Technical Session IV (Wednesday, October 30, 2013, 2:00 PM)

TAXONOMY, BIOGEOGRAPHY, AND PHYLOGENY OF MIOCENE ENDEMIC SOUTH AMERICAN UNGULATES (MAMMALIA) FROM THE LAGUNA DEL LAJA REGION, ANDEAN MAIN RANGE, CENTRAL CHILE

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A stratigraphically superposed series of early-late Miocene fossil mammal assemblages has been recovered from the Andean Main Range of Chile, near Laguna del Laja (LdL; ~37.5º S, 71º W), shedding light on the poorly known extra-Patagonian history of South American Neogene mammals. Localities within the Cura-Mallín and overlying Trapa-Trapa formations at LdL, from which several hundred specimens have been recovered, are well constrained stratigraphically and with high precision $^{40}Ar/^{39}Ar$ ages, providing a robust temporal framework for the fossiliferous horizons spanning ~20-9 Ma. Rodents from LdL have been reported to exhibit high levels of endemism throughout the stratigraphic section. Herein we provide a detailed account of the ungulates from the Cura-Mallín Formation at LdL; these range in age from ~20-15 Ma. Specimens referred to *Protypotherium*, *Pachyrukhos*, *Colpodon*, and *Astrapothericulus*, together with radioisotopic ages, indicate that faunas pertaining to the Colhuehuapian, Santacrucian, Friasian?, and Colloncuran South American Land Mammal "Ages" (SALMAs) occur in direct stratigraphic superposition at LdL. In addition, new species of *Pachyrukhos* and *Colpodon*, plus four new typotherian genera, occur at LdL, heightening the pattern of endemism already observed in the rodent faunas. The five new taxa described in this study are typotherian notoungulates, including four interatheriines and one hegetotheriine. The new material and taxa from LdL provide the basis for a taxonomic revision of *Protypotherium* and *Pachyrukhos*, as well as robust phylogenetic analyses of the Interatheriinae and Hegetotheriinae, thus contributing to our understanding of the evolution of these diverse typotherian clades. Given the geographic proximity of faunas from LdL with roughly coeval counterparts in neighboring regions of Argentina, the high level of endemism across multiple SALMAs at LdL is striking. This provinciality of the Andean faunas, relative to Argentine assemblages, likely reflects sampling of a regionally distinct and isolated paleoenvironment, potentially related to uplift of the central Chilean Andes in this area.

Preparators' Session (Thursday, October 31, 2013, 8:15 AM)

UNDER THE HEADWALL: FIELD LOGISTICS OF EXCAVATING FOSSILS FROM LARGE VERTICAL EXPOSURES

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*Field collection techniques for recovering vertebrate fossils have remained relatively unchanged since the late 19th Century. Traditional methods include: (1) removal of overburden using picks and shovels; (2) careful excavation of fossils with hand tools; and (3) removal of specimens within protective plaster jackets. Occasionally, specific locality characteristics require the development of alternative field collection techniques. Here we describe field logistics associated with excavating and collecting fossils from large, vertical exposures. Quarries situated at the base of large vertical headwalls (e.g., cut-banks, erosional cliffs) can result in insurmountable overburden, producing vertical excavation surfaces necessitating unique collecting approaches. To complicate matters, matrix can vary from poorly consolidated to highly indurated sedimentary facies. Fossil horizons can also extend deep into the vertical surfaces causing precarious destabilization of overburden as quarry faces are expanded into the headwalls. Moreover, fossil horizons can lie near water seeps or the water table, resulting in damp to waterlogged matrix that severely limits the types of consolidants (e.g., Paraloid B-72, Rhoplex B60A) and jacketing techniques that may be applied. Effective approaches include: (1) careful mining of fossil specimens from the quarry face; (2) block removal of larger and more complex materials; and (3) hours to days of block desiccation prior to conventional methods of stabilization and protection. The friable condition of waterlogged specimens can be transformed to a highly durable state once the surrounding matrix has dried; subsequent laboratory preparation of specimens can reveal exquisitely preserved details. The geological and paleontological importance of some localities warrants a multi-phase collecting effort, and insights gathered over the past several years of field excavations are documented for use in other locales with similarly challenging collecting conditions.

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

TESTING MOLECULAR HYPOTHESES OF LATE PLEISTOCENE EQUID ABUNDANCE IN NORTH AMERICA: HORSES FROM GYPSUM CAVE, NEVADA

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Horses (genus *Equus*) are a common taxon in Pleistocene faunas throughout North America. Molecular studies have proposed that there may only have been two species of horses present in North America during the later Pleistocene, one stilt-legged and the other stout-limbed. To test this hypothesis, we examined specimens from Gypsum Cave, a late Pleistocene limestone cavern in the Frenchman Mountains of southern Nevada. Originally excavated in 1930-31, Gypsum Cave yielded multiple well-preserved fossils of *Equus* and other late Pleistocene megafauna. Preservation is exceptional, including soft tissues; fossils from the site have previously yielded both radiocarbon dates and DNA. Horse fossils from Gypsum Cave dating to ~13 ka were included in earlier molecular studies assessing late Pleistocene equid diversity in North America, therefore quantifying the entire sample of horse fossils from the site was warranted. Remains of *Equus* at Gypsum Cave are well represented in the assemblage. Multiple skeletal elements, both cranial and postcranial, are preserved. As noted, some fossils retain soft tissues including ligaments, tendons, skin, and hooves. Based upon dental elements, the sample includes two adults, two subadults, and five juveniles. Five left metatarsals, four with fused distal epiphyses, when combined with the dental elements indicate a minimum number of ten individuals in the sample. All of these fossils represent a small stilt-legged species, confirmed metrically and through previous mDNA analysis. Radiocarbon dates associated with these remains yielded ages of ~13 ka. Additionally, a single terminal phalanx encased within an intact hoof represents a large species; this fossil has been previously dated to ~25 ka. Based upon these data, two species of horse are present at Gypsum Cave: a large stout-limbed species and a smaller stilt-legged form. Lack of more diagnostic remains precludes specific assignment for any of these fossils at present. Comparison of these remains with fossils from other Pleistocene localities in the Mojave Desert (e.g., Lake Manix, Kokoweef Cave, Tecopa) confirmed the presence of small stilt-legged horses elsewhere in the region. In contrast, more coastal assemblages (e.g., Rancho La Brea) lack stilt-legged equids altogether, instead preserving two stout-limbed species, the larger *Equus "occidentalis"* and the smaller *E. conversidens*. We conclude that there were at least three species of *Equus* in North America in the late Pleistocene: large and small stout-limbed species and a smaller stilt-legged form.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

A NEW PISTOSAUROID (REPTILIA: SAUROPTERYGIA) FROM THE LATEST LADINIAN XINGYI MARINE VERTEBRATE LEVEL, SOUTHWESTERN CHINA

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Triassic stem pistosauroids are believed to be closely related to the plesiosaurs, the crown taxon of Sauropterygia that comprised cosmopolitanly distributed predators in Jurassic and Cretaceous marine ecosystems. Eight genera of Triassic stem pistosauroids were reported, but the complete cranial osteology was only known for a few, and *Yunguisaurus* was the only one to date represented by a complete skeleton. A new complete and articulated skeleton of a pistosauroid, with a skull perfectly preserved in three dimensions, was collected from the latest Ladinian (Middle Triassic) of Xingyi in Guizhou Province, southwestern China. The new specimen has two apomorphies: the pineal foramen is located far posteriorly in the parietal skull table, and the parietal is raised into a distinct sagittal crest. There are about 33 cervical vertebrae, 16 dorsal vertebrae, and 4 sacral vertebrae. The anterior 10 caudal vertebrae are preserved. Five carpal and four tarsal ossifications are present, and the hindlimb shows a phalangeal formula of 3 (?)- 3- 4- 5- 5, indicating hyperphalangy for the fifth digit. These characters allow us to refer this new specimen to pistosauroids. The constricted snout, the fused parietals, and the jugal entering the posterior margin of the orbit indicate that the new specimen is more similar to the pistosauroid *Cymatosaurus* than to the geographically and stratigraphically closer *Yunguisaurus*. But it still differs from *Cymatosaurus* which has reduced nasals, paired frontals, and the pineal foramen close to the middle of the skull table. However, the new specimen also shares some interesting morphological similarities with *Nothosaurus*, such as the elongate upper temporal fenestra whose longitudinal length is 3.1 times that of the orbit, the unpaired frontal, the plate-like occiput with no distinct paroccipital process, and the horizontally oriented supraoccipital. Although the monophyly of the infraorder Pistosauroidea was found to be well supported, the interrelationships among them remain controversial. Our new complete specimen provides new information that helps to solve the interrelationships among Triassic pistosauroids. A preliminary phylogenetic analysis confirms this new taxon as a member of Triassic pistosauroids, within which the monophyly of (*Pistosaurus* + *Augustasaurus*) is again supported.

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

AGGREGATION OF MORPHOLOGICAL CHARACTERS ACROSS STUDIES USING AN ONTOLOGY-BASED PHENOTYPE APPROACH

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Comparative descriptions of vertebrate morphology have been formalized in the phylogenetic systematic literature, yet they remain uncomputable and thus difficult to integrate across studies or with developmental or genetic data. The Phenoscape team has developed and used anatomy, quality, and taxon ontologies to represent the free-text descriptions of character states for taxa as 'Entity-Quality' (EQ) statements, or 'taxon phenotypes'. We have annotated close to 3000 fin and limb phenotypes for 787 extant and fossil sarcopterygian taxa from 938 characters from 38 papers for the Phenoscape Knowledgebase (kb.phenoscape.org), where morphological variation of vertebrates, including fossils, is linked to genetic mutants of vertebrate models (zebrafish, mouse, Xenopus), thus enabling formulation of evo-devo hypotheses. In the process of annotation, a character state from an original matrix is frequently decomposed into multiple EQ phenotypes. Such atomization enables similar phenotypic variants (e.g., changes in humerus shape) to be automatically aggregated across studies. Using fin/limb phenotypes as a focus data set, we contrast and characterize the sum of these data with their matrix-based descriptions from component studies. Morphological data in this computable format can be browsed, sorted and aggregated in ways that present new views of character evolution. Translating character states into multiple phenotypes, however, means that it is not possible to automatically reconstruct a supermatrix from component data sources. We describe the workflow and challenges involved in applying