediensis* Zone.

The most important sections are in the Crimea, where radiolarians are present in the interval from the upper Albian to the lower part of the Coniacian inclusive and in the upper Santonian. Radiolarians are found together with planktonic foraminifers, occasionally inoceramids and ammonoids, and also nannofossils. Therefore, zones 1–8 were established in the Crimea sections, characterized by limestones and marls with intercalations cherts. Zones 9–13 were established in the sections of Cyprus (Mangaleni), comprising by umbers (ferro-manganese deep-water sediments) and radiolarian cherts. Sections from Cyprus show the most complete succession of radiolarian assemblages in the upper Turonian–uppermost Santonian interval, which facilitates substantiation of the stratigraphic subdivision of the more problematic Coniacian–middle Santonian interval. The exceptional preservation, abundance, and diversity of radiolarians from the Turonian–Santonian beds of Cyprus are noteworthy. Zones 1–9 and 13 were calibrated by planktonic foraminifers in the Crimean sections. Zones 10–12 have not yet precise biostratigraphic calibration and their stratigraphic position was determined tentatively. The proposed zones are traced over a large territory, encompassing the Crimea, Greater Caucasus, Serbia, Turkey, Italy, Spain, Cyprus, Bavaria, Poland, and part of the North Atlantic. The biostratigraphic subdivisions are correlated with bioevents in the schemes proposed previously for the Tethys and Pacific (PESSAGNO, 1976; SANFILIPPO & RIEDEL, 1985; O'DOGHERTY, 1994; BRAGINA, 2004).

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Barremian–Aptian plankton foraminiferal stratigraphy of the southern framing of the East European platform (Crimea and Ulyanovsk Volga region)

Brovina, E.[1]

1) Geological Institute of the Russian Academy of Sciences, Moscow, Russia,
E-mail: brovina.ekaterina@gmail.com

Although detailed scale for this region was developed in 1986 (GORBATCHIK, 1986), a new stratigraphic and systematic data call for reinvestigation of mid-Cretaceous deposits of the Tethys realm of the former USSR (Crimea and Ulyanovsk Volga region).

Taxonomy of lower Cretaceous planktonic foraminifera is still under study and revision. There are several divergent views on the systematics of the group, which resulted in existence of genera with not distinct definitions (e.g. in hedbergellids – *Hedbergella, Clavihedbergella, Praehedbergella, Blefuscuiana*, etc.). According to the most accepted opinion, all the mid-cretaceous trochoid forms belong to the *Hedbergella* (except the late Aptian *Paraticinella*), and all planispiral forms belong to the *Globigerinelloides* (except ones with elongate chambers – *Leupoldina, Pseudoshackoina*). The present study, using a set of criteria, reveals a clear distinction between *Blowiella* and *Globigerinelloides*, and between *Clavihedbergella* and *Hedbergella*. These genera helped to divide the studied deposits into the following zones (using zone definitions from: COCCIONI et al., 2007; MOULLADE et al., 2015; GRADSTEIN et al., 2012; OGG et al., 2016): Upper Barremian: *Blowiella blowi, Hedbergella ruka, H. excelsa*. The lower border of latter is below for several meters the br/ap border (bazed on magnetic cron M0). Lower Aptian: *H. excelsa, L. cabri, Clavihedbergella luterbacheri*. Upper Aptian: *Globigerinelloides ferreolensis, G. barri, G. algerianus, H. trocoidea, Paraticinella rohri*.

Though all zones of the Mediterranean region were found, not all of them are detected in all outcrops. Everywhere the basis of the complex is *Hedbergella infracretacea*. The index types of taxa are rare (especially in the range from *L. cabri* to *G. barri*), besides *Globigerinelloides* represented only by juvenile forms. All these factors indicate the poor conditions for these genera in the basin. Probably, the reason for the almost absence of all other morphotypes, except *Hedbergella infracretacea*, is the lack of the open ocean conditions in this area during the Barrem–Aptian. However, not only *Globigerinelloides* meets these conditions, as it is widely known, but also other forms – such as *Leupoldina, Clavihedbergella* and *Paraticinella*. Therefore, in epicontinental basins, despite the presence of planktonic foraminifera, it is complicated to determine the exact zones.

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Palaeoenvironmental and climatic changes in the uppermost Jurassic to lower Cretaceous in the southern Hemisphere (Central and southern Chile, Antarctica)

Brysch, S.[1,*], ***Jäger, H.***[1], ***Stinnesbeck, W.***[1], ***Crame, A.***[2], ***Salazar, C.***[3]

1) *Institute of Earth Sciences, Heidelberg University, Heidelberg, Germany, *E-mail: Sven.Brysch@geow.uni-heidelberg.de*
2) *British Antarctic Survey, Cambridge, UK*
3) *Facultad de Ingeniería, Universidad del Desarrollo, Santiago de Chile, Chile*

The palaeoenvironmental development of the upper Jurassic (Tithonian) to lower Cretaceous (Hauterivian) of the southern hemisphere is analysed in high-resolution by a multidisciplinary study. It is focused on palaeoenvironmental and sea level changes and its connection to climatic pertubations. In the carbonate shelf system of central Chile two transgressive cycles are identified in this interval. The relatively low sea level in the uppermost Tithonian with proximal to inner platform deposits is followed by the first transgressive interval in the Berriasian, leading to deep shelf to basin depositional systems. The early Valanginian shows again a relatively low sea level with inner platform to slope deposits, followed by the second transgressive phase in the upper Valanginian to Hauterivian at the top of the sections, represented by deep shelf to basin deposits. Sedimentary organic matter (OM) in the sections is mostly terrestrial with only very minor amounts of marine OM, showing strong terrestrial input even in transgressive intervals. The first transgression (Berriasian) led to organic-rich marlstones and micritic limestones, representing euxinic conditions within this basin. But also calpionellids are found in this interval, indicating warm, oxygen-rich conditions above the euxinic bottom waters. No organic rich sediments are recorded from the second transgression due to more oxic conditions in this phase. In both intervals of lower sea level (uppermost Tithonian, early Valanginian) microscopic glendonite is found. The occurrence of glendonites in these shallow marine shelf environments indicates very cold temperatures in the water column but also cold air temperatures. This gives evidence for climatic cooling in the uppermost Tithonian and early Valanginian and a strong influence of climatic pertubations on facies and sea-level changes in the upper Jurassic to lower Cretaceous shelf system of central Chile.

Time equivalent sections from southern Chile and the South Shetland Islands, Antarctica, show continuously clastic sedimentary successions. Nevertheless first samples also recorded microscopic glendonites in the early Valanginian, indicating certain carbonate level in the primary sediments. High resolution sample sets are studied from these areas, enabling long distance correlations of climatic changes in the southern hemisphere and its impact on palaeoenvironmental changes identified by lithofacies and palynofacies analysis.

Foraminifera across the Jurassic–Cretaceous transition at Kurovice section (Western Carpathians, Czech Republic)

Bubik, M.[1,*] ***and Reháková, D.***[2]

*1) Czech Geological Survey, Brno, Czech Republic, *E-mail: miroslav.bubik@geology.cz*
2) Department of Geology and Palaeontology, Comenius University, Bratislava, Slovakia

For the formal definition of the Jurassic–Cretaceous system boundary the high-resolution studies of numerous sections worldwide are crucial. In the Magura Group of Nappes in Moravia the early Tithonian–early Valanginian strata were already studied in composite section at Kurovice Quarry by ELIÁŠ et al. (1996). New continuous Kurovice section was recently chosen for integrated multistratigraphic study including magnetostratigraphy, isotope stratigraphy and biostratigraphy based mainly on calpionellids, calcispheres and calcareous nannofossils. The Tithonian–Berriasian strata of the section consist of bedded radiolaria-rich pelagic limestones. They may be characterized as predominantly radiolaria-spiculite wackestones, occasionally intercalated by mudstones and few coarse-grained turbidites with accumulations of aptychi. Besides the biostratigraphically important planktonic microfossil groups, benthic foraminifers were studied in thin sections and acetolytic residues received by method of LIRER (2000). Generally the recovery of foraminifers was rather poor and diversity low. Preliminary results of calpionellid stratigraphy provide helpful biostratigraphic framework for biostratigraphic evaluation of the foraminifers. Long-ranging involutinids (*Spirillina Miliospirella, Globospirillina, Neotrocholina* and *Patellina*) and nodosariids (*Lenticulina, Astacolus, Laevidentalina, Pyramidulina, Bullopora tuberculata*) prevail in foraminifer assemblages. Agglutinated foraminifers constitute minor elements of the assemblages and miliolids (*Quinqueloculina, Ophthalmidium*) are rare. In the lower part of the section without calpionellids (lower Tithonian) agglutinated taxa *Bicazammina jurassica* (Haeus.), *Hippocrepina depressa* Vaš. and *Uvigerinammina uvigeriniformis* (Seib. & Seib.) occur. Within late Tithonian Crassicolaria zone following taxa were recorded: *Paleogaudryina magharaensis* Said & B., *Everticyclammina praekelleri* B. & H., (?)*Parurgonina caelinensis* Cuvill. & al., *Pseudomarssonella dumortieri* (Schwag.). Upper part of the section assigned to Calpionella zone (lower Berriasian) contains *Pseudomarssonella dumortieri, Verneuilina subminuta* Gorb. and *Pseudonodosinella troyeri* (Tappan). Foraminifer study is still in progress and may bring new findings. Special attention is paid to search for important Berriasian foraminifer marker *Globospirillina neocomiana* (Moull.) or additional stratigraphic markers *Praedorothia praehauteriviana* (Moull.) and *Lenticulina busnardoi* Moull.

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Foraminiferal biostratigraphy and ecology of the Coniacian/Santonian boundary at the Stöckelwaldgraben section (Northern Calcareous Alps)

Bukenberger, P.[1,*]***, Wolfgring, E.***[2]***, Wagreich, M.***[2]

1) Department of Palaeontology, University of Vienna, Vienna, Austria,
**E-mail: patrick.bukenberger@univie.ac.at*
2) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria

The Coniacian/Santonian boundary is represented in the Austrian Stöckelwaldgraben section (Streiteck- and Grabenbach formations, Gosau-Group, Upper Cretaceous). This section exposes grey marls with frequent tempestite events throughout the section. The Stöckelwaldgraben section was located on the southern margin of the Penninic Ocean and represents a shelf environment. The late Coniacian to early Santonian are covered by the *Dicarinella concavata* and *Dicarinella asymetrica* planktic foraminifera zones. The boundary is marked by the first occurrence of *Sigalia carpatica* and the first occurrence of *Dicarinella asymetrica*. The primary marker, the inoceramid *Platyceramus undulatoplicatus*, which is defined by the GSSP (Global Stratotype Section and Point), could not be found in this outcrop as well as the ammonite genus *Texanites*. The rise in abundance and diversity of benthic foraminifera suggests a gradual sea-level shift from a shallow marine to a neritic environment. In the Coniacian samples, planktic foraminifera were scarcely found but large sized miliolids were plenty. The overall diversity of benthic foraminifera was very low. This suggests very shallow marine conditions. The content of planktonic foraminifera was gradually increasing up to 40 % in the Santonian, where the planktic foraminiferal fauna was predominantly represented by large sized marginotruncanids, biserial planktics, dicarinellids and archeoglobigerinids. The preservation state of the microfossils recovered is ranging from moderate to well preserved except for high-magnesium calcite tests of miliolids. The latter show signs of decalcification and pyrite infillings.

Implications of changing the Jurassic-Cretaceous boundary on the chronostratigraphic correlation between marine and coastal–continental sequences: the example of the dinosaur-rich Villar del Arzobispo Fm (E Spain)

Campos-Soto, S.[1], Caus, E.[2], Cobos, A.[3], Alcalá, L.[3,*], Benito, M.I.[1], Mas, R.[1], Fernández-Labrador, L.[1], Suarez-Gonzalez, P.[1], Quijada, E.[1], Royo-Torres, R.[3]

1) Department of Stratigraphy-IGEO, Madrid, Spain
2) Department of Geology, Autonomous University of Barcelona, Cerdanyola del Vallés, Spain
3) Fundación Conjunto Paleontológico de Teruel-Dinópolis, Teruel, Spain,
**E-mail: alcala@fundaciondinopolis.org*

The Villar del Arzobispo Formation is a mixed siliciclastic-carbonate unit that crops out at eastern Spain and has been traditionally assigned to the Late Tithonian–Middle Berriasian. In the Maestrazgo and South-Iberian Basins, this unit, which includes abundant dinosaur remains, was deposited in an inner platform that evolved upwards into a coastal and alluvial plain, and finally into an inner platform again (CAMPOS-SOTO et al., 2016a; 2016b). The detailed micropaleontological study of this unit has shown the presence of a larger foraminifera association dominated by *Alveosepta personata* in its lower part, indicating a Kimmeridgian age for the lower part of the unit (CAMPOS-SOTO et al., 2016a). The upper part of the unit contains a larger foraminifera association dominated by *Anchispirocyclina lusitanica*, indicating a Tithonian–earliest Berriasian? age for the uppermost part (CAMPOS-SOTO et al., 2016b). A Late Jurassic age for the Villar del Arzobispo Fm is, in fact, consistent with the dinosaur fossils preserved in the unit, which show a Late Jurassic affinity (COBOS et al., 2014).

The Jurassic-Cretaceous boundary has been recently formally changed by the Berriasian Working Group and it has been placed in the middle of Chron M19n, at the base of Calpionellid Zone B (delimited by the *Crassicollaria* to *Calpionella* turnover) in deep shelf to pelagic marine deposits (OGG et al., 2016). This change will have implications when dating coastal and continental deposits, which typically contain very scarce fossils with chronostratigraphic value. This is the case of the Villar del Arzobispo Fm, which contains dinosaur fossils currently considered as typical of the Late Jurassic (COBOS et al., 2014; CAMPOS-SOTO et al., 2016b).

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Cretaceous terrestrial deposits in China

Cao, K.[1]

1) Qingdao Institute of Marine Geology, Qingdao, China. E-mail: cdutck@163.com

As an important part of epidermic system, the terrestrial deposits may give a good response to major geological events in the Cretaceous epidermic system. This article is a review of the geological background, paleogeography, paleoclimate, basin evolution and sedimentary characteristics in China through the Cretaceous, in order to provide a comprehensive understanding for interested researchers. During Berriasian–Hauterivian, red-mainly fluvial and shallow lacustrine deposition developed under arid and semi-arid climate in westen China when eastern China had been occupied by “East Plateau”. During Barremian–Albian, coal-bearing deposition occurred to the north of Yanshan Mountain under wet and warm climate. However, red-mainly fluvial and shallow lacustrine depositions were prevailing in most of south to Yanshan Mountain except for basins where seawater could enter and caused green-mainly deposition. During Cenomanian–Santonian, high land uplift occurred in northwestern China. Red-mainly deposition with developed alluvial plains occupied southwestern China and South China when the Songliao Basin was filled by black deep lacustrine mud shale caused by transgression. Red-mainly deposition under arid and semi-arid climate occupied all basins in China during Campanian–Maastrichtian.

The Turonian-Coniacian stage boundary in the Bohemian Cretaceous Basin (Czech Republic), correlated between nearshore and offshore facies

Čech, S.[1,*] ***and Uličný, D.***[2]

*1) Czech Geological Survey, Prague, Czech Republic, *E-mail: stanislav.cech@geology.cz*
2) Institute of Geophysics, The Czech Academy of Sciences, Prague, Czech Republic

During the latest Turonian – early Coniacian, the Bohemian Cretaceous Basin (BCB, Central Europe) was characterized by increased rates of tectonic subsidence compensated by high clastic supply (cf. ULIČNÝ et al., 2009). As a result, a succession of sand-rich, Gilbert-type deltas developed at the faulted basin margin, fining along depositional dip into prodeltaic heterolithic facies and offshore mudstones to marlstones. The active tectonic setting with accelerated subsidence and supply turned out to be an advantage for preservation of otherwise insufficiently known parts of the Turonian-Coniacian (T-C) record. In this study a combination of detailed biostratigraphy, genetic sequence stratigraphy, and carbon isotope chemostratigraphy is employed to characterize the T-C boundary in the northern part of the BCB, in both nearshore and offshore facies. Tracing of the continuity of foreset, bottomset, and offshore strata in individual delta bodies, at high stratigraphic resolution, was made possible by a combination of the study of outcrop stratigraphic architecture, well-log data, and a succession of biostratigraphic markers. The basis of the biostratigraphic framework was the establishment of the same succession of inoceramid bivalves and other molluscan marker taxa and bioevents as that in Salzgitter-Salder (Germany) and Słupia Nadbrzezna (Poland), localities currently considered candidates for a combined type section for the Turonian-Coniacian boundary (WALASZCZYK et al., 2010). All the faunal markers from the *M. scupini* to *C.c. crassus* inoceramid zones were found both in the nearshore and offshore facies. The linkage of biostratigraphic and carbon isotope-stratigraphic data to a regional stratigraphic picture, as well as to individual outcrop and core sections, provides an important new database for further study of the boundary interval, with a direct link to the transgressive-regressive history of the nearshore depositional systems. Therefore it is proposed here that the T-C interval in the BCB complements the Salzgitter-Salder and Słupia Nadbrzeżna sections and together with them constitutes a broader type region for definition of the T-C boundary.

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Inoceramids and calcareous nanoplankton at the lower and middle Coniacian substage boundary in the Bohemian Cretaceous Basin

Čech, S.[1,*] ***and Švábenická, L.***[1]

*1) Czech Geological Survey, Prague, Czech Republic, *E-mail: stanislav.cech@geology.cz*

Coniacian deposits fill the central part of the Bohemian Cretaceous Basin (BCB). Thus the study of an extensive Coniacian succession is possible only in boreholes. There are several thousand boreholes in the BCB, but only part of them is well documented by macrofauna and nannoflora. Among inoceramids, the genus *Cremnoceramus* dominates the lower Coniacian whereas in the younger Coniacian strata inoceramids of the genera *Platyceramus* and *Volviceramus* prevail. The turover interval, from the *Cremnoceramus*- to *Platyceramus*-*Volviceramus*-dominated parts of the successin, is characterized by a distinct acme of the *Inoceramus frechi*, the species described earlier from surface outcrops of the BCB as *Inoceramus kleini* (ANDERT, 1934, ČECH & ŠVÁBENICKÁ, 1992). The species appears just above *Cremnoceramus crassus crassus* Zone, at the base of so called Emscher Marl (Březno Formation). The first occurrence of *I. frechi* defines the base of the *I. frechi* Zone. This zone with a thickness of appoximately 10 m was recognized in boreholes and oucrops throughout the BCB and in the Czech part of the Nysa Kłodzka Graben. At the base of the *I. frechi* Zone the nannoplankton species *Micula staurophora* and the acme of the benthic foraminifer *Steinsioeina granulata* appear. This assemblage may serve as a good marker for the base of the middle Coniacian since the ammonites are very scarce in this interval.

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Mercury enrichment indicates volcanic triggering of Valanginian environmental change

Charbonnier, G.[1,*]***, Morales, C.***[2]***, Duchamp-Alphonse, S.***[3]***, Westermann, S.***[4]***, Adatte, T.***[1]***, Föllmi, K.***[1]

1) University Lausanne, Lausanne, Switzerland, E-mail: guillaume.charbonnier@unil.ch
2) University of Utrecht, Utrecht, The Netherlands
3) University Paris Sud, Orsay, France
4) Cantonal Agency Environment, Sion, Switzerland

The Valanginian stage (Early Cretaceous, ~137–132 Ma) recorded an episode of pronounced palaeoenvironmental change, which is marked by a globally recorded positive $\delta^{13}C$ excursion of 1.5 to 2‰ amplitude, also known as the "Weissert event or episode". Its onset near the early/late Valanginian boundary (*B. campylotoxus–S. verrucosum* ammonite Zones) coincides with a phase of warmer climate conditions associated with enhanced humidity, major changes in the evolution of marine plankton, and the drowning of tropical and subtropical marine shallow-water carbonate ecosystems. The globally recorded excursion indicates important transformations in the carbon cycle, which have tentatively been associated with Paraná-Etendeka large igneous province (LIP) volcanic activity. Incertainties in existing age models preclude, however, its positive identification as a trigger of Valanginian environmental change.

Since very recently, mercury (Hg) chemostratigraphy offers the possibly to evaluate the role of LIP activity during major palaeoenvironmental perturbations. In this study we investigate the distribution of Hg contents in four Valanginian reference sections located in pelagic and hemipelagic environments in the Central Tethyan Realm (Lombardian Basin, Breggia section), the northern Tethyan margin (Vocontian Basin, Orpierre and Angles sections), and the narrow seaway connecting the Tethyan and Boreal Oceans (Polish Basin, Wawal core).

All records show an enrichment in Hg concentrations at or near the onset of the Weissert Episode, with maximal values of 70.5 ppb at Angles, 59.5 ppb at Orpierre, 69.9 ppb at Wawal, and 17.0 ppb at Breggia. The persistence of the Hg anomaly in Hg/TOC and Hg/phyllosilicate ratios shows that organic-matter scavenging and/or adsorbtion onto clay minerals only played a limited role. We propose that volcanic outgassing was the primary source of the Hg enrichment and conclude that an important magmatic pulse triggered the Valanginian environmental perturbations.

Carbon isotope and ammonite biostratigraphy of the Early Aptian Oceanic Anoxic Event in Tethyan Himalaya of Southern Tibet

***Chen, X.*[1,*], Idakieva, V.[2], Stoykova, K.[3], Liang, H.[1], Yao, H.[1], Wang, C.[1]**

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: xichen@cugb.edu.cn*
2) Department of Geology, Paleontology and Fossil Fuels, Sofia University, Sofia, Bulgaria
3) Department of Paleontology, Stratigraphy and Sedimentology, Geological Institute Bulgarian Academy of Sciences, Sofia, Bulgaria

The early Aptian Oceanic Anoxic Event, OAE1a, is well documented in western Tethys, North Atlantic and Pacific areas, but has not yet been reported from the eastern Tethys region. Here, we present carbon isotope data and ammonite biostratigraphy of the Lower Aptian succession in Gucuo area of southern Tibet to substantiate for the first time its occurrence in the eastern Tethys. The studied sediments belong to *D. forbesi* and *D. deshayesi* ammonite zones of the Lower Aptian. The obtained $\delta^{13}C_{org}$ curve could be correlated to the early Aptian carbon isotope records in western Tethys and in Pacific Ocean areas. A distinct negative carbon isotope excursion (CIE) by 2.4‰ in the upper part of the section is correlated to the segment C3 of OAE1a, whereas the subsequent positive excursion up section is referred to the segment C4. The absolute values of carbon isotope ratio in Gucuo area are higher than those known from the western Tethys and equatorial Pacific sections. We suggest that digenetic alterations and lower temperatures are responsible for these higher absolute values in Gucuo. According to spectral analysis on high resolution magnetic susceptibility data, the best fit mean sedimentation rate of the succession is ~17 cm/kyr. Therefore, the duration of the CIE in the studied section is ~29 kyr, which matches well with the estimations of C3 in other continents (Li et al., 2008).

Li, Y. et al., EPSL, 2008, **271**, 88–100.

Calcareous nannofossil extinction, survivorship and speciation during the OAE2 in the Tethys Realm

Chen, X.,[1,*], Maurrasse, F.[2], Lamolda, M.[3], Duque-Botero, F.[4], Roban, R.D.[5], Melinte-Dobrinescu, M.[6]

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: xichen@cugb.edu.cn*
2) Department of Earth Sciences, Miami, USA
3) Department of Stratigraphy and Paleontology, Granada, Spain
4) Saudi Arabia Oil Company, Dhahran, Saudi Arabia
5) Faculty of Geology and Geophysics, University of Bucharest, Bucharest, Romania
6) National Institute of Marine Geology and Geo-ecology (GEOECOMAR), Bucharest, Romania

The Oceanic Anoxic Event 2 (OAE2) is discussed, taking into account the calcareous nannofossil data gathered from several sections around the Tethyan Realm, i.e., N Spain, Romanian Carpathians, China (Tibet) and Mexico, spanning the Cenomanian-Turonian boundary. In all the investigated successions, $d^{13}C$ and $d^{18}O$ isotope analyses have been performed; hence the calcareous nannofossil events are correlated with the chemostratigraphic ones.

During the onset of OAE2, few nannofossils vanished, the rate of extinction being in general very low, up to 4 % of total assemblages. Near the maximum of $d^{13}C$ fluctuation, speciation in terms of calcareous nannoplankton taxa occurs, but also showing a low rate, up to 5-6 % of assemblages. Initial phase of the OAE2 is coeval with significant increase in abundance of high fertility taxa, such as *Biscutum constans, Zeugrhabdotus erectus* and *Cyclagelosphaera margerelii*. Productivity seems to have increased through a short period preceding the critical turnover episode, but the ecosystem quickly became starved as the aforementioned species almost disappear from the record. The maximum of $d^{13}C$ values is coincident in some Tethyan studied sections, such as N Spain, by blooms of the calcareous dinoflagellate *Thoracosphaera* in the UC5a-b subzones, event that probably mirrored unstable ecosystem during critical phase of this oceanic event. In other Tethyan regions, such as Tibet, discrete peaks of *Braarudosphaera bigelowii* have been recorded. These bioevents are followed by a significant increase of *Watznaueria barnesiae*, over 40–50 %, along with poorly diversified nannofossil assemblages. As this bioevent was identified in various settings, such as open-marine and shelf, it may reflect global paleoenvironmental deterioration. Even in these stressful conditions, speciation took place, as new *Eprolithus* taxa and *Quadrum intermedium* successively occur. In the $d^{13}C$ post-excursion interval, high fertility taxa *Biscutum constans* and *Zeugrhabdotus erectus* occur again, showing a high abundance. During the main OAE2 interval, the correlation pattern between the most common nannofossils, such as *Watznaueria barnesiae*, *Eprolithus floralis*, *Biscutum constans*, *Zeugrhabdotus erectus*, *Thoracosphaera* spp., *Cyclagelosphaera margerelii*, *Prediscosphaera* spp. and *Eiffellithus turriseiffelii*, presents several inconsistencies, according to their proposed trophic behavior, linked to the establishment of anoxic conditions.

Late Cretaceous cooling enhanced by continental weathering expressed by clay minerals in Campanian sediments

Chenot, E.[1,*], ***Deconinck, J.-F.***[1], ***Jaubert, M.***[1], ***Puceat, E.***[1], ***Pellenard, P.***[1], ***Boussaha, M.***[2], ***Thibault, N.***[2], ***Cocquerez, T.***[1], ***Bruneau, L.***[1], ***Jarvis, I.***[3], ***Sizun, J.-P.***[4], ***Richard, J.***[4]

1) Biogéosciences, UMR 6282, UBFC/CNRS, Université Bourgogne Franche-Comté, Dijon, France, E-mail: elise.chenot@u-bourgogne.fr
2) IGN, University of Copenhagen, Copenhagen, Denmark
3) Department of Geography and Geology, Kingston University London, UK
4) Chrono-environnement, UMR 6249 UBFC/CNRS, Univ. Bourgogne Franche-Comté, Besançon, France

The latest Cretaceous was marked by major changes in the ocean-climate system, with oxygen isotopes indicating a long-term cooling that seems to have accelerated during the Early Campanian (FRIEDRICH et al., 2012), while ε_{Nd} data from ocean sediments demonstrate a contemporaneous reorganization of the overall thermohaline circulation (MOIROUD et al., 2016). A recent study performed on Campanian sediments of the Tercis-les-Bains section (Aquitaine Basin) and of the Poigny borehole (Paris Basin) has shown evidence of detrital input of illite, kaolinite and chlorite that coincides with a global carbon-isotope negative excursion, the so-called "Late Campanian Event" (CHENOT et al., 2016). Although conducted in a limited region of the western Tethys, this study hints toward possible modifications of continental weathering that may have affected climate through enhanced atmospheric CO_2 consumption. In order to better constrain the spatial extent of this event characterised by enhanced detrital inputs, we have analysed clay mineralogical assemblages of sediments from several additional sections and boreholes of Campanian sediments from the Tethyan and Boreal realms, along a palaeolatitudinal transect from 20° to 45°N (Danish Basin, North Sea, Paris Basin, Mons Basin, Aquitaine Basin, Umbria-Marche Basin, Saharan Platform). Our results show that the clay fraction of the Campanian sediments from all sections is largely dominated by smectites, which represent the background of Late Cretaceous clay sedimentation (DECONINCK & CHAMLEY, 1995). However, in several sections, intervals of significantly enhanced detrital input are evidenced by increased proportions of illite, kaolinite, chlorite, palygorskite and talc at various levels in the Upper Campanian.

These detrital inputs result from the erosion of nearby continental areas and thus reflect an intensification of continental weathering during the Late Campanian. This may be explained by a tectonic rejuvenation of exposed continental areas, triggered by closure of the Tethyan Ocean and the anti-clockwise rotation of Africa (JOLIVET et al., 2015). As this event seems to be recorded at a broad geographic scale in the Tethyan Realm, the associated increase in chemical weathering may have induced a decrease in pCO_2 levels, thereby contributing to the Late Cretaceous global cooling trend.

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Taxonomic revision of *Cypridea* (Ostracoda: Cyprideidae) from the Lower Cretaceous Jinju Formation of the Gyeongsang Basin, South Korea

***Choi, B.-D.*[1,*] and Huh, Min[1]**

*1) Faculty of Earth Systems and Environmental Sciences, Chonnam National University, Gwangju, Republic of Korea, *E-mail: dinobd@jnu.ac.kr*

The representatives of the non-marine ostracod genus *Cypridea* (Family Cyprideidae) from the Jinju Formation (Albian) of the Gyeongsang Basin, Korean Peninsula have been reported with 12 species (Paik et al., 1988; Choi, 1990). However, based on new data and detailed revision, 12 species of *Cypridea* are merged into 4 species thus far (Choi, in progress). In this study, we focus on significant features of 4 species of *Cypridea*: *C. jinjuria*, *C*. sp., *C*. cf. *yumenensis*, *C*. ex gr. *alta*.

1) *Cypridea jinjuria* was first discovered from the Gwanghyeon section (Gunwi area) by CHOI (1990). This species is an endemic taxon of the Jinju Formation, which has punctated surface and a distinct swelling-like node at the anterior cardinal angle in the left valve. CHOI (1990) noted that the diagnostic feature of *Cypridea*, the anteroventral rostrum and alveolus, was either lacking in *C. jinjuria* or is characterized by just a weakly developed rostrum in the anteroventral area. However, her specimens have been examined by the first author (visit to KIGAM, June, 2016), and in the view of our examination, this species has both a small but distinct rostrum and alveolus (alveolar notch and furrow). Additionally, *C. jinjuria* of CHOI (op. cit.) probably represents juveniles because newly collected specimens from the Hotan section (Jinju City) have a very distinct rostrum/alveolus and larger carapaces. However, both morphotypes have never been found to co-occur, this view is uncertain thus far. Thus, these two morphs are described as different species herein (*C*. *jinjuria* and *C*. sp.). 2) *Cypridea yumenensis* HOU was first reported from the Gansu province of China, but HOU (1958) did not give the detailed formation name, therefore, its stratigraphic range remains uncertain (pers. comm. Dr. Yaqiong Wang). Thus, *C*. cf. *yumenesis* from the Jinju Formation is able to constrain the possible stratigraphic range of this species. However, this information is hitherto fragmentary. More specimens should be investigated in further studies. 3) *Cypridea* ex gr. *alta* herein is badly preserved, and many morphologic features are dependent on the figures of KIM (1987), and therefore, the detailed comparison remains very difficult. However, its lateral outline is very similar to specimens from North America (see SAMES, 2011). Although of bad preservation, *C*. ex gr. *alta* from the Jinju Formation is considered to be a species of the *C*. *alta*-group and, consequently, would extend the stratigraphic range of this group to late Albian.

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Cretaceous Mammals of Eurasia and North America

Cifelli, R.L.[1,*]***, Cohen, J.E.***[1]***, Davis, B.M.***[1]

*1) Sam Noble Museum, Norman, OK, USA, *E-mail: rlc@ou.edu*

Mammalian faunas underwent dramatic change over the course of the nearly 80 Ma-long Cretaceous Period. Late Jurassic and earliest Cretaceous assemblages are dominated by extinct groups of small, insectivorous forms (‘symmetrodonts,’ dryolestoids, and basal zatherians), with lesser numbers of presumed omnivores (docodonts, plagiaulacidan multituberculates) and carnivores (eutriconodonts). By the end of the Cretaceous, archaic groups had disappeared, cimolodontan multituberculates proliferated, and modern groups, the therians, had diversified. As currently known, the patterns of diversification and extinction vary between the major northern landmasses.

Most of the morphologically informative specimens come from Asia, whereas North America has yielded the most taxonomically diverse, stratigraphically complete record of mammalian faunas. In both Eurasia and North America, archaic groups including eutriconodonts, plagiaulacidan multituberculates, and basal trechnotheres (dryolestoids, spalacotherioids) remained well represented through the Early Cretaceous. Therians, which first appear in the Late Jurassic of China, are represented by basal Metatheria and Eutheria on both landmasses by the Aptian-Albian. Large-bodied carnivorous eutriconodonts appeared on both landmasses at this time, with Gobiconodontidae represented in Eurasia (also present, presumably as an immigrant, in North America), and Triconodontidae in North America. Archaic groups vanished from Eurasia by the onset of the Late Cretaceous, but spalacotheriids and triconodontids persisted until the Campanian of North America. During the Late Cretaceous, eutherians proliferated in Eurasia whereas Metatheria dominated in North America until the Campanian. New data suggest immigration of at least three eutherian clades to North America by the Turonian. Of these, one lies within (or is a proximal sister taxon to) Placentalia, supporting the “long fuse” model of placental origin and diversification well prior to the Cretaceous-Paleogene boundary.

Albian shallow-water sedimentary archives: elemental evidence of major perturbations?

Coimbra, R.[1,2,*]***, Horikx, M.***[3]***, Huck, S.***[3]***, Heimhofer, U.***[3]***, Immenhauser, A.***[4]***, Rocha, F.***[1]***, Dinís, J.***[2]***, Duarte, L.V.***[1]

*1) GeoBioTec, Departamento de Geociências, Universidade de Aveiro, Portugal, *E-mail: rcoimbra@ua.pt*
2) MARE, Departamento de Ciências da Terra, Universidade de Coimbra, Portugal
3) Institut für Geologie, Leibniz Universität Hannover, Germany
4) Institute for Geology, Mineralogy and Geophysics, Ruhr Universität Bochum, Germany

Geochemical data from Albian hemipelagic successions as well as their shallow-water counterparts have been increasingly reported, mainly focusing on carbon-isotope records across black shale deposits and the significance of OAE 1b and 1d (Early and Late Albian) as stratigraphic tie points. But the elemental record is a widely under-explored tool, even more so when applied to coastal sedimentary archives. These challenging settings offer complex natural depositional dynamics added to potential diagenetic overprint, but a careful multi-proxy approach helps to extract valuable paleoenvironmental information.

The São Julião section (Lusitanian Basin, Portugal) spans across marly, carbonate and sandstone-rich coastal-marine deposits of Early Albian to Early Cenomanian age, representing fluctuations between terrestrial and shallow-marine depositional environments. Major and trace elements (Ca, Mg, Sr, Fe and Mn) were investigated by means of a thorough statistic data management (double PCA). No signature for major paleoenvironmental perturbation could be identified. Instead, four well differentiated geochemical clusters were obtained and contrasted with independent petrographic, geochemical and mineralogical information. Mixed-carbonate siliciclastic and limestone samples were established as the best preserved, whilst the elemental signature of the siliciclastic intervals and partially dolomitized limestones was significantly affected.

Mixed carbonate-siliciclastics and limestone facies allowed interpreting relative sea-level fluctuations, also providing paleoclimatic information. The influence of the globally long-term sea-level rise reported for Albian times was recognized along the studied succession, superimposed by local to regional shorter-term fluctuations. During lower sea-level stands, sharp increase of Fe and Mn concentrations in relation to continental input agreed well with periods of enhanced hydrological cycle and consequent increased weathering on adjacent lands. In contrast, higher sea-level inferred for late Albian to early Cenomanian times was accompanied by warmer and more arid climatic conditions. Changes in dominant carbonate mineralogy are invoked to explain higher Sr and Ca content, as a result of increased aragonite contribution during warmer conditions.

The highly variable and partially obscured elemental record was fully accounted for, providing reliable information on regional to global climate and sea-level fluctuations, but far from the influence of major perturbations recorded in more distal marine areas.

The Barremian GSSP–state of the art

***Company, M.*[1,*], *Aguado, R.*[2], *Baudin, F.*[3], *Boulila, S.*[3], *Coccioni, R.*[4], *Deconinck, J.-F.*[5], *Frontalini, F.*[4], *Giusberti, L.*[6], *Martinez, M.*[7], *Moiroud, M.*[5], *Monna, F.*[5], *O'Dogherty, L.*[8], *Pellenard, P.*[5], *Rawson, P.F.*[9], *Riquier, L.*[3], *Romero, G.*[10], *Sandoval, J.*[11], *Tavera, J.M.*[11], *Weissert, H.*[12]**

1) Departamento de Estratigrafía y Paleontología, Universidad de Granada, Granada, Spain,
**E-mail: mcompany@ugr.es*
2) Universidad de Jaén, Linares, Spain
3) Université Pierre et Marie Curie, Paris, Fance
4) Università di Urbino, Urbino, Italy
5) Université de Bourgogne Franche-Comté, Dijon, France
6) Università di Padova, Padova, Italy
7) MARUM, Bremen, Germany
8) Universidad de Cádiz, Puerto Real, Spain
9) University of Hull, UK
10) Universidad de Murcia, Murcia, Spain
11) Universidad de Granada, Granada, Spain
12) ETH Zentrum, Zürich, Switzerland

Following the discussions at and after the 2nd Symposium on Cretaceous Stage Boundaries (Brussels, 1995), the Barremian Working Group decided to recommend drawing the lower boundary of the Barremian stage at the base of the Taveraidiscus hugii ammonite Zone (defined by the FO of the index species). Concurrently, the Río Argos section (Caravaca, SE Spain) was selected as the best candidate for the Barremian GSSP. During the last years we have been carrying out an integrated analysis of this section including biostratigraphy (ammonites, planktonic and benthic foraminifera, and calcareous nannofossils), chemostratigraphy (organic matter and stable isotopes) and cyclostratigraphy (magnetic susceptibility and clay mineralogy). Unfortunately, a secondary remagnetization precludes any magnetostratigraphic dating, although indirect correlation by ammonite and isotope stratigraphy with the Gorgo a Cerbara section (central Italy) allows to correlate the Hauterivian-Barremian boundary with the upper part of chron M5n (CHANNELL et al., 1995).

The main problems concern the correlation potential of the primary marker event. Due to the persistence of a relatively low eustatic sea level during the latest Hauterivian and early Barremian, many marine basins became isolated, which triggered a high degree of endemicity among many fossil groups, strongly hampering interregional correlation. Thus, the index species has not been reported outside the Mediterranean region (from Spain to the Caucasus). And no other biostratigraphic event appears to be a better alternative for defining and correlating the base of the Barremian. Nevertheless, Sr-isotope stratigraphy can provide an independent and reliable test of the established biostratigraphic correlations (MUTTERLOSE et al., 2014).

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Integrated stratigraphy of the Austin Chalk (Coniacian – early Campanian) in south Texas: unravelling tectonic control on depositional geometries

Cooper, J.R.[1], *Godet, A.*[1,*], *Hardwick, J.*[1], *Spangenberg, J.*[2]

*1) The University of Texas at San Antonio, San Antonio, USA, *E-mail: alexis.godet@utsa.edu*
2) University of Lausanne, Lausanne, Switzerland

Sediments of the Austin Chalk Group were deposited during the Coniacian – early Campanian on the northern margin of the proto-Gulf of Mexico. Although chalk deposits typically consist of fine-grained material deposited in low energy conditions, the integration of outcrop and subsurface data from Bexar County illustrates large-scale lateral heterogeneities of individual beds that are capped by discontinuity surfaces. The goal of this research is to understand the mechanisms behind lateral thickness variations and formation of stratigraphic discontinuities within chalk deposits, in order to update depositional models that help to predict lateral and vertical heterogeneities within chalk reservoir architecture.

The lower Austin Chalk consists of argillaceous chalk with finely abraded skeletal material separated by thin marl stringers and contains numerous shallow channel-cut features. The presence of extensive shell lag deposits, high energy facies, and lateral thickness variations of chalk beds within the upper Austin Chalk indicates a change in depositional regime influenced by relative sea level change or other paleoenvironmental conditions. The correlation of gamma ray profiles of measured outcrops to geophysical logs of water wells drilled through the Austin Chalk Group in Bexar County enhances the stratigraphic framework within the study area. This is complemented by the chemostratigraphic ($d^{13}C$) correlation of the succession of the Bexar County to well-dated reference sections, whereas the paleoenvironmental conditions that led to periodic non-deposition of chalk and formation of stratigraphic discontinuities were traced using geochemical proxies measured by X-ray fluorescence spectrometry.

The improved stratigraphic framework reveals that the lower Austin Chalk thins from Bexar County across the San Marcos Arch, while the upper Austin Chalk thickens from Bexar County across the San Marcos Arch. Large-scale lateral thickness variations within the Austin Chalk Group could be induced by either local tectonic inversion around the San Marcos Arch or contour parallel bottom currents involved in the redeposition of the chalk sediments. Depositional geometries of the Austin Chalk Group in Bexar County are heavily influenced by interplay of tectonic and paleoenvironmental forces under periodic high-energy conditions during periods of relative low sea level.

Comparison of the Darwin atoll and the Mecsek type reef

Császár, G.[1]

1) ELTE Eötvös Loránd University, Budapest, Hungary, E-mail: csaszar.geza@gmail.com

Darwin Atoll is a circularly shaped structure of coral-algal reef surrounding a lagoon in a tropical oceanic environment. The terminology of this special type of reef formulated by DARWIN (1842) contains three stages. The first stage is the *fringing reef,* the second one is the *barrier reef* lying offshore with a lagoon. Around volcano coral reef was formed, especially during the warming up periods when the sea-level increases and the reef construction continues (NEUMANN & MACINTY, 1985). Its most matured stage is the real *Darwin atoll.* Dependent on the global sea-level changes and the local volcanic activity the reef could grow or erode. According to GRIGG (2008) at the Darwin Points the coral can grow, drown and bioerod. The form of the coral reef can vary from the ideal circular, rectangular e.g. Thureia Darwin atoll, to the irregular as the elongated Kwajaline Darwin atoll. Independently from their shape they can be typical atolls, the form of which is probably preserved the original shape of the one-time volcano.

In addition to the tropical environment the most important condition is the hotspot developed in the mantle located below the oceanic crust and can produce giant volcanos. Because of the intensive subduction of the oceanic plate it is continuously moving, while the position of the hotspot stay in its original position. During the study of the Mecsekjános Bazalt (MBFm) in the Mecsek Mts, Hungary there are plenty of pebbles of well-rounded basalt, various coral colonies, and different types of bivalves incl. rudists. On the slope of the volcano basalt pebbles and various fossils slit down into the basin. The MBFm is covered by Hidasivölgy Marl (HMFm) followed by hyaloclastite and then by Magyaregregy Conglomerate (MCFm), occasionally with different fossils: molluscs and corals (CSÁSZÁR & TURNSEK, 1997). There is tectonic contact between the Upper Jurassic limestone and the hyaloclastite, with ammonite-bearing sandstone and marl in the HMFm. The same is with the MCFm. In the Vékény Valley above the MBFm and HMFm as erosional remnant the red, pelagic Vékény Marl Fm (VMFm) is also found together with ammonites and planktonic forams. Based on the poorly developed pillow lavas taken from the base of the volcanic rocks the water depth was approx. 500 m. At first glance the situation resembles that one at the Nicaraguan Rise, where the majority of the volcanos doesn't have the characteristics of the Darwin atoll. As a consequence, instead of Mecsek-type atoll we suggest to use it Mecsek-type reef, where the continental crust is deepening and thinning towards the oceanic crust.

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Corrosion of heavy minerals in the middle Campanian siliciclastic deposits of SE Poland – environmental implications

Cyglicki, M.[1,*] ***and Remin, Z.***[1]

*1) Institute of Geology, University of Warsaw, Warsaw, Poland, * E-mail: mcyglicki@uw.edu.pl*

The Campanian and Maastrichtian (Upper Cretaceous) deposits of the Roztocze Hills, represented mainly by opoka, sandy opoka, gaize or sandy limestone have been consequently considered to represent relatively deep, shelf type deposits. In the so far interpretations, the studied opoka-like facies were located close to the axial part of the Danish-Polish Trough, which has usually been equated with its deepest part, with main transport direction along its axis. The current studies covering the "middle/upper" Campanian deposits showed unexpected sedimentological features, which are in contrast to the supposed deep-sea depositional environment and can be attributed to cyclic, deltaically influenced sedimentation (REMIN et al., 2015; WALASZCZYK & REMIN, 2015). Here we present preliminary results of microscopic analysis of heavy and light minerals coming from the middle Campanian deposits of the SE Poland.

Amongst the analyzed heavy and light minerals, considerable variability in the degree of weathering (mechanical and chemical) is observed. Even within a single sample, the state of preservation of heavy "ultrastable minerals" (e.g. zircon, rutile, tourmaline) varies markedly. Surprisingly, in the studied sediments we observed co-occurence of "ultrastable minerals" with well-preserved minerals susceptible to chemical and mechanical weathering, i.e. feldspars (microcline), pyroxenes (augite) and amphiboles (hornblende). Glauconite content changes within the cyclothems, always rising up-section with the highest content in the gaize part of the cyclothem.

The results indicate that the terrigenous material in the cyclic middle Campanian deposits of SE Poland originated from various sources. One of the sources was most likely "old" sediments, repeatedly redeposited and subjected to long-term weathering. The second source must have to be represented by fresh weathered zones, which were the source of minerals susceptible to weathering and simultaneously with low degree of chemical weathering.

Such an association of heavy and light minerals in the studied sediments, together with their various degree of weathering, indicates changing climatic conditions that additionally influenced the sedimentological processes. The current interpretations pointing to warm or subtropical climate seems to confirm this (e.g. CIEŚLIŃSKI, 1964; HALAMSKI, 2011).

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Climate Records of Color and Magnetic Susceptibility of continental Sedimentary Rocks of the Lower Cretaceous in Jiuxi Basin, NW China

Dai, S.[1,*]***, Yan, N.***[1]***, Chen, R.***[1]***, Peng, D.***[1]

*1) Key Laboratory of Western China's Environmental Systems (MOE), College of Earth and Environmental Sciences, Lanzhou University, Lanzhou, China, *E-mail: daisher@lzu.edu.cn*

The Valanginian–Albian continental strata in the Jiuxi Basin, NW China, are composed of reddish or greenish clastic rocks and gray carbonate rocks. A total of 1682 samples were collected on the Hongliuxia section (2302.5 meters thick) and color indexes (lightness, redness and yellowness) and MS (calculated to low- and high-frequency mass MS) are measured. Rock-magnetism measurements show that magnetic minerals are mainly magnetite and maghemite in greenish and gray-black rocks, but hematite in reddish rocks. According to lithology, sedimentary facies, color indexes and MS, the section can be divided into four intervals upwards, representing four different phases of paleoenvironmental conditions, which seem to be related to palaeoclimatic changes. The first stage (0~197 m) represents alluvial fan facies, with gray greenish sandstone, siltstone and conglomerates. Redness and lMS (low-frequency mass MS) are relatively high (-1.94~13.38, 1.82E-8 - 20.76×E-8 m3/kg), suggesting a relatively warm and humid climate. The second stage (196.7~1029.7 m) is made of gray-greenish sandstone, siltstone and conglomerates of alluvial and fan-delta deposits. Redness is relatively low (-1.78 ~ 9.24), but lMS is high and strongly fluctuation (0.07×E-8 ~ 45.97×E-8 m^3/kg), indicating relatively cold and humid conditions. The third stage (1029.7~1743.7 m) represents deep to semi-deep lake deposits, made of gray-black shales, mud- and marlstones Redness and lMS ranges -1.70~12.20 and 5.09×E-8 ~34.92×E-8 m^3/kg, suggesting relatively dry and hot paleoclimatic conditions. The fourth stage (1743.7–2302.5 m) is made of reddish siliciclastic rocks of braided and meandering river deposits. Redness and lMS are high with strong fluctuations (-1.62~30.5 and 1.57 E-8~60.96×E-8 m^3/kg), suggesting relatively humid and hot conditions. The proposed changes on the paleoclimate of this region are generally consistent with the global climate variations (FÖLLMI, 2012).

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Oscillating redox state in Vocontian Basin (SE France) during the Cenomanian–Turonian Oceanic Anoxic Event (OAE 2)

Danzelle, J.[1,*]***, Riquier, L.***[1]***, Baudin, F.***[1]***, Caron, B.***[1]***, Thomazo, C.***[2]***, Villemant, B.***[1]

1) UPMC-Paris VI, UMR 7193 ISTeP, Paris, France, *E-mail: julien.danzelle@gmail.com
2) UBFC, UMR 6282 Biogéosciences, Dijon, France

The Oceanic Anoxic Event 2 (OAE 2) spanning the Cenomanian-Turonian boundary (CTB) represents a global interval of enhanced organic carbon burial triggered by widespread oxygen deficiency in water column and/or an increased primary production. In the epicontinental Vocontian Basin (SE France) the CTB is characterized by the so-called “niveau Thomel”. This level is well exposed at the Pont d’Issole section as a ~22 m succession of calcareous shale and black shale, disrupted by bioturbated limestone intervals. Those lithological variations, highlighted by fluctuations in total organic concentration (TOC) along the CTB, are in favor of a non-permanent anoxia in the Vocontian Basin with important migration of the chemocline inside the sediments and the water column. The aims, here, is to precisely determined the conditions of bottom-water oxygenation and further to decipher which environmental parameters are at the origin of anoxia establishment and disappearance.

Iron speciation measurements indicate anoxic to euxinic conditions during the deposition in the shaley intervals and widespread oxic conditions associated with limestone intervals. This observation is consistent with high variations in the sedimentary degree of sediment pyritisation. Water column or sedimentary pore fluids bacterial sulfate reduction (BSR) is suggested by extremely negative values ($\delta^{34}S$ ~-40‰). Such $\delta^{34}S_{py}$ negative excursion was previously observed in other OAE 2 sites associated with an anti-correlated positive excursion in the marine sulfur isotope sulfate measures as carbonate associated sulfate ($\delta^{34}S_{CAS}$)[a,b]. These signals associated with massive pyrite burial suggest important external S flux (intensified volcanism[a] and/or enhanced weathering[c]) in a pre-OAE low-sulfate ocean which may have triggered anoxia. Fe-P coupling in those sediments indicates, otherwise, that bottom water was dominantly non-sulfidic and was dominated by redox cycling of iron and manganese. P release from sediments to water column in anoxic environment may have contribute to fertilized the photic zone and enhance primary production maintaining anoxia. On the other side, P enrichment peaks in low TOC and low S intervals suggest intense phases of reoxygenation. While presence of anoxia is evident in shale, redox sensitive Trace Element (e.g. Mo, V, U) display only small enrichments, probably reflecting post-depositional reoxygenation. Interval of reoxygenation inside the OAE 2 record was previously pointed out in other European and Atlantic sites and was associated with a regional atmospheric pCO_2 drawdown highlighted by a $\Delta^{13}C$ ($\delta^{13}C_{org}$ - $\delta^{13}C_{carb}$) decrease resulting in an episode of cooling, known as the Plenus Cold Event.

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Multi-proxy analysis and growth modelling of Late Cretaceous fossil bivalves: Disentangling seasonal parameters

***De Winter, N.J.**[1,*], **Goders, S.**[1,2], **Van Malderen, S.J.M.**[2], **Vanhaecke, F.**[2], **Claeys, P.**[1]*

*1) Analytical, Environmental and Geochemistry (AMGC) Department, Vrije Universiteit Brussel, Belgium, *E-mail: niels.de.winter@vub.be*
2) Department of Analytical Chemistry (A&MS research unit), Ghent University, Belgium

The Late Cretaceous greenhouse world is characterized by high atmospheric pCO_2 values and serves as an ideal analogue for future climate change due to anthropogenic CO_2 emissions (IPCC, 2014). While the Late Cretaceous is often studied on a long timescale, it also is important that the short-term seasonal-resolution climate of this system is understood. Trace element and stable isotope proxies in incrementally growing bivalve shells have been used to reconstruct palaeoseasonality (STEUBER et al., 2005). However, internal parameters, such as growth and metabolic rate also control the recording of palaeoenvironmental proxies in bivalve calcite (e.g. LORRAIN et al., 2005; SCHÖNE et al., 2011). Culture experiments with extant bivalves can be used to constrain some of these vital effects, but these are not available for extinct bivalve species such as the extremely common Cretaceous rudistid bivalves.

In the present work, a multi-proxy, multi-species approach is used in an attempt to disentangle the effects of species-specific vital effects on palaeoenvironmental proxies. High-resolution micro-X-Ray Fluorescence (microXRF) and Laser Ablation-Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) trace element profiles are combined with stable oxygen and carbon isotope profiles. The relative expression of palaeoenvironmental proxies (e.g. $\delta^{13}C$, $\delta^{18}O$, Mg/Ca, Sr/Ca, S/Ca, Zn/Ca) in fossil bivalves is compared. Furthermore, a new numerical modelling routine based on growth increments in cross sections of fossil bivalve shells is used to reconstruct growth rates through the lifetime of the organisms. This model is combined with microXRF mapping and phase analysis of shell cross-sections to trace accumulation rates of trace elements and stable isotopes through time in an attempt to trace the role of growth on these proxy records. Application of this growth model in combination with multi-proxy records through the shells sheds light on the respective roles of internal and external parameters that control incorporation of proxies in bivalve shells. This multi-proxy modelling approach critically assesses the application of calcite palaeoenvironmental proxies and their relationship with Cretaceous climate and sea water chemistry without the use of species-specific culture experiments. As a result, a more detailed reconstruction is made of Late Cretaceous environments, and seasonal fluctuations are interpreted.

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Lithostratigraphy of Upper Cretaceous deposits of the southern Münsterland (Northwest Germany) – correlations of borehole lithostratigraphical, biostratigraphical and natural gamma radiation (GR) log data

Dölling, B.[1,*], ***Dölling, M.***[1], ***Hiss, M.***[1], ***Berensmeier, M.***[2], ***Püttmann, T.***[3]

*1) Geological Survey of North Rhine-Westphalia, Krefeld, Germany, *E-mail: bettina.doelling@gd.nrw.de*
2) Senckenberg Naturhistorische Sammlungen Dresden, Dresden, Germany
3) Ruhr-Universität Bochum, Bochum, Germany

Along the southern margin of the Münsterland Cretaceous Basin (MCB, NW Germany) over a distance of 125 km, 22 cores and approximately 80 chipped drillings of Cenomanian–Campanian strata (Upper Cretaceous) have been logged in detail for lithology and natural gamma radiation (GR). Additionally, biostratigraphical investigations have been carried out for stratigraphical classification of the calcareous to siliciclastic deposits using foraminifera (DÖLLING et al., 2014; DÖLLING et al., subm.). In the westerly sandy-glauconitic facies also nannofossils have been considered for selected cores (cf. PÜTTMANN et al., subm.). The strata were lithostratigraphically assigned to the Essen Greensand, Baddeckenstedt, Brochterbeck, Hesseltal, Büren, Duisburg, Oerlinghausen, Salder, Erwitte, Emscher, Recklinghausen, Haltern and Bottrop formations including the Wamel, Ascheloh, Hoppenstedt, Bochum Grünsand, Soest Grünsand, Mülheim Grünsand, Emscher Grünsand and Osterfeld members. In the west, the dominating lithofacies are glauconitic sandstones and glauconitic (marly-sandy) limestones as well as clayey-silty marls and spiculitic marly limestones (see BERENSMEIER et al., subm.). Here, non-separable strongly glauconitic sandy marls and marlstones ("greensands") constitute the complete stratigraphy from the middle Turonian to the lower Coniacian. For this succession, the Duisburg Formation is introduced, including the Bochum Grünsand and Soest Grünsand members. Additionally, the formation includes an early Coniacian glauconitic succession that is introduced as the Mülheim Grünsand Member (DÖLLING et al., subm.). Eastward, calcareous marlstones, marly limestones and limestones (locally spiculitic) are predominant, partially interrupted by strongly glauconitic greensands (Bochum Grünsand and Soest Grünsand members of the Duisburg Fm).

The drillings have been successfully correlated using an integrated approach of microbiostratigraphy and GR log based stratigraphy. Correlations of 51 boreholes are shown in three cross-sections. Although a bed-by-bed correlation by GR log is not possible over long distances, significant curve progressions can be well correlated. Additionally, several sequence boundaries investigated by RICHARDT & WILMSEN (2012) and by Berensmeier et al. (subm.) could be correlated by GR logs. In the southwestern part of the MCB, several local depositional gaps concerning the Turonian strata (biostratigraphically proven) have been recorded within the drill cores, which cannot be explained by regressive eustatic events. They are induced by synsedimentary tectonic movements (see DÖLLING et al., subm.).

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DÖLLING, B. et al., subm. Cret. Res.
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Late Cretaceous positive inversion tectonics and synsedimentary movements in the southern Münsterland (Northwest Germany)

Dölling, M.[1,*] ***and Dölling, B.***[1]

*1) Geological Survey of North Rhine-Westphalia, Krefeld, Germany, *E-mail: manfred.doelling@gd.nrw.de*

Within the Turonian strata of the southern Münsterland (Northwest Germany), regional variations in thickness exist. The lower Turonian Büren Formation is missing in many parts of the southwestern Münsterland whereas the middle–upper Turonian successions are missing in the northwestern part of the southern Münsterland. Most reductions in thickness and layer gaps are obviously related to synsedimentary crustal movements and associated short-term sea regressions and intraformational erosion processes. The movements presumably indicate the onset of the subhercyne positive inversion tectonics, which reached its maximum in the north-west of Germany from Santonian to Maastrichtian times. The structural genetic links between the thickness of the Büren Formation and the tectonic structures are clearly visible (Dölling et al., subm.). NW–SE to N–S-oriented stresses led to a compression (transpression) associated with horizontal displacements on many of the already existing faults. Subsequently, once active normal faults act as oblique reverse faults and reduce the prior vertical displacement again (Dölling et al., 2014). Late Cretaceous inversion tectonics, however, has not only been ruptural. Oblique-directed, narrowing stresses initiated mostly non-ruptural bulges above the fracture lines of the Plaeozoic basement. Thus, within the Cretaceous cover of the southwestern Münsterland, expansive fold structures have been developed striking NW–SE to W–E (Drozdzewski, 1988). The anticlines of these folds are obviously pinnately related to subsurface fractures, which were active during the time of the inversion tectonics (Drozdzewski, 1988). Based on exploration drillings within the southern Münsterland, the tectonic movement sequences can be exemplified for the Blumenthal fault and the Drevenack fault. Thus, one can see that this movement has accelerated more and more, reaching maxima within the lower Turonian and lower Santonian strata. The principal movements occurred during the early Santonian times (upper Emscher Formation). Wrede (2010) investigated a movement rate of approximately 0.12 mm/year for this time period. The movements had probably come to a standstill not before the Santonian/Campanian boundary. Partly, movements in the opposite direction seem to have taken place once again.

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Planktonic foraminiferal and nannofossil biostratigraphy of the Upper Cretaceous at Aurachtal-Herbstau and Nussdorf am Attersee (Helvetic units, Upper Austria)

Domanski, H.[1,*]***, Peryt, D.***[2]***, Wagreich, M.***[1]***, Kallanxhi, M.-E.***[3]

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: domanski@gmx.at*
2) Institute of Paleobiology PAS, Warszawa, Poland
3) Department of Geology, Babes-Bolyai University, Cluj-Napoca, Romania

Planktonic Foraminifera and calcareous nannofossils from Ultrahelvetic limestone-marlstone cycles of the Upper Cretaceous at Aurachtal-Herbstau (SAG 1 profile) and Nussdorf am Attersee (ROTT 1 and ROTT 4 profiles), both in Upper Austria, were studied.

Grey coloured rocks from Nussdorf am Attersee (SAG 1 profile) represent pre-CORB-phase deposition and formed in a depositional environment with low oxidation. The planktonic foraminiferal assemblages from this site are characterized by the dominance of complex morphogroups represented mainly by *Thalmanninella* and *Rotalipora*; *Praeglobutruncana* forms a minor component of the assemblages. The co-occurrence of *Thalmanninella micheli*, *Th. globotruncanoides*, *Th. greenhornensis*, *Rotalipora cushmani*, *R. montsalvensis* and *Praeglobotruncana gibba* without *Dicarinella algeriana* indicates the lower part of the *Rotalipora cushmani* Zone—the *Th. greenhornensis* Subzone (middle to lower upper Cenomanian).

The reddish facies at Aurachtal-Herbstau (ROTT 1 and ROTT 4 profiles) represents the CORB-phase and shows the typical reddish colouration of the “Buntmergelserie”. Planktonic foraminiferal assemblages from these profiles show moderate diversity but poorly preserved. Assemblages are dominated by *Marginotruncana* (common: *M. pseudolinneiana*, *M. coronata*, *M. marginata*, *M. renzi*; rare: *M. sigali*, *M. sinuosa*, *M. undulata*, *M. tarfayaensis*, *M. paraconcavata*, *M*. cf. *schneegansi*). The presence of *Archaeoglobigerina bosquensis* and *Macrohedbergella flandrini* and the absence of first representatives of *Globotruncana* indicate the *Marginotruncana schneegansi* and lower part of the *Dicarinella concavata* Zones in the ROTT 1 and ROTT 4 profiles. However, a lack of *Dicarinella concavata* does not facilitate to place the boundary between the two zones. According to planktonic Foraminifera, the ROTT 1 and ROTT 4 profiles represent upper Turonian–lower Coniacian strata.

Calcareous nannofossils are generally badly preserved and show strong recrystallization. However, several marker species could be found. In the grey facies of SAG 1 we recorded the presence of *Corollithion kennedyi, Cretarhabdus striatus* and *Lithraphidites pseudoquadratus* indicating nannofossil zones UC1–UC4, most probably the higher part of UC1 of middle Cenomanian age. The red facies of ROTT 1 and ROTT 4 yielded biostratigraphic marker species such as *Eiffellithus eximius, Lithastrinus septenarius, Marthasterites furcatus,* and higher up in the sections in addition rare *Micula staurophora* and *Lithastrinus grillii.* These markers indicate nannofossil zones UC9 and UC10, and thus late Turonian to middle Coniacian ages.

New structurally preserved seed cones of *Pityostrobus* from the Lower Cretaceous of Northwestern China and its evolutionary significance

Dong, C.[1,*]***, Wang, Yongdong***[1]***, Sun, B.***[2]***, Du, Baoxia***[2]

*1) Nanjing Insititute of Geology and Palaeontology, Chinese Academy of Science, Nanjing, China, *E mail: cdong@nigpas.ac.cn*
2) School of Earth Sciences and Key Laboratory of Mineral Resources in Western China (Gansu Province), Lanzhou University, Lanzhou, China

A new structurally preserved conifer seed cone is investigated from the Lower Cretaceous of Jiuquan Basin in Northwestern China, and could be systematically assigned to *Pityostrobus yumenensis* sp. nov., belonging to Pinaceae. The cones are large (>12 cm), cylindrical, with well-developed helically arranged bracts and ovuliferous scales, which are both thinning distally. Cone axis has a prominent parenchyma surrounded by numerous small cauline bundles and traces. The cortex is constructed by thin-walled parenchyma which is differentiated into an inner zone of light-colored cells and an outer zone of dark cells. Numerous resin canals occur throughout the cortex. Vascular traces to the ovuliferous scales and bracts diverge separately from the vascular cylinder and accompanied by a single resin canal from the pith that is pointed between the arms of the horse-shaped ovuliferous scale trace. The bract trace is diverging as a terete bundle, subtending two small traces to ovuliferous scale. Bracts and scales separate from each other. Two inverted seeds, about 5 mm long and 3 mm wide, are adaxially attached to each ovuliferous scale. A phylogenetic analysis using morphological data from the ovulate cones of extant and fossil taxa of Pinaceae was undertaken to assess the phylogenetic position of the present new species within Pinaceae. *P. yumenensis* appears to be most closely related to the Jurassic pinaceous *Eathiestrobus mackenziei* from the Scotland, *P. hokodzensis* from the Lower Cretaceous of Russia, and *P. californiensis* from the Lower Cretaceous of North America. These seed cones provide further evidence that the pinaceous conifer were undergoing a rapid Cretaceous radiation.

Polar ice sheets during the warm Cretaceous? Insights from coupled numerical modelling

Donnadieu, Y.[1,*] ***and Ladant, J.-B.***[2]

*1) CNRS - CEREGE, Aix/Provence, France, *E-mail: donnadieu@cerege.fr*
2) LSCE - CNRS, Gif/Yvette, France

Most proxy estimates of Cretaceous climates reveal oceanic and terrestrial temperatures substantially warmer than modern's. Fossils of crocodilian species and remains of what is now low-latitude flora have been unearthed in polar locations. On top of that, direct evidence of polar ice sheets have yet to be found. The Cretaceous has thus historically been considered as a long and stable period of supergreenhouse with elevated CO_2 levels. For a couple of decades however, studies have suggested that dynamical climatic variations affect the Cretaceous greenhouse, in particular with the episodic growth of ephemeral polar ice sheets, for which indirect evidence have been argued for. In addition, new estimates of CO_2 levels suggest more modest values (400–1500 ppm), potentially in the range of those in place during Cenozoic glaciations. Here, we use a suite of models of climate and ice sheets to investigate the impact of the changing palaeogeography during the Middle-Late Cretaceous (120–70 Ma) on the development of ice sheets on polar latitudes. We show that palaeogeography alone, through a series of complex feedbacks, has the potential to significantly alter the CO_2 threshold for the onset of ice sheets, nucleating in particular at higher CO_2 concentrations in the Aptian (~115 Ma) and the Maastrichtian (~70 Ma) than in the Cenomanian–Turonian (~95 Ma). Our simulations demonstrate notably that part of the Cenomanian–Turonian climatic optimum can be explained by its specific palaeogeography and support the vision of an ice-free Earth during this stage. In addition, our numerical work derives Aptian and Maastrichtian glacial CO_2 threshold that are in the range of latest data compilations, thus adding to the growing body of evidence suggesting that ice sheets were once present during these stages.

Middle Cretaceous climate and *p*CO_2 estimates of Liupanshan Basin in the hinterland of China

***Du, Baoxia*[1,*], Lei, X.[1], Sun, B.[1], Dai, S.[2]**

*1) Key Laboratory of Mineral Resources in Western China (Gansu Province) and School of Earth Science, Lanzhou University, Lanzhou, China, *E-mail: dubx@lzu.edu.cn*
2) College of Earth Environmental Sciences, Lanzhou Unversity, Lanzhou, China

The extinct conifer family Cheirolepidiacea, especially *Pseudofrenelopsis* are commonly used to reconstruct the atmospheric palaeo-CO_2 concentration during the Cretaceous period. In recent years, many *Pseudofrenelopsis* specimens were collected from the uppermost of the Naijiahe Formation in the Liupanshan Basin, Ningxia Hui Autonomous Region, NW China. The stomatal parameters (stomatal density and stomatal index) of the present *Pseudofrenelopsis* were analyzed to recover the middle Cretaceous atmospheric CO_2 levels. Based on the statistic stomatal data, the palaeo-atmospheric CO_2 concentrations in the Liupanshan Basin during the middle Cretaceous were estimated. Two standardizations are used (the recent standardization and the Carboniferous standardization) to reconstruct the ancient atmospheric CO_2 concentrations in the study area. Using the recent standardization the palaeo-atmospheric CO_2 concentrations in the Liupanshan Basin during the middle Cretaceous was 549–660 ppmv, compared to 915–1099 ppmv based on the carboniferous standardization. Furthermore, the palynoflora of the fossil-bearing layers is dominated by *Classopollis*, with up to more than 70 %. For further analysis of the palaeo-environmental conditions of the Liupanshan Basin during the middle Cretaceous, the stable carbon isotope compositions of *Pseudofrenelopsis* was analyzed. It ranges from -21.5‰ to -23.1‰, with an average of -22.5‰, indicating that the climate was extremely dry and hot during the middle Cretaceous in Liupanshan Basin, which is also supported by palynological, lithological and geochemical evidence.

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An integrated study (benthic and planktonic foraminifera, calcareous nannofossils, crinoids, stable carbon isotopes and magnetic polarities) across the Santonian/Campanian boundary at Bocieniec, southern Poland: A new GSSP Candidate for the Base of the Campanian Stage

Dubicka, Z.[1,*], ***Jurkowska, A.***[2], ***Thibault, N.***[3], ***Razmjooei, M.J.***[3], ***Szaniawski, R.***[4], ***Gorzelak, P.***[5], ***Felisiak, I.***[2]

*1) University of Warsaw, Faculty of Geology, Warszawa, Poland, *E-mail: z.dubicka@uw.edu.pl*
2) AGH University of Science and Technology, Kraków, Poland
3) University of Copenhagen, Copenhagen, Denmark
4) Institute of Geophysics, Warszawa, Poland
5) Institute of Paleobiology, Warsaw, Poland

The integrated biostratigraphic, chemostratigraphic and magnetostratigraphic study of the Bocieniec section is presented. The section is well exposed in an easily accessible abandoned quarry in the Laski Dworskie village (southern Poland). It represents a sedimentary record of the Santonian-Campanian interval of the Miechów Synclinorium deposited in the south-central part of the Late Cretaceous European Basin. The section is 5.5-meter thick, continuous and characterised by lithologically monotonous marls and siliceous chalk with no evidence of significant diagenetic alteration, nor any sedimentary or tectonic disturbance. Well-preserved stratigraphically relevant fossil groups such as planktonic and benthic foraminifera, calcareous nannofossils, belemnites, and echinoderms are recorded including the crinoid species Marsupites testudinarius which is the preferred boundary-marker fossil for determining the base of the Campanian Stage. Primary stable isotope signatures with the presence of the Santonian/Campanian boundary positive excursion (SCBE) as well as palaeomagnetic signal are detectable. Due to the array of stratigraphic events recorded at Bocieniec, this new section enables a straightforward correlation with other international reference sections for the basal Campanian of the Boreal and Tethyan realms: Seaford Head (southern England), Lägerdorf (northwestern Germany), Waxahachie Dam Spillway (Texas) and Gubbio (Italy). However, in contrast to any of the aforementioned sections, Bocieniec presents the whole suit of the main biostratigraphic, chemostratigraphic and magnetostratigraphic criteria of the Santonian-Campanian boundary. As it also appears continuous and contains well-preserved macrofauna, microfauna and microflora, Bocieniec should be considered as a new GSSP candidate for the base of the Campanian Stage.

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Depositional Facies, Carbon and Oxygen Isotope Records and Sequence Stratigraphy of the Coniacian–Santonian Matulla Formation, West Central Sinai, Egypt

El Belasy, A.[1,*]***, Grammer, G.M.***[2]***, Genedi, A.***[1]***, Anan, T.***[1]***, Wanas, H.***[3]

*1) Department of Geology, Mansoura University, Mansoura City, Dakahlia Governorate, Egypt, Egypt, *E-mail: elbelassy@mans.edu.eg*
2) Boone Pickens School of Geology Oklahoma State University, Stillwater, USA
3) Department of Geology, Menoufia University, Shebin El-Kom, Menoufia, Egypt

Four outcrops of the Coniacian-Santonian Matulla Formation in west central Sinai were studied to determine facies associations and depositional environments within a sequence stratigraphic framework and to evaluate C/O isotopic signatures to compare with global events. The Matulla Formation is composed of wave and tide influenced mixed siliciclastic-carbonates with ironstone interbeds. Deposition took place in coastal and shallow marine environments on a mixed siliciclastic-carbonate ramp. Three 3rd order depositional sequences made of up higher frequency 4th and 5th order sequences and cycles have been identified. The limestone, marl, dolostone and calcareous sandstone of the Matulla Formation have been investigated for their carbon and oxygen isotopic signatures. The results showed that, despite the locally pronounced effect of diagenesis, that there are major positive $\delta^{13}C$ excursions especially in the lower part of the section (Coniacian) with a general pattern that appears to correlate to data from the English Chalk (JARVIS et al., 2006) and other reference sections (WENDLER, 2013). There is a pronounced positive $\delta^{13}C$ excursion at the uppermost Turonian in all the studied sections with $\delta^{13}C$ values ranging from +1.24‰ to +2.76‰. This is followed across the Turonian/Coniacian boundary by a remarkable decrease in the $\delta^{13}C$ at the base of the Coniacian in all the studied outcrops with $\delta^{13}C$ values ranging from +0.16‰ to +0.83‰. We propose that this change is very similar and may be equivalent to the change from the Hitchwood Event to the Navigation Event (JARVIS et al., 2006). The Santonian/Campanian boundary is characterized by a significant positive shift in the $\delta^{13}C$ excursion with an average $\delta^{13}C$ values of 2.58‰ which may also be equivalent to the Santonian/Campanian Boundary Event (JARVIS et al., 2006). Other regional and global signals may also be present. This study provides some of the highest resolution C/O isotopic data for the Coniacian–Santonian in Egypt in an attempt to provide a correlation tool and to enhance our understanding for the diagenetic history of the studied rocks.

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Early Maastrichtian palaeoecology of the chalk at Kronsmoor (Saturn quarry, northern Germany): an integrated approach

Engelke, J.[1,*]***, Linnert, C.***[2]***, Mutterlose, J.***[2]***, Wilmsen, M.***[1]

*1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, *E-mail: julia.engelke@senckenberg.de*
2) Institut für Geologie, Mineralogie und Geophysik, Ruhr Universität Bochum, Bochum, Germany

The Saturn quarry near Kronsmoor (northern Germany) offers an undisturbed section of upper Campanian to lower Maastrichtian chalks. The target interval of this study comprises the belemnite biozones of *Belemnella obtusa* and the lower–middle part of *B. sumensis* (lower Maastrichtian). The benthic body fossils of the section were studied based on a collection of more than 1,000 specimens. Two successive benthic macrofossil assemblages were recognised. The upper interval (*B. sumensis* Zone) shows an eight times higher macroinvertebrate abundance than the lower part (*B. obtusa* Zone) without apparent lithofacies changes (Engelke et al. 2016). In order to quantify the observed palaeoecological changes of the low-resolution body fossil study, 33 bulk samples of about 6 kg each were retrieved in a distance of 0.75 m. The fraction 500 µm–1 mm and >1 mm were picked, sorted and counted, the coarse size fraction also weighted. A diverse assemblage of bryozoans, foraminifers, shell fragments of brachiopods and bivalves, spines and test fragments of different echinoid taxa, parts of asteroids and ophiuroids, sponge debris, crinoids and small serpulids is present. Reduced abundances in the lower part and generally higher abundances in the upper part are recognised. The palaeoecological analysis of both datasets indicates different guilds, of which epifaunal suspension feeders (fixo-sessile and libero-sessile guilds), comprising ca. 50 % of the fauna in the lower interval, increase to a dominance of ca. 80 % in the upper interval, including a considerable proportion of rhynchonelliform brachiopods. The increasing abundance of the total benthic community of Kronsmoor and changes in the guild structure suggested a higher nutrient availability during the early Maastrichtian. However, there is no evidence of change in productivity in the overlying photic zone (calcareous nannofossil data; Linnert et al. 2016), a lateral input (upwelling) of nutrient-rich waters onto the shelf to fuel the benthic ecosystem has to be considered. This view is supported by records of contemporaneous changes in latest Cretaceous ocean circulation that followed the latest Campanian cooling event, inclusive of a southward spread of waters of intermediate depth from high-latitudes. Stable isotopes and geochemical proxies have been collected as well and will contribute to the understanding of the palaeoenvironmental change at Kronsmoor during the early Maastrichtian.

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Keeled planktic foraminifera in the Lower to Middle Cenomanian of the Boreal Cretaceous, North German Basin

***Erbacher, J.*[1,*], Bornemann, A.[1], Petrizzo, M.R.[2]**

1) Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, Germany,
**E-mail: jochen.erbacher@bgr.de*
2) Dipartimento di Scienze della Terra "A. Desio", Università degli Studi di Milano, Milano, Italy

Recent investigation of three new drill cores from the Cenomanian center of the North German Basin (core Anderten I, BORNEMANN et al., 2017) and two industrial cores Wunstorf 2011/2 and 2011/8) revealed a potentially complete composite Late Albian to Late Cenomanian succession. High-resolution bulk-rock $d^{13}C_{carb}$ data from these cores clearly document the positive excursions around the Albian-Cenomanian boundary and the Mid Cenomanian Event (MCE) 1 and 2.

Here we focus on the 130-m-thick interval between the Albian-Cenomanian boundary and MCE 1. While planktic foraminifera are present in all of the samples investigated, keeled forms (rotaliporids and praeglobtruncanids) almost only occur in distinct intervals. These intervals correlate well with sea-level highstand or maximum flooding zones (WILMSEN et al., 2003). The first level with abundant keeled forms correlates with the highstand of depositional sequence Ce II. Above MCE 1, during the sea-level highstand of sequence Ce IV, planktic foraminifera become dominant (P/B break, see CARTER & HART, 1977; and keeled planktic foraminifera are present throughout (WEISS, 1982). The observed sea-level control results in species ranges clearly differing from Tethyan standard planktic foraminiferal biozonation. E.g., the species *Thalmaninella globotruncanoides*, marker of the Albian-Cenomanian boundary, has its first appearance (FA) in the middle of the Lower Cenomanian; *Rotalipora montsalvensis*, a species with its Tethyan first occurrence in the Lower Cenomanian has its FA in the late Middle Cenomanian above MCE 1. Our results deliver new aspects to the discussion about the timing and depth of connections between Boreal and Tethyan basins. Furthermore, they put the chronostratigraphic interpretation of older Boreal planktic foraminiferal zonations into perspective.

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Climate change and planktonic foraminiferal evolution during the Late Cretaceous

Falzoni, F.[1,*]***, Petrizzo, M.R.***[1]***, Clarke, L.J.***[2]***, MacLeod, K.G.***[3]***, Jenkyns, H.C.***[4]

1) Dipartimento di Scienze della Terra "A. Desio", Università degli Studi di Milano, Milano, Italy,
**E-mail: francesca.falzoni@unimi.it*
2) School of Science and the Environment, Manchester Metropolitan University, Manchester, UK
3) Department of Geological Sciences, University of Missouri-Columbia, Columbia, USA
4) Department of Earth Sciences, University of Oxford, Oxford, UK

The Late Cretaceous greenhouse climate has been subjected to a number of studies with particular emphasis on the Cenomanian-Turonian and late Campanian–Maastrichtian intervals. By contrast, far less information is available for the Turonian–early Campanian, even though it encompasses the transition from the extreme warmth of the Cenomanian-Turonian greenhouse climate optimum to significant cooling throughout the early Campanian to Maastrichtian. This interval also includes a ~3 myr-long mid-Coniacian to mid-Santonian interval when planktonic foraminifera underwent a large-scale, but poorly understood, turnover. This variation in the assemblages was followed by the extinction of all pre-Campanian double-keeled taxa (*Marginotruncana* and *Dicarinella*) within the latest Santonian-earliest Campanian, whose cause(s) has/have never been established. This lack of understanding relates to the limited recovery of stratigraphically complete Turonian–early Campanian deep-sea records, as well as to the generally poor preservation of Turonian-lower Campanian microfossils from outcrop sections. Further uncertainty is introduced by the results of several studies that found the traditional morphology-based scheme for inferring Cretaceous planktonic foraminiferal paleoecology to be probably incorrect for many taxa (ABRAMOVICH et al., 2003; ANDO et al., 2010; FALZONI et al., 2013, 2014).

This study presents ~1350 $\delta^{18}O$ and $\delta^{13}C$ values of well-preserved benthic and planktonic foraminifera from the Exmouth Plateau off Australia (eastern Indian Ocean - ODP Leg 122, Hole 762C). These data provide: (i) the most continuous, highly resolved and stratigraphically well-constrained record of the long-term climate trend in the southern mid-latitudes during the Late Cretaceous, (ii) new information on the paleoecological preferences of planktonic foraminiferal taxa, and (iii) new insights on the mechanisms that controlled planktonic foraminiferal evolution.

The results indicate that the mid-Cretaceous climate optimum actually persisted until the mid-Santonian, while sea-surface cooling occurred from the mid-Santonian through the mid-Campanian, and short-term climatic variability dominated during the late Campanian–Maastrichtian (FALZONI et al., 2016). Moreover, our study suggests that whilst several keeled taxa (i.e., *Falsotruncana* and bi-convex *Dicarinella* species) were effectively deeper/cool dwellers, as recognized by the morphology model, many double-keeled species, for which few or no isotope data were previously available (umbilico-convex *Dicarinella*, most *Marginotruncana* and *Contusotruncana* species) yield an isotopic signature that suggests a shallower/warmer water-column habitat. Finally, we infer that the cause of Coniacian–Santonian turnover among planktonic foraminifera may have been the evolution of a temperature/salinity-tolerant genus (*Marginotruncana*) and the cause of the Santonian-early Campanian extinction of *Dicarinella* and *Marginotruncana* may have been surface-ocean cooling and competition with globotruncanids.

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Shell size measurements of the planktonic foraminiferal species *Rotalipora cushmani* and *Whiteinella brittonensis* across the Oceanic Anoxic Event 2 (middle Cretaceous)

Falzoni, F.[1,*]***, Valagussa, M.***[1]***, Petrizzo, M.R.***[1]

1) Dipartimento di Scienze della Terra "A. Desio", Università degli Studi di Milano, Milano, Italy,
**E-mail: francesca.falzoni@unimi.it*

Planktonic foraminiferal response to the latest Cenomanian–earliest Turonian Oceanic Anoxic Event (OAE) 2 has been estimated through quantitative analyses of assemblage composition in several sections all over the world. Despite the occurrence of anomalously dwarfed planktonic foraminiferal specimens is frequently signaled during the OAE 2 (e.g., KELLER et al., 2001; COCCIONI & LUCIANI, 2004; ELDERBAK et al., 2014), no studies include species-specific shell size measurements along a stratigraphically complete upper Cenomanian–lower Turonian record. Aim of this study is to test the relationship between selected biometric parameters of planktonic foraminiferal shells (number of chambers in the last whorl, height of the trochospire, maximum diameter) and present the first dataset of shell size variations of two planktonic foraminiferal species *Rotalipora cushmani* and *Whiteinella brittonensis* across the OAE 2 in three key-localities: 1) Eastbourne, Gun Gardens, UK (TSIKOS et al., 2004), 2) Clot Chevalier, SE France (FALZONI et al., 2016) and 3) Tarfaya, Core S57, Morocco (TSIKOS et al., 2004).

Results indicate that the maximum diameter crossing the proloculus is the most easily replicable methodology to estimate shell size variations of trochospiral planktonic foraminifera across key-stratigraphic intervals. Moreover, median values of the maximum diameter of the specimens measured fluctuate significantly from one sample to another, but general trends remain clear. Overall, our data do not support the occurrence of dwarfed specimens for the species analyzed; rather, we observe a general trend toward an increase in the shell size of *W. brittonensis* in all the sections studied. Interestingly, changes in the maximum diameter of *R. cushmani* at the onset of the OAE 2 follow reproducible patterns (an increase to the highest values followed by a sharp decrease) that appear synchronous at all localities, suggesting that common forces might have driven the shell size variations of this species slightly before its extinction.

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Reassessing planktonic foraminiferal biostratigraphy across the Cenomanian-Turonian boundary interval (middle Cretaceous)

***Falzoni, F.*[1,*], Petrizzo, M.R.[1], Caron, M.[2], Leckie, R.M.[3]**

1) Dipartimento di Scienze della Terra "A. Desio", Università degli Studi di Milano, Milano, Italy,
**E-mail: francesca.falzoni@unimi.it*
2) Department of Geosciences, University of Fribourg, Fribourg, Switzerland
3) Department of Geosciences, University of Massachusetts-Amherst, Amherst, USA

The upper Cenomanian–lower Turonian is a key-stratigraphic interval, as it includes the mid-Cretaceous maximum greenhouse phase and a major perturbation of the global carbon cycle (i.e, the Oceanic Anoxic Event 2) testified by a globally and synchronously registered positive carbon isotope excursion and by the deposition of organic-rich facies in open marine environments. A turnover in planktonic foraminiferal assemblages (extinction of single-keeled rotaliporids replaced by double-keeled dicarinellids and marginotruncanids) and in other marine organisms has been related to these environmental perturbations; however, the reconstruction of the cause and effect relationship between ecological forcing and organism response requires a highly-resolved chronostratigraphic framework.

The appearance and extinction levels of planktonic foraminiferal species represent a powerful tool to trace accurate intra- and supra-basinal correlations. However, bioevents cannot be assumed to be globally synchronous, because the stratigraphic and geographic distribution of each species is modulated by its ecological preferences. The aim of this study is to test the synchronicity and reliability of planktonic foraminiferal bioevents across the C-T boundary interval by correlating each bioevent to the carbon isotope profile. To perform this study, we have completed a highly-resolved biostratigraphic analysis of the European reference section for the C/T boundary at Eastbourne (UK), and of core S57 (Tarfaya, Morocco). The sequence of bioevents identified is compared to those recorded in other coeval sections (the GSSP section for the base of the Turonian at Rock Canyon, Pueblo, Colorado [KENNEDY et al., 2005]; wadi Bahloul, Tunisia [CARON et al., 2006]; Clot Chevalier [FALZONI et al., 2016] and Pont d'Issole [GROSHENY et al., 2006], SE France; Gongzha, Tibet [BOMOU et al., 2013]) that satisfy the condition of lacking major unconformities and of yielding a highly-resolved planktonic foraminiferal and $\delta^{13}C$ record.

Results indicate that the extinctions of *Thalmanninella deeckei*, *Thalmanninella greenhornensis*, *Rotalipora cushmani* and "*Globigerinelloides*" *bentonensis* in the latest Cenomanian are extremely reliable bioevents for correlation. Other promising lowest occurrences (LOs) that, however, need to be better constrained by bio- and chemostratigraphy include the LOs of *Praeglobotruncana oraviensis* and of *Marginotruncana schneegansi*, the latter event falling close to the C/T boundary. By contrast, other bioevents, including the LO of *Helvetoglobotruncana helvetica*, the LO of several *Dicarinella* species, as well as the '*Heterohelix* shift' appear to be diachronous. Although the stenotopic ecological behavior of these species might explain these results, we believe that evolutionary transition between species, different species concepts among authors, and rarity of the species might partially account for the discrepancies observed in the identification of extinction and appearance levels in the sections compared in this study.

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Sedimentary characteristics on the Jurassic/Cretaceous boundary in the Junggar Basin, Central Asia: Tectonic and climate implications

Fang, Y.[1,*]***, Wu, Chaodong***[2]***, Wang, Yizhe***[2]

1) *Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, *E-mail: ynfang@nigpas.ac.cn*
2) *Peking University, Beijing, China*

The Upper Jurassic–lower Cretaceous strata in the Junggar basin include the Qigu, Kalazha, and Qingshuihe formations in ascending order. By synthesizing outcrop and well data, we conducted a detailed sedimentologic and stratigraphic correlation analysis for the three formations. Our study shows that a sharp lithofacies change from intermittent braided-river red fine-grained sediments of the Qigu Formation to alluvial fan conglomerates of the Kalazha Formation, is widespread along the basin margins. From bottom to top, the Kalazha alluvial fan conglomerates can be divided into six sequences showing a progradation to retrogradation cycle, and they finally retrograde into the lake sediments of the lowermost Cretaceous Qingshuihe Formation. However, within the Junggar Basin, the Kalazha Formation is commonly considered to be absent and the Qingshuihe Formation possesses a basal fluvial coarse-grained sandstone bed (50–100 m), beneath which a widespread unconformity is observed. Stratigraphic correlation suggests that the alluvial fan conglomerates of the Kalazha Formation along the basin margins are equivalent to the basal sandstone bed of the Qingshuihe Formation within the basin. Finally, we conclude that progressive tectonic uplift and climate aridification occurred in the Junggar Basin during deposition of the Qigu Formation in the Late Jurassic, while the basin began to experience a relatively humid climate and underwent rapid subsidence during deposition of the Kalazha Formation in the latest Jurassic-earliest Cretaceous, probably driven by the far-field effects of the short-lived but significant Mongol-Okhotsk collisional orogeny.

Lower Cretaceous microbialite and encrusters; implication for lagoon-sea level oscillations under Milankovitch effects in NE-Iran

***Fateh-Bahari, L.*[1], *Mahmudy Gharaie, M.H.*[1,*], *Mahboubi, A.*[1], *Moussavi Harami, R.*[1]**

*1) Ferdowsi University of Mashhad, Mashhad, Iran, *E-mail: mahmudygharaie@gmail.com*

During the Early Cretaceous time, carbonate-siliciclastic sequences (Zard and Tirgan Formations) were widely deposited on shallow platforms of the west Kopet-Dagh basin in NE-Iran. Facies variations within the Lower Cretaceous deposits are interpreted as a transgressive succession that formed during the drowning of many Tethyan carbonate platforms. In addition, changes in fossil components associated with less terrigenous input during the transition from the deposition of Zard Formation (Hauterivian- Barremian in age) to Tirgan Formation (Barremian-Aptian in age) indicates that the initial microbialite community was replaced by the encrusters community. Periodical input of terrigenous sediments, interrupting the carbonate deposition of the Zard Formation, indicates that microbialite beds formed as a response to the decrease of terrigenous influx. Lagoonal environments during the deposition of the Zard Formation become more restricted with high nutrient concentration causing high primary productivity, which in turn reduced oxygen in the environment through bacterial decomposition of organic matter. Therefore, lagoons were changed to suitable environments for the formation of thrombolite-dominated microbialites. These periodical changes in the Tirgan Formation are associated with environmental fluctuations that are shown by changes in the taxonomic composition. The Existence of encrusters and micro-encrusted associations in some beds indicate open lagoonal conditions. Sea-level fluctuations played an important role in opening and closing the environments on the shallow platform. This is influenced by climatic changes affecting the rate of siliciclastics and nutrients influx, as well as the alkalinity of the water. Strong sea level fall led to restricted lagoonal conditions with high nutrient concentration inducing high primary productivity, which in turn leads to oxygen consumption through bacterial decomposition of organic matter. The resulting dysoxic to anoxic environment is suitable for the formation of pure thrombolite-dominated microbialites. The low-amplitude sea-level variations which are related to the precession (20-ky orbital cycles) could probably be influenced by opening and closing lagoons. Therefore, sea-level oscillation and climatic changes and consequently, the crises in growth of encrusters, are linked to orbital cycles in the Milankovitch frequency band.

Palaeoclimatic reconstruction of Maastrichtian oil shale deposition in the southern Tethyan realm, Egypt

Fathy, D.[1,2*]***, Wagreich, M.***[1]***, Gier, S.***[1]

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria
*2) Department of Geology, Minia University, Egypt, El-Minia, Egypt, *E-mail: douaafathy@mu.edu.eg*

Sedimentary records of climatic conditions and sea-level rise during the Late Cretaceous across the northeast African craton were examined based on integrated elemental geochemistry, clay mineralogy and biostratigraphy of three Maastrichtian oil shale (MOS) horizons from Egypt. The age of these horizons is constrained by nannofossil biostratigraphy. The Cretaceous oil shale beds accumulated in intracratonic sedimentary basins on the stable African shelf and occupied large-scale asymmetric syncline systems in the southern Eastern Desert of Egypt. These basins were formed due to deformation, structural differentiation and subsidence of the rigid cratonic African plate. The evolution of these basins was mainly controlled by a system of NW-trending faults. The Maastrichtian oil shales have slightly elevated Ga/Rb ratios (~ 0.4) that progressively increase upwards in the upper horizon (~ 0.8). Moreover, the average ratios of Rb/Sr are generally low (~ 0.03). The calculated C-value of the lower MOS horizons ranges from 0.05 to 0.79 and fluctuates between 0.07 and 0.16 in the upper MOS horizon. In addition, the average CIW and CIA values of the studied MOS samples are 87 % and 83 %, respectively. The MOS samples are specifically enriched in Sr and P and depleted in Mn. The studied intervals of MOS are characterized by the occurrence of warm water nannofossil taxa such as Lithraphidites quadratus and Micula sp. Mineralogical data proves the abundance of smectite within the lower MOS horizons and the prevalence of kaolinite in the upper MOS horizon. The MOS horizons are distinguished by a northward increasing carbonate/siliciclastic ratio (from 0.43 to 1.43) and an upwards increase in the upper horizon (up to 1.98). The occurrence of MOS beds is mainly assigned to a major Late Cretaceous transgression of the Tethyan Ocean. This marine transgression resulted in continuous deposition of clastics from the exposed Arabian-Nubian Shield basement rocks. We suggest that the deposition of MOS in the Eastern Desert of Egypt exemplifies warm greenhouse climate during a general cooling trend, with a transition from a cooler, seasonal fluctuating phase during the early Maastrichtian, to a warmer period at the early to late Maastrichtian transition, accompanied by a regional sea-level rise.

Aptian integrated micropaleontological study from the Brazilian Equatorial Margin (Pará-Maranhão Basin): biostratigraphic and paleoecologic interpretation

Fauth, G.[1,*]***, Krahl, G.***[2]***, Baecker Fauth, S.***[2]***, Bruno, M.D.R.***[2]***, Guerra, R. do M.***[2]***, Bergue, C.T.***[2]***,***
Aguiar, E. da S.[2]***, Santos, A. da S.***[2]***, Vieira, C.E.L.***[2]

*1) itt Fossil, Unisinos University, São Leopoldo, RS, Brazil, *E-mail: gersonf@unisinos.br*
2) UNISINOS University, São Leopoldo, RS, Brazil

The Brazilian Equatorial Margin (BEM) is a passive continental margin at equatorial latitudes and is composed by a well exposed Aptian section. This study presents a biostratigraphic and paleocological interpretation for the Aptian, based on the integration of some microfossils groups from a well drilled in the offshore portion of Pará-Maranhão Basin. In this well the late Aptian was recovered between 1.272 and 2.676 m, by the palynomorph zones *Sergipea variverrucata* and *Complicatisacus cearensis*. The planktic foraminifera zone *Paraticinella eubejaouaensis* and the last occurrence (LO) of the radiolarians *Hiscocapsa grutterinki* (1.344 m) and *Cryptamphorella clivosa* (2.109 m) corroborate this interpretation. According to the distribution pattern of palynomorphs and microfossils (calcareous and siliceous), it is possible to subdivide the late Aptian in three intervals: (i) basal (2.208–2.676 m) is represented by land palynomorphs, whose species richness increased to the top of the interval. The predominance of pollen grains on spores, while among the aquatic elements the presence of fresh or brackish water is greater than marine (dinoflagelate cists); (ii) medium (1.902–2.208 m) is similar to the basal, however there is a downward trend in the number of species. The limit between this interval (2.208–2.217 m) is characterized by the acme of land palynomorphs species found in the well and a punctual dinoflagelate cists disappearance; (iii) upper (1.272–1.902 m) is marked by the constant and consistent co-occurrence of planktic and benthic foraminifera, calcareous nannofossils and ostracods, with palynomorphs. Towards the top of the studied section, slightly below the Aptian/Albian boundary, the presence of radiolarians and a predominance of marine palynomorphs has been observed. Also in this interval it was described fluctuations in the proportion between the planktic and benthic foraminifera fauna, which may be related to low frequency oscillations of sea level in a marine context. The marine ostracods indicate typical neritic conditions. Among the radiolarians recovered, there is a predominance of the cryptocephalic forms, (resistant to dissolution). The integration based on different groups of microfossils for well ME-02, allowed a refined understanding of the paleoenvironmental evolution of the basin during the late Aptian.

Recognizing Lauraceae in Cretaceous assemblages from Mexico

***Flores Rocha, L.A.*[1], *<u>Cevallos Ferriz, S.R.S.</u>*[1,*], *Santa Catharina, A.*[2], *Kneller, B.*[2]**

*1) Instituto de Geología, Universidad Nacional Autónoma de México (UNAM), Mexico City, Mexico, *E-mail: scrscfpb@unam.mx*
2) Kings College, Aberdeen, UK

Plant megafossils collected from different localities in Northern Mexico have yielded leaves and woods that have characteristics suggestive of Lauraceae affinity. A wood sample from an Upper Cretaceous sequence close to El Rosario, Baja California, has distinct growth rings, diffuse porosity, alternate vestured intervascular pits, simple perforation plates, vessel ray pits similar to intervascular ones, scares paratracheal and marginal parenchyma, septet fibres, heterocellular rays and oil/mucilage cells associated with rays. These anatomical features are today found in *Alseodaphne*. From the Upper Cretaceous Cabullona Group, Sonora, a notophyllous, trilobate leaf with entire margin, acute apex, palmate actinodromous venation and secondary brochydodromous venation resembles those of *Sassafras*. From the Campanian/Maastrichtian flora of Coahuila 3 different leaf types have Lauraceae characters. Trilobated mesophyll leaves similar to those of Sonora are a common type; a second type resemble leaves of *Cinnamomum* and *Neolitsea* in being oblong, nothophyllous, and having entire margin, obtuse apex, subparallel actinodromous primary venation, and eucamptodromous secondary venation that becomes brochydodromous distally; leaf type 3 is notophyllous, ovate, and has acute apex, entire margin, actinodromous venation and brochydodromous secondary venation, resembling those of *Ocotea*, *Neolitsea* and *Nectandra*. The described plants suggest the family was an important component of the paleovegetation in transitional or near coastal areas, and that the family reached important morphological/anatomical diversity early in their lineage history, but it is necessary to understand how this diversity defines taxa through whole plant reconstructions.

Early Cretaceous climate, anoxia and sea-level change

***Föllmi, K.*[1]**

1) Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland, E-mail:-karl.foellmi@unil.ch

The Early Cretaceous environment was strongly influenced by the break up of Pangea leading to both increased seafloor spreading and volcanic activity, as well as the formation of epicontinental rift basins. These processes were important for the development of Early Cretaceous climate and the associated hydrological cycle. Predominantly arid conditions are postulated for the early Berriasian, the late Barremian, and partly also the late Aptian. Predominantly humid conditions, likely linked with intensified greenhouse conditions, were important during the shorter episodes of important environmental change during the Valanginian, the late Hauterivian, the early Aptian, the early late Aptian, and the late Aptian to early Albian. Arid conditions went along with increased evaporation, lower biogeochemical weathering rates, and lower nutrient fluxes. Humid conditions triggered elevated biogeochemical weathering rates and nutrient fluxes, important runoff and the buildup of freshwater lids in proximal basins, intensified oceanic and atmospheric circulation, widespread upwelling and phosphogenesis, important primary productivity and enhanced preservation of organic matter in expanded oxygen-minimum zones. Negative feedback on the global carbon cycle and climate through increased marine organic matter preservation was less important than organic burial on the continent during the Early Cretaceous. The transition of arid to humid climates went along with the net transfer of water to the continent due to the infill of dried-out groundwater reservoirs in internally drained inland basins. This resulted in fluctuations in sea level, which are independent from the presence or absence of ice. These sea-level changes and the influx of freshwater into the ocean may have influenced marine oxygen-isotope signatures und suggest that this proxy can not be translated one-to-one into sea-surface water temperature.

The Eagle Ford Group at the surface: a palynostratigraphic and palaeoenvironmental framework for the Cenomanian - Turonian in South Texas

Forshaw, J.[1,*]***, Jarvis, I.***[2]***, Gröcke, D.***[3]***, Pearce, M.***[4]***, Tocher, B.***[5]

*1) Kingston University, London, UK, *E-mail: Jolineuk@hotmail.com*
2) Kingston University, Kingston upon Thames, UK
3) Durham University, Durham, UK
4) Evolution Applied Limited, Lechlade, UK
5) Statoil Limited, Houston, Texas, USA

Episodic black shale deposition is observed throughout the Cretaceous, with one of the most distinct intervals being Oceanic Anoxic Event 2 (OAE 2) at the Cenomanian-Turonian Boundary (93.9 Ma), spanning ~500 kyr (JARVIS et al., 2015). Late Cretaceous black shale deposition is confined to OAE2 in most places, but it is stratigraphically much more extensive in areas of the SW proto-North Atlantic, particularly in northern Venezuela (Maracaibo and Eastern Venezuela Basins) and offshore Suriname (Demerara Rise), where black shales extend continuously from the Upper Albian to Santonian. Similarly, in the US Gulf Coast region, the Cenomanian–Coniacian Eagle Ford Shale of South Texas consists of organic-rich carbonate mudstones with total organic carbon (TOC) contents locally exceeding 10 wt%. These high TOC mudrocks make the Eagle Ford Group an ideal unconventional hydrocarbon reservoir and much work has been carried out in the last decade to determine the heterogeneous nature of the deposit. The Lozier's Canyon outcrop in Tyrrell County, West Texas, was studied in detail by DONOVAN et al. (2012) to characterise the individual facies and stratigraphy within the Eagle Ford Group. The objective was to develop a surface stratigraphic framework to help correlate the subsurface stratigraphy in future exploration.

Antonio Canyon is a tributary to Lozier's Canyon located 5 miles (8 km) to the southwest, on the border of Val Verde County. This locality provides a unique opportunity to study bedding surfaces obscured at other locations, and to determine horizontal heterogeneities and lateral changes in depositional environment (GARDNER et al., 2013). The stratigraphic framework developed by DONOVAN et al. (2012) at Lozier's Canyon has been applied to constrain lithological correlations with high confidence. In this study we have used palynological correlation to calibrate dinoflagellate cyst markers and to assimilate these into the existing framework setup by DODSWORTH (2015) in Lozier's Canyon. Palynomorph assemblages are dominated by green algal prasinophyte phycomata in the lower parts of the Eagle Ford, and peridinioid dinoflagellate cysts in the upper parts. We document the presence of diverse dinoflagellate cyst assemblages, including inter-regional (high- to mid-latitude) marker events. Additionally, elemental and isotopic geochemical results obtained from Antonio Canyon are integrated with published data to establish a robust outcrop-based biostratigraphic / chemostratigraphic framework for future subsurface work.

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The Eagle Ford Subsurface: from the depths to the shallows in Cenomanian–Turonian palynology

***Forshaw, J.*[1,*], *Jarvis, I.*[2], *Gröcke, D.*[3], *Pearce, M.*[4], *Tocher, B.*[5]**

*1) Kingston University, London, UK, *E-mail: Jolineuk@hotmail.com*
2) Kingston University, Kingston upon Thames, UK
3) Durham University, Durham, UK
4) Evolution Applied Limited, Lechlade, UK
5) Statoil Limited, Houston, Texas, USA

The Eagle Ford Group is a carbonate and siliciclastic deposit in Texas, United States. With high Total Organic Carbon (TOC) contents locally exceeding 10 wt%, it is an ideal unconventional shale gas reservoir with a vast expanse of more than 600 miles. However, the Eagle Ford Shale in extremely heterogeneous in nature, and a detailed stratigraphic framework is required for inter-well correlation in the subsurface. Over the last decade, extensive study of the Eagle Ford Shale has taken place at both the surface, in outcrops, and in the subsurface through core material (e.g. GARDNER et al., 2013; DONOVAN et al., 2015). Workers have tried to produce a robust facies, lithostratigraphic, chemostratigraphic, chronostratigraphic and biostratigraphic framework that can be applied throughout the deposit. With the distinctive chronostratigraphic units now in place, it is possible to correlate core material in the subsurface across considerable sections of the Eagle Ford Group.

The extent of the Eagle Ford Group and variations in its thickness and stratigraphy are in large part constrained by regional tectonic features, including the Maverick Basin, the San Marcos Arch, the Stuart City and Sligo Shelf margin, and the East Texas Basin. The Eagle Ford is thickest in the Maverick Basin on the Mexican border, and thins northeastwards to a minimum in the San Marcos Arch region, east of San Antonio. Building upon the foundations established at outcrop by DODSWORTH (2015), in this study we have utilised dinoflagellate cyst markers as a tool in the subsurface to produce a complete facies transect, correlating core material across the whole of the Maverick Basin. We have endeavoured to create a sound biostratigraphic framework and palaeoenvironmental reconstruction of the Maverick Basin during the Cenomanian–Turonian.

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The discontinuous Lower Cretaceous of Northeast Germany: Late Cimmerian Unconformity or Early Cretaceous pre-inversion?

Franke, S.[1,*] ***and Franz, M.***[1]

*1) Universität Göttingen, Göttingen, Germany, *E-mail: sfranke@gwdg.de*

In Northeast Germany, the disconformable contact between the Cretaceous base and the truncated Jurassic top is referred to as Late Cimmerian Unconformity (ZIEGLER, 1990). Above this unconformity, Lower Cretaceous successions are discontinuous followed by mainly continuous Upper Cretaceous successions. Wealden type sediments (Bückeberg Group) of up to 360 m thickness are only present in narrow ENE-WSW to NE-SW oriented, isolated grabens at the Darß and the islands of Rügen and Usedom. Facies analysis of these successions revealed wetlands of a wide-spread delta plain; a marine influence up to Usedom is testified by marine phytoplankton. Based on palynology, these Wealden type sediments can be correlated with the Wealden A-E of Southwest Mecklenburg dated to the Berriasian (DÖRING et al., 1969). With a sharp and disconformable base, up to 15 m thick carboniferous to glauconitic shaly sandstones of clastic shelf environments follow. These transgressive sediments are dated to the Upper Hauterivian based on marine micro- and macrofauna. In contrast to the Berriasian and Upper Hauterivian successions, which are only present in grabens, up to 60 m thick whitish to reddish marls of carbonate shelf environments dated to the Aptian to Albian occur widespread in Northeast Germany. The Aptian to Albian succession disconformably follows Upper Hauterivian sandstones in the grabens, but forms the Cretaceous base outside the grabens. With a sharp and disconformable base, the Upper Cretaceous occurs widespread in Northeast Germany. Upper Cretaceous successions are between 150 m (Darß) and 1.100 m thick (NE of Rügen) and predominantly formed of pelagic limestones, chalks and chalky marls.

Sedimentology, stratigraphy and structural geology of the discontinuous Lower Cretaceous in Northeast Germany points to: (1) The Berriasian and Upper Hauterivian successions, today only present in grabens, represent remnants of a wide-spread sedimentary cover. (2) Thus, the graben fills were part of a larger sedimentary basin, most probably the North Sea Basin. They do not represent isolated smaller basins as previously assumed (VOIGT et al., 2008). (3) Syn- to post-sedimentary graben formation prevented the Berriasian and Upper Hauterivian successions from erosion. (4) Outside the grabens, more than 400 m of Berriasian to Barremian sediments were eroded. (5) So far, a pre-Hauterivian phase and pre-Aptian phase of graben formation and wide-spread erosion are identified. (6) These phases represent either descendant phases of the Late Cimmerian Unconformity or ascendant phases of the Late Cretaceous inversion, herein referred to as Early Cretaceous pre-inversion.

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Evolution of the oceanic circulation on the southern Tethyan margin during the Late Cretaceous

***Freslon, N.**[1,*], Pucéat, E.[1], Abramovich, S.[2], Ashckenazi-Polivoda, S.[3], Cappetta, H.[4], Deconinck, J.-F.[1], Pellenard, P.[1], Thomazo, C.[1], Chenot, E.[1]*

1) Université de Bourgogne-Franche-Comté - UMR 6282 Biogéosciences, Dijon, France,
**E-mail: nicolas.freslon.ub@gmail.com*
2) Dept. of Geological and Environmental Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel
3) Dead Sea and Arava Science Center, Dead-Sea, Israel
4) Institut des Sciences de l'Evolution de Montpellier - UMR CNRS 5554, Montpellier, France

Within the Late Cretaceous, the Campanian-Maastrichtian interval is marked by the occurrence of large deposits of phosphorites and organic-rich sediments on the southern Tethyan margin (GLENN et al., 1994). The occurrence of these deposits has been largely attributed to the development of upwelling regimes, possibly linked to an intensification of the Tethyan Circumglobal Current (TCC; e.g. ALMOGI-LABIN ET AL., 1993; SOUDRY et al., 2006; PUCÉAT et al., 2005). Yet there is currently no direct evidences of the prevailing of this upwelling regime, apart from tracers of a high primary productivity regime (ASHCKENAZI-POLIVODA et al., 2011 and references therein). In this context, our study aims to track changes in water masses on an area of the southern Tethyan margin that recorded phosphorites, organic-rich deposits, and high productivity microfossil assem-blages, through the evolution of local seawater neodymium isotope composition (ε_{Nd}).

To that purpose, we have collected fish teeth from 25 different levels within the Turonian to Maastrichtian interval on the Levant Platform in the modern Negev desert of Israel. The fish teeth have been analyzed for their ε_{Nd} and rare earth element (REE) composition, along with 32 carbonate leachates from a core drilled in southern Israel (Mishor Rotem, RE-6 core). REE composition and ε_{Nd} of the detrital clay-size fraction of RE-6 core sediments have additionally been determined. The carbonate leachates yield similar ε_{Nd} values and trend than those displayed by the fish teeth from the Negev, pointing to a local seawater origin for both records. The new data highlight a decrease in local seawater ε_{Nd} from quite radiogenic values of about -3.5 ε-units in the Coniacian to minimum values of -6.5 ε-units in the Early Campanian. Local seawater Nd isotope values then increase prior to the main phosphorite unit to reach a maximum of -4 ε-units within the phosphorite level, and then decreased again down to -6 ε-units in the Maastrichtian. By contrast, ε_{Nd} values of the detrital fraction of the sediment are much less radiogenic, ranging from -11 to -6 ε-units, which points to a conservation of an oceanographic signal in the local seawater ε_{Nd} record, at least partially. The origin of the variations depicted in the local seawater εNd record is then discussed: oceanographic or linked to local changes in the composition of the nearby eroded material.

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Outcrop based γ-ray measurements and detailed facies analyses of the Natih Fm in Jabel Akdhar area of Oman: a powerful tool for improving surface to sub-surface correlation

Frijia, G.[1]

1) Sultan Quaabos University, Muscat, Oman, E-mail: gfrijia@libero.it

The upper Albian to Lower Turonian Natih Fm. of Oman (and equivalent stratigraphic units in the Arabian Peninsula) is one of the most studied, prolific source rock interval and hydrocarbon reservoirs of the country. It rests conformably on the carbonate/clastic Nahr Umr Fm. whereas its top is marked by a large regional unconformity, the base Aruma unconformity. This latter developed due to the extensive erosion during the mid Turonian caused by the bulging of the continental lithosphere associated with SW-ward obduction of the Oman ophiolites. The Natih Fm. is overlain by the Muti Fm which represents the infill of the foreland basin derived from the eroded Natih Fm. starting in the Late Turonian. Beside this major unconformity the deposition of the Natih Fm. was interrupted several times by subaerial exposures with emersion and incision. All these erosional events caused locally different stratigraphic patterns making often problematic a precise correlation of the Formation from East to West and from subsurface to surface.

The Natih Fm. has been generally subdivided by petroleum geologists in seven informal members (g to a, from bottom to top) based on cores and on characteristics patter of gamma-ray and density log curves. The adaptation of this subsurface nomenclature into surface lithostratigraphic “members” is extensively used mainly because of the need to study outcrop sections as analogues of the subsurface. However, correlations among members are not quite straight forward. Significant heterogeneity in platform growth associated to complex diachronous infill of accommodation and erosional episodes can be found from East to West of northern Oman. Furthermore, the lithological properties and boundaries of these members can locally be very confusing and a rock outcrop-comprehensive description of them is still lacking thus hampering a precise comparison with well data.

The aim of the study is to build high resolution outcrop-based γ-ray profiles throughout Natih Fm. members e to a, anchored to detailed facies analyses. The studied sections are located in the southern part of the Jabel Akdhar area and represent an ideal transect from platform top to intrashelf setting. The obtained γ-ray curves will serve as reference curves for the Natih Fm. is surface sections. We will show how detailed outcrop γ-ray measurements allow for high-resolution correlation with subsurface data. We will also show how local sedimentary variations in the studied members can be easily detected and we will discuss the possible reasons. Finally, we will precise/refine the definition of the “informal” Natih members.

Paleo-temperature and C-isotopes records derived from bivalves shells across the OAE-2 in the shallow water carbonates of the Apennine Platform of Italy: Local or global signal?

***Frijia, G.*[1], Forkner, R.[2], Jekel, D.**

1) Sultan Quaabos University, Muscat, Oman, E-mail: gfrijia@libero.it
2) Statoil, Austin, USA

Oceanic Anoxic Event 2 (OAE-2), spanning the Cenomanian-Turonian boundary, represents a major perturbation of the global carbon cycle with an extensive deposition of organic-carbon rich deposits (black shales) in ocean basins worldwide. A number of studies have suggested, as potential trigger mechanism of the OAE-2, enhanced volcanic activity at mid oceanic ridges and large igneous province (LIP) eruptions. These phenomena would have led to CO_2 degassing and a consequent dramatic increase in temperature. Several studies showed that Late Cenomanian-Early Turonian SSTs were the warmest in the Cretaceous Greenhouse period and much warmer than today. The onset of the OAE-2 was characterized by a rapid increase in the SST during very short time. However, in this general picture of warm regime during the OAE-2 a brief cooling episode has been reported, potentially related to atmospheric pCO_2 drawdown. Up to date the reconstructed paleotemperature records come from deep water deposits, mainly, from the proto-Atlantic Ocean. Furthermore, whilst the sedimentological, geochemical and paleontological aspects of deep water expressions of OAE-2 have been intensively studied in the last few decades, much less attention has been put on the coeval shallow water deposits.

The Campanian Apenninic Platform (Italy) preserves a record of shallow-water carbonates through the OAE-2, offering the unique opportunity of looking at a continuous archive of paleoenvironmental changes at tropical latitude, in the Tethys ocean, far from the influence of large continental blocks. Here we present the first continuous high-resolution record of temperature changes across the OAE-2, based on bivalves O-isotopes together with C-isotopes stratigraphy performed on the same shells. This latter were used to establish the time-framework corresponding to OAE-2 helping to precisely tie the onset of the event which was, otherwise, masked by diagenesis in the bulk-derived C-isotope curve.

The study is completed with a detailed facies analysis which allows to discuss the factors influencing facies changes and isotopic trends in the context of local Vs global processes associated to the OAE-2. We will show that Paleo-temperature trend in the platform carbonates of the Tethys is comparable, during the OAE-2, to that observed in the open proto-Atlantic Ocean sites thus opening new interesting possibilities to the understanding/modeling of oceanic circulation and heat transport during the event. Finally, we will demonstrate how the Campanian Platform, during the OAE-2, experienced dramatic facies/biotic changes which represented an ecological response of the system to temperature and others paleoenvironmental variations.

Cyclostratigraphic, lithological-geochemical and paleoecological characteristics of the sedimentation within Mountainous Crimea in Maastrichtian age

Gabdullin, R. [1]

1) Lomonosov Moscow State University, Moscow, Russia, E-mail: gabdullin@fgp.msu.ru

Conditions of sedimentation on the Southern edge of the Tethys Ocean based on a complex comprehensive study of Maastrichtian deposits in four sections in Bahchisaray area (Staroselye, Besh-Kosh, Chakh-Makhly and Tokma) and two sections in the Sevastopol area (Maloye Sadovoye, Tankovoye) were detailed. The model of variations of temperature, salinity and depth to the peripheral part of the Tethys Ocean in Maastrichtian age was proposed. A detailed study of the nature of bedding cyclicity for part of the section, containing sponge and non-sponge beds showed that, as a rule, the beginning (base) of sponge horizons coincide to relative warming, deepening and / or possible weakening of terrigenous input and salinity increase of the Tethyan waters, and their end (tor) corresponds to relative cooling, relative shallowing and/or increase of the terrigenous input and decrease of salinity at the Tethys Ocean. In general, during the Maastrichtian Age the temperature of ocean water increases from 14,6°C at the beginning of the Age to 37,5°C at the end. Transgression was accompanied by an increase in salinity ocean waters (up to 30 ‰), and regression – decreasing salinity (up to 12–24 ‰). Mineral composition and salinity change could affect sufficiently above $\delta^{18}O$ distribution that resulted in the anomaly high temperature (37,5°C) calculated for the end of the Maastrichtian Age. On the basis of available data on Staroselye, Besh-Kosh and Maloye Sadovoye sections the composite regional curves of $\delta^{18}O$ and $\delta^{13}C$ variations were compiled. Comparing these curves with curves of $\delta^{18}O$ and $\delta^{13}C$ fluctuations for section of Mullinex-1 site (Texas, USA [Keller et al., 2009]) we obtained a good hemostratigraphic correlation, which allows to determine the stratigraphic position of the level of Chicxulub impact and Deccan trapps events at the end of the Maastrichtian in the sections of the Mountain Crimea, as well as conduct hemostratigraphic correlation of sections of the Crimean Mountains with ones from other regions.

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Towards a formally defined Campanian Stage: correlations, potential GSSPs and boundary markers

Gale, A.[1]

1) University of Portsmouth, Portsmouth, UK, E-mail: andy.gale@port.ac.uk

The criterion for definition of the base of the Campanian remains problematical. In the 1984 Cretaceous Stage boundaries symposium (Copenhagen, Denmark) numerous fossil markers for the base of the stage were suggested, included the extinction of the crinoid *Marsupites*, the last occurrence of *Dicarinella asymetrica* (i.e. the base of the *Globotruncanita elevata* Zone), the first occurrence of *Aspidolithus* (now *Broinsonia*) parcus. In recent practice, workers in Boreal chalks have tended to use the *Marsupites* extinction as an informal boundary marker, whereas Tethyan workers have used the *D. asymetrica* extinction to mark the base of the Campanian. The Geological Timescale 2012 took the base of Chron 33R to mark the base of the stage; this is known to occur close to the LO of *D. asymetrica* and the FO of *Broinsonia parca expansa* from the Bottacione Gorge, Gubbio and Austria. What was not clear, however, was the correlation between the Tethyan micropalaeontological datums and the *Marsupites* extinction. This is now made possible using the $^{13}C_{carb}$ called the δ distinctive double positive excursion in "Santonian-Campanian Boundary Event", which has now been found in the UK, northern Germany and Gubbio, Italy, and demonstrates that the extinction of *Marsupites* falls a little beneath the top of Chron 33N. It is proposed that the reversal is taken as a boundary marker in the Bottacione Gorge (GSSP), with secondary markers including the Santonian-Campanian Boundary Event, planktonic forams (extinction of *D. asymetrica*) and the FO of various *Broinsonia* spp. and sspp. Correlation of the Santonian–Campanian boundary is further confused by the widespread presence of an hiatus, often of large magnitude (millions of years), close to or at the base of the Campanian as here defined. This is present across the Gulf Coast of the USA, and has been found widely in the Anglo-Paris Basin, and Western Australia. Because this hiatus truncates the top of Chron 33N and the range of *Dicarinella asymetrica*, and because the *Globotruncanita elevata* Zone is so long (c. 4 myr), sections can have a 3 million + year gap, but still be biostratigraphically "complete".

A microcrinoid zonation for the Late Cenomanian–Campanian interval – Chalk Group, Anglo-Paris Basin, and its potential for global correlation

Gale, A.[1]

1) University of Portsmouth, Portsmouth, UK, E-mail: andy.gale@port.ac.uk

Microcrinoid remains, mostly comprising isolated ossicles belonging to the pelagic order Roveacrinida, are often abundant in chalk facies residues, but have previously been largely ignored or overlooked by micropalaeontologists. Detailed sampling and processing of the Late Cenomanian–Campanian interval in the Anglo-Paris Basin (northern France, southern England) has yielded over 50 species of Roveacrinida, most of which are undescribed forms belonging to the families Saccocomidae and Roveacrinidae. Higher diversity faunas are found in the Late Turonian, Mid-Coniacian and Early Campanian intervals, separated by units of lower diversity and variable abundance. The material provides the basis for a microcrinoid biostratigraphy for the Late Cenomanian–Campanian which recognizes 25 zones, with a mean duration of approximately 400 kyr.

Because Roveacrinida were members of the mesoplankton, living in the upper part of the water column, they were widely distributed by ocean currents, and some species, such as *Applinocrinus cretaceus*, have a global distribution. Furthermore, they do not show significant latitudinal variation in their distribution, and therefore have potential for Boreal-Tethyan-Austral correlation. It is therefore likely that at least part of the zonation is very widely applicable and offers potential for long-distance correlation. For example, the zonation developed in the Early Campanian of the UK can be identified in the Gulf Coast of the USA, and permits the identification and quantification of hiatuses in central Texas. It is also expected that Roveacrinida are present in deep sea cores, but their value is perhaps limited by the small volumes of sediment usually available.

Cyclostratigraphic tuning of the Albian–Cenomanian stages

Gambacorta, G.[1,*]***, Malinverno, A.***[2]***, Erba, E.***[1]

1) Dipartimento di Scienze della Terra ''A. Desio'', University of Milan, Milano, Italy,
**E-mail: gabriele.gambacorta@guest.unimi.it*
2) Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, USA

We applied a cyclostratigraphic analysis to the early Albian – early Turonian time interval in four Tethyan sections from the Umbria-Marche Basin, Italy (Furlo, Contessa, Le Brecce and Monte Petrano). Starting from high-resolution (cm- to mm-scale) lithological logs (GAMBACORTA et al., 2016), simulated calcium carbonate contents were used as input data for a probabilistic cyclostratigraphic analysis. The orbital tuning used short eccentricity and obliquity and was tied to an absolute age of 93.9 My at the Cenomanian/Turonian boundary (MEYERS et al., 2012). We joined our Monte Petrano Cenomanian $\delta^{13}C$ record (GAMBACORTA et al., 2015) with published Albian $\delta^{13}C$ record (TIRABOSCHI et al., 2009; GIORGIONI et al. 2012) to produce an astronomically dated composite $\delta^{13}C$ record for the whole Albian to Cenomanian time interval. According to our sedimentation rate model, we were able to convert into time the carbon isotope record, thus allowing the dating of the C-isotopic anomaly associated with OAE1d and MCE I as well as their duration.

According to our results the OAE1d lasted from 101.21 ± 0.15 My to 99.72 ± 0.15 My with an approximate total duration of about 1.49 My. We obtained an astronomical tuned age of 96.96 ± 0.15 My to 96.77 ± 0.15 My for the MCE I with a total duration of the event of about 200 kyr. Our data provide an estimate of the total duration of about 12.65 My and about 5.23 My for the Albian and Cenomanian stages respectively. In particular, the Aptian/Albian boundary lies at 111.78 ± 0.15 My and the Albian/Cenomanian boundary at 99.13 ± 0.15 My. A detailed review of available literature on the application of cyclostratigraphy to this stratigraphic interval shed light on the main reasons behind the differences in the stage durations absolute ages estimates. In particular, differences in data types, signal analysis methods, and in the definitions of the chronostratigraphic limits and time scale assumptions plays a major role in determining the observed results variability.

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Late Cretaceous terrestrial paleoclimate recorded by paleosols in the Songliao Basin, northeast China

***Gao, Y.*[1,*], Ibarra, D.[2], Caves, J.[3], Zhang, L.[1], Wang, C.[1]**

*1) China University of Geosciences Beijing, Beijing, China, *E-mail: yuangao@cugb.edu.cn*
2) Stanford University, Stanford, USA
3) ETH Zürich, Zürich, Switzerland

The Late Cretaceous (late Campanian to Maastrichtian) was characterized by a variable greenhouse climate, with evidence for cooling and/or glaciation and warming events. Most of these climatic signals are derived from marine records, and knowledge of the terrestrial climate, especially in the mid-latitudes, is limited due to the fragmentary geological record on continents. In this study, we report terrestrial stable oxygen and carbon and clumped isotope data from pedogenic carbonates in the nearly continuous Late Cretaceous age SK-1 core drilled in the mid-latitude Songliao Basin, northeastern China. More than 50 paleosol layers are preserved in the Sifangtai-Mingshui Formations in the SK-1 core. Our sedimentary and isotopic data indicate mid-latitude terrestrial climate in the Late Cretaceous characterized by distinct perturbations (GAO et al., 2015). We interpret a negative excursion of pedogenic carbonate $d^{18}O$ in the early Maastrichtian to be the result of decreasing temperature and/or southward-shifted westerlies during global cooling and possible glaciation, providing the first mid-latitude terrestrial evidence for this event at ~70.5 Ma. A negative $d^{13}C$ isotopic excursion ca. 66 Ma is modeled as higher primary productivity caused by increasing temperature and precipitation in response to a warming climate in the latest Cretaceous. The terrestrial temperature record spanning K-Pg boundary suggests a pre-impact cooling coincident with glacioeustatic regression and then warming caused be Deccan volcanism followed by a short-term cooling caused by Chicxulub impact. Our continuous stable isotopic and paleotemperature records in the Songliao Basin are in accordance with previously published global Late Cretaceous records of climate variability from marine and terrestrial regions. These records demonstrate the mid-latitude terrestrial climate of East Asia tightly linked to global climate in the Late Cretaceous greenhouse world, and indicate that temperature changes caused by Deccan volcanism probably destabilized terrestrial ecosystems prior to the devastation caused by Chicxulub impact at the K-Pg boundary.

GAO, Y. et al., 2015. Geology, **43**/4, 287–290.

A new carpet shark from the Hell Creek Formation increases latest Cretaceous freshwater biodiversity

***Gates, T.*[1,*] *and Makovicky, P.*[2]**

*1) North Carolina State University, Raleigh, USA, *E-mail: tagates@ncsu.edu*
2) Field Museum of Natural History, Chicago, USA

Freshwater habitats during the Late Cretaceous were occupied by diverse vertebrate taxa including lissamphibians and varieties of bony fish. These habitats also contained an unappreciated number of sharks belonging to the Orectolobiformes. These sharks are generally small-bodied and have a complex dentition for feeding on a variety of prey. In recent years, extinct orectolobiform species have been identified in increasing numbers from continental deposits throughout western North America (KIRKLAND et al., 2013) including the Maastrichtian-aged Hell Creek Formation (COOK et al., 2014). The new species described here from the Sue locality—bringing the total species richness of orectolobiform sharks known from the Hell Creek Formation to four—is diagnosed currently with 11 traits observed on 24 teeth from throughout the dental row. Of the four autapomorphies identifed, the most apparent is a large swelling on the lingual tooth crown that forms a constricted neck at the crown-root interface. Other unique features include labial crown ornamentation, angulation of the medial and distal heels, as well as morphology of the central basal foramen.

This collection of teeth may represent the most complete orectolobiform dentition collected from North America. Even though our dental suite is not articulated, it seems likely that they derive from a single individual because all teeth are quite similar in size, represent teeth from across the jaw, and none of the other orectolobiform species known from the Hell Creek Formation are present in the collection from this site. Flooding of North America by the warm Western Interior Seaway provided an ideal environment for the diversification of orectolobiform species, especially those tolerant of estuarine to completely freshwater habitats. Given the abundance of such fossiliferous units in the Late Cretaceous of North America, the diversity of carpet sharks will likely grow allowing studies of phylogenetics and evolutionary diversification.

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KIRKLAND, J.I. et al., 2013. In: TITUS, A.L. et al. (Eds.), At the Top of the Grand Staircase: The Late Cretaceous of Southern Utah, 153–194.

Diversity in the sedimentological and geochemical features of the late Cenomanian OAE2 in the different areas of the Crimea-Caucasus area

Gavrilov, Y.[1,*] ***and Shcherbinina, E.***[1]

*1) Geological Institute of RAS, Moscow, Russia, *E-mail: yugavrilov@gmail.com*

Sediments accumulated during OAE2 occur in many localities of the Greater Caucasus and Crimea. We studied 10 sections through this interval, with the easternmost section at a distance of ca. 1000 km from the westernmost section. Accordingly, these sediments accumulated in different sedimentological environments, which caused the variations in their architecture (GAVRILOV et al., 2013). The distinct cyclicity in the black shales corresponding to OAE2 is displayed in Dagestan and Chechnya, eastern Caucasus. 10 to 12 bands are recognized; each band is built up of organic carbon-rich clayey sediments at the base gradually changing upward to light grey calcareous sediment with minor TOC content, but the contacts between bands are well-marked. In the flysch sequences of the western Caucasus, the black shale interval is disintegrated by intercalations of turbiditic sandstones. Thus, the concurrent supply of sedimentary material (background supply and turbiditic supply) makes the reconstruction of TOC-rich sediments difficult. The sediments accumulated during OAE2 in the central Crimea demonstrate weakly pronounced cyclicity, while in the western Crimea, where the sedimentation occurred in a basin-floor setting marked by rugged topography that caused variations in thickness and submarine slumping, the OAE2 black shales are rather homogenous. The positive C-isotope and negative O-isotope anomalies are found in most of the OAE2 records of Crimea-Caucasus. However, in the central Crimea, only the negative $\delta^{18}O$ excursion (ca. 2 ‰) is detected, while the positive $\delta^{13}C$ excursion is not present. Nannofossil assemblages of the OAE2 interval from eastern Caucasus and central Crimea are poor to absent compared to embedding sediments, but in the western Crimea they display a relatively diverse species composition, strongly dominated by opportunistic Watznaueria spp. In all areas studied, the increased relative abundance of cool-water species in the upper part of the black shales suggests short a cooling episode during the OAE2 terminal phase. The comparison of the structure of OAE2 and surrounding sediments from different parts of the Crimea-Caucasus area shows some common features: 1) the distinct boundary between OAE2 sediments and underlying Cenomanian limestones with erosion and hiatus marks; 2) the basal layer of a shallow clay-mudstone, which is 10–30 cm thick; 3) differently structured organic carbon-rich sediments, which are 20–60 cm thick; 4) in many sections, OA2 sediments are onlapped by Turonian limestones, and a gradual Cenomanian–Turonian transition occurs rarely. The structure of the Cenomanian sequence evidences the regressive pulse prior to OAE2 following by accumulation of clayey sediments in a very shallow environment and, later, formation of organic carbon-rich sediments during rapid transgression.

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The paleogeographic setting and biostratigraphy of the South-East part of Georgia at the boundary of the Cretaceous/Paleogene

Gavtadze, T.[1,*]***, Chkhaidze, Z.***[1]***, Mikadze, K.***[2]

*1) Javakhishvili State University, Geological Institute, Tbilisi, Gorgia, *E-mail: tamaragavtadze@yahoo.com*
2) Georgia National Museum, Institute of Paleobiology, Tbilisi, Georgia

The Georgian part of the Alpine-Himalayan orogenic belt is characterized by the highly complex structure of Upper Cretaceous and Lower Paleogene sediments of the Alpine sedimentary cover. Within the territory of Georgia are distinguished the following structural-morphological units: 1) the fold (fold-nappe) system of the Greater Caucasus; 2) The Transcaucasian intermountain area; and 3) The fold (fold-thrust) system of the Lesser Caucasus. Each of these consists of several tectonic units of higher order. These tectonic units controlled sedimentary environments in the region and also, to a large extent, the marine habitat, so that there are differences in the biota between the different basins.

In the fold system of the Greater Caucasus, the nannoplankton and planktonic foraminifers from a representative section of the western Gagra-Java (fold) zone, and one from the eastern Mestia-Tianetian (fold nappe) zone have been investigated. In the Maastrichtian, the sediments are carbonate turbidites, mainly composed of alternating granular-argillaceous and sandy limestones, marls, limy sandstones and clays. Locally, one rock type may predominate, for example, in the Mestia-Tianetian zone (basin of the rivers Patara Liakhvi, Mejuda, Lekhura, Aragvi, etc.), bands and lenses of conglomerates and olistostrome-type boulder-breccias are observed. These represent a chaotic pile of boulders and large blocks of Lower Jurassic slates, Bajocian volcanics, Upper Jurassic limestones, and Cretaceous sandstones and limestones. Rounded or poorly rounded fragments of granitoids also occur. In the Transcaucasian Intermountain area, the Maastrichtian is represented by limestones, which are sometimes clayey and/or arenaceous.

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Campanian to Maastrichtian planktic foraminifera of the Pálava Formation from the southern Waschberg-Ždánice-Unit, Lower Austria

Gebhardt, H.[1]

1) Geologische Bundesanstalt (GBA), Vienna, Austria, E-mail: Holger.Gebhardt@geologie.ac.at

In the Austrian part of the Waschberg-Ždánice-Unit, the Pálava Formation consists of glauconite sands/sandstones and grey marls. In order to reveal the areal distribution of Meso- and Cenozoic sediments, several hundreds of near-surface samples were taken by hand-drillings (50 to 200 cm depth), with 26 samples from the Pálava Formation. Both facies of the Pálava Formation contain basically the same original foraminiferal composition but those from the glauconite sands are much more corroded, resulting in biased assemblages with predominantly thick-shelled, resistant taxa. The state of preservation of the near-surface samples varies from nearly pristine (glassy tests) to highly corroded. A general trend of better preserved assemblages towards the northern areas and poor state in the south can be observed. The found foraminiferal assemblages yielded at least 33 planktic species: *Abathomphalus intermedius, A. mayaroensis, Archaeoglobigerina blowi, A.* aff. *bosquensis, A. cretacea, Contusotruncana contusa, C. fornicata, C. plicata, C. walfishensis, Globotruncana aegyptiaca, G. arca, G. bulloides, G.* cf. *lapparenti, G. linneiana, G.* cf. *ventricosa, Globotruncanella havanensis, G. pschadae, Globotruncanita stuarti, Heterohelix globulosa, Laeviheterohelix dentata*, *Macroglobigerinelloides alvarezi, M. multispinus, M. prairiehillensis, M.* cf. *subcarinatus, Plummerita* cf. *reicheli, Pseudoguembelina hariaensis, Pseudotextulatia elegans, Racemiguembelina fructicosa, Rugoglobigerina hexacamerata, R. rugosa, Rugotruncana subcircumnodifer, R. subpennyi,* and *Ventilabrella riograndensis*. The ages of the found assemblages range from (middle) Campanian to latest Maastrichtian (*Abathomphalus mayaroensis*-Zone). It is remarkable that *Gansserina gansseri* has not been found in any of the investigated samples and *A. mayaroensis* is the most frequent keeled species in the youngest samples. This may be attributed to the relatively northern position of the sites ("cool water"-assemblages). The results confirm the age assignments for the Pálava Formation of the northern parts of the Waschberg-Ždánice-Unit in Lower Austria.

Plant megafossils and amber from the Upper Cretaceous of Vernasso (Friuli-Venezia Giulia, northeastern Italy)

Giusberti, L.[1,*]***, Roghi, G.***[2]***, Gomez, B.***[3]***, Ragazzi, E.***[4]***, Fornaciari, E.***[1]***, Angelini, I.***[5]

*1) Department of Geosciences, University of Padua, Padua, Italy, *E-mail: luca.giusberti@unipd.it*
2) Institute of Geosciences and Earth Resources, CNR, Padua, Padua, Italy
3) CNRS-UMR 5276 LGL-TPE, Université Lyon 1 (Claude Bernard), Villeurbanne, France
4) Department of Pharmaceutical and Pharmacological Sciences, University of Padua, Padua, Italy
5) Department of Cultural Heritage, University of Padua, Padua, Italy

The most famous and richest Cretaceous plant assemblage of northern Italy has been reported at the end of the nineteenth century in the Vernasso quarry from limestone boulders contained inside a giant megabed from the lower Eocene Flysch of Julian Prealps, Friuli-Venezia Giulia Region, northeastern Italy. The plant assemblage was described by BOZZI in 1891, and since it has never been revised. The flora consists of conifers (*Araucaria macrophylla*, *Cunninghamites elegans*, *Cyparissidium gracile*, *Frenelopsis koenigii*, "*Sequoia*" *ambigua*, and "*S." concinna*) and rarer angiosperms (*Arundo groenlandica*, *Myrica vernassiensis*, *Phyllites proteaceus*, *P. platanoides*, and *Rhus antigua*) (BOZZI, 1891). Plants are associated with bivalves, gastropods and rare ammonites. The entire assemblage was ascribed to the "lower Senonian" (Tommasi, 1891), and more recently to the Coniacian-Santonian based on calcareous nannofossil analyses (GOMEZ ET AL., 2002). The plant-bearing limestones probably deposited in a lagoonal environment, which was sporadically influenced by open sea and was partly surrounded by emerged parts of the platform (MUSCIO & VENTURINI, 1990). Plant megafossils usually look like impressions covered by orange to brown, limonite powder. Less frequently, compressions with brown to black carbonized matter occur on the unweathered rock surfaces, but cuticles are not preserved. The plant assemblage of Vernasso has been of a renewed interest in the recent years because it consists of the first record of Cretaceous amber in Italy. Thus ROGHI et al. (2004) have reported that two conifer specimens were associated with amber. Since, we undertook a survey of known plant fossil collections from Vernasso with over 400 hand specimens, including the type material described by BOZZI (1891). This survey also led to further observations of amber in several conifer types. These include Araucariaceae, Cupressaceae and, possibly, Cheirolepidiaceae. A set of the new amber samples has been characterized by µ-Raman and infrared spectroscopy. We suggest that almost all Cretaceous conifers exuded resin, and that this defense behavior might be related to particular greenhouse conditions developed during the Coniacian-Santonian.

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Early Fagaceae from the Late Cretaceous of the Northern Pacific

Gnilovskaya, A.[1]

1) Komarov Botanical Institute, Russian Academy of Sciences, St. Petersburg, Russia,
E mail: agnilovskaya@gmail.com

The Fagaceae is one of the most significant families of woody plants in the Northern Hemisphere. Representatives of this family began to play an important role in the vegetation from the beginning of the Paleogene. Early records of Fagaceae in the Cretaceous are rare. Flowers and pollen are known from the Santonian of North America and from the Coniacian of Japan. Fossil leaves similar to foliage of extant Fagaceae appeared also in the Late Cretaceous.

The earliest findings of fagaceous-like leaves were recorded from the Santonian-Campanian of the Northern Pacific Region. They belong to the genus *Barykovia* MOISEEVA, which are known from Northeastern Russia and Alaska.

The earliest unequivocal fagaceous leaves appeared in the Maastrichtian deposits of the Koryak Upland (Northeastern Russia). They are assigned to *Fagopsiphyllum groenlandicum* (HEER) Manchester. In the Paleocene, the distribution of this species increased considerably. It was recorded from Northeastern Russia, Canada, USA (Alaska, Washington, Wyoming), Greenland, Spitsbergen and Scotland (Isle of Mull). The second species of this genus (*Fagopsiphyllum nipponicum* TANAI) comes from the Eocene deposits of Japan (Hokkaido) and Russia (Sakhalin, Kamchatka).

Leaves of *Fagopsiphyllum* have the greatest similarity with those of the genus *Fagopsis* Hollick. However, the distinctive reproductive structures of *Fagopsis* have never been found associated with *Fagopsiphyllum*. Representatives of *Fagopsis* were recorded from the Eocene–Oligocene deposits of USA (Washington, Colorado, Montana) and from the Eocene deposits of Russia (Kamchatka).

Barykovia, Fagopsiphyllum and *Fagopsis* share a specific combination of leaf characters, such as elongate shape, pinnate craspedodromous venation, dentate margin, teeth with biconvex sides, and triangular acute sinuses, which distinguished them from other extinct and extant Fagaceae. We supposed that these tree genera represented a separate evolutionary lineage of extinct early Fagaceae, which can be traced from the Santonian to the Oligocene. The evolution of this lineage was related with the Northern Pacific region. Only *Fagopsiphyllum groenlandicum* is characterized by the wide circumpolar area in the Paleocene.

The impact of early meteoric diagenesis on Urgonian platform carbonates: A case study from the western Swiss Jura

Godet, A.[1,*]***, Durlet, C.***[2]***, Spangenberg, J.E.***[3]***, Föllmi, K.B.***[4]

*1) The University of Texas at San Antonio, San Antonio, USA, *E-mail: alexis.godet@utsa.edu*
2) University of Bourgogne Franche-Comte, Dijon, France
3) Institute of Earth Surface Dynamics, Lausanne, Switzerland
4) University of Lausanne, Lausanne, Switzerland

The moderate preservation of sedimentological and geochemical evidence often hampers the identification of subaerial exposure surfaces in carbonate platform successions. Such discontinuities may represent significant time gaps, justifying the quest for undeniable indications. We investigated a lower Hauterivian to upper Barremian sedimentary succession from northwestern Switzerland to highlight the stratigraphic impact of meteoric diagenesis on platform carbonates. Petrographic observations under conventional and cathodoluminescence microscope revealed the presence of five generations of calcitic cements. Punctual carbon and oxygen stable isotope composition ($\delta^{13}C$ and $\delta^{18}O$ values, respectively) measurements relate them to specific diagenetic environments: selected blocky calcite cements (fC1 and C1) exhibit an enrichment in light isotopes (^{12}C, ^{16}O), indicative of a meteoric eogenesis origin, whereas very negative $\delta^{18}O$ values link the last phase of cementation C2 to mesogenesis. Meteoric calcitic cements formed during karstification of the top of the upper Barremian series that started in the latest Barremian since karst pockets are filled by marls dated to the early Aptian, based on ammonite findings; burial diagenetic phases overlap these eogenetic phases, which thus cannot be related to recent telogenesis. Based on the observation of thin section under a cathodoluminescence microscope, we estimated the ratio of early meteoric versus burial cements within the studied succession: its stratigraphic evolution reveals that lower Aptian eogenesis influenced the isotope geochemistry of platform carbonates as deep as 45 m below the exposure surface. In this interval, negative whole-rock $\delta^{13}C$ values do not reflect contemporaneous variations of the $\delta^{13}C$ curves documented in sections devoid of strong diagenetic impact. Such an impact is a function of the amount of meteoric cement in the porosity as well as of the primary carbon isotope composition of the carbonate sediments and of the meteoric cement. In the case of these sediments of the Urgonian platform, the perturbation of isotope systems is not necessarily accompanied with alteration of microfacies, and the vertical influence of a karst is not restricted to the first meters directly below the exposure surface. Consequently, the application of $\delta^{13}C$ chemostratigraphy to platform carbonates can only be performed with great caution and after a careful examination of diagenetic features.

Extinction of high latitude Kakanaut biota, North-East of Russia

Golovneva, L.[1]

1) Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russia,
E mail: Lina_Golovneva@mail.ru

The association of fossil plants and vertebrate remains was discovered in the late Maastrichtian volcanogenic-terrigenous deposits of the Kakanaut Formation in the southeastern part of the Koryak Upland, North-East of Russia. The Kakanaut Formation contains the richest Maastrichtian plant assemblage of the Arctic region, dinosaurs and fish. This allows estimating the climatic and environmental conditions in which diverse dinosaur fauna could existed. Troodontids, dromaeosaurids and tyrannosaurid were identified among the carnivorous dinosaurs. Herbivorous dinosaurs are represented by basal ornithopods, hadrosaurids, ankylosaurians and neoceratopsians. Dinosaur eggshell fragments have also been discovered at the Kakanaut. The Kakanaut paleoflora includes more than 50 taxa. Among them conifers and angiosperms predominate. Horsetails, liwerworts and ferns occur rarely and are represented by 1–3 species in each group. The remains of cycadophytes and *Ginkgo* formed monodominant associations. Conifers are assigned to the Taxodiaceae, Cupressaceae and Pinacea. Angiosperms include about 30 species. Families that can be confidently recognized are Platanaceae (*Platanus*), Cercidiphyllaceae (*Trochodendroides*), Betulaceae (*Corylus*), Fagaceae (*Fagopsiphyllum*), Rosaceae (*Peculnea, Arctoterum*). The remains of large-leaved platanoids and Trochodendroides usually prevail in fossil assemblages. The floral change near the K/T boundary was the result of climatic change, which was expressed in an increase of latitudinal temperature gradient, sharper seasonality, and increased humidity and cooling. The change of climate near the K/T boundary led the destruction of the Cretaceous plant communities and extinction of the majority of specialized stenobionts, which were dominant in the climax vegetation.

The fossiliferous Kakanaut Formation is about 1000 m thick and consists of tuffaceous sandstone and siltstone, tuff, and andesibasaltic rocks, which represents lacustrine and fluviodeltaic deposition of coastal lowland. The presence of lava flows and tuff material in the sediments indicate to the close vicinity of an active volcano. The Maastrichtian strata are covered by effusive-pyroclastic deposits about 600 m in thickness, which was formed during the Cretaceous–Paleogene transition (part of the Bristol-Anadyr volcanic belt). We supposed that intensive flood volcanism can also be responsible for declining and extinction of dinosaur fauna in this region.

Early–middle Albian angiosperms from the Kolyma river basin, Northeastern Russia

Golovneva, L.[1]

1) Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russia, E mail: Lina_Golovneva@mail.ru

In Northeastern Russia angiosperms firstly appeared in the early–middle Albian, preserved in deposits of the Buorkemuss Formation of the Kolyma river basin. The Buorkemuss flora is characterized by high taxonomic diversity. It includes about 80 species and consists of ferns, cycadophytes, czekanowskialeans, conifers and angiosperms. Ferns predominate. Diversity is rather high, comprising about 20 species. The early spreading of angiosperms was not accompanied by reduction of the older Mesozoic groups that had also experienced a progressive phase in their evolution at that time. The dominant plant communities in the early-middle Albian are reconstructed as closed deciduous forests consisted of conifers, ginkgophytes and czekanowskialeans. Another widespread vegetational type was represented by open herbaceous to shrubby communities consisted of ferns and cycadophytes. The fern diversity during the Early Cretaceous was negatively correlated with the diversity of ginkgophytes, czekanowskiales and conifers. Such relationships can be evidence that the majority of ferns formed separate communities rather than were incorporated as undergrowth in the ginkgo-conifer forests. These open fern communities developed mostly on periodically flooded areas of river valleys.

The angiosperm remains occur rare and irregular. Most part of species is represented by single or by several specimens. All angiosperm leaves of the Buorkemuss flora are characterized by small sizes, up to 1–4 cm. This suggests predominance of herbaceous and shrubby life forms. Angiosperm remains were found mostly in association with ferns. Other fossils occur very rare in angiosperm sites as allochtonous admixture. It is likely, that angiosperms inhabited periodically flooded open herbaceous fern communities as a minor component.

The process of replacement of the older Mesozoic elements began in the late Albian and Cenomanian. In this time the conifers *Parataxodium, Araucarites, Sequoia* and *Elatocladus* became dominant. The late Albian and Cenomanian angiosperms represent an entirely new stage of evolution in this group. The small-leaved shrubby forms, members of the Mesozoic-type communities, were replaced by broad-leaved arboreal plants that could probably form predominantly angiosperm communities. Diverse platanoids and representatives of genus *Trochodendroides* first appeared. Later these taxa formed a core of the Late Cretaceous floras in Siberia. Angiosperm radiation was correlated with extinction or considerable reduction of different Mesozoic groups. Among them ferns underwent the strongest reduction.

New details of bio- and magnetostratigraphical correlations in the Jurassic/Cretaceous boundary interval: Lókút (Transdanubian Range, Hungary), Veliky Kamenets (Pieniny Klippen Belt, Ukraine), Barlya (Western Balkan, Bulgaria)

Grabowski, J.[1,*]***, Bakhmutov, V.***[2]***, Haas, J.***[3]***, Krobicki, M.***[1]***, Lakova, I.***[4]***, Petrova, S.***[4]***, Reháková, D.***[5]***, Schnabl, P.***[6]***, Stoykova, K.***[4]***, Sobien, K.***[1]

1) Polish Geological Institute - National Research Institute, Warsaw, Poland,
**E-mail: jacek.grabowski@pgi.gov.pl*
2) Institute of Geophysics, National Academy of Sciences of Ukraine, Kiev, Ukraine
3) MTA-ELTE Geological, Geophysical and Space Science Research Group, Eötvös Loránd University, Budapest, Hungary
4) Geological Institute of the Bulgarian Academy of Sciences, Sofia, Bulgaria
5) Comenius University, Dept. of Geology and Palaeontology, Bratislava, Slovakia
6) Institute of Geology of the CAS, v.v.i., Praha, Czech Republic

New bio- and magnetostratigraphical calibration of three pelagic to hemipelagic sections from the Western Tethyan domain is presented. The most complete data are available in the Lókút section (GRABOWSKI et al., 2010). Magnetozones from M21r (Malmica Zone, Lower Tithonian) to M18r (Alpina Subzone, Lower Berriasian) have been documented. The J/K boundary (Intermedia/Alpina boundary) is situated at the 37 % of M19n2n magnetozone. First occurrences of *Nannoconus kamptneri minor* and *N. steinmannii minor* fall in the topmost part M19n2n and lowermost part of M19n1r respectively. Their position is similar as in Puerto Escaño section (southern Spain) and slightly lower than in Italian sections (Southern Alps). Veliky Kamenets section (REHÁKOVÁ et al., 2011) yielded reliable magnetostratigraphy, from the topmost part of M20n1n (Intermedia Subzone) to lower part of M17r magnetozone (Ferasini Subzone). J/K boundary, defined as Parvula – Colomi/Alpina boundary, occurs at the 56 % of M19n2n. Uppermost part of the section, in the Elliptica Subzone, is apparently remagnetized by a basalt intrusion. Crucial Upper Tithonian/Lower Berriasian interval of the Barlya section (LAKOVA et al., 2007), covering M20n to M18n magnetozones, is most probably remagnetized. Despite dense sampling, only very thin reversed intervals have been identified which might be interpreted as remnants of M19r, and either M19n1r or M18r. Uppermost Lower Tithonian and Upper Berriasian to lowermost Valanginian parts of the section yielded reliable magnetostratigraphy with M20r magnetozone situated in Chitinoidella Zone and M17r to M14r documented between Elliptica and Darderi subzones (GRABOWSKI et al., 2016). The important nannofossil bioevents (first occurrences) of *N. wintereri, N. kamptneri minor, N. steinmanni minor, N. st. steinmanni* are precisely pinpointed within the J/K boundary interval there.

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Magnetic susceptibility and chemostratigraphy of the Tithonian - Berriasian succession in the Polish Basin

Grabowski, J.[1], Ploch, I.[1,*], Chmielewski, A.[1], Gazdzicka, E.[1], Leszczynski, K.[1], Smolen, J.[1]

1) Polish Geological Institute - National Research Institute, Warsaw, Poland,
**E-mail: izabela.ploch@pgi.gov.p*

During the Early Cretaceous, climate went through some perturbations which are well recorded in some sections. The Polish Basin is part of the Central European Basin, but because of its specific position, connected to the Tethys in the south and to the North Sea Basin in the northwest, it can be important for studies of the paleoclimate. The predominantly siliciclastic sediments of the Polish Basin were extensively studied during the previous century (see MAREK, 1989, for review), but also more recently new studies were performed (DZIADZIO et al. 2004). Based on well samples parasequences and sequences were distinguished, providing a precise correlation of the studied sedimentary series and a chronostratigraphic framework of the reconstructed events. Sedimentological and geochemical results from the Wąwał section (MORALES et al., 2015) indicate humid and increased chemical weathering in the early Valanginian, with deposition of relatively high amounts of terrestrial organic matter in the Polish Basin. These previous results encouraged to continue the study of climate changes in other sections. Results from the Tithonian/Berriasian boundary and the Valanginian interval from the Kcynia IG 2 borehole located near Bydgoszcz (central Poland) are presented. It shows a gradual change from shallow-water mudstones through carbonates to massive evaporites of about 70-m thickness. The evaporites are overlain by transgressive deposits (mostly mudstones) containing Berriasian ammonites in its upper part. The Jurassic/Cretaceous boundary is located most probably within the evaporites (DZIADZIO et al., 2004). We report results of a detailed magnetic susceptibility and geochemical survey, which documents variations in clastic input and paleoproductivity changes. The correlation with climatic and tectono-eustatic events documented in NW Europe and the Western Tethys will be proposed.

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Regional stages: What is the use of them – A case study in Lebanon

Granier, B.[1,*], Gèze, R.[2], Azar, D.[2], Maksoud, S.[2]

*1) Carnets Geol., Brest cedex 3, France, *E-mail: bgranier@univ-brest.fr*
2) Lebanese University, Fanar - El-Matn, Lebanon

In Lebanon, the lithostratigraphic succession established by DUBERTRET (1963) – and the units of which were later renamed by WALLEY (1997) – comprises from base to top the J7 (“Salima Fm”), the C1 (“Chouf Sandstone Fm”), the C2a (“Abeih Fm”), the C2b (“Mdairej Fm”) and the C3 (“Hammana Fm”). DUBERTRET ascribed J7 to the uppermost Jurassic (excluding the Tithonian and the Berriasian), C1 to the “Néocomien” (possibly comprising the Barremian), C2 to the Aptian (a for the lower part, b for the upper part), and C3 to the Albian. All these mappable units are facies-driven, diachronous units: it is suggested to call them “FACIES”, not formations. Because the depositional environments are not favorable, there were very few records of ammonites (merely some *Knemiceras* in the C3), calpionnellids or planktonic foraminifers: accordingly a direct implementation of the standard chronostratigraphic units, i.e., the international stages, is not feasible – such as in most non-basinal Cretaceous sections where these index fossils are lacking. MAKSOUD et al. (2014) and GRANIER et al. (2016) identified a number of significant unconformities, which led to the identification of genuine unconformity-bounded units: we call them “FORMATIONS”. Accordingly the revised Dubertret’s succession comprises the “Couches jaunes supérieures” Fm (an oolitic unit) separated by a karst surface from the overlying “Grès du Liban” Fm, followed by the “Falaise de Jezzine” Fm that is also a unit framed by two sequence boundaries (note: each of these SB is merged with its associated transgressive surface as it is often the case with shallow-water settings). In addition to the recent finding of Bedoulian ammonites (MAKSOUD et al., 2014) above the upper unconformity of “Falaise de Jezzine”, which indicates this last unit is slightly older than previously assumed, rich micropaleontological assemblages (benthic foraminifers and Dasycladales) make it possible to biostratigraphically characterize each of the above units: we call them “REGIONAL STAGES”. In non-basinal settings, which lack the classical index fossils, these regional stages – neither facies, nor formations – are the mandatory step in the correlation process with the international standard stages. As a result of this approach, the gathering of the lithostratigraphic and biostratigraphic information led to ascribe the “Couches jaunes supérieures” to the Valanginian stage (with the identification of significant hiatuses below and above them), the “Grès du Liban” to the Barremian, and the “Falaise de Jezzine” (or Jezzinian regional stage) to the transition Barremian–Aptian; the transgressive strata above the latter starts in the lower Aptian.

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Palaeo-circulation and paleogeographic changes in the Late Coniacian - Early Santonian (Late Cretaceous) of Europe, as based on ammonites and stable carbon and oxygen isotopes

Gruszczynski, M., Marshall, J.[1], Remin, Z.[2,*]

1) Department of Earth, Ocean and Ecological Sciences, University of Liverpool, Liverpool, UK
*2) University of Warsaw, Warsaw, Poland, *E-mail: zbyh@uw.edu.pl*

Ammonite distribution patterns and carbon and oxygen stable isotopes from the Lipnik-Kije (Poland) and Dubovcy (Ukraine) sections, in combination with literature data from other European sections, allow us to propose a model of sea water paleo-circulation for the Coniacian–Santonian transition. A key to understand the biogeographic dynamics of the ammonite faunas in Europe was the material from the sections of the Lipnik-Kije (SW margin of the Holy Cross Mountains, central Poland) and Dubovcy (western Ukraine) surveyed recently by Remin (2010) and Remin et al. (2016). The dominance of Tethyan ammonite forms at Lipnik-Kije, in an area typically included into the Boreal Province (central Poland), led to the hypothesis that warm Tethyan currents penetrated areas far to the north, reaching the territory of present central Poland. In contrast, the more southerly located section of Dubovcy in Ukraine is dominated by Boreal forms. The paleotemperature estimates calculated for the Lipnik-Kije section appear to be higher than in East Kent (UK), which was a part of Boreal Atlantic, but also higher than paleotemperature estimates obtained for sections in northern Spain, which was definitely a part of the northern Tethyan area (Remin et al., 2016). In order to reconcile faunal and paleotemperature data, we propose a new paleogeographic interpretation, which assumes the presence of a land area (Łysogóry-Dobrogea Land or Krukienic Island), functioning as a paleobiogeographic barrier in SE Poland and western Ukraine between the Lipnik-Kije and Dubovcy sections. Both sections (Lipnik-Kije and Dubovcy) were located on opposite (respectively south and north) sides of the postulated land area.

The presented model of oceanic paleo-circulation in Europe at the Coniacian/Santonian transition is confirmed independently by (1) biotic data (ammonites, foraminifera, calcareous nannoplankton) and (2) geochemical data (stable oxygen isotopes). The stable oxygen isotope values, despite showing evidence for a slight diagenetic overprint, are in accordance with the biotic data and support the proposed paleo-circulation model. This indicates that bulk carbonate $\delta^{18}O$ data, at least to some extent, retain original paleotemperature signatures. These data allow the recognition of the end-Coniacian–Early Santonian cooling event, resulting from cold currents flowing from the north, which is traceable, with different magnitude, in several European sections.

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The Reverse polarity zone in the Turonian–Coniacian interval of the Lower Volga region

Guzhikov, A.[1,*]***, Guzhikova, A.***[1]***, Pervushov, E.***[1]***, Ryabov, I.***[1]***, Surinskiy, A.***[1]
Seltser, V.[1]***, Beniamovski, V.***[2]

*1) Saratov State University, Saratov, Russia, *E.mail: aguzhikov@yandex.ru*
2) Geological Institute, Russian Academy of Sciences, Moscow, Russia

The reverse (R) polarity zone was detected in the Turonian-Coniacian carbonate (chalky marls) succession (constrained by the terrigenous Cenomanian and the condensed, middle-upper Coniacian “sponge” horizon) of the Lower Volga region, Russia.

In the Ozerki-2 section, 5 m thick Turonian-Coniacian marls are dated by micro- and macrofaunal complexes. The middle–upper Turonian LC4 Zone (foraminiferal zones after BENIAMOVSKI, 2008) was recognized is the marls. The “Sponge” horizon is referred to the uppermost part of the middle–upper Coniacian LC7 Zone. The upper Coniacian–lower Santonian LC8 Zone is recognized above the “sponge” horizon. The Coniacian–early Santonian belemnites, *Goniocamax lundgreni* (STOLL.), *Belemnitella propinqua* (MOB.), and *Belemnitella rylskiana* NIK., and upper Turonian–lower Coniacian inoceramids, *Inoceramus lusatiae* AND., *Cremnoceramus waltersdorfensis* (AND.), *Mytiloides striatoconcentricus* (GÜMB.), *Inoceramus seitzi* AND., and *I. annulatus* GOLDF., were found in the marls. *Sphenoceramus pachti* (ARKH.) and *Sph. cardissoides* (GOLDF.) were found above the “sponge” horizon. The R-zone spans the entire carbonate succession of the Ozerki-2 section.

In the Kamenniy Brod section, 200 km to the south of the Ozerki-2 section, the R-zone spans a ~15-m thick interval of the ~45-m thick carbonate succession characterized by normal (N) polarity. In contrast to the Ozerki-2 section, the R-zone is not limited by visible gaps in the sedimentary record.

In the Nizhnyaya Bannovka section, situated between the Ozerki-2 and Kamenniy brod sections, the ~20 m thick carbonate formation is completely covered by N-polarity.

The data obtained during this study satisfy the criteria of reliability accepted in magnetostratigraphy (OPDYKE & CHANELL, 1996). The detected R-polarity zone should be included into the Geomagnetic Polarity Time Scale (GRADSTEIN et al., 2012). For now, its Turonian–Coniacian interval is characterized exclusively by normal polarity regime. The detected R-zone confirms the alternative point of view about the presence of reverse polarity epoch in the Coniacian, reflected in the Global Magnetostratigraphic Scale (KHRAMOV & SHKATOVA, 2000).

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Sedimentology, biostratigraphy and palaeogeographic evolution of the Lower Cretaceous of the Ait Ourir basin, High Western Atlas, Marocco

Hadach, F.[1,*]***, Algouti, Ah.***[1]***, Algouti, Ab.***[1]***, Mourabit, Z.***[1]

1) Cadi Ayyad University, Faculty of Sciences Semlalia, Marrakech, Morocco,
**E-mail: fatiha.hadach@gmail.com*

The study of the Aptian-Albian terrains of the High Western Atlas, in the Ait Ourir basin, Morocco, allowed us to acquire new sedimentological, biostratigraphic and palaeogeographic data (Algouti et al., 2015, 2016; Hadach et al., 2017). The succession of the Tadhart limestones and dolomitic marls (Tadhart Formation), the Lemgo Formation and the formation of the sandy limestones of Oued Tidzi (Oued Tidzi Fm.) show ages of Gargasian, Clansayésian and Albian, resepctively. For the first time in this sector reef species are described which characterize the Lemgo Formation. In addition, gastropods and rudists have been found.

The first two formations are transgressive, formed in an internal carbonate platform communicating with the open sea transitional from an intertidal to a subtidal depositional area. The Oued Tidzi Fm. is regressive, formed in a coastal environment with continental influences.

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Integrated stratigraphy and facies analysis of the uppermost Albian-Cenomanian Glauconitic Limestone of Esfahan (Iran)

Hairapetian, V.[1], Wilmsen, M.[2,*], Ahmadi, A.[1], Shojaei, Z.[1]

1) Department of Geology, Isfahan Branch, Islamic Azad University Isfahan, Esfahan, Iran
*2) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, *E-mail: markus.wilmsen@senckenberg.de*

The Glauconitic Limestone of Esfahan (Central Iran) is well known for its diverse (nearly 80 taxa) and well-preserved late Albian to Cenomanian ammonite faunas (e.g., SEYED-EMAMI, 1977; KENNEDY et al., 1979; IMMEL & SEYED-EMAMI, 1985). However, much less is known about the depositional setting, stratigraphic significance and regional correlation of the unit. In order the overcome this gap in knowledge, a sedimentological-stratigraphical study of the upper Albian to lower Turonian interval comprising the Glauconitic Limestone has been conducted in the Kolah-Qazi National Park area (southeast of Esfahan) and preliminary results are reported here.

The Glauconitic Limestone rests with an erosional basal unconformity on lower upper Albian strata of the Bazyab Formation (informal *Beaudanticeras* shales; see WILMSEN et al., 2015, for details on the regional Cretaceous stratigraphy). It reaches a thickness of up to five metres but can be reduced to a few decimeters only on relatively short distances (~1 km). The lower part of the unit commonly consists of bioclastic packstone that is poor in macrofossils. In the middle to upper part, a fossiliferous glauconitic conglomerate with large limestone clasts and sharp base is developed, yielding the bulk of the ammonite faunas known from the Glauconitic Limestone. Locally, the beds underlying the conglomerate are absent and it directly rests on the *Beaudanticeras* shales. In addition to ammonites, bivalves, gastropods, belemnites, corals, brachiopods, echinoids and shark remains are known from the bed. The conglomerate shows a fining-upward trend and grades into the overlying marly and argillaceous limestone and *Inoceramus* limestone units. These fine-grained offshore deposits could be dated as late Cenomanian to early Turonian in the Takhte-Sheitan section by means of ammonites and inoceramid bivalves. Thus, the Glauconitic Limestone comprises the uppermost Albian to middle Cenomanian, defining its hitherto controversially discussed age more precisely (KENNEDY et al., 1979: exclusively early Cenomanian; IMMEL & SEYED-EMAMI, 1985: latest Albian to late Cenomanian). It correlates with the ammonite-bearing uppermost Albian to Middle Cenomanian strata of the Debarsu Formation of the Yazd Block in the south (WILMSEN et al., 2013). The Glauconitic Limestone is regarded as a complex, condensed transgressive lag deposit onlapping a considerable palaeotopography.

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The 'Black Band': local expression of a global event

Hart, M.B.[1]

1) School of Geography, Earth & Environmental Sciences, Plymouth University, Plymouth, UK, E-mail: mhart@plymouth.ac.uk

The Cenomanian–Turonian Boundary Event (CTBE) or Oceanic Anoxic Event II (OAEII) is regarded as one of the major global bioevents, though not as dramatic as the 'big five'. The biotic changes at the CTBE are at the generic or species level, rather than that of Family or above, and the percentage change is not so significant on a global scale (GALE et al., 2000). Perhaps more significant is the importance of this event as one of the Cretaceous OAEs that begin in the early Cretaceous (Weissert Event, Faraoni Event, etc.) and continue into the Santonian (OAEIII). The Black Band of Yorkshire, Humberside and Lincolnshire is, of course, where the study of Cretaceous OAEs began with the seminal work of SCHLANGER & JENKYNS (1976). The quarry on the south bank of the Humber Estuary, at South Ferriby, was the location where the first description of an oceanic anoxic event was related to changes in the water column, notably anoxia. Since that time, OAEII has been recognised as a global event, being recognised in the world's oceans (DSDP, ODP, IODP cores), and on every continent in both deep water mudstones and relatively shallow water carbonate successions (WOHLWEND et al., 2016). Despite all the research on this interval the original question as to whether it represents exceptional preservation of organic matter or enhanced productivity still remains.

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Dinocyst stratigraphy and paleoenvironmental interpretation of the Cretaceous/Paleogene boundary at Stevns klint, Denmark

Hart, M.B.[1,*]***, FitzPatrick, M.E.J.***[1]***, Forber, D.A.***[2]

*1) School of Geography, Earth and Environmental Sciences, Plymouth University, Plymouth, UK, *E-mail: mhart@plymouth.ac.uk*
2) University of Exeter, UK

A re-examination of the uppermost Maastrichtian chalks and an expanded section of the Fish Clay (Fiskeler Member) undertaken at Stevns Klint, Denmark, one of the classic outcrops of the Cretaceous/Palaeogene boundary, has identified some differences between our findings and most earlier dinoflagellate cyst studies. The white coccolith chalk of the uppermost Maastrichtian (Sigerslev Member) is placed in the *Palynodinium grallator* Zone. The overlying 'Grey Chalk' (Højerup Member) represents a shallower-water, but still open marine succession that is characterised by a series of dune-like structures. The last occurrence of *P. grallator* is within the Højerup Member, confirming the Danian age for the Fish Clay (Fiskeler Member) and a latest Maastrichtian age for the *P. grallator* Zone. Within the Fiskeler Member, *Danea californica* (previously known as *Damassadinium californicum*), a key biostratigraphical marker is only intermittently present, while the distributions of *Carpatella cornuta* and *Xenicodinium reticulatum* may be used to generate a potential zonation. The highest samples in the Fiskeler Member indicate a progressive transition towards more proximal environments, with no dinoflagellate cysts recorded, having been replaced in the samples by pollen grains. Our data confirm the dinocyst stratigraphy seen in other locations (e.g., Brazos River area, Texas and the El Kef succession in Tunisia) and refute the suggestion by HULTBERG (1985, 1986, 1987) that the Fiskeler Member represents a diachronous event.

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Response to Cretaceous Cenomanian/Turonian OAE2 in southern high latitude, Pacific

***Hasegawa, T.**[1,*], Muta, S.[1], Goto, A.[1], Crampton, J.[2], Nemoto, T.*

1) Faculty of Natural System, Kanazawa University, Kanazawa-City, Japan,
**E-mail: jh7ujr@staff.kanazawa-u.ac.jp*
2) GNS Science, Lower Hutt, New Zealand

At the Cretaceous Cenomanian/Turonian (C/T) boundary, a short-term event is known where sediment rich in organic matter is deposited in an extended oceanic area. This event is called Oceanic Anoxic Event 2 (OAE2) and considered to be one of the strongest and best studied perturbations of the carbon cycle during the Phanerozoic. Carbon isotope ratios of sedimentary organic carbon and carbonates show a unique positive excursion (CIE) through OAE2, which is identified throughout the world. Most studies on OAE2 have been undertaken for the Atlantic Ocean, the Tethys Sea and epicontinental seas of Europe and North America. Although the Pacific Ocean was the largest ocean on the Earth during the Cretaceous period, little is known about its response associated with OAE2. To understand the influence of surface carbon cycle disturbances on ocean and terrestrial realms in southern high latitude Pacific, a comprehensive organic geochemical study on samples extracted from outcrops comprising C/T boundary segments was carried out. These outcrops are situated near Blenheim in Marlborough, South Island, New Zealand. The homohopane Index (HHI) obtained from biomarker analysis produced remarkable data that were not identified from OAE2 intervals elsewhere before– i.e., the periodic fluctuation of suboxic (anoxic) and oxic environments at the sea floor. The correlative interval of the earliest phase of OAE2 shows strong oxygen depletion, followed by a rapid and prominent shift from anoxic to oxic conditions. A dramatic decrease in the sterane/hopane (S/H) ratio is found ~100 kyr following the HHI drop, and therefore nearly in conjunction with it. This diminished and/or reduced ratio in eukaryote-derived biomarkers is an indication of decreased transportation of marine organic matter to the ocean floor and therefore of diminished marine productivity. This palaeo-ecological change through the water column might lead to oxic instead of anoxic sea bottom conditions during the OAE2 interval. As it cannot explain the oxic bottom conditions preceding the phase of diminished productivity, bottom water oxygenation with exotic cold water inflow is more likely to explain these marine biomarker fluctuations through the OAE2 interval. Relative concentration of terrestrial PAHs across the OAE2 interval indicates high-latitude southern Pacific climate to have gradually turned into a condition with frequent wildfire just before the OAE2 interval. Thereafter, wildfire frequency dramatically decreased coincident with the onset of the CIE and remained low through the OAE2 interval and increased following OAE2. From biomarkers related to oceanic and terrestrial environments, both ocean and terrestrial realms in southern high latitude Pacific appear to have significantly changed during the OAE2 interval. The environmental change in this region during OAE2 was very different from the Tethys Ocean and other sites, indicating that the mechanisms involved in the triggering and evolution of the OAE2 were more complex than thought before.

Continental vegetation and climate dynamics during Oceanic Anoxic Event 2

<u>Heimhofer, U.</u>[1,*], Wucherpfennig, N.[1], Adatte, T.[2], Schouten, S.[3], Schneebeli-Hermann, E.[4], Gardin, S.[5], Keller, G.[6], Kujau, A.[7]

*1) Leibniz University Hannover, Hannover, Germany, *E-mail: heimhofer@geowi.uni-hannover.de*
2) Université de Lausanne, Lausanne, Switzerland
3) Royal Netherlands Institute for Sea Research (NIOZ), Den Burg (Texel), The Netherlands
4) Universität Zürich, Zürich, Switzerland
5) Université Pierre et Marie Curie Paris, Paris, France
6) Princeton University, Princeton, USA
7) GFZ German Research Centre for Geosciences, Potsdam, Germany)

The Cenomanian-Turonian boundary witnessed major perturbations in global biogeochemical cycling, oceanography and climate expressed in the widespread deposition of organic-rich marine shales (OAE2) and a pronounced positive carbon isotope excursion (CIE). Despite the global significance of this event, information on the dynamics of continental ecosystems during OAE2 is still lacking. Given the outstanding warm sea-surface temperatures (SSTs) reconstructed from proxy data for the OAE2 interval, the composition of terrestrial biomes must have responded to the inferred climatic changes. Here we present palynological and organic-geochemical data from a stratigraphically well-constrained marine succession from the Southern Provence Basin (SPB) located in the western Tethys domain. New biostratigraphic results (calcareous nannofossils, planktonic foraminifera) coupled with carbon isotope stratigraphy show that the interval corresponding to the OAE2 and associated CIE is represented by a ~150 m thick section composed of marls with few limestone intercalations. TEX_{86} data indicate very warm SSTs of up to 33°C, which is in line with previous mid-latitude temperature records. An interval with lower TEX_{86}-derived temperature estimates is paralleled by a trough-shaped decline in carbon-isotopes and tentatively correlated with the so-called Plenus Cold Event, a phase of distinct cooling in the early phase of OAE2. The spore-pollen assemblage is dominated by non-saccate gymnosperm (*Inaperturopollenites*, *Araucariacites*, *Classopollis*) and angiosperm pollen (mainly representatives of the Normapolles group incl. *Atlantopollis* and *Complexiopollis*), with pteridophyte spores being diverse but quantitatively less important. With stratigraphic height, the spore-pollen assemblage shows distinct changes in frequency distribution patterns including a pronounced increase in *Inaperturopollenites* and *Classpollis*. In contrast, the interval assigned to the Plenus Cold Event is characterized by a distinct rise in the angiosperm pollen *Atlantopollis microreticulatus*, reaching up to 16.4 % of the total palynoflora. In summary, the integrated palynological and geochemical dataset from the SPB documents the dynamics of mid-latitude vegetation during a phase of outstanding global warmth during OAE2. Despite the exceptional temperatures, a diverse and rich flora occupying various habitats in the hinterland of the SPB can be observed. Fluctuations in spore-pollen frequency distribution are considered to reflect significant climatic changes in the course of OAE2 controlled ultimately by the interplay of large-scale magmatic activity and enhanced organic carbon burial.

The stable isotope record from the Albian to Turonian Shilaif Basin (United Arab Emirates) – Climatic perturbations from a palaeo-equatorial intra-shelf basin perspective

Hennhoefer, D.[1,*]***, Al Suwaidi, A.***[1]***, Bottini, C.***[2]***, Helja, E.***[3]***, Steuber, T.***[1]

*1) Khalifa University of Science and Technology, Abu Dhabi, UAE, *E mail: dhennhoefer@pi.ac.ae*
2) University of Milan, Milan, Italy
3) ADCO, Abu Dhabi, ARE

The Cretaceous on the Arabian shelf is expressed by a thick succession of shallow marine to pelagic carbonates and siliciclastic sediments. During the Albian stage a widespread transgression led to the formation of the extensive Shilaif intra-platform basin, which persisted into the Turonian. Yet, a detailed regional chronostratigraphic framework does not exist for this time interval on the Arabian shelf. Carbon isotope chemostratigraphy ($\delta^{13}C_{CARB}$, $\delta^{13}C_{ORG}$), especially when carried out at high resolution and coupled with independent stratigraphic tools such as biostratigraphy, has been proven to be a valuable tool to integrate the sedimentary succession into a precise time frame. The continuous pelagic to hemipelagic carbonate succession of the Shilaif basin further offers an exceptional opportunity to observe marine equatorial palaeoenvironmental changes in the Cretaceous (Albian – Turonian) greenhouse climate.

Here we present a high-resolution chemostratigraphic profile ($\delta^{13}C_{CARB}$, $\delta^{13}C_{ORG}$, $\delta^{18}O_{CARB}$) and a biostratigraphic (nannofossil) record over 270 meters of continuous core material from central Abu Dhabi (United Arab Emirates). The investigated succession from the Shilaif intra-platform basin includes the Mauddud and Shilaif formations and extends from the mid Albian to the Early Turonian. The sediments represent outer ramp to basinal intra-shelf carbonates that vary from laminated organic-rich to clean bioturbated intervals. Carbonate carbon isotope values across the core range between ~1.0‰ VPDB and ~3.0‰ VPDB and organic carbon isotope values between -27‰ VPDB and -24‰ VPDB. Isotopic evidence of the Middle Albian Oceanic Anoxic Event (OAE) 1c, latest Albian OAE 1d, Mid-Cenomanian event (MCE I) and Cenomanian-Turonian boundary event (OAE 2) are confirmed and supported by calcareous nannofossil biostratigraphy. The results of this study contribute to an improved chronostratigraphic framework for the Shilaif basin as it allows correlation with regional (Vahrenkamp, 2013; Vahrenkamp et al., 2015; Wohlwend et al., 2016) and global (e.g. Jarvis et al., 2006; Gambacorta et al., 2015) well-calibrated carbon isotope records.

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Geochemical Assessment of the Cabó Formation Section North of Organyà, Catalunya, Spain

***Herdocia, C.**[1,*] and Maurrasse, F.[1]*

*1) Florida International University, Miami, USA, *E-mail: cherd002@fiu.edu*

The road cut of Catalunya Route C-14 along the west side of the Segre River canyon just north of the town of Organyà shows a thick and continuous sedimentary succession of light to dark gray and black limestones of the Organyà Basin deposits (CAUS, E. et al., 1990; BERNAUS et al., 2003). The succession exposes the northern flank of the large Santa Fé syncline of the Boixols thrust sheet (CAUS et al., 1990; GARCÍA-SENZ, 2002). This study focuses on 35.6 m of limestones just south of the tunnel that delineates the Cabó Formation in order to assess the organic geochemical characteristics with respect to Barremian–Aptian environmental changes in the Organyà Basin (SANCHEZ-HERNANDEZ & MAURRASSE, 2014). Microfacies show scarce benthic foraminifera, rare fragments of gastropods, echinoderms (roveacrinids, holothurian ossicles), bivalves, spumellarid and nasselarid radiolarians (from above level 0.68 m), and *G. blowi* planktonic foraminifera, in concurrence with previous biostratigraphic studies (*Ref. op. cit*). The organic carbon isotope values ($\delta^{13}C_{org}$) fluctuate from a low of -24.41‰ at a distance of 5.96 m from the tunnel wall (bottom of the studied section) to a positive shift of -22.15 ‰ at 0.43 m, followed by an abrupt negative inflection of -23.86‰ at 1.93 m. The succeeding values increase to -22.63 ‰ at 4.38 m then drop to around -23.2 ‰ up to the level of 27.4 m. These C-isotope values are consistent with the results obtained at the El Pui section, suggesting that the Barremian-Aptian boundary may be correlated with the negative excursion at 1.93 m (about 7.89 m from the tunnel wall). Biomarker analyses at 0 m, 0.43 m, 3.93 m, 10.75 m, 14.85 m, and 29.95 m, respectively, show *n*-alkanes with chain lengths that vary between C10 to a highest of C34, with predominance below C21. The highest chain length of C34 is recorded at 0 m, indicative of terrestrial input at that level. The preserved n-alkanes most likely characterize the original composition of the OM because Pristane/Phytane (Pr/Ph) ratios vary between 0.57 and 1.54 less than 2.5 indicative of overmature organic matter. Spumellarid and nasselarid radiolarians concur with normal open marine environments characteristic of the basin flooding succeeding Jurassic–Barremian shallow-water conditions.

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Turonian–Coniacian flora of the Okhotsk-Chukotka volcanogenic belt (North-eastern Russia)

***Herman, A.*[1,*], *Golovneva, L.*[2], *Shczepetov, S.*[2]**

*1) Geological Institute, Russian Academy of Sciences, Moscow, Russia, *E-mail: alexeiherman@yandex.ru*
2) Komarov Botanical Institute, Russian Academy of Sciences, St. Petersburg, Russia

The Okhotsk-Chukotka volcanogenic belt (OChVB) formed in the middle-Late Cretaceous as a result of intense land volcanism extends along the northeastern margin of Asia. Volcanogenic and terrigenous deposits of the OChVB reflect depositional environments of intermontane valleys and volcanic plateaus. The Arman Flora comes from the Arman Formation in the Arman, Nelkandya and Khasyn rivers basins. Seventy-three plant fossil species belonging to liverworts, horsetails, ferns, caytonialeans, cycadaleans, bennettitaleans, ginkgoaleans, leptostrobaleans, conifers, gymnosperms *incertae sedis* and angiosperms are described. The Arman flora shows a unique taxonomic combination, with relatively ancient Early Cretaceous ferns and gymnosperms occurring alongside Late Cretaceous plants, primarily angiosperms. This flora is dated as Turonian and Coniacian due to its similarity with Penzhina and Kaivayam floras of Northwest Kamchatka and Tylpegyrgynai Flora of the Pekul'nei Ridge, with the latter floras being securely dated due to the correlation of plant-bearing beds with marine biostratigraphy. Turonian–Coniacian age of the Arman Flora is corroborated by isotopic (U-Pb SHRIMP and $^{40}Ar/^{39}Ar$) age determination. Our estimates using CLAMP technique, GRIDMET3BR meteorological data and PHYSG3BRC set of foliar physiognomic scores (http://clamp.ibcas.ac.cn/) shows that the Arman plants experienced a humid temperate climate with warm summers, mild winters and a weak seasonality in precipitation. This climate was most similar to those experienced by the Penzhina, Kaivayam and Tylpegyrgynai floras existed in coastal lowlands east of the volcanic range. This implies that the elevation of the Arman Flora site was low and it had no effect on the Arman plants physiognomy. Using CLAMP-derived moist enthalpy value, the most probable elevation of the Arman Flora biotope is estimated to be 0.61 km above the sea level. The correlation of the OChVB plant-bearing beds with the adjacent Anadyr-Koryak Subregion phytostratigraphy yields the uppermost Albian-Cenomanian-lower Turonian stratigraphic gap in the volcanites. This gap within the OChVB might be due to the following reasons: we have not found any fossil floras of this age within the OChVB yet, or we do not recognise the fossil floras of this age existed within the volcanic range at some altitude, or in the latest Albian–Cenomanian–early Turonian the volcanism of the OChVB ceased completely or significantly diminished.

Cretaceous seeds interpreted as insect eggs

Hermanová, Z.[1,*], Kvacek, J.[1], Bodor, E.R.[2], Vasile, S.[3], Csiki-Sava, Z.[3]

*1) National Museum, Prague 1, Czech Republic, *E-mail: zuzka.hermanova@gmail.com*
2) Geological and Geophysical Institute of Hungary, Budapest, Hungary
3) University of Bucharest, Bucharest, Romania

Small seeds of angiosperms resemble particular insect eggs in their shape and size. In the fossil record, insect eggs may easily be misinterpreted as seeds, because of their similar morphology and preservation. Both insect eggs and angiosperm seeds are often preserved as charcoal. *Palaeoaldrovanda splendens* Knobloch et Mai from the South Bohemia Basins was originally described as a fossil seed, closely related to the extant carnivorous plants *Aldrovanda vesiculosa* (Droseraceae). *Knoblochia cretacea* Heřmanová et al. from the Late Cretaceous of Austria, Czech Republic and Poland was originally described as an angiosperm seed of the family Stemonaceae. However, reinvestigation of both these fossils shows that *Palaeoaldrovanda* and *Knoblochia* are insect eggs (HEŘMANOVÁ & KVAČEK, 2010, HEŘMANOVÁ et al., 2013).

During investigations of Late Cretaceous vertebrate localities from the Haţeg Basin (Romania), new fossils were found that were not the vertebrate remains for which the locality is known. Detailed studies revealed that these fossils show morphological similarities to insect eggs.

Another possible insect egg is *Costatheca diskoensis*, described from a number of Late Cretaceous localities from Central Europe (BATTEN & ZAVATTIERI, 1996). In contrast to *Palaeoaldrovanda* and *Knoblochia*, it is preserved as cuticle.

Common characters of fossil insect eggs are: surfaces showing rectangular cells in rows, and projections on both ends of the fossils. The projections, sometimes surrounded by a rim, resemble an operculum at one end and a posterior polar mound. Such projections are also seen in recent Phasmatodea. The structure of rectangular cells in rows resembles the chorion of Lepidoptera. Due to the large number of extinctions among insects since the Cretaceous, their systematic affinity remains open.

BATTEN, D.J. & ZAVATTIERI, A.M., 1996. Cretac. Res., **17**, 691–714.
HEŘMANOVÁ, Z. et al., 2013. Cretac. Res., **45**, 7–15.
HEŘMANOVÁ, Z. & KVAČEK, J., 2010. J. Natl. Museum (Prague), Nat. Hist. Ser., **179**, 105–118.

Discovery of the first theropod dinosaur tracks in the Lower Albian lacustrine facies of Central Tunisian Atlas

***Houla, Y.*[1,*], El Ferhi, F.[2], Soussi, M.[3], Gierlinski, G.D.[4], Nasri, A.[2], Skanji, A.[2], Trabelsi, K.[5], Niedzwiedzki, G.[6], Sames, B.[7], Wagreich, M.[7]**

1) National Office of Mines of Tunisia (ONM), Geology Department, Tunis, Tunisia,
**E-mail: yassine.houla@omn.nat.tn*
2) Tunisienne d'Activités Pétrolières (ETAP), Tunis, Tunisia
3) Université de Tunis El Manar, Faculté des Sciences de Tunis, Tunis, Tunisia
4) Polish Geological Institute - National Research Institute, Warszawa, Poland
5) Université de Sfax, Faculté des Sciences de Sfax, Sfax, Tunisia
6) Evolutionary Biology Centre, Uppsala University, Uppsala, Sweden
7) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria

Recent geological investigations undertaken within a National Project framework involving the University, ETAP and ONM on the Cretaceous series of central Tunisian Atlas have led to a detailed facies mapping of the Aptian-Albian series from Gafsa to Kasserine areas. In Jebel Koumine (Kasserine region) the continental facies, which represents the equivalent of the well-known Kebar Formation, have been recently dated as Lower Albian thanks to the presence of diagnostic fauna and flora (Trabelsi et al., 2016). These continental facies resting over the shallow marine Aptian carbonate platform of the Orbata Formation comprise at their base a distinct sedimentary interval made up of whitish, laminated and fine grained limestones deposited in a lacustrine environment (Nasri et al., in progress). Within this facies belt we have identified theropod dinosaur tracks for the first time. Two track morphotypes were identified on the same bedding surface. The larger track shows an enlarged proximal (metatarsal pads) area corresponding most likely to the Early Cretaceous ichnogenus *Irenesauripus* (preliminary interpretation). This specimen is also morphologically close to *Kayentapus* and *Eubrontes* ichnogenera. These tracks constitute the northernmost witnesses of the dinosaurs ever described in the Tunisian Atlas and can be correlated to the well preserved and documented dinosaur bones from fluvial sandstones of the Chenini Formation outcropping in the Saharan Platform 300 km south of our study area.

This new important discovery (ongoing research) rekindles the debate on the northern limit of the Albian continental facies and boosts the research in order to revise the paleogeography of Tunisia during the Early Albian, considered as lacking overall central Tunisia in most previous stratigraphic works.

Trabelsi, K. et al., 2016. dx.doi.org/10.1016/j.cretres.2016.07.004

Microbial tetraether biomarker records in the Lower Cretaceous paleosols in Sichuan Basin, China

***Hu, Jianfang**[1,*], Liao, W.[1], Huang, Chengmin[2]*

*1) Guangzhou Institute of Geochemistry, Guangzhou, China, *E-mail: hujf@gig.ac.cn*
2) Guangzhou Institute of Geochemistry, Guangzhou, China

The ubiquious occurrence of microbial tetraethers-glycerol dialkyl glycerol tetraethers (GDGTs) in soils and their ability to record the temperature and environmental variations offer the promise of reconstructing continental paleotemperature and paleoenvironment from the paleosol sequences. In this study, the GDGT-derived proxies are investigated for the paleosol sequences taken from the Sichuan Basin. The studied sequence consists of non-marine synorogenic deposits, including lacustrine, alluvial and fluvial sandstone, siltstone, shale and mudstone (LI et al., 2016). The strata were mainly distributed in the northwestern Sichuan Basin and divided into Gudian, Qiqusi, Bailong and Cangxi Formation. The ages were assigned to Lower Cretaceous (Berriasian to Early Hautervian) according to the paleomagnetic and biostratigraphic data.

The branched GDGTs (brGDGTs) including 6-methyl brGDGTs were identified in the paleosols. The total concentrations of brGDGTs are 0.022–3.215 ng/g. Temperature record reconstructed using the modified MAT_{mr} (DE JONGE et al., 2014) display that pronounced phases of climatic cooling existed during the Late Berriasian, Early Valanginian and Early Hautervian. The continental temperature varied between 8.9 °C and 21.0 °C, indicating a temperate climate prevailed in the Sichuan Basin during the the Lower Cretaceous. The reconstructed temperate is roughly coupled with the paleoatmospheric CO_2 concentration (LI et al., 2016).

DE JONGE, C. et al., 2014. Geochim. Cosmochim. Acta, **141**, 97–112.
LI, J. et al., 2016. Cretaceous Res., **62**, 154–171.

Cretaceous–Paleogene lithostratigraphic and tectonostratigraphic frameworks in southern Tibet: implication to the timing of the India-Asia collision

***Hu, Xiumian**[1,*], Li, Juan[2], An, Wei[1,3], Wang, Jiangang[1,4]*

*1) School of Earth Sciences and Engineering, Nanjing University, Nanjing, China, *E-mail: huxm@nju.edu.cn*
2) School of Marine Science, Guangxi University, Nanning, China
3) Hefei University of Technology, Hefei, China
4) Chinese Academy of Sciences, Beijing, China

Lithostratigraphic redefinition is a fundamental and important work, and reflects present knowledge to understanding the strata in a given region. This paper presents detailed description and critical review of 34 lithostratigraphic units in southern Tibet, including 14 lithostratigraphic units of southern Tethyan Himalaya, which are Gucuocun, Dongshan, Chaqiela, Lengqingre, Bolinxiala, Gambacunkou, Jiubao, Zhepure Shanpo and Zongshan formations of the Cretaceous; Jidula, Zongpu, Enba and Zhaguo formations of the Paleogene; 9 lithostratigraphic units of northern Tethyan Himalaya which are Weimei, Rilang, Jiabula and Chuangde formations of the Cretaceous, Zongzhuo, Jiachala, Denggang, Sangdanlin and Zheya formations of the Paleogene; 9 lithostratigraphic units of Xigaze forearc basin, which include Sangzugang, Ngamring, Padana and Qubeiya formations of the Cretaceous, Quxia, Jialazi, Dajin, Qiuwu and Dazhuka formations of the Paleogene; and two from the Indus-Yarlung suture zone, which are Cretaceous Chongdui Formation and Oligocene-Miocene Liuqu group. Based on obtained stratigraphic, sedimentological, provenance and basin evolution data, this paper divides 7 tectonostratigraphic units in southern Tibet including two Cenozoic tectonostratigraphic units (TS1, TS2) after India-Asia initial collision, 5 Cretaceous tectonostratigraphic units prior to the India-Asia collision including the TSI3, TSI4, TSI5 units belong to the northern margin of India and the TSL3, TSL4 units belong to southern margin of Asia.

Was the late Albian–Santonian too warm to support ephemeral polar ice sheets? ^{18}O paleotemperature evidence from southern high latitudes

Huber, B.[1,*] ***and MacLeod, K.G.***[2]

*1) Department of Paleobiology, Smithsonian Institution, Washington, USA, *E-mail: huberb@si.edu*
2) Department of Geological Sciences, University of Missouri-Columbia, Columbia, USA

Determining when and if polar ice sheets existed during the Cretaceous has many implications for models attempting to explain the record of sea level variations, patterns of atmospheric and oceanic circulation, and mechanisms of global heat transport. Direct evidence for glacial ice in Antarctica during the Cretaceous is non-existent, but reports of tillites and cobble to boulder-sized dropstones in South Australia suggest that glacial ice was present several times during the Valanginian through Aptian. Compilations of late Aptian-Maastrichtian foraminiferal $\delta^{18}O$ measurements are providing an increasingly complete history of mid–Late Cretaceous climates. The most dynamic and continuous archive of global paleotemperature shifts occurs in hemipelagic and pelagic chalk sequences deposited at southern high latitudes. A new compilation of $\delta^{18}O$ values from well preserved foraminifera from Falkland Plateau and Maud Rise (southern South Atlantic, 58–65°S paleolatitude) and Naturaliste Plateau (southern Indian Ocean, 60°S paleolatitude) is presented for the late Aptian-Maastrichtian using revised age-depth models for accurate correlation. The trend is similar to previous compilations showing decreasing $\delta^{18}O$ values for high latitude surface and intermediate water temperatures from the late Aptian-middle Cenomanian, minimum Turonian $\delta^{18}O$ values, and increasing Coniacian through Maastrichtian values. Paleotemperature calculations from the benthic and planktic $\delta^{18}O$ values (using standard assumptions for Cretaceous seawater) indicate that subpolar intermediate and surface waters averaged (1) 12° and 16°C, respectively during the middle Albian, (2) 19° and 28°C, respectively during the Turonian, (3) 12° and 14°C, respectively during the early Campanian, and (4) 6° and 8°C, respectively during the early Maastrichtian. Comparison with Paleogene foraminiferal $\delta^{18}O$ values from the same southern high latitude sites reveals that the late Albian and early Campanian were comparable to those recorded during the early-middle Eocene, and maximum temperatures during the Turonian thermal maximum were warmer by 10°C than the Paleocene-Eocene thermal maximum. Considering that the continental interior of Antarctica was probably bathed by a very warm ocean throughout the late Albian–early Campanian and the polar plateau was not likely to have been at an extraordinarily high elevation, we suggest that existence of even ephemeral continental ice sheets is highly unlikely from the late Albian through Santonian; before and after that interval, existence of Cretaceous ice sheets is unproven.

Barremian-Aptian rudist shells record dramatic shallow-water sea-surface temperature changes in the subtropical Tethyan Ocean

Huck, S.[1,*] ***and Heimhofer, U.***[1]

*1) Leibniz Universität Hannover, Hannover, Germany, *E-mail: huck@geowi.uni-hannover.de*

The dramatic and stepwise emplacement of large igneous provinces is generally accepted as primary driver of Cretaceous Oceanic Anoxic Events (OAEs). Although excess output of volcanically induced greenhouse gases should have promoted “super greenhouse phases”, several studies provide evidence for transient Cretaceous “cold snaps”, particularly during the Barremian-Aptian stage. To date, high-resolution reconstructions of Cretaceous sea surface temperatures (SSTs) are predominantly based either on $\delta^{18}O$ analyses of pristine foraminiferal calcite or on crenarchaeotal membrane lipid distributions (TEX_{86}) in pelagic deposits. Both types of proxies provide at best estimates of mean annual SSTs of open ocean settings.

In order to better understand the dynamics of Cretaceous global warmth and the impact of fluctuating SSTs on carbonate platform ecosystems, the current project aims at reconstructing the stratigraphic and spatial evolution of subtropical shallow-marine sea-surface temperatures. Well-preserved low-Mg calcite rudist shells hold a strong potential to act as archives for the reconstruction of Cretaceous palaeoclimatic and palaeo-environmental conditions, as ontogenetic isotopic and trace element variability of these shells also resolve sub-annual (seasonal) temperature fluctuations (STEUBER et al., 2005). In the context of the current project, high-resolution sclerochemistry ($\delta^{18}O$, Mg/Ca ratios) has been performed on rudists derived from chemostratigraphically ($^{87}Sr/^{86}Sr$, $\delta^{13}C$) well-constrained Barremian–Aptian carbonate platform settings in the subtropical Tethyan realm (France, Croatia, Spain, Portugal). The outcome of this work will be of significance both for those studying the triggering factors of major carbonate platform crises culminating in oceanic anoxic events and the palaeoecology of rudist bivalves.

STEUBER, T. et al., 2005. Nature, **437**, 1341–1344.

Assembling coniferous plants from Mexico based on reproductive and vegetative organs

Huerta Vergara, A.R.[1,*] ***and Cevallos Ferriz, S.R.S.***[2]

1) Posgrado en Ciencias de la Sostenibilidad, Instituto de Ecología, UNAM, CDMX, Mexico,
**E-mail: alma12136@hotmail.com*
2) Instituto de Geología, UNAM, Mexico DF, Mexico

Little is known from Mexican Cretaceous floras, but since the 1970's sporadic reports suggest they were an important component of the vegetation. In the last decade material from the Lower Cretaceous Sierra Madre Formation, Chiapas, and Upper Cretaceous, Cabullona Group, Sonora, have yield well preserved vegetative and reproductive organs, some in organic connection. Recently, members of Cupressaceae and Podocarpaceae from Chiapas have been described based on leafy twigs, and ovuliferous cones. Their systematic affinity was further explored through a cladistic analysis (GÓNZALEZ-RAMÍREZ, 2017). Presence of a member of the Cheirolepidaceae is proposed based on leafy twigs that carry a mature cone. Isolated leaves further suggest the presence of a different member of Podocarpaceae, and a probable Araucariaceae plant, but cuticle (not well preserved in the material so far collected) studies are needed to confirm their systematic position. From Sonora a leafy twig and an ovuliferous cone support the presence of a Pinaceae plant, and their morphology and anatomy suggest that both may be members of a plant representing an extinct section of *Pinus*, if their match to the same plant is proved. The proposed plant reconstructions based on the associations of leafy twigs and ovuliferous cones is greatly improved by their association with recently collected twigs holding pollen cones in both localities. Those from Chiapas further support the presence of extinct Cupressaceae plants, while the material from Sonora further supports the presence of Pinaceae. The extinct fossil plants represent taxa that formed part of the conifer vegetation of low latitude North America. Their relative importance, measured as their dominance in the collection effort, suggest that at that time Cupressaceae were dominant in the vegetation, and that only in recent time Pinaceae became the dominant element among coniferous vegetation in Mexico. Further work in the area will help to construct a continuous account of coniferous vegetation in Mexico, and establish biogeographic relationships among lineages involved in this history.

GONZÁLEZ-RAMÍREZ, I.S., 2017. Diversidad de coníferas fósiles… M.Sc. Thesis, UNAM, Mex.

New insights into micro- and macrofaunal assemblages from the uppermost Hauterivian *Pseudothurmannia* beds of the Polomec hill (Western Carpathians, Slovakia)

Hyzný, M.[1,*], Józsa, S.[1], Rybár, S.[1], Halásová, E.[1], Lukeneder, A.[2], Setoyama, E.[3]

*1) Comenius University, Bratislava, Slovakia, *E-mail: hyzny.matus@gmail.com*
2) Natural History Museum, Vienna, Austria
3) University of Utah, Salt Lake City, USA

Outcrops with well-exposed strata of the Pseudothurmannia beds, characteristic ammonoid-rich Tethyan successions of the uppermost Hauterivian, are rare in Central Europe. In Slovakia, the best studied section of the *Pseudothurmannia* beds is located on the Polomec hill on the foot of the Strážovské vrchy Mts. (northeastern Western Carpathians), close to Lietavská Lúčka village. On the Polomec hill numerous outcrops are located in a large quarry with several levels; one of them exposes the *Pseudothurmannia* beds. The exposed strata consist of marly limestones of the Maiolica-type Mráznica Formation.

In the latest decade, rich assemblages of ammonoids, calcareous nannoplankton, planktonic foraminifera and smaller benthic foraminifera were collected bed-by-bed from the studied section consisting of approximately 6 metres (38 beds) of continuous sequence. This portion of the otherwise much larger section was selected because of a potential to locate the Hauterivian–Barremian stratigraphic boundary. An abundant ammonoid fauna of the *Pseudothurmannia* beds consists mainly of the heteromorphic taxa of the families Crioceratitidae (Crioceratites, Pseudothurmannia) and Emericiceratidae (Honnoratia, Paraspiticeras) and a typical upper Hauterivian ammonoid fauna with *Lytoceras*, *Phyloceras*, *Phyllopachyceras*, *Plesiospitidiscus*, *Acrioceras* and *Megacrioceras*. The ammonoid-dominated macrofauna is accompanied by locally abundant lamellaptychi, belemnites, rare brachiopods and crinoids. The biostratigraphy is based on the ammonoids (*Pseudothurmannia ohmi* Zone) and calcareous nannoplankton (*Litraphidites bollii* NC5B and NC5C zones).

Concerning agglutinated foraminifera, the LO of *Protomarssonella subtrochus* at the base of the studied section was observed. Within the section rare to occasional taxa include *Saccammina* sp., *Reophax helveticus*, *Scherochorella minuta*, *Eobigenerina variabilis*, *Pseudobolivina varians*, *Verneuilinoides neocomiensis* and *Praedorothia hauteriviana*. Common or relatively abundant are *Haplophragmoides* spp., *Cribrostomoides* spp., *Conglophragmium* spp. or *Trochammina* spp. The most abundant species belong to astrorhizid and ammodiscid genera *Rhabdammina, Batysiphon, Lagenammina, Tolypammina, Rhizammina, Glomospirella, Ammodiscus* and *Glomospira*.

Interestingly, the quantitative distribution of the foraminifera shows several events of decreasing quantity. Although deep-water agglutinated foraminifera are taxonomically not very diverse, several short-term changes in the morphogroup composition were identified. Some of these changes are correlated with changes recorded in microfacies, planktonic foraminifera and calcareous benthic foraminifera (spirilinids, miliolids and nodosarids). Within the section agglutinated foraminifera assemblages display two events of quantitative decline. Some of these declines can be equivalent to the anoxic Faraoni Level in the *Pseudothurmannia ohmi* Zone (*Pseudothurmannia mortilleti* Subzone), which was considered to be coeval with the *Pseudothurmannia* beds.

Maastrichtian paleotemperature changes in the Southern Russia

Iakovishina, E.[1,*]***, Mashkina, Y.A., Blinov, I.V., Bordunov, S.I.***

*1) Lomonosov Moscow State University (MSU), Moscow, Russia, *E-mail: yakovishina@mail.ru*

Water temperature change of even a few degrees can have irreversible consequences for the environment. We have studied several sections in the south of the Russian Platform, in the Crimea and the Caucasus. Sections of the Crimea, the Caucasus and the Saratov-Volga region in Maastricht, located near one paleolatitude. At this time, this area was a shallow-marine epicontinental basin north-eastern shelf zone of the Tethys Ocean. In this area, sediments of various types of sedimentation: carbonate and carbonate-clayey-clastic. To analyze the variation paleotemperatures values analyzed isotopic composition of carbon and oxygen carbonates, as well as the concentrations of elements and their relationships V, Ca, Ni, Mn, Ca/Sr, Ca/Mg, Sr/Ba, Si/Al, Zn/Nb, (Ce, Nd, La, Ba)/Yb, (Y, Zr), titanium module (TM) (BADULINA et al., 2016). The coefficient of variation $\delta^{18}O$ / $\delta^{16}O$ measured by a mass-spectrometer with an accuracy of ± 0,01 %. Paleotemperatures determined with an accuracy of up to 1° C rarely up to 0.5°C. Information about the surrounding environment indicator organisms (paleoecological analysis) helped to clarify the results and build a synthetic curve of temperature change on a range of techniques. For the Caucasus (Daria river section) paleotemperatures were quite high (from 19.33° to 34.59°C). According to earlier estimates, the climate in the Maastrichtian was warm enough, is characterized by high temperature of the sea basin, an average of about 14°C with strong warming in the range of 65.55–65.20 million years. Temperature data from the Crimea (Ak-Kaya section) to Maastrichtian range from 16.5° C to 21.7° C, whereas the Danian temperatures were higher: 26.4°C and 29.9° C. The increase of $\delta^{13}C$ indicates an increase in the role of organic matter in the basin as well as living organisms use for photosynthesis $\delta^{12}C$ and $\delta^{13}C$ remains in the water and carbonates. Distribution of oxygen isotopes in the Ak-Kaya section shows that $\delta^{18}O$ content decreases with increasing temperature. In determining the conditions of sedimentation section of the Saratov-Volga region (Lower Bannovka section) ratio of the chemical elements and their modules are allowed to detail the situation of sedimentation. By isotope data were calculated according to the formulas paleotemperatures, which were quite high (from 19.33° to 26.14° C). On the formation of this section deposits influenced Priurals strait connecting Tethys and Paleoarktic. Through the strait of deep cold waters, rich of SiO_2, penetrated into the territory of the Saratov-Volga region, so the rock bottom of the section, represented by clays, noted the presence of the mineral opal (BLINOVA et al., 2015).

Thus, in all studied sections marked local temperature rise in the Late Maastrichtian, which is well correlated with the warm Late Maastrichtian transgression. This confirms the connection of the studied paleobasins in that time.

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BADULINA, N. et al., 2016, Bull. M. Soc. I. N., Dep. Geol., 17–26.
BLINOVA, I. et al., 2015. In: LISIZYN, A. et al. (eds.), Geology of seas and oceans, 59–62.

Lower Cretaceous formations and paleontology in southeast Mongolia

Ichinnorov, N.[1,*]***, Hasegawa, H.***[2]***, Ando, H.***[3]***, Nyamsambuu, O.***[4]***, Adiya, E.***[5]***, Gombosuren, T.***[1]

*1) Institute of Paleontology and Geology, MAS, Ulaanbaatar, Mongolia, *E-mail: iichka@yahoo.com*
2) University Museum, Nagoya University, Nagoya, Japan
3) Department of Earth Sciences, Faculty of Science, Ibaraki University, Mito, Japan
4) School of Geology and Mining, NUM, Ulaanbaatar, Mongolia
5) Uyan Geo resource LLC, Ulaanbaatar, Mongolia

The Lower Cretaceous formations in Mongolia are composed of alluvial to fluvio-lacustrine deposits of the Tsagantsav Formation, lacustrine deposits of the Shinekhudag Formation and coal-bearing fluvial deposits of the Khukhteeg Formation in ascending order. Here we summarize stratigraphy and paleontological age constrains of Mongolian Lower Cretaceous deposits.

The Lower Cretaceous Tsagantsav Formation consists of coarse-grained fluvial deposits, fine-grained alluvial plain and lacustrine deposits. The type section of the Tsagantsav Formation is well exposed in Khara Khutul in the East Gobi basin, which consists of sandstone dominant and finer-grained lithology. GRAHAM *et al.* (2001) reported late Neocomian age based on ^{40}Ar/^{39}Ar age of 131 ± 1 Ma (Khara Khutul section) and 126 ± 1 Ma (Tsagan Tsav section) of the intercalated basalts. Plant fossils preserved within the sediments also indicate Valanginian to Barremian age. The Tsagantsav Formation contains abundant fossil remains, such as conchostracans, ostracode, plants, dinosaurs (Psittacosauridae), spores and pollen.

The Shinekhudag Formation crops out well in the East Gobi, Nyalga and Choibalsan basins. The type section of this formation crops out in the Shine Khudag locality in northeastern East Gobi. The Formation with 300 to 700 m thickness is composed of paper shale (well-laminated shale), dolomitic marls, dolomite, siltstone and sandstone, which represent characteristics of offshore lacustrine facies in large (extensive), perennial lakes. It also contains abundant fossil remains, such as conchostracans, ostracode, plants, bivalves, and gastropods, charophytes, spores and pollen. The Ar^{40}/Ar^{39} age of intercalated basalts in the upper part of the underlying Tsagantsav Formation is also consistent with the Aptian age of the Shinekhudag Formation. Based on the radiometric age dating (U/Pb age of intercalated tuff), the Shinekhudag Formation is considered to be deposited between ca. 123–119 Ma.

The Khukhteeg Formation is composed mainly of dark greyish coaly mudstone, light greyish sandstones and conglomerates. It is widespread in the east and central Mongolia with a characteristic feature of abundant coal seams (Shivee Ovoo, Tevshin Gobi, Bayan Erkhet, Khuren Dukh, Nalaikh, Baga Nuur localities). The thickness is about 150–300 m. In the type section of the Khukh Teeg hill there are abundant remains of stromatolites. The Khukhteeg Formation is dated as Albian or Aptian–Albian based on the basis of stratigraphic occurrences of turtles and mammals (Dosh Uul, Khar Khutul, Khukh Teeg), molluscs (Khamaryn Khural), champsosaurs and pollen-spore. Plant megafossils suggest that the deposits are late Aptian to Albian in age due to the floral similarity with the equivalent strata in the Amur Basin, Japan and northeastern China.

The Rosario section, Coahuila, northeastern Mexico and its potential as Global Stratotype Section and Point for the Turonian-Coniacian boundary (Upper Cretaceous)

Ifrim, C.[1,*] ***and Stinnesbeck, W.***[1]

1) Institut für Geowissenschaften, Ruprecht-Karls-University Heidelberg, Heidelberg, Germany,
**E-mail: christina.ifrim@geow.uni-heidelberg.de*

The Rosario section in northern Coahuila, northeastern Mexico, contains a 50 m thick succession of limestone and marl across the Turonian-Coniacian boundary. The sediments formed on the open shelf of the Gulf of Mexico in an oceanic junction between the Tethys, North- and South Atlantic, and the Western Interior Seaway of North America. The faunal assemblage is thus conformed by a palaeobiogeographical mix from these faunal provinces. Inoceramid bivalves are represented by thirteen taxa (IFRIM et al., 2014) and allow for a biostratigraphic subdivision. The uppermost Turonian *Mytiloides scupini* and *C. waltersdorfensis w.* zones and the lowermost Coniacian *C. deformis erectus* and *C. deformis dobrogensis* zones are well represented in Rosario. They may be more expanded than in the sections of the US Western Interior and Europe, although some questions remain when details of this correlation are concerned. These will be addressed within this presentation. The early Coniacian *C. waltersdorfensis hannovrensis* is an unreliable index species for correlation between the Old and New World due to its scarcity in North America. The European *C. waltersdorfensis hannovrensis* Zone can be correlated with the North American *C. crassus crassus* Zone. This long-distance correlation is supported by stable isotope stratigraphy. Several isotope peaks and minima can be correlated with signals in the European sections.

IFRIM, C. et al., 2014. Newslett. Stratigr., **47**, 211–246.

The Jimenez sections in Northeastern Mexico and their sedimentary record across the Santonian-Campanian boundary

***Ifrim, C.**[1,*] **and Stinnesbeck, W.**[1]*

1) Institut für Geowissenschaften, Ruprecht-Karls-University Heidelberg, Heidelberg, Germany,
**E-mail: christina.ifrim@geow.uni-heidelberg.de*

The Santonian-Campanian boundary is among the last Cretaceous stages without a Global Boundary Stratotype Section and Point (GSSP), mostly due to the absence of adequate sections. Here we introduce two north-eastern Mexican sections from Jiménez, Coahuila, immediately south of the Rio Grande. These are superbly exposed, lithostratigraphically monotonous and rich in fossils, and they cross the Santonian-Campanian boundary. The sections have long been known for their occurrence of giant *Parapuzosia*, but were never studied in detail. Along the prerennial Río Tecolote, a tributary to the Rio Grande, an estimated 30 m section of sediment is exposed over ca. 3 km of the riverbed and in tributaries to the north. The outcrops comprise a succession of grey and white limestone at the base, followed by to bright grey and white limestone, and 5 m of yellow chalk at the top. The top of the section is also accessible in a well exposed section at Jiménez, where we identified *Sphenoceramus*, *Cordiceramus*, and plates of crinoids *Marsupites testudinaris* and *Uintacrinus anglicus*. These fossils indicate that the uppermost Santonian and basal Campanian is present there, according to the biostratigraphic zonation presented by (GALE et al., 2008) for the Austin Chalk near Dallas, Texas. The second outcrop area is at Tepeyac along the Río Blanco, ca. 50 km to the South. Several hundreds of square meters of outcrop are exposed in a wide and mostly dry riverbed. The section is 30 m thick and consists of white limestone intercalated with thin-bedded grey marl. *Submortoniceras tequesquitense* indicates an early Campanian age for the upper levels of this section. Our initial data lead to the following preliminary conclusions: Santonian-Campanian boundary sections in the Jiménez area are lithologically monotonous, rich in fossils, and individual beds can be followed over continuous outcrops of up to 1km extension. Both the Río Blanco and the Río Tecolote outcrops may contain complete and well expanded records of the Santonian-Campanian boundary, but this needs additional research. During the Upper Cretaceous, the area was located in an oceanic junction between the Tethys, North- and South Atlantic, and the Western Interior Seaway of North America, which suggests that a mixture of faunal elements from these palaeobiogeographical provinces is present.

GALE, A.S. et al., 2008. Cret. Res., **29**, 131–167.

Extreme greenhouse conditions: Mesozoic examples of palaeoclimatic fluctuations from the southwestern margin of the Neotethys in the Salt Range, Pakistan

***Iqbal, S.**[1,*], **Wagreich, M.**[1], **Jan, I.**[2], **Kürschner, W.**[3], **Gier, S.**[1]*

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: siqbal_geol@yahoo.com*
2) National Centre of Excellence in Geology, Peshawar, Pakistan
3) Department of Geosciences, Oslo, Norway

The Triassic was generally dominated by warm-semiarid to arid palaeoclimate. However, palaeoclimatic reconstructions at the Triassic-Jurassic boundary indicate a prominent sea-level fall and change from warm-arid to warm-humid conditions in the Tethyan realm. In the Tethyan Salt Range of Pakistan a succession of Upper Triassic dolomites/green-black mudstones (Kingriali Formation), overlying quartzose sandstone, mudstones, laterites and Lower Jurassic conglomerates/pebbly sandstones (Datta Formation) provide information on the palaeoclimatic evolution and sea-level fluctuation of the area. Preliminary palynological results for the Kingriali Formation indicate dominance of pollens in the mudstones whereas spores are dominant in the Datta Formation. Clay mineralogy of the upper part of the Kingriali Formation (Rhaetian) indicates high illite to kaolinite ratio. The kaolinite content, a reflection of the advanced stage of chemical weathering and hence greenhouse conditions, increases up-section in the overlying sandstone-mudstone succession (Hettangian). The overlying laterite-bauxite horizons lack illite/smectite and are rich in kaolinite, boehmite and haematite. At places these kaolinite rich horizons are mined in the area (Western Salt Range). The bulk rock geochemistry of the succession confirms a similar trend. The Chemical Index of Alteration (CIA) displays an increasing trend from the Upper Triassic shales (CIA 75–80) through the overlying sandstones/mudstones-laterites to the overlying quartz rich sandstones and mudstones (CIA 90–97). The overall results for the succession reveal an increasing chemical maturity trend (increase in the intensity of chemical weathering) thereby supporting a change from warm-arid to a warm-humid palaeoclimate, probably extreme greenhouse conditions. During the late Mesozoic, a similar situation was established in the Salt Range, Trans-Indus Ranges and Kohat-Potwar Plateau. The Lower Cretaceous Chichali and Lumshiwal formations represent siliciclastic deposition on top of Middle Jurassic carbonates of the Samana Suk Formation. Striking similarities to the Datta Formation include: 1) both successions represent thick siliciclastic deposition on top of a carbonate platform, an indication of general sea-level fall, and 2) the sandstones in both the successions are texturally and compositionally mature quartz arenites deposited in warm-humid palaeoclimate of typical Mesozoic greenhouse conditions favouring chemical weathering.

The ENCI-HeidelbergCement Group quarry at Maastricht, the Netherlands – a latest Cretaceous mosasaur park from 2018 onwards?

***Jagt, J.W.M.*[1,*] and Jagt-Yazykova, E.A.[2]**

*1) Natuurhistorisch Museum Maastricht, Maastricht, The Netherlands, *E-mail: john.jagt@maastricht.nl*
2) Uniwersytet Opolski, Katedra Biosystematyki, Opole, Poland

The still active ENCI-HeidelbergCement Group quarry at Sint-Pietersberg, south of the city of Maastricht, is currently undergoing marked changes that have been agreed upon in a so-called 'Plan of Transformation'. Quarrying will come to a halt by July 1, 2018, after which date the quarry will be turned into a multi-purpose recreation/nature/arts and sciences area. In fact, the foundation 'Stichting Ontwikkelingsmaatschappij ENCI-gebied' is already well underway in seeing these plans through.

Exposed at the quarry, which is adjacent to the type section of the Maastrichtian Stage of André H. DUMONT (first described and named in 1849), are various units of biocalcarenites assigned to the Gulpen and Maastricht formations of late Maastrichtian (*c.* 69–66 Ma) age. Of special note are the flint cyclicity in the Lixhe and Lanaye members (Gulpen Formation), the four partial mosasaur skeletons that have been unearthed here between 1998 and 2015 and the overall increase in fossil biodiversity towards the top of the sequence that illustrates deposition in a shallow, warm-water (subtropical) setting. Primarily the mosasaurs, nicknamed Bèr (1998), Kristine (2009), Carlo (2012) and Lars (2015) appeal to the general public and are instrumental in getting the palaeontological message across, so to speak. The quarry grounds make for ideal open-air museum exhibits that are complementary to the ones at the Natuurhistorisch Museum Maastricht/Centre Céramique in the city of Maastricht and present visitors with an unsurpassed 'hands-on' experience. The local branch ('afdeling Limburg') of the Dutch Geological Society, in conjunction with staff members of the Natuurhistorisch Museum Maastricht, contribute the necessary know how. The biocalcarenites at the quarry are covered by uppermost Eocene/lowermost Oligocene mostly decalcified sands (that have yielded isolated bones of an archaeocete whale) and Pleistocene (*c*. 700 ka) gravels of the River Maas (Meuse) and aeolian sands (loess). This sequence is ideal for illustrating large-scale geological processes (transgressions/regressions, erosion, sedimentation) and evolutionary turnovers in fauna and flora that have occurred in the past 70 million years.

http://www.enci-gebied.nl/
https://www/natuurmonumenten.nl/enci-groeve-maastricht

New stratigraphical and faunal data on the type Maastrichtian (uppermost Cretaceous; southeast Netherlands and northeast Belgium)

***Jagt, J.W.M.**[1,*] **and Jagt-Yazykova, E.A.**[2]*

*1) Natuurhistorisch Museum Maastricht, Maastricht, The Netherlands, *E-mail: john.jagt@maastricht.nl*
2) Uniwersytet Opolski, Katedra Biosystematyki, Opole, Poland

The introduction in 1975 of a formal lithostratigraphical subdivision for Upper Cretaceous and lower Paleogene strata in the southeast Netherlands and northeast Belgium has led to a renewed interest in the biostratigraphy and macropalaeontology of these rocks. The use of bioclasts (size range of 1–2.4 mm) has resulted in more reliable correlations between the various units of the Vaals, Gulpen, Maastricht and Kunrade formations, often challenging previous interpretations based solely on lithological features. Attempts are now being made to link such bioclast-based ecozones to sequence stratigraphy and flint rhythmicity (Milankovitch cyclicity), with a strontium isotope backup.

Key index fossils for interregional/intercontinental correlations include dinoflagellates, benthic and planktonic foraminifera, calcareous nannoplankton, ammonites (mostly heteromorphs, such as scaphitids and baculitids), belemnitellid coleoids and inoceramid bivalves. Mainly as a result of close co-operation with non-professional palaeontologists in the area, numerous new records have been published over recent years and more work is underway. Because of the generally coarse-grained nature of these biocalcarenites and the lack of any significant overburden, preservational biases (i.e., aragonite dissolution, selective silicification processes) tend to blur the overall picture. However, obrution deposits at some levels have yielded unsurpassed echinoderm Lagerstätten. Towards the top of the Maastricht Formation (uppermost Maastrichtian), the shallowing trend in these (sub)tropical settings is reflected in the wealth of micro- and macrofossil taxa and of bioerosional ichnotaxa. Numerous new records of sponges, scleractinian corals, octocorals, cirripedes and decapod crustaceans, rudistid and other bivalves, gastropods and ammonoids have been made. Sea grass (*Thalassocharis bosquetii*, occasionally silicified) and other marine plants such as *Mosacaulis spinifer* are common as well. Vertebrates include teleost fish (with a few near-complete skeletons, mostly dercetids), sharks, rays and chimaeras, as well as marine turtles, mosasaurs (five taxa in all) and the odd plesiosaur. Terrestrial elements include various plants, mammals, lizards and birds. Near the Cretaceous-Paleogene (K/Pg) boundary section at the Geulhemmerberg subterranean galleries, east of Maastricht, at the former Curfs quarry unit IVf-7 of the Meerssen Member (Maastricht Formation) has an indigenous earliest Paleocene molluscan fauna with articulated bivalves and survivor species amongst heteromorph ammonites.

Mid-Cenomanian Event I vs. the CTBE: geochemical and palaeoenvironmental contrasts between two major Late Cretaceous carbon isotope events

***Jarvis, I.*[1,*], *Gröcke, D.*[2], *Roest-Ellis, S.*[3], *Selby, D.*[2]**

*1) Kingston University London, Kingston upon Thames, UK, *E-mail: i.jarvis@kingston.ac.uk*
2) Durham University, Durham, UK
3) Oxford University, Oxford, UK

Cenomanian times (100.5–93.9 Ma) represent perhaps the best documented episode of eustatic rise in sea level in Earth history and the beginning of the Late Mesozoic thermal maximum, driving global expansion of epicontinental seas and the onset of widespread pelagic and hemipelagic carbonate (chalk) deposition. Significant changes occurred in global stable-isotope records, including two prominent perturbations of the carbon cycle – Mid-Cenomanian Event I (MCEI; ~96.5–96.2 Ma) and Oceanic Anoxic Event 2 (OAE2; ~94.5–93.8 Ma). OAE2 was marked by the widespread deposition of black shales in the deep ocean and epicontinental seas, and a global positive carbon stable-isotope excursion of 2.0–2.5‰ $\delta^{13}C$ in marine carbonates. Osmium isotopes and other geochemical evidence indicate that OAE2 was associated with a major pulse of LIP-associated volcanism, with coincident changes in eustatic sea level, rising atmospheric pCO_2 and warming climate, but including a transient phase of global cooling – the Plenus Cold Event.

MCEI, by contrast, shows a <1‰ $\delta^{13}C_{carb}$ excursion, and has no associated black shales in most areas, yet it also displays evidence of two episodes of cooling, comparable to the Plenus Cold Event. MCEI represents a major breakpoint on long-term carbon-isotope profiles, from relatively constant to very slowly rising $\delta^{13}C$ values through the Lower Cenomanian, to a trend of generally increasing $\delta^{13}C$ values through the Middle and Upper Cenomanian. This represents a significant long-term change in the global carbon cycle starting with MCEI. Here, we present new high-resolution elemental data and $^{187}Os/^{188}Os$ isotope results for MCEI from an English Chalk reference section at Folkestone. Our results are compared to published $\delta^{13}C_{carb}$, $\delta^{18}O_{carb}$, $\delta^{13}C_{org}$ stable isotope and neodymium isotope εNd(t) data from the same section. Elemental proxies (Mn, Ti/Al, Zr/Al, Si/Al) define key sequence stratigraphic surfaces, providing a basis for refining relative sea-level curves. Cyclical small-scale transgressive events within the mid-Cenomanian TST of depositional sequence Ce IV are accompanied by coupled increases in εNd(t) and decreases in $^{187}Os/^{188}Os$ ratios. Os_i ratios of 0.8–0.9 prior to MCEI, rise to 1.2 in the lower peak of the isotope excursion, coincident an influx of boreal fauna and the lowest εNd(t) values in the section (<-10), and show a stepped fall thereafter. Highly unradiogenic Os_i values of ≤ 0.2 occur immediately above MCEI, in an interval of high εNd(t). These geochemical data are interpreted to represent cyclical changes in water mass sources and distribution in the Chalk sea, driven by sea-level and climate change. The remarkably low Os_i values recorded following MCEI indicate a dominance of hydrothermal/mantle-like sourced Os in southern England waters at that time.

Early Cretaceous paleoclimate and paleogeography in Tarim Basin, northwestern China: a palynological record

Jiang, Dexin[1], Wang, Yongdong[2,3], Jiang, Wei[4], Li, Liqin[2,*]

1) Lanzhou Insititute of Geology, Chinese Academy of Sciences, Lanzhou, China
*2) Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, *E-mail: lqli@nigpas.ac.cn*
3) State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing, China
4) Norfolk State University, Norfolk, VA, USA

The Early Cretaceous palynofloras from the Shushanhe Formation in the northern Tarim Basin and the Kizilsu Group in the southwestern and southeastern Tarim Basin of China are dealt with in this study. The palynoflora from the Shushanhe Formation is characterized by the predominance of Coniferales including Cheirolepidiaceae, Pinaceae and Podocarpaceae, and the subdominance of Filicales including Lygodiaceae, Schizaeaceae, Lyatheaceae and Osmundaceae. The palynofloras from the Kizilsu Group are characterized by the dominance of Coniferae, the abundance of Schizaeaceous ferns and the presence of primitive angiosperms.

The palynological evidence suggests that the Shushanhe Formation and the Lower Kizilsu Group should belong to Neocomian or Hauterivian to Barremian in age and the Upper Kizilsu Group should be of Aptian to Albian in age. The results of this study indicate that the early Early Cretaceous palaeoclimate in the Tarim Basin should belong to the arid or semi-arid type of subtropics, and the late Early Cretaceous palaeoclimate there should belong to the subtropical semi-arid type with relatively moist conditions.

The discussion of the relationship between the phototropism and the plate motion

Jiang, Z.[1,*], ***Min, Huang***[1], ***Yuanzheng, L.***[2], ***Benpei, L.***[3], ***Wang, Yongdong***[4]

*1) Chinese Academy of Geological Sciences, Beijing, China, *E-mail: jiangmaomao_925@sina.com*
2) Research Institute of Petroleum Exploration and Development, Beijing, China
3) China University of Geosciences, Wuhan, China
4) Nanjing Instituete of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China

Plant phototropism means that trees on the side directly exposed to sunlight generally grow faster than on the opposite. The positive phototropism is easy to observe in crown and trunk. We choose the transverse section of the tree trunk to observe. The definitive intensity of plant phototropism ranges regularly from "strong to weak and finally disappeared" along with the latitudinal change from high to low. In the well-preserved in situ petrified wood phototropism phenomenon also exists (JIANG et al., 2014). Different plates have different tectonic movements. Some rotated during certain geological time, which recovered from the palaeomagnetic records. The eccentricity of tree growth rings should be related to the direction of sunshine. Then compare the phototropism direction of the trunk of the fossil wood with the living normal growth stumps, thus verify the paleomagnetic evidence whether the plates rotated or not (LIU, 2012).

The positive phototropism is received by measuring the eccentricity of the growth rings. The eccentricity is the direction from the pith to the longest part of the transverse section of the trees. We measured the eccentricity of the in situ preserved fossil trunks and the extant normal growth stumps in the same latitude without any disturbing elements. The difference of the two data of the eccentricity may reflect differences in latitude, which could deduce whether plate rotation occurs. The silicified wood in Xinchang of Zheijiang Province was preserved in Xinchang National Geopark of Silicified Wood. The in situ silicified stumps were preserved in the Guantou Formation of the Early Cretaceous. One well-preserved petrified stump showing distinct growth rings was chosen for measuring the positive phototropism direction, the result is SW225o. For comparison with the relevant data of living trees in the same area, without any other disturbing factors, exhibits a positive phototropism direction of SW219o± 5o. Compared the phototropism of the silicified wood in Xinchang with the modern normal growth stumps in plain area, we found that both of them have eccentricity towards about 219°±5°, indicating that the South China Plate from the Early Cretaceous to nowadays did not rotate almost.

JIANG, Z.K. et al., 2014. Acta Geol. Sinica, **88**/5, 1352–1355.
LIU, B.P., 2012. 5th National Synposium on Structural Geology & Geodynamics, Abstracts, 26–27.

Dynamic pedostratigraphy: Vertisol genesis and sedimentation in an Early Cretaceous (Neocomian–Aptian) fluvial-to-palustrine setting, Sevier foreland, Utah, USA

Joeckel, R.M.[1,*]***, Ludvigson, G.A.***[2]***, Kirkland, J.I.***[3]

*1) University of Nebraska-Lincoln, Lincoln, NE, USA, *E-mail: rjoeckel3@unl.edu*
2) Kansas Geological Survey, Lawrence, KS, USA
3) Utah Geological Survey, Salt Lake City, UT, USA

The Yellow Cat Member (YCM) of the Cedar Mountain in the Poison Strip in Grand County, Utah consists of at many as six alluvial sequences (not channel stories) consisting of fluvial channel, overbank, and splay deposits, as well as minor palustrine carbonates. These sequences are bounded by erosional surfaces that are very prominent in many places, but slightly obscured by soil development in others. The stratigraphy and internal architecture of the YCM was partially determined by syndepositional pedogenesis and the development of soil microrelief.

The YCM is dominated overall by comparatively thick, massive, reddish mudstones in which paleo-Vertisol profiles as deep as 450 cm have developed. Within these profiles, nested, synformal sets of very large slickensides ("bowls") intersect at their margins as "peaks" distributed at intervals of a few to several meters, in a fashion identical to the general pattern among modern Vertisols. In a prominent paleo-Vertisol that dominates one of the uppermost alluvial sequences of the YCM, palustrine carbonates are displaced along slickensides, indicating pedoturbation followed an episode of mixed alluvial-clastic and palustrine-carbonate deposition. Sediment colors, textures, and fabrics exhibit variable degrees of vertical and lateral gradations that are relatable to pedogenesis. Many thin beds of sandstone or intercalated sandstone and mudstone have termini that curve upward by at least one bed thickness. This phenomenon appears to be related to: (1) syndepositional control of deposition in splays and shallow floodplain channels by pre-existing gilgai microrelief atop paleo-Vertisols, and (2) deformation of the same kinds of strata by soil-related processes after the shallow burial of a given alluvial sequence.

Paleo-Vertisols exhibiting deep cracking suggest deep desiccation under a seasonal rainfall regime and they seem to reflect the emergence of an orographic effect east of the contemporary Sevier Mountains. We refer to the cumulative effects of ancient pedogenesis on deposition, erosion, and the lateral and vertical relationships of sedimentary bodies as *dynamic pedostratigraphy*. In devising this term, we seek to communicate that there were feedbacks and other linkages between ancient soil development and sedimentation.

Multiproxy analysis of the nature and origin of carbonate and non-carbonate microparticles in siliceous chalk

Jurkowska, A.[1,*]***, Bąk, M.***[1]***, Świerczewska-Gładysz, E.***[2]***, Okoński, S.***[3]

*1) Faculty of Geology, Geophysics and Environmental Protection AGH, University of Science and Technology, Kraków, Poland; *E-mail: jurkowska.a@gmail.com*
2) Institute of Earth Science, University of Łódź, Łódź, Poland
3) Institute of Geography, Pedagogical University of Kraków, Kraków, Poland

Lower Campanian carbonate rocks of the Miechów Synclinorium (southern Poland) were deposited in a epicontinental sea, which was a part of the Late Cretaceous European Basin. The carbonate deposits of the studied sections differ from the typical chalk (e.g., Stevns chalk; HJULER et al., 2007) lower calcium carbonate content (63–89 %) and higher content of insoluble residue (opal CT, chalcedony and clay minerals). Different macrotexture rock features observed during sampling were the basis for distinguishing three different rock type: marly siliceous chalk, siliceous chalk and siliceous marls. The main matrix component of all studied rocks is allomicrite (disintegrated individual coccoliths shields) and pseudomicrite (microcrystalline calcite < 4 µm) (sensu FLÜGEL, 2010) with different admixture of opal CT and clay flakes. Primary sediment composition (microfossils, terrigenic input), palaeoecological factors (sedimentation rate, bathymetry, redox) and later rock transformations after depositions and during diagenesis (physical and chemical compaction, cementation) have the biggest influence on carbonate rock macro- and microtextures.

The multiproxy analysis of a nature and origin of the main microparticles of three different rocks types is presented. The integrated study using SEM-EDS, SEM-BSE analysis combined with XRD, CL analysis allow to recognize the mineralogical composition, origin of the main microparticles and described its influence on the carbonates micro and macrotexture.

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New Data on the Upper Barremian–Aptian Bio- and Sequence Stratigraphy in the Racha Region (West Georgia)

***Kakabadze, M.V.*[1,*], *Kakabadze, I.M.*[2], *Lanchava, G.J.*[1]**

*1) Alexandre Janelidze Institute of Geology, I. Javakhishvili Tbilisi State University, Tbilisi, Georgia, *E-mail: mishakakab@gmail.com*
2) Ilia State University, Tbilisi, Georgia

Within the eastern segment of the Racha-Lechkhumi syncline of the northern stripe of the Transcaucasian Intermountain area, in the vicinity of villages Kvatskhuti and Khimshi the Lower Aptian *Deshayesites weissi, Deshayesites deshayesi* and *Dufrenoyia furcata* Zones are absent and lowermost Upper Aptian with reworked brecciate basement lies on the erosion uneven surface of limestones of the upper Barremian–lowermost lower Aptian sequence. As it turns out, the causes of formation of the mentioned stratigraphic break primarily was related to eustatic sea-level changes, established also in some adjacent southern regions of Georgia, where the synchronous Lower Cretaceous sequences are represented by shallow water carbonate subplatform facies (DEVDARIANI et al., 1975; KAKABADZE, 2006; KAKABADZE & KAKABADZE, 2012; KAKABADZE et al., 2013). It is noteworthy that similarity between the Georgian (KAKABADZE, 2006) and global (HAQ, 2013) sequence statigraphic Aptian schemes, is in coincidence namely of lower boundaries of the lowermost Upper Aptian sequence, whereas there is no synchronicity when correlating the subsequent Upper Aptian–Lower Albian sequences. Such mismatch, in all probability, points out to a more or less simultaneous influence of the eustasy and regional tectonic movements in formation of the revealed sequences and their stratigraphical unconformities in Georgia and its some adjacent areas during the latest Aptian–early Albian.

Palaeogeographic features of the pre-late Aptian basin within the studied and adjacent southern areas of Georgia are discussed. In particular, questions of location of the pre-late Aptian shallow sea areas, with their submarine elevations and temporary islands, as well as subsequent event of the earliest late Aptian transgressive subcycle are reconsidered.

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Paleoenvironmental perturbation across the Cenomanian-Turonian boundary (OAE2) in the Kopet-Dagh basin inferred from benthic foraminiferal assemblages and geochemical anomalies

Kalanat, B.[1], Vahidinia, M.[1], Mahmudy Gharaie, M.H.[1,*], Kumon, F.[2]

*1) Ferdowsi University of Mashhad, Mashhad, Iran, *E-mail: mahmudygharaie@gmail.com*
2) *Shinshu University, Matsumoto, Japan*

In order to evaluate the effects of the Oceanic Anoxic Event 2 (OAE2) on benthic foraminifera, a stratigraphic section (Taherabad) in the east of Kopet-Dagh basin of Iran was studied to document the pattern of changes in foraminiferal communities. TOC concentration in the studied successionwas increased up to 1 % in the two intervals belonging to *Rotalipora cushmani* and *Whiteinella archaeocretacea* biozones. The $\delta^{13}C$ curve show the typical features of the globally documented Cenomanian/Turonian positive excursion which is the result of burial of isotopically depleted organic carbon. Organic matter-rich intervals are characterized by lower $\delta^{18}O$ values that indicate deposition under a warm condition with limited oxygen contents and enhanced primary productivity. These intervals are associated with a low abundance and low diversity of benthic assemblages that strongly dominated by shallow and deep infaunal agglutinated foraminifera. Characteristics taxa in this intervals are *Lagenammina*, *Saccammina*, *Reophax* and *Tritaxia*. A few opportunistic calcareous foraminifera include *Gavelinella dakotensis* and *Lenticulina* spp. are also present. By contrast, the assemblages found below and above warm intervals are more diverse and contain high abundance of calcareous benthic foraminifera. Common taxa in these parts are praebuliminids, lenticulinids, gavelinellids and *Valvulineria*. The significant abundance of praebuliminids and co-existence of infaunal and epifaunal morphogroups indicate a relatively high primary productivity (mesotrophic condition) during the improved ventilation of sea-floor.

Heterohelix and *Guembelitria* blooms before the K-Pg boundary in Haymana Basin, Turkey

Karabeyoglu, A.U.[1,*]***, Altiner, S.***[1]***, Altiner, D.***[1]

*1) Middle East Technical University, Ankara, Turkey, *E-mail: uygar.karabeyoglu@metu.edu.tr*

Abundance and diversity patterns in planktonic foraminifera are important for paleo-environmental and paleoclimatic interpretations before and after the Cretaceous-Paleogene mass extinction. A 14,53 m-thick section was measured crossing the boundary between the Haymana Formation and the Yeşilyurt Formation in the northern part of the Haymana Basin. In the last 3.75 meters of the Maastrichtian below the K-Pg boundary, a series of quantitative analyses were carried out on planktonic foraminifera found above 63 and 150-micron screen sizes. By using foraminiferal bioevents, biozones were established which are: *Pseudoguembelina hariaensis* Zone for the uppermost Maastrichtian; P0 and *Parvularugoglobigerina eugubina* zones for the base of Danian. Additionally, paleobathymetry of the measured section was studied with the help of planktonic-benthic ratios. Calculations indicate approximately 340 m water depth for the depositional environment. Identification of deep water dweller planktonic foraminifers in the studied section, such as *Planoglobulina multicamerata* and *Gublerina cuvillieri* also supports this result.

Quantitative analyses resulted that at the end of Maastrichtian, *Heterohelix* species, which are tolerant to temperature, nutrient, oxygen and salinity fluctuations, dominated (~40 %) the environment while those which are not resilient such as *Globotruncana* species remained low (~10 %). On the other hand, *Guembelitria cretacea*, which show opportunistic blooms during environmental crisis and dwell at the surface of the water column, survived from the K-Pg mass extinction. This study, for the first time in Turkey, shows blooms of *Guembelitria cretacea* in Haymana Basin for the latest Maastrichtian and right after the K-Pg boundary in P0 Zone.

After the K-Pg mass extinction, first samples of the Danian P0 Zone are characterized by an abrupt increase in calcareous spherical forms whose diameters are ranging between 10 to 20 microns. Apart from that, another sharp increase was also found in echnioid fecal pellets at 2 cm above the boundary. Previously, the same pellet increment was recognized in the southern part of the basin. These discoveries support the idea of 'Echinoid fecal pellet peak as a K-Pg boundary marker'.

In the Haymana Basin, Maastrichtian mudstones are overlain by limestone and mudstone alternations in the Danian indicating a major change in the depositional regime after the K-Pg boundary. A similar stratigraphy has also been observed in the Mudurnu-Göynük Basin in the K-Pg boundary beds. This similarity in an interval of high chronostratigraphic resolution brings the question whether these two basins were connected to each other during end Cretaceous and the beginning of Paleocene.

Late Barremian–Aptian Ostracod biostratigraphy in the Mountain Crimea

***Karpuk, M.*[1]**

1) Geological Institute of RAS, Moscow, Russia, E-mail: maria.s.karpuk@gmail.com

Lower Cretaceous (particularly upper Barremian–Aptian) deposits of the Crimea have been studied for many decades. Several biostratigraphical schemes based on ammonites (BARABOSHKIN et al., 2004 etc.), Planktonic Foraminifera (PF) (GORBACHIK, 1986) and Calcareous Nannoplankton (CN) (SHCHERBININA & LOGINOV, 2012) were developed for these sediments. However, no ostracod biostratigraphy has as yet been established.

Abundant and various complexes of ostracodes from eight outcrops were analyzed and a zonation upon ostracods was established. This zonation is correlated with PF (MOULLADE et al., 2015) and CN zones (SHCHERBININA & LOGINOV, 2012). Correlation with ammonite zones is impossible because of their rarity. Comparison of the studied ostracodes with evenaged complexes from Eastern Europe, South America, Africa and Caucasus showed high level of endemity of the Crimean ostracodes. There are only a few common species that cover an extensive stratigraphycal range; it completely constrains the direct correlations between the regions. The only exception is *Protocythere triplicata*, that occurs in the lowest part of the studied interval (lower part of upper Barremian) and represents an index of cognominal zone, established by CHRISTENSEN (1974) in Hauterivian–upper Barremian. The other established zones are local and are traced only in the Mountain Crimea. These are *Robsoniella minima – Loxoella variealveolata* cooccurrence zone (from FO of *R. minima* to LO of *L. variealveolata*), which covers the upper part of upper Barremian to lower part of Lower Aptian and corresponds upper part of *Globigerinelloides blowi* PF zone and upper part of NC5E and lower part of NC6 zones. *Monoceratina bicuspidata – R. minima* interval-zone (from FO of *M. bicuspidata* to FO of *Saxocythere omnivaga*), which corresponds *Leopoldina cabri*, *Hedbergella luterbacheri* and *G. ferreolensis heptacameratus* PF zones and lower part on NC7 zone. *S. omnivaga* zone (from FO to LO of *S. omnivaga*), corresponds *G. fereolensis fereolensis*, *G. barri*, *G. algerianus* and lower part of *H. trocoidea* PF zones and the middle part of NC7 zone. *M. bicuspidata – D. stafeevi* interval-zone (from LO of *S. omnivaga* to LO of *M. bicuspidata*), corresponds the upper part of *H. trocoidea* and lower part of *Paraticinella eubejaouaensis* PF zones and upper part of NC7 zone.

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Provenance of the chalk grounds of the medieval icons from the National Museum in Kraków on the basis of their calcareous nannoplankton assemblages

***Kedzierski, M.*[1,*] *and Kruk, M.*[2]**

1) Institute of Geological Sciences, Jagiellonian University, Kraków, Poland,
**E-mail: mariusz.kedzierski@uj.edu.pl*
2) National Museum in Krakow, Kraków, Poland

Due to its peculiar features, Upper Cretaceous chalk was commonly used in arts as an underpainting layer, so-called whites, especially in Middle Ages. For arts, the white, fine-grained pelagic limestone, consisting of almost pure foraminiferal and nannoplankton ooze, was the most precious sort of chalk grounds. So far, the Boreal Chalk (Netherlands, N Germany, Denmark) is considered the main source of these kind of whites. The National Museum in Kraków (Poland) has a large collection of medieval orthodox icons, mostly coming from the Carpathians. Their origin is still disputable since there is no proper source of chalk whites in the Carpathians and their foreland. This study aims to recognize the provenance of the underpainting layers regarding their calcareous nannoplankton assemblages, the major component of whites. Moreover, the qualitative and quantitative analysis of these assemblages allow us to recognize similarities, and to compare with assemblages provided from localized outcrops.

Among 56 simple-smear slides taken from whites, 47 contain Upper Cretaceous nannofossil taxa (11 barren in nannofossil slides seems to be sampled from gypsum/anhydrite grounds). 45 slides indicate Upper Campanian—Upper Maastrichtian assemblages and 2 Turonian—Coniacian. The latter may represent Central Russia sources regarding the manner of painting of icons. 3 of 45 from the Campanian—Maastrichtians slides yield Tethyan assemblages and may come from the southern Carpathians and/or Balkans.

The rest, i.e. 42 of 45 slides provide Boreal nannofossil assemblages, dominated by *Micula staurophora*, *Arkhangelskiella* spp. and *Prediscosphaera* spp. The cluster analysis clearly separates the Turonian—Coniacian and Tethyan assemblages from the Boreal ones and shows the strong similarity between them. The second cluster analysis combines the slides sampled in the Chełm City outcrops (Lublin Upland, E Poland) and those from medieval icon reveals their close affinity.

The group of the oldest icons (14th-16th c.) in the National Museum in Krakow was tested thanked to the grant from the National Programme for the Development of Humanities, obtained in 2015 (1bH 15 0435 83).

Sedimentation on the northern Tethys margin during the Campanian–Maastrichtian Boundary Event: case study from the Skole Nappe of the Polish Carpathians

Kedzierski, M.[1,*] ***and Leszczynski. S.***[1]

1) Institute of Geological Sciences, Jagiellonian University, Kraków, Poland,
**E-mail: mariusz.kedzierski@uj.edu.pl*

The Skole Nappe of the Polish Carpathians is built of sediments deposited on the northern margin of the Tethys ocean. The sediments were deposited in the Skole Basin bordered directly by the shelf of the European Platform, which was the main source area. During the late Campanian–early Maastrichtian, the Skole Basin provided accommodation for the Kropiwnik Fucoid Marl (KFM) succession characterized by thinly-bedded, soft to hard turbiditic marlstones alternated in various proportions with thinly-bedded turbiditic sandstones, subordinate conglomerates, and turbiditic to hemipelagic muddy to clayey shales. Previous interpretations on the origin of the KFM indicated sedimentation control by regional tectonic factors. Lithofacies and calcareous nannofossil analysis by the authors suggests that fluctuations in marlstone distribution in the KFM succession were controlled mainly by eustatic sea-level changes and associated changes in oceanographic conditions, both resulting from global climate alteration within the Campanian–Maastrichtian Boundary Event. A tentative palaeoceanographic model has been proposed (KĘDZIERSKI & LESZCZYŃSKI, 2013) to show the sedimentation control. Moreover, recent detailed sedimentological studies have revealed sediment supply from intrabasinal source(s). These, most probably, were blind anticlines resulting from ongoing Laramian compression. Consequently, the KFM succession exemplifies a combined effect of climatic, oceanographic and tectonic changes that took place during the Campanian–Maastrichtian Boundary Event.

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A revised integrated Cretaceous biostratigraphy of eastern Greenland

Kelly, S.R.A.[1,*]***, Braham, W.***[2]***, Doyle, P.***[3]***, Gregory, J.F.***[4]***, Kennedy. W.J.***[5]***, Owen, H.***[6]***, Walaszcyk, I.***[7]***, Whitham, A.G.***[1]

*1) CASP, Cambridge, UK, *E-mail: simon.kelly@casp.cam.ac.uk*
2) Deceased
3) Department of Earth Sciences, University College, London, UK
4) Petrostrat Ltd, Tan-y-Craig, Parc Caer Seion, Conwy, Wales, UK
5) Oxford University Museum, Parks Road, Oxford OX1 3PW, UK
6) Department of Palaeontology, The Natural History Museum, London, UK
7) Institute of Geology, University of Warsaw, Warsaw, Poland

Part of eastern Greenland bordering the western seaboard of the northern North Atlantic contains a near complete succession, all be it fragmented, of marine Cretaceous strata. All stages are represented from Berriasian to Maastrichtian. It is the best analogue for sedimentary rocks offshore Norway which are a major target for hydrocarbon exploration. Similar successions are not available onshore in Scotland or Norway. In Svalbard only the Early Cretaceous is exposed. An integrated biostratigraphic scheme is presented in this paper of the Cretaceous of eastern Greenland uniting macropalaeontology, a favoured tool of onshore field geologists at outcrop, with microbiota, used heavily by the hydrocarbon industry from borehole information. Of the macrofauna, ammonites, buchiid and inoceramid bivalves are of particular value, but belemnites are also of use. Marine dinoflagellate cysts with spores and pollen, together with microfauna, particularly foraminifera and radiolarians, all obtained from mudstones provide a more continuous biostratigraphic history. All groups also provide data on palaeoenvironment. For over a quarter of a century now, CASP has routinely sampled onshore mudrocks as well as macrofauna from a variety of sedimentary rock types, which allows close associations to be recognised between important biostratigraphic indicators. A significant collection of identified macrofossils has been built up that can be used for comparative biostratigraphic purposes. Detailed *Stratabugs* distribution charts have been drawn up for many sections using macro-and micro biota. Construction of an integrated biostratigraphic scheme has resulted in significant advances, such as the recalibration of parts of the palynological scheme for the region. At the same time our understanding of the age of part of the ammonite succession has been improved by knowledge of the associated dinoflagellate cyst succession. Thus the integrated scheme helps to avoid some of the pitfalls generated by using single taxonomic groups only. Diagenetic history may obscure the biostratigraphic value of some groups of biostratigraphic indicators, but knowledge of others from the same or adjacent horizons may compensate for the ommission.

This fully integrated scheme will be of value not just to field geologists, but also to the hydrocarbon industry, working in wells both on- and offshore in the Norway-Greenland Sea region and adjacent areas, such as the Barents Shelf and the North Atlantic.

Biostratigraphy of the Barremian-Aptian (Early Cretaceous) of eastern Greenland

***Kelly, S.R.A.*[1], Braham, W.[2], Schneider, S.[1]**

*1) CASP, Cambridge, UK, *E-mail: simon.kelly@casp.cam.ac.uk*
2) Deceased

In eastern Greenland, marine Barremian-Aptian deposits are known from the Watkins Fjord Formation on Kangerlussuaq. Going northwards scattered outcrops of the Steensby Bjerg Formation or equivalent units in the 'Mid Cretaceous sandy shale sequence' occur principally on Traill Ø, Geographical Society Ø, Hold with Hope, Wollaston Forland, eastern Kuhn Ø, Hochstetter Forland, Store Koldewey and some of the smaller islands. Detailed knowledge of the biostratigraphy of this interval in eastern Greenland is variable. A good dinoflagellate cyst stratigraphy has been established for the mudrocks through the work of NØHR-HANSEN (1993). He recognised five biozones in the Early Cretaceous, of which three are of relevance to this study: *Batioladinium longicaudatum* (Early-Late Barremian, with 3 subzones); *Pseudoceratium nudum* (earliest Aptian) and *Circulodinium brevispinosum* (Early Aptian to Early Albian, with 4 subzones). However, detailed association of the dinoflagellates with other important macrofossil groups is often lacking. CASP studies (KORAINI, 1997) demonstrated the soundness of Nohr-Hansen's scheme and the potential of relating the microfloras to macrofossils. A number of often large heteromorph ammonites have been discovered which include *Audouliceras* and *Procheloniceras* that are related to the principal *Sanmartinoceras* fauna of the region appearing to be of Late Barremian age. Lytoceratid ammonites are also common ranging up to levels with deshayesitids. Certainly the coming of the deshayesitid faunas heralds the Early Aptian (KELLY & WHITHAM, 1999) and *Tropaeum subarcticum* Casey may indicate the Late Aptian. Allocation of the first-described ammonite faunas including *Sanmartinoceras* to the Late Aptian by BØGVAD & ROSENKRANTZ (1934) and FREBOLD (1935) is challenged herein; these are probably of Late Barremian age. Significant belemnite faunas of oxyteuthids as well as the inoceramid bivalve *Neocomiceramus* span the Barremian-Aptian boundary. The successive biotas are brought together to give a more integrated biostratigraphy for eastern Greenland and comparisons will be drawn with equivalent successions of northwest Europe, the Russian Platform and the Barents Shelf including Spitsbergen.

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Integrated Lower Cretaceous stratigraphy from the Aisén Basin, Patagonia, Chile

***Kesjar, D.*[1,*], Özy, I.[2], Price, G.[3], Condon, D.[4], Salazar, C.[5], Pálfy, J.[6,7]**

1) Dept. of Mineralogy and Geology, University of Debrecen, Debrecen, Hungary,
**E-mail: kesjar.dora@csfk.mta.hu*
2) Dept. of Palaeontology and Geology, Hungarian Natural History Museum, Budapest, Hungary
3) School of Geography, Earth and Environmental Sciences, Plymouth, UK
4) British Geological Survey, NIGL, Keyworth, UK
5) Dept. of Geology, University of Desarrollo, Concepción, Chile
6) Dept. of Physical and Applied Geology, Eötvös Loránd University, Budapest, Hungary
7) MTA-MTM-ELTE Research Group for Paleontology, Budapest, Hungary

The Early Cretaceous is an eventful epoch in the Mesozoic, but data coverage is geographically uneven. New data from underexplored regions, such as South America, help global correlation, our understanding of geologic, biotic and environmental events, and the geologic time scale calibration. The Aisén Basin is a Cretaceous back arc basin in Chilean Patagonia, forming part of the larger Austral Basin. A section at Rio Simpson contains an extended record of Lower Cretaceous formations, suitable for integrated stratigraphic research. This study focuses on fossiliferous strata and zircon-bearing volcanic tuff layers in the Katterfeld Formation, using ammonite biostratigraphy, carbon isotope and Sr isotope stratigraphy and U-Pb radioisotopic dating.

The ammonite fauna is dominated by the endemic genus *Favrella*, represented by three species, of which *F. americana* appears first in the lower Hauterivian, followed by *F. wilkensi* in the Upper Hauterivian. Due to the high paleolatitude, the ammonite fauna is of low diversity and correlation with the Tethyan faunas is difficult. For the first time, an organic carbon isotope curve was developed from this part of the Lower Cretaceous in South America. The δ13Corg values from base to the top show an increase from -27‰ to -24‰ and then oscillate around -24.5‰. The pronounced positive shift in the lower part of the section permits correlation with the Late Hauterivian segment in the global curve, known mostly from carbonate carbon analyses of Tethyan sections (FÖLLMI et al., 2006). However, the shift may also be explained by more localised effect of bottom-water upwelling in the Aisén/Austral Basin during the Hauterivian sea-level rise. Two tuff layers yielded zircon U-Pb ages of 129.35±0.05 Ma and 127.52±0.03 Ma. AGUIRRE-URRETA et al. (2015) presented similar ages from a correlative section in the Neuquén Basin, from the base of the Upper Hauterivian and near the Hauterivian/Barremian boundary. Together with other numerical ages reported by VENNARI et al. (2014), the Early Cretaceous timescale can now be improved by new constraints and tie-points from South America.

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Episodes of anoxic ferruginous conditions in the Coniacian–Campanian on the Eastern Russian Platform

Khabipyanov, L.[1], Zorina, S.[1,*], Afanasieva, N.[2], Sokerina, N.[3], Perovskiy, I.[3], Morozov, V.[1], Eskin, A.[1]

*1) Kazan Federal University, Kazan, Russia, *E-mail: svzorina@yandex.ru*
2) TSNIIGEOLNERUD, Kazan, Russia
3) Insitute of Geology, Komi Science Center, UB RAS, Syktyvkar, Russia

OAE 3 was identified as a long-time event in the organic-rich Coniacian–Santonian successions of the low- to mid-latitudinal part of the Atlantic, the Maracaibo Basin, and the Western Interior Basin (WAGREICH, 2012). At the same time, most of the Tethys was characterized by oxic deep-water conditions and the deposition of red to brownish or light grey deep water sediments (WAGREICH, 2012). During the Late Cretaceous the Boreal basin on the Eastern Russian Platform has been a part of the North-Eastern Peri-Tethys which was connected with the Turonian Platform by the Turgai strait and with the West Siberian Basin by a system of small Uralian straits (BARABOSHKIN et al., 2003). Mainly carbonate sedimentation prevailed but at times siliceous sedimentation dominated in the basin.

The Coniacian–Campanian succession has been studied in the western part of the Uljanovsk-Saratov meridional depression by XRD, SEM, microprobe, and geochemical analyses. The Coniacian and Lower Santonian deposits are presented mostly by light gray carbonate gaizes and dark gray zeolitic clays, the Campanian consists dominantly of light gray marls. The section was devided into biostratigraphical zones (OLFER'EV et al., 2008) and correlated with the GTS 2012 (GRADSTEIN et al., 2012). XRD analysis of the Coniacian light greenish-gray siliceous clays revealed essential quantities of siderite and haematite (1–2 %), besides main rock-forming components (illite, smectite, opal-CT, calcite, etc.). Lower Campanian light gray calcareous gaizes contain siderite (2 %) as well. SEM studies revealed that highly calcareous, clayey, and siliceous sediments are rich in spherical and octahedral bacteria-like structures composed of siderite. There is also strong geochemical evidence for episodic anoxic ferruginous conditions (CLARKSON et al., 2016) in the Coniacian and Early Campanian in contrast the general oxic conditions during the Coniacian–early Santonian and Campanian. Two intervals characterized by elevated values of siderite and hematite which consist of a higly reacted Fe, and negative anomalies of $\delta^{13}C_{bulk}$ demonstrate that anoxic intervals on the Eastern Russian Platform were ferruginous, with no evidence for the pyrite enrichments that would be prevalent under euxinic conditions (CLARKSON et al., 2016). Remarkably, there are no black shales in the section.

Consequently, we infer at least two short-lived ferruginous episodes in the Coniacian and Lower Campanian on the Eastern Russian Platform which could probably correspond with OAE 3 or another unexplored anoxic event.

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Latest Volgian (earliest Berriasian) *Volgidiscus*-bearing beds of the European part of Russia and their significance for inter-regional correlation and palaeogeography

Kiselev, D.[1], Rogov, M.[2,*], Victor, Z.[2]

1) Yaroslavl State Pedagogical University, Yaroslavl, Russia
*2) Geological Institute of RAS, Moscow, Russia, *E-mail: russianjurassic@gmail.com*

More than 40 years ago Raymond CASEY (1973) has recognized Volgidiscus lamplughi as a highest zone of the Volgian Stage in East Anglia. *Volgidiscus*, which is an only ammonite genus recorded from this zone, has been considered as direct descendant of *Subcraspedites*, the genus common in the underlying strata. For a long time, occurrences of ammonite genus *Volgidiscus* were known from NE Europe and Subpolar Urals only. Recently *Volgidiscus* were discovered in the Yaroslavl region of the Russian Platform, where they occurred within the beds with *Volgidiscus (V.) singularis* (KISELEV, 2003). However, *Volgidiscus* at first were found in the single section only, and relationship of *Volgidiscus*-bearing strata with underlying and overlying zones remains unclear. Recently along with additional records of this genus together with *Shulginites* in the glacial boulders one more section showing slightly older assemblage with *Volgidiscus* has been discovered in the same region. Here within the relatively thick sandy member an assemblage consists from *Volgidiscus (V.) pulcher*, *V. (Anivanovia)* sp., rare *Garniericeras* aff. *subclypeiforme* and bivalves (mainly *Anopaea* and *Camptonectes*) occurs. Presence of a single specimen of *Garniericeras*, the genus which numerous to dominant in the middle part of the Late Volgian and gradually decrease in abundance later provides direct link with underlying sands of the Nodiger Zone, where this genus is also uncommon (1–2 %). Presence of two successive assemblages with *Volgidiscus* (tentatively recognized as *pulcher* and *singularis* biohorozons) provides direct link with ammonite succession of the highest Upper Volgian of Subpolar Urals as well as with V. lamplughi zone of NE Europe. Although uppermost Volgian is poorly fossiliferous in the possible immigrational pathway of these ammonites (Greenland-Norwegian Seaway), at least one ammonite from the core 6814/04-U02 drilled in the Norwegian part of the Barents Sea has a special significance as it could be assigned to as *V. (V.) lamplughi*. *Volgidiscus (V.) pulcher*, which has been described from the both East Anglia and Subpolar Urals (CASEY et al., 1977), should be considered as a species closely related (or even conspecific) with *V. lamplughi*. Thus records of *V. pulcher* in the Russian Platform and Subpolar Urals (as well as from the Northern Siberia) perhaps reflecting quick eastwards immigration of early *Volgidiscus* at the beginning of the Lamplughi Chron, providing good correlative level, which lies close to the base of the Arctic Chetaites chetae Zone and slightly above the lower boundary of the Berriasian Stage. Surprisingly, beds with *Volgidiscus* are lacking typical Boreal bivalve genus *Buchia* in both England and European Russia. Among bivalves' bipolar genus *Anopaea* is most abundant in the studied succession, while other bivalves (*Plagiostoma* and *Entolium*) are not common.

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The Cretaceous-Paleogene Boundary Ejecta Layer and its Source Crater at Chicxulub

***Köberl, C.*[1]**

1) Department of Lithosperic Research, University of Vienna, Vienna, Austria,
E-mail: christian.koeberl@univie.ac.at

Impact cratering is a high-energy event that occurs at more or less irregular intervals. At the Cretaceous-Paleogene (K-Pg) boundary, the discovery of an extraterrestrial signature, together with the presence of shocked minerals, led not only to the identification of an impact event as the cause of the end-Cretaceous mass extinction, but also to the discovery of a large buried impact structure about 200 km in diameter, the Chicxulub structure. The Chicxulub impact crater, Mexico, is unique. It is the only known terrestrial impact structure that has been directly linked to a mass extinction event. It is the only one of the three largest impact structures on Earth that is well-preserved. It is the only terrestrial crater with a global ejecta layer. It is the only known terrestrial impact structure with an unequivocal topographic "peak ring." Chicxulub's role in the K-Pg mass extinction and its exceptional state of preservation make it an important natural laboratory for the study of both large impact crater formations on Earth and other planets, and the effects of large impacts on the Earth's environment and ecology. Effects of the large impact event at Chicxulub range from minutes to millennia and include a variety of short-term and severe environmental perturbations.

An ICDP-financed borehole, Yaxcopoil-1, was drilled from December 2001 through March 2002 in the southern sector of the crater, 62 km from the approximate crater center. The Yaxcopoil-1 (Yax-1) borehole was planned to core continuously into the lower part of the post-impact carbonate sequence, the impact breccias, and the displaced Cretaceous rocks. Drilling extended to a depth of 1,510 m. Approximately 795 m of post-impact Tertiary carbonate rocks, 100 m of impactites, and 615 m of pre-impact Cretaceous rocks (megablock) were intercepted.

A new drilling project at Chicxulub by ICDP and IODP was conducted in 2016. The goal was to address several questions, including: 1) what is the nature of a peak ring, 2) how are rocks weakened during large impacts to allow them to collapse and form relatively wide, flat craters, and 3) what caused the environmental changes that led to a mass extinction? Our understanding of the impact process is far from complete, and the first two questions represent fundamental gaps in our knowledge. Despite over 30 years of intense debate, we are still striving to answer the third question. A principal objective of the proposed drilling is to understand the fundamental impact process of peak ring formation. Drill hole Chicx-03A was intended to sample material that forms a topographic peak ring, and reveal the lithological and physical state of these rocks, including porosity, fracturing and extent of shock effects. IODP expedition 364 took place 5th April to 6th June 2016 and was highly successful. The studies of the rocks contribute to our understanding of such a large-scale impact event.

Late Cretaceous microfossils (Foraminifers and Radiolarians) as indicators of paleoclimate fluctuations (by example of the Russian sector of eastern Europe)

Kopaevich, L.[1,*] ***and Vishnevskaya, V.***[2]

*1) Lomonosov Moscow State University, Moscow, Russia, *E-mail: lfkopaevich@mail.ru*
2) Geological Institute of RAS, Moscow, Russia

The main Late Cretaceous palaeoceanographic features of the Russian Platform (RP) and Crimea-Caucasus (CC) area were controlled by the Tethyan/Boreal connection and sea-level changes (BARABOSHKIN et al., 2003). Rifting or some extension took place in the Crimea-Caucasus area during Albian-Cenomanian (NIKISHIN et al., 2008). This event resulted in the closing of the RP longitudinal sea connection, which was gradually interrupted. However, the foraminifers of the RP kept the previous structure and assemblages consist mainly of benthic taxa, similar to those of the West Siberian assemblages. Unlike in the RP, typical planktonic elements of the Tethyan fauna are clearly observed in the CC basin (keeled groups, rotaliporids and planomalinids). Among radiolarians, most *Crolanium*-species and the last representatives of the conical dictyomitrids became extinct at the Albian-Cenomanian boundary. These data on microfossil events indicate a gradual climate change. The most important foraminifers of the RP were calcareous benthic species, for which a detailed zonation has recently been proposed (BENIAMOVSKY & KOPAEVICH, 2001). At the same time, the Cenomanian was a time of diversification of the *rotaliporids* in the CC area. In the Cenomanian successions of the study area, there are no less than 4–5 species of *Thalmanninella* s.l., a typical group of Peri-Tethyan basins. New genera such as *Guttacapsa* and *Lipmanium* appeared, being accompanied by mass occurences of pseudoaulophacoid discoid forms among radiolarians. These microfossil events indicate a warming, and prevailing influence of the Tethys.

During the Turonian–Coniacian interval the warm Tethyan Ocean extended to the north, however since the latest Santonian the water mass of the RP underwent a gradual cooling. Cold Boreal water influence (siliciclastic facies) is recognized along the northern margin of the RP. An obvious prevalence of benthic foraminifers and the presence of cosmopolitan taxa among planktonic forms are characteristic of the RP basin. The Uppermost Santonian–Lower Campanian is characterized by low diversity assemblages of planktonic foraminifers as the variety of previous groups reduced, and new morphotypes such as the globotruncanids s.l. developed gradually and not immediately achieved a high diversity. The appearance of the Family Prunobrachidae among radiolarians and the presence of taxa adapted to the boreal environment confirmed a cold water penetration near the Santonian-Campanian boundary (KOPAEVICH & VISHNEVSKAYA, 2016). Obvious warming impulses are associated with the terminal Maastrichtian. A deepening of the RP basin and a warming were recognized for the *Pseudotextularia elegans* interval. Isotopic data and calcareous dinoflagellate cysts (GUZHIKOV et al., 2017) confirm this warming impulse.

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Stable isotope record ($\delta^{13}C$, $\delta^{18}O$), invertebrates and small vertebrate fauna from the Jurassic-Cretaceous transition of the Kurovice quarry (Czech Republic, Outer Western Carpathians)

Košťák, M.[1,*]***, Vaňková, L.***[1]***, Mazuch, M.***[1]

1) Institute of Geology and Palaeontology, Faculty of Science, Charles University, Praha, Czech Republic,
**E-mail: martin.kostak@natur.cuni.cz*

A high resolution sampling in the Kurovice section (Czech Republic, eastern Moravia) provided a new data of the stable isotope record ($\delta^{13}C$ and $\delta^{18}O$) from almost 52 m thick section (lower Tithonian–Berriasian *sensu* ELIÁŠ et al., 1996). Additionally, a very rare invertebrate macrofauna and both macro- and micro- vertebrate faunas have been recorded in a few fossiliferous horizons. The stable isotope record shows only minor excursions of the $\delta^{13}C$, not exceeding values 0.5‰ (varying from 0.7 to 1.2 ‰ V-PDB, the largest negative peak exceeds 0.2 ‰ V-PDB, probably in the lower part of the M19 magnetozone). Similar trend at the critical J/K boundary interval (M19-M18 magnetozones, near the *C*. *alpina* LORENZ abundant occurrence) is seen in several Tethyan sections (i.e. Brodno, Hlboča, Puerto Escaño, Hárskút HK II, and numerous others – see the summary in PRICE et al., 2016). The $\delta^{18}O$ curve shows a larger excursions varying between -1.5 to -4.3 ‰ V-PDB in the J/K boundary interval.

While the aptychii fauna has been described and revised in great details by MĚCHOVÁ et al., 2010, rare belemnite rostra (Belemnopseidae NAEF and Duvaliidae PAVLOW) are re-evaluated herein within the modern belemnite taxonomic concept and they are stratigraphically investigated. Less diversificated rhyncholites (genera *Rhynchoteuthis* D´ORBIGNY, *Hadrocheilus* TILL, *Leptocheilus* TILL) as well as the vertebrate fauna consisting predominantly of Chondrichthyans (i.e. hybodontid sharks, etc.) are reported newly from the J/K boundary interval in the Kurovice section and they are compared to those fauna within the North-west Tethyan localities.

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Late Cretaceous foraminifers and ammonities and palaeoceanographic events of northeastern Brazil – An overview

Koutsoukos, E.[1,*] ***and Bengtson, P.***[2]

*1) Cretaceous Research - Journal - Elsevier, Heidelberg, Germany, *E-mail: ekoutsoukos@gmail.com*
2) Institut für Geowissenschaften, Universität Heidelberg, Heidelberg, Germany

The Coniacian–Maastrichtian deposits of northeastern Brazil, mainly represented by siliclastic and calci-siliciclastic successions of the Sergipe and Pernambuco-Paraiba basins, are of key importance for better understanding the evolution of the South Atlantic Ocean at low latitudes and assessing its global impact during the Late Cretaceous. Integration of foraminiferal and ammonite biostratigraphy and biogeographic data has contributed to reconstructing the sequence of major palaeoceanographic events (e.g., BENGTSON & KOUTSOUKOS, 2014).

The establishment of a deep-oceanic circulation regime by late Coniacian–early Santonian times, resulting from the final structural separation of the South American Plate from the African Plate, caused a radical change in the sedimentary regime of northeastern Brazil, from a carbonate-dominated (Cenomanian–mid-Coniacian) to a siliciclastic cycle (KOUTSOUKOS & BENGTSON, 1993; KOUTSOUKOS, 1998). Long-term high stands of sea level, coupled with overall well-oxygenated water masses and widespread oligotrophic pelagic conditions in neritic and oceanic settings, considerably increased the potential for species migration from low-latitude, central Atlantic–western Tethyan provinces, resulting in the development of polytaxic benthic, planktic and nektic communities. Late Coniacian to Maastrichtian, high-diversity, shelf and upper slope, calcareous benthic and planktic foraminiferal assemblages and ammonites demonstrate patterns of oceanic surface circulation apparently similar to the present conditions at low latitudes on both sides of the northern South Atlantic (KOUTSOUKOS, 1992; KOUTSOUKOS & DE KLASZ, 2000). A bathymetric maximum appears to have occurred during the Campanian, when the deepest environments are recorded in all studied sites (e.g., KOUTSOUKOS, 1998). Late Cretaceous deep-slope calcareous and agglutinated foraminiferal assemblages were pandemic, indicating that deeper oceanic circulation patterns had been established around that time interval (e.g., KOUTSOUKOS, 1992; KOUTSOUKOS & DE KLASZ, 2000).

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Morphological differentiation of loricas of *Calpionella alpina* and its significance for the J/K boundary interpretation

Kowal-Kasprzyk, J.[1,*] ***and Reháková, D.***[2]

*1) Polish Academy of Sciences, Institute of Geological Sciences, Research Centre in Krakow, Krakow, *E-mail: justyna.kowal@uj.edu.pl*
2) Comenius University, Faculta of Natural Sciences, Bratislava, Slovakia

Calpionellids are typical late Tithonian and Early Cretaceous microfossils with a significant biostratigraphic significance and *Calpionella alpina* constitutes one of the most important species. It reveals a large diversity of the largeness and proportions of lorica, which can be observed within time as well as in co-occurring assemblages. Recent studies done by Berriasian Working Group shown its potential to offer the marker for J/K boundary limit. Changes in morphological parameters of *C. alpina* loricas along the J/K boundary interval previously declared by NOWAK (1971), BORZA (1984), REMANE (1986) and later verified numerically by LAKOVA (1994) were observed practically by all specialists studied the calpionellid succession in this time interval. Biometrical analysis done from the exotic limestone pebbles of the Polish Outer Carpathians by KOWAL-KASPRZYK (2014) and the recent studies running in some of published Tethyan sections (Brodno and Strapkova sections situated in Pieniny Klippen Belt of the Slovak Western Carpathians and Le Chouet, Drôme sections situated in Vocontian trough (SE France) proved older observations statistically.

In the late Tithonian Crassicollaria Zone *C. alpina* is strongly diversified morphologically – in both largeness (predominantly 55–95 µm) and ellipticity (predominantly 0.8–1.4). The boundary of the Crassicollaria/Calpionella zones can be defined by the onset of *C. alpina* event which is characterized by decline of large, elongated specimens of *C. alpina* (="*C. grandalpina*" Nagy), disappearance of the homeomorph of *C. elliptica* (="*C. elliptalpina*" Nagy), the last occurrence of *Crassicollaria brevis* and *Crassicollaria massutiniana* and increase in the relative abundance of small to medium-sized, spherical species of *C. alpina* (largeness predominantly 55–75 µm, ellipticity predominantly 0.8–1.15). Changes in morphological parameters of *C. alpina* loricas along the J/K boundary interval could reflect change of environmental condition prior to sea level fall, increase of water temperature and salinity.

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The Cretaceous/Paleogene transition in the Brazilian Equatorial Margin (Pará-Maranhão Basin): a micropaleontological approach

Krahl, G.[1,*]***, Fauth, G.***[2]***, Bruno, M.D.R.***[1]***, Guerra, R. do M.***[1]***, Bergue, C.T.***[1]***, Ceolin, D.***[1]***, Aguiar, E. da S.***[1]***, Lopes, F.M.***[1]***, Leandro, L.M.***[1]

*1) UNISINOS University, São Leopoldo, RS, Brazil, *E-mail: gkrahl@unisinos.br*
2) itt Fossil, Unisinos University, São Leopoldo, RS, Brazil

The Cretaceous/Paleogene (K/P) boundary extinction event is one of the most impressive events in the Earth history, characterized by a drastic reduction in marine biota. The K/P boundary is largely known in marine sedimentary sections, such as at El Kef, Brazos River, and in many DSDP and (I)ODP sites. In South America, the K/P boundary was recognized in the Pernambuco, Campos and Neuquen basins, mostly based on microfossil groups. The Brazilian Equatorial Margin is positioned in a low latitudinal basin in a region with little detailed information about its biostratigraphy and evolution of the paleoenvironment. The objective of this study is to apply microfossil biostratigraphy in cutting samples from well ME-02, drilled in the Pará-Maranhão Basin. Sample preparation was based on the standard technique for microfossils and calcareous nannofossils. The calcareous microfossils observed across the K/P boundary show moderate preservation with full abundance through the Lower Danian. Well ME-02 recovered 4,310 m and the K/P boundary was recognized at 2,040 m based on the LOs of the planktic foraminifera *Globotruncana aegyptiaca*, *Planoheterohelix globulosa*, *Rugoglobigerina rugosa* and *Globigerinelloides prairiehillensis*, as well as the LO of the calcareous nannofossil *Arkhangelskiella cymbiformis*. The Danian was recognized between 2,040 and 1,929 m, represented by the planktic foraminiferal zones P0/Pα, based on the LO of *Parvularuglobigerina eugubina*. The LO of the nannofossil *Lanternithus duocavus* (1,965 m) and the ostracod *Langiella reymenti* (1,929 m) corroborate this interpretation. The sedimentation rate in the Danian was relatively high and the sediments were deposited in a neritic environment.

Early Cretaceous (Valanginian) unique polychelidean lobsters (Decapoda, Polychelidae) as autochthonous fauna of deep-sea flysch environments (Carpathians, Czech Republic)

Krobicki, M.[1,*]***, Audo, D.***[2]***, Charbonnier, S.***[3]

1) Polish Geological Institute - National Research Institute, Krakow, Poland,
**E-mail: michal.krobicki@pgi.gov.pl*
2) UMR CNRS 6118 Géosciences, Université de Rennes I, Rennes, France
3) Muséum national d'Histoire naturelle, Sorbonne Universités, Paris, France

Polychelidan lobsters are one of the rare groups of decapod crustaceans which were first discovered as fossil long before being identified in extant deep-sea palaeoenvironments. In 1863, Ludwig Hohenegger discovered in Dolní Líštná village near Třinec (Czech Republic) in the Moravian part of the Flysch Carpathians, a unique specimen of polychelidan lobster, "*Eryon neocomiensis*". In the fossil record, most species of Eryonidae are associated with shallow-water environment. Our reinvestigation has shown this specimen is in fact one of the rare example of Polychelidae, the family to which all extant deep-dwelling species are ascribed. This prompted us to study its palaeoenvironmental and sedimentary context. In the Dolní Líštná region, the Outer Western Carpathians are dominated by the Silesian Unit, and in this area the so-called Godula Subunit occurs and is represented by very thick (up to 6,000 m) turbidite system. The surroundings of Dolní Líštná are formed mainly by the so-called Hradiště Formation, and especially its lower part, which has been known earlier as Upper Těšín (Cieszyn) Shales (= Obere Teschener Schiefer or Obere Těšín-Schichten), belongs recently to the Cisownica Shale Member of the Hradiště Formation. The sedimentological character of this unit indicates typical flysch features, including dark brown-grey, variably silty-sandy claystones and marly shale-type deposits intercalated with rare thin-bedded fine-grained calcareous sandstones and marlstones, representing classical fan-shaped submarine lobes and their outer, more distal, parts of deep-sea turbiditic system. A few finds of ammonites in this interval are mainly connected with the Dolní Líštná area which is also the type locality of *Busnardoites campylotoxus* (UHLIG, 1902). *B. campylotoxus* is a valuable taxon for the Early Valanginian biostratigraphy in Mediterranean province which was until recently an index taxon for upper part of the lower Valanginian (*Busnardoites campylotoxus* Zone). If *E. neocomiensis* indeed co-occurs with this ammonite (it could also correspond to another horizon, although the lithology is similar), this implies it comes from the upper part of the middle Early Valanginian (= *V. dolioliformis* Subzone of the *N. neocomiensiformis* Zone of the Lower Valanginian), according to recent biozonation.

Interestingly, *E. neocomiensis* seems to be autochthonous in its host rock. Indeed, it is preserved complete and articulated, with very fine morphological details such as delicate spines. It was also probably quickly buried, perhaps by fine-grained silty muds of weak turbiditic suspension clouds. As modern polychelids, *E. neocomiensis* presents reduced ocular incision, perhaps an adaptation to deep-sea dwelling. *E. neocomiensis* is therefore probably one of the rare and interesting deep-sea macrofossil providing evidence for a relatively deep bathymetry of the Silesian Basin during Early Valanginian times.

The early Late Cretaceous transgression in the Busko Zdrój area (southern Poland) – facies development, syn-sedimentary tectonic events and palaeorelief of basement

Krobicki, M.[1,*]***, Gagulski, T.***[1]***, Gorczyca, G.***[1]

1) Polish Geological Institute - National Research Institute, Krakow, Poland,
**E-mail: michal.krobicki@pgi.gov.pl*

The Busko Zdrój Spa area is situated in the most southeasterly corner of the Miechów Trough (= Nida Synclinorium) which belongs to southernmost part of the Szczecin-Łódź-Miechów Synclinorium as Alpine (Laramide) tectonic units of extra-Carpathian Poland. The Cretaceous deposits overlie unconformably the Jurassic rocks (mainly Kimmeridgian) and are represented by the Upper Albian–Lower Maastrichtian, and in the southern part of the Miechów Trough they are covered by the Miocene deposits of the Carpathian Foredeep (Fore-Carpathian Depression). Palaeogeographically, this is part of the so-called Polish Basin (= German-Polish Cretaceous Basin), and during the early Late Cretaceous times (the latest Albian?–Cenomanian) has been covered by an epicontinental sea as a result of the rapid transgression, which mainly deposited glauconitic-rich conglomerates and sandstones. These rocks are the lowermost part of the Cenomanian–Santonian siliciclastic-carbonate sequence which is overlying by carbonate sequence of the Campanian–Lower Maastrichtian strata. In the SW part of the Miechów Trough these sequences are sometimes full of condensation features (hard grounds, hiatuses and discontinuities). On the contrary, the opposite NE side of this trough (Busko Zdrój vicinity), these units are practically deprived of such structures. Usually the thickness of the lower sequence is less than 300 m, whereas the upper one is about 450 m.

Recently, 6 new boreholes (OB-I – OB-VI) have been drilled in the vicinity of Busko Zdrój, which were partially cored both in the so-called mid-Cretaceous (Cenomanian–Turonian) and Upper Cretaceous (Coniacian–Campanian) strata. The lowermost deposits are developed as deep-green glauconitic siliciclastic rocks represented by conglomerates (poorly-sorted) and sandstones with high-hydrodynamic regime features as cross-bedding structures of large scale (OB-II). In the same horizon some redeposition of sediments produced large clasts of glauconitic-poor sandstones which were incorporated to glauconitic-rich matrix (OB-I) also occur. The thickness of these Cenomanian deposits in analyzed boreholes are variable and never exceed 20-25 meters, but according to former drills may reach even 100 m. The overlying strata, sometimes with full record of transitional sequence, are more and more carbonatic and pelagic up to the open-marine limestones with cherts of Turonian in age (OB-I, II, III). After such unification of facies started very thick sequence of spotty-limestones/marly limestones and opoka-limestones/marls full in Planolites/Chondrites-type trace fossils. In the lowermost part of this unit spectacular syn-sedimentary slump structures occur which indicate intensive gravitational mass-movements on the sea-floor. Most probably, both Cenomanian and Turonian sedimentary-tectonic events mentioned above, were connected with syn-sedimentary tectonic reorganization and movements which presumably reflect origin of the early Late Cretaceous tilted blocks on the Peri-Tethys region as effect of extensional regime on the Tethyan ocean margin. Therefore, the relief of basement before, during and even after the so-called mid-Cretaceous transgression was very distinct and supported by such tectonic events/regime.

Turonian inoceramid bivalves from the Nodular Limestone Formation (Bagh Group) of the Narmada Basin, Central India and their biostratigraphic implications

Kumar, S.[1,*]***, Jaitly, A.K.***[1]***, Pandey, B.***[1]***, Pathak, D.B.***[1]***, Gautam, J.P.***[1]

1) Stratigraphy and Invertebrate Palaeontology Laboratory, Varanasi, India,
**E-mail: skumarpetro09@gmail.com*

The Nodular Limestone Formation of Turonian age is exposed in different parts of the Narmada Basin in the Central India and it is underlained and overlained by the Nimar Sandstone and Coralline Limestone formations of the Bagh Group, respectively. The Nodular Limestone Formation has been further differentiated into Karondia and Chirakhan members in ascending order. This lithostratigraphic unit of the Bagh Group is highly fossiliferous and rich in megainvertebrates.

The present contribution is based on the study of over 90 freshly collected inoceramid bivalves from 3 distinct levels of the Nodular Limestone Formation exposed around Sitapuri, Ramapura, Khanwara, Kosdana and Karondia localities of the Dhar district in Madhya Pradesh. The detail taxonomic study of these specimens allows to organized theminto two genera *Inoceramus* Sowerby and *Mytiloides* Schlotheim and sixteen species have been identified namely *Inoceramus hobetsensis* Nagao and Matsumoto, *Inoceramus teshioensis* Nagao and Matsumoto, *Inoceramus tenuistriatus* Nagao and Matsumoto, *Inoceramus apicalis* (Woods), *Inoceramus prefragilis stephensoni* Kauffman and Powell var. *agrwali* n. var., *Inoceramus niger* Heinz, *Inoceramus* aff. *albertensis* McLearn, *Inoceramus* aff. *lamarcki geinitzi* Heinz, *Inoceramus lamarcki* Parkinson var. *baghensis* n. var., *Mytiloides labiatus* Sclotheim, *Mytiloides* aff. *subhercynicus* Seitz, *Mytiloides* cf. *Lamarcki* var. *cuvieri* (Sowerby), *Mytiloides* sp., *Mytiloides duplex* (Chiplonkar and Badve), *Mytiloides* cf. *labiatoidiformis* Tröger, *Mytiloides striatoconcentricus* Gümbel. Remarkable is the identification for first time from the Indian sub-continent of *Inoceramus hobetsensis*, *Inoceramus teshioensis*, *Inoceramus tenuistriatus*, *Inoceramus apicalis and Inoceramus niger*.

The age of Nodular Limestone Formation is refined at Substage level on the basis of inoceramid bivalves. The *Mytiloides labiatus* Schlotheim of Early Turonian age has been recorded from lower Karondia Member. The age of the upper Karondia Member is assigned as Middle Turonian based on the occurrence of *Inoceramus hobetsensis* Nagao and Matsumoto, which is known to be restricted within this time interval. The Chirakhan Member has yielded Late Turonian index *Inoceramus teshioensis* Nagao and Matsumoto. These age assignments are well supported by the occurrence of ammonoid species *Spathites* (*Jeanrogericeras*) aff. *revelieranus* Courtiller in the lower Karondia Member, *Collignoniceras* cf. *carolinum* d'Orbigny in the upper Karondia Member and Vredenburg in the Chirkhan Member.

Palaeoecology and palaeoclimate of Late Cretaceous of Central Europe based on fossil plants

Kvacek, J.[1]

1) National Museum, Praha, Czech Republic, E-mail: jiri.kvacek@nm.cz

Documentation of Late Cretaceous palaeofloristics of Central Europe is based on four key floras: 1) Peruc Flora from the Cenomanian of the Bohemian Cretaceous Basin, 2) Klikov Flora from the Santonian-Coniacian of the South Bohemian Basins, 3) Idzików Flora from the Coniacian of the Sudetic Basin, 4) Grünbach Flora from the Campanian of the Gosau Group. Major vegetational associations are characterised: aquatic fresh water environment (dominated by monocot *Pandanites*), saltmarsh environment (dominated by conifer *Frenelopsis*), back swamp environment (dominated by cupressoid conifers), flood plain of meandering and braided rivers (dominated by platanoid and lauroid angiosperms). Upland steppe vegetation was likely dominated by xerophytic ferns.

Palaeoclimatic conditions based on CLAMP analysis are discussed. Central European Late Cretaceous floras show quite similar palaeoclimatic values. This fact is a result of their quite similar latitude and relatively stable palaeogeography. In terms of mean annual temperature (MAT), the highest temperatures are calculated for Coniacian Idzików Flora (17.1°C), while the coldest MAT 13.2°C is calculated for Campanian Grünbach Flora. The highest values for the warmest month mean temperature (WMMT) come from the Cenomanian Peruc Flora (28.12°C), while the lowest values of WMMT were calculated for Grünbach Flora (25.2°C). The highest values of the coldest month mean temperature (CMMT) were obtained for Idzików Flora, which experienced milder temperature extremes over the course of the year. The lowest values of CMMT calculated for Grünbach Flora were 2.3°C, which does not preclude the possibility of some days when the temperature dropped below 0°C. The longest growing season was reconstructed for the Peruc Flora (9.7 month), the shortest growing season is suggested for Grünbach Flora (7.6 months).

Paleoclimatic estimations in the Upper Cretaceous of Magallanes Region, Southern South America

Leppe, M.[1,*]***, Stinnesbeck, W.***[2]***, Hinojosa, F.***[3]***, Nishida, H.***[4]***, Dutra, T.***[5]***, Wilberger, T.***[1]***, Trevisan, C.***[5]***, Pino, J.P.***[3]***, Mansilla, H.***[1]***, Garrido, S.***[6]

*1) Paleobiology Lab of Patagonia and Antarctica, Chilean Antarctic Institute, Punta Arenas, Chile, *E-mail: mleppe@inach.cl*
2) Ruprecht-Karls-University Heidelberg, Heidelberg, Germany
3) Laboratorio de Sistemaítica y Ecología Vegetal, Chile
4) Department of Biological Sciences, Tokyo, Japan
5) Postgraduate Program in Geology, Brazil
6) Departamento Ciencias de La Tierra, Chile

The Cerro Guido – Las Chinas complex is the most diverse fossil-bearing sequence with an Upper Cretaceous age in Chile. At least the last five million years before the K/Pg boundary are recorded in approximately 1 km thickness. A broad variety of environments, from an offshore to a deltaic alluvial fan, with at least 4 marine transgressions, provide a unique opportunity to test the paleoclimatic models in high latitudes using both continental and marine proxies. Two localities are analyzed here: the oldest, Casa Nano, represented an interior and shallow neritic environment, the other, El Puesto, was part of a shallow prograding system finishing with a delta alluvial fan, overlain by a marine transgression. In Casa Nano sequence, the presence of foraminifers assigned to *Heterohelix* and *Pseudotextularia* (cf. *Pseudotextularia elegans*) indicates a tropical to subtropical affinity. In addition, we present results obtained from univariate and multivariate foliar physiognomic methods to estimate paleoclimate: Leaf Margin analysis (LMA), Leaf Area Analysis (LAA) and CLAMP (Climate Leaf Analysis Multivariate Program), with mean annual temperature reconstructions (MAT) between 14,9–16,1°C. At latitudes over 50°S (estimated paleolatitude 53–54°S) such temperatures point to a hothouse world. In contrast, at the El Puesto locality, the presence of *Haplophragmoides walteri*, an epifaunal benthic foraminifer, is used as an indicator of hyposaline deltaic environments, from cold-temperate waters. The cold environment is also conspicuous in the LMA and CLAMP analyses of this section, resulting in MAT between 6,9–8,6°C, indicating near icehouse conditions. Different dating methods have estimated an age of ~69 Ma for El Puesto and 77–78 Ma for Casa Nano. Our results thus suggest icehouse conditions in the early Maastrichtian. According to the general paleogeography of the southern South America and northern tip of the Antarctic Peninsula for the Campanian-Maastrichtian interval, the existence of a submerged mountain range, surrounded by shallow marine waters, connecting both continents, is a very plausible explanation for the apparition of ephemeral land bridges due to glacioeustacy, which would have permitted a biotic exchange between the two continents.

Interpreting the Early Cretaceous record of *Nothofagus* in Antarctica and Patagonia

Leppe, M.**[1,*]**, Stinnesbeck, W.**[2]**, Hinojosa, F.**[3]**, Nishida, H.**[4]**, Dutra, T.**[5]**, Wilberger, T.**[1]**, Trevisan, C.**[5]**, Fernandez, R.**[6]**, Ortuya, M.J.**[6]**, Manriquez, L.**[1]**, Mansilla, H.**[1]**, Bastías, J.

*1) Paleobiology Lab of Patagonia and Antarctica, Chilean Antarctic Institute, Punta Arenas, Chile,*E-mail: mleppe@inach.cl*
2) Ruprecht-Karls-University Heidelberg, Heidelberg, Germany
3) Laboratorio de Sistemaítica y Ecología Vegetal, Chile
4) Department of Biological Sciences, Tokyo, Japan
5) Postgraduate Program in Geology, Brazil
6) Departamento Ciencias de La Tierra, Chile

The Genus *Nothofagus* Blume has been considered a key constituent of the Austral ecosystems, both for the aspects of its biology that make it important for biogeographic inferences, and for its extensive fossil record. Different authors have postulated their origin and diversification at the end of the Cretaceous, but in places as distant as New Caledonia and the Antarctic Peninsula. Recent paleontological exploration in the Magallanes Region, Southern Chile, and Antarctica, resulted in new fossil record and localities. In 2016, the study of new outcrops in a Campanian sequence at Rip Point, Stansbury Peninsula, Nelson Island, Antarctica, have ended with *Nothofagus* leaf imprint beds, associated with ferns and angiosperm remains, in rocks with an estimated age of ~81 Mya. Three different *Nothofagus* morphotypes dominated those Lower Campanian assemblages. One year before, our paleontological survey to Cerro Guido-Las Chinas Cretaceous complex, northern Magallanes Region, Chile, discovered close to an hadrosaur bonebed, the oldest South American record of *Nothofagus* imprints, in rocks assigned to the Lower Maastrichtian (~68 Mya). Four morphotypes, associated with a complex assemblage of angio and gymnosperms have dominated a continental forest in an alluvial fan, tidally controlled. We interpreted the asynchrony in the records of *Nothofagus* imprints in Antarctica and Patagonia as a consequence of the land discontinuity between the northern tip of the Antarctic Peninsula and the southern of South America during the Campanian–Maastrichtian interval. The apparition of a land bridge during the Early Maastrichtian due to the glacioeustatic fall in the sea level, probably permitted the dispersion and colonization, from Antarctica to South America. The event could be linked with the global record of cooling events. The biology of *Nothofagus* support the idea that land bridges are needed to disperse because its anemochory and anemophily dispersal syndromes. *Nothofagus* is an important element of the modern Sub-Antarctic forests of New Caledonia, Queensland, New Zealand, Chile and Argentina. Its current disjoint distribution, oldest record in Antarctica and the molecular phylogeny endorsed the hypothesis of the Antarctic center of diversification.

Revised age constraints for Late Cretaceous to early Paleocene strata from the Dawson Creek section, Big Bend National Park, west Texas

Leslie, C.E.[1,*]***, Peppe, D.J.***[1]***, Williamson, T.E.***[2]***, Heizler, M.***[3]***, Jackson, M.***[4]***,***
Atchley, S.C.[1]***, Nordt, L.***[1]***, Standhardt, B.***[5]

*1) Terrestrial Paleoclimatology Research Group, Department of Geosciences, Baylor University, Waco, TX, USA, *E-mail: Caitlin_leslie@baylor.edu*
2) New Mexico Museum of Natural History and Science, Albuquerque, NM 87104, USA
3) New Mexico Bureau of Geology, New Mexico Tech, Socorro, NM 87801, USA
4) Institute for Rock Magnetism, University of Minnesota, Minneapolis, MN 55455, USA
5) 14700 FM 307, Stanton, TX, 79782, USA

The Dawson Creek section within Big Bend National Park, Texas documents a series of Upper Cretaceous though lower Paleocene alluvial deposits that accumulated along a passive continental margin within the Tornillo Basin of west Texas. The Cretaceous dinosaur faunas from the Dawson Creek area are key for understanding regional patterns in dinosaur community diversity and biostratigraphy. Additionally, analyses of paleosols at the Dawson Creek section have been used to argue for two short-lived greenhouse events during the Maastrichtian (NORDT et al., 2003; DWORKIN et al., 2005). Despite the importance of Dawson Creek record for understanding Cretaceous and Paleocene paleoclimate and the composition of vertebrate communities, the absolute age and duration of the Upper Cretaceous Aguja and Javelina Formations and Paleocene Black Peaks Formation are relatively poorly constrained.

In this study, we develop a precise chronostratigraphic framework for the Dawson Creek section using magnetostratigraphy, detrital sanidine geochronology, and biostratigraphy based on a reevaluation of the vertebrate fauna. The documented polarity zones can be correlated to C32n–C31n, C29r, and C27r of the geomagnetic polarity time scale (GPTS) with three hiatuses spanning more than 1 Ma each. Rock magnetic analyses indicate that the dominant magnetic carrier in the Aguja and Black Peaks formations is titanomagnetite while the Javelina Formation has varying magnetic carriers including hematite, magnetite, and oxidized magnetite. An overprint interval surrounding the K-Pg boundary suggests the primary magnetic carrier, titanohematite, was likely reset by burial and/or overlying basaltic flows. Our age model shows that the dinosaur fauna found in the section are Maastrichtian and restricted to C29r. This is the first independent age model for the Cretaceous-Paleocene strata at the Dawson Creek section that determines the age and duration of deposition of each formation in the section, as well as the age and duration of multiple unconformities through the succession. As a result, this age model can be used to reassess biostratigraphic and isotopic correlations between the Big Bend area and other Cretaceous-Paleogene (K-Pg) basins across North America.

NORDT, L. et al., 2003, GSA Today, **13**, 4–9.
DWORKIN, S. et al., 2005, EPSL, **237**, 56–68.

Evolution of the Late Cretaceous clam shrimps in the Songliao Basin, northeastern China

Li, Gang[1]

1) Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, E-mail: gangli@nigpas.ac.cn

The almost complete Upper Cretaceous continental sequences and the 2485.89 m scientific drilling cores of SKI in the long-lived Songliao Basin of northeastern China provide an excellent opportunity to reconstruct a Late Cretaceous green house climate in East Asia (WANG et al., 2013). The established astronomical time scale (WU et al., 2013) and geomagnetic polarity chrons (HE et al., 2012) provide a precise calibration for the correlation of strata and events between marine and terrestrial systems (WAN et al., 2013).

The Late Cretaceous clam shimps in the Songliao Basin are abundant and diverse, whose rapid evolution makes them biostratigraphically very useful for subdividing and classifying non-marine strata (CHEN et al., 2007). First, *Jilinestheria* of the *Nemestheria* fauna evolved to *Dictyestheria* during the late Coniacian by the development of reticulation on the whole carapace, indicating the beginning of age of the *Euestherites* fauna. Subsequent developments led to the chain-like ornament of *Halysestheria* during the Santonian (lower Nenjiang Formation). By the beginning of the Campanian in a high lake water level environment *Halysestheria* evolved to *Euestherites* (with cavernous ornament) and *Tylestheria* (with widely spaced, pronounced radial lirae with intercalated short fine radial lines and cross bars), respectively. At last, *Calestheria* evolved from *Euestherites* through the development of a row of caves along the lower margin of each growth band. During the middle Campanian, *Mesolimnadiopsis* (attributed to Lioestheriacea), the end member of the *Euestherites* fauna appeared, which has growth lines slightly recurved near the posterior end of the dorsal margin. A Maastrichtian *Daxingestheria* fauna occurs in the Mingshui Formation. The carapace in *Daxingestheria* is ornamented with widely spaced short and long lirae, the short lirae on both the lower and upper parts of each growth band.

CHEN, P.J. et al., 2007. Geol. Jour., **42**, 391–413.
HE, H.Y. et al., 2012. Geoch., Geoph., Geosyst., **12**, Q02002.
WAN, X.Q. et al., 2013. Palaeogeog., Palaeoclim., Palaeoec., **385**, 31–43.
WANG, C.S. et al., 2013. Palaeogeog., Palaeoclim., Palaeoec., **385**, 17–30.
WU, H.C. et al., 2013. Palaeogeog., Palaeoclim., Palaeoec., **385**, 55–70.

Charophytes from the Cretaceous-Paleocene boundary of the Songliao Basin (Northeastern China) and calibration of the Chinese charophyte biozonation to the Global Polarity Time Scale

***Li, Sha**[1,*], Wang, Q.[1], Zhang, H.[1], Wan, X.[2], Martín-Closas, C.[3],*

1) *Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, *E-mail: shali@nigpas.ac.cn*
2) *China University of Geosciences (Beijing), Beijing, China*
3) *Departament d'Estratigrafia, Paleontologia i Geociències Marines, Universitat de Barcelona, Barcelona, Catalonia, Spain*

Charophyte assemblages from the mid-Campanian to lower Paleocene of the Songliao Basin (NE China) are re-studied and their biozones are correlated to the Global Polarity Time Scale (GPTS). Three charophyte biozones are recognized from the Sifangtai and Mingshui Formations, including a latest Campanian–early Maastrichtian *Microchara gobica* zone, a late Maastrichtian *Microchara prolixa* zone and an earliest Danian *Psilochara changzhouensis* zone. Among them, the *Microchara gobica* zone and the Microchara prolixa zone can be correlated with the Microchara cristata zone (without the top) from the Pingyi Basin, NE China, and the Àger Basin in Spain. *Psilochara changzhouensis* appears first at the depth of 336.04 m (in the C29r magnetic polarity chron of the SK1 from the upper Mingshui Formation) and this event is proposed as the marker of the basal Paleocene.

The comparison of biozones of the Pingyi Basin with those of the Songliao Basin allow for two observations. First, the flora between the two basins differed probably due to different paleogeography and environments. In the Late Cretaceous, geographically, *Atopochara trivolvis ulanensis* was only found in the Songliao Basin and adjacent areas such as Inner Mongolia and Mongolia. Ecologically, the brackish species *Feistiella anluensis* occurred in the Pingyi Basin but not lived in the Songliao Basin without brackish water sediments. In the Paleocene, the floral difference between the two basins increased mainly due to totally different environments. In the Songliao Basin, a diverse flora consisting of *Microchara cristata*, *M*. *prolixa*, *Lychnothamnus vectensis*, *Sphaerochara parvula*, *S*. *jacobii*, *Collichara taizhouensis*, *Psilochara changzhouensis* and *Peckichara sinulata* thrived in flooded lakes, while in the Pingyi Basin the flora was dominant by *Peckichara varians* in permanentlacustrine environments with little terrigenous inputs. Second, the two basins also share the same species, such as *Lamprothamnium ellipticum* and *Mesochara voluta* in the Late Cretaceous and *Microchara cristata* in Late Cretaceous to Paleocene. In the Paleocene, the two basins shared the species *Sphaerochara parvula*. In fact, some of these species are widely distributed in Eurasia, which are very important for correlations between Asia and Europe.

Mid-Cretaceous terrestrial environments and climates in Hengyang Basin, Hunan province, South China

Li, Xianghui[1,*]***, Wang, Jingyu***[1]***, Zhang, C.***[1]

*1) Nanjing University, Nanjing, China, *E-mail: leeschhui@126.com*

The Hengyang Basin is a typical extensional basin within continent, which was formed about 500 km fay away from the arc island and subduction zones in east between the Asia and Paleo-Pacific plates. Thick terrestrial strata of the Cretaceous through the Paleogene are well documented in the basin, and they are totally over 10,000 m thick, indicating a relatively continuous sedimentation. Of the strata, the Dongjing Formation well outcrops as the lower part in the western Hengyang Basin, providing good chance for intracontinental paleoenvironmental and paleoclimatic study of the mid-Cretaceous.

The investigated 3,000 m cross-section is 3–4 km east to the Baishui Middle School, Hengyang county. The Dongjing Formation is mainly composed of reddish brown fine (para-) conglomerates and mudrocks, intercalated/interbedded with sandstones/ graywackes and siltstones. Youngest age populations of detrital zircon from sandstone samples and former spore-pollen biostratigraphy indicate the formation is of the Aptian–Albian.

Field observation shows that lenticular paraconglomerates and graywackes are common; mudrocks are the dominant lithology with gravels, sands, and silts. Particularly, isolated cobbles/pebbles often occur within sandy/silty mudrocks. These lithologies and associations imply that the gravity flowing by muddy, sandy and gravy debris is crucial for the sedimentation. Proximal braded rivers associated pulse floodings could be the main depositional paleoenvironments.

Pedogenesis is another feature for the formation. About 130 calcisols were recognized in about 1,700 m thick stratal succession. The punctuated pedogenic horizons often display in silty mudrocks or muddy siltstones with more or less calcites, which are probably related to subordinate environments such as levee, overbank, split fan, flooding plain, inter-channels. Calcretes are abundant in most calcisols, changing 1–3 %, up to 15 %. They mostly shape in globe, ginger-like, ellipse. They alter in size, from 5 mm to 200 mm. Those small calcretes (5–30 mm) are often developed within few calcic mudrocks, and big ones (50–150 mm) within calcic and harden (silty) mudrocks. Lots of calcisols combined with some gypsum pseudomorphs indicate periodic subaerial environments and hot and (semi-) arid climates characterized the Aptian–Albian in the Hengyang Basin.

Carbon isotope of ~130 calcrete horizons shows that $\delta^{13}C$ are -3‰ to -8‰, mainly -5‰ to -7‰, compatible with those from published data. About ten distinct cycles of increasing-decreasing $\delta^{13}C$ are distinguished. pCO_2 concentrations from the calcrete $\delta^{13}C$ are estimated as 500–2,500 (mainly 1,000–2,000) ppmV, and cyclic perturbations of pCO_2 concentration perhaps imply an astronomical control. High and cyclic pCO_2 concentrations support hot and arid climate by sediments.

Radiolarian assemblage of Barremian to Aptian interval in the Tethys and the influence of the oceanic anoxic event (OAE) 1a

***Li, Xin*[1,*], Matsuoka, A.[2], Chiari, M.[3], Bertinelli, A.[4], Wang, C.[5]**

*1) Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, *E-mail: lixindida@163.com*
2) Niigata University, Niigata, Japan
3) Italian National Research Council, Firenze, Italy
4) Università degli Studi di Perugia, Perugia, Italy
5) China University of Geosciences, Beijing, Beijing, China

Radiolarian biostratigraphic study ranging from the latest Barremian to the Aptian has been carried out in a siliceous sequence (section BB1) near Babazhadong in southern Tibet. No fossils other than radiolarians can be obtained from the strata. Based on the phyletic evolution of *Aurisaturnalis* and *Turbocapsula*, two radiolarian zones for the Barremian to Aptian interval have been defined: the *Aurisaturnalis carinatus* Zone and the *Turbocapsula costata* Zone. This zonal scheme can be used for identifying episodes, such as OAEs, in the pelagic realms (Li et al., 2017).

Stepwise extinction and radiation events of radiolaria in the late Early Aptian have been reported in the western Tethys (Erbacher & Thurow, 1997). The Umbria–Marche sedimentary sequence in central Italy was accumulated during the Middle Jurassic to the Eocene at bathyal depths within a relatively isolated pelagic basin. The lower Cretaceous Maiolica Formation is overlain by the Marne a Fucoidi Formation. The section of Gorgo a Cerbara in the northern Umbria–Marche Basin has been constrained geochronologically by planktic foraminiferal biozones, calcareous nannofossil biozones, and magnetostratigraphy.

Totally, 52 samples from the section BB1 and 15 samples from the section Gorgo a Cerbara were collected for our radiolarian biostratigraphic study. During the Early Aptian, black shale layers (OAE 1a) were deposited in marine successions of the Mediterranean Tethys. However, no black shale layers are recorded in the siliceous sequence of southern Tibet. Comparison of radiolarian assemblages from sections of Gorgo a Cerbara and BB1 shows the faunal change before and around the OAE 1a event in the whole Tethys. Our radiolarian biostratigraphic study on the pelagic basin of Umbria–Marche will provide the better age-constraint for the radiolarian zonation of Li et al. (2017) and is necessary to testify the applicability of this zonation. The Early Aptian OAE 1a is located between the first appearance bio-horizon of the genus *Turbocapsula* and the evolutionary first appearance bio-horizon of *T. costata multicostata*.

Erbacher, J. & Thurow, J., 1997. Mar. Micropaleontol., **30**, 139–158.
Li, X. et al., 2017. Mar. Micropaleontol., **130**, 29–42.

Superiortrapa (Lythraceae s.l.) from the Miocene of North China

***Li, Ya*[1,*], *Liang, X.-Q.*[2], *Wang, Yongdong*[1], *Li, C.-S.*[3]**

*1) Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, *E-mail: yali@nigpas.ac.cn*
2) Yuxi Normal University, Yuxi, China
3) Institute of Botany, Chinese Academy of Sciences, Beijing, China)

Superiortrapa weichangensis gen. et sp. nov. (Lythraceae s.l.) is described on the basis of receptacle, calyx and fruit remains, collected from the early Miocene of Weichang County, Hebei Province, North China. *Superiortrapa* has actinomorphic, 4-merous, hypogynous flower, 4 decussate antennae-shaped sepals with recurved barbs, 4 inter-sepal appendages (or epicalyx segments), and a superior ovary. Fruits are fusiform with persistent sepals and approximately 8 slender ribs on the fruit body. Detailed morphological analyses and comparison of the genus with related fossil and extant genera allowed the placement into the subfamily Trapoideae of the Lythraceae s.l. based on a suite of characters. *Superiortrapa* can be distinguished from all the other genera of the family Lythraceae s.l. by having hypogynous flower rather than perigynous flowers in Lythraceae s.str., or hemi-epigynous to epigynous flowers in *Duabanga*, *Punica*, *Sonneratia* and *Trapa*. It might represent an extinct linage, probably secondarily derived from the extinct genus *Hemitrapa* of Trapoideae, Lythraceae s.l.

Evidence for palaeoenvironmental stability during the earliest Maastrichtian – implications from benthic foraminiferal assemblages from North Germany

Linnert, C.[1,*], **Engelke, J.**[2], **Wilmsen, M.**[1], **Mutterlose, J.**[2]

*1) Ruhr-Universität Bochum, Bochum, Germany. *E-mail: christian.linnert@rub.de*
2) Senckenberg Naturhistorische Sammlungen, Dresden, Germany

The latest Campanian – earliest Maastrichtian interval is well known as a period of global palaeoenvironmental perturbations including climate cooling, changing oceanic circulation patterns and an altered nutrient regime. These perturbations significantly affected marine phytoplankton communities like calcareous nannofossils (e.g. LINNERT et al., 2016; THIBAULT et al., 2016). Typical late Campanian nannofloral elements (e.g. *Biscutum* spp., *Watznaueria barnesiae*, *Rheinhardtites levis*) were increasingly replaced by cool-water taxa (e.g. *Arkhangelskiella cymbiformis*, *Kamptnerius magnificus*).

The impact of these environmental shifts on benthic communities is, however, less well known. In order to overcome this gap, we studied benthic foraminifer assemblages from the Kronsmoor section (northwest Germany). This section provides a continuous succession of upper Campanian – lower Maastrichtian chalks with well-preserved foraminifera. Benthic assemblages are highly diverse (~40 species per sample) and abundant (~$3.2*10^5$ specimens/Kg in >125µm fraction). Large size fractions (>500µm, >1000µm) are characterised by abundant infaunal agglutinated taxa like *Ataxophragmium*, *Eggerellina*, *Orbignyna, Tritaxia* and abundant lenticulids like *Lenticulina nuda* or *Lenticulina rotula*. The smaller fractions (>125µm, >250µm) show more diverse benthic communities with less frequent agglutinated species. Common taxa of these fractions include *Bolivina incrassata*, *Cibicidoides voltzianus*, *Gyroidinoides umbilicatus*, *Osangularia cordieriana*, *Sitella laevis* and *Stensioeina pommerana*. No variations of diversity or in the composition of morphogroups have been observed throughout the studied interval. Only a few taxa (e.g. *B. incrassata*, *Cibicidoides* spp., *Eponides* spp.) show a trend of decreasing abundances, whereas other taxa (*Cibicides beaumontianus*, *G. umbilicatus*, *Leavidentalina* spp.) increase. The relatively stable composition of benthic morphogroups suggests that there were no severe palaeoenvironmental disruptions in the North Sea basin like excess productivity or oxygen depletion. Sufficient organic matter was produced to supply abundant and diverse benthic communities without consuming too much oxygen. Minor palaeoenvironmental shifts are indicated by the variation patterns of individual taxa like *G. umbilicus* (increasing influx of organic matter) and *Bolivinoides* spp. (cooling).

LINNERT, C. et al., 2016. Paleoceanography, **31**, 694–714.
THIBAULT, N. et al., 2016. Clim. Past, **12**, 429–438.

Paleoclimate Evolution Driven by Astronomical Forcing in the Early Cretaceous Songliao Basin, Northeast China

***Liu, Wei*[1,*], *Wu, Huaichun*[2], *Hinnov, L.*[3], *Ma, Chao*[3], *Li, Mingsong*[3], *Pas, D.*[3]**

*1) China University of Geosciences (Beijing), Beijing, China,*E-mail: lwgeo90@gmail.com*
2) School of Ocean Sciences, China University of Geosciences, Beijing, China, China
3) Department of Atmospheric, Oceanic, and Earth Sciences, George Mason University, Fairfax, VA, USA

Early Cretaceous climate and environmental change remain speculative and disputed, due in large part to time scale uncertainties and a lack of information on terrestrial environments. Recent exploration of the Songliao Synrift Basin, NE China, which is one of the largest and long-lived Cretaceous continental basins in the world with a continuous 10-km thick sequence of strata, provides a new opportunity to improve the Early Cretaceous time scale and study terrestrial climate change. Understanding the evolution of the basin, including the climatic and environmental changes that affected sediment deposition, is key to identifying the forces that led to the carbon burial and preservation, leading to today's oil and gas reserves in the basin. We have conducted cyclostratigraphic analysis on natural gamma-ray logs from extended boreholes in the terrestrial Songliao Basin. The target is the Lower Cretaceous Shahezi Formation (K_1S), a 836-m-thick succession with black mudstone, siltstone, gravel-bearing sandstone and conglomerate, together with meter-scale black coal units distributed throughout the upper part of the formation. Time series analysis of the gamma-ray logs from selected boreholes reveals power spectra that are consistent with Earth's astronomical frequencies of precession, obliquity and orbital eccentricity, providing strong evidence for astronomically driven climate change in this Early Cretaceous basin. The results also indicate that black coal coincides with short eccentricity minima that exceed a threshold. The cyclic evolution of the lithology indicates a paleo-lake and surrounding environment that expanded and contracted repeatedly. We infer that astronomical forcing influenced paleo-lake level: climate was warm and humid with high eccentricity, and cold and dry with low eccentricity. Based on the interpreted astronomical cycles and other available chronostratigraphy, we conclude that the age of K_1S is from early Valanginian to late Hauterivian with a duration of approximately 10 million years. The formation may also reflect the well-known transient cooling Weissert Event in the mid-Valanginian as evidenced by marine glendonites at Svalbard Island accompanied by polar ice.

Crassicollaria and *Calpionella* zones in the Neuquén Basin (Argentine Andes): First approach to the correlation of the Tithonian/Berriasian boundary with western Tethys

López-Martínez, R.[1,*]***, Aguirre-Urreta, B.***[2]***, Lescano, M.***[2]***, Concheyro, A.***[2]***, Vennari, V.***[3]***, Ramos, V.A.***[4]

1) Instituto de Geología. Universidad Autonoma de Mexico, Mexico, Mexico,
**E-mail: rafaelopez83@hotmail.com*
2) Instituto de Estudios Andinos, Departmento de Ciencias Geológicas, Buenos Aires, Argentina
3) Grupo vinculado al Instituto Argentino de Nivología, Glaciología y Ciencias Ambientales (IANIGLA-CONICET), San Rafael, Argentina
4) Instituto de Estudios Andinos, Departmento de Ciencias Geológicas, Buenos Aires, Argentina

Calpionellids are presently considered as primary markers of the Tithonian/Berriasian boundary, mainly due to the absence of provincialism and its isochronic apparition in the whole Tethys (WIMBLEDON et al., 2011). In the Neuquén Basin, with a proved connection with Tethys since Early Jurassic times, calpionellid apparition is an expected finding. For the first time, the study on calpionellid distribution in the well-documented Las Loicas section of the Vaca Muerta Formation (Neuquén Basin, Argentine Andes), allows the recognition of the Crassicollaria and Calpionella zones. The Crassicollaria Zone (Upper Tithonian) is composed of *Calpionella alpina* Lorenz, *Crassicolaria* cf. *C. brevis, Crassicollaria* cf. *C. intermedia, Crassicollaria massutiniana* (Colom), *Tintinnopsella remanei* (Borza) and *Tintinopsella carpathica* (Murgeanu and Filipescu). The Calpionella Zone, Alpina Subzone (Lower Berriasian), is detected by the explosion of the small and globular form of *Calpionella alpina* Lorenz dominating over very scarce *Crassicollaria massutiniana* (Colom). The FAD of *Nannoconus wintereri* can be clearly correlated with the uppermost part of the Crassicollaria Zone and the FAD of *Nannoconus kamptneri minor* with the first records of the Calpionella Zone. Ammonites were identified on the basis of abundant material defining zones according to the classic ammonite biostratigraphy of the Andes (VENNARI et al., 2014).

Calpionellid distribution in Las Loicas section is very similar to that reported for the same zones in Cuban and Mexican sections in paleowestern Tethys (LOPEZ-MARTINEZ et al. 2013 a, b), pointing to a good correlation of calpionellid bioevents between both areas. Additional studies (in process) are necessary to establish a more accurate calpionellid biozonation and its correlation with other fossil groups, but the present work confirms similar calpionellid bioevents in western Tethys and the Andean region strenghthing the Paleopacific-Tethyan correlations already known from other fossil groups.

LOPEZ-MARTINEZ, R. et al., 2013a. Journ. South Amer. Earth Sci., **47**, 142–151.
LOPEZ-MARTINEZ, R. et al., 2013b. Geol. Carpathica, **64**, 195–208.
VENNARI, V. et al. 2014. Gondw. Res., **26**, 374–385.
WIMBLEDON, W.A.P. et al., 2011. Riv. Ital. Paleont. Strat., **17**, 295–307.

Size variations of calcareous nannofossils – a good tool for understanding past ocean perturbations?

Lübke, N.[1], Möller, C.[1], Mutterlose, J.[1,*], Bottini, C.[2], Erba, E.[2], Faucher, G.[2]

1) Institute for Geology, Mineralogy and Geophysics, Ruhr-University Bochum, Bochum, Germany,
**E-mail: joerg.mutterlose@rub.de*
2) Department of Earth Sciences, Università degli Studi di Milano, Milan, Italy

Coccolithophores are an important group of marine primary producers. Their sensitivity to the environment and their dominant role among marine phytoplankton make them an essential tool for reconstructing ecological parameters also in the geological record through the study of their fossil remains. Recent biometric studies have shown that dwarfism of certain calcareous nannofossil species in the Cretaceous goes along with significant ecological changes in the marine paleoenvironment. Dwarfism has been specifically described for some intervals of the mid Cretaceous (~125–90 Ma) characterised by perturbation of the C-cycle and profound alteration of the ocean-atmosphere system which resulted in Oceanic Anoxic Events (OAE)s. Some OAEs were strictly related to Large Igneous Province (LIP) volcanic activity which is thought to have induced major environmental perturbations.

Here, we present new calcareous nannofossil morphometric data performed on selected species integrated with published datasets through specific intervals across the Valanginian, Aptian and Albian. The results are discussed in the context of global ocean perturbations related to OAEs and an increased LIPs volcanism. Currently two different hypotheses are discussed to explain size reductions of some nannofossil species across studied OAEs: 1) the "light attenuation" model proposes the disappearance of size-selecting ecological niches in muddy waters due to high atmospheric CO_2 concentrations, a humid climate and enhanced run-off; 2) the "toxic metal" model links dwarfism to the increased input of toxic metals into the oceans, related to hydrothermal activities. Both scenarios ask for an extensive volcanism, documented for the Valanginian (Parana-Etendeka LIP), Aptian (Kerguelen Plateau) and Cenomanian (Caribbean Plateau).

Aptian–Albian Terrestrial Paleoclimatology of the North American Western Interior Basin

***Ludvigson, G.*[1,*], Gonzalez, L.[1], Suarez, M.[2], Joeckel, R.M.[3], Moeller, A.[1], Ross, J.[1]**

*1) University of Kansas, Lawrence, Kansas, USA, *E-mail: gludvigson@kgs.ku.edu*
2) University of Texas at San Antonio, San Antonio, Texas, USA
3) University of Nebraska-Lincoln, Lincoln, Nebraska, USA

The north-south trending Western Interior Basin (WIB) of North America extended from Boreal to Tethyan realms, and encompassed zonal climatic belts including the subtropical Hadley Cell (northern boundary near 30°N palolatitude), the mid-latitude Ferrel Cell (northern boundary near 60°N paleolatitude), and the high-latitude Polar Cell. These zonal belts exerted strong influence on climatically-sensitive terrestrial deposits, which included calcic mudstone paleosols in the Hadley Cell, with coals and sideritic mudstone paleosols predominating in the Ferrel and Polar cells. A north–south transect of the $\delta^{18}O$ values of pedogenic carbonates (calcic and sideritic) in the WIB has been used to constrain oxygen isotope mass balance models of Aptian–Albian hydrologic cycles, and suggest substantial increases in both global and zonal precipitation rates over that of the modern climate system. The age of the oldest Cretaceous terrestrial deposits filling the WIB are still subject to question, although evidence for the presence of Neocomian units is starting to emerge, with Maximum Depositional Ages (MDAs) of up to 139 Ma observed in the Yellow Cat Member of the Cedar Mountain Formation of Utah, USA. Published terrestrial records of Aptian-Albian Carbon Isotope Excursions (CIEs) show that these global-scale carbon cycle perturbations can be traced into continental deposits. Sedimentologic characters of terrestrial units spanning these CIEs clearly show evidence for major paleoclimatic impacts on land. Pedogenic carbonate pCO_2 time series constructed from Aptian–Albian paleosols in the WIB (LUDVIGSON et al., 2015) and in China (LI et al., 2014) both show an overall long-term fall through the Aptian-Albian interval punctuated by abrupt changes, with peak values in the C10 C-isotope feature in the late Aptian. The C10 feature also coincided with a pronounced aridification event in the WIB, a result seemingly at odds with many other indications for a late Aptian cold snap. We advocate wider use of chronstratigraphically-useful MDAs from large detrital zircon populations (n=300) from mudstone paleosols as a means for calibrating terrestrial records of Aptian–Albian CIEs.

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The 6th international meeting of the IUGS Lower Cretaceous Ammonite Working Group, the « Kilian Group » (Vienna, Austria, 20th August 2017)

***Lukeneder, A.**[1,*], Reboulet, S.[2], Klein, J.[3], Rawson, P.[4], Szives, O.[5]*

*1) Natural History Museum, Vienna, Austria, *E-mail: alexander.lukeneder@nhm-wien.ac.at*
2) Université Claude Bernard Lyon, Lyon, France
3) Private, EC Vinkeveen, The Netherlands
4) University College London, London, UK
5) Natural History Museum, Budapest, Hungary

The Lower Cretaceous Ammonite Working Group forms part of the IUGS Subcommission on Cretaceous Stratigraphy and is the successor of the Lower Cretaceous Cephalopod Team. The aims of the Kilian Group are (HOEDEMAEKER et al., 2003): (1) construct a standard ammonite zonation for the Lower Cretaceous Series, which is in fact the zonation for the (West) Mediterranean Faunal Province; (2) develop ammonite zonations for other key areas in the Tethyan, Central Atlantic, Boreal and Austral realms and to calibrate them with the « Standard »; and (3) make recommendations on the definitions of Lower Cretaceous (sub-stage boundaries to the appropriate stage Working Groups of the Subcommission.

The recommendations on the working method are (REBOULET et al., 2009): 1) new proposals made by members of the Kilian Group should be preferentially based on published or submitted data which have been reviewed or discussed previously by some members of the Kilian Group; 2) the Kilian Group should preserve, as much as possible, the stability of the Standard zonation as some frequent changes could be more or less difficult to follow by non-ammonite workers; however, the group has to take into account recent paleontological revisions and must allow the development of the current zonal scheme; 3) colleagues who work on Lower Cretaceous stages are encouraged to use consistently the Standard or they should correlate it with their local zonal scheme in order to make easier comparisons of zonal schemes between different studies and to improve communication.

Five meetings have been organized (Lyon 2002, Neuchâtel 2005, Vienna 2008, Dijon 2010 and Ankara 2013). The main changes of the Standard zonation have concerned the Valanginian, Hauterivian, Barremian, Lower Aptian and Upper Albian stages (HOEDEMAEKER et al., 2003; REBOULET et al., 2006; 2009; 2011; 2014). Thus, the Kilian Group encourages new proposals on the Berriasian and Lower Middle Albian zonations. The last meeting also dealt with the calibration of different ammonite zonal schemes of the Boreal, Austral and Central Atlantic realms with the Standard (Reboulet et al., 2014).

The results of the next meeting that is planned just before the 10th Cretaceous Symposium held in Vienna will be presented by Alexaner Lukeneder (poster).

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A new Lower Cretaceous ammonoid fauna from the Northern Calcareous Alps

Lukeneder, A.[1,*]

*1) Natural History Museum, Vienna, Austria, *E-mail: alexander.lukeneder@nhm-wien.ac.at*

A new ammonoid fauna is presented for a Lower Cretaceous pelagic to hemipelagic succession of the Bajuvaric Langbath Zone (Northern Calcareous Alps, Upper Austria). The studied sites comprise outcrops of the High Bajuvaric Unit west of the Lake Traunsee, in the northernmost part of the Northern Calcareous Alps. The ammonoids and accompanying fauna (nautiloids, belemnoids, aptachi, bivalves, gastropods, sponges, echinoids) from the Klausbachgraben area originate from the upper Hauterivian to lower Barremian deposits of the Schrambach Formation. This formation consists mainly of light and dark grey marly limestones and marls. Ammonoid material is known from private collections but nothing was published so far. The sites can only be accessed with permission from the forest agency, over a forest road which starts from the main road between Altmünster at Lake Traunsee to Steinbach at Lake Attersee. Abundant ammonoids enable recognising the standard Mediterranean ammonoid zones, from the upper Hauterivian *Balearites balearis* Zone (*Balearites balearis* Subzone) up to the lower Barremian *Kotetishvilia nicklesi* Zone. Numerous ammonoid species are documented for the first time from the Northern Calcareous Alps. Ammonoid abundances are clearly linked to sea-level changes. The accumulations in distinct layers (horizons, mass occurrences) are triggered by redeposition of ammonoid shells. The ammonoid assemblages of the Schrambach Formation shed light on the Early Cretaceous palaeobiogeography of the northernmost parts of the Northern Calcareous Alps, the Bajuvaric Units. The new ammonoid fauna also provides insights into the faunal composition and distribution within the investigated interval, linked to other Mediterranean areas and assemblages.

The ammonoid assemblage consists of 13 families including 28 different upper Hauterivian to lower Barremian genera: Phylloceratidae (4 %) with *Phylloceras*, *Phyllopachyceras*; Lytoceratidae (5 %) with *Lytoceras*; Desmoceratidae (51 %) with Plesiospitidiscus (dominant element with 85 %), *Barremites*, *Abrytusites*, ?*Melchiorites*; Pulchelliidae (1 %) with *Buergliceras*, *Discoidellia*, *Kotetishvilia*; Haploceratidae (1 %) with *Neolissoceras*; Crioceratidae (27 %) with *Crioceratites*, *Pseudothurmannia* (dominant element with 72 %), *Paracostidiscus*, *Sornayites*; Emericiceratidae (1 %) with *Honnoratia*, *Paraspiticeras*; Acrioceratidae (1 %) with *Acrioceras*; Ancyloceratidae (0.25 %) with *Toxancyloceras*, *Ancyloceras*; Leptoceratoididae (2 %) with *Hamulinites*, *Sabaudiella*; Hamulinidae (4 %) with *Anahamulina*, *Amorina*, *Hamulina*; Megacrioceratidae (2 %) with *Liautaudia*, *Megacrioceras*; Macroscaphitidae (0.1 %) with *Macroscaphites*. The nautiloid genus *Eucymatoceras* (1 %) accompanies the ammonoid fauna.

The evolution of the d13Cbulk trend in the Southern Alps

Lukeneder, A.[1,*], Soták, J.[2], Jovane, L.[3], Giorgioni, M.[4], Savian, J.F.[5], Halásová, E.[6], Rehákova, D.[6], Józsa, S.[6], Kroh, A.[1], Florindo, F.[7], Sprovieri, M.[8]

*1) Natural History Museum, Vienna, Austria, *E-mail: alexander.lukeneder@nhm-wien.ac.at*
2) Slovak Academy of Science, Banská Bystrica, Slovakia
3) Universidade de São Paulo, São Paulo, Brazil
4) Instituto de Geociências da Universidade de Brasília, Brasília, Brazil
5) Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil
6) Comenius University, Bratislava, Slovakia
7) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy
8) Università di Palermo, Palermo, Italy

Carbon isotope values are consistent with those observed in other Early Cretaceous records of the northern Tethyan Realm and show the secular variations of the paleoceanographic history on the Trento Plateau (Southern Alps, N. Italy). The presented $\delta^{13}C$ record exhibits typical values for Early Cretaceous hemipelagic to pelagic deposits which are in our case open-marine carbonates. The $\delta^{13}C$ data obtained from numerous Tethyan sections appear with an almost identical trend through stratigraphy, indicating the enormous value as calibration and correlation tool of carbon isotopes.

Single peaks and trends in the $\delta^{13}C$ record are also important for correlation with other reference sections. The positive $\delta^{13}C$ shift by 0.59‰ at P1/53 and the subsequent by 0.32‰ mark the Faraoni anoxic event (Upper Hauterivian), and the ~1‰ increase in the upper part of the Puez Limestone Member is typical of the boundary between the early and late Barremian. The increasing trend of about ~1‰ $\delta^{13}C$ from the late Hauterivian to early Barremian was also reported from S. France (e.g., Angles). The comparable bulk rock (composite) curve from the Vocontian Basin appears with an almost identical trend from the late Hauterivian to the late Barremian as the $\delta^{13}C$ curve from Puez. The late Aptian to early Albian $\delta^{13}C$ curve seems to be more constant around a mean of ~2‰ at Puez compared to the strongly fluctuating curve with values from +1.0‰ (early Late Aptian) to +3.52‰ (earliest Late Aptian and latest Late Aptian) from the Vocontian Trough. Belemnite $\delta^{13}C$ values range at Puez from late Hauterivian +0.39‰ (mean) to late Barremian +0.90‰ (mean). The $\delta^{13}C$ data show a similar positive trend compared to data from Hungary (Bersek section) with +0.40–+0,50‰ in the late Hauterivian (*Balearites balearis* Zone) to +0.6–+0,90‰ in the late Barremian (*Toxancyloceras vandenheckii* Zone). Similar $\delta^{13}C$ records, from ~+0.5‰ to +2.0‰, were reported from late Hauterivian to early Late Barremian deposits from the Southern Carpathians (S. Rumania). δ^{13} values and trends calculated from Vocontian Trough belemnite data show a similar picture for the western Tethyan Realm, with a positive shift of 0.50‰ (mean) from the late Hauterivian (*B. balearis* Zone) to late Barremian (*Gerhardtia sartousiana* Zone). The Hauterivian of central Italy (e.g., Gorge a Cerbara, Bosso), the $\delta^{13}C$ average values of 1.9‰ followed by a long and continuous trend to positive values is observed culminating in the Barremian with values of 2.5‰, exactly mirrors the trend from the Puez reference sections. No isotopic signature of the early Aptian OAE-1a occurs at Puez because of a prominent hiatus at the base of the in the Puez Redbed Member, while $\delta^{13}C$ values in the Puez Marl Member reflect the long term Albian trend observed in the Vocontian Trough, the Apennines and other sites of the Tethys. Despite the presence of organic rich layers in the Lower Albian, no isotopic signature of the OAE 1b has been observed in the P2 or P6 sections. Upper Albian values display the typical increasing trend of approximately 0.5‰, here displaced by a fault, observed in several archives around the world and interpreted as the signature of the OAE-1d.

The Early Aptian Oceanic Anoxic Event 1a in western Iran (Garau Formation, Zagros Basin) – evidence from calcareous nannofossils

Mahanipour, A.[1,*], ***Eftekhari, M.***[1]***, Mutterlose, J.***[2]

1) Department of Geology, Shahid Bahonar University of Kerman, Kerman, Iran,
**E-mail: a_mahanipour@uk.ac.ir*
2) Institut für Geologie, Mineralogie und Geophysik, Ruhr Universität Bochum, Bochum, Germany

The Garau Formation (Zagros Basin, west Iran), which was deposited under pelagic conditions, consists of alternations of black shales, limestones, marlstones and radiolarian rich layers. The lithology is very similar to other hemipelagic – pelagic successions of late Early Aptian age in the Tethys. In order to obtain data suitable for a paleooceanographic interpretation, calcareous nannofossils have been studied with respect to their biostratigraphy and paleoecology from the Early Aptian interval of the Garau Formation.

The studied interval is spanning calcareous nannofossil zones NC6 and NC7 following ROTH (1978). Nannoconid abundance is decreasing from the middle part of NC6, the lowest abundances of nannoconids are recorded from the uppermost part of NC6. The interval between the first occurrence (FO) of *Hayesites irregularis* and the FO of *Eprolithus floralis* is considered to reflect the nannoconid crisis recorded worldwide (ERBA, 2004). An increase in abundance of *Micrantholithus* spp. is recorded from the lower part of the nannoconid crisis. *Micrantholithus* spp. is mainly thought to have been associated with low surface water salinity conditions (TREMOLADA et al., 2009), enhanced nutrient contents (STREET & BOWN, 2000) and warm waters. High abundances of this group can be interpreted as a result of higher biogeochemical weathering and increased runoff under warm, humid conditions. Simultaneously with the nannoconid crisis, a decrease in calcium carbonate content is recorded. Following the nannoconid crisis, an increase in the abundance of nannoconids (especially of wide and intermediate canal forms) has been observed, though nannoconids do not reach pre-crisis values. According to these data, the OAE 1a can be very well constrained in the Early Aptian of the Garau Formation in the Zagros Basin (west of Iran).

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A multi-proxy chemostratigraphy of the Cenomanian/Turonian transition in Kopet-Dagh basin (NE Iran); implication for oceanic temperature and *p*CO_2 variations

Mahmudy Gharaie, M.H.[1,*]***, Kalanat, B.***[1]***, Vahidinia, M.***[1]***, Kumon, F.***[2]

*1) Ferdowsi University of Mashhad, Mashhad, Iran, *E-mail: mahmudygharaie@gmail.com*
2) *Shinshu University, Matsumoto, Japan*

In a global scale, the Cenomanian-Turonian anoxic event (OAE2) has been characterized by warm climate accompanied by a major sea level transgression. However, chemo- and biostratigraphy studies in the Kopet-Dagh basin (NE Iran) indicate two intervals of low sea surface temperature in the uppermost *Rotalipora cushmani* and *Whiteinella archaeocretacea* biozones, according to *p*CO_2 proxy (difference between $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$) minima and high $\delta^{18}O$ values. These cold intervals began shortly after episodes of warm sea surface temperature and enhanced burial of organic matter (high TOC contents) and have been attributed to a drop in atmospheric *p*CO_2 level which in turn was caused by enhanced carbon sequestration by black shale deposition. The first cooling interval at onset of OAE2 is recorded throughout the world and called "Plenus cold event" in Europe and "benthic oxic zone" in the proto north Atlantic and Western Interior Seaway of North America respectively. It coincides with positive shift of carbon isotope values both in carbonate and organic matter. A common feature of the two organic-rich sediments intervals (corresponding to warm episodes) in the Kopet-Dagh basin is their low $\delta^{15}N$ values that falls around 0‰ and implies enhanced nitrogen fixation process as a consequence of enhanced productivity and expanded oxygen minimum zone.

Sub-Milankovitch cycles in Upper Cretaceous pelagic successions along the active and passive continental margins of the NW Tethys

Mair, L.[1], Wolfgring, E.[1,*], Wagreich, M.[1]

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: erik.wolfgring@univie.ac.at*

Two Upper Cretaceous sections in the Eastern Alps of Austria were investigated in detail to decipher Milankovitch and sub-Milankovitch cycles. The two sections were situated palaeogeographically at the passive (northern Penninic-Helvetic) margin of the European Foreland and at the active (southern) margin of the northwestern Tethys ocean branch (Penninic Ocean or Alpine Tethys). Sample material was collected from three short profiles of visible and known cyclic succession yielding limestone-marlstone cycles (Northern Calcareous Alps: Postalm section; Ultrahelvetic Unit: Rehkogelgraben section). Samples cover a time range of 240 ka in total based on published Milankovitch-type cyclostratigraphy (NEUHUBER et al., 2009, 2016; WAGREICH et al., 2012). High-resolution geochemical analyses of whole rock analyses using ICP-MS, EDXRF/ EDXRF-handheld device, WDXRF, stable C and O isotopes measurements and continuous thin-sections profiles were performed to characterize the various beds.

Elemental abundance ratios show cyclic arrangements and thus allow an interpretation as being climatic in origin, controlled by orbital parameters. Using spectral analyses and bandpass filtering it was possible to interpret a ~10 ka, ~5 ka and a ~7–8 ka signal based on fluctuations in $CaCO_3$, stable carbon and oxygen isotopes. The 5 ka signal is most likely an artefact reflecting the first harmonic of the precession signal. The 7–8 ka signal is interpreted most likely as an artificial product of the statistical methods used. The 10 ka or semi-precession period is possibly, in accordance with previous studies, an original climate cyclic signal that may be linked to cyclic climatic variations especially in the tropics, which themselves are controlled by orbital forcing (BERGER et al., 2006).

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Long journey, tectonic and geodynamics of Indo-Pak plate: evidences from Pakistan

Malkani, M.S.[1]

1) Geological Survey of Pakistan, Azad Kashmir, Pakistan, E-mail: malkanims@yahoo.com

The geodynamics and tectonic study of Indo-Pak is significant due to its present regional contact with Asia but past contact with Gondwana. The ironstone and ferruginous brown strata of Jurassic-Cretaceous boundary provide a clue of separation from Madagascar and start of northward long journey at about 135 Ma. The marine strata was dominant in the Lower Cretcaeous while coastal sandstone were dominat in the Upper Cretaceous. The eastern part of upper Indus basin show a wide range of erosion where the Precambrian Salt Range Formation in Eastern Salt Range and Cambrian dolomite in Tatta Pani, Kotli are capped by Infra Tertiary boundary Indus Formation (bauxite/laterite). This erosion show a long journey of more than 5000 km in a period of 68 Million years (135 Ma–67 Ma) with average speed of 10cm/year. When Indo-Pak plate came close to Asian plate, the stress created subduction of Tethys plate (at the line of Karakoram Suture) under Hindukush-Karakoram resulted in the form of Karakoram magmatic arc. Further stress at later created subduction of Tethys sea plate (at the line of Northern Indus Suture) under Kohistan-Ladakh belt resulted in the form of Kohistan-Ladakh magmatic arc. The Indo-Pak collided first time with Afghan block at Latest Cretaceous about 67 Ma. The Indo-Pak plate docked with Kohistan-Ladakh Tethyan belt. Due to first collision, uplift took place resulted in the birth of Paleo Indus river systems and end of Paleo Vitakri river systems. During Eocene the Paleo Indus river systems deposited the Shagala Group in Balochistan basin, Chamalang (Ghazij) in middle Indus and western part of upper Indus, and Kuldana groups in uppermost and middle and eastern part of upper Indus basins. At Latest Eocene (40–35 Ma) the northern part of Indo-Pakistan collided hard which resulted in the uplift, folding and faulting (mainly south verging thrusts) in the northwestern Foreland and deposition of terrestrial Potwar/Vihowa (Siwalik) Group in the Hinterland. The last major geoevent at Pliocene-Pleistocene boubdary created further uplift, folding and faulting and the deposition of Pleistocene-Holocene Sakhi Sarwar Group (Dada conglomerate and Sakhi Sarwar snad and clays). This orogeny is responsible for creating highest peaks and present morphology.

Mesozoic vertebrates from Pakistan: Recent advances in discoveries of Cenozoic vertebrates from Balochistan and Sulaiman basins (Pakistan): Paleobiogeographic affinity

Malkani, M.S.[1]

1) Geological Survey of Pakistan, Azad Kashmir, Pakistan, E-mail: malkanims@yahoo.com

The vertebrates of Indo-Pak created major insights into the paleobiogeography of the Indo-Pak subcontinent due to its present connection with Asia (Northern hemisphere) and past, especially Triassic–Jurassic, connection with Gondwana (Southern hemisphere). The Triassic strata of Pakistan have not yielded any vertebrates so far while the Jurassic has produced body fossils of titanosauriforms/early titanosaurs (*Brohisaurus kirthari*) and a footprint of a sauropod, tracks of a couple of small theropods (*Himalayadrinda potwari*) and trackways of a herd of titanosauriforms/early titanosaurian sauropods, *Malakhelisaurus mianwali*, confronted by a large theropod, *Samanadrinda surghari*. The Cretaceous of Pakistan yielded body fossils of the titanosaurian sauropods *Khetranisaurus barkhani*, *Sulaimanisaurus gingerichi* and *Pakisaurus balochistani* (pakisaurids), and *Marisaurus jeffi*, *Balochisaurus malkani* and *Maojandino alami* (balochisaurids), *Nicksaurus razashahi* (saltasaurids), *Gspsaurus pakistani* and *Saraikimasoom vitakri* (gspsaurids), theropods – the abelisaurian *Vitakridrinda sulaimani* and the noasaurian *Vitakrisaurus saraiki*, the mesoeucrocodiles *Pabwehshi pakistanensis* and *Induszalim bala* (induszalimids) and *Sulaimanisuchus kinwai* (sulaimanisuchids), mesocrocodiles (*Khuzdarcroco zahri*), flying reptile/pterosaur saraikisaurids (*Saraikisaurus minhui*), fishes (*Karkhimachli sangiali*), and trackways of titanosaurs (*Pashtosaurus zhobi*). Besides diverse postcranial remains and osteoderms, the cranial fossils include two skulls of titanosaurs and two rostra and anterior mandibles of mesoeucrocodiles, dentaries of pterosaurs and a theropod braincase. The Mesozoic vertebrates show closer affinity to Gondwana than Laurasia. Recently, Balochistan Basin for the first time yielded the Early Eocene vertebrate giant baluchithere *Pakitherium shagalai*. Previously, Sulaiman basin is famous for baluchitheres, whales, proboscidean and other mammals and some reptiles. Despite severe security disturbance, the recent geological and paleontological exploration in Sulaiman Basin yielded Latest Cretaceous dinosaurs, mesoeucrocodiles and pterosaurs, Early Eocene cyonids (*Bolanicyon shahani*), Middle Eocene basilosaurids (*Sulaimanitherium dhanotri*), the Oligocene baluchithere *Buzdartherium gulkirao*, the eucrocodile *Asifcroco retrai*, and the Miocene proboscidean *Gomphotherium buzdari*. The Cenozoic vertebrates show Eurasian affinity and migrated from Eurasia to the Indo-Pak subcontinent or vice versa via Western and Northern Indus Suture, after the collision of the Indo-Pak subcontinent with Asia occurring at the terminal Cretaceous.

Evolution of weathering and erosion in the South Atlantic during the Late Cretaceous

Marlot, L.[1], Freslon, N.[1], Pucéat, E.[1,*], Pellenard, P.[1], Bayon, G.[2], Guiraud, M.[1], Chenot, E.[1], Gourlan, A.T.[3], Bougeault, C.[1]

1) Université de Bourgogne-Franche-Comté - UMR 6282 Biogéosciences, Dijon, France,
**E-mail: emmanuelle.puceat@u-bourgogne.fr*
2) IFREMER - Unité de Recherche Géosciences Marines, Plouzané, France
3) Université Grenoble Alpes ISTerre, Grenoble, France

The Late Cretaceous period is marked by a long-term climatic cooling (FRIEDRICH et al., 2012) and by major geodynamic changes, that include modifications in the direction and velocity in the African plate motion toward Eurasia (GUIRAUD & BOSWORTH, 1997). During the Senonian, the African continent underwent a major uplift event, that is most pronounced in its southern part (GUIRAUD & BOSWORTH, 1997; BRAUN et al., 2014). These geodynamical changes may have led to modifications in weathering and erosion rates, that may have initiated or enhanced the recorded long-term cooling through CO_2 drawdown linked to silicate weathering.

In order to explore the possible links between uplift in south Africa, continental weathering, and climate, we performed analyses of clay mineral assemblages and of a new proxy of local continental weathering, the combined Lu-Hf and Sm-Nd isotope systems in clays (BAYON et al., 2016), on sediments from DSDP site 364 in the Angola Basin. About 100 analyses of clay mineral assemblages have been conducted that display a marked increase in illite, chlorite, and kaolinite proportions during the Santonian-Campanian interval dominated by a smectite-rich sedimentation. We interpret this evolution as reflecting increased mechanical weathering of nearby crustal material. About 20 analyses of combined Hf isotopic (ε_{Hf}) and Nd isotopic (ε_{Nd}) compositions of part of the sample set have additionally been realized. These newly acquired data display a decrease in the ε_{Nd} composition of the eroded material transported to site 364, from values of about -15 ε-units in the Turonian to Santonian interval, to values of about -22.5 ε-units on average during the Campanian and Maastrichtian. A concomitant increase in Deltaε_{Hf} values, representing deviation from the clay array of the ε_{Hf} values of clay-size sediments (BAYON et al., 2016), suggests an increase in chemical continental weathering during the Santonian-Campanian. We link this concomitant change in clay mineral assemblages, clay ε_{Nd}, and clay Deltaε_{Hf} values during the Santonian-Campanian interval to the uplift event of South Africa. This event could have induced both erosion of more ancient underlying crustal material and an increase in mechanical weathering, that itself could have favored an increase in chemical weathering.

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Synchronizing the astronomical time scales in the Valanginian–Hauterivian from the Neuquén Basin (Argentina) and the Tethyan area

Martinez, M.*[1,*], Aguirre-Urreta, B.[2], Marina, L.[2], Omarini, J.[3], Tunik, M.A.[3], Frederichs, T.[1], Nickl, A.-L.[1], Pälike, H.[1]

*1) MARUM – Center for Marine Environmental Sciences, Bremen, Germany, *E-mail: mmartinez@marum.de*
2) Universidad de Buenos Aires, Buenos Aires, Argentina
3) Universidad de Río Negro, Río Negro, Argentina

Important discrepancies between the numerical ages stated by the Geological Time Scale 2016 and radio-astrochronological works have been reported in the last years (AGUIRRE-URRETA et al., 2015; MARTINEZ et al., 2015; OGG et al., 2016). Large uncertainties notably exist for the Valanginian-Hauterivian stages for which the recently provided timescales are still debated. Here, we present an astronomical calibration for the Agrio Formation (Neuquén Basin, Argentina) to better constraint the durations of the Valanginian and the Hauterivian stages. The formation is divided into a lower and an upper member (called Pilmatué and Agua de la Mula members, respectively) composed of marl-limestone alternations deposited in a semi-pelagic to outer ramp environment and related to an orbital forcing. A rapidly (<0.5 myr) deposited member of continental sandstone, separates these two members. A total of 2130 bulk-rock samples have been collected each 25 cm and their mass-corrected magnetic susceptibility has been measured to detect lithological cycles. In the lower part of the Pilmatué Member (Lower Agrio), the record of the 405-kyr eccentricity cycle is obvious but its amplitude promptly decreases at younger intervals. However, the orbital cycles of precession, obliquity and 100-kyr eccentricity are recorded, allowing the duration of the Pilmatué Member to be assessed at 4.70 myr. Anchoring this duration to the CA-ID-TIMS age of 130.39 ± 0.16 Ma provided in the Pilmatué Member, the age of this member ranges from 133.76 to 129.07 ± 0.16 Ma. The age of the top of the Lower Agrio slightly overlaps the age of the base of the Upper Agrio (129.09 ± 0.16 Ma). Such an overlap falls in the range of the uncertainties in the CA-ID-TIMS ages. First correlations to the Tethyan area suggest that the early Hauterivian has a duration of 2.1 myr, falling in the range of uncertainty mentioned by MARTINEZ et al. (2015) (2.5 ± 0.4 myr), but being much longer than the duration of 1.21 myr proposed in the geological time scale 2016 (OGG et al., 2016), suggesting the duration of the Hauterivian stage has to be increased by, at least, 0.9 myr for the next compilation.

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Late Campanian–Early Maastrichtian heteromorph dominated ammonite fauna of the Northwestern Pacific region: an example from the Nakaminato Group (Hitachinaka, central Honshu, Japan)

Masukawa, G.[1,*] and Ando, H.[2]

1) Graduate School of Science and Engineering, Ibaraki University, Mito, Japan,
**E-mail: 16nm312h@vc.ibaraki.ac.jp*
2) Faculty of Science, Ibaraki University, Mito, Japan

Late Campanian to Early Maastrichtian ammonite fauna in the Northwestern Pacific region has known to be dominated by such characteristic heteromorphs as *Didymoceras*, *Pravitoceras*, *Diplomoceras*, *Baculites*, etc., occurring from some of offshore mudstone strata (Izumi, Sotoizumi, Yezo and Nakaminato groups) around Japan. Among those strata, the Nakaminato Group is suitable to demonstrate their stratigraphic succession as well as other molluscan fauna, because of continuously exposed strata observed along the Pacific coast, though fossils are not so prolific in occurrence. We report the faunal components and their succession in addition to the lithostratigraphy and sedimentary environments of the Nakaminato Group as basic information for reconstructing their habitat and ecological significance.

The Nakaminato Group crops out only 4 km north-southward on wave-cut benches along the Pacific coast in Hitachinaka City, Ibaraki Prefecture, central Honshu. The homoclinal (30 to 40° NE) strata provide a continuous lithostratigraphic succession of the Upper Campanian to the Lower Maastrichtian about 1,900 m thick. The Nakaminato Group is subdivided into the offshore mudstone-dominated Hiraiso, and sandstone- and sandy turbidite-dominated Isoai formations in ascending order.

Didymoceras sp. occurred from massive mudstone of the lowermost part of the Hiraiso Formation. *Didymoceras awajiense* and *Diplomoceras* sp. co-occurred from siltstone frequently intercalated with thin, fine to very fine sandstone of the lower part of the Hiraiso Formation. *D. awajiense* shows a wide range of variation in modes of coiling and shell ornamentation. It commonly occurs also from other upper Upper Campanian strata in Japan: Izumi Group and Toyajo Formation of Sotoizumi Group in Southwest Japan. However, the co-occurrence with *Diplomoceras* has not been known in other areas in Japan at all. In having coarser ribs, *Didymoceras* sp. morphologically differs from *D. awajiense* and also *D. hidakense*. *Pravitoceras*, a possible descendant of *Didymoceras*, has not discovered yet, though the equivalent horizon seems to exist within this group. *Baculites* sp. with an indeterminate large nostoceratid occurred from mudstone of the upper part of the Isoai Formation. Based on inoceramid ("*Inoceramus*" *kusiroensis*) and U-Pb age of detrital zircons in sandstone, the age of the upper part of the Isoai Formation is assigned as Early Maastrichtian.

On the basis of a few fragmentary specimens of *Diplomoceras* sp. from the Nakaminato Group, preserving early to middle growth stages, the entire shell form of a world-wide genus *Diplomoceras* can be reconstructed especially for initial and late to final stages, by referring to the previous good records from the Yezo Group, Japan, France and Antarctica. Our reconstruction suggests that the adult shell of *Diplomoceras* is composed of nine shafts and eight U-shaped turned shells. Its length will exceed 1.6 m. It reminds us *Diplomoceras* was one of the largest giant heteromorphs with mostly benthic mode of life.

Stratigraphic potential of radiolarians for determining the Jurassic/Cretaceous boundary: evidence from pelagic sequences in the Pacific and Tethys

Matsuoka, A.[1]

1) Niigata University, Niigata, Japan, E-mail: amatsuoka@geo.sc.niigata-u.ac.jp

The Global Boundary Stratotype Section and Point (GSSP) of the Jurassic/ Cretaceous (J/K) boundary is the last among the GSSPs in the Phanerozoic. It is defined as the base of the Berriasian Stage. The formal definition was made in 2016 to use the base of the *Calpionella alpina* Subzone as the primary marker by the Berriasian Working Group in the International Subcommission on Cretaceous Stratigraphy. The definition is satisfactorily applicable for shallow marine deposits within the western Tethys and north Atlantic. Unfortunately, the primary marker taxon cannot be found in the Pacific and circum-Pacific regions since the distribution of *Calpionella* is limited to the western Tethys and north Atlantic. To determine the base of the Berriasian outside of these regions, alternative markers are needed.

Radiolarians are good candidates for determining the J/K boundary because they are wide spread and can be found both shallow and deep sedimentary facies. Pelagic sequences across the J/K boundary have been reported in ODP/IODP sites in the western Pacific and land sections in Japan, the Philippines, southern Tibet, Iran and others. Evolutionary series of several radiolarian lineages across the J/K boundary are reviewed and suitable bioevents, which are approximate to the J/K boundary, are proposed. These lineages include the radiolarian genera *Archaeodictyomitra, Cinguloturris, Eucyrtidiellum, Hemicryptocapsa, Hsuum, Loopus, Mirifusus, Neorelumbra, Ristola, Podocapsa, Pseudodictyomitra, Tethysetta, Thanarla*, and *Vallupus*.

A peep into a private life of a Late Cretaceous burrowing shrimp: a case study from Muthmannsdorf, Austria.

Hyzný, M.[1, 2,*] and Summesberger, H.[2]

1) Comenius University, Department of Geology and Palaeontology, Bratislava, Slovak Republic,
**E-mail: hyzny.matus@gmail.com*
2) Geological-Palaeontological Department, Natural History Museum, Vienna, Austria

Callianassid ghost shrimps are soft-bodied, usually heterochelous fossorial decapod crustaceans living in a variety of marine environments or environments under marine influence. They are among major bioturbators of muddy and sandy marine substrates where their behaviour involves digging complex permanent or semi-permanent burrow systems. This behaviour is often preserved in the fossil record in the form of the trace fossils. These trace fossils usually do not contain any body fossils, thus, their attribution to ghost shrimps often is indirect. In some cases, however, a tracemaker is preserved, providing invaluable information about the private life of these shrimps (SWEN et al., 2001; MOURIK et al., 2005; HYŽNÝ, 2011; HYŽNÝ & KLOMPMAKER, 2015).

Numerous individuals of a new ghost shrimp species *Mesostylus* sp. n. are reported from the Upper Campanian–Lower Maastrichtian of the Piesting Formation exposed at Muthmannsdorf (Lower Austria, Austria). They are preserved *in situ* within their burrows. Often more than one individual is preserved in the same burrow structure; the orientation of the specimens suggests they represent moults. Interestingly, the presumed moults from the same burrow structure do not seem to belong to the same individual suggesting that more animals were sharing the same burrow system at a time. This may come as a surprise since extant callianassid ghost shrimps are known to exhibit strong antagonistic behaviour (SHIMODA et al., 2005).

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Towards a Chemostratigraphic Approach to Determine the Barremian-Aptian Boundary

Maurrasse, F.[1,*] ***and Sanchez-Hernandez, Y.***[1]

*1) Florida International University, Miami, USA, *E-mail: maurrass@fiu.edu*

The Barremian-Aptian (B/A) boundary was traditionally reported to characterize a major shift in facies from generally shallower to deeper water sediments, hence the lithologic change became often the hallmark of that transitional stage (e.g. NW Germany, MUTTERLÖSE, 1998; Mexico, IMLAY, 1937). Subsequent studies revealed that the global change assumed at the boundary occurred diachronously (e.g., NE Mexico, BARRAGAN & MAURRASSE, 2008); SE France, Provence, MOULLADE et al., 1998), implying that lithology itself could not be a valid criterion to define the stage boundary. Identification of the B/A boundary using biostratigraphy has proven to be problematic as well, especially in sections with a marked expression of oxygen-depleted conditions where index taxa are lacking or very rare. Faunal variations and the possible lack of synchronism in biostratigraphic events are among the main factors associated with these uncertainties in chronologic reliability (e.g. AGUADO et al., 2014).

Since chemostratigraphic data based on carbon isotope ($\delta^{13}C_{org}$ and $\delta^{13}C_{carb}$) variations in Lower Cretaceous sediments have been calibrated with magnetostratigraphy and dependable microfossils at different Tethyan sections and elsewhere, they thus provide an improved resource that reflects extant fluctuations in the ocean carbon reservoir suitable for regional correlation. Published C-isotope curves have indeed shown a consistent negative shift (up to -1.5 ‰) associated with the Barremian-Aptian boundary at different localities worldwide: e.g., Cau section, NE Spain; Provencal platform, SE France; Organyà Basin, Catalunya, Spain; Apulia carbonate platform of the Borgo Celano section, Italy; Adriatic platform, Croatia; IODP Site 765 in the Argo Abyssal Plain, located north of the Exmouth Plateau NW of Australia; Comanche carbonate platform, northern Gulf of Mexico. The constancy of the negative trend in the $\delta^{13}C$ record and its concurrence with the Barremian-Aptian transition suggests a relatively synchronous change in the global carbon reservoir coincident with the stage boundary. Thus, albeit modulating effects conditioned by biotic factors inherent to local basins, this negative shift in $\delta^{13}C_{org}$ and $\delta^{13}C_{carb}$ can be applied as a potentially more accurate chronostratigraphic tool to determine the B/A boundary independent of biostratigraphic ambiguities.

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Clay mineralogy of a 10 Ma interval in the NW Tethyan Upper Cretaceous (Postalm, Austria)

Meszar, M.[1,*], ***Gier, S.***[1], ***Wagreich, M.***[1]

*1) Department für Geodynamik und Sedimentologie, Wien, Austria, *E-mail: maria.meszar@univie.ac.at*

The changes in clay mineralogy of Upper Cretaceous sediments of the Northern Calcareous Alps over a time span of 10 Ma were investigated in this study. The Upper Santonian to Upper Campanian Postalm section (Gosau Group, Nierental Formation, Austria) comprises more than 180 m of alternating and cyclic pelagic limestones and marlstones with a distinct CORB (Cretaceous Oceanic red Beds) facies. The section was logged bed-by-bed, a total of 369 samples were taken for sedimentological and stratigraphical investigations. Selected samples were investigated for clay minerals as indicators for paleoclimatic conditions. Chlorite and illite are interpreted as indicators for predominantly physical weathering during cooler climate whereas smectite and kaolinite are indicators for predominantly chemical weathering in more warm-humid climate.

The clay fraction was extracted out of the limestones and marlstones with EDTA to dissolve the carbonate without affecting the clay minerals. After complete dissolution of carbonate, the < 2 µm fraction was separated by sedimentation. The clay fractions were further treated with different saturations (Mg-ions, K-ions, ethylene glycol and glycerol), analyzed with x-ray diffraction, and quantified.

First results show that the clay fractions consist of 52–59 % smectite, 32–36 % illite, 4–6 % kaolinite and 5–7 % chlorite. It seems that the amount of smectite is decreasing up section whereas kaolinite is increasing. This mineralogical change could indicate a shift to a more humid climate.

Resedimented Cretaceous platform material in the Manín Unit, Western Carpathians.

***Michalík, J.*[1,*], Boorová, D.[2], Lintnerová, O.[3], Fekete, K.[1], Soták, J.[4]**

1) Slovak Academy of Sciences, Institute of Earth Sciences, Bratislava, Slovakia,
**E-mail: geolmich@savba.sk*
2) State Geological Institute of Dionýz Štúr; Bratislava, Slovakia
3) Comenius University, Faculty of Natural Sciences, Department of Economic Geology, Bratislava, Slovakia
4) Geological Institute, Slovak Academy of Sciences, Banská Bystrica, Slovakia

Lower Cretaceous sequence in the Manin Unit consists of Valanginian–Barremian pelagic carbonate sequence and of neritic carbonate complex compared with the „Urgonian" development (MICHALÍK et al., 2012). However, the latter sequence yielded planktonic foraminifers indicating the Albian Ticinella primula Zone, colomiellids *Colomiella recta*, *C. mexicana,* and calcareous dinoflagellate *Calcisphaerula innominata*. The rock consists mostly of numerous limestone clasts derived from destructed strata. Caprinid rudist shell fragments, orbitolinid foraminifers *Palorbitolina* ex gr. *lenticularis* and *O. (M.) texana* indicate their Aptian age (FEKETE et al., 2017). Isotopes within both formations change in wide intervals ($\delta^{13}C$ is in range +1.03 to +4.20 ‰ V-PDB and $\delta^{18}O$ is in range -0.14 to -5.55 ‰ V-PDB). High values of $\delta^{13}C$ suggest that periplatform carbonate could retain isotope signal of former aragonite mineralogy. Distribution of $\delta^{13}C$ in the section reveal eustatic sea level oscillation and suggest neritic conditions and continual marine diagenesis. During Late Aptian eustatic changes, this highstand carbonate platform sequence has been destroyed by erosion. A new mid-Albian lowstand carbonate platform accumulated carbonate clasts on toe of the slope. After stabilization and aggradation stage, carbonate platform growth was stopped and the platform collapsed. A hardground surface was formed, overlain by thin layer of calcisphaerulid limestone characterized by planktonic foraminifers of the latest Albian Thalmanninella appenninica Zone and calcareous dinoflagellates of the Innominata Acme Zone. This layer starts the sequence of Cenomanian pelagic marls of the Butkov Fm.

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MICHALÍK, J. et al., 2012. Cretac. Research, **38**, 68-79.
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The Khrami Shallo's Paleogeography During The Campanian–Maastrichian Stages

Mikadze, K.[1,*] ***and Menabde, A.***[1]

*1) Georgia National Museum, Institute of Paleobiology, Tbilisi, Georgia, *E-mail: xatmikadze@yahoo.com*

On the protrusion of foundation Khrami the deposits of Campanian stage are white and gray limestones with the lenses of flint and interlayers of marls. The volcanic activity practically was stopped at that time, and were being observed by the rare interlayers of tuffs. The Khrami protrusion in average of the Campanian had been still covered with sea water. The depth of the sea pond of the Campanian age reached not less than 180–200 m. Judging by the remains of ammonites and belemnites, at the beginning of the Campanian the temperature of the water of the open basin composed 15–18°C. This basin was connected with the seas of adjacent Russian platform and different regions of the Tethys.

The fluctuations of bathymetry of the sea basin from the Turonian to the Maastrichian inclusively, predetermined the appearance of the rough sculpture, the keels shells of the genus, that have the thick and two- or three-layered thickened walls. The Late Cretaceous basin of the South-East Georgia was connected to the Mediterranean Sea.

The maximum of transgresion is reflected in the boundary of Campanian and Maastrichian increase of a percentage the relationship of limestones in deposit and establishment of broad communications with the Pacific Ocean, the Central-Asian, the Mediterranean Sea and the MeditoEuropean paleobiogeographic regions. On the background of the general warming up on the warm and cold water, which enter from different regions of Eurasia.

In the late Maastrichtian–Paleogene stage of geological time appeared the tectonic movement, caused by the Laramide orogeny of folding, on what respectively reacted the fauna of microforaminifera by the decrease of planktonic and by the complete retention of benthic forms.

By the end of the Maastrichtian age the temperature of waters of the top layers of the marine environment has increased from 20°C to 26°C. In late Maastrichtian and at the beginning of Paleogene continued impulsy of Laramide orogeny. Lying in the limestones of by the valley, Khrami intra-formational conglomerations with the well rounded pebbles indicate the wash-out of underwater raisings.

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Sequence stratigraphy of the Raha Formation, Bakr Oil Field, Gulf of Suez, Egypt: Insights from electrical well log and palynological data

Mohamed, O.[1,*]***, Mansour, A.***[1]***, Tahoun, S.***[2]***, Elewa, A.***[2]

*1) Geology Department, Minia University, Minia, Egypt, *E-mail: omar.mohamed@mu.edu.eg*
2) Cairo University, Giza, Egypt

The sequence stratigraphic framework of the Upper Cretaceous Raha Formation is constructed using the lithologic, palynologic as well as palynofacies stratigraphic variations in addition to gamma ray data and is based on sixty cuttings from three wells (Bakr-114, B-115, and B-109) in the central province of the Gulf of Suez. The gamma-ray log is commonly used and relied upon to construct the illustrated sequence stratigraphic framework proposed for the three sections of the present study of Bakr Basin. Biostratigraphic analysis reveals a Cenomanian age for the studied samples. Some palynofacies parameters and palynological criteria (e.g., spore:pollen ratio, marine:terrestrial palynomorphs, total dinocyst count, equidimensional: lath-shaped opaques ratio, translucent phytoclasts %, opaque phytoclasts % and amorphous organic matter % (AOM%)) were used as environmental indicators for the proximal-distal trends within the various facies present. The nature of terrestrial organic matter was utilized for delineating the depositional sequences and their bounding surfaces. The Raha Formation corresponds to a second-order depositional sequence, which can be further subdivided into eight third-order depositional sequences. Furthermore, the correlation between the three studied wells illustrates the vertical and lateral distribution of the depositional sequences of the Raha Formation. The general results of the palynofacies analysis suggest that the Raha Formation predominantly records a transgressive episode, interrupted by short-lived regressive phases. The unit reflects deposition within a continental shelf setting, with facies ranging from supratidal to middle neritic conditions, and reflects a low-rate of accumulation of <200 m during ~6 Myr.

Late Cretaceous Ayanka Flora and Plant Communities of the Okhotsk-Chukotka Volcanogenic Belt (Northereastern Russia)

Moiseeva, M.[1,*]***, Herman, A.***[1]***, Sokolova, A.***[2]***, Spicer, R.***[3]

1) Geological Institute, Russian Academy of Sciences, Moscow, Russia,
**E-mail: masha.moiseeva@gmail.com*
2) Paleontological Institute, Russian Academy of Sciences, Moscow, Russia
3) The Open University, Milton Keynes, UK

An insight into the process of restructuring communities that took place during the transition from Mesophytic to Cenophytic vegetation can be gained by comparing taphofloras across the North Pacific Region and here is illustrated first by examining the plant fossils of the Ayanka Flora. These remains were collected in 1985 by Lebedev, Herman and Kostina from three florules (Sites 700–702) preserved in tuffaceous-terrigenous deposits of the Atvuveem Formation in the Bol'shaya Ayanka River basin within the Penzhina-Anadyr Sector of the Okhotsk-Chukotka volcanogenic belt. In site 700 fossil plants belonging to the family Cupressaceae *s.l. (Metasequoia occidentalis, Parataxodium, Sequoia obovata)* and diverse angiosperms ("*Vitis" penzhinika*, *Macclintockia ochotica*, *Cissites*, *Trochodendroides notabilis*, *Menispermites*, *Celastrinites*, *Barykovia tchucotica)* predominate. In site 701 impressions of *Sequoia fastigiata* shoots are the most abundant. Among conifers *Parataxodium*, *Glyptostrobus comoxensis*, *Elatides* aff. *asiatica* also have been found. Angiosperm remains are very rare and, apart from *Quereuxia*, fragmentary. In site 702 remains of angiosperm leaves are the most abundant and similar in composition to those from site 700.

Taken as a whole, the Ayanka Flora is most similar to the securely dated Barykov Flora of the Ugolnaya Bay and Upper Bystraya Flora of NW Kamchatka Peninsula and is most probably early Campanian in age. However, in the fossil plant assemblage from Site 701 plants typical of Albian and early Late Cretaceous floras predominate, advanced angiosperms are rare and not diverse. If considered alone, this assemblage could be easily dated as Cenomanian–Turonian or even older. By contrast Sites 700 and 702 contain an abundance of angiosperm and conifer remains more typical of later parts of the Late Cretaceous. The Ayanka Flora localities show that remains of relatively old Mesophytic and advanced Cenophytic plants do not co-occur in the assemblages, and taphocoenoses of two types existed in a limited area. This flora provides good evidence that as late as the Campanian some habitats were still populated by Mesophytic communities (site 701) while others experienced invasion of angiosperm-dominated Cenophytic plant communities (sites 700 and 702). The mutual exclusion of Mesophytic and Cenophytic plant remains in the assemblages suggests replacement of whole plant communities rather than incremental penetration of more advanced species taxon by taxon.

Aptian ammonite biostratigraphy of the Sierra del Patrón section, Durango State, Northeast Mexico

Moreno, J.A.[1,*] ***Frau, C.***[2]***, Pictet, A.***[3]***, Barragán, R.***[1]

1) Universidad Nacional Autónoma de México, Ciudad de México, Mexico,
**E-mail: josepamb@geologia.unam.mx*
2) Groupement d'Intérêt Paléontologique, Toulon, France
3) Department of Earth Sciences, University of Geneva, Geneva, Switzerland

A standard ammonite zonation for the Central Atlantic Province, i.e., the southern part of North America and Central America (REBOULET et al., 2014), is currently being developed through several contributions focused on the Lower Cretaceous ammonites of Mexico (e.g. MORENO-BEDMAR et al., 2013; MORENO-BEDMAR et al., 2015). The present contribution documents the ammonite record of the La Peña Formation from the la Sierra del Patrón (Durango State, NE Mexico). Twenty four taxa have been recognized among the 268 specimens collected bed-by-bed. The careful biostratigraphic analysis of the ammonite distribution allow us to propose a revised zonation for the Lower–Upper Aptian boundary interval of northeast Mexico, composed of the upper Lower Aptian *Dufrenoyia justinae* interval Zone (including the *Dufrenoyia scotti*/*Burckhardtites nazasensis* concurrent range Subzone at its top) and the lower Upper Aptian *Caseyella aguilerae* interval Zone (including the *Gargasiceras*? *adkinsi* total range Subzone at its base). The latter zone defines the lower part of the *Kazanskyella minima* interval Superzone which almost spans the complete Upper Aptian. Although based on endemic taxa, the Sierra del Patrón section records a strong ammonite faunal turnover at the generic levels comparable with those of the Euro-Boreal regions (end of Deshayesitidae balanced by the renewal in the douvilleiceratid, desmoceratid and acanthohoplitid stocks). The proposed zonation of the Sierra del Patrón section is an important step forward and also a turning point in the development of the Aptian zonation for the Central Atlantic Province and its correlation with the IUGS standard scheme.

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The OAE2 and Late Cretaceous cooling across the Cenomanian–Campanian succession in the Kopet-Dagh Basin, NE of Iran (Eastern Tethyan Region)

Mousavi, N.[1,*]***, Wagreich, M.***[2]***, Kani, A.***[1]***, Mosavinia, A.***[3]***, Wolfgring, E.***[2]

*1) Department of Geology, Faculty of Earth Sciences, Shahid Beheshti University, Tehran, Iran, *E-mail: n_mousavi2004@yahoo.com*
2) University of Vienna, Department of Geodynamics and Sedimentology, Vienna, Austria
3) Department of Geology, Payam Noor University, Mashhad, Iran

The shallow water Upper Cretaceous succession (Cenomanian–Campanian) in Kopet-Dagh basin, Northeast of Iran, considered as eastern part of the Tethys, has been investigated to evaluate Oceanic Anoxic Event (OAE2), mid-Cretaceous peak warming and late Cretaceous cooling trends. The succession is characterized by silty shales and shales of upper Aitamir Formation and marls and limestones of the Abderaz Formation. Age control has been based on calcareous nannofossils. In this carbonate shelf environment, the OAE2 $\delta^{13}C$ excursion appears comparable to that of open marine environments. Although TOC content is low across the succession, it shows a gradual increasing trend across OAE2. It seems that organic carbon sedimentation was dilution due to the high rate of carbonate sedimentation. $\delta^{18}O$ data imply relatively high paleotemperatures at the Cenomanian-Turonian boundary up to 34°C. This is comparable with other studies from the same palaeolatitude (20 to 30° N) e.g. ODP site 1276. In the late Santonian-early Campanian, the paleotemperature shows a decrease which is accompanied by an increase in relative abundance of cool water nannofossil taxa such as *Ahmuellerella octoradiata*, *Gartnerago segmentatum* and *Kamptnerius magnificus*. This can be interpreted by the movement of Kopet-Dagh basin from 20–25° N to 25-30° N paleolatitude position, besides the effect of Late Cretaceous cooling.

Spectral analyses performed separately on data from the Aitamir and Abderaz Formations show evidence for harmonic frequencies preserved in the carbonate contetnt record. Distinct signals that could indicate orbitally driven cycles can be interpreted from the limestone – marl rhythmites of the Abderaz formation, while data from shales provide faint hints towards Milankovitch cycles. However, the harmonic frequencies could be interpreted as evidence for an eccentricity cycles (405ka and 100ka).

SINNINGHE DAMSTÉ et al., 2010. doi: 10.1016/j.epsl.2010.02.027

Cenomanian-Coniacian Carbonate Sequence in the Northwestern Part of the Arabian Carbonate Platform (SE Turkey): Characteristics and Implications

Mulayim, O.[1,*] ***and Yılmaz, İ.Ö.***[2]

1) Turkish Petroleum Corporation, Adiyaman District Management. Adiyaman, Turkey,
**E-mail: oguzzmlym@gmail.com*
2) Middle East Technical Unviersity, Ankara, Turkey

The Cenomanian-Coniacian carbonate platform of the northwestern of Arabian platform (SE Turkey) records an abrupt transition from neritic carbonate deposits to pelagic deposits. Compilation of the results of litho-, bio-, and microfacies analyses revealed extensive evidence for reconstruction of marine paleoenvironmental conditions. Shallow water carbonate deposits (the Derdere Formation) are overlain by beige-dark brown, very fine-grained pelagic limestones (the Krb-A Member of Karababa Formation) which contains organic matter and abundant planktonic foraminifera. The boundary between shallow carbonate succession and pelagic unit is sharp. Litho-biostratigraphy and facies characteristics of the succession were studied by three detailed stratigraphic sections. $\delta^{13}C$ and $\delta^{18}O$ stable isotope analyses show the influence of the global Oceanic Anoxic Event (OAE2) on the different parts of the Arabian Carbonate Platform (ACP) (Rahimpour-Bonab et al., 2013; Wohlwend et al., 2016). Anoxic and hypoxic conditions in the water column lead to major changes in the shallow water carbonate system of the ACP. Many benthic foraminifera declined during that time, but the opportunistic species (e.g., planktonic foraminifera), which are less sensitive to change in salinity, temperature, nutrients and oxygen saturation), diversified and expanded greatly (Nagm, 2015; Kalanat et al., 2015). Meanwhile, local and regional tectonics combined with sea-level dynamics led to facies differentiation in the study area.

Consequently, the investigated upper Cretaceous marine lithostratigraphic units of the ACP represent a record of the relationship between global eustatic changes and local tectonics. The results of this research provide new insights into the character of the Cenomanian-Coniacian interval in the northwestern part of the ACP and allow correlation of these deposits with global events.

Kalanat et al., 2015. doi.10.1007/s12517-015-1779-6
Nagm, 2015. Cretaceous Research, **52**, 9–24.
Rahimpour-Bonab et al., 2013. Journal of Petroleum Geology, **36**/4, 33 –362.
Wohlwend et al., 2016. doi.10.1002/dep2.15

The taxonomic status of the rudist bivalve genus *Pironaea* Meneghini, 1868 amongst the multiple-fold hippuritids

Munujos, H.[1], Pons, J.M.[1,*], Vicens, E.[1]

1) Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès), Spain,
**E-mail: josepmaria.pons@uab.cat*

Multiple-fold hippuritid rudist bivalves, i.e., those having in-folds of the outer shell layer into the inner shell layer (secondary pillars) other than the three hippuritid pillars, were known from both sides of the Atlantic since the second half of the nineteen century (WOODWARD, 1855, 1862). Eurasian species have currently been referred to the genus *Pironaea* Meneghini, 1868, as it also happened originally to some American ones. Those species with poor development of the secondary pillars have been ascribed to not widely accepted new genera (e.g., *Pseudopironaea* Bilotte, 1982) or to known genera having other characters in common (e.g., *Vaccinites loftusi* Woodward, 1855); *Tetravaccinites* Bilotte, 1981, having a single secondary pillar, is now recognized as a teratology. American species have been mainly ascribed to *Barrettia* Woodward, 1862 or *Praebarrettia* Trechmann, 1924 with *Pseudobarrettia* Müllerried, 1931 being also recognized as a teratology. The number or the degree of development of secondary pillars has always been considered as the main character.

Recent taxonomic work on American multiple-fold hippuritids (MITCHELL, 2014) stressed the relevance of the myo-cardinal apparatus and the shell structure in defining genera and recognizing phylogenies. Thus, the genera: *Barrettia* and *Whitfieldiella* Mitchell, 2010, and *Praebarrettia*, are evidenced as members of two different clades. Similar work on Eurasian multiple-fold hippuritids (MUNUJOS et al., 2016, and the authors' work in progress) pay also attention to the myo-cardinal apparatus and shell structure, as well as to the ontogenetic and intra-specific variability of different species, thus recognizing synonymies, and relating the pore and canal system to the development of the secondary pillars. From all this, it becomes manifest that: 1) the presence of secondary pillars is a convergent character in different hippuritid lineages and can't be used as discriminative when stablishing genera; and 2) the genus *Pironaea* should be reserved to *P. polystyla* Pirona, 1868, and a few related species, and should not be used for other ones with a different myo-cardinal pattern.

MITCHELL, S., 2014. In: PONS, J.M. & VICENS, E. (Eds.), Tenth International Congress on Rudist Bivalves. Scientific Program and Abstracts, 16–17.
MUNUJOS, H. et al., 2016. Cretac. Res., **63**, 122–141.
WOODWARD, S.P., 1855. Quart. J. Geol. Soc., **11**, 40–61.
WOODWARD, S.P., 1862. The Geologist, 3–8.

An integrated stratigraphy of the Early Cretaceous (Valanginian - Albian) - implications for Boreal–Tethys correlation

Mutterlose, J.[1*]***, Möller, C.***[1]***, Alsen, P.***[2]

*1) Institute for Geology, Mineralogy and Geophysics, Ruhr-University Bochum, Bochum, Germany, *E-mail: joerg.mutterlose@rub.de*
2) Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark

The interpretation of past oceanographic events on a supra-regional scale requires precisely dated and well correlated biostratigraphic schemes. Only synchronous events can be interpreted in a global context. Events of local or regional character have therefore to be accurately correlated with time-equivalent shifts in other areas in order to be interpreted in a wider context. One of the problems of inter-basin correlation based on biostratigraphy lies in floral and faunal provincialism of the relevant index fossils. In order to overcome such limitations, chemostratigraphy can be used as a stratigraphic tool independent of biostratigraphy.

We present stable isotope data ($\delta^{13}C$, $^{87}Sr/^{86}Sr$) for the Lower Cretaceous (Valanginian - Albian) partly based on previously published data (Speeton, northeast England; Vocontian Basin, southeast France) in addition to new findings from Northeast Greenland and northern Germany. The belemnite and bulk rock based isotope data allow a correlation of the Lower Cretaceous sequences of the Boreal Realm and the Tethys independent of biostratigraphy. This chemostratigraphic approach may help to overcome the biostratigraphic problems which have been discussed for more than 40 years. Various offsets of the biostratigraphic scheme, which are asking for adjustment, are being discussed.

Our findings allow for a correlation of different paleoclimatic, paleoenvironmental and paleobiological shifts which occurred in the Valanginian – Albian. These include the Valanginian Weissert Event and the Nannoconid crises as well as a warming peak during the Barremian. This mid Barremian warming event is mirrored by the highest Sr-isotope values observed throughout the entire Early Cretaceous. We link the high Sr-isotope values to continental weathering and increased run-off. In more restricted basins of the Boreal Realm these conditions are reflected by the deposition of black shales (Hauptblätterton, Munk marl bed). High resolution data are presented for the early Aptian oceanic anoxic event (OAE 1a).

Stratigraphy of the Lower-Middle Coniacian core section (NW-part of the Bohemian Cretaceous Basin): deciphering T-R history and linking offshore to proximal deposits

***Nádaskay, R.*[1,*], Čech, S.[1], Svabenicka, L.[1], Valecka, J.[1]**

1) Czech Geological Survey, Praha, Czech Republic, E-mail: roland.nadaskay@geology.cz

Integrated stratigraphic research focused on the Lower–Middle Coniacian interval recorded by the borehole 4650_A Skalice, NW-part of the Bohemian Cretaceous Basin (BCB). It comprises a c. 175 m thick, predominantly fine-grained sequence bracketed by sandstones deposited in deltaic environment (ULIČNÝ et al., 2009). Two basic lithofacies were distinguished: 1) unconfined beds of calcareous mudstones to siltstones, locally with sand admixture; 2) turbidites (as interpreted by ČECH et al., 1987) represented by heterolithic facies, an irregular alteration of mudstones and thin beds of sandstones, and by isolated upward-fining sandstone bed – Žandov Sandstone.

Biostratigraphy was employed to resolve stratigraphic subdivision of the monotonous fine-grained succession due to absence of lithostratigraphic markers. Lower Coniacian strata were determined by inoceramids *Cremnoceramus walterdorfensis hannovrensis (Cwh)* and *C. crassus inconstans (Cci)* ca. 20 m above the top of underlying Turonian–Coniacian sandstones. Concerning nannofossils, a quantitative rise of *Marthasterites furcatus* was observed below the occurrences of *Cwh* and the appearance of transitional forms *Quadrum-Micula* was recorded above *Cci*. Top of the *Cci* zone marks the boundary of genetic sequences CON 1 and 2. Timespan of CON 2 sequence is defined by the extent of the *C. crassus crassus (Ccc)* zone that corresponds to the upper part of Rohatce Mb. (silicified limestones) in the axial part of the BCB. The scarce presence of the nannofossil *Micula staurophora*, UC10 zone, was recorded between the last occurrence (LO) of *Ccc* and the FO of *Inoceramus frechi* and indicates the base of Middle Coniacian. Geochemical proxies acquired by XRF core scanning – Si/Al, Ti/Al, Zr/Al – are lithology-dependent, and within fine-grained rocks reflect subtle variations in siliciclastic input. Local increase of Ti/Al and Zr/Al may reflect elevated heavy mineral content. Overall, elevated values represent a signal of distal turbidites in deltaic bottomsets. Periodic action of high-energy currents transporting clastic material from proximal setting is evidenced by abundant shell debris and relative scarcity of nannofossils due to dissolution and mechanical damage. Intensity of weathering and erosion in the source area can be estimated from proportions of clay minerals and K/Al ratio.

In the next phase, biostratigraphic data will be linked to geochemical proxies to explain the dynamics of the depositional environment in time, and supplemented by C/O stable istope data and Sr isotope curves for inter-basinal correlation.

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ČECH, S. et al., 1987. Sbor. geol. věd, Geol., **4**, 113–159.
ULIČNÝ, D. et al. 2009. Sedimentology, **56**/4, 1077–1114.

Aptian shallow marine carbonate platform and Lower Albian lacustrine and fan delta siliciclastic deposits of Jebel Koumine (Central Atlas Tunisia)

Nasri, A.[1,*]***, Trabelsi, K.***[2]***, El Ferhi, F.***[1]***, Skanji, A.***[1]***, Ben Alaya, S.***[1]***, Houla, Y.***[3]***,***
Soussi, M.[4]***, Kadri, A.***[5]***, Bouakadi, N.***[4]***, Sames, B.***[6]***, Wagreich, M.***[6]

*1) Tunisienne d'Activités Pétrolières (ETAP), Tunis, Tunisia, *E-mail: ahmednasri@gmail.com*
2) Université de Sfax, Faculté des Sciences de Sfax, Sfax, Tunisia
3) National Office of Mines of Tunisia (ONM), Geology Department, Tunis, Tunisia
4) Université de Tunis El Manar, Faculté des Sciences de Tunis, Tunis, Tunisia
5) Université de Carthage, Tunis, Tunisia
6) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria

Former lithostratigraphic and biostratigraphic studies conducted on the Central Atlas Tunisia suggested an upper Aptian to lower Albian major sedimentary gap between the Aptian shallow marine carbonate platform deposits and their overlying Upper Albian widespread transgressive carbonate and fossiliferous shaly facies. This hypothesis, always advanced without direct biostratigraphic arguments, is revised in this work based on new and detailed investigations of thick (up to 800 m) exposed successions in Jebel Koumine (Sbeitla region, Central Atlas). The compilation of detailed sedimentological logging and ostracods and charophytes biozonation, allowed the characterization of the Lower Albian and the subdivision of the Koumine succession by several well-dated regional sedimentary events. These events which can be correlated with their coeval lateral facies, outcropping in other localities of central Tunisia, are briefly presented thereafter.

The Aptian deposits are subdivided into six units attesting to different depositional environments comprising subtidal, tidal-flats, evaporitic sabkha at the base and oolithic shoal, lagoonal and marginal-coastal marine conditions at the top. The ostracods and charophytes assemblies collected from these units indicate an early to late Aptian age. The overlying succession dominantly represented by continental facies is splitted into five units.

The first four units are of lacustrine, eustuarine and tidal flats depositional settings. The lowermost one, which is made of whitish varved and micritic lacustrine limestones, is rich in charophytes and non-marine ostracods indicating an early Albian age. These deposits evolved laterally, at the western part of the J. Koumine, to alluvial fan deposits represented by fine to medium-grained sandstones and numerous meter-thick conglomerates including reworked blocks derived from Triassic and Barremian rocks. The last unit corresponds to a distinctive carbonate bar made of quartz-rich vuggy bioclastic dolomite that could be ranged within the early to middle Albian.

The stacking pattern of the transgressive-regressive depositional marine and non-marine sequences of the Aptian–Albian of central Atlas Tunisia constitute an excellent example of how relative sea level fluctuations of diverse orders control facies and architecture of carbonate platform despite the impact of the local tectonics and associated halokinetics activities.

Cretaceous fossils of Saxony, part 1 (Cenomanian-Coniacian Elbtal Group, Saxony, Germany)

Niebuhr, B.[1,*] ***and Wilmsen, M.***[1]

*1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, *E-mail: niebuhr.birgit@googlemail.com*

The fossiliferous lower Upper Cretaceous (Cenomanian to Middle Coniacian) strata of the Elbtal Group of Saxony are a classical field of geoscientific research since the early 19th century. However, many fossil groups have not been revised since the early surveys (e.g., GEINITZ, 1871–1875, 1872–1875). Thus, a modern revision has been initiated by means of the monograph series "Kreide-Fossilien in Sachsen". Part 1 (NIEBUHR & WILMSEN, 2014) deals with the following groups:

Corals (Hannes Löser): preferentially from the Red Conglomerate of the Meißen Formation (Lower–Middle Cenomanian) and the rocky shore facies of the Dölzschen Fornation (upper Upper Cenomanian), ca. 120 colonial corals were described, supplemented by solitary forms from the Strehlen Limestone of the lower Strehlen Formation (mid-Upper Turonian). 61 of them were figured, mostly in thin sections, and briefly described. Serpulids and sabellids (Manfred Jäger): the ca. 20 taxa are frequent in the rocky shore facies and the silty sandstones (Plänersandsteinen) of the Dölzschen Formation as well as in the Strehlen Limestone of the lower Strehlen Formation. The mass occurrence of the sabellid *Glomerula lombricus*, formerly known as *Serpula gordialis*, is eponymous for the Upper Cenomanian Serpulasand of Bannewitz. Bivalves (Birgit Niebuhr, Simon Schneider & Markus Wilmsen): bivalves are a dominant component of the Saxonian Cretaceous fossil faunas and have mostly not been revised at all. GEINITZ (1871–1875, 1872–1875) described nearly 150 taxa, of which ca. 120 can be confirmed after the revision; ca. 100 taxa were illustrated. Inoceramid bivalves (Karl-Armin Tröger & Birgit Niebuhr): because of their biostratigraphical relevance, inoceramid bivalves were treated in a separate chapter, and the specimens formerly described by GEINITZ (1871–1875, 1872–1875) and ANDERT (1911, 1934) were integrate in three genera (*Inoceramus*, *Mytiloides*, *Cremnoceramus*) with 24 species and some subspecies. 31 taxa were briefly taxonomically described and figured. Ammonites (Markus Wilmsen & Emad Nagm): ca. 30 ammonite species have been recorded, many of which with biostratigraphic significance. Rich populations appear within the Lower and Upper Turonian Pläner and marl facies, respectively. Belemnites (Markus Wilmsen): belemnites are rare findings with a single taxon each from the Meissen, Dölzschen and Strehlen formations.

ANDERT, H., 1911. Festschr. Humboldtverein Ebersbach, 33–64.
ANDERT, H., 1934. Abh. preuß. geol. L.-Anst., N.F., **159**, 1–477.
GEINITZ, H.B., 1871–1875. Palaeontographica, **20** (I), I.1–I.319.
GEINITZ, H.B., 1872–1875. Palaeontographica, **20** (II), I–VII, II.1–II.245.
NIEBUHR, B. & WILMSEN, M., 2014 (Eds.). Geol. Sax., **60** (1), 1–254.

Cretaceous fossils of Saxony, part 2 (Cenomanian-Coniacian Elbtal Group, Saxony, Germany)

Niebuhr, B.[1,*] ***and Wilmsen, M.***[1]

*1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, *E-mail: niebuhr.birgit@googlemail.com*

The fossiliferous lower Upper Cretaceous (Cenomanian to middle Coniacian) strata of the Elbtal Group of Saxony are a classical field of geoscientific research since the early 19th century but many fossil groups have not been revised since the early surveys. Thus, a modern revision has been initiated (monograph series "Kreide-Fossilien in Sachsen"). Part 2 (NIEBUHR & WILMSEN, 2016) deals with the following groups:

Cheilostome bryozoans (Silviu Martha, Birgit Niebuhr & Joachim Scholz): in the 19th century H.B. GEINITZ and A.E. REUSS altogether described 33 cheilostome bryozoans from the Upper Cenomanian and mid-Upper Turonian of Saxony, including 18 new species. The revision confirms 23 species. The genus *Hillmeropora* and five species are new. Scaphopoda (Birgit Niebuhr): four scaphopod species have been recorded which all belong to the genus *Dentalium*. Nautilids (Markus Wilmsen): eight nautilid species in four genera have been documented from the Upper Cenomanian to Upper Turonian. Representatives of the largely smooth-shelled genera *Eutrephoceras* and *Angulithes* predominantly occur in offshore Pläner and marl facies while ribbed forms of the genera *Cymatoceras* and *Deltocymatoceras* also have been recorded from nearshore sandy deposits. Crinoids (Birgit Niebuhr & Bruno Ferré): five crinoid genera are recorded – *Bourgueticrinus*, *Nielsenicrinus*?, *Glenotremites*, *Semiometra* and *Roveacrinus*. Roveacrinids have mass occurrences in the rocky shore facies of the Dölzschen Formation (upper Upper Cenomanian). Asteroids (Birgit Niebuhr & Ekbert Seibertz): twelve sea-star species occur, five of which are known by completely preserved beautiful internal moulds from quader sandstones, overall representing the Astropectinidae, Stauranderasteridae, Goniasteridae and an inferred new family. *Manfredaster praebulbiferus* and *Calliderma lindneri* are described as new species; *Comptoniaster michaelisi* gets a new replacement name. Bony fishes (Martin Licht et al.): eight osteichthyan genera have been ascertained to occur in the Cretaceous of Saxony: the actinopterygians *Anomoeodus*, *Pycnodus* (Pycnodontiformes), *Ichthyodectes* (Ichthyodectiformes), *Osmeroides* (Elopiformes), *Pachyrhizodus* (incertae sedis), *Cimolichthys*, *Rhynchodercetis*, *Enchodus* (Aulopiformes) and *Hoplopteryx* (Beryciformes). These fishes occupied various trophic niches from durophagues to large fish predators. Reptiles (Sven Sachs et al.): reptilian fossils are rare. Remains from the Dölzschen Formation are fragmentary and cannot be safely identified. However, better-preserved material from the Strehlen and Weinböhla Limestone reveals the presence of at least two different plesiosaurian families (Elasmosauridae and ?Polycotylidae) as well as different marine turtles of the family Protostegidae. Ichnofossils (Birgit Niebuhr & Markus Wilmsen): the taxonomic revision of the trace fossils of the Elbtal Group of Saxony resulted in the recognition of 28 ichnotaxa which can be classified in simple, unbranched, branched, horizontal concentric and three-dimensionally coiled traces as well as traces defined by their filling, spreiten structures and coprolites. An ichnofacies zonation for the Elbtal Group is presented.

GEINITZ, H.B., 1871–1875. Palaeontographica, **20** (I), I.1–I.319.

GEINITZ, H.B., 1872–1875. Palaeontographica, **20** (II): I–VII, II.1–II.245.

NIEBUHR, B. & WILMSEN, M., 2016 (Eds.). Geol. Sax., **62**.

Late Cretaceous climate with different gateway configurations and CO_2 concentrations as simulated by the Earth System Model. Implications for the Arctic region.

Niezgodzki, I.[1,*]***, Knorr, G.***[2]***, Lohmann, G.***[2]***, Tyszka, J.***[1]***, Radmacher, W.***[3]

*1) Institute of Geological Sciences PAS, Krakow, Polan, *E-mail: ndniezgo@cyf-kr.edu.pl*
2) Alfred Wegener Institute, Bremerhaven, Germany
3) Instytut Nauk Geologicznych Polskiej Akademii Nauk, Warszawa, Poland

We simulate the Maastrichtian climate with a fixed paleogeography and 6 different CO_2 levels, ranging from 1–6 x pre-industrial level. Our results indicate that, globally, the good match with the proxy-based temperature reconstructions is obtained for the simulations with 3 and 4 x pre-industrial CO_2 levels. Based on this result, we performed 12 additional simulations of Late Cretaceous climate with different gateway configurations in the northern polar region and fixed (4 x pre-industrial) CO_2 levels. The paleogeography is modified according to scenarios which represent the possible gateway configurations from the period Campanian – Cretaceous–Paleogene (K-Pg) boundary (~83–66 Ma). Sub-sequently, we compare our simulated results with the proxy based temperatures and salinity reconstructions from the Arctic Ocean region.

Our results support a hypothesis that the Greenland-Norwegian Sea (GNS) could have been characterized by bathyal depths in the Campanian. Our simulated salinities in the GNS and the Arctic Ocean in the experiment with the GNS as deep as ~1 km are in agreement with the proxy based salinity reconstructions (RADMACHER, 2015). Towards the end of the Maastrichtian, the gateway became shallower but most likely didn't close entirely before the onset of the Paleogene. The progressive isolation of the Arctic Basin (closure of the Hudson Seaway, Western Interior Seaway and shallowing of the GNS) effects in the freshening of the Arctic Ocean, from the moderately brackish conditions of the Campanian to the almost freshwater conditions at the end of the Maastrichtian. Furthermore, during the entire interval, the Arctic Ocean remains well stratified due to salinity gradients, thus enhancing anoxic conditions in the ocean. Additionally, Arctic gateways configuration changes cannot reproduce cooling trends during the latest Cretaceous as recorded in the proxy data from the GNS. This indicates that the CO_2 level decline (possibly to the value even as low as 2 x pre-industrial) was responsible for the cooling trend toward the end of the Maastrichtian.

RADMACHER, W., 2015. PhD Thesis, Institute of Geological Sciences PAN, Krakow, Poland.

Phoenicopsis (Leptostrobales) and *Pseudotorellia* (Ginkgoales) in the Cretaceous of the north of Eastern Siberia and Northeastern Russia

Nosova, N.[1]

1) Komarov Botanical Institute RAS, Saint-Petersburg, Russia, E-mail: natanosova@gmail.com

The genera *Phoenicopsis* HEER and *Pseudotorellia* FLORIN were common elements of the Mesozoic floras in Northern Asia. Detached leaves and their fragments belonging to these genera have similar morphological but different epidermal features. Unfortunately, only morphology of many *Phoenicopsis* and *Pseudotorellia* leaves were described, therefore some identifications are doubtful. Numerous *Phoenicopsis* findings were reported from the Jurassic of Western Siberia and south of Eastern Siberia, but they are unknown in the Cretaceous of these regions. Cretaceous species of *Phoenicopsis* with epidermal structure studied were described from the north of Eastern Siberia and Northeastern Russia: five – from the Early Cretaceous and three – from the Late Cretaceous. Two species (*P. mirabilis* and *P. vassilevskiana*) were reported from the Berriasian–Valanginian of Aldan River, and three species (*P. annae*, *P. parva* and *P. silapensis*) came from the Aptian of Indigirka and Kolyma rivers. Three Late Cretaceous species were described from the Turonian–Senonian of Arkagala River (*P. glabra*, *P. papullosa* and *P. steenstrupii*). Besides this, brachiblasts with bundles of narrow linear leaves attached lacking preserved cuticle were identified as *P.* ex gr. *angustifolia* from the Turonian–Coniacian of Arman River (Magadan oblast'). Revision of leaves from the Turonian of New Siberia Island, described originally as Torellia sp., shows that these leaves are most similar to *Phoenicopsis papullosa* from Arkagala. That is the northernmost finding of the genus in Russia.

No findings of Pseudotorellia leaves were reported from the Jurassic of north of Eastern Siberia and Northeastern Russia, and they were not numerous in the Cretaceous of these regions, unlike in Western Siberia and south of the Eastern Siberia. Three *Pseudotorellia* species with characteristic epidermal features were described from the Early Cretaceous of Yakutia: *P. nordenskjoeldii* from the Hauterivian–Barremian of Bulunsky District, *P. emarginata* from the Aptian of Indigirka River, and *P. tjukansis* from the Albian of Lena River basin. Recently, we found very small *Pseudotorellia* leaves in the Berriasian–Valanginian of Kenkeme River (Lena River basin). *Pseudotorellia parvifolia*, sp. nov. (in press.) is described based on morphological and epidermal features. Only two *Pseudotorellia* species were reported from the Late Cretaceous of this area: *P. insolita* from the Turonian–Coniacian of Vilyui River and *P. postuma* from Arkagala.

Sedimentology and magnetostratigraphy of the Cretaceous formations in the Hamakoussou and Mayo Oulo-Lere basins in Northern Cameroon (Benue Trough)

Ntsama Atangana, J.[1,*]***, Bennami, M.***[2]***, Vignaud, P.***[3]***, Hell, J.V.***[3]***,***
Bessong, M.[4]***, Ndjeng, E.***[4]

*1) University of Ngaoundere, Ngaoundéré, Cameroon, *E-mail: ntsamaatangana@gmail.com*
2) University of Poitiers, Poitiers, France
3) Institute of Geological and Mining Research of Cameroon, Yaounde, Cameroon
4) University of Yaounde I, Yaounde, Cameroon

A magnetostratigraphic study has been carried out on a succession of fine-grained sediments in the upper part of each section. Palaeomagnetic samples subjected to progressive alternating field and thermal demagnetization show that the deposits preserve a primary magnetization. The directions of magnetization indicate a later regional tectonism marked by a rotation and block translation. Rock magnetic investigations reveal the presence of both high and low coercivity minerals. A sequence of three polarities was determined in the Hamakoussou basin: one reversed polarity and two normal polarities, whereas two polarities (normal and a reversal) were determined in the Mayo Oulo-Lere basin. The correlation between these polarities and the geomagnetic polarity time scale (GTS2004, GRADSTEIN et al., 2004) allowed us to attribute a Barremian age to these basins and to establish their chronology of formation.

GRADSTEIN, F. et al., 2004 (Eds.). A Geological Time Scale, Cambrige University Press.

Barremian-Turonian episodes of accelerated global change in Mexico

***Nuñez, F.*[1,*], *Barragán, R.*[1], *Canet, C.*[1], *Moreno, J.*[1], *Alfonso, P.*[2], *López-Martínez, R.*[1]**

1) Universidad Nacional Autónoma de México, Ciudad de México, Mexico,
**E-mail: fernandonunezu@gmail.com*
2) Universitat Politècnica de Catalunya, Manresa, Spain

During Cretaceous times Mexico constituted a key area of the western margin of the proto-North Atlantic, since it marked the transition between the open oceanic basin and the Western Interior Seaway. In this study, an integrated approach combining sedimentological, petrographic, biostratigraphic, geochronological, mineralogical and geochemical analyses provide information about the record and paleoenvironmental conditions of several episodes of accelerated global change spanning the Barremian-Albian interval in north and central part of the country. The OAE 1a (early Aptian) is recorded in several shelfal (Cupido Formation) and basinal sections (Lower Tamaulipas-La Peña formations). It is associated with the episodic arrival of detrital material and nutrients and the subsequent development of eutrophic conditions. Variable redox conditions and a phase of alkalinity are associated with this event. A negative C-isotope excursion correlatable with the Intra-Furcata Negative Excursion (late early Aptian) is also a remarkable feature of the investigated sections. This fact confirms its use as a global chemostratigraphic marker for the Aptian record. Two stratigraphic intervals enriched in organic matter and equivalent to the Aparein (latest early Aptian) and Noire (earliest late Aptian) levels are also recorded in the La Peña Formation. The deposition of the Aparein Level occurred under climatically induced eutrophic marine conditions, coincident with a global warming trend that resulted in the stratification of the water column; while the Noire Level was deposited under eutrophic marine conditions that resulted from a local upwelling system. The OAE 1b set interval is recognized by a long-term negative C-isotope excursion during the Aptian-Albian transition in the middle part of the La Peña Formation. It is punctuated by short-term negative spikes that show values and positions similar to those associated with the Jacob, Kilian, Paquier and Leenhardt episodes. This anoxic events occurred during warm and humid conditions that caused intense biogeochemical weathering and runoff, and resulted in density stratification of the water column and organic matter burial in sediments. Finally, the OAE 2 (Cenomanian-Turonian) is recorded in organic-rich pelagic facies of the Agua Nueva Formation showing the faunal turnover linked to this event. High marine productivity, partly controlled by intrabasinal vocanic ash-fall, favored anoxic-dysoxic bottom water conditions during the anoxic event, and more oxygenated waters thereafter. In general, such oxygen-depleted conditions fostered bacterial sulfate reduction in sediments. Maximum value of sulfur isotope fractionation within the OAE 2 is related to a higher organic matter burial and sulfate availability. This fact confirms the proposal of a global mechanism that controlled the S isotope signature during this event.

Orbital forcing of climate in the Mississippi Embayment during the Campanian

***O'Connor, L.K.*[1,*], *Robinson, S.A.*[1], *Batenburg, S.J.*[1], *Jenkyns, H.C.*[1], *Naafs, B.D.A.*[2], *Pancost, R.D.*[2]**

*1) Department of Earth Sciences, University of Oxford, Oxford, UK, *E-mail: lauren.oconnor@univ.ox.ac.uk*
2) Organic Geochemistry Unit, School of Chemistry and Cabot Institute, University of Bristol, Bristol, UK

Over periods of tens to hundreds of thousands of years, Earth's climate is controlled by small quasi-periodic variations in energy received from the Sun. However, for past periods of greenhouse climate, such as the Cretaceous, the mechanisms by which changes in solar insolation are amplified by the Earth's system remain poorly understood. Many records from the Cretaceous greenhouse world indicate roles for both variabilities in low-latitude seasonal climates and carbon cycling that may have driven changes in global climates. In addition to their palaeoclimatic significance, records of Cretaceous cyclicity may also be useful for the construction of orbitally tuned timescales.

Here we present geochemical records from the Shuqualak-Evans borehole, Mississippi (USA), which provides a Campanian record of hemipelagic shelf sedimentation in the Mississippi Embayment. The Mississippi Embayment was strategically located to record both the influence of the Western Interior Seaway, through which the embayment is connected to the high latitudes, as well as the influence of the Tethys Ocean and local run-off from North America, both affected by low-latitude climatic processes.

High resolution geochemical data show strong periodic variability, which spectral analysis suggests is consistent with orbital frequencies. These data indicate a palaeoclimatic response to a hierarchy of cycles, including a prominent obliquity component. Although the Campanian is generally considered a period of climatic quiescence, our records demonstrate that the palaeoenvironmental conditions off the south coast of North American varied considerably in response to local, regional, and potentially global climatic processes. The interplay of high- and low-latitude signals sheds light on climate dynamics in the Late Cretaceous greenhouse world.

Radiolarian stratigraphy of the proposed GSSP for the base of the Aptian Stage (Gorgo Cerbara, Umbria-Marche Apennines, Italy)

O'Dogherty, L.[1,*]***, Baumgartner, P.O.***[2]***, Gorican, S.***[3]

*1) Dpto. Ciencias de la Tierra, Universidad de Cádiz, Puerto Real, Spain, *E-mail: luis.odogherty@uca.es*
2) Institut des Sciences de la Terre, Geopolis, Lausanne, Switzerland
3) Paleontoloski institut Ivana Rakovca, Ljubljana, Slovenia

A revision of the radiolarian stratigraphy recorded at the proposed GSSP stratotype for the Barremian/Aptian boundary is presented. This revision encompasses the overlap interval of the biostratigraphic works carried out by JUD (1994) and O'DOGHERTY (1994) in the Gorgo Cerbara section.

We have re-examined a total of 52 productive samples yielding moderately to well-preserved radiolarians throughout the upper part of the Maiolica Formation and the Lower part of the Marne a Fucoidi Formation (up to the Lower Reddish Member). This interval corresponds to the stratigraphic levels 882 m to 915 m of LOWRIE AND ALVAREZ (1984), which are equivalent to -14 m to 19 m of PATRUNO et al. (2011). The Marne a Fucoidi consist of thick red pelitic levels with short intervals of whitish siliceous limestone beds and radiolarian sands, whereas the Maiolica is made up of whitish cherty limestones bearing discrete levels of black shales in its upper part. This sharp change in the lithology led to an uneven sample spacing, closer in the Marne a Fucoidi and looser at the upper part of the Maiolica Formation (46 samples from the Marne a Fucoidi Formation and only 6 form the upper part of the Maiolica Formation).

A detailed stratigraphic and taxonomic revision of the radiolarian assemblages from the uppermost Barremian–lower Aptian succession is presented, and a new subdivision of former radiolarian zones is proposed. In addition, we also present a brief analysis on the radiolarian turnover that occurred at the Barremian/Aptian boundary. The uppermost Barremian is characterized in Gorgo Cerbara by an important faunal crisis, encompassing the extinction of more than half of radiolarian species, whereas the earliest Aptian is characterized by a moderate and slow recovery (only a third of the fauna is renewed). An unusual biotic aspect is the absence of a true radiolarian extinction within the OAE-1a (Selli level), with the extinction of only seven radiolarian species immediately before or during the anoxic event and a high survivor number of species.

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New Paleontological and Geochronological Data of Upper Cretaceous Volcanoedimentary Sequence form the Eastern Sakarya Zone, NE Turkey

Oguz, S.[1,*]***, Aydin, F.***[1]***, Kandemir, R.***[2]***, Sari, B.***[3]

1) Karadeniz Technical University, Trabzon, Turkey, E-mail: soguz@ktu.edu.tr*
2) Recep Tayyip Erdogan University, Rize, Turkey
3) Dokuz Eylül University, Izmir, Turkey

Based on the recent volcanostratigraphic studies, new paleontological data and U-Pb zircon ages, the Upper Cretaceous sequence of the Eastern Sakarya Zone (ESZ), NE Turkey, is divided into four different volcano-sedimentary formations. These are, from bottom to top, Çatak, Kızılkaya, Çağlayan and Tirebolu formations. This sequence of the ESZ is represented by voluminous volcaniclastic rocks alternating with six different levels of planktonic foraminifera-bearing red limestone interlayers (4 within the Kızılkaya, one within the Çağlayan and one within the Tirebolu formations). The presence of *Dicarinella asymetrica* in the lower stratigraphic levels suggests latest Coniacian-early Santonian, while presence of *Globotruncana esnehensis, Globotruncana linneiana* and *Gansserina gansseri* in the uppermost level suggests latest Campanian-Maastrichtian. First period of the late Cretaceous volcanism is generally represented by mafic-intermediate rock series (basaltic-andesitic lava flows, hyaloclastites and pyroclastic deposits). Although there is no geochronological data for the Çatak volcanics, a Turonian age was assigned based on its stratigraphic position and paleontological data. Second volcanic period is characterized by pyrite-bearing felsic volcanics (dacitic domes and lava flows, hyaloclastites and crystal-vitric tuffs) of the Kızılkaya Formation. U-Pb zircon dating from these felsic rocks yielded ages ranging from 88.5±0.8 to 85.6±0.5 Ma (i.e. Coniacian-early Santonian). Third volcanic activity related to Çağlayan Formation begins with the mafic-intermediate rock series (basaltic-andesitic lava flows, hyaloclastites and pyroclastic deposits), which is late Santonian-early Campanian in age, based on the planktonic foraminifera from the red pelagic limestones. The upper most volcanic period is composed of biotite-bearing felsic rock suites (rhyolitic domes and lava flows, and pyroclastic deposits). U-Pb zircon dating for this horizon yielded ages varying from 83.5±0.8 to 80.9±0.6 Ma (i.e. early Campanian). All these units are covered by Campanian-Paleocene calciturbidites, marl and lesser red limestones, which are often cut by mafic dykes and sills. U-Pb zircon dating for these small mafic intrusions yielded ages varying from 82.9 to 78.5±1.1 Ma (i.e. early-middle Campanian), suggesting the latest magmatic activity in the final stage of subduction-related magmatism of the ESZ.

The detailed planktonic foraminifera analyses suggest that the red pelagic limestones of the Upper Cretaceous sequence from the ESZ should not be older than the latest Coniacian-Santonian and, in a regional-scale, should not be younger than the late Campanian-Maastrichtian. New U-Pb zircon ages support the paleontological records and indicate that the late Cretaceous subduction-related volcanism of the ESZ was active between the earliest late Turonian and middle Campanian.

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Cretaceous geological evolution of the Central Pontides

Okay, A.[1,*]***, Altiner, D.***[2]***, Sunal, G.***[1]***, Akdogan, R.***[1]***, Altiner, S.***[2]***, Simmons, M.D.***[3]

*1) Istanbul Technical University, Istanbul, Turkey, *E-mail: okay@itu.edu.tr*
2) Middle East Technical University, Ankara, Turkey
3) Halliburton, Abingdon, UK

Before the Late Cretaceous opening of the Black Sea as a back-arc basin, the Pontides constituted part of the southern margin of Laurasia. During the Late Jurassic – Early Cretaceous (Kimmeridgian-Berriasian) the region was a wide carbonate platform, which passed south into a continental margin dominated by carbonate deposition. The limestone deposition was terminated by uplift and erosion during the Valanginian and Hauterivian, followed by the deposition in the Central Pontides of an over 2-km-thick sequence of Barremian-Aptian turbidites. Paleocurrent measurements and detrital zircon ages indicate that the major part of the turbidites was derived from the East European Platform in the north, implying that the Black Sea was not open before the Aptian (AKDOGAN et al., 2017). The middle Cretaceous turbidites formed a large submarine fan, 400 km by 90 km, extending from a mixed clastic-carbonate shelf in the north along the present southern Black Sea coast, to the Tethyan subduction zone in the south. The distal turbidites in the south were deformed and metamorphosed in the subduction zone during the Albian (OKAY et al., 2013). Albian times also witnessed accretion of Tethyan oceanic crustal and mantle sequences to the southern margin Laurasia, represented by Albian eclogites and blueschists in the Central Pontides (OKAY et al., 2006).

A new depositional cycle started in the Late Cretaceous with the Coniacian-Santonian red pelagic limestones, which lie unconformably over the older units. The limestones pass up into thick sequences of Santonian-Campanian arc volcanic rocks. The oceanic crust in the West Black Sea basin was generated during this arc volcanism. The arc volcanism ceased in the middle Campanian, and the interval between late Campanian and middle Eocene is represented by a thick sequence of siliciclastic and calciclastic turbidites in the northern part of the Central Pontides. Coeval sequences in the south are shallow marine and are separated by unconformities.

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Crustal scale Upper Cretaceous mass flows northwest of Ankara related to the destruction of the forearc

Okay, A. [1,*] ***and Altiner, D.*** [2]

*1) Istanbul Technical University, Istanbul, Turkey, *E-mail: okay@itu.edu.tr*
2) Middle East Technical University, Ankara, Turkey

Huge Upper Cretaceous (Turonian-Coniacian) olistostromes, with a stratigraphic thickness close to two kilometres, crops out along an 80-km-long belt west and north of Ankara. The Kargabedir Olistostromes are stratigraphically underlain by the Lower Jurassic sandstones or by the Upper Triassic Karakaya Complex. Over 90 % of the blocks in the mass flows are made up of pelagic limestones, which reach 600 m in size. Paleontological studies have shown the presence of limestones blocks of Callovian-Oxfordian, Tithonian, Berriasian, Aptian, Albian, Cenomanian and Turonian ages. Apart from the dominant limestone blocks, there are minor tuff, volcanoclastic sandstone and radiolarian chert blocks within the olistostromes. No tectonic deformation, apart from that induced during the emplacement, was observed in the olistostromes. The individual mass flows are separated by horizons, up to 160 m thick, made up of fine-grained siltstone, marn, volcanoclastic sandstone and calciturbidite. The youngest ages obtained from these horizons are latest Turonian and Coniacian.

The Kargabedir Olistostromes are stratigraphically overlain by an ophiolitic melange made up of basalt, chert, serpentinite and limestone. The Kargabedir Olistostromes and the ophiolitic melange were emplaced into the basin during the latest Turonian – Coniacian and were later unconformably overlain by Santonian red pelagic limestones. During the early Campanian the region was deformed, uplifted and eroded and this phase was followed by the deposition during the middle-late Campanian of continental sediments, rudist-bearing limestones and volcanoclastic turbidites. The emplacement of the Kargabedir Olistostromes and the ophiolitic melange is related to the tectonic uplift of the distal fore-arc and the accretionary ridge during the latest Turonian – Coniacian, which resulted in the collapse of these regions to the northwest towards the continent.

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Cretaceous (Early Maastrichtian - Aptian) stratigraphy of the Shiranish Islam area, northern Iraq

Packer, S.[1,*]***, Canner, K.***[2]***, Chalabi, A.***[2]

*1) Millennia SC Ltd., Wingrave, Buckinghamshire, UK, *E-mail: s.r.packer@btinternet.com*
2) DNO ASA, Oslo, Norway

The Cenozoic and Cretaceous succession of north-west Iraqi Kurdistan is exposed in outcrop in the Derker Ajam and Shiranish Islam area just to the north of Zakho. The exposed Paleogene to Lower Cretaceous succession includes the Anah, Pila Spi, Gercus, Khurmala, Kolosh, Shiranish, Mergi and Qamchuqa Formations. This area is well documented in literature and contains the Iraq type section localities for the Shiranish and Mergi Formations (Van Bellen *et al*., 1959). Since 2003 the area has been studied by DNO field teams as part of wider regional geological studies. This study focusses on the Cretaceous interval including the Shiranish, Bekhme, Mergi and Qamchuqa Formations. The status of the 'Turonian' Mergi Formation has been the subject of some discussion since the 1960's. A number of historical papers include some reference to the stratigraphy, sedimentology, and micropalaeontological records from the Cretaceous succession, though this is largely piecemeal and is often wholly or partially derived from the original fieldwork descriptions from early IPC (Iraq Petroleum Company) reports in the 1940's and 1950's.

The primary aim of this study is to provide a concise biostratigraphic record of the Shiranish, Bekhme, Mergi and Upper Qamchuqa Formations based on detailed field sampling and biostratigraphic analysis of multiple logged sections. Six separate sections were logged and sampled within the Shiranish Islam area. Two hundred and sixty-seven samples for biostratigraphic analysis were collected at c. 1 m intervals allowing for suitable exposure. Over critical boundaries the sampling density was reduced to in order to capture small scale changes across potential hiatal or condensed surfaces. Samples collected from the Bekhme and Qamchuqa Formations comprise mostly limestones that are variably dolomitised/re-crystallised and as such are only suitable for thin-section micropalaeontological analysis. Thin-sections analysed contain well preserved faunas and floras throughout comprising rich assemblages of benthic and planktonic foraminifera, calcispheres, ostracods, calcareous algae and macrofossil debris. Nannofossil recovery is very poor due to the effects of re-crystallisation and dolomitisation, and low organic yield results in generally poor recovery of palynomorphs. The interbedded limestones and marls of Shiranish Formation were analysed for thin-section and routine micropalaeontology, nannofossils and palynology, with all disciplines yielding good floras and faunas. Based on the new biodata generated an updated stratigraphic model for the succession is presented.

Shallow benthic environment at the Cretaceous/Paleogene (KPg) Boundary documented by abiotic and biotic data on the Pg Adria CP from NE Italy to South Dalmatia

Palinkaš, L.[1,*], Tewary, V.C.[2], Dolenec, M.[3], Markic, M.[4], Premec Fucek, V.[5], Pecimotika, G.[5], Trutin, M.[6], Barattolo, F.[7], Pugliese, N.[8], Drobne, K.[9]

*1) Department of Geology, University of Zagreb and Croatian Acad. of Sci. and Arts, Zagreb, Croatia, *E-mail: lpalinkas@geol.pmf.hr*
2) Sikkim Univ. - Dept. of Geology, Gangtog, India
3) Univ. of Ljubljana, NTF, Dept. of Geology, Ljubljana, Slovenia
4) Geological Survey of Slovenia, Ljubljana, Slovenia
5) INA Industrija nafte, Zagreb, Croatia
6) Retired, Zagreb, Croatia
7) Univ. of Naples Federico II, Dept. of Earth, Environ., and Resources Sci., Napoli, Italy
8) Univ. of Trieste, Dept. of Math. and Geosciences, Trieste, Italy
9) Cent. of Slovenian Acad. of Sci. and Arts, Ljubljana, Slovenia

The research at the KPg boundary was resumed after 1980 following the publication of increased iridium (Ir) contents in deep sea environment at the KT boundary in the Gubbio profile. In 1982, higher Ir and carbon isotope anomalies ($\delta^{13}C$ -8‰ PDB) were documented within thin beds of peritidal lagoonal environment interrupted with hiatuses at Dolenja Vas (DV). Further research continued in the profiles of Padriciano 1, 2, Basovizza, Sopada, and Vremski Britof (TEWARI et al., 2007). In the DV profile, a 2–5 m thick horizon is also marked by a mercury (Hg) anomaly, which is interpreted as evidence of intensive volcanism (PALINKAŠ et al., 1996). Paleomagnetic analyses indicate CW[S1] rotation of 28° in the chron C29R. Stromatolites were recorded within the Danian limestones. The studied interval covers a time span of 40–200 kyr. Sphaerules found at Padriciano were interpreted as a proof of the meteorite impact. Benthic foraminifera, *R. liburnica* and *Fleuryana adriatica* were recognized in Maastrichtian. In the initial sedimentation after the KPg transition, algae were the most effective group, comprising *Decastroporella tergestina,* the Mexican species *Acroporella chiapasensis* (dasycladaceas), *Drobnella slovenica* (algae incerte sedis), and *Decastronema barattoloi* (cyanobacteria), and among foraminifers *Bangiana hanseni.* Parts of these features were confirmed also in the Sjekoše profile in Herzegovina (DROBNE et al., 2009).

KORBAR et al. (2017) discovered a continuous KPg boundary succession on the Hvar and Brač Islands, with 2 cm thick layers of red-brown clay interpreted astsunamite. Planktonic foraminifera, shock quartz, high contents of K feldspars, pyroxene and elevated concentrations of PGE "in chondritic proportions" indicate a link to the Chicxulub asteroid impact.

Recently, the paper by A.N. SIAL et al. (2016) utilized Hg as a proxy for volcanism by studying four distal and two proximal sections in relation to the volcanic center of the Deccan traps, straddling the KPg boundary. Besides India (Maghalaya, Jhilmili), it was also identified in Højerup (Denmark), Bottaccione and Padriciano (Italy), Bajada del Jagüel (Argentina), and Dolenja Vas (Slovenia).

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The original colours and the preservation potential of chitin from the cuticles of insects in Myanmar ambers

***Pan, Yanhong*[1]**

1) Nanjing Institute of Geology and Palaeontology, CAS, Nanjing, China, E-mail: yhpan@nigpas.ac.cn

Metallic structural colours are common among insects and can be preserved in their fossil counterparts, usually recorded from “normal” sediments such as carbonates. However, insects in ambers may preserve color patterns, but appear in brown-to-black colours. It is unclear whether the colours have been altered during fossilization, and whether the absence of colour is real. Insect remains in amber are usually restricted to the cuticle and the metallic colour of insects relies on cuticular ultrastructures creating specific refraction patterns in light. If the cuticular ultrastructures of insects in ambers are preserved, it can be tested whether the absence of colour is real or not.

Three wasps in ambers from the Upper Cretaceous of Myanmar were ultrathin-sectioned and observed with a transmission electron microscope (TEM). Our results support the retention of the original ultrastructures of the cuticles, which are consistent with modern wasps.

The cuticle of insects is a complex of chitin cross-linked with proteins. In modern chrysidid cuticles, chitin is the main refractive component contributing to the metallic colour. It is thus possible that the loss of structural colour is due to the modified chemical compositions. However, additional chemical and molecular analyses are essential to test this hypothesis.

Benthic foraminifers and ostracods from the early Cretaceous Rosablanca Formation (Middle Magdalena Basin, Colombia)

Patarroyo, G.D.[1,*]***, Ceolin, D.***[2]***, Fauth, G.***[2]***, Torres, G.A.***[1]***, Cárdenas, C.***[1]***, Rincón, D.A.***[1]

*1) Instituto Colombiano del Petróleo, Piedecuesta, Colombia, *E-mail: paleo.patarroyo@gmail.com*
2) itt Fossil-Instituto Tecnológico de Micropaleontologia, UNISINOS, São Leopoldo, Brazil

In the Lower Cretaceous Rosablanca Formation (Middle Magdalena Basin, Colombia), a micropaleontological survey was conducted in two wells that drilled strata of the formation in order to understand its biostratigraphic framework and its depositional environments. Despite the moderate recovery of microfossils, results suggested that in the upper part of the Rosablanca Formation, the benthic foraminiferal genera *Lenticulina* and *Choffatella* are present along with fragments of rotalids and textulariids. In contrast, for the lower part of this formation, the presence of several ostracod genera of the families Cytheridae, Cytherideinae, Ilyocyprididae and Trachyleberididae is recorded. This study constitutes the first detailed report of these Lower Cretaceous ostracods in Colombia.

The benthic foraminiferal assemblages suggest a Valanginian to Barremian age for the Rosablanca Formation, in concordance with previous studies based on macrofossil assemblages. Furthermore, the ostracod fauna suggests a transitional (mixohyaline) to normal marine environment, mainly based on the ecologic preferences of the genera *Fabanella*, *Schuleridea* and *Perissocytheridea*.

Late Cretaceous foraminiferal turnover along the Colon-La Luna contact (Northern Colombia): Biostratigraphy and palaeoenvironmental overview

***Patarroyo, G.D.*[1,*], *Torres, G.A.*[1], *Cárdenas, C.*[2], *Rincón, D.A.*[1]**

*1) Instituto Colombiano del Petróleo, Piedecuesta, Colombia, *E-mail: paleo.patarroyo@gmail.com*
2) Universidad EAFIT, Medellín, Colombia

Compared with other areas in the Tethyan realm, the latest Cretaceous (Campanian-Maastrichtian) strata in northern South America lack of detailed studies about their foraminiferal assemblages. Among the few surveys published from the Colon and La Luna formations surveys focused on biostratigraphic or paleoenvironmental aspects in each separated unit, but never about the transition between them (e.g. MARTÍNEZ, 1989; PARRA et al., 2003).

Recent studies on exploratory wells (cores and cutting material) suggest a late Campanian to Maastrichtian age for the lowermost Colon Formation. The foraminiferal assemblages are highly diverse, mainly composed by epifaunal benthic foraminifera and non-keeled planktonics, suggesting an inner shelf setting with oligotrophic to mesotrophic conditions. Well preserved taxa such as *Globotruncana* spp., *Rugoglobigerina* spp., *Siphogenerinoides* spp., *Anomalina* spp., *Pullenia cretacea*, *Praebulimina petroleana* and *Haplophragmoides excavata* are common elements in the lowermost Colon Formation. Due to shallowing of the area, the recognition of the K-T boundary with foraminifers proofed to be challenging. In contrast, an abrupt change in the foraminiferal assemblages is observed for the uppermost part of the La Luna Formation. There, the assemblages are less diversified, with a high proportion of recrystallized infaunal foraminifera, biserial and keeled planktonics. An oxygen-depleted upper shelf environment is suggested, probably related with regional upwelling conditions or local anoxia. In addition, a Coniacian to Campanian? age is proposed by the presence of *Bolivinoides* spp., *Anomalina redmondi*, *Praebulimina* spp., *Whiteinella* spp. and *Heterohelix* spp.

This contrast in the foraminiferal assemblages from the respective formations and their inferred paleoenvironments agrees with previous studies which propose a regional unconformity between the Colon and La Luna formations and coeval units in Colombia.

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Late Cretaceous to Paleocene Nannofossil Assemblage Characteristics Conserved in Deccan intertrappean Sediments, Mannar Basin, Sri Lanka

Perera, S. [1,*] ***and Singh, A.*** [2]

*1) Post Graduate Institute of Science, Peradeniya, Sri Lanka, *E-mail: siyuminiperera@gmail.com*
2) Birbal Sahni Institute of Palaeosciences, Lucknow, India

A qualitative nannofossil study was carried out from twenty drill cutting samples recovered from Barracuda oil exploration well at Mannar Basin in Indian Ocean. The samples were chosen from the depth of 3,760 m to 3,865 m. It represents approximately 50 m depth interval to both sides from the Cretaceous-Paleogene Boundary inferred by the geophysical studies carried out previously. The samples belong to the layers of claystone and sandstone inter-trapped between intermittently discharged dense volcanic flows originated from Deccan volcanic eruptions.

The study reveals a well-diversified good to moderately preserved nannofossil assemblage of 113 species, belonging to 57 genera representing Latest Campanian to Late Paleocene age. However, since these are intertrappean sediments among Deccan volcanic flows which occurred during Maastrichtian to Early Danian, the time period represents by the samples should be restricted to the Maastrichtian to Early Danian timeframe (PUNEKAR *et al*., 2014). Therefore, the time period which was directly suggested by the assemblage can't be taken into consideration, as it accounts for a wider timeframe exceeding Maastrichtian to Early Danian. Thus, the assemblage had been thoroughly reworked and substantial amount of contamination during sampling must have occurred. A total of 53 species which shows signs of existence during Late Cretaceous had extinct as a result of K-Pg mass extinction including the microbiota like, *Arkhangelskiella cymbiformis*, *Retecapsa crenulata*, *Tranolithus orionatus, Eiffellithus* spp.*, Chiastozygus litterarius, Placozygus fibuliformis, Prediscophaera* spp. and *Microrhabdulus* spp., while *Zeugrhabdotus sigmoides, Markalius inversus, Octolithus multiplus* and calcareous dinoflagellates (*Thoracosphaera* spp.) bloom, had sustained the crisis. Newly evolved species after K-Pg extinction, *Cruciplacolithus primus, Neochiastozygus digitosus*, *Neobiscutum parvulum* and *Neobiscutum romeinii* show a significant reduction in their size indicating that the extinction must be due to the higher stress conditions resulted from Deccan volcanic extrusions which coincides with the same timeframe. The presence of *Watznaueria barnesae* (> 40 %) in the lowermost section of the succession suggests that this part had undergone at least partial diagenetic alteration. Recovery followed up by extinction favoured oligotrophic species over eutrophic species. The warm water conditions had existed around 30° S latitudes while some cold water species had migrated near to the basinal area during the Late Cretaceous.

Planktonic foraminiferal biostratigraphy across the Coniacian-Santonian boundary interval in Tanzania and its reproducibility in coeval settings

***Petrizzo, M.R.*[1]**

1) Department of Earth Sciences, University of Milano, Milano, Italy, E-mail: mrose.petrizzo@unimi.it

This study is focused on the identification of the best sequence of planktonic foraminiferal bioevents that is reproducible across the Coniacian-Santonian boundary interval by comparing data from sections located in different paleogeographic area: core TDP 39 drilled in Tanzania (PETRIZZO et al., 2017), the Ten Mile Creek section in Texas (candidate GSSP stratotype section for the base of the Santonian; GALE et al., 2007) and the Cantera de Margas section at Olazagutia in northern Spain (GSSP stratotype section for the base of the Santonian; LAMOLDA et al., 2014). In the stratotype section the GSSP is marked by the lowest occurrence of the inoceramid *Cladoceramus undulatoplicatus* (= *Platyceramus undulatoplicatus*) comprised within the planktonic foraminifera *D. asymetrica* Zone and exhibits secondary microfossil events and a negative 0.3‰ excursion in $\delta^{13}C$. The same bio- and chemostratigraphic record have been identified in the Ten Mile Creek section. In Tanzania the GSSP secondary marker event *Globotruncana linneiana* has been used in the absence of *C. undulatoplicatus* and of correlative chemostratigraphic tie-points.

The composition of the planktonic foraminiferal assemblage in the three stratigraphic sections is similar although discrepancies are observed in the reproducibility of some bioevents. Similarities between sections include the same order of (1) appearances of the marker species *Sigalia carpatica*, *Costellagerina pilula* and *G. linneiana* at Olazagutia and TDP 39, (2) disappearances of *Marginotruncana schneegansi* and *Whiteinella* spp. at TDP 39 and Ten Mile Creek, and (3) appearance of *C. pilula* and absence of the single keeled globotruncanids (*G. stuartiformis*, *G. elevata*) at Ten Mile Creek and Olazagutia.

The comparison among the three sections reveals that discrepancies mostly pertain to particular ecological preferences of species that develop and diversify in specific paleoenvironmental conditions. Moreover, the apparent diachronism of some species is also due to species misidentifications and/or different species concepts that are thoroughly discussed. Results provide insights into the correct taxonomic identification and stratigraphic distribution of foraminiferal species and allow deriving a more accurate and reproducible sequence of bioevents across the Coniacian-Santonian boundary interval calibrated against other stratigraphic tools and applicable in different paleogeographic and depositional settings.

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LAMOLDA, M.A. et al., 2014. Episodes, **37**, 1–13.
PETRIZZO, M.R. et al., 2017. dx.doi:10.1111/sed.12331

Preludes of the Oceanic Anoxic Event 1a along the northern Tethyan margin: a progressive climatic destabilization from the latest Hauterivian (Early Cretaceous) onward

Pictet, A.[1]

1) Department of Earth Sciences, University of Geneva, Geneva, Switzerland,
E-mail: Antoine.Pictet@unige.ch

The Hauterivian to latest Barremian is a key interval of underestimated environmental change in the Early Cretaceous. After a short recovery in the Hauterivian, the sedimentation is characterized by a considerable modification in palaeoceanographic and palaeoenvironmental conditions, which initiated with the Faraoni event, the first widely recognized OAE of the Cretaceous. The palaeoenvironmental conditions continued to fluctuate through the Barremian, with a succession of platform drownings and condensation processes, up to the early Aptian witnessing one of the major phases of palaeoenvironmental change of the entire Cretaceous – the Selli episode. The aim of this contribution is to highlight the importance and the evolution of these modifications on the northern Tethyan margin announcing the dense succession of anoxic events of the “Mid Cretaceous“ period, and how there are linked to the turover of the fauna and of the different type of carbonate-factories. In order to achieve this, two key areas, one in the Swiss Helvetic Alps (Alpstein), and one in the Languedoc (Gorges de l'Ardèche, SE France) were examined, sampled, and analyzed for their paleontology, microfacies, sequence stratigraphy, sedimentology, geochemistry (stable C & O isotopes, phosphorus content). Thus, the latest Hauterivian (*ohmi* Zone) Faraoni Episode is characterized by: a minor extinction event wich affected marine life (Sepkoski, 2002), a major turnover event in the ammonites (Company et al., 2005), an important platform drowning event (SB Ha6), a $\delta^{13}C$ whole-rock record evolving towards heavier values (Bodin et al., 2009). This episode marks a paleoenvironmental turning point, which in some places of the northern Tethyan margin (Helvetic and Central Jura domains) lasted up to the latest early Barremian (Bodin et al., 2006), associated to condensation (glauconite and phosphogenesis). In direct continuation, the Barremian record is characterized by a succession of events, associated to drownings, condensation processes, small $\delta^{13}C$ increases, and the deposition of pelagic organic-rich deposits. These events are stratigraphicaly situated in the: earliest Barremian (*hugii* Zone), early Barremian (*nicklesi* Zone), late early to middle late Barremian (*darsi* to *sartousiana* Zone, Mid Barremian Event), latest Barremian (*sarasini* Zone; Taxy Episode) with a strong $\delta^{13}C$ decrease with a negative excursion (Föllmi, 2012). The cause of this progressive climatic destabilization from the latest Hauterivian onwards may be sought in a possible increasing submarine volcanic activity during this time period, which up to now was not detected.

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Sepkoski, J.J., Jr., 2002. Bulletins of American Paleontology, **363**, 560 p.

A better-ventilated ocean triggered by Late Cretaceous changes in continental configuration

***Pohl, A.**[1,*], **Donnadieu, Y.**[1], **Puceat, E.**[2], **Moiroud, M.**[2], **Guillocheau, F.**[3], **Deconinck, J.-F.**[2], **Poli, E.**[4], **Borgomano, J.**[1]*

*1) CEREGE, Aix en Provence, Cedex 4, France, *E-mail: pohl@cerege.fr*
2) Université de Bourgogne Franche-Comté, UMR 6282 Biogéosciences, Dijon, France
3) Géosciences Rennes, Rennes, France
4) Total CSTJF, Pau, France
5) CEREGE, Marseille Cedex 3, France

Cretaceous oceanic anoxic events (OAEs) are large-scale events of oxygen depletion in the deep ocean associated with widespread burial of organic carbon. The respective contributions of nutrient loading and ocean ventilation during these events remain hard to disentangle, feeding the debate over the 'enhanced productivity' as opposed to the 'enhanced preservation' model for black shale deposition. Here we use an ocean-atmosphere general circulation model to show that the continental configuration made the mid-Cretaceous ocean (Cenomanian-Turonian, 94 Ma, OAE2) more prone to anoxia than the Late Cretaceous ocean (Maastrichtian, 71 Ma). Changes in ocean dynamics between the two time slices further explain the previously enigmatic decrease in ε_{Nd} values recorded in the Atlantic and Indian deep waters during the Late Cretaceous (DONNADIEU et al., 2016). Additional simulations conducted using an up-to-date ocean model with biogeochemical capabilities (MITgcm), explicitly accounting for oxygen cycling in the ocean, confirm these patterns. Our results demonstrate that the continental configuration, through its impact on ocean circulation and thus oxygen concentration, significantly affected the threshold required to trigger anoxia throughout the Cretaceous.

DONNADIEU, Y. et al., 2016. Nat. Commun., **7**, 10316.

Planktonic Foraminiferal Distribution From Uppermost Hauterivian-Lower Barremian Strata At Arroyo Gilico (Betic Cordillera, SE Spain): An Update

***Premoli Silva, I.*[1,*], *Petrizzo, M.R.*[1], *Soldan, D.M.*[1]**

*1) Department of Earth Sciences A. Desio, Milan, Italy, *E-mail: isabella.premoli@unimi.it*

Latest Hauterivian-earliest late Barremian planktonic foraminifera from the Arroyo Gilico section (Subbetic domain, Betic Cordillera) have been investigated in order to correlate their distribution to ammonite zonation, calcareous nannofossil bioevents and stable isotope stratigraphy performed by AGUADO et al. (2008, 2014). This section, 72 m thick, spans the interval between the upper Hauterivian ammonite Crioceratites binelli Subzone, Crioceratites baleraris Zone and the lowermost upper Barremian ammonite Barrancyloceras barremense Subzone, Toxancyloceras vandenheckii Zone. Planktonic foraminiferal assemblages turned out to be much richer and in part more diversified than previously described from the nearby Rio Argos composite section. At the base of the section in the Binelli Subzone, Balearis Zone, as already known, *Hedbergella sigali, H. infracretacea, H. daminiae* and *Lilliputianella semielongata* are recorded, however new findings can be mentioned, common *Hedbergella praetrocoidea* and *H. aptiana* along with rare specimens recalling *H. excelsa* for the long and elevated spire. Early appearances of taxa continue up-section with the lowest occurrences (LOs) of *Hedbergella ventriosa*, then *Lilliputianella eocretacea* in the overlying Krenkeli Subzone, followed by *Hedbergella gorbachikae*, while the LO especially of the "clavate" *Lilliputianella pauliani* does occur just before the end of the Hauterivian within the topmost Picteti Subzone. The lower Barremian is punctuated by a number of successive appearances: the most important stratigraphically is the LO of typical *Globigerinelloides blowi* recorded in the upper lower Barremian Compressisima Zone. As already reported by Aguado et al. (2008, 2014), at Arroyo Gilico the acme of the "clavate" morphotypes occurs in the Moutonianum Zone across the Mid Barremian Event (MBE); besides common *Lilliputianella semielongata*, the taxa consistently present are *Lilliputianella pauliani* with typical as well as transitional morphologies, *L. eocretacea* and to a minor extent *"Globigerinelloides" sigali*.

AGUADO, R. et al., 2008. Berichte der Geol. B.-A., **74**, 36–37.
AGUADO, R. et al., 2014. Cret. Res., **49**, 105–124.

A high-resolution belemnite geochemical analysis of Early Cretaceous (Valanginian-Hauterivian) environmental and climatic perturbations

Price, G.[1,*]***, Janssen, N.***[2]***, Martinez, M.***[3]***, Company, M.***[4]***, Vandevelde, J.***[1]***, Grimes, S.***[1]

*1) University of Plymouth, Plymouth, UK, *E-mail: g.price@plymouth.ac.uk*
2) Geertekerkhof, Utrecht, The Netherlands
3) MARUM, Bremen, Germany
4) Universidad de Granada, Granada, Spain

The oxygen isotopic composition and Mg/Ca ratios of calcitic belemnites have been widely used to determine palaeotemperatures and the isotopic composition of seawater (and salinity) in Jurassic and Cretaceous times. Here we evaluate high-resolution temporal trends through the Early Cretaceous (Valanginian-Hauterivian) interval using carbon and oxygen isotopes and Mg/Ca ratios of belemnites from the Vocontian Trough (France) and SE Spain. A major positive carbon isotope excursion is evident in the Valanginian (within the Verrucosum ammonite zone) documenting a significant perturbation of the carbon cycle, i.e. the 'Weissert Event'. Combining data from the oxygen isotopic composition and the Mg/Ca ratios in the belemnite calcite allows us to evaluate changes in temperature and the oxygen isotopic composition of seawater. Changes in the latter have previously been interpreted in terms of changes in polar ice-volume. Our combined data suggest a cooling and a decrease in the oxygen isotopic composition of seawater (consistent with a decrease in salinity) during the peak of the 'Weissert Event'. These changes are synchronous between France and Spain. During the latest Valanginian and early Hauterivian further changes are evident whereby the oxygen isotopic composition of seawater becomes more positive, either a response to the formation of polar ice or a response changes in salinity.

Integrated stratigraphy of the Jurassic-Cretaceous sequences of the Kurovice Quarry, Outer Western Carpathians: correlations and tectonic implications

Pruner, P.*[1,*], Schnabl, P.[1], Cížková, K.[1], Elbra, T.[1], Kdýr, Š.[1], Svobodová, A.[1], Reháková, D.[2]

1) *Institute of Geology of the CAS, v.v.i., Praha, Czech Republic, *E-mail: pruner@gli.cas.cz*
2) *Comenius University in Bratislava, Bratislava, Slovakia*

Sedimentary rocks of Jurassic-Cretaceous age from Kurovice quarry are one of the key study materials for the research project "Integrated multi-proxy study of the Jurassic-Cretaceous boundary in marine sequences: contribution to global boundary definition". The Kurovice section belongs to the Magura Group of Nappes within Carpathian Flysch Belt. Rocks of the interest comprise of Kurovice limestones and overlying Tlumačov marlstones in medium to thick beds. Fossil record consists of radiolarians, sponge spicules, nannofossils, calpionellids, calcareous dinoflagellate cysts, ostracods, foraminifera, aptychi, rhyncholites of nautiloids and rare belemnites. The biostratigraphy of the sequences studied was supported by calpionelllid and nannofossils distribution. Zonations of REHÁKOVÁ & MICHALÍK (1997) and CASSELATO (2010) were used. The result of studied samples revealed very low remanent magnetization and susceptibility. Acquisition of remanent magnetization suggests presence of weak (magnetite) and strong (goethite or hematite) coercivity fractions. The section shows for normal and five reverse polarity zones. The span of the studied sections is M20r to M17r. Increased abundance of sphaerical species of *Calpionella alpina* Lorenz was observed along the J/K boundary interval, which help to interpret the magnetostratigraphic column and can be correlated with the magnetozone M19n.2n. Slighty below this bioevent, the first occurrence of calcareous nannofossil species *Nannoconus wintereri* was recorded. The preliminary Tithonian/Berriasian mean paleomagnetic direction from the Kurovice section is counter-clockwise rotated if compared with the expected European reference directions by about 150° and is in agreement with that obtained from the Brodno section (HOUŠA et al., 1999). Conversely, clockwise rotation was recorded from the Tatra Mountains in Poland (GRABOWSKI et al., 2010). Inclination of paleomagnetic directions around the J/K boundary from Western Carpathians are in good agreement (44–49°) which indicates a 26–30°N paleolatitude. The rotations were interpreted as the result of tectonic escape of the Western Carpathians from the domain of the Alpine collision. A specific distribution of paleomagnetic pole positions for rocks of the same age motivated a formulation of a theoretical model simulating paleotectonic rotation of rocks assemblages about vertical axis.

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Late Cretaceous (Cenomanian to Campanian) calcareous nannofossils from northern Germany as a record for shallow marine coastal dynamics

***Püttmann, T.*[1,*], Dölling, B.[2], Linnert, C.[1], Mutterlose, J.[1]**

*1) Institute for Geology, Mineralogy and Geophysics, Ruhr-University Bochum, Bochum, Germany, *E-mail: tobias.puettmann@rub.de*
2) Geological Survey of North Rhine-Westphalia, Krefeld, Germany

The early Late Cretaceous was characterized by a warm equable climate and a global sea level rise of approximately +100 m, causing the flooding of vast continental areas. These conditions were favorable for calcareous phytoplankton radiation, evidenced by a unique diversity and high abundances in pelagic to hemipelagic environments. Previous studies on calcareous nannofossil biostratigraphy and paleoecology of Cretaceous and Cenozoic sediments focused on open oceanic chalks and marls, including the sites investigated by DSDP (Deep Sea Drilling Project) and IODP (International Ocean Discovery Program). For this study, we analysed the nannofossil assemblages of marginal marine sediments, recovered in six cores drilled in northwest Germany. The wells cored the entire Cenomanian - Campanian succession in a nearshore setting, deposited about 5–10 km off the former coast located farther south. The sediments encountered are dominated by glauconitic marls and sand-rich limestones, which yield rich and diverse calcareous nannofossil assemblages. These assemblages have been studied in detail with respect to their biostratigraphy and ecology. In addition, stable isotopes ($\delta^{13}C$) have been measured, which allow a calibration of the biostratigraphic findings.

The glauconite rich sediments cover an interval of earliest Cenomanian (nannofossil zones UC0-1a) to Early Campanian age (nannofossil zone UC14). Seven major hiatuses, which are stratigraphically of different age, have been recognized. These are related to a) eustatically controlled shifts of the former shoreline and b) synsedimentary tectonics and subsequent erosion. The recognition and accurate dating of these hiatuses results in a detailed reconstruction of the dynamic evolution of the former coastline. Our calcareous nannofossil findings allow to differentiate between eustatic and epirogenetic sea-level fluctuations. In addition to the global eustatic sea level rise of the Cenomanian – Turonian interval, synsedimentary tectonic movements influenced the sedimentation patterns. Local tectonics of Late Cenomanian–Early Turonian age caused the uplift of a regional swell structure approximately 15 km north off the former coast. These movements are thought to be related to a major regional inversion in the Coniacian–Santonian.

Stratigraphy of the Lower Cretaceous Dabeigou Formation from Luanping Basin, North China: implications from non-marine ostracod biostratigraphy

Qin, Z.[1,*]***, Xi, Dangpeng***[1]***, Sames, B.***[2]***, Xu, Yankang***[1]***, Ding, C.***[1]***, Wan, X.***[1]

*1) China University of Geosciences (Beijing), Beijing, China, *E.mail: qinzh@cugb.edu.cn*
2) Department of Geodynamics und Sedimentolog, University of Vienna, Vienna, Austria

The Dabeigou Formation of the Luanping Basin in northern Hebei is well known for its continuous non-marine Lower Cretaceous deposits and the preservation of the earliest Jehol Biota, including abundant ostracod fossils (YANG, 1984; PANG et al., 2002). However, it has been suggested that the species diversity of non-marine Early Cretaceous ostracods, particularly among the Superfamily Cypridoidea, has been greatly exaggerated in general (SAMES & HORNE, 2012), which also applies to those in northern Hebei as well as in the adjacent western Liaoning region (YANG, 1984; WANG et al., 2015). In addition, the biostratigraphic age given for the Dabeigou Formation (?Upper Jurassic, Valanginian–Hauterivian) based on the ostracod fauna is in conflict with the published isotope and magnetostratigraphic ages. Detailed lithostratigraphic analysis of the newly exposed Yushuxia section of the Luanping Basin suggests that the Dabeigou Formation can be subdivided into three members and 46 layers. The First Member mainly consists of tuffaceous and coarse clasolites of fan delta front, while the Second and Third Member are mainly composed of grey to dark grey fine clasolite of semi-deep lake facies. Ostracod analysis on samples from the Dabeigou Formation revealed 15 species of nine genera. Biostratigraphically, the ostracods of the Dabeigou Formation belong to the *Luanpingella-Eoparacypris-Pseudoparacypridopsis* zone (PANG et al., 2002), which can be divided into two subzones: the *Luanpingella postacuta* subzone, and the *Torinina obesa* subzone which is here revised to *Pseudoparacypridopsis* aff. *mountfieldensis* subzone. Most of the species range from the latest Jurassic to the earliest Cretaceous. However, some species show a closer relation with ostracods from the later Lower Cretaceous (Hauterivian to Aptian) Dadianzi Formation, the Yixian Formation of North China, and the Purbeck-Wealden Group of Britain. Combined with the U-Pb age (135–130 Ma) given by LIU et al. (2003), it is suggested that the ostracod fauna of the Dabeigou Formation might be of Early Cretaceous age entirely.

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Late Cretaceous climate change in the sub-Arctic region recorded by dinoflagellate cysts

Radmacher, W.[1,*]***, Tyszka, J.***[2]***, Niezgodzki, I.***[2]***, Mangerud, G.***[3]***, Pearce, M.***[4]

*1) Instytut Nauk Geologicznych Polskiej Akademii Nauk, Warszawa, Poland, *E-mail: ndkrol@cyf-kr.edu.pl*
2) Polish Academy of Sciences, Institute of Geological Sciences, Kraków, Poland
3) Department of Earth Science, University of Bergen, Bergen, Norway
4) Evolution Applied Limited, Lechlade, UK)

Arctic Late Cretaceous paleoclimate is poorly understood due to the limited number of available sections and their often discontinuous nature. We investigate a unique, composite section of core-samples from the Greenland-Norwegian Seaway, applying organic-walled dinoflagellate cysts as sensitive proxies of palaeoenvironmental conditions. The Late Cretaceous climate, often referred to as a greenhouse world, likely experienced significant cooling towards its end. Some studies even suggest a concern about glacial conditions in the high latitudes. The sea-surface temperatures estimated by different methods indicate temperature range from below freezing up to 15°C in high latitudes during the latest Cretaceous. According to our study, distinct variations in the assemblage composition recorded from Albian to Maastrichtian provide indirect evidence for climate changes, indicating sea-level fall and gradual cooling towards the end of the Cretaceous. High numbers of peridinioid cysts in the Coniacian, Santonian and ?lower Campanian succession are possibly associated with high-productivity connected to shallow marine conditions, strong terrigenous influx and warm sea-surface temperature. Initial decrease of low-latitude dinoflagellate cysts in the sediment from the Greenland-Norwegian Seaway is recorded in the Campanian, and an influx of high-latitude dinoflagellate cysts in the late Maastrichtian. This is interpreted as a possible change in water mass circulation that could have been caused by reconfiguration of marine gateways between Tethys and the Arctic, and/or cooling that was most likely triggered by lowering concentration of carbon dioxide. The interpretation is partially supported by Earth system models that indicate Campanian and Maastrichtian sea-surface temperatures of 10–14°C and 4–7°C in the Greenland-Norwegian Seaway and central Arctic, respectively.

Ammonite biostratigraphy of Lower Aptian-Upper Albian deposits (Kazhdumi Formation) in Zagros Basin, SW Iran

Raisossadat, S.N.[1,*]***, Hamdani, H.***[1]***, Amiribakhtiar, H.***[2]

*1) Geology Department, University of Birjand, Birjand, Iran, *E-mail: snraeisosadat@birjand.ac.ir*
2) Petroleum University of Technology, Abadan, Iran

The Zagros sedimentary basin is situated in south western Iran. This study is focused on biostratigraphy of lower Aptian- upper Albian deposits (Kazhdumi Formation). The measured section with 270 meters thickness includes three stratigraphic rock units consisting dark grey shale with inter-bedded limestones and marls.

11 genera and 16 species of ammonites were identified in this section: *Cheloniceras* sp*., Douvilleiceras* cf. *mammillatum, D. mammillatum* cf*. aequinodum, Dufrenoyia* cf. *furcata*, *Epicheloniceras* sp., *Hypacanthoplites* sp*., Hysteroceras* sp., *Kossmatella* sp., *Lyelliceras* cf. *lyelli, Oxytropidoceras* (*Mirapelia*) cf*. mirapelianum, Oxytropidoceras* (*Mirapelia*) cf*. buarquianum*, *Parahoplites* sp., *Venezoliceras* cf. *bituberculatum, Venezoliceras* cf. *karsteni* that some (see BULOT, 2010).

The Lower Cretaceous biozonation of the Tethys (especially south margin) has been discussed during recent years (COOPER, 1982; RENZ, 1982; OWEN, 1999; TAVARES et al., 2007, REBOULET et al., 2014). Based on the assemblage the following subzones and biozones are proposed; *Dufrenoyia* cf. *furcata* Zone is defined by presence of *Dufrenoyia* cf. *furcata* and *Cheloniceras* sp*.* Presence of *Epicheloniceras* sp., *Parahoplites* sp. and *Hypacanthoplites* sp. probably could suggest *Epicheloniceras martini*, *Parahoplites melchioris* and *Hypacanthoplites jacobi* zones. *Kossmatella* sp. co-occurs with *Parahoplites* sp. *Douvilleiceras* cf*. mammillatum* and *D. mammillatum* cf*. aequinodum* confirm *mammillatum* Zone. The *Lyelliceras* cf. *lyelli* Subzone which is known as part of *Hoplites dentatus* Zone, and *Oxytropidoceras (Mirapelia)* cf. *mirapelianum* and *Oxytropidoceras (Mirapelia) buarquianum* occurre in this subzone. *Oxytropidoceras (Mirapelia) buarquianum* is also introduced as ammonite horizon (COOPER, 1982). The *Hysteroceras* sp. subzone is defined by the presence of *Venezoliceras* cf. *bituberculatum, Venezoliceras* cf. *karsteni.* This subzone could be equal to the *Hysteroceras orbignyi* subzone (RENZ, 1982) or the *Hysteroceras varicosum* Subzone (OWEN, 1999).

According to the ammonite assemblage and occurring biozones a late Early Aptian to Late Albian age is proposed for the Kazhdumi Formation. Moreover the identified assemblage shows affinity with ammonites reported mostly from southern margin of the Tethys Realm and numerous ammonite taxa seem to be cosmopolitan.

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TAVARES, T. et al., 2007. S. Afr. J. Geol., **110**/1, 137–156.

Foraminifera biostratigraphy of Albian- Cenomanian deposits in southwest of Qayen, East of Iran

Raisossadat, S.N.[1,*]***, Motamedalshariati, M.***[1]***, Erfani, M.***[1]

*1) Geology Department, University of Birjand, Birjand, Iran, *E-mail: snraeisosadat@birjand.ac.ir*

Cretaceous deposits in the southwestern Qayen, east of Iran (eastern margin of the Lut Block), have been investigated for foraminiferal biostratigraphy. The Albian-Cenomanian succession outcropping in the east of Iran represents a case study for better understanding the eastern part of Tethyan Ocean biostratigraphy. The thickness of the measured section is 260 meters and the main lithologies consist of marl, shale, marly limestone and limestone. The biostratigraphic study led to the identification of 22 genera and 28 species of planktonic and benthic foraminifera recorded for the first time in this stratigraphic section. Based on the foraminiferal assemblage, four biozones are identified as follows:

1- *Muricohedbergella planispira* Interval zone: the lower boundary of this biozone is defined by the first appearance of *Muricohedbergella delrioensis* (PREMOLI SILVA AND VERGA, 2004) and the upper boundary of this biozone is determined using the first appearance of *Ticinella praeticinensis*. The foraminiferal assemblage in this biozone includes: *Valvulineria* cf. *lenticula*, *Lagena* sp., *Berthelina intermedia*, *Pleurostomella reussi*, *Vaginulinopsis excentrica*, *Valvulineria gracillima* and *Hemirobulina inaequalis*. 2- *Ticinella praeticinensis* subzone: this belongs to the *Biticinella breggiensis* Interval zone and is defined by the first appearance of *Ticinella praeticinensis* (PREMOLI SILVA & VERGA, 2004; OGG et al., 2008). The foraminiferal assemblage in this biozone includes *Tritaxia tricarinata, Spirillina minima, Dentalina cylindroides, Dorothia hyperconica* and *Nodosaria paupercula.* 3- *Ticinella raynaudi* Interval zone: the lower boundary of this biozone is defined based on the first appearance of *Ticinella raynaudi* (LONGORIA, & GAMPER, 1977). The foraminiferal assemblage in this biozone includes *Berthelina baltica*, *Spiroplectammina* sp., *Gaudryina jendrejakovae* and *Caudammina crassa*. 4- *Lenticulina subangulata - Lenticulina macrodisca* assemblage zone: this biozone is defined based on the presence of *Lenticulina subangulata* and *Lenticulina macrodisca*. Other foraminifera occurring in this biozone are: *Gavelinella berthelini*, *Spiroplectammina gandolfi*, *Valvulineria* cf. *lenticula* and *Valvulineria angulate* (WEIDICH, 1990; HOLBOURN AND KAMINSKI, 1997).

The identified foraminiferal assemblages allow to discuss and correlate the inferred biozones with those commonly used in the Tethys Realm. An Early Albian-Early Cenomanian age are assigned for the studied stratigraphic interval. Data based on the ammonite contents in the studied section confirm an Early Albian-Early Cenomanian age (SHARIFI et al., 2016).

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A Km-scale Cretaceous slope in western Sicily (Italy)

***Randazzo, V.*[1,*], *Cacciatore, M.S.*[2], *Todaro, S.*[1], *Zarcone, G.*[1], *Di Stefano, P.*[1]**

1) Department of Earth and Marine Sciences, University of Palermo, Palermo, Italy,
**E-mail: vincenzo.randazzo04@unipa.it*
2) Eni, San Donato Milanese, Milano, Italy

Cretaceous slopes are well known from many regions of the world, since they are among the most prone depositional systems to host hydrocarbons. As far as Italy, in spite of fully described examples as the Majella and Gargano escarpments, detailed sedimentological and biostratigraphic studies from Sicily are not available, although the presence of slope carbonates of Cretaceous age in northwestern Sicily, is mentioned in several papers dealing with regional geology or geological mapping. The Cretaceous slope carbonates from this area, i.e. the San Vito Lo Capo Peninsula, belong to several thrust sheets of the Maghrebian chain. The stratigraphic setting in these tectonic units allows to reconstruct the aggradation of a thick carbonate platform during Late Triassic-earliest Jurassic, the drowning and conversion to a pelagic plateau during Pliensbachian-Toarcian and its evolution into a slope, since latest Jurassic times. The Cretaceous carbonates from this area are intensely exploited as ornamental stones since the past century and are known with the commercial name of “Perlato di Sicilia”. The wire-cutted walls of a number of quarries either active or abandoned offer the opportunity to study in detail the facies architecture along the slope and define its sedimentary evolution throughout the Cretaceous.

The preliminary results of the researches, that are carried out in the frame of a PhD study on the stratigraphy and sedimentology of this depositional system, allow to document the presence of slope to toe-of-slope sediments since at least the Aptian. The facies associations consist of gravitative skeletal sediments, mostly rudist rudstones to which are intercalated debrites and thick megabreccia beds formed by rudist-bearing extraclasts. Along the succession, the presence of repeated pillow lava intercalations highlights the role of the tectonics in the slope evolution and the crustal involvement in the extensional processes that have controlled the geometry of the slope. At present the slope sediments cover an area of about 100 square kilometers, however, owing to the Maghrebian contraction, the original extension of the slope is largely underestimated. Upsection, the occurrence of pelagic, scaglia-type, sediments points to a significant reduction of the clastic supply along the slope during lower Senonian times. However, debrites with Cretaceous carbonate extra-clasts occur into the pelagic calcilutites until the Eocene.

Rhynchostreon oyster's beds from Orlové sandstones - New view for one of the most problematic palaeoecological queries of the Western Carpathian's Klippen Belt (Klape unit, Western Carpathians)

Rantuch, J.[1]

1) Institute of Geology and Palaeontology, Faculty of Science, Charles University, Prague, Czech Republic, E-mail: jakub.rantuch@gmail.com

Oyster's beds (sp. *Rhynchostreon suborbiculatum* Lam.) from Orlové sandstones represent one of the most problematic palaeoecological queries of the Klippen Belt of the Western Carpathians. The presence of oyster´s palaeopopulations directly within the mobile-margin zone of Tethys area, especially during the massive tectonical activity period of late Cretaceous, is really striking. In the past decades there were published several partial studies (focused mainly to sedimentary record) that capture the evolution of opinions of the strata genesis (e.g. ANDRUSOV, 1945; SALAJ & SAMUEL, 1966; MARSCHALKO & SAMUEL, 1980; MARSCHALKO, 1986 etc.). These are in principle different in conclusions and interpretation of various palaeoecological aspects of the sedimentary environment (like bathymetry, internal energy etc.). A high resolution sampling (bed by bed method) in the "Hôrka nad pumpou" section (Považské podhradie, Slovakia) provided a new dataset to comparate. In an attempt to a complex view we summarize results of detailed sedimentary analysis (grainsize), oyster's shell morphology and taphonomy, ICP MS analysis of the sedimentary rocks and new data of the stable isotope record ($\delta^{13}C$ and $\delta^{18}O$) from *Rhynchostreon* oyster shells. In comparison with data from several oyster-bearing sequences around the European region (mainly Bohemian Cretaceous Basin and Paris Basin) could help us to understand the genesis of studied areas and also potencial influence of palaeoecological aspects to the evolution of genus *Rhynchostreon* Bayle.

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Evolution and palaeogeographical dispersion of the radiolitid rudist genus *Auroradiolites* (Bivalvia: Hippuritida), with descriptions of new material from Tibet and archived specimens from Afghanistan

Rao, Xin[1,*]***, Skelton, P.***[2]***, Sano, S.***[3]***, Sha, J.***[1]

1) Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China,
**E-mail: xinrao@nigpas.ac.cn*
2) School of Environment, Earth and Ecosystem Sciences, The Open University, Milton Keynes, UK
3) Fukui Prefectural Dinosaur Museum, Fukui, Japan,

Diagnostic characters of the recently established new genus of radiolitid rudist *Auroradiolites* include an entirely compact outer shell layer, a distinctly convex upper (left) valve and a robust myocardinal apparatus surrounding a strongly internally projected ligamentary infolding. Until now, *A. biconvexus* (previously considered as exclusively Late Albian in age) has been reported only from the Langshan Formation, which crops out along the northern portion of the Lhasa Block, Tibet. In addition, *A. biconvexus* is here recorded for the first time from the Sangzugang Formation of the Xigaze Forearc Basin, situated at the southern margin of the Lhasa Block. *A. biconvexus* differs from the southwest Asian type species *A. gilgitensis* (Late Aptian to Albian) by its relatively larger size, more strongly domed left valve and distinct radial undulations of the outer shell layer. The characters of *A. gilgitensis* are further clarified by means of archived material from central Afghanistan, also newly identified and described herein. All *Auroradiolites* records to date are revised. The recognition of examples of *A. biconvexus* from Upper Aptian strata increases both the stratigraphical and geographical ranges of the species, indicating that it had already branched off from *A. gilgitensis* in the Late Aptian. Some new radiolitid specimens that combine both compact and cellular calcitic outer shell layer structures are also described from the Langshan Formation, but a number of internal differences from *Auroradiolites* cast doubt on their constituting a sister group to the latter and we assign them to *Eoradiolites* cf. *hedini*. Rather, the evolution of *Auroradiolites* directly from the ancestral radiolitid genus *Agriopleura* is favoured on the grounds of parsimony.

So far, the genus *Auroradiolites* has been recorded from Iran, central and eastern Afghanistan, the type locality of Yasin in northwestern Pakistan, southern and northern Ladakh, the Lhasa Block, as well as Hokkaido in northern Japan. During the Late Aptian to Albian interval, all these localities were associated with terranes and blocks that were limited to the northeastern margin of Tethys and the western Pacific margin, making *Auroradiolites* an indicator of a SW Asian to Pacific faunal province.

Sedimentological and biological changes at the Jurassic Cretaceous transition (West Carpathian JK boundary type-section area)

Reháková, D.[1,*], Michalík, J.[2], Lintnerová, O.[3]

*1) Comenius University, Faculty of Natural Sciences, Department of Geology and Palaeontology, Bratislava, Slovakia, *E-mail: rehakova@fns.uniba.sk*
2) Slovak Academy of Sciences, Institute of Earth Sciences, Bratislava, Slovakia
3) Comenius University, Faculty of Natural Sciences, Department of Economic Geology, Bratislava, Slovakia

One of the most complete Upper Jurassic/Lower Cretaceous pelagic limestone records in Western Carpathians is preserved in NW sector of the Pieniny Klippen Belt around the classical Brodno section (MICHALÍK et al., 2009). Upper Jurassic brown to greenish - brown pseudonodular limestones (*Saccocoma* packstones) contain calcareous dinoflagellates of Early Kimmeridgian Parvula Acme Zone, Late Kimmeridgian Moluccana and Borzai zones, Early Tithonian Pulla, Tithonica and Malmica zones (REHÁKOVÁ, 2000). Overlying crinoidal packstones seldomly contain chitinoidellids of the latest Early Tithonian Chitinoidella dobeni Subzone. The upper part of red nodular biomicrite wackstones belong to the Upper Tithonian Crassicollaria Zone. Eight pale allodapic layers of laminated *Saccocoma* wackstones to packstones contain distinctly graded reworked bioclasts and cysts of Early Tithonian Pulla, Malmica, Tithonica and Dobeni subzones. The crassicollarian association in biomicrite wackstones decreasing in abundance is finally, close to the J/K boundary, replaced by small sphaerical *Calpionella alpina* Lorenz. Overlying Biancône - type limestone contains biomarkers of Ferasini and Elliptica subzones of the standard Calpionella Zone (REHÁKOVÁ & MICHALÍK, 1997). This facies, called as the Pieniny Lst Formation comprises all Berriasian, Valanginian and Hauterian time span. The isotope analysis recorded typical decrease of values during Tithonian and their shift to stable ratios around 1.00 ‰ in the J/K boundary interval (MICHALÍK et al., 2009, 2016). Larger variability of $\delta^{13}C$ and $\delta^{18}O$ ratios in higher part of the section signalises a continuous change of hydrological and paleoecological regimes.

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Enigmatic 3-meters long vertical structures in the Turonian deposits of Poland - biotic (paramoudra-like structures) versus abiotic origin

Remin, Z.[1]

1) University of Warsaw, Warsaw, Poland, E-mail: zbyh@uw.edu.pl

The Middle Vistula Valley section in south central Poland exhibits Albian through Maastrichtian successions. The Turonian deposits, represented by limestone and opoka facies (siliceous limestone), are accessible in series of natural and artificial exposures along the bank of the Vistula River. The studied Turonian succession to the south borders on the Mid-Polish Anticlinorium. The latter structure represents an inverted part of the former Danish-Polish Trough. Accordingly, the Upper Cretaceous deposits bordering on the recent Mid-Polish Anticlinorium were consequently considered to represent relatively deep, shelf type deposits linked with the axial and deepest part of the Danish-Polish Trough. However, recent studies of the Author show that the host opokas for the investigated vertical structures to the south are surrounded by clearly shallow-marine deposits represented by detrical limestone (Janików Limeston) deposited over the storm-wave base. Therefore, it might be expected that the host rock for this enigmatic structures were shallow-water as well.

The studied structures occur in medium to thick bedded opokas and can be up to 3–3.5 m long; the largest are up to 20 cm in diameter. All these tubes are straight and vertical with no branches. These structures are dispersed chaotically throughout the rock with no preferential horizons for their start or end. The bottom part of those tubes seem to be U-shape or J-shape. The sediment inside and outside the tube is at first glance completely structure-less; there are not traces or remnants of internal bedding; the sediment neither outside of the tube nor inside is bent upward at margins and the lateral contact of the sediment and the tube is abrupt. Interestingly, the host sediment is devoid of any macrofauna (ammonites, inocerams, echinoderms etc.), but the sediment is definitely of marine origin what is confirmed by foraminifera and sponge spicules etc. Such structures might be biotic in origin and could be interpreted as a giant burrows linked with paramoudra columnar flints widely recognizable in English Chalk. On the other hand several abiotic explanations have been considered like dewatering, fluid escape structures, gas bubble escape structures or even specific kind of cold seeps. The crustacean burrows are the most likely candidate however the answer of true origin is still matter of debate.

WALASZCZYK, I. & REMIN, Z., 2015. Przewodnik LXXXIV Zjazdu Polskiego Towarzystwa Geologicznego, Chęciny, 9–11 września 2015, 41–50.

Late Barremian - Early Aptian Calcareous Algae and Benthic Foraminifera from, Western Kopet Dagh Basin (Tirgan Formation, North Eastern Iran)

***Riahi, N.**[1,*], Sadeghi, A.[1], Kamyabi Shadan, H.[2]*

*1) Shahid Beheshti University, Tehran, Iran, *E-mail: riahi.nassim@gmail.com*
2) Exploration Directorate of the National Iranian Oil Company, Tehran, Iran

The middle part of the Cretaceous sedimentary deposits from Koet Dagh region (North-East of Iran) consists of thick to sometimes medium bedded gray and weathered cream colored limestones (the Tirgan Formation). The study of the stratigraphic section led to the identification of an interesting assemblage of dasycladalean calcareous algae such as: *Acicularia* sp.*; Actinoporella* cf. *A. podolica; Salpingoporella hispanica; Salpingoporella hasi; Salpingoporella muehlbergii; Salpingoporella piriniae; Montiella elitzae; Korkyrella texana (Stalk); Boueina minima; Coptocompylodon lineolatus; Triporella* cf. *T. adriatica; Kopetdagharia sphaerica; Trequemella* sp.; *Girvanella* sp; *Linoporella* sp.; *Rajkaella* sp. *Holosporella* sp*.; Permocalcalus* sp. Benthic Foraminifera associated to the algal assemblages are as follows: *Palorbitolina lenticularis*; *Alpillina antiqua*; *Nautiloculina oolithica*; *Rectodictyoconus giganteus*; *Rumanoloculina pseudominima*; *Trocholina odukpaniensis; Novalesia producta*; *Valserina broennimanni*; *Haplophragmoides globosus*; *Mayncina bulgarica*; *Charentia cuvillieri*; *Egalierina turbinata*; *Vercorsella scarsellai*; *Vercorsella arenata*; *Pseudocyclammina hedbergi*; *Vercorsella composaurii*; *Eopalorbitolina charollaisi*; *Scythiloculina bancilai*; *Falsurgonina pileola*; *Paracoskinolina sunnilandensis*; *Derventina filipescui*; *Paleodictyoconous pachymarginalis*; *Iraqia simplex*; *Glomospira urgoniana; Debarina hahounerensis*; *Praechrysalidina infracretacea*; *Orbitolinopsis* cf. *elongatus*; *Orbitolinopsis subkiliani*; *Nezzazata isabella. Palorbitolina lenticularis* is dominate in most of the samples. The orbitolinid assemblage indicates a Late Barremian – Early Aptian age for the studied limestone successions.

Keywords: Lithostratigraphy, Biostratigraphy, Tirgan Formation, Nabia (Navia) – Robat Eshgh Section, Ghezelghan Section, Kopet Dagh, Barremian, Aptian

Provenance of Eastern Carpathian mid-Cretaceous clastic sediments: Implications for the evolution of Moldavides

***Roban, R.D.**[1,*], Ducea, M.N.[2], Krézsek, C.[3], Profeta, L.[1], Panaiotu, C.G.[1], Dimofte, D.[1], Francovschi, I.[1], Apotrosoaei, V.[1], Melinte-Dobrinescu, M.C.[4]*

*1) University of Bucharest, Bucharest, Romania, *E-mail: reludumitru.roban@g.unibuc.ro*
2) University of Arizona, Tucson, USA
3) OMV Petrom, Bucharest, Romania
4) National Institute of Marine Geology and Geoecology (GEOECOMAR), Bucharest, Romania

The Moldavides represent the sedimentary remnants of the Ceahlau-Severin basin, an Alpine Tethys rift opened since the Early Jurassic, which are preserved today in a Cretaceous-Miocene thrust belt along much of the East Carpathians. It is unclear how large the basin was and if it contained any oceanic crust as a result of rifting. The basin is located between the Dacia Block in the West and an assembly encompassing the Moesian, Scythian and East European platforms, as well as the North Dobrogea Orogen. Following the mid Cretaceous collision with the Dacia Block, the Moldavides acted as a foredeep. Mid-Cretaceous Moldavide sediments are thick in the west up to 1000 m and much thinner, around 200 m, in central and eastern parts. The western Moldavides are made of turbidite channels and levees, i.e. conglomerates and lithic sandstones showing to the North to East flow directions. The central part contains turbiditic lobes having sublithic sandstones and greywackes while the flow directions are both to the Weast and the East. The eastern Moldavides are made of carbonate and siliciclastic sandstones with low grade metamorphic green clasts, incorporated by channels, levees and lobes, showing to Weast and North flow directions. The green clasts are known to be sourced in the Proterozoic of the Eastern Moesian Platform, while the sandstone source of central and western Moldavides is controversial, i.e. western orogenic one, eastern or intra-basinal. We carried out a detrital zircon U-Pb chronology on 9 samples, ~900 ages. Our results show that western Moldavides show 2 peaks, at ~450 and 590 Ma, similar to those found in the Dacia Block basement. The eastern Moldavide sediments are similar to those of the Eastern Moesian Platform and North Dobrogea Orogen, with 2 peaks at ~330 and 600 Ma, but also older ages, peaking at 2,000 and 2,700 Ma, typical for the East European Platform. The zircon from central Moldavides, sandstones and graniodiorite clasts show values similar to the Danubian basement or Western Moesian Platform, with peaks at ~320 and 600 Ma. The uplifted blocks supplying granodiorites located in central Moldavides belong to the Weastern Moesian Platform.

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Early Cretaceous climate and glendonites

Rogov, M.[1,*] ***and Jäger, H.***[2]

*1) Geological Institute of RAS, Moscow, Russia, *E-mail: russianjurassic@gmail.com*
2) Geologisch-Paläontologisches Institut, Universität Heidelberg, Heidelberg, Germany

The link between glendonites and cooling events and high-latitude cold-water environments was already understood even before it was recognized, that glendonite is a pseudomorph of ikaite, a metastable cold-water carbonate hexahydrate (KEMPER, SCHMITZ, 1975). Although factors affecting glendonite distribution are still in discussion (QU et al., 2017; LU et al., 2015), the temperature limitation for the origination of ikaite/glendonite just as the spatial and stratigraphic distribution of glendonite linked to cooling events is unquestionable. This is confirmed by other independent palaeoclimatic parameters like occurrence of tillites and/or dropstones, oxygen isotope values, TEX86, changes in climate-sensitive flora and fauna, etc. We provide a brief review of all known Early Cretaceous glendonite records correlated to other independent evidence for climate changes. It should be considered, that high-latitude sections, which are suggested to be more climate-sensitive compared to those of mid latitudes, are still insufficiently studied and, for example, studies of oxygen isotopes in molluscan shells are restricted to few areas and time slices. Latest Jurassic (Tithonian) and earliest Cretaceous (Berriasian to earliest Valanginian) glendonites are rare. They are known from few areas only: Chile and Arctic Canada for the Tithonian, Northern Siberia and Arctic Canada for the Berriasian. These glendonite occurrences may indicate beginning of the Early Cretaceous high-latitude cooling event, which became much stronger later. The maximum glendonite distribution in both, Northern and Southern Hemispheres, is in the Valanginian and Late Aptian, which are known as cold episodes (BODIN et al., 2015), while Late Hauterivian (and Early Albian) glendonite occurrences in the Arctic indicate minor cooling events, clearly coinciding with strong southward migration of boreal faunas. But there is an obvious asymmetry in the spatial distribution of glendonites in the Early Cretaceous: In the Late Aptian glendonites have been known for a long time from the northern and southern Hemisphere, while in the Valanginian glendonites are just recently discovered, but represented by ‘microglendonites’ only. Macroscopic glendonites are still unknown from the southern hemisphere.

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Tithonian - Berriasian Ammonites From The Lo Valdés Formation At Cruz De Piedra, Central Chile

Salazar, C.[1,*] ***and Stinnesbeck, W.***[2]

1) Geología, Facultad de Ingeniería, Universidad del Desarrollo, Santiago, Chile,
**E-mail: christiansalazar@udd.cl*
2) Ruprecht-Karls-University Heidelberg, Heidelberg, Germany

Sedimentary successions from the Jurassic-Cretaceous transition are well exposed in central Chile, especially in the Andean Cordillera. The locality of Cruz de Piedra located close to the Maipo Volcano. The ammonite assemblage is represented by 251 specimens assigned to 15 different species. New records to Chile are *Pterolytoceras exoticum*, *Aspidoceras rogoznicense*, *Micracanthoceras microcanthum*, *Micracanthoceras vetustum*, *Corongoceras mendozanum*, *Spiticeras acutum*, *Tirnovella kayseri* and *Substeueroceras striolatissimum*. New records for this locality are *Aulacosphinctes proximus*, *Micracanthoceras spinulosum*, *Corongoceras* cf. *koellikeri*, *Berriasella* "*fraudans*" and *Substeueroceras callistoide. Substeueroceras koeneni* and *Cuyaniceras transgrediens* (as *C. raripartitum*) were previously recorded from the locality and are here documented again.

Pterolytoceras exoticum is considered to be a senior synonym of *Pterolytoceras magnum*. *Aspidoceras rogoznicense* is known to be a highly variable species (SALAZAR, 2012). Additionally, *A. euomphalum*, *A cieneguitense*, *A. andinum*, *A. auomphaloides*. *A. quemadense*, *A. haupti*, *A. neuquensis*, are considered junior synonyms of *A. rogoznicense*. *Micracanthoceras vetustum* is considered a homonym of *Berriasella subvetusta*, *B. subprivasensis* and *Corongoceras duraznense*. Also *Corongoceras mendozanum* is considered a homonym of *C. submendozana*. *Spiticeras burckhardti*, *S. hauthali*, *S. stulum*, *S. andinum* and *S. mammatum* are considered junior synonyms of *Spiticeras acutum*. *Cuyaniceras inflatum*, *C. mendozanum*, *C. raripartitum*, *C. acanthicum*, *C. argentinum* are junior synonyms of *C. transgrediens* (SALAZAR, 2012).

Berriasella "*fraudans*" is considered to be a close relative of *B. jacobi. B*. "*fraudans*" is considered to be a senior synonym of *Parandiceras*? *fallax*, *Berriasella steinmanni, Andiceras acuticostum, Berriasella curvicostata* and *Berriasella peruviana*. *M. microcanthum* is the zonal index fossil of the upper Tithonian in the Tethys and in the Baños del Flaco Formation (SALAZAR & STINNESBECK, 2016). At Cruz de Piedra section the taxon is registered in the lower part of Placa Roja Member. *Substeueroceras koeneni* is referred to the uppermost Tithonian and lowermost Berriasian, and is here recorded in the upper part of Placa Roja Member.

We assign the Cruz de Piedra section (Lo Valdés Formation) to the upper Tithonian reaching into the lowermost Berriasian.

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SALAZAR, C. & STINNESBECK, W., 2016. Journal of Systematic Palaeontology, **14**, 149–182.

Facies and Biostratigraphy of Late Cretaceous (Maastrichtian) in central Chile

Salazar, C.[1,*] ***and Stinnesbeck, W.***[2]

1) Geología, Facultad de Ingeniería, Universidad del Desarrollo, Santiago, Chile,
**E-mail: christiansalazar@udd.cl*
2) Ruprecht-Karls-University Heidelberg, Heidelberg, Germany

The Late Cretaceous Quiriquina Formation in Central Chile is well recorded around the Bay of Concepción and assigned to the late Early to Late Maastrichtian, based on a diverse ammonite assemblage. Species richness and abundance of ammonoids are high throughout the Quiriquina Formation but gradually decline in the uppermost 10 meters of the section. No ammonoids are recorded from the last 5 meters of the unit. The following three biozones are distinguished: Zone of *Baculites anceps*, Zone of *Eubaculites carinatus* (subdivided into the *Menuites fresvillensis* and *Kitchinites darwini* sub-biozones), and a Zone without baculitids (subdivided into the *Hoploscaphites constrictus* biozone and a zone without ammonites (Salazar et al. 2010). The assemblage shows an Indopacific character, but endemic, cosmopolitan as well as Europe-Tethyan elements are also present. Lithologies of the Quiriquina Formation are siliciclastic and consist of a basal conglomerate, between a few centimetres and 15 metres thick, overlain by yellow cross-bedded sandstone, green siltstone with bivalve coquina layers (*Cardium, Pacitrigonia*) and a unit of green mottled siltstone with limestone concretions (SALAZAR et al., 2010).

Four parasequences are identified by a retrogradational pattern of depositional facies. Parasequences 1 to 3 were determined at Las Tablas and are also recognized in numerous other sections in the area. They correspond to the basal conglomerate (parasequence 1), the yellow cross-bedded sandstone (parasequence 2) and the coquina unit (parasequence 3); they represent shoreface facies of decreasing energy. Parasequence 4 corresponds to the silty sandstone with calcareous sandstone concretions and reflects offshore transitional facies.

Based on the vertical stacking pattern of the 4 parasequences described above, a single depositional sequence is recognized in the Quiriquina Formation. It consists of a TST, which is characterized by a retrogradational stacking pattern of parasequences 1 to 3. Parasequence 3 contains the maximum flooding surface (mfs). The HST is formed by the retrogradational stacking pattern of parasequences 3 and 4. Parasequences 1 to 3 correspond to shoreface facies and parasequence 4 to offshore transition facies representing maximum water depths in the depositional area.

In consequence, parasequence 1 represents a retrogradational facies pattern in a shoreface high energy environment. This transgression resulted from sea level rise near the end of the Early Maastrichtian. Transgression continued through parasequences 2 to 3 which also reflect shoreface facies, but with gradually decreasing energy levels. During parasequence 4, this retrogradational system (transgression) continued in an offshore transition environment with low energy levels. A strong regression ended marine sedimentation either near the end of the Maastrichtian or cutting down from the Paleocene. The K/T boundary is thus incomplete due to erosion and an extended hiatus.

SALAZAR, C. et al., 2010. N. Jb. Geol. Palaeont. Abh., **257**/2, 181–236.

Paleosols and Paleoclimate of the Prince Creek Formation, Arctic Alaska, during the middle Maastrictian global warming event

Salazar Jaramillo, S.[1,*], ***McCarthy, P.**[2], **Fowell, S.**[2], **Ochoa, A.**[3], **Flaig, P.**[4]*

*1) National University of Colombia, Bogotá, Colombia, *E-mail: ssalazarj@unal.edu.co*
2) University of Alaska Fairbanks, Fairbanks, USA
3) Universidad Nacional de Colombia, Medellin, Colombia
4) The University of Texas at Austin, TX, USA

During the Late Cretaceous the long-term global cooling trend was interrupted at ~69 Ma by an intense greenhouse episode known from terrestrial records as the Middle Maastrichtian Event (MME). In the paleo-arctic, we identified the MME in the lower Catnwell Formation (~64º N paleolatitude; 69.5±0.7 Ma U–Pb age) characterized by a fluctuation in the carbon isotope composition of atmospheric CO_2 from more negative (−6.6 ‰) to less negative values (−6.3‰). We assume the presence of the MME in the coeval Prince Creek Formation (~75-85º N; 69.2±0.5 Ma $^{40}Ar/^{39}Ar$ age) by chronostrati-graphic correlation with the lower Cantwell Formation. Reconstruction of mean annual precipitation (MAP), meteoric water composition and mean annual temperature (MAT), suggests a strong variability of MAP, an increased MAT and an increased latent heat transport, over a period of 10^4 years, consistent with reported data of the global-scale climate phenomenon MME. 1,200–3,900 mm/yr and 350–1,000 mm/yr are, respectively, the highest and the lowest MAP interval obtained using carbon stable isotopes. The average MAP value of 1,254±181 mm/yr calculated using climofunctions agrees with the higher MAP interval and is consistent with independent estimates of paleoprecipitation from fossil plants. MAT values ~12.5±4.4°C are consistent with warm month mean temperatures obtained previously from paleobotanical data. Estimates of atmospheric CO_2 concentration indicate higher levels of ρCO_2 (~1.2 PIAL, pre-industrial atmospheric levels) but not as high as previously predicted for the MME (~4 PIAL), a drawdown probably related to CO_2 consumption by silicate weathering and consequently carbon burial. The $d^{18}O$ value of meteoric water calculated from bentonitic smectite is ~ -24‰, assuming a mean annual temperature of 6.3°C, which is a more ^{18}O-depleted value when compared with previous data of meteoric water calculated from siderite. This confirms highly $d^{18}O$-depleted precipitation in the Late Cretaceous paleo-Arctic. These data strongly support previous studies from the Prince Creek Formation that have suggested the Mid-Maastrichtian global warming event (MME) as a plausible explanation for an intensified hydrological cycle that enhanced latent heat transport, resulting in increased rainout effects.

Testing cyclostratigraphy in the non-marine Lower Cretaceous by reinvestigating parts of the English Wealden (UK)

***Sames, B*[1,*], *Wolfgring, E.*[1], *Horne, D.J.*[2], *Mac Niocaill, C.*[3]**

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: benjamin.sames@univie.ac.at*
2) School of Geography, Queen Mary, University of London, London, UK
3) Department of Earth Sciences, University of Oxford, UK

To date, relatively few studies on changing palaeoenvironments and climate cycles in non-marine (terrestrial) archives of the Cretaceous greenhouse Earth do exist, being primarily a result of the nature of these deposits—strong lateral facies change on local scales and the strong local to regional control of deposition—let alone the lack of high-resolution stratigraphy and correlations to the marine record. On the other hand, major advances in the refinements of the Cretaceous timescale now facilitate the correlation and dating of significant (20–110 m) short-term eustatic sea-level fluctuations and their supposable relation to climate and/or tectonic events with appropriate resolution: on long-term Milankovitch scales (4th-order, mainly 405 ka, and 3rd-order, mainly 1–2.4 Ma ranges), thus implying globally synchronous forcing (e.g. WENDLER et al., 2014, 2016; SAMES et al., 2016). Provided chronological linking, cyclic climate fluctuations play an important role for Cretaceous high-resolution marine chronostratigraphy with considerable potential for marine to non-marine correlations. Despite the progress in non-marine bio-, magneto- and chemostratigraphy and growing data on Cretaceous non-marine successions, convincing evidence for orbitally (climate) driven cyclicity in non-marine Lower Cretaceous deposits is thus far sparse.

The non-marine Wealden deposits (Weald Clay Group) of England are a ‘classical’ example for a Lower Cretaceous non-marine succession for which depositional cycles have been suggested since the 1970s, including the famous ostracod ‘faunicycles’ by F.W. Anderson, but so far lack convincing analyses. The project ‘Lower Cretaceous Climate and Non-marine Stratigraphy (LCCNS)’ funded by the Austrian Science Fund (FWF) analyses an interval of the English Wealden at Clock House Brickworks pit (near Capel, Surrey, England) for orbitally/climate driven cyclicities on long- (405 Ma) and short term Milankovitch scales with an interdisciplinary methodology: micropalaeontology, sedimentology, and geochemistry. Ostracod faunal composition changes are correlated with the variation of geochemical and sedimentological parameters through time to decipher the controlling (palaeoenvironmental) factors and their regulating mechanisms (‘climate changes’, orbital cycles?), while magnetostratigraphy is used for chronological control. First results will be presented and discussed. Crucial point of the approach is that the fluctuating evolution of a Wealden ecosystem over time is presumed to be climatically (thus, orbitally) controlled and that cyclic changes deducible from multiple proxies in its geologic record can be tested and used for cyclostratigraphy.

SAMES, B. et al., 2016. Palaeogeogr. Palaeoclimatol. Palaeoecol., **441**, 393–411.
WENDLER, J.E. et al., 2014. Newsl. Stratigr. **47**/1, 1–19.
WENDLER, J.E. et al., 2016. Palaeogeogr. Palaeoclimatol. Palaeoecol., **441**, 430–437.

An overview on IGCP 609: Climate-environmental deteriorations during greenhouse phases: Causes and consequences of short-term Cretaceous sea-level changes

Sames, B[1,*] ***and Wagreich, M.***[1]

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: benjamin.sames@univie.ac.at*

Sea level constitutes a crucial geographic boundary for humans, and sea-level fluctuations drive major shifts in the landscape. UNESCO-IUGS IGCP project 609 (http://www.univie.ac.at/igcp609/index.html) uses the Cretaceous climate and sea-level history as 'laboratory' to investigate the Earth under different climate conditions to infer causes and consequences of eustatic climate and sea-level changes, and to model scenarios for climate extremes and the shift between climate modes. Identifying different processes and factors controlling climate and sea-level changes (e.g. HAY, 2017) during the Cretaceous is essential to better evaluate global climate models and near future predictions.

The Cretaceous yields increasing evidence for significant (20–110 m amplitude) short-term eustatic sea-level fluctuations that follow long-term Milankovitch cycles (4th-order – mainly 405 ka, and 3rd-ordee – mainly 1–2.4 Ma), and, thus, imply globally synchronous forcing (WENDLER et al., 2014, 2016; SAMES et al., 2016). Provided chronological linking, these cyclic climate – and corresponding sea- and lake-level – fluctuations play an important role for Cretaceous high-resolution marine chronostratigraphy with substantial potential for marine to non-marine stratigraphic and palaeoenvironmental correlations.

Though glacio-eustasy is considered to be the main process controlling short term eustatic sea-level fluctuations the presence of large continental ice shields is highly unlikely for the warm greenhouse to hothouse conditions during the mid-Cretaceous. Alternatively, aquifer-eustasy may have played a significant role during these times, by storing water as groundwater (and in lakes) on the continents. Lake-level changes (non-marine sequences) may provide information on significant groundwater-table changes and corresponding continent-ocean water distribution imbalances that should lie within the longer Milankovitch band, but out-of-phase with sea-level change (WAGREICH et al., 2014).

Processes and feedback for sea-level change are highly complex, resulting from various combinations of climate and solid-Earth mechanisms leading to changes in either ocean water volume or capacity of ocean basins. Operative timescales of processes, their water volume equivalents and the corresponding orders of magnitude in eustatic sea-level change remain controversial. Ongoing progress in Cretaceous climate change and integrated stratigraphy, as well as progress in our understanding of solid-Earth processes and their different effects on both regional and global sea-level fluctuations, has led to changing ideas concerning Cretaceous climate and sea-level change.

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Planktonic Foraminifera Biostratigraphy of the Cenomanian - Campanian Succession in the Haymana - Polatli Basin (Ankara, Turkey)

Sariaslan, N.[1,2,*] ***and Altiner, S.***[2]

*1) Slagelse, Denmark, *E-mail: nisansariaslan@gmail.com*
2) Middle East Technical University, Ankara, Turkey

In order to establish the planktonic foraminiferal biostratigraphy of the Cenomanian – Campanian deposits in the Haymana – Polatlı Basin, a stratigraphic section of 92 meters was measured and 75 samples were collected. The stratigraphic section starts with limestones containing late Cenomanian aged rotaliporid and dicarinellid forms and continues with early-middle Turonian aged clayey limestones with sporadic shale beds. These units are overlain by, red colored Santonian limestones and shales containing abundant globotruncanids. The stratigraphic section ends with monotonous grey colored silty shales of the Campanian, whose silt content increases towards the upper part.

At the end of detailed taxonomic studies performed on both the washed material and thin sections of the samples, the distributions of planktonic foraminifera throughout the stratigraphic section were determined. Based on these findings, a biostratigraphic framework including 9 biozones and one subzone was established. In ascending order, the *Rotalipora cushmani* Zone and *Dicarinella algeriana* Subzone, *Whiteinella archaeocretacea* and *Helvetoglobotruncana helvetica* Zones were defined. The inability to determine the zones representing the late Turonian-Coniacian suggests the existence of an unconformity covering this time period. In the upper part of the stratigraphic section, *Dicarinella asymetrica, Globotruncanita elevata, Globotruncana ventricosa, Globotruncanella havanensis* and *Globotruncana aegyptiaca* Zones were identified. The presence of *Gansserina gansseri* in the last sample of the section shows that the section ends in the lowest part of the *Gansserina gansseri* Zone.

An integrated bio-chemostratigraphic framework for Lower Cretaceous (Barremian-Cenomanian) shallow-water carbonates of the Central Apennines (Italy)

Schmitt, K.*[1,*], Heimhofer, U.[1], Frijia, G.[2], Huck, S.[1]

*1) Institut für Geologie, Leibniz Universität Hannover, Germany, *E-mail: schmitt@geowi.uni-hannover.de*
2) Sultan Qaboos University, Muscat, Oman

Shallow-water carbonate platform sections are valuable archives for the reconstruction of deep-time environmental and climatic conditions, but the biostratigraphic resolution is often rather low. Moreover, chemostratigraphic correlation with well-dated pelagic sections by means of bulk carbonate carbon-isotope stratigraphy is notoriously difficult and afflicted with large uncertainties, as shallow-water sections are particularly prone to the impact of diagenesis.

In the current study, an integrated biostratigraphic-chemostratigraphic approach is applied to southern Tethyan Lower Cretaceous carbonate platform deposits (Santa Lucia, Monte La Costa sections) situated in the Central Apennines in Italy. The 500 m thick Santa Lucia section, representing an open lagoonal inner carbonate platform setting, provides a characteristic carbon- and oxygen-isotope pattern that allows for correlation with pelagic composite reference curves (Vocontian and Umbria Marche basins). Calibrated by means of foraminiferal biostratigraphy and rudist bivalve strontium-isotope stratigraphy, the section serves as local chemostratigraphic shallow-water reference for the Barremian to Cenomanian. The 250 m thick Monte La Costa section comprises predominantly coarse grained (biostromal) and often strongly cemented shelf margin deposits. Although benthic foraminifera are scarce and the carbonates evidently suffered strong diagenetic alteration, high-resolution (rudist shell) strontium-isotope stratigraphy in combination with superimposed carbon-isotope trends and biological-lithological changes (e.g., mass occurrences of *Bacinella irregularis* s.l) enables correlation with the Early Albian to Cenomanian portion of the Santa Lucia reference section. At both localities, chemostratigraphy indicates a major gap covering large parts of the Lower and middle Cenomanian.

After having considerably improved the stratigraphic resolution of the studied sections, selected best-preserved rudist shells are going to be used for sclerochronological investigations. This will allow reconstructing the impact of long-term (Myr) and short-term (seasonal) paleoclimatic and paleoenvironmental changes on Cretaceous shallow seas.

Magnetostratigraphy and biostratigraphy of Jurassic-Cretaceous boundary sections in the Vocontian Basin, France

Schnabl, P.[1,*]***, Kdýr, Š.***[1]***, Svobodová, A.***[1]***, Reháková, D.***[2]***, Címková, K.***[1]***, Elbra, T.***[1]***,***
Pruner, P.[1]***, Frau, C.***[3]***, Wimbledon, W.A.P.***[4]

*1) Institute of Geology of the CAS, v.v.i., Praha, Czech Republic, *E-mail: schnabl@gli.cas.cz*
2) Comenius University in Bratislava, Bratislava, Slovakia
3) Groupement d'Intérêt Paléontologique, Science et Exposition, Toulon, France
4) School of Earth Sciences, University of Bristol, Bristol, UK

Three sections in the Vocontian basin have been studied for magnetostratigraphy and biostratigraphy (Le Chouet, Belvedere (Haute Beaume) and St Bertrand's Spring). The profiles are easily accessible and make up a robustly connected composite sequence.

The lithology consists of well-bedded mostly micritic limestone with bioclastic interlayers. In the upper parts of all three sections there are intercalations of marl. In the Le Chouet and the St Bertrand section there are intrabasinal conglomerates/breccias, which are omitted from further evaluation. Preliminary results on the distribution of the age-diagnostic ammonite taxa show that Belvedere and St. Bertrand span most of the *B. jacobi* Zone *auctorum*, and the Le Chouet profile starts in the Microcanthum ammonite zone (Wimbledon et al., 2013).

All the sections show magnetostratigraphic normal and reverse polarity zones. And the base of *C. alpina* zone and the FAD of *Nannoconus wintereri* falls in a normal polarity zone, thus identified as M19n. The span of the studied sections is i) M19n to M17r (Intermedia to Ferasini Sz.) for Belvedere, ii) M19n to M17n (Intermedia to Elliptica Sz.) for St Bertrand's Spring, and iii) M20n to M19n (Remanei to Alpina Sz.) for Le Chouet. Magnetic susceptibility shows negative values, due to the dominance of diamagnetic calcium carbonate. However, in the upper interval (in M17r) MS rises slightly, which is probably caused by an increase of terrigenous material.

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Stratigraphy and paleoclimate of non-marine deposits of the Jurassic/Cretaceous boundary interval in northern Germany

Schneider, A.C.[1,*], ***Heimhofer, U.***[2], ***Heunisch, C.***[3], ***Mutterlose, J.***[1]

*1) Ruhr University Bochum, Bochum, Germany, *E-mail: christoph.schneider@rub.de*
2) Leibniz University Hannover, Hannover, Germany
3) Landesamt für Bergbau, Energie und Geologie (LBEG), Hannover, Germany

Non-marine Purbeck and Wealden type deposits of latest Jurassic (Tithonian) and earliest Cretaceous (Berriasian) age characterize the Jurassic/Cretaceous (J/K) boundary interval in northwest Europe. A stratigraphic correlation of the non-marine strata throughout northern Germany, northern France and southern England is difficult, because appropriate index fossils are missing. Sporomorph data and ostracods have provided a rough biostratigraphic scheme allowing to correlate the non-marine J/K boundary beds in the past. Calibrations with the marine successions of Boreal Realm and the Tethys are even more problematic, due to a distinctive provincialism of marine floras and faunas.

New palynological (spores, pollen, dinoflagellate cysts) and micropaleontological (ostracods) data from three sections in northern Germany are complementing the existing biostratigraphic scheme. Terrestrial palynomarkers (*Classopollis* decline, last occurrence of *Pilasporites couperi*, first occurrence of *Aequitriradites spinulosus*, first common occurrence of *Cicatricosisporites purbeckensis*) and brackish-marine palynomarkers (first occurrences of *Cantulodinium speciosum*, *Muderongia simplex, Muderongia simplex microperforata*) are used for intra- and interbasinal correlation. Additionally, seven marine flooding events, characterized by abundant dinoflagellate cysts, have been recognized in northern Germany; two of them were correlated with marker horizons in England and Sweden. Correlation with the marine successions of the Boreal Realm and the Tethys is possible via the Purbeck type section in England. The palynological data yield clear evidence for a climatic change from a semi-arid setting in the latest Jurassic to more humid conditions in the earliest Cretaceous. The paleoclimatic trends, reconstructed from our findings in northern Germany, are compared with published data from southern England and the North Sea.

The Rollrock Section - the most comprehensive Jurassic-Cretaceous boundary section of the Canadian Arctic Islands

Schneider, S.[1,*]***, Kelly, S.R.A.***[1]***, Chavanne, A.***[2]***, Hülse, P.***[1]***, López-Mir, B.***[1]

*1) CASP, Cambridge, UK, *E-mail: simon.schneider@casp.cam.ac.uk*
2) Expedition Guide, Davis, USA

The Sverdrup Basin of Arctic Canada contains strata of Late Palaeozoic to Mesozoic age. The Deer Bay Formation, a lithostratigraphic unit in the upper part of the Sverdrup Basin succession, is up to 970 m thick and generally considered to be of Tithonian to Late Valanginian age. The Rollrock Section on northern Ellesmere Island, NE Canadian Arctic, Nunavut, exposes more than 500 m of mud- and siltstones of the Deer Bay Formation. Despite being located beyond the depocentre of the basin, the section was previously identified as the most important Jurassic-Cretaceous boundary section of the Sverdrup Basin in terms of macrofossil evidence. We revisited the Rollrock Section in summer 2015, producing a detailed log. 345 mudstone samples were taken at 1.5 m intervals, for micropalaeontology, palynology and geochemistry. Preliminary results of our study are presented here.

The base of the mudstone succession is not exposed. At the top, the contact with the fluvial-deltaic sandstones of the overlying Isachsen Formation is gradational. Over much of the succession, supposedly cyclic intercalations of sideritic concretions were recorded. Macrofossils, particularly ammonites and bivalves of the genus *Buchia*, were found in nine of these concretion horizons. Only five fossiliferous horizons had previously been documented. The newly obtained fossils include the best-preserved dorsoplanitid ammonites ever collected from the Canadian Arctic, among them a giant, >40 cm-sized specimen.

The fossil assemblages provide evidence for Early (?), Middle and Late Volgian (= Tithonian to Early Berriasian) ages, corresponding to the *Buchia rugosa* to *B. unschensis* biozones. Unlike in the western part of the Canadian Arctic, no Valanginian ammonites or *Buchia keyserlingi* were found. However, horizons with glendonites in the higher part of the Rollrock Section are tentatively correlated with similar, well-dated horizons of Valanginian age on Ellef Ringnes Island. The higher part of the succession further contains abundant dropstones indicating a cold seasonal climate with floating ice during much of the latest Jurassic and earliest Cretaceous. Microfauna, palynomorphs, $\delta^{13}C$ isotope values and TOC need to be analysed, to assess the presence of a 'Berriasian hiatus', which was proposed for the eastern Sverdrup Basin in the literature. Integrating these data with ammonite and *Buchia* zones will result in a refined biostratigraphy for the Deer Bay Formation, and will lead to a better understanding of the palaeoecology and palaeoclimate of the Jurassic–Cretaceous boundary interval in the Arctic.

Understanding Valanginian continental climate using $\delta^{18}O$ from sphaerosiderites as a proxy for precipitation

***Sengupta, R.*[1,*], Robinson, S.A.[1], Tosca, N.J.[1]**

*1) Department of Earth Sciences, University of Oxford, Oxford, UK, *E-mail: ritwika.sengupta@seh.ox.ac.uk*

Terrestrial carbon isotope records indicate that during the Valanginian stage, the carbon cycle experienced a significant perturbation (the Valanginian positive Carbon Isotope Event, CIE), that may have been associated with decreased pCO_2 and climatic change (GRÖCKE et al., 2005), however evidence shows low latitude sea surface temperatures remained warm (LITTLER et al., 2011). Therefore, climate change during the Valanginian CIE, and the hydrological response is not fully understood yet. Sphaerosiderites, or iron carbonate concretions ($FeCO_3$) which formed mainly in wetland environments, are ideal recorders of terrestrial precipitation patterns because their $\delta^{18}O$ is locally invariant and decoupled from $\delta^{13}C$ (LUDVIGSON, 1998; ROBINSON et al., 2010). Despite their utility in preserving the isotopic composition of meteoric groundwater, sphaerosiderites are compositionally and isotopically heterogeneous. Chemical variation in sphaerosiderites is thought to reflect their mode of formation, although this is yet to be fully tested in the laboratory. Marine influence is thought to be represented by elevated Mg concentrations, while freshwater environments have, typically, higher Mn and lower Mg and Ca (MOZLEY, 1989). To better understand the sphaerosiderite proxy, we utilise microanalytical and experimental approaches to understand the significance of chemical and isotopic variations in sphaerosiderites. Our experiments examine chemical controls in fresh to brackish porewater by synthesising siderite from solution matrices with varying Fe^{2+}, Mg^{2+}, Mn^{2+} and Ca^{2+} concentrations, pH and salinity. As only freshwater sphaerosiderites would preserve the $\delta^{18}O$ of precipitation, it is important to develop a fingerprint for this depositional mode in the geological record. Preliminary results show Mn^{2+} uptake into siderite structure is preferential to Ca^{2+} and proportional to the concentration in solution. Mg^{2+} is not taken into the siderite structure under these low concentrations. Natural samples from the Lower Cretaceous, non-marine Wealden beds (southern England) show high Mn concentrations compared to Ca and Mg. Two types of internal growth patterns were noted; concentric zoning and core-rim separate growth. Chemical analysis shows anti-correlation between Fe-Ca, Mn-Ca and positive correlation between Mg-Ca. Through experimental synthesis, we hope to better understand this record, and then use $\delta^{18}O$ of Wealden sphaerosiderites as a reliable proxy record for precipitation during the Valanginian CIE.

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Response of East Asian Late Mesozoic lake systems to the destruction of the North China Craton

***Sha, Jingeng*[1]**

1) State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology Chinese Academy of Sciences, Nanjing, China, E-mail: jgsha@nigpas.ac.cn

The destruction of the North China Craton during the Late Mesozoic, has been seen as paradigm of the destruction of an ancient craton of the world. There are numerous different-sized Late Mesozoic terrestrial basins, almost completely preserved and oriented subparallel to NE- to NNE-trending fault zones (the Tan-Lu fault system) in NE China, SE Korea, SW Japan, and even in the northeastern part of southeastern Far East of Russia. In these basins, the strata consist of cyclic lacustrine deposits, intercalated with numerous volcanic and volcanoclastic rocks, yielding various fossils, including the famous Jehol Biota. These deposits also yield very significant coal and oil reserves. By means of research into the corresponding relations of biological, geologic, environmental, and coal and oil accumulation events recorded in the basins, the relationship of response of Late Mesozoic lake systems to the destruction of the North China Craton were revealed.

The main phase of the destruction of the North China Craton occurred during the Hauterivian–Barremian. Such destruction created the Tan-Lu fault system and a series of basins as well as violent volcanism, and marine transgressions along or subparallel to the fault system. During the late Early Cretaceous, the successive marine transgressions and flooding along the Tan–Lu fault system in northeast China led to a humid climate across all northeastern China. These transgressions and climatic conditions produced a number of extensive and long-lasting swamps and marsh lands, in both paralic and limnic environments, allowing the animals and plants to thrive, and controlling the distribution of the biota. New taxa originated in, or migrated into these settings. Angiosperms appeared and the flowers attracted numerous insects. The seeds, fruits and nuts produced, together with the insects and adjacent forest, were attractive to vertebrate animals including birds and dinosaurs. Large molluscs, ostracods, fishes and reptiles thrived in the lakes and swamps. Luxuriant plant and thriving animal growth led to the accumulation of abundant organic matter in the respective deposits. As a result, a number of late Early Cretaceous coal basins and oil fields formed in northeast China. Volcanism and sea-level changes modified environmental parameters of the basins and even changed the overall ecosystem causing some taxa to become extinct and others to adapt and evolve. The ashes and peak transgressions during sea-level highstands caused the anoxia in the basins which were very advantageous to fossil preservation.

Early Aptian anoxic basin of the Russian Plate as a response to OAE1a: $\delta^{13}C$ chemostratigraphy and palaeoecological changes of cephalopod communities

Shchepetova, E.[1], Rogov, M.[1,*], Pokrovsky, B.[1]

*1) Geological Institute of RAS, Moscow, Russia, *E-mail: russianjurassic@gmail.com*

Lower Aptian black shales (4–9 % of C_{org}) are are very widespread in the central part of the Russian Platform (GAVRILOV et al., 2002), but their linkage to OAE1a remains controversial in the absence of carbon isotopic signatures. In contrast to the Southern Europe, mid-Cretaceous succession of the Russian Platform is poor in pelagic and benthic carbonates, and the Lower Aptian sediments are mainly siliciclastic. Here we are providing first results of the systematic stable isotope ($\delta^{13}C$) study on ammonites, sampled across the contact of the black shale and underlying mudstone. Sampling covers 3 m of mudstone top and 2.5 m of the lower black shale, exposed in few outcrops near Balakovo (Saratov region, European part of Russia). 12 specimens of well-preserved shells of *Deshayesites*, mostly *D. volgensis*, were proved to be suitable. X-ray diffraction analysis suggests that 99–100 % of nacreous layer is made of aragonite. The obtained $\delta^{13}C$ values vary from -1.9 to +2.4‰. They are negative in the mudstone and demonstrate a drastic positive turnover near the mudstone–shale boundary, with a maximum values at the base of black shales. This positive excursion of +3–4 ‰ in magnitude, shows a good correlation with C3-C4 segment of $\delta^{13}C$ curve, characterized the onset of OAE1a (MENEGATTI et al.,1998). But above, within black-shale member the gradual return to negative values (-1-1,4 ‰) is in a strong contradiction with the profile of $\delta^{13}C$ curve, showing a prolonged positive excursion C4-C5 at the course of OAE1a.

Abrupt environmental changes coinciding with onset of black shale deposition strongly influenced on cephalopods. In few sections, characterized by facies typical for near-shore and offshore parts of the basin, we have recognized simultaneous changes in ammonite and belemnite successions. Belemnites, which are common in a siltstone or mudstone, became virtually missing within black shales, as in many European sites (BODIN et al., 2015). An obvious shell size reduction across the mudstone – black shale boundary (maximum shell diameter reduced from ~20 cm to ~7–8 cm) is observed for the *Deshayesites*. Some other ammonites became numerous (*Sinzovia*) or show a first occurrence particularly in the black shales (*Koeneniceras* and *Volgoceratoides*). We propose to delimit factors, influenced on belemnites and on ammonites. Absence of belemnites in the black shales was possibly influenced by oxygen decrease, while diminishing of the ammonite shell size was caused by coupling of progressive warming and ocean acidification.

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Early Cretaceous Syn-Rift Deposition in the Western Black Sea: Insights from Outcrops in the Zonguldak Region, Northern Turkey

Simmons, M.[1]

1) Halliburton, Abingdon, UK, E-mail: Mike.Simmons@halliburton.com

Geodynamic reconstructions of the Black Sea region identify an episode of extension within the Barremian-Aptian period. This extension is expressed as a series of tilted fault blocks visible from regional outcrop mapping and on regional seismic data. Associated sedimentation patterns include the transgression of structural highs with clastic and carbonate shelfal sediments, while in the basins created during extension, clastic turbidite systems are present along with potential source rocks. A regional seal is created by the pelagic carbonates of the Late Cretaceous post-rift drift succession.

Outcrop analogues in northern Turkey, Romania, and Crimea suggest that shelfal sandstones might have reservoir potential in porous and permeable quartz-rich sands derived from local Pre-Cambrian massifs. Shelfal carbonates are highly cyclic and have multiple phases of exposure within them, possibly creating enhanced reservoir quality in the subsurface. In the structural lows between the highs, deeper-water clastic facies are prevalent, and these form a variety of facies types dependent on proximity to uplifted blocks, angle of slope, and provenance source. However, relatively clean sands can be present in those rock units derived from the Ukrainian Shield.

In the Zonguldak region of northern Turkey, excellent exposures of the Early Cretaceous shelfal sediments exist that would have been deposited on the shoulders of one of the rifts. These lie unconformably on Jurassic carbonates (with which they have been confused) and Palaeozoic sediments. The succession represents a complex interdigitation of shallow marine carbonates with a variety of fluvial, shoreface, and offshore siliciclastic sediments. Detailed logging of outcrops supported by subsequent petrographic and micropalaeontological analysis resulted in a better understanding of the precise depositional environment of the sediments present and their age relationships. Results are presented in the form of a new chronostratigraphic chart and a series of palaeogeographic maps.

Taphocoenoses of the OAE2 interval as indicators of changing depositional and paleoecological conditions, Bohemian Cretaceous Basin

***Sklenár, J.**[1,*], **Čech, S.**[2], **Ekrt, B.**[1], **Uličný, D.**[3], **Košťák, M.**[4], **Mazuch, M.**[4]*

*1) National Museum, Prague, Czech Republic, *E-mail: jan_sklenar@nm.cz*
2) Czech Geological Survey, Prague, Czech Republic
3) Institute of Geophysics, the Czech Academy of Sciences, Prague, Czech Republic
4) Institute of Geology and Palaeontology, Faculty of Science, Charles University, Prague, Czech Republic

The Pecínov quarry in west-central Bohemia, Czech Republic, represents the most complete outcrop section of the OAE2 interval in the Bohemian Cretaceous Basin, extending from the lowermost *Metoicoceras geslinianum* to the top of *Watinoceras devonense* Zones. Current collecting, made possible by recently renewed progress in quarrying, yielded one of the most diverse fauna reported so far from the *M. geslinianum* Zone in Central Europe, and provided material for study of changes in taphocoenoses through the OAE2 interval in a relatively broad shelf embayment at the western edge of the Bohemian Cretaceous Basin. The sedimentological, geochemical and paleontological record indicates variations in oxygen content within the sediment and at the sediment/water interface, expressed, e.g., in variations of mode of pyritization, differences in ichnofabric and trace fossil distribution (e.g. *Trichichnus*, *Chondrites* isp.) and in the structure of the benthic communities. Several distinct taphocoenoses dominated by one or a few species have been found. One of the most prominent is a *Sciponoceras gracile* event (*S. gracile* / *Euomphaloceras septemseriatum* Subzone). This, apart from the simple autochthonous high population density, may be interpreted as a record of repeated spawnings of *S. gracile* in optimal environmental conditions. Another example is the succession of *Modiola* sp.-terebratellidinid/glyphaeid -dominated communities (top part of *S. gracile*/*E. septemseriatum* Subzone), or a *Protocardia*-*Turritella* dominated, infaunal community at the base of the *M. geslinianum* Zone.

The recent improvement of biostratigraphic and chemostratigraphic correlations provide a high-resolution chronostratigraphic framework within which these events may be correlated regionally and the local ecological dynamics can be understood in the context of processes acting on extrabasinal scale during the OAE2 time.

Micropaleontology of the Jurassic and Cretaceous boundary deep marine sediments

Skupien, P.[1,*]***, Doupovcová, P.***[1]***, Polácková, E.***[1]

*1) VSB-Technical University of Ostrava, Ostrava, Czech Republic, *E-mail: petr.skupien@vsb.cz*

The natural outcrop near Bruzovice village represent deep marine sediments of the Jurassic/Cretaceous boundary. Lower part of the section is formed by the uppermost part of the Vendryně Formation, which is represented by dark grey calcareous claystones with two horizons of concretions and blocks of limestones. Limestones represent gravels, blocks and concretions of size at least 1.5 m in size. Accumulation of limestones can be compared with the Ropice horizon (MENČÍK *et al*., 1983) which occures in the uppernost part of the Vendryně Formation. Upper part of profile is represented by lowest layers of Těšín Limestone, formed by light gray limestones (detritic in the lower part), gray, spotted claystones and marlstones.

Claystones of the Vendryně Formation provided a relatively poor association of non-calcareous dinoflagellates with *Circulodinium distinctum, Cometodinium* sp., *Cribroperidinium* sp., *Endoscrinium* sp., *Gonyaulacysta* sp., *Stiphrosphaeridium anthophorum, Systematophora areolata, Tubotuberela* sp., *Valensiella* sp. Dinoflagellate cyst association is of late Tithonian age. Palynofacies are dominated by phytoclasts and amorphous organic matter typical for anoxic environment.

Thin-sections of the concretions and blocks are recrystalized. Cysts of calcareous dinoflagellates are common: *Cadosina semiradiata semiradiata* (Wanner), *Cadosina semiradiata cieszynica* (Nowak), *Cadosina semiradiata fusca* (Wanner), *Cadosina semiradiata olzae* (Nowak), *Cadosina minuta* (Borza), *Cadopsinopsis nowaki* (Borza), *Colomisphaera fortis* (Rehanek), *Colomisphaera conferta* (Rehanek), *Colomisphaera carpathica* (Borza), *Colomisphaera lapidosa* (Vogler), *Cadosina parvula* (Nagy), *Colomisphaera fibrata* (Nagy), *Colomisphaera minutissima* (Colom), *Colomisphaera radiata* (Vogler). Limestones studied contain small bioclasts and fragments of echinoids ophiuroids, spicules, ostracods, pyritized radiolaria and foraminifera.

The micritic limestones of the Těšín Limestones provided determinable and stratigraphically important microfossils. Representatives of calpionellids *Calpionella alpina* (Lorenz), *Calpionella elliptica* (Cadisch), *Calpionella grandalpina* (Nagy), *Calpionella minuta* (Houša), *Crassicollaria massutiniana* (Colom), *Crassicollaria parvula* (Remane), *Lorenzeilla hungarica* (Knauer), *Lorenziella plicata* (Remane), *Remaniella durandelgai* (Pop), *Remaniella catalanoi* (Pop), *Tintinnopsella carpathica* (Colom), *Tintinnopsella doliphormis* (Colom) and calcareous dinoflagellates *Cadosina semiradiata fusca* (Wanner), *Cadosina semiradiata cieszynica* (Nowak), *Cadosina semiradiata semiradiata* (Wanner), *Colomisphaera fortis* (Řehánek), *Colomisphaera radiata* (Vogler), *Colomisphaera lapidosa* (Vogler) were determined.

The association of calpionellids is typical for the uppermost Tithonian to lower Berriasian age (LAKOVA & PETROVA, 2013). The age of limestones from the sample Br3 is Early Berriasian on the base of the presence of *Tintinnopsella doliphormis* (Colom).

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Geochemical Characterization of the Basal El Pujal Section, Organyà Basin (NE Spain), in Relation to its Chronostratigraphic Position to OAE1a

Socorro, J.[1,*] ***and Maurrasse, F.J.-M.R.***[1]

*1) Florida International University, Miami, USA, *E-mail: jsoco002@fiu.edu*

The results of a high-resolution geochemical study of a 42.35 m interbedded limestone and marlstone sequence at the El Pujal further extend previous studies of the adjacent El Pui section, Organyà Basin (SANCHEZ-HERNANDEZ & MAURRASSE, 2014). TIC ($CaCO_3$ %) values average 71.52 % and show recurrent intervals reflecting the field-scale expression of bedding as they fluctuate with a minimum of 61.92 % occurring at 25.7 m and a maximum of 81.46 % at 20.14 m. TOC (Cwt%) values follow much the same repetitive pattern with enhanced OM preservation at levels with low TIC, which are almost perfectly inversely correlated (r = -0.68). $\delta^{13}C_{org}$ values range from a maximum of -22.55 ‰ at 0.55 m from the base of the studied section, to a minimum of -24.54 ‰ at 26.81 m, fluctuating from an overall negative trend (0 m–14.69 m) to a positive trend (14.69 m–22.16 m) followed by a second negative trend (22.16 m–26.81 m), shifting again towards a positive trend (26.81 m–42.35 m) independent of the lithology. Also, $\delta^{13}C_{org}$ values show no correlation with TOC (r = -0.068), and their values approach the range of those reported for segment C5 (MENEGATTI et al., 1998), and as in some expanded sections that show a slight negative inflection towards the end of C5. Together with the presence of *L. cabri,* the carbon isotope values may be correlated with C5 and reflect a response to the extant global carbon isotopic reservoir.

The lower 13.77 m interval reveals 6 distinct episodes of RSTEs (V, Ni, Co, Cr, Cu, Mo, Th) enrichment at ~1.47 m, 3.68 m, 5.82 m, 7.67 m, 9.78 m and 12.2 m, with the highest values occurring in between ~ 4.38–6.82 m correlative with higher TOC. Major, terrestrially derived elements (Al, Si, Ti) and bio-limiting elements (Fe, P) show a similar trend to RSTEs and TOC. Similarly, density counts of benthic foraminifera show an inverse pattern to that of RSTEs, major elements, and TOC, thus further corroborating continuous recurrence of dysoxic phases in the Organyà Basin during the time interval corresponding to the closing stage of OAE1a. Bimodal distribution of the *n*-Alkanes where autochthonous marine components ($\leq nC_{19}$) and macrophytes (nC_{20} - nC_{25}) predominate over terrestrial OM ($>nC_{25}$) likewise corroborates a terrestrial influence. Mean terrestrial/aquatic ratio TAR ($nC_{27}+nC_{29}+nC_{31})/(nC_{15}+nC_{17}+nC_{19}$) of 0.23 substantiates the major elements that indicate riverine input. However, TAR values of 0.19, 0.15, 0.05, 0.17, 0.21, and 0.18, in an inverse trend to RSTEs, TOC, and major elements also suggest periodic increase of in situ productivity associated with higher input of P and Fe into the basin at that time.

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Biostratigraphy and facies analysis of the Upper Cretaceous platform carbonates of the Anamas-Akseki Autochton in the Central Taurides, S Turkey

Solak, C.[1,*]***, Tasli, K.***[1]***, Koç, H.***[1]

1) *Mersin University, Faculty of Engineering, Mersin, Turkey, *E-mail: cemilesolak@mersin.edu.tr*

The Upper Cretaceous platform carbonate successions of the Anamas-Akseki Autochton (western Central Taurides, S Turkey) include bauxite deposits. There is an agreement on that the basal limestones of the bauxite are of the Cenomanian age, while the overlying limestones range from the Cenomanian to the Senonian or uncertain in age according to the published age data. Biostratigraphic and facies analysis of the Madenli and Doğankuzu outcrop sections permit to more precisely dating of the platform emersion periods. The Cenomanian is represented by grey-coloured, well-bedded limestones intercalated with pinkish sparitic and yellowish grey dolomitic beds. The middle to upper Cenomanian benthic foraminiferal assemblage consists of mainly *Chrysalidina gradata*, *Pastrikella balcanica* (Association 1). The lower part of the unconformably overlying massive limestones contains long-ranging taxa such as *Cuneolina pavonia*, *Spiroloculina* sp., *Nezzazata* sp. (Association 2) and can be assigned to the uppermost Cenomanian or Turonian. The upper part of the massive limestones with mm-scale rudist fragments contains a different assemblage comprising *Minuoxia* sp., *Arenobulimina* sp., *Accordiella conica* and rare *Fleuryana adriatica* (Association 3) which is placed to the Campanian. The top of the massive limestone unit is truncated by a disconformity surface with minor bauxite deposit. The unconformably overlying limestones are characterised a by alternation of white laminated-dolomitic limestones and rudist-bearing limestones with intercalations of collapse breccias. They are assigned to the middle-upper Maastrichtian based on the presence of *Rhapydionina liburnica* and *Fleuryana adriatica* (Association 4). The Upper Cretaceous shallow carbonate platform is unconformably overlain by Lower Eocene limestones which do not contain rudists and the pre-existing foraminiferal assemblage. It is assigned to the Lower Eocene based on the presence of a different assemblage comprising abundant dasycladacean algae, *Valvulina* aff. *triangularis* and rare *Laffitteina* sp. (Association 5). The Upper Cretaceous succession is characterised by inner platform environments including peritidal and shallow subtidal environments with occasional subaerial exposures. Biostratigraphic and sedimentologic analysis revealed that the first major emersion period of the platform is between Cenomanian-Turonian(?) and Campanian and second one corresponds to the early Maastrichtian.

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High-resolution foraminiferal stratigraphy of the Puez Formation (Dolomites, Austria): a reference section for definition of the Cretaceous stage boundaries

***Soták, J.*[1,*], *Lukeneder, A.*[2], *Józsa, S.*[3]**

*1) Slovak Academy of Science, Banská Bystrica, Slovakia, *E-mail: sotak@savbb.sk*
2) Natural History Museum, Vienna, Austria
3) Comenius University, Bratislava, Slovakia

The section studied occurs in expanded outcrops on the southern margin of the Puez Plateau in the northern part of the Dolomites (South Tirol, Northern Italy). The high-resolution study of planktonic foraminifera makes possible to improve the stratigraphy of the Puez section (composite P-1, P-2, P-3, P-5, P-7 sections). Fundamental results are as follows:

1) P–1 and P-7 sections represent the stratigraphic inteval from the Late Valanginian to the Late Barremian. Foraminiferal stratigraphy is based on the Late Valanginian – Hauterivian asssociations of gorbachikellids and praehedbergellids, Late Hauterivian association of *Hedbergella semielongata* Zone in P-7 section and praehedbergellids of the *Blefuscuiana (P.) kuznetzove* Zone and Barremian-Aptian praehedbergellids at the top of P-1 section.

2) The Puez section lacks the foraminiferal zones from the Earliest Aptian, which indicates a stratigraphic gap between the P-1 and P-3 sections. Post-hiatus microfauna contains rich hedbergellids (*occulta – aptiana – praetrocoidea* group), and pseudo-planispiral forms belonging to the *Praehedbergella luterbacheri* Zone and *Globigerinelloides ferreolensis* Zone (Early Late Aptian) in the lower part of the P-3 and P 6 sections. The upper part of these sections has been assigned to the Late Aptian zones of *Hedbergella trocoidea* and *Paraticinella rohri (sensu* ANDO et al. 2013*).*

3) Aptian/Albian boundary is approximated at the top in the P-3 section (24 horizon), P-6 section (35 horizon) and P-2 section (24 horizon) by disappearance of pustulose hedbergellids with perforation cones, like *Hedbergella infracretacea* (P-3/24), and appearance of tiny smooth-walled hedbergellid species, like *Microhedbergella praeplanispira, Mi. richi* and *Mi. renilaevis*, which define a basal Albian biozone (see HUBER & LECKIE, 2011, PETRIZZO et al., 2012).

4) Albian formations in the Puez P–2 section contain common ticinellids allowing the identification of the *Ticinella primula* Zone (P-2/30-57), followed by the *Biticinella breggiensis* Zone (P-2/57-192) and ancestral forms of thalmanninellids (*Th. praeticinensis*, *Pseudothalmanninnella subticinensis, P. ticinensis)* to representatives of *Th. appeninnica* and *Planomalina buxtorfi* Zones in the Latest Albian (from P-2-192, P-5-12 beds).

5) The Albian/Cenomanian boundary is defined by the first occurrences of *Thalmanninella globotruncanoides in the topmost part of the Puez section*. This marker species of the Early Cenomanian biozone provided FO from P-2/254 and P-5/39 beds, higher up even associated with *reicheli*-type rotaloporids (early middle Cenomanian).

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Upper Cretaceous depositional systems in the NE part of the Polish Basin (NE Poland) - new insight based on seismic data

***Stachowska, A.**[1,*] **and Krzywiec, P.**[1]*

1) Institute of Geological Sciences, Polish Academy of Sciences, Warsaw, Poland,
**E-mail: aleksandra.stachowska@twarda.pan.pl*

The study area located in NE Poland (vicinity of Gdańsk) belonged to a peripheral part of the Permo-Mesozoic Polish Basin. The Polish Basin underwent complete inversion in Late Cretaceous–Palaeogene times. Upper Cretaceous succession of the Polish Basin is characterized by numerous local unconformities and progradational patterns, usually associated with uplifted and eroded axial parts of the basin (KRZYWIEC et al., 2009) or compressionally reactivated salt structures (KRZYWIEC, 2006). The Upper Cretaceous succession of NE Poland is represented by the siliciclastic shelf system covered by pelagic carbonates. The Cenomanian–Santonian is represented mostly by sandstone, muddy(silty)-sandy-marly and muddy(silty)-marly facies. The Campanian–Maastrichtian is dominated mainly by carbonate-siliceous and sandy carbonate facies; gaizes (carbonate-siliceous rock containing detritial quartz and sponge spicules) are more common there. Increase of terrigenous quartz content and occurrences of lydites within the Upper Cretaceous succession are observed towards the North.

The Upper Cretaceous succession in N Poland was recently imaged by regional high-end seismic survey PolandSPAN. It is characterized by a large-scale (approx. several hundreds of meters thick) clinoforms prograding generally from the North and characterized by sigmoidal to oblique pattern. Other identified seismic stratigraphic features include numerous local unconformities underlined by reflection terminations such as toplap, downlap and onlap. Overall depositional progradational architecture with the main direction of progradation from the North towards the South indicates that the Upper Cretaceous deposits in N Poland did not develop due to inversion and uplift of the axial part of the Polish Basin i.e. due to formation of the Mid-Polish Swell that is located SW from the study area. Instead, development of the Upper Cretaceous sedimentary cover must have been related to uplift, exposure and pervasive erosion of the area located generally in the North, within the present-day Baltic Sea. Proposed model of development of syn-tectonic Late Cretaceous succession would be then similar to a model developed for the Late Cretaceous sedimentation for the offshore area located S from the Bornholm Island (KRZYWIEC et al., 2003).

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Continental paleotemperatures from lacustrine carbonates in Asia and North America

Suarez, M.[1,*]***, Montgomery, E.***[1]***, Paige, M.***[1]***, Ludvigson, G.***[2]***, Gonzalez, L.***[3]***, You, Hailu***[4]***, Kirkland, J.***[5]

*1) The University of Texas at San Antonio, San Antonio, USA, *E-mail: marina.suarez@utsa.edu*
2) Kansas Geological Survey, Lawrence, USA
3) The University of Kansas, Lawrence, USA
4) Institute of Vertebrate Paleontology and Paleoanthropology, CAS, Beijing, China
5) Utah Geological Survey, Salt Lake City, USA

Cretaceous lacustrine strata may hold many clues for understanding Cretaceous continental climate. Lacustrine strata of Asia, for example, have been key to improving our record of the Cretaceous Terrestrial Revolution (avian and non-avian dinosaurs, early mammals and angiosperms are well represented in Early Cretaceous lacustrine units). Lacustrine strata are also excellent archives for climate data. Here we present new paleotemperature data from lacustrine strata from two continents: North America and Asia. The advance of clumped isotope paleothermometry has opened the continental realm to enhanced investigation of paleoclimate and paleoenvironments.

Samples from an important fossil bird locality in the Xiagou Formation, in Gansu Province, China were collected and investigated utilizing petrographic observations, powder x-ray diffraction, traditional stable isotopes and clumped isotope paleothermometry. The section is interpreted to span the early Aptian Selli event. Petrographic and XRD analyses indicated that the majority of the lacustrine carbonates are fine grained dolomites. Carbon isotopic compositions of these samples are enriched, ranging from +0.4‰ to +11.4 ‰, PDB. Oxygen isotopes range from -8.5 to -1.9‰ PDB, and clumped isotope values range from 0.652 to 0.707 ‰ compared to the absolute reference frame.

Lacustrine samples from the late Aptian to early Albian Ruby Ranch Member of the Cedar Mountain Formation of North America (Utah, United States of America) were recovered and investigated using petrography, XRD and stable and preliminary clumped isotope analyses. Carbon isotopic compositions range from -12.0 to +8.8‰ PDB; oxygen isotopic compositions range from -8.9‰ to +1.8‰ PDB and clumped isotope values range from 0.617 to 0.732 ‰. The carbonates present in the Cedar Mountain Formation seem to have a more complex diagenetic history with calcite, high Mg calcite, and dolomite present.

Clumped derived temperatures from the Aptian Xiagou Formation range 20.6 to 47.2°C. Clumped isotope derived temperatures from the Cedar Mountain Formation range from 18.5 to 40.2°C. Taking into consideration seasonal biases and filtering for later diagenetic phases, these temperatures are consistent for a Greenhouse climate in mid-latitudes (~35 to 40°N). In addition, the presence of abundant dolomite and enriched $\delta^{18}O$ values suggests that the lakes experienced significant evaporative flux.

Early Cretaceous Fossil Plants from Huolinhe Basin of Inner Mongolia, China and their Geological Analysis

***Sun, Bainian*[1,*], *Li, Ruiyun*[2], *Xu, Xiaohui*[3], *Yan, Defei*[4]**

*1) School of Earth Sciences, Lanzhou University, Lanzhou, China, *E-mail: bnsun@lzu.edu.cn*
2) Northwest University Museum, Northwest University, Xi'an, China
3) Anhui University of Science & Technology, Huainan, China
4) School of Earth Sciences, Lanzhou University, Lanzhou, China)

Some fossil plants were collected from the Lower Cretaceous of Huolinhe Basin, Inner Mongolia, China. The fossils were classified and identified based on the general morphology and the anatomical features. They were assigned to *Blasiites, Marchantites, Rebouliothallus ，Ricciopsis，Lycopodites, Equisetites, Eogonocormus, Osmunda, Coniopteris, Cladophlebis, Athyrium, Adiantopteris, Dicksonia, Ctenis, Pterophyllum, Nilssoniopteris, Anomozamites, Ginkgo, Baiera, Sphenobaiera, Phoenicopsis, Pityocladus, Athrotaxites, Taxus, Podozamites, and Schizolepis*. Among them, *Ginkgo* sp. is identified as a new species on the basis of well-preserved *Ginkgo* ovulate organ fossils from the Huolinhe Basin of Inner Mongolia. The microstructures of ovulate organ of *Ginkgo* sp. and associated *Ginkgo* leaves are detailedly studied. This finding is further confirmed that the ovulate organs of living *Ginkgo biloba* could have originated from the Jurassic *Ginkgo yimaensis* type. Then, the morphological features and microstructures of *Schizolepis longipetiolus* are analyzed in detail. The result shows that it is not appropriate to assign *Schizolepis* into Pinaceae, so it could be as a conifer incertae sedis. And then, stable carbon isotope compositions ($\delta^{13}C$) of *Marchantites huolinhensis* were measured. The paleoatmospheric CO_2 concentration of the early Early Cretaceous were reconstructed using the BRYOCARB model. The result is in the range of the GEOCARB II. Based on the distribution of the related living species of the fossil liverworts, and we think that the fossil liverwort studied here can be considered as a paleoclimatic proxy. Finally, a preliminary estimation on paleoelevation was made by using $\delta^{13}C$ values of *Marchantites huolinhensis*.

Key words: fossil plants, microstructures, carbon isotope, paleoclimate, the Early Cretaceous, Huolinhe Basin, Inner Mongolia

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Calpionellid and nannofossil correlation across the Jurassic-Cretaceous boundary interval, Kurovice Quarry, Outer Western Carpathians

Švábenická, L.[1,*], ***Reháková, D.***[2], ***Svobodová, A.***[3]

*1) Czech Geological Survey, Praha, Czech Republic, *E-mail: lilian.svabenicka@geology.cz*
2) Comenius University, Department of Geology and Palaeontology, Bratislava, Slovakia
3) Czech Academy of Sciences, Institute of Geology, Praha, Czech Republic

Marine sequences of the Tethyan realm at the locality of Kurovice, Czech Republic were chosen for the multidisciplinary study of the J–K boundary. The aim of this study is to compare the distribution of calpionellids and nannofossils including the biostratigraphic interpretation. Tithonian–Valanginian strata, Kurovice Limestone and Tlumačov Marl respectively, are represented by whitish grey allodapic limestones intercalated with marlstones and belong to the Carpathian Flysch. REHÁKOVÁ (in ELIÁŠ et al., 1996) mentioned here calpionellid zones ranging from Late Tithonian *Crassicollaria* to Late Berriasian *Calpionellopsis* Zone. J-K boundary was not strictly confirmed due to tectonic reduction. Recent bed-by-bed study of Kurovice sequences confirmed more or less the calpionellid distribution pattern as it was presented in paper mentioned above, but J-K boundary and the onset of further calpionellid subzones is now more precised. Nannofossil and calpionellid record depends evidently on the lithological character of strata. This phenomenon may affect final stratigraphic and other interpretations. Calcarenites contain scarce nannofossils, not frequent calpionellids (many of them are resedimented); sponge spicules and radiolarians dominated in homogenous limestones in which calpionellids are rare and nannofossils are rare to few ones; marlstone intercalations contain relative abundant nannofossil specimens while calpionellids are seldom in them. Generally, calcareous nannofossils are poorly preserved, majority of calpionellid loricas are deformed, lorica's colars are often damaged. Nannofossils are characterized by dominance of Ellipsagelosphaeraceae (90 %) that may furnish proof of strong etching and secondary post mortem modification of nannofloras. Specimens of genus *Conusphaera* occur in small numbers and nannoconids are scarce especially in the lower part of section.

From the underlie to overlie, following succession of the first (FO) or last (LO) occurrences of nannofossils compared to the acme of *Calpionella alpina* was observed: the FO of *Helenea chiastia* accompanied by *Nannoconus puer* (NJT16b), FO *Nannoconus globulus minor* (NJT17a), FO *Watznaueria cynthae*, LO *Polycostella beckmannii,* FO *Nannoconus wintereri* (NJT17b, uppermost Tithonian), the acme of *Calpionella alpina,* follow the FO of *Nannoconus globulus globulus*, FO *Nannoconus kamptneri kamptneri* (NKT) and FO *Speetonia colligata*. Jurassic NJT and Cretaceous NKT nannofossil zones were applied by CASELLATO (2010).

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Contextualizing newly discovered dinosaurian assemblage in the Mussentuchit Member of the Cedar Mountain Formation, Central Utah, USA: insights from the sedimentary record

Symons, R.C.R.[1,*], ***Tucker, R.T.***[1], ***Jonk, L.***[1], ***Makovicky, P.J.***[2], ***Zanno, L.E.***[3]

*1) Stellenbosch University, Stellenbosch, RSA, *E-mail: nybor.sa@gmail.com*
2) Science & Education, Museum of Natural History, Chicago, USA
3) Research & Collections, North Carolina Museum of Natural Sciences, Raleigh, USA

The paleobiota of the Upper Cretaceous (Cenomanian) Mussentuchit Member is key to understanding a period of dramatic faunal reorganization in western North America characterized by the extirpation of sauropods and allosaurs and the rise of Late Cretaceous assemblages dominated by hadrosaurs, ceratopsians, and tyrannosaurids. Discovery of a previously undocumented dinosaurian fauna in the Mussentuchit including the first Late Cretaceous allosaur (*Siats meekerorum*), as well as at least four additional, as of yet unnamed, dinosaurs including an orodromine, a basal iguanodontian, and two new coelurosaurians, together with new data from the Lower Cretaceous Cloverly Formation including the ceratopsian *Aquilops* (FARKE et al., 2014) and advanced tyrannosauroids (ZANNO & MAKOVICKY, 2011) suggests that this transition was more complex than previously appreciated. Specifically, newly emerging data indicates a prolonged, step-wise transition that resulted in the mixing of taxa with Asian ties and endemic North American clades over more than 10 million years. However, teasing out fine scale patterns and macroevolutionary rates of turnover requires fine-scale temporal resolution, which to date, is lacking for the Mussentuchit assemblage.

Due to the relative proximity of coeval volcanic and plutonic source rocks along the developing Western Cordillera during the Sevier Orogeny, the Mussentuchit Member is ideal to obtain near-synchronous detrital zircons. Foundational studies by Cifelli et al. (1997) and others provide a regional-scale temporal framework, yet by age dating the in-situ, newly discovered fossil assemblage, we can gain much more precise temporal resolution. This study ablated eight (8) samples [~1000 grains] obtained from throughout the stratigraphy and at key fossil localities, including all new dinosaurian holotype quarries. To compliment these results, this study coupled radiometric age dating with palaeoenvironmental reconstruction and taphonomic analysis. As a result, this study identified a mosaic of marginal marine to inland deltaic (distal alluvial) continental alluvial depo-centres that provided sites for skeletal accumulation and preservation. Taphonomic work indicated these flood-prone mudflats trapped and preserved many parautochthonous mixed-fossil concentration(s). These results provide a significant advancement in understanding the more precise age of the Mussentuchit Member flora and fauna, and emphasize the utility of detrital zircon geochronology for better constraining terrestrial faunas.

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Late Cretaceous provenance change in the Jiaolai basin, East China: Evidences from detrital zircon U-Pb ages from the Wangshi Group

Tan, Jie[1,*]***, Zhang, L.***[2]***, Wang, C.***[3]

*1) China University of Geosciences in Beijing, Beijing, China, *E-mail: 836383955@qq.com*
2) School of Energy Resources, China University of Geosciences, Beijing, Beijing, China
3)School of Earth Science and Resources, China University of Geosciences in Beijing, Beijing, China

The provenance history of Jiaolai basin is of great significance to the paleogeographic and tectonic pattern in Jiaodong Peninsula, East China. Previous studies had suggested that the detrital zircons of sandstones of Early Cretaceous (130 Ma) Laiyang Group mainly came from granites in Sulu orogenic belt. However, the source provenance of the Late Cretaceous Wangshi Group has not been determined. Here, we apply integrated methods including conglomerate clast analysis, heavy mineral analysis, sandstone petrographic analysis, and U-Pb detrital zircon analysis to sandstone samples of Late Cretaceous Wangshi Group from a borehole (Luke-1) in Jiaolai basin, Shandong. The results indicate that the peak age of U-Pb detrital zircons of these samples is about 115 Ma. The compositions are dominated (60–80 %) by basic-intermediate volcanic clasts (e.g. andesite, basalt, tuff, basaltic andesite, and rhyolite), similar to the the compositions of Qingshan Group. In addition, the heavy mineral assemblages of our samples also show a basic-intermediate volcanic origin, also consistent with that of the Qingshan Group. Our results suggest that the provenance of Jiaolai basin had changed during the Late Cretaceous, from the relatively distal Sulu orogenic belt granite to the intra-basinal Qingshan group basic-intermediate volcanic rocks. We attribute this provenance change to a sudden NW-SE shortening event and uplift caused by the collision between the Okhotsk block and East Asian margin between 98–80 Ma.

The continuation of the Late Cretaceous volcanic arc of the Balkan orogen beneath the Black Sea: implications for hydrocarbon exploration plays

Tari, G.[1]

1) OMV, Vienna, Austria, E-mail: gabor@allygabor.com

The Upper Cretaceous volcanics in the Srednogorie Zone of Bulgaria have been already considered in the opening record of the Western Black Sea (GÖRUR, 1988). Whereas this Turonian to Senonian rifted basin complex is well studied onshore (e.g. GEORGIEV et al., 2012), its offshore continuation in the Burgas embayment of the Western Black Sea is much less known (TARI et al., 2015). Moreover, taking into account the offset of the offshore Srednogorie Zone by about 200 km to the southeast along a poorly constrained West Black Sea Fault, the Upper Cretaceous volcanics can be followed to the East along the entire deepwater Turkish margin as imaged by recently acquired seismic reflection data (NIKISHIN et al., 2015). The undrilled Cretaceous volcanics, presently located in the deepwater, correspond to two distinct reflection seismic sequences, interpreted as the offshore equivalents of the Turonian Dereköy and the Campanian Cambu Formations known from the onshore part of the Pontides in Turkey. On a regional scale, the volcanics are part of a Late Cretaceous magmatic arc extending over 1000 km in length from the Apuseni Mts of Romania, through Serbia and Bulgaria to the Black Sea (GALLHOFER et al., 2015). This arc represents the westernmost segment in the Alpine-Himalayan orogenic system related to the northward subduction of the Neotethys.

The numerous Cretaceous paleo-volcanoes along the Turkish margin of the Black Sea do have an impact on the hydrocarbon exploration efforts in the basin. Many of these very large cone-shaped paleo-volcanoes have large detachment faults on their flanks compensating for the pronounced differential compaction above them in the locally very thick (6-8 km) post-Senonian basin fill. These extensional faults, propagating very high up into the Oligocene and Miocene sedimentary strata above the Cretaceous volcanoes, can have 3-way closure traps in their footwall blocks. This somewhat unusual speculative trap style remains untested in the deepwater of the Turkish Black Sea. A deeper trap type, unlikely to be tested any time soon, is provided by roll-over structures on the volcano flank detachment faults.

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Stratigraphy and Geology of the Sao Khau and Phu Phan Formations, Phu Khum Kao, Kalasin Province, Thailand

Teerarungsigul, N.[1,*] ***and Summart, O.***[1]

*1) Department of Mineral Resource, Bangkok, Thailand, *E-mail: naramase@hotmail.com*

The Jurassic-Cretaceous Khorat Group, exposed in the Phu Khum Kao of Kalasin Province, Thailand, comprises 65 m thick of non-marine strata of two formations: the Sao Khua, and Phu Phan Formations, respectively, in ascending order. These two formations are conformably underlain and overlain by the Pha Wihan and Khok Kuat Formations, respectively, in the vicinities areas.

The Sao Khua, Formation consists of four lithofacies; the calcareous conglomerate with fragment of dinosaur bones, vertebrate fossils and bivalves, sandstone intercalated siltstone with cross-bedding, siltstone, and uppermost sandstone lithofacies. The succession, internal sedimentary structure and faunal assemblages reflect meandering environment during Early Cretaceous. The Phu Phan Formation consists mainly of the thickly bedded conglomerate intercalated with thin arkosic sandstones with dinosaur bone. The rocks were deposited in braided stream origins.

The fossil assemblages were collected from the Sao Khua Formation at Phu Khum Kao site, are the various theropods and sauropods. They found more than 700 pieces of bones which belong to at least seven sauropod dinosaurs. One of these seven is the most complete dinosaur skeleton found to date in Thailand. These bones belong to *Phuwiangosaurus sirindhornae.* The Early Cretaceous Phu Phan Formation has been found a few sauropod bone fragments.

Barremian to early Aptian environmental changes in the North Sea: new results from high-resolution carbon and oxygen stable isotopes, major and trace elements, and calcareous nannofossils

Thibault, N.[1,*]***, Anderskouv, K.***[1]***, Sheldon, E.***[2]***, Perdiou, A.***[1]***, Razmjooei, M.J.***[1]

*1) University of Copenhagen, Copenhagen, Denmark, *E-mail: nt@ign.ku.dk*
2) GEUS, København, Denmark

The Barremian to lower Aptian Tuxen and Sola Formations have been investigated in the North Jens-1 well (Danish Central Graben, North Sea) for environmental changes based on a revised calcareous nannofossil biostratigraphy, on geochemical analysis of 316 samples (stable isotopes, hand-held XRF element analysis) and quantitative nannofossil abundance counts of 75 samples. Our results delineate the well-established Barremian rise in carbon isotopes as well as the typical excursions across the early Aptian Oceanic Anoxic Event (OAE) 1a characterized by two short and prominent negative excursions right below and at the base of the Fischschiefer laminated black shale horizon, followed by the long-lasting positive carbon isotope excursion of the lower to upper Aptian. Our new results also show significant cyclic changes in the Barremian carbon cycle with a number of new possible negative and positive excursions that could be defined and used for refinement of the stratigraphy of this stage. Oxygen isotopes and calcareous nannofossil assemblages highlight the coupling of significantly warm episodes associated to eutrophic conditions during deposition of the lower Barremian Munk marl and early Aptian Fischschiefer laminated horizons whereas a significant cooling associated to oligotrophy triggered the deposition of nannoconid chalk in the upper Barremian. Major and trace elements suggest rather similar environmental contexts for the deposition of the Munk marl and Fischschiefer and advocate for these levels being deposited in association with maximum flooding, in accordance with results of the Lower Saxony Basin in North Germany.

Discovery of millennial-scale climate change signals in the Cretaceous terrestrial sediments from the Songliao Basin, Northeast China

***Tian, W.*[1,*], *Huang, Y.*[1], *Wang, C.*[1], *Wu, Huaichun*[1]**

*1) China University of Geosciences (Beijing), Beijing, *E-mail: wenqian850721@163.com*

Present paleoclimatic research on the Cretaceous greenhouse world focuses mainly on climate change events, e.g., oceanic anoxic events (FRIEDRICH et al., 2012) and sedimentary cycles attributed to orbital forcing (e.g., WU et al., 2014). Due to the lack of continuous and high resolution records, there are few studies that concentrated on millennial-scale climate fluctuations during the Cretaceous period. Recently, long and continuous terrestrial records have been recovered from the Songke SK-I core in the Cretaceous terrestrial Songliao Basin, NE China, and a precise and high-resolution chronostratigraphic framework has been built for Late Cretaceous to Early Paleocene strata of the basin (HE et al., 2012; DENG et al., 2013; WAN et al., 2013).These continuous Cretaceous records probably provides a unique opportunity for exploring terrestrial climate changes at millennial scale for the Cretaceous greenhouse world.

In this work, we investigate the potential for using high-quality elemental records, achieved by XRF core scanning, in the determination of millennial-scale climate changes in Cretaceous terrestrial records. Results suggest that ten elements (Al, Si, S, K, Ca, Ti, Fe, Mn, Rb and Sr) can be robustly detected from XRF core scanning. Multiple climate proxies suggest the presence of abrupt and short cold/warm transitions. Moreover, Spectral analysis of those climatic proxies reveals numerous millennial periodicities. When compared to millennial climate changes that occurred during the Quaternary, ~1500 year cycles discovered in the Songliao Basin are very similar to the period of the Dansgaard-Oeschger events. If this is correct, such similarities may provide new insights into the origins of millennial climate signals during the Cretaceous Period. We conclude that similar forcing factors, which were working during the last glacial period, have also been active during the Cretaceous greenhouse and controlling millenial-scale cyclicities recorded in SK-I, either precessional forcing at low latitude or solar activity changes.

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Charophytes and ostracods as tool to detect key stratigraphic surfaces in Mid-Cretaceous strata from the Central Tunisian Atlas (North African margin)

***Trabelsi, K.**[1,*], Nasri, A.[2], Sames, B.[3], El Ferhi, F.[2], Skanji, A.[2], Houla, Y.[4], Wagreich, M.[3], Soussi, M.[5], Martín-Closas, C.[6]*

*1) University of Sfax, Faculty of Sciences, Sfax, Tunisia, *E-mail: trabkhalfss@yahoo.fr*
2) Entreprise Tunisienne d'Activités Pétrolières (ETAP), Tunis, Tunisia
3) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria
4) Département de la Géologie, Office National des Mines, Tunis cedex, Tunisia
5) Université de Tunis El Manar II, Tunis, Tunisia
6) Departament d'Estratigrafia, Paleontologia i Geociències Marines, Universitat de Barcelona, Barcelona, Catalonia, Spain

In Central Tunisia, the Mid-Cretaceous (Aptian–Early Albian) Orbata Formation (Aptian super-sequence in the sense of M'RABET et al., 1979) is characterized by lateral and vertical litho-facies variations, associated with unconformities due to erosion or non-deposition. These changes have been related to tectono-eustatic control (CHEKHMA & BEN AYED, 2013). In lithostratigraphic terms, the Orbata Fm is subdivided into three units; a lower dolomitic Member "A", a middle Member "B" and an upper Member "C", respectively, attributed to the Upper Barremian–Lower Aptian, Middle Aptian, and Upper Aptian (M'RABET et al., 1979). Two "major regional discontinuities" of eustatic order have been detected in this Formation throughout the studied sections of the Central Tunisian Atlas. The first emersion surface corresponds to the karstified and eroded summit of the lower dolomitic Member "A" as response to the major sea-level fall event KAp1 of major amplitude (> 75 m) of HAQ (2014). As consequence, marginal-coastal deposits developed with new biota dominated by associations of charophytes (TRABELSI et al., 2016) and ostracods (TRABELSI et al., 2015), which both well evidence the Lower Aptian interval age of the considered stratigraphic surface. Subsequently, minor transgressive-regressive cycles controlled the development of the Orbata Formation until the following prominent major sea-level fall (KAp7 of HAQ, 2014) which caused the quasi-total emersion of the central domain of the Tunisian Atlas ("Kairouan Island" in the sense of M'RABET et al., 1979). Following this second major emersion surface, continental to marginal-coastal deposits again developed bearing charophytes and ostracods, which confirm an Uppermost Aptian?–Lower Albian age of this second key stratigraphic interval (TRABELSi et al., 2016). Hence, a major Lower Albian terrigenous event has been identified throughout the Tunisian Atlas basins from north to south which implicates the requirement to review the related paleogeographic scheme.

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Ostracod faunicycles in the Mid-Cretaceous carbonate platform from the Central Tunisian Atlas (North African margin): Biostratigraphic and paleoecologic implications

Trabelsi, K.**[1,*]**, Nasri, A.**[2]**, El Ferhi, F.**[2]**, Skanji, A.**[2]**, Sames, B.**[3]**,
***Wagreich, M.**[3]**, Houla, Y.**[4]**, Soussi, M.**[5]*

*1) University of Sfax, Faculty of Sciences, Sfax, Tunisia, *E-mail: trabkhalfss@yahoo.fr*
2) Entreprise Tunisienne d'Activités Pétrolières (ETAP), Tunis, Tunisia
3) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria
4) Département de la Géologie, Office National des Mines, Tunis cedex, Tunisia
5) Université de Tunis El Manar II, Tunis, Tunisia

High-resolution sedimentary records across the Aptian–Albian transition from the Central Tunisian Atlas (southern Tethyan margin), precisely in the Jebel Koumine locality, were investigated for their ostracods contents. Detailed taxonomic studies allows us to describe about 60 ostracods species and subspecies belonging to freshwater, brackish and marine groups. The analysis of the structure of the ostracod assemblages and information provided by other groups (foraminifers, echinoderms, gastropods, charophytes) as well as sedimentological features, evidences a shallow inner platform sporadically emerged. Indeed, notably during the Lower Albian interval the ostracods are represented by higher specific diversity but variable density, and are adapted to a higher energy environment and detrital influx. Biostratigraphic analysis of the vertical distribution of the ostracods species throughout the studied Koumine section allows us to establish a tentative biozonation of the Aptian–Albian strata, with the description of three well distinguishable ostracod biozones attached to the Early Aptian, Late Aptian and Early Albian ages. Correlated and supported by the charophyte biozonation recently described by TRABELSI et al. (2016) in the same section as well as in the Jebel Kebar section, the ostracod biozonation provides us a new tool for a more accurate chronostratigraphy of the mid-Cretaceous strata of the Central Tunisian Atlas. The main result arising from both ostracods and charophytes study is the evidence of the presence of the Early Albian in Central Tunisia, a time interval that had previously been considered as lacking in this area. Hence, the Aptian–Lower Albian stratigraphic correlations as well as the paleogeographic reconstruction of the Tunisian Atlas should be revised taking into account these new important findings.

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Mid-Cretaceous development of the Eromanga Basin, Queensland, Australia; palaeoenvironmental and palaeobiogeographic context for newly discovered fossil assemblages

***Tucker, R.T.*[1,*] *and Roberts, E.M.*[2]**

*1) Stellenbosch University, Stellenbosch, RSA, *E-mail: tucker@sun.ac.za*
2) Geosciences, College of Science and Engineering, James Cook University, Townsville, Australia

The Winton Formation of central Queensland is recognized as a primary sedimentary repository for mid-Cretaceous terrestrial faunas and floras in Australia. However, investigations linking fossil assemblages and contextualizing palaeogeographic and palaeoenvironmental relationships across the Eromanga basin remain limited. Therefore, this study employed a multifaceted approach to better understand the cryptic tectonic setting, palaeogeography and palaeoenvironmental of eastern Australia during the late Mesozoic. Further focus was to interpret the depositional environments and improve stratigraphic correlations between multiple newly discovered fossil localities within the preserved Winton Formation in the Eromanga Basin, including Isisford, Lark Quarry Conservation Park, and Bladensburg National Park. Initial work included U-Pb geochronology and Lu-Hf isotope analysis of detrital zircons recovered from the mid-Cretaceous Winton and Mackunda Formations. Cretaceous-age zircon populations dominate the provenance record and indicate that deposition was largely synchronous with ongoing volcanism to the east (TUCKER et al., 2016). Lu-Hf isotopic data suggest that these zircon populations were sourced from igneous rocks of a mixed juvenile and crustal source, similar to Lu-Hf isotopic systematics for older terranes, which lie within eastern Australian. Results from this study support the hypothesis that the Whitsunday igneous association was the main source of Cretaceous sediment to the Eromanga Basin, and likely for sediment transported across the continent southward and into the Ceduna Delta system offshore South Australia.

Palaeoenvironmental reconstruction included the identification of twenty-three facies types and nine repeated facies associations. This study identified a mosaic of marginal marine to inland continental alluvial depo-centres. These developed synchronously with the final regression of the Eromanga Seaway from central Australia during the early Turonian. This work further demonstrates that the Isisford fauna is part of the lower member of the preserved Winton Formation; whereas, fossil localities around Winton, including Lark Quarry and Bladensburg National Park, are part of the upper member of the Winton Formation (TUCKER et al., 2013). These results permit a more meaningful framework for both regional and global comparisons of the Winton flora and fauna (MANNION et al., 2013; LEAHEY et al., 2015; BELL et al., 2016).

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Microfacies and depositional environment of Campanian (Cretaceous) deposits, Düzköy (Trabzon, NE Turkey)

Türk Öz, E.[1] and Yildiz, M.[1,*]

*1) Karadeniz Technical University, Trabzon, Turkey, *E-mail: merveyildiz@ktu.edu.tr*

Campanian (Cretaceous) deposits which represents the upper part of the Mesozoic sequence in the Eastern Pontides (NE Turkey), mainly composed of calciclastic turbidites includes thin grey-red pelagic limestone, sandstone, siltstone, marl interlayers dominated by volcanoclastics; neritic carbonate lenses and pillow lavas. Düzköy-Çayırbağı stratigrafic section consisting of grey and red pelagic limestone well exposed in the Düzköy (NE Turkey) is studied with a combined sedimentological and paleontological approach.

Based on the planktonic foraminiferal assemblages which consist mainly of *Globotruncana* cf. *arca* (Cushman), *Globotruncana arca* (Cushman), *Globotruncana* sp., *Whiteinella* sp., *Archaeoglobigerina* sp., *Archaeoglobigerina blowi* (Pessagno), *Globotruncana lineiana* (d'Orbigny), *Whiteinella* sp., *Archaeoglobigerina cretacea* (d'Orbigny), grey and red pelagic limestone is Campanian in age. Two microfacies were identified and interpreted by petrographic analysis on the basis of their depositional textures and fauna. These are planktonic foraminiferal wackestone-mudstone with rare allochthonous neritic skeletal grain and planktonic foraminiferal mudstone lithofacies, respectively. Microfacies and paleontological characteristic of the studied section suggest that a deep marine environment existed in Düzköy (NE Turkey) during the Campanian. The presence of rare allochthonous neritic skeletal grains in the lower part of the section indicates that the existence of a shallower water carbonate depositional environment was adjacent to the deep marine environment during the earliest Campanian.

Cretaceous Geodynamic Settings of the Southwestern Margin of the Black Sea, Turkey

Tüysüz, O.[1]

1) Istanbul Technical University, Istanbul, Turkey, E-mail: tuysuz@itu.edu.tr

The Western Black Sea Basin (WBSB) possibly opened in two stages. In the first stage, during the Aptian - Albian, the rifting was a wide-rift style and caused thinning of the continental crust. Development of an extensional magmatic arc since middle Turonian in response to the northward subduction of the Northern Tethys was followed by narrow-style back-arc rifting in the north of Istanbul Zone, breaking up the already thinned crust and starting of oceanic spreading. Syn-rift clastic sedimentation on the İstanbul Zone, southern continental margin of the WBSB, started during the early Aptian, following deposition of the Upper Barremian Urgonian type platform carbonates, and lasted until the late Albian in a southward deepening environment. These sediments possibly evolved to a passive margin sedimentary prism facing to the Intra Pontide Ocean to the south. Closing of this ocean and soft(?) collision of the Istanbul and the Sakarya Zones at the end of the Albian caused a low-grade metamorphism along the collision zone and uplifting of the whole Istanbul Zone during the Cenomanian. The Pontide magmatic belt unconformably overlying the Lower Cretaceous and older units developed in two distinct stages. The first stage between the middle Turonian and the early Santonian developed in an extensional arc setting, corresponding to the narrow-style back-arc rifting of the Western Black Sea Basin. During the late Santonian, due to breakup of the continental crust and beginning of oceanic spreading, first stage of the volcanism stopped and a deep-marine environment covered the whole region. The second stage of the arc magmatism started during the Campanian and lasted until the beginning of the Maastrichtian. Geochemical data indicate that lavas derived from a depleted source are abundant in both stages, while lavas derived from an enriched asthenospheric mantle appear towards the end of the second stage. While the first stage clearly displays a subduction signature, alkaline lavas of the second stage may indicate thinning of the lithosphere and upwelling of the asthenosph --eric mantle in the matured stages of back-arc rifting. We argue that the main cause of both rifting in the Western Black Sea Basin and temporal change in magma generation was the steepening and rollback of the northward subducting slab of the Tethys Ocean.

In this paper, I will present stratigraphic, geochemical and palaeontological properties of the Cretaceous deposits of the Istanbul Zone, NW Turkey, and a tectonic model for two- stages opening of the WBSB.

High-frequency, shallow marine clastic sequences across the Turonian - Coniacian boundary, correlated between the Bohemian Cretaceous and Western Canada basins

Plint, G.[1], Uličný, D.[2,*], Čech, S.[3], Walaszczyk, I.[4], Gröcke, D.R.[5], Laurin, J.[1], Shank, J.A.[6], Jarvis, I.[7]

1) Department of Earth Sciences, London, Ontario, Canada
*2) Institute of Geophysics, Czech Academy of Sciences, Prague, Czech Republic, *E-mail: ulicny@ig.cas.cz*
3) Czech Geological Survey, Prague, Czech Republic
4) Faculty of Geology, University of Warsaw, Warszawa, Poland
5) Department of Earth Sciences, Durham, UK
6) Esso Resources Canada Ltd., Calgary, Canada
7) School of Geography, Geology and the Environment, Kingston Univ. London, Kingston upon Thames, UK

The Turonian-Coniacian (T-C) boundary is associated with a well-defined succession of inoceramids and other faunal biostratigraphic markers recognized in a number of key sections in Europe and North America. In carbon-isotope chemostratigraphy the boundary has mostly been associated with the negative trough of the Navigation C-isotope Event. A fall in sea level somewhere in the broader T-C boundary interval has been interpreted by a number of studies. However, problems with stratigraphic resolution and the incompletness of many records due to hiatuses and unconformities have prevented a reliable, detailed correlation between basins which is necessary to address the potential eustatic history across this boundary. Our study focuses on a comparison of clastic depositional systems from two basins, in which 2D-3D physical stratigraphic frameworks were complemented by detailed biostratigraphic and chemostratigraphic data. In the Bohemian Cretaceous Basin of Central Europe, rapid tectonic subsidence combined with abundant sediment supply provided a rare opportunity to study an expanded succession across the T-C boundary, recorded both in offshore hemipelagic facies and nearshore coarse-grained deltas. The transgressive-regressive history of the deltaic system was established with resolution better than 100 kyr in some cycles, based on a detailed biostratigraphic framework and carbon-isotope data from several cores. The T-R history of this interval from the Bohemian Basin was compared to a high-resolution regional stratigraphic framework of the Cardium Formation in the Western Canada Basin, correlated distally to the Niobrara Formation in Pueblo, CO. Despite different tectonic regimes and vastly different dimensions of the basin-fills compared, a majority of the high-frequency T-R cycles in the study interval can be correlated in surprising detail, particularly in the uppermost Turonian, which strongly suggests a pattern of high-frequency eustatic fluctuations across the T-C boundary. Our results emphasize the importance of very high stratigraphic resolution that allows high-frequency cyclicity to be recognized. A comparison of longer-term stacking patterns would be misleading because they contain a stronger signature of the basinal subsidence and supply history in time and space.

Climate of southern Laramidia: A multi-proxy paleobotanical reconstruction for the upper Campanian Jose Creek Member, McRae Formation, south-central New Mexico, USA.

Upchurch, G.[1,*]***, Parrott, J.***[1]***, Estrada-Ruiz, E.***[2]***, Contreras, D.***[3]

*1) Texas State University, San Marcos, USA, *E-mail: gu01@txstate.edu*
2) National Polytechnic Institute of Mexico, Mexico City, Mexico
3) University of California, Berkeley, USA

Leaf physiognomy of dicots is a long-standing source of data on Late Cretaceous terrestrial climate. Wood anatomy of dicots has similar potential, but calibration errors lead wood anatomists to urge caution. Leaf and wood macrofossils rarely occur in sufficiently close stratigraphic/geographic proximity to permit cross checking, and Cretaceous angiosperm wood floras often have insufficient diversity to use published physiognomic transfer functions.

The upper Campanian (74–76 mya) Jose Creek Member (JCM) of the McRae Formation, south-central New Mexico, USA, provides a unique opportunity to reconstruct climate through a combined analysis of leaf physiognomy, wood anatomy, and life form. The JCM preserves an abundant and diverse leaf macroflora of >175 species, and an exceptionally preserved wood flora of >50 species that comprises dicots, conifers, and palms. Dicot leaf margins estimate Mean Annual Temperature (MAT) of 21–22° C, based on an early collection of 42 species and an expanded collection of 161 species from the same volcanic ash bed. A preliminary analysis of dicot wood anatomy estimates MAT of 24–25° C, based on 30 morphotypes from the entire Jose Creek Member. These same dicot woods estimate a Cold Month Mean Temperature (CMMT) of 15° C. Leaf and wood estimates of MAT and CMMT are congruent with the absence of annual rings in most dicot and conifer wood types, and the presence of diverse fossils of rosette plants, including palm leaves, multiple types of palm wood, leaves and cones of thermophilic cycads (cf. *Ceratozamia*), and a palm stem base indicative of tree habit. These constrain MAT to >13°C and CMMT >10–11° C. Estimates of Mean Annual Precipitation (MAP) are in general less certain, but year-round precipitation is indicated by abundant palms and gingers and published evidence for non-calcic paleosols; dicot wood physiognomy sets an upper limit for MAP of 3 m. The more southerly Olmos flora of Mexico provides similar climatic estimates from dicot leaf margins and wood anatomy. This indicates the common occurrence in southern Laramidia, during the late Campanian to early Maastrichtian, of climate and vegetation most analogous to modern paratropical rainforest and tropical premontane moist to wet forest.

How is the opening of the Black Sea reflected in the Cretaceous sequence of the Bulgarian Moesian Platform?

Vangelov, D.[1] and Tari, G.[2,*]

1) Sofia University St. Kliment Ohridski, Sofia, Bulgaria
*2) OMV, Vienna, Austria, *E-mail: gabor@allygabor.com*

The age of rifting in the Western Black Sea (WBS) basin remains an unresolved issue. Various models have been suggested for the timing of the basin opening spanning a long period from the Barremian to the Santonian. The main reason for the different rifting models is the asymmetry of the Cretaceous stratigraphic record on the conjugate margins of the WBS basin. In the Pontides of Turkey, a significant part of the Cretaceous syn-rift strata is missing either by erosion or by non-deposition. On the conjugate Bulgarian, Romanian and Ukrainian margin, the stratigraphic record of the Black Sea rifting is much more complete, indicating separate extensional periods for the Aptian-Albian, Cenomanian-Coniacian and the Santonian-Campanian.

The Eastern Moesian Platform in Bulgaria has a fairly complete Upper Cretaceous strata composed of well-studied shallow-marine successions. There is a major unconformity between the Lower and Upper Cretaceous with a hiatus of variable time span. The basal Upper Cretaceous (Cenomanian-Turonian) with mixed siliclastic/carbo-nate units deposited in foreshore-shoreface environment (Madara Formation) tends to infill the existing paleorelief. Typically, these sediments are composed of siliciclastic framework grains with abundant bioclasts and minor authigenic components (glauconite pellets and phosphatic concretions). Upward in the section chalky limestones dominate (Cherencha Member) reflecting lower sedimentary input to the basin and relative sea-level rise. Above a regional unconformity, the Upper Turonian has thin glauconitic mixed rocks (Dobrindol Formation). This unit transitions upwards into chalks with cherty nodules, interpreted to be deposited in open-marine shelfal environments (Venchan Formation). The Senonian chalks are overlain by sandstones (mainly feldsarenites of the Shumen Formation) and bioclastic limestones deposited in shallow-water environments (foreshore-shoreface) of Novachene and Nikopol Formations.

Regionally, the entire Upper Cretaceous succession records deposition on a south-facing passive margin with migrating depocenters (nearshore-shelfal environments) partly influenced by eustatic control on sedimentation. The Upper Cretaceous “platform” type basin of the Moesian Platform, is subdivided on its Bulgarian segment into a western and eastern sub-basin. The western one is related with the expansion of the Jurassic-Lower Cretaceous remnant basin eastward. The eastern subbasin is interpreted as the western continuation of the WBS and its real expansion occurred in Late Turonian. During Campanian the two subbasins were merged together and expanded southward, covering the Forebalkan area.

The opening of the WBS Basin can be explained by asymmetric rifting at the southern margin of the European plate in a wide-rift style during the Aptian-Albian. The fine stratigraphic subdivision in the Bulgarian Moesian Platform allows the interpretation of two other rift-related sequences within the Cenomanian-Lower Turonian and Upper Turonian-Coniacian corresponding to narrow-rift style rifting of the WBS basin may have been driven by subduction roll-back associated with the Pontides. The subsequent prolonged Senonian post-rift subsidence is responsible for the coalescence of the earlier syn-rift subbasins in the Bulgarian Moesian Platform.

Taxonomy and stratigraphy of the Lower Cretaceous belemnites from Štramberk (Czech Republic, Outer Western Carpathians)

Vanková, L.[1]

1) Institute of Geology and Palaeontology, Faculty of Science, Charles University, Prague, Czech Republic, E-mail: vankova.luc@seznam.cz

Belemnites belong in Štramberk area (Czech Republic, north Moravia) to the quite common fossils. A relatively high taxonomic diversity of belemnites is closely connected to geological development of this heterogenous complex. There are strongly ambiguous views on the genesis of the reef Štramberk limestone, suggesting a different sedimentary history (i.e. HOUŠA, 1975; ELIÁŠ & STRÁNÍK, 1963). The Lower Cretaceous sediments infill fissures or pockets in older Jurassic limestones, therefore, the stratigraphic position seems to be sometimes confusing.

Diversificated belemnite fauna from the "Š-12 pocket" (Kotouč quarry) stratigraphically ranges from the Tithonian to the Barremian. The belemnite distribution in time was triggered by selective exposition and erosion of an individual sedimentary units during the Jurassic and the Lower Cretaceous age (within the Outer Western Carpathians orogeny). Therefore, belemnite rostra and especially their alveolar cavities are natural archives containing depositional record. Analysis of several generations of sediment infills seems to be an excellent tools for a study of sedimentary history (as these rostra have several times been reworked).

Detailed research of belemnites rostra from the "Š-12 pocket" (collection of Dr. V. Houša - almost 10 000 belemnites rostra), reveals both belemnite taxonomy and systematics and sedimentary units stratigraphy as well. Inside of examined belemnites (Duvaliidae, Pseudobelidae, Mesohibolitidae), the oldest representatives of the genus *Conobelus* (Tithonian) were recorded. The majority of rostra investigated belong to the Berriasian through the Hauterivian genera *Duvalia*, *Berriasibelus* and *Pseudobelus*. The genus *Castellanibelus* has been recorded and rarely. Abundantly present *Mesohibolites* and *Conohibolites* (the Barremian and younger deposits) reported herein do not correspond with the previously assumed age of pocket, and it rather corresponds to the Upper Lower Hauterivian (*sensu* SVOBODOVÁ et al., 2011). Belemnites clearly demonstrate not only the younger age of sedimentary units but they also upgrade the geological understanding of the formation region in a broader context.

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High Arctic record of Early Cretaceous climate and carbon-cycle perturbations: evidence from Spitsbergen, Svalbard

***Vickers, M.**[1,*], Price, G.[1], Watkinson, M.[1], Jerrett, R.[2]*

*1) Plymouth University, Plymouth, UK, *E-mail: madeleine.vickers@plymouth.ac.uk*
2) Manchester University, Manchester, UK

The Early Cretaceous was characterised by high atmospheric CO_2 levels, and a long-term greenhouse climate. However, many studies suggest that short episodes of cooling and warming punctuated this greenhouse trend, often reflected in perturbations in the stable isotopic record. The magnitude of warming and cooling is still debated, as the various climate proxies do not agree necessarily with model predictions or each other, particularly with respect to Polar climates. Low pole-to-equator temperature gradients are suggested by various palaeothermometers, but these are not reproduced in climate models. Palaeo-high latitude sediments deposited at this time are of key importance to understand these global geochemical and climate changes, as the poles of the Earth are extremely sensitive to climate change. There is an on-going debate as to whether temperatures were ever low enough for small Polar ice-caps to develop, with possible glacial sediments being reported from the high latitudes (e.g. FRAKES et al., 1995), countered by temperature reconstructions from proxies such as calcite palaeothermometry and TEX_{86} that yield a range in temperature estimates.

The Svalbard archipelago preserves Lower Cretaceous sediments, and had a palaeolatitude of >60°N. These sediments are reported to contain both cold – and warm- climate indicators, such as dinosaur bones and footprints (HURUM et al., 2016); evidence for temperate forests (HARLAND & KELLY, 1997); paradoxically together with interpreted dropstones (DALLAND, 1977); and enigmatic "cold water" glendonites (e.g. PRICE & NUNN, 2010). However, due to poor dating and poor correlation between sites, the evidence can be contradictory and its palaeoclimatic significance unclear. We present data from a high-resolution carbon isotopic study of the Early Cretaceous succession on Svalbard, which, coupled with detailed sedimentological and petrological data, has allowed identification of significant global CIEs (which are all linked to climatic perturbations) and critical evaluation of the enigmatic sedimentological evidence (glendonites and outsized clasts) for cool climates, placing the Lower Cretaceous Succession of Spitsbergen in the context of global climate changes observed from other locations around the world.

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Cretaceous Microplankton of the Russian Arctic and Pacific Rims: Superplume and Cooling during Supergreenhouse

***Vishnevskaya, V.**[1,*] **and Kopaevich, L.**[2]*

*1) Geological Institute of RAS, Moscow, Russia, *E-mail: valentina.vishnaa@mail.ru*
2) Lomonosov Moscow State University, Moscow, Russia

The Berriasian and Valanginian of the Arctic rim of Russia is represented by shale facies with radiolarians, foraminiferas (VISHNEVSKAYA et al., 2014) and calcareous dinoflagellates, while Pacific rim facies are siliceous and contain tethyan radiolarians due to superplume (VISHNEVSKAYA & FILATOVA, 2016). Hauterivian-Aptian microplankton is radiolarian and determined only in Pacific rim of Russia (KURILOV & VISHNEVSKAYA, 2011), while Albian-Cenomanian radiolarian and foraminiferal facies are widespread everywhere. Cenomanian radiolarian assemblage *Pseudodictyomitra pseudomacrocephala* of hot greenhouse phase expanded to Koryak-Kamchatka region in the Pacific rim and occurs together with planktonic foraminifera *Hedbergella globigerinellinoides, H. planispira, Globigerinelloides ultramicrus* (VISHNEVSKAYA, 2001). Turonian-Coniacian microplankton of the Arctic and Pacific rims is scarce. In the frame of the North-West Pacific in the Chukchi-Koryak-Kamchatka region foraminiferal zonal scale does not work but is used radiolarian scheme (VISHNEVSKAYA, 2001). Significant changes in radiolarian associations were fixed at the Santonian and Campanian boundary of Pacific rim sequences. *Pseudoaulophacus floresensis* assemblage of warm greenhouse phase during Santonian, comprising 46 species, replaced by *Prunobrachium crassum* assemblage of cool greenhouse conditions during the early-Campanian, where the association has 27 species, among which the spheroid and cyrtoidal groups are represented on an equal, and discoid is in a subordinate amount. Among foraminifera a warm-water Santonian plankton association (*Archaeoglobigerina bosquensis, Hedbergella delrioensis, H. holmdelensis, Heterohelix globulosa, H. reussi*) replaced into Campanian cold-water benthic ones (VISHNEVSKAYA & BASOV, 2007). In addition, the Campanian radiolarian association of Pacific rim, along with zonal species *Prunobrachium articulatum* of Arctic rim, contains *Heliodiscus borealis* Vishnevskaya, *Spongasteriscus rozanovi* Vishnevskaya, *Prunopyle stanislavi* Vishnevskaya - typical cold-water species.

Previously, it was known that many members of the Cenozoic radiolarian fauna appeared in the late Cretaceous - *Amphisphaera, Bathropyramis, Clathrocyclas* (late Campanian / Maastrichtian). But, on the example of *Heliodiscus, Spongasteriscus, Prunopyle*, it is clear that the first representatives of many Cenozoic genera could occur even earlier - in the early Campanian.

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The first hexactinellid sponge skeleton from the Cretaceous of Austria (Schrambach Formation, Northern Calcareous Alps)

Vodrážka, R.[1,*] ***and Lukeneder, A.***[2]

*1) Czech Geological Survey, Prague, Czech Republic, *E-mail: radek.vodrazka@geology.cz*
2) Natural History Museum, Vienna, Austria

The Early Cretaceous outcrops at Klausbachgraben yield abundant and diverse radiolarian and sponge-spicule microfauna. Macrofossils, represented mainly by ammonites and accompanying epifauna (bivalves, serpulids), have been collected and studied by A. Lukeneder, suggesting Late Hauterivian age. During 2016 field-season he found very unusual fossil – a large sponge skeleton encased in silicified calcareous wackestone. This unexpected finding actually represents the first hexactinellid sponge skeleton from the Cretaceous of Austria; its taxonomical, palaeoecological and palaeobathymetrical significance is therefore discussed herein.

The studied outcrops belong to a Lower Cretaceous (Berriasian-Aptian) pelagic to hemipelagic succession of the Bajuvaric Langbath Zone (Northern Calcareous Alps, Upper Austria). The studied sites are outcrops of the High Bajuvaric Unit west of the Lake Traunsee, in the northernmost part of the Northern Calcareous Alps.

The sediment encasing the studied sponge forms irregular calcareous nodule showing early diagenetic microcrystalline silicification. Sediment adhering to walls of the sponge is composed of abundant radiolarian tests, sponge spicules and fragments of sponge skeletons. All these siliceous bioclasts show traces of silica dissolution in places (corroded surface) but secondary silica deposition was documented too - both in the sponge wall (in the form of chalcedony quartz) and in the matrix (microcrystalline silica).

The sponge skeleton is irregularly spreading with peripherally branching and anatomising tubes. Skeletal canals are represented by closely spaced diarhyses perforating both skeletal surfaces. Canal openings of dermal and gastral surface are closely spaced, rounded, oval to polygonal in shape and arranged in seemingly regular honeycomb-like pattern. Cortical meshwork on dermal side is relatively dense with secondarily enlarged nodes in the centre of hexactinosidan spicules. The wall of the sponge is lacking any superficial network on both gastral and dermal surface of the skeleton. All above given characteristics are typical for genus *Aphrocallistes* Gray (class Hexactinellida Schmidt, order Hexactinosida Schrammen, family Aphrocallistidae Gray). More detail examination of studied material will allow comparison with other known *Aphrocallistes* representatives.

Hexactinellid sponges are important source of palaeobathymetrical and palaeoecological data. This is true especially for *Aphrocallistes alveolites* (Campanian-Maastrichtian of Germany and Poland), showing adaptations for both soft-bottom sediments and calm, non-disturbed (neritic) offshore shelf environments. Similar palaeoenvironmental conditions are also suggested for studied sequence, as also evidenced by (1) abundant radiolarians, (2) presence of other groups of siliceous sponges (represented by isolated spicules only) and (3) presence of ammonite shells with numerous epibionts (bivalves, serpulids), that took advantage of scarcely available hard-substrate.

Reassessment of Salzgitter-Salder as potential stratotype for the Turonian-Coniacian Boundary

Voigt, S.[1,*], ***Püttmann, T.***[2], ***Mutterlose, J.***[2]

*1) Goethe University Frankfurt, Frankfurt, Germany, *E-mail: s.voigt@em.uni-frankfurt.de*
2) Department of Geology, Mineralogy and Geophysics, Ruhr-University Bochum, Bochum, Germany

The Turonian-Coniacian succession of the Salzgitter-Salder limestone quarry (Lower Saxony, Germany) has been proposed as international standard section based on its assumend completeness, comparable high sedimentary thickness and its high abundance and diversity of macrofossils (WOOD et al., 1984). The succession contains one of the richest and most persistent record of inoceramid bivalves in Europe. The base of the Coniacian in the Salzgitter-Salder section is marked by a flood occurrence of *Cremnoceramus deformis erectus* and an apparent local change in one scaphitid lineage a short distance below the boundary (WALASZCZYK et al., 2010). In terms of calcareous nannofossils, the boundary falls within the interval between the first occurrence of *Broinsonia parca expansa* and the last occurrence of *Helicolithus turonicus* (LEES, 2007). A carbon isotope curve of rather low resolution shows the Turonian–Coniacian boundary in the inflection point from falling to rising $\delta^{13}C$ values consistent with other sections in Europe (VOIGT & HILBRECHT, 1997). In 1995, the Coniacian Working Group of the Subcommission on Cretaceous Stratigraphy proposed the Salzgitter-Salder quarry as the main candidate Global Boundary Stratotype Section and Point (GSSP) for the base of the Coniacian Stage. However, later stratigraphic work at the Słupia Nadbrzeżna section in Poland showed the first occurrence of *Cremnoceramus erectus* to predate its first flood occurrence, which indicates a small hiatus in the boundary interval at Salzgitter-Salder (WALASZCZYK et al., 2010). Here we present new high-resolution carbon isotope data together with detailed calcareous nannofossil assemblages for the Turonian–Coniacian boundary interval to tie in precisely the recorded macrofossil events and to reassess the magnitude of the hiatus.

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Santonian calcareous nannofossil zonations

Wagreich, M.[1]

1) Department für Geodynamik und Sedimentologie, Wien, Austria, E-mail: michael.wagreich@univie.ac.at

Santonian times were characterized by a shallow calcite compensation depth, and, consequently, a marked increase in deposition of carbonate-free red shales (CORBs) in oceanic sections which are hardly biostratigraphically dateable as calcareous plankton is impoverished. The biostratigraphic subdivision of this time interval is of rather poor resolution in the pelagic realm as exemplified by standard calcareous nannofossil zones. In the old zonation by SISSINGH (1977) and PERCH-NIELSEN (1985) only 3 (low latitude) nannoplankton zones are distinguished: CC15-UC17. BURNETT (1998) indicates originally 2 zones: UC11 (base defined by the FO of *Lithastrinus grillii*) and UC12 (base defined by the LO of *Lithastrinus septenarius*). Lateron, UC13 (base defined by the FO of *Arkhangelskiella cymbiformis*) was also included at least partly into the (late) Santonian (HAMPTON et al., 2007). Especially the CC zones of this time interval were strongly discussed as most of the primary markers of SISSINGH (1977), including *Reinhardtites anthophorus* (FO base CC15), *Lucianorhabdus cayeuxii* (FO base CC 16; base of subzone UC 11c of Burnett, 1998) and *Calculites obscurus* (FO base CC17), were shown to be diachronous, ecologically controlled, and have an earlier and/or doubtful first occurrence (Burnett, 1998, Lees, 2008). No nannofossil zonal marker event is common to both CC and UC low-latitude nannofossil standard zonations during the Santonian. This results in a rather low-resolution chronostratigraphic subdivision of the Santonian in deep-water settings.

The base of the Santonian was defined using the FO of the inoceramid bivalve Platyceramus undulatoplicatus by LAMOLDA et al. (2014) within the GSSP at Olazagutia, Spain. The nannofossil record allows a placement in CC16/17 and UC11, above the successive FOs of *Lithastrinus grilli*, *Lucianorhabdus cayeuxii*, and *Calculites obscurus*, and below the LO of *Lithastrinus septenarius* some distance above the boundary level. The *Amphizygus* lineage, although rare, may give additional markers for the base of the Santonian, with the LO of *Amphizygus brooksi brooksi* and the subsequent FO of *Amphizygus minimus* near the boundary.

Ongoing discussions on the base of the Santonian, and the differences in proposed nannofossil events hamper exact correlation within the Santonian, and thus application of absolut ages. Using cyclostratigraphy within a macro- and microfossil framework and radiometric dates, LOCKLAIR AND SAGEMAN (2008) published a Coniacian-Santonian floating orbital timescale from the Western Interior (Niobrara Formation). According to their results, the duration of the Santonian is 2.24 to 2.53 Ma. THIBAULT et al. (2016) recently compiled data on carbon isotopes from UK, Germany, Italy, and the Western Interior, USA, resulting in a robust astronomical calibration of five 405 ka cycles, and a duration of the Santonian of 2.30 Ma.

The Gosau Group of Austria – reference sections for the Santonian-Campanian boundary in the NW Tethys and the *Broinsonia parca parca* bioevent

***Wagreich, M.**,*[1], Wolfgring, E.[1], Summesberger, H.[2]*

*1) Department für Geodynamik und Sedimentologie, Wien, Austria, *E-mail: michael.wagreich@univie.ac.at*
2) Geological-Palaeontological Department, Natural History Museum, Vienna, Austria

Santonian-Campanian sections of the Gosau Group at Gosau (Upper Austria) and Abtenau (Salzburg) record various stratigraphic signals around the boundary interval. Ammonite, inoceramid, echinoid, plankton and isotope data from the upper Santonian Schattau section are complemented by the Postalm section where the boundary could be defined by the base of the reversed magneto-Chron C33r above the Long Cretaceous Normal Chron C34n. A composite section indicates the following sequence of regional marker events in the late Santonian to lowermost Campanian interval from base to top:

- consistent occurrence/acme of *Calculites obscurus* (base of nannofossil zone CC17)
- FO of curved *Lucianorhabdus cayeuxii* ssp. B (base of subzone CC17b)
- late Santonian ammonites and inoceramids, e.g. *Boehmoceras arculus*, *Cordiceramus muelleri muelleri*
- (local) FO of *Globotruncanita elevata* and *Gta. stuartiformis*
- occurrence of *Marsupites laevigatus* in a *Micraster* bed
- FO of *Arkhangelskiella* (cf.) *cymbiformis* (base of UC13)
- highest local ammonite occurrence (*Texasia dentatocarinata*)
- Onset of positive carbon isotope excursion (probably the SCBE – Santonian-Campanian boundary event)
- FO of *Stensioina pommerana*
- Peak of negative oxygen isotope excursion, onset of positive magnetic susceptibility excursion
- FO of *Calculites obscurus* W (widely separated sutures; local event?)
- magnetostratigraphic reversal - base of the Campanian as defined by base of reversed Chron C33r (strontium isotope value of 0.707534)
- LO of *Muricohedbergella flandrini*
- LO of *Dicarinella asymetrica* (top of D. asymetrica Zone, base of Globotruncanita elevata Zone)
- FO of *Broinsonia parca parca* sensu stricto (base of CC18a and UC14a)
- rare FO of *Ceratolithoides* sp.
- FO of *Broinsonia parca constricta* (base of CC18b and UC14b)
- LO of *Marthasterites furcatus* (base of CC19)

Five transitional forms of the *Broinsonia parca*-group can be distinguished according to two morphological parameter, i.e. the length of the coccolith and the b/a ratio (ratio between width of the central area b and rim/shield(s) width): (1) *Broinsonia enormis* ssp.1 (length < 9 µm, b/a ratio ≥ 2); (2) *Broinsonia enormis* ssp.2 (length < 9 µm, b/a ratio < 2); (3) *Broinsonia parca expansa* (length > 9–10 µm, b/a ratio ≥ 2); (4) *Broinsonia parca parca* (length > 9–10 µm, b/a ratio < 2 - ≥ 1= *Broinsonia parca parca* sensu stricto); *Broinsonia parca constricta* (length > 9–10 µm, b/a ratio < 1).

Events in Earth history: The K/Pg impact versus the Anthropocene

Wagreich, M.[1]

1) Department für Geodynamik und Sedimentologie, Wien, Austria, E-mail: michael.wagreich@univie.ac.at

The Anthropocene in terms of stratigraphy comprises a short-duration event, especially if seen as beginning with the Great Acceleration some 70 years ago (WATERS et al., 2016). The only known fundamental stratigraphic events that have a similar time frame associated with immense global implications constitute asteroid impacts such as the Cretaceous/Paleogene boundary Chicxulub impact. Rates of global change and rates of extinction may be compared between these two short-time events. Some of the proxies encountered, such as stable carbon isotope values, show similar ranges of change from pre-Industrial values to Today as during the impact event. Iridium spikes can be compared to the bomb spike produced by artificial radiogenic fallout associated with nuclear weapons testing, i.e., plutonium isotopes from 1952–1964. Rates of extinction, although increasing dramatically, will lead to the sixth mass extinction in several hundreds of years, but may be still comparable to the K/Pg mass extinction. The perturbation of the atmospheric CO2 will last several tens of ka, similar to the K/Pg boundary, and recovery thus may take hundreds of ka. However, the wealth of new materials and minerals as well as the global spread of anthropogenic signals and markers in the Anthropocene is enormous and not equalled by any of the big five, making the Anthropocene an exceptional event in Earth history and stratigraphy, strongly supporting a formal chronostratigraphic Anthropocene epoch (ZALASIEWICZ et al., 2017).

WATERS, C. et al., 2016. dx.doi.org/10.1126/science.aad2622.
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Stratigraphic subdivision of the Coniacian Stage: State of the art

Walaszczyk, I.[1]

1) Faculty of Geology, University of Warsaw, Warszawa, Poland, E-mail: i.walaszczyk@uw.edu.pl

After more than two decades of studies, the boundary definition of the Coniacian Stage as accepted in Brussels 1995 (see KAUFFMAN et al., 1996), i.e. at the first appearance of *Cremnoceramus deformis erectus* (Meek) [*Cremnoceramus rotundatus* sensu (Tröger *non* Fiege) at that time] appears to be the best choice available. It became clear (WALASZCZYK and WOOD, 1999, WOOD et al., 2004) that the appearance of this species is a well recorded cladogenetic speciation event and hence an evolutionary phenomenon which represents a good time point.

The first appearance level of *C. deformis erectus* is well recognizable throughout the entire Euramerican biogeographic region and appears to be correlatable to the East African Province (WALASZCZYK et al., 2004) where it probably equates with the base of the *Tethyoceramus madagascarensis* Zone (all biogeographical units after KAUFFMAN, 1973). This Euramerican marker is therefore either valid on its own for recognizing the base of the Coniacian Stage directly, or it enables indirect correlation with other biomarkers in coeval marine successions elsewhere in the world (WALASZCZYK et al., 2010). Carbon-isotope data for the boundary intervals (VOIGT in WALASZCZYK et al., 2010) and for the entire Coniacian are available (e.g., JARVIS et al., 2006; YOO & SAGEMAN, 2014).

Of the stratotype proposals for the base of the Coniacian presented during the Brussels Symposium in 1995 (KAUFFMAN et al., 1996), only the Salzgitter-Salder Quarry section (Lower Saxony, northern Germany), seems to be still worth of considering, in spite of the fact that it was shown to contain hiatuses in the boundary interval (WALASZCZYK & WOOD, 1999; WOOD et al., 2004). Neither the Wagon Mound section (New Mexico, US Western Interior), Słupia Nadbrzeżna (central Poland), nor the Pueblo section (SE Colorado, US Western Interior) appeared suitable (WALASZCZYK et al., 2010, 2012).

Subsequently, the working group had proposed a composite section for the GSSP candidate (WALASZCZYK & WOOD, 2008). This composite section would have combined the succession exposed in Salzgitter–Salder (Lower Saxony, Germany) and in Słupia Nadbrzeżna (central Poland).

The two latest stratotype proposals are: (1) the Hot Springs Trail section, in the Big Bend National Park, in Texas (Dee Ann Cooper, Texas University, Austin, and Roger Cooper, Lamar University) and (2) the El Rosario section, in Coahuila, northeastern Mexico (IFRIM et al., 2014). Both are expanded fossiliferous successions which require, however, further investigation.

The Coniacian substage subdivision, as proposed and accepted during the Brussels Symposium, is in general use since then. The bases of the Middle and of the Upper Coniacian are defined by the first appearances of inoceramid species *Volviceramus koeneni* and *Magadiceramus subquadratus* respectively. No stratotype was suggested or formally proposed either for the base of the Middle of for the Upper Coniacian substage.

The Coniacian stratigraphy in the Western Interior of North America: A Canadian perspective

Walaszczyk, I.[1,*], Plint, A.G.[2], Landman, N.H.[3]

*1) Faculty of Geology, University of Warsaw, Warszawa, Poland, *E-mail: i.walaszczyk@uw.edu.pl*
2) Department of Earth Sciences, The University of Western Ontario, London, Ontario, Canada
3) Division of Paleontology, American Museum of Natural History, New York, USA

The Coniacian in the foredeep of the Western Canada Foreland Basin (western Alberta, including northern Montana), is dominated by mudstone and subordinate sandstone, deposited on a very low-gradient, storm-dominated marine ramp. The rocks are characterized by upward-shoaling successions, ~3–10 m thick, bounded by marine flooding surfaces. Flooding surfaces that were particularly widely-traceable in wireline logs were chosen as the boundaries of 24 informal allomembers. Most allomembers could be mapped along the foredeep for > 750 km and traced to outcrop in the Rocky Mountain fold and thrust belt. Certain allomembers and flooding surfaces have distinctive characteristics that allow confident correlation between subsurface and outcrop. Consequently, fossils collected at outcrop could be placed precisely in a regional (~ 200,000 km^2) spatial and temporal context.

Molluscan fossils are dominated by inoceramid bivalves and scaphitid ammonites. In the upper Lower Coniacian - basal Santonian, six successive inoceramid zones are recognised. In ascending order, these are: *Cremnoceramus crassus / deformis*; *Inoceramus gibbosus*, *Volviceramus koeneni*, *Volviceramus involutus*, *Sphenoceramus subcardissoides*, and *Sphenoceramus* ex gr. *pachti*. Four standard scaphitid zones of the North American Western Interior (*Scaphites preventricosus*, *S. ventricosus*, *S. depressus* and *Clioscaphites saxitonianus*) are precisely correlated with the inoceramid succession.

The studied succession provides a good record of the *Inoceramus gibbosus* Zone of the uppermost Lower Coniacian. Due to stratigraphic gaps resulting from eustatic changes, the *I. gibbosus* zone is commonly absent. The base of the Middle Coniacian is marked by a distinct lag-strewn flooding surface, above which appear *Volviceramus* fauna (*V. koeneni, V. exogyroides*, *V. cardinalensis*), associated with *Inoceramus undabundus* Meek and Hayden. *Scaphites ventricosus*, taken to mark the base of the Middle Coniacian, appears with *I. gibbosus* in the late Early Coniacian. The base of the Upper Coniacian is placed at a distinct flooding surface and is marked by the first appearance of *Sph. subcardissoides*, which co-appears with *Scaphites depressus*, the traditional marker for this boundary. The base of the Santonian is marked by facies change to more offshore sediment, accompanied by the abrupt appearance of *Sphenoceramus* ex gr. *pachti* (Arkhangelsky), accompanied by *Clioscaphites saxitonianus*, the scaphitid marker of this boundary.

The high-resolution, regional allostratigraphic framework makes it clear that the appearance of new inoceramid faunas takes place immediately above major flooding surfaces, most of which succeed significant regressions suggestive of eustatic sea-level fall and exposure of inner shelf areas. This observation suggests that there is a causal link between evolutionary and/or migration events and episodes of sea-level change. Repeated sea-level excursions therefore appear to explain the rapid turnover rate among Coniacian inoceramid faunas.

Preliminary carbon-isotope data from one section, supported by biostratigraphic tie-points, allow a preliminary and tentative correlation to the English Chalk reference curve.

Terrestrial biota and climate during Cretaceous greenhouse in NE China

***Wan, Xiaoqiao**[1,*], Wu, Huaichun[1], Xi, Dangpeng[1], Qin, Zuohuan[1]*

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: wanxq@cugb.edu.cn*

Northeast China offers a unique opportunity to perceive Cretaceous stratigraphy and climate of terrestrial settings. The sediments contain variegated clastic and volcanic rocks, diverse terrestrial fossils, and important coal and oil resources. Four Cretaceous biotas of Jehol, Fuxin, Songhuajiang and Jiayin occurred in ascending order. For scientific purpose, a coring program (SK1) provides significant material for Cretaceous research. The SK1 presents a continuous section of Upper Cretaceous non-marine fossils, magnetochron successions and chronostratigraphic events. These events are integrated with marine events by an X/Y graphic plot between the core data and a global database of GSSP and key reference sections (SCOTT et al., 2012). More precisely, age interpolation based on CA-ID-TIMS U–Pb zircon dates and the calibrated cyclostratigraphy places the end of the Cretaceous Normal Superchon at 83.07 ±0.15 Ma (DENG et al., 2013). This date also serves as an estimate for the Santonian–Campanian stage boundary (HE et al., 2012; WANG et al., 2016). It also places the K/Pg boundary within the upper part of the Mingshui Formation. The terrestrial and marine life and the analytical data of elemental composition, $\delta^{13}C_{org}$, and biomarkers show that lake water salinity changed along with a Coniacian–Santonian marine incursion. High lake-level coincides with the sea transgression during the time. High salinity resulted in the development of periodic anoxic environments of the basin. One of these times of deposition of organic-rich mud correlates with the mangnetochron of C34N/C33R and Coniacian–Santonian planktic foraminifera horizon. This marine flooding correlates with OAE 3 and it is possible that the global oceanic anoxic event may have influenced organic carbon burial in the Songliao Basin for this brief period. The evolution of 4 biotas corresponds to the Cretaceous climate change. We tentatively interpret the terrestrial record to reflect the changes in both global climate and regional basin evolution.

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Early Eocene Radiolarian Fauna from the Sangdanlin, Southern Tibet: Constraints on the Timing of Initial India-Asia Collision

Wang, Tianyang[1] and Li, Guobiao[1,*]

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: liguobiao@cugb.edu.cn*

A number of previous works were done on the timing of initial India-Asia collision and the closing age of Neotethys (e.g. DING, 2003; LI & WAN, 2003; LI et al., 2004, 2005; WAN et al., 2014). This is a new report on the early Eocene radiolarian fauna from Sangdanlin section, Gyirong along the southern margin of the Yarlung Zangbo Suture Zone. The measured Sangdanlin section in this study is subsequently divided into three lithostratigraphic units from bottom to top: Zongzhuo, Sangdanlin and Zheya formations. Abundant radiolarian fossils were obtained from the Sangdanlin section, and a total of 54 species of 30 genera were identified, which were assigned to late Cretaceous *Cryptamphorella conara-C. macropora* Assemblage Zone and Paleocene–early Eocene *Amphisphaera coronate*, *Buryella tetradica* - *Bekoma campechensis* and *Bekoma campechensis-B. divaricata* interval zones. Three Paleocene–early Eocene radiolarian zones could be comparable to the radiolarian RP4–RP8 zones in New Zealand (HOLLIS, 1997). Based on the data of radiolarian zones and lithofacies, it is suggested that the Zongzhuo Formation should be deposited along the base of the north facing continental slope of the Greater Indian continental margin and the Sangdanlin Formation should be a deep marine sedimentary sequence located in a foredeep basin. The early Eocene radiolarian fauna in the Sangdanlin Formation constrains the initial age of the India-Asia collision to no later than 53.6 Ma.

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Ostracod biostratigraphy suggests no non-marine J/K boundary in the Dabeigou Formation or Dadianzi Formation, Luanping Basin, China

***Wang, Yaqiong*[1]**

1) Key Laboratory of Economic Stratigraphy and Palaeogeography, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, Email: yqwang@nigpas.ac.cn

The non-marine Jurassic/Cretaceous boundary was thought in the Luanping Basin. But the definition of this boundary in the Luanping Basin is still problematic. Some researchers defined the J/K boundary at the basal part of the Fourth Member of the Dadianzi Formation, based on ostracod biostratigraphy (e.g. TIAN et al., 2004). While in some opinions, the J/K boundary is at the basal part of the Dabeigou Formation or the upper part of the Tuchengzi Formation according to the radiometric date's data (e.g. WAN et al., 2003). They also mentioned that the non-marine J/K boundary from fossil biostratigraphic results does not match the radiometric dates.

In this study, we revised ostracod species from the genera *Cypridea*, *Ziziphocypris*, *Rhinocypris*, *Alicenula*, *Luanpingella*, *Torinina* and *Daurina* of the Dabeigou and Dadianzi formations. Among them, four species are valuable for biostratigraphic correlations and age determination. The species *Luanpingella postacuta* is found in the Dabeigou Formation of China, the Tsagentsabskaya Suite/Formation (Tithonian to Valanginian) and Gurvan Eren Formation of Mongolia and the Member Supérieur of the Iouaridènes Formation of Morocco (Hauterivian to Barremian [ANDREU et al., 2003]). *Torinina tersa* and *Torinina chimkae* occur in the Dabeigou Formation of China (PANG, 1984), the Unduruhinskaya Formation (Lower Cretaceous) of Mongolia, and the Torey? and Turga formations (Valanginian to Hauterivian) and the Gidar Suite (Valanginian to Barremian) of Russian. The species *Daurina eggeri* is know from the Dadianzi (PANG, 1984) and Yixian formation (CAO, 1999) (Hauterivian to Barremian) of China, the Turga Formation (Valanginian to Hauterivian), the Gidar and the Godimboy suites of Russian and the Ulugeyskaya? Formation of Mongolia (Lower Cretaceous). In conclusion, our ostracod bostratigraphic study suggests that the age of Dabeigou Formation is Valanginian to Hauterivian, and that of the Dadianzi Formation is Hauterivian to Barremian. Therefore, the J/K boundary in the Luanping Basin is nether in the Dabeigou Formation nor in the Dadianzi Formation. This matches the radiometric dates from the Dabeigou and Dadianzi formation very well.

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Triassic to Cretaceous fossil wood studies of China: Diversity variations and paleoclimate implications

***Wang, Yongdong**[1,*], Tian, N.[2], Jiang, Z.[3], Yang, X.[4], Ding, Q.[5]*

*1) State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, *E-mail: ydwang@nigpas.ac.cn*
2) College of Paleontology, Shenyang Normal University, Shenyang, China
3) Chinese Academy of Geological Sciences, Beijing, China
4) Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China
5) Shenyang Geological Center, China Geological Survey, Shenyang, China

As an important component of plant remains, fossil wood plays a significant role in understanding the floral composition and evolution of plants in the geological past. Fossil wood is also one of the significant proxies for terrestrial palaeoclimate and palaeogeographical reconstruction in earth history. Diversified fossil wood has been documented from the Mesozoic deposits in China after a long time of investigations. During the past few years, many new fossil wood materials were reported from a variety of horizons in some fossil localities, including Sichuan, Chongqing, Yunnan, Xinjiang and Liaoning provinces, ranging from Triassic to the Cretaceous, providing significant references for reconstructing the Mesozoic palaeoclimate. In this study, we summarize the recent advances in fossil wood studies of Triassic to Cretaceous in China. Particularly, the new discoveries of fossil wood from the Upper Triassic in Sichuan of southern China, the Jurassic Yanliao Biota and the Early Cretaceous Jehol Biota in western Liaoning are reviewed with emphasis on the diversity variations, palaeoclimate perturbations and tempo-spatial distribution of the Mesozoic wood in China. The future research directions of Mesozoic fossil wood in China are further discussed.

A new fossil Musci (Bryidae) from the Cretaceous of Northeast China

***Wang, Yongdong*[1,*] and Wu, Xiangwu[2]**

*1) State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China, *E-mail: ydwang@nigpas.ac.cn*
2) Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China

Fossil mosses are very limited in deep time, less than 100 species have been documented so far globally for the Pre-Quaternary history (JASSENS et al., 1979). In China, the fossil record of mosses is rare. In the Cenozoic, only two species are recorded, including *Calymperopsis yunfuensis* Wu, Luo et Meng from the Quaternary of Guangdong, *Neckera shanwanica* Wu et Fen from the Miocene in Shandong. Prior to the Cenozoic, less than 10 species of fossil mosses have been described in China. The fossil sporophytes with undoubted affinity of Bryidae are in particular very rare. Among previous reports, only two species including *Muscites yallournensis* Clif. *et* Cookson from the Oligocene of Australia and *Stachybryolites zhoui* Wu, Wu *et* Wang from the Lower Jurassic in Kramay of Xinjiang have been recorded. These specimens are however represented by the dispersed preservation of capsules. Here we report a new fossil Bryidae (Musci) *Panchiehia jiayinensis* gen. *et* sp. nov. from the Lower Cretaceous Taoqihe Formation in Jiaying of Yichun City, Heilongjiang Province of northeastern China. Although the specimen is small and fragment, the essential structures of Bryidae are all well preserved, including vegetative organs (such as stem, leaves, false root, paraphyllia), reproductive organs (male shoot) and the stalked capsule of the sporophyte. The stem of this plant is creepy, branches are vertical to erect, and are many times dichotomous branching. The sporophytes are in the top of the lateral branches, with stalk and an oval capsule that is bilateral symmetrical, and with two layers of peristomal teeth. These features are quite similar to those from the relative genera of living Leskeaceae belonging to Hypnobryales of Bryidae, implying their potential affinity. The fossil specimen reported from the Lower Cretaceous of Heilongjiang is very remarkable and represents the first discovery of fossil gametophyte with the reproductive organs and sporophytes (capsules and stalks). Therefore, this new fossil Musci from the Cretaceous of China shows very important significance for understanding the evolution of fossil bryophytes.

Mesozoic C-cycle perturbations and climate: evidence for increased resilience of the Cretaceous biosphere to greenhouse pulses

Weissert, H.[1]

1) Earth Sciences, ETH Zurich, Zurich, Switzerland, E-mail: helmut.weissert@erdw.ethz.ch

The Mesozoic C-isotope record traces the history of the global carbon cycle. Major perturbations of the carbon cycle triggered by extraordinary volcanic activity are recorded in negative spikes coupled with positive C-isotope excursions. Prominent examples are the extreme events at the Permo-Triassic and Triassic-Jurassic boundaries and in the Toarcian or in the Aptian. While major volcanic pulses at the P-T and T-J boundary are considered as the main trigger of mass-extinctions, extreme events in the Cretaceous were not accompanied by comparable extreme loss of marine or terrestrial biota. The data suggest that either changes in degassing of LIPs (SOBOLEV et al., 2011) and/or that the resilience of the Mesozoic biosphere to climate pulses changed through time. It is hypothesized that two factors contributed to increased resilience of the biosphere in the Cretaceous: (1) Starting in the Late Jurassic, pelagic carbonate developed into an important sink of carbon dioxide in the long-term carbon cycle, contributing to increased resilience of the carbon cycle to perturbations if compared with the Early Mesozoic dominated by shallow-water carbonate production. The Aptian C-isotope anomaly, for example, was accompanied by a shallowing of the CCD (THIERSTEIN, 1979). Shallowing of the CCD contributed to rapid lowering of elevated pCO_{2atm} and to dampening of extreme acidification events associated with volcanic activity. (2) Increasing fragmentation of Pangea resulted in the establishment of a transequatorial current system coupled with equatorial upwelling and strong deep-water erosion. This circulation pattern was intensified during greenhouse pulses. Increased marine productivity and widespread basinal anoxia (Oceanic Anoxic Events) favoured the intensification of the biological carbon pump. Peculiar oceanography coupled with an intensified biological carbon pump contributed to the stabilisation of atmospheric CO_2 levels. Increased resilience of the Cretaceous biosphere to volcanic activity may explain why Deccan Trap volcanism was not sufficient anymore as a trigger of a mass-extinction at the K-Pg boundary, ultimately triggered by the Chicxulub asteroid impact.

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The crux of interpreting oxygen isotope data with respect to Milankovitch-scale sea-level changes during greenhouse climates

Wendler, I.[1]

1) Friedrich Schiller University Jena, Jena, Germany, E-mail: flatter@uni-bremen.de

Oxygen isotope data from marine carbonates are routinely used to interpret fluctuations in temperature, continental ice volume and sea level for the glacial – interglacial periods of the Pleistocene icehouse climate. Such interpretation is fraught with difficulties for older records from greenhouse epochs such as the Cretaceous, especially the very warm middle Cretaceous, when cyclic Milankovitch-scale (3^{rd} and higher -order) sea-level changes were most likely not forced by glaciation – deglaciation cycles. Instead, the higher temperatures cause stronger hydrological cycling and potentially a landward shift of the ocean – land water balance that would lead to falling sea level as temperatures rise and vice versa. This relationship is opposite to the positive correlation between sea level and temperature during icehouse climates. What does that mean for the interpretation of oxygen isotope records with respect to sea level? Apart from the well-known problems that hamper interpretation of deep-time $\delta^{18}O$ records, such as unknown pH and $\delta^{18}O$ value of the seawater and diagenetic alteration, a number of other factors need to be considered when relating $\delta^{18}O$ records to sea level in greenhouse climates.

Oxygen-isotope fractionation occurs through preferential removal of ^{16}O from seawater during evaporation and preferential removal of ^{18}O from the water vapor during condensation. The evaporative removal of water from the ocean and its storage on land, both as continental ice and as liquid water in aquifers, sequesters ^{16}O and increases the $\delta^{18}O$ value of the remaining water in the ocean (effect of ice volume and groundwater volume). However, because oxygen-isotope fractionation is temperature dependent and there is an opposite effect of temperature on the accumulation of terrestrial ice versus groundwater, the net fractionation effect for oxygen is different for icehouse and greenhouse climates. The presentation discusses the various influences on the $\delta^{18}O$ record such as latitudinal temperature gradients, number of precipitation steps, dynamics of terrestrial water storage, spatial salinity variations and the temperature effect itself.

Gains and pitfalls of proxies for the reconstruction of ocean-continent water transfer - testing aquifer eustasy

***Wendler, J.*[1,*], *Wendler, I.*[1], *Sames, B.*[2], *Wagreich, M.*[2]**

*1) Friedrich-Schiller-University Jena, Jena, Germany, *E-mail: wendler@uni-bremen.de*
2) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria

One of the most intriguing factors of the global water cycle is the balance of polar ice and continental water storage in managing global sea-level fluctuations. It was shown that greenhouse climates, e.g. during certain times in the Cretaceous, were probably dominated by aquifer eustasy (WENDLER & WENDLER, 2016), and on the contrary icehouse climates seem to be dominated by glacio eustasy. But it is the balance between both factors which is particularly interesting for a holistic understanding of sea-level change by involving observational data available today. Namely the human influence on the water cycle is a major factor in shaping the Anthropocene because we humans screw up both the households of aquifers and polar ice at the same time. 21 of the 37 largest aquifers have been significantly depleted contributing to sea-level rise (RICHEY et al., 2015). On the other hand rainfall increases related to the ENSO phenomenon La Nina in certain regions around the globe move water back on land causing notable sea-level fall (REAGER et al., 2016). Through these processes the spatial expand of vegetation changes and influences amounts of biological CO_2-uptake and thus the global carbon cycle as well as global temperatures. That way, global vegetation coverage represents the third regulation factor of a system whose impact on sea level we can actually observe and measure today, a system which needs to be understood when reconstructing sea-level in the geological past, and also when forecasting future sea-level. Proxies for a faithful reconstruction of precipitation appear to be a crucial prerequisite for such tasks. This talk introduces the idea of an ice-aquifer-biosphere water balance and addresses gains and pitfalls of proxies for continental precipitation.

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When the going gets tough, the tough gets going - Cretaceous deep sea atelostomate echinoids resist oceanic anoxic events

Wiese, F.[1,*], ***Reich, M.***[2], ***Schlüter, N.***[3]

*1) Department of Geobiology, Geoscience Centre, Georg-August University Göttingen, Göttingen, Germany, *E-mail: fwiese1@gwdg.de*
2) SNSB - Bavarian State Collection of Palaeontology and Geology, München, Germany
3) Museum fürNaturkunde, Leibniz Institute for Evolution and Biodiversity Science, Berlin, Germany

By re-investigation of Aptian/Albian irregular echinoid spines (ODP Leg 171B Blake Nose (800–1,000 m palaeodepth) from Thuy et al. (2012), we show that – based on the pore arrangement in the spine's cylinder (Schlüter et al., 2015) – Spatangoida and Holasteroida possibly inhabited the deep sea already at that time. From IODP Leg 342 Newfoundland (site 1407C, estimated palaeodepth 800–1,000 m), Upper Cenomanian to Middle Turonian chalk-like sediments, yielding black shales of the OAE 2 (Cenomanian/Turonian boundary), contain frequent, morphologically distinct and variable irregular echinoid spines, belonging to crown group Atelostomata (Spatangoida, Holasteroida). Remarkable is the almost complete lack of remains from any other echinoid group. It contradicts the diversity and structure of nowadays deep-sea echinoid communities. A generic identification of taxa based spine characteristics is impossible (at the moment?). However, due to general minute spine size, it must be assumed that the atelostomate assemblage consisted of small-sized taxa with very thin-shelled tests, showing low preservation potential, why no test fragments were recovered. These features are in accord with several recent deep-sea Atelostomata (e.g. *Pourtalesia*, *Echinosigra*). No atelostomata records occur for the black shale intervals, but the quasi continuous record of atelostomate spines below and above demonstrates resilience against OAEs. The persistence of the group possibly ever since the Albian predates the inferred Santonian invasion of the deep sea by crown group Atelostomata (Smith, 2013) potentially by c. 27 my and supports ideas about the antiquity of some of the deep sea macrofauna (Thuy et al., 2012). At the moment, pre- and post-OAE 2 spine assemblages are tested for its disparity (identical taxa or immigration?). Finally, the deep sea records will be compared to occurrence from the Cenomanian/Turonian succession of shelf deposits (Eastborne). Stay tuned!

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Early Late Cretaceous sea-level changes: new insights from Cenomanian-Turonian successions around the Mid-European Island

Wilmsen, M.[1]

1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, E-mail: markus.wilmsen@senckenberg.de

During the early Late Cretaceous, a substantial global sea-level rise flooded vast continental areas, creating extensive shelf seas all across the globe. The course of this early Late Cretaceous transgression is reflected by the stratigraphic patterns in the basins surrounding the Mid-European Island (MEI; e.g., JANETSCHKE et al., 2015). Based on an integrated study and sequence stratigraphic correlation of well-dated sections in these basins, the patterns of early Late Cretaceous sea-level changes have been elucidated and the focus will be on new unpublished results.

The early Late Cretaceous transgression can be subdivided into two superordinate transgressive-regressive (T/R) cycles composed of stacked, unconformity-bounded depositional sequences. The first T/R cycle commenced in the earliest Cenomanian and was characterized by a prolonged transgression phase culminating in an earliest Turonian maximum flooding interval. The five sequences of this transgressive hemicycle are retrogradationally stacked and the major part of the stratigraphic onlap patterns observed at various places around the MEI formed during this interval (e.g., NIEBUHR et al., 2014). The progradational hemicycle was relatively short and comprises the early Turonian when accommodation was rapidly filled by prograding coastal facies (e.g., RICHARDT et al., 2013). A conspicuous unconformity in the lower–middle Turonian boundary interval delineates the first from the second T/R cycle (e.g., WILMSEN et al., 2014) that started with a significant transgression in the early middle Turonian. Maximum flooding was during the late middle Turonian, and a major mid-late Turonian sea-level fall ended the second T/R cycle, consisting of three depositional sequences. The integrated dating of newly cored sections at the southern margin of the Münsterland Cretaceous Basin resulted in a detailed correlation of proximal and distal facies zones, a better understanding of the sequence stratigraphic dynamics in the basin and a revised dating of glauconitic marker beds. The following T/R cycle likewise started with a major late Turonian transgression but the onset/acceleration of basin inversion in central Europe during the latest Turonian to Coniacian complicates sequence stratigraphic analyses of post-Turonian successions. However, this study provides strong evidence for the predominant eustatic control on Cenomanian–Turonian stratigraphic architectures in Central Europe.

JANETSCHKE, N. et al., 2015. Cretac. Res., **56**, 530–549.
NIEBUHR, B. et al., 2014. Z. dt. Ges. Geowiss., **165**, 621–640.
RICHARDT, N. et al., 2013. Facies, **59**, 803–827.
WILMSEN, M. et al., 2014. Z. dt. Ges. Geowiss., **165**, 641–654.

Upper Cretaceous nautilids from the Elbtal Group (Cenomanian-Coniacian, Saxony, Germany)

***Wilmsen, M.*[1]**

1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, E-mail: markus.wilmsen@senckenberg.de

Nautilids are quite common in appropriate facies of the Saxonian Cretaceous (lower Upper Cretaceous Elbtal Group), especially in the offshore Pläner and marl deposits. However, specimens are often strongly deformed internal moulds that are difficult to identify to species and even genus level. This taphonomic issues, in combination with systematic problems and the lack of synoptic modern revisions on Cretaceous nautilids, led to considerable uncertainty in the knowledge on the taxonomy and palaeobiodiversity of the group, not only in the Saxonian Cretaceous.

Extensive material in the palaeozoological collection of the Museum for Mineralogy and geology of the Senckenberg Natural History Collections Dresden forms the basis for the systematic revision of the Cretaceous nautilids from Saxony (WILMSEN, 2016). In total, eight nautilid species' in four genera have been documented for late Cenomanian to late Turonian interval (ca. 5 myr): *Eutrephoceras sublaevigatum* (D'ORBIGNY, 1850), *E. sphaericum* (FORBES, 1845), *E. justum* (BLANFORD, 1861), *Angulithes fleuriausianus* (D'ORBIGNY, 1840) and *Cymatoceras elegans* (J. SOWERBY, 1816) as well as *Deltocymatoceras rugatum* (FRITSCH, 1872), *D. galea* (FRITSCH, 1872) and *D. leiotropis*? (SCHLÜTER, 1876). Representatives of the genus *Eutrephoceras* are the most common group and most specimens have been classified as *E. sublaevigatum* in former times. However, two more species of the genus have been identified, the strongly inflated *E. sphaericum* and the compressed *E. justum*. Furthermore, it turned out that understanding of taphonomy plays a crucial role for nautilid identification because deformation can produce inflated or compressed taphoforms as well. Moreover, the differentiation of simple *versus* composite internal moulds may be important for the taxonomy of ribbed taxa and the existence of "taphospecies" may be a widespread problem in nautild systematics (e.g., inferred taphonomic pair of "*Angulithes*" *galea* and *D. rugatum*). Representatives of the largely smooth-shelled genera *Eutrephoceras* and *Angulithes* predominantly occur in offshore Pläner and marl facies while ribbed forms of the genera *Cymatoceras* and *Deltocymatoceras* also have been recorded from nearshore sandy deposits of the Saxonian Cretaceous.

WILMSEN, M., 2016. Geol. Sax., **62**, 59–102.

Coniacian-Campanian epeiric carbonate platform system of the Haftoman Formation (northern Yazd Block, Central Iran)

***Wilmsen, M.*[1,*], Berensmeier, M.[1], Fürsich, F.T.[2], Majidifard, M.R.[3], Schlagintweit, F.[4]**

*1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, *E-mail: markus.wilmsen@senckenberg.de*
2) GeoZentrum Nordbayern, Erlangen, Germany
3) Geological Survey of Iran, Tehran, Iran
4) München, Germany

The Central-East Iranian Microcontinent (CEIM) was an independent structural unit isolated from the southern margin of Eurasia (Turan Plate) during most of the Mesozoic Era. It consists of three structural blocks, i.e., the Yazd, Tabas and Lut blocks (from W to E). The Cretaceous succession of the Yazd Block has a thickness of up to >5 km and comprises two transgressive–regressive megacycles (TRMs), separated by a major upper Turonian/lower Coniacian tectonic unconformity (WILMSEN et al., 2015). In the northern part of the Yazd Block, the up to 1,000-m-thick Haftoman Fm rest on this pronounced unconformity clearly associated with tectonic movements and karstification. Above a basal transgression conglomerate, the Haftoman Fm commences with thick-bedded to massive shallow-water carbonates which biostratigraphically have been calibrated using inoceramid bivalves, ammonites and larger benthic foraminifera. Careful litho-, micro- and biofacies analyses led to the identification of several facies types that can be merged into four principal facies associations (FA). FA 1 groups fine-grained, micritic facies (wacke- to packstones) with open-marine biota (calcispheres, sponge spicules, small foraminifera) that accumulated in subtidal offshore settings. FA 2 consists of well-sorted bio- and intraclastic pack- and grainstones occasionally showing cross-bedding and large-scale clinoformed bedsets. FA 3 comprises coarse-grained, more poorly sorted bioclastic float- and rudstones. FAs 2 and 3 indicate high to moderately high water energy and may characterize wind- and leeward sub-environments of extensive submarine shoal complexes. FA 4 combines lagoonal facies types (e.g., fenestral mudstones, bindstones, foraminiferal mud-/wackestones, rudist bafflestones) that indicated reduced water energy and often have been subjected to meteoric diagenesis. An epeiric carbonate platform environment with open circulation integrates all observations derived from the integrated study of the Haftoman Formation. The widespread uniform facies development and nearly absent terrigenous input suggest a period of tectonic quiescence and even subsidence of the northern Yazd Block during Coniacian–Campanian times. Stacked depositional sequences separated by subaerial sedimentary unconformities (karstified and mineralized hardgrounds) indicate superimposed 3rd-order sea-level changes.

WILMSEN et al., 2015. J. Asian Earth Sci., **102**, 73–91.

High-resolution chemostratigraphic calibration of the Campanian-Maastrichtian boundary interval at Kronsmoor (northern Germany): a Boreal reference section revisited

Wilmsen, M.[1,*]***, Engelke, J.***[1]***, Linnert, C.***[2]***, Mutterlose, J.***[2]***, Niebuhr, B.***[1]

*1) Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Dresden, Germany, *E-mail: markus.wilmsen@senckenberg.de*
2) Ruhr-Universität Bochum, Institut für Geologie, Mineralogie und Geophysik, Bochum, Germany

The Saturn quarry near Kronsmoor (northern Germany) exposes a continuous fossiliferous succession of upper Campanian to lower Maastrichtian chalks (Kronsmoor and lowermost Hemmoor formations). It has been suggested as a reference section for the base of the Maastrichtian Stage in the Boreal Realm (NIEBUHR et al., 2011), the GSSP being situated in the Tethyan Realm at Tercis les Bains in SW France (ODIN & LAMAURELLE, 2001). In the original definition of the GSSP, the base of the Maastrichtian was established on an arithmetic mean of 12 biohorizons at the 115.2-m-level at Tercis. However, carbon stable isotope data were originally not included and $d^{13}C$ curves for Tercis were later published independently by THIBAULT et al. (2012) and VOIGT et al. (2012). Low-resolution carbon stable isotope curves for Kronsmoor were presented by VOIGT et al. (2010) and NIEBUHR et al. (2011), the latter interpolating the GSSP level mainly by means of macrofossil data to the lower part of the *Belemnella obtusa* Zone, ca. 10–12 m higher than the formerly accepted level at flint layer F600 (base of the *B. lanceolata* Zone).

In a recent reappraisal of the Kronsmoor section in the course of a palaeoecological study, high-resolution geochemical data including carbon and oxygen stable isotopes have been obtained from the uppermost Campanian to lower Maastrichtian (45 m, sample spacing 0.25 m). The resulting very detailed $d^{13}C$ curve allows a precise calibration of the GSSP level at Kronsmoor and a high-resolution correlation to the stratotype section (Tercis) as well as to other important Campanian–Maastrichtian boundary sections (Norfolk, Stevns-1 core, Contessa). All sections are characterized by a cyclic decrease in $d^{13}C$ of ca. 1‰ V-PDB during the latest Campanian to earliest Maastrichtian (lower part of the CMBE sensu VOIGT et al., 2010). The base of the Maastrichtian is located slightly below the earliest Maastrichtian isotope minimum (eMIM) and corresponds to a horizon in the lowermost part of the *B. obtusa* Zone, 12.5 m above F600 at Kronsmoor and close to the level formerly identified by (commonly rare) ammonite occurrences (NIEBUHR et al., 2011). Thus, the FAD of *B. obtusa* provides a useful proxy datum for the base of the Maastrichtian in the Boreal Realm. During the early Maastrichtian, $d^{13}C$ values remained low in Kronsmoor, fluctuating between 1.2 and 1.8‰ V-PDB, and are characterized by a conspicuous cyclic pattern.

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THIBAULT, N. et al., 2012. Cretac. Res., **33**, 72–90.
VOIGT, S. et al., 2010. Newsl. Stratigr., **44**, 57–72.
VOIGT, S. et al., 2012. Newsl. Stratigr., **45**, 25–53.

The Tithonian/Berriasian stage boundary and the base of the Cretaceous System

Wimbledon, W.A.P.[1]

1) School of Earth Sciences, University of Bristol, Bristol, UK, E-mail: mishenka1@yahoo.co.uk

Past decisions state that a Berriasian GSSP should be defined in Tethys, the largest geographical entity at that time. In 2007, the Berriasian WG (ISCS) agreed to initiate a new phase of activity, refining Tithonian-Berriasian correlations, partly directed at fixing a J/K boundary (WIMBLEDON et al., 2011). The J/K interval lacks any marked chemostratigraphic event that helps fix a boundary. The WG has concentrated on the detailed documentation of key sites, calibrating magnetostratigraphy with fossil range data, and prospective primary marker levels for a boundary (including the bases of the Jacobi Sbz., the calpionellid Alpina Sbz., of M18r, and the Grandis Sbz.). Many localities, from California to Tibet and the Russian Far East, have been assessed, and putative J/K levels have been better documented, but long-range correlation to some remote boreal regions, with impoverished, endemic biotas (*vis a vis* Tethys), and extensive non-marine basins, remains approximate. We have highlighted the absence of '*Berriasella' jacobi* in the lower nominal Jacobi Sbz. (FRAU et al., 2016) (and the predominance of *Delphinella*, e.g. France & Ukraine), and the species has been ruled out as a GSSP marker, as has the Grandis Sbz's base. Also, lack of biotic events near the base of M18r makes it an unsuitable alternative. J/K correlation had by 2007 already shifted away from a concentration on ammonites, with endemism repeatedly recognised as an obstacle, even in western Tethys. Calpionellids have been seen as the most useful J/K fossil group by many authors, and the turnover from *Crassicollaria* to small orbicular *Calpionella alpina,* (+*C. parvula* & *T. carpathica*) documented as a consistent and widespread marker in mid M19n.2n. A formal ballot of the Berriasian WG in June 2016 led to a decisive vote (76 %) that selected the Alpina Subzone base as the primary T/B boundary marker. Nannofossil FADs bracket this calpionellid turnover: the FADs of *Hexalithus strictus* [=*H. geometricus*], *Cruciellipsis cuvillieri* and *Nannoconus globulus globulus* occur a little below this event, and the FAD of *N. steinmannii minor* immediately above it (Puerto Escano; but just below it at Rio Argos (HOEDEMAEKER et al., 2016)). The FAD of *N. wintereri* occurs just below the Alpina Sbz's base (e.g. Puerto Escano: SVOBODOVA & KOSTAK, 2016) or just above (e.g. Strapkova). *N. kamptneri minor* appears in M19n.2n (e.g. Theodosia: BAKHMUTOV et al., 2016), and in M19n.1r (e.g. Puerto Escano) (WIMBLEDON, 2016). The core area with precise correlations has been expanded by recent studies: with the unambiguous application of the 'W.Tethyan' calpionellid scheme to Mexico (LOPEZ et al., 2013), Arabia, N. Iraq and Iran, finds of lower Berriasian nannofossil markers in N. Africa, Yemen, Iraq, Tibet and the Andes, and magnetostratigraphy extended to California, the Andes and N. Africa for the first time. Better resolution shows that the bases of the Alpina and Jacobi subzones do not coincide, and the Elliptica Sbz. base is below the Occitanica Zone. Definite calpionellid records in Australasia and Argentina await fuller investigation, as do problematic nannofossils and radiometric dates in southern Tibet. Work must now focus on expanding efforts to identify proxies for the *C. alpina* level in austral and little studied boreal areas (e.g. belemnites – Siberia/Pacific), and on better targeting of magnetostratigraphy (SCHNABEL et al., 2015).

Magnetostratigraphy constrained by biostratigraphy: the lower Berriasian of the Theodosia coast of southern Ukraine

Wimbledon, W.A.P.[1,*]***, Bakhmutov, V.G.***[2]***, Halásová, E.***[3]***, Reháková, D.***[3]***, Ivanova, D.***[4]

*1) School of Earth Sciences, University of Bristol, Bristol, UK, *E-mail: mishenka1@yahoo.co.uk*
2) Institute of Geophysics of NAS Ukraine, Kiev, Ukraine
3) Department of Geology & Palaeontology, Comenius University, Bratislava, Slovakia
4) Geological Institute, Bulgarian Academy of Sciences, Sofia, Bulgaria

Near Theodosia, around the headland of Ili Burnu ("Cape St Ilya"), there are extensive lower Berriasian outcrops, on which our integrated study has focussed since 2000. Above a massive 2 m+ breccia (the base of the Berriasian of soviet geologists), the upper Dvuyakornaya Fm comprises 80 m of mudstones and grainstones/breccias. Above, *circa* 80 m of micrites and marls, partly inaccessible, are named by us the Mayak Formation. Despite the thickness of the sequence, we can recognise only two faunas, those of the *Berriasella jacobi* (see Frau et al., 2016) and *Pseudosubplanites grandis* subzones of authors. Long intervals lack any ammonite, but just above the breccia bed a few were assigned to the Jacobi Sbz. (Guzhikov et al., 2012); then in the lower Mayak Fm. there is a common Jacobi fauna of *Delphinella* species occurs (+ *Dalmasiceras subloevis*, *Retowskiceras,* spiticeratids & *Berriasella;* but no *'B.' jacobi*); and the upper Mayak Fm yields large *Pseudosubplanites* (*P. grandis,* etc). The Occitanica Zone is unknown on this coast. One of our initial aims was to apply the standard calpionellid zonation to the southern Ukrainian sequence. However, loricas *in situ* (not in clasts) are rare and sometimes misleading. Beds about 10 m above the 2 m breccia yield Crassicollaria Zone species, but *Nannoconus kamptneri minor* here suggests this should be Alpina Sbz. Above, calpionellids are rarer, but the lower Mayak Formation yields *Calpionella elliptica* and *C. alpina*, and the upper part *Remaniella colomi* and *Tintinnopsella carpathica*. Zonal boundaries cannot be fixed, but the Alpina, Ferasini and Elliptica subzones are broadly identifiable twixt the 2 m breccia and the top of the Mayak Fm. In the studied interval we identify magnetozones M19n, M18r, M18n and a long M17r (Bakhmutov et al., 2016): which is congruent with the M16r noted inland at Zavodskaya Balka (Occitanica-Boissieri zones). In addition to the ammonite biostratigraphic control (only Jacobi Sbz. to Grandis Sbz.: i.e. M19n2n and above), we can accurately relate first appearances of calcareous nannofossil species to magnetozones. The FADs of *N. steinmannii steinmannii* and *N. kamptneri kamptneri* sit in the lower Mayak Fm, in a reversal we interpret as M18r. Beneath, in the Dvuyakornaya Fm we find nannofossils which in western Tethys appear in M19n: e.g. *N. s. minor, N. k. minor, N. wintereri,* and *Cruciellipsis cuvillieri,* close to the Alpina Sbz. base. The placing of the Chitinoidella/Crassicollaria zonal boundary (*sensu* Platonov et al., 2014) in M19n.2n (misnumbered "M19n.1r") is unsustainable: elsewhere that boundary occurs in M20n, and of the base of the Calpionella Zone is consistenly located in M19n.2n: thus our magneto- and biostratigraphy differ from earlier accounts (Guzhikov et al., 2012).

Bakhmutov, V.G. et al., 2016. In: Michalìk, J. & Fekete, K. (Eds.), XIIth Jurassica Conference. Slovak Acad. of Sciences, pp. 97–100.
Frau, C. et al., 2016. Cretaceous Research, **66**, 94–114.
Guzhikov, A.Y. et al., 2012. Stratigraphy & Geological Correlation, **20**, 261–294.
Platonov, E. et al., 2014. Geologica Balcanica, **43**, 63–76.

The Santonian - Campanian boundary at Göynük, Northwestern Anatolia, Turkey

***Wolfgring, E.**[1,*], **Böhm, K.**[2], **Wagreich, M.**[1], **Dinarès-Turell, J.**[3], **Yılmaz, İ.Ö.**[4]*

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: erik.wolfgring@univie.ac.at*
2) University of Amsterdam, Amsterdam, The Netherlands
3) Istituto Nazionale di Geofisica e Vulcanologia, Laboratorio di Paleomagnetismo, Roma, Italy
4) Department of Geological Engineering, METU, Ankara, Turkey

A Santonian - Campanian boundary section, close to the village of Göynük in North-western Turkey (Bolu province), was recorded and examined with respect to nannofossil and foraminiferal biostratigraphy, magnetic polarity, as well as magnetic susceptibility.

Located on the Sakarya continent in the Upper Cretaceous, the Mudurnu-Göynük basin was confined by the Intra Pontide Ocean to the North and the northern branch of the Tethys Ocean to the South. Deposits at this locality record a variety of facies; inner neritic shelf-, continental slope – and pelagic open marine environments, are evident in this region.

The sections assessed for this study yield hemipelagic to pelagic deposits. Five localities were examined and a composite record spanning the Santonian – Campanian boundary was established. The main focus of this study is on the “Road” - and “Jandarma” sections, which are interpreted to be complementary. The older deposits of this composite section are characterised by uniform reddish limestone, while we frequently record shaly marls and marly limestones with recurrent tuff intercalations in the younger subsections. The other three sections serve as auxiliary sections that help to complete the biostratigraphical record.

A biostratigraphic investigation of planktonic foraminifera and calcareous nanoplankton assemblages together with magnetostratigraphy provides a sound stratigraphic framework and allows to approach the Santonian -Campanian boundary. The biostratigraphic data suggest an age from the late Santonian Dicarinella asymetrica to the early Campanian *Globotruncanita elevata* planktonic foraminifera biozone (calcareous nannofossil zones UC13-14, CC16-CC18). The reversal in magnetic polarity from chron 34n to 33r that coincides with the base of the Campanian is evident in the “Road” section.

Upper Cretaceous planktonic stratigraphy of the Göynük composite section, western Tethys (Bolu province, Turkey)

***Wolfgring, E.*[1,*], Liu, Shaha[2], Wagreich, M.[1], Böhm, K.[3], Yılmaz, İ.Ö.[4]**

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: erik.wolfgring@univie.ac.at*
2) Beijing Normal University, Beijing, China
3) University of Amsterdam, Amsterdam, The Netherlands
4) Department of Geological Engineering, METU, Ankara, Turkey

A composite geological record from the Upper Santonian to Maastrichtian is evident from the Mudurnu Göynük basin (Bolu Province, Northwestern Anatolia, Turkey). These deposits were originally located on the Sakarya continent in the western Tethyan realm with a palaeolatitude of a bit less than 30°.

Grey shales and clayey marls are exposed in close vicinity and in the town of Göynük. We find frequent volcanic intercalations in the older subsections while the uppermost layers seem to depict a more complete open marine record. Rich low latitude planktonic foraminifera and calcareous nannoplankton assemblages were recorded. Microfossil indicators point towards a distal slope setting at the Göynük section. Predominantly well preserved biostratigraphic markers (calcareous nannoplankton and planktonic as well as some benthic foraminifera) were assessed to establish a biozonation.

The three sections sampled for this study reveal a composite record from the Campanian *Contusotruncana plummerae* planktonic foraminifera Zone to the Maastrichtian *Racemiguembelina fructicosa* planktonic foraminifera Zone. The oldest sub section ("GK-section") yields the "mid" Campanian *Contusotruncana plummerae* or *Globotruncana ventricosa* Zones and is followed by the "GC-section". The latter records the *Globotruncanita havanensis* as well as the *Globotruncana aegyptiaca* Zone and are overlain by the youngest section examined in this study ("GS -section"). Due to absence of the nominative taxon, the *Radotruncana calcarata* Zone could not be identified. In the "GS-section", we recognize the *G. aegyptiaca* Zone in the lowermost part, the upper Campanian/lower Maastrichtian *Gansserina gansseri* Zone, and the Maastrichtian *Racemiguembelina fructicosa* Zone. Nannofossil standard zones UC15b to UC18 are recorded within the composite section.

The planktonic foraminiferal assemblages assessed in the Göynük area feature a diverse, well preserved plankton record that can be correlated to other western Tethyan sections from the Upper Cretaceous. Especially the Austrian Alpine sections (i.e. Northern Calcareous Alps and Ultrahelvetics) show similar palaeoenvironmental and palaeo-latitudinal traits and present a well established biostratigraphic and cyclostratigraphic record. Comparing the multi-proxy record assessed in these sections to the biostratigraphic data from the Göynük region provides useful insights into planktonic foraminiferal palaeoecology and the multistratigraphic high-resolution correlation in the Upper Cretaceous Tethyan realm.

The Postalm section, Northern Calcareous Alps, Austria - towards an astrochronological solution for the Tethyan Campanian

Wolfgring, E.**[1,*]**, Wagreich, M.[1], Dinarès-Turell, J.[2]

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: erik.wolfgring@univie.ac.at*
2) Istituto Nazionale di Geofisica e Vulcanologia, Laboratorio di Paleomagnetismo, Roma, Italy

The Postalm section from the Austro-Alpine Northern Calcareous Alps recording Northwestern Tethyan deposits is investigated for cyclostratigraphy and palaeoenvironments. With a special focus on the impact and duration of palaeoenvironmental changes, this work aims at establishing an astrochronologically calibrated framework for the Tethyan upper Campanian. The Postalm section (Gosau Group, Northern Calcareous Alps) displays rhythmic deposits recording an almost uninterrupted Santonian to Maastrichtian succession. Greyish marly limestones of the Santonian Bibereck Formation represent the oldest deposits recorded at the Postalm section and display rapidly increasing water depths. While the Bibereck formation is interpreted as a neritic to outer neritic palaeoenvireonment, the overlying Nierental Formation displays a hemipelagic to pelagic facies. These younger deposits recorded at the Postalm section are recorded in reddish foraminifera pack stones displaying distinct limestone/marl alternations. These rhythmic alternations presumably represent precession cycles. Over 300 samples were taken bed-by-bed to provide a per-cycle resolution. Foraminiferal and nannoplankton biostratigraphy confirms an almost uninterrupted succession at the Postalm section and the presence of planktonic foraminiferal biozones from the *Dicarinella asymetrica* to the *Gansserina gansseri* Zone, nannofossil Zones CC17 to CC22. A small part of the section – the mid-Campanian *Radotruncana calcarata* interval – was already investigated for cyclostratigraphy as well as biostratigraphy and palaeoenvironments. The investigation of the stable isotope signature curves recorded at the Postalm section provides further means to correlate local results to other Campanian reference sections.

The Santonian-Campanian boundary in the NW Tethys; magneto-, isotope- and biostratigraphy from the pelagic Postalm section (Northern Calcareous Alps, Austria)

***Wolfgring, E.*[1,*], *Wagreich, M.*[1], *Dinarès-Turell, J.*[2], *Gier, S.*[1], *Böhm, K.*[3], *Sames, B.*[1], *Spötl, C.*[4], *Popp, F.*[1]**

1) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,
**E-mail: erik.wolfgring@univie.ac.at*
2) Istituto Nazionale di Geofisica e Vulcanologia, Laboratorio di Paleomagnetismo, Roma, Italy
3) University of Amsterdam, Amsterdam, The Netherlands
4) University of Innsbruck, Innsbruck, Austria

The Postalm section in the Austrian Northern Calcareous Alps yields Upper Cretaceous deposits recording an almost complete succession from the latest Santonian to the uppermost Campanian. To address the Santonian – Campanian transition, it is possible to integrate several stratigraphic signals from macro- and microfossils to chemostratigraphy and magnetostratigraphy at the Postalm and adjacent Gosau sections.

The interval spanning the S-C boundary at the Postalm section shows a deepening trend from upper Santonian conglomerates and grey shelf marls to pelagic bathyal red marly limestones of Campanian age. 61 samples for magnetostratigraphy, 27 rock samples for isotopes as well as 50 smear slides prepared for calcareous nannofossil and 43 samples for foraminiferal biostratigraphy were investigated.

The base of the Campanian can be defined by magnetostratigraphy, i.e. the reversal from Chron C34n (the Long Cretaceous Normal Polarity-Chron) to C33r. Two of the main suggested biomarkers for the S-C boundary, i.e. the last occurrence of planktonic foraminifer *Dicarinella asymetrica* and the first occurrence of the calcareous nannofossil *Broinsonia parca parca* are documented in close proximity to the reversal. Strontium isotope stratigraphy indicates a value of 0.707534 (mean of 4 measurements around the boundary interval) for the base of the Campanian at the Postalm section. Furthermore, both carbon and oxygen isotopes show a negative excursion below the S-C boundary. The magnetic susceptibility signature shows a prominent positive excursion at the end of C34n. The well resolved record at the Postalm section illustrates the pace of (bio) events around and during the Santonian/Campanian transition in hemipelagic to pelagic deposits.

Intercalibration of astrochronologic and radioisotopic time scales for Late Cretaceous continental records in Songliao Basin, Northeastern China

***Wu, Huaichun**[1,*], Hinnov, L.[2], Wang, C.[1], Wan, X.[1], Zhang, S.[1], Yang, T.[1]*

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: whcgeo@cugb.edu.cn*
2) George Mason University, Fairfax, USA

Songliao Basin (SB) in northeastern China is one of the largest and long-lived Cretaceous continental basins in the world. Two overlapping scientific drillcores (SK-1n and SK-1s) recently obtained from the basin depocenter (total length of 2485.89 m) together provide a unique opportunity for investigating continental climate/environmental changes in the Cretaceous greenhouse world (WANG et al., 2013). Establishing a high-resolution chronostratigraphic framework for these drillcores is the essential first step for studying the terrestrial paleoclimate signals and their correlation with marine records. Multidisciplinary chronostratigraphic studies on the two cores have greatly improved the time framework in SB (WAN et al., 2013; WU et al., 2013). Recently, WANG et al. (2016) reported four high-precision U-Pb TIMS zircon ages of interbedded bentonites in SK-1s drill-core, which show consistent estimated durations for Qingshankou Formation, but a 0.6 myr discrepancy for Nenjiang Formation. Here we use thorium (Th) logging data to reanalyze the cyclostratigraphy of SK-1s. The results indicate that Quantou, Qingshankou, Yaojia and Nenjiang formations record significant Milankovitch cycles. We tune 405 kyr cycles to the orbital eccentricity solution La2011 using U-Pb ID-TIMS age of 91.886±0.033 Ma in the lower Qingshankou Formation as an anchor point. This revised astronomical time scale (ATS) is consistent with the other three U-Pb ID-TIMS ages within the errors, and provides new constraints on geological events and their counterparts in marine records, as follows: 1. The SK-Is borehole spans 10.16 Myr from 92.63 Ma–82.47 Ma (Early Turonian to Early Campanian). 2. The age of the polarity boundary of C33r/C34n (985.95 m) is estimated as 82.884 Ma. 3. Filtered 2.4 Myr long orbital eccentricity cycles and 1.2 Myr obliquity modulation cycles are consistent with those of La2011. 4. The new ATS links the continental records in SB and marine sediments in Western Interior basin, USA at the astronomical level (SAGEMAN et al., 2014).

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Late Cretaceous Inversion Tectonics in Northern Germany deciphered by calcareous nannofossils

Wulff, L.[1,*]***, Kaplan, U.***[2]***, Mutterlose, J.***[1]

*1) Ruhr-Universität Bochum, Bochum, Germany, *E-mail: lena.wulff@rub.de*
2) Gütersloh, Germany

The depositional history of Late Cretaceous sediments in northern Germany was partly controlled by differential subsidence and uplift, causing a complex distribution pattern. Following a eustatic sea-level rise in the early Late Cretaceous (Cenomanian, Turonian), which caused a flooding of major parts of northern Germany this area experienced an inversion in the mid Late Cretaceous (Coniacian, Santonian). The former Lower Saxony Basin, the main area of sedimentation in the Early Cretaceous, experienced uplift along a major fault zone, the Osning Lineament. At the same time the Münsterland, positioned south of the Osning Lineament, subsided and formed a major depositional centre for sediments supplied by the uplifted area in the north.

Two quarries near the Osning Lineament expose an extended and complete succession of lower Cenomanian to lower Coniacian marine sediments. They play a crucial role for the understanding of the tectonic setting and the Late Cretaceous inversion of northern Germany. The uppermost part of the 350 m thick sedimentary sequence (Turonian, Coniacian) is characterised by chaotic structural conditions. Submarine slides and phacoids, olistolith-like sediment bodies up to several meters in diameter, are the dominant features. Previous studies analysed and dated similar slides based on foraminifera. The poor preservation of foraminifera was a great obstacle and did not allow a high resolution biostratigraphic assignment. Based on calcareous nannofossil dating, the phacoids are of middle Turonian age (nannofossil zone UC9a), the surrounding matrix is of middle Coniacian age (nannofossil zone UC10). For the first time reworked Cenomanian material has been recognized in the samples. The new biostratigraphic data are used to estimate the timing and the rates of erosion in the inverted area. Uplift most likely started in the late middle or early late Turonian.

Late Cretaceous - Early Paleogene ostracod biostratigraphy in the Songliao Basin, NE China

***Xi, Dangpeng*[1,*], Sames, B.[2], Qu, Haiying[1], Li, Shun[1], Shi, Z.[1], Wan, X.[1]**

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: xdp1121@163.com*
2) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria

The Songliao Basin was one of the largest non-marine rift basins in Asia during the Cretaceous. Widespread non-marine deposits in the basin are mainly composed of clastic sediments which contain abundant ostracods and other fossils, such as gastropod, bivalves, and vertebrates (YE et al., 2002). These well-preserved ostracod fossils provide us valuable information about Cretaceous climate changes and biotic responses in a greenhouse environment. The Cretaceous International Continental Scientific Drilling Project core SK1 from the Songliao Basin (SK1) offers a rare opportunity to study Late Cretaceous non-marine ostracods over a long, continuously documented time interval. The SK1 was drilled separately in two boreholes: the lower 959.55-meter-thick long south core (SK1(s)), and the upper 1636.72-meter-thick long north core (SK1 (n)), containing, in ascending order, the upper Quantou Formation, the Qingshankou, Yaojia, Nenjiang, Sifangtai, and Mingshui formations, and the lower Taikang Formation (WANG et al., 2013). A high-resolution non-marine ostracod biostratigraphy based on SK1 has been established (XI et al., 2012; QU et al., 2014). A total of 80 species belonging to 12 genera have been recovered from SK1(s), and 45 species assigned to 20 genera from SK1(n). However, their taxonomy has to be revised. Nineteen ostracod assemblage zones have been recognized from the upper Quantou to Mingshui formations (XI et al., 2012; QU et al., 2014). This series of zones can be correlated regionally and supraregionally. The preliminary correlation indicates that Assemblage Zones 1 to 18 span the Late Cretaceous, while Assemblage Zone 19 might span the latest Maastrichtian to earliest Danian, which is supported by an astronomical time scale of the SK1 (WU et al., 2014). Although the preliminary biostratigraphy of SK1 has been established, the further detailed taxonomy, supraregional correlation and paleoecology are still needed.

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Late Cretaceous (Santonian) lake anoxic events (LAEs) in the Songliao Basin, NE China

Xi, Dangpeng[1,*]***, Sames, B.***[2]***, Shi, Z.***[1]***, Wan, X.***[1]***, Wagreich, M.***[2]

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: xdp1121@163.com*
2) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria

Cretaceous ocean anoxic events (OAEs) have been well studied, but the lake anoxic events (LAEs) are still little understood. The Songliao Basin (SLB) in northeastern China is one of the largest Cretaceous continental rift basins in the world. The largest lake transgression event (largest extent of the Songliao paleo-lake) occurred during the Santonian, with black and oil shales preserved in the Lower Nenjiang Formation (K_2n), indicating a ‘lake anoxic event’ (LAE) (HUANG et al., 1998). The Lower K_2n is divided into Member 1 (K_2n^1) and Member 2 (K_2n^2). The lowermost K_2n^1 and lowermost K_2n^2 mainly consist of black shale and oil shale, both in the central and marginal parts of the basin, while the middle–upper K_2n^1 and the middle–upper K_2n^2 are mainly composed of grayish and grayish green mudstone. The black and oil shales of the lowermost K_2n^1 and lowermost K_2n^2 are characterized by high TOC (~5 % on average), high Fe^{2+}/Fe^{3+}, high reducing sulfur and a wide distribution of black and oil shales (HUANG et al., 1998; XI et al., 2011), indicating a stable, stratified deep lake with anoxic bottom water. We suggest that two large-scale lake anoxic events (LAE2a and LAE2b) occurred during sedimentary of the lowermost K_2n^1 and lowermost K_2n^2, respectively.

LAE2a and LAE2b of the Songliao Basin occured at about 85.7 Ma and 83.4 Ma. Considering the thickness of lake anoxic deposits (5–10 m) and average sedimentary rates (~50 m/Ma), the LAE2a and LAE2b might have lasted 0.1–0.2 Ma, respectively. LAE2a and LAE2b coincide with the beginning of the two large lake transgression events, when the lake level rose dramatically. During the LAEs, the Songliao paleolake was also periodically affected by seawater incursion events. Therefore, the LAEs may have been affected by changes in both regional lake level and climate as well as global sea level and climate change, respectively. OAE3 occurred during the Coniacian–Santonian (WAGREICH et al., 2002). The Cretaceous Songliao Basin has been well correlated and compared with the Western Interior Seaway (WANG et al., 2013). Considering the age interval covered, LAE2 might be related to an early Santonian OAE3. This may be because both were affected by the relatively high sea level of the Pacific Ocean and the high primary productivity in the lake during this period.

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Late Cretaceous biostratigraphy and sea-level change in the northwest Tethys

***Xi, Dangpeng**[1,*], Zhang, W.[1], Li, Yuanhui[1], Sames, B.[2], Wan, X.[1], Wagreich, M.[2]*

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: xdp1121@163.com*
2) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria

The Upper Cretaceous sediments of the west Tarim Basin include the remnants of a large epicontinental sea, northwest Tethys. Although the biostratigraphy and sea-level of the Tethys is well studied, the northwest Tethys is still less understand. Based on the analyses of sedimentation, foraminifera, ostracods, bivalves, and other fossils from Akeqi Section in the Kunlun Mts. area, together with the results of Simuhana Section in the Tianshan Mts. area, west Tarim Basin, an preliminary study of integrated biostratigraphy and sea-level change in the west Tarim Basin has been carried out. The Upper Cretaceous marine strata include the Kukebai, Wutitage, Yigeziya and Tuyiluoke formations. On the basis of biostratigraphic correlation of foraminifera, ostracods, calcareous nannfossils, bivalves, and other fossils, the proposed age of the Lower and Middle Kukebai Formation is Cenomanian to earliest Turonian; the Upper Kukebai is of Turonian to early Coniacian age. The Wuyitage Formation is late Coniacian to early Campanian, the Yigeziya Formation is late Campanian to early Maastrichtian, and the Tuyiluoke Formation is late Maastrichtian in age, possibly extending into the Danian. The relative sea level began to rise since early Cenomanian, and reached a maximum during Turonian. After a subsequent sea level fall, another large marine transgression began during late Campanian to early Maastrichtian, and then, the sea level fell dramatically since late Maastrichtian. Though the biostratigraphy and sea level of Tianshan Mts. area and Kunlun Mts. area can be correlated, the marine transgression of Yigeziya Formation is larger in the Kunlun Mts. area.

An Early Cretaceous *Ginkgo* ovulate organ from the Inner Mongolia, China

***Xu, Xiaohui*[1,*], Chen, P.[1], Yang, L.[1], Sun, B.[2], Wang, Yongdong[3]**

*1) Anhui University of Science & Technology, Huainan, China, *E-mail: xiaohuix2015@163.com*
2) Lanzhou University, Lanzhou, China
3) Nanjing Institute of Geology and Palaeontology, Nanjing, China

Abundant Ginkgoalean leaf fossils were collected and described from the Lower Cretaceous of the Huolinhe Basin, Inner Mongolia, North China. However, up to now, Ginkgoalean reproductive organ fossils have never been found in the Huolinhe Basin. In this study, a well-preserved *Ginkgo* ovulate organ are reported from the Early Cretaceous Huolinhe Formation of the Huolinhe Basin. This ovulate organ bears a cluster of (up to 6) ovules at the apex of a peduncle. The ovules are each seated in a collar, four developed ovules directly attached to the peduncle, other two aborted ovules terminated in a short pedicel. The epidemis of the ovulate organ is also investigated detailedly. This is the first discovery of *Ginkgo* ovulate organ in the Huolinhe Basin.

The unequivocal and reliable ovulate organs of *Ginkgo* are very rare. Detailed comparisons between the new *Ginkgo* with other reliable *Ginkgo* ovulate organsreveal that the new material differs from any of them. A new speciesis established. *Ginkgo yimaensis* from the Middle Jurassic Yima Formation of Henan, China, is the oldest known *Ginkgo* ovulate organ (ZHOU & ZHANG, 1989). ZHOU (1994) named the ovule-bearing organs similar to *G. yimaensis* with long pedicles on a peduncle as *Ginkgo yimaensis* type (or Jurassic type or ancestral type), while others like *G. biloba* without obvious pedicles called *Ginkgo biloba* type (or modern type). The Palaeocene species *Ginkgo cranei* distinctly belongs to modern type (ZHOU et al., 2012). The Early Cretaceous *Ginkgo apodes* with short pedicels when young, but sessile when mature, was considered as the oldest morden type ovulate organs (ZHENG & ZHOU, 2004). In ovulate organ structure, the new species is closely comparable to *G. apodes*. The present study further corroborates that the modern *Ginkgo* type ovulate organ first appeared in the Early Cretaceous, and also provides new evidence for *Ginkgo* evolutionary history.

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The Late Mesozoic Plants from Northwest Lhasa of Tibet (Xizang), China

***Yang, Xiaoju**[1,*], Xu, Qing[1], Lin, M.-Q.[1], Li, Jian-Guo[1]*

*1) Nanjing Institute of Geology and Palaeontology, CAS, Nanjing, China, *E-mail: xjyang@nigpas.ac.cn*

The fossil plants from the lower part of the Linbuzong Formation, Qubsang, Doilungdeqen, Lhasa, Tibet is reports briefly. Due to regional orogenic movement the plant-bearing bed is metamorphic and there is no cuticle of fossil plants available. The assemblage comprise ? Neocalamites sp., Anomozamites sp., Ptilozamites tibeticus Yang, Ptilophyllum sp., ? Sphenozamites sp., Zamites honeneggeri (Schenk) Sze et Lee, Zamites sp., Pterophyllum sp., Zamiophyllum sp., Torreyites sp., Elatides curvifolia (Dunker) Nathorst. Among these plants at least two of them are firstly discovered in this area, and others are frequently occurring in the mesozoic flora in Tibet. The general aspect of this flora is however basically identical to the plant assemblage of the Lagongtang Formation from the Changdu area of eastern Tibet. The abundance of Ptilophyllum, Zamiophyllum, and conifer Elatides curvifolia and the absent of Ginkgoales might indicate both a low latitude and high temperatures, and a tropic semi-arid climate dominate this area in a seashore environment. This assemblage, composed mainly of Cycadopsida and Coniferopsida, does not resemble any contemporaneous ones known from Gondwanaland or Euorasia. Although the flora lack characteristic Wealden ferns, such as Weichselia, the plant assemblage shows a relation to the floras of the Tethys area and might roughly correspond in age to the Wealden floras of Europe.

Bio-, carbon isotope and cyclo-stratigraphy of the Albian-Cenomanian Boundary Event in southern Tibet

Yao, Hanwei[1,*]***, Melinte-Dobrinescu, M.***[2]***, Wu, Huaichun***[1]***, Liang, H.***[1]***, Weissert, H.***[3]

*1) China University of Geosciences (Beijing), Beijing, China, *E-mail: yaohw@cugb.edu.cn*
2) National Institute of Marine Geology and Geo-ecology (GEOECOMAR), Bucharest, Romania
3) Department of Earth Sciences, Geological Institute, ETH Zurich, Zürich, Switzerland

During the Albian-Cenomanian the Earth was marked by profound changes in the climatic and oceanographic state that are recorded in sedimentary successions on a global scale. Carbon isotopic records of this time interval are well established in the western Tethys, Atlantic and Pacific Ocean, but have not yet been reported from the eastern Tethys. Here we firstly documented the biostratigraphic, chemostratigraphic and cyclostratigraphic characteristics of the uppermost Albian–lowermost Cenomanian interval of the Youxia section (eastern Tethys, today cropping out in southern Tibet). Based on nannofossil biozones (UC0–UC1) and the $\delta^{13}C$ curve, the Albian-Cenomanian Boundary Event (ACBE) was identified and correlated with that of the western Tethys and the Atlantic Ocean. In the Youxia section, $\delta^{13}C$ values for this interval mainly range from 0‰ to 1.3‰ with a maximum of 1.31‰ and a minimum of -0.03‰. Compared to representative sections in other continents, four subevents of the ACBE carbon isotope curve were distinguished and separated by four peaks, i.e., a, b, c and d. Additionally, we used spectral analyses on the closely-spaced measurements of calcium carbonate content of the rocks at Youxia section. The Milankovitch short eccentricity (~100ka) and precession cycles (22.2ka) are well defined and suggest that orbital variations have modulated depositional processes. Thus, we could estimate the duration of the ACBE together with all the subevents. The duration of the whole ACBE is estimated with ~ 311ka together with ~233ka for OAE1d. The recognition of the ACBE from Tethys Himalaya can improve our understanding of the Tethys and global carbon cycle changes during the mid-Cretaceous.

Records of paleoclimatic and palaeoenvironmental conditions in platform to slope carbonates, lower Cretaceous, Ayralaksa Yayla (Trabzon, NE Turkey)

Yildiz, M.[1,*]***, Kirmaci, M.Z.***[1]***, Yılmaz, İ.Ö.***[2]***, Kandemir, R.***[3]

*1) Karadeniz Technical University, Trabzon, Turkey, *E-mail: merveyildiz@ktu.edu.tr*
2) Middle East Technical University, Ankara, Turkey
3) Recep Tayyip Erdogan University, Rize, Turkey

Campanian (Cretaceous) deposits which represents the upper part of the Mesozoic sequence in the Eastern Pontides (NE Turkey), mainly composed of calciclastic turbidites includes thin grey-red pelagic limestone, sandstone, siltstone, marl interlayers dominated by volcanoclastics; neritic carbonate lenses and pillow lavas. Düzköy-Çayırbağı stratigrafic section consisting of grey and red pelagic limestone well exposed in the Düzköy (NE Turkey) is studied with a combined sedimentological and paleontological approach.

Based on the planktonic foraminiferal assemblages which consist mainly of *Globotruncana* cf. *arca* (Cushman), *Globotruncana arca* (Cushman), *Globotruncana* sp., *Whiteinella* sp., *Archaeoglobigerina* sp., *Archaeoglobigerina blowi* (Pessagno), *Globotruncana lineiana* (d'Orbigny), *Whiteinella* sp., *Archaeoglobigerina cretacea* (d'Orbigny), grey and red pelagic limestone is Campanian in age. Two microfacies were identified and interpreted by petrographic analysis on the basis of their depositional textures and fauna. These are planktonic foraminiferal wackestone-mudstone with rare allochthonous neritic skeletal grain and planktonic foraminiferal mudstone lithofacies, respectively. Microfacies and paleontological characteristic of the studied section suggest that a deep marine environment existed in Düzköy (NE Turkey) during the Campanian. The presence of rare allochthonous neritic skeletal grains in the lower part of the section indicates that the existence of a shallower water carbonate depositional environment was adjacent to the deep marine environment during the earliest Campanian.

Geochemical characteristics and origin of dolomite in Late Jurassic-Early Cretaceous platform carbonates, Ayralaksa Yayla (Trabzon, NE Turkey)

Yildiz, M.[1,*]***, Kirmaci, M.Z.***[1]***, Kandemir, R.***[2]

*1) Karadeniz Technical University, Trabzon, Turkey, *E-mail: merveyildiz@ktu.edu.tr*
2) Recep Tayyip Erdogan University, Rize, Turkey

The Upper Jurassic-Cretaceous deposits are widely distributed and superbly exposed in southern zone of the Eastern Pontides (NE Turkey). This work represents the depositional environments and tectono-sedimentary evolution of Tithonian - Campanian succession from the Mescitli area (Gümüşhane, NE Turkey) based on microfacies characteristics, including depositional texture, grain composition, and fossil content. The studied stratigraphic sections are characterized by the following three units: 450 m medium-thick to massive neritic limestone including dolostone, benthic foraminiferal packstone, allochthonous skeletal/ peloidal grainstone, sponge spicule packstone / wackestone, and allochthonous skeletal packstone facies, which are deposited in low-middle energetic shallow tidal, lagoon to deep shelf during the Tithonian–Early Santonian time. The 15 m yellowish sandstone to sandy limestone derived mainly from neritic limestone that was broken up by Albian-Santonian extensional tectonic regim, deposited in the fault-slope environment during Turonien-Santonian. The 5 m red *Globutruncana*-bearing pelagic limestone deposited in basin environment during the Campanian.

The microfacies analyses of the studied stratigraphic section indicates that shallow marine conditions were present during the Tithonian - early Santonian in the Mescitli area (Gümüşhane, NE Turkey). However, these conditions ended during the Albian extensional tectonic regim, when the carbonate platform was broken up, and the basin was deepened and yellowish sandstone to sandy limestone was deposited in the fault-slope environment. Deepening of the basin was continued until the deposition of red *Globutruncana*-bearing pelagic limestones which are represented by the maximum flooding surface sediments, during the campanian entire study area had became a deep-marine depositional environment.

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Cretaceous black shales (Oceanic Anoxic Events) in Turkey: collaboration of tectonics, sea level and oceanographic changes

***Yılmaz, İ.Ö.*[1]**

1) Middle East Technical Unviersity, Ankara, Turkey, E-mail: ioyilmaz@metu.edu.tr

Cretaceous oceanic anoxic events are recorded as black shale deposits in Mid-Barremian, Aptian, Cenomanian/Turonian stages in different basins in Turkey. The Mid-Barremian black shales (MBE) have been recorded within a turbidite succession in a deep marine setting in central Sakarya zone of Pontides (YILMAZ et al., 2012). 2 ‰ shifts in the carbon isotope curve are recorded in parallel with European basins, but with low TOC values. The Aptian black shales (OAE1a) are recorded in pelagic carbonate slope environments in central Sakarya zone of Pontides and represented by a negative carbon isotope shift with 2 ‰, and TOC around 2 % (YILMAZ et al., 2004; HU et al., 2012). The C isotope curve is well correlated to those of European basins and this indicates common paleoceanographic conditions. In the Sakarya zone of Pontides, OAE2 is recorded in pelagic carbonate slopes (YILMAZ et al., 2010) with a carbon isotope curve characterized by a > 1 ‰ positive shift and > 2 % TOC. A further section through the OAE2 was recorded in Antalya Nappes of Taurides with TOC > 20 % (YURTSEVER et al., 2003; BOZCU et al., 2011).

The OAE1a and OAE2 levels recorded in Turkey can easily be correlated with European examples and were mainly controlled by sea level and tectonics during large-scale and climate and oceanographic changes on a small scale. However, MBE was recorded on the drowned carbonate platform in Pontides and interpreted as mainly controlled by tectonics. The most extensive distribution of the OAE records in Turkey belongs to OAE1a and OAE2, and display potential for the presence of source rocks for hydrocarbon exploration.

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Valanginian Sea-Level Records on the Bilecik Carbonate Platform and Slope Environment, Western Sakarya Zone, Western Pontides

***Yılmaz, İ.Ö.*[1,*] *and Altiner, D.*[1]**

1) Middle East Technical Unviersity, Ankara, Turkey, E-mail: ioyilmaz@metu.edu.tr

The peritidal carbonate successions have been studied on the Valanginian part of the Bilecik platform in the north-western Turkey. They display cyclic patterns through the sections. This cyclicity is generally seen as shallowing upward type and interpreted as the records of short-term sea-level fluctuations. On the Bilecik Platform, intraclastic/pelloidal/bioclastic subtidal facies are more frequently encountered. Pelloidal grainstone/packstone, intraclastic/bioclastic grainstone/packstone display iron encrusted/corroded surfaces around pelloids, oncoids and intraclasts. This iron encrustation is not well observed within the matrix or cements. Therefore, it can be interpreted as the subaerial contribution during transportation/deposition of grains followed up a weathering condition possible by storms/tide activities. Alternation of wet and dry climate conditions could also have contributed to have such a color change.

Pelloidal grainstone/packstone, intraclastic/bioclastic grainstone/packstone or facies lies at the bottom and fenestral/birds eye limestones or lime mudstone facies take place at the top of the cycles which display a shallowing upward character. Thickness and number of subaerially capped cycles increases in the Valanginian compared to Jurassic cycles in the Bilecik Platform. Reddish-pinkish and beige colored facies display alternations on the Bilecik platform. The Bilecik carbonate platform margin displays alternation of pelagic carbonates and tongues of the platform carbonates. Tongues of the Bilecik Platform display thick-bedded bioclastic packstone facies lying between thin-bedded pelagic lime mudstones/wackestones. Consequently, this study implies that climate effected sea-level variations on studied shallow carbonate platform were on the order of meters and effects of possible storms/tides were also recorded. Pelagic equivalents of these sea-level records displayed alternation of thick bedded bioclastic packstone facies and thin-bedded pelagic lime mudstone/wackestone facies.

Cyclic Carbonate Facies Changes on the Middle to Upper Cenomanian Arabian Carbonate Platform, SE Turkey: An Approach for the Causes of Short- and Long-Term Sea-Level Change

***Yılmaz, İ.Ö.*[1,*], Hosgor, I.[2], Mulayim, O.[3], Sari, B.[4], Simmons, M.[5]**

1) Middle East Technical Unviersity, Ankara, Turkey, E-mail: ioyilmaz@metu.edu.tr
2) Calik Energy, Ankara, Turkey
3) Turkish Petroleum Company, Ankara, Turkey
4) Dokuz Eylül University, Izmir, Turkey
5) Halliburton, Abingdon, UK

The studied Cenomanian shallow water platform carbonates of the Derdere Formation lies on the northern Arabian platform in Mardin area, SE Turkey. The sedimentology and cyclic nature of the facies along the studied composite sections have been analysed in terms of cyclostratigraphy. In the lower section, alternations of benthic foraminiferal - algal packstone/wackestone and bioturbated bioclastic wackstone/lime mudstone take place at the base of small scale cycles. Alternations of bivalve/ostracod wackestone/packstone and lime mudstone with ostracoda or dolomitic limestone/dolostone or fenestral limestone facies lie at the top representing a relative shallowing feature in this part of the section. At the top of the cycles mud cracks can be occasionally observed. In the middle part of the lower section, a cross bedded bioclastic tidal channel deposit is recorded. In the upper section, slope to outer ramp carbonates lies at the bottom and characterized by echinoidal-crinoidal bioclastic wackestone to packstone facies. This facies alternates with bivalve packstones which display oriented accumulation of monotaxic bivalve species down dip orientation with an imbricate fabric. Matrix of the bivalve packstone is composed of micrite with planktonic foraminifera and calcispheres. Inside of the shells includes abundant “Favreina” like caprolite fossils and displays a pelloidal grainstone facies. Presence of abundant monotaxic shells infilled by “Favreina” like fossils with orientation has been interpreted that suspension feeding bivalve shells caused an increase in bioaccumulation on the shelves and transported down the slope of the Arabian Platform by a unidirectional flow.

Bioclastic wackestone/packstone facies with crinoids and echinoids including benthic foraminifera, ammonites and ostrea takes place in the middle part of the section representing a relative deepening. Nerinid gastrapod, dasyclad algae, benthic foraminifera bearing pelloidal intraclastic wackestone-packstone facies occurs at the top most part of the section representing a relative shallowing. Consequently, oriented bivalve accumulation indicates current controlled transportation. No storm or mass flow evidence was observed. Cyclic carbonate facies changes revealed that collaboration of climate, carbonate production and subsidence played important role on small meter scale sea level changes. However, sea level and tectonics contributed in large scale as alternating shallowing and deepening cycles in 10’s meters.

The Upper Campanian Paleoceanographic and paleoclimatic records on the northern Arabian Platform, SE Turkey

Yılmaz, İ.Ö.[1,*], ***Hosgor, I.***[2], ***Altiner, S.***[1], ***Wagreich, M.***[4], ***Kvacek, J.***[5]

1) Middle East Technical Unviersity, Ankara, Turkey, E-mail: ioyilmaz@metu.edu.tr
2) Calik Energy, Ankara, Turkey
3) Turkish Petroleum Company, Ankara, Turkey
4) Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria
5) National Museum Prague, Prague, Czech Republic

The studied pelagic succession lies on the northern Arabian Platform in the Mazidag-Derik area, SE Turkey. Upper Campanian paleoceanographic events and paleoecology in the studied area have been determined for the first time in Turkey by sedimentological, geochemical and micopaleontological analysis. A composite stratigraphic section has been measured and sampled in detail. The section is characterized by alternation of marls, clayey limestones, shales and black shales. There are no coarse siliciclastic sediments or turbiditic structures recorded in the section. Stable isotope analysis have been carried out on 45 samples along the Mazıdağ measured stratigraphic section with a thickness of 119.25 m. $\delta^{13}C$ values range between min. 0.57 ‰ and max. 1.92 ‰ and $\delta^{18}O$ values range between min. -4.23 ‰ and max. -3.45 ‰. The isotope curves obtained are divided in to 4 zones to analyze the minor details in between. The isotope zones display similar patterns with curves determined in European and Chinese basins in the same time interval. Especially, the negative carbon isotope excursion determined in the second zone is parallel with the Upper Campanian Event.

Proxy elemental geochemistry displays generally two relative phases of rise in productivity; One in the lower part of the section and the other one in the mid part. Redox proxy elements indicate that the lower part of the section is relatively more dysoxic compared to the upper part. This coincides with the presence of frequent black shale beds in the lower part. The result of nannofossils analysis indicated that warm-water marine and low-latitude Tethyan oceanic environment was present in the studied interval. Independently, the plant fossils records in the same measured section displayed that there was a tropical humid climate condition similar to those of north east Australia. Consequently, warm water, tropical humid atmospheric conditions developed on the studied area on the northern Arabian platform causing the rise in productivity, precipitation and transportation of plant debris in to offshore following an oceanic event developed on the Arabian platform margin.

Isotope composition of Mesozoic molluscs from the Saratov-Samara region and main Early Cretaceous climate trends at the Russian Platform-Caucasus area

***Zakharov, Y.D.**[1,*], Seltser, V.B.[2], Kakabadze, M.[3], Smyshlyaeva, O.P.[1], Safronov, P.P.[1]*

1) Far Eastern Geological Institute, Russian Academy of Sciences, Vladivostok, Russia,
**E-mail: yurizakh@mail.ru*
2) N.G. Chernyshesky, Saratov State National Research University, Saratov, Russia
3) Alexandre Janelidze Institute of Geology, Tbilisi, Georgia

Palaeotemperatures obtained from calcitic bivalve shells from the Middle and Upper Volgian substages in the Samara area range from 26.8 to 39.8 (average 34.0) ^{o}C and from 28.7? to 32.6 (average 31.8) ^{o}C, respectively. However, Late Volgian belemnites secreted their rostra in cooler conditions (14.3–23.6 ^{o}C) likely of mesopelagic depths in adjacent basins. They arrived to warmer places possibly for spawning. The Aptian aragonitic bivalve and gastropod molluscs, observed in *Laevidentalium*-bearing sandstone (~10 m), exposed in the Volsk area and provisionally dated to the Volgensis or Tenuicostatus zones, give palaeotemperatures of 25.5–34.4, average 27.7^{o}C. However, belemnite rostra associated with them were also secreted in cooler conditions (17.1–23.6^{o}C). The higher temperatures, comparable of those for the mid Volgian interval, were deduced from the O isotope composition of ammonite shells, occurring in overlaying clay (~ 3 m) of the Volgensis Zone (20.5–38.6, average 32.7^{o}C). In contrast, some investigated benthic and nectobenthic dwellers from the Saratov-Samara region (an inoceramid bivalve of late early Campanian age and belemnites of Maastrichtian age) inhabited significantly cooler waters (14.3^{o}C and 7.4–10.2 ^{o}C, respectively). The obtained isotope records and a review literature data on the Russian Platform and the Caucasus allow supposing of the following temperature trend in these regions during Early Cretaceous time: 1. Estimated Valanginian-early Hauterivian cooling was followed by warmer temperature conditions at least during the early late Barremian. 2. A drop of isotopic palaeotemperature at the end of Barremian time, very similar to lower-middle Callovian one, has been documeted in both the Ulyanovsk and the Caucasus areas (however, it was not so marked apparently than that of the late early Campanian-Maastrichtian time in this area). 3. The highest temperatures for the E. Cretaceous were calculated for the mid early Aptian of the Saratov and Ulyanovsk areas, as well as the early late Aptian of the Caucasus. 4. This warming was followed by somewhat cooler conditions at the end of the Aptian in the Northern Caucasus. 5. Judging from an E. Cretaceous belemnite palaeotemperature trend for the Caucasus and a late Albian ammonite oxygen isotope record for the adjacent area (Mangyshlak), the mentioned environments were likely followed by the warmer and the significantly warmer conditions in the early Albian and the late Albian, respectively.

Palynological records from the Sikouzi Section in the Liupanshan Basin, central China: Evidence for the terrestrial response to the Aptian-Albian cold snap

***Zhang, Mingzhen*[1,*] and Dai, Shuang[2]**

*1) Gansu Provincial Key Laboratory of Petroleum Resources; Key Laboratory of Petroleum Resources Research, Chinese Academy of Sciences, Lanzhou, China, *E-mail: zhangmzh08@lzb.ac.cn*
2) Key Laboratory of Mineral Resources in Western China (Gansu Province) and School of Earth Science, Lanzhou University, Lanzhou, China

The amount of calcareous marine organisms assemblages and also paleotemperature proxies have indicated a global cooling at the Aptian-Albian transition which interrupted the equably warm climate conditions of the mid-Cretaceous period (MCANENA et al., 2013; MUTTERLOSE et al., 2009). So far this environmental event is largely based on palaeoclimatic information from marine sedimentary archives with little evidence from the continental record. This study presents a spore-pollen record from the Sikouzi Section exposed in the Liupanshan Basin of northwestern China, central Asia. This sectioncovers the Upper Liwaxia to Naijiahe Formations, which were dated as late Aptian to Albian by high resolution magnetostratigraphy (DAI et al., 2009). The palynological results showed a significant increase of conifer bisaccate pollen at the Aptian-Albian lower Madongshan Formation, indicating a change to cooler climate. After that the content of *Classopollis* affinities with thermophilous Cheirolepidiaceae rapidly increases to a continuous high level, reflecting a long-term dry and warm climate within the region of Liupanshan. This harsh environment just slightly improved from the latest Albian. It suggests that global climatic changes were the main driver controlling the regional environmental changes during the middle Cretaceous. In conclusion, the whole climatic change trends in the late Aptian to Albian sediments in the Liupanshan Basin correspond to the global record of climatic changes.

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Paleoenvironment reconstitution of uppermost Albian deposits in Northern Tunisia inferred from foraminiferal and radiolarian assemblages

Zrida, R.[1,*]***, Ben Haj Ali, N.***[1]***, Zargouni, F.***[1]

*1) Université de Tunis El Manar, Faculté des Sciences de Tunis, Département de géologie, El Manar Tunis, Tunisia, *E-mail: reem.zrida@gmail.com*

The southwestern flank of Jbel el Goraa syncline in northern Tunisia shows that uppermost Albian deposits are made by an alternation of grey marls and yellow limestones. The presence of these limestones make this lithology distinguished from the other Albian sections in northern Tunisia. A quantitative approach to analyze the abundance of foraminifera and radiolarians is used to deduce their paleoecological potential and to track the paleoenvironmental reconstitution of northern Tunisia.

In this work, two different marine conditions in the late Albian can be distinguished: The K-selection strategy (CARON & HOMEWOOD, 1983) is installed into the Uppermost Albian deposits of the section revealing a stable ecosystem and recording an important diversification of the foraminifera and a high abundance of radiolarians. The planktonic foraminiferal assemblage is abundant by large and complex morphotypes such as *Ticinella*, *Biticinella*, *Preaglobotruncana* and *Rotalipora*. These "Deep Water Fauna" (LECKIE et al., 1998) indicate the presence of stratified water conditions. This tethyan foraminiferal assemblage leads to contribute this succession to the *Planomalina buxtorfi* taxon range zone (equivalent of the *Rotalipora appenninica* zone).

The r-selection strategy (CARON & HOMEWOOD, 1983) is recorded in the upper Albian s.s. deposits and suggests an unstable environment. Small sized and primitive foraminifera represented by the *Microhedbergella* and the *Globigerinelloides* genera, are more abundant. These "Shallow Water Fauna" (LECKIE et al., 1998) opportunistic species that live near the well oxygenated surface proliferate significantly with an environment rich in nutrient; while the large morphotypes hardly survive this surface-water productivity. The installation of the OAE1-d may be the reason for such instability.

The nassellarians/spumellarians ratio reaches its peak (>5) in the yellowish limestone levels of the section. However, in the dark grey marls the N/S ratio records less significant rates (1–4). Since the nassellarians are more abundant in deeper water sediment (Kiessling, 1996), we may therefore conclude that these yellowish limestones have been deposited in a shallower environment than the gray marl depositional environment that may be linked to turbidity currents.

The quantitative analysis of both planktonic and benthic foraminifera has revealed an index of oceanity that varies from 96 % to 98.22 %. These values then suggest a marine depositional environment of bathyal zone according to Gibson (1989).

CARON et al., 1983. Marine Microplaleontology, **7**, 453–462.
LECKI et al., 1998. SEPM, Concepts in sedimentology and paleontology N°**6**, 101–126.
GIBSON, 1989. Marine Micropaleontology, **15**/1–2, 29–52.
KIESSLING, 1996. Facies, **35**, 237–274.

Ammonite stratigraphy of the Santonian (Upper Cretaceous) in the type area of the Gosau Group (Northern Calcareous Alps, Austria)

Summesberger, H.[1,*], Kennedy, W.J.[2], Wagreich, M.[3], Tröger, K.-A.[4], Skoumal, P.[5]

1) Geological-Palaeontological Department Museum of National History, Vienna, Austria,
**E mail: herbert.summesberger@nhm-wien.ac.at*
2) Oxford University, Museum of Natural History, Oxford, UK
3) Department of Geodynamics and Sedimentology, University of Vienna, Austria
4) Institut für Geologie, Technische Universität Freiberg, Freiberg/Sa., Germany
5) Bastiengasse 56, 1180 Vienna, Austria

In the Gosau area (Gosau/Upper Austria/ Russbach/Salzburg) the *Placenticeras polyopsis* Zone (Santonian) can locally be subdivided by ammonite assemblages into three subzones.

A) *Eulophoceras natalense* Subzone (early Santonian).

Eulophoceras natalense appears in the basal Santonian together with *Nowakites savini, Texanites quinquenodosus* and *Cladoceramus undulatoplicatus*. "*Hemitissotia randoi"* Gerth 1961 frequent in the basal Santonian is the juvenile stage of *Eulophoceras natalense*, and is its synonym. *Texanites quinquenodosus* extends through the early and middle Santonian until about 20 m below the occurrence of the Late Santonian *Placenticeras paraplanum*.

B) *Muniericeras gosauicum* Subzone (middle Santonian).

Muniericeras gosauicum occurs abundantly together with *Texanites quinquenodosus, Parapuzosia corbarica* and baculitids in the Randobach area (Russbach, Salzburg).

C) *Placenticeras paraplanum* Subzone (late Santonian).

Placenticeras paraplanum occurs together with abundant *Placenticeras polyopsis*, *Boehmoceras arculus* and *Boehmoceras krekeler*i and *Eulophoceras jacobi* and *Diaziceras austriacum*. *Reginaites* is the only representative of the Texanitidae. The highest ammonite occurring in the Schattau section (Russbach, Salzburg) is *Texasia dentatocarinata* which seems to be already close to the base of the Campanian. Also indicative for the late Santonian is *Marsupites laevigatus*. *Cordiceramus muelleri muelleri* and *Sphenoceramus* ex gr. *pachti/cardissoides* occur in a remarkable cluster of articulated specimens in the late Santonian. In a local mass occurrence of *Micraster coranguinum rostratus* the planktic foraminifera *Globotruncanita elevata* and *Globotruncanita stuartiformis* have their first (local) appearance. *Dicarinella asymetrica* is still present up to the top of the Schattau section, indicating the *asymetrica* total range zone or the *asymetrica-elevata* concurrent range zone according to planktic foraminiferal zonations. Nannofossils give evidence for nannofossil standard zones CC17 and UC12–13.

Alphabetical Index of Authors

Underlined Numbers (e.g. 274) – Presenting and/or first author of respective contribution

A
Abramovich, Sigal ... 83
Adatte, Thierry ... 1, 16, 47, 110
Adiya, Eviikhuu ... 123
Adloff, Markus ... 2
Afanasieva, Nadezhda ... 143
Afonin, Maxim ... 3
Aguado, Roque ... 4, 54
Aguiar, Eduardo da Silva ... 77, 150
Aguirre-Urreta, Beatriz ... 5, 165, 177
Ahmadi, Amir ... 106
Akdogan, Remziye ... 203
Al Suwaidi, Aisha ... 111
Alcalá, Luis ... 6, 43
Aleksandrova, Sonya ... 22
Alekseev, Pavel ... 7
Alfonso, Pura ... 199
Algouti, Abdellah ... 8, 105
Algouti, Ahmed ... 8, 105
Alsen, Peter ... 191
Altiner, Demir ... 9, 17, 136, 203, 204, 307
Altiner, Sevinç ... 10, 136, 203, 235, 309
Amalfitano, Jacopo ... 11, 12, 13
Amiribakhtiar, Hassan ... 220
An, Wei ... 117
Anan, Tarek ... 68
Anderskouv, Kresten ... 257
Ando, Hisao ... 14, 123, 178
Angelini, Ivana ... 95
Apotrosoaei, Vlad ... 228
Arkadiev, Vladimir ... 15, 23
Arnaud-Vanneau, Annie ... 16
Ashckenazi-Polivoda, Sarit ... 83
Atasoy, Serdar Görkem ... 17
Atchley, Stacy ... 157
Audo, Denis ... 151
Ayala, Daniel ... 6
Aydin, Faruk ... 202
Azami, Seyed Hamidreza ... 18
Azar, Dany ... 102

B
Baecker Fauth, Simone ... 77
Bajnai, Dávid ... 19
Bąk, Krzysztof ... 20
Bąk, Marta ... 20, 133
Bakhmutov, Vladimir ... 100, 291
Baraboshkin, Evgenij E. ... 15, 21, 22, 23
Baraboshkin, Evgeny Yu. ... 22, 23
Barattolo, Filippo ... 206
Barragán, Ricardo ... 187, 199
Barragán-Manzo, Ricardo ... 24
Bastías, Joaquín ... 156
Batenburg, Sietske J. ... 25, 26, 200
Batezelli, Alessandro ... 27
Baudin, François ... 54, 59
Baumgartner, Peter O. ... 201
Bayon, Germain ... 176
Begusch, Christina ... 28
Ben Alaya, Sonia ... 193
Ben Haj Ali, Nebiha ... 312
Benchaabane, Najeh ... 29
Bengtson, Peter ... 30, 31, 148
Benito, M. Isabel ... 43
Bennami, Mouloud ... 198
Benpei, Liu ... 131
Benyamovski [Beniamovski], V.N. ... 22, 104
Benzaggagh, Mohamed ... 32
Berensmeier, Michaela ... 33, 34, 61, 288
Bergue, Cristianini Trescastro ... 77, 150
Bernal, Juan Pablo ... 24
Bertinelli, Angela ... 161
Bessong, Moise ... 198
Bibi, Mehwish ... 35
Blinov, I.V. ... 122
Bodor, Emese Reka ... 114
Böhm, Katharina ... 292, 293, 295
Boorová, Daniela ... 183
Bomou, Brahimsamba ... 16
Bordunov, S.I. ... 122
Borgomano, Jean ... 213
Bornemann, André ... 36, 70
Bottini, Cinzia ... 37, 111, 166
Bouakadi, Nourredine ... 193
Bougeault, Cédric ... 176
Boulila, Slah ... 54
Boussaha, Myriam ... 50
Bragina, Liubov ... 38
Braham, William. ... 140, 141
Brovina, Ekaterina ... 39
Bruneau, Ludovic ... 50
Bruno, Mauro Daniel Rodrigues ... 77, 150
Bryndal, Tomasz ... 20
Brysch, Sven ... 40
Bubik, Miroslav ... 41
Bukenberger, Patrick ... 42

C
Cacciatore, Maria Simona ... 222
Campos-Soto, Sonia ... 43
Canet, Carles ... 199
Canner, Kathryn ... 205
Cao, Ke ... 44
Cappetta, Henri ... 83
Cárdenas, Claudia ... 208, 209
Carnevale, Giorgio ... 11, 12, 13
Caron, Benoit ... 59
Caron, Michèle ... 73
Carvalho, Marcelo ... 31
Caus, Esmeralda ... 43

Caves, Jeremy 90
Čech, Stanislav 45, 46, 192, 244, 264
Ceolin, Daiane 150, 208
Cevallos Ferriz, Sergio R.S. 78, 120
Chalabi, Ali 205
Charbonnier, Guillaume 47
Charbonnier, Sylvain 151
Chavanne, Alex 239
Chen, Ping 301
Chen, Ruiling 58
Chen, Xi 48, 49
Chenot, Elise 50, 83, 176
Chiari, Marco 161
Chkhaidze, Zviadi 93
Chmielewski, Andrzej 101
Choi, Byung-Do 51
Cifelli, Richard L. 52
Ciurej, Agnieszka 20
Cížková, Kristýna 216, 237
Claeys, Philippe 60
Clarke, Leon J. 71
Cobos, Alberto 6, 43
Coccioni, Rodolfo 54
Cocquerez, Théophile 50
Cohen, Joshua E. 52
Coimbra, Rute 53
Company, Miguel 4, 54, 215
Concheyro, Andrea 5, 165
Condon, Daniel 142
Contreras, Dori 265
Cooper, John R. 55
Crame, Alistair 40
Crampton, James 109
Császár, Géza 56
Csiki-Sava, Zoltán 114
Cyglicki, Michal 57

D

Dai, Shuang 58, 66, 311
Dalla Vecchia, Fabio Marco 13
Danzelle, Julien 59
Davis, Brian M. 52
De Winter, Niels J. 60
Deconinck, Jean-François 50, 54, 83, 213
Di Stefano, Pietro 222
Dickson, Alexander J. 25
Dimofte, Daniela 228
Dinarès-Turell, Jaume 292, 294, 295
Ding, Cong 218
Ding, Qiuhong 280
Dinís, Jorge 53
Dolenec, Matej 206
Dölling, Bettina 33, 34, 61, 62, 217
Dölling, Manfred 61, 62
Dölling, Markus 34
Domanski, Hubert 63
Dong, Chong 64
Donnadieu, Yannick 65, 213
Doupovcová, Pavlína 245
Doyle, Peter 140
Drobne, Katica 206
Du, Baoxia 64, 66
Duarte, Luís Vitor 53
Dubicka, Zofia 67
Ducea, Mihai N. 228
Duchamp-Alphonse, Stéphanie 47
Dulemba, Pawel 20
Duque-Botero, Fabian 49
Durlet, Christophe 97
Dutra, Tania 155, 156

E

Eftekhari, Maryam 171
El Belasy, Ahmed 68
Ekrt, Boris 244
El Ferhi, Faycel 115, 193, 259, 260
Elbra, Tiiu 216, 237
Eldrett, James S. 25
Elewa, Ashraf 185
Engelke, Julia 69, 163, 289
Erba, Elisabetta 37, 89, 166
Erbacher, Jochen 36, 70
Erfani, Mohammad Ali 221
Eskin, Alexey 143
Espílez, Eduardo 6
Estrada-Ruiz, Emilio 265

F

Fabianska, Monika 20
Falzoni, Francesca 71, 72, 73
Fang, Yanan 74
Fateh-Bahari, Leili 75
Fathy, Douaa 76
Faucher, Giulia 166
Fauth, Gerson 77, 150, 208
Fekete, Kamil 183
Felisiak, Ireneusz 67
Fernandez, Roy 156
Ferhi, Faycel .... see El Ferhi, Faycel
Fernández-Labrador, Laura 43
FitzPatrick, Meriel E.J. 108
Flaig, Peter 232
Flores Rocha, Luis Alberto 78
Florindo, Fabio 170
Föllmi, Karl B. 47, 79, 97
Font, Eric 1
Forber, David A. 108
Forkner, Rob 85
Fornaciari, Eliana 11, 12, 13, 95
Forshaw, Joline 80, 81
Fowell, Sarah 232
Fözy, István 19, 142
Francovschi, Ion 228
Frank, Martin 26
Franke, Sandra 82
Franz, Matthias 82
Frau, Camille 187, 237
Frederichs, Thomas 177
Freslon, Nicolas 83, 176
Friedrich, Oliver 26
Frijia, Gianluca 33, 34, 84, 85, 236
Frontalini, Fabrizio 54
Fürsich, Franz Theodor 288

G

Gabdullin, Ruslan ... 86
Gagulski, Tomasz ... 152
Gale, Andy ... 87, 88
Gambacorta, Gabriele ... 89
Gao, Yuan ... 90
Gardin, Silvia ... 110
Garrido, Sebastián ... 155
Gates, Terry ... 91
Gautam, Jai P. ... 153
Gavrilov, Yuri ... 92
Gavtadze, Tamara ... 93
Gazdzicka, Elzbieta ... 101
Gebhardt, Holger ... 94
Genedi, Adel ... 68
Gèze, Raymond ... 102
Gier, Susanne ... 76, 126, 182, 295
Gierlinski, Gerard D. ... 115
Giorgioni, Martino ... 170
Giusberti, Luca ... 11, 12, 13, 54, 95
Gnilovskaya, Anastasia ... 96
Goders, Steven ... 60
Godet, Alexis ... 55, 97
Golovneva, Lina ... 7, 98, 99, 113
Gombosuren, Tsolmon ... 123
Gomez, Bernard ... 95
Gómez-Tuena, Arturo ... 24
González, Ana ... 6
Gonzalez, Luis ... 167, 250
Gorczyca, Grazyna ... 152
Gorican, Spela ... 201
Gorzelak, Przemyslaw ... 67
Goto, Akiko ... 109
Gourlan, Alexandra Tiaré ... 176
Grabowski, Jacek ... 100, 101
Grammer, G. Michael ... 68
Granier, Bruno ... 102
Greene, Sarah ... 2
Gregory, John F. ... 140
Grimes, Stephen ... 215
Gröcke, Darren R. ... 80, 81, 129, 264
Gruszczynski, Michal ... 103
Guerra, Rodrigo do Monte ... 77, 150
Guillocheau, François ... 213
Guiraud, Michel ... 176
Guzhikov, Andrey ... 15, 22, 23, 104
Guzhikova, Anastasiya ... 22, 104

H

Haas, Janos ... 100
Hadach, Fatiha ... 8, 105
Hairapetian, Vachik ... 106
Halásová, Eva ... 121, 170, 291
Hamdani, Hayat ... 220
Hardwick, Jeffrey ... 55
Hart, Malcom B. ... 107, 108
Hasegawa, Hitoshi ... 123
Hasegawa, Takashi ... 109
Heimhofer, Ulrich ... 36, 53, 110, 119, 236, 238
Heizler, Matthew ... 157
Helja, Emina ... 111
Hell, Joseph Victor ... 198
Hennhoefer, Dominik ... 111
Herdocia, Carlos ... 112
Herman, Alexey ... 113, 186
Hermanová, Zuzana ... 114
Hesselbo, Stephen ... 2
Heunisch, Carmen ... 238
Hinnov, Linda ... 164, 296
Hinojosa, Felipe ... 155, 156
Hiss, Martin ... 61
Horikx, Maurits ... 53
Horne, David J. ... 233
Hosgor, Izzet ... 308, 309
Houla, Yassine ... 115, 193, 259, 260
Hu, Jianfang ... 116
Hu, Xiumian ... 117
Huang, Chengmin ... 116
Huang, Yongjian ... 258
Huber, Brian ... 118
Huck, Stefan ... 36, 53, 119, 236
Huerta Vergara, Alma Rosa ... 120
Huh, Min ... 51
Hülse, Peter ... 239
Hyzný, Matúš ... 121, 180

I

Iakovishina, Elena V. ... 22, 122
Ibarra, Daniel ... 90
Ichinnorov, Niiden ... 123
Idakieva, Vyara ... 48
Ifrim, Christina ... 124, 125
Immenhauser, Adrian ... 53
Iqbal, Shahid ... 35, 126
Ivanova, Daria ... 291

J

Jackson, Mike ... 157
Jäger, Hartmut ... 40, 229
Jagt, John W.M. ... 127, 128
Jagt-Yazykova, Elena A ... 127, 128
Jaitly, Anand Kumar ... 153
Jan, Irfan ... 126
Janssen, Nico ... 215
Jarvis, Ian ... 50, 80, 81, 129, 264
Jaubert, Maxime ... 50
Jekel, Denise ... 85
Jenkyns, Hugh C. ... 25, 71, 200
Jerrett, Rhodri ... 268
Jiang, Dexin ... 130
Jiang, Wei ... 130
Jiang, Zikun ... 131, 280
Joeckel, R. Matt ... 132, 167
Jonk, Louis ... 253
Jovane, Luigi ... 170
Józsa, Stafan ... 121, 170, 248
Jurkowska, Agata ... 67, 133

K

Kadri, Ali ... 193
Kakabadze, I.M. ... 134
Kakabadze, Mikheil V. ... 30, 134, 310
Kalanat, Behnaz ... 135, 172
Kaljakin, E.A. ... 22

Kallanxhi, Madalina-Elena 63
Kamyabi Shadan, Hossein 227
Kandemir, Raif 202, 304, 305
Kani, Anoshiravan 188
Kaplan, Ulrich 297
Karabeyoglu, Ali Uygar 136
Karpuk, Maria 137
Kdýr, Šimon 216, 237
Kedzierski, Mariusz 138, 139
Keller, Gerta 1, 110
Kelly, Simon R.A. 140, 141, 239
Kelsey, Benjamin S. 25
Kennedy, William J.. .... 140, 313
Kesjar, Dora 142
Khabipyanov, Lenar 143
Khemiri, Fares 29
Kirkland, James I. 132, 250
Kirmaci, M. Ziya 304, 305
Kiselev, Dmitry 144
Klein, Jaap 168
Klein, Tina 26
Kneller, Ben 78
Knorr, Gregor 196
Köberl, Christian 145
Koç, Hayati 247
Kopaevich, Ludmila 22, 146, 269
Košťák, Martin 147, 244
Koutsoukos, Eduardo 148
Kowal-Kasprzyk, Justyna 149
Krahl, Guilherme 77, 150
Krézsek, Csaba 228
Kriwet, Jürgen 13
Krobicki, Michal 100, 151, 152
Kroh, Andreas 170
Kruk, Miroslaw 138
Krzywiec, Piotr 249
Kujau, Ariane 110
Kumar, Susheel 153
Kumon, Fujio 135, 172
Kürschner, Wolfram 126
Kvacek, Jiri 114, 154, 309

L

Ladant, Jean-Baptiste 65
Ladeira, Francisco 27
Lakova, Iskra 100
Lamolda, Marcos 49
Lana, Cecília 31
Lanchava, Giorgi J. 134
Landman, Neil H. 276
Laurin, Jirí 264
Leandro, Lilian Maia 150
Leckie, R. Mark 73
Lei, Xiangtong 66
Leppe, Marcelo 155, 156
Lescano, Marina 5, 165
Leslie, Caitlin E. 157
Leszczynski, Krzysztof 101
Leszczynski, Stanislaw 139
Li, Cheng-Sen 162
Li, Gang 158
Li, Guobiao 278
Li, Jian-Guo 302
Li, Juan 117
Li, Liqin 130
Li, Mingsong 164
Li, Ruiyun 251
Li, Sha 159
Li, Shun 298
Li, Xianghui 160
Li, Xin 161
Li, Ya 162
Li, Yuanhui 300
Liang, Huimin 48, 303
Liang, Xiao-Qing 162
Liao, Weisen 116
Lin, Miao-Qin 302
Linnert, Christian 33, 69, 163, 217, 289
Lintnerová, Otília. 183, 225
Liu, Shasha 293
Liu, Wei 164
Lohmann, Gerrit 196
Lopes, Fernando Marcanth 150
López-Martínez, Rafael 24, 165, 199
López-Mir, Berta 239
Lübke, Nathalie 166
Luciani, Valeria 12, 13
Ludvigson, Greg A. 132, 167, 250
Lukeneder, Alexander .. 121, 168, 169, 170, 248, 270
Lunt, Dan 2

M

Ma, Chao 164
Mac Niocaill, Conall 233
MacLeod, Kenneth G. 71, 118
Mahanipour, Azam 171
Mahboubi, Asaollah 75
Mahmudy Gharaie, M. Hosein ...18, 75, 135, 172
Mair, Lukas 173
Majidifard, Mahmoud Reza 288
Makovicky, Peter J. 91, 253
Maksoud, Sibelle 102
Malinverno, Alberto 89
Malkani, M. Sadiq 174, 175
Mampel, Luis 6
Mangerud, Gunn 219
Manriquez, Leslie 156
Mansilla, Hector 155, 156
Mansour, Ahmed 185
Marina, Lescano 177
Markic, Milos 206
Marlot, Loïc 176
Marshall, Jim 103
Martín-Closas, Carles 159, 259
Martinez, Mathieu 4, 5, 19, 54, 177, 215
Martínez-López, F. Javier 4
Martini, Michelangelo 24
Mas, Ramón 43
Mashkina, Y.A. 122
Masukawa, Genya 178
Matsuoka, Atsushi 161, 179
Maurrasse, Florentin M.-J.R.... 49, 112, 181, 246
Mazuch, Martin 147, 244

Mbabi Bitchong, André 1
McCarthy, Paul 232
Melinte-Dobrinescu, Mihaela C. 49, 228, 303
Menabde, Anna 184
Meszar, Maria 182
Michalik, Jozef 183, 225
Mikadze, Khatuna 93, 184
Min, Huang 131
Misz-Kennan, Magdalena 20
Moeller, Andreas 167
Mohamed, Omar 185
Moiroud, Mathieu 54, 213
Moiseeva, Maria 186
Möller, Carla 166, 191
Monna, Fabrice 54
Monteiro, Fanny 2
Montgomery, Elizabeth 250
Morales, Chloé 47
Moreno, Josep Anton 187, 199
Morozov, Vladimir 143
Mosavinia, Abdolmajid 188
Motamedalshariati, Maryam 221
Mourabit, Zahra 8, 105
Mousavi, Nasim 188
Moussavi Harami, Reza 75
Mulayim, Oguz 189, 308
Munujos, Heleni 190
Muta, Soichiro 109
Mutterlose, Jörg 69, 163, 166, 171, 191, 217, 238, 271, 289, 297

N

Naafs, David 2, 200
Nádaskay, Roland 192
Naglik, Beata 20
Nasri, Ahmed 115, 193, 259, 260
Ndjeng, Emmanuel 198
Nemoto, Toshifumi 109
Neu, Christoph 26
Nickl, Anna-Leah 177
Niebuhr, Birgit 194, 195, 289
Niedzwiedzki, Grzegorz 115
Niezgodzki, Igor 196, 219
Nishida, Harufumi 155, 156
Nordt, Lee 157
Nosova, Natalya 197
Ntsama Atangana, Jacqueline 198
Nuñez, Fernando 199
Nyamsambuu, Odgerel 123
Nyerges, Anita 19

O

Ochoa, Andrés 232
O'Connor, Lauren 200
O'Dogherty, Luis 4, 54, 201
Oguz, Simge 202
Okay, Aral 203, 204
Okoński, Szymon 133
Omarini, Julieta 5, 177
Ortega, Carlos 24
Ortuya, María Jesús 156
Osborne, Anne 26
Owen, H. 140
Ovechkina, M.N. 22

P

Packer, Stephen 205
Paige, Marquise 250
Pálfy, József 19, 142
Pälike, Heiko 177
Palinkas, Ladislav 206
Pan, Yanhong 207
Panaiotu, Cristian George 228
Pancost, R. D. 200
Pandey, Bindhyachal 153
Parrott, Joan 265
Pas, Damien 164
Patarroyo, German David 208, 209
Pathak, Deo Brat 153
Pearce, Martin 80, 81, 219
Pecimotika, Gabrijela 206
Pellenard, Pierre 50, 54, 83, 176
Peng, Dongxiang 58
Peppe, Daniel 157
Perdiou, Anastasios 257
Perera, Siyumini 210
Perovskiy, Igor 143
Pervushov, Evgeniy 22, 104
Peryt, Danuta 63
Petrizzo, Maria Rose 70, 71, 72, 73, 211, 214
Petrova, Silviya 100
Pictet, Antoine 187, 212
Pino, Juan Pablo 155
Plint, Guy 264, 276
Ploch, Izabela 101
Pohl, Alexandre 213
Pokrovsky, Boris 22, 242
Polácková, Eliška 245
Poli, Emmanuelle 213
Pons, Josep Maria 190
Popp, Friedrich 295
Premec Fucek, Vlasta 206
Premoli Silva, Isabella 214
Price, Gregory 19, 142, 215, 268
Profeta, Lucia 228
Pruner, Petr 216, 237
Pucéat, Emmanuelle 50, 83, 176, 213
Pugliese, Nevio 206
Püttmann, Tobias 61, 217, 271

Q

Qin, Zuohuan 218, 277
Qu, Haiying 298
Quijada, Emma 43

R

Radmacher, Wieslawa 196, 219
Ragazzi, Eugenio 95
Raisossadat, Seyed Naser 220, 221
Ramos, Victor A. 5, 165
Randazzo, Vincenzo 222
Rantuch, Jakub 223
Rao, Xin 224
Rawson, Peter F. 5, 54, 168

Razmjooei, Mohammad J. 67, 257
Reboulet, Stéphane 168
Reháková, Daniela ... 24, 41, 100, 149, 170, 216, 225, 237, 252, 291
Reich, Mikle 285
Remin, Zbyszek 57, 103, 226
Riahi, Nassim 227
Richard, James 50
Ridgwell, Andy 2
Rincón, Daniel Andrés 208, 209
Riquier, Laurent 54, 59
Roban, Relu Dumitru 49, 228
Robert, Emmanuel 29
Roberts, Eric M. 261
Robinson, Stuart A. 25, 200, 240
Rocha, Fernando 53
Roest-Ellis, Sascha 129
Roghi, Guido 13, 95
Rogov, Mikhail 144, 229, 242
Romero, Gregorio 54
Ross, Jeff 167
Royo-Torres, Rafael 6, 43
Ruhl, Micha 25
Ryabov, Iliya 104
Rybár, Samuel 121

S

Sadeghi, Abbas 227
Safronov, Peter P. 310
Salazar Jaramillo, Susana 232
Salazar, Christian 40, 142, 230, 231
Sames, Benjamin 115, 193, 218, 233, 234, 259, 260, 284, 295, 298, 299, 300
Sánchez-Bellón, Ángel 4
Sanchez-Hernandez, Yosmel 181
Sandoval, José 4, 54
Sano, Shin-ichi 224
Santa Catharina, Amanda 78
Santos, Alessandra da Silva 77
Sari, Bilal 202, 308
Sariaslan, Nisan 235
Savian, Jairo F. 170
Schlagintweit, Felix 288
Schlüter, Nils 285
Schmitt, Katharina 236
Schmitz, Mark 5
Schnabl, Petr 100, 216, 237
Schneebeli-Hermann, Elke 110
Schneider, Anton Christoph 238
Schneider, Simon 141, 239
Schoene, Blair 1
Schouten, Stefan 110
Selby, David 129
Seltser [Selzer], Vladimir B. 22, 104, 310
Sengupta, Ritwika 240
Setoyama, Elichi 121
Sha, Jingeng 224, 241
Shank, Joel A. 264
Shchepetova, Elena 242
Shcherbinina, Ekaterina 92
Shczepetov, Sergei 7, 113
Sheldon, Emma 257
Shi, Zhongye 298, 299
Shojaei, Ziba 106
Simmons, Mike D. 203, 243, 308
Singh, Abha 210
Sizun, Jean-Pierre 50
Skanji, Ahmed 115, 193, 259, 260
Skelton, Peter 224
Sklenár, Jan 244
Skoumal, Peter 313
Skupien, Petr 245
Smolen, Jolanta 101
Smyshlyaeva, Olga P. 310
Sobien, Katarzyna 100
Socorro, Jander 246
Sokerina, Natalia 143
Sokolova, Alexandra 186
Solak, Cemile 247
Soldan, Dario Marcello 214
Soták, Ján 170, 183, 248
Soussi, Mohamed 29, 115, 193, 259, 260
Spangenberg, Jorge E. 55, 97
Spicer, Robert 186
Spötl, Christoph 295
Sprovieri, Mario 170
Stachowska, Aleksandra 249
Standhardt, Barbara 157
Steuber, Thomas 111
Stinnesbeck, Wolfgang .. 40, 124, 125, 155, 156, 230, 231
Stoykova, Kristalina 48, 100
Suarez, Marina 167, 250
Suarez-Gonzalez, Pablo 43
Summart, Ornuma 256
Summesberger, Herbert 180, 273, 313
Sun, Bainian 64, 66, 251, 301
Sunal, Gürsel 203
Surinskiy, Arseny 104
Svábenická, Lilian 46, 192, 252
Svobodova, Andrea 216, 237, 252
Świerczewska-Gładysz, Ewa 133
Symons, Robyn C.R. 253
Szaniawski, Rafal 67
Szives, Ottilia 168

T

Tahoun, Sameh 185
Takahashi, Massaki 14
Tan, Jie 254
Tari, Gabor 255, 266
Tasli, Kemal 247
Tavera, José M. 54
Teerarungsigul, Naramase 256
Tewary, Vinod Chandra 206
Thibault, Nicolas 50, 67, 257
Thomazo, Christophe 59, 83
Tian, Ning 280
Tian, Wenqian 258
Tocher, Bruce 80, 81
Todaro, Simona 222
Torres, Gustavo Adolfo 208, 209
Tosca, Nicholas J. 240
Trabelsi, Khaled 115, 193, 259, 260

Trevisan, Cristine 155, 156
Tröger, Karl-Armin 313
Trutin, Mladen 206
Tucker, Ryan T. 253, 261
Tunik, Maísa A. 5, 177
Türk Öz, Emine 262
Tüysüz, Okan 263
Tyszka, Jaroslaw 196, 219

U

Uličný, David 45, 244, 264
Upchurch, Garland 265

V

Vahidinia, Mohammad 135, 172
Valagussa, Marco 72
Valecka, Jaroslav 192
Van Malderen, Stijn J.M. 60
Vandevelde, Justin 215
Vangelov, Dian 266
Vanhaecke, Frank 60
Vaňková, Lucie 147, 267
Vasile, Stefan 114
Vennari, Verónica 165
Vicens, Enric 190
Vickers, Madeleine 268
Victor, Zakharov 144
Vieira, Carlos Eduardo Lucas 77
Vignaud, Patrick 198
Villemant, Benoit 59
Vishnevskaya, Valentina S. 22, 146, 269
Vodrážka, Radek 270
Voigt, Silke 26, 271

W

Wagreich, Michael 18, 28, 35, 42, 63, 76, 115, 126, 173, 182, 188, 193, 234, 259, 260, 272, 273, 274, 284, 292, 293, 294, 295, 299, 300, 309, 313
Walaszczyk, Ireneusz 140, 264, 275, 276
Wan, Xiaoqiao 159, 218, 277, 296, 298, 299, 300
Wanas, Hamdalla 68
Wang, Chengshan 48, 90, 161, 254, 258, 296
Wang, Jiangang 117
Wang, Jingyu 160
Wang, Qifei 159
Wang, Tianyang 278
Wang, Yaqiong 279
Wang, Yizhe 74
Wang, Yongdong 64, 130, 131, 162, 280, 281, 301
Watkinson, Matthew 268
Weissert, Helmut 54, 282, 303
Wendler, Ines 283, 284
Wendler, Jens 284
Westermann, Stéphane 47
Whitham, Andrew G. 140
Wiese, Frank 285
Wilberger, Thiers 155, 156
Williamson, Thomas 157
Wilmsen, Markus...... 33, 69, 106, 163, 194, 195, 286, 287, 288, 289
Wimbledon, Wiliam A.P. 237, 290, 291
Wolfgring, Erik 42, 173, 188, 233, 273, 292, 293, 294, 295
Wu, Chaodong 74
Wu, Huaichun 164, 258, 277, 296, 303
Wu, Xiangwu 281
Wucherpfennig, Nina 110
Wulff, Lena 297

X

Xi, Dangpeng 218, 277, 298, 299, 300
Xu, Qing 302
Xu, Xiaohui 251, 301
Xu, Yankang 218

Y

Yan, Defei 251
Yan, Ningyun 58
Yang, Liuyin 301
Yang, Tianshui 296
Yang, Xiaoju 280, 302
Yao, Hanwei 48, 303
Yildiz, Merve 262, 304, 305
Yılmaz, İsmail Ömer 9, 189, 292, 293, 304, 306, 307, 308, 309
You, Hailu 250
Yuanzheng, Lu 131

Z

Zakharov, Yuri D. 310
Zanno, Lindsay E. 253
Zarcone, Giuseppe 222
Zargouni, Fouad 312
Zhang, Chaokai 160
Zhang, Haichun 159
Zhang, Laiming 90, 254
Zhang, Mingzhen 311
Zhang, Shihong 296
Zhang, Wenping 300
Zielinska, Magdalena 20
Zorina, Svetlana 143
Zrida, Rim 312

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