females of one species. A second, separate species is represented by two skulls from the Valmonte Diatomite of the Monterey Formation of Los Angeles County (late Miocene). Finally, three skulls from the Oso Member of the Capistrano Formation of Orange County (late Miocene) might represent a species different from the aforementioned complete specimen. A single skull from the same unit definitively represents an additional new species. In addition to these 11 skulls, more fragmentary material demonstrates that the presence of *Gomphotaria pugnax* in the Oso Member, which would mean that this unit would have 3-4 coeval walruses, making it the most diverse fossil odobenid assemblage. Our phylogenetic analysis demonstrates that instead of an early and late radiation of walruses, the second radiation may have begun in the middle Miocene, depending on the age resolution of the Monterey Formation walruses of Orange County.

Romer Prize Session (Thursday, August 24, 2017, 8:45 AM)

USING CANCELLOUS BONE ARCHITECTURE TO INFER THEROPOD DINOSAUR LOCOMOTOR BIOMECHANICS AND ITS EVOLUTION

BISHOP, Peter J., Griffith University, Gold Coast, Australia

Cancellous bone is known for being sensitive to its mechanical environment, and its ability to adapt its architecture to this environment. It therefore has great potential utility for biomechanical inference in extinct vertebrates. Here, the three-dimensional architecture of cancellous bone was investigated in theropod dinosaurs, to quantitatively test hypotheses of posture, bone loading and muscle control, as well as how these evolved on the line to birds. The hindlimb bones of various non-avian theropods and modern birds (> 150 in total) were subject to computed tomographic scanning; the resulting data was then processed using quantitative image analysis. This identified several important architectural differences between species. For example, the primary direction of cancellous bone in the femoral head of derived non-avian species was more anteriorly inclined compared to basal species (e.g., *Troodon*, 15.8°; tyrannosaurs, 8°). This likely reflects differences in posture, as such patterns also occur in extant bipeds: birds (crouched femur, 21.7°) have a marked anterior inclination compared to humans (erect femur, 1.1°). The observations were also utilized in a reverse application of the 'trajectorial theory'. A novel integration of musculoskeletal and finite element models of the whole hindlimb was used to determine what posture could align stress trajectories with observed cancellous architecture in the femur, tibia and fibula. The approach was validated with a modern chicken, identifying a posture and loading mechanics comparable to empirical observations (femur 35° below horizontal, torsion exceeds bending, hip long-axis rotator muscles strongly recruited). It was then applied to two extinct theropods, *Daspletosaurus* (tyrannosaur) and *Troodon* (paravian). The posture identified for *Daspletosaurus* was largely erect (femur angle 70°), with bending-dominant bone loading and hip abductors being strongly recruited. In *Troodon*, the posture was of an intermediate nature (femur angle 55°), with bone loading and muscle recruitment patterns also intermediary. This study has provided new insight into locomotion in extinct theropods, and supports the hypothesis that the evolution of terrestrial locomotion in theropods occurred in a gradual fashion. The generality of the approaches used here means that they can also provide insight in other extinct vertebrate groups, such as ceratopsians, therapsids or stem-tetrapods.

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Poster Session II (Thursday, August 24, 2017, 4:15 – 6:15 PM)

WATER FROGS (ANURA, RANIDAE) FROM THE PLIOCENE CAMP DELS NINOTS KONSERVAT-LAGERSTÄTTE (CALDES DE MALAVELLA, NE SPAIN)

BLAIN, Hugues-Alexandre, Institut Català de Paleoecologia Humana i Evolució Social (IPHES), Tarragona, Spain; LOZANO-FERNÁNDEZ, Iván, Institut Català de Paleoecologia Humana i Evolució Social (IPHES), Tarragona, Spain; PRIKRYL, Tomas, Institute of Geology AS CR, v.v.i., Prague, Czech Republic; OMS, Oriol, Universitat Autònoma de Barcelona, Bellaterra, Spain; ANADÓN, Pere, Institut de Ciències de la Terra Jaume Almera ICTJA-CSIC, Barcelona, Spain; RODRÍGUEZ-SALGADO, Pablo, Irish Centre for Research on Applied Geosciences (iCRAG), Belfield, Ireland; AGUSTÍ, Jordi, ICREA, Institut Català de Recerca i Estudi Avançat (ICREA), Barcelona, Spain; CAMPENY, Gerard, Institut Català de Paleoecologia Humana i Evolució Social (IPHES), Tarragona, Spain; GÓMEZ DE SOLER, Bruno, Institut Català de Paleoecologia Humana i Evolució Social (IPHES), Tarragona, Spain

Water frogs are one of the most common vertebrate fossils in the European Cenozoic. Nevertheless, the rare reproductive phenomenon of hybridogenesis, as well as the absence of osteological studies on several living species within the group, makes it almost impossible either to distinguish fossil forms neither to distinguish between the various extant species. Here we present the description of 11 articulated fossil water frogs in different developmental stages and 353 isolated bones recovered from the 2005-2010 field campaigns at the Pliocene (ca. 3.2 Ma; MN15-16) Camp dels Ninots Konservat-Lagerstätte (NE Spain). This locality corresponds to a lacustrine sedimentary sequence in a maar infill which delivered complete articulated skeletons of large mammals (*Alephis tigneresi*, *Stephanorhinus jeanvireti* and *Tapirus arvernenis*), turtles and small vertebrates (as rodents, frogs, newts and fishes). Excellent preservation of the fossils was favored by the meromictic conditions of the lake. Frog's skeletons are all presented in dorsoventral aspect with snout-vent length ranging between 13 and 45 mm. Presence of diplasiocoelous vertebral column, with short and non-imbricate neural arch, sacral vertebra unfused with the urostyle that bears cylindrical sacral apophysis, bicondylar sacro-urostylar articulation, absence of transverse processes of the urostyle and of ribs, firmisternous sternum with ossified omosternum, premaxilla and maxilla teeth bearing clearly refer to the family Ranidae. Attribution to genus *Pelophylax* relies on a higher dorsal crest on the ilial shaft and more open sacral apophysis than in genus *Rana*. Approximation to a more precise systematic attribution among extant European and North African water frogs has been done using morphometrical measurements on the ilium, using a comparative modern sample of 506 ilia. Fossil ilia from Camp dels Ninots fall within the variability of extant *P. lessonae*, and thus would represent the earliest mention for this species. However attribution must be done carefully, as the status of the extinct species *Pelophylax pueyoi* from the late Miocene (MN9-10) Libros Konservat-Lagerstätte has still to be elucidated. Preliminary description of their physical taphonomy is also done, taking into account their distribution, completeness, articulation and limb position.

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Poster Session I (Wednesday, August 23, 2017, 4:15 – 6:15 PM)

LOCOMOTOR KINEMATICS OF THE MANUS AND PES IN DINOCEPHALIAN THERAPSIDS RECONSTRUCTED FROM THREE-DIMENSIONAL MORPHOLOGY OF FOOTPRINTS FROM GANSFONTEIN, SOUTH AFRICA

BLOB, Richard W., Clemson University, Clemson, SC, United States of America; WILSON, Jeffrey A., University of Michigan, Ann Arbor, MI, United States of America; MARSICANO, Claudia A., Universidad de Buenos Aries, Buenos Aires, Argentina; PANKO, Laura J., Northwestern University, Evanston, IL, United States of America; SMITH, Roger M., Iziko Museums of South Africa, Cape Town, South Africa

The Gansfontein paleosurface from the Mid-Permian Abrahamskraal Formation (Beaufort Group, *Tapinocephalus* Assemblage Zone) of South Africa, preserves several vertebrate trackways. Among the best-preserved is a series of footprints attributed to a single dinocephalian therapsid walking across the surface. Trackmaker identification is based on the large size of the prints (25 cm wide) and the reduction of digit I in the manus and pes. A curious feature of the trackway is that, in contrast to the straight digital axis indicated by articulated bones of the dinocephalian manus and pes, digit impressions left by the trackmaker are curved so that their tips are directed towards the trackway midline. To test hypotheses about the locomotor kinematics of the tetrapod that produced these curved-digit prints, we constructed contour maps that depict how the depth of an impression varied within individual prints. In our initial analysis, we constructed the maps by pouring milk into the prints in successive increments of 2 mm in height and tracing the perimeters of filled areas on translucent paper fixed to the paleosurface by tape. We have also used surface scanners to generate depth profiles with finer scale resolution. Contour maps show several features consistent with outward rotation of the hand and foot during the stance phase of the step cycle. For example, impressions of digit I are shallow, but impressions of digit V are deeper. In addition, lateral edges of digit IV impressions are steeper than the medial edges in both manus and pes prints. Thus, where depth asymmetry is present in the print between or within digits, impressions are deeper or steeper laterally, consistent with outward foot rotation. Finally, the distal tips of digit impressions are among the shallowest portions of the prints; however, local 'overdeepened' depressions are present several centimeters from the distal tips of digit impressions, indicating that the toes had rotated out from their initial point of placement prior to lifting of the foot off the substrate. Besides these features, spacing between left and right prints is less than the breadth of individual prints, indicating an apparent 'narrow gauge' trackway. However, the presence of foot rotation during stance supports osteological evidence that dinocephalians used sprawling, rather than parasagittal limb posture. Close spacing of footprints likely resulted from a combination of lateral bending of the body and significant cranio-caudal limb excursion, rather than increased adduction of the limbs under the body.

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Technical Session XI (Friday, August 25, 2017, 11:00 AM)

NEW DISCOVERIES OF XENOROPHIDAE FROM THE OLIGOCENE OF THE CAROLINAS: INSIGHTS INTO THE EVOLUTION OF FEEDING MORPHOLOGY, ENCEPHALIZATION, AND LOCOMOTION OF THE EARLIEST DOLPHINS (ODONTOCETI)

BOESSENECKER, Robert W., College of Charleston, Charleston, SC, United States of America; CHURCHILL, Morgan, New York Institute of Technology, Old Westbury, NY, United States of America; FRASER, Danielle L., Canadian Museum of Nature, Ottawa, ON, Canada; GEISLER, Jonathan H., New York Institute of Technology, Old Westbury, NY, United States of America

The family Xenorophidae is a short-lived monophyletic radiation of odontocetes known only from the Oligocene of North and South Carolina. Xenorophids are typically long-snouted odontocetes that possess heterodont teeth, variably asymmetrical skulls, facial fossae suggesting the presence of air sinuses, and a cranial telescoping that evolved in parallel with taxa more closely related to the odontocete crown group. Recent studies on the facial osteology and inner ear of the xenorophids *Cotylocara* and *Echovenator* revealed traits consistent with echolocation, suggesting that echolocation and ultrasonic hearing evolved at the base of the odontocete radiation. New discoveries of xenorophid skulls and skeletons from the South Carolina include 1) specimens of *Albertocetus meffordorum* from the Ashley Formation; 2) new skulls and skeletons of a new species of *Xenorophus* from the Ashley and Chandler Bridge Formations; and 3) a skull of a diminutive, toothless, short-snouted xenorophid representing a new genus, also from the Ashley Formation. New material of *Albertocetus* (CCNHM 218, 303) includes a 50% complete vertebral column, with caudal vertebrae indicating the absence of a transversely narrowed caudal peduncle. A digital endocast extracted from CT data indicate that *Albertocetus* had the highest encephalization quotient (EQ) of any early Oligocene odontocete. New skulls and skeletons (n=11+; CCNHM 104, 168, 1077; ChM PV 4266, 4823, 7677) expand morphological details known for *Xenorophus* (including braincase, petrotympanic, mandibles, and vertebrae) and permit assessment of individual variation within a single xenorophid species. None of the new specimens appear referable to *Xenorophus sloani* and instead appear to represent a single new species. A new dwarf xenorophid possesses a shortened, downturned rostrum and lacks maxillary teeth-features associated with suction feeding in other odontocetes. The new dwarf species represents the earliest obligate suction feeding cetacean and demonstrates that odontocetes evolved suction feeding early in their radiation. Overall, xenorophids not only provide insights into early odontocete evolution, they also demonstrate that some aquatic adaptations (i.e. telescoping, short rostrum, tooth loss) evolved multiples times within Odontoceti. A