

(*Guizhouichthysaurus*), pistosauroid sauropterygian (*Yunguisaurus*). Level 3, age of latest Ladinian-earliest Carnian, exposed in Dingxiao and Wusha of Xingyi City, and Luoping (Yunnan), yields pachypleurosauria sauropterygian (*Keichousaurus*), nothosaurid sauropterygians (*Nothosaurus*, *Lariosaurus*), thalattosaurs (*Anshunsaurus*). Level 4, age of Ladinian, exposed in Luoping County (Yunnan), contains sauropterygians (*Keichousaurus*, *Lariosaurus*). Level 5, age of mid Anisian, exposed in Panxian County (Guizhou), contains mixosaurid ichthyosaur (*Mixosaurus*, *Phalarodon*), pachypleurosauria sauropterygian, nothosaurid sauropterygian (*Nothosaurus*, *Lariosaurus*), placodontia sauropterygian (*Placodus*), protosauroid (*Dinocephalosaurus*) and strange *Qianosuchus*. This site located some far from Nanpanjiang Basin and may more open to northwest, and shows strong western Tethyan paleobiogeographic affiliation in the Middle Triassic.

Poster Session IV (Saturday)

A NEARLY COMPLETE SPECIMEN OF *STRATODUS APICALIS* (TELEOSTEI: DERCEITIDAE) FROM THE UPPER NIOBRARA FORMATION OF SOUTH DAKOTA, USA

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Since its initial description in 1872, *Stratodus apicalis* has been known from only a few fragmentary skulls, short vertebral segments, and scattered osteoderms. Consequently, the taxonomic position of *S. apicalis* has been uncertain and the subject of much debate. In 2006, a new specimen of *S. apicalis* was recovered from the Niobrara Formation along the bank of the Missouri River near Oacoma, South Dakota. This new specimen, which is housed at the South Dakota School of Mines and Technology, is nearly complete and is partially articulated. The specimen consists of a partial skull, a complete vertebral column, fin rays, osteoderms, and the caudal endoskeleton. The skull possesses the distinctively pitted, triangular palatines that are diagnostic of the species. Other partially preserved skull elements include the ectopterygoids, sphenotics, frontals, pterotics, and basioccipital. The vertebral column consists of 83 separate centra of which 28–30 are caudals. The anteriormost thoracic vertebrae are slightly elongated and all possess reduced neural spines. Several fin elements are present and preserved in partial articulation. These include an elongate dorsal fin, pectoral fin, pelvic fin, and anal fin. Numerous triradiate osteoderms are present, some in articulation. Osteoderm shape and position indicate that there was one lateral row on each side and at least one dorsal or ventral midline row present. The caudal endoskeleton possesses a convoluted suture between hypurals 2 and 3. A quantitative cladistic analysis was performed using known cranial characters from described specimens and adding postcranial characters from the current specimen. Results show that *Stratodus apicalis* belongs to the monophyletic clade Dercetidae based on the presence of an unkeeled operculum, reduced precaudal neural spines, and the presence of a convoluted suture between hypurals 2 and 3.

Technical Session VIII, Thursday 2:15

NEW LONG-SNOUDED DYROSAURID (CROCODYLIFORMS, MESOEUCROCODYLIA) FROM THE PALEOCENE OF NORTHEASTERN COLOMBIA

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The fossil record of dyrosaurid crocodyliforms spans the Late Cretaceous to Middle Eocene of Africa, Asia, North America, and South America. Prior to the discovery of the Paleocene-aged Cerrejón fossil site in Colombia, dyrosaurid specimens from South America were limited to a few fossils with only two taxa diagnosed. Previously we reported the discovery of a new short-snouted dyrosaurid based on three nearly complete skulls from Cerrejón related to *Hyposaurus rogersii* from North America. Here we describe a second new dyrosaurid from the Cerrejón fossil assemblage. The new taxon is represented by three lower jaws of varying completeness. The diagnostic posterior region including the surangular, articular, and angular bones is preserved in one specimen. In addition, one mandible was found with associated maxillary fragments, including several teeth. The teeth of the new taxon are relatively stout with strong anterior and posterior carinae and are not recurved as in *Dyrosaurus* from the Eocene of Africa, or *Guarinisuchus* from the Paleocene of Brazil. The teeth also lack the 'twisted' carinae of *H. rogersii*. At least partial dentaries are present in all specimens, and tooth position is known for one specimen, enabling in-depth comparison to other known dyrosaurid mandibles. The new mandibles have a reduced seventh dentary tooth and a jaw articulation with a laterally depressed retroarticular process, both diagnostic characteristics of Dyrosauridae. The rostrum of the new taxon is much more elongate than the recently described short-snouted form from the same site. Results from a cladistic analysis using 80 characters for 17 dyrosaurid species with relatively complete cranial and mandibular material, suggest that the new taxon is basal to a clade uniting *Rhabdognathus* and *Atlantosuchus* + *Guarinisuchus*. The included *Rhabdognathus* species are known from Paleocene (and possibly Late Cretaceous) deposits in Africa, and *Atlantosuchus* is known from the late Paleocene of Morocco. Our results indicate an early Paleocene (possibly Late Cretaceous) dispersal from Africa to South America with a radiation of dyrosaurid crocodyliforms in the Paleocene of tropical South America.

Poster Session II (Thursday)

REVERSIBLE FILLER: A FRESH LOOK AT BUTVAR-76

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B-76 (polyvinyl butyral) has long been used in fossil preparation as an adhesive. By changing the ratio of solvent to solution and using a variety of new techniques, B-76 can be used to create filler that is both reversible and archival and therefore preferable to other more traditional fillers. Due to its several desirable properties, it is ideal for making specimens ready for museum display without detracting from their research value. B-76 filler can be reversed with very little trouble, which makes it a better candidate for museum prep than more commonly used fillers that are permanent. Serious damage occurs if permanent fillers must be removed, a process that often involves grinding tools. B-76 filler can be dissolved with the application of acetone. The process can be accelerated by removing the bulk of the filler with cutting tools. B-76 filler is very strong but can easily be removed with a razor, and the remnants can then be dissolved away and cleaned off. B-76 in its purest form is translucent. From a researcher's standpoint this can be desirable as traditional fillers obscure the actual fossil and make it unclear what is real and what is replicated. Yet it still holds the various elements together in a pleasing way suitable for display. If the first priority for the specimen is display and the preparator so desires, various coloring substances can be mixed into the filler while it is being made. B-76 can also be used to coat the breaks/contacts and then traditional filler can be used to fabricate the missing elements with the B-76 acting as a buffer that can later be removed. B-76 filler is incredibly strong. Even when stretched into thin sheets its performance when stressed is remarkable. Unlike other fillers it is not brittle, it holds a rigid form but should not crack under extreme stress. In fact it should bend somewhat before any tearing occurs. In this way it could be compared to metal where other fillers are more like cement. Due to this strength it can be used to rebuild extremely thin or delicate structures, such as palates more accurately.

Poster Session I (Wednesday)

PORASPIDINE HETEROSTRACANS (CYATHASPIDIDAE: PORASPIDINAE) FROM THE DEVONIAN OF THE MACKENZIE MOUNTAINS OF CANADA

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Poraspidine cyathaspidid specimens are described from the Man On The Hill (MOTH) locality in the Mackenzie Mountains in the Northwest Territories of Canada, which has produced a taxonomically diverse assemblage of well-preserved early vertebrate specimens. At least three distinct taxa are present, and are distinguished based mainly on the shape and relative proportions of the dorsal shield, and the pattern and coarseness of the dentine ridges that comprise the ornament of the dermal skeleton. The description of these specimens contributes to the understanding of evolutionary trends in morphology within *Poraspis* and other poraspidines. Representatives of Poraspidae are known from other localities within the Mackenzie Mountains, as well as the Canadian Arctic, Spitsbergen, and both western and eastern Europe. As the Canadian Arctic has been proposed as a centre of origin and site of adaptive radiation for *Poraspis*, the description of the poraspidine fauna from the MOTH locality allows for improved comparisons with other poraspidine-bearing localities to generate more informed hypotheses on the distribution and dispersal patterns in this subfamily.

Technical Session XIV, Friday 1:45

DEFENSIVE WEAPONS OF THYREOPHORAN DINOSAURS: HISTOLOGICAL COMPARISONS AND STRUCTURAL DIFFERENCES IN SPIKES AND CLUBS OF ANKYLOSAURUS AND STEGOSAURUS

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Thyreophoran dinosaurs have spike- and club-shaped osteoderms probably used for defensive weapons. The structural and histological variations have been little known. Here, we provide the comparisons of the internal structures in defensive weapons of ankylosaurs and stegosaurs, using spikes of a polacanthid (*Gastonia*) and a nodosaurid (*Edmontonia*), clubs of ankylosaurids (*Saichania* and Ankylosauridae indet. from Canada), and spikes of stegosaurids (*Stegosaurus* and *Dacentrurus*), which sheds light on understandings of evolutionary history and functional implications of defensive weapons in thyreophorans. In ankylosaurs, the structural and histological features of spikes and clubs are similar with those of small osteoderms in having thin compact bones, thick cancellous bones with large vascular canals, and abundant collagen fibers. A previous study demonstrated that each of three groups of ankylosaurs (polacanthid, nodosaurid, and ankylosaurid) has distinct characteristic arrangements of collagen fibers in small osteoderms. This study shows that spikes and clubs of ankylosaurs maintain the same characteristic features for each group despite of the differences in shapes and sizes. Conversely, the spike-shaped osteoderms in primitive (*Dacentrurus*) and derived (*Stegosaurus*) stegosaurids have similar structure to each other and are significantly different from the other types of stegosaur osteoderms (throat bony ossicles and plates) in having thick compact bones with a medullary cavity. These lack abundant collagen fibers unlike ankylosaur osteoderms. The spikes of

ankylosaurs and stegosaurs are similar in shape, but their structural and histological features are different in having unique structures of collagen fibers for ankylosaurs and thick compact bones for stegosaurs, providing enough strength to have large spikes and to use them as defensive weapons. Although the shapes of ankylosaur clubs are different from spikes, the internal structures are similar, suggesting that ankylosaurs maintain similar structures despite of different shapes in osteoderms. These results indicate that ankylosaurs and stegosaurs used different strategies independently to evolve defensive weapons.

Technical Session III, Wednesday 3:30

ASSEMBLY AND BIOGEOGRAPHY OF NORTH AMERICAN PALEOGENE SNAKE FAUNAS BASED ON AN EXPANDED FOSSIL RECORD

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The North American record of Cenozoic snake faunas is extensive, but understanding of the timing and mechanisms driving their assembly is poorly constrained due to phylogenetic and taxonomic ambiguity. We reexamined the fossil record of Paleogene snakes based on samples from the mid-Paleocene to middle Eocene of the Western Interior and the middle Eocene of southern California in order to address biogeographic and phylogenetic hypotheses. Our reassessment indicates that: 1) taxa previously referred to Aniliioidea are phylogenetically indeterminate fossorial ecomorphs that are not monophyletic with South American and Asian pipe snakes and shield-tailed snakes; 2) *Helagras prisciformis* (Paleocene, Torrejonian) represents the only known North American record of an archaic, South American madtsoiid, based on cranial and postcranial remains; 3) specimens referable to extant boid clades appear at the Paleocene-Eocene boundary; and, 4) the ubiquitous, early-middle Eocene boid genus *Boavus* is a basal member of the South American boine clade. This revised record indicates that the archaic or indeterminate forms comprising Paleocene faunas were reorganized by immigration of unambiguous crown-group alethinophidians during the Eocene, coincident with long and short-term temperature increases. The first occurrence of modern boid clades is recorded at the Paleocene-Eocene Thermal Maximum by small-bodied taxa tentatively referable to the Ungaliophiinae+*Charina* clade followed by the introduction of large-bodied (SVL > 1 meter) taxa (*Boavus*) during the Cenozoic climatic optimum beginning in the late early Eocene. Assembly of the Paleogene North American snake faunas was exclusively the result of Central and South American immigration (including both archaic forms and modern boid clades) during globally warm intervals, a pattern consistent with other herpetofaunal (lizards and turtles) and paleofloral records. Conversely, modern snake faunas are derived primarily from Asian immigration during the Neogene (viperids, elapids, most colubroids).

Poster Session IV (Saturday)

EXCEPTIONAL TAXONOMIC DIVERSITY FROM A SINGLE SITE: THE UPPER TRIASSIC MONCURE MICROVERTEBRATE LOCALITY, CUMNOCK FORMATION, SANFORD SUB-BASIN, NORTH CAROLINA, USA

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Late Triassic nonmarine vertebrate assemblages are often paucispecific and dominated by archosaurs, synapsids, or temnospondyls. The Moncure microvertebrate fauna is unique in preserving abundant, albeit fragmentary, fossils of dipnoans, temnospondyls, archosauromorphs, and synapsids. Dipnoan toothplates from the site are minute (3-8 mm anteroposterior length) with 5-7 sharp ridges radiating through 120° from the mesial corner, thus we refer them to *Asiatoceratodus* (= *Arganodus*). These are the first records of lungfish from the Newark Supergroup. Other osteichthyans include abundant semionotids and probable redfieldiids, both represented by scales, teeth, and fragmentary skull and dentulous elements. Temnospondyl fossils are isolated small centra and textured skull elements consistent with assignment to Metoposauridae indet. aff. *Apachesaurus*. Amniote fossils include numerous teeth of both archosauriforms and cynodonts. The archosauriform teeth include representatives of typical larger taxa (phytosaurs, "rauisuchians"), mid-sized taxa (*Revueltosaurus* sp.), and several smaller morphotypes, including teeth assignable to the putative ornithischian *Galtonia gibbidens* (Huene), which is best considered Archosauriformes *incertae sedis*. The *Revueltosaurus* teeth range from tiny (1 mm) to more typical 3-6 mm crown height and are distinct from the type species *R. callenderi* Hunt. Teeth we refer to *Galtonia* are small (<2 mm crown height), conical to recurved, with relatively few (~7) denticles that are oblique to the tooth margin and occupy prominent carinae that are laterally compressed relative to the main body of the tooth. This is the first record of *Galtonia* from outside the type locality in Pennsylvania. Synapsid fossils consist of numerous small, polycuspsate teeth similar to the chiniquodontid *Microconodon* as well as less common traversodont teeth. Few of *Microconodon* teeth possess a cingulum, but many have an incipiently bifurcated root. The Moncure fauna thus demonstrate how a single microvertebrate locality can alter our understanding of a basin's fauna as it includes many new records as well as taxa not normally associated with the Newark Supergroup.

Edwin H. and Margaret M. Colbert Poster Competition (Thursday)

PALAEODIETARY RECONSTRUCTION AND FUNCTIONAL MORPHOLOGY OF BOVID MOLARS

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The objective of this study was to provide a new means of dietary reconstruction for extinct Bovids using the form of the occlusal surface of upper molars. Using characteristics of exposed enamel and dentine with methods based on 2-dimensional images, 78 species of bovid were analysed using Discriminant Function Analyses (DFA) in a 5 group dietary classification. DFA conducted with occlusal surface characters allowed a successful classification of 78% of specimens. After the addition of published crown height data, classification was improved to 82%. Classification success increased further still if mixed feeders are distinguished between those that prefer open versus closed habitats. Broadly, grazers and frugivores possessed thicker enamel than other groups, whereas grazers differed further by having more enamel ridges, in particular the central ridge. Most classification errors were browsers classified as mixed feeders, and vice versa. This is in accordance with a previous study on southern African Bovids where most mixed feeders clustered with browsing taxa. Other misclassifications were concentrated on taxa whose dietary grouping was uncertain, or where phylogenetic influences were strong. Browsers and most mixed feeders differ little in occlusal form, crown height being the only major difference. In addition to providing predictive algorithms for diet reconstruction, this study suggests that there is selection in favour of a change in occlusal form only above a certain level of grass consumption. Mixed feeders incorporating significant amounts of grass may be able to cope with this dietary component through cranial morphological, physiological or behavioural adaptations. The classification functions calculated allow accurate classification of unknown fossil samples with data on both worn and unworn upper molars. In addition, the method has potential to be applied to other ruminant groups with similar occlusal characteristics, in particular the mostly extinct family Antilocapridae.

Technical Session XIX, Saturday 2:00

THE FACIAL SKIN OF MAJUNGASAURUS CRENATISSIMUS (ABELISAURIDAE: SAURISCHIA): PRONOUNCED DERMAL METAPLASIA AS THE CAUSE OF RUGOSITY IN ABELISAURID SKULLS

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Abelisaurid theropods are characterized by pronounced bony ornamentation present on their skulls, ranging from rugosity to structures interpreted as horn cores. This ornamentation was directly overlain by skin in life, and has often been compared to the bony ornamentation associated with heavily cornified plates such as the rhamphotheca of birds and turtles. We investigated the bony ornamentation of the abelisaurid theropod *Majungasaurus* by comparing the histology and gross morphology of its ornamented bone with similar bony structures seen in extant sauropods. We sampled an area of rugose bone from a *Majungasaurus* lacrimal (UA 8718). This sample was μ CT scanned, embedded in polystyrene resin, and sectioned at 1 mm intervals. A set of skin/bone contact samples from several extant sauropod taxa were embedded in polymethylmethacrylate resin and sectioned at 0.8 mm intervals for synoptic comparison. We found that the fine-scale bony ornamentation of *Majungasaurus* is composed of metaplastically ossified dermal tissue. Large fiber bundles from the base of the preserved dermis formed crossed arrays, an organization consistent with dermis that is subject to relatively high mechanical stress. Similar arrays of fiber bundles attach avian rhamphotheca to bone. This arrangement contrasts to the parallel arrays of smaller-diameter fiber bundles that attach squamate scales or crocodylian skin to underlying bone. Although the base of the dermis itself is directly preserved by ossification, the morphology of the overlying epidermis must be inferred from gross osteological correlates. The diversity of gross correlates across the skull of *Majungasaurus* are consistent with a range of epidermal structures, from lightly cornified and tightly adherent skin (e.g. *Chelydra*, *Alligator*), to heavily cornified epidermal sheets (e.g. avian rhamphotheca), to elaborate epidermal scales (e.g. *Moloch*). Given the apparent bias in theropods towards dorsal nasal and frontal crests, an elaboration of scaled epidermis across the skull roof, involved in comparatively high-energy agonistic behaviors, is suggested as the most likely alternative.

Technical Session II, Wednesday 9:00

INTERPRETING PAST CLIMATE USING MACROPHYSICAL CLIMATE MODELING AND ISOTOPIC ANALYSIS OF MAMMAL TEETH: TWO METHODS, ONE STORY?

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Climate models provide estimates of climate variables (such as mean annual temperature, MAT, and mean annual precipitation, MAP) over periods of time in the geological past. Macrophysical climate models (MCM) differ from the more widely used general circulation models (GCM), by providing temporally high-resolution (~100 years) and site-specific estimations of monthly values of variables such as temperature and precipitation. However,