Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM) EVOLUTION OF CERATOPSIAN DENTAL MICROSTRUCTURE

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Throughout vertebrate evolution, a number of lineages evolved dental occlusion, whereby the contact faces of the teeth self-wear to their functional morphology. It has been shown that in mammals, increases in dental complexity accompany such changes. These presumably allowed for modifications in biomechanical form, function and performance relevant to dietary ecology. Recently, it was shown that a lineage of reptiles, the duck-billed dinosaurs (Hadrosauridae), evolved among the most architecturally sophisticated teeth known in association with their acquisition of a grinding dentition. Independently, another lineage of ornithischian dinosaurs, the horned-dinosaurs (Ceratopsia), evolved dental occlusion in the form of slicing cheek teeth. Here, we tested the hypothesis that ceratopsian teeth increased in complexity in association with their evolution of shearing. Transverse and occlusal plane histological sections were made using cheek teeth from representative Ornithischia spanning the transformation series leading to the evolution of slicing in ceratopsians. The sections were viewed with dissecting and polarizing light microscopy. The microstructure was described and mapped as a phylogenetic character in association with whole tooth and wear facet morphological attributes. Our results show that ceratopsian teeth are considerably more complex than those of the outgroup ornithischians in possessing four distinct tissues: enamel, orthodentine, coronal cementum, and osteodentine. Coronal cementum evolved in association with shearing in the common ancestor of Leptoceratops + Triceratops. Osteodentine appeared in the common ancestor of Protoceratops + Triceratops with the advent of slicing. These findings represent the second demonstration of complex dental architecture outside of Mammalia, and show that some reptiles rivaled if not exceeded most mammals in dental complexity.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

DENTAL MORPHOMETRICS PREDICT SPECIFIC TROPHIC CATEGORIES IN RODENTS

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*Advances in laser scanning and X-ray microtomography (µCT) have led to rapid expansion in nondestructive collection of phenotypic data from fossils. Previously, such data were often linear measurements between landmarks, gross area and volume ratios in homologous regions, or categorical descriptions. Recently, traditional methods have been supplanted by high-throughput, orientation and homology-independent morphometric analyses emphasizing geometry, precise area or subvolume measurements, and holistic mathematical surface attributes. Rodents are ideal subjects for such approaches because high taxonomic and morphological diversity renders traditional, homology-based metrics inapplicable, and fewer paleodiet studies have focused on rodents relative to larger bodied mammals (e.g. ungulates, carnivorans). Here, we measure Dirichlet Normal Energy (DNE, a measure of tooth curvature), Orientation Patch Count (OPC, a measure of tooth complexity), M2 mesiodistal length, Relief Index (RFI), and Volumetric Hypsodonty Index (HI) in µCT-computed surfaces of North American small mammal teeth with the goal of differentiating folivores, granivores, omnivores, and insectivores. We scanned upper and lower tooth rows of 25 species at 10-30 µm resolution, created 3D surfaces, and designed new reproducible cropping protocols to better capture the functional tooth crown as defined by the enamel-dentin junction (EDJ). X-ray attenuation produces grayscale values that clearly demarcate dentin and enamel allowing segmentation by thresholding. Feature extraction with manual corrections in RapidForm XOR then segments tooth meshes to produce well-defined crown surfaces. However, in truly hypsodont taxa such as lagomorphs and arvicolines, molars are ever-growing, and enamel extends to the teeth roots. For these species, we fit a spline to the alveolar margin and extracted a best-fit plane to define the crown as the surface projecting above the plane. Preliminary intraobserver variation for EDJ-delineated tooth crown volumes and areas was lower than 2%. Mean RFI of M1 and OPCR of all molars are statistically distinct for granivores and folivores based on t-tests. RFI for other molars, HI, and DNE appear to cluster by trophic category, but mean differences are not statistically distinct, perhaps because of currently small sample sizes. As taxon sampling increases, we will analyze species for which continuous measures of diet composition are available and will more rigorously assess statistical differences between trophic categories.

Romer Prize Session (Thursday, October 31, 2013, 10:15 AM) ECOMORPHOLOGICAL DIVERSITY OF TRIASSIC MARINE REPTILES

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The evolution of multiple clades of marine reptile during the Triassic coincided with the recovery of marine ecosystems from the end-Permian mass extinction. However, the role that marine reptiles played in Triassic ecosystems remains uncertain, and the trophic habits of many of these taxa continue to be debated. I compiled dietary data from eightythree species of living aquatic tetrapods (mammals and reptiles) and utilized linear discriminant analysis of seventeen cranial, jaw and tooth measurements to develop a framework to correlate skull morphology with adaptation to specific feeding strategies. This analysis found a strong connection between diet and morphology that applies across a phylogenetically broad sample of extant aquatic tetrapod taxa. I then employed this framework to generate hypotheses about the trophic ecology of fifty-one species of Triassic marine reptiles. I compared these hypotheses with direct evidence of marine reptile dietary habits based on preserved gut contents, and found them to be largely concordant. These results indicate that Triassic marine reptiles included small-bodied aquatic invertebrate specialists, medium-sized fish specialists and larger generalized predatory species that preyed on a variety of prey including other marine reptiles. Many Early Triassic marine reptiles had fish-dominated diets, while the Middle Triassic saw the rise of new ecological groups including aquatic invertebrate specialists and apex predators. These groups declined after the Middle Triassic, while fish eating marine reptiles persisted. Increasing adaptation toward pelagic food sources facilitated the survival of some marine reptile lineages during an interval when nearshore niches were contracting. A comparative scarcity of herbivorous or specialist squid-feeding taxa in the Triassic relative to modern aquatic tetrapods may indicate these food resources were not readily available to Triassic marine reptiles. Both taxonomic diversity and ecomorphological disparity peaked in the Middle Triassic, and then declined during much of the Late Triassic. The persistence of some specialist groups and the eventual appearance of new forms characteristic of Jurassic assemblages led to an increase in overall morphological disparity at the very end of the Triassic. This analysis suggests that Triassic marine reptiles were ecologically diverse and may have played an important role in the restructuring of marine ecosystems during the Mesozoic.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

ON AN UNUSUAL TAPEJARID PTEROSAUR FROM THE EARLY CRETACEOUS OF BRAZIL AND COMMENTS ON THE PTEROSAUR PALATE

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Among the most important pterosaur deposits known to date is the Romualdo Formation (Aptian-Albian) of the Araripe Basin, north-eastern Brazil. Since the discovery of the first specimen in 1971, hundreds have been unearthed so far, some preserved in three dimensions. Most of them represent juveniles or sub-adults, and fully ontogenetically developed individuals are rare. Here we present a new unusual tapejarid pterosaur from this deposit (MN 4726-V) housed in the Museu Nacional/UFRJ, composed of skull, lower jaw and some postcranial elements. Scapula and coracoid are fused, as are all cranial elements, indicating that it represents an adult individual. MN 4726-V has the typical high nasoantorbital fenestra of the Thalassodrominae but lacks a palatal ridge observed in Thalassodromeus and Tupuxuara. It shows a down-turned rostral end, a typical feature of the Tapejarinae. Among other characters, the new species differs from all other tapejarids in having an anteriorly and posteriorly expanded premaxillary sagittal crest and the lacrimal process of the jugal strongly inclined posteriorly. The surface of the premaxillary crest presents grooves indicating the impressions of blood vessels and corroborates with the growing evidence that pterosaurs could have used their cranial crests in thermoregulation. The area corresponding to the jugal-quadratojugal-quadrate of the left side shows a pathology, likely the result of an infection. MN 4926-V also has an extremely well preserved palate that shows a slit-like postpalatine fenestra. The palatines are large, forming the anterior region of the choanae and the postpalatine fenestra and a secondary subtemporal fenestra, indicating that this is the regular condition within derived pterosaurs. The palatal configuration of the new specimen argues against the hypothesis that the presence of a secondary subtemporal fenestra is unique to non-pterodactyloids. If previous interpretations of the palatal configuration in non-pterodactyloid pterosaurs are correct, the evolution of palatal region in those flying reptiles is more complex than previously thought.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

DIETS OF LATE EARLY MIOCENE LITOPTERNS FROM SANTA CRUZ, ARGENTINA, BASED ON MESOWEAR AND ENAMEL MICROWEAR

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Paleodietary reconstruction of two South American litoptern families from the Miocene Santa Cruz Formation was undertaken using mesowear and stereomicrowear analyses. Taxa studied included *Anisolophus*, *Diadiaphorus*, *Tetramerorhinus*, and *Thoatherium* of the family Proterotheriidae and *Theosodon* of the family Macraucheniidae.

Mesowear analysis examines gross wear of molars by examining the shape of cusps in lateral view, which provides a measure of total dietary abrasion incurred in the lifetime of an individual animal. Mesowear scores were obtained using a standardized mesowear "ruler" that allows the teeth of fossil taxa to be compared to molar teeth of extant mammals ranging in shape from high and sharp (score of 0) to completely blunt with no relief (score of 3). Mesowear scores of individuals were averaged to obtain an average mesowear score for that taxon. Microscopic enamel scars were examined using stereomicrowear analysis. A standard 0.4x0.4 mm ocular reticle was employed at 35x magnification to quantify the number of pits and scratches and to score (presence or absence) three qualitative variables: large pits, gouges, and scratch texture.

All litoptern genera studied here have relatively low mesowear scores typical of attrition-dominated extant browsers and apparently encountered little dietary or nondietary (i.e., grit) abrasive substances in their trophic regimes. Microwear average scratch/pit results are consistent with extant leaf-browsing ungulates. Raw scratch distributions are all unimodal and within the low-scratch range. This is typical of browsing ungulates and does not indicate seasonal or regional variations in diet (i.e., mixed feeding).

While both mesowear and microwear results point to the likely occupation of mainly closed habitats in these forms (e.g., low abrasion and little gouging), the macraucheniid *Theosodon* has coarser scratch textures and more large pitting than the proterotheriids and may have occupied somewhat more open habitats. *Theosodon* may have been a high-level browser as has been inferred previously based on its elongate neck.