Poster Session IV (Saturday)

DIVERSIFICATION PATTERNS OF EARLY SHARKS AND RAYS (CHONDRICHTHYES, NEOSELACHII)

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Neoselachians constitute a well-defined monophyletic clade representing one of the most successful groups of aquatic vertebrates. Their evolutionary history extends back at least into the Early Triassic, although rare isolated teeth from the Palaeozoic may represent plesiomorphic members of this group. The Jurassic is generally assumed to have been an important time in the evolution and diversification of neoselachians. So far, historical biodiversity patterns of neoselachians were either inferred directly from the fossil record or empirically studied using first and last occurrences of taxa. However, the fossil record is biased and care must be taken to remove as much bias as possible. For the study of ancient diversity patterns, the most severe bias results from the heterogeneous quality of the fossil record. Time intervals with many findings of a particular group alternate with times when only few occurrences are reported. Diversity strongly depends on sample size and this heterogeneity needs to be compensated. The relationship between sample size and diversity is non-linear and thus diversity cannot be assessed by extrapolation. We used subsampling approaches, which randomly draws the same quota of occurrences from each time interval (bin), where the quota is dictated by the most poorly sampled bin. A total of 507 occurrences and 96 genera and 175 species, 28 of which are in open nomenclature from the Triassic and Jurassic were assessed to gain reliable information on early neoselachian diversification patterns. The comparison of SIB (taxa in a stratigraphic sample) and boundary-crosser diversity indicates that edge-effects are substantial only in the first and last bin. The sampling standardized pattern of standing diversity is thus one of low fairly constant diversity in the Late Triassic and earliest Jurassic, with a steep rise in the Toarcian towards a Middle and Late Jurassic plateau. Besides the Hettangian-Sinemurian bin (likely due to edge effects), the Toarcian also saw the maximum diversification rate in the Jurassic. These results are similar to results from phylogenetic hypotheses but not from fossil record analyses.

Poster Session III (Friday)

"*GONGBUSAURUS*" AND THE EARLY PHYLOGENY OF THE NEORNITHISCHIA

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Gongbusaurus shiyii (type species of the genus) is based on a premaxillary tooth and a cheek tooth from the Oxfordian of the Upper Shaximiao Formation in Rong County (Sichuan Province, P. R. China). The taxon was first considered a fabrosaurid, but it was afterwards regarded as a hypsilophodontid ornithopod. More recently, it has been suggested that it may be an ankylosaur. The dentition of *G. shiyii* is of a primitive type so that determining affinities on this basis is problematical. It is possibly a basal neornithischian, but it is provisionally best assigned to Ornithischia indet. "*Gongbusaurus*" *wucaiwanensis* is based on a fragmentary mandible, caudal vertebrae, and an incomplete forelimb (type specimen) from the Oxfordian of the Shishugou Formation in Fuyun County (Xinjiang Province, P. R. China). The paratype and the referred specimens described with the type include dorsal, sacral, and caudal vertebrae, an incomplete pelvis, and hind limbs. The taxon was first considered a hypsilophodontid, but it was subsequently identified as a fabrosaurid. The caudal process of the ilium with a distinct brevis shelf that first turns medially and then downwards (visible in lateral view) shows that "*G.*" *wucaiwanensis* is more primitive than *Hexinlusaurus multidens* (Bajocian, P. R. China). Furthermore, the degree of development of the pubic peduncle of the ilium suggests that "*G.*" *wucaiwanensis* is more basal than *Agilisaurus louderbacki* (Bajocian, P. R. China). Nevertheless, the caudal extension of the caudal process of the ilium in "*G.*" *wucaiwanensis* indicates that this taxon is more derived than *Lesothosaurus diagnosticus* (Hettangian, southern Africa). In conclusion, "*Gongbusaurus*" *wucaiwanensis*, *Agilisaurus louderbacki*, and *Hexinlusaurus multidens* appear to form a phylogenetic sequence between the most basal neornithischian (*Lesothosaurus diagnosticus*) and more derived taxa such as *Othnielosaurus consors* (Kimmeridgian, USA). This highlights the relevance of the Chinese Jurassic to improve our knowledge of the early phylogeny of the Neornithischia.

Technical Session XIX, Saturday 2:30

A NEW BASAL ORNITHOMIMID (DINOSAURIA: THEROPODA) FROM THE LATE CRETACEOUS IN HENAN PROVINCE OF CHINA

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Henan Province has been known as one of richest places for dinosaur eggs. After the first record of isolated tyrannosaur teeth (named as *Tyrannosaurus luanchuanensis*), the Henan Geological Museum recovered four dinosaur taxa from this province: an iguanodontian (*Nanyangosaurus zhugeii*), a nodosaurid (*Zhongyuansaurus luoyangensis*), a sauropod (*Huanghetitan ruyangensis*), and a dromaeosaurid (*Luanchuanraptor henanensis*). A new locality, yielded *Luanchuanraptor*, in Tantou Basin in Luanchuan County exposes the Upper Cretaceous Qiupa Formation and is rich in dinosaur eggs and bones, such as undescribed skeletons of an oviraptorid, troodontid, ankylosaurid, ornithopod and ornithomimid. This study reveals that the disarticulated skeletons of the Qiupa ornithomimid, preserves pelvis and hindlimb elements, is a new taxon and the most basal ornithomimid. A phylogenetic analysis suggests that the Qiupa ornithomimid is placed as a sister taxon to the other ornithomimids. The Qiupa ornithomimid is clearly more derived than *Shenzhousaurus* (non-ornithomimid ornithomimosaur from the Early Cretaceous) because of the deep brevis fossa of ilium and is more derived than Early Cretaceous forms and *Garudimimus* because of the presence of arctometatarsalian condition, suggesting that the Qiupa form belongs to Ornithomimidae. A short anterior extension of the pubic boot indicates that it is more primitive than the other ornithomimids. The Qiupa ornithomimid differs from the other ornithomimids in having a notch on the lateral surface of the medial posterior process of the proximal end of tibia and a small pit is present at the contact between astragalus and calcaneum, indicating that it is probably a new taxon. Ornithomimids are common in the Upper Cretaceous sediments of Asia, and four ornithomimid taxa are known so far (*Sinornithomimus* and *Archaeornithomimus* from China and *Gallimimus* and *Anserimimus* from Mongolia). The tree topology shows that all of the Late Cretaceous ornithomimids from China are successive stem taxa for the clade of Ornithomimidae, supporting that ornithomimids originated in Asia.

Technical Session IV, Wednesday 2:45

VISUALIZING FOSSILIZATION HISTORIES IN BONES USING HIGH RESOLUTION ELEMENTAL MAPPING

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Fossilization of bone is a dynamic process controlled by pore water chemistry, hydrology, temperature, microbiology, and bone architecture. Given the inherent complexity of the diagenetic system, the processes and rates of fossilization can be expected to vary both within and between depositional environments. This in turn exerts a major control on preservation potential and the quality of the vertebrate fossil record. Here we reveal the complexities of fossilization using laser ablation inductively coupled mass spectrometry (LA-ICP-MS) to generate high-resolution maps of trace elements in a sample of fossil bones collected from a variety of facies in the Late Cretaceous of Montana and Madagascar (Judith River and Maevarano Formations). The LA-ICP-MS maps generated for this study provide a previously unavailable visualization of the complex physicochemical conditions operating within individual bones during the early stages of fossilization. Some of the bones in our sample show distinct gradients in concentrations of trace elements, with highest concentrations seen at the external margins of bones. Concentration gradients are steep and show an exponential form consistent with uptake via a diffusion-adsorption mechanism. In these bones fossilization clearly occurred before equilibrium was achieved, and the elemental distribution was frozen at the point of recrystallization. Other bones in our sample show more shallow gradients that suggest relatively prolonged bone-water interaction, and by implication, relatively slow rates of recrystallization. Still others show complex patterns of element distribution mediated by variations in bone architecture. This study provides the first direct visual comparison of recrystallization rates among individual fossil bones, and clarifies the fact that exquisite morphological and histological preservation does not necessarily correlate with reduced geochemical alteration or even rapid recrystallization. This study also highlights the potential for using LA-ICP-MS mapping of elemental distributions as a tool to identify bones or regions of bones suitable for prospecting for intact biogeochemical signals.

Technical Session XVII, Saturday 8:45

ENAMEL DIFFERENTIATION IN EARLY PERISSODACTYLS

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Perissodactyls, in contrast to most other ungulates, differentiated the schmelzmuster of the various tooth families in their dentition by reorganising the lateral orientation of the Hunter Schreger-bands. This happened during the early diversification of the group in the Eocene. So far at least four different types of schmelzmuster could be identified. 1. Equoids retained the transverse orientation of HSB which can be regarded as the primitive condition inherited from phenacodontids. 2. Rhinocerotoids have vertical HSB in their premolars and molars, while incisors and canines have transversely oriented HSB. 3. Chalicotheres are characterized by U-shaped HSB in premolars and molars. This schmelzmuster is shared by brontotheres. 4. Tapiroid molars show transverse HSB in the lingual and buccal walls, but in the lophs these HSB bend from both sides into a vertical orientation forming a characteristic interface between both fields. Incisors and canines retain transverse HSB. - The phylogenetic position of *Lophiodon* and *Hyrachyus* has been debated in previous studies. *Lophiodon* shares the typical tapiroid schmelzmuster. *Hyrachyus*, however, is different from rhinos as well as tapirs and might represent a fifth type of schmelzmuster. - The frequent parallelisms in enamel structures complicate the phylogenetic interpretation, but the schmelzmuster might contribute significantly to the reconstruction of the phylogeny since only very specific transformations from one type to another seem to be possible.