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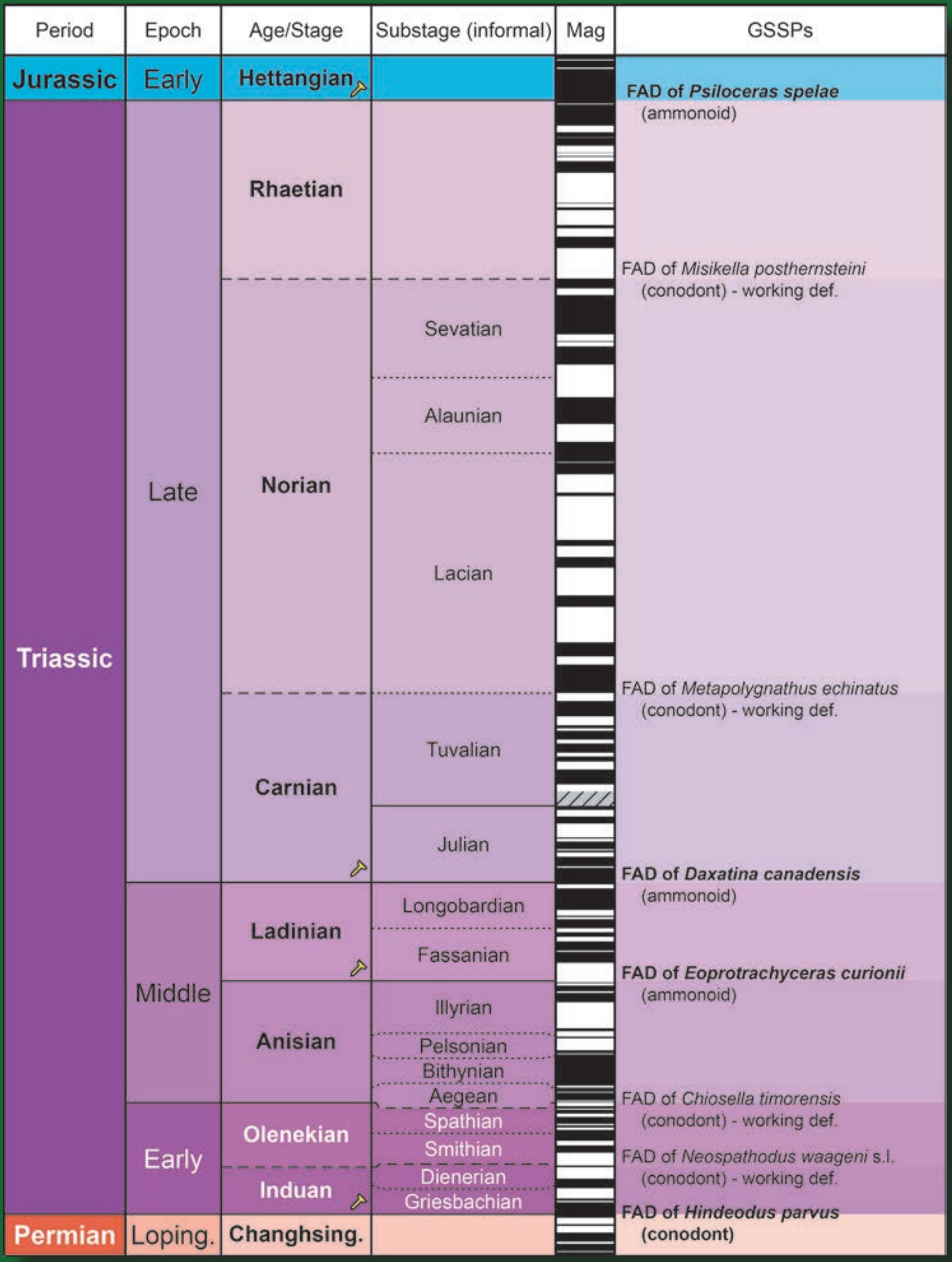

Period	Epoch	Age/Stage	Substage (informal)	Mag	GSSPs
Jurassic	Early	Hettangian			**FAD of *Psiloceras spelae*** (ammonoid)
Triassic	Late	Rhaetian			FAD of *Misikella posthernsteini* (conodont) - working def.
		Norian	Sevatian		
			Alaunian		
			Lacian		FAD of *Metapolygnathus echinatus* (conodont) - working def.
		Carnian	Tuvalian		
			Julian		**FAD of *Daxatina canadensis*** (ammonoid)
	Middle	Ladinian	Longobardian		
			Fassanian		**FAD of *Eoprotrachyceras curionii*** (ammonoid)
		Anisian	Illyrian		
			Pelsonian		
			Bithynian		
			Aegean		FAD of *Chiosella timorensis* (conodont) - working def.
	Early	Olenekian	Spathian		
			Smithian		FAD of *Neospathodus waageni* s.l. (conodont) - working def.
		Induan	Dienerian		
			Griesbachian		**FAD of *Hindeodus parvus*** (conodont)
Permian	Loping.	Changhsing.			

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ISSN 0619-4324

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Albertiana is the international journal of Triassic research. The primary aim of *Albertiana* is to promote the interdisciplinary collaboration and understanding among members of the I.U.G.S. Subcommission on Triassic Stratigraphy. *Albertiana* serves as the primary venue for the dissemination of orignal research on Triassic System. *Albertiana* also serves as a newsletter for the announcement of general information and as a platform for discussion of developments in the field of Triassic stratigraphy. *Albertiana* thus encourages the publication of contributions in which information is presented relevant to current interdisciplinary Triassic research and at provides a forum for short, relevant articles including. original research articles, reports on research and works in progress, reports on conferences, news items and conference announcements, *Albertiana* Forum: letters, comment and reply, and literature reviews. *Albertiana* is published bianually by SUNY Cortland's Paleontological Laboratory for the Subcommission on Triassic Stratigraphy. *Albertiana* is available as PDF at http://paleo.cortland.edu/Albertiana/

Cover Image: Triassic time scale. See Ogg et al., p. 3

Editorial Note

Dear Friends of the Triassic.

As I begin my tenure as Editor-in-Chief of *Albertiana*, I look upon this opportunity as both an honor and a real challenge. Since the first volume was published in 1983, *Albertiana* has served the Triassic research community and Triassic Subcommission providing a vehicle for dissemination of original research, as a newsletter for the announcement of general information and as a platform for discussion of developments in the field of Triassic stratigraphy, biostratigraphy, paleontology, geochronology, magnetostratigraphy and other related disciplines. I am very grateful to Subcommission on Triassic Stratigraphy Chair Marco Balini for offering me this opportunity to serve as the new Editor-in-Chief.

Before going any further, I wish to publicly thank Wolfram Kürschner for his many years of service as editor to *Albertiana*. Under Wolfram's stewardship, *Albertiana* really transformed itself into a professional and vital means of dissemination of research and news to the Triassic community — all this while overseeing the transition from print to an online format. Wolfram will continue his relationship as an associate editor and member of the editorial board. The editorial board has now expanded to 10 dedicated scientists whose expertise covers a broad range of disciplines and extensive experience in the Triassic. The board will be managing individual manuscript submissions and their peer reviews.

We are striving to improve not only the quantity and quality of submissions to *Albertiana*, but to raise the stature of the journal making it the "go to place" to publish new and original research of interest to the Triassic community. Other components of the journal (e.g., news, reviews, announcements, bibliographies, etc.) will remain in place. We will continue to publish *Albertiana* twice a year in electronic format and I have made it one of my primary goals to keep journal production to a regular schedule.

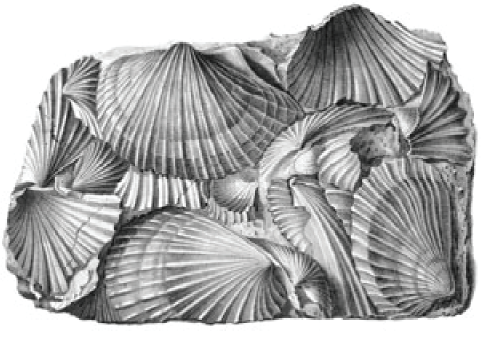
This issue's feature article by Jim Ogg and others is a review of the Triassic time scale and should look somewhat familiar to most of you. This invited contribution is not meant to be an authoritative technical research paper in which new data are presented, but instead, is essentially a republication of Jim's chapter in *The Geologic Time Scale 2012* (published by Elsevier). It is my desire that this review contribution will stimulate discussion and debate on the more pressing issues impeding progress in developing a robust and integrated timescale for the entire Triassic and the business of the Subcommission (e.g., establishing the remining GSSPs).

A couple of changes of the journal are now in place and others will soon be implemented. This edition of *Albertiana* inaugurates a somewhat modified format – one that will likely change as I learn the ins-and-outs of Adobe InDesign©. We have also revamped the submission and review processes to both strengthen the quality of research and to streamline the path from submission to publication. Additionally, I am also in the process of migrating *Albertiana*'s web site (as well as other sites hosted on paleo.cortland.edu) over to a new sever. The new instructions for authors and of course past issues of *Albertiana* will always be available on the journal's website whose URL will not change: paleo.cortland.edu/albertiana.

With this note, I am asking that you consider submitting your research to be published in *Albertiana*. Although *Albertiana* may not be able to compete with ISI journals in its impact factor, it is the perfect place to publish your Triassic research (including preliminary research/results) and other contributions like reviews and/or discussion-type papers. We would also, of course, like to publish any news, announcements, or other information that would be of interest to the Triassic research community. Given that *Albertiana* is a digital-only publication and electrons are relatively cheep we would be happy to publish lengthy articles, all-color images and would consider special thematic issue requests.

Finally, once again, I look forward to working with the editorial team, our reviewers and authors.

Christopher A. McRoberts
Editor-in-Chief, *Albertiana*
Secretary General, Subcommission on Triassic Stratigraphy



Executive Note

Dear Friends of the Triassic.

It has been a long time since the last issue of *Albertiana* was published, but we finally have a new issue ready. As you will notice, we have a new Editor; Chris McRoberts who has enthusiastically agreed to accept responsibility for publication of the newsletter. *Albertiana* now has a new layout. The Editorial Board has been updated, and I warmly welcome aboard new members Arnaud Brayard, Margaret Fraser, Piero Gianolla, Mark Hounslow, Wolfram Kürschner and Yuri Zakharov, who are joining Aymon Baud, Spencer Lucas, Mike Orchard and me. I also would like to very warmly thank Wolfram Kürschener for the tremendous amount of work he put forth over the past years as Editor of our Newsletter. He has invested lot of time collecting and editing manuscripts and perhaps most importantly, improving the layout of *Albertiana* from the original "basic" layout and paper print to its current much more effective two column organization and free PDF distribution.

I am confident that the new Editor and Board will come together in short order and work efficiently to produce a quality newsletter of which we all can be proud. We are hopeful that these new improvements will also stimulate the discussion of Triassic topics. After all, the mission of the STS is to define standards by solving problems, and problems cannot be solved without discussions.

Albertiana is ready to host discussions on those Triassic GSSPs whose definitions are still pending. During the past few years, these discussions and in a broader sense, the activities of the STS Working Groups, have been significantly delayed. The reasons behind these delays can be largely traced to the economic crisis, which reflects budget cuts for scientific research in many countries and the different methods for dissemination of the results with respect to what was the standard at the end of the 20th century. Now-a-days, we feel pressure to publish our scientific results in journals with a high impact factor and with major emphasis on fascinating and fashionable topics such as climate change, mass extinction and recovery, each of which ensures a high number of citations in a short time. Taxonomy as well as much of the work necessary to define a GSSP does not set well with this general trend, but nevertheless, this work must be done. Most discussions regarding GSSPs, chronostratigraphy and time scales would never be published in ISI journals, but Triassic specialists have the opportunity to publish them in *Albertiana*. Authors may even submit a short summary of research to *Albertiana*, which will be more fully described in a manuscript under review or in press.

Albertiana is again scheduled to be published twice per year. Again, this is an advantage for authors, who can have their contributions printed in a short time, and it is also an important enticement to shorten the time of discussions. Much time has been spent and ultimately lost during recent years while waiting for final acceptance by ISI journals of data critical to the discussion of GSSPs. A delay of one year from the informal announcement of new data and their presentation might be the exception, but it surely cannot be the rule for discussion. In this respect, WG leaders will be required to define deadlines and to promote discussions in *Albertiana*, and they will be made keenly aware that due to the shortage of funds, the organization of meetings and workshops specifically dedicated to the eventual definition of GSSPs is becoming more and more complex.

It pleases me to announce that there is also some good news regarding future activities of the Subcommission. Next year STRATI 2015, the 2nd international symposium on Stratigraphy, will be held in Graz (Austria) from July 19-23 (see the 1st circular at the end of this issue). This event follows the 1st international symposium held in Lisbon in 2013, and it is now the official reference symposium of the International Commission of Stratigraphy. The Organizing Committee together with the ICS is actively planning for the event and sessions and excursions devoted to Triassic topics will be included. The ICS, in particular, is showing an active interest and is providing support for the event. All Subcommissions have been invited to organize activities and discussions in the form of scientific sessions and/or in business meetings. In line with these suggestions and in cooperation with WG leaders, we will define and set goals with deadlines for 2015 for each WG. These deadlines will not necessarily pertain to final decisions for GSSPs, but they at least will include balloting for sections and possible primary marker events. The WGs from which results are expected include the base Olenekian (chair Y. Zakharov), base Norian (chair W. Kürschner) and base Rhaetian (chair M. Balini).

Thanks to the efforts of Leo Krystyn and his colleagues, the WG that is probably closest to final GSSP determination is the base Rhaetian. In December 2013 Krystyn asked me to take his place as WG leader because of the possible conflict created by his direct involvment with the Steinbergkogel proposal. The final proposal is nearly ready and the WG should initiate the final discussion. The next issue of *Albertiana* would be an ideal opportunity to publish the final proposal as well as any other comments, discussions and proposals for auxiliary/additional sections for this important boundary of the Upper Triassic Series.

The base Norian WG is also quite close to the final round of discussions. Important data from North America will probably be published this summer, and hopefully, the WG will be able to agree on a recommendation by the end of 2015. Nevertheless, the amount of data published for this boundary during the past four years is quite impressive.

A huge amount of data has also been published by members of the base Olenekian WG. This group is not far from a final conclusion of its activities, even though some data have not yet been published, namely the revision of the conodont *Neospathodus waageni*. Hopefully, this deficiency will be rectified in the very near future.

Marco Balini
Chair, Subcommission on Triassic Stratigraphy

Feature Review Article

TRIASSIC TIMESCALE STATUS: A BRIEF OVERVIEW

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Abstract – The Triassic is bounded by two mass extinctions that coincide with vast outpourings of volcanic flood basalts. Ammonoids and conodonts are the main correlation tools for marine deposits, but the precise calibrations of terrestrial animal and plant events to the marine stratigraphy are generally uncertain. The Pangea supercontinent has no known glacial episodes during the Triassic, but the modulation of its monsoonal climate by Milankovitch cycles left sedimentary signatures useful for high-resolution scaling, especially of magnetic polarity zones from terrestrial basins. However, the correlation of those segments of the cycle-scaled magnetic polarity pattern and the associated terrestrial stratigraphy to the marine-based records is ambiguous for most intervals. The age model for Early and Middle Triassic is relatively well constrained by cyclostratigraphy and radio-isotopic dates, but there is a lack of precise biostratigraphic-constrained radio-isotopic dates for the Late Triassic, and two end-member options are possible. In contrast to the rapid evolution and pronounced environmental changes that characterize the Early Triassic through Carnian, it appears that the Norian stage of the Late Triassic was a 20-million-year interval of stability in Earth history.

INTRODUCTION

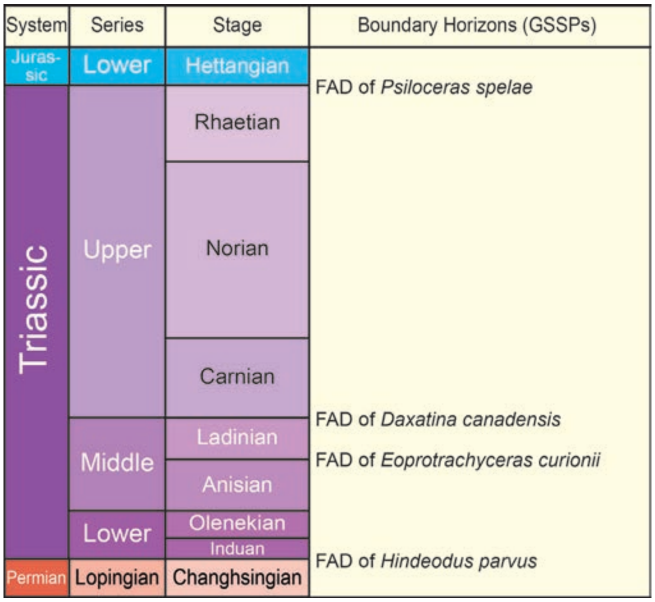
Our understanding of the Triassic underwent a revolution after 2002. Collaborations among geochemists, paleomagnetists, paleontologists and other stratigraphers have concentrated on its exciting boundary intervals, but have also enabled compilation of a comparatively detailed bio-mag-chem-cyclostratigraphy scale for much of the Triassic. Abundant high-precision radio-isotopic dates, coupled with enhanced methods for global correlation and detailed compilations of geochemical oscillations, have revealed a startling inequality in duration of Triassic subdivisions and pacing of evolutionary and environmental change. The Norian of Late Triassic apparently spans nearly three times the duration of the entire Early Triassic (Induan and Olenekian). The early half of that brief Early Triassic has been revealed as an interval of pronounced environmental stress and extraordinarily rapid evolutionary turnover.

This knowledge and the inevitable new questions and debates have been partially summarized in review articles and special volumes. In particular, the book "Triassic Time Scale" (Lucas, 2010a) contains separate papers on every main stratigraphic topic (e.g., history and status of chronostratigraphy, biostratigraphy of different marine and terrestrial groups, magnetic polarity time scale, radio-isotopic age database, etc.). This suite and selected other studies were compiled with potential numerical age models as a Triassic chapter in Geologic Time Scale 2012 (Gradstein et al., 2012).

This article is largely a condensed extract of the status of subdivisions and possible numerical age models from that GTS2012 Triassic chapter, with the inclusion of selected later publications. We highlight aspects where research will establish a more robust international Triassic time scale.

TRIASSIC SUBDIVISIONS

The Trias of Friedrich August von Alberti (1834) united a trio of formations widespread in southern Germany – a lower Buntsandstein ('colored sandstone'), Muschelkalk ('clam limestone') and an upper Keuper (non-marine reddish beds). These continental and shallow-marine formations were difficult to correlate beyond Germany; therefore, most of the traditional stages (Anisian, Ladinian, Carnian, Norian, Rhaetian) were named from ammonoid-rich successions of the Northern Calcareous Alps of Austria. However, the stratigraphy of these Austrian tectonic slices proved unsuitable for establishing formal boundary stratotypes, or even deducing the sequential order of the stages (Tozer, 1984). For example, the Norian was originally considered to underlie the Carnian stage, but after a convolute scientific-political debate (reviewed in Tozer, 1984), the Norian was established as the younger stage. Over 50 different stage names have been proposed for subdividing the Triassic (tabulated in Tozer, 1984).



System	Series	Stage	Boundary Horizons (GSSPs)
Jurassic	Lower	Hettangian	FAD of *Psiloceras spelae*
Triassic	Upper	Rhaetian	
		Norian	
		Carnian	FAD of *Daxatina canadensis*
	Middle	Ladinian	FAD of *Eoprotrachyceras curionii*
		Anisian	
	Lower	Olenekian	
		Induan	FAD of *Hindeodus parvus*
Permian	Lopingian	Changhsingian	

Figure 1 – Summary of Triassic stage nomenclature and status. Stages with ratified GSSPs are indicated by the first-appearance datum (FAD) of the main correlation marker, which are ammonoids except for the conodont Hindeodus parvus at the beginning of the Triassic. Relative durations of stages for this Triassic diagram is "Option 2" (long Rhaetian; shorter Carnian) that was used in GTS2012 Phanerozoic scale, but a modified "Option 1" (a shorter Rhaetian span) is suggested by on-going dating of the Norian-Rhaetian boundary interval (Jörn Wotzlaw, pers. commun.).

The Subcommission on Triassic Stratigraphy (International Commission on Stratigraphy) adopted seven standard Triassic stages in 1991 (Visscher, 1992); but the general lack of unambiguous historical precedents for placement of Triassic stage boundaries slowed the establishment of formal GSSPs (Figure 1). Probably as with many geologic systems, if one could "start over with present knowledge", a more global suite of series and stages could be proposed (see the stimulating discussion and suggestions in Lucas, 2013). However, as with many geologic systems [other than for the international Cambrian and Ordovician, where an entirely new global division and nomenclature was adopted], there is a trend to retain historical usage rather than accept a more "natural" set of semi-equal divisions marked by recognized major global events in Earth's biological and environmental history.

European stratigraphers commonly use substages with geographic names, whereas North American stratigraphers prefer a generic lower/middle/upper nomenclature (e.g., Fassanian substage versus Lower Ladinian). The most common substages are summarized here, these are informal working versions.

Details of the history, definitions and correlation of Triassic subdivisions include the Albertiana newsletters and the annual reports of the Subcommission on Triassic Stratigraphy (ICS). Excellent reviews are in Tozer (1967, 1984) and Lucas (2010b, 2013).

The Permian–Triassic Boundary (base of Induan Stage)

The Paleozoic terminated in a complex environmental catastrophe and mass extinction of life. The latest Permian to earliest Triassic events include the progressive disappearance of up to 80% of marine genera, pronounced negative carbon-isotope and strontium-isotope anomalies, the massive flood basalts of the Siberian Traps, widespread anoxic oceanic conditions, a major sea-level regression and exposure of shelves followed by a major transgression, a "chert gap" and "coal gap", and replacement of reefal ecosystems with microbial-dominated carbonate precipitation (e.g., reviews by Holser and Magaritz, 1987; Erwin, 1993, 2006; Kozur, 1998, 2007; Hallam and Wignall, 1999; Erwin et al., 2002; Wignall, 2007; Knoll et al., 2007; Metcalfe and Isozaki, 2009a; Korte et al., 2010; and many other compilations). The majority of ecosystems did not fully recover until near the end of the Early Triassic. A common hypothesis is that the onset of the enormous Siberian continental flood basalts was the main contributor to the end-Permian wave of extinctions. The dated initiation of the Siberian Traps at 252.28 Ma (Seth Burgess and Samuel Bowring, as reported by Kerr, 2013) is just before or coincides with the onset of the end-Permian mass extinctions at 251.94 ±0.04 Ma (Burgess et al., 2014). Release of aerosols and/or carbon dioxide, coupled with their cooling/warming feedbacks on ocean circulation and stratification and on terrestrial systems, precipitated a progression of environmental and ecological stresses (e.g., Renne et al., 1995; Krull and Retallack, 2000; Wignall, 2001, 2007; Yin et al., 2007; Korte et al., 2010; Isozaki, 2009; Lucas, 2009; Metcalfe and Isozaki, 2009b; Cao et al., 2009; Preto et al., 2010; etc.).

The mass disappearance of the Paleozoic fauna and flora, coupled with the widespread occurrence of a major regression-transgression unconformity in most regions, led to a dilemma. It was easy to recognize the bleak final act of the Permian, but how should the beginning of the Mesozoic be defined? Ammonoids are the common biostratigraphic tool throughout the Mesozoic, and the *Otoceras* ammonoid genus was long considered to be the first 'Triassic' form. Therefore, Griesbach (1880) assigned the Triassic base to the base of the *Otoceras woodwardi* zone in the Himalayan region, but this species is only known from the Peri-Gondwana paleo-margin of eastern Tethys (e.g., Iran to Nepal). The first occurrence of *Otoceras* species in the Arctic realm (*Otoceras concavum* zone) was used by Tozer (1967, 1986, 1994) for a Boreal marker of the base of the Triassic, but is now known to appear significantly prior to *Otoceras woodwardi* in the Tethyan realm (Krystyn and Orchard, 1996). It was realized that the progressive evolution of the conodont *Hindeodus* genera through the Permian–Triassic boundary interval provided global correlation markers with no obvious facies dependence. Therefore, in 2000, the Triassic Subcommission chose the first occurrence of the conodont *Hindeodus parvus* (= *Isarcicella parva* of some earlier conodont studies) within the evolutionary lineage *Hindeodus typicalis*–*H. latidentatus praeparvus*–*H. parvus*–*H. postparvus* as the primary correlation marker for the base of the Mesozoic and Triassic. This biostratigraphic event is the first cosmopolitan correlation level associated with the initial stages of recovery following the end-Permian mass extinctions and environmental changes. Global correlations indicate that this conodont species appears just after the carbon-isotope (δ13C) minimum, although its lowest occurrence may be slightly earlier in some local successions (e.g., Payne et al., 2009). This level is slightly lower than the base of the *Otoceras woodwardi* ammonoid zone of the Himalayas. The revised definition for the base-Triassic assigns the *Otoceras concavum* and lowermost portion of *Otoceras boreale* ammonoid zones of the Arctic (the lower part of the 'Griesbachian' substage of Tozer, 1967) into the Permian (Orchard and Tozer, 1997).

In continental settings, the correlated level to this conodont event is close to the disappearance of typical Permian Dicynodon tetrapods after an interval of co-occurrence with 'Triassic' dicynodont *Lystrosaurus* (Kozur, 1998).

The choice of the first appearance of this conodont to serve as the primary marker for the beginning of the Triassic implies that former traditional concepts of the Permian–Triassic boundary, such as the disappearance of typical Permian marine fauna, rapid facies changes, extensive volcanism and onset of isotope anomalies are now assigned to the latest Permian.

The GSSP for the base of the Mesozoic Erathem, the Triassic System and the Induan Stage is at the base of Bed 27c at a section near Meishan, Zhejiang Province, southern China. This level coincides with the lowest occurrence of conodont *Hindeodus parvus* (Yin et al., 2001, 2005). This Meishan section is now within a special GeoPark that includes a museum of Earth's history. Indeed, the formal park-like setting with sculptures and educational exhibitions is probably the most impressive GSSP-site for the geologic record.

Subdivisions of the Lower Triassic

The Triassic Subcommission adopted the current subdivision into a lower Induan stage and an upper Olenekian stage in 1991. The Induan and Olenekian stages of Kiparisova and Popov (1956, revised in 1964) were named after exposures in the Indus river basin in the Hindustan region of Asia and in the lower reaches of the Olenek river basin of northeast Siberia, respectively.

A suite of four substages is widely used. In an imaginative procedural twist, these Griesbachian, Dienerian, Smithian and Spathian substages are named after exposures along associated small creeks on Ellesmere and Axel Heiberg islands in the Canadian Arctic, which in turn were named after the Triassic paleontologists – Carl L. Griesbach (1847-1907), Carl Diener (1862-1928), James Perrin Smith (1864-1931) and Leon Spath (1888-1957) – who played important roles in Lower Triassic biostratigraphy (Tozer, 1965). These substages were originally defined by grouping of ammonoid zones.

Griesbachian and Dienerian substages of Induan (informal)

The Induan Stage is informally divided into two substages. The lower substage, Griesbachian, is named after Griesbach Creek on northwest Axel Heiberg Island. The definition of the Permian–Triassic boundary implies that the lower portion of the original Griesbachian of Tozer (1965, 1967) is now assigned to the uppermost Permian.

The Dienerian substage is named after Diener Creek of northwest Ellesmere Island. The original placement of the Griesbachian/Dienerian boundary is marked by the appearance of Gyronitidae ammonoids. This substage boundary is recognized in Canada and in the Himalayas as the boundary between *Otoceras* and *Meekoceras* ammonoid-bearing beds of Diener (1912) and in the Salt Range of Pakistan at the base of the Lower Ceratite Limestone (Tozer, 1967).

Olenekian

The Olenekian Stage was originally proposed from sections in Arctic Siberia, whereas the stratotype for the Induan stage was in the Hindustan region of Pakistan-India. Neither region has fossiliferous strata spanning their mutual boundary – the Induan in the Olenek River basin is marginal marine to lagoonal, and ammonoids in the transitional interval in the Hindustan region are rare or absent (Zakharov, 1994). The lower Olenekian is marked by the appearance of a diverse ammonoid assemblage of *Hedenstroemia*, *Meekoceras*, *Juvenites*, *Pseudoprospingites*, *Arctoceras*, *Flemingites* and *Euflemingites*. A sea-level regression caused a scarcity of age-diagnostic conodonts and bivalves during the latest Induan to earliest Olenekian, but the transition seems to be within the lower portion of the *Neospathodus pakistanensis* conodont zone (Zakharov, 1994; Paull, 1997; Orchard and Tozer, 1997). Proposed ammonoid-based biostratigraphic definitions of the stage boundary were the highest occurrence of the ammonoid *Gyronites subdharmus* and the lowest occurrence of the representatives of the *Meekoceras* or *Hedenstroemia* ammonoid genera (Zahkarov et al., 2000, 2002). The base of its lower Smithian substage was originally defined as the base of a broad *Euflemingites romunderi* ammonoid zone (Tozer, 1965, 1967), but this zonation was revised to add a *Hedenstroemia hedenstroemi* ammonoid zone (e.g., Orchard and Tozer, 1997). Conodonts were undergoing a pronounced evolutionary change at the beginning of the Olenekian; and, even though some taxonomic details remain to be resolved, the widespread distribution and resolution of *Neospathodus* species provide the main method for inter-regional correlations (Orchard, 2010).

Therefore, the current working definition selected by the base-Olenekian task group is the lowest occurrence of the conodont *Neospathodus waageni* sensu lato. Correlation of ammonoid and conodont events among paleogeographic provinces indicates equivalence of the first occurrence of *N. waageni* with the lowermost part of the *Rohillites rohilla* ammonoid zone (Spiti region of Tethyan realm), slightly below the lowest occurrence of *Flemingites* and *Euflemingites* ammonoid genera (S. China, Tethyan realm), and lower part of *Lepiskites kolyhmensis* Zone (Siberia, Boreal realm; which is just above the regional *Hedenstroemia hedenstromia* zone) (Zakharov et al., 2009). This level is also just prior to the peak of the first Triassic positive excursion in δ^{13}C, slightly below the top of the second major Triassic reversed-polarity magnetozone (LT2r of Hounslow and Muttoni, 2010), and just above widely recognizable sequence boundary (Subcommission on Triassic Stratigraphy, annual reports of 2008 and 2009; Krystyn et al., 2007a).

Two leading candidate GSSPs for this transition are a roadside outcrop near Chaohu city in the Anhui Province of eastern China (Tong et al., 2004; Sun et al., 2007; Chinese Triassic Working Group, 2007) and Mud (Muth) village in the Spiti Valley of northwest India (Krystyn et al., 2007a, b). A preliminary vote to select Mud as the GSSP was put on hold in 2008 when the desired conodont marker was identified in strata lower than the proposed GSSP level.

Smithian and Spathian substages (informal)

Two informal substages of the Olenekian Stage were named after Smith and Spath creeks on Ellesmere Island of the Canadian Arctic. A major environmental and evolutionary event occurring in their boundary interval (e.g., Payne and Kump, 2007; Galfetti et al., 2007a, b, c) has been termed the "biggest crisis in Triassic conodont history" (Goudemand et al., 2008). A sudden reduction of ammonoid diversity and shift from latitudinal to cosmopolitan distributions (Brayard et al., 2009a) coincides with a major positive peak in Carbon-13 (δ^{13}C) and climatic shift (e.g., Galfetti et al., 2007a). The ammonoids recovered in early Spathian with a dramatic evolutionary radiation accompanied by the development of a pronounced latitudinal gradient of diversity (Brayard et al., 2009a). In the original stratotypes, the Smithian–Spathian boundary was placed at the base of the *Olenekites pilaticus* ammonoid zone, but there appears to be a missing biostratigraphic interval in the type region (Tozer, 1967; Orchard and Tozer, 1997).

The exciting discovery of major global-scale geochemical, climatic and paleontological events that occur within this substage boundary interval should enable precise inter-regional correlations including to terrestrial settings.

Subdivisions of the Middle Triassic

Anisian

The Anisian Stage was named after limestone formations near the Enns (= Anisus) River at Grossreifling, Austria (Waagen and Diener, 1895). The original Anisian stratotype lacks ammonoids in the lower portion, and lower limit was later clarified in the Mediterranean region (Assereto, 1974). The appearance of a number of ammonoid genera, including *Aegeiceras*, *Japonites*, *Paracrochordiceras* and *Paradanubites*, may be used to define the base of the Anisian within different regions (e.g., Gaetani, 1993). However, other markers are suggested that may provide a more global correlation value. The lowest occurrence of the *Chiosella timorensis* conodont slightly precedes the ammonoid level and can be correlated to North American and Asian stratigraphy (Orchard and Tozer, 1997; Orchard, 2010). The boundary interval is also close to a peak in Carbon-13 (δ^{13}C) values. A shift from reversed-polarity- to normal-polarity-dominated magnetostratigraphy (base of normal-polarity magnetozone MT1n of Hounslow and Muttoni, 2010) has been formally proposed as a primary global boundary marker that can be unambiguously correlated between Boreal and Tethyan faunal realms (Hounslow et al., 2007).

A long-standing candidate for the base-Anisian GSSP at Desli Caira Hill in north Dobrogea, Romania (Gradinaru et al., 2007) has been within a condensed Hallstatt limestone facies that may be missing a partial ammonoid zone in the boundary interval (Subcommission on Triassic Stratigraphy annual report, 2009). A potential alternative is a conodont-magnetic-isotope reference section at Guandao in the Nanpanjiang Basin (Guizhou Province, South China) where volcanic ashes within the boundary interval also produced radio-isotopic dates (ca. 247 Ma; e.g., Lehrmann et al., 2006). However, this section lacks a good ammonoid record and the chronostratigraphic reliability of the lowest occurrence of the conodont *Chiosella timorensis* marker is questioned (Ovcharova et al., 2010). Even though the correlations among different stratigraphic methods are fairly well established, no single section spanning the boundary interval has yielded satisfactory records for the main correlation techniques.

Anisian substages (informal)

The Anisian Stage has three to four informal substages. Assereto (1974) proposed a stratotype for a Lower Anisian substage (also called "Aegean" or "Egean") in beds with *Paracrochordiceras* ammonoids at Mount Marathovouno on Chios Island (Aegean Sea, Greece). The Middle Anisian is sometimes subdivided into two substages: a lower "Bithynian", named by Assereto (1974) after the Kocaeli Peninsula (Bithynia) of northwest Turkey, and an upper "Pelsonian", from the Latin name for the region around Lake Balaton in Hungary (Pia, 1930) spanning the *Balatonites balatonicus* ammonoid zone (Assereto, 1974). The Upper Anisian substage is also called "Illyrian" after the Latin term for Bosnia (Pia, 1930).

Ladinian

The Ladinian Stage arose after a heated semantic argument of "Was ist norisch?" (Bittner, 1892), when it was realized that most of the strata that had been assigned to a "pre-Carnian" Norian Stage (Mojsisovics, 1869) were actually deposited after the Carnian (Mojsisovics, 1893). This debate and the emergence of the Ladinian Stage for the actual pre-Carnian strata split the Vienna geological establishment (vividly reviewed by Tozer, 1984). The Ladinian, named after the Ladini inhabitants of the Dolomites region of northern Italy, was assigned to encompass the Wengen and Buchenstein beds (Bittner, 1892).

This historical major revision and even partial inversion of the upper Triassic stratigraphy, coupled with uncertainties about correlation potentials and definition of ammonoid zones, contributed to the problems in assigning a basal limit of the Ladinian Stage (e.g., Gaetani, 1993; Brack and Rieber, 1994, 1996; Mietto and Manfrin, 1995; Brack et al., 1995; Vörös et al., 1996; Muttoni et al., 1996a; Orchard and Tozer, 1997; Pálfy and Vörös, 1998). The ammonoid contenders for the primary correlation markers were distributed over at least two zones; including the lowest occurrence of representatives of the *Kellnerites* genus, of the *Nevadites* genus, of the *Eoprotrachyceras* genus, of the *Reitziites reitzi* species, and of the *Aplococeras avisianum* species. The lowest occurrence of the *Budurovignathus* conodont genus was also considered. The base of *Eoprotrachyceras curionii* zone (lowest occurrence of *Eoprotrachyceras* ammonoid genus, which is the onset of the Trachyceratidae ammonoid family) was eventually preferred. The Bagolino section (eastern Lombardian Alps, Province of Brescia, Northern Italy) was selected for its multiple stratigraphic records, including bracketing of the boundary interval by dated volcanic ashes (Brack et al., 2005).

The Ladinian GSSP at Bagolino is located at the top of a distinct 20-to-25-cm-thick interval of limestone nodules in a shaly matrix ("Chiesense groove"), located at approximately 5 m above the base of the Buchenstein Beds. The *Nevadites secedensis* ammonoid zone of the lowermost Buchenstein Beds, which was historically assigned as Ladinian (e.g., Bittner, 1892), has now become the uppermost zone of the Anisian. Secondary global markers include the lowest occurrence of the conodont *Budurovignathus praehungaricus* and a brief normal-polarity magnetozone (MT8n of Hounslow and Muttoni, 2010) within the uppermost Anisian. The bracketing U-Pb dated volcanic ashes indicate a boundary age of approximately 241 Ma (Brack et al., 2005).

The Ladinian GSSP site is accessible through a geological pathway with explanatory notes and ammonoid casts (Brack, 2010).

Ladinian substages (informal)

Mojsisovics et al. (1895) divided the Ladinian into two substages – Lower or Fassanian (named after Val di Fassa in northern Italy, where it was equated to the Buchenstein Beds and Marmolada Limestone), and Upper or Longobardian (named after the Langobard people of northern Italy, and spanning the Wengen Beds). His substage boundary is approximately at the base of the "*Eoprotrachyceras*" *gredleri* ammonoid zone in the Alpine zonation or the base of *Meginoceras meginae* ammonoid zone in the Canadian zonation.

Subdivisions of the Upper Triassic

The Upper Triassic consists of three stages – Carnian, Norian and Rhaetian – that were originally defined by characteristic ammonoids (Mojsisovics, 1869). However, these units were originally recognized in different locations in the northern Alps of Austria with uncertain stratigraphic relationships. Indeed, until 1892, Norian units were considered to underlie the Carnian, and only after a major geological controversy was the name 'Norian' applied to the same units after recognition that they were younger than Carnian (reviewed in Tozer, 1984).

Carnian

The Carnian stage, named either after localities in the Kärnten (Carinthia) region of Austria, or after the nearby Carnian Alps, was originally applied to Hallstatt Limestone beds bearing ammonoids of *Trachyceras* and *Tropites* (Mojsisovics, 1869: 127). The first occurrence of ammonoid *Trachyceras* (=base of *Trachyceras aon* zone in Tethys or *Trachyceras desatoyense* in Canada) was the traditional base, although it appears that a *Trachyceras* datum would be asynchronous and not cosmopolitan (e.g., Mietto and Manfrin, 1999). Mojsisovics et al. (1895) included the St. Cassian Beds of northern Italy in a revised Carnian subdivision, therefore the level with lowest occurrence of the cosmopolitan ammonoid *Daxatina* at the Prati di Stuores type locality in the Dolomites (northern Italy) was proposed for the base-Carnian GSSP (Broglio Loriga et al., 1998). This section has relatively rapid sedimentation and proved suitable for multiple types of stratigraphy, therefore it was ratified ten years later (2008). Two other reference sections with multiple biostratigraphic successions are in Spiti in Himalaya of northwest India (Balini et al., 1998, 2001) and the New Pass section of Nevada (USA).

The Carnian GSSP at Prati di Stores/Stuores Wiesen is 45 m above the base of the St. Cassian (San Cassiano) Formation. This level is near the lowest occurrence of the ammonoid *Daxatina* (base of *Daxatina canadensis* subzone, lowest subzone of *Trachyceras* zone), of the conodont "*Paragondolella*" *polygnathiformis*, and of the bivalve group of *Halobia* (Mietto et al., 2007). The placement of the base-Carnian at the appearance of *Daxatina* ammonoids implies that the Carnian now begins in the middle of the classical "Ladinian" *Frankites regoledanus* ammonoid zone. This GSSP is just above the base of a normal-polarity magnetic magnetozone (S2n in the local scale of Borglio Loriga et al., 1999; or UT1n in the synthesis scale of Hounslow and Muttoni, 2010), and lies above an interpreted maximum flooding surface within Sequence Lad 3 of Hardenbol et al. (1998).

Carnian substages (informal) and mid-Carnian wet intermezzo

Mojsisovics et al. (1895) subdivided the Carnian into three substages (Cordevolian, Julian and Tuvalian) corresponding to his three ammonoid zones. Cordevolian (=their *Trachyceras aon* zone), from the St. Cassian Beds, was named after the Cordevol people who lived in this area of northern Italy. Julian (=their *Trachyceras aonoides* zone) was based on the Raibl Formation of the Julian Alps in southern Austria. The Tuvalian (=their *Tropites subbullatus* zone) was named after the Tuval Mountains, the Roman term for the region between Berchtesgaden and Hallein near Salzburg, Austria. This trio of original ammonoid zones was later split into additional zones; but these main divisions can be correlated among regions.

Stratigraphers often combine the Cordevolian and Julian into a single Lower Carnian, with the Lower/Upper Carnian substage boundary traditionally assigned as the first occurrence of *Tropites* ammonoids (base of the *Tropites subbullatus* ammonoid zone of Tethys and *Tropites dilleri* zone of Canada). The ammonoid change at this substage boundary is more significant than at the bases of either the Carnian or the Norian stages (Tozer, 1984), conodont diversity may have been reduced to single genus (Mazza et al., 2010), and there were major changes in radiolarians and other faunal groups (Kozur and Bachmann, 2010).

A dramatic event that is considered to be "the most distinctive climate change within the Triassic" (Preto et al., 2010) was a global disruption of the Earth's land-ocean-biological system due to a sudden carbon-dioxide-induced warming and associated increased rainfall on the continents. In the middle of the Carnian stage, tropical carbonate platforms abruptly ended, waves of extinction affected the ocean animals, and engorged river systems left widespread sand-rich layers across coastal regions. This pulse lasted less than a million years. The recovering world saw the first known dinosaurs on land and the emergence of the calcareous nannoplankton in the oceans that now govern Earth's carbon cycle (e.g., Rigo et al., 2007, Dal Corso et al., 2012; Preto et al., 2013, Benton et al., 2014). This unusual climate-oceanographic event in the latest Julian has various regional names – e.g., "Reingraben turnover" (Schlager and Schöllnberger, 1974), "Raibl Event", "Carnian pluvial episode" (Simms and Ruffell, 1989), and "Middle Carnian Wet Intermezzo" (Kozur and Bachmann, 2010). The triggers for both the onset of this "Carnian pluvial episode" and its sudden termination could be a combination of paleogeographic and paleoceanographic factors (e.g., Kozur and Bachmann, 2010), perhaps triggered by volcanic releases during the formation of the former oceanic "Wrangellia" plateau (Greene et al., 2008, 2011; Dal Corso et al., 2012). The distinct fossil assemblages within this "wet intermezzo" interval provide an important means of calibration among terrestrial settings (conchostracans, pollen, ostracod and tetrapod biostratigraphy) from the southwest USA to Germanic Basin and into marine settings (ammonoid, conodont, ostracod and bivalve biostratigraphy) (Roghi et al., 2010; Kozur and Weems, 2010). The abrupt end to this "wet intermezzo" interval in the Germanic-Alpine region coincides with the Lower/Middle Carnian substage boundary as assigned by ammonoid biostratigraphy.

Norian

The Norian derives its name from the Roman province of Noria, south of the Danube and including the area of Hallstatt, Austria (Mojsisovics, 1869). The stratigraphic extent of strata assigned as "Norian" had a contorted history (reviewed in Tozer, 1984).

Ammonoid successions in Nevada and British Columbia led to a proposal that the base of the Norian be assigned to the base of the *Stikinoceras kerri* ammonoid zone, overlying the *Klamathites macrolobatus* zone (Silberling and Tozer, 1968). This level is approximately coeval with a Tethyan placement between the *Anatropites* and *Guembelites jandianus* ammonoid zones (Krystyn, 1980; Orchard et al., 2000). However, early studies had concluded that this ammonoid-based level did not correspond to an unequivocal microfossil signal, whereas the base of the preceding *K. macrolobatus* ammonoid zone is coincident with the first occurrences of conodont *Metapolygnathus communisti* and some radiolarian species (Orchard et al., 2000). But, later examinations of conodont lineages has indicated that the first appearance of *Metapolygnathus* ex gr. *M. echinatus* is at approximately the beginning of the *Stikinoceras kerri* ammonoid zone and coincides with a major faunal turnover (Orchard, 2010).

The leading candidates for placing the Norian GSSP (FAD of *Metapolygnathus echinatus*; or approximately coeval base of *Stikinoceras kerri* ammonoid zone) are Pizzo Mondello in Sicily (Muttoni et al., 2001; Nicora et al., 2007) or Black Bear Ridge on Williston Lake of northeast British Columbia (Orchard et al., 2001; Orchard, 2007; McRoberts, 2007). The section at Black Bear Ridge did not yield a useful magnetostratigraphy; whereas the recommended Norian GSSP level at Pizzo Mondello coincides with the top of a narrow reversed-magnetozone (magnetozone "PM4r" in local terminology; or "UT12r" in the synthesis of Hounslow and Muttoni, 2010) and is just above a positive shift in $\delta^{13}C$ (Nicora et al., 2007).

Norian substages (informal)

The Norian is traditionally subdivided into three substages, following Mojsisovics et al. (1895). The boundary between the lower Norian (or 'Lacian', after the Roman name for the Salzkammergut region of the northern Austrian Alps) and middle Norian (or 'Alaunian', named for the Alauns, who lived in the Hallein region of Austria during Roman times) is the base of the Tethyan *Cyrtopleurites bicrenatus* ammonoid zone. The base of the upper Norian (or 'Sevatian', after the Celtic tribe who lived between the Inn and Enns rivers of Austria) is generally assigned as the base of the North American *Gnomohalorites cordilleranus* ammonoid zone or the Tethyan *Sagenites quinquepunctatus* ammonoid zone; however, there has not been a consistent usage of this Sevatian substage and some include the underlying *Halorites macer* ammonoid zone within it (e.g, Kozur, 1999).

Rhaetian

The Rhaetian was the first Triassic stage to be established, when Carl Wilhelm Ritter von Gümbel (1861) applied the term to strata containing the pteriid bivalve *Rhaetavicula contorta*, such as the Kössen Beds of Austria. This distinction bivalve is found in shallow-marine facies from the western Tethys and across northwestern Europe. His "Rhätische Gebilde" name was derived from either the Rhätische Alpen or the Roman province of Rhaetium. For a while, it appeared that the Rhaetian interval would be incorporated into the Jurassic (and perhaps renamed as a "Bavarian Stage) or incorporated into the Norian Stage (reviewed in Lucas, 2010a). For example, the Rhaetian was eliminated in some Triassic time scales (e.g., Zapfe, 1974; Palmer, 1983; Tozer, 1984, 1990). In 1991, the Subcommission on Triassic Stratigraphy decided to retain the Rhaetian as an independent stage. Many options were considered for the primary biostratigraphic marker for the lower boundary. The bivalve *Monotis* that had been abundant on late Norian shelves nearly vanishes, and low-latitude Tethyan conodonts shift from a dominance by robust *Epigondolella* species to fragile *Misikella* forms (e.g., McRoberts et al., 2008; McRoberts, 2010; Krystyn and Kürschner, 2005).

In 2010, the base of the Rhaetian was placed by the Task Group as the lowest occurrence of the conodont *Misikella posthernsteini* (Krystyn, 2010). This conodont is a phylogenetic descendent of *Misikella hernsteini*, but is very rare at the beginning of its range. Therefore, several secondary markers should be employed to assign the base of the Rhaetian (Krystyn, 2010) including: (1) lowest occurrence of conodont *Epigondolella mosheri* (morphotype B sensu Orchard), (2) lowest occurrence of ammonoid *Paracochloceras suessi* and the closely allied genus *Cochloceras* and other taxa, (3) disappearance of ammonoid genus *Metasibirites*, (4) lowest occurrence of radiolarian *Proparvicingula moniliformis* and other species (Carter and Orchard, 2007), (5) disappearance of *Monotis* bivalves, except for continuation by dwarf *Monotis* species in parts of the Tethys (McRoberts et al., 2008), and (6) just below is a prominent change from an extended normal-polarity magnetozone upward into a reversed-polarity magnetozone (UT23n to UT23r in the tentative Norian-Rhaetian composite scale of Hounslow and Muttoni, 2010).

The leading candidate for the Rhaetian GSSP is the Steinbergkogel section near Hallstatt, Austria (Krystyn et al., 2007c, d). The published magnetostratigraphy from the condensed interval spanning the proposed boundary has been verified; but correlation to the cycle-scaled magnetic polarity scale from non-marine strata (Newark group) is disputed (e.g., Gallet et al., 2007; Muttoni et al., 2010; Hounslow and Muttoni, 2010; Hüsing et al., 2011). Other important reference sections are in British Columbia, Canada and in Turkey.

End-Triassic (base of Jurassic)

The end-Triassic mass extinction terminated many groups of marine life, including the conodonts. After a major international effort to correlate environmental and biostratigraphic events associated with the end-Triassic extinctions and the extensive eruption of the Central Atlantic Magmatic Province at ~201 Ma (e.g., review by Hesselbo et al., 2007), it was decided to utilize the earliest forms of *Psiloceras* ammonites to define the onset of the Jurassic.

The GSSP for the base of the Jurassic (base of Hettangian Stage) was ratified in 2010 as the Kuhjoch section within the Northern Calcareous Alps of Austria (Hillebrandt et al, 2013). The GSSP level, as initially ratified as 5.80 m above the base of the Tiefengraben Member of the Kendelbach Formation, corresponds to the local lowest occurrence of the ammonite *Psiloceras spelae* (new subsp. *tirolicum* Hillebrandt and Krystyn). Other markers include the lowest occurrences of the widely distributed continental palynomorph *Cerebropollenites thiergartii* (Kürschner et al., 2007), of the aragonitic foraminifer *Praegubkinella turgescens* and of the ostracod *Cytherelloidea buisensis* (Hillebrandt et al., 2013). The $\delta^{13}C_{org}$ record shows an initial negative excursion near the boundary between the underlying Koessen and the Kendelbach formations, and a shift to more positive $\delta^{13}C_{org}$ at the GSSP level; and this carbon-isotope signature provides a primary method for high-resolution correlation to other sections (e.g., Ruhl et al., 2009; Deenen et al., 2010b; Ruhl and Kürschner, 2011).

TRIASSIC NUMERICAL AGE MODELS

Ammonoids dominate the historical zonation of the Triassic (reviewed in Balini et al., 2010), but conodonts have become the major tool for global correlation (Orchard, 2010). Thin-shelled bivalves (e.g, *Daonella*, *Halobia*, etc.) provide important regional markers (McRoberts, 2010). During much of the Triassic, the sedimentary record across the Pangea supercontinent was dominated by terrestrial deposits, therefore widespread conchostracan, tetrapod and plant remains are important for global correlation (Kozur and Weems, 2010; .Kürschner and Herngreen, 2010; Lucas, 1998, 1999, 2010d).

Other biostratigraphic, magnetostratigraphic, chemostratigraphic and other events are typically calibrated to these standard ammonoid or conodont zones. Extensive compilations and inter-correlation of Triassic stratigraphy of European basins were coordinated by Hardenbol et al. (1998), and a suite of detailed Triassic reviews and stratigraphic scales are in The Triassic Timescale (Lucas, 2010a) and summarized with composite charts in Geologic Time Scale 2012 (Ogg, 2012).

There is no agreed numerical age model for the majority of the Triassic stages and their component biozones and other events. The numerical age models for the zonations and stage boundaries in the Cenozoic, Cretaceous and a large part of the Jurassic is based on the correlation of the primary biostratigraphic standards (microfossils, ammonite zones) to a verified cycle-scaled magnetic polarity pattern that has partial constraints from radio-isotopic ages (Ar-Ar and UPb). For the majority of the Jurassic through Cenozoic, the cycle-scaled magnetic polarity pattern was obtained from correlation of modeled marine magnetic anomaly patterns to the magnetostratigraphy from multiple overlapping sections of pelagic carbonates that spanned at least one entire stage without a stratigraphic break.

For large portions of the Triassic, there are also cycle-scaled polarity patterns compiled from extended time spans, but these are mainly derived from terrestrial deposits of Upper Triassic lacustrine beds (Newark series of eastern North America) and the major oscillations interpreted as short-eccentricity-induced climatic cycles within the Lower Triassic Buntsandstein of the Germanic Basin. The challenges are (1) to make an unambiguous correlation of these terrestrial cycle-scaled magnetic polarity “floating time scales” to the composite skeleton of magnetic polarity sequences obtained from relatively brief marine strata that contain ammonoids and conodonts of regional importance (Hounslow and Muttoni, 2010), (2) to verify that the terrestrial cycle stratigraphy interpretations are robust, and (3) to confirm that the terrestrial successions do not contain major interruptions or other distortions in their cycle-magnetic patterns. Two additional hurdles are that none of the available radio-isotopic dates are from levels within the cyclic terrestrial deposits and that the dated strata associated with marine fossils are from sections lacking magnetic stratigraphy. Lucas (2013) has suggested that “magnetostratigraphy has been more of a hindrance than a help to timescale definition and correlation” and that “Triassic cyclostratigraphic studies remain far from the goal of developing a reliable, astronomically-calibrated Triassic timescale”. However, we are more confident that the union of these two stratigraphic methods with biostratigraphic constraints provides a powerful tool for global correlation and assigning durations.

The Triassic age models in GTS2012 were an effort to simultaneously merge (1) published cycle-scaled magnetostratigraphy, (2) interpreted correlation of those terrestrial successions to marine-zoned magnetostratigraphy, and (3) guidance from radio-isotopic dates from other marine strata which commonly had uncertainties in their inter-regional correlation. Therefore, the suite of GTS2012 age models represented a temporary working hypothesis that will be revised when additional cycle stratigraphy, magnetostratigraphy, inter-regional biostratigraphic correlations and additional radio-isotopic ages are published. Indeed, since GTS2012 was compiled in 2011, there have been important Triassic studies published and submitted analyses that suggest that the GTS2012 age models require a revised synthesis.

Constraints from Cycle Stratigraphy

The monsoon-dominated climate of the Pangea megacontinent was sensitive to Milankovitch cycles, especially the precession-eccentricity components of these orbital-climate oscillations. The interpretations and controversies concerning these Triassic cyclic deposits are critically examined by Tanner (2010). Extended and quasi-continuous deposits of continental facies having excellent magnetostratigraphy in central Europe and eastern North America are the basis of cycle-scaled polarity patterns for the Early and the Late Triassic. In theory, these successions should be the Rosetta stone to project cycle-scaled durations onto marine sequences for a precise relative time scale, similar to what has been developed for the Cenozoic. In practice, there is a lack of a unique pattern match for correlation of these extended intervals of cycle-scaled magnetostratigraphies with marine-based composite polarity patterns.

Variations in clastic input into the Buntsandstein basins of central Europe during the Early Triassic provide a detailed regional stratigraphy that is applicable to surface exposures and downhole logs (e.g., reviews in Röhling, 1991; Bachmann and Kozur, 2004; Szurlies, 2004; Menning et al., 2005; Feist-Burkhardt et al., 2008). The cycles, spanning about 10-20 meters with sandstones fining upward into more clay-rich sediments, are generally interpreted as oscillations between more arid and more humid conditions. Constraints from terrestrial biostratigraphy (conchostracan, pollen-spores) combined with radio-isotope ages on the span of the Early Triassic indicate that the depositional sequences appear to coincide with the 100 kyr short-eccentricity cycle (e.g., Bachmann and Kozur, 2004; Menning et al., 2005). However, the expected 400 kyr long-eccentricity has not been unambiguously resolved. The magnetostratigraphy from the Buntsandstein, especially within the lower portion, which has relatively longer-duration polarity zones and biostratigraphic constraints, is fairly well correlated to the Early Triassic composite (Szurlies, 2007; Hounslow and Muttoni, 2010). Even though a monotonic 100 kyr periodicity is not expected for short-eccentricity and there is a possibility of "missing beats" at possible exposure horizons within this Buntsandstein succession, the projected cycle-scaling of the marine zonation and associated Early Triassic substages via this magnetostratigraphy is a close fit to radio-isotopic ages and was used in GTS2012 for detailed scaling of the Early Triassic and early Anisian (Figure 2).

Interbedded marls and limestones of shallow-marine origin spanning the Permian–Triassic boundary interval in the Austrian Alps display cycles with ratios matching Milankovitch periodicities, and have been interpreted to imply that the latest Permian extinction and negative carbon-isotope spike spanned less than 30 kyr (Rampino et al., 2000, 2002). However, the entire end-Permian mass extinction interval and initial recovery (defined by Huang et al., 2011, as start of the *Neogondolella meishanensis* conodont zone or *Otoceras* / *Hypophiceras* ammonoid zone at the onset of the negative $\delta^{13}C$ excursion to the base of the *Isarcicella isarcica* conodont zone or *Ophiceras* ammonoid zone and *Claraia wangi* bivalve assemblage zone when $\delta^{13}C$ values again increase) spans approximately 700 kyr according to cycle stratigraphy of sections in China and Austria (Huang et al., 2011).

There is a conflict in interpretation of the cyclostratigraphy through the Induan stage of basal Triassic. Guo et al. (2008) examined the Pingdingshan Section of Chaohu, which contains a candidate for the base-Olenekian GSSP, and concluded that the 56 beds spanning the Induan stage in this section were precession modulated by short eccentricity, therefore the Induan stage spanned 1.1 myr. Unfortunately, neither the basal Induan conodont zone (*Hindeodus parvus*) nor the lower portion of the succeeding conodont zone (*H. typicalis*) is identifiable in this section. An analysis of the cycle-stratigraphy of Induan sections in central China and re-analysis of this Chaohu section (Mingsong Li and Chunju Huang, in prep.) indicated that the Induan stage spanned at least ~1.6 myr (~0.9 myr for Griesbachian, ~0.7 myr for Dienerian), although there may be another 405-kyr cycle in the condensed basal Triassic interval in this sections that would imply a ~2 myr duration for the Induan in China, which is identical to the cyclostratigraphy estimate from the Germanic Basin. Cyclostratigraphy from the Chaohu section suggests a duration of ~4 myr for the Olenekian stage (~1.7 myr for Smithian; ~2.3 myr for Spathian) (Mingsong Li and Chunju Huang, in prep.), although the implied 4 myr Olenekian stage duration is difficult to reconcile with the Germanic basin cyclostratigraphy estimates and the published radio-isotope dates from the Olenekian-Anisian boundary interval (discussed below).

The Latemar massif in the Italian Dolomites was an atoll-like feature with a core of flat-lying Anisian and Ladinian platform carbonates. Oscillations in sea level were created over 500 thin depositional cycles (Goldhammer et al., 1987). Stacking patterns and spectral analysis of the sea-level oscillations had been interpreted as representing precession modulated by short-term (100 kyr) eccentricity, therefore yielding an implication that the Latemar deposit spans approximately 10 myr (Goldhammer et al., 1990; Hinnov and Goldhammer, 1991). In contrast, U-Pb ages from coeval tuff-bearing basinal deposits appear to constrain the Latemar platform to span only a 2 to 4 myr (e.g., Brack et al., 1996, 1997; Mundil et al., 1996; Hardie and Hinnov, 1997; and extended review in Tanner, 2010). A possible solution to this disparity is that an extremely rapid rate of platform construction (ca. 500 m/myr or greater) enabled recording of sub-Milankovitch sea-level oscillations with misleading similarity in ratios to precession-eccentricity (e.g., Kent et al., 2004; Hinnov, 2006; Meyers, 2008). This debate demonstrates that any cycle-stratigraphic analysis based on a single section requires verification from other independent basins and facies.

Radiolarian-rich pelagic chert successions from Japan spanning the Middle Triassic are characterized by ribbon bedding. These chert-clay couplets have been interpreted as productivity fluctuations induced by 20-kyr precession cycles, medium-term variations in bed thickness correspond to 100-kyr and 405-kyr eccentricity cycles, and long-term trends are interpreted as a ~2 myr (Earth-Mars resonance) and ~8 myr eccentricity modulation (Ikeda et al., 2010; Ikeda and Tada, 2013). These cyclostratigraphic interpretations, the tentative correlation of radiolarian taxa to geologic stages, the potential of long-term modulations, and the continuity of the bedded-chert sections await further verification. It would be a major achievement if these radiolarites would yield a reproducible magnetostratigraphy.

Studies of similar oscillating Lofer facies within upper Triassic platform carbonates of the Austrian Alps played an important role in developing fundamental concepts of cyclostratigraphy (e.g., Fischer, 1964), but the reality of regular cyclicity in these deposits has also been debated (e.g., Satterley, 1996, versus Schwarzacher, 2005, and Cozzi et al., 2005; reviewed in Tanner, 2010). There are no published magnetostratigraphies from these extensive deposits.

During the late-Middle Triassic through Early Jurassic, a set of rift basins formed as Pangea underwent an initial phase of breakup. The thick Newark group of lacustrine sediments from these tropical basins are characterized by oscillations between semi-stagnant deep lakes and arid playas as the intensity of monsoonal rains responded to Earth's precession modulated by short-term (ca. 100 kyr) and long-term (ca. 400 kyr) eccentricity cycles. Spectral analysis of sediment facies successions in a series of deep-drilling cores enabled compilation of a cycle-scaled stratigraphic record, including a detailed polarity pattern that is unprecedented in its 30-myr temporal span (e.g., Kent et al., 1995; Olsen et al., 1996; Kent and Olsen, 1999). Uppermost Triassic lacustrine deposits with alternating red-to-green coloration at St. Audrie's Bay have also yielded both a magnetostratigraphy (Hounslow et al., 2004) and an interpreted cyclostratigraphy spanning 3.7 myr (Kemp and Coe, 2007); and its cycle-scaled polarity pattern partially resembles the upper Newark interval of polarity zones E19n-E16n. Unfortunately, as examined below, the comparison of these cycle-scaled terrestrial polarity signature to the un-scaled marine magnetostratigraphy does not provide a unique match owing to the lack of a distinctive "bar code" and the distortion of the relative durations of polarity zones caused by variable sediment accumulation rates in the marine sections.

Constraints from Radio-isotopic Dates

The Triassic and uppermost Permian were the focus of extensive sampling, application of ultra-high-resolution methods and standardization of procedures by different geochronology laboratories. An extensive set of 206Pb/238U CA-TIMS dates from analyses of individual zircons treated by annealing followed by chemical abrasion have replaced the dates derived from multi-grain analyses and K-Ar methods. The new sets of radio-isotopic dates have replaced or called into question nearly all of the Triassic radiogenic isotope ages published before 2004 (reviewed by Mundil et al., 2010). The initiation and termination of the Triassic Period have been constrained by a remarkably extensive suite of ages, implying a span from 252 to 201 Ma (51 myr).

However, nearly all the ages from marine strata having adequate biostratigraphic control are clustered within the early half of the Triassic (ca. 255 to 239 Ma) and within a brief interval spanning the Triassic-Jurassic boundary (ca. 202-200 Ma). In particular, there is a 30-myr gap in reliable dates for the majority of the upper half of the Triassic. Therefore, the Late Triassic remains an interval of controversy in correlation of terrestrial zonations (e.g., dinosaur evolution) to marine stages.

The Permian-Triassic boundary is well constrained as approximately 252 Ma (U-Pb, TIMS) from sets of samples from the Induan GSSP at Meishan, Zhejiang Province and Shangsi section from Sichuan Province in China. Shen et al. (2010, 2011) had used U-Pb (TIMS method) to propose that the late-Permian extinctions peaked at about 252.28 ±0.08 Ma and interpolated the base-Triassic boundary as 252.16 ±0.05 Ma (analytical precision). However, recently, Burgess et al. (2014) constrained the main end-Permian extinction interval as spanning 251.94 ±0.04 to 251.88 ±0.03 Ma, indicating that the largest mass extinction in the Phanerozoic was only 60 ± 48 kyr in duration.

Published dates using the Ar-Ar method are younger – Reichow et al. (2009) obtained an age from sanidines in volcanic-ash Bed 28 about 8 cm above the GSSP at Meishan of 248.25 ±0.14 Ma (based on a monitor standard FCs of 28.02 Ma) which converts to 249.85 ±0.14 Ma using the revised FCs monitor standard of 28.201 Ma. Renne et al. (2010) suggest a "best-fit" (U-Pb plus recalculated Ar-Ar, but using a slightly older FCs assignment of 28.30 Ma) of 252.3 ±0.2 Ma. An FCs standard of 28.20 Ma is used in other GTS2012 radio-isotopic tables. Based on considerations of published (as of 2012) array of dates and external errors, the GTS2012 summary had adopted the P/T age from Shen et al. (2010) of 252.16 ±0.2 Ma. However, a revised and enhanced dating of the Meishan ash beds (Burgess et al., 2014) indicate a slightly younger boundary age of ca. 251.9 Ma.

The age for the base of the Olenekian stage, or rather a candidate level for placing a future GSSP at Chaohu in China, had been considered to be slightly older than sample CHIN-40 that yielded a U-Pb date of 251.2 ±0.2 Ma (Galfetti et al., 2007b). However, that published base-Olenekian date would be difficult to reconcile with the recently-published date of 251.495± 0.064 Ma from a mid-Griesbachian ash bed at Meishan (Burgess et al., 2014). As emphasized by Burgess et al. (2014), if both dates are accepted, then this would imply that the span of the mid-Griesbachian through Dienerian substages would be less than 300 kyr, and that the entire Induan stage was less than 1 myr in duration. Therefore, they advise that it is "unwise to combine/compare dates" until "dates from the Smithian are repeated". In contrast, the cycle stratigraphy of the Induan stage in the Germanic Basin as correlated by magnetostratigraphy to the candidate base-Olenekian GSSP section (e.g., Bachmann and Kozur, 2004; Menning et al., 2005; Szurlies, 2007; Hounslow and Muttoni, 2010) would imply a ~2 myr duration for the Induan. This estimate from the Germanic Basin is consistent with the analysis of the cycle-stratigraphy of Induan sections in central China (Mingsong Li and Chunju Huang, in prep.) which indicates a duration for the Induan stage of ~1.6 myr, or perhaps ~2.0 myr depending upon the 405-kyr tuning of the condensed basal Triassic interval.

The base of the Anisian stage, as potentially recognized by conodont zonation in southern China, was estimated as 247.2 ±0.1 Ma (between samples PGD Tuff-3 and Tuff-2) by Lehrmann et al. (2006). However, U-Pb dates from a nearby ammonoid-bearing basinal section suggest that the ammonoid-defined (top of the regional *haugi* ammonite zone) placement for the base-Anisian may instead be slightly younger than 246.83 ±0.44 Ma (Ovtcharova et al., 2006, 2010).

The base of the Ladinian is constrained to be between

239.3 ±0.2 Ma (sample FP2 of mid-Ladinian; Brühwiler et al., 2007) and 242.1 ±0.6 Ma (sample Mundil MSG.09 at the Grenzbitumen horizon near base of the uppermost Anisian *Nevadites secedensis* ammonoid zone; Mundil et al., 2010). Mundil et al. (2010) estimate the Anisian-Carnian boundary as 242.0 Ma. However, this boundary age would truncate the *Nevadites secedensis* ammonoid zone, and an Ar-Ar measurement on sanadines in MSG.09 from the same Grenzbitumen horizon by Mundil et al. (2010) yielded 240.95 ±0.5 Ma (after adjusting the original 239.5 ±0.5 Ma to an FCs monitor standard of 28.201 Ma). Therefore, until further work enables a convergence of the Ar-Ar and U-Pb ages on that Grenzbitumen horizon, the base-Ladinian was estimated as ca. 241.5 ±1 Ma in GTS2012.

Spanning the Ladinian-Carnian boundary is a gap of about 9 myr in radio-isotopic dates that satisfy both analytical criteria (e.g., suite accepted by Mundil et al., 2010, for their table 3) and biostratigraphic control. However, a U-Pb date of 237.3 Ma (+0.4/-1.0) from the Predazzo granites of northern Italy (Brack et al., 1997) was tentatively correlated to the *Regoledanus* ammonite zone (highest zone of Ladinian) by Pálfy et al. (2003). A volcanic ash from the southern Apennines yielding a date of 230.9 ±0.06 Ma (sample Aglianico; Furin et al., 2006) was tentatively assigned as mid-upper Carnian; and may be near the base of Tuvalian substage (H. Kozur, pers. comm., 2010). The date from this horizon is similar to Ar-Ar ages from strata in Argentina containing some of the earliest dinosaurs (Ischigualasto Formation). If one uses the Predazzo granite as a constraint within the latest Ladinian ammonite zone, then a provisional assignment of 237 ±1 Ma was assigned to the Ladinian-Carnian boundary in GTS2012.

Although no reliable Norian or early Rhaetian radio-isotopic ages have been published, there are suggestions that the Norian may extend to 225 Ma or older. Suites of redeposited zircons within sediments of the southwestern USA that have yield Adamanian and Revueltian tetrapods and early dinosaurs have enabled a temporal framework for that interval of tetrapod evolution. The array of dated horizons suggests that the "Adamanian-Revueltian faunal turn-over occurred between 219.37 and 213.15 Ma." (Ramezani et al., 2009). However, the correlation of the Norian-Carnian stage boundary interval to these deposits is controversial. If the base-Norian is close to 225 Ma, then "A mid-Norian age for the Adamanian to Revueltian land vertebrate faunachron boundary, as suggested by the revised Late Triassic timescale, is no longer compatible with the idea that the faunachron boundary is coincident with the Carnian-Norian Stage boundary" (Ramezani et al., 2010). Alternatively, palynology, vertebrate and conchostracan biostratigraphy correlations from the southwestern USA to the Germanic Basin and European stages are interpreted to imply that the Adamanian is mainly Carnian, and that the redeposited zircon dates are "consistent with the approximately 218 Ma Carnian-Norian boundary in the Newark Supergroup, not a "long Norian" extending to approximately 228 Ma as recently proposed" (Heckert et al., 2009). This ten-million-year divergence in opinion on the placement of the Carnian-Norian boundary requires future acquisition of radio-isotopic dates on marine-zoned lowermost Norian.

There are no published constraints from radio-isotopic dates on the Norian-Rhaetian boundary interval, although groups are actively working on obtaining dates and new results are expected to be published shortly (Christopher McRoberts, pers. commun., March 2014)

In contrast, the Triassic-Jurassic boundary has a precise radio-isotopic age. Schoene et al. (2010) project that T/J boundary age is 201.31 Ma (±0.18/0.38/0.43) based on constraints from ammonoid-bearing strata in Peru (LM4-90 and LM4-100/101) and a similar age from the former GSSP candidate section in New York Canyon, Nevada. They conclude that initiation of the main phase of the Central Atlantic Volcanic Province (CAMP) preceded the Triassic-Jurassic boundary by only ca. 70 kyr (or a maximum of 290 kyr if the extremes on the uncertainties are applied). A proposed significant age difference between these major volcanic eruptions and the marine extinctions (e.g., Pálfy et al., 2000a, b) is now considered to have been an artifact from those multi-grain zircon analysis techniques (reviewed in Mundil et al., 2010). Radio-isotopic ages from CAMP flows in North America and Morocco and cyclostratigraphy of intervening periods of sedimentation within the flow succession indicate that the main phase of eruptions was a brief peak spanning ca. 600 kyr (e.g., Whiteside et al., 2007; Jourdan et al., 2009a; Marzoli et al., 2011). Recent U-Pb dating now indicates an age of 201.546 ±0.015 Ma (analytical uncertainty) for the end-Triassic extinction, and the Triassic-Jurassic boundary is astronomically extrapolated as 100 ±40 kyr after this event (Blackburn et al., 2013).

Early and Middle Triassic age model of GTS2012

The primary method for assigning an age model to the Early Triassic biozones and substage boundaries in GTS2012 is the cycle-scaled magnetostratigraphy from the Germanic Basin (Figure 2). The following constraints and assumptions are made:

(a) The base of the Triassic in GTS2012 was 252.16 ±0.2 Ma [modified from Shen et al., 2010; although revised dating by Burgess et al. (2014) now indicates ca. 251.88 ±0.03 Ma]. The GTS2012 uncertainty of 0.2 myr on that U-Pb isotopic age applies to all other extrapolated numerical ages for Early Triassic zones/events; but not to the cycle-derived durations (e.g., if the base-Triassic is shifted younger by 0.2 myr, then the base-Olenekian and base-Anisian must also be shifted younger by the same 0.2 myr).

(b) The Germanic Basin cycles are a uniform 100-kyr Milankovitch orbital-climate signal with the base of the Triassic at the base of Calvorde cycle s1.2 and the base of the Anisian at the base of Röt cycle s7.1 (Bachmann and Kozur, 2004; Kozur and Bachmann, 2005; Menning et al., 2005). Therefore, the 51 named cycles span 5.1 myr, which was identical to the span of 5.2 myr for the combined Induan and Olenekian stages derived from radio-isotopic dates in GTS2012 (ca. 252.16 to 247 Ma).

(c) The magnetostratigraphy from these cycle-scaled deposits in the Germanic Basin (Szurlies, 2004, 2007) was correlated to the ammonoid-zoned Early Triassic bio-magnetostratigraphy of the Boreal Realm according to Hounslow and Muttoni (2010: fig. 4). Their correlation utilizes the main trends in polarity patterns, although there may be alternative correlations of the

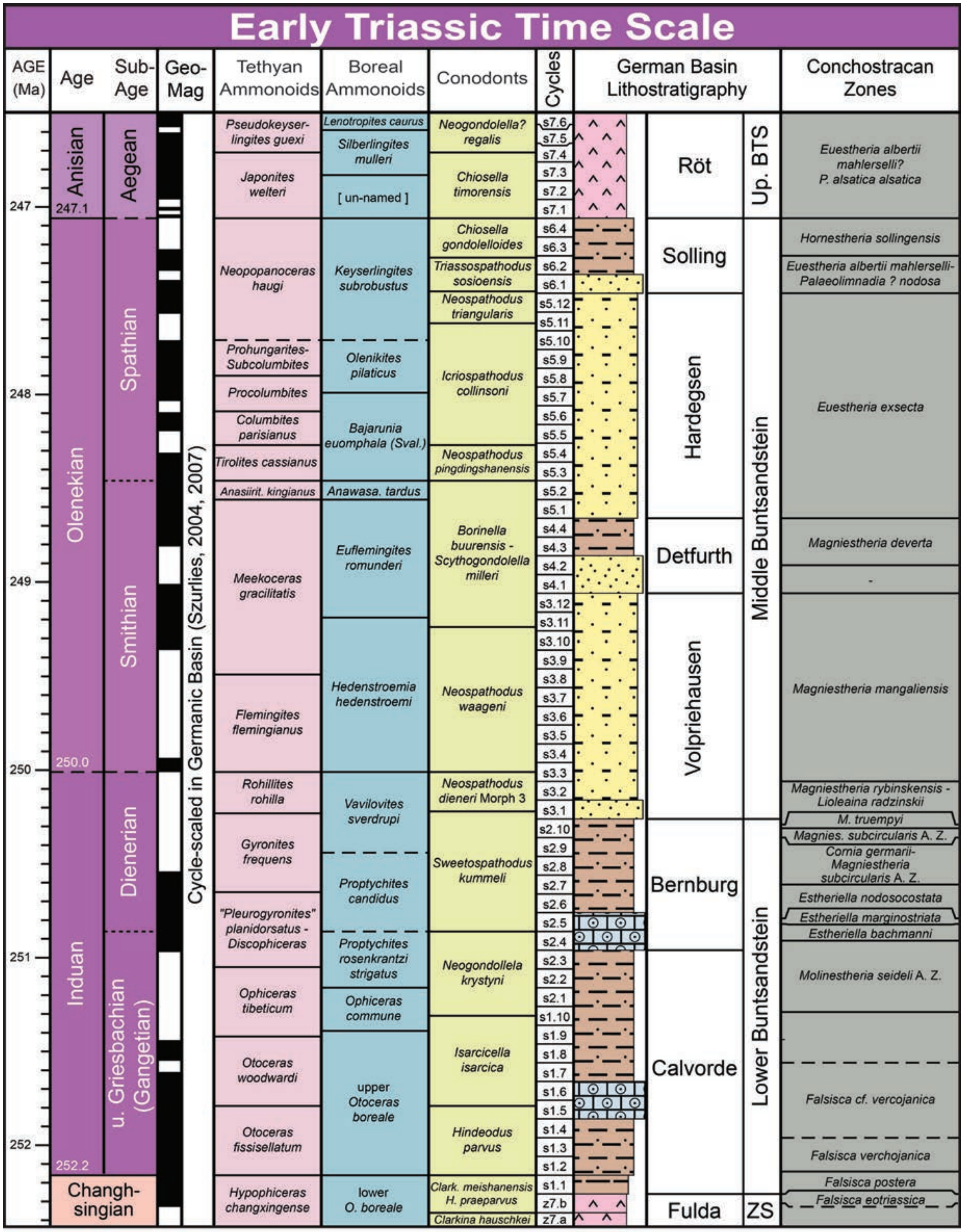


Figure 2 – Early Triassic time scale with magnetic polarity chrons, selected biostratigraphic zonations and Germanic-Basin cyclostratigraphy and main lithostratigraphic units. Working definitions of the Olenekian and Anisian stage boundaries are indicated by dashed lines; but the final definitions will eventually be made by the International Commission on Stratigraphy (see www.stratigraphy.org, or http://stratigraphy.science.purdue.edu). Germanic-Basin cycles are interpreted as eccentricity-induced 100-kyr climatic oscillations (e.g., Szurlies, 2004, 2007; Menning et al., 2005; Kozur and Bachmann, 2005, 2008). Magnetostratigraphy correlated to that cycle-scale is modified from Szurlies (2007) and Hounslow and Muttoni (2010). A selection of marine biostratigraphy relative to the magnetostratigraphy and/or adjacent zonations is represented by generalized ammonoid zones for the Tethyan and Boreal (western North America) realms (e.g., Kozur, 2003 and pers. comm., 2010; Balini et al., 2010; McRoberts, 2010) and by a conodont zonation for Tethyan realm (Kozur, 2003; and pers. comm., 2010). Terrestrial biostratigraphy is represented by conchostracan zones calibrated to the Germanic Basin cycles (Kozur and Weems, 2010, and Kozur, pers. comm., 2010).

details of the meter-scaled Boreal polarity pattern to the cycle-scaled Germanic pattern.

(d) Assignment regional working definitions of stage and sub-stage boundaries are according to their traditional placement relative to Boreal ammonoid zones; with a mean position of each ammonoid zone relative to magnetozones taken as the approximate middle of the uncertainty interval in the summary diagrams of Hounslow and Muttoni (2010). Some of these substage boundary assignments may not correspond to future GSSPs or to current working definitions in other regions (e.g., in China where there are the majority of radio-isotopic dates).

(e) Conodont zones and other stratigraphic scales are placed relative to Boreal ammonoid zones according to selected correlation diagrams of other paleontologists (e.g., charts by Hardenbol et al., 1998; Hounslow et al., 2008b; etc.).

These assumptions yield an age model for the Lower Triassic stages and substages as currently used in the Boreal faunal realm:

Dienerian substage base (base of *Proptychites candidus* ammonoid zone) is estimated by Hounslow and Muttoni (2010) as 25% up in magnetozone LT2n (= magnetozone CG5n of Szurlies, 2007). Therefore, the Dienerian/Griesbachian boundary had a projected age from the cycle-magnetic stratigraphy of 250.9 Ma.

Olenekian stage boundary (base of Smithian substage; base of *Hedenstroemia hedenstroem*i ammonoid zone) is near the base of magnetozone LT3n, which Hounslow and Muttoni (2010) correlate to magnetozone CG6n of Szurlies (2007). This yielded a projected age of 250.0 Ma. This projected age is significantly younger than a radio-isotope-derived estimate from China of ca. 251.2 Ma ±0.2 (Galfetti et al., 2007b), which may indicate different placements of the base- Olenekian between conodont-event versus regional ammonite-zone placements, a problem in radio-isotopic standards (NOTE: see discussion in Burgess et al., 2014, who also identified this problem), a mis-correlation between Boreal and Germanic magnetostratigraphy, and/or a distortion in the cycle stratigraphy. However, the younger age used in GTS2012 was also consistent with preliminary UPb dating of ammonite-zoned strata of Nevada across its regional-ammonite placement of a Smithian/Dienerian boundary (Mark Schmitz, written communications, 2013). It is apparent that a collaborative project and the use of common radio-isotopic and biostratigraphic standards are required.

Spathian substage base (base of *Bajarunia euomphala* ammonoid zone in Svalbard or Siberia zonation) is approximately 70% up in Hounslow and Muttoni's normal-polarity-dominated interval of LT5n-7n of which they correlate to magnetozone CG8n of the Germanic Basin. The implied base-Spathian age was 248.5 Ma in GTS2012.

The relative proportions of these Early Triassic substages as derived from cyclostratigraphy in GTS2012 implies that the first initial stages of recovery (Induan-Smithian) after the end-Permian mass extinctions took slightly longer than estimates based solely on selected U-Pb dates. It is essentially that additional U-Pb dates are acquired from the Induan and that "dates from the Smithian are repeated" (Burgess et al., 2014) to test the cyclostratigraphy scalings.

The "working" base of the Anisian was assigned as the base of Rot formation of Germany and the base of magnetozone MT1n of Hounslow and Muttoni (2010), which is the upper part of magnetozone CG10r of Szurlies (2007). The cycle-stratigraphy age for the base of this Anisian working definition and base of Middle Triassic is 247.06 Ma, which was consistent with published radio-isotopic ages.

The base of the Bithynian substage of the lower Anisian is estimated by Hounslow and Muttoni (2010) as approximately the base of polarity subzone MT3r.3. This subzone spans the upper third of CG11r of Szurlies (2007) in the uppermost Röt Formation; therefore implying a cycle-stratigraphy age of 246.36 Ma. The implied short duration of the underlying Aegean substage is consistent with its compact thickness relative to the Germanic Basin cycle-stratigraphy (Szurlies, 2007) and a radio-isotopic age of 246.3 ±0.07 Ma in early Anisian at Guizhou, China (sample GDGB-0, Ramezani et al., 2007).

There is no verified cyclostratigraphy calibrated to ammonoid/conodont biostratigraphy for the middle and upper Anisian or Ladinian. Therefore, until additional constraints become accepted, a schematic display of ammonite zones within each interval was incorporated in GTS2012, in which the relative duration of ammonite zones was apportioned according to their relative number of ammonite subzones or allocating 1.5 "subzonal units" for undivided zones. The Tethyan ammonite zonal scheme was selected as the standard, therefore all other apparent ages for other biostratigraphic, magnetostratigraphic or chemostratigraphic scales are according to the estimated correlations to this Tethyan scale. This scaling was done for the Bithynian, Pelsonian and Illyrian substages relative to the U-Pb-derived age of 242.1 Ma for the base of the uppermost Anisian *Nevadites secedensis* ammonoid zone. A similar scaling was applied for the Ladinian from the 241 ±1 Ma for the lower boundary relative to the interim assigned age of ~237 Ma for the base-Carnian.

Therefore, this Anisian through lowermost Carnian interval awaits a CONOP-type compilation of biostratigraphic sections to achieve a more realistic scaling of biozones, a verifiable cycle stratigraphy and the acquisition of additional biostratigraphic-constrained radio-isotopic dates. This interval requires a group effort of biostratigraphers, cycle-stratigraphy workers and radio-isotopic labs.

Late Triassic age model options

The relative durations of the Carnian, Norian and Rhaetian stages and the assignment of numerical ages to events within them has been a debated topic with extreme divergence of models. When GTS2012 was prepared (March, 2011), there was a lack of any reliable published radio-isotopic dates within the latest Carnian through early Rhaetian constrained by marine-based biostratigraphy. There is a high-resolution magnetostratigraphy scaled to Milankovitch cycles from lacustrine strata in the Newark Basin that spanned much of the Norian and Carnian (and maybe Rhaetian). However, this pattern lacked an adequate "fingerprint" to correlate with compilations of magnetostratigraphy of marine-zoned strata (e.g., two options of Muttoni et al., 2004b, and in Ogg et al., 2008; three options discussed in detail within

Hounslow and Muttoni, 2010). We present two end-member options.

The "puzzle" of how-to-correlate-the-polarity-zones is illustrated in Figure 3a, which assumed an arbitrary Rhaetian duration of 3 myr and assigned the Carnian-Norian boundary as 223 Ma. In this initial scale, the ammonoid zones (and their magnetic polarity patterns) within each stage have been uniformly scaled by allocating equal durations for each ammonoid subzone and 1.5 subzonal equivalents for those ammonoid zones that have no subzonal divisions. It is obvious that there are many options for visually correlating between the Newark cycle-magnetostratigraphy and the Late Triassic outcrop-based polarity patterns. Once such a correlation is attained, then the duration of each Late Triassic ammonoid zone would be known, plus estimates of sediment accumulation rate changes within the reference sections.

However, in addition to ambiguous matching of magnetic polarity patterns, there are at least four main factors in inter-regional correlation, each of which is disputed:

(1) Whether the published correlation of terrestrial-based biostratigraphy (conchostracans, palynology, tetrapods) from the Germanic Basin and the Southwest USA to the stratigraphic sequences in the Newark basins and to marine-based stages and substages is valid.

(2) Whether the Newark lacustrine cycle succession (the standard for the scaling of magnetostratigraphy) is continuous, and whether the overlying basalts dated at 201 Ma are conformably overlying the highest lacustrine deposits without a significant break in deposition. These factors determine whether numerical ages can be reliably assigned to the magnetozones. For example, some paleontologists have interpreted a major stratigraphic hiatus omitted at least part of the Rhaetian stage below the basalts (e.g., Cirilli et al., 2009; Kozur and Weems, 2005), and a comparison of cycle-magnetostratigraphy below the CAMP volcanics in Morocco suggested a ca. 1-myr hiatus that shortened a major normal-magnetozone (E22n) in the Newark reference succession about 1.8 myr below its CAMP volcanics (Deenen et al., 2010a; in Deenen, 2010: 60).

(3) Deciding on the temporal proximity of the upper-mid Carnian U-Pb date of 230.9 ±0.1 Ma (Aglianico date in Phanerozoic table in Chapter 6 GTS2012) relative to the base of the Norian, and whether a poorly documented date of 225 ±3 Ma (Gehrels et al., 1987) is a reliable constraint on base of the early Norian.

(4) Selecting an appropriate correlation of Rhaetian magnetostratigraphy to the Newark succession, thereby constraining the upper limit of the Norian relative to Newark cyclostratigraphy (e.g., Hüsing et al., 2011, compared to other options in Hounslow and Muttoni, 2010)

Therefore, the two end-members that represent current (2013) published views will be summarized and diagrammed in this review.

Option #1 – Long-duration Tuvalian substage and absence of Rhaetian in Newark cycle-magnetostratigraphy (Left column in Figure 3b)

One fit of this model (modified after Lucas et al., 2012, and Kozur and Weems, 2010) incorporates six main paleontological and stratigraphic conclusions:

(1) The upper-mid Carnian U-Pb date of 230.9 ±0.1 Ma is above the Carnian pluvial event and just below lowest occurrence of the conodont *P. carpathicus* (same as *M. carpathicus,* because genera assignment of *carpathicus* is not yet established). This *M. carpathicus* zone begins below the base of the *T. subbullatus* ammonoid zone, therefore this radio-isotopic age is assigned to the middle of the underlying *T. dilleri* ammonoid zone of lowest Tuvalian substage.

(2) The upper Stockton Formation of the Newark Group has conchostracans of the lower Tuvalian *Gregoriusella* n. sp. Zone (Kozur and Weems, 2010). Therefore, Newark magnetozones E8 or E7 are in the lowermost Tuvalian. The estimated age of ca. 237.0 Ma for the base of the Carnian implies that the four main magnetozone pairs and three subzones (UT1n-UT4r of Hounslow and Muttoni, 2010) are compacted into approximately 5 myr, therefore should correlate to a relatively high-frequency interval in the older portion of the Newark magnetic polarity pattern, hence potentially within the E1-E6 interval.

(3) Newark magnetozone E11r (a relatively long reversed-polarity interval in the middle of Lockatong Formation) correlates with the upper-Lower Tuvalian (upper mid-Carnian). Common taxa indicate that the conchostracan *Laxitextella seegisi* zone of the Germanic Basin is coeval with the *Howellisaura princetonensis* conchostracan zone of Newark succession in this interval and with the *Anyuanestheria wingatella* conchostracan zone of southwest USA within the lower Adamanian land vertebrate faunal chron (e.g., Kozur and Weems, 2010). This zone in the Lehrberg Beds of the Weser Formation in the Germanic Basin (following the Stuttgart Formation of Schilfsandstein deposited during the "mid-Carnian pluvial episode") contains ostracod *Simeonella nostorica*, which is common in the marine lower Turvalian of Hungary and Austria (Kozur and Weems, 2010: 332). Therefore, Newark magnetozone E11r is correlated with the *T. subbullatus* ammonoid zone and its relatively long reversed-magnetozone "Subb-R" ("UT10r" of Hounslow and Muttoni, 2010).

(4) The *Tropites subbullatus* ammonoid zone of the Tuvalian usually encompasses a relatively thicker lithostratigraphic interval than most Carnian-Norian ammonoid zones; therefore, it conceivably spans a correspondingly greater interval of time (H. Kozur, pers. comm., 2010).

(5) Palynostratigraphy had placed the Carnian-Norian boundary in the Newark Supergroup succession near the base of the Passaic Formation (e.g., Cornet and Olsen, 1985) or within Newark magnetozone E13 (as used in Kent and Olsen, 1999). Magnetostratigraphy of the proposed base-Norian GSSP at Pizzo Mondello (Muttoni et al., 2001, 2004a) places the boundary horizon at the top of a relatively narrow reversed-magnetozone (PM4r) between two relatively longer normal-magnetozones. One interpretation is that this Carnian-Norian boundary level corresponds to the top of Newark magnetozone E13r. [NOTE: In contrast, Muttoni et al. (2004a) prefer a correlation to the top of magnetozone E7; which is ca. 10-myr older.]

(6) The Rhaetian stage is not represented in the uppermost Newark succession. In sections of the upper Passaic Formation which have yielded conchostracans, the fauna represent the *Shipingia olseni* Zone of uppermost Norian (no well-dated

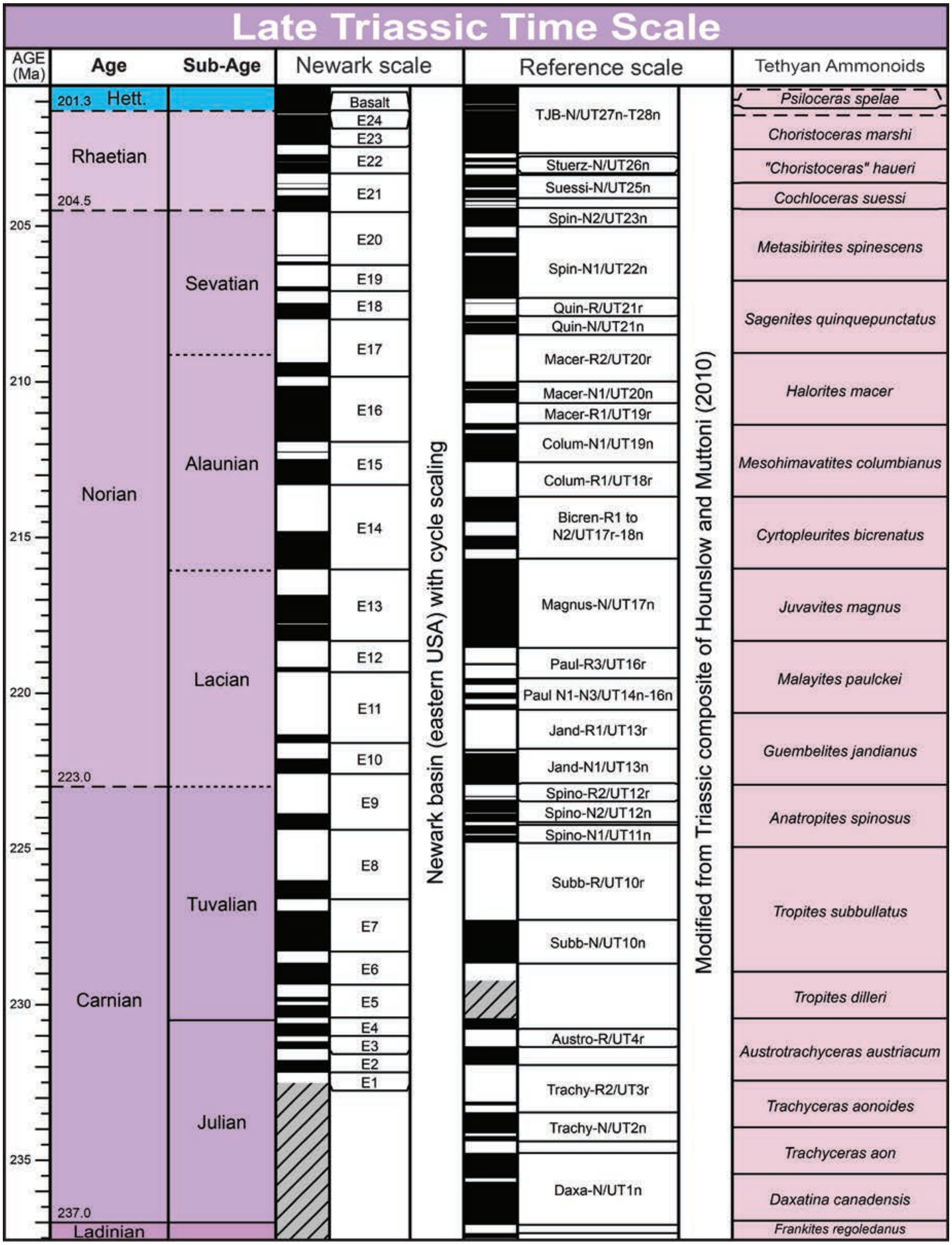


Figure 3 – The Late Triassic Magnetic Correlation Puzzle. (a) The ambiguity in correlating Upper Triassic magnetic polarity scales derived from two independent sources. Lacustrine basins of the Newark Supergroup (eastern USA) have yielded a high-resolution magnetic polarity pattern with durations derived from Milankovitch cycles (Kent et al., 1995), but lack direct calibrations to marine stratigraphy. Magnetostratigraphy from ammonite- or conodont-zoned marine sections have been assembled into a composite bio-magnetostratigraphy scale (modified from Hounslow and Muttoni (2010) by adding stage-based abbreviations for major polarity zones to their "UT" numbering), but lack cycle stratigraphy to estimate elapsed durations. This initial bio-magnetostratigraphy reference pattern is scaled by assigning equal durations to ammonite subzones. Several possible correlations are possible due to: (1) the lack of a distinctive "fingerprint" to correlate cycle-scaled polarity zones to marine sections that have uncertain continuity in sedimentation rates, (2) uncertainties in the correlation of terrestrial biostratigraphy (Newark) to marine biostratigraphy,

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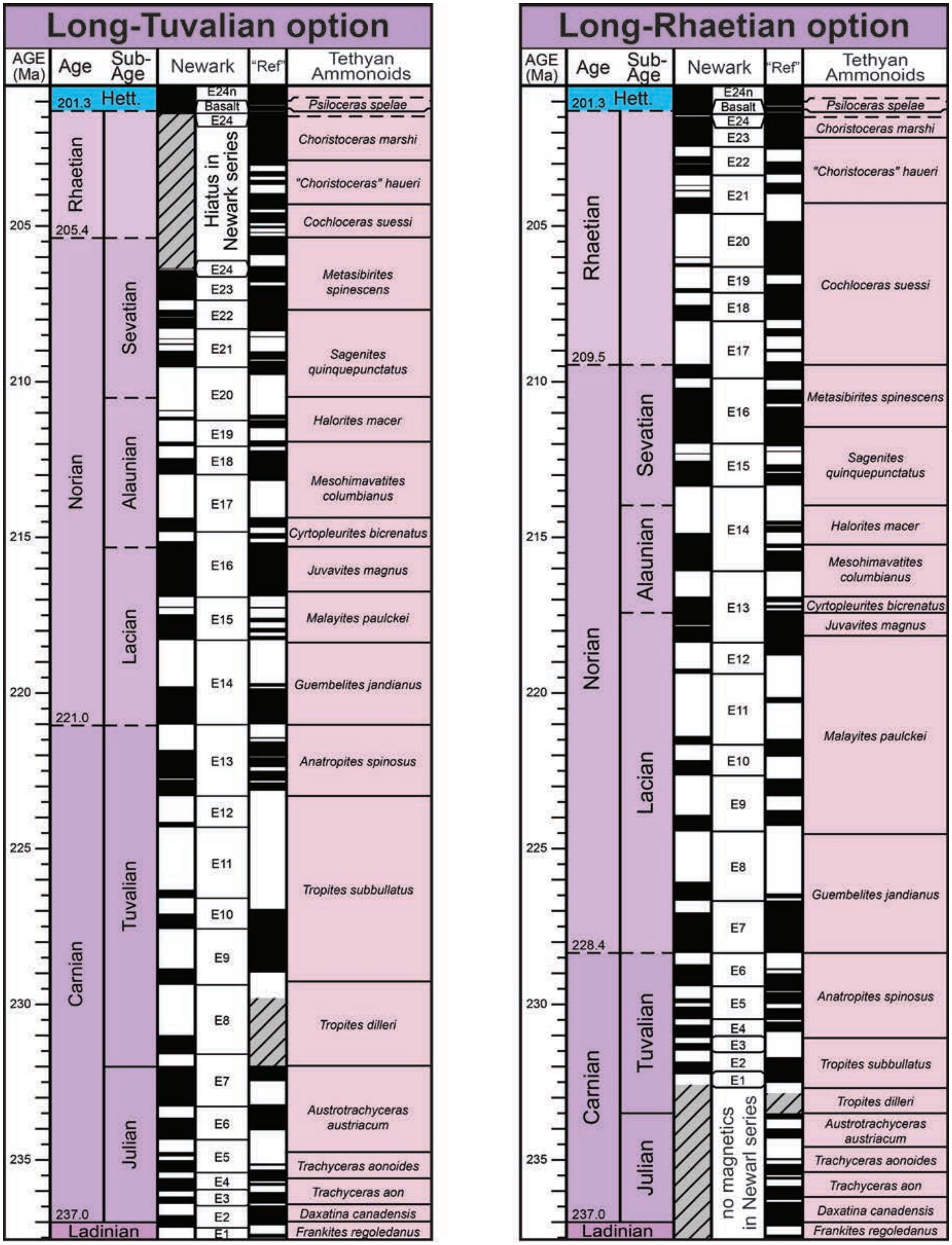

and (3) possible significant gaps in both records. (b) Examples of two suggested end-member correlations are shown: (Left) an Option 1 "Long-Tuvalian" and absence of Rhaetian in the Newark cycle-magnetostratigraphy (modified after Lucas et al., submitted, and others), and (Right) an Option 2 "Long-Rhaetian" spanning the upper Newark cycle-magnetostratigraphy that would imply a short-duration Carnian (modified after Muttoni et al., 2010; Hüsing et al., 2011; and others). In each case, the ages for the top of the Triassic (201.3 Ma) and base of the Carnian (237.0 Ma) are the same. See text for details. In each option, the potential definitions of the Norian and Rhaetian stage boundaries are indicated by dashed lines; but the final decisions will be made by the International Commission on Stratigraphy (see www.stratigraphy.org, or http://stratigraphy.science.purdue.edu). For GTS2012, the age model of Option 2 ("Long-Rhaetian") was selected for scaling the upper Triassic in other diagrams.

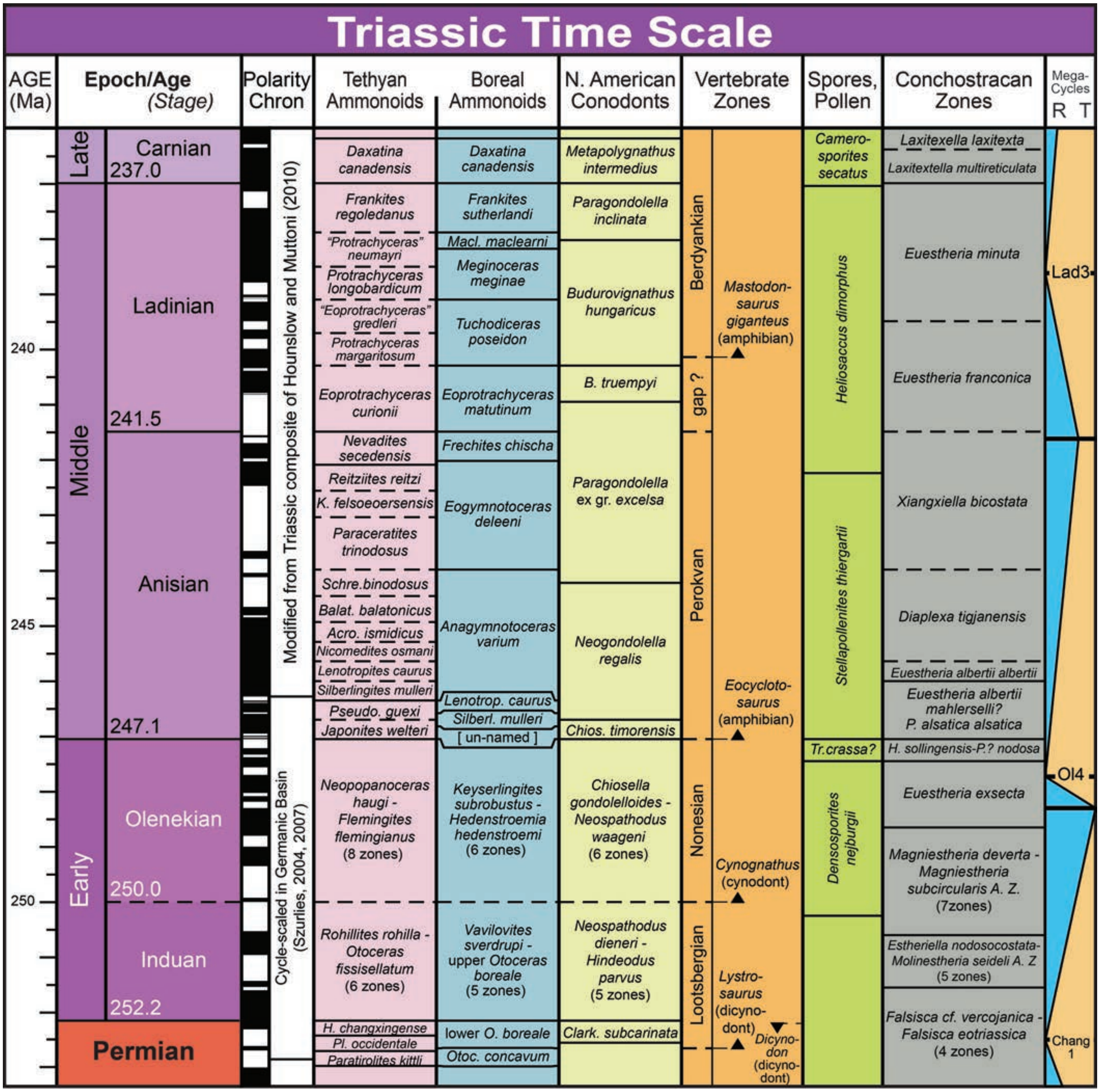

Figure 4 – Summary of a possible age model for epoch/series and age/stage boundaries of the Triassic with selected marine biostratigraphic zonations and principle trends in sea level. ["Age" is the term for the time equivalent of the rock-record "stage".]. Potential definitions of the Olenekian, Anisian, Norian and Rhaetian are indicated by dashed lines; but the final decisions will be made by the International Commission on Stratigraphy (see www.stratigraphy.org, or http://stratigraphy.science.purdue.edu). For GTS2012, the age model of Option 2 ("Long-Rhaetian and Short-Carnian") was selected for scaling the upper Triassic. Magnetic polarity pattern is modified from Hounslow and Muttoni (2010). Marine biostratigraphy are representative ammonoid zones for the Tethyan and Boreal (western North America) realms (e.g., Kozur, 2003 and pers. comm., 2010; Balini et al., 2010; McRoberts, 2010) and conodont zonation for North American realm (e.g., Orchard and Tozer, 1997; Orchard, 2010). Terrestrial biostratigraphy is represented tetrapod "faunachrons" with defining first appearances (Lucas, 2010d), generalized spore-pollen zones (Kürschner and Herngreen, 2010) and Conchostracan zones (Kozur and Weems, 2010; Kozur, pers. comm., 2010). The major sequences are from Jacquin and Vail (1998, as inter-calibrated in Hardenbol et al., 1998). For details in Early Triassic, see expanded scale in Figure 2. Additional Triassic zonations, geochemical trends, sea-level curves, etc. are compiled in the internal datasets within TimeScale Creator (www.tscreator.org).

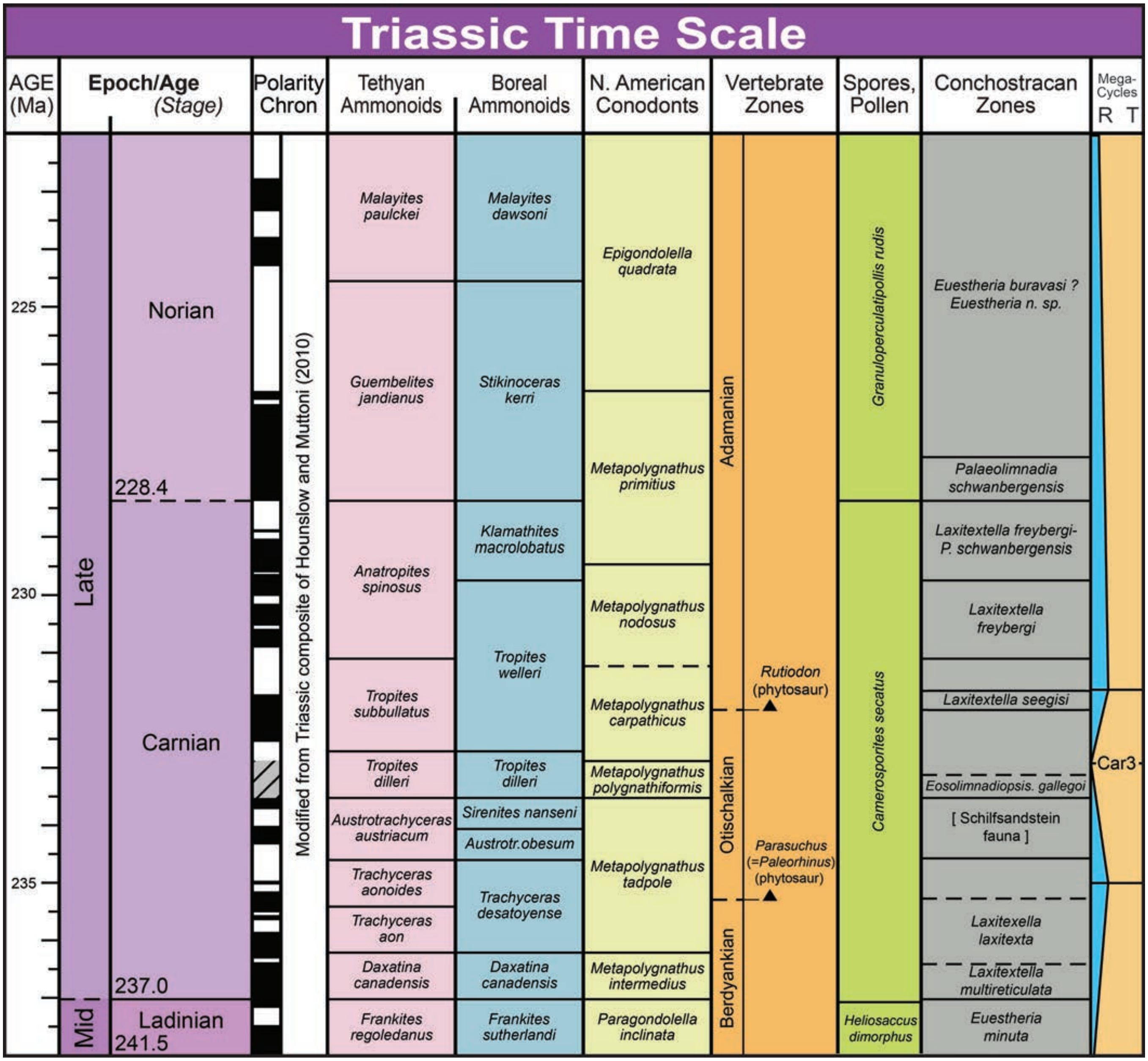

Figure 4 (Continued)

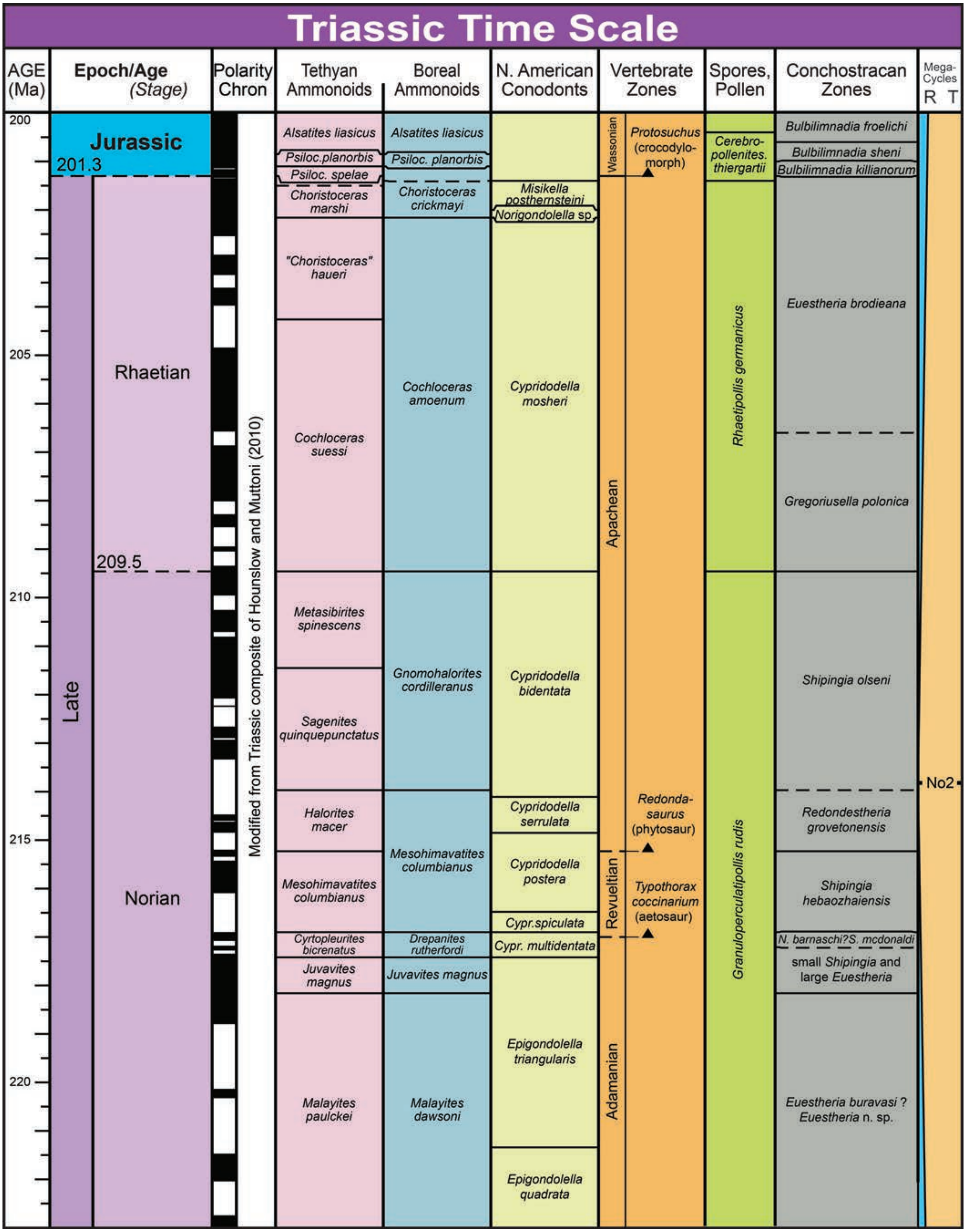

Figure 4 (Continued)

Rhaetian section in any part of the world has yielded any *Shipingia*) overlain locally by a very short interval of the uppermost *E. brodieana* Zone of latest Rhaetian (Kozur and Weems, 2005, 2010). The uppermost Sevatian, lower Rhaetian and part of the upper Rhaetian are not present. Therefore, under this Option 1, then the numerical ages of the magnetozones of the underlying Newark Supergroup cannot be assigned using cycle-stratigraphy “downward” from the overlying basalts that are dated as 201 Ma.

These constraints imply a “Long Tuvalian” with Newark magnetozone E7 near the base of Tuvalian, the 230.9 Ma radio-isotopic date in the middle of *T. dilleri* ammonoid zone, the Newark magnetozone E11r in the middle of the *T. subbullatus* ammonoid zone, and the top of Newark magnetozone E13r (ca. 4-myr later) marking the base of the Norian.

A conservative estimate is to assign the base of the Tuvalian (base of *T. dilleri* ammonoid zone) as 232 Ma and to position this boundary at the base of E7r. Then, assuming that the Newark cycle-magnetic sequence is complete, an age can be assigned to each magnetozone progressively upward and downward from this E7r control age. This implies that the age of the top of magnetozone E13r, which was interpreted as the Carnian-Norian boundary (item #5 above), is ca. 221.9 Ma. The uppermost portion of the preserved Newark magnetostratigraphy, the lower portion of magnetozone E24n of the uppermost Norian, is projected as 206.5 Ma. The Norian-Rhaetian stage boundary would be slightly younger than this level, hence about 205.5 Ma. The age of the Triassic-Jurassic boundary at 201.3 Ma would imply that the Rhaetian was 4 myr in duration, which would be essentially the time-span for the interpreted hiatus in the Newark succession.

If the base of the Carnian is assigned as exactly 237 Ma, then the age assignments to Newark magnetozones imply that the basal Carnian reversed-polarity zone Daxa-R corresponds to Newark magnetozone E2r.

One can propose a suite of possible correlations of the magnetostratigraphy patterns of the other ammonoid zones of the Carnian and Norian to this model of the age-assigned Newark magnetic pattern. One set of possible Newark-to-ammonoid zone correlations has partially used the relative number of ammonoid subzones per zone as an approximate guide to relative durations for adjacent zones. The scaling of polarity patterns within individual ammonite zones are according to magnetostratigraphy reference sections (e.g., Hounslow and Muttoni, 2010), and only the placement of ammonite zonal boundaries have been adjusted for the potential fit to the Newark cycle-scaled polarity pattern. There is the caveat that portions of these composite polarity patterns are not well calibrated to ammonoid (or conodont) zones. Such a model could be tested in different ways, such as obtaining cycle-stratigraphy from the ammonite-zoned reference sections or clarifying the magnetostratigraphy within middle Carnian ammonoid zones (e.g., *T. dilleri*) to ascertain the predicted presence of a long reversed-polarity interval (E8r) from the Newark succession.

In the illustrated Option 1 age model that attempts to match major magnetic polarity characteristics, the 36-myr span of the Late Triassic is distributed as sub-equal ~16-myr durations for the Carnian and Norian, and a 4-myr “short” Rhaetian.

Option #2 – Short-duration Carnian and presence of a long Rhaetian in Newark cycle-magnetostratigraphy (Right column in Figure 3b)

At the other end of the spectrum of models, the suite of biostratigraphic interpretations is relaxed in favor of a hiatus-free Newark succession that is continuous into the CAMP basalts of 201.4 Ma. This assumption is combined with additional interpretations from magnetostratigraphy patterns and radio-isotopic ages:

(1) The ages of all Newark magnetozones are computed downward from the CAMP age of 201.4 Ma.

(2) The Rhaetian is fully present in the uppermost Newark magnetostratigraphy. There is no lithostratigraphic evidence for the interpreted major biostratigraphic gap in the uppermost Newark lacustrine cycles (P. Olsen, pers. comm., 2010), and studies of cycle-magnetostratigraphy of coeval deposits in other basins indicates a nearly identical time span (within 20 kyr) for the uppermost magnetozones to the onset of CAMP volcanics (Deenen, 2010; Deenen et al., 2010b). Therefore, the narrow UT27r of the latest Hettangian in the composite by Hounslow and Muttoni (2010) is correlated with magnetozone E23r of the uppermost Newark. The underlying upper and middle Rhaetian magnetozones (BIT5r to BIT1r/UT24r) are progressively correlated to Newark magnetozones through E22r (Muttoni et al., 2010).

(3) The cluster of reversed-polarity-dominated magnetozones in the lower Rhaetian is underlain by a relatively thick normal-polarity magnetozone UT22n. This may imply that this lowermost Rhaetian interval is interpreted as condensed in the Austrian reference section; therefore this suite corresponds to the expanded set of reversed-polarity dominated E20r-E17r underlain by normal-polarity magnetozone E16n-E17n in the Newark succession (Option A of Hounslow and Muttoni, 2010, or similar model by Hüsing et al., 2011). The Norian-Rhaetian boundary is assigned to just above the base of E17r with an age of 209.5 Ma. A similar “8-myr Rhaetian” model was proposed by McArthur (2008, 2010) upon applying a uniform rate-of-change to the declining 87Sr/86Sr ratios from latest Norian through Sinemurian.

(4) The polarity change at the Carnian-Norian boundary at the candidate GSSP of Pizzo Mondello corresponds to the base of E7n (Muttoni et al., 2004a) with an age projected from the Newark cycle-magnetostratigraphy of ca. 228.5 Ma. This is consistent with reported ages of ca. 225 Ma for lower Norian strata (e.g., Gehrels et al., 1987).

(5) Given these correlations for the top and base of the Norian, then the general trends in polarity dominance would project the base of the Alaunian stage (base of UT17r, above a relatively thick normal-polarity Magnus-N/UT17n) to the base of Newark magnetozone E13r, and the base of the Sevatian (base of Quin-N/UT21n) to perhaps the base of Newark magnetozone E15n (Option A of Hounslow and Muttoni, 2010). One problem is that the outcrop-derived magnetostratigraphy within the mid-Norian Alaunian substage has more interpreted magnetozones than the Newark cycle-magnetostratigraphy; and this apparent inconsistency was noted by Hounslow and Muttoni (2010) in

their similar Option A for Norian correlations.

(6) Correlations within the Carnian proceed downward from the assigned base-Norian at E7r. This would imply that the *A. spinosus* ammonite zone may be slightly longer than the preceding *T. subbullatus* zone, and that the apparently simple polarity pattern of that *T. subbullatus* zone requires further resolution. The duration of the Carnian is much shorter than the Norian, with the Julian-Tuvalian substage boundary projected as approximately midway at 233.5 Ma.

In this model, the 36-myr span of the Late Triassic is apportioned among a "long" 8-myr Rhaetian, a 19-myr Norian, and a ~10-myr Carnian.

We had selected the Option #2 (Short-duration Carnian and a longer Rhaetian) for the Triassic summary figures in GTS2012. This choice was partly influenced by reported radio-isotopic dates of 223-225 Ma (223.81 ±0.78 Ma and 224.52 ±0.22 Ma) derived by U-Pb CA-TIMS methods from single zircons from volcanic tuffs in the Nicola Group of British Columbia that are constrained by conodont assemblages to bracket the lower/middle Triassic boundary interval as used in North America (Diakow et al., 2011, abstract). If confirmed, then those dates were only consistent with the "long-Carnian" aspects of Option #2. The choice between a "long" (ca. 7 myr) versus "short" (ca. 4 myr) Rhaetian is a separate issue, but its resolution from additional radio-isotopic dating and cyclostratigraphy will require also satisfactory correlation of the polarity patterns magnetostratigraphic reference sections.

SUMMARY

During the past decade, Triassic workers have defined most of the stages, greatly enhanced the inter-correlation of biostratigraphic zones, enabled compilation of a nearly complete magnetic polarity pattern calibrated to marine biostratigraphic datums, discovered major excursions in stable isotopes (especially carbon isotope excursions within the lower Triassic), and achieved or rejected cycle-stratigraphic scaling of several intervals. A generalized synthesis of selected Triassic stratigraphic scales is compiled in Figure 4.

Extensive radio-isotopic dating with advanced techniques replaced nearly the entire radiometric dataset used in GTS2004 and established well-constrained dates for the bases of the Early Triassic (Induan Stage), of both Middle Triassic stages (Anisian, Ladinian) and top of the Triassic (base of Hettangian Stage). Unfortunately, there are lingering major uncertainties on the age models and durations for most of the Triassic stages. In particular, establishing a robust Late Triassic time scale requires definitive radio-isotopic dates and cyclostratigraphy on marine sections that have standard biostratigraphy.

ACKNOWLEDGEMENTS

The compilation of the GTS2012 version of the Triassic chronostratigraphy and understanding the current disputes on correlations and age models were greatly aided by discussions with several colleagues, including in alphabetical order, Marco Balini, Mark Hounslow, Heinz Kozur, Leopold Krystyn, Mingsong Li, Spencer Lucas (who also provided preprints of several articles), Christopher McRoberts, Manfred Menning, Michael Orchard (previous chair of the Triassic subcommission, who also provided abstracts of to-be-submitted radio-isotopic dates supporting the "short Carnian" scaling), Paul Olsen and Lawrence Tanner. None of them will entirely agree with the brief summaries, with the selected genera-species nomenclature and zonations used in the figures, or with either of the dual possibilities for numerical age scaling for the Late Triassic, but all will agree that future research into the Triassic correlations and acquisition of radio-isotopic dates that are reliably correlated to standard biostratigraphies will lead to inevitable surprises. Additional or alternative zonal schemes are available through the TimeScale Creator visualization datapacks (www.tscreator.org). Gabi Ogg prepared all of the figures. Further advances in formalizing GSSPs, zonal schemes, inter-regional correlations, and eventual consensus on the best age models will be found in the Albertiana newsletters of the Subcommission on Triassic Stratigraphy.

The compilation and application of cycle stratigraphy to enhance the Mesozoic time scale was partially supported by U.S. National Science Foundation grant EAR-0718905 (J. Ogg, L. Hinnov) and by a research fellowships (J. Ogg) from the China University of Geosciences (Wuhan).

REFERENCES

von Alberti, F.A., 1834, Beitrag zu einer Monographie des Bunter Sandsteins, Muschelkalks und Keupers und die Verbindung dieser Gebilde zu einer Formation. Stuttgart and Tübingen: Verlag der J.G. Cottaíshen Buchhandlung, 326 pp.

Assereto, R., 1974, Aegean and Bithynian: proposal for two new Anisian substages. Schriftenreihe der Erdwissenschaftlichen Kommissionen, Österreichische Akademie der Wissenschaften, 2: 23-39.

Bachmann, G.H., and Kozur, H.W., 2004, The Germanic Triassic: correlations with the international scale, numerical ages and Milankovitch cyclicity. Hallesches Jahrbuch fur Geowissenschaften, B26: 17-62.

Balini, M., Drystyn, L., and Torti, V., 1998, In search of the Ladinian/Carnian boundary: perspectives from Spiti (Tethys Himalaya). Albertiana, 21: 26-32.

Balini, M., Krystyn, L., Nicora, A., and Torti, V., 2001, The Ladinian-Carnian boundary succession in Spiti (Tethys Himalaya) and its bearing to the definition of the GSSP for the Carnian stage (Upper Triassic). Journal of Asian Earth Sciences, 19(3A): 3-4.

Balini, M., Lucas, S.G., Jenks, J.F., and Spielmann, J.A., 2010, Triassic ammonoid biostratigraphy: an overview. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 221-262.

Benton, M.J., Forth, J., and Langer, M.C., 2014. Models for the rise of the dinosaurs. Current Biology, 24: R87-R95.

Bittner, A., 1892, Was ist norisch? Jahrbuch Geologischen Reichsanstalt, 42: 387-396.

Blackburn, T.J., Olsen, P.E., Bowring, S.A., McLean, N.M., Kent, D.V., Puffer, J., McHone, G., Rasbury, E.T., and Et-Touhami, M., 2013, Zircon U-Pb geochronology links end Triassic extinction with the Central Atlantic Magmatic Province. ScienceExpress, 10.1126/ science.1234204.

Bowring, S.A., Erwin, D.H., Jin, Y.G., Martin, M.W., Davidek, K., and Wang, W., 1998, U/Pb zircon geochronology and tempo of the end-Permian mass extinction. Science, 280: 1039-1045.

Brack, P., 2010, The "golden spike" for the Ladinian is set! Albertiana, 38: 8-10.

Brack, P., and Rieber, H., 1994, The Anisian/Ladinian boundary: retrospective and new constraints. Albertiana, 13: 25-36.

Brack, P., and Rieber, H., 1996, The new 'High-resolution Middle Triassic ammonoid standard scale' proposed by Triassic researchers from Padova - a discussion of the Anisian/Ladinian boundary interval. Albertiana, 17: 42-50.

Brack, P., Rieber, H., and Mundil, R., 1995, The Anisian/Ladinian boundary interval at Bagolino (Southern Alps, Italy): I. Summary and new results on ammonoid horizons and radiometric dating. Albertiana, 15: 45-56.

Brack, P., Mundil, R., Oberli, F., Meier, M., and Rieber, H., 1996, Biostratigraphic and radiometric age data question the Milankovitch characteristics of the Latemar cycles (Southern Alps, Italy). Geology, 24: 371-375.

Brack, P., Mundil, R., Oberli, F., Meier, M., and Rieber, H., 1997, Biostratigraphic and radiometric age data question the Milankovitch characteristics of the Latemar cycles (Southern Alps, Italy) – Reply. Geology, 25: 471-472.

Brack, P., Rieber, H., Nicora, A., and Mundil, R., 2005, The Global boundary Stratotype Section and Point (GSSP) of the Ladinian Stage (Middle Triassic) at Bagolino (Southern Alps, Northern Italy) and its implications for the Triassic time scale. Episodes, 28(4): 233-244.

Brayard, A., Escarguel, G., Bucher, H., and Brühwiler, 2009a, Smithian and Spathian (Early Triassic) ammonoid assemblages from terranes: paleoceanographic and paleogeographic implications. In Metcalfe, I., and Isozaki, Y. (eds), End-Permian mass extinction: events & processes, age & timescale, causative mechanism(s) & recovery. Journal of Asian Earth Sciences, 36(6): 420-433.

Broglio Loriga, C., Cirilli, S., De Zanche, V., di Bari, D., Gianolla, P., Laghi, G.R., Lowrie, W., Manfrin, S., Mastandrea, A., Mietto, P., Muttoni, G., Neri, C., Posenato, R., Rechichi, M., Rettori, R., and Rohgi, G., 1998, A GSSP candidate for the Ladinian-Carnian boundary: the Prati di Stuores/Stuores Wiesen section (Dolomites, Italy). Albertiana, 21: 2-18.

Broglio Loriga, C., Cirilli, S., De Zanche, V., di Bari, D., Gianolla, P., Laghi, G.R., Lowrie, W., Manfrin, S., Mastandrea, A., Mietto, P., Muttoni, G., Neri, C., Posenato, R., Rechichi, M., Rettori, R., and Rohgi, G., 1999, The Prati di Stuores/ Stuores Wiesen section (Dolomites, Italy): a candidate Global Stratotype Section and Point for the base of the Carnian stage. Rivista Italiana di Paleontologia e Stratigrafia, 105: 37-78.

Brühwiler, T.,Hochuli, P.,Mundil, R., Schatz,W., and Brack, P. 2007, Bio- and chronostratigraphy of the Middle Triassic Reifling Formation of the westernmost Northern Calcareous Alps. Swiss Journal of Geosciences, 100: 443–455.

Burgess, S. D., Bowring, S., and Shen, S.-Z., 2014, High-precision timeline for Earth's most severe extinction. Proceedings of the National Academy of Sciences, 111: 3316-3322.

Cao, C.Q., Love, G.D., Hays, L.E., Wang, W., Shen, S.Z., and Summons, 2009, Biogeochemical evidence for euxinic oceans and ecological disturbance presaging the end-Permian mass extinction. Earth and Planetary Science Letters, 281: 188-201.

Carter, E.S., and Orchard, M.J., 2007, Radiolarian – conodont – ammonoid intercalibration around the Norian-Rhaetian Boundary and implications for trans-Panthalassan correlation. Albertiana, 36: 149-163.

Chinese Triassic Working Group, 2007, Final report of the GSSP candidate for the I/O boundary at West Pingdingshan Section in Chaohu, Southeastern China. Albertiana, 36: 10-21.

Cirilli, S A. Marzoli, L. Tanner, H. Bertrand, N. Buratti, F. Jourdan,, G. Bellieni, D. Kontak, and Renne, P.R., 2009, Latest Triassic onset of the Central Atlantic Magmatic Province (CAMP) volcanism in the Fundy Basin (Nova Scotia): new stratigraphic constraints. Earth and Planetary Science Letters, 286: 514-525.

Cornet, B., and Olsen, P.E., 1985, A summary of the biostratigraphy of the Newark Supergroup of Eastern North America with comments on early Mesozoic provinciality. In Weber, R. (ed), III Congreso Latinoamericano de Paleontologia Mexico, Simposio Sobre Floras del Triasico Tardio, su Fitogeografpia y Paleoecologia, Memoria. Mexico: Universidad Nacional Autónoma de México, p. 67-81.

Cozzi, A., Hinnov, L.A., and Hardie, L.A. 2005, Orbitally forced Lofer cycles in the Dachstein Limestone of the Julian Alps (northeastern Italy). Geology, 33: 789-792.

Dal Corso, J., Mietto, P., Newton, R.J., Pancost, R.D., Preto, N., Roghi, G., and Wignall, P., 2012, Discovery of a major 13C spike in the Carnian (Late Triassic) linked to the eruption of Wrangellia flood basalts. Geology, 40: 79–82.

Deenen, M.H.L., 2010, A new chronology for the late Triassic to early Jurassic. PhD thesis, Utrecht University, Faculty of Geosciences, Department of Earth Sciences. Geologica Ultraiectina, 323.

Deenen, M.H.L., Langereis, C.G., Krijgsman, W., El Hachimi, H., and El Hassane, C., 2010a, Paleomagnetic research in the Argana basin, Morocco: Trans-Atlantic correlation of CAMP volcanism and implications for the late Triassic geomagnetic polarity time scale. In Deenen, M.H.L., A new chronology for the late Triassic to early Jurassic. Geologica Ultraiectina, 323: 43-64.

Deenen, M.H.L., Ruhl, M., Bonis, N.R., Krijgsman, W., Kuerschner, W.M., Reitsma, M., and van Bergen, M.J., 2010b, A new chronology for the end-Triassic mass extinction. Earth and Planetary Science Letters, 291: 113-125.

Diakow, L., Orchard, M.J., and Friedman, R., 2011, Absolute ages for the Norian Stage: a contribution from southern British Columbia, Canada. 21st Canadian Paleontological Conference, University of British Columbia, 19-20 Aug 2011. Abstract sent by M.J. Orchard to J. Ogg . [July 2011]

Diener, C., 1912, The Trias of the Himalayas. Geological Survey of India Memoirs, 36(3), 159 pp.

Erwin, D.H., 1993, The Great Paleozoic Crisis: Life and Death in the Permian. New York: Columbia University Press, 327 pp.

Erwin, D.H., 2006, Extinction: How Life on Earth Nearly Ended 250 Million Years Ago. Princeton: Princeton University Press, 320 pp.

Erwin, D.H., Bowring, S.A., and Yugan, J., 2002, End-Permian mass extinctions: a review. In Koeberl, C., and MacLeod, K.G. (eds), Catastrophic events and mass extinctions: impacts and beyond. Geological Society of America Special Paper, 356: 363-383.

Feist-Burkhardt, S., Götz, A.E., Szulc, J., Borkhataria, R., Geluk, M., Haas, J., Hornung, J., Jordan, P., Kempf, O., Michalik, J., Nawrocki, J., Reinhardt, L., Ricken, W., Röhling, H.-G., Rüffer, T., Török, A., and Zühlke, R., 2008, Triassic. In McCann, T. (ed), The Geology of Central Europe. Vol.2: Mesozoic and Cenozoic. London: The Geological Society, p. 749-821.

Fischer, A.G., 1964, The Lofer cyclothems of the Alpine Triassic. In Merriam, D.F. (ed), Symposium on Cyclic Sedimentation. Kansas Geological Survey Bulletin, 169: 107-149.

Furin, S., Preto, N., Rigo, M., Roghi, G., Gianolla, P., Crowley, J.L., and Bowring, S.A., 2006, High-precision U-Pb zircon age from the Triassic of Italy: implications for the Triassic time scale and the Carnian origin of calcareous nannoplankton and dinosaurs. Geology, 34: 1009-1012.

Gaetani, M., 1993, Anisian/Ladinian boundary field workshop, Southern Alps - Balaton Highlands, 27 June - 4 July 1993. Albertiana, 12: 5-9.

Galfetti, T., Hochuli, P.A., Brayard, A., Bucher, H., Weissert, H., and Vigran, J.O., 2007a, The Smithian/Spathian boundary event: a global climatic change in the wake of the end-Permian biotic crisis. Evidence from palynology, ammonoids and stable isotopes. Geology, 35: 291-294.

Galfetti, T., Bucher, H., Ovtcharova, M., Schaltegger, U., Brayard, A., Brühwiler, T., Goudemand, N, Weissert, H., Hochuli, P.A., Cordey, F., and Guodun, K.A., 2007b, Timing of the Early Triassic carbon cycle perturbations inferred from new U-Pb ages and ammonoid biochronozones. Earth and Planetary Science Letters, 258: 593-604.

Galfetti, T., Bucher, H., Brayard, A., Hochuli, P.A., Weissert, H., Guodun, K., Atudorei, V., and Guex, J., 2007c, Late Early Triassic climate change: insights from carbonate carbon isotopes, sedimentary evolution and ammonoid paleobiogeography. Palaeogeography, Palaeoclimatology, Palaeoecology, 243: 394-411.

Gallet, Y., Krystyn, L. Marcoux, J., and Besse, J., 2007, New constraints on the End-Triassic (Upper Norian–Rhaetian) magnetostratigraphy. Earth and Planetary Science Letters, 255: 458-470.

Gehrels, G.E., Saleeby, J.B., and Berg, H.C., 1987, Geology of Annette, Gravina, and Duke islands, southeastern Alaska. Canadian Journal of Earth Sciences, 24: 866-881.

Goldhammer, R.K., Dunn, P.A., and Hardie, L.A., 1987, High frequency glacio-eustatic oscillations with Milankovitch characteristics recorded in northern Italy. American Journal of Science, 287: 853-892.

Goldhammer, R.K., Dunn, P.A., and Hardie, L.A., 1990, Depositional cycles, composite sea level changes, cycle stacking patterns, and the hierarchy of stratigraphic forcing: examples from the Alpine Triassic platform carbonates. Geological Society of America Bulletin, 102: 535:562.

Goudemand, N., Orchard, M., Bucher, H., Brayard, A., Brühwiler, T., Galfetti, T., Hochuli, P.A., Hermann, E., and Ware, D., 2009, Smithian-Spathian boundary: the biggest crisis in Triassic conodont history. Abstracts with Program, Geological Society of America, 40(6): 505.

Gradinaru, E., Orchard, M.J., Nicora, A., Gallet, Y., Besse, J., Krystyn, L., Sobolev, E.S., Atudorei, N.-V., and Ivanova, D., 2007, The Global Boundary Stratotype Section and Point (GSSP) for the base of the Anisian Stage: Desli Caira Hill, North Dobrogea, Romania. Albertiana, 36: 54-71.

Gradstein, F.M, Ogg, J.G., Schmitz, M.D., Ogg, G.M. (coordinators), 2012, The Geologic Time Scale 2012. Boston, USA: Elsevier, 2 volumes plus chart, 1176 pp. [Note: contributors include: Agterberg, F.P., Anthonissen, D.E., Becker, T.R., Catt, J.A., Cooper, R.A., Davydov, V.I., Gradstein, S.R., Henderson, C.M., Hilgen, F.J., Hinnov, L.A., McArthur, J.M., Melchin, M.J., Narbonne, G.M., Paytan, A., Peng, S., Peucker-Ehrenbrink, B., Pillans, B., Saltzman, M.R., Simmons, M.D., Shields, G.A., Tanaka, K.L., Vandenberghe, N., Van Kranendonk, M.J., Zalasiewicz, J., Altermann, W., Babcock, L.E., Beard, B.L., Beu, A.G., Boyes, A.F., Cramer, B.D., Crutzen, P.J., van Dam, J.A., Gehling, J.G., Gibbard, P.L., Gray, E.T., Hammer, O., Hartmann, W.K., Hill, A.C., Paul F. Hoffman, P.F., Hollis, C.J., Hooker, J.J., Howarth, R.J., Huang, C., Johnson, C.M., Kasting, J.F., Kerp, H., Korn, D., Krijgsman, W., Lourens, L.J., MacGabhann, B.A., Maslin, M.A., Melezhik, V.A., Nutman, A.P., Papineau, D., Piller, W.E., Pirajno, F., Ravizza, G.E., Sadler, P.M., Speijer, R.P., Steffen, W., Thomas, E., Wardlaw, B.R., Wilson, D.S., and Xiao, S.]

Greene, A., Scoates, J., and Weis, D., 2008, The Accreted Wrangellia Oceanic Plateau in Alaska, Yukon, and British Columbia. Internet article from Large Igneous Provinces Commission, Large Igneous Province of the Month: December 2008. Available at www.largeigneousprovinces.org/.

Greene, A., Scoates, J., and Weis, D., 2011, The Accreted Wrangellia Oceanic Plateau in Alaska, Yukon, and British Columbia. Available at www.eos.ubc.ca/research/wrangellia. [Last update was 2010 when viewed Feb., 2011]

Griesbach, C.L., 1880, Paleontological notes on the Lower Trias on the Himalayas. Records of the Geological Survey of India, 13(2): 94-113.

von Gümbel, C.W., 1861, Geognostische Beschreibung des bayerischen Alpengebirges und seines Vorlands. Gotha: Perthes, 950 pp.

Guo, G., Tong, J.N., Zhang, S.H., Zhang, J., and Bai, L.Y., 2008, Cyclostratigraphy of the Induan (Early Triassic) in West Pingdingshan Section, Chaohu, Anhui Province. Science in China Series D: Earth Sciences, 51(1): 22-29.

Hallam, A., and Wignall, P.B., 1999, Mass extinctions and sea-level changes. Earth-Science Reviews, 48: 217-250.

Hardenbol, J., Thierry, J., Farley, M.B., Jacquin, Th., de

Graciansky, P.-C., and Vail, P.R. (with numerous contributors), 1998, Mesozoic and Cenozoic sequence chronostratigraphic framework of European basins. In de Graciansky, P.-C., Hardenbol, J., Jacquin, Th., and Vail, P.R. (eds), Mesozoic-Cenozoic Sequence Stratigraphy of European Basins. SEPM Special Publication, 60: 3-13, 763-781.

Hardie, L.A., and Hinnov, L.A., 1997, Biostratigraphic and radiometric age data question the Milankovitch characteristics of the Latemar cycles (Southern Alps, Italy) – Comment. Geology, 25: 470-471.

Heckert, A.B., Lucas, S.G., Dickinson, W.R., and Mortensen, J.K., 2009, New ID-TIMS U-Pb ages for Chinle Group strata (Upper Triassic) in New Mexico and Arizona, correlation to the Newark Supergroup, and implications for the "long Norian". Geological Society of America Abstracts with Programs, 41(7): 123.

Hesselbo, S.P., McRoberts, C.A., and Pálfy, J., 2007, Triassic–Jurassic boundary events: problems, progress, possibilities. Palaeogeography, Palaeoclimatology, Palaeoecology, 244: 1-10.

Hillebrandt, A.v., Krystyn, L., Kürschner, W.M., Bonis, N.R., Ruhl, M., Richoz, S., Schobben, M. A. N., Urlichs, M., Bown, P.R., Kment, K., McRoberts, C.A., Simms, M., and Tomãsových, A., 2013, The Global Stratotype Sections and Point (GSSP) for the base of the Jurassic System at Kuhjoch (Karwendel Mountains, Northern Calcareous Alps, Tyrol, Austria). Episodes, 36(3): 162-198.

Hinnov, L.A., 2006, Discussion of "Magnetostratigraphic confirmation of a much faster tempo for sea-level change for the Middle Triassic Latemar platform carbonates" by by D.V. Kent, G. Muttoni and P. Brack [Earth Planet. Sci. Lett. 228 (2004), 369–377]. Earth and Planetary Science Letters, 243: 841-846.

Hinnov, L.A., and Goldhammer, R.K., 1991, Spectral analysis of the Middle Triassic Latemar Limestone. Journal of Sedimentary Petrology, 61: 1173-1193.

Holser, W.T., and Magaritz, M., 1987, Events near the Permian–Triassic boundary. Modern Geology, 11: 155-180.

Hounslow, M.K., and Muttoni, G., 2010, The geomagnetic polarity timescale for the Triassic: linkage to stage boundary definitions. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 61-102.

Hounslow, M.W., Posen, P.E., and Warrington, G., 2004, Magnetostratigraphy and biostratigraphy of the Upper Triassic and lowermost Jurassic succession, St. Audrie's Bay, UK. Palaeogeography, Palaeoclimatology, Palaeoecology, 213: 331-358.

Hounslow, M.K., Szurlies, M., Muttoni, G., and Nawrocki, J., 2007, The magnetostratigraphy of the Olenekian-Anisian boundary and a proposal to define the base of the Anisian using a magnetozone datum. Albertiana, 36: 72-77.

Hounslow, M.K., Hu, M., Mørk, A., Weitschat, W., Vigran, J.O., and Karloukovski, V., Orchard, M.J., 2008b, Intercalibration of Boreal and Tethyan timescales: the magneto-biostratigraphy of the Middle Triassic and the latest Early Triassic, central Spitsbergen (arctic Norway). Polar Research, 27: 469-490.

Huang, C., Tong, J., Hinnov, L., and Chen, Z.Q., 2011, Did the great dying of life take 700 k.y.? Evidence from global astronomical correlation of the Permian-Triassic boundary interval. Geology, 29: 779-782.

Hüsing, S.K., Deenen, M.H.L., Koopmans, J.G., and Krijgsman, W., 2011, Magnetostratigraphic dating of the proposed Rhaetian GSSP at Steinbergkogel (Upper Triassic, Austria): implications for the Late Triassic time scale. Earth and Planetary Science Letters, 302: 203-216.

Ikeda, M., and Tada, R., 2013, Long period astronomical cycles from the Triassic to Jurassic bedded chert sequence (Inuyama, Japan); Geologic evidences for the chaotic behavior of solar planets. Earth, Planets, Space, 65: 1-10.

Ikeda, M., Tada, R., and Sakuma, H., 2010, Astronomical cycle origin of bedded chert: a middle Triassic bedded chert sequence, Inuyama, Japan. Earth and Planetary Science Letters, 297: 369-378

Isozaki, Y., 2009, Integrated "plume winter" scenario for the double-phased extinction during the Paleozoic–Mesozoic transition: the G-LB and P-TB events from a Panthalassan perspective. In Metcalfe, I., and Isozaki, Y. (eds), End-Permian mass extinction: events & processes, age & timescale, causative mechanism(s) & recovery. Journal of Asian Earth Sciences, 36(6): 459-480.

Jacquin, Th., and Vail, P.R. (coordinators), 1998, Sequence chronostratigraphy. Columns for Triassic chart, Mesozoic and Cenozoic sequence chronostratigraphic framework of European basins by Hardenbol, J., Thierry, J., Farley, M.B., Jacquin, Th., de Graciansky, P.-C., and Vail, P.R. In de Graciansky, P.-C., Hardenbol, J., Jacquin, Th., and Vail, P.R. (eds), Mesozoic-Cenozoic Sequence Stratigraphy of European Basins. SEPM Special Publication, 60: Chart 8.

Jourdan, F., Marzoli A., Bertrand H., Cirilli S., Tanner L. H., Kontak D. J., McHone G., Renne P. R. and Bellieni G., 2009a, 40Ar/39Ar ages of CAMP in North America: implications for the Triassic–Jurassic boundary and the 40K decay constant bias. Lithos, 110: 167-180.

Kemp, D.B., and Coe, A.L., 2007, A nonmarine record of eccentricity forcing through the Upper Triassic of southwest England and its correlation with the Newark Basin astronomically calibrated geomagnetic polarity time scale from North America. Geology, 35: 991-994.

Kent, D.V., and Olsen, P.E., 1999, Astronomically tuned geomagnetic polarity timescale for the Late Triassic. Journal of Geophysical Research, 104: 12831-12841. Web page update (2002) posted at Newark Basin Coring Project website: www.ldeo.columbia.edu/~polsen/nbcp/nbcp.timescale.htm [Accessed 3 July 2010].

Kent, D.V., Olsen, P.E., and Witte, W.K., 1995, Late Triassic–earliest Jurassic geomagnetic polarity sequence and paleolatitudes from drill cores in the Newark rift basin, eastern North America. Journal of Geophysical Research, 100: 14965-14998.

Kent, D.V., Muttoni, G., and Brack, P., 2004, Magnetostratigraphic confirmation of a much faster tempo for sea-level change for the Middle Triassic Latemar platform carbonates. Earth and Planetary Science Letters, 228: 369-377.

Kerr, R.A., 2013, Mega-eruptions drove the mother of mass extinctions. Science, 342: 1424.

Kiparisova, L.D., and Popov, Yu.N., 1956, Subdivision of the Lower series of the Triassic system into stages. Doklady Academy Sciences U.S.S.R., 109: 842-845. [In Russian]

Kiparisova, L.D., and Popov, Yu.N., 1964, The project of subdivision of the Lower Triassic into stages. XXII International Geological Congress, Reports of Soviet geologists, Problem 16a: 91-99. [In Russian]

Knoll, A.H., Bambach, R.K., Payne, J.L., Pruss, S., and Fischer, W.W., 2007, Paleophysiology and end-Permian mass extinction. Earth and Planetary Science Letters, 256: 295-313.

Korte, C., Pande, P., Kalia, P., Kozur, H.W., Joachimski, M.M., and Oberhänsli, 2010, Massive volcanism at the Permian–Triassic boundary and its impact on the isotopic composition of the ocean and atmosphere. Journal of Asian Earth Sciences, 37: 293-311.

Kozur, H.W., 1998, Some aspects of the Permian–Triassic boundary (PTB) and of the possible causes for the biotic crisis around this boundary. Palaeogeography, Palaeoclimatology, Palaeoecology, 143: 227-272.

Kozur, H.W., 1999, Remarks on the position of the Norian-Rhaetian boundary. Proceedings of the Epicontinental Triassic International Symposium, Halle (Germany), 21-23 Sept., 1998. Zentralblatt für Geologie und Paläontologie, I(7-8): 523-535.

Kozur, H. W., 2003, Integrated ammonoid, conodont and radiolarian zonation of the Triassic. Hallesches Jahrbuch fur Geowissenschaften, B25: 49-79.

Kozur, H.W., 2007, Biostratigraphy and event stratigraphy in Iran around the Permian–Triassic boundary (PTB): implications for the causes of the PTB biotic crisis. Global and Planetary Change, 55: 155-176.

Kozur, H.W., and Bachmann, G.H., 2005, Correlation of the Germanic Triassic with the international scale. Albertiana, 32: 21-35.

Kozur, H.W., and Weems, R.E., 2005, Conchostracan evidence for a late Rhaetian to early Hettangian age for the CAMP volcanic event in the Newark Supergroup, and a Sevatian (late Norian) age for the immediately underlying beds. Hallesches Jahrbuch für Geowissenschaften, Reihe B: Geologie, Paläontologie, Mineralogie, 27: 21-51.

Kozur, H.W., and Bachmann, G.H., 2008, Updated correlation of the Germanic Triassic with the Tethyan scale and assigned numeric ages. Berichte der Geologischen Bundesanstalt, 76: 53-58.

Kozur, H.W., and Bachmann, G.H., 2010, The Middle Carnian Wet Intermezzo of the Stuttgart Formation (Schilfsandstein), Germanic Basin. In Kustatscher, E., Preto, N., and Wignall, P. (eds), Triassic climates. Palaeogeography, Palaeoclimatology, Palaeoecology, 290: 107-119.

Kozur, H.W., and Weems, R.E., 2010, The biostratigraphic importance of conchostracans in the continental Triassic of the northern hemisphere. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 315-417.

Krull, E.S., and Retallack, G.J., 2000, ∂13C depth profiles from paleosols across the Permian-Triassic boundary: Evidence for methane release. Geological Society of America Bulletin, 112: 1459-1472.

Krystyn, L., 1980, Triassic conodont localities of the Salzkammergut region (northern Calcareous Alps). In Schonlaub, H.P (ed), Second European Conodont Symposium ECOS II: Guidebook and Abstracts. Abhandlungen der Geologischen Bundesanstalt, 35: 61-98.

Krystyn, L., 2010, Decision report on the defining event for the base of the Rhaetian stage. Albertiana, 38: 11-12.

Krystyn, L., and Kürschner, W., 2005, Biotic events around the Norian-Rhaetian boundary from a Tethyan perspective: Albertiana, 32: 17–20.

Krystyn, L., and Orchard, M.J., 1996, Lowermost Triassic ammonoid and conodont biostratigraphy of Spiti, India. Albertiana, 17: 10-21.

Krystyn, L., Richoz, S., and Bhargava, O.N., 2007a, The Induan-Olenekian Boundary (IOB) in Mud – an update of the candidate GSSP section M04. Albertiana, 36: 33-49.

Krystyn, L., Bhargava, O.N., and Richoz, S., 2007b, A candidate GSSP for the base of the Olenekian Stage: Mud at Pin Valley; district Lahul & Spiti, Himachal Pradesh (Western Himalaya, India). Albertiana, 35: 5-29.

Krystyn, L., Boquerel, H., Kuerschner, W., Richoz, S., and Gallet, Y., 2007c, Proposal for a candidate GSSP for the base of the Rhaetian Stage. New Mexico Museum of Natural History and Science Bulletin, 41: 189-199.

Krystyn, L., Richoz, S., Gallet, Y., Bouquerel, H., Kürschner, W.M., and Spötl, C., 2007d, Updated bio- and magnetostratigraphy from the Steinbergkogel (Austria), candidate GSSP for the base of the Rhaetian stage. Albertiana, 36: 164-173.

Kürschner, W.M., and Herngreen, G.F.W., 2010, Triassic palynology of central and northwestern Europe: a review of palynofloral diversity patterns and biostratigraphic subdivisions. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 263-283.

Kürschner, W.M., Bonis, N.R., and Krystyn, L., 2007, Carbon-isotope stratigraphy and palynostratigraphy of the Triassic–Jurassic transition in the Tiefengraben section – Northern Calcareous Alps (Austria). Palaeogeography, Palaeoclimatology, Palaeoecology, 244: 257-280.

Lehrmann, D.J., Ramezani, J., Bowring, S.A., Martin, M.W., Montgomery, P., Enos, P., Payne, J.L., Orchard, J.J., Wang, H., and Wei, J., 2006, Timing of recovery from the end-Permian extinction: geochronologic and biostratigraphic constraints from south China. Geology, 34: 1053-1056.

Lucas, S.G., 1998, Global Triassic tetrapod biostratigraphy and biochronology. Palaeogeography, Palaeoclimatology, Palaeoecology, 143: 345-382.

Lucas, S.G., 1999, A tetrapod-based Triassic timescale. Albertiana, 22: 31-40.

Lucas, S.G., 2009, Timing and magnitude of tetrapod extinctions across the Permo-Triassic boundary. In Metcalfe, I., and Isozaki, Y. (eds), End-Permian mass extinction: events & processes, age & timescale, causative mechanism(s) & recovery. Journal of Asian Earth Sciences, 36(6): 491-502.

Lucas, S.G. (ed), 2010a, The Triassic Timescale. Geological Society, London, Special Publication, 334, 500 pp.

Lucas, S.G., 2010b, The Triassic chronostratigraphy scale: history and status. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 447-500.

Lucas, S.G., 2010c, The Triassic timescale: an introduction. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 1-16.

Lucas, S.G., 2010d, The Triassic timescale based on nonmarine tetrapod biostratigraphy and biochronology. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 17-39.

Lucas, S.G., Tanner, L.H., Kozur, H.W., Weems, R.E., and Heckert, A.B., 2012, The Late Triassic timescale: age and correlation of the Carnian-Norian boundary. Earth-Science Reviews, 114: 1-18.

Lucas, S.G., 2013, A new Triassic timescale. In: The Triassic System (Tanner, L.H., Spielmann, J.A., and Lucas, S.G., eds.), New Mexico Museum of Natural History and Science Bulletin, 61: 366-374.

Marzoli, A., Jourdan, F., Puffer, J.H., Cuppone, T., Tanner, L.H., Weems, R.E., Bertrand, H., Cirilli, S., Bellieni, G., De Min, A., 2011, Timing and duration of the Central Atlantic magmatic province in the Newark and Culpeper basins, eastern U.S.A. Lithos, 122: 175-188.

Mazza, M., Furin, S., Spöti, C., and Rigo, M., 2010, Generic turnovers of Carnian/Norian conodonts: climatic control or competition? In Kustatscher, E., Preto, N., and Wignall, P. (eds), Triassic climates. Palaeogeography, Palaeoclimatology, Palaeoecology, 290: 120-137.

McRoberts, C.A., 2007, The halobid bivalve succession across a potential Carnian/Norian GSSP at Black Bear Ridge, Williston Lake, northeast British Columbia, Canada. Albertiana, 36: 142-145.

McRoberts, C.A., 2010, Biochronology of Triassic pelagic bivalves. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 201-219.

McRoberts, C.A., Krystyn, L., and Shea, A., 2008, Rhaetian (Late Triassic Monotis (Bivalvia: Pectinacea) from the Northern Calcareous Alps (Austria) and the end-Norian crisis in pelagic faunas. Journal of Paleontology, 51: 721-735.

Menning, M., Gast, R., Hagdorn, H., Kading, K.-C., Simon, T., Szurlies, M., and Nitsch, E., 2005, Zeitskala für Perm und Trias in der Stratigraphischen Tabelle von Deutschland 2002, zyklostratigraphische Kalibrierung von höherer Dyas und Germanischer Trias und das Alter der Stufen Roadium bis Rhaetium 2005. In Menning M., and Hendrich, A. (eds), Erläuterungen zur Stratigraphischen Tabelle von Deutschland. Newsletters of Stratigraphy, 41(1/3): 173-210.

Metcalfe, I., and Isozaki, Y. (eds), 2009a, End-Permian mass extinction: events & processes, age & timescale, causative mechanism(s) & recovery. Journal of Asian Earth Sciences, 36(6): 407-540.

Metcalfe, I., and Isozaki, Y., 2009b, Current perspectives on the Permian–Triassic boundary and end-Permian mass extinction: Preface. In Metcalfe, I., and Isozaki, Y. (eds), End-Permian mass extinction: events & processes, age & timescale, causative mechanism(s) & recovery. Journal of Asian Earth Sciences, 36(6): 407-412.

Meyers, S.R., 2008, Resolving Milankovitchian controversies: the Triassic Latemar Limestone and the Eocene Green River Formation. Geology, 36: 319-322.

Mietto, P., and Manfrin, S., 1995, A high resolution Middle Triassic ammonoid standard scale in the Tethys Realm: a preliminary report. Bulletin de la Société géologique de France, 166(5): 539-563.

Mietto, P., and Manfrin, S., 1999, A debate on the Ladinian-Carnian boundary. Albertiana, 22: 23-27.

Mietto, P., Andreetta, R., Broglio Loriga, C., Buratti, N., Cirilli, S., De Zanche, V., Furin, S., Gianolla, P., Manfrin, S., Muttoni, G., Neri, C., Ncora, A., Posenato, R., Preto, N., Rigo, M., Roghi, G., and Spötl, C., 2007, A candidate of the Global Boundary Stratotype Section and Point for the base of the Carnian Stage (Upper Triassic): GSSP at the base of the canadensis Subzone (FAD of Daxatina) in the Prati di Stuores/Stuores Wiesen section (Southern Alps, NE Italy). Albertiana, 36: 78-97.

Mojsisovics, E. von, 1869, Über die Gliederung der oberen Triasbildungen der östlichen Alpen. Jahrbuch Geologischen Reichsanstalt, 19: 91-150.

Mojsisovics, E. von, 1893, Faunistische Ergebnisse aus der Untersuchung der Ammoneen-faunen der Mediterranen Trias. Abhandlungen der Geologischen Reichsanstalt, 6: 810.

Mojsisovics, E. von, Waagen, W., and Diener, C., 1895, Entwurf einer Gliederung der pelagischen Sedimente des Trias-Systems. Sitzungberichte Akademie Wissenschaften Wien, 104:1271-1302.

Mundil, R., Brack, P., Meier, M., Rieber, H., and Oberli, F., 1996, High resolution U–Pb dating of Middle Triassic volcaniclastics: Time-scale calibration and verification of tuning parameters for carbonate sediments. Earth and Planetary Science Letters, 141: 137-151.

Mundil, R., Ludwig, K. R., Metcalfe, I., and Renne, P.R., 2004, Age and timing of the Permian mass extinctions: U/Pb dating of closed-system zircons. Science, 305: 1760–1763.

Mundil, R., Pálfy, J., Renne, P.R., and Brack, P., 2010, The Triassic timescale: new constraints and a review of geochronological data. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 41-60.

Muttoni, G., Kent, D.V., Nicora, A., Rieber, H., and Brack, P., 1996a, Magneto-biostratigraphy of the 'Buchenstein Beds' at Frötschbach (western Dolomites, Italy). Albertiana, 17: 51-56.

Muttoni, G., Kent, D.V., DiStefano, P., Gullo, M., Nicora, A., Tait, J., and Lowrie, W., 2001, Magnetostratigraphy and biostratigraphy of the Carnian/Norian boundary interval from the Pizzo Mondello section (Sicani Mountains, Sicily). Palaeogeography, Palaeoclimatology, Palaeoecology, 166: 383-399.

Muttoni, G., Nicora, A., Brack, P., Kent, D.V., 2004a, Integrated Anisian–Ladinian boundary chronology. Palaeogeography, Palaeoclimatology, Palaeoecology, 208: 85-102.

Muttoni, G., Kent, D.V., Olsen, P.E., DiStefano, P., Lowrie, W., Bernasconi, S.M., and Hernandez, F.M., 2004b, Tethyan magnetostratigraphy from Pizzo Mondello (Sicily) and correlation to the Late Triassic Newark astrochronological polarity time scale. Geological Society of America Bulletin, 116: 1043-1058.

Muttoni, G., Kent, D.V., Flavio, J., Olsen, P., Rigo, M., Galli, M.T., and Nicora, A., 2010, Rhaetian magnetostratigraphy from the Southern Alps (Italy): constraints on Triassic chronology. Palaeogeography, Palaeoclimatology, Palaeoecology, 285: 1-16.

Nicora, A., Balini, M., Bellanea, A., Bowring, S.A., Di Stefano, P., Dumitrica, P., Guaiumi, C., Gullo, M., Hungerbuehler, A., Levera, M., Mazza, M., McRoberts, C.A., Muttoni, G., Preto, N., and Rigo, M., 2007, The Carnian/Norian boundary interval at Pizzo Mondello (Sicani Mountains, Sicily) and its bearing for the definition of the GSSP of the Norian Stage. Albertiana, 36: 102-129.

Ogg, J.G., Ogg, G.M., and Gradstein, F.M., 2008, Triassic Period. In Ogg, J.G., Ogg, G.M., and Gradstein, F.M. (eds), Concise Geologic Time Scale. Cambridge: Cambridge University Press, p. 95-106.

Ogg, J.G., 2012. Triassic. In: The Geologic Time Scale 2012 (Gradstein, F.M., Ogg, J.G., Schmitz, M.D., and Ogg, G.M., editors), Elsevier Publ.: pg. 681-730.

Olsen, P.E., Kent, D.V., Cornet, B., Witte, W.K., and Schlische, R.W., 1996, High-resolution stratigraphy of the Newark rift basin (early Mesozoic, eastern North America). Geological Society of America Bulletin, 108: 40-77.

Orchard, M.J., 2007, A proposed Carnian-Norian Boundary GSSP at Black Bear Ridge, northeast British Columbia, an a new conodont framework for the boundary interval. Albertiana, 36: 130-141.

Orchard, M.J., 2010, Triassic conodonts and their role in stage boundary definitions. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 139-161.

Orchard, M.J., and Tozer, E.T., 1997, Triassic conodont biochronology, its intercalibration with the ammonoid standard, and a biostratigraphic summary for the Western Canada Sedimentary Basin. Bulletin of Canadian Petroleum Geology, 45: 675-692.

Orchard, M.J., Carter, E.S., and Tozer, E.T., 2000, Fossil data and their bearing on defining a Carnian-Norian (upper Triassic) boundary in western Canada. Albertiana, 24: 43-50.

Orchard, M.J., Zonneveld, J.P., Johns, M.J., McRoberts, C.A., Sandy, M.R., Tozer, E.T., and Carrelli, G.G., 2001, Fossil succession and sequence stratigraphy of the Upper Triassic of Black Bear Ridge, northeast British Columbia, a GSSP prospect for the Carnian-Norian boundary. Albertiana, 25: 10-22.

Ovtcharova, M., Bucher, H., Schaltegger, U., Galfetti, T., Brayard, A., and Guex, J., 2006, New Early to Middle Triassic U–Pb ages from South China: Calibration with ammonoid biochronozones and implications for the timing of the Triassic biotic recovery. Earth and Planetary Science Letters, 243: 463-475.

Ovtcharova, M., Bucher, H., Goudemand, N., Schaltegger, U., Brayard, A., and Galfetti, T., 2010, New U/Pb ages from Nanpanjiang Basin (South China): implications for the age and definition of the Early-Middle Triassic boundary. Geophysical Research Abstracts, 12: EGU2010-12505-3.

Pálfy, J., and Vörös, A., 1998, Quantitative ammonoid biochronological assessment of the Anisian–Ladinian (Middle Triassic) stage boundary proposals. Albertiana, 21: 19-26.

Pálfy, J., Smith, P.L., and Mortensen, J.K., 2000a, A U–Pb and 40Ar/39Ar time scale for the Jurassic. Canadian Journal of Earth Sciences, 37: 923-944.

Pálfy, J., Mortensen, J.K., Carter, E.S., Smith, P.L., Friedman, R.M., and Tipper, H.W., 2000b, Timing the end-Triassic mass extinction: first on land, then in the sea? Geology, 28: 39-42.

Pálfy, J., Parrish, R.R., David, K., and Voros, A., 2003, Mid-Triassic integrated U/Pb geochronology and ammonoid biochronology from the Balaton Highland (Hungary). Geological Society of London Journal, 160: 271-284.

Palmer, A.R., 1983, Geologic Time Scale, Decade of North American Geology (DNAG). Boulder: Geological Society of America.

Paull, R.K., 1997, Observations on the Induan-Olenekian boundary based on conodont biostratigraphic studies in the Cordillera of the western United States. Albertiana, 20: 31-32.

Payne, J.L., and Kump, L.R., 2007, Evidence for recurrent Early Triassic massive volcanism from quantitative interpretation of carbon isotope fluctuations. Earth and Planetary Science Letters, 256: 264-277.

Payne, J.L., Lehrmann, D.J., Wei, J., Orchard, M.J., Schrag, D.P, and Knoll, A.H., 2004, Large perturbations of the carbon cycle during recovery from the end-Permian extinction. Science, 305: 506–509.

Payne, J.L., Lehrmann, D.J., Follet, D., Seibel, M., Kump, L.R., Riccardi, A., Altiner, D., Sano, H., and Wei, J.-Y., 2009, Erosional truncation of uppermost Permian shallow-marine carbonates and implications for Permian-Triassic boundary events: reply. Geological Society of America Bulletin, 121: 957-959.

Pia, J., 1930, Grundbegriffe der Stratigraphie mit ausführlicher anwendung auf die Europäische Mitteltrias. Leipzig and Wien: Deuticke.

Preto, N., Kustatscher, E., and Wignall, P.B., 2010, Triassic climates – state of the art and perspectives. In Kustatscher, E., Preto, N., and Wignall, P. (eds), Triassic climates. Palaeogeography, Palaeoclimatology, Palaeoecology, 290: 1-10.

Preto, N., Willems, H., Guaiumi, C., and Wesphal, H., 2013, Onset of significant pelagic carbonate accumulation after the Carnian Pluvial Event (CPE) in the western Tethys. Facies, 59: 891-914.

Ramezani, J., Bowring, S.A., Martin, M.W., Lehrmann, D.J., Montgomery, P., Enos, P., Payne, J.L., Orchard, M.J., Wang, H.M., and Wei, J. 2007, Reply: Timing of recovery from the end-Permian extinction: geochronologic and biostratigraphic constraints from south China: Comment. Geology, Online Forum, e137.

Ramezani, J., Bowring, S.A., Fastovsky, D.E., and Hoke, G.D., 2009, U-Pb-ID-TIMS geochronology of the Late Triassic Chinle Formation, Petrified Forest National Park, Arizona. Geological Society of America Abstracts with Programs, 41(7): 421.

Ramezani, J., Bowring, S.A., Fastovsky, D.E., and Hoke, G.D., 2010, Depositional history of the Late Triassic Chinle fluvial system at the Petrified Forest National Park: U-Pb geochronology, regional correlation and insights into early dinosaur evolution. American Geophysical Union Fall meeting 2010, abstract #V31A-2313.

Rampino, M.,R., Prokoph, A., and Adler, A.C., 2000, Tempo of the end-Permian event: high-resolution cyclostratigraphy at the Permian-Triassic Boundary. Geology, 28: 643-646.

Rampino, M.,R., Prokoph, A., Adler, A.C., and Schwindt, D.M., 2002, Abruptness of the end-Permian mass extinction as determined from biostratigraphic and cyclostratigraphic analysis of European western Tethyan sections. In Koeberl, C., and MacLeod, K.G. (eds), Catastrophic Events and Mass Extinctions: Impacts and Beyond. Geological Society of America Special Paper, 356: 415-427.

Reichow, M.K., Pringle, M.S., Al'Mukhamedov, A.I., Allen, M.B., Andreichev, V.L., Buslov, M.M., Davies, C.E., Fedoseev, G.S., Fitton, J.G., Inger, S., Medvedev, A.Ya., Mitchell, C., Puchkov, V.N., Safonova, I.Yu., Scott, R.A., and Sauders, A.D., 2009, The timing and extent of the eruption of the Siberian Traps large igneous province: implications for the end-Permian environmental crisis. Earth and Planetary Science Letters, 27: 9-20.

Renne, P.R., Zhang Zichao, Richards, M.A., Black, M.T., and Basu, A.R., 1995, Synchrony and causal relations between Permian-Triassic boundary crisis and Siberian flood volcanism. Science, 269: 1413-1416.

Renne, P.R., Mundil, M., Balco, G., Min, K., and Ludwig, K.R., 2010, Joint determination of 40K decay constants and 40Ar*/40K for the Fish Canyon sanidine standard, and improved accuracy for 40Ar/39Ar geochronology. Geochimica et Cosmochimica Acta, 74: 5349–5367.

Rigo, M., Preto, N., Roghi, G., Tateo, F., and Mietto, P., 2007, A rise in the carbonate compensation depth of western Tethys in the Carnian (Late Triassic): deep-water evidence for the Carnian pluvial event. Palaeogeography, Palaeoclimatology, Palaeoecology, 246: 188-205.

Roghi, G., Gianolla, P., Minarelli, L., Pilati, C., and Preto, N., 2010, Palynological correlation of Carnian humid pulses throughout western Tethys. In Kustatscher, E., Preto, N., and Wignall, P. (eds), Triassic climates. Palaeogeography, Palaeoclimatology, Palaeoecology, 290: 89-106.

Röhling, H.-G., 1991, A lithostratigraphic subdivision of the Lower Triassic in the northwest German Lowland and the German Sector of the North Sea, based on Gamma-Ray and Sonic Logs. Geologisches Jahrbuch A, 119: 3-24.

Ruhl, M., and Kürschner, W.M., 2011, Multiple phases of carbon cycle disturbances from large igneous province formation at the Triassic-Jurassic transition. Geology, 39: 431–434.

Ruhl, M., Kürschner, W.M., and Krystyn, L., 2009, Triassic-Jurassic organic carbon isotope stratigraphy of key sections in the western Tethys realm (Austria). Earth and Planetary Science Letters, 281: 169-187.

Satterley, A.K., 1996, The interpretation of cyclic successions of the Middle and Upper Triassic of the Northern and Southern Alps. Earth-Science Reviews, 40: 181-207.

Schlager, W., and Schöllnberger, W., 1974, Das Prinzip stratigraphischer Wenden in der Schichtenfolge der Nördlichen Kalkalpen. Mitteilungen der Österreichischen Geologischen Gesellschaft, Wien, 66/67: 165-193.

Schoene, B., Guex, J., Bartolini, A., Schaltegger, U., and Blackburn, T.J., 2010, Correlating the end-Triassic mass extinction and flood basalt volcanism at the 100 ka level. Geology, 38: 387-390.

Schwarzacher, W. 2005, The stratification and cyclicity of the Dachstein Limestone in Lofer, Leogang and Steinernes Meer (Northern Calcareous Alps, Austria). Sedimentary Geology, 181: 93-106.

Shen, S.-Z., Henderson, C.M., Bowring, S.A., Cau, C.-Q., Wang, Y., Wang, W., Zhang, H., Zhang, Y.-C., and Mu, L., 2010, High-resolution Lopingian (Late Permian) timescale of South China. Geological Journal, 45: 122-134.

Shen, S.-Z., Crowley, J.L., Wang, Y., Bowring, S.A. Erwin, D.H., Peter M. Sadler, P.M., Cao, C.-Q., Rothman, D.H., Henderson, C.M., Ramezani, J., Zhang, H., Shen, Y., Wang, X.-D., Wang, W., Mu, L., Li, W.-Z., Tang, Y.-G., Liu, X.-L., Liu, L.-J., Zeng,Y., Jiang,Y.-F., Jin, Y.-G., 2012. Calibrating the end-Permian mass extinction. Science, 334: 1367-1372.

Silberling, N.J., and Tozer, E.T., 1968, Biostratigraphic classification of the marine Triassic in North America. Geological Society of America Special Paper, 10: 1-63.

Simms, M.J., and Ruffel, A.H., 1989, Synchroneity of climate change and extinctions in the Late Triassic. Geology, 17: 265-268.

Sun, Z., Hounslow, M.W., Pei, J., Zhao, L., Tong, J., and Ogg, J.G., 2007, Magnetostratigraphy of the West Pingdingshan section, Chaohu, Anhui Province: relevance for base Olenekian GSSP selection. Albertiana, 36: 22-32.

Szurlies, M., 2004, Magnetostratigraphy: the key to global correlation of the classic Germanic Trias – case study Volpriehausen Formation (Middle Buntsandstein), Central Germany. Earth and Planetary Science Letters, 227: 395-410.

Szurlies, M., 2007, Latest Permian to Middle Triassic cyclo-magnetostratigraphy from the Central European Basin, Germany: implications for the geomagnetic polarity timescale. Earth and Planetary Science Letters, 261: 602-619.

Tanner, L.H., 2010, Cyclostratigraphy record of the Triassic: a critical examination. In Lucas, S.G. (ed), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 119-137.

Tong, J., Zakharov, Y.D., Orchard, M.J., Yin, H., and Hansen, H.J., 2004, Proposal of the Chaohu section as the GSSP candidate of the I/O boundary. Albertiana, 29: 13-28.

Tozer, E.T., 1965, Lower Triassic stages and ammonoid zones of Arctic Canada. Geological Survey of Canada Paper, 65-12: 1-14.

Tozer, E.T., 1967, A standard for Triassic time. Geological Survey of Canada Bulletin, 156, 104 pp.

Tozer, E.T., 1984, The Trias and its Ammonites: the evolution of a time scale. Geological Survey of Canada Miscellaneous Report, 35, 171 pp.

Tozer, E.T., 1986, Definition of the Permian–Triassic (P–T) boundary: the question of the age of the *Otoceras* beds. Memorie della Societa Geologica Italiana, 34: 291-301.

Tozer, E.T., 1990. How many Rhaetians? Albertiana, 8: 10-13.

Tozer, E.T. 1994. Age and correlation of the Otoceras beds at the Permian–Triassic Boundary. Albertiana, 14: 31-37.

Visscher, H. 1992. The new STS Triassic stage nomenclature. Albertiana, 10: 1-2.

Vörös, A., Szabó, I., Kovács, S., Dosztály, L., and Budai, T. 1996. The Felsöörs section: a possible stratotype for the base of the Ladinian Stage. Albertiana, 17: 25-40.

Waagen, W., and Diener, C. 1895. Untere Trias. *In*, Mojsisovics, E., von Waagen, W., and Diener, C. (eds), Entwurf einer Gliederung der pelagischen Sedimente des Trias-Systems. Sitzungberichte Akademie Wissenschaften Wien, 104: 1271-1302.

Whiteside, J.H., Olsen, P.E., Kent, D.V., Fowell, S.J., and Et-Touhami, E., 2007, Synchrony between the Central Atlantic magmatic province and the Triassic–Jurassic mass-extinction event? Palaeogeography, Palaeoclimatology, Palaeoecology, 244: 345-367.

Wignall, P.B. 2001. Large igneous provinces and mass extinctions. Earth-Science Reviews, 53: 1-33.

Wignall, P.B. 2007. The End-Permian mass extinctions – how bad did it get? Geobiology, 5: 303-309.

Yin, H., Zhang K., Tong, J., Yang, Z. and Wu, S. 2001. The Global Stratotype Section and Point (GSSP) of the Permian-Triassic boundary. Episodes, 24: 102-114.

Yin, H., Tong, J., and Zhang, K., 2005, A review of the global stratotype section and point of the Permian-Triassic boundary. Acta Geologica Sinica, 79: 715-728.

Yin, H., Feng, Q., Xie, S., Yu, J., He, W., Liang, H., Lai, X., and Huang, X. 2007. Recent achievements on the research of the Paleozoic–Mesozoic transitional period in South China. Frontiers in Earth Science of China, 1: 129-141.

Zakharov, Y.D. 1994. Proposals on revision of the Siberian standard for the Lower Triassic and candidate stratotype section and point for the Induan–Olenekian boundary. Albertiana, 14: 44-51.

Zakharov, Y.D., Shigata, Y., Popov, A.M., Sokarev, A.N., Buryi, G.I., Golozubov, V.V., Panasenko, E.S., and Dorukhovskaya, E.A. 2000. The candidates of global stratotype of the boundary of the Induan and Olenekian stages of the Lower Triassic in Southern Primorye. Albertiana, 24: 12-26.

Zakharov, Y.D., Shigeta, Y., Popov, A.M., Buryi, G.E., Oleinikov, A.V., Dorukhovskaya, E.A., and Mikhalik, T.M. 2002. Triassic ammonoid succession in South Primorye: 1. Lower Olenekian *Hedenstroemia bosphorensis* and *Anasibirites nevolini* Zones. Albertiana, 27: 42-64.

Zakharov. Y.D., Shigeta, Y., & Igo, H. 2009. Correlation of the Induan-Olenekian boundary beds in the Tethys and Boreal realm: evidence from conodont and ammonoid fossils. Albertiana, 37: 20-27.

Zapfe, H. 1974. Die Stratigraphie der Alpin-Mediterranen Trias. Schriftenreihe der Erdwissenschaftlichen Kommissionen, Österreichische Akademie der Wissenschaften, 2: 137-144.

Research Note

THE PERMIAN AND TRIASSIC IN THE ALBANIAN ALPS: PRELIMINARY NOTE

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The Albanian Alps is a tectonic unit, together with Gashi, Cukali, and Kruja units, lying to the NW of the Shkodra-Pes transverse zone (Auboin & Ndojaj, 1964), forming a part of the Adria Mesozoic margin (Fig. 1). Albanian Alps are the only unit in which Permian rocks crop out and the Triassic succession is relatively well exposed. Their knowledge is still preliminary (Meco & Aliaj, 2000), but it represent a significant section, linking Dinarides with Hellenides.

A more detailed report is submitted elsewhere (Gaetani et al., submitted) and an oral presentation is scheduled for the next Karpatho-Balkan Association meeting, to be held in Tirana, September 24-26, 2014.

The Albanian Alps consists of several (at least five) stacked thrust sheets with an internal stratigraphic succession spanning from the Permian to Triassic or from Triassic to Cretaceous, verging to the south-east and thrusted on the Cukali Zone (ISPGJ-IGJN 1983, 1999; Xhomo et al. 2002) (Fig. 1). The complex is subdivided in the Valbona Sub-Zone, forming the lower part of the edifice and the Malsia e Madhe Sub-Zone overlying the previous one. The basal stack may be analyzed along the Kir, Shala, and Curraj valleys, where the thrust-fault system bringing the Albanian Alps to override the flyschoid Cretaceous-Eocene sediments capping the Cukali Zone, is complicated by decoupling of the sole of the Albanian Alps. They are here made up of Permian rocks, in which slivers of Cretaceous flyschoid sediments pertaining to the Cukali Zone are also included.

In the Valbona sub-zone two major stacks are recognized (Fig. 2).

The Bishkaz-Shale Block (Xhomo et al. 2002), forms the first thick stack, with a succession spanning from the Middle Permian to the Upper Triassic. Internal folds and thrusts complicate the stratigraphic succession.

The Permian part consists of a mixed carbonatic/fine clastic succession, more massive and calcarenitic to the west and with thinner beds and finer calcarenite (packstone) to the east. A carbonate ramp deepening towards NE in present co-ordinates developed during the Middle Permian. This unit is sealed by carbonatic breccia bodies, linked significant block faulting, and by fine mature clastics. The position of the Permian/Triassic boundary is not yet constrained.

The Lower Triassic and the lower Anisian were characterized

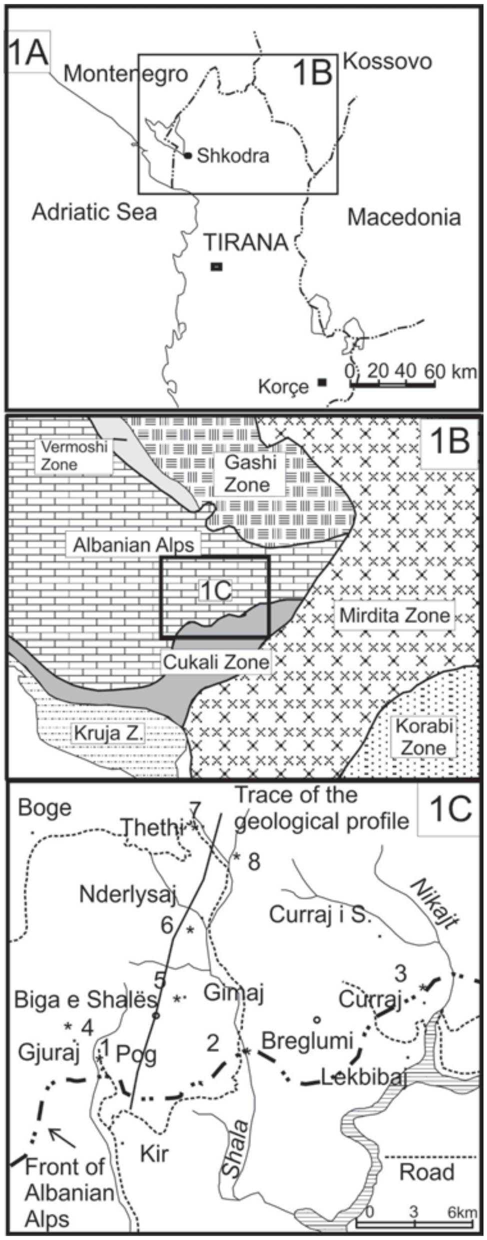

Figure 1 – The Albanian Alps, with position of the studied sections and the trace of the geological cross-section.

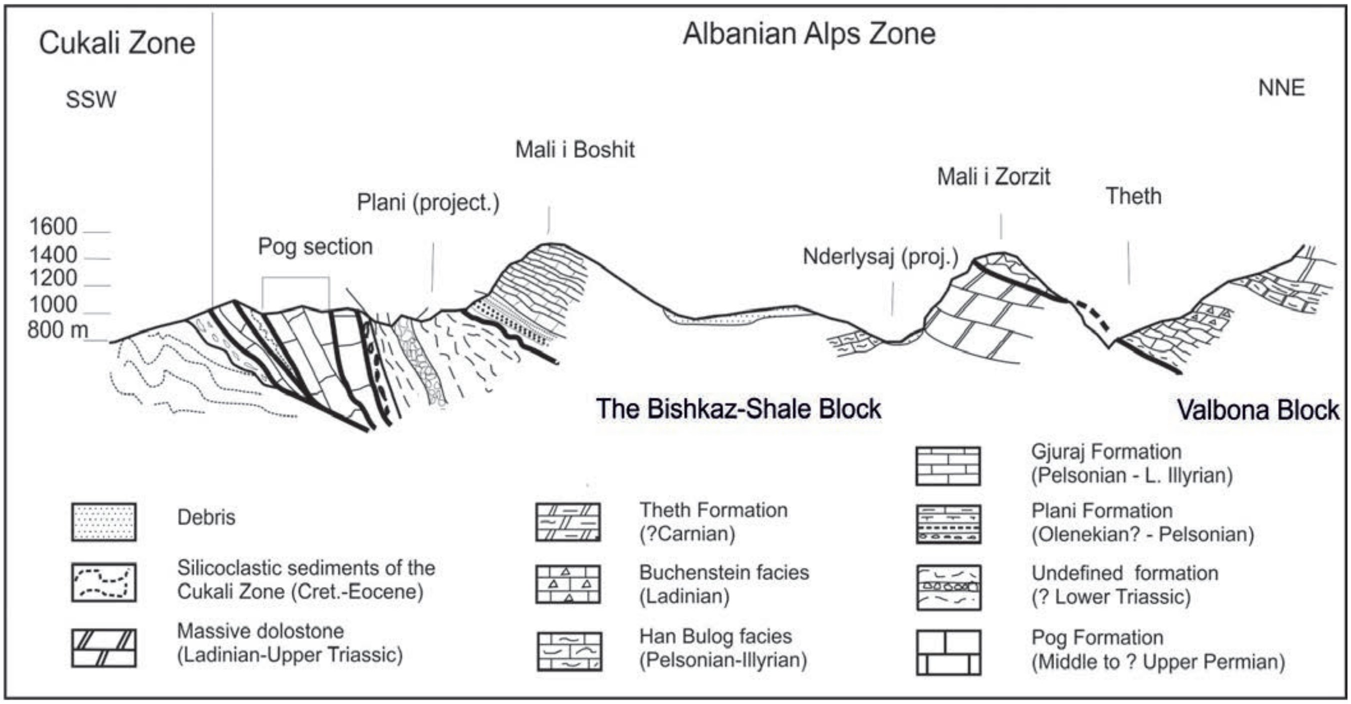

Figure 2 – Cross-section through the lower part of the Albanian Alps edifice.

by very thick terrigenous deposition with cobble conglomerate levels up to 80 m-thick, linking this area with the equivalent area in southern Montenegro. Gradually the clastic deposition was over during the Pelsonian and a wide calcarenitic ramp occupied the area.

The tectonic repetitions allow to observe a facies trend from south to north on the right side of the Shala valley, along the transect Gimaj - Nderlysaj. More to southwest (present co-ordinates) lies the important and well exposed section of Gjuraj. The succession is mostly calcarenitic to the south, where carbonate banks produced abundant skeletal debris, and progressively became more pelagic northwards (present direction), with increasing thickness of red nodular wackestones of the Han Bulog Fm. This facies is overlain by grey, cherty, well bedded nodular limestones. The succession is closed by thick bedded light carbonates, peritidal in the upper part, referred to the upper Ladinian.

The second major stacked thrust, named Valbona Block, with a minor subdivision forming the Theth Block (Xhomo et al. 2002), is only Triassic in age. The basal part is composed of poorly exposed terrigenous clastics mixed with carbonates, followed by nodular limestones of Anisian age, overlain by cherty nodular limestones with tuffs recalling the Buchenstein Fm. of the Southern Alps in Italy. The succession is closed by the black limestone and dolostone of Theth Fm., partly interfingering and eventually capped by thick bedded peritidal dolostones. Conodonts indicate a late Ladinian age for the lower part of the Theth Formation.

REFERENCES

Auboin J. & Ndojaj I. 1964. Regard sur la géologie de l'Albanie et sa place dans la géologie des Dinarides. Bull. Soc. Geol. France, 7, 593-625.

Gaetani M., Meco S., Rettori R., Tulone A. - The Permian and Triassic in the Albanian Alps. Acta Geologica Polonica (submitted).

ISPGJ-IGJN. 1983. Geological Map of Albania. 1:200.000 scale, MMKS, Tirana, Albania.

ISPGJ-IGJN. 1999. Tectonic Map of Albania. 1:200.000 scale 2nd edition, MMKS, Tirana, Albania.

Meço S. & Aliaj S. 2000. Geology of Albania. 246 pp, Gebr. Borntraeger, Berlin.

Xhomo A., Dimo Ll., Xhafa Z., Nazaj X., Nakuçi V., Yzeiraj D., Lula F, Sadushi P., Shallo M., Vranaj A., Melo V., Kodra A. 2002. Gjelogjia e Shqiperise. Stratigrafia, Magmatizmi, Tektonika, Neotektonika dhe Evolucioni Paleogjeografik dhe Gjeodinamik. 412 pp., Archiv, Tirana.

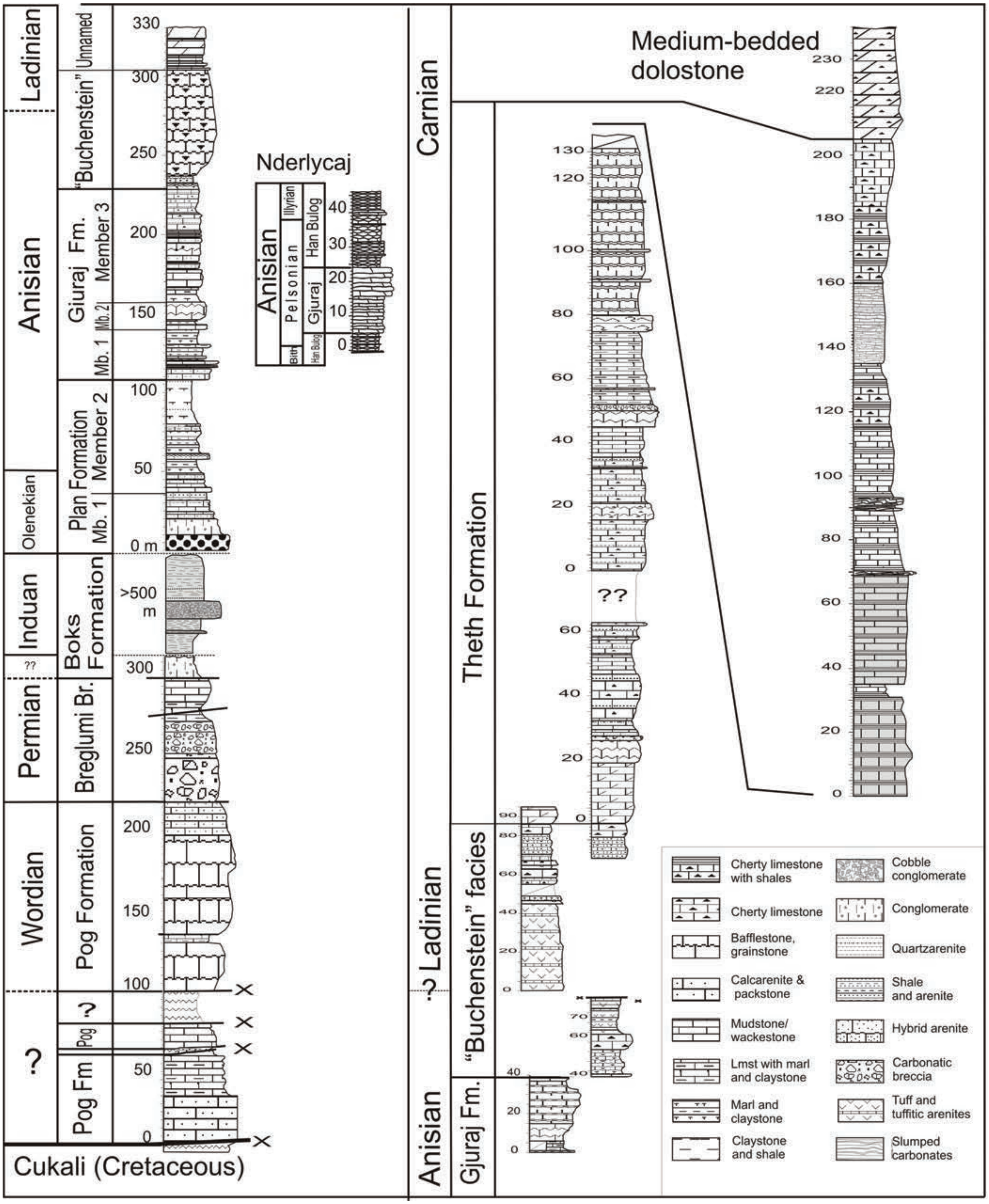

Figure 3 – To the left, the synthetic log of the Bishkaz Shala Block and to the right the synthetic log of the Valbona Block.

Research Note

THE FIRST FIND OF WELL-PRESERVED FORAMINIFERA IN THE LOWER TRIASSIC OF RUSSIAN FAR EAST

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Abstract – The first information on well-preserved Foraminifera from the Lower Triassic of South Primorye (Russian Far East) is given. Foraminifera preliminarily identified as *Ammodiscus* sp. were found in the upper Smithian of the Smolyaninovo section in a member characterized by the occurrence of ammonoid *Churkites syaskoi* Zakharov & Shigeta.

INTRODUCTION

Lower Triassic deposits of Russian Far East are characterized mainly by bryozoans, brachiopods, mollusks, crinoids, ostracods, fishes, amphibians and conodonts, which were mostly investigated in South Primorye (e.g., Diener, 1895; Kiparisova, 1938, 1961, 1972; Shishkin, 1964; Zakharov, 1968, 1978, 1997; Buryi, 1979; Burij & Zharnikova, 1980; Shigeta et al., 2009; Bondarenko et al., 2013; Zakharov & Moussavi Abnavi, 2013). However, information on undetermined Early Triassic Foraminifera from South Primorye found in thin sections of limestones (Korzh, 1959) are restricted. Korzh recognized small Foraminifera shells in limestones from the so-called "*Meekoceras* horizon" of Russian Island (Fig. 1). It is impossible to determine a stratigraphical position of the undetermined Foraminifera found by Korzh, because he did not indicated the sampled locality on Russian Island. Following Burij (1959), he considered that the *Meekoceras* horizon" of Russian Island consisted of mainly sandy sediments, located between Induan basal conglomerates and the Zhitkov Formation, characterized by the dominance of mudstones and siltstones. According to recent data (Zakharov & Moussavi Abnavi, 2013), the "*Meekoceras* horizon" of Russian Island, sensu Korzh, corresponds to Smithian (*Mesohedenstroemia bosphorensis* and *Anasibirites nevolini* zones) and lower Spathian (*Tirolites-Amphistephanites* Zone) beds. We assume that the undetermined Foraminifera may have been found in one of the lower Spathian limestone lenses.

The aim of this paper is to highlight the occurrence of well-preserved Foraminifera (*Ammodiscus* sp.), in eastern South Primorye, and to show their palaeobiogeographical significance. Selected test samples were examined with a scanning electron microscope (SEM, EVO 50XVIP) at the Analytical Center of the Far Eastern Geological Institute (FEGI). The studied Foraminifera collection is kept at the FEGI (Vladivostok) under number 12.

GEOLOGICAL SETTING

Five tests, preliminarily determined as *Ammodiscus* sp., were found in the upper Smithian sediments (*Churkites syaskoi* Beds of the *Anasibirites nevolini* Zone) of the Smolyaninovo section (Fig. 1). *Churkites syaskoi* Beds (68 m thick) exposed in the quarry near village of Smolyaninovo, are represented mainly of mudstones with calcareous-marl concretions and lenses, and sandstone layers (Figs. 2-4).

Ammodiscus sp. occurs in Member 7 (20.2 m thick), consisting of grey mudstones with large (20-50 cm) calcareous nodules, characterized by ammonoids *Churkites syaskoi* Zakharov & Shigeta (dominant), *Mianwalites* sp., Prionitidae gen. and sp. indet., *Preflorianites*? sp., *Juvenites* sp., *Clypeoceras*? sp. and *Hanielites*? sp.

SYSTEMATIC PALAEONTOLOGY
(PRELIMINARY DESCRIPTION)

In this work, the used Foraminifera systematics is adapted from Mikhalevich (2000).

Phylum Foraminifera d'Orbigny, 1826
Class Spirillinata Maslakova, 1990
Subclass Ammodiscana Mikhalevich, 1980
Order Ammodiscida Mikhalevich, 1980
Family Ammodiscidae Reuss, 1862
Genus *Ammodiscus* Reuss, 1862
Ammodiscus sp.
(Fig. 4)

Material. Five specimens in the sample 745-Sm12/5.

Description. The two-chambered test, consisting of 6-7 almost complete whorls, is planispiral, slightly curved discoid; periphery

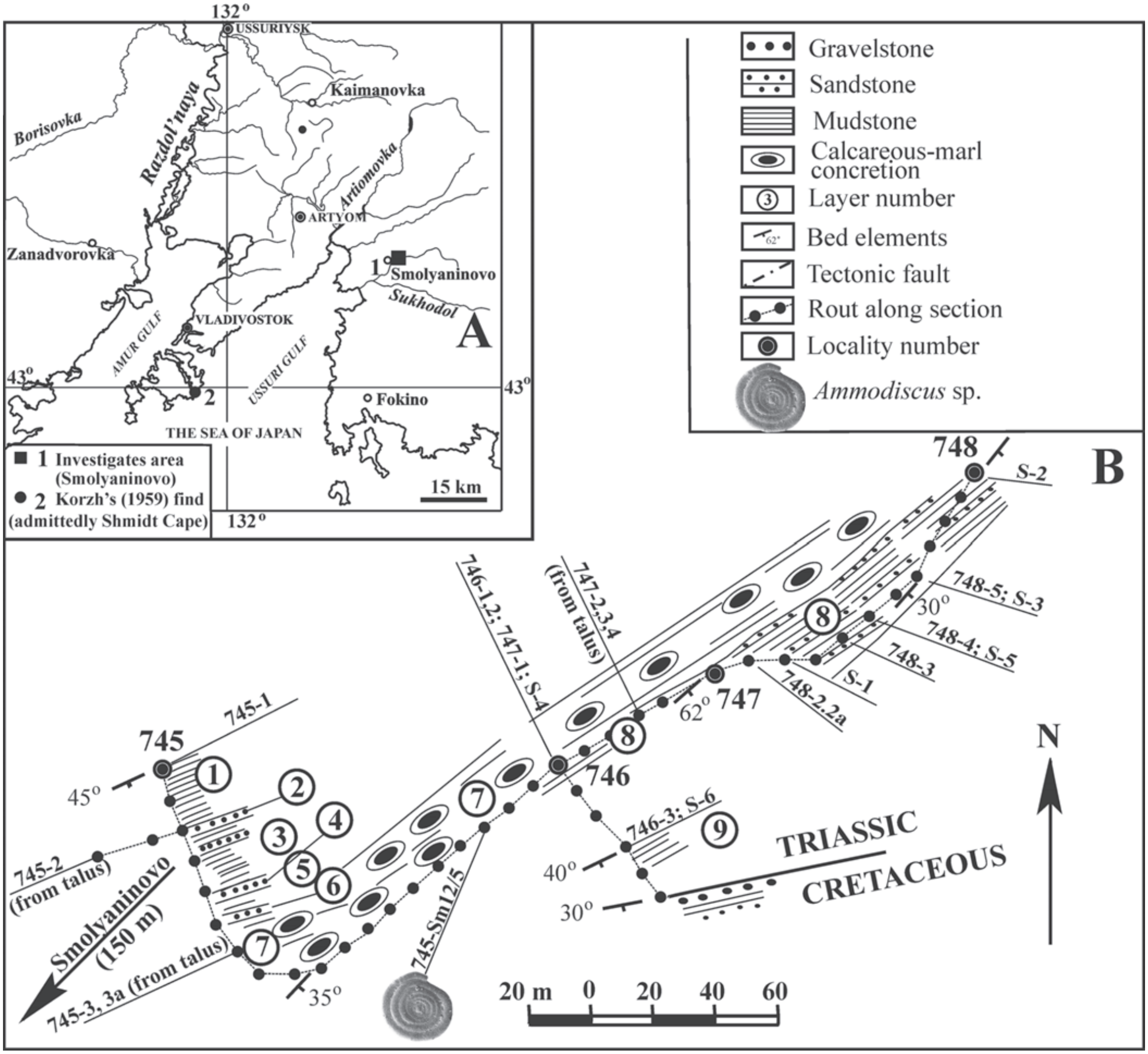

Figure 1 – (A) Map showing location of investigated areas in South Primorye (Smolyaninovo and Russian Island) and (B) Sketch map locating the Smolyaninovo section.

rounded, bent on both sides. The spherical proloculus, about 20 μm in diameter, is followed by a tubular second chamber with the planispiral winding, gradually increasing in height from center to periphery, from 7.5 μm to 25 μm; the tube in cross section is nearly roundish. The wall is agglutinated, microgranular, up to 4 μm thick. The aperture is terminal representing the open end of the tubular chamber.

Comparison. *Ammodiscus* sp. from South Primorye differs from the Lower Triassic species of *Ammodiscus minutus* Efimova by its larger size, number of whorls, and the slowly increasing height of the second chamber. It can be distinguished from Triassic *Ammodiscus parapriscus* Ho by its higher number of whorls and a higher tubular second chamber.

Stratigraphic and geographic occurrence. Upper Smithian (*Churkites syasko*i Beds, *Anasibirites nevolini* Zone) of South Primorye.

CONCLUSIONS

Since the pioneering study of Reuss (1862), who originally described *Ammodiscus*, this genus is known to occur in many Phanerozoic (Silurian – Recent) formations (e.g., Gaždzicki et al., 1975; Alekseychik-Mitsckewich et al., 1981; Kolar-Jurkovšek et al., 2013). However, only some species of this genus were discovered in the Lower Triassic (Efimova, 1974, 1991; Vuks, 2007).

Among them, *Ammodiscus paraprіcus* Ho is the most widely

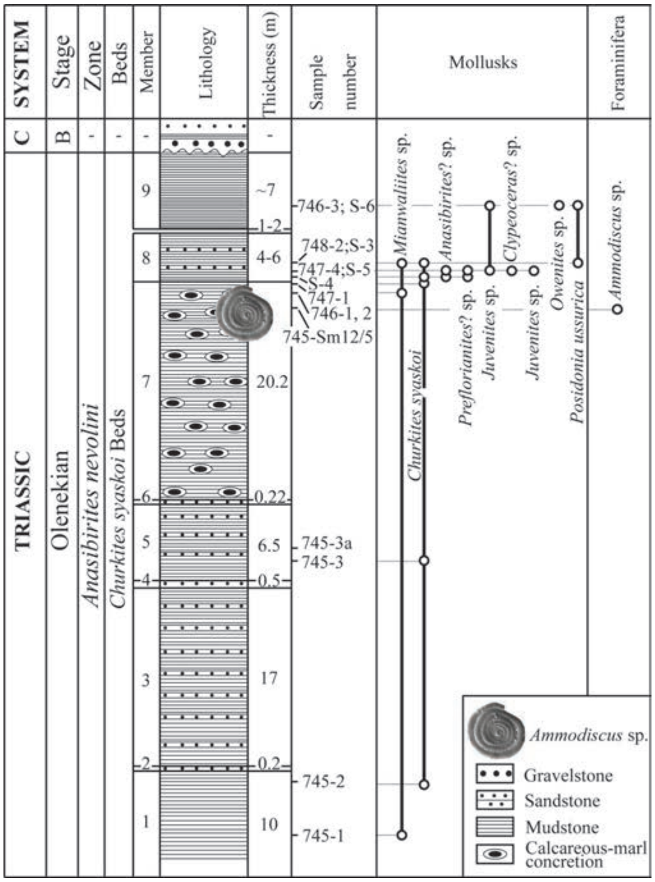

Figure 2 – Distribution of late Smithian ammonoids and Foraminifera in the Smolyaninovo quarry section. Abbreviations: C, Cretaceous, B, Barremian.

Figure 3 – *Ammodiscus* sp. site– Smolyaninovo quarry (photo courtesy of A.M. Popov).

Figure 4 – *Ammodiscus* sp. from the Lower Triassic (*Churkites syaskoi* Beds, *Anasibirites nevolini* Zone) of Smolyaninovo quarry section (scale bar is 100 µm): 1, DVGI 4–2/12, 2, DVGI 4-1/12, 3, DVGI 4–3/12, 4-6, DVGI 4-4/12.

TABLE 1 – Measurements of *Ammodiscus* sp. from the Lower Triassic of South Primorye.

Specimens	Diameter (mm)		Thickness (mm)		Whorl height (mm)		Whorl numbers
	Large	Small	Peripheral part	Central part	First	Last	
1, DVGI 4–2/12	0.26	0.27	-	-	0.008	0.027	6
2, DVGI 4-1/12	0.33	-	-	-	-	-	7
3, DVGI 4–3/12	0.31	0.29	-	-	0.008	0.038	6
4-6, DVGI 4-4/12	-	-	0.03	0.01	0.011	0.029	7

distributed in the Lower Triassic, but it is known only in the Tethys: South China, Himalaya, Germany, France, Spain, Albania, Hungary, Bulgaria, Greece, Turkey, Iran, Slovenia and the Carpathian area (e.g., Ho, 1959; Goel et al., 1981; Salaj et al., 1983; Blau et al., 1995; Fréchengues et al., 1990; Kolar-Jurkovšek et al., 2013). In the Lower Triassic of the Boreal realm, representatives of the genus *Ammodiscus* (*Ammodiscus* sp.; *A.* cf. *filliformis* (Reuss)) seem to be especially rare (Gerke, 1961; Kasatkina et a1., 1985). The occurrences of representative specimens in both the eastern and the western parts of the Tethys apparently indicate that long-distance dispersal was effective in this basin during the Early Triassic. However, the studied late Smithian *Ammodiscus* sp., here discovered in the western circum-Pacific differs from all other Early Triassic taxa and is therefore probably a new species.

ACKNOWLEDGMENTS

Our thanks are due to Dr. Arnaud Brayard (Associate Editor, Albertiana) and V.A. Piskunova (FEGI, Vladivostok) for providing valuable editorial comments, and Dr. V.Ja. Vuks (VSEGEI, St.-Petersburg) for his help in finding references and stimulating remarks that substantially improved this paper.

This work is supported by the Russian grants RFBR (14-05-00011) and FEB RAS (12-III-A-08-144).

REFERENCES

Alekseychik-Mitsckewich, L.S. & Bulatova, Z.I. 1981. Ammodiscida group. In, Subbotina, N. A., Voloshinova, N.A. & Azbel, A.Ya. (eds.), Introduction to study of foraminifera (Classification of the Mesozoic-Cenozoic fine foraminifera). Nedra, Leningrad, pp. 21-37. [in Russian].

Blau, J., Wenzel, B., Senff, M. & Lukas, V. 1995. Die Foraminiferen des Buntsandsteins (Röt) und des Unteren Muschelkalks (Germanische Trias: Skyth, Anis) in Nordhessen. Geologisch Paläontologische mitteilungen Innsbruck, 20: 13-33.

Bondarenko, L.G., Buryi, G.I., Zakharov, Y.D., Bushkareva, X.Y. & Popov, A.M. 2013. Late Smithian (Early Triassic) conodonts from Artyom, South Primorye, Russian Far East. New Nexico Museum of Natural History and Science Bulletin, 61: 55-66.

Bulynnikova, S.P., Komissarenko, V.K., Belousova, N.A., Bogomjakova, E.D., Ryl'kova, G.E. & Tylkina, K.E. (eds.). 1990. Atlas molluskov i foraminifer morskikh otlozhenij verkhnej jury i neokoma Zapadno-Sibirskoj neftegazonosnoj oblasti [Atlas of mollusks and foraminifera of sea deposits of the Upper Jurassic and Neokomian time of the West Siberian oil-and-gas area], v. 2. Foraminifera. Nedra, Moscow, 359 pp. [in Russian].

Buryi, G.I. 1979. The Lower Triassic conodonts of South Primorye. Trudy Instituta Geoligii i Geofiziki Sibirskogo Otdeleniya Akademii Nauk SSSR, 412: 1-143 [in Russian].

Burij, I.V. 1959. Stratigraphy of Triassic sediments of South Primorye. Trudy Dalnevostochnogo Politekhnicheskogo Instituta, 2: 3-34 [in Russian].

Burij, I.V. & Zharnikova, N.K. 1980. Ammonoids from the Tirolites Zone of South Primorye. Paleontologicheskiy Zhurnal, 3: 61-69 [in Russian].

Diener, C. 1895. Triadische Cephalopodenfaunen der ostsibirischen Küstenprovinz. Mémoires du Comité Geologique, 14(3): 1-59.

Efimova, N.A. 1974. Triassic Foraminifera of the North-West Caucasus and Cis-Caucasus. Questions of Micropaleontology: Morphology, classification, and phylogeny of Foraminifera, 17: 54-84 [in Russian].

Efimova, N.A. 1991. Triassic system. In, Azbel, A.Y. & Gridelis, A.A. (eds.), Prakticheskoe rukovodstvo po microfaune SSSR, 5. Foraminifery mezozoja [Practical manual on microfauna of the USSR, 5. Mezozoic foraminifers]. Nedra, Leningrad, pp. 16-21 [in Russian].

Fréchengues, M., Martini, R., Peybernés, B & Zaninetti, L. 1990. Mise en evidence d'associations de foraminifères benthiques dans la séquence de dépôt ladino-?carnienne du "Muschelkalk" des Pyrénées Catalanes (France, Espagne). Comptes Rendus des Séances de l'Académie des Sciences. Micropaléontologie, 310 (2): 667-673.

Gaždzicki, A., Trammer, J. & Zavidzka, K. 1975. Foraminifers from the Muschelkalk of southern Poland. Acta Geologica Polonica, 25(2): 285-298.

Gerke, A.A. 1961. Foraminifers of the Permian, Triassic and Liassic deposits of the petroliferous region of the north Central Siberia. Trudy Nauchno-Issledovatel'skogo Instituta Geologii Arctiki, 120. Gostoptechizdat, Leningrad, 519 pp. [in Russian].

Goel, R.K., Zaninetti, L. & Srivastava, S.S. 1981. Les foraminifères de l'Anisien (Trias moyen) de la localité de Guling, Vallée de Spiti (Himalaya, Inde septentrionale). Archives des Sciences Genève, 34(2): 227-234.

Ho, Y. 1959. Triassic Foraminifera from the Chialingkiang

Limestone of South Szechuan. Acta Palaeontologica Sinica, 7(5): 387-418.

Kasatkina, E.A., Preobrajenskaya, E.N. & Cherkesov, O.B. 1985. Foraminiferal assemblages from terrigenous sediments of the Permian, Lower and Middle Triassic of the north-eastern coast of Kotelnyj Island. In, Vasilevskaya, N.D. (ed.), Stratigrafiya i paleontologiya mezozojskikh osadochnykh basseinov severa SSSR. Sevmorgeologija, Leningrad, pp. 55-62. [in Russian].

Kiparisova, L.D. 1938. Lower Triassic Lamellibranchia of Ussuri region. Trudy GIN AN SSSR, 7: 197-311 [in Russian].

Kiparisova, L.D. 1961. Palaeontological basis for the stratigraphy of Triassic deposits of the Primorye region. I, Cephalopod mollusca. Trudy Vsesoyuznogo Geologicheskogo Nauchno-Issledovatelskogo Instituta (VSEGEI), Nov. Ser., 48: 1-278 [in Russian].

Kiparisova, L.D. 1972. Palaeontological basis for the stratigraphy of Triassic deposits of the Primorye region. 2. Late Triassic mollusks and general stratigraphy. Trudy Vsesoyuznogo Geologicheskogo Nauchno-Issledovatelskogo Instituta (VSEGEI), 181: 1-246 [in Russian].

Kolar-Jurkovšek, T., Vuks, V.J., Aljinović, D., Hautmann, M., Kaim, A. & Jurkovšek, B. 2013. Olenekian (Early Triassic) fossil assemblage from Eastern Julian Alps (Slovenia). Annales Societalis Geologorum Poloniae, 83: 213-227.

Korzh, M.V. 1959. Petrografiya triasovykh otlozhenij Yuzhnogo Primorya [Petrography of Triassic deposits of South Primorye and palaeogeography of their formation time]. Izdatelstvo Akademii nauk SSSR, Moskva, 83 pp. [in Russian].

Levchuk, L.K. & Nikitenko, B.L. 2010. Callovian and Late Jurassic foraminifera of Western and Central parts of the West-Siberian plain. News of Palaeontology and Stratigraphy. Annex to the Geology and Geophysics Magazine, 51(14): 85-110 [in Russian].

Maslakova, N.I. 1990. Criteria of allocation of the foraminifer supreme taxa. *In*, Menner V.V. (ed.), Systematics and phylogeny of the invertebrates. Nauka, Moscow, pp. 22-27. [in Russian].

Mikhalevich, V.I. 1980. Systematics and evolution of the Foraminifera in view of the new data on their cytology and ultrastructure. Trudy Zoologicheskogo Instituta, 94: 42-61. [in Russian].

Mikhalevich, V.I. 2000. The phylum Foraminifera d'Orbigny, 1826 – Foraminifers. *In*, Alimov A.F. (ed.), Protista: Manual on Zoology. P.1, Nauka, St.-Petersburg, pp. 533-623. [in Russian, English summary].

d'Orbigny, A. 1826. Tableau méthodique de la classe des Céphalopodes. Annales des Sciences Naturelles Paris, 1(7): 245-314.

Reuss, A.E. 1862. Entwurf einer systematischen Zusammenstellung der Foraminiferen. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften Mathematisch-Naturwissenschaftlichen Classe, 44(1): 355-396.

Salaj, J., Borza, K. & Samuel, O. 1983. Triassic foraminifers of the West Carpathians. Geologicky Ustav Dionyza Stura, Bratislava, pp. 1-213.

Shigeta, Y., Zakharov, Y.D., Maeda, H. & Popov, A.M. (eds.). 2009. The Lower Triassic system in the Abrek Bay area, South Primorye, Russia. National Museum of Nature and Science Monographs no. 38, Tokyo, 218 pp.

Shishkin, M.A. 1964. Suborder Stereospondyli. In, Y.A. Orlov (ed.). Osnovy Paleontologii. Zemnovodnye, Presmykayuschiesya i Ptitsy. Nauka, Moscow, pp. 83-123 [in Russian].

Vuks, V.Ja. 2007. Olenekian (Early Triassic) foraminifers of the Gorny Mangyshlak, Eastern Precaucasus and Western Caucasus. Palaeogeography, Palaeoclimatology, Palaeogeology, 252: 82-92.

Zakharov, Y.D. 1968. Biostratigrafiya i ammonoidei nizhnego triasa Yuzhnogo Primorya [Lower Triassic biostratigraphy and ammonoids of South Primorye], Moskva, Nauka, 175 pp. [in Russian].

Zakharov, Y.D. 1978. Rannetriasovye ammonoidei vostoka SSSR [Early Triassic ammonoids of the eastern USSR], Moskva, Nauka, 224 pp. [in Russian].

Zakharov, Y.D. 1997. Ammonoid evolution and the problem of the stage and substage division of the Lower Triassic. *In*, Baud, A., Popova, I., Dickins, J.M., Lucas, S., & Zakharov, Y. (eds.), Late Paleozoic and Early Mesozoic circum-Pacific events: biostratigraphy, tectonic and ore deposits of Primoryie (Far East Russia). Mémoires de Géologie (Lausanne), 30: 121-136.

Zakharov, Y.D. & Moussavi Abnavi, N. 2013. The ammonoid recovery after the end-Permian mass extinction: evidence from the Iran-Transcaucasia area, Siberia, Primorye, and Kazakhstan. Acta Palaeontologica Polonica, 58(10): 127-147.

NEW EVIDENCE ON EARLY OLENEKIAN BIOSTRATIGRAPHY IN NEVADA, SALT RANGE, AND SOUTH PRIMORYE (REPORT ON THE IOBWG ACTIVITY IN 2013)

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MAIN RESULTS

1. A new ammonoid genus *Minersvillites* (family Arctoceratidae), 9 new ammonoid species of the genera *Kashmirites*, *Xiaoqiaoceras*?, *Minersvillites*, *Inyoites*, *Meekoceras* and *Vercherites* from the lower and middle Smithian of Utah, USA, have been described (Brayard et al., 2013). Some new subdivisions are recognized in the Smithian of the mentioned area. They are following in descending order: *Vercherites undulates* bed, *Radioceras* aff. *evolvens* beds, *Meekoceras oliveri* beds, *M. millardense* bed, *Preflorianites-Kashmirites* beds, *Inyoites beaverensis* beds, *Owenites* beds (with two horisons), *Anasibirites kingianus* beds, and *Xenoceltitidae* gen. indet. A beds (Brayard et al., 2013).

2. New Triassic ammonoid suborders *Proptychitina* and *Ussuritina* (Zakharov and Moussavi Abnavi, 2013), new Smithian genera *Ussurijuvenites* (family Melagathiceratidae) (Smyshlyaeva and Zakharov, 2012), *Subbalhaeceras* (family Flemingitidae) (Zakharov and Moussavi Abnavi, 2013), and *Ussuriaspenites* (family Aspenitidae) (Zakharov et al., 2013), as well as 18 new species of the genera *Ussurijuvenites*, *Flemingites*, *Euflemingites*, *Subbalhaeceras*, *Monneticeras*, *Brayardites*, *Anasibirites*, *Prionites*, *Anawasatchites*, *Kashmirites*, *Xenoceltites*?, and *Mianwaliites* (with holotypes from the Smithian of South Primorye) have been described.

3. The extensive investigation of Smithian sediments at Artyom area in South Primorye has demonstrated that the upper Smithian (Olenekian) section in the SMID section, encompassing the *Anasibirites nevolini* Zone (45.6 m thick), includes a unique and complete ammonoid succession as well as a nearly complete conodont record (Bondarenko et al., 2013; Zakharov et al., 2013). Judging from data on generic content of ammonoid assemblage of the *Anasibirites nevolini* Zone of the SMID section (*Pseudosageceras*, *Arctoceras*, *Churkites*, *Monneticeras*, *Clypeoceras*, *Brayardites*, *Dieneroceras*, *Juvenites*, *Prosphingitoides*, *Owenites*, *Meekoceras*, *Anasibirites*, *Prionites*, *Anawasatchites*, *Kashmirites*, *Xenoceltites*?, *Mianwaliites*, *Xenodiscoides*?), it is possible to conclude that *Anasibirites* fauna, recognized worldwide, is characterised by far not low-diversity of ammonoids, as it is considered by Brayard ‘s et al. (2013).

4. Ammonoids occurring in the SMID section encompass the genera *Anasibirites* (three species), *Anawasatchites* (one species), Hemiprionites (three species), *Mianwaliites* (one species), *Glyptophiceras* (one species), and *Xenoceltitites*? (one species), known in the upper Smithian of the Central Himalayas and Salt Range (Brühwiler et al., 2010, 2012; Ware et al. 2011). It allows the correlation of the *A. nevolini* Zone in Primorye at least with the *Wasatchites distractus*, *Subvishnuites posterus* and *Glyptophiceras sinuatum* beds, recently documented in Spiti and Nammal.

5. The conodont *Scythogondolella miller*i Zone extends in the SMID Quarry section to the lower part (Member A) of the ammonoid *Anasibirites nevolini* Zone in South Primorye. At the base of Member A, a rich conodont assemblage was found represented by *Ellisonia nevadensis* Müller, *Ellisonia triassica* Müller, *Furnishius triserratus* Clark, *Neospathodus* ex gr. *waageni* Sweet, *Scythogondolella milleri* (Müller) and *Scythogondolella mosheri* (Kozur & Mostler). The top of Member B is characterised by less abundance and less diversity of conodonts that is partially connected, apparently with the degree of their preservation. In this level only *Scythogondolella milleri* (Müller) has been recognized with certainty. Overlying layers of the *Anasibirites nevolini* Zone (the top of Member B, respectively base of Member C), again demonstrates great abundance and diversity of conodonts, which are represented by *Furnishius triserratus* Clark, *Ellisonia triassica* Müller, *Discretella discreta* (Müller), *Neospathodus novaehollandiae* McTavish, *Hadrodontina* sp., and several neogondolellid elements (S3-S4 or possibly S0 posterior processes) formerly identified as “*Hindeodella*” *triassica* Müller. This level is however dominated by an apparently new S – element. Thus, the *Scythogondolella milleri* Zone (Member A) and the “*Hindeodella*” Group B Beds (Members B - base Member C), as the lower and middle parts, respectively, of the *Anasibirites nevolini* Zone, are distinguished in South Primorye.

6. A high-resolution Early Triassic temperature record based on the oxygen isotope composition of pristine apatite from conodonts has been presented for the first time (Romane et al., 2013). This reconstruction shows that the beginning of Smithian was marked by cooler climate, followed by an interval of extreme warmth, lasting until the end of Smithian. Cooler conditions

Figure 1 – *Field*

resumed in the Spathian. It is suggested that climate upheaval and carbon-cycle perturbations due to volcanic outgassing were important drivers of Early Triassic biotic recovery.

Field-work results

Churkites cf. syaskoi-bearing sediments, possible equivalent of the *Anasibirites nevolini* Zone, have been discovered in the upper part of the Tri Kamnya section in South Primorye.

REFERENCES

Bondarenko, L.B., Buryi, G.I., Zakharov, Y.D., and Popov, A.M., 2013. Late Smithian (Early Triassic) conodonts from Artyom, South Primorye, Russian Far East. New Mexico Museum of Natural History & Science, Bulletin 61, p. 55-66.

Brayard, A., Bylund, K.G., Jenks, J.F., Stephen, D.A., Oliver, N., Escargurl, G.,Fara, E., Vennin, E., 2013. Smithian ammonoid faunas from Utah: implications for Early Triassic biostratigraphy, correlation and basinal paleogeography. Swiss J. Palaeontol., DOI 10.1007/s13358-013-0058-y.

Romano, C., Goudemand, N., Vennemnn, T.W., Ware, D., Schneebeli,-Hermann, E., Hochuli, P., Brühwiler, T., Brinkmann, W., Bucher, H., 2013. Climatic and biotic upheavals following the end-permian mass extinction. Nature Geoscience, no. 6, p. 57-60.

Smyshlyaeva, O.P., Zakharov, Y.D., 2012. New representatives of the family Melagathiceratidae (Ammonoidea) from the Lower Triassic of South Primorye. Paleontologicheskij Zhurnal, no. 2, p. 34-39 (in Russian).

Smyshlyaeva, O.P., Zakharov, Y.D., 2013. New representatives of the family Flemingitidae (Ammonoidea) from the Lower Triassic of South Primorye. Paleontologicheskij Zhurnal, no. 3, p. 16-24 (in Russian).

Zakharov, Y.D., Bondarenko, L.B., Smyshlyaeva, O.P., Popov, A.M., 2013. Late Smithian (Early Triassic) ammonoids from the *Anasibirites nevolini* Zone of South Primorye, Russian Far East. New Mexico Museum of Natural History & Science, Bulletin 61, p. 597-612.

Zakharov, Y.D., Moussavi Abnavi, N., 2013. The ammonoid recovery after the end-Permian mass extinction: Evidence from the Iran-Transcaucasia area, Siberia, Primorye, and Kazakhstan. Acta Palaeontologica Polonica, vol. 58, no. 1, p. 127-147.

Obituary

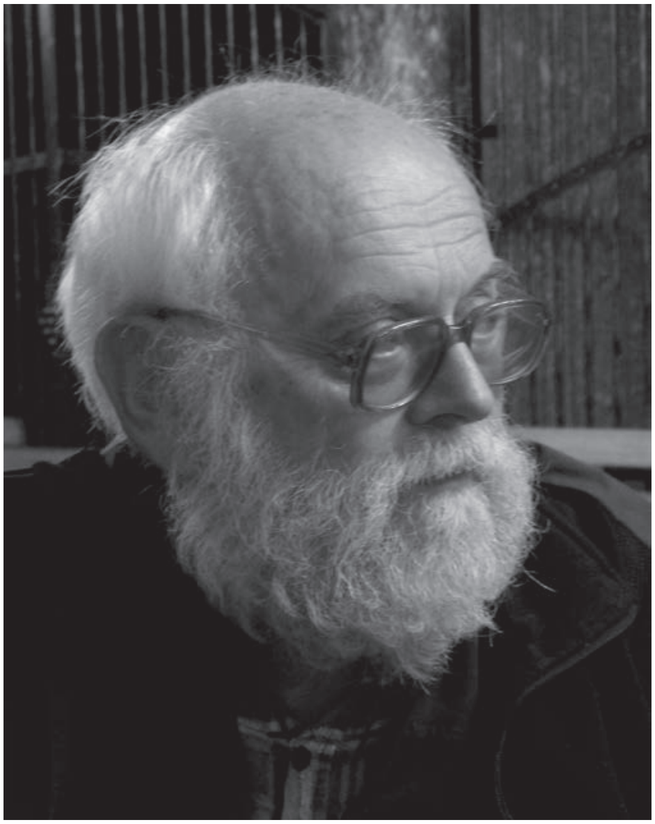
HEINZ W. KOZUR (1942-2013)

On 20 December 2013, Heinz W. Kozur died in Budapest, Hungary, after a long struggle with illness caused by several brain strokes. Born in Hoyerswerda (Sachsen), Germany, on 26 March 1942, Heinz began his studies of geology at the Bergakademie Freiberg/ Sachsen in 1961. There, he completed a diploma thesis in 1967 on the conodonts and scolecodonts of the Upper Muschelkalk of Middle Europe under the supervision of Professor Dr. A. H. Müller. For this, and his other student accomplishments, Heinz was awarded the Agricola Medal.

Postgraduate study at Freiberg under the direction of Müller followed. In 1971, Heinz received his doctoral degree (Dr. rer. nat. geol.) for his dissertation (awarded summa cum laude) on the micropaleontology, biostratigraphy and biofacies of the German Middle Triassic. By the time he received this degree, he had begun employment as the Chief of the Department of Natural Science at the Staatliche Museen Meiningen/ Thüringen, a position Heinz held until 1981. In 1975, Heinz finished his Habilitation at Freiberg, again under the direction of Prof. Müller, on the biostratigraphy, facies and paleogeography of the Triassic.

Outspoken and headstrong, Heinz came into conflict with the socialist authorities in the former German Democratic Republic (GDR or East Germany). Thus, when the socialist establishment seriously impeded his scientific career in East Germany, he went into exile to Hungary in 1981. Employment at the Geological Survey of Hungary in Budapest followed (1981-1985), which led to Heinz's election to the Hungarian Academy of Science. However, in 1985, political problems resurfaced due to the long arm of the GDR authorities, and Heinz lost his position in Budapest. He was banned from his profession and had his scientific notes, documents and specimens confiscated.

Thus began the remainder of Heinz's professional career, during which regular, full-time employment was replaced by part-time or short-term employment as a visiting professor or by funds supplied by research stipends, grants and professional consulting. Heinz thus undertook most of his professional work and achieved his remarkable and extensive research results of the last three decades as a private citizen without long-term institutional support.



During the 1980s and 1990s, Heinz was a visiting professor at several universities, including Yarmouk University in Jordan, Northern Arizona University in the USA, the University of Palermo in Italy, the University of Lausanne in Switzerland, the University of Salzburg and Innsbruck University, both in Austria, and (after the collapse of the GDR) at the University of Halle in Germany. Long-term research stipends came from Middle East University in Turkey, the Geological Survey of Japan and Innsbruck University. Additionally, Heinz received many research grants from diverse sources.

The research of Heinz Kozur covers a broad range of topics in historical geology, with a strong focus on the Permian and Triassic timescales. To those ends, Heinz served as a voting member of the IUGS Subcommission on Permian Stratigraphy from 1976 to 2007, and remained an honorary member until his death. From 1969 until his death, Heinz was a voting member of the IUGS Subcommission on Triassic Stratigraphy. Within these subcommissions, Heinz participated in the research and deliberations of many of the key working groups devoted to defining geological time boundaries, including the Carboniferous-Permian, the Permian-Triassic and the Triassic-Jurassic boundaries. He was also an integral member of the groups that defined the Guadalupian, that deciphered the Tethyan Triassic and that worked to develop the chronology of nonmarine Triassic strata. He was also active in the Permian-Triassic Subcommission of the German Stratigraphic Commission.

Most of the major advances that have been achieved in refining and defining the Permian and Triassic timescales of the last 30-40 years owe much to Heinz Kozur. As but one example, consider that the defining criterion of the base of the Triassic System (and therefore the base of the Mesozoic Erathem) is the first appearance of the conodont species *Hindeodus parvus*, a species named by Kozur and Pjatkova in 1975.

In his curriculum vitae, Heinz divided his research contributions into six areas: stratigraphy, paleoecology, bioevents, tectonics, paleogeography/paleoclimatology and paleontology/biostratigraphy. In the area of stratigraphy, Heinz contributed much to understanding Cambrian-Devonian marine stratigraphy and both the marine and nonmarine stratigraphy of Carboniferous-Triassic rocks, especially in central Europe. In paleoecology, our understanding of the complex ecosystems of the Permian and Triassic and how they responded to the end-Permian extinctions owes much to Heinz's insight. With regard to bio-events, Heinz contributed much to the analysis and timing of biotic crises, especially at the Permo-Triassic and Triassic-Jurassic boundaries.

All stratigraphic refinement has tectonic implications, and Heinz applied his work to deciphering various tectonic puzzles, particularly of the Variscan and Alpine orogenies in Europe and the Cadomic to Cimmerian orogenies in Turkey. The paleogeography and paleoecology of Pangea, especially the Tethyan realm and the Germanic basin, was one of Heinz's great areas of expertise. However, it is fair to say that it is in paleontology and biostratigraphy that Heinz's greatest contributions were made, as his nearly 600 published articles indicate.

As a paleontologist, Heinz worked on diverse fossil groups. But, perhaps his largest contributions were to the conodonts, radiolarians and conchostracans. In all three groups, many of the new taxa described by Heinz and his collaborators were used to build landmark understandings of the evolution and biostratigraphy (especially during the Triassic) of these groups. Indeed, the work of Heinz Kozur on Triassic conodonts in his doctoral dissertation was the beginning of modern Triassic conodont taxonomy and biostratigraphy. His Muschelkalk conodont zonation is still standard, and many of the key conodont taxa used in Triassic correlations were first identified and analyzed by Kozur. The radiolarians tell a similar story, with Kozur early on the scene to recognize the value of these microfossils to the subdivision of Triassic time; all subsequent work has built on his. And, in the terrestrial Triassic, the last eight years saw Heinz, in collaboration with Rob Weems, elaborate on Heinz's earlier work to present a Triassic conchostracan zonation built largely on the records from the Germanic basin and the Newark Supergroup basins of eastern North America. Among other noteworthy results here is the first demonstration by conchostracan biostratigraphy that the beginning of the Jurassic was in fact during the episode of CAMP volcanism that accompanied the rifting that opened a nascent Atlantic Basin, not prior, as suggested earlier. Truly, it is fair to say that nobody can touch the biostratigraphy and chronology of Triassic Pangea without using the work of Heinz Kozur.

Beyond conodonts, radiolarians and conchostracans, Heinz also made major contributions to other groups of fossils, among them ostracods, holothurian sclerites, scolecodonts, charophytes, megaspores and miospores and the footprints of arthropods and tetrapods.

Throughout much of his career, Heinz was a member of several scientific societies, among them the Deutsche Gesellschaft für Geowissenschaften (since 1990), the Ungarische Geologische Gesellschaft (since 1982), the Deutsche Paläontologische Gesellschaft (since 1990) and he was elected to the Ungarische Akademie der Wissenschaften (in 1984) and the New York Academy of Science (in 1996).

After the collapse of the Soviet Union and the loosening of restrictions on travel by scientists in Eastern Bloc countries, we both met Heinz in the early 1990s. Since then he was a valued collaborator on various projects. To add some personal insight, we can say that Heinz was a person of great energy – a tireless worker on the outcrop, at the museum, in the laboratory as well as behind the microscope and the computer. A polyglot, he moved freely from his native German to fluent English and Russian or on to a working technical knowledge of several other languages, not to forget Hungarian, the language of his adopted country and his wife Dr. jur. Zsuzsánna Tömpe. He never learned how to drive a car, so to drive Heinz to the outcrop was to transport an encyclopedia of Pangea – an earth scientist who had been all over the globe and knew its Triassic outcrops and biostratigraphic problems as well as any and better than most. When other people had to check their notes – Heinz simply knew it. But, listening to Heinz also made it obvious that the conflicts and struggles of bygone years caused many, long open wounds.

When Heinz turned 70, at its Annual Meeting at Hannover in October 2012, the Deutsche Gesellschaft für Geowissenschaften awarded him the Leopold-von-Buch-Plakette to honor his scientific contributions. In 2013, New Mexico Museum of Natural History and Science Bulletin 61, The Triassic System: New developments in stratigraphy and paleontology, was dedicated to Heinz, and his complete scientific bibliography through early 2013 is published there.

With the death of Heinz Kozur we have lost one of the great experts on the geological timescale, particularly of the Permian and the Triassic Periods. Few scientists knew as much about the Triassic System as did Heinz Kozur, and few have ever made such a significant contribution to our understanding of its stratigraphy, paleoecology, bioevents, tectonics, paleogeography/paleoclimatology and paleontology/biostratigraphy. We will miss Heinz, a great geologist and paleontologist, a precious colleague, comrade and friend.

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INNA A. DOBRUSKINA (1933-2014)

Inna Dobruskina, one of the foremost experts on Triassic paleobotany, died peacefully in Jerusalem, Israel, on January 4, 2014; she was 80 years old. Born December 25, 1933 in Moscow, Russia, Inna attended Moscow State University (MSU) from 1952 to 1957 and received a M.Sc. degree in 1957. She then undertook doctoral study at MSU, from 1960 to 1964, and she was awarded the Ph.D. in 1964. She later completed a Dr.Sci. degree (awarded 1977). Inna's first academic position was at MSU, where she sat on the Faculty of Geology from 1957 to 1964. From 1964 to 1989 she worked at the Geological Institute of the Soviet Academy of Sciences. And, after emigrating to Israel, she held positions at the Institute of Earth Sciences of the Hebrew University of Jerusalem from 1990 to 1999.

These are the summary facts of Inna Dobruskina's academic career, so let us provide more perspective on her life, which was one of many challenges and achievements. Inna was born in a "communal apartment" in downtown Moscow. Having nationalized all real estate after the Revolution, the Soviet Government had allotted individual rooms in apartment buildings to unrelated families who were forced to share kitchens and bathrooms in these ad-hoc "communes." (For some residents, these arrangements continued into the late 1980s; indeed, Inna's mother lived in the same communal apartment until her death in 1987).

Inna was 7 years old when Germany invaded the Soviet Union in 1941. There was panic as the Wehrmacht approached Moscow, and Inna's mother, at the time an interpreter with a Comintern publishing house, arranged for Inna to be sent into the country's interior, as one member of a large group of children. Inna lived at the thus created impromptu boarding school until 1943. It so happened that many in the group were the children of foreign communist leaders who were hiding out in Moscow during WWII. After WWII, many of the parents of these children became either government bosses in newly communist countries or the heads of opposition communist parties in the free world. Thus, for example, one of Inna's classmates was Rudolf Slansky, Jr. The older Slansky became secretary general of the Czech Communist Party and wielded great power in that country, until he and 11 other top communists were executed by their own party in 1951 in what became known as the Slansky Trial.

When Inna entered MSU in 1952, science was one of the few careers available that afforded a somewhat comfortable living without having to work for the government politically. In contrast, a career in the humanities meant working for the Party (if one majored in scientific communism, dialectic materialist philosophy, etc.) or the KGB (psychology, foreign languages, foreign relations). Within science, geology was one of the few fields without direct military applications; physics, chemistry, biology and electronics were of interest to the government inasmuch as they assisted the development of new types of weapons. For Inna, non-petroleum geology turned out to be the narrow path between Scylla and Charybdis.

Inna's geological studies included practical field work in the Kola Peninsula, Mangush in the Crimea and along the Cherek River in the Caucasus. Upon earning her M.Sc. in 1957, Inna remained at MSU, joining the newly-formed Amur Expedition. At that time, an urgent project focused on building a joint Sino-Soviet hydroelectric dam on the Amur River, which forms the border between the two countries in the Far East. The scheme required selecting a site for damming the upper Amur River system, possibly as high as the confluence of the Argun and Shilka rivers.

Detailed geological maps were needed along the river system at and around the dam site.

The Expedition's mandate thus was to produce 1:200,000 scale maps of a 1300-km-long stretch of the river, 15 km wide on each bank. Inna and the other young graduates spent three-to-four-month-long summers mapping the area on both sides of the river. Each geologist lead a party of 10 to 15 men into the wilderness, without contact with the outside world for weeks at a time. The conditions were harsh and the equipment basic. Inna recalled how, on one return trip to Moscow, a train conductor neglected to check Inna's tickets, concluding from her clothing and appearance that she was a convict freed under the recent Khrushchev amnesty.

Indeed, a young female academic faced special challenges to her leadership in the wilderness. Inna liked to recount how, early in the expedition, her subordinates challenged her to drink a shot of undiluted alcohol with them (it's not a Russian geological party without a keg of pure alcohol). Convinced that her authority would disintegrate if she refused, Inna upped the challenge to a full glass (250 ml) and drank it in one gulp—the first and the last time in her life she drank more than a glass of wine. She faced no further challenges from her subordinates that year.

Sino-Soviet relations soured as the 1950s wore on, and, in July 1960, the Soviets recalled all scientific advisers from China, cancelling some 200 cooperative scientific projects. The Amur Dam was one of these canceled projects, and 1959 was the Amur Expedition's last field season (Inna participated for all three years: 1957, 1958 and 1959).

Following the cancellation of the Amur Expedition, Inna entered the Ph.D. program at MSU. Her research focused on processing material from the Amur Expedition, and in 1964 she defended her thesis, "Stratigraphy and flora of the Jurassic and Lower Cretaceous of the Amur River." As a teaching assistant during her Ph.D. studies, she returned to Mangush for the 1961 field season, this time as an instructor.

On receiving her Ph.D., Inna took a position at the Paleofloristics Laboratory of the Geological Institute of the Soviet Academy of Sciences (GIN). At GIN, Inna took on the Triassic flora of Eurasia as her subject. She worked on this project for the next 25 years, continuing to travel widely inside the Soviet Union, and conducting field work at Issyk Kul, Madygen, the North Caucasus, Mangyshlak, Pamir, Baskunchak, Bogdo, Rybinsk and at other locales. She received her Dr. Sci. in 1977, for a dissertation titled "Triassic floras of Eurasia (stratigraphic position, systematics, phytogeography)."

In 1965, Inna married Arnold Krupnikov, a mining safety engineer. For their honeymoon, the couple spent four weeks collecting Triassic fossils in the field at Madygen under the direction of Dr. A. G. Sharov; they also visited historic Bukhara and Samarkand on their return journey to Moscow. Inna had worked at the site the previous year and would return the following year, and ultimately again with paleoichthyologists Drs. Maxim and Alla Minich in 1987. Inna and Arnold's marriage produced two children, Irina (b. 1968) and Ari (b. 1977). The couple divorced in 1982.

Although she was the daughter of two Communist Party members, Inna had grown disillusioned with government policy by the time she graduated from the university. She then became an outspoken critic of the regime and helped distribute illicit, often typewritten copies of "samizdat" literature. Despite the persistent threat of prison terms for possession of such subversive material, Inna would often make additional copies for distribution by retyping the text through four or five layers of carbon copy paper. Xerox-style copying technology was understandably unavailable to Soviet citizens.

By the mid-1980s, Inna's frustration with the Soviet authorities grew to a boiling point. She decided that emigration was the only option for her, and with border controls loosening during Perestroyka, she petitioned to renounce her Soviet citizenship and depart the Soviet Union. She settled in Jerusalem, Israel, in 1989, and accepted an adjunct professor position with the Institute of Earth Sciences at the Hebrew University. In Jerusalem, Inna taught undergraduate stratigraphy and continued her research on Triassic floras. Her monograph "Triassic Floras of Eurasia" was published in English in 1994 (it had been published in Russian in 1982).

After leaving the Soviet Union, Inna traveled widely, conducting fieldwork in Austria (with Dr. Harald Lobitzer), France (with Dr. Lea Grauvogel-Stamm), South Africa (with Drs. John and Edith Anderson) and the USA (with Dr. Spencer Lucas). In 1993, she was a Distinguished Visiting Professor at Ohio State University at the invitation of Dr. Thomas Taylor. Inna retired from The Hebrew University in 1999.

In retirement, Inna put much effort into reconciling her knowledge of her family history with the history of the Russian Revolution and civil war. She searched archives as far afield as Stanford, California, and discovered her paternal grandfather's part in establishing communist rule in Siberia and the Caucasus--F. M. Afanasiev had been a colonel in the Imperial Russian Army, wounded in the Russo-Japanese war of 1904-5 and decorated for bravery in that campaign as well as in World War I. In 1918, he chose the Red side in the unfolding civil war, and ultimately rose to Chief of Staff of Soviet forces in Siberia. In this role, he planned and directed military suppression of the numerous peasant uprisings against communist governments in Siberia, as well as oversaw incursions deep into Mongolia to destroy retreating White units.

Inna suffered a stroke in 2011 from which she never fully recovered. She passed away peacefully on January 4 at Shaarey Tzedek hospital in Jerusalem. She is survived by her children Irina and Ari and grandchildren Elisha, Ada and Leah.

With her passing we have lost one of the great students of the Triassic--of its plant fossils, stratigraphy and timescale. Inna's contributions to Triassic paleobotany and stratigraphy were diverse, as her list of published works below demonstrates. Indeed, her monograph on the Triassic floras of Eurasia is one of the most important syntheses of Triassic paleobotany published during the 20th Century. It did much to clarify the complex and diachronous changes from the Paleophytic floras to the Mesophytic floras, most of which took place during the Early to Middle Triassic. Few have ever achieved the knowledge and experience with Triassic paleobotany that came to Inna Dobruskina through her extensive research. She will long be remembered as one of the great students of the Triassic System.

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BIBLIOGRAPHY OF INNA A. DOBRUSKINA

Dobruskina, I. 1961. Mesozoic flora of the Upper Amur. Vestnik Mosk. un-ta, ser.geol., 6: 25-35 [in Russian].

Dobruskina, I. 1962. Some new data on the stratigraphy and flora of continental Mesozoic deposits of the Upper Amur. In, Engineering geology problems of the Upper Amur [in Russian].

Dobruskina, I. 1962. Lower Mesozoic deposits. In, Geology and engineering geology characteristics of the Upper Amur valley, chapter 6, MGU [in Russian].

Dobruskina, I. 1962. Lower Cretaceous flora of the Upper Amur. Bull.MOIP, otd. geol., 6 [in Russian].

Dobruskina, I. 1964. New Jurassic cycadophytes from the Upper Amur. Paleont. zhurn., 2: 132-142 [in Russian].

Dobruskina, I. 1965. Revision of the Jurassic flora of the Amur River, described by O. Heer. Paleont. zhurn., 3: 110-118 [in Russian].

Dobruskina, I. 1965. New data on the Tolbuzin palaeofloristic assemblage (the Upper Amur River). Vestn. Mosk. un-ta, ser. geol., 2: 62-74 [in Russian].

Dobruskina, I. 1965. On the age of the Lower Shilka and Argun continental deposits. Bull. MOIP, otd. geol., 40: 6 [in Russian].

Dobruskina, I. 1965. On the presence of gigantopterids in the USSR territory. Doklady AN SSSR, 171: 1187-1190 [in Russian].

Dobruskina, I. and Meyen, S.V. 1967: On the great palaeobotanical wall, genus Gondwanidium, real and false, and yet about a good tradition to the details (palaeobotany and continent drift hypothesis). Znanie-sila, # 7 [in Russian].

Dobruskina, I. 1967. Biogeographical analysis of the Triassic flora of the Russian platform and Priuralye. Bull. MOIP, otd. geol., 42: 151-152 [in Russian].

Dobruskina, I. 1968 On the boundary between the Middle and Upper Triassic in the continental sediments of the USSR. Izv. AN SSSR, ser. geol., 9: 87-90 [in Russian].

Dobruskina, I. 1969. Genus *Scytophyllum* (the morphology, epidermic texture and systematic position). Trudy GIN AN SSSR, vyp. 190: 35-58 [in Russian].

Dobruskina, I. 1970. The age of the Madygen Formation and the Permian-Triassic boundary in Middle Asia. Sov. geologia, 12: 16-28 [in Russian].

Dobruskina, I. 1970. The Triassic floras. Trudy GIN AN SSSR, vyp. 208: 158-212 [in Russian].

Dobruskina, I. 1972. Induan stage. Bol. Sov. Entsiklopedia, 26 [in Russian].

Gomolitskiy, O. & Dobruskina, I. 1973 a: Are there Upper Triassic plant-bearing deposits in Middle Asia? Bull. MOIP, otd. geol., 48, : 55-70 [in Russian].

Dobruskina, I. 1973. Karnian stage. Bol. Sov. Entsiklopedia, 11 [in Russian].

Dobruskina, I. 1973. Ladinian stage. Bol. Sov. Entsiklopedia, 14 [in Russian].

Dobruskina, I. 1974. Norian stage. Bol. Sov. Entsiklopedia, 17 [in Russian].

Dobruskina, I. 1974. Olenekian stage. Bol. Sov. Entsiklopedia, 18 [in Russian].

Dobruskina, I. 1974. The Triassic lycopsids. Paleont. zhurn., 3: 111-124 [in Russian].

Dobruskina, I. 1974. Rhaetian stage. Bol. Sov. Entsiklopedia., 22 [in Russian].

Dobruskina, I. 1974. Significance of the peltaspermous pteridosperms in the Late Permian and Triassic floras. Paleont. zurn., 4: 120-132 [in Russian].

Dobruskina, I. 1976. Correlation of the Triassic continental sediments. Sov. geologia, # 3: 34-45 [in Russian].

Dobruskina, I. 1976. The Permian-Triassic boundary. – In, The boundaries of the geological systems, Izd. Nauka: 145-166 [in Russian].

Dobruskina, I. 1976. The Triassic-Jurassic boundary. In, The boundaries of the geological systems, Izd. Nauka: 167-184 [in Russian].

Dobruskina, I. 1977. An important contribution to the knowledge of the Earl Mesozoic flora. Paleont. zhurn., 4: 146-149 [in Russian].

Dobruskina, I. 1977. History of development of Eurasian Mesophytic floras. In, Abstracts of XXIII session of VPO: 28-29 [in Russian].

Dobruskina, I. 1977. Paleontological evidence of the presence of the Lower and Upper Triassic in the Eastern Predkavkazye. Bull. MOIP, otd. geol., 52: 94-102 [in Russian].

Dobruskina, I. 1977. Triassic period/system. Bol. Sov. Entsiklopedia, 26 [in Russian].

Vakhrameev, V.A., Dobruskina, I., Zhatkova, E.A., & Yaroshenko, O.P. 1977 e: Upper Triassic plant-bearing beds in the East Cis- Caucasus. Izv. AN SSSR, ser. geol.:62-72 [in Russian].

Dobruskina, I. 1978. Die Trias Floren. In, Palaeozoische und Mesozoische Floren Eurasiens und die Phytogeographie dieser Zeit, VEBG.Fischer Verl.-Jena: 101-131.

Dobruskina, I. 1978. Relationships in flora and fauna evolution during the transition from the Palaeozoic to Mesozoic. In, The problems of stratigraphy and geological history, Izd. MGU: 127-139 [in Russian].

Dobruskina, I. with coauthors. 1980. Mesozoic gymnosperms. Reference Manual [in Russian].

Dobruskina, I. with coauthors. 1980. Mesozoic higher spore plants. Reference Manual [in Russian].

Dobruskina, I. 1980. Stratigraphical position of Triassic plant-bearing beds of Eurasia. Trudy GIN AN SSSR, vyp. 346: 1-164. [in Russian].

Dobruskina, I. 1981. Triassic Period/System In, A Translation of the Third Edition of the Great Soviet Encyclopedia, v. 26, 1977, MacMillan Educational Corporation, London, 26: 334-336.

Dobruskina, I. & Yaroshenko, O.P. 1982. Macro- and microflora possibilities in view of stratigraphical subdivision and correlation of the Triassic. Abstracts of the XXVIII session. of VPO: 11-13 [in Russian].

Dobruskina, I. 1982. Meridional phytogeographical zonation in the Triassic of Eurasia. Bull. MOIP, otd. geol., 57: 143-144 [in Russian].

Dobruskina, I. 1982. Triassic floras of Eurasia. Trudy GIN AN SSSR, vyp. 365: 1-196 [in Russian].

Vakhrameev, V.A., Dobruskina, I., Zhatkova, E., & Turtygina, A. 1983. Subdivisions of the Upper Triassic deposits of Kuma area (Cis-Caucasus). Sov. geologia, 4: 54-63 [in Russian].

Dobruskina, I. & Yaroshenko. O.P. 1983. The relationships between the Triassic floras of both sides of the Northern Atlantic Ocean. Bull. MOIP, otd. geol., 3: 83-96 [in Russian]. With O. P. Yaroshenko.

Dobruskina, I. 1984. Triassic conifers as the basis for stratigraphical correlation. Geobios, 17: 861-863.

Dobruskina, I. 1985. Correlation of the Lower Triassic plant-bearing beds of Siberia and China. Albertiana, 3: 21-23.

Dobruskina, I. 1985. Madygen flora (USSR, Middle Asia) as a typical representative of Keuper floras. Memoria di simposio sobre floras del Triassico Tardio, su Fitogeografia y paleoecologia. III Congresso Latino-Americano de Paleontologia, Mexico: 11-19.

Dobruskina, I. 1985. Questions on systematic of Triassic lycopods. Paleont. zhurn., 3: 90-104 [in Russian].

Dobruskina, I. & Yaroshenko. O.P. 1985. The relationships between the Triassic floras of both sides of the Northern Atlantic Ocean. Memoria di simposio sobre floras del Triassico Tardio, su Fitogeografia y paleoecologia. III Congresso Latino-Americano de Paleontologia, Mexico: 21-31.

Dobruskina, I. 1985. Triassic flora of the Russian platform. In, Triassic deposits of the Russian platform, Izd. Saratov University: 88-100 [in Russian].

Dobruskina, I. & Lozovski. V.R. 1986 Are there Upper Permian deposits in Gornyi Mangyshlak? Geologia i Razvedka, 9: 92-95 [in Russian].

Mogutcheva, N.K. & Dobruskina, I. 1986. Buntsandstein conifers in the Korvunchana flora. In, Biostratigraphy of the Mesozoic of Siberia and the Far East, Trans. Inst. Geol. Geoph. of Siberian branch AN SSSR, 649: 72-76 [in Russian].

Dobruskina, I. 1986. Correlation of the Lower Triassic plant-bearing beds of Siberia and China. In, The Permo-Triassic events in the development of organic world of northeastern Asia, Izd. DVNTZ SSSR, Vladivostok: 24-32 [in Russian].

Mogutcheva, N.K. &. Dobruskina, I. 1986. On the age of the Tunguska volcanics. Geologia I Geofizika, 1: 29-37 [in Russian].

Dobruskina, I. 1986. The Permo-Triassic boundary in continental deposits of Siberia. Permophiles, 10: 5-6.

Dobruskina, I. 1987. History of the Triassic flora and geological history. In, Historical geology: results and perspectives, Izd. MGU: 230-242 [in Russian].

Dobruskina, I. 1987. Lepidopteris from Northern Viet Nam. Geobios, 20: 129-132.

Dobruskina, I. 1987. Phytogeography of Eurasia during the Early Triassic. Palaeogeography, Palaeoclimatology, Palaeoecology, 58: 75-86.

Dobruskina, I. 1988. Collections of the Lunz flora in Graz. Mitt. Abt. Geol. Palaeont. Landesmus. Joanneum, Graz, 47: 19-25.

Dobruskina, I. 1988. "Perestroyka" in the plant kingdom of Eurasia during the Triassic. Resumes de Seminaire de Palaebotanique. Lille, 31 Mai - 1 Juin 1988 (Organization Francaise de Paleobotanique): 6.

Dobruskina, I. 1988. The history of land plants in the northern hemisphere during the Triassic, with special reference to the floras of Eurasia. Geol. Palaeont. Mitt. Innsbruck, 15: 1-12.

Dobruskina, I. 1989. Alpine Lunz Flora - a standard flora of the Karnian stage of the Triassic. Izv. AN SSSR, ser. geol., 11: 57-64 [in Russian].

Dobruskina, I. 1989: Correlation of Triassic plant-bearing beds of the northern hemisphere. Abstracts of the 28th International Geological Congress in Washington D. C., July 1989, 1: 401-402.

Dobruskina, I., Petrosyantz, M.A. & Shelekhova, M.N. 1989. Palynological background of the Triassic-Jurassic boundary of Kendelbachgraben, Austria. Abstracts of the 6th All Union Palynological Conference “Palynology and economic minerals,” Minsk, December 18-22 [in Russian].

Dobruskina, I. 1989. Particuliarities of the Lower Triassic stage of florogenesis. In, Problems of stratigraphy of the Upper Proterozoic and Phanerozoic, Trudy GIN AN SSSR, 431: 146-156 [in Russian].

Dobruskina, I. 1990. “Perestroyka” in the plant kingdom at the Palaeozoic-Mesozoic boundary. Abstracts of Intern. Conf. on Late Palaozoic and Mesozoic floristic change, 16-20 April, Cordoba: 7-8.

Dobruskina, I. 1990 Phytogeographical zonation in the Cretaceous. Cretaceous field conference in Israel, Program and Abstracts, Jerusalem, Israel, Sept. 5-15: 9.

Dobruskina, I. 1991. Triassic System (Period). Mining Encyclopedia, Izd-vo Sovetskaya Enzyclopedia, Moscow, 5: 186-188 [in Russian].

Dobruskina, I. 1992. Asian Triassic Floras. IOP (International Organisation of Palaeobotany), 4th Conference, Paris, Abstracts, p. 50.

Dobruskina, I. 1993. Mesozoic plant kingdom and plate tectonics. Annual Meeting of Israel Geol. Soc., ed. I. Gabrieli, March 15-18, 1993, Arad: 26.

Dobruskina, I. 1993. Relationships in flora and fauna evolution during the transition from the Palaeozoic to Mesozoic. Bulletin of the New Mexico Museum of Natural History and Science, 3: 107-112.

Dobruskina, I. 1993. The first data on Seefeld conifer flora (Upper Triassic; Tirol, Austria). Bulletin of the New Mexico Museum of Natural History and Science, 3: 113-115

Dobruskina, I. 1993. Triassic plants and Pangea. Program and Abstracts of Annual Convention of Canadian Society of Petroleum Geology with Global Sedimentary Geological Program “Carboniferous to Jurassic Pangea” (August 15-19, 1993, Calgary, Canada): p.79.

Dobruskina, I. 1994. Triassic floras of Eurasia. Osterreich. Akad. d. Wissenschaften,Schriftenreihe d. Erdwiss. Komissionen, 10: 1-408.

Dobruskina, I. 1994. Damage from using computers. IOP (International Organization of Paleobotany) Newsletter, 52: 7-8.

Krassilov, V.A., Dobruskina, I.A. 1995. Angiosperm fruit from the Lower Cretaceous of Israel and origins in rift valleys. Paleontological Journal, 20: 110-115.

Dobruskina, I. & Durante. M.V. 1995: Carboniferous and Permian plant localities in the Middle Cisural. Permophiles, 27: 13-17..

Gruzman, Y. & Dobruskina, I.1995 Fossil woods from Makhtesh Ramon: Stratigraphy, mineralogy, biology. Annual Meeting of Israeli Geological Society, March 1995: 21.

Dobruskina, I. 1995. Keuper flora from Middle Asia (Madygen, Southern Fergana). New Mexico Museum of Natural History and Science, Bulletin 5: 1-49 p.

Dobruskina, I. 1995. Mesozoic floras of Israel. Annual Meeting of Israeli Geological Society: 20.

Dobruskina, I. 1995. The first review of Israeli fossil floras. International Conference on Diversification and Evolution of Terrestrial Plants in Geological Time, September 4-6, 1995, Nanjing, China:29-30.

Dobruskina, I. 1995. Triassic plants and Pangea. The Paleobotanist, 44:116-127.

Dobruskina, I. 1996. Alpine Triassic floras as standard floras for global correlation. Abstracts of the 30th International Geological Congress in Beijing, China, 4-14 August 1996, 2: 63 .

Dobruskina, I. 1996. An open letter to the Chief of International Stratigraphic Commission Prof. J. Remane. Permophiles, 29: 8.

Dobruskina, I. 1996. Connections of Israeli Upper Cretaceous flora with coeval floras of adjacent regions. Rheedea, 37: 1-15.

Dobruskina, I. 1996. The Gerofit flora and its connections with coeval floras. Annual Meeting of Israeli Geological Society: 21.

Dobruskina, I. & Durante. M.V. 1996. Permian plant localities in the northern Cisurals. Permian plant localities in the southern Cisurals. Permophiles, 28: 25-27.

Dobruskina, I. & Durante. M.V. 1997. Rise and development of Late Palaeozoic phytochoria. Transition from Palaeophytic to Mesophytic. Memorial Conference Dedicated to S. V. Meyen, Abstracts. March 26, 1997, GIN RAS and Moscow Soc. of Naturalists, Moscow: 11-12 [in Russian].

Dobruskina, I. 1997. Turonian plants from the southern Negev, Israel. Cretaceous Research, 17: 1-21.

Dobruskina, I., Pononarenko, A.G. & Rasnitsyn, A.P. 1997. Finds of fossil insects in Israel. Paleontological Journal, 5: 91-95 [in Russian].

Dobruskina, I. & Durante. M.V. 1998. Changes in floral composition, phytogeography and climate around the margins of the Russian Platform from the Carboniferous to the Triassic. Abstracts of the International Symposium Upper Permian Stratotypes of the Volga Region, 28 July-3 August 1998.

Dobruskina, I. 1998. Comparison between Triassic floras of the German Basin and the Alps. Abstracts of the Epicontinental Triassic Symposium, Halle/Saale, Germany, September 21-23, 1998.

Krassilov, V.A. & Dobruskina, I. 1998. A gramminoid plant from the Cretaceous of the Middle East. Paleontological Zhurnal, 4: 106-110 [in Russian].

Krassilov, V.A. & Dobruskina, I. 1998. A gramminoid plant from the Cretaceous of the Middle East. Paleontological Journal, 4: 429-434 (Translation from Paleontological Zhurnal, 4: 106-110).

Dobruskina, I. 1998. Lunz flora in the Austrian Alps-a standard for Carnian floras. -Palaeogeography, Palaeoclimatology, Palaeoecology, 143: 307-346.

Dobruskina, I. 1999. Final Discussion of the International Symposium “Upper Permian Stratotypes of the Volga Region” (August, 2, 1998). Proceedings of International Symposium Upper Permian Stratotypes of the Volga Region, 28 July-3 August 1998, Kazan State University, Tatarstan, Russia: 370-374 [in Russian], 374-377 [in English].

Dobruskina, I., Jurkovsek, B. & Kolar-Jurkovsek, T. 1999: Upper Ctretaceous flora of Slovenia. Annals for Istran and

Mediterranean Studies 17/ 99, Series Historia Naturalis, 9: 243-268.

Lugardon, L. Grauvogel-Stamm, and Dobruskina, I. 1999. The microspores of *Pleuromeia rossica* Neuburg (Lycopsida; Triassic): Comparative ultrastructure and phylogenetic implications. - C.R. Acad. Sci. Paris. Sciences de la Terre et des Planets/ Earth & Planetary Sciences, 329: 435-442. With Bernard Lugardon and Lea Graufogel-Stamm.

Lugardon, L. Grauvogel-Stamm, and Dobruskina, I. 2000. Comparative ultrastructure of the megaspores of the Triassic lycopsid *Pleuromeia rossica* Neuburg. - C.R. Acad. Sci. Paris. Sciences de la Terre et des Planets/ Earth & Planetary Sciences, 330: 501-508.

Dobruskina, I. 2000. Levant in the geological past: A bridge or a barrier? Bull. MOIP, otd. geol., 75: 3-12 [in Russian].

Dobruskina, I., Jurkovsek, B., and Kolar-Jurkovsek, T. 2001. Upper Triassic flora from 'Raibl Beds' of Julian Alps (Italy) and Karavanke Mts. (Slovenia). Geologija, Vol. 44(2): 263-290.

NEW TRIASSIC LITERATURE

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PART I

New Triassic literature dated pre-2012 but not included in earlier issues of Albertiana.

Alifanov, V.R. & Kurochkin, E.N. 2011. *Kyrgyzsaurus bukhanchenkoi* gen. et sp. nov., a new reptile from the Triassic of southwestern Kyrgyzstan. Paleontological Journal, 45(6): 639-647.

Auton, C., Merritt, J. & Goodenough, K. 2011. Moray and Caithness. A Landscape Fashioned by Geology. Perth: Scottish Natural Heritage, 73pp.

Avanzini, M., Petti, F.M., Bernardi, M. & Tomasoni, R. 2010. Crocodyle-like footprints from the Upper Triassic (Carnian) of the Italian southern Alps. *In*, Milàn, J., Lucas, S.G., Lockley, M.G. & Spielmann, J.A. (eds), Crocodyle tracks and traces. New Mexico Museum of Natural History & Science Bulletin 51: 61-64.

Bai Dao-yuan, Ni Yan-jun, Li Song-wen, Ma Tie-qiu, Wang Xian-hui, Peng Yun-yi & Li Gang. 2009. Jiangnan orogenic belt in northern Early Mesozoic Yueyang–Chibi fault-fold belt: deformation mechanism of tectonic features and research. Geology in China, 2009/5: 996-1009.

Bailey, R.J. 2009. Cyclostratigraphic reasoning and orbital time calibration. Terra Nova, 21(5): 340–351.

Bailey, R.J. & Smith, D.G. 2008. Quantitative tests for stratigraphic cyclicity. Geological Journal, 43(4): 431-446.

Barron, A.J.M., Sheppard, T.H., Gallois, R.W., Hobbs, P.R.N. & Smith, N.J.P. 2011. Geology of the Bath district – a brief explanation of the geological map. Sheet Explanation of the British Geological Survey, 1:50 000 Sheet 265 Bath (England and Wales). Keyworth, Nottingham: British Geological Survey, ii+35pp.

Barth, G. & Kozur, H.W. 2011. A latest Norian age for insect-bearing beds of the Fuchsberg and Langenberg near Seinstedt, northern foreland of the Harz Mountains (lower Saxony, Germany). *In*, Sullivan, R.M., Lucas, S.G. & Spielmann, J.A. (eds), Fossil Record 3. New Mexico Museum of Natural History & Science Bulletin 53: 157-165.

Bechly, G. & Stockar, R. 2011. The first Mesozoic record of the extinct apterygote insect genus *Dasyleptes* (Insecta: Archaeognatha: Monura: Dasyleptidae) from the Triassic of Monte San Giorgio (Switzerland). Palaeodiversity, 4(1): 23-37.

Bensalah, M.K., Youbi1, N., Mahmoudi, A., Bertrand, H., Mata, J., El Hachimi, H., Madeira, J., Martins, L., Marzoli, A., Bellon, H., Medina, F., Karroum, M., Karroum, L.A. & Ben Abbou, M. 2011. The Central Atlantic Magmatic Province (CAMP) volcanic sequences of Berrechid and Doukkala basins (Western Meseta, Morocco): volcanology and geochemistry. Comunicações Geológicas, 98: 15-27.

Benson, R.B.J. & Butler, R.J. 2011. Uncovering the diversification history of marine tetrapods: ecology influences the effect of geological sampling biases. Geological Society, London, Special Publications, 358: 191-208.

Benton, M.J. 2011. Archosaur remains from the Otter Sandstone Formation (Middle Triassic, late Anisian) of Devon, southern UK. Proceedings of the Geologists' Association, 122(1): 25-33.

Benton, M.J., Dunhill, A.M., Lloyd, G.T. & Marx, F.G. 2011. Assessing the quality of the fossil record: insights from vertebrates. Geological Society, London, Special Publications, 358: 63-94.

Bernardi, M., Avanzini, M. & Bizzarini, F. 2011. Vertebrate fauna from the San Cassiano Formation (Early Carnian) of the Dolomites region. Geo.Alp, 8: 122–127.

Bernardi, M., Petti, F.M. & Avanzini, M. 2010. A webbed archosaur footprint from the Upper Triassic (Carnian) of the Italian southern Alps. *In*, Milàn, J., Lucas, S.G., Lockley, M.G. & Spielmann, J.A. (eds), Crocodyle tracks and traces. New Mexico Museum of Natural History & Science Bulletin 51: 65-68.

Bozkaya, Ö., Yalçin, H. & Kozlu, H. 2011. Clay mineralogy of the Paleozoic-Lower Mesozoic sedimentary sequence from the northern part of the Arabian Platform, Hazro (Diyarbakir, Southeast Anatolia). Geologica Carpathica, 62(6): 489-500.

Bragin, N.Yu. 2011. Triassic radiolarians of Kotel'nyi Island (New Siberian Islands, Arctic). Paleontological Journal, 45(7): 711-778.

Bragin, N.Yu., Bragina, L.G., Djerić, N. & Toljić, M. 2011. Triassic and Jurassic radiolarians from sedimentary blocks of ophiolitic mélange in the Avala Gora area (Belgrade surroundings, Serbia). Stratigraphy and Geological

Correlation, 19(6): 631-640.

Brandner, R. & Keim, L. 2011. A 4-day geological field trip in the western Dolomites. Geo.Alp, 8: 76–118.

Chang Jin-xiang, Guo Tong-lou, Tan Qin-yin, Wang Rui-hua & Zhang Qing-hong. 2011. Characteristics and controlling factors of the reef shoal reservoirs from the Changxing Formation-Feixianguan Formation in the Xuanhan-Daxian zone, northeastern Sichuan. Sedimentary Geology and Tethyan Geology, 31(3): 64-70.

Chatalov. A. 2010. Depositional environment of the Middle Triassic carbonate rocks from Granitovo strip. Northwestern Bulgaria. Review of the Bulgarian Geological Society, 71(1-3): 83-111.

Chen Fei, Luo Ping, Zhang Xingyang, Wang Xunlian, Luo Zhong, Fan Tailiang, Liu Liuhong & Shan Wei. 2010. Stratigraphic architecture and sequence stratigraphy of Upper Triassic Yanchang Formation in the eastern margin of Ordos Basin. Earth Science Frontiers, 17(1): 330-338.

Chen Fei, Luo Ping, Zhang Xing-yang, Wang Xun-lian, Luo Zhong & Liu Liu-hong. 2010. Characteristics of the grain size of delta sandbody framework in Yanchang Formation, Upper Triassic, north Shaanxi. Acta Sedimentologica Sinica, 28(1): 58-67.

Chen Liu-qin, Guo Rong-tao & Zhong Yan. 2011. Jingmen–When Triassic sedimentary basin with the structural characteristics and tectonic control. Geology in China, 2011/6: 1446-1453.

Chen Mei. 2011. Application of carbon and oxygen isotope to carbonate reservoirs in northeast Sichuan Basin. Acta Sedimentologica Sinica, 29(2): 217-225.

Chen Xiao-hong & Chang Long. 2010. A new species of *Mixosaurus* (Reptilia: Ichthyosauria) from the Middle Triassic of Pu'an, Guizhou, China. Acta Palaeontologica Sinica, 49(2): 251-260.

Chen Xu. 2011. Identification and application of sequence boundaries and system tract boundaries for the Triassic of Tarim Basin. Acta Sedimentologica Sinica, 29(5): 917-925.

Cherns, L. & Wright, V.P. 2011. Skeletal mineralogy and biodiversity of marine invertebrates: size matters more than seawater chemistry. Geological Society, London, Special Publications, 358: 9-17.

Chiochinni, M., Chiochinni, R.A., Didaskalou, P. & Potetti, M. 2008. Microbiostratigraphia del Triassico superiore, Giurassico e Cretacio in facies di piattaforma carbonatica del Lazio centro-meridionale e Abruzzo: revisione finale. Memorie descrittive della Carta Geologica d'Italia, 84: 5-169.

Dai Li-guo, Zheng Rong-cai, Li Shuang, Zheng Chao & Hu Zhing-gui. 2009. East Sichuan–Yubei district Feixianguan sequence – lithofacies paleogeography. Geology in China, 2009/1: 110-119.

De Almeida Garcia, M., Ribeiro, H.J.P.S., de Souza, E.S. & Triguis, J.A. 2011. Correlação entre a faciológia e a geoquímica orgânica dos Tar Sands da Formação Pirambóia Triássico da Bacia do Paraná, Fazenda Betumita no Estado de São Paulo. Geociências, 30(3): 357-369.

Desojo, J.B. & Ezcurra, M.D. 2011. A reappraisal of the taxonomic status of *Aetosauroides* (Archosauria, Aetosauria) specimens from the Late Triassic of South America and their proposed synonymy with *Stagonolepis*. Journal of Vertebrate Paleontology, 31(3): 596-609.

Didenko, A.N. 2011. Possible causes of quasiperiodic variations in geomagnetic reversal frequency and ^{87}Sr/^{86}Sr ratios in marine carbonates through the Phanerozoic. Russian Geology and Geophysics, 52(12): 1530-1538.

Diedrich, C.G. 2011. The shallow marine placodont *Cyamodus* of the central European Germanic Basin: its evolution, paleobiogeography and paleoecology. Historical Biology, 23(4): 391-409.

Ding Xiao-qi. 2011. Research on diagenesis system of Yanchang Formation reservoirs, southeast Ordos Basin. Acta Sedimentologica Sinica, 29(1): 97-104.

Dixon, J. 2011. A review of the character and interpreted origins of thick, mudstone-encased sandstone bodies in the Middle Triassic Doig Formation of Western Canada. Bulletin of Canadian Petroleum Geology, 59(3): 261-276.

Duam Yi. 2011. Geochemical characteristics and genesis of crude oil from Dongzhi Zhengning area of Ordos Basin. Acta Sedimentologica Sinica, 29(5): 1002-1009.

Dou Wei-tan, Liu Xin-she, Luo Jing-lan, Du Jin-liang & Wang Tao. 2010. Relationship of slope-break, slope type with hydrocarbon pool-forming of the Upper Triassic from Jiyuan area, the northwestern Ordos Basin. Acta Sedimentologica Sinica, 28(6): 1129-1134.

Fan Li, Jiang Yu-qiang, Ge Zhong-wei, Shen Zhao-guo & Yang Jin-li. 2010. The comparison study on oil – gas source features of Upper Triassic and Middle to Lower Jurassic reservoirs in Yingshan area, Sichuan Province. Journal of Geology and Mineral Resources of South China, 2010(1): 60-67.

Fu Qiang & Li Yi, 2010. Characteristics of slope breaks and its implication on petroleum geology in Yanchang Formation Chang 6 (Late-Triassic) of Ordos Basin. Acta Sedimentologica Sinica, 28(2): 294-298.

Fu Suo-tang, Deng Xiu-qin & Pang Jin-lian. 2010. Characteristics and mechanism of thick sandbody of Yanchang Formation at the centre of Ordos Basin. Acta Sedimentologica Sinica, 28(6): 1081-1089.

Fugagnoli, A. & Posenato, R. 2004. Middle Triassic (Anisian) benthic Foraminifera from Monte Pra' della Vacca/Kühwiesenkopf section (Dont Formation, Braies Dolomites, Northern Italy). Bollettino della Società Paleontologica Italiana, 44(3): 347-360.

Gale, L., Rettori, R., Martini, R., Šmuc, A., Kolar-Jurkovšek, T. & Rožič, B. 2011. Duostominidae (Foraminiferea, Robertinida) from the Upper Triassic beds of the Slovenian Basin (Southern Alps, Slovenia). Rivista Italiana di Paleontologia e Stratigrafia, 117(3): 375-397.

Gallego, O.F., Rébori, L., Zavattieri, M., Sinitshenkova, N., Lara, M.B. & Martins-Neto, R.G. 2011. The most ancient platyperlidae (Insecta, Perlida = Pecoptera) from early Late Triassic deposits of southern South America. Ameghiniana, 48(4): 447-461

Gallois, R.W. 2011. Natural and artificial influences on coastal erosion at Sidmouth, Devon, UK. Geoscience in South-West England, 12(4): 304-312.

Ghosh, P. & Sarkar, S. 2011. Pedogenic and sedimentologic criteria for recognition of overbank sub-environments in a Triassic anabranching-river deposit. SEPM Special Publications, 97: 125-142.

Gong Qing-shun. 2010. Characteristics of alluvial fan in Baikouguan Formation of Wuerhe oil field in Junggar Basin and petroleum propecting significance. Acta Sedimentologica Sinica, 28(6): 1135-1144.

Goodenough, K. & Bradwell, T. 2004. Rum and the Small Isles. A Landscape Fashioned by Geology. Perth: Scottish Natural Heritage, 39pp.

Goswami, B. & Ghosh, D. 2011. Understanding the transportational and depositional setting of Panchet Formation, Purulia and Bankura districts of West Bengal, India – evidence from grain size analysis. Frontiers of Earth Science, 5(2): 138-149.

Guo De-yun, Guo Yan-qin, Li Wen-hou, Li Ke-yong & Long Li-ping. 2010. Diagenesis and pore structure characteristic of Yanchang Formation of Upper Triassic in Fuxian exploration area. Acta Sedimentologica Sinica, 28(2): 264-273.

Guo Ji An, Pang Jun Gang, Wang Gui Cheng, Li Wen Hou, Chen Quan Hong & Cao Hong Xia. 2010. Lake basin evolution and petroleum accumulation of Late Triassic Yanchang Formation in Ordos Basin. Global Geology (Changchun), 2010/30(2): 277-283, 291.

Hagdorn, H. 2011. Benthic crinoids from the Triassic Cassian Formation of the Dolomites. Geo.Alp, 8: 128–135.

Hagdorn, H. & Mutter, R.J. 2011. The vertebrate fauna of the Lower Keuper Albertibank (Erfurt Formation, Middle Triassic) in the vicinity of Schwäbisch Hall (Baden-Württemberg, Germany). Palaeodiversity 4: 223-243.

Han Tian-you, Li Hui, Li Wen-hou, Tian Yong-qiang, Liu Guang-lin, Ma Hai-yong & Li Ji-hong. 2011. Distribution characteristics and geological significance of U-Pb age of detrital zircon in Yanchang Formation of Yanhe strata section of Ordos Basin. Northwestern Geology, 44(1): 105-111.

Han Yong-lin, Wang Cheng-yu, Wang Hai-hong, LI Shi-chun, Zheng Rong-cai, Wang Chang-yong & Liao Yi 2009. Sedimentary characteristics of shallow-water deltas in Chang-8 subsection of Yanchang Formation, Jiyuan area. Acta Sedimentologica Sinica, 27(6): 1057-1067.

Han Zhen-zhe, Zhao Hai-ling, Li Juan-juan, Leng Cheng-en, Lu Jun & Li Wen-long. 2010. Yichun area southeast Xiaoxing'anling early Mesozoic granites and polymetallic mineralization. Geology in China, 2010/1: 74-87.

Hanlie Hong, Shucheng Xie & Xulong Lai. 2011. Volcanism in association with the prelude to mass extinction and environment change across the Permian-Triassic boundary (PTB), southern China. Clays and Clay Minerals, 59(5): 478-489.

Hansen, J.-A., Bergh, S.G. & Henningsen, T. 2011. Mesozoic rifting and basin evolution on the Lofoten and Vesterålen Margin, North-Norway; time constraints and regional implications. Norwegian Journal of Geology, 91(4): 203-228.

Hao Guo Li, Liu Guang Di, Xie Zeng Ye, Yang Wei & Xie Wu Ren. 2010. Distribution and origin of abnormal pressure in Upper Triassic Xujiahe Formation reservoir in central and southern Sichuan. Global Geology (Changchun), 2010/30(2): 298-304.

Hauschke, N. & Kozur, H.W. 2011. Two new conchostracan species from the Late Triassic of the Fuchsberg, northern foreland of the Harz Mountains northeast of Seinstadt (lower Saxony, Germany). *In*, Sullivan, R.M., Lucas, S.G. & Spielmann, J.A. (eds), Fossil Record 3. New Mexico Museum of Natural History & Science Bulletin 53: 187-194.

He Jing. 2011. Effects of provenance on porosity development of Chang 6 Sandstone of the Yanchang Formation in the centre of Ordos Basin. Acta Sedimentologica Sinica, 29(1): 80-87.

Hong You-chong. 2009. First discovery of Mid Triassic Order Miomoptera (Insecta) in China. Geological Bulletin of China, 28(1): 11-15.

Hongfu Yin, Weihong He & Shucheng Xie. 2011. How severe is the modern biotic crisis? – A comparison of global change and biotic crisis between Permian-Triassic transition and modern times. Frontiers of Earth Science, 5(1): 1-13.

Hu Hai-tao, Zhang Zhong-yi, Yu Jian, Song Jiang-hai, Sun Bo, Liu Li-li & Xue Jun-lin. 2011. Evolution and controls of the slope breaks on the Yanchang Formation sandstones in the Ordos Basin: an example from the Chang-6 oil measures of the Yanchang Formation. Sedimentary Geology and Tethyan Geology, 31(2): 43-48.

Hu Ming. 2010. Characteristics of sequence based lithofacies and paleogeography, and reservoir prediction of the Jialingjiang Formation in Sichuan basin. Acta Sedimentologica Sinica, 28(6): 1145-1152.

Hu Pei-yuan, Li Cai, Yang Han-tao, Zhang Hai-bo & Yu Hong. 2010. Characteristic zircon dating and tectonic significance of Late Triassic granite in the Guoganjianianshan area, central Qiangtang, Qinghai-Tibet Plateau, China. Geological Bulletin of China, 29(12): 1825-1832.

Hu Zuo-wei, Huang Si-jing, Huang Ke-ke, Sun Wei & Gong Ye-chao. 2010. Eastern Sichuan Huaying Mountain Triassic marine carbonate rocks on the sea of information preservation assessment. Geology in China, 2010/5: 1374-1382.

Hwang, S.H. 2011. The evolution of dinosaur tooth enamel microstructure. Biological Reviews, 86(1): 183-216.

Ishida, K. & Hirsch, F. 2011. The Triassic conodonts of the NW Malayan Kodiang Limestone revisited: taxonomy and paleogeographic significance. Gondwana Research, 19(1): 22-36.

Ivakhnenko, M.F. 2011. Permian and Triassic therocephals (Eutherapsida) of eastern Europe. Paleontological Journal, 45(9): 981-1144.

James, K.H. 2009. In situ origin of the Caribbean: discussion of data. Geological Society, London, Special Publications, 328: 77-125.

James, K.H. 2009. Evolution of Middle America and the in situ Caribbean Plate model. Geological Society, London, Special Publications, 328: 127-138.

Jasin, B. & Harun, J. 2011. Radiolarian biostratigraphy of Peninsular Malaysia – an update. Bulletin of the Geological Society of Malaysia, 57: 27-38.

Jasinski, S.E. 2011. Biomechanical modelling of *Coelophysis bauri*: possible feeding methods and behaviour of a Late Triassic theropod. *In*, Sullivan, R.M., Lucas, S.G. & Spielmann, J.A. (eds), Fossil Record 3. New Mexico Museum of Natural History & Science Bulletin 53: 195-201.

Jiang Hong Xia, Wu Ya Sheng, Diao Jian Bo & Chen Jian Yang. 2010. A dwarf euomphalid fauna from the Permian-Triassic boundary in Laolongdong, Beibei, Chongqing: opportunity taxa surviving the disaster event? Acta Geoscientica Sinica, 2010/2: 163-169.

Jones, D.W. & Underhill, J.R. 2011. Structural and stratigraphic evolution of the Connemara discovery, Northern Porcupine Basin: significance for basin development and petroleum prospectivity along the Irish Atlantic Margin. Petroleum Geoscience, 17(4): 365-384.

Jones, H. 2011. A Rambler's Guide to Building Stones in Warwickshire. Kenilworth: Warwickshire Geological Conservation Group, 58 pp.

Kammerer, C.F., Angielczyk, K.D. & Fröbisch, J. 2011. A comprehensive taxonomic revision of *Dicynodon* (Therapsida, Anomodontia) and its implications for dicynodont phylogeny, biogeography, and biostratigraphy. Society of Vertebrate Paleontology Memoir 11: 158 pp. (Journal of Vertebrate Paleontology, 31, Supplement 1).

Keim, L. & Kustatscher, E. 2011. Vorwort zu den erweiterten Kurzfassungen vom "Workshop on the Cassian beds (Upper Triassic) 2011". Geo.Alp, 8: 120–121.

Kelber, K.-P. 2009. Lebensbilder der Unterkeuperzeit im Spiegel der paläontologischen Forschung. Veröffentlichungen des Naturhistorischen Museums Schleusingen, 24: 27-52.

Kimmig, J. & Spielmann, J.A. 2011. Biologic factors influencing phytosaur (Archosauria: Phytosauridae) taxonomy: a prospectus. *In*, Sullivan, R.M., Lucas, S.G. & Spielmann, J.A. (eds), Fossil Record 3. New Mexico Museum of Natural History & Science Bulletin 53: 289-294.

Klein, H. & Lucas, S.G. 2010. Review of the tetrapod ichnofauna of the Moenkopi Formation/Group (Early-Middle Triassic) of the American Southwest. New Mexico Museum of Natural History & Science Bulletin 50: ii+ 67 pp.

Klein, H. & Lucas, S.G. 2010. The Triassic footprint record of crocodylomorphs – a critical re-evaluation. *In*, Milàn, J., Lucas, S.G., Lockley, M.G. & Spielmann, J.A. (eds), Crocodyle tracks and traces. New Mexico Museum of Natural History & Science Bulletin 51: 55-60

Kolar-Jurkovšek, T., Jurkovšek, B., Aljinovič, D. & Nestell, G. 2011. Stratigraphy of the Upper Permian and Lower Triassic strata of the Žiri area, (Slovenia). Geologija, 54(2): 193-204.

Kovacs, S., Sudar, M., Gradinaru, E., Gawlick, H.-J., Karamata, S., Haas, J., Péró, C., Gaetani, M., Mello, J., Polak, M., Aljinovic, D., Ogorelec, B., Kolar-Jurkovšek, T., Jurkovšek, B. & Buser, S. 2011. Triassic evolution of the tectonostratigraphic units of the circum-Pannonian region. Jahrbuch der Geologischen Bundesanstalt, 151(3-4) 199-280.

Kozur, H.W. & Weems, R.E. 2011. Additions to the uppermost Alaunian through Rhaetian (Triassic) conchostracan zonation of North America. *In*, Sullivan, R.M., Lucas, S.G. & Spielmann, J.A. (eds), Fossil Record 3. New Mexico Museum of Natural History & Science Bulletin 53: 295-200.

Kroh, A. 2011. Echinoids from the Triassic of St. Cassian – a review. Geo.Alp, 8: 136–140.

Kroh, A., Nichterl, T. & Lukeneder, A. 2011. Type specimens from the Cassian Beds in the collection of the NHM Vienna. Geo.Alp, 8: 142–145.

Kubo, T. 2011. Evolution of bipedality and herbivory among Triassic dinosauromorphs. Memoir of the Fukui Prefectural Dinosaur Museum, 10: 55-62.

Kustatscher, E., Bizzarrini, F. & Roghi, G. 2011. Plant fossils from the Cassian Beds and other Carnian formations of the southern Alps (Italy). Geo.Alp, 8: 146–155.

Kustatscher, E., Pott, C. & van Konijnenburg-van Cittert, J.H.A. 2011. *Scytophyllum waehneri* (Stur) nov. comb., the correct name for *Scytophyllum persicum* (Schenk) Kilpper, 1975. Zitteliana, 51: 9-18.

Kustatscher, E. & van Konijnenburg-van Cittert, J.H.A. 2005. The Ladinian flora (Middle Triassic) of the Dolomites: paleoenvironmental reconstructions and palaeoclimatic considerations. Geo.Alp, 2: 31-51.

Langer, M.C., Ezcurra, M.D., Bittencourt, J.S. & Novas, F.E. 2010. The origin and early evolution of dinosaurs. Biological Reviews, 85(1): 55-110.

Lecuona, A. & Desojo, J.B. 2011. Hind limb osteology of *Gracilisuchus stipanicicorum* (Archosauria: Pseudosuchia). Earth and Environmental Science Transactions of the Royal Society of Edinburgh, 102(2): 105-128.

Leitner, C. & Neubauer, F. 2011. Tectonic significance of structures within the salt deposits Altaussee and Berchtesgaden-Bad Dürnberg, Northern Calcareous Alps. Austrian Journal of Earth Sciences, 104(2): 2-21.

Li Cong, Chen Shi-yue, Zhang Peng-fei, Yang Huai-yu & Chen Li-hua. 2011. The multiphase composite orogenic Lu Xuefeng Aurora – Triassic sedimentary evolution. Geology in China, 2011/1: 43-51.

Li Fei, Wang Xia, Xue Wu-qiang & Yan Jia-xin. 2010. Origin and environmental significance of giant ooids in the Early Triassic: a new kind of anachronistic facies. Acta Sedimentologica Sinica, 28(3): 585-595.

Li Kuan-liang, Zhang Wei & Tian Jing. 2011. Influential factors and characteristics of Chang 6 Bed reservoir in Baliangou-Jinzhuang area of Nanniwan oil field, Ordos Basin. Northwestern Geology, 44(4): 132-139.

Li Mei Luo, Liu Chu Xiong, Jiang Da Yong, Hao Wei Cheng, Sun Yuan Lin & Sun Zuo Yu. 2011. The analysis of microfacies and palaeoenvironment reconstruction of Panxian fauna from the Guanling Formation (Middle Triassic) of Xinmin, Panxian County, Guizhou. Earth Science Frontiers, 18(6): 329-340.

Li Sheng-yong, Fu Heng, Li Zhong-dong, Li Xiu-hua & Da Li-ya. 2011. Morphology and genesis of the solid bitumen from the Changxing Formation-Feixianguan Formation in northeastern Sichuan. Sedimentary Geology and Tethyan Geology, 31(1): 72-79.

Li Shu-tong. 2011. Genetic type of oil and gas accumulation paleogeography and favourable conditions for petroleum accumulation: taking the paleogeomorphology of pre-Jurassic in Shangliyuan area, Ordos Basin as an example. Acta Sedimentologica Sinica, 29(5): 962-969.

Li Wei, Zou Cai-neng, Yang Jin-li, Wang Kun, Yang Jia-jing, Wu Ya-dong & Gao Xiao-hui. 2010. Types and controlling factors of accumulation and high productivity in the Upper Triassic Xujiahe Formation gas reservoirs, Sichuan Basin. Acta Sedimentologica Sinica, 28(5): 1037-1045.

Li Xiang-bo. 2010. Characteristics of slope break belt in large depression lacustrine basin and its controlling effect on sandbody and petroleum: taking the Triassic Yanchang Formation in Ordos Basin as an example. Acta Sedimentologica Sinica, 28(4): 717-729.

Li Xiang-bo, Liu Hua-qing, Chen Qi-lin, Wanyan Rong, Wei Li-hua, Feng Ming, Liao Jian-bo & Ma Yu-hu. 2010. Characteristics of slope break belt in large depression lacustrine basin and its controlling effect on sandbody and petroleum: taking the Triassic Yanchang Formation in the Ordos Basin as an example. Acta Sedimentologica Sinica, 28(4): 717-729.

Li Yan-jun, Zhang Wen-ji, Li Qi-rong, Zhang Ben-jian, Long Hui & Ma yan-liang. 2010. Triassic Xujiahe genetic types and sources of natural gas on the Luzhou. Geology in China, 2010/6: 1747-1752.

Li Yong, Bao Zhi-dong & Hu Guang-cheng. 2011. Sedimentary facies and palaeogeography of the middle-upper Yangtze area during the Leikoupoan (Middle Triassic). Sedimentary Geology and Tethyan Geology, 31(3): 20-27.

Liao Yi. 2010. Analysis of high resolution sequence stratigraphy in Chang 8 subsection of Yanchang Formation, Jiyuan area of Ordos Basin. Acta Sedimentologica Sinica, 28(3): 481-488.

Liao Yi, Zheng Rong-cai, Wang Cheng-yu, Wang Hai-hong, Han Yong-lin & Wang Chang-yong. 2010. Analysis of high-resolution sequence stratigraphy in Chang-8 subsection of Yanchang Formation, Jiyuan area of Ordos Basin. Acta Sedimentologica Sinica, 28(3): 481-488.

Liu Chun Yan, Wang Yi, Hu Zong Quan, Yin Wei, Wang Chuan Gang & Li Song. 2009. Depositional features and properties analysis of Yanchang Formation in Fuxian area, Ordos Basin. Global Geology (Changchun), 2009/29(4): 491-497.

Liu Liang-gang, Luo Shun-she, Wu Yuan & Liu Qi-liang. 2011. Diagenesis of the reservoir sandstones from the Chang 4 + 5 member in the Fengdikeng-Hongde region, Ordos Basin. Sedimentary Geology and Tethyan Geology, 31(1): 85-88.

Liu Xin & Fu Heng. 2011. Sequence stratigraphy of the Feixianguan Formation in the Yuanba gas field, northeastern Sichuan. Sedimentary Geology and Tethyan Geology, 31(1): 42-47.

Liu Xin-chun, Chen Xiao-zheng, Ye Fa-heng, Liu Jing, Wang Yue, Liao Zhuo-ting, Qi Yu-ping, Zheng Quan-feng & Wang Wei. 2010. Surface microstructures of the microbialite around Permo-Triassic boundary, NE Sichuan, China. Acta Palaeontologica Sinica, 49(2): 261-268.

Liu Yin, Li Rong-she, Ji Wen-hua, Pan Shu-juan, Shi Chao, Chen Fen-ning, Chen Shou-jin & Zhao Zhen-ming. 2010. Definition and significance of Permian-Triassic magmatic arc at Dangjiangrong, south of Duocai ophiolite mélange zone in the Zhiduo area, Qinhai, China. Geological Bulletin of China, 29(12): 1840-1850.

Lockley, M.G., Gierlinski, G.D. & Lucas, S.G. 2011. *Kayentapus* revisited: notes on the type material and the importance of this theropod footprint ichnogenus. *In*, Sullivan, R.M., Lucas, S.G. & Spielmann, J.A. (eds), Fossil Record 3. New Mexico Museum of Natural History & Science Bulletin 53: 330-336.

Lockley, M.G., Hups, K. & Gerwe, S. 2011. A zone of sauropodomorph footprints in the basal Wingate Sandstone (latest Triassic) of western Colorado and eastern Utah: is *Eosauropus* a common ichnogenus in this region? *In*, Sullivan, R.M., Lucas, S.G. & Spielmann, J.A. (eds), Fossil Record 3. New Mexico Museum of Natural History & Science Bulletin 53: 337-343.

Lombardo, C., Sun, Z., Tintori, A., Jiang, D. & Hao, W. 2011. A new species of the genus *Perleidus* (Actinopterygii: Perleidiformes) from the Middle Triassic of Southern China. Bollettino della Società Paleontologica Italiana, 50(2): 75-83.

Long, C., Xiaohong, C., Baomin, Z. & Yongjian, C. 2011. A new study of *Anshunsaurus huangnihensis* Cheng, 2007 (Reptilia: Thalattosauria): revealing its transitional position in Askeptosauridae. Acta Geologica Sinica, 85(6): 1231-1237.

Lu Jin-bo, Wang Ying-min, Zhang Lei & Wang Gai-yun. 2011. Sandstone distribution and prediction of the favourable zones in the Triassic lower oil measures in the Julianpian region along the Tarim River, Xinjiang. Sedimentary Geology and Tethyan Geology, 31(1): 53-58.

Lucas, S.G. & Heckert, A.B. 2011. Late Triassic aetosaurs as the trackmaker of the tetrapod footprint ichnotaxon *Brachychirotherium*. Ichnos 18(4): 197-208.

Lutz, A., Gnaedinger, S., Mancuso, A. & Crisafulli, A. 2011. Paleoflora from the Los Rastros Formation (Middle Triassic), San Juan Province, Argentina. Taxonomic and taphonomic considerations. Ameghiniana, 48(4): 568-588.

Ma De-sheng, Xiong Xing-guo, Jiang Kai-yuan, Li Yue-sen, Long Sheng-qing & Zeng Yu-ren. 2011. The discovery of the Upper Triassic strata in Bangong CoNujiang junction zone of Gerze area in Tibet and its significance. Geological Bulletin of China, 30(11): 1701-1705.

Ma De-wen. 2011. Analysis of evolution of abnormal high formation pressure in gas fields of Upper Triassic Xujiahe Formation, central Sichuan Basin. Acta Sedimentologica Sinica, 29(5): 953-961.

Mang Ben-hao, Wu Bai-lin, Liu Chi-yang & Qin Xin-wei. 2011. Occurrence of uranium in hydrocarbon of Chang-7 Member of Yanchang Formation of Ordos Basin. Northwestern Geology, 44(2): 124-132.

Mannion, P.D., Upchurch, P., Carrano, M.T. & Barrett, P.M. 2011. Testing the effect of the rock record on diversity: a multidisciplinary approach to elucidating the generic richness of sauropodomorph dinosaurs through time. Biological Reviews, 86(1): 157-181.

Matzke, A.T. & Maisch, M.W. 2011. The first aetosaurid archosaur from the Trossingen Plateosaurus Quarry (Upper Triassic, Germany). Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 262(3): 354-357.

McGowan, A.J. & Smith, A.B. (eds). 2011. Comparing the Geological and Fossil Records: Implications for Biodiversity Studies. Geological Society, London, Special Publications, 358: 247 pp.

Mei Mingxiang. 2010. Stratigraphic impact of the Indo-China movement and its related evolution of sedimentary-basin pattern of the Late Triassic in the middle-upper Yangtze region, South China. Earth Science Frontiers, 17(4): 99-111.

Metcalfe, I. 2011. Tectonic framework and Phanerozoic evolution of Sundaland. Gondwana Research, 19(1): 3-21.

Michalik, J. 2011. Mesozoic paleogeography and facies distribution in the northern Mediterranean Tethys from western Carpathians view. Iranian Journal of Earth Science, 3(1): 10-19.

Milàn, J., Lucas, S.G., Lockley, M.G. & Spielmann, J.A. (eds). 2010. Crocodyle tracks and traces. New Mexico Museum of Natural History & Science Bulletin 51: iv+ 244 pp.

Mitchell, W.I., Cooper, M.R., McKeever, P.J., & McConnell, B. 2010. The Classic Geology of the North of Ireland. Belfast: Geological Survey of Northern Ireland, xii+ 94 pp.

Mohr, B.A.R., Kustatscher, E., Hiller, C. & Böhme, G. 2008. Hugo Rühle von Lillenstern and his palaeobotanical collection – an East-West German story. Earth Sciences History, 27: 278-296.

Morato, L., Schultz, C.L., Vega Dias, C. & Da Silva, F.P. 2008. Discussion of a myth: biomechanical comparisons between *Dinodontosaurus* (Synapsida, Dicynodontia) and extinct ground sloths. Arquivos do Museu Nacional (Rio de Janiero), 66(1): 145-154.

Morel, E.M., Artabe, A.E., Ganuza, D.G. & Zúñiga, A. 2011. The Triassic paleoflora of Cerra Cachueta, Mendoza Province, Argentina. Petriellales, Cycadales, Ginkgoales, Voltziales, Coniferales, Gnetales and Gymnosperms incertae sedis. Ameghiniana, 48(4): 520-540.

Nikishin, V.A., Malyshev, N.A., Nikishin, A.M. & Obmetko, V.V. 2011. The Late Permian-Triassic system of rifts of the South Kara sedimentary basin. Moscow University Geology Bulletin, 66(6): 377-384.

Niu Xin Sheng, Wang Cheng Shan & Zhang Yu Xiu. 2010. Carbonate debris flow deposition from Devonian to Triassic in Bailongjiang uplift, Songpa area and its palaeogeographical implications. Global Geology (Changchun), 2010/30(1): 33-44.

Nupur, B. & Neelam, D. 2011. Further report on megaspores from the Triassic of Nidpur, Madhya Pradesh, India. Acta Palaeobotanica, 51(2): 107-125.

O'Connor, A., Moncrieff, C. & Wills, M.A. 2011. Variation in stratigraphic congruence (GER) through the Phanerozoic and across higher taxa is partially determined by sources of bias. Geological Society, London, Special Publications, 358: 31-52.

Ogorelec, B. 2011. Mikrofacies mezosojskih karbonatnih kamnin slovenije. Geologija, 54(3): 1-136.

Othman, A.R. & Leman, M.S. 2010. Middle Triassic ammonoid fossils from Aring, Kelantan, Malaysia. Bulletin of the Geological Society of Malaysia, 56: 53-59.

Ouyang Shu, Ji Liu-xiang & Luo Wei. 2011. Early Triassic spore-pollen assemblages from the Hongshuichuan Group of central – western Qinghai. Acta Palaeontologica Sinica, 50(2): 187-218.

Partouazar, M.R. 2010. The study of Permian-Triassic boundary in Esfeh section, NE Shahreza (central Iran). Geosciences (Iran), 19(75): 13-18.

Qian Li-jun, Shi Zhi-qiang, Li Zhi-wu & Ou Li-hua. 2010. Fossil wood of the upper Triassic Xujiahe Formation on the western margin of Sichuan Basin: implication for palaeoclimate. Acta Sedimentologica Sinica, 28(2): 324-330.

Qiang Kun-sheng, Wang Jian-min, Feng Yong-chun, Tian Xin-wen, Gao Ya-gong, Yang Jie & Lu Xiu-xiang. 2011. Origin of extra-low permeability and controlling factors of the Chang-6 reservoirs in the Yongning prospect area, Zhidan oil field, Ordos Basin. Sedimentary Geology and Tethyan Geology, 31(2): 82-90.

Qiao Zhan-feng. 2010. Characteristics and evolution model of sequence stratigraphy of Feixianguan Formation in northeast of Sichuan Basin. Acta Sedimentologica Sinica, 28(3): 462-470.

Qiu Xin-wei, Liu Chi-yang, Li Yuan-hao, Mao Guang-zhou & Wang Jian-qiang. 2009. Distribution characteristics and geological significances of tuff interlayers in Yanchang Formation of Ordos Basin. Acta Sedimentologica Sinica, 27(6): 1138-1146.

Qiu Xin-wei, Liu Chi-yang, Mao Guang-zhou, Deng Zuo & Wang Fei-gei. 2010. Enrichment feature of thorium elements in tuff interlayers of Upper Triassic Yanchang Formation in Ordos Basin, China. Geological Bulletin of China, 29(8): 1185-1191.

Radley, J.D. 2011. Biostratinomic signature of Penarth Group (Upper Triassic) shell concentrations (Severn Estuary, South-West England): a preliminary account. Geoscience in South-West England, 12(4): 351-355.

Rashidi, K. & Senobari-Daryan, B. 2011. Sponges from a section of the Upper Triassic Nayband Formation, northeast of Esfahan, central Iran. Annalen des Naturhistorischen Museums in Wien, Serie A, 113: 309-371.

Ratschbacher, L., Franz, L., Myo Min, Bachmann, R., Martens, U., Stanek, K., Stübner, K., Nelson, B.K., Herrmann, U., Weber, B., López-Martínez, M., Jonckherre, R., Sperner, B., Tichomirova, M., McWilliams, M.O., Gordon, M., Meschede, M. & Bock, P. 2009. The North American – Caribbean Plate boundary in Mexico – Guatemala – Honduras. Geological Society, London, Special Publications, 328: 219-293.

Rein. S. 2008. "Black layer" bei *Ceratites* – eine Fehldiagnose und ihre Konsequenzen. Veröffentlichungen des Naturhistorischen Museums Schleusingen, 23: 87-94.

Rein, S. & Werneburg, R. 2010. *Parapinacoceras* und *Gymnites* (Ammonoidea) aus der *enodis*/*posseckeri*-zone im Oberen Muschelkalk (Mitteltrias, Ladin) Thüringens. Semana (Veröffentlichungen des Naturhistorischen Museums Schleusingen), 25: 87-100.

Rinehart, L.F., Lucas, S.G., Heckert, B., Spielmann, J.A. & Celeskey, M.D. 2009. Paleobiology of *Coelophysis baueri* (Cope) from the Upper Triassic (Apachean) Whitaker quarry, New Mexico, with detailed analysis of a single quarry block. New Mexico Museum of Natural History & Science Bulletin, 45: 260 pp.

Roghi, G., Kustatscher, E. & van Konijnenburg-van Cittert, J.H.A. 2006. Late Triassic plants from the Julian Alps (Italy). Bollettino della Società Paleontologica Italiana, 45(1): 133-140.

Ros, S. & Echevarría, J. 2011. Bivalves and evolutionary resilience: old skills and new strategies to recover from the P/T and T/J extinction events. Historical Biology, 23(4): 411-429.

Sánchez-Beristain, F. & López-Esquivel Kranksith, L. 2011. Análisis geoquímico (elementos mayores, menores, traza, $\delta^{13}C$, $\delta^{18}O$ y tierras raras) de microbialitas selectas provenientes de la Formación San Casiano (Triásico Medio – Superior, NE de Italia). Boletin de la Sociedad Geológica Mexicana, 63(3): 399-420.

Schlagintweit, F. 2011. Taxonomic revision of Late Triassic "*Lithocodium aggregatum* Elliott" (Northern Calcareous Alps, Austria). Jahrbuch der Geologischen Bundesanstalt, 151(3-4): 375-396.

Schindler, T., Uhl, D., Schoch, R. & Wuttke, M. 2009. Die Fossilgemeinschaften des Buntsandsteins und des basalen Muschelkalks in der Pfalz – Abbilder einer stufenweisen Floren-/Faunen Erholung nach der Perm-Trias-Krise? Mitteilungen der Pollichia, 94: 11-37.

Schoch, R.R. 2011. Tracing Seemann's dinosaur excavation in the Upper Triassic of Trossingen: his field notes and the present status of the material. Palaeodiversity 4: 245-282.

Schorn, A. & Neubauer, F. 2011. Emplacement of an evaporitic mélange nappe in central Northern Calcareous Alps: evidence from the Moosegg Klippe (Austria). Austrian Journal of Earth Sciences, 104(2): 22-46.

Seidel, G. 2011. Zur Fazies des Zechsteins und der Trias am Thüringer Wald. Semana (Veröffentlichungen des Naturhistorischen Museums Schleusingen), 26: 45-56.

Senowbari-Daryan, B., Rashidi, K., Amirzadeh, M., Saberzadeh, B. & Talebi, A. 2011. Sponges from the Upper Triassic (Norian-Rhaetian) Nayband Formation, northeast Iran. Jahrbuch der Geologischen Bundesanstalt, 151(3-4): 355-374.

Senobari-Daryan, B., Rashidi, K. & Saberzadeh, B. 2011. Dasycladalean green algae and some problematic algae from the Upper Triassic of the Nayband Formation (northeast Iran). Geologica Carpathica, 62(6): 501-517.

Shang Lin, Liu Xu & Bian Bao-li. 2011. Sedimentary facies in the Triassic Karamay Formation, Beisantai, Junggar basin, Xinjiang. Sedimentary Geology and Tethyan Geology, 31(3): 33-38.

Shang Yuke. 2011. Late Triassic palynology of Yunnan and Guizhou, China. Palaeontologica Sinica, New Series A, 16 (Whole Number 196): 276pp.

Shen Zhong-min. 2011. Vertical geochemical characteristics of continental formation water and its water – rock interaction in the middle area of western Sichuan Depression. Acta Sedimentologica Sinica, 29(3): 495-502.

Shucheng Xie & Yongbiao Wang. 2011. Geomicrobiological perspective on the pattern and causes of the 5-million-year Permo-Triassic biotic crisis. Frontiers of Earth Science, 5(1): 23-36.

Siegesmund, S., Grimm, W.-F., Dürrast, H. & Ruedrich, J. 2010. Limestones in Germany used as building stones: an overview. Geological Society, London, Special Publications, 331: 37-59.

Song Feng-lin, Yang Hao & Wang Qin-xian. 2010. Reef facies strata of Permian-Triassic boundary in Kangjiaping section, Cili area, Hunan Province and its implications for biological mega-deracination. Journal of Geology and Mineral Resources of South China, 2010(3): 51-56.

Song He-ping & Zhang Wei. 2011. Oil geological characteristics and exploration trend of Triassic Lower Group in Xiasiwan area of Ordos Basin. Northwestern Geology, 44(4): 122-131.

Song Zi-qi. 2011. Based on the quantitative classification mode of diagenetic reservoir facies to filter relatively excellent quality: taking the quantitative assessment of diagenetic facies of Chang 6 1 reservoir of AS oilfield hyposmosis reservoirs for an example. Acta Sedimentologica Sinica, 29(1): 88-96.

Spalletti, L., Morel, E., Artabe, A., Ganuza, D. & Bodnar, J. 2011. Latin American Journal of Sedimentology and Basin Analysis, 18(2): 89-104.

Stephenson, D. 2011. Mull and Iona. A Landscape Fashioned by Geology. Perth: Scottish Natural Heritage, 34 pp.

Stephenson, D. & Merritt, J. 2010. Argyll and the Islands. A Landscape Fashioned by Geology. Perth: Scottish Natural Heritage, 61 pp.

Stiller, F. & Bucher, H. 2011. Precise biostratigraphical correlation and age of the Leidapo fossil assemblages, Early Middle Triassic of Qingyan, southwestern China. Acta Palaeontologica Sinica, 50(1): 1-12.

Stockar, R. & Renesto, S. 2011. Co-occurrence of *Neusticosaurus edwardsii* and *N. peyeri* (Reptilia) in the Lower Meride Limestone (Middle Triassic, Monte San Giorgio). Swiss Journal of Geosciences, 104 (Suppl. 1): 167–178.

Su Nan, Long Hao, Tian Jing-chun, Wang Wei-hong & Zhang Jin-quan. 2011. Reservoir sandstones and their physical properties of the Chang-6 oil measures in the Yanchang Formation, Huaqing region, Ordos Basin. Sedimentary Geology and Tethyan Geology, 31(1): 65-71.

Sues, H.-D. & Fraser, N.C. 2010. Triassic Life on Land. New York: Columbia University Press, x+ 236 pp.

Sues, H.-D., Nesbitt, S.J., Berman, D.S. & Henrici, A.C. 2011. A late-surviving basal theropod dinosaur from the latest Triassic of North America. Proceedings of the Royal Society, B.278 (1723): 3459-3464.

Sullivan, R.M., Lucas, S.G. & Spielmann, J.A. (eds). 2011. Fossil Record 3. New Mexico Museum of Natural History & Science Bulletin 53: vi+736 pp.

Szabó, J. 2007. Initial notes to a revision of Late Triassic gastropods from Budapest (Hungary): Hungariella Kutassy, 1933 (Neritopsidae). Fragmenta palaeontologica hungarica, 24-25: 69-75.

Szwedo, J. & Nel, A. 2011. The oldest aphid insect from the Middle Triassic of the Vosges, France. Acta Palaeontologica Polonica, 56(4): 757-766.

Tan Xue-cheng. 2011. Research on the method of recovering micro-topography of epeiric carbonate platform in depositional stage: a case study from the layer A of Jia 2 2 Member in Moxi Gas field, Sichuan Basin. Acta Sedimentologica Sinica, 29(3): 486-494.

Tan Xiu-cheng, Liu Xiao-guang, Chen Jing-shan, Liu Hong, Wu Xiao-qing & Qiu Wen-bin. 2009. Shoal development within the epicontinental carbonate platform, Jia 2 Member, Lower Triassic, Moxi gas field, central Sichuan Basin. Acta Sedimentologica Sinica, 27(5): 995-1001.

Tang Yue, Wang Liang-liang & Cui Ze-hong. 2011. An analysis of the gas source in the Upper Triassic Xujiahe Formation, central Sichuan basin. Geological Bulletin of China, 30(10): 1608-1613.

Tian Ji-jun, Jiang Zai-xing, Li Xi-zhe & Zhang Man-lang, 2010. Kawanishi – Upper Triassic sequence stratigraphic correlation and characteristics of Sichuan. Geology in China, 2010/5: 1313-1326.

Tosti, F., Guido, A., Demasi, F., Mastandrea, A., Naccarato, A., Tagarelli, A. & Russo, F. 2011. Microbialites as primary builders of the Ladinian – Carnian platforms in the Dolomites: biogeochemical characterization. Geo.Alp, 8: 156–162.

Trombetta, G.L. 2011. Facies analysis, geometry and architecture of a Carnian carbonate platform: the Settsass/Richthofen reef system (Dolomites, Southern Alps, northern Italy). Geo.Alp, 8: 56-75.

Trotteyn, M.J. 2011. Postcranial material of *Proterochampsa barrionuevoi* Reig, 1959 (Diapsida, Archosauriformes) from the Upper Triassic of central-western Argentina. Ameghiniana, 48(4): 424-446.

Upchurch, P., Mannion, P.D., Benson, R.B.J., Butler, R.J. & Carrano, M.T. 2011. Geological and anthropogenic controls on the sampling of the terrestrial fossil record: a case study from the Dinosauria. Geological Society, London, Special Publications, 358: 209-240.

Urlichs, M. 2011. Stunting in invertebrates from the type area of the Cassian Formation (Early Carnian) of the Dolomites (Italy). Geo.Alp, 8: 164–169.

Van der Walt, M., Day, M., Rubidge, B., Cooper, A.K. & Netterberg, I. 2010. A new GIS-based biozone map of the Beaufort Group (Karoo Supergroup), South Africa. Palaeontologia Africana, 45: 1-5.

Vasyukova, E.A., Izokh, A.E., Borisenko, A.S., Pavlova, G.G., Sukhorukov, V.P. & Tran Tuan Anh. 2011. Early Mesozoic lamprophyres in Gorny Altai: petrology and age boundaries. Russian Geology and Geophysics, 52(12): 1574-1591.

Vaughan, S., Bailey, R.J. & Smith, D.G. 2011. Detecting cycles in stratigraphic data: spectral analysis in the presence of red noise, Paleoceanography, 26(4): PA4211, 15pp.

Vaziri, S.H. 2011. Sedimentary structures and depositional environment of the Ashin Formation in Nakhlak area, Central Iran. Iranian Journal of Earth Science, 3(1): 69-79.

Veselá, P., Söllner, F., Finger, F. & Gerdes, A. 2011. Magmato-sedimentary Carboniferous to Jurassic evolution of the western Tauern window, Eastern Alps (constraints from U-Pb zircon dating and geochemistry). International Journal of Earth Sciences, 100(5): 993-1027. [Publisher's erratum to this article: ibid, 101 (2): 603].

Wall, P.D., Ivany, L.C. & Wilkinson, B.H. 2011. Impact of outcrop area on estimates of Phanerozoic terrestrial biodiversity trends. Geological Society, London, Special Publications, 358: 53-62.

Wang Bing-zhang, Luo Zhao-hua, Li Huai-yi, Chen Hong-wei & Hu Xu-li. 2009. East Kunlun Qimantag corridor domain Late Paleozoic – Early Mesozoic intrusive rocks timely combination. Geology in China, 2009/4: 769-782.

Wang Hui, Zhang Feng, Wang Bing Jie, Yin Wei Jun & Liu Chi Yang. 2009. The structure characteristics and coal-accumulating features under sequence framework in the Late Triassic of Qiangtang Basin. Northwestern Geology, 42(4): 92-101.

Wang Shu-yi, Jiang Xiao-qing, Guan Hong-lin & Bao Yun-jie. 2010. Origin of intragranular dissolution pores of oolite dolomite reservoirs in Puquan gasfield, northeastern Sichuan Province. Acta Sedimentologica Sinica, 28(1): 10-16.

Wang Wei, Wang Xing Zhi, Zhang Fan, Shi Xin, Qiu Wen Bin & Du Jing Min. 2010. Diagenesis and pore evolution of reservoir in the 4th member of Xujiahe Formation in Guangian area of Sichuan Province. Global Geology (Changchun), 2010/30(1): 96-103.

Wang Yi, Wang Xing-zhi, Wang Yi-gang, Wen Ying-chu, Qiang Zi-tong, Wang Bao-quan & Deng Jing. 2009. Geochemical characteristics of dolomites in the Lower Triassic Feixianguan Formation, northeast Sichuan, China. Acta Sedimentologica Sinica, 27(6): 1043-1049.

Wehrmann, A., Gerdes, G. & Höfling, R. 2011. Microbial mats in Lower Triassic siliciclastic playa environment (Middle Buntsandstein, North Sea). SEPM Special Publication, 101: 177-190.

Werneburg, R. & Sommer, G. 2009. Gewichtige Fossilplatten auf dem Weg ins Foyer des Naturhistorischen Museums Schloss Bertholdsburg Schleusingen. Veröffentlichungen des Naturhistorischen Museums Schleusingen, 24: 3-13.

Wu Li-qun, Jiao Yang-quan, Yang Qin, Zhang Cheng-ze & Yang Sheng-ke. 2010. Provenance system analysis of Yanchang Formation of Ordos Basin. Acta Sedimentologica Sinica, 28(3): 434-440.

Xia Guo-qing, Yi Hi-sheng, Hui Bo, Wu Xiang-feng, Chen Gung-yi & Chen San-yun. 2010. Discovery of the Middle Triassic Falang Formation liquefied oil seepage in Luxi area, eastern Yunnan, China and its significance. Geological Bulletin of China, 29(2): 312-316.

Xiao-Chun Wu, Yen-Nien Cheng, Chun Li, Li-Jun Zhao & Sato, T. 2011. New information on *Wumengosaurus delicatomandibularis* Jiang et al., 2008 (Diapsida: Sauropterygia), with a revision of the osteology and phylogeny of the taxon. Journal of Vertebrate Paleontology, 31(1): 70-83.

Xie Wu-ren, Li Xi-zhe, Yang Wei, Zhang Man-lang, Xie Zeng-ye & Jin Hu. 2009. Genetic combination of the sandbody in the Fourth Member of the Xujiahe Formation (Upper Triassic) and its influence on oil and gas reservoirs. Acta Sedimentologica Sinica, 27(6): 1084-1092.

Xu Wen-li, Li Xiang-hui, Wang Yin, Zeng Qing-gao, Sun Yong & Nima Ciren. 2011. Provenance analysis of the Upper Triassic flysch in Renbu area, southern Tibet. Geological Journal of China Universities, 17(2): 220-230.

Xie Yao-wu, Liu Heng-fei, Qiangba Zha-xi & Zhang Gung-wu. 2010. Determination of the formation sequence of Chaqupu Formation of Early-Middle Triassic in the Quesang area, Tibet, China, and its tectonic significance. Geological Bulletin of China, 29(12): 1833-1839.

Xu Sheng-lin, Chen Hong-du, Lin Liang-biao & Chen An-qing. 2009. Sichuan southeast Feixianguan sequence facies paleogeography. Geology in China, 2009/5: 1055-1064.

Xu Zhao-hui. 2011. Restoration of paleoclimate and its geological significance: as an example from Upper Triassic Xujiahe Formation in Sichuan Basin. Acta Sedimentologica Sinica, 29(2): 235-244.Y

Yan Zhao-kun, Li Yong, Dong Shun-li, Han Bing & Chen Hao. 2010. The sediment flux of the Longmen Shan Foreland Basin during the Late Triassic epoch and the uplift and denudation of the orogenic belt. Acta Sedimentologica Sinica, 28(1): 91-101.

Yang Hua. 2011. Analysis of tectonic sedimentary setting in Middle and Upper Triassic in the west margin of the Ordos Basin. Acta Sedimentologica Sinica, 29(3): 427-439.

Yang Hua, Dou Wei-tan, Liu Xian-yang & Zhang Cai-li. 2010. Analysis on sedimentary facies of Member 7 in Yanchang Formation of Triassic in Ordos Basin. Acta Sedimentologica Sinica, 28(2): 254-263.

Yang Li-zhen, Liu Rong-tao & Bai Yan-ping. 2011.The Early-Middle Triassic volcanic event – the Taima porphyroclastic lava in the Qinzhou area, southern Guangxi, China. Geological Bulletin of China, 30(1): 95-100.

Yao Jing-li. 2011. Forming mechanism and their environmental implications of chlorite coatings in Chang 6 Sandstone (Upper Triassic) of Hua Qing area, Ordos Basin. Acta Sedimentologica Sinica, 29(1): 72-79.

Yongbiao Wang, Zheng Meng, Wei Liao, Zeting Weng & Hao Yang. 2011. Shallow marine ecosystem feedback to the Permian/Triassic mass extinction. Frontiers of Earth Science, 5(1): 14-22.

Yuan Dong-xun & Shen Shu-zhong. 2011. Conodont succession across the Permian – Triassic boundary of the Liangfengya section, Chongqing, South China. Acta Palaeontologica Sinica, 50(4): 420-438.

Zavialova, N., Buratti, N. & Roghi, G. 2010. The ultrastructure of some Rhaetian Circumpolles from southern England. Grana, 49(4): 281-299.

Zeng De-ming, Wang Xing-zhi, Shi Xin, Zhang Fan, Wang Juan & Zhu Yong-gang. 2010. Characteristic and reservoir property of the Leikupo Formation of Middle Triassic in northeastern Sichuan Basin. Acta Sedimentologica Sinica, 28(1): 42-49.

Zeng De-yong. 2011. Tempestites of Early Triassic Feixianguan Formation in Shangsi Section, Guanyuan: are they extreme climatic event under megamonsoon system? Acta Sedimentologica Sinica, 29(3): 440-448.

Zeng Hong-liu. 2011. Seismic sedimentology in China: a review. Acta Sedimentologica Sinica, 29(3): 417-426.

Zeng Qing-luan. 2009. Succession and palaeoecological environments of brachiopod faunas through the early Upper Triassic from Xinpu area, Guanling, Guizhou, China – with comments on palaeoecology of pseudopelagic crinoids and bivalves. Journal of Geology and Mineral Resources of South China, 2009(4): 59-82.

Zhang Bao-min, Chen Xiao-hong & Cheng Long. 2010. Discovery of *Macrocnemus* cf. *fuyuanensis* of the Middle Triassic in Xinyi, Guizhou Province, SW China. Journal of Geology and Mineral Resources of South China, 2010(2): 43-47.

Zhang Hai, Fang Wei-xuan, Zhang Guishan, Gan Feng-wei, Wei Ning & Guo Yu-qian. 2009. Yunnan Triassic Anisian recovery phase sequence of metavolcanic rocks and mineralization analysis. Geology in China, 2009/6: 1322-1330.

Zhang Hong-mei, Li Hai-ping, Feng Qiao, Jiao Xin & Xue Cheng. 2011. Geochemical characteristics and tectonic environmental analysis of volcanic rocks from Late Triassic in southeastern margin of the Qaidam Basin. Northwestern Geology, 44(4): 15-22.

Zhang Qi-yue, Zhou Chang-yong, Lv Tao & Bai Jian-ke. 2010. Discovery of Middle Triassic Saurichthys in the Luoping area, Yunnan, China. Geological Bulletin of China, 29(1): 26-30.

Zhang Shun-cun, Ding Chao, He Wei-guo, Zhang Da-yong, Shi Jian & Zhang Jie. 2011. Middle and Lower Triassic sedimentary facies within the Urho uplift on the northwestern margin of the Junggar Basin. Sedimentary Geology and Tethyan Geology, 31(2): 17-25.

Zhang Wei, Jian Ping, Liu Dun-yi & Hou Ke-jun. 2010. Geochemistry, geochronology and Hf isotopic compositions of Triassic granodiorite-diorite and shoshonite from the Damaoqi area, central Inner Mongolia, China. Geological Bulletin of China, 29(6): 821-832.

Zhang Wen-zheng, Yang Hua, Xie Li-qin & Yie Gu-wei. 2011. Discovery of micro- and nannofossils in high grade hydrocarbon source rocks of the Triassic Yanchang Formation Chang 7 Member in Ordos Basin and its scientific significance. Acta Palaeontologica Sinica, 50(1): 109-117.

Zhang Xing-xiang. 2010. Diagenetic facies types and semiquantitative evaluation of low porosity and permeability sandstones of the Fourth Member. Acta Sedimentologica Sinica, 28(1): 50-57.

Zhang Xiang-xiang, Zou Cai-neng, Tao Shizhen, Xu Chun-chun, SONG Jian-rong & LI Guohui. 2010. Diagenetic facies types and semiquantitative evaluation of low porosity and permeability sandstones of the Fourth Member, Xujiahe Formation, Guangan area, Sichuan Basin. Acta Sedimentologica Sinica, 28(1): 50-57.

Zhang Xuefeng, He Yunlan, Ma Yongsheng, Liu Bo, Zhao Peirong, Go Jixian & Yang Yunkun. 2011. Controls on sedimentation of reservoir formation in Lower Triassic Feixianguan Formation, northeastern Sichuan Basin. Earth Science Frontiers, 18(4): 224-236.

Zhang Yue-chao, Dong Shu-wen, Li Jian-hua &Shi Wei. 2011. Mesozoic tectonic extrusion and multidirectional formation and transformation of the Sichuan Basin. Geology in China, 2011/2: 233-250.

Zhao Wei-zhi, Xu Chun-chun, Wang Tong-shan, Wang Hong-jun, Wang Ze-cheng, Bian Cong-sheng & Li Xia. 2011. Comparative study of gas accumulations in the Permian Changxing reefs and Triassic Feixianguan oolitic reservoirs between Longgang and Luojiazhai-Puguang in the Sichuan Basin. Chinese Science Bulletin, 56(31): 3310-3320.

Zhao Xia-fei. 2011. Stratigraphic division between Xujiahe Formation and Zhenzhuichong Member in the NE part of central Sichuan Basin. Acta Sedimentologica Sinica, 29(4): 631-643.

Zhao Xiao-ming, Niu Zhi-jun, Tong Jin-nan & Yao Hua-zhou. 2010. The distinctive sediments in the Early Triassic recovery time: "Anachronistic Facies". Acta Sedimentologica Sinica,

28(2): 314-323.

Zheng Chao-yang, Liu Yi-qun, Duan Yi, Yu Wen-xiu, Fan Ting-ting & Zhang Xue-jun. 2011. Geochemical characteristics and genesis of crude oils of Carboniferous and Triassic in Tahe oil field of Tarim Basin. Geological Journal of China Universities, 17(2): 249-259.

Zheng De-ming. 2010. Characteristic and reservoir property of the Leikoupo Formation of Middle Triassic in northwestern Sichuan basin. Acta Sedimentologica Sinica, 28(1): 42-49.

Zheng Qing-luan. 2010. Palaeoecology of Carnian brachiopods from Xinpu area, Guanling, Guizhou, China and query on the lifestyle of pseudoplanktonic *Traumatocrinus* (crinoid). Acta Palaeontologica Sinica, 49(1): 96-107.

Zhu Rukai, Bai Bin, Liu Liuhong, Su Ling, Gao Zhiyong & Luo Zhong. 2011. Research on standardization of continental sequence stratigraphy and palaeogeography: a case study from the Upper Triassic Xujiahe Formation in Sichuan Basin. Earth Science Frontiers, 18(4): 131-143.

Zhu Shi-fa, Zhu Xiao-min, Wang Yi-bo, Xu Zhao-hui, Li De-jiang, Xian Ben-zhong & Gong Wen-qiang. 2010. Dissolution characteristics and pore evolution of Triassic reservoir in Ke-Bai area, northwestern margin of Junggar Basin. Acta Sedimentologica Sinica, 28(3): 547-555.

Zhuang Yi-peng, Guo Xi-feng & Fu Bin. 2011. Analysis of sediment provenance of Chang-8 group of Yanchang Formation in Yanchi-Dingbin area of Ordos Basin. Northwestern Geology, 44(2): 133-140.

Zijlstra, G., Kustatscher, E. & van Konijnenburg-van Cittert, J.H.A. 2007. (1789-1790) Proposal to conserve the name *Schizoneura* against *Convallarites* (fossil Sphenopsida), with a conserved type. Taxon, 56(3): 965-966.

Zijlstra, G., Kustatscher, E. & van Konijnenburg-van Cittert, J.H.A. 2009. (1910) Proposal to conserve the name *Sphenozamites* (fossil Cycadophyta). Taxon, 58(3): 1016.

Zonneveld, J.-P., Beatty, T.W., Williford, K.H., Orchard, M.J. & McRoberts, C.A. 2010. Stratigraphy and sedimentology of the lower Black Bear Ridge section, British Columbia: candidate for the base-Norian GSSP. Stratigraphy, 7(1): 61-82.

PART 2

Publications appearing in 2012

Aberhan, M., Nürnberg, S. & Kiessling, W. 2012. Vision and diversification of Phanerozoic marine invertebrates. Paleobiology, 38(2): 187-204.

Abu Hamad, A.M.B., Jasper, A. & Uhl, D. 2012. The record of Triassic charcoal and other evidence for palaeo-wildfires; signal for atmospheric oxygen levels, taphonomic biases or lack of fuel? International Journal of Coal Geology, 96-97: 60-71.

Adam, J. & Krezsek, C. 2012. Basin-scale salt tectonic processes of the Laurentian Basin, eastern Canada: insights from integrated regional 2D seismic interpretation and 4D physical experiments. Geological Society, London, Special Publications, 363: 331-360.

Agnolin, F. & Martinelli, A.G. 2012. *Guaibasaurus candelariensis* (Dinosauria, Saurischia) and the early origin of avian-like resting posture. Alcheringa, 36(2): 263-267.

Akal, C., Candan, O., Koralay, O.E., Oberhänsli, R., Chen, F. & Prelević, D. 2012. Early Triassic potassic volcanism in the Afyon Zone of the Anatolides/Turkey: implications for the rifting of the Neo-Tethys. International Journal of Earth Sciences, 101(1): 177-194.

Algeo, T., Henderson, C.M., Ellwood, B., Rowe, H., Elswick, E., Bates, S., Lyons, T., Hower, J.C., Smith, C., Maynard, B., Hays, L.E., Summons, R.E., Fulton, J. & Freeman, K.H. 2012. Evidence for a diachronous Late Permian marine crisis from the Canadian Arctic region. Geological Society of America Bulletin, 124(9-10): 1424-1448.

Alsleben, H., Wetmore, P.H., Gehrels, G.E. & Paterson, S.R. 2012. Detrital zircon ages in Palaeozoic and Mesozoic basement assemblages of the Peninsula Ranges batholith, Baja California, Mexico: constraints for depositional ages and provenance. International Geology Review, 54(1): 93-110.

Ambrose, K. 2012. National Forest, National Treasure now has a geology publication. Down to Earth, 80: 8-9.

Ambrose, K., McGrath, A., Weightman, G., Strange, P., Lattaway, S., Lott, G., Barrett, D., Dean, S. & Liddle, P. 2012. Exploring the landscape of the National Forest. Keyworth, Nottingham: British Geological Survey, 106 pp + 1:50 000 map.

Andreev, P.S. & Cuny, G. 2012. New Triassic stem selachimorphs (Chondrichthyes, Elasmobranchii) and their bearing on the evolution of dental enameloid in Neoselachii. Journal of Vertebrate Paleontology, 32(2): 255-266.

Andres, B. 2012. The early evolutionary history and adaptive radiation of the Pterosaurs. Acta Geologica Sinica, 86(6): 1356-1365.

Anon. 2012. Third Arabian Plate Geology Workshop, Part I. The Permo-Triassic sequence of the Arabian Plate. GeoArabia, 17(1): 181-239.

Anon. 2012. Third Arabian Plate Geology Workshop, Part II. The Permo-Triassic sequence of the Arabian Plate. GeoArabia, 17(2): 189-256.

Avanzini, M. & Wachtler, M. 2012. S*phingopus ladinicus* isp. nov. from the Anisian of the Braies Dolomites (Southern Alps, Italy). Bollettino della Società Paleontologica Italiana, 51(1): 63-70.

Bachan, A., van de Schootbrugge, B., Fiebig, J., McRoberts, C.A., Ciarapica, G. & Payne, J.L. 2012. Carbon cycle dynamics following the end-Triassic mass extinction: constraints from paired $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ records. Geochemistry, Geophysics, Geosystems, 13(9): Q09008, DOI: 10.1029/2012GC00415.

Bacon, K.L., Belcher, C.M., Haworth, M. & McElwain, J.C. 2012. Leaf physiognomic variations as a proxy for elevated atmospheric SO_2 across the Triassic-Jurassic boundary. Palaeontological Association Newsletter, 81; Annual Meeting Programme and Abstracts: 22-23.

Bai Ru, Zhang Jin-gong & Li Wei. 2012. Reservoir geological model of lithological reservoir of Chang 63 in Heshui area, Ordos Basin. Journal of Jilin University (Earth Science Edition), 42(6): 1601-1609.

Balini, M., Bertinelli, A., Carter, E., Di Stefano, P., Kyrstyn, L., Levera, M., Mazza, M., McRoberts, C., Muttoni, G., Nicora,

A., Orchard, M.J., Preto, N., Rigo, M., Tripodo, A., and Zonneveld, J.P. 2012. Towards the definition of the GSSP of the Norian Stage (Upper Triassic): integrated stratigraphy and correlation of the two candidate sections Black Bear Ridge (BC, Canada) and Pizzo Mondello (Italy). Abstracts of the 34th International Geological Congress, Brisbane, Australia. Abs. No. GC126222.

Balini, M., Jenks, J. & Martin, R. 2012. Taxonomy and stratigraphic significance of *Trachyceras silberlingi* n. sp., from the Lower Carnian of South Canyon (New Pass Range, central Nevada, USA). Bollettino della Società Paleontologica Italiana, 51(2): 127-136.

Balini, M., Krystyn, L., Levera, M. & Tripodo, A. 2012. Late Carnian-Early Norian ammonoids from the GSSP candidate section of Pizzo Mondello (Sicani Mountains, Sicily). Rivista Italiana di Paleontologia e Stratigrafia, 118(1): 47-84.

Balini, M. & Renesto, S.C. 2012. *Cymbospondylus* vertebrae (Ichthyosauria, Shastasauridae) from the Upper Anisian Prezzo Limestone (Middle Triassic, Southern Alps) with an overview of the chronostratigraphic distribution of the group. Rivista Italiana di Paleontologia e Stratigrafia, 118(1): 155-172.

Ballanti, L.A., Tullis, A. & Ward, P.D. 2012. Comparison of oxygen consumption by *Terebratalia transversa* (Brachiopoda) and two species of pteriomorph bivalve molluscs: implications for surviving mass extinctions. Paleobiology, 38(4): 525-537.

Barash, M.S. 2012. Causes and prime causes of mass biotic extinctions in the Phanerozoic. Doklady Earth Sciences, 445(2): 925-928.

Bartolini, A., Guex, J., Spangenberg, J.E., Schoene, B., Taylor, D.G., Schaltegger, U. & Atudorei, V. 2012. Disentangling the Hettangian carbon isotope record: implications for the aftermath of the end-Triassic mass extinction. Geochemistry, Geophysics, Geosystems, 13(1): (11pp). Q01007, DOI: 10.1029/2011GC003807.

Bashkuev, A., Sell, J., Aristov, D., Ponomarenko, A., Sinitshenkova, N. & Mahler, H. 2012. Insects from the Buntsandstein of Lower Franconia and Thuringia. Paläontologische Zeitschrift, 86(2): 175-185.

Baud, A., Richoz, S., Beauchamp, B., Cordey, F., Grasby, S., Henderson, C.M., Krystyn, L. & Nicora, A. 2012. The Buday'ah Formation, Sultanate of Oman: a Middle Permian to Early Triassic oceanic record of the Neotethys and the late Induan microsphere bloom. Journal of Asian Earth Sciences, 43(1): 130-144.

Baudon, C., Redfern, J. & Van Den Dreissche, J. 2012. Permo-Triassic structural evolution of the Argana Valley, impact of the Atlantic rifting in the High Atlas, Morocco. Journal of African Earth Sciences, 65: 91-104.

Beardmore, S.R., Orr, P.J., Manzocchi, T., Furrer, H. & Johnson, C. 2012. Death, decay and disarticulation: modelling the skeletal taphonomy of marine reptiles demonstrated using *Serpianosaurus* (Reptilia; Sauropterygia). Palaeogeography, Palaeoclimatology, Palaeoecology, 337–338: 1-13.

Beauchamp, B. & Grasby, S.E. 2012. Permian lysocline shoaling and ocean acidification along NW Pangea led to carbonate eradication and chert expansion. Palaeogeography, Palaeoclimatology, Palaeoecology, 350–352: 73-90.

Behan, C., Walken, G. & Cuny, G. 2012. A Carboniferous chondrichthyan assemblage from residues within a Triassic karst system at Cromhall quarry, Gloucestershire, England. Palaeontology, 55(6): 1245-1263.

Benavente, C.A., Mancuso, A.C. & Cabaleri, N.G. 2012. First occurrence of charophyte algae from a Triassic paleolake in Argentina and their paleoenvironmental context. Palaeogeography, Palaeoclimatology, Palaeoecology, 363-364: 172-183.

Benson, R.B.J., Butler, R.J., Carrano, M.T. & O'Connor, P.M. 2012. Air-filled post-cranial bones in theropod dinosaurs: physiological implications and the 'reptile'-bird transition. Biological Reviews, 87(1): 168-193.

Benton, M.J. 2012. Naming the Bristol dinosaur, *Thecodontosaurus*: politics and science in the 1830s. Proceedings of the Geologists' Association, 123(5): 766-778.

Benton, M.J., Schouten, R., Drewitt, E.J.A. & Viegas, P. 2012. The Bristol Dinosaur Project. Proceedings of the Geologists' Association, 123(1): 210-225.

Berra, F. 2012. Sea-level fall, carbonate production, rainy days: how do they relate? Insight from Triassic carbonate platforms (Western Tethys, Southern Alps, Italy). Geology, 40(3): 271-274.

Berra, F., Balini, M., Levera, M., Nicora, A. & Salmati, R. 2012. Anatomy of carbonate mounds from the Middle Anisian of Nakhlak (Central Iran): architecture and age of a subtidal microbial-bioclastic carbonate factory. Facies, 58 (4): 685-705.

Berra, F. & Carminati, E. 2012. Differential compaction and early rock fracturing in high-relief carbonate platforms: numerical modelling of a Triassic case study (Esino Limestone, Central Southern Alps, Italy). Basin Research, 24(5): 598-614.

Bhomik, N. & Das, N. 2012. On three new species of *Pteruchus* Thomas from the Triassic of Nidpur, M.P., India. Palaeontographica, B 288(1-4): 5-39.

Bhowmik, N. & Parveen, S. 2012. On *Vertebraria* Royle from Triassic of Nidpur, Madhya Pradesh. Journal of the Geological Society of India, 79(6): 618-626.

Bialik, O.M., Korngreen, D. & Benjamini, C. 2012. Lithofacies and cyclicity of Mohilla evaporite basins on the rifted margin of the Levant in the Late Triassic, Makhtesh Ramon, southern Israel. Sedimentology, 59(7): 2097-2124.

Bin Deng, Shugen Liu, Luba Jansa, Junxing Cao, Yang Cheng, Zhiwu Li & Shun Liu. 2012. Sedimentary record of Late Triassic transpressional tectonics of the Longmenshan thrust belt, SW China. Journal of Asian Earth Sciences, 48: 43-55.

Birkenmajer, K. 2012. Geology of the Lower Subtatric Nappe, Kopy Sołtysie area, Eastern Tatra Mts (West Carpathians, Poland). Studia Geologica Polonica, 135: 55-116.

Bittencourt, J.S., Leal, L.A., Langer, M.C. & Azevedo, S.A.K. 2012. An additional basal sauropodomorph specimen from the Upper Triassic Caturrita Formation, southern Brazil, with comments on the biogeography of plateosaurids. Alcheringa, 36(2): 269-278.

Black, B.A., Elkins-Tanton, L.T., Rowe, M.C. & Peate, I.U. 2012. Magnitude and consequences of volatile release from the Siberian Traps. Earth and Planetary Science Letters, 317-318: 363-373.

Blättler, C.L., Henderson, G.M. & Jenkyns, H.C. 2012. Explaining the Phanerozoic Ca isotope history of seawater. Geology, 40(9): 843-846.

Blinova, M., Faleide, J.I., Gabrielsen, R.H. & Mjelde, R. 2012. Analysis of structural trends of sub-sea-floor strata in the Isfjorden area of the West Spitsbergen Fold- and Thrust Belt based on multichannel seismic data. Journal of the Geological Society, London, 170(4): 657-668.

Bo Ran, Chengshan Wang, Xixi Zhao, Yalin Li, Jun Meng, Ke Cao & Pingkang Wang. 2012. Dimension of Greater India in the early Mesozoic: paleomagnetic constraints from Triassic sediments in the Tethyan Himalaya. Journal of Asian Earth Sciences, 53: 15-24.

Bo Yang, Xulong Lai, Wignall, P.B., Haishui Jiang, Chunbo Yan & Yadong Sun. 2012. A newly discovered earliest Triassic chert at Gaimao section, Guizhou, southwestern China. Palaeogeography, Palaeoclimatology, Palaeoecology, 344–345: 69-77.

Bo Zhang, Jinjiang Zhang, Shuyu Yan, Zhidong Gu & Xiaoxian Wang. 2012. Detrital quartz and quartz cement in Upper Triassic reservoir sandstones of the Sichuan basin: characteristics and mechanisms of formation based on cathodoluminescence and electron backscatter diffraction analysis. Sedimentary Geology, 267–268: 104-114.

Bodnar, J. 2012. Estudios evolutivos-del desarrollo en tallos fósiles de Corystospermaceae (Corystospermales, Spermatopsida). Revista del Museo Argentino de Ciencias Naturales, 14(1): 143-166.

Bodor, S., Szakmány, G., Józsa, S. & Máthé, Z. 2012. Petrology and geochemistry of the Upper Permian – Middle Triassic siliciclastic formations of the IBAFA-4 Borehole (NW-Mecsek Mts., Hungry). Carpathian Journal of Earth & Environmental Sciences, 7(4): 219-230.

Bodzioch, A. & Kowal-Linka, M. 2012. Unraveling the origin of the Late Triassic multitaxic bone accumulation at Krasiejów (S Poland) by diagenetic analysis. Palaeogeography, Palaeoclimatology, Palaeoecology, 346–347: 25-36.

Bomfleur, B., Escapa, I.H., Taylor, E.L. & Taylor, T.N. 2012. Modified basal elements in *Dicroidium* fronds (Corystospermales). Review of Palaeobotany and Palynology, 170: 15-26.

Bomfleur, B. & Kerp, H. 2012. *Dicroidium* diversity in the Upper Triassic of north Victoria Land, East Antarctica. Review of Palaeobotany and Palynology, 160(3-4): 67-101.

Bomfleur, B., Kerp, H., Taylor, T.N., Moestrup, Ø. & Taylor, E.L. 2012. Triassic leech cocoon from Antarctica contains fossil bell animal. Proceedings of the National Academy of Sciences, 109(51): 20971-20974.

Bonaparte, J.F. 2012. Miniaturisation and the origin of mammals. Historical Biology, 24(1): 43-48.

Bonev, N., Dilek, Y., Hanchar, J.M., Bogdanov, K. & Klain, L. 2012. Nd–Sr–Pb isotopic composition and mantle sources of Triassic rift units in the Serbo-Macedonian and the western Rhodope massifs (Bulgaria–Greece). Geological Magazine, 149(1): 146-152.

Bonis, N.R. & Kürschner, W. 2012. Vegetation history, diversity patterns, and climate change across the Triassic/Jurassic boundary. Paleobiology, 38(2): 240-264.

Botha-Brink, J. & Smith, R.M.H. 2012. Palaeobiology of Triassic procolophonids, inferred from bone microstructure. Comptes Rendus Paleovol, 11(6): 419-433.

Bottjer, D.J. 2012. Life in the Early Triassic Ocean. Science, 338 (6105): 336-337.

Boudagher-Fadel, M.K. 2012. The Mesozoic planktonic foraminifera: the Late Triassic – Jurassic. *In*, Boudagher-Fadel, M.K. (ed.), Biostratigraphic and Geological Significance of Planktonic Foraminifera. Developments in Palaeontology and Stratigraphy, 22: 47-65.

Bragin, N.Yu., Konstantinov, A.G. & Sobolev, E.S. 2012. Upper Triassic stratigraphy and paleobiogeography of Kotel'nyi Island (New Siberian Islands). Stratigraphy and Geological Correlation, 20(6): 541-566.

Brand, U., Posenato, R., Came, R., Affek, H., Angiolini, L., Azmy, K. & Farabegoli, E. 2012. The end-Permian mass extinction: a rapid volcanic CO_2 and CH_4 climatic catastrophe. Chemical Geology, 322–323: 121-144.

Brühwiler, T., Bucher, H., Goudemand, N. & Galfetti, T. 2012. Smithian (Early Triassic) ammonoid faunas from Exotic Blocks from Oman: taxonomy and biochronology. Palaeontographica, A.296(1-4): 3-107.

Brühwiler, T, Bucher, H. & Krystyn, L. 2012. Middle and late Smithian (Early Triassic) ammonoids from Spiti (India). Special Papers in Palaeontology, 88: 115-174.

Brühwiler, T., Bucher, H., Ware, D., Schneebeli-Herman, E., Hochuli, P., Roohi, G., Rehman, K. & Yaseen, A. 2012. Smithian (Early Triassic) ammonoids from the Salt Range, Pakistan. Special Papers in Palaeontology, 88: 1-114.

Bryda, G. 2012. Neue biostratigraphische Daten zur Mitteltrias-Schichtfolge am Polzberg bei Lunz am See (NÖ). Jahrbuch der Geologischen Bundesanstalt Wien, 152(1-4): 201-204.

Buchwitz, M., Foth, C., Kogan, I. & Voigt, S. 2012. On the use of osteoderm features in a phylogenetic approach on the internal relationships of the Chroniosuchia (Tetrapoda: Reptiliomorpha). Palaeontology, 55(3): 623-640.

Buchwitz, M. & Voigt, S. 2012. The dorsal appendages of the Triassic reptile *Longisquama insignis*: reconsideration of a controversial integument type. Paläontologische Zeitschrift, 86(3): 313-331.

Buratti, N., Mehdi, D., Cirilli, S., Kamoun, F. & Mzoughi, M. 2012. A Carnian (Julian) microflora from the Djerba Melita 1 Borehole (Gulf of Gabes, south-eastern Tunisia). Micropaleontology, 58(4): 377-388.

Butcher, G.S., Kendall, A.C., Boyce, A.J., Millar, I.L., Andrews, J.E., Dennis, P.F. & Grasby, S. 2012. Age determination of the Lower Watrous red-beds of the Williston Basin, Saskatchewan, Canada. Bulletin of Canadian Petroleum Geology, 60(4): 227-238.

Butler, R.J., Barrett, P.M., Irmis, R.B., Scheyer, T.M., Mundil, R. & Sánchez-Villagra, M.R. 2012. A new primitive ornithischian dinosaur from the La Qunita Formation of Venezuela. Palaeontological Association Newsletter, 81; Annual Meeting Programme and Abstracts: 26-27.

Caihua Kou, Zhaochong Zhang, Santosh, M., He Huang, Tong Hou, Baoli Liao, & Hongbo Li. 2012. Picritic porphyrites generated in a slab-window setting: implications for the transition from Paleo-Tethyan to Neo-Tethyan tectonics. Lithos, 155: 375-391.

Caineng Zou, Lan Wang, Ying Li, Shizhen Tao & Lianhua Hou. 2012. Deep-lacustrine transformation of sandy debrites into turbidites, Upper Triassic, Central China. Sedimentary Geology, 265–266: 143-155.

Callegaro, S., Rigo, M., Chiaradia, M. & Mazoli, A. 2012. Latest Triassic marine Sr isotopic variations, possible causes and implications. Terra Nova, 24(2): 130-135.

Cascales-Miñana, B. & Cleal, C.J. 2012. Plant fossil record and survival analyses. Lethaia, 45(1): 71-82.

Cassinis, G., Perotti, C.R. & Ronchi, A. 2012. Permian continental basins in the Southern Alps (Italy) and peri-mediterranean correlations. International Journal of Earth Sciences, 101(1): 129-157.

Cavin, L., Avanzini, M., Bernardi, M., Piuz, A., Proz, P.-A., Meister, C., Boissonnas, J. & Meyer, C.A. 2012. New vertebrate trackways from the autochthonous cover of the Aiguilles Rouges Massif and reevaluation of the dinosaur record in the Valais, SW Switzerland. Swiss Journal of Palaeontology, 131(2): 317-324.

Chao Zhang, Liang Cui, Kai Shao, Longyi Shao & Yihong Hu. 2012. The sedimentary environment and palaeogeographic characteristics of the Late Triassic Epoch in Shaoshan coal field of Hunan Province. Procedia Environmental Sciences, 12, Part A: 499-504.

Chen, Z.Q. & Benton, M.J. 2012. The timing and pattern of biotic recovery following the end-Permian mass extinction. Nature Geoscience, 5(6): 375-383.

Chiari, M., Bortolotti, V., Marcucci, M., Photiades, A., Principi, G. & Saccani, E. 2012. Radiolarian biostratigraphy and geochemistry of the Koziakas massif ophiolites (Greece). Bulletin de la Société Géologique de France, 183(4): 287-306.

Chikov, B.M., Zinoviev, S.V. & Deyev, E.V. 2012. Post-Late Paleozoic collisional framework of southern Great Altai. Acta Geologica Sinica, 86(5): 1093-1104.

Choi, T., Lee, Y.I. & Orihashi, Y. 2012. Mesozoic detrital zircon U-Pb ages of modern river sediments in Korea: implications for migration of arc magmatism in the Mesozoic East Asian continental margin. Terra Nova, 24(2): 156-165.

Christ, N., Immenhauser, A., Amour, F., Mutti, M., Preston, R., Whitaker, F.F., Peterhänsel, A., Egenhoff, S.O., Dunn, P.A. & Agar, S.M. 2012. Triassic Latemar cycle tops — subaerial exposure of platform carbonates under tropical arid climate. Sedimentary Geology, 265–266: 1-29.

Chun Li, Xiao-Chun Wu, Li-Jun Zhao, Sato, T. & Li-Ting Wang. 2012. A new archosaur (Diapsida, Archosauriformes) from the marine Triassic of China. Journal of Vertebrate Paleontology, 32(5): 1064-1081.

Chunju Huang, Jinnan Tong, Hinnov, L. & Zhong Qiang Chen. 2012. Did the great dying of life take 700 k.y.? Evidence from global astronomical correlation of the Permian-Triassic boundary interval: REPLY. Geology, 40(5): e268, doi: 10.1130/G33200Y.1

Clapham, M.E. & Karr, J.A. 2012. Environmental and biotic controls on the evolutionary history of insect body size. Proceedings of the National Academy of Sciences, 109(27): 10927-10930.

Clarke, J.T. & Friedman, M. 2012. Role reversal in the Mesozoic: when teleost fish played second fiddle to their sister group. Palaeontological Association Newsletter, 81; Annual Meeting Programme and Abstracts: 27.

Clemence, M.-E. 2012. Oberhauserellidae (benthic foraminifera) blooms during the environmental perturbations at the Triassic-Jurassic boundary: palaeoecological implications. Palaeontological Association Newsletter, 81; Annual Meeting Programme and Abstracts: 65.

Cope, J.C.W. 2012. Geology of the Dorset Coast. Geologists' Association Guide 22, viii+232pp.

Cope, J.C.W. 2012. Examining the Triassic-Jurassic boundary extinction. Palaeontological Association Newsletter, 81; Annual Meeting Programme and Abstracts: 65.

Costamagna, L.G. 2012. Alluvial, aeolian and tidal deposits in the Lower to Middle "Buntsandstein" of NW Sardinia (Italy): a new interpretation of the Neo-Tethys transgression. Zeitschrift der Deutschen Gesellschaft für Geowissenschaften, 163(2): 165-183.

Cotton, J.M. & Sheldon, N.D. 2012. New constraints on using paleosols to reconstruct atmospheric pCO_2. Geological Society of America Bulletin, 124(9-10): 1411-1423.

Crofts, R.G., Hough, E., Humpage, A.J. & Reeves, H.J. 2012. Geology of the Manchester district – a brief explanation of the geological map. Sheet Explanation of the British Geological Survey, 1:50 000 Sheet 85 (Manchester) (England and Wales). Keyworth, Nottingham: British Geological Survey, ii+45pp.

Cubo, J., Le Roy, N., Martínez-Maza, C. & Montes, L. 2012. Paleohistological estimation of bone growth rate in extinct archosaurs. Paleobiology, 38(2): 335-349.

Da Silva, R.C., Barboni, R., Dutra, T., Godoy, M.M. & Binotto, R.B. 2012. Footprints of large theropod dinosaurs and implications on the age of Triassic biotas from Southern Brazil. Journal of South American Earth Sciences, 39: 16-23.

Daily, P.J.J., Riley, J.J., Shepley, M.G. & Buss, S.R. 2012. Simulation of a water transfer tunnel at catchment scale in the Permo-Triassic Sandstone aquifer. Geological Society, London, Special Publications, 364: 319-332.

Dal Corso, J., Mietto, P., Newton, R.J., Pancost, R.D., Preto, N., Roghi, G. & Wignall, P.B. 2012. Discovery of a major negative $\delta^{13}C$ spike in the Carnian (Late Triassic) linked to the eruption of Wrangellia flood basalts. Geology, 40(1): 79-82.

Damborenea, S.E. & Mancenido, M.O. 2012. Late Triassic bivalves and brachiopods from southern Mendoza, Argentina. Revue de Paléobiologie, Vol. spéciale 11: 317-344.

Das, D.P. & Gupta, A. 2012. A new cynodont record from Lower Triassic Panchet Formation, Damodar Valley. Journal of the Geological Society of India, 79(2): 175-180.

De Grave, J., Glorie, S., Ryabinin, A., Zhimulev, F., Buslov, M.M., Izmer, A., Elburg, M., Vanhaecke, F. & Van den haute, P. 2012. Late Palaeozoic and Meso-Cenozoic tectonic evolution of the southern Kyrgyz Tien Shan: constraints from multi-method thermochronology in the Trans-Alai, Turkestan-Alai segment and the southeastern Ferghana Basin. Journal of Asian Earth Sciences, 44: 149-168.

De Jager, J. 2012. The discovery of the Fat Sand Play (Solling Formation, Triassic), northern Dutch offshore – a case of serendipity. Netherlands Journal of Geosciences, 91(4): 609-619.

D'Elia, L., Muravchik, M., Franzese, J.R. & Bilmes, A. 2012. Syn-rift volcanism of the Neuquén Basin, Argentina: relationships with the Late Triassic-Early Jurassic evolution of the Andean margin. Andean Geology, 39(1): 106-132.

D'Elia, L., Muravchik, M., Franzese, J.R. & Lopez, L. 2012. Tectonostratigraphic analysis of the Late Triassic-Early Jurassic syn-rift sequence of the Neuquén Basin in the Sañicó depocentre, Neuquén Province, Argentina. Andean Geology, 39(1): 133-157.

Dehler, S.A. 2012. Initial rifting and breakup between Nova Scotia and Morocco: insight from new magnetic models. Canadian Journal of Earth Sciences, 49(12): 1385-1394.

Deng Ping, Ren JiShun, Ling HongFei, Shen WeiZhou, Sun LiQiang, Zhu Ba & Tan ZhengZhong. 2012. SHRIMP zircon U-Pb ages and tectonic implications for Indosinian granitoids of southern Zhuguangshan granitic composite, South China. Chinese Science Bulletin, 57(13): 1542-1552.

Dentzien-Dias, P.C., de Figueiredo, A.E.Q. & Schultz, C.L. 2012. On the genesis of tetrapod burrows from the Paleozoic and Mesozoic. Pesquisas em Geociências, 39(2): 99-107.

Di Stefano, P., McRoberts, C., Renda, P., Tripodo, A., Torre, A. & Torre, F. 2012. Middle Triassic (Ladinian) deep-water sediments in Sicily: new findings from the Madonie Mountains. Rivista Italiana di Paleontologia e Stratigrafia, 118(2): 235-246.

Dias-da-Silva, S., Sengupta, D.P., Cabreira, S.F. & da Silva, L.R. 2012. The presence of *Compsocerops* (Brachyopoidea: Chigutisauridae) (Late Triassic) in southern Brazil with comments on chigutisaurid palaeobiogeography. Palaeontology, 55(1): 163-172.

Díaz-Martínez, I. & Pérez-Garcia, A. 2012. Historical and comparative study of the first Spanish vertebrate paleoichnological record and bibliographic review of the Spanish chirotheriid footprints. Ichnos, 19(3): 141-149.

Diedrich, C.G. 2012. The Middle Triassic marine reptile diversity in the Germanic Basin, in the centre of the Pangaean world. Central European Journal of Geosciences, 4(1): 9-46.

Diedrich, C.G. 2012. Middle Triassic chirotherid trackways on earthquake influenced intertidal limulid reproduction flats of the European Germanic basin coasts. Central European Journal of Geosciences, 4(3): 495-529.

Dilkes, D. & Arcucci, A. 2012. *Proterochampsa barrionuevoi* (Archosauriformes: Proterochampsia) from the Late Triassic (Carnian) of Argentina and a phylogenetic analysis of Proterochampsia. Palaeontology, 55(4): 853-885.

Dill, H.G., Bechtel, A., Berner, Z., Botz, R., Kus, J., Heunisch, C. & Abu Hamad, A.M.B. 2012. The evaporite-coal transition: chemical, mineralogical and organic composition of the Late Triassic Abu Ruweis Formation, NW Jordan – reference type of the Arabian Keuper. Chemical Geology, 298-299: 20-40.

Doguzhaeva, L.A. & Summesberger, H. 2012. Pro-ostraca of Triassic belemnoids (Cephalopoda) from Northern Calcareous Alps, with observations on their mode of preservation in an environment of northern Tethys which allowed for carbonization of non-biomineralized structures. Neues Jahrbuch für Geologie und Paläontologie – Abhandlungen, 266(1): 31-38.

Domeier, M., Van der Voo, R. & Torsvik, T.H. 2012. Paleomagnetism and Pangea: the road to reconciliation. Tectonophysics, 514–517: 14-43.

Domnanovich, N.S. & Marsicano, C.A. 2012. The Triassic dicynodont *Vinceria* (Therapsida, Anomodontia) from Argentina and a discussion on the basal Kannemeyeriiformes. Geobios, 45(2): 173-186.

Donskaya, T.V., Gladkochub, D.P., Mazukabzov, A.M., De Waele, B. & Presnyakov, S.L. 2012. The Late Triassic Kataev volcanoplutonic association in western Transbaikalia, a fragment of the active continental margin of the Mongol-Okhotsk Ocean. Russian Geology and Geophysics, 53(1): 22-36.

Dozet, S., Kanduč, T. & Markič, M. 2012. A contribution to the petrology of dark grey to black interbeds within Upper Permian and Triassic carbonate rocks in the area between Ljubljana and Bloke, Central Slovenia. Geologija, 55(1): 77-92.

Elitok, Ö. 2012. Geology, geochemistry and geodynamic implications of the mafic-ultramafic rocks from the northern part of the Antalya Complex, SW Turkey. Tectonophysics, 568-569: 335-356.

Escudeo-Mozo, M.J., Marquez, L., Martin-Chivelet, J. & López-Gómez, J. 2012. Anisian foraminifera from the Laudete Fm. (Muschelkalk facies): biostratigraphic implications for the first Mesozoic transgression in the Iberian ranges. Geogaceta, 51: 31-34.

Esfahani, A.-K.N. 2012. Tectonic setting of metabasites of the Neo-Tethyan oceanic remains in Sanandaj-Sirjan structural zone west of Isfahan, central Iran. Iranian Journal of Earth Sciences, 4(2): 75-84.

Evans, D.J., Kingdon, A., Hough, E., Reynolds, W. & Heitmann, N. 2012. First account of resistivity borehole micro-imaging (FMI) to assess the sedimentology and structure of the Preesall Halite, NW England: implications for gas storage and wider applications in CCS caprock assessment. Journal of the Geological Society, London, 169(5): 587-592.

Ezaki, Y., Liu, J.B. & Adachi, N. 2012. Lower Triassic stromatolites in Luodian County, Guizhou Province, South China: evidence for the protracted devastation of the marine environments. Geobiology, 10(1): 48-59.

Ezcurra, M.D. & Apaldetti, C. 2012. A robust sauropodomorph specimen from the Upper Triassic of Argentina and insights on the diversity of the Los Colorados Formation. Proceedings of the Geologists' Association, 123(1): 155-164.

Færseth, R.B. 2012. Structural development of the continental shelf offshore Lofoten–Vesterålen, northern Norway. Norwegian Journal of Geology, 92(1): 19-40.

Falconnet, J., Andriamihaja, M., Läng, É. & Steyer, J.-S. 2012. First procolophonid (Reptilia, Parareptilia) from the Lower Triassic of Madagascar. Comptes Rendus Palevol, 11(5): 357-369.

Fan Yu-hai, Qu Hong-jun, Wang Hui, Yang Xian-chao &

Feng Yang-wei. 2012. Trace element analysis in determining sedimentary media environment – the western Ordos Basin as an example in the Late Triassic. Geology in China, 2012/2: 382-389.

Farabegoli, E. & Tonidande, D. 2012. Stratigrafia e facies al limite Permiano – Triassico nelle Dolomiti occidentali (Provincia di Bolzano, Italia): una revisione. Geo.Alp, 9: 120-155.

Farki, K., Zahour, G., Zerhouni, Y. & Wafa, H. 2012. Contribution à la compréhension de l'évolution sédimentaire et tectono-volcanique de la série Triasico-Liasique de l'Oued N'Fifikh (Meseta cotière, Maroc). Annales de la Société Géologique du Nord (2e série), 19: 145-156.

Fattah, R.A., Verweij, J.M., Witmans, N. & ten Veen, J.H. 2012. Reconstruction of burial history, temperature, source rock maturity and hydrocarbon generation in the northwestern Dutch offshore. Netherlands Journal of Geosciences, 91(4): 535-554.

Feldmann, R.M., Schweitzer, C.E., Shixue Hu, Qiyue Zhang, Changyoing Zhou, Tao Xie, Jinyuan Huang & Wen Wen. 2012. Macrurous Decapoda from the Luoping biota (Middle Triassic) of China. Journal of Paleontology, 86(3): 425-441.

Feldman-Olszewska, A., Adamczak-Biały, T. & Becker, A. 2012. Characterization of the Jurassic and Triassic reservoirs and seals from north Mazovia as a candidate site for CO_2 storage based on data from deep boreholes. Biuletyn Państwowy Instytut Geologiczny, 448(1): 27–46.

Ferrière, J., Chanier, F. & Ditbanjong, P. 2012. The Hellenic ophiolites: eastward or westward obduction of the Maliac Ocean, a discussion. International Journal of Earth Sciences, 101(6): 1559-1580.

Filleaudea, P.-Y., Mouthereau, F. & Pik, R. 2012. Thermo-tectonic evolution of the south-central Pyrenees from rifting to orogeny: insights from detrital zircon U/Pb and (U-Th)/He thermochronometry. Basin Research, 24(4): 401-417.

Fischer, J., Voigt, S., Franz, M., Schneider, J.W., Joachimski, M.M., Tichomirowa, M., Götze, J. & Furrer, H. 2012. Palaeoenvironments of the late Triassic Rhaetian Sea: implications from oxygen and strontium isotopes of hybodont shark teeth. Palaeogeography, Palaeoclimatology, Palaeoecology, 353–355: 60-72.

Friedman, M. & Sallan, L.C. 2012. Five hundred million years of extinction and recovery: a Phanerozoic survey of large-scale diversity patterns in fishes. Palaeontology, 55(4): 707-742.

Fulong Cai, Lin Ding, Leary, R.J., Houqi Wang, Qiang Xu, Liyun Zhang & Yahui Yue. 2012. Tectonostratigraphy and provenance of an accretionary complex within the Yarlung-Zangpo suture zone, southern Tibet: insights into subduction-accretion processes in the Neo-Tethys. Tectonophysics, 574-575: 181-192.

Gaetano, L.C., Mocke, H., Abdala, F. & Hancox, J. 2012. Complex multicusped postcanine teeth from the Lower Triassic of South Africa. Journal of Vertebrate Paleontology, 32(6): 1411-1420.

Gale, L. 2012. Rhaetian foraminiferal assemblage from the Dachstein Limestone of Mt. Begunjščica (Košuta Unit, eastern Southern Alps). Geologija, 55(1): 17-44.

Gale, L., Kolar-Jurkovšek, T., Šmuc, A. & Rožič, B. 2012. Integrated Rhaetian foraminiferal and conodont biostratigraphy from the Slovenian Basin, eastern southern Alps. Swiss Journal of Geosciences, 105(3): 435-462.

Gale, L., Rettori, R. & Martini, R. 2012. Critical review of Pseudocucurbitidae (Miliolina, Foraminiferea) from the Late Triassic reef environments of the Tethyan area. Journal of Micropalaeontology, 31(2): 179-186.

Gale, L., Rettori, R., Martini, R., Kastelic, A., Praprotnik, J., Jamnik, M., Šmuc, A. & Rožič, B. 2012. *Miliolipora* species (Foraminifera, Miliolina) from the Rhaetian Dachstein Limestone of Karavanke Mts (Slovenia): palaeoecological and palaeobiogeographic implications. Revue de micropaléontology, 55(3): 99-112.

Gallois, R.W. 2012. The influence of reactivated fault movements on river development and coastal evolution: examples from the Devon-Dorset coast, UK. Geoscience in South-West England, 13(1): 77-83.

Gallois, R. W. 2012. Field excursion to Culverhole Point, The Slabs and Goat Island, east Devon, 5th January, 2012. Geoscience in South-West England, 13(1): 135-141.

Galster, F., Cavargna-Sani, M., Epard, J.-L. & Masson, H. 2012. New stratigraphic data from the Lower Penninic between the Adula nappe and the Gotthard massif and consequences for the tectonics and the paleogeography of the Central Alps. Tectonophysics, 579: 37-55.

Galton, P.M. 2012. Notes on bones and teeth of *Bromsgroveia* and other archosaurian reptiles from the lower Middle Triassic (Anisian) of the English Midlands. Revue de Paléobiologie, 31(1): 171-204.

Gandin, A. 2012. Tectonic control on the sedimentary architecture of Early Mesozoic mixed siliciclastic-carbonate Pseudoverrucano successions (southern Tuscany, Italy). Italian Journal of Geosciences, 131(1):77-94.

Gardin, S., Krystyn, L., Richoz, S., Bartolini, A. & Galbrun, B. 2012. Where and when the earliest coccolithophores? Lethaia, 45(4): 507-523.

Garland, J., Neilson, J.E., Laubach, S.E. & Whidden, K.J. (eds). 2012. Advances in Carbonate Exploration and Reservoir Analysis. Geological Society, London, Special Publications, 370: 311 pp.

Gastaldo, R.A. & Neveling, J. 2012. The terrestrial Permian–Triassic boundary event is a nonevent: REPLY. Geology, 40(3): e257, doi. 10.1130/G32975Y.1

Gawlick, H.-J., Goričan, Š., Missoni, S. & Lein, R. 2012. Late Anisian platform drowning and radiolarite deposition as a consequence of the opening of the Neotethys ocean (High Karst nappe, Montenegro). Bulletin de la Société Géologique de France, 183(4): 349-358.

Geng Bing-he, Jin Fan, Wu Fei-xiang & Wang Qiang. 2012. New perleidid fishes from the Middle Triassic strata of Yunnan Province. Geological Bulletin of China, 31(6): 915-927.

Gernigon, L. & Brönner, M. 2012. Late Palaeozoic architecture and evolution of the southwestern Barents Sea: insights from a new generation of aeromagnetic data. Journal of the Geological Society, London, 169(4): 449-459.

Geske, A., Zorlu, J., Richter, D.K., Buhl, D., Niedermayr, A. & Immenhauser, A. 2012. Impact of diagenesis and low grade metamorphosis on isotope (δ^{26}Mg, δ^{13}C, δ^{18}O and ^{87}Sr/^{86}Sr) and elemental (Ca, Mg, Mn, Fe and Sr) signatures of Triassic sabkha dolomites. Chemical Geology, 332-333: 45-64.

Ghosh, S., Sarkar, S. & Ghosh, P. 2012. Petrography and major element geochemistry of the Permo-Triassic sandstones, central India: implications for provenance in an intracratonic pull-apart basin. Journal of Asian Earth Sciences, 43(1): 207-240.

Ghosh, S.C. 2012. An overview of fossil conchostraca of Indian Gondwana and new contributions to Gondwana geology in global context. Indian Journal of Geosciences, 66(1): 1-26.

Giles, P.S. 2012. Low-latitude Ordovician to Triassic brachiopod habitat temperatures (BHTs) determined from $\delta^{18}O_{[brachiopod\ calcite]}$: a cold hard look at ice-house tropical oceans. Palaeogeography, Palaeoclimatology, Palaeoecology, 317–318: 134-152.

Glorie, S., De Grave, J., Buslov, M.M., Zhimulev, F.I., Elburg, M.A. & Van den haute, P. 2012. Structural control on Meso-Cenozoic tectonic reactivation and denudation in the Siberian Altai: insights from multi-method thermochronometry. Tectonophysics, 544–545: 75-92.

Goddéris, Y., Donnadieu, Y., Lefebvre, V., Le Hir, G. & Nardin, E. 2012. Tectonic control of continental weathering, atmospheric CO_2, and climate over Phanerozoic times. Comptes Rendus Geoscience, 344(11-12): 652-662.

Gorzelak, P., Salamon, M.A. & Baumiller, T.K. 2012. Predator induced macroevolutionary trends in Mesozoic crinoids. Proceedings of the National Academy of Sciences, 109(18): 7004-7007.

Götz, A.E. & Feist-Burkhardt, S. 2012. Phytoplankton associations of the Anisian Peri-Tethys Basin (Central Europe): evidence of basin evolution and palaeoenvironmental change. Palaeogeography, Palaeoclimatology, Palaeoecology, 337-338, 151-158.

Goudemand, N., Orchard, M.J., Bucher, H. & Jenks, J. 2012. The elusive origin of *Chiosella timorensis* (Conodont Triassic). Geobios, 45(2): 199-207.

Goudemand, N., Orchard, M.J., Tafforeau, P., Urdy, S., Brühwiler, T., Brayard, A, Galfetti, T. & Bucher, H. 2012. Early Triassic conodont clusters from South China: revision of the architecture of the 15 element apparatuses of the Superfamily Gondolelloidea. Palaeontology, 55(5): 1021-1034.

Gradstein, F.M., Ogg, J.G. & Hilgen, F.J. 2012. On the Geologic Time Scale. Newsletters on Stratigraphy, 45(2): 171-188.

Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds). 2012. The Geologic Time Scale 2012. Boston, USA: Elsevier B.V; 2 volumes, 1176 pp.

Graham, R., Jackson, M., Pilcher, R. & Kilsdonk, B. 2012. Allochthonous salt in the sub-Alpine fold-thrust belt of Haute Provence, France. Geological Society, London, Special Publications, 363: 595-615.

Greene, S.E., Bottjer, D.J., Corsetti, F.A., Berelson, W.M. & Zonneveld, J.-P. 2012. A subseafloor carbonate factory across the Triassic-Jurassic transition. Geology, 40(11): 1043-1046.

Greene, S.E., Martindale, R.C., Ritterbush, K.A., Bottjer, D.J., Corsetti, F.A. & Berelson, W.M. 2012. Recognising ocean acidification in deep time: an evaluation of the evidence for acidification across the Triassic-Jurassic boundary. Earth-Science Reviews, 113(1-2): 72-93.

Greff-Lefftz, M. & Besse, J. 2012. Paleo movement of continents since 300 Ma, mantle dynamics and large wander of the rotational pole. Earth and Planetary Science Letters, 345-348: 151-158.

Grossman, E.L. 2012. Chapter 10 – Oxygen Isotope Stratigraphy. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 181-206.

Gründel, J. & Nützel, A. 2012. On the early evolution (Late Triassic to Late Jurassic) of the Architectibranchia (Gastropoda: Heterobranchia), with a provisional classification. Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 264(1): 31-59.

Gu Na, Wan Yu-li, Ding Xiao-qi, Ying tao & Cheng Wen-bo. 2012. The lithofacies characteristics and influencing factors of Yanchang Formation in Fuxian, Ordos Basin. Xinjiang Geology, 30(3): 335-340.

Guex, J., O'Dogherty, L., Carter, E.S., Goričan, Š., Dumitrica, P. & Bartolini, A. 2012. Geometrical transformations of selected Mesozoic radiolarians. Geobios, 45(6): 541-554.

Guex, J., Schoene, B., Bartolini, A., Spangenberg, J., Schaltegger, U., O'Dogherty, L., Taylor, D., Bucher, H. & Atudorei, V. 2012. Geochronological constraints on post-extinction recovery of the ammonoids and carbon cycle perturbations during the Early Jurassic. Palaeogeography, Palaeoclimatology, Palaeoecology, 346-347: 1–11.

Guitang Pan, Liquan Wang, Rongshe Li, Sihua Yuan, Wenhua Ji, Fuguang Yin, Wanping Zhang & Baodi Wang. 2012. Tectonic evolution of the Qinghai-Tibet Plateau. Journal of Asian Earth Sciences, 53: 3-14.

Haas, J., Budai, T. & Raucsik, B. 2012. Climatic controls on sedimentary environments in the Triassic of the Transdanubian Range (Western Hungary). Palaeogeography, Palaeoclimatology, Palaeoecology, 353–355: 31-44.

Haig, D.W. & McCartain, E. 2012. Intraspecific variation in Triassic Ophthalmidiid Foraminifera from Timor. Revue de micropaléontologie, 55(2): 39-52.

Haijun Song, Wignall, P.B., Jinnan Tong, Bond, D.P.G., Huyue Song, Xulong Lai, Kexin Zhang, Hongmei Wang & Yanlong Chen. 2012. Geochemical evidence from bio-apatite for multiple oceanic anoxic events during Permian–Triassic transition and the link with end-Permian extinction and recovery. Earth and Planetary Science Letters, 353-354: 12-21.

Hao Cheng, Chao Zhang, Vervoort, J.D., Honghua Lu, Chao Wang & Dadi Cao. 2012. Zircon U-Pb and garnet Lu-Hf geochronology of eclogites from the Lhasa Block, Tibet. Lithos, 155: 341-359.

Hara, H., Kunii, M., Hisada, K., Ueno, K., Kamata, Y., Srichan, W., Charusiri, P., Charoentitirat, T., Watarai, M., Adachi, Y. & Kurihara, T. 2012. Petrography and geochemistry of clastic rocks within the Inthanon zone, northern Thailand: implications for Paleo-Tethys subduction and convergence. Journal of Asian Earth Sciences, 61: 2-15.

Hart, M.B. 2012. Developments in Mesozoic and Cenozoic stratigraphy and palaeontology during the last fifty years (1962-2012). Geoscience in South-West England, 13(1): 12-30.

Hayman, J. 2012. Deep-diving dinosaurs. [Comment on Rothschild et al., 2012, q.v.]. Naturwissenschaften, 99(8): 671-672.

Hays, L.E., Grice, K., Foster, C.B. & Summons, R.E. 2012. Biomarker and isotopic trends in a Permian–Triassic sedimentary section at Kap Stosch, Greenland. Organic Geochemistry, 43: 67-82.

Heckert, A.B., Lucas, S.G. & Spielmann, J.A. 2012. A new species of the enigmatic archosauromorph *Doswellia* from the Upper Triassic Bluewater Creek Formation, New Mexico, USA. Palaeontology, 55(6): 1333-1348.

Heckert, A.B., Mitchell, J.S., Schneider, V.P. & Olsen, P.E. 2012. Diverse new microvertebrate assemblage from the Upper Triassic Cumnock Formation, Sanford Subbasin, North Carolina, USA. Journal of Paleontology, 86(2): 368-390.

Heckert, A.B., Sload, E.J., Lucas, S.G. & Schumacher, B.A. 2012. Triassic fossils found stratigraphically above 'Jurassic' eolianites necessitate the revision of lower Mesozoic stratigraphy in Picket Wire Canyonlands, south-central Colorado. Rocky Mountain Geology, 47(1): 37-53.

Helbig, M., Keppie, J.D., Murphy, J.B. & Solari, L.A. 2012. U-Pb geochronological constraints on the Triassic-Jurassic Ayú Complex, southern Mexico: derivation from the western margin of Pangea-A. Gondwana Research, 22(3): 910-927.

Henares, S., Viseras, C. & Cultrone, G. 2012. Petrophysical evaluation of fluvial sandstones. The Triassic example of the Alcaraz area (Albacete). Geogaceta, 52: 89-92.

Henares, S., Viseras, C., Fernández, J., Cultrone, G. & Caracciolo, L. 2012. Petrological chracterization of the Triassic red beds of the tabular cover of the Iberian Meseta (Alcaraz area). Geogaceta, 52: 61-64.

Henderson, C.M., Davydov, V.I., Wardlaw, B.R., Gradstein, F.M. & Hammer, O. 2012. Chapter 24 – The Permian Period. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 653-679.

Hermann, E., Hochuli, P.A., Bucher, H., Brühwiler, T., Hautmann, M., Ware, D., Weissert, H., Roohi, G., Yaseen, A. & Rehman, K. 2012. Climatic oscillations at the onset of the Mesozoic inferred from palynological records from the North Indian Margin. Journal of the Geological Society, London, 169(2): 227-237.

Hermann, E., Hochuli, P.A., Bucher, H. & Roohi, G. 2012. Uppermost Permian to Middle Triassic palynology of the Salt Range and Surghar Range, Pakistan. Review of Palaeobotany and Palynology, 169: 61-95.

Hesheng Shi & Chun-Feng Li. 2012. Mesozoic and early Cenozoic tectonic convergence-to-rifting transition prior to opening of the South China Sea. International Geology Review, 54(15): 1801-1828.

Hillebrandt, A. von. 2012. Are the Late Triassic to early Jurassic aragonitic Oberhauserellidae (Robertinina) the ancestors of planktonic Foraminifera? Neues Jahrbuch für Geologie und Paläontologie – Abhandlungen, 266(3): 199-215.

Hinnov, L.A. & Hilgen, F.J. 2012. Chapter 4 – Cyclostratigraphy and Astrochronology. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 63-83.

Hinojosa, J.L., Brown, S.T., Jun Chen, DePaolo, D.J., Paytan, A., Shu-zhong Shen & Payne, J.L. 2012. Evidence for end-Permian ocean acidification from calcium isotopes in biogenic apatite. Geology, 40(8): 743-746.

Holt, P.J., van Hunen, J. & Allen, M.B. 2012. Subsidence of the West Siberian Basin: effects of a mantle plume impact. Geology, 40(8): 703-706.

Hongfu Yin, Shucheng Xie, Genming Luo, Algeo, T.J. & Kexin Zhang. 2012. Two episodes of environmental change at the Permian-Triassic boundary of the GSSP section Meishan. Earth-Science Reviews, 115(3): 163-172.

Hongyuan Zhang, Junlai Liu & Wenbin Wu. 2012. Geochronology and tectonic evolution of the Lincang batholith in southwestern Yunnan, China. Journal of Geological Research: 11pp.

Hönisch, B., Ridgwell, A., Schmidt, D.N., Thomas, E., Gibbs, S.J., Sluijs, A., Zeebe, R., Kump, L., Martindale, R.C., Greene, S.E., Kiessling, W., Ries, J., Zachos, J. C., Royer, D.L., Barker, S., Marchitto Jr., T.M., Moyer, R., Pelejero, C., Ziveri, P., Foster, G.L. & Williams, B. 2012. The geological record of ocean acidification. Science, 335 (6072): 1058-1063.

Horton, A. 2012. The occurrence of calcium phosphate in the Mesozoic and Tertiary of eastern England. Mercian Geologist, 18(1): 60-68.

Hu, Z.W., Huang, S.J., Li, Z.M., Qing, H.R., Fan, M. & Lan, Y.F. 2012. Temperatures of dolomitizing fluids in the Feixianguan Formation from the Northeastern Sichuan Basin. SCIENCE CHINA Earth Sciences, 55(10): 1627–1640.

Huaichun Wu, Shihong Zhang, Qinglai Feng, Ganqing Jiang, Haiyan Li & Tianshui Yang. 2012. Milankovitch and sub-Milankovitch cycles of the early Triassic Daye Formation, South China and their geochronological and paleoclimatic implications. Gondwana Research, 22(2): 748-759.

Huang, S.J., Huang, K.K., Lü, J. & Lan, Y.F. 2012. Carbon isotopic composition of Early Triassic marine carbonates, Eastern Sichuan Basin, China. SCIENCE CHINA Earth Sciences, 55(12): 2026–2038.

Huaqi, L., Zhiqin, X., Jinhsui, Y. & Zhemin, T. 2012. Indosinian orogenesis in the Lhasa terrane, Tibet: new muscovite ^{40}Ar-^{39}Ar geochronology and evolutionary process. Acta Geologica Sinica, 86(5): 1116-1127.

Hugi, J. & Scheyer, T.M. 2012. Ossification sequences and associated ontogenetic changes in the bone histology of pachypleurosaurids from Monte San Giorgio (Switzerland/Italy). Journal of Vertebrate Paleontology, 32(2): 315-327.

Hunt, A.P., Milàn, J., Lucas, S.G. & Spielmann, J.A. (eds). 2012. Vertebrate Coprolites. New Mexico Museum of Natural History & Science Bulletin 57: iv+ 387 pp.

Huttenlocker, A.K. & Sidor, C.A. 2012. Taxonomic revision of therocephalians (Therapsida, Theriodontia) from the Lower Triassic of Antarctica. American Museum Novitates, 3738: 19 pp.

Iacono-Marziano, G., Marecal, V., Pirre, M., Gaillard, F., Arteta, J., Scaillet, B. & Arndt, N.T. 2012. Gas emissions due to magma-sediment interactions during flood magmatism at the Siberian Traps: gas dispersion and environmental consequences. Earth and Planetary Science Letters, 357–358: 308-318.

Iba Y., Sano, S., Mutterlose, J. & Kondo, Y. 2012. Belemnites originated in the Triassic – a new look at an old group. Geology, 40(1): 911-914.

Irmis, R.B. & Whiteside, J.H. 2012. Delayed recovery of non-marine tetrapods after the end-Permian mass extinction tracks global carbon cycle. Proceedings of the Royal Society, B. 279 (1732): 1310-1318.

Issautier, B., Le Nindre, Y.-M., Memesh, A., Dini, S. & Viseur, S. 2012. Managing clastic reservoir heterogeneity I: sedimentology and sequence stratigraphy of the Late Triassic Minjur Sandstone at the Khashm al Khalta type locality, Central Saudi Arabia. GeoArabia, 17(2): 17-56.

Jackson, C.A.-L. & Lewis, M.M. 2012. Origin of an anhydrite sheath encircling a salt diapir and implications for the seismic imaging of steep-sided salt structures, Egersund Basin, Northern North Sea. Journal of the Geological Society, 169(5): 593-599.

Jha, N. & Aggarwal, N. 2012. Permian–Triassic palynostratigraphy in Mailaram area, Godavari Graben, Andhra Pradesh, India. Journal of Earth System Science, 121(5): 1257-1285.

Jha, N., Chary, M.B. & Aggarwal, N. 2012. Permian Triassic palynofloral transition in Chintalapudi area, Godavari Graben, Andhra Pradesh, India. Journal of Earth System Science, 121(5): 1287-1303.

Jia, C., Huang, J., Kershaw, S., Luo, G., Farabegoli, E., Perri, M.C., Chen, L., Bai, X. & Xie, S. 2012. Microbial response to limited nutrients in shallow water immediately after the end-Permian mass extinction. Geobiology, 10(1): 60-71.

Jia Chun-ming, Guan Jian, Liang Ze-liang, Yao Wei-jiang & Shi Jian. 2012. Reservoir forming conditions and the main control factors analysis of Triassic System in Chepaizi Prominence, Junggar Basin. Xinjiang Geology, 30(4): 434-437.

Jian Hu, Shao-Yong Jiang, Hai-Xiang Zhao, Yi Shao, Zun-Zhong Zhang, E. Xiao, Yan-Fen Wang, Bao-Zhang Dai & Hai-Yong Li. 2012. Geochemistry and petrogenesis of the Huashan granites and their implications for the Mesozoic tectonic settings in the Xiaoqinling gold mineralization belt, NW China. Journal of Asian Earth Sciences, 56: 276-289.

Jian Liu, Yue Zhao, Xiaoming Liu, Yu Wang & Xiaowen Liu. 2012. Rapid exhumation of basement rocks along the northern margin of the North China craton in the early Jurassic: evidence from the Xiabancheng Basin, Yanshan Tectonic Belt. Basin Research, 24(5): 544-558.

Jian-Wei Zi, Cawood, P.A., Wei-Ming Fan, Yue-Jun Wang, Tohver, E., McCuaig, T.C. & Tou-Ping Peng. 2012. Triassic collision in the Paleo-Tethys Ocean constrained by volcanic activity in SW China. Lithos, 144–145: 145-160.

Jianghai Yang, Cawood, P.A., Yuansheng Du, Hu Huang, Hongwei Huang & Ping Tao. 2012. Large Igneous Province and magmatic arc sourced Permian–Triassic volcanogenic sediments in China. Sedimentary Geology, 261–262: 120-131.

Jianghai Yang, Cawood, P.A., Yuansheng Du, Hu Huang & Lisha Hu. 2012. Detrital record of Indosinian mountain building in SW China: provenance of the Middle Triassic turbidites in the Youjiang Basin. Tectonophysics, 574-575: 105-117.

Jianmin Hu, Hong Chen, Hongjie Qu, Guoli Wu, Jiaxi Yang & Zhongyi Zhang. 2012. Mesozoic deformations of the Dabashan in the southern Qinling orogen, central China. Journal of Asian Earth Sciences, 47: 71-184.

Jin Nin-dong, Liu Xiao-hong, Zhang Jin-wu, Du Zi-qian, Ding Ying-zhan & Shu-Yun. 2012. Sedimentary facies in the first member of the upper Triassic Xujiahe Formation in Hexidong, Beibei, Chongqing. Sedimentary Geology and Tethyan Geology, 32(2): 37-43

Jin-Hui Yang, Jin-Feng Sun, Ji-Heng Zhang & Wilde, S.A. 2012. Petrogenesis of Late Triassic intrusive rocks in the northern Liaodong Peninsula related to decratonization of the North China Craton: zircon U-Pb age and Hf-O isotope evidence. Lithos, 153: 108-128.

Jin-Hui Yang, Jin-Feng Sun, Min Zhang, Fu-Yuan Wu & Wilde, S.A. 2012. Petrogenesis of silica-saturated and silica-undersaturated syenites in the northern North China Craton related to post-collisional and intraplate extension. Chemical Geology, 328: 149-167.

Jin-Yang Zhang, Chang-Qin Ma, Fu-Hao Xiong & Bin Liu. 2012. Petrogenesis and tectonic significance of the Late Permian–Middle Triassic calc-alkaline granites in the Balong region, eastern Kunlun Orogen, China. Geological Magazine, 149(5): 892-908.

Jing, W. & Zhongjie Zhang. 2012. Spatial distribution of seismic layer, crustal thickness, and Vp / Vs ratio in the Permian Emeishan Mantle Plume region. Gondwana Research, 22(1): 127-139.

Joachimski, M.M., Xulong Lai, Shuzhong Shen, Haishui Jiang, Genming Luo, Bo Chen, Jun Chen & Yadong Sun. 2012. Climate warming in the latest Permian and the Permian–Triassic mass extinction. Geology, 40(3): 195-198.

Jóźwiak, K., Andrejczuk, V. & Różkowski, J. 2012. Results of geochemical modelling of groundwater in the gypsiferous Triassic series of the Deshat Korabi mountains. Biuletyn Państwowy Instytut Geologiczny, 451: 107-114.

Jun Shen, Algeo, T.J., Qing Hu, Ning Zhang, Lian Zhou, Wenchen Xia, Shucheng Xie & Qinglai Feng. 2012. Negative C-isotope excursions at the Permian-Triassic boundary linked to volcanism. Geology, 40(11): 963-966.

Jung, A., Aigner, T., Palermo, D., Nardon, S., & Pontiggia, M. 2012. A new workflow for carbonate reservoir modelling based on MPS: shoal bodies in outcrop analogues (Triassic, SW Germany). Geological Society, London, Special Publications, 370: 277-293.

Junlai Liu, My-Dung Tran, Yuan Tang, Quang-Luat Nguyen, Thanh-Hai Tran, Wenbin Wu, Jiafu Chen, Zhaochong Zhang & Zhidan Zhao. 2012. Permo-Triassic granitoids in the northern part of the Truong Son belt, NW Vietnam: geochronology, geochemistry and tectonic implications. Gondwana Research, 22(2): 628-644.

Kai-Jun Zhang, Bing Li & Qing-Guo Wei. 2012. Diversified provenance of the Songpan-Ganzi Triassic turbidites, Central

China: constraints from geochemistry and Nd isotopes. The Journal of Geology, 120(1): 69-82.

Kaiho, K., Oba, M., Fukuda, Y., Ito, K., Ariyoshi, S., Gorjan, P., Riu, Y., Takahashi, S., Chen, Z-Q, Tong J. & Yamakita, S. 2012. Changes in depth-transect redox conditions spanning the end-Permian mass extinction and their impact on the marine extinction: evidence from biomarkers and sulphur isotopes. Global and Planetary Change, 94-95: 20-32.

Kammerer, C.F., Flynn, J.J., Ranivoharimanana, L. & Wyss, A. R. 2012. Ontogeny in the Malagasy traversodontid *Dadadon isaloi* and a reconsideration of its phylogenetic relationships. Fieldiana Life and Earth Sciences, 5: 112–125.

Kammerer, C.F., Nesbitt, S.J. & Shubin, N.H. 2012. The first silesaurid dinosauriform from the Late Triassic of Morocco. Acta Palaeontologica Polonica, 57(2): 277-284.

Kanjanapayont, P., Klötzli, U., Thöni, M., Grasemann, B. & Edwards, M.A. 2012. Rb–Sr, Sm–Nd, and U–Pb geochronology of the rocks within the Khlong Marui shear zone, southern Thailand. Journal of Asian Earth Sciences, 56: 263-275.

Kerr, R. 2012. Tying megaeruptions to a mass extinction long after the fact. Science, 338 (6114): 1522-1523.

Kershaw, S., Crasquin, S., Li, Y., Collin, P.-Y., Forel, M.-B., Mu, X., Baud, A., Wang, Y., Xie, S., Maurer, F. & Guo, L. 2012. Microbialites and global environmental change across the Permian–Triassic boundary: a synthesis. Geobiology, 10(1): 25-47.

Kershaw, S., Crasquin, S., Yue Li, Collin, P.-Y. & Forel, M.-B. 2012. Ocean acidification and the end-Permian Mass Extinction: to what extent does evidence support hypotheses? Geosciences, 2(4): 221-234.

Khalifa, M.A. 2012. Peritidal to intrashelf basin, facies transition of the Adgham Formation (Late Triassic) Al Qasim Province, Saudi Arabia. Carbonates and Evaporites, 27(3-4): 299-319.

Kiecksee, A.P., Seyfullah, L.J., Dörfelt, H., Heinrichs, J., Süß, H. & Schmidt, A.R. 2012. Pre-Cretaceous *Agaricomycetes* yet to be discovered: reinvestigation of a putative Triassic bracket fungus from southern Germany. Fossil Record, 15(2): 85-89.

Ki-Hong Chang & Xixi Zhao. 2012. North and South China suturing in the east end: what happened in Korean Peninsula? Gondwana Research, 22(2): 493-506.

Kim, H.S. 2012. P-T modelling of margarite + anorthite-bearing Al-rich metapelites in the Taebaeksan basin, South Korea: implications for accretion-related metamorphism during the Late Permian-Triassic. Geosciences Journal, 16(3): 207-227.

Kim, H.S., Ree, J.-H. & Kim, J. 2012. Tectono-metamorphic evolution of the Permo-Triassic Songrim (Indosinian) orogeny: evidence from the late Paleozoic Pyeongan Supergroup in the northeastern Taebaeksan Basin, South Korea. International Journal of Earth Sciences, 101(2): 483-498. [Publisher's erratum to this article; ibid, 499].

Kirillova, G.L. & Krapiventseva, V.V. 2012. Mesocyclicity of Upper Triassic-Jurassic rocks in the Bureya Basin in the Far East of Russia: their tectonics, eustasy, and sequence stratigraphy. Russian Journal of Pacific Geology, 6(4): 294-309.

Kiss, G., Molnár, F., Palínkaš, L.A., Kovács, S. & Horvatović, H. 2012. Correlation of Triassic advanced rifting-related Neotethyan submarine basaltic volcanism of the Darnó Unit (NE-Hungary) with some Dinaridic and Hellenidic occurrences on the basis of volcanological, fluid-rock interaction, and geochemical characteristics. International Journal of Earth Sciences, 101(6): 1503-1521.

Klein, H. & Niedźwiedzki, G. 2012. Revision of the Lower Triassic tetrapod ichnofauna from Wióry, Holy Cross Mountains, Poland. New Mexico Museum of Natural History & Science Bulletin 56: ii+59 pp.

Klein, N. 2012. Postcranial morphology and growth of the pachypleurosaur *Anarosaurus heterodontus* (Sauropterygia) from the Lower Muschelkalk of Winterswijk, The Netherlands. Paläontologische Zeitschrift, 86(4): 389-408.

Klug, C. & Jerjen, I. 2012. The buccal apparatus with radula of a ceratitic ammonoid from the German Middle Triassic. Geobios, 45(1): 57-65.

Knaust, D. & Costamagna, L.G. 2012. Ichnology and sedimentology of the Triassic carbonates of north-west Sardinia, Italy. Sedimentology, 59(4): 1190-1207.

Knoll, F. & Rohrberg, K. 2012. CT scanning, rapid prototyping and re-examination of a partial skull of a basal crocodylomorph from the Late Triassic of Germany. Swiss Journal of Geosciences, 105(1): 109-115.

Kombrink, H., Doornenbal, J.C., Duin, E.J.T., den Dulk, M., van Gessel, S.F., ten Veen, J.H. & Witmans, N. 2012. New insights into the geological structure of the Netherlands; results of a detailed mapping project. Netherlands Journal of Geosciences, 91(4): 419-446.

Kombrink, H., ten Veen, J.H. & Geluk, M.C. 2012. Exploration in the Netherlands, 1987-2012. Netherlands Journal of Geosciences, 91(4): 403-418.

Konstantinov, A.G. 2012. A revision of the early Carnian Trachyceratidae (Ammonoidea) of northeastern Asia. Paleontological Journal, 46(5): 453-460.

Koot, M.B. 2012. Permian-Triassic chondrichthyans from the Oman Mountains. Palaeontological Association Newsletter, 79: 75-78.

Koutsovitis, P., Magganas, A. & Ntaflos, T. 2012. Rift and intra-oceanic subduction signatures in the Western Tethys during the Triassic: the case of ultramafic lavas as part of an unusual ultramafic–mafic–felsic suite in Othris, Greece. Lithos, 144–145: 177-193.

Kraimer, K., Lucas, S.G. & Ronchi, A. 2012. Tetrapod footprints from the Alpine Buntsandstein (Lower Triassic) of the Drau Range (Eastern Alps, Austria). Jahrbuch der Geologischen Bundesanstalt Wien, 152(1-4): 205-211.

Kravchinsky. V.A. 2012. Paleozoic large igneous provinces of Northern Eurasia: correlation with mass extinction events. Global and Planetary Change, 86-87: 31-36.

Krzywiec, P. 2012. Mesozoic and Cenozoic evolution of salt structures within the Polish Basin: a review. Geological Society, London, Special Publications, 363: 381-394.

Kubo, T. & Kubo, M.O. 2012. Associated evolution of bipedality and cursoriality among Triassic archosaurs: a phylogenetically controlled evaluation. Paleobiology, 38(3): 474-485.

Kümmell, S.B., & Frey, E. 2012. Digital arcade in the autopodia of Synapsida: standard position of the digits and dorsoventral excursion angle of digital joints in the rays II-V. Palaeodiversity and Palaeoenvironments, 92(2): 171-196.

Kustatscher, E., Bauer, K. & Reich, M. 2012. A new Middle Triassic (Pelsonian) plant locality in the Non Valley (Trentino, Northern Italy). Geo.Alp, 9: 60-73.

Kustatscher, E., Heunisch, C. & van Konijnenburg-van Cittert, J.H.A. 2012. Taphonomical implications of the Ladinian megaflora and palynoflora of Thale (Germany). Palaios, 27(11): 753-764.

Kustatscher, E., Kelber, K.-P. & van Konijnenburg-van Cittert, J.H.A. 2012. *Danaeopsis* Heer ex Schimper 1869 and its European Triassic species. Review of Palaeobotany and Palynology, 183: 32-49.

Lagnaoui, A., Klein, H., Voigt, S, Hminna, A, Saber, H, Schneider, J.W. & Werneburg, R. 2012. Late Triassic tetrapod-dominated ichnoassemblages from the Argana Basin (Western High Atlas, Morocco). Ichnos, 19(4): 238-253.

Laojumpon, C., Matkhammee, T., Wathanapitaksakul, A., Suteethron, V., Suteethron, S., Lauprasert, K., Srisuk, P. & Le Loeuff, J. 2012. Preliminary report on coprolites from the Late Triassic of Thailand. *In*, Hunt, A.P., Milàn, J., Lucas, S.G. & Spielmann, J.A. (eds),Vertebrate Coprolites. New Mexico Museum of Natural History & Science Bulletin 57: 207-214.

Lebing Fu, Junhao Wei, Kusky, T.M., Huayong Chen, Jun Tan, Yanjun Li, Lingjun Kong & Yongjian Jiang. 2012. Triassic shoshonitic dykes from the northern North China craton: petrogenesis and geodynamic significance. Geological Magazine, 149(1): 39-55.

Lehrmann, D.J., Minzoni, M., Xiaowei Li, Meiyi Yu, Payne, J.L., Kelley, B.M., Schaal, E.K. & Enos, P. 2012. Lower Triassic oolites of the Nanpanjiang Basin, south China: facies architecture, giant ooids, and diagenesis—implications for hydrocarbon reservoirs. AAPG Bulletin, 96(8): 1389-1414.

Lei He, Yongbiao Wang, Woods, A., Guoshan Li, Hao Yang & Wei Liao. 2012. Calcareous tubeworms as disaster forms after the end-Permian mass extinction in South China. Palaios, 27(12): 878-886.

Levera, M. 2012. The halobiids from the Norian GSSP candidate section of Pizzo Mondello (Western Sicily, Italy): systematics and correlations. Rivista Italiana di Paleontologia e Stratigrafia, 118(1): 3-45.

Li Guo-xin, Xu Sheng-lin, Chen Hong-de & Chen An-qing. 2012. Triassic Chang 6 sandbody distribution law research on Fu County, Ordos Basin. Geology in China, 2012/4: 923-930.

Li Li, Niu Zhi-jun, Bai Yun-shan, Yao Hua-zhou & Duan Qi-fa. 2012. Volcanic rocks of the Late Triassic Nadigangri Group of the Geladandong area, source region of Yangtze River. Journal of Stratigraphy, 36(1): 49-54.

Li, P.-F., Rosenbaum, G. & Rubatto, D. 2012. Triassic asymmetric subduction rollback in the southern New England Orogen (eastern Australia): the end of the Hunter-Bowen Orogeny. Australian Journal of Earth Sciences, 59(6): 965-981.

Li Ting-dong, Zheng Ning, Ding Wei-cui, Liu Yong, Zheng Hong-wei & Wang Jun. 2012. The upper Triassic strata in Dege-Batang area, western Sichuan Province. Geological Bulletin of China, 31(7): 1017-1023.

Li Yi-ke, Wang An-jian, Cao Dian-hua, Huang Yu-feng, Zhang Ming-chao, Li Rui-ping, Yang Li-jun & Xi Wan-wan. 2012. Sequence stratigraphic definition of Late Triassic salt-bearing horizons in northern Lanping Basin of northwestern Yunnan Province and its implications. Geological Bulletin of China, 31(8): 1313-1322.

Lian Zhou, Wignall, P.B., Jie Su, Qinglai Feng, Shucheng Xie, Laishi Zhao & Junhua Huang. 2012. U/Mo ratios and $\delta^{98/95}$Mo as local and global redox proxies during mass extinction events. Chemical Geology, 324-325: 99-107.

Lindström, S., van de Schootbrugge, B., Dybkjær, K., Pedersen, G.K., Fiebig, J., Nielsen, L.H. & Richos, S. 2012. No causal link between terrestrial ecosystem change and methane release during the end-Triassic mass extinction. Geology, 40(6): 531-534.

Lins, L.S.F., Ho, S.Y.U., Wilson, G.D. & Lo, N. 2012. Evidence for Permo-Triassic colonization of the deep sea by isopods. Biology Letters, 8(6):979-982.

Liu, C.Y., Zheng, H.R., Hu, Z.Q., Yin, W. & Li, S. 2012. Characteristics of carbonate cementation in clastic rocks from the Chang 6 sand body of Yanchang Formation, southern Ordos Basin. SCIENCE CHINA Earth Sciences, 55(1): 58–66.

Liu Jun, Shang Qing-Hua, Sun Ke-Qin & Li Lu. 2012. The horizon of Dashankou fauna and the Permo-Triassic strata in northern Qilian area, China. Vertebrata Palasiatica, 50(4): 373-381.

Liu Yan-ting, Fu Heng, Chen Ji, Sun Xian-zhang, Da Li-ya, Sun Li-chuan & Yue Wen-cheng. 2012. The discovery of the micropellets from the Triassic Leikoupo Formation-Xujiahe Formation boundary in northeastern Sichuan. Sedimentary Geology and Tethyan Geology, 32(2): 49-51.

Lloyd, G.T., Wang, S.C. & Brusatte, S.L. 2012. Identifying heterogeneity in rates of morphological evolution: discrete character change in the evolution of lungfish (Sarcopterygii; Dipnoi). Evolution, 66(2): 330-348.

Lombardo, C. Tintori, A. & Tona, D. 2012. A new species of *Sangiorgioichthys* (Actinopterygii, Semionotiformes) from the Kalkschieferzone of Monte San Giorgio (Middle Triassic; Meride, Canton Ticino, Switzerland). Bollettino della Società Paleontologica Italiana, 51(3): 203-212.

Longyi, S., Hao, W., Xiaohui, Y., Jing, L. & Mingquan, Z. 2012. Paleo-fires and atmospheric oxygen levels in the latest Permian: evidence from maceral compositions of coals in eastern Hunnan, southern China. Acta Geologica Sinica, 86(4): 949-962.

López-Gómez, J., Galán-Abellán, B., de la Horra, R., Barrenechea, J.F., Arche, A., Bourquin, S., Marzo, M. & Durand, M. 2012. Sedimentary evolution of the continental Early–Middle Triassic Cañizar Formation (Central Spain): implications for life recovery after the Permian–Triassic crisis. Sedimentary Geology, 249–250: 26-44.

Lovelace, D.M. & Lovelace, S.D. 2012. Paleoenvironments and paleoecology of a Lower Triassic invertebrate and vertebrate ichnoassemblage from the Red Peak Formation (Chugwater Group), central Wyoming. Palaios, 27(9): 637-658.

Lu TingQing, Wang ZhanLei, Yang XiYan & Zhang XiaoLi.

2012. First record of Lower Triassic *Undichna* spp. fish swimming traces from Emei, Sichuan Province, China. Chinese Science Bulletin, 57(11): 1320-1324.

Lucas, S.G. 2012. The extinction of the Conularids. Geosciences, 2(1): 1-10.

Lucas, S.G., Tanner, L.H., Kozur, H.W., Weems, R.E. & Heckert, A.B. 2012. The Late Triassic timescale: age and correlation of the Carnian-Norian boundary. Earth-Science Reviews, 114: 1-18.

Lukeneder, R. & Lukeneder, S. 2012. Computed tomography in palaeontology – case studies on Triassic and Cretaceous cephalopods. Berichte der Geologischen Bundesanstalt Wien, 94: 16.

Lukenender, S. & Lukenender, A. 2012. Susceptibility data from Upper Triassic beds in Turkey: implications on climatic changes. Berichte des Institutes für Geologie und Paläontologie der Karl-Franzens-Universität Graz, 17: 33.

Lukeneder, S. & Lukeneder, R. 2012. Systematic ammonoid investigations at the Julian/Tuvalian boundary (Carnian, Upper Triassic) at Asagiyaylabel (Taurus Mountains). Berichte der Geologischen Bundesanstalt Wien, 94: 15.

Lukeneder, S., Lukeneder, R., Harzhauser, M., İslamoğlu, Y., Krystyn, L. & Lein, R. 2012. A delayed carbonate factory breakdown during the Tethyan-wide Carnian Pluvial Episode along the Cimmerian terranes (Taurus, Turkey). Facies, 58(2): 279-296.

Machowiak, K., Stawikowski, W. & Achramowicz, S. 2012. Late Triassic ^{40}Ar-^{39}Ar ages of the Baga-Gazryn Chuluu granites (Central Mongolia). Journal of GEOsciences, 57(3): 173-188.

Mackintosh, P.W. & Robertson, A.H.F. 2012. Late Devonian – Late Triassic sedimentary development of the central Taurides, S. Turkey: implications for the northern margin of Gondwana. Gondwana Research, 21(4): 1083-1114.

Malenda, H.F., Simpson, E.L., Szajna, M.J., Fillmore, D.L., Hartline, B.W., Heness, E.A., Kraal, E.R. & Wilk, J.L. 2012. Taphonomy of lacustrine shoreline fish-part conglomerates in the Late Triassic age Lockatong Formation (Collegeville, Pennsylvania, USA): toward the recognition of catastrophic fish kills in the rock record. Palaeogeography, Palaeoclimatology, Palaeoecology, 313–314: 234-245.

Mancuso, A.C. 2012. Taphonomic analysis of fish in rift lacustrine systems: environmental indicators and implications for fish speciation. Palaeogeography, Palaeoclimatology, Palaeoecology, 339–341: 121-131.

Mancuso, A.C. & Caselli, A.T. 2012. Paleolimnology evolution in rift basins: the Ischigualasto-Villa Unión Basin (central-western Argentina) during the Triassic. Sedimentary Geology, 275-276: 38-54.

Manzotti, P., Rubatto, D., Darling, J., Zucali, M., Cenki-Tok, B. & Engi, M. 2012. From Permo-Triassic lithospheric thinning to Jurassic rifting at the Adriatic margin: petrological and geochronological record in Valtournenche (Western Italian Alps). Lithos, 146–147: 276-292.

Mao Jing-wen, Zhou Zhen-hua, Feng Cheng-you, Wang Yi-tian, Zhang Chang-qing, Peng Hui-juan & Yu Miao. 2012. Early Triassic mass of Chinese mineralization and geodynamics. Geology in China, 2012/6: 1437-1471.

Mao Qiong, Zheng Rong-cai, Zou Guang-fu, Yang Kai, Wang Fang & Zhang Zhi-yong. 2012. Upper Triassic sedimentary facies and sedimentary evolution in the northeastern Sichuan foreland basin. Sedimentary Geology and Tethyan Geology, 32(1): 1-11.

Marenco, P.J., Griffin, J.M., Fraiser, M.L. & Clapham, M.E. 2012. Paleoecology and geochemistry of Early Triassic (Spathian) microbial mounds and implications for anoxia following the end-Permian mass extinction. Geology, 40(8): 715-718.

Martin-Rojas, I., Somma, R., Delgado, F., Estévez, A., Iannace, A. & Zamparelli, V. 2012. The Triassic platform of the Gador-Turon unit (Alpujarride complex, Betic Cordillera, southeast Spain): climate versus tectonic factors controlling platform architecture. Facies, 58(2): 297-323.

Martindale, R.C., Berelson, W.M., Corsetti, F.A., Bottjer, D.J. & West, A.J. 2012. Constraining carbonate chemistry at a potential ocean acidification event (the Triassic–Jurassic boundary) using the presence of corals and coral reefs in the fossil record. Palaeogeography, Palaeoclimatology, Palaeoecology, 350–352: 114-123.

Martindale, R.C., Bottjer, D.J. & Corsetti, F.A. 2012. Platy coral patch reefs from eastern Panthalassa (Nevada, USA): unique reef construction in the Late Triassic. Palaeogeography, Palaeoclimatology, Palaeoecology, 313–314: 41-58.

Martindale, R.C., Corsetti, F.A., Bottjer, D.J. & Senobari-Daryan, B. 2012. Microbialite fabrics and diminutive skeletal bioconstructors in lower Norian Summit Point reefs, Oregon, United States. Palaios, 27(7): 489-508.

Martínez, A.N., Tobares, M.L., Giaccardi, A., Aguilera, D., Roquet, M.B. & Giambiagi, L. 2012. Depósitos piroclásticos gondwánicos en el sur de la sierra de Varela, provincia de San Luis: su petrografía y geoquímica. INSUGEO – Serie Correlación Geológica 28(1): 23-32.

Masrouhi, A. & Koyi, H.A. 2012. Submarine 'salt glacier' of northern Tunisia, a case of Triassic salt mobility in North African Cretaceous passive margin. Geological Society, London, Special Publications, 363: 579-593.

Mata, S.A. & Bottjer, D.J. 2012. Microbes and mass extinctions: paleoenvironmental distribution of microbialites during times of biotic crisis. Geobiology, 10(1): 3-24.

Maxwell, E.E., Caldwell, M.W. & Lamoureux, D.O. 2012. Tooth histology, attachment, and replacement in the Ichthyopterygia reviewed in an evolutionary context. Paläontologische Zeitschrift, 86(1): 1-14.

Mayhew, P.J., Bell, M.A., Benton, T.G. & McGowan, A.J. 2012. Biodiversity tracks temperature over time. Proceedings of the National Academy of Sciences, 109(38): 15141-15145.

Maystrenko, Y.P., Bayer, U. & Scheck-Wenderoth, M. 2012. Regional-scale structural role of Permian salt within the Central European Basin System. Geological Society, London, Special Publications, 363: 409-430.

Mazza, M., Cau, A. & Rigo, M. 2012. Application of numerical cladistics to the Carnian-Norian conodonts: a new approach for phylogenetic interpretations. Journal of Systematic Palaeontology, 10(3): 401-422.

Mazza, M., Rigo, M. & Gullo, M. 2012. Taxonomy and biostratigraphic record of the Upper Triassic conodonts of the Pizzo Mondello section (Western Sicily, Italy), GSSP candidate for the base of the Norian. Rivista Italiana di Paleontologia e Stratigrafia, 118(1): 85-130.

McArthur, J.M., Howarth, R.J. & Shields, G.A. 2012. Chapter 7 – Strontium Isotope Stratigraphy. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 127-144.

McLoughlin, S., Stullu-Derrien, C., Kenrick, P., Phillipe, M., Mørk, A. & Roult, J.-P. 2012. Arthropod and fungal interactions with gymnosperm roots in a Triassic permineralized peat from Hopen, Svalbard Archipelago. Palaeontological Association Newsletter, 81; Annual Meeting Programme and Abstracts: 43.

McMillan, A.A., Floyd, J.D., Barnes, R.P. & Phillips, E.R. 2012. British Regional Geology: South of Scotland (Fourth edition). Keyworth, Nottingham: British Geological Survey, xi+247pp.

McRoberts, C.A., Krystyn, L. & Hautmann, M. 2012. Macrofaunal response to the end-Triassic mass extinction in the west-Tethyan Kössen Basin, Austria. Palaios, 27(9): 608-617.

Medvedev, A.Ya. & Al'mukhamedov, A.I. 2012. Geochemistry of silver in Permo-Triassic traps of the Siberian Platform. Russian Geology and Geophysics, 53(7): 669-674.

Melnikova, G.K. & Roniewicz, E. 2012. Early Jurassic corals of the Pamir Mountains – a new Triassic-Jurassic transitional fauna. Geologica Belgica, 15(4): 376-381.

Meloro, C. & Jones, M.E.H. 2012. Tooth and cranial disparity in the fossil relatives of *Sphenodon* (Rhynchocephalia) dispute the persistent 'living fossil' label. Journal of Evolutionary Biology, 25(11): 2194-2209.

Meng He, Moldowan, J.M., Nemchenko-Rovenskaya, A. & Peters, K.E. 2012. Oil families and their inferred source rocks in the Barents Sea and northern Timan-Pechora Basin, Russia. AAPG Bulletin, 96(6): 1121-1146.

Metcalfe, I. 2012. Changhsingian (Late Permian) conodonts from Son La, northwest Vietnam and their stratigraphic and tectonic implications. Journal of Asian Earth Sciences, 50: 141-149.

Mette, W., Elsler, A. & Korte, C. 2012. Palaeoenvironmental changes in the Late Triassic (Rhaetian) of the Northern Calcareous Alps: clues from stable isotopes and microfossils. Palaeogeography, Palaeoclimatology, Palaeoecology, 350–352: 62-72.

Metz, R. 2012. First record of an arthropod from the Passaic Formation (Late Triassic), near Milford, New Jersey. Central European Journal of Geosciences, 4(1): 3-8.

Meyer, K. 2012. Palaeontology: slowed by sulphide. Nature Geoscience, 5(9): 593-594.

Mietto, P., Manfrin, S., Preto, N., Rigo, M., Roghi, G., Furin, S., Gianolla, P., Posenato, R., Muttoni, G., Nicora, A., Buratti, N., Cirilli, S., Spötl, C., Ramezani, J. & Bowring, S. A. 2012. The Global Boundary Stratotype Section and Point (GSSP) of the Carnian Stage (Late Triassic) at Prati di Stuores/Stuores Wiesen Section (Southern Alps, NE Italy). Episodes, 35(3): 414-430.

Mikhaltsov, N.E., Kazansky, A.Yu., Ryabov, V.V., Shevko, A.Ya., Kuprish, O.V. & Bragin, V.Yu. 2012. Paleomagnetism of trap basalts in the northwestern Siberian craton, from core data. Russian Geology and Geophysics, 53(11): 1228-1242.

Milàn, J., Clemmensen, L.B., Adolfssen, J.S., Estrup, E.J., Frobøse, N., Klein, N., Mateus, O. & Wings, O. 2012. A preliminary report on coprolites from the Late Triassic part of the Kap Stewart Formation, Jameson Land, East Greenland. *In*, Hunt, A.P., Milàn, J., Lucas, S.G. & Spielmann, J.A. (eds),Vertebrate Coprolites. New Mexico Museum of Natural History & Science Bulletin 57: 203-206.

Mingxiang Mei & Jinhan Gao. 2012. Giant Induan oolite: a case study from the Lower Triassic Daye Formation in the western Hubei Province, South China. Geoscience Frontiers, 3(6): 843-851.

Missoni, S., Gawlick, H.-J., Sudar, M.N., Jovanović, D. & Lein, R. 2012. Onset and demise of the Wetterstein Carbonate Platform in the mélange area of the Zlatibor Mountain (Sirogojno, SW Serbia). Facies, 58(1): 95-111.

Moisan, P., Labandeira, C.C., Matushkina, N.A., Wappler, T., Voigt, S. & Kerp, H. 2012. Lycopsid–arthropod associations and odonatopteran oviposition on Triassic herbaceous *Isoetites*. Palaeogeography, Palaeoclimatology, Palaeoecology, 344–345: 6-15.

Moisan, P., Voigt, S., Schneider, J.W. & Kerp, H. 2012. New fossil bryophytes from the Triassic Madygen Lagerstätte (SW Kyrgyzstan). Review of Palaeobotany and Palynology, 187: 29-37.

Monaghan, A., Ford, J., Milodowski, A., McInroy, D., Pharaoh, T., Rushton, J., Browne, M., Cooper, A., Hulbert, A. & Napier, B. 2012. New insights from 3D geological models at analogue CO_2 storage sites in Lincolnshire and eastern Scotland, UK. Proceedings of the Yorkshire Geological Society, 59(1): 53-76.

Monnet, C., Bucher, H., Guex, J. & Wasmer, M. 2012. Large-scale evolutionary trends of Acrochordiceratidae Arthaber, 1911 (Ammonoidea, Middle Triassic) and Cope's Rule. Palaeontology, 55(1): 87-107.

Moore, F. & Esmaeili, A. 2012. Mineralogy and geochemistry of the coals from the Karmozd and Kiasar coal mines, Mazandaran province, Iran. International Journal of Coal Geology, 96-97: 9-21.

Morton, N. 2012. Inauguration of the GSSP for the Jurassic System. Episodes, 35(2): 328-332.

Mukherjee, D. & Ray, S. 2012. Taphonomy of an Upper Triassic vertebrate bonebed: a new rhynchosaur (Reptilia; Archosauromorpha) accumulation from India. Palaeogeography, Palaeoclimatology, Palaeoecology, 333–334: 75-91

Müller, J. & Bickelmann, C. 2012. Genes and fossils. German Research, 2/2012: 28-31.

Nasterlack, T., Canoville, A. & Chinsamy, A. 2012. New insights into the biology of the Permian genus *Cistecephalus* (Therapsida, Dicynodontia). Journal of Vertebrate Paleontology, 32(6): 1396-1410.

Natal'in, B.A., Sunal, G., Satir, M. & Toraman, E. 2012. Tectonics of the Strandja Massif, NW Turkey: history of a long-lived arc at the northern margin of Palaeo-Tethys.

Turkish Journal of Earth Sciences, 21(5): 755-798.

Naugolnykh, S.V. 2012. *Vetlugospermum* and Vetlugospermaceae: a new genus and family of peltasperms from the Lower Triassic of Moscow syneclise (Russia). Geobios, 45(5): 451-462.

Neenan, J.M. & Scheyer, T.M. 2012. The braincase and inner ear of *Placodus gigas* (Sauropterygia, Placodontia)–new reconstruction based on micro-computed tomographic data. Journal of Vertebrate Paleontology, 32(6): 1350-1357.

Nel, A., Bechly, G., Prokop, J., Béthoux, O. & Fleck, G. 2012. Systematics and evolution of Paleozoic and Mesozoic damselfly-like Odonatoptera of the 'Protozygopteran' Grade. Journal of Paleontology, 86(1): 81-104.

Neng Jiang, Jingzhi Chen, Jinghui Guo & Guohu Chang. 2012. In situ zircon U–Pb, oxygen and hafnium isotopic compositions of Jurassic granites from the North China craton: evidence for Triassic subduction of continental crust and subsequent metamorphism-related ^{18}O depletion. Lithos, 142–143: 84-94.

Nevolin, P.L., Utkin, V.P., Mitrokhin, A.N. & Kutub-Zade, T.K. 2012. Geologic structure of western Primorye: structuring dynamics. Russian Journal of Pacific Geology, 6(4): 275-293.

Newell, A.J., Benton, M.J., Kearsey, T., Taylor, G., Twitchett, R. & Tverdokhlebov, V.P. 2012. Calcretes, fluviolacustrine sediments and subsidence patterns in Permo-Triassic salt-walled minibasins of the south Urals, Russia. Sedimentology, 59(5): 1659-1676.

Niedźwiedzki, G., Sulej, T. & Dzik, J. 2012. A large predatory archosaur from the Late Triassic of Poland. Acta Palaeontologica Polonica, 57(2): 267-276.

Nikishin, A.M., Ziegler, P.A., Bolotov, S.N. & Fokin, P.A. 2012. Late Palaeozoic to Cenozoic evolution of the Black Sea-Southern Eastern Europe region: a view from the Russian Platform. Turkish Journal of Earth Sciences, 21(5): 571-634.

Novikov, I.V. 2012. New data on trematosauroid labyrinthodonts of Eastern Europe: 3. *Qantas samarensis* gen. et sp nov. Paleontological Journal, 46(2): 177-186.

Novikov, I.V. 2012. New data on trematosauroid labyrinthodonts of Eastern Europe: 4. Genus *Benthosuchus* Efremov, 1937. Paleontological Journal, 46(4): 400-411.

Noy, D.J., Holloway, S., Chadwick, R.A., Williams, J.D.O., Hannis, S.A. & Lahann, R.W. 2012. Modelling large-scale carbon dioxide injection into the Bunter Sandstone in the UK Southern North Sea. International Journal of Greenhouse Gas Control, 9: 220-233.

Nützel, A., Aghababalou, B. & Senobari-Daryan, B, 2012. Gastropods from the Norian (Late Triassic) Nayband Formation near Natanz (Iran). Bulletin of Geosciences, 87(1): 53-65.

Obermaier, M., Aigner, T. & Forke, H.C. 2012. Facies, sequence stratigraphy and reservoir/seal potential of a Jihl Formation outcrop equivalent (Wadi Sahtan, Triassic, Upper Mahil Member, Sultanate of Oman). GeoArabia, 17(3): 85-128.

Ogden, D.E. & Sleep, N.H. 2012. Explosive eruption of coal and basalt and the end-Permian mass extinction. Proceedings of the National Academy of Sciences, 109(1): 59-62.

Ogg, J.G. 2012. Chapter 25 – Triassic. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 681-730.

Ogg, J.G., Hinnov, L.A. & Huang, C. 2012. Chapter 26 – Jurassic. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 731-791.

Okay, A.I., İşintek, İ., Altiner, D., Özkan-Altiner, S. & Okay, N. 2012. An olistostrome-mélange belt formed along a suture: Bornova Flysch zone, western Turkey. Tectonophysics, 568-569: 282-295.

Okere, D. & Toothill, S. 2012. New insights into hydrocarbon plays in the Caspian Sea, Kazakhstan. Petroleum Geoscience, 18(3): 253-268.

Oliva-Urcia, B., Pueyo, E.L., Larrasoaña, J.C., Casas, A.M., Román-Berdiel, T., Van der Voo, R. & Scholger, R. 2012. New and revisited paleomagnetic data from Permian–Triassic red beds: two kinematic domains in the west-central Pyrenees. Tectonophysics, 522–523: 158-175.

Oprčkal, P., Gale, L., Kolar-Jurkovšek, T. & Rožič, B. 2012. Outcrop-scale evidence for the Norian-Rhaetian extensional tectonics in the Slovenian Basin (Southern Alps). Geologija, 55(1): 45-56.

Osozawa, S. & Wakabayashi, J. 2012. Exhumation of Triassic HP-LT rocks by upright extrusional domes and overlying detachment faults, Ishigaki-jima, Ryukyu islands. Journal of Asian Earth Sciences, 59: 70-84.

Ouarhache, D., Charriere, A., Chalot-prat, F. & El Wartiti, M. 2012. Triassic to early Liassic continental rifting chronology and process at the southwest margin of the Alpine Tethys (Middle Atlas and High Moulouya, Morocco): correlations with the Atlantic rifting, synchronous and diachronous. Bulletin de la Société Géologique de France, 183(3): 233-249.

Özkan, A.M. & Elmas, A. 2012. Petrographic and geochemical characteristics of the Kiciloren Formation (Upper Triassic – Lower Jurassic) in the Akpinar (Konya, Turkey) area. Acta Geologica Sinica, 86(6): 1455-1470,

Ozsvárt, P., Dosztály, L., Migiros, G., Tselepidis, V. & Kovács, S. 2012. New radiolarian biostratigraphic age constraints on Middle Triassic basalts and radiolarites from the Inner Hellenides (Northern Pindos and Othris mountains, northern Greece) and their implications for the geodynamic evolution of the early Mesozoic Neotethys. International Journal of Earth Sciences, 101(6): 1487-1501.

Ozsvárt, P., & Kovács, S. 2012. Revised Middle and Late Triassic radiolarian ages for the ophiolite mélanges: implications for the geodynamic evolution of the northern part of the early Mesozoic Neotethyan subbasins. Bulletin de la Société Géologique de France, 183(4): 273-286.

Palermo, D., Aigner, T., Seyfang, B. & Nardon, S. 2012. Reservoir properties and petrophysical modelling of carbonate sand bodies: outcrop analogue study in an epicontinental basin (Triassic, Germany). Geological Society, London, Special Publications, 370: 111-138.

Pálfy, J. & Zajzon, N. 2012. Environmental changes across the Triassic–Jurassic boundary and coeval volcanism inferred from elemental geochemistry and mineralogy in the Kendlbachgraben section (Northern Calcareous Alps, Austria). Earth and Planetary Science Letters, 335-336:

121–134.

Pan Yan-chun, Luo Yong, Li De-liang & Miao Juan. 2012. Morphology and life habit of *Halobia* from the Upper Triassic of western Sichuan. Acta Palaeontologica Sinica, 51(3): 320-327.

Pang Jun-gang, Guo Ji-an, Song Li-jun & Li Wen-hou. 2012. The event deposits from the Yanchangian lacustrine basin in the Ordos Basin. Sedimentary Geology and Tethyan Geology, 32(1): 32-37.

Payne, J.L. & Clapham, M.E. 2012. End-Permian mass extinction in the ocean: an analog for the Twenty-First Century? Annual Review of Earth and Planetary Sciences, 40: 89-111.

Paytan, A. & Gray, E.T. 2012. Chapter 9 – Sulfur Isotope Stratigraphy. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 167-180.

Pengtao Yang, Shuwen Liu, Qiugen Li, Zongqi Wang, Ruiting Wang & Wei Wang. 2012. Geochemistry and zircon U-Pb-Hf isotopic systematics of the Ningshan granitoid batholith, middle segment of the south Qinling belt, Central China: constraints on petrogenesis and geodynamic processes. Journal of Asian Earth Sciences, 61: 166-186.

Pérez, J.G., Imaz, A.G. & Gómez, J.L.S. 2012. Kinematic characterization of cleavage in Permo-Triassic red beds of the Espadán Range (Castellón, NE Spain). Geogaceta, 51: 75-77.

Pérez-López, A. & Pérez-Valera, F. 2012. Tempestite facies models for the epicontinental Triassic carbonates of the Betic Cordillera (southern Spain). Sedimentology, 59(2): 646-678.

Pérez-López, A., Pérez-Valera, F. & Götz, A.E. 2012. Record of epicontinental platform evolution and volcanic activity during a major rifting phase: the Late Triassic Zamoranos Formation (Betic Cordillera, S Spain). Sedimentary Geology, 247–248: 39-57.

Peucker-Ehrenbrink, B. & Ravizza, G. 2012. Chapter 8 – Osmium Isotope Stratigraphy. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p 145-166.

Pieńkowski, G., Niedźwiedzki, G. & Waksmundzka, M. 2012. Sedimentological, palynological and geochemical studies of the terrestrial Triassic–Jurassic boundary in northwestern Poland. Geological Magazine,149(2): 308-332.

Piñeiro, G., Ramos, A. & Marsicano, C. 2012. A rhinesuchid-like temnospondyl from the Permo-Triassic of Uruguay. Comptes Rendus Palevol, 11(1): 65-78.

Ping Jian, Kröner, A. & Gaozhi Zhou. 2012. SHRIMP zircon U-Pb ages and REE partition for high-grade metamorphic rocks in the North Dabie complex: insight into crustal evolution with respect to Triassic UHP metamorphism in east-central China. Chemical Geology, 328: 49-69.

Ponomarenko, A.G., Yan, E.V., Wang Bo & Zhang Hai-chun. 2012. Revisions of some early Mesozoic beetles from China. Acta Palaeontologica Sinica, 51(4): 475-490.

Preto, N. 2012. Petrology of carbonate beds from the stratotype of the Carnian (Stuores Wiesen section, Dolomites, Italy): the contribution of platform-derived microbialites. Geo. Alp, 9: 12-29.

Preto, N., Rigo, M., Agnini, C., Bertinelli, A., Guaiumi, C., Borello, S. & Westphal, H. 2012. Triassic and Jurassic calcareous nannofossils from the Pizzo Mondello section: a SEM study. Rivista Italiana di Paleontologia e Stratigrafia, 118(1): 131-141.

Proskurnin, V.F., Vinogradova, N.P., Gavrysh, A.V. & Naumov, M.V. 2012. Evidence for the volcanoclastic genesis of the Carnian diamondiferous bed in the Ust'-Olenek area (from petrographic and geochemical data). Russian Geology and Geophysics, 53(6): 535-545.

Qiang Ma, Jianping Zheng, Griffin, W.L., Ming Zhang, Huayun Tang, Yuping Su & Xianquan Ping. 2012. Triassic "adakitic" rocks in an extensional setting (North China): melts from the cratonic lower crust. Lithos, 149: 159-173.

Qing-Liang Yang, Zi-Fu Zhao & Yong-Fei Zheng. 2012. Modification of subcontinental lithospheric mantle above continental subduction zone: constraints from geochemistry of Mesozoic gabbroic rocks in southeastern North China. Lithos, 146–147: 164-182.

Quanfeng Wang, Xichun Wu & Xia Yang. 2012. Clay and shaly claystones in the Upper Triassic siliceous sponge-microbe reef mounds and oolitic bank complex in NW Sichuan, China. Carbonates and Evaporites, 27(1): 19-32.

Quanlin Hou, Qing Liu, Hongyuan Zhang, Xiaohui Zhang & Jun Li. 2012. The Mesozoic tectonic dynamics and chronology in the eastern North China Block. Journal of Geological Research, 11pp.

Racki, G. 2012. The Alvarez impact theory of mass extinction; limits to its applicability and the "great expectations syndrome". Acta Palaeontologica Polonica 57(4): 681-702.

Rampino, M.R. & Kaiho, K. 2012. Did the great dying of life take 700 k.y.? Evidence from global astronomical correlation of the Permian-Triassic boundary interval: COMMENT. Geology, 40(5): e267, doi: 10.1130/G32821C.1

Ranivoharimanana, L. 2012. Analyse biomécanique masticatrice chez des traversodontidés eucynodontes du Trias de Madagascar. Geodiversitas, 34(3): 505-515.

Rego, B.L., Wang, S.C., Altiner, D. & Payne, J.L. 2012. Within- and among-genus components of size evolution during mass extinction, recovery, and background intervals: a case study of Late Permian through Late Triassic foraminifera. Paleobiology, 38(4): 627-643.

Ri-Xiang Zhu, Jin-Hui Yang & Fu-Yuan Wu. 2012. Timing of destruction of the North China Craton. Lithos, 149, 51-60.

Richoz, S., van de Schootbrugge, B., Pross, R., Püttmann, W., Quan, T.M., Lindström, S., Heunisch, C., Fiebig, J., Maquil, R., Schouten, S., Hauzenberger, C.A. & Wignall, P.B. 2012. Hydrogen sulphide poisoning of shallow seas following the end-Triassic extinction. Nature Geoscience, 5(9): 662-667.

Ridd, M.F. 2012. The role of strike-slip faults in the displacement of the Palaeotethys suture zone in Southeast Thailand. Journal of Asian Earth Sciences, 51: 63-84.

Riding, J.B. 2012. A compilation and review of the literature on Triassic, Jurassic, and earliest Cretaceous dinoflagellate cysts. AASP Contributions Series, 46: 119 pp + CD ROM.

Riding, J.B., Pound, M.J., Hill, T.C.B., Stukins, S. & Feist-Burkhardt, S. 2012. The John Williams Index of Palaeopalynology. Palynology: 1–10, iFirst article, DOI:10.

1080/01916122.2012.682512.

Rigaud, S., Martini, R. & Rettori, R. 2012. Parvalamellinae, a new subfamily for Triassic glomospiroid Involutinidae. Journal of Foraminiferal Research, 42(3): 245-256.

Rigo, M., Preto, N., Franceschi, M. & Guaiumi, C. 2012. Stratigraphy of the Carnian – Norian Calcari con Selce Formation in the Lagonegro Basin, Southern Apennines. Rivista Italiana di Paleontologia e Stratigrafia, 118(1): 143-154.

Rigo, M., Trotter, J.A., Preto, N. & Williams, I.S. 2012. Oxygen isotopic evidence for Late Triassic monsoonal upwelling in the northwestern Tethys. Geology, 40(6): 515-518.

Riley, T.R., Flowerdew, M.J. & Whitehouse, M.J. 2012. U-Pb ion-microprobe zircon geochronology from the basement inliers of eastern Graham Land, Antarctic Peninsula. Journal of the Geological Society, London, 169(4): 381-393.

Ritterbush, K.A. & Bottjer, D.J. 2012. Westermann Morphospace displays ammonoid shell shape and hypothetical paleoecology. Paleobiology, 38(3): 424-446.

Robertson, A.H.F. 2012. Late Palaeozoic-Cenozoic tectonic development of Greece and Albania in the context of alternative reconstructions of Tethys in the Eastern Mediterranean region. International Geology Review, 54(4): 373-454.

Robertson, A.H.F., Parlak, O. & Ustaömer, T. 2012. Overview of the Palaeozoic-Neogene evolution of Neotethys in the Eastern Mediterranean region (southern Turkey, Cyprus, Syria). Petroleum Geoscience, 18(4): 381-400.

Robertson, A.H.F. & Ustaömer, T. 2012. Testing alternative tectono-stratigraphic interpretations of the Late Palaeozoic–Early Mesozoic Karakaya Complex in NW Turkey: support for an accretionary origin related to northward subduction of Palaeotethys. Turkish Journal of Earth Sciences, 21(6): 961-1007.

Roger, F., Maluski, H., Lepvrier, C., Tich Vu Van & Paquette, J.-L. 2012. LA-ICPMS zircons U/Pb dating of Permo-Triassic and Cretaceous magmatisms in Northern Vietnam – geodynamical implications. Journal of Asian Earth Sciences, 48: 72-82.

Ros, S. & Echevarría, J. 2012. Ecological signature of the end-Triassic biotic crisis: what do bivalves have to say? Historical Biology, 24(5): 489-503.

Rothschild, B.M. 2012. Perspectives on decompression syndrome and the methodology of science. [Reply to Hayman, 2012, q.v.]. Naturwissenschaften, 99(8): 673-674.

Rothschild, B.M., Xiaoting, Z. & Martin, L.D. 2012. Adaptations for marine habitat and the effect of Triassic and Jurassic predator pressure on development of decompression syndrome in ichthyosaurs. Naturwissenschaften, 99(6): 443-448.

Ruban, D.A. 2012. Were Phanerozoic mass extinctions among brachiopod superfamilies selective by taxa longevity? Palaeoworld, 21(1): 1-10.

Ruiliang Wang, Shuichang Zhang, Brassell, S., Jiaxue Wang, Zhengyuan Lu, Qingzhong Ming, Xiaomei Wang & Lizeng Bian. 2012. Molecular carbon isotope variations in core samples taken at the Permian-Triassic boundary layers in southern China. International Journal of Earth Sciences, 101(5): 1397-1406.

Saâdi, Z., Fedan, B., Laadila, M., Azzouz, O. & de Galdeano, C.S. 2012. Las sucesiones terrigenas del Triásico superior y la base del Jurásico del Alto Muluya (Marruecos): estratigrafía y contexto geodinámico. Estudios Geológicos, 68(1): 41-56.

Salamon, M., Aghababalou, B., Gorzelak, P. & Niedźwiedzki, R. 2012. Intriguing crinoid remains from the Rhaetian of Iran and their possible implications for the mid-Carnian crinoid extinction event. Geobios, 45(5); 479-484.

Salamon, M.A., Niedźwiedzki, R., Gorzelak, P., Lach, R. & Surmik, D. 2012. Bromalites from the Middle Triassic of Poland and the rise of the Mesozoic Marine Revolution. Palaeogeography, Palaeoclimatology, Palaeoecology, 321–322: 142-150.

Saltzman, M.R. & Thomas, E. 2012. Chapter 11 – Carbon Isotope Stratigraphy. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 207-232.

Sánchez-Beristain, F. & Reitner, J. 2012. Paleoecology of microencrusters and encrusting "coralline" sponges in Cipit boulders from the Cassian formation (upper Ladinian – lower Carnian, Dolomites, Northern Italy). Paläontologische Zeitschrift, 86(2):113-133.

Sánchez Martínez, S., De la Horra, R., Arenas, R., Gerdes, A., Galán-Abellán, A.B., López-Gómez, J., Barrenechea, J.F. & Arche, A. 2012. U-Pb ages of detrital zircons from the Permo-Triassic series of the Iberian ranges: a record of variable provenance during rift propagation. The Journal of Geology, 120(2): 135-154.

Sanei, H., Grasby, S.E. & Beauchamp, B. 2012. Latest Permian mercury anomalies. Geology, 40(1): 63-66.

Sano, H., Kuwahara, K., Yao, A. & Agematsu, S. 2012. Stratigraphy and age of the Permian-Triassic boundary siliceous rocks of the Mino terrane in the Mt. Funabuseyama area, central Japan. Paleontological Research, 16(2): 124-145.

Sano, H., Onoue, T., Orchard, M.J. & Martini, R. 2012. Early Triassic peritidal carbonate sedimentation on a Panthalassan seamount: the Jesmond succession, Cache Creek Terrane, British Columbia, Canada. Facies, 58(1): 113-130.

Sano, H., Wada, T. & Naraoka, H. 2012. Late Permian to Early Triassic environmental changes in the Panthalassic Ocean: record from the seamount-associated deep-marine siliceous rocks, central Japan. Palaeogeography, Palaeoclimatology, Palaeoecology, 363-364: 1-10.

Sanz, T., Lago, M., Gil, A., Pocovi, A., Galé, C., Ubide, T., Ramajo, J. & Tierz, P. 2012. Upper Triassic (Norian) alkaline magmatism in the NW margin of the Aragonese branch of the Iberian Range: emplacement model in relation to syn-sedimentary faults. Geogaceta, 51: 3-6.

Sanzhong Li, Santosh, M., Guochun Zhao, Guowei Zhang & Chong Jin. 2012. Intracontinental deformation in a frontier of super-convergence: a perspective on the tectonic milieu of the South China Block. Journal of Asian Earth Sciences, 49: 313-329.

Sawada, K., Kaiho, K. & Okano, K. 2012. Kerogen morphology and geochemistry at the Permian–Triassic transition in the Meishan section, South China: implication for paleoenvironmental variation. Journal of Asian Earth Sciences, 54–55: 78-90.

Sayago, J., Di Lucia, M., Mutti, M., Cotti, A., Sitta, A., Broberg, K., Przybylo, A., Buonaguro, R. & Zimina, O. 2012. Characterization of a deeply buried paleokarst terrain in the Loppa High using core data and multiattribute seismic facies classification. AAPG Bulletin, 96(10): 1843-1866.

Schaller, M.F., Wright, J.D., Kent, D.V. & Olsen, P.E. 2012. Rapid emplacement of the Central Atlantic Magmatic Province as a net sink for CO_2. Earth and Planetary Science Letters, 323-324: 27-39.

Scheyer, T.M., Neenan, J.M., Renesto S., Saller, F., Hagdorn, H., Furrer, H., Rieppel, O. & Tintori, A. 2012. Revised paleoecology of placodonts – with a comment on 'The shallow marine placodont *Cyamodus* of the central European Germanic Basin: its evolution, paleobiogeography and paleoecology' by C. G. Diedrich (Historical Biology, iFirst article, 2011, 1-19, doi: 10. 1080/089 12963.2012.575938). Historical Biology, 24(3): 257-267.

Schlagintweit, F. & Velić, I. 2012. Foraminiferan tests and dasycladalean thalli as cryptic microhabitats for thaumatoporellacean algae from Mesozoic (Late Triassic – Late Cretaceous) platform carbonates. Facies, 58(1): 79-94.

Schlirf, M. 2012. *Heliophycus seilacheri* n.isp. and *Biformites insolitus* LINCK, 1949 (trace fossils) from the Late Triassic of the Germanic Basin: their taxonomy and palaeoecological relevance. Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 263(3): 185-198.

Schmidt, A.R., Jancke, S., Lindquist, E.E., Ragazzi, E., Roghi, G., Nascimbene, P.C., Schmidt, K., Wappler, T. & Grimaldi, D.A. 2012. Arthropods in amber from the Triassic Period. Proceedings of the National Academy of Sciences, 109(37): 14796-14801.

Schmitz, M.D. 2012. Appendix 2 – Radiometric ages used in GTS 2012. *In*, Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds), The Geologic Time Scale 2012. Boston, USA: Elsevier B.V, p. 1045-1082.

Schneebeli-Hermann, E. 2012. Extinguishing a Permian World. Geology, 40(3): 287-288.

Schneebeli-Hermann, E., Hochuli, P.A., Bucher, H., Goudemand, N., Brühwiler, T. & Galfetti, T. 2012. Palynology of the Lower Triassic succession of Tulong, South Tibet — evidence for early recovery of gymnosperms. Palaeogeography, Palaeoclimatology, Palaeoecology, 339–341: 12-24.

Schoch, R.R. 2012. A dicynodont mandible from the Triassic of Germany forms the first evidence of large herbivores in the Central European Carnian. Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 263(2): 119-123.

Schoch, R.R. & Witzmann, F. 2012. Cranial morphology of the plagiosaurid *Gerrothorax pulcherrimus* as an extreme example of evolutionary stasis. Lethaia, 45(3): 371-385.

Schoepfer, S.D., Henderson, C.M., Garrison, G.H. & Ward, P.D. 2012. Cessation of a productive coastal upwelling system in the Panthalassic Ocean at the Permian–Triassic Boundary. Palaeogeography, Palaeoclimatology, Palaeoecology, 313–314: 181-188.

Schönlaub, H.P. 2012. Scientific research in the Geopark Carnic Alps – a never ending story. Berichte des Institutes für Geologie und Paläntologie der Karl-Franzens-Universität Graz, 17: 61-63.

Schweigert, G. & Fuchs, D. 2012. First record of a true coleoid cephalopod from the Germanic Triassic (Ladinian). Neues Jahrbuch für Geologie und Paläontologie – Abhandlungen, 266(1): 19-30.

Sciunnach, D. & Garzanti, E. 2012. Subsidence history of the Tethys Himalaya. Earth-Science Reviews, 111(1-2): 179-198.

Scotney, P.M., Carney, J.N. & Harwood, M. 2012. New information on Neoproterozoic-Cambrian geology and the Triassic unconformity around Groby, southern Charnwood Forest, UK. Proceedings of the Yorkshire Geological Society, 59(1): 37-51.

Searle, M.P., Whitehouse, M.J., Robb, L.J., Ghani, A.A., Hutchison, C.S., Sone, M., Ng, S.W.-P., Roselee, M.H., Chung, S.-L. & Oliver, G.J.H. 2012. Tectonic evolution of the Sibumasu–Indochina terrane collision zone in Thailand and Malaysia: constraints from new U-Pb zircon chronology of SE Asian tin granitoids. Journal of the Geological Society, London, 169(4): 489-500.

Sendino, C., Taylor, P.D. & van Iten, H. 2012. *Metaconularia? pyramidata* (Bronn, 1837): a scyphozoan from the Ordovician of Normandy, France, recorded for the first time as a reworked fossil in the Triassic of Devon, England. Geodiversitas, 34(2): 283-296.

Sennikov, A.G. 2012. The first ctenosauriscid (Reptilia: Archosauromorpha) from the Lower Triassic of eastern Europe. Paleontological Journal, 46(5): 499-511.

Sennikov, A.G. & Golubev, V.K. 2012. On the faunal verification of the Permo-Triassic boundary in continental deposits of eastern Europe: 1. Gorokhovets-Zhukov ravine. Paleontological Journal, 46(3): 313-323.

Senobari-Daryan, B., Stanley, G.D. & Onoue, T. 2012. Upper Triassic (Carnian) reef biota from the Sambosan Accretionary Complex, Kyushu, Japan. Facies, 58(4): 671-684.

Seton, M., Müller, R.D., Zahirovic, S., Gaina, C., Torsvik, T., Shephard, G., Talsma, A., Gurnis, M., Turner, M., Maus, S. & Chandler, M. 2012. Global continental and ocean basin reconstructions since 200 Ma. Earth-Science Reviews, 113(3-4): 212-270.

Shan Li, Tao Wang, Wilde, S.A., Ying Tong, Dawei Hong & Qianqian Guo. 2012. Geochronology, petrogenesis and tectonic implications of Triassic granitoids from Beishan, NW China. Lithos, 134–135: 123-145.

Shekarifard, A., Baudin, F., Seyed-Emami, K., Schnyder, J., Laggoun-Defarge, F., Riboulleau, A. & Shahidi, A. 2012. Thermal maturity of the Upper Triassic–Middle Jurassic Shemshak Group (Alborz Range, Northern Iran) based on organic petrography, geochemistry and basin modelling: implications for source rock evaluation and petroleum exploration. Geological Magazine, 149(1): 19-38.

Shekarifard, A., Baudin, F., Seyed-Emami, K., Schnyder, J. & Rahimpour Bonab, H. 2012. Organic matter characterization and thermal modeling of the basal black shale from the Shemshak Group (Upper Triassic-Middle Jurassic) in the Tazareh section, eastern Alborz, northern Iran. Geosciences

(Iran), 83: 219-228.

Shellnutt, J.G., Denyszyn, S.W. & Mundil, R. 2012. Precise determination of mafic and felsic intrusive rocks from the Permian Emeishan large igneous province (SW China). Gondwana Research, 22(1): 118-126.

Shen, J., Algeo, T.J., Zhou, L., Feng, Q., Yu, J. & Ellwood, B. 2012. Volcanic perturbations of the marine environment in South China preceding the latest Permian mass extinction and their biotic effects. Geobiology, 10(1): 82-103.

Shepherd, H.M.E., Stanley, G.D. Jr. & Amirhassankhani, F. 2012. Norian to Rhaetian scleractinian corals in the Ferdows patch reef (Nayband Formation, East Central Iran). Journal of Paleontology, 86(5): 801-812.

Shepley, M.G. & Soley, R.W.N. 2012. The use of groundwater levels and numerical models for the management of a layered, moderate-diffusivity aquifer. Geological Society, London, Special Publications, 364: 303-318.

Shepley, M.G., Whiteman, M.I., Hulme, P.J. & Grout, M.W. (eds). 2012. Groundwater Resources Modelling: a Case Study from the UK. Geological Society, London, Special Publications, 364: xi+378 pp.

Shi Xiao-zhang, Ren Lai-yi, Qu Feng-jie, Du Yan-jun & Wang Bian-yang. 2012. Depositional characteristics of Triassic in northern Tarim Basin and its significance for petroleum exploration. Global Geology (Changchun), 2012/32(4): 712-720.

Shiwen Xie, Yuanbao Wu, Shan Gao, Xiaochi Liu, Lian Zhou, Laishi Zhao & Zhaochu Hu. 2012. Sr–Nd isotopic and geochemical constraints on provenance of late Paleozoic to early Cretaceous sedimentary rocks in the Western Hills of Beijing, North China: implications for the uplift of the northern North China Craton. Sedimentary Geology, 245–246: 17-28.

Shuan-Hong Zhang, Yue Zhao, Hao Ye, Ke-Jun Hou & Chao-Feng Li. 2012. Early Mesozoic alkaline complexes in the North China Craton: implications for cratonic lithospheric destruction. Lithos, 155: 1-18.

Shuqin Zan, Axsmith, B.J., Escapa, I., Fraser, N.C., Feng-Xiang Liu & De-He Xing. 2012. A new *Neocalamites* (Sphenophyta) with prickles and attached cones from the Upper Triassic of China. Palaeoworld, 21(2): 75-80.

Sibuet, J.-C., Rouzo, S. & Srivastava, S. 2012. Plate tectonic reconstructions and paleogeographic maps of the central and North Atlantic oceans. Canadian Journal of Earth Sciences, 49(12): 1395-1415.

Sigurdsen, T., Green, D.M. & Bishop, P.J. 2012. Did *Triadobatrachus* jump? Morphology and evolution of the anuran forelimb in relation to locomotion in early salientians. Fieldiana Life and Earth Sciences, 5: 77-89.

Sigurdsen, T., Huttenlocker, A.K., Modesto, S.P., Rowe, T.B. & Damiani, R. 2012. Reassessment of the morphology and paleobiology of the therocephalian *Tetracynodon darti* (Therapsida), and the phylogenetic relationships of Baurioidea. Journal of Vertebrate Paleontology, 32(5): 1113-1134.

Silva, D.R., Mizusaki, A.M.P., Milani, E.J. & Pimentel, M. 2012. Depositional ages of Paleozoic and Mesozoic pre-rift supersequences of the Recôncavo Basin in northeastern Brazil: a Rb–Sr radiometric study of sedimentary rocks. Journal of South American Earth Sciences, 37: 13-24.

Ślączka, A., Renda, P., Cieszkowski, M., Golonka, J. & Nigro, F. 2012. Sedimentary basins evolution and olistoliths formation: the case of Carpathian and Sicilian regions. Tectonophysics, 568-569: 306-319.

Smyshlyaeva, O.P. & Zakharov, Y.D. 2012. New representatives of the family Melagathiceratidae (Ammonoidea) from the Lower Triassic of South Primorye. Paleontological Journal, 46(2): 142-147.

Soares, A.F., Kullberg, J.C., Marques, J.F., Bordalo de Rocha, R. & Callapez, P.M. 2012. Tectono-sedimentary model for the evolution of the Silves Group (Triassic, Lusitanian basin, Portugal). Bulletin de la Société Géologique de France, 183(3): 203-216.

Solaymani, Z. & Taghipour, N. 2012. Petrographic characteristics and palaeoenvironmental setting of Upper Triassic Olang coal deposits in northeastern Iran. International Journal of Coal Geology, 92: 82-89.

Sone, M., Metcalfe, I. & Chaodumrong, P. 2012. The Chanthaburi terrane of southeastern Thailand: stratigraphic confirmation as a disrupted segment of the Sukhothal Arc. Journal of Asian Earth Sciences, 61: 16-32.

Song, H.J., Tong, J.N., Xiong, Y.L., Sun, D.Y. & Song, H.Y. 2012. The large increase of $\delta^{13}C_{carb}$-depth gradient and the end-Permian mass extinction. SCIENCE CHINA Earth Sciences, 55(7): 1101-1109.

Sookias, R.B., Benson, R.B.J. & Butler, R.J. 2012. Biology, not environments, drives major patterns in maximum tetrapod body size through time. Biology Letters, 8(4): 674-677.

Sookias, R.B., Butler, R.J. & Benson, R.B.J. 2012. Rise of dinosaurs reveals major body-size transitions are driven by passive processes of trait evolution. Proceedings of the Royal Society, B.279 (1736): 2180-2187.

Sookias, R.B., Butler, R.J. & Benson, R.B.J. 2012. Body size during the rise of the archosauromorphs: weak support for Cope's rule, and biological not environmental limits on maximum size. Palaeontological Association Newsletter, 81; Annual Meeting Programme and Abstracts: 89.

Soto, R., Kullberg, J.C., Oliva-Urcia, B., Casas-Sainz, A.M. & Villalaín, J.J. 2012. Switch of Mesozoic extensional tectonic style in the Lusitanian basin (Portugal): insights from magnetic fabrics. Tectonophysics, 536–537: 122-135.

Spielmann, J.A. & Lucas, S.G. 2012. Tetrapod fauna of the Upper Triassic Redonda Formation, east-central New Mexico: the characteristic assemblage of the Apachean land-vertebrate Faunachron. New Mexico Museum of Natural History & Science Bulletin 55: iv+119pp.

Starodubtseva, I.A. & Novikov, I.V. 2012. The history of the recognition of the Triassic of European Russia (Central and Caspian Sea areas). Stratigraphy and Geological Correlation, 20(1): 42-52.

Stevens, G.R. 2012. Otopirian and Aratauran sequences (latest Triassic and earliest Jurassic) along the northern Marokopa coast (SW Auckland, New Zealand) and observations on the Triassic/Jurassic boundary in New Zealand. New Zealand Journal of Geology and Geophysics, 55(1): 37-51.

Stockar, R., Baumgartner, P.O. & Condon, D. 2012. Integrated Ladinian bio-chronostratigraphy and geochronology of Monte San Giorgio (Southern Alps, Switzerland). Swiss Journal of Geosciences, 105(1): 85-108.

Stockar, R., Dumitrica, P. & Baumgartner, P.O. 2012. Early Ladinian radiolarian fauna from the Monte San Giorgio (Southern Alps, Switzerland): systematics, biostratigraphy and paleo(bio)geographic implications. Rivista Italiana di Paleontologia e Stratigrafia, 118(3): 375-437.

Stocker, M.R. 2012. A new phytosaur (Archosauriformes, Phytosauria) from the Lot's Wife beds (Sonsela Member) within the Chinle Formation (Upper Triassic) of Petrified Forest National Park, Arizona. Journal of Vertebrate Paleontology, 32(3): 573-586.

Stone, P., McMillan, A.A., Floyd, J.D., Barnes, R.P. & Philips, E.R. 2012. British Regional Geology: South Scotland (Fourth edition). Keyworth, Nottingham: British Geological Survey, xi+247 pp.

Strullu-Derrien, C., McLoughlin, S., Philippe, M., Mørk, A. & Strullu, D.G. 2012. Arthropod interactions with bennettitalean roots in a Triassic permineralized peat from Hopen, Svalbard Archipelago (Arctic). Palaeogeography, Palaeoclimatology, Palaeoecology, 348–349: 45-58.

Stylianos, C., Grimaldi, D.A., Engel, M.S. & Fraser, N.C. 2012. *Leehermania prorova*, the earliest staphyliniform beetle, from the late Triassic of Virginia (Coleoptera, Staphylinidae). American Museum Novitates, 3761: 28pp.

Suan, G., Föllmi, K.B., Adatte, T., Bomou, B., Spangenberg, J.E. & van De Schootbrugge, B. 2012. Major environmental change and bonebed genesis prior to the Triassic–Jurassic mass extinction. Journal of the Geological Society, London, 169(2): 191-200.

Sulej, T., Niedźwiedski, G. & Bronowicz, R. 2012. A new Late Triassic vertebrate fauna from Poland with turtles, aetosaurs, and coelophysoid dinosaurs. Journal of Vertebrate Paleontology, 32(5): 1033-1041.

Sun, Z., Lombardo, C., Tintori, A., Dayong Jiang, Weicheng Hao, Yuanlin Sun & Hunqin Lin. 2012. *Fuyuanperleidus dengi* Geng et al., 2012 (Osteichthyes, Actinopterygii) from the Middle Triassic of Yunnan Province, South China. Rivista Italiana di Paleontologia e Stratigrafia, 118(3): 359-373.

Szaniawski, R., Ludwiniak, M. & Rubinkiewicz, J. 2012. Minor counterclockwise rotation of the Tatra Mountains (Central Western Carpathians) as derived from paleomagnetic results achieved in hematite-bearing Lower Triassic sandstones. Tectonophysics, 560–561: 51-61.

Szurlies, M., Geluk, M.C., Krijgsman, W. & Kürschner, W.M. 2012. The continental Permian-Triassic boundary in the Netherlands: implications for the geomagnetic polarity time scale. Earth and Planetary Science Letters, 317-318: 165-176.

Tackett, L.S. & Bottjer, D.J. 2012. Faunal succession of Norian (Late Triassic) level-bottom benthos in the Lombardian Basin: implications for the timing, rate, and nature of the early Mesozoic marine revolution. Palaios, 27(8): 585-593.

Tan Xian-feng, Li Jie, He Jin-ping & Peng Ping. 2012. Kaijiang-Liangping trough area with a southern section Feixianguan sequence – lithofacies, paleogeography. Geology in China, 2012/3: 612-622.

Tang Xianchun & Zhang Kaijun. 2012. ^{40}Ar-^{39}Ar geochronology and tectonic implications of the blueschist from northeastern Qiangtang, northern Tibet, western China. Acta Geologica Sinica, 86(6): 1471-1478.

Tanner, L.H. & Lucas, S.G. 2012. Carbonate facies of the Upper Triassic Ojo Huelos Member, San Pedro Arroyo Formation (Chinle Group), southern New Mexico: paleoclimatic implications. Sedimentary Geology, 273–274: 73-90.

Tarailo, D.A. & Fastovsky, D.E. 2012. Post-Permo-Triassic terrestrial vertebrate recovery: southwestern United States. Paleobiology, 38(4): 644-663.

Tavakoli, V. & Rahimpour-Bonab, H. 2012. Uranium depletion across Permian–Triassic Boundary in Persian Gulf and its implications for paleooceanic conditions. Palaeogeography, Palaeoclimatology, Palaeoecology, 350–352: 101-113.

Ten Veen, J.H., van Gessel, S.F. & den Dulk, M. 2012. Thin- and thick-skinned salt tectonics in the Netherlands; a quantitative approach. Netherlands Journal of Geosciences, 91(4): 447-464.

Tevelev, A.V. 2012. Peculiarities of the kinematics of the South Uralian suture zones as a cause of the formation of the convergent structure of the East Uralian Megazone. Moscow University Geology Bulletin, 67(1): 157-167.

Trammer, J. 2012. Two phases in the evolution of the body size of dinosaurs. Journal of Geography and Geology, 4(1): 75-78.

Trendell, A.M., Atchley, S.C. & Nordt, L.C. 2012. Depositional and diagenetic controls on reservoir attributes within a fluvial outcrop analog: Upper Triassic Sonsela member of the Chinle Formation, Petrified Forest National Park, Arizona. AAPG Bulletin, 96(4): 679-707.

Tresise, G. & King, M.J. 2012. History of ichnology: the misconceived footprints of rhynchosaurs. Ichnos, 19(4): 228-237.

Trotteyn, M.J. & Haro, J.A. 2012. The braincase of *Chanaresuchus ischigualastensis* (Archosauriformes) from the Late Triassic of Argentina. Journal of Vertebrate Paleontology, 32(4): 867-882.

Trotteyn, M.J., Martinez, R.N. & Alcober, O.A. 2012. A new proterochampsid *Chanaresuchus ischigualastensis* (Diapsida, Archosauriformes) in the early Late Triassic Ischigualasto Formation, Argentina. Journal of Vertebrate Paleontology, 32(2): 485-489.

Trude, J., Graham, R. & Pilcher, R. 2012. Salt-related structures on the Bristol Channel coast, Somerset. Geological Society, London, Special Publications, 363: 533-544.

Tscherny, R.G., Littke, R., Büker, C., Nöth, S. & Uffmann, A.K. 2012. Coalification of dispersed organic matter in the Dolomites, Italy: implications for burial and thermal history. Geo.Alp, 9: 186-203.

Tyrell, S., Haughton, P.D.W., Souders, A.K., Daly, J.S. & Shannon, P.M. 2012. Large-scale, linked drainage systems in the NW European Triassic: insights from the Pb isotopic composition of detrital K-feldspar. Journal of the Geological Society, London, 169(3): 279-295.

Ueno, K., Miyahigashi, A., Kamata, Y., Kato, M., Charoentitirat, T. & Limruk, S. 2012. Geotectonic implications of Permian and Triassic successions in the Central Plain of Thailand. Journal of Asian Earth Sciences, 61: 33-50.

Urlichs, M. 2012. Stunting in some invertebrates from the Cassian Formation (Late Triassic, Carnian) of the Dolomites (Italy). Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 265(1): 1–25.

Van den Berg, T., Whiteside, D.I., Viegas, P., Schouten, R. & Benton, M.J. 2012. The Late Triassic microvertebrate fauna of Tytherington, UK. Proceedings of the Geologists' Association, 123(4): 638-648.

Van der Meer, D.G., Torsvik, T.H., Spakman, W., van Hinsbergen, D.J.J. & Amaru, M.L. 2012. Intra-Panthallasa Ocean subduction zones revealed by fossil arcs and mantle structure. Nature Geoscience, 5(3): 215-219.

Vaughan, A.P.M., Leat, P.T., Dean, A.A. & Millar, I.L. 2012. Crustal thickening along the West Antarctic Gondwana margin during mid-Cretaceous deformation of the Triassic intra-oceanic Dyer Arc. Lithos, 142–143: 130-147.

Veevers, J.J. 2012. Reconstructions before rifting and drifting reveal the geological connections between Antarctica and its conjugates in Gondwanaland. Earth-Science Reviews, 111(3-4): 249-378.

Velichko, B.M. 2012. The results of complex geophysical investigations in the northwest Barents Sea Shelf (at the junction between the Svalbard Anteclise and East Barents Megatrough). Moscow University Geology Bulletin, 67(1): 58-64.

Verweij, J.M., Simmelink, H.J., Underschultz, J. & Witmans, N. 2012. Pressure and fluid dynamic characterisation of the Dutch subsurface. Netherlands Journal of Geosciences, 91(4): 465-490.

Vijaya, V. & Murthy, S. 2012. Palynomorphs and oribatid mites - from the Denwa Formation, Satpura Basin, Madhya Pradesh, India. International Journal of Geosciences, 3(1): 195-205.

Vishnevskaya, V.S. & Filatova, N.I. 2012. Allochthonous Mesozoic marine sequences of northeastern Asia and western North America: correlation of the stratigraphic levels and geodynamic depositional settings. Russian Journal of Pacific Geology, 6(3): 189-208.

Wang Hui, Ruan Lin-sen, Guo Jian-qiu, Wang Xuan-ce, Liu Qi, Liang Bin, Li Zhen-jiang & Wang Bang-quan. 2012. Late Triassic sedimentary geochemistry and tectonic significance in the Yajiang Basin, Sichuan. Northwestern Geology, 45(2): 88-98.

Wang, S.C., Zimmerman, A.E., McVeigh, B.S., Everson, P.J. & Wong, H. 2012. Confidence intervals for the duration of a mass extinction. Paleobiology, 38(2): 265-277.

Wang Wen-zhi, Tian Jing-chun, Zhang Xiang, Luo Yang, Yang Wei & Tan Xian-feng. 2012. Reservoir characteristics and controlling factors of the 6th member of the Xujiahe Formation in the Guanyinchang-Washi region, southern Sichuan. Sedimentary Geology and Tethyan Geology, 32(1): 38-43.

Wang Xiang Zeng, Zhang Jin Chuan, Cao Jin Zhou, Zhang Li Xia, Tang Xuan, Lin La Mei, Jiang Chang Zuo, Yang Zuo Zuo, Wang Long & Wu Ying. 2012. A preliminary discussion on evaluation of continental shale gas resources: a case study of Chang 7 of Mesozoic Yanchang Formation in Zhiluo-Xiasiwan area of Yanchang. Earth Science Frontiers, 19(2): 192-197.

Wang ZiChang. 2012. A bizarre *Palissya* ovulate organ from Upper Triassic strata of the Zixing coal field, Hunan Province, China. Chinese Science Bulletin, 57(10): 1169-1177.

Ward, P.D., Retallack, G.J. & Smith, R.M.H. 2012. The terrestrial Permian–Triassic boundary event bed is a nonevent: COMMENT. Geology, 40(3): e256. doi.10.1130/G31473C.1

Warren, A. 2012. The South African stereospondyl *Microposaurus* from the Middle Triassic of the Sydney Basin, Australia. Journal of Vertebrate Paleontology, 32(3): 538-544.

Warrington, G. 2012. The legacy of mining at Alderley Edge. Mercian Geologist, 18(1): 75-76.

Warrington, G. 2012. British Triassic palaeontology: new literature supplement 34. Mercian Geologist, 18(1): 77.

Warrington, G., Barclay, W.J., Leveridge, B.E. & Waters, C.N. 2012. The Global Devonian, Carboniferous and Permian Correlation Project: a review of the contribution from Great Britain. Geoscience in South-West England, 13(1): 47-51.

Warrington, G. & Pollard, J.E. 2012. On the record of 'corals' from the Late Triassic Arden Sandstone Formation, Western Park, Leicester. Mercian Geologist, 18(1): 55-59.

Wasmer, M., Hautmann, M., Hermann, E., Ware, D., Roohi, G., Ur-Rehman, K., Yaseen, A. & Bucher, H. 2012. Olenekian (Early Triassic) bivalves from the Salt Range and Surghar Range, Pakistan. Palaeontology, 55(5): 1043-1073.

Weihong He, Shi, G.R., Yang Zhang, Tinglu Yang, Fei Teng & Shunbao Wu. 2012. Systematics and palaeoecology of Changhsingian (Late Permian) Ambocoeliidae brachiopods from South China and implications for the end-Permian mass extinction. Alcheringa, 36(4): 515-530.

Welford, J.K., Shannon, P.M., O'Reilly B.M. & Hall, J. 2012. Comparison of lithosphere structure across the Orphan Basin–Flemish Cap and Irish Atlantic conjugate continental margins from constrained 3D gravity inversions. Journal of the Geological Society, London, 169(4): 405-420.

Wen Wen, Qi-Yue Zhang, Shi-Xue Hu, Chang-Yong Zhou, Xie Tao, Jin-Yuan Huang, Zhong Qiang Chen & Benton, M.J. 2012. A new basal actinopterygian fish from the Anisian (Middle Triassic) of Luoping, Yunnan Province, Southwest China. Acta Palaeontologica Polonica, 57(1): 149-160.

Wendler, J., Köster, J., Götze, J., Kasch, N., Zisser, N., Kley, J., Pudlo, D., Nover, G. & Gaupp, R. 2012. Carbonate diagenesis and feldspar alteration in fracture-related bleaching zones (Buntsandstein, central Germany): possible link to CO_2-influenced fluid–mineral reactions. International Journal of Earth Sciences, 101(1): 159-176.

Wendruff, A.J. & Wilson, M.V.H. 2012. A fork-tailed coelacanth, *Rebellatrix divaricerca*, gen. et sp. nov. (Actinistia, Rebellatricidae, fam. nov.), from the Lower Triassic of Western Canada. Journal of Vertebrate Paleontology, 32(3): 499-511.

Weston, J.F., MacRae, R.A., Ascoli, P., Cooper, M.K.E., Fensome, E.A., Shaw, D. & Williams, G.L. 2012. A revised biostratigraphic and well-log sequence-stratigraphic framework for the Scotian Margin, offshore eastern Canada.

Canadian Journal of Earth Sciences, 49(12): 1417-1462.

Williams, M.L., Jones, B.G. & Carr, P.F. 2012. Geochemical consequences of the Permian-Triassic mass extinction in a non-marine succession, Sydney Basin, Australia. Chemical Geology, 326-327: 174-188.

Willner, A.P., Massonne, H.-J., Ring, U., Suo, M. & Thomson, S.N. 2012. P–T evolution and timing of a late Palaeozoic fore-arc system and its heterogeneous Mesozoic overprint in north-central Chile (latitudes 31–32°S). Geological Magazine, 149(2): 177-207.

Wilson, J.H., McLennan, S.M., Glotch, T.D., Rasbury, E.T., Gierlowski-Kordesch, E.H. & Tappero, R.V. 2012. Pedogenic hematitic concretions from the Triassic New Haven Arkose, Connecticut: implications for understanding Martian diagenetic processes. Chemical Geology, 312-313: 195-208.

Wingruth, C. & Wingruth, A.M.E. 2012. Simulating Permian–Triassic oceanic anoxia distribution: implications for species extinction and recovery. Geology, 40(2): 127-130. [Erratum: Simulating Permian–Triassic oceanic anoxia distribution: implications for species extinction and recovery. Geology, 40(2): 130].

Witzmann, F., Schoch, R.R., Hilger, A. & Kardjilov, N. 2012. Braincase, palatoquadrate and ear region of the plagiosaurid *Gerrothorax pulcherrimus* from the Middle Triassic of Germany. Palaeontology, 55(1): 31-50.

Wu Jing, Liang HuaYing, Huang WenTing, Wang ChunLong, Sun WeiDong, Sun YaLi, Li Jing, Mo JiHai & Wang XiuZhang. 2012. Indosinian isotope ages of plutons and deposits in southwestern Miaoershan-Yuechengling, northeastern Guangxi and implications on Indosinian mineralization in South China. Chinese Science Bulletin, 57(9): 1024-1035.

Wu Xiang-feng, Yi Hai-sheng, Huan Yu-long, Xia Guo-ting & Hui Bo. 2012. A new method for calculating tidal sedimentary rhythm and its application: a case study of the algal dolomite laminae from Middle Triassic Leikoupo Formation, Jiangyou area, Sichuan Province. Geological Bulletin of China, 31(5): 758-762.

Xi-An Yang, Jia-Jun Liu, Ye Cao, Si-Yu Han, Bing-yu Gao, Huan Wang & Yue-Dong Liu. 2012. Geochemistry and S, Pb isotope of the Yangla copper deposit, western Yunnan, China: implication for ore genesis. Lithos, 144–145: 231-240.

Xia Lin-qi, Xu Xue-yi, Li Xiang-min, Xia Zu-chun & Ma Zhong-ping. 2012. Comparison of three Large Igneous Provinces (Emeishan, Siberia, Deccan) in Asia. Northwestern Geology, 45(2): 1-26.

Xia Zhang, Chun-Ming Lin, Yuan-Feng Cai, Chang-Wei Qu & Zhao-You Chen. 2012. Pore-lining chlorite cements in lacustrine-deltaic sandstones from the Upper Triassic Yanchang Formation, Ordos Basin, China. Journal of Petroleum Geology, 35(3): 273-290.

Xianqing Guo, Zhen Yan, Zongqi Wang, Tao Wang, Kejun Hou, Changlei Fu & Jiliang Li. 2012. Middle Triassic arc magmatism along the northeastern margin of the Tibet: U-Pb and Lu-Hf zircon characterization of the Gangcha complex in the West Qinling terrane, central China. Journal of the Geological Society, London, 169(3): 327-336.

Xiao Liang, Genhou Wang, Guoli Yuan & Yang Liu. 2012. Structural sequence and geochronology of the Qomo Ri accretionary complex, Central Qiangtang, Tibet: implications for the Late Triassic subduction of the Paleo-Tethys Ocean. Gondwana Research, 22(2): 470-481.

Xiao Ling, Wei Qin-lin & Zhong Rong-cai. 2012. High resolution sequence stratigraphic characteristics of the Chang 6 oil reservoir in the Baibao area, Ordos Basin. Journal of Stratigraphy, 36(1): 125-131.

Xiao-Ying Gao, Yong-Fei Zheng, Yi-Xiang Chen & Jingliang Guo. 2012. Geochemical and U–Pb age constraints on the occurrence of polygenetic titanites in UHP metagranite in the Dabie orogen. Lithos, 136–139: 93-108.

Xiaochi Liu, Yuanbao Wu, Shan Gao, Min Peng, Jing Wang, Hao Wang, Hujun Gong & Honglin Yuan. 2012. Triassic high-pressure metamorphism in the Huwan shear zone: tracking the initial subduction of continental crust in the whole Dabie orogen. Lithos, 136–139: 60-72.

Xiaohui Zhang, Lingling Yuan, Fuhong Xue & Yanbin Zhang. 2012. Contrasting Triassic ferroan granitoids from northwestern Liaoning, North China: magmatic monitor of Mesozoic decratonization and a craton–orogen boundary. Lithos, 144–145: 12-23.

Xiaowei Li, Meiyi Yu, Lehrmann, D.J., Payne, J.L., Kelley, B.M. & Minzoni, M. 2012. Factors controlling carbonate platform asymmetry: preliminary results from the Great Bank of Guizhou, an isolated Permian–Triassic Platform in the Nanpanjiang Basin, south China. Palaeogeography, Palaeoclimatology, Palaeoecology, 315–316: 158-171.

Xie Li, Yang Wenqiang, Liu Guichun & Feng Qinglai, 2012. Late Paleozoic and Middle Triassic radiolaria from the Upper Triassic sedimentary mélange in Shangrila, southwest China and its geological significance. Acta Micropalaeontologica Sinica, 29(3): 253-269.

Xu GuangHui & Wu FeiXiang. 2012. A deep-bodied ginglymodian fish from the Middle Triassic of eastern Yunnan Province, China, and the phylogeny of lower neopterygians. Chinese Science Bulletin, 57(1): 111-118.

Yadong Sun, Joachimski, M.M., Wignall, P.B., Chunbo Yan, Yanlong Chen, Haishui Jiang, Wang, L. & Xulong Lai. 2012. Lethally hot temperatures during the Early Triassic Greenhouse. Science, 338 (No. 6105): 366-370.

Yan, T., Longkang, S., Yanming, Y., Jishun, Y., Yunpeng, Z., Xianmao, Q. & Yunlong, Y. 2012. Illite crystallinity mapping of very low grade metamorphism of Triassic metapelites in the Zoigê area, western China. Acta Geologica Sinica, 86(1): 96-105.

Yan Tang, Longkang Sang, Yanming Yuan, Yunpeng Zhang & Yunlong Yang. 2012. Geochemistry of Late Triassic pelitic rocks in the NE part of Songpan-Ganzi Basin, western China: implications for source weathering, provenance and tectonic setting. Geoscience Frontiers, 3(5): 647-660.

Yang Chu, Faure, M., Wei Lin & Qingchen Wang. 2012. Early Mesozoic tectonics of the South China block: insights from the Xuefengshan intracontinental orogen. Journal of Asian Earth Sciences, 61: 199-220.

Yang Chu, Faure, M., Wei Lin, Qingchen Wang & Wenbin

Ji. 2012. Tectonics of the Middle Triassic intracontinental Xuefengshan Belt, South China: new insights from structural and chronological constraints on the basal décollement zone. International Journal of Earth Sciences, 101(8): 2125-2150.

Yang Chu, Wei Lin, Faure, M., Qingchen Wang & Wenbin Ji. 2012. Phanerozoic tectonothermal events in the Xuefengshan Belt, central South China: implications from U-Pb age and Lu-Hf determinations of granites. Lithos, 150: 243-255.

Yao, H.Z., Zhang, R.J., Sha, J.G., Wang, J.X., Niu, Z.J. & Duan, Q.F. 2012. The Norian megalodontid fauna in Qinghai-Tibet Plateau, western China. SCIENCE CHINA Earth Sciences, 55(10): 1620–1626.

Yao-Hui Jiang, Guo-Dong Jin, Shi-Yong Liao, Qing Zhou & Peng Zhao. 2012. Petrogenesis and tectonic implications of ultrapotassic microgranitoid enclaves in Late Triassic arc granitoids, Qinling orogen, central China. International Geology Review, 54(2): 208-226.

Yen-Nien Cheng, Xiao-Chun Wu, Sato, T. & Hsi-Yin Shan. 2012. A new eosauropterygian (Diapsida, Sauropterygia) from the Triassic of China. Journal of Vertebrate Paleontology, 32(6): 1335-1349.

Yi, K., Cheong, C., Kim, J., Kim, N., Jeong Y. & Cho, M. 2012. Late Paleozoic to early Mesozoic arc-related magmatism in southeastern Korea: SHRIMP zircon geochronology and geochemistry. Lithos, 153: 129-141.

Yin, H., Xie, S., Luo, G., Algeo, T.J. & Zhang, K. 2012. Two episodes of environmental change at the Permian-Triassic boundary of the GSSP section Meishan. Earth-Science Reviews, 115(3): 163-172.

Yongsheng Liu, Xiaohong Wang, Dongbing Wang, Detao He, Keqing Zong, Changgui Gao, Zhaochu Hu & Hujun Gong. 2012. Triassic high-Mg adakitic andesites from Linxi, Inner Mongolia: insights into the fate of the Paleo-Asian ocean crust and fossil slab-derived melt-peridotite interaction. Chemical Geology, 328: 89-108.

Yuejun Wang, Chunming Wu, Aimei Zhang, Weiming Fan, Yanhua Zhang, Yuzhi Zhang, Touping Peng & Changqin Yin. 2012. Kwangsian and Indosinian reworking of the eastern South China Block: constraints on zircon U-Pb geochronology and metamorphism of amphibolites and granulites. Lithos, 150: 227-242.

Yui, T.F., Maki, K., Lan, C.Y., Hirata, T., Chu, H.T., Kon, Y., Yokoyama, T.D., Jahn, B.M. & Ernst, W.G. 2012. Detrital zircons from the Tananao metamorphic complex of Taiwan: implications for sediment provenance and Mesozoic tectonics. Tectonophysics, 541–543: 31-42.

Yunpeng Dong, Xiaoming Liu, Guowei Zhang, Qing Chen, Xiaoning Zhang, Wei Li & Chen Yang. 2012. Triassic diorites and granitoids in the Foping area: constraints on the conversion from subduction to collision in the Qinling orogen, China. Journal of Asian Earth Sciences, 47: 123-142.

Zaffarana, C.B., Montenegro, T. & Somoza, R. 2012. The host rock of the Central Patagonian Batholith in Gastre: further insights on the Late Triassic to Early Jurassic deformation in the region. Revista de la Asociación Geológica Argentina, 69(1): 106-126.

Zajzon, N., Kristály, F., Pálfy, J. & Németh, T. 2012. Detailed clay mineralogy of the Triassic-Jurassic boundary section at Kendlbachgraben (Northern Calcareous Alps, Austria). Clay Minerals, 47(2): 177–189.

Zhang Baomin, Chen Xiaoyan, Cheng Long & Zhang Miao, 2012. Middle Triassic (Ladinian) elasmobranch scales from southwestern Guizhou, China. Acta Micropalaeontologica Sinica, 29(1): 52-61.

Zhang Cheng-gong, Chen Hong-de, Lin Liang-biao & Chen Anqing. 2012. Qiannan-Guangxi Permian – Triassic sedimentary filling in the characteristics and evolution. Geology in China, 2012/2: 414-425.

Zhang, M., Huang, G.H., Li, H.B., Hu, G.Y. & Zhang, S.C. 2012. Molecular geochemical characteristics of gas source rocks from the Upper Triassic Xujiahe Formation indicate transgression events in the Sichuan Basin. SCIENCE CHINA Earth Sciences, 55(8): 1260–1268.

Zhang Tian Shu, Wu Yin Ye, Guo Bin Cheng & Feng You Liang. 2012. The characteristics of the Late Triassic depositional sequence controlled by foreland thrust-faulting in southwestern Ordos Basin. Earth Science Frontiers, 19(1): 40-50.

Zhang Yu-xi, Zhou Jiang-yu & Li Xiao-feng. 2012. Reservoir characteristics and controlling factors of the Triassic clastic rocks in the Liangbei region, Xinjiang. Sedimentary Geology and Tethyan Geology, 32(2): 66-71.

Zhang Zhang, Zhu Yu Shuang, Chen Chao Bing, Niu Xiao Bing, Xin Hong Gang, Zhu Jing & Quan Hong Hui. 2012. Microflow characteristics and influencing factors on oil displacement efficiency of Chang-6 reservoir in Heshui area. Earth Science Frontiers, 19(2): 176-182.

Zhao Yun-jiang, Zheng Chun, Huang Liang, Bo Jia-feng, Li Bing, Wang Xiao-lin & Liu Xiao-yan. 2012. Catastrophic event characteristics of stratigraphic slope slumping accumulation: a case study of the Upper Triassic Nanshuha Formation in Baoshan area, western Yunnan Province. Geological Bulletin of China, 31(5): 745-757.

Zhen Li, Jiansheng Qi & Jincheng Zhou. 2012. Geochronology, geochemistry, and Nd-Hf isotopes of early Palaeozoic-early Mesozoic I-type granites from the Hufang composite pluton, Fujian, South China: crust-mantle interactions and tectonic implications. International Geology Review, 54(1): 15-32.

Zhenbing She, Changqian Ma, Yusheng Wan, Jinyang Zhang, Min Li, Ling Chen, Wenjing Xu, Yanqing Li, Longfei Ye & Jian Gao. 2012. An Early Mesozoic transcontinental palaeoriver in South China: evidence from detrital zircon U-Pb geochronology and Hf isotopes. Journal of the Geological Society, London, 169(3): 353-362.

Zheng, J.P., Griffin, W.L., Ma, Q., O'Reilly, S.Y., Xiong, Q., Tang, H.Y., Zhao, J.H., Yu, C.M. & Su, Y.P. 2012. Accretion and reworking beneath the North China Craton. Lithos, 149: 61-78.

Zheng Quan-bo, Wang Yan, Zhang Guang-yu & Jin Zhe-yan. 2012. Confirmation of Late Triassic A-type granite and their geochemical constraints on structural setting in eastern Heilongjiang. Global Geology (Changchun), 2012/32(3): 471-478.

Zheng-Xiang Li, Xian-Hua Li, Sun-Lin Chung, Ching-Hua Lo, Xisheng Xu & Wu-Xian Li. 2012. Magmatic switch-on and switch-off along the South China continental margin since the Permian: transition from an Andean-type to a Western Pacific-type plate boundary. Tectonophysics, 532–535: 271-290.

Zhi-Wu Li, Shugen Liu, Hongde Chen, Bin Deng, Mingcai Hou, Wenhui Wu & Junxing Cao. 2012. Spatial variation in Meso-Cenozoic exhumation history of the Longmen Shan thrust belt (eastern Tibetan Plateau) and the adjacent western Sichuan basin: constraints from fission track thermochronology. Journal of Asian Earth Sciences, 47: 185-203.

Zhong-Qiang Chen, Fraiser, M.L. & Bolton, C. 2012. Early Triassic trace fossils from Gondwana Interior Sea: implication for ecosystem recovery following the end-Permian mass extinction in south high-latitude region. Gondwana Research, 22(1): 238-255.

Zhou Zhang, Hongfu Zhang, Ji'an Shao, Jifeng Ying, Yueheng Yang & Santosh, M. 2012. Guangtoushan granites and their enclaves: implications for Triassic mantle upwelling in the northern margin of the North China Craton. Lithos, 149: 174-187.

Zhou Zhi-cheng, Luo Hui, Zhu You-hua, Xu Bo, Cai Hua-wei & Chen Jin-hu. 2012. Early Triassic carbonate microfacies and sedimentary environments of the Xiejiacao section at Guangan, Sichuan. Acta Palaeontologica Sinica, 51(1): 114-126.

Zhu, R.X., Xu, Y.G., Zhu, G., Zhang, H.F., Xia, Q.K. & Zheng, T.Y. 2012. Destruction of the North China Craton. SCIENCE CHINA Earth Sciences, 55(10): 1565–1587.

Zhu You-hua, Luo Hui, Cai Hua-wei, Xu Bo, Yang Hao, Zhao Yuan-yuan, Zhou Zhi-cheng & Chen Jin-hua. 2012. Stratigraphic division of the Early and Middle Triassic at the Xiejiacao section in Guangan, Sichuan. Journal of Stratigraphy, 36(4): 784-791.

Zhu Zong-liang, Li Wen-hou, Li Ke-yong, Chen Quan-hong, Guo Yan-qin & Yuan Zhen. 2012. Provenance analysis of Late Triassic sediments in the southern Ordos Basin. Geological Journal of China Universities, 16(4): 547-555.

Zhuoheng Chen, Yexin Liu & Osadetz, K. 2012. Geological risk evaluation using the Support Vector Machine with examples from the late Triassic–early Jurassic structural play in western Sverdrup Basin, Canadian Arctic Archipelago. Bulletin of Canadian Petroleum Geology, 60(3): 142-157.

Zi-Fu Zhao, Yong-Fei Zheng, Juan Zhang, Li-Qun Dai, Qiuli Li & Xiaoming Liu. 2012. Syn-exhumation magmatism during continental collision: evidence from alkaline intrusives of Triassic age in the Sulu orogen. Chemical Geology, 328: 70-88.

Zuo Zhen, Guo Xian Qing, Fu Chang Lei, Wang Tao, Wang Zong Qi & Li Ji Liang. 2012. Petrology, geochemistry and SHRIMP U-Pb dating of zircons from Late Triassic OIB-basalt in the conjunction of the Qinling-Qilian-Kunlun orogens. Earth Science Frontiers, 19(5): 164-176.

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Theme Session 195. Extreme Environmental Conditions and Biotic Responses during the Permian-Triassic Boundary Crisis and Early Triassic Recovery.

Conveners: *Thomas J. Algeo, Hugo Bucher, Peter Roopnarine, Arne M.E. Winguth*

This session will feature new research related to the globally disturbed conditions associated with the end-Permian mass extinction and its aftermath during the early Triassic.

Theme Session 205. Major Evolutionary Events of the Early Mesozoic—Paleontology and Paleoecology from the Middle Triassic to the Late Jurassic

Conveners *Lydia S. Tackett, Rowan C. Martindale, David Bottjer*

The early Mesozoic represents one of the most evolutionarily chaotic intervals of the Phanerozoic. This session encourages paleontological and paleoecological studies from the middle Triassic through the Jurassic (e.g., Mesozoic Marine Revolution, Triassic-Jurassic, Toarcian OAE).

Theme Session 206: Mass Extinctions: Volcanism, Impacts, and Catastrophic Environmental Change

Conveners: *David P.G. Bond, Gerta Keller, Thierry Adatte*

This session explores recent advances in the stratigraphic and geochemical records of mass extinctions and impacts that have seen the impact-kill scenario recede in favor of terrestrial causes that may ultimately derive from massive volcanism.

Theme Session 199: Conodonts as Stratigraphic and Paleoclimatic Tools

Conveners: *Charles M. Henderson, Michael J. Orchard*

This session will focus on the increasing use of conodonts as stratigraphic and paleoclimatic tools and welcomes contributions involving conodont biostratigraphy and isotope geochemistry of conodonts.

Theme Session 243. Road-Testing the Placement of the GSSP Golden Spikes

Conveners: *Lucy E. Edwards, Stanley C. Finney, Brian R. Pratt*

This session is devoted to discussing the utility of GSSP boundary placement from the end-user perspective of geoscientists doing regional mapping and correlations and utilizing outcrop and subsurface data.

Theme Session 206: Mass Extinctions: Volcanism, Impacts, and Catastrophic Environmental Change

Conveners: *David P.G. Bond, Gerta Keller, Thierry Adatte*

This session explores recent advances in the stratigraphic and geochemical records of mass extinctions and impacts that have seen the impact-kill scenario recede in favor of terrestrial causes that may ultimately derive from massive volcanism.

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Symposium 4: Rapid climate/environmental changes in Mesozoic greenhouse world

Conveners: *Xiumian Hu, Michael Wagreich, Helmut Weissert*

This session is to provide a platform for discussion among sedimentologists interested in Mesozoic rapid climate/ environmental changes, such as oceanic anoxic events, oceanic red beds, carbonate drowning events, other extreme climatic and environmental events. Papers are invited on discussing specific stratigraphic and sedimentological records related to those rapid climate/ environmental events in Mesozoic greenhouse world.

Symposium 31: Triassic to Jurassic basin analysis in the Tethyan realm

Conveners: *Sigrid Missoni, Fabrizio Berra, Tetsuji Onoue*

A substantial lack of knowledge limits our understanding of the north-western Tethys margins during the Triassic-Jurassic and the interplay with (a) the onset of extension in the future Alpine-Atlantic/Alpine-Tethys system, and (b) the closure of the Palaeotethys (early Cimmerian orogeny) and the Neotethys (late Cimmerian orogeny). Open questions include: When and where Tethys related oceans were formed respectively when and where they were consumed?; which intervening continental units, terranes or miroplates were isolated by oceanization processes?.

Field Trip B3: Stratigraphic architecture and facies distribution of high-relief Middle Triassic carbonate platform (Central Southern Alps, Bergamo, Italy

Field Trip Leaders: *Fabrizio Berra, Marco Binda, Flavio Jadoul (University of Milano)*

During the field trip different aspect of a high-relief, flat-topped prograding platform will be observed. In particular, the field trip will focus on the general architecture of a well-preserved carbonate platform (Pegherolo Massif), with the observation of the basinal facies interfingering with the prograding slope breccias and the platform demise, both in the basinal area and on the platform top, where the subaerial exposure of the platform top is spectacularly documented . Visit of the historical Calcare Rosso tepee rich succession