remodeling and erosion cavities (some completely lacking Haversian systems) indicating different ontogentic stages. Overall, the bone pattern is similar to mid-latitude specimens and has important implications for hesperornithiform migration and paleobiology. Similarities in internal structure of hesperornithiforms bones refute the hypothesis that mid- and high-latitude hesperornithiforms have distinctly different growth regimes reflected in histologic patterns. This may provide supporting evidence for long distance migration, possibly for nesting in high-latitude environments, as has been suggested by previous studies. Additional comparisons of vascularity, primary osteon density, and osteocyte density between high- and mid-latitude specimens provide insight into variations in growth regimes.

The Cleveland Shale and Beyond: Early Vertebrate Form, Function, and Phylogeny, Wednesday 9:45

MORPHOLOGY AND SQUAMATION OF FORK-TAILED THELODONTS (THELODONTI: FURCACAUDIFORMES): NEW OBSERVATIONS AND INSIGHTS

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Since their discovery 15 years ago, the unusual morphological features of the Silurian-Devonian fork-tailed thelodonts have caused researchers to suggest a variety of systematic positions, including a close relationship to gnathostomes, an artificial, paraphyletic assemblage, or as a derived clade within a monophyletic Thelodonti. One of their most striking features is the fan-shaped, superficially symmetrical caudal fin, while the structure of the mouth in thelodonts remains imperfectly known. Recently discovered specimens from the Lochkovian (Early Devonian) MOTH locality in northwestern Canada reveal new details of the underlying structure of the caudal fin in one species and excellent preservation of the oral region in two other species. The tail is remarkably similar to that in several heterostracans, as best seen in specimens from the same locality. The oral region of the best-preserved specimens gives evidence of internal supporting structures. The branchial region is also well preserved on the same specimens, confirming its similarity in form throughout the group. New research on scale morphology of all species suggests that furcacaudids have the same categories of body scale types as certain other thelodont genera, yet fewer variations than some other genera. Taken together these observations indicate that advanced furcacaudiforms were capable of complex swimming and feeding behaviors, while sharing a modified version of a body plan inherited just once from primitive thelodont ancestors.

Poster Session IV (Saturday)

GIS ANALYSIS OF THE JONES RANCH SAUROPOD QUARRY (EARLY CRETACEOUS, TEXAS)

WINKLER, Dale, Southern Methodist University, Dallas, TX, USA; POLCYN, Michael, Southern Methodist University, Dallas, TX, USA

Jones Ranch quarry in the Early Cretaceous Trinity Group (Texas) preserves an accumulation of multiple individuals of the sauropod *Paluxysaurus jonesi*, along with numerous logs and other plant macrofossils. Many bones and logs are large, stacked in multiple layers, and commonly encased in massive concretions. Fossils are commonly invisible within concretions in the field. The skeletons are only partially articulated, with isolated elements and skeletal segments of different individuals juxtaposed. An X-Y-Z coordinate system was used to map more than 150 field blocks (and bones if visible) relative to a fixed datum over more than 15 years of excavations. Emplacement of bones and plants by episodes of flooding in a sandy ephemeral stream channel has been demonstrated. Jones Ranch quarry data are amenable to analysis using a Geographic Information System database, which can greatly enhance understanding the taphonomic origin of the accumulation and the paleoecology of the biota. For the minimum of four sauropods that are present in the quarry, GIS analysis also offers the best means to substantiate the allocation of bones to different individuals. As blocks are prepared, laboratory data including the dimensions, orientation, sketches and photographs of additional elements not visible in the field can be added to the database. GIS software facilitates visualization of the vertical sequence of fossils in the multistory sandstone, thereby more easily demonstrating the timing of their emplacement. Spatial patterning of different fossil types provides insight into the interaction of fossil clasts during emplacement. Separate analysis of the pattern and detailed distribution of articulated skeletal segments, each individual body part, and the relationship of fossils to depositional units helps to reconstruct the breakup and burial of individual skeletons. GIS analysis amplifies insight into the origin of the deposit that is not possible with traditional quarry maps alone.

Technical Session XVI, Saturday 10:30

AIR SPACES WITHIN THE HEADS OF DINOSAURS AND THEIR CONTRIBUTION TO CEPHALIC STRUCTURE

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When compared to such cephalic anatomical components as the brain, jaw muscles, eyes, or vascular system, air is all but forgotten. Nevertheless, air-filled spaces perform essential roles, and any integrated assessment of head structure and function must incorporate these spaces. The nasal cavity, paranasal sinuses, middle ear, and paratympanic sinuses were studied along with other cephalic spaces (brain cavity) in certain dinosaurs via CT scanning and 3D visualization to document the anatomy and to examine the contribution of the air spaces to the organization of the head as a whole. Two representatives each of two dinosaur clades are compared as examples: the theropods *Majungasaurus* and *Tyrannosaurus* and the ankylosaurians *Panoplosaurus* and *Euoplocephalus*. Their extant archosaurian outgroups, birds and crocodilians, display a diversity of paranasal sinuses, yet they share only a single homologous antorbital sinus, which in birds has an important subsidiary diverticulum, the suborbital sinus. Both of the theropods had a large antorbital sinus that pneumatized many of the facial and palatal bones as well as a birdlike suborbital sinus. Given that the suborbital sinus interleaves with jaw muscles, the paranasal sinuses of at least some theropods (including birds) were actively ventilated rather than being dead-air spaces. Respiratory and olfactory regions of the nasal cavity can be discriminated, and all four taxa devoted considerable space to olfaction. Although many ankylosaurians have been thought to have had extensive paranasal sinuses, most of the snout is instead (and surprisingly) occupied by a highly convoluted airway, which may have played a role in vocalization and/or physiology. Digital segmentation, coupled with 3D visualization and analysis, allows the positions of the sinuses to be viewed in place within the skull and head and to be measured volumetrically. These quantitative data allow the first reliable estimates of dinosaur head mass and an assessment of the potential savings in mass afforded by the sinuses (6-8% and 16-19% mass savings in the head and skull, respectively, for the theropods).

Technical Session XV, Friday 2:30

THE BONE HISTOLOGY OF OSTEODERMS IN TEMNOSPONDYLS

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The histology of the osteoderms is compared among armored temnospondyls. Taxa examined include plagiosaurids (*Gerrothorax*, *Plagiosuchus*), and dissorophids (*Aspidosaurus*, *Platyhystrix*). The chroniosuchian *Bystrowiella* serves as outgroup. The osteoderms of *Bystrowiella* possess thin cortices of parallel-fibered bone. Their fine cancellous central region consists of primary interwoven fibers with bone cell lacunae having stumpy canaliculi. This indicates that this tissue developed by metaplastic ossification. In the armor of *Gerrothorax*, the primary matrix is parallel-fibered bone in both the cortices and in the fine-to-coarse cancellous central region. Strong anchoring fibers penetrate the internal cortex. In *Plagiosuchus* osteoderms, the central region is compact and the bone matrix is composed mostly of interwoven primary fibers with extensively developed Sharpey's fibers. The osteoderms of the investigated dissorophids consist of a thin cortex of parallel-fibered tissue organized into a plywood structure that surrounds an extensively remodeled trabecular region with large vascular spaces. The differences in the histological structure of dissorophids and plagiosaurids suggest an iterative evolution of osteoderms. Furthermore, histology in *Plagiosuchus* indicates a metaplastic development of the osteoderms, whereas the osteoderms of *Gerrothorax* represent periosteal ossifications like in dissorophids. This accounts for a different origin of osteoderms also within the plagiosaurids. The osteoderm structure allows inferences concerning the mode of life. In the aquatic plagiosaurids and *Bystrowiella*, the osteoderms are rather compact and might have reduced buoyancy. Additionally, the extensive armor in *Gerrothorax* likely constituted a calcium reservoir, indicated by cyclical resorption events preserved in the external cortex and interpreted as a physiological response to periodic changes in salinity of the aquatic environment. In contrast, the unique osteoderm structure of dissorophids provides maximum stability and minimum bone mass, and is coherent with the interpretation that the osteoderms served to strengthen the vertebral column during terrestrial locomotion.

Technical Session VII, Thursday 3:00

OSTEODERM HISTOLOGY OF THE CINGULATA (XENARTHRA, MAMMALIA): IMPLICATIONS FOR SYSTEMATICS

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Recent research on xenarthan osteoderm histology yielded new evidence for the reconstruction of phylogenetic relationships among armadillos and glyptodonts. It can be inferred that pampatheres and true glyptodonts are derived monophyletic taxa, pampatheres uniquely featuring criss-crossing strands of marginal fibers within their osteoderms. Pampatheres furthermore appear to be more closely related to glyptodonts than to the cingulates commonly grouped as Dasypodidae. Dasypodid osteoderms are generalized regarding their histological structure and show no clear synapomorphy. This observation supports current hypotheses that the Dasypodidae are a paraphyletic assemblage of basal cingulates. Whereas pampathere osteoderms are histologically organized in a very uniform way, subgroups within both the dasypodid and glyptodont cingulates could be distinguished. Among the dasypodids, the Dasypodinae form a distinctive subgroup. Within the dasypodid euphractines, a group comprising the genera *Prozaedyus* and *Zaedyus* can be distinguished from other taxa. A further and probably derived dasypodid taxon is represented by *Tolypeutes*. The Glyptodontidae can be separated into two subgroups. A basal subgroup is characterized by a well-developed, presumably plesiomorphic diploe-like structure. The other, more derived subgroup exhibits lightly built and strongly secondarily reconstructed osteoderms. The controversial systematic position of the eutatine cingulates remains unresolved. Peltephilid cingulates presumably form a sister taxon with all other cingulates, peltephilid osteoderms featuring, amongst other unique characteristics, an unusual type of primary cancellous cortical bone. There is furthermore evidence that *Cochlops*, a taxon of unclear systematic position, belongs to the Peltephilidae and is not a basal glyptodont as previously suggested.