

Symposium: Vertebrate Paleontology in the Northern Neotropics: Cradle and Museum of Evolution across Geological Time (Wednesday, October 17, 9:15 am)

CENOZOIC MAMMALS FROM AMAZONIA: DIVERSITY, ENVIRONMENT, AND BIOGEOGRAPHY

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The Amazon Basin constitutes more than one third of South America's emerged areas. Essentially covered by tropical rainforests and a dense river network, this area is today a major biodiversity hotspot, notably for mammals. Yet, the mode and timing of the settlement of the corresponding mammalian guilds are far from being well known, due to the virtual lack of well-constrained data, notably for the Paleogene period. Although dramatically under-investigated, pre-Holocene Cenozoic deposits from Western Amazonia contain a wide array of fossil mammals, most of them being highly relevant to test major evolutionary and/or biogeographic hypotheses.

The earliest Cenozoic mammals from Amazonia are middle Eocene in age (~41 Ma). They were recently recovered nearby Contamana, eastern Peru, and consist of both endemic groups (gondwanatherians, marsupials, xenarthrans and native ungulates of high latitude affinities) and early immigrants from Africa (South America's earliest rodents). Another locality of eastern Peru, Santa Rosa (?late Eocene-early Oligocene), yielded a somewhat similar mammalian guild, as well as a 'possible bat'. A new locality, nearby Contamana, documents the late Oligocene period, with affinities to both Santa Rosa and Salla, Bolivia. In the Madre de Dios Basin, southern Peru, a new early Miocene locality provides the earliest low-latitude platyrrhine primate. By contrast, several middle and late Miocene faunas discovered in the last decades, from western Brazil (Acre and Juruá) and eastern/southern Peru ('Fitzcarrald Local Fauna'; Madre de Dios), yield much more diversified mammalian guilds, including marsupials, xenarthrans, native ungulates, caviomorph rodents, primates, bats, aquatic placentals (river dolphins and trichechid sirenians), and perhaps an early proboscidean of North American origin. Younger faunas, late Pleistocene-Holocene in age, widely postdate the Great American Interchange (~3.5 Ma), and accordingly include Northern invaders, such as perissodactyls, artiodactyls, proboscideans, carnivores, and muroid rodents, together with xenarthrans and toxodontid ungulates.

Paleontological data as a whole point to the presence of tropical rainforests in Amazonia throughout the Cenozoic period, at least during mammal-yielding intervals, with obligate arboreal marsupials, rodents, and primates co-occurring with terrestrial hoofed ungulates. However, Western Amazonia hosted peculiar environments in the late early-early late Miocene interval, with marine incursions and the settlement of the long-lived marine-like Pebas megalake. This episode played a pivotal role in the biotic differentiation of southern/northern South American ecosystems and corresponding mammalian guilds, as earlier faunas show relatively low degrees of endemism.

Poster Session III (Friday, October 19, 4:15 - 6:15 pm)

DIVERSITY OF THE HESPERORNITHIFORMES (AVES) FROM THE UPPER CRETACEOUS PIERRE SHALE IN SOUTHERN MANITOBA, CANADA

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Hesperornithiformes (Aves; Ornithurae) is a group of Cretaceous foot-propelled diving birds. Their remains are most commonly reported from Campanian deposits in North America where the Western Interior Seaway existed during the Cretaceous, and numerous hesperornithiform fossils have been collected from the Pierre Shale (Campanian) between South Dakota (USA) and Manitoba (Canada). *Hesperornis regalis* was the only species of the Hesperornithiformes from the Pierre Shale for many years, but since 2002, an additional five species (*H. chowi*, *H. bairdi*, *H. macdonaldi*, *H. mengeli* and *Brodavis varneri*) were described from South Dakota and Manitoba, suggesting higher taxonomic diversity of the Hesperornithiformes in the Pierre Shale. The current study aims to update the taxonomic composition of the Hesperornithiformes in the Pierre Shale in southern Manitoba. Nearly 200 hesperornithiform specimens have been collected from the Pierre Shale in southern Manitoba and stored in the Canadian Fossil Discovery Centre in Morden since 1972, but these fossils have not been studied since 1989. This study follows previous taxonomic studies in which the diagnosis of most species of *Hesperornis* is based on the morphology of the tarsometatarsus and tibiotarsus. Consequently, five species of two genera (*Hesperornis regalis*, *H. chowi*, *H. sp. A*, *H. cf. rossicus*, *Baptornis advenus*) were identified in this study. *H. sp. A* likely represents a new species because it displays unique characters in the shaft and proximal view of the tarsometatarsus; the shaft is strongly constricted at midshaft and the proximal articulation displays a nearly D-shaped outline. Results indicate that the genus- and species-level diversity of the Hesperornithiformes in Manitoba is much higher than previously recognized. This study also demonstrates the wider geographic range of two hesperornithiform species; *H. chowi* and *B. advenus* were previously known only from South Dakota and Kansas respectively. In addition, *H. rossicus* was previously reported from Russia and Sweden but not reported from North America, and the *H. cf. rossicus* specimen from Manitoba possibly indicates a wider geographic distribution of this species as well.

Technical Session XI (Friday, October 19, 3:00 pm)

LATE JURASSIC THEROPOD EMBRYOS FROM PORTO DAS BARCAS, LOURINHÃ FORMATION, PORTUGAL

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A clutch of several crushed eggs and embryos from the Late Jurassic (near the Kimmeridgian-Tithonian boundary), Lourinhã Formation, Portugal contains a complete maxilla, erupted and scattered teeth, and presacral vertebrae. The maxilla bears four teeth separated by individualized interdental plates, the dorsal process of the maxilla is confluent with the maxillary body, the ventral rim of the antorbital fossa is parallel to the tooth row, and the anterior border of the maxilla forms a right angle with the ventral margin. The teeth are conical and recurved distally with carinae on mesial and distal sides. The vertebrae are amphiplatyan, with a ventral pair of neurovascular foramina and heavily pitted articular facets. These fossils allow unambiguous association of basal theropod osteology (Megalosauroida) with a new eggshell morphotype. Synchrotron micro-computed tomographic scanning (SRμCT), scanning electron microscopy, and thin-sections under polarized and normal light revealed that the outer ornamentation of the eggshell is composed of anastomosing ridges and islets, the pores communicate near the outer region of the eggshells, and in radial section they are irregular canals that ramify towards the surface. Micro-proton induced x-ray emission (micro-PIXE) analysis of the eggshell (excluding pores) revealed the presence of Mg, Fe, Mn (0.33%, 0.27% and 0.18%, respectively) and several trace elements, with a corresponding loss of Ca (39.4% detected but 40.0% expected for calcite), which suggests minimal eggshell diagenesis. The eggshells do not luminesce, which could imply that no diagenetic alteration took effect. However, the quenching effect of Fe²⁺ has to be taken into consideration. Conversely, luminescence is observed in the pores since they are filled with sediment, composed of phyllosilicates, as revealed by SRμCT, micro-PIXE and x-ray diffraction analyses.

Technical Session XV (Saturday, October 20, 12:00 pm)

A NEW ANKYLOSAURID DINOSAUR FROM THE UPPER CRETACEOUS BARUUNGOYOT FORMATION OF MONGOLIA: NEW CRANIAL CHARACTERS FOR ANKYLOSAURINE ANKYLOSAURIDS AND A REASSESSMENT OF ANKYLOSAURID POSTCRANIAL SPECIMENS FROM MONGOLIA

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The Upper Cretaceous sediments of the Gobi Desert, Mongolia, have produced several ankylosaurid taxa with distinctive bulbous, pyramidal cranial ornamentation, including *Tarchia gigantea* (from the Nemegt Formation) and *Saichania chulsanensis* (from the Baruungoyot Formation). Although a third taxon, *Minotaurasaurus ramachandrani*, is of unknown provenance, it bears a strong similarity to both *Tarchia* and *Saichania* and may also derive from the Upper Cretaceous of Mongolia. A new ankylosaurid skull (Mongolian Paleontological Center [MPC] D100/1338) from the Baruungoyot Formation at Khermeen Tsav can be differentiated from *Saichania* and *Tarchia* based on the unusual double-layered appearance of the squamosal horns, and the presence of ornamentation posterior to the orbit. Several new ankylosaurid cranial characters are identified, including the presence or absence of a constriction behind the narial osteoderms, squamosal horn shape, the shapes of domed cranial osteoderms, number of discrete nuchal osteoderms, presence or absence of small osteoderms on the premaxilla between the narial osteoderms, and the shapes of the lateral edges of the supraorbitals.

The presence of a second potentially distinct ankylosaurid taxon in the Baruungoyot Formation necessitates a reevaluation of postcranial material referred to *Saichania*, previously the only known ankylosaurid in the formation. The holotype of *Saichania* (MPC 100/151) includes the skull and anterior part of the postcranial skeleton. A nearly complete skeleton with in situ osteoderms, but lacking a skull and cervical rings (MPC 100/1305), has been referred to *Saichania*, but no synapomorphies have been used to support this referral. The humerus of MPC 100/1305 appears to have a similar proximal concavity lateral to the humeral head, present in the holotype of *Saichania* but absent in other ankylosaurids, which may support the referral of MPC 100/1305 to this genus. Although ankylosaur postcranial remains are abundant in the Gobi Desert, postcranial remains associated with diagnostic skull material are rare, hindering efforts to identify additional characters for phylogenetic analyses.

A revised phylogenetic analysis of the ankylosaurine ankylosaurids using updated character codings and the new characters identified here shows a close relationship between MPC D100/1338, *Minotaurasaurus*, and *Pinacosaurus grangeri*. *Saichania* is more closely related to *Pinacosaurus mephistocephalus* than to MPC D100/1388. However, bootstrap supports for ankylosaurine interrelationships are low, highlighting the need for additional characters (possibly from the postcranial skeleton) to help resolve relationships within this clade.