
 Virtuelle Paläontologie

3D Modelling in palaeontology: a case study on Triassic ammonites

 Susanne Lukeneder¹⁾ & Alexander Lukeneder¹⁾

An ammonite mass occurrence (*Orthoceltites* sp.), deposited during Carnian time within an intra shelf area at the western end of the Cimmerian terranes, now located at the boundary from Kartoz and Kasimlar Formation (e.g. Asagiaylabel, Anatolia, Turkey), can act as proxy for the environmental activities and biotic crisis in the Carnian time (Upper Triassic). The section is situated in the southwest of Turkey, about 90 km northeast of Antalya and approx. 70 km southeast of Isparta, near a little village called Asagiaylabel. Geologically the area is located on the Anamas Dağ carbonate platform or Anamas-Akseki Autochthonous. The main formations are the Middle to Late Triassic Formation (Early Carnian) and the Kasimlar Formation (latest Early Carnian to Late Carnian). The Carnian Pluvial Episode (CPE) is a well known phase during the Upper Triassic Carnian stage (approx. 225 ma) within the western Tethyan Ocean, well observed within different studies (SIMMS & RUFFELL, 1989, HORNUNG & BRANDNER, 2005, KOZUR & BACHMANN, 2010), but main triggers of this demise are still under dispute.

Well established 3D visualisation and geometrical modelling techniques in an exciting palaeontological task of reconstructing the distribution and alignment of ammonites in a Triassic mass-occurrence from Turkey will be essential to reach geodynamic, palaeoceanographic and palaeobiological conclusions. By using the commercial software package GOCAD, individual objects can be created from imported 2D sections by combining matching line features to a surface object. Statistical analysis of the orientation and relative position (e.g. imbrication) of the fossils, but also calcite cement distribution (representing geopetal structures) and post-diagenetic calcite veins displacing several ammonites will complete the geometrical reconstruction. Investigations, undertaken at sections (e.g. Asagiaylabel) possessing this time interval, can work as proxy for the major Upper Triassic Tethyan crisis. Environmental changes as displayed by the sea level and climate can become clearer and the 'motor' behind the demise better understood.

Geological and Palaeontological Department, Natural History Museum, Burgring 7, A-1010 Vienna, Austria, e-mail: susanne.lukeneder@nhm-wien.ac.at, Phone: +34 (1) 52177-251, e-mail: alexander.lukeneder@nhm-wien.ac.at, fax: +34 (1) 52177-459, Phone: +34 (1) 52177-251

Freies Thema

Palaeoenvironmental evolution of Lake Gacko (Southern Bosnia and Herzegovina): impact of the Middle Miocene Climatic Optimum on the Dinaride Lake System

 Oleg Mandić¹⁾, A. de Leeuw²⁾, B. Vuković³⁾, W. Krijgsman²⁾, M. Harzhauser¹⁾ & K.F. Kuiper⁴⁾

The Dinaride-Anatolian Island acted during Middle Miocene as a major paleogeographic barrier between the Paratethys and the proto-Mediterranean seas. The western part of that land mass comprised a large-scale freshwater lacustrine environment termed the Dinaride Lake System. Its deposits represent today sedimentary infills of numerous intra-mountainous basins distributed throughout the Dinaride Alps and attaining thicknesses greater than 2000 m. Our present study deals with one of those basins – the Gacko basin in the southern Bosnia and Herzegovina. The architecture of its about 360 thick sedimentary succession can be interpreted as a single, lacustrine transgression-regression mega-cycle. The sedimentation started with detritic deposits representing the initial flooding of the basin. The subsequent coal building phase marks the installation of swamp conditions, passing upward into limestones originating from hard-water lake deposition. Subsequently, dropping water levels triggered again the swamp and mire conditions in the terminal phase of the Lake Gacko.

Huge outcrop at Gračanica opencast coal-mine provided excellent insight into lake deposition on basin's paleo-margin. Results from integrated Ar/Ar geochronology and magnetostratigraphy fixed the age of the lacustrine deposition into Langhian and Badenian implying its relation with the Middle Miocene Climatic Optimum. Furthermore, results from sediment petrography, geophysical logging and mollusk paleoecology indicated vivid changes of regional water budget. Indeed, the cyclostratigraphic analysis revealed the presence of two first order and seven second order transgression-regression cycles. These were orbitally tuned to ~400-kyr and ~100-kyr eccentricity cycles. The lake level high-stands were thereby related to eccentricity maxima, accompanied by environmental eutrophication events in consequence to enhanced denudation and terrestrial input into the basin. Dry climate intervals became related to ~400-kyr eccentricity minima. In the lower part of the succession they resulted in iterative swamp forest extension reflected by vast lignite accumulations. In the upper part of the succession they resulted, in contrast, in pedogenic and palustrine carbonate accumulation, secondarily distributed across the basin's margin.

This study represents partial results of the Austrian FWF Project P18519-B17: "Mollusc Evolution of the Neogene Dinaride Lake System"

¹⁾ Department of Geology & Paleontology, The Natural History Museum Vienna, Burgring 7, 1010 Wien, Austria; e-mail: oleg.mandic@nhm-wien.ac.at

²⁾ Paleomagnetic Laboratory 'Fort Hoofddijk', Utrecht University, Budapestlaan 4, 3584 CD, Utrecht, Netherlands

³⁾ Rudnik i Termoelektrana Gacko, Elektroprivreda Republike Srpske, Industrijska zona bb, 89240 Gacko, Bosnia and Herzegovina

variation in the limb skeleton. However, the amount of variation was related to functional digit length, not the number of phalanges per digit. Additional sources of variation (digital duplication, phalangeal fusion, interdigital ossicles) were frequently observed in the forefins of *Stenopterygius*, but never in the forefins of *Mixosaurus*, indicating that the loss of proximal-distal differentiation was more closely associated with the presence of these qualitative variants than was hyperphalangy. These results suggest that although variation, both in phalangeal count and qualitative anomalies, may be retained in a population due to enclosure in a soft-tissue flipper, the presence of the flipper does not itself predict either high levels of qualitative variation or the degree of variation in phalangeal count.

¹⁾ Museum für Naturkunde, Invalidenstraße 43, 10115 Berlin, Germany

Freies Thema

Hyperphalangy and intraspecific variation in ichthyosaur limbs

Erin E. Maxwell¹⁾

Adaptation to an aquatic habitat results in profound changes to tetrapod limb morphology as limbs take on the roles of propulsion and steering and lose their weight-bearing function. Changes include enclosure of the limb in a soft-tissue flipper, and proportional lengthening of the distal limb, often accomplished through the addition of de novo skeletal elements (hyperphalangy). Alteration of the developmental architecture allowing for hyperphalangy and the flipper structure itself are thought to increase limb variability, based on a cetacean model. The objective of this study was to examine the roles of hyperphalangy and morphological differentiation of limb regions on intraspecific variation. I addressed these questions using the ichthyosaurs *Stenopterygius* and *Mixosaurus*. *Mixosaurus* is a basal ichthyosaur from the Middle Triassic, with a large, well-preserved sample of available specimens originating from the area around the Italian-Swiss border. *Stenopterygius* is a derived ichthyosaur from the Lower Jurassic of Europe, with the largest available sample originating from the region around the village of Holzmaden, in southwestern Germany. *Mixosaurus* differs from *Stenopterygius* in retaining more digits and a greater degree of proximal-distal differentiation of elements, but the limbs of both genera were modified as flippers and exhibit hyperphalangy.

Large amounts of variation in phalangeal count were observed in *Stenopterygius* and *Mixosaurus*, consistent with the hypothesis that hyperphalangy increased observed

Freies Thema

Coral reef diversity after rapid warming: the Last Interglacial

Heike Mewis¹⁾, Wolfgang Kiessling¹⁾
& John Pandolfi²⁾

The Last Pleistocene Interglacial (LPI, 130–120 ka) was the result of rapid global warming culminating in temperatures two to four degrees warmer than today. To explore the ecological impact of such warming, we compared coral distributions and coral reef diversity between the LPI and today at global and regional scales. Global scale comparisons were done using the Paleobiology Database for the Pleistocene and OBIS (Ocean Biogeographic Information System) for the Recent. The warmer LPI showed a pronounced equatorial diversity depression of reef corals, due to range retractions away from the equator. These retractions were far more profound than high-latitude range expansions, confirming the deleterious consequences of global warming.

At regional scales we analyzed and compared quantitative community data from LPI coral reefs in the Red Sea and the Caribbean. Caribbean Pleistocene reefs have been extensively studied, while Indo-Pacific reefs are poorly explored. Accordingly, we used previously published material from the Caribbean and generated new data from taxon-quantitative line-transects from the Red Sea Gulf of Aqaba region. Just as today, Pleistocene coral diversity was much lower in the Caribbean than in the Red Sea, in spite of much more comprehensive sampling.