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Technical Session 3: Terrestrial Ecosystems – Early Cretaceous (Saturday, June 10, 2023, 12:00 PM)

THE PTEROSAUR TRACKS OF KOREA: THE DIVERSITY AND ECOLOGY OF THE CRETACEOUS PTEROSAURS THROUGH THE FOOTPRINTS

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Subsequent to the first report of pterosaur footprints in Asia from the Upper Cretaceous Uhangri Formation of South Korea (Hwang et al., 2002), numerous pterosaur ichnofossils have been found and studied in the Cretaceous non-marine deposits of the Korean Peninsula. Although the pterosaur fossil records in Korea are strongly biased toward ichnofossils, their quantity, and diversity are exceptional. Pterosaur ichnofossils have been reported at about twenty tracksites in Korea, and their total number is approximately 4,000 (Ha et al., 2018). Diverse footprint types have led to the recognition of four novel pterosaurian ichnotaxa (e.g., *Haenamichnus uhangriensis* (Hwang et al., 2002), *H. gainensis* (Kim et al., 2012), *Pteraichnus koreanensis* (Lee et al., 2008), and *P. gracilis* (Ha et al., 2022) and the recent improvements in analysis and sampling have led to the new interpretations of existing controversial tracks.

The pterosaur tracksites of Korea are restricted to the Cretaceous and range in age from the Aptian-Albian (118 ± 2.6 to 112.4 ± 1.3 Ma) Hasandong Formation (Lee et al., 2008) to the Santonian-Campanian (84-79 Ma) deposits on Saok Island (Park et al., 2018). Given this range includes Late Cretaceous deposits in which the body fossil records of pterosaurs decreased rapidly, it can help to answer questions about the diversity and ecology of pterosaurs.

In several tracksites, such as the Hwasun Seoyuri tracksite, pterosaur footprints tend to be preserved at very high densities on a single layer with size variation (Jung et al., 2022). Considering their size distributions, the tracks may represent pterosaur flock(s) of sub-adult individuals. A similar tendency has been found in other pterosaur tracksites, and further quantitative analysis of these footprints may reveal their ecologies, such as size, age, and species structure of the pterosaur flocks.

The pterosaur tracksites in Korea were discovered along with various vertebrate footprints, including dinosaurs, birds, turtles, crocodiles, lizards, amphibians, and mammalians. This diverse ichnofauna will play an essential role in understanding the Cretaceous non-marine ecosystems of Korea.

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Poster Session 3 (Saturday, June 10, 2023)

REASSESSMENT OF *YURGOVUCHIA* PELVIC MATERIAL AND THEROPOD DIVERSITY IN THE LOWER YELLOW CAT MEMBER OF THE CEDAR MOUNTAIN FORMATION OF CENTRAL UTAH

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The Doelling's Bowl Quarry in the lower Yellow Cat Member of the Lower Cretaceous Cedar Mountain Formation is the oldest fossil producing quarry in the Cedar Mountain Formation and is likely Berriasian in age ~140Ma (Joeckel et al., 2020, 2023). The quarry has produced several important dinosaurs including the turiasaurian sauropod *Mierasaurus bobyoungi*, an undescribed new species of polacanthid ankylosaurian, and a growth series for an undescribed basal steracosternid onithopod (Kirkland et al., 2016; Royo-Torres, 2016). The quarry has produced the oldest putative dromaeosaurid material including *Yurgovuchia doellingi* (UMNH VP 20211), a single associated individual including cervical, dorsal, and caudal vertebrae and what was identified as a proximal left pubis lacking a pubic tubercle along with a second distinct pubis (UMNH VP 21752) found three meters from the type of *Yurgovuchia* identified as an unnamed velociraptorine (Senter et al., 2012).

Continued excavation at Doelling's Bowl has revealed additional theropod material. Isolated teeth indicate the presence of a large allosauroid. An incomplete theropod ilium (UMNH VP 26013) was found 3 meters from the type of *Yurgovuchia* that is consistent in size with the pubis UMNH VP 21752. Finally, a complete pelvis (UMNH VP 26015) was found nine meters from the type of *Yurgovuchia*. An isolated one cm long tooth (UMNH VP 26016) indicates the presence of therizinosauria in the quarry. Assessment of these specimens has resulted in a reevaluation of the type of *Yurgovuchia* and suggests the diversity of the theropod fauna in Doelling's Bowl may be greater and more interesting than initially thought.

UMNH VP 26015 represents the complete left pelvis of a medium sized theropod dinosaur. The left ilium of UMNH VP 26015 is composed of a sub-rectangular blade that measures 321 cm in length. The preacetabular blade is shorter and three times taller compared to the postacetabular blade. The cuppedicus fossa is well developed and continues onto the medial ventral half of the preacetabular blade forming a pronounced preacetabular hook on the anterior iliac blade. The brevis fossa is completely obscured in lateral view and extends from a point 1/3 of the length of the postacetabular blade to the posterodorsal tip of the medial surface of the postacetabular blade. The anteroventral pubic peduncle and posteroventral ischial peduncle are relatively dorsoventrally tall with the pubic peduncle twice as long as the ischial peduncle. The pubic peduncle has a ventral flange that articulates lateral to the pubis and the ischial peduncle is peg shaped. The acetabulum is 154 mm long includes a laterally projecting supraacetabular hood originating on the pubic peduncle. The ilium appears to have a supraacetabular ridge, but this is an artifact of postdepositional deformation as the ilium was preserved on top of the pubic shaft.

The pubic shaft of UMNH VP 26015 is straight and propubic ventral to the articulation with the ischium. Distally, the pubis is posteriorly elongated into a triangular, postpubic boot oriented at 68° from the pubic shaft. The pubis does contribute to the acetabulum, but part of the ischial peduncle is not preserved. There is no preacetabular tubercle on the proximal pubis An interpubic apron lamina is present on the distal 2/3rds of the element. The pubis is 33.7 cm long with a midshaft circumference of 183 mm and is mediolaterally elongated and ellipsoidal cross-section.

The ischium of UMNH VP 26015 is overall a blade-like element with an expanded distal end. The iliac peduncle has a deep socket for articulation with the ischial peduncle of the ilium. The ischium measures 178 mm in length and 30 mm in minimum midshaft anteroposterior length diameter. The ischium is posterodorsally and laterally concave. The distal end is expanded posteriorly and also includes an distal anterior obturator process that is broken and of unknown extent.

UMNH VP 26015 represents a previously unrecognized theropod taxon in Doelling's Bowl. The lack of a supraacetabular ridge on the ilium differentiates it from ornithomimids and tyrannosauroids. The anteroventral process of the ilium, the supraacetabular hood and the shape of the cuppedicus and brevis fossae are most similar to *Falcarius*. The pubis is similar to allosaurids, ornithomimids, tyrannosaurids, *Falcarius*, and *Achillobator* in the propubic orientation of the pubis but differs from allosaurids, ornithomimids, tyrannosaurids, *Falcarius, Deinonychus, Achillobator, Adasaurus*, and *Velociraptor* in lacking a prepubic component to its pubic boot. The blade-like ischial shaft with a distal anterior obturator process of UMNH VP 26015 is similar to *Falcarius*, *Deinonychus*, and most known dromaeosaurids and differs from allosauroids, compsognathids, tyrannosauroids, and *Achillobator* which have rod-shaped ischial shafts. The socket on the ischium for articulation with the ilium is most similar to the condition in *Falcarius*.

Closer inspection of the holotype pelvis of Y*urgovuchia* (UMNH VP 20211.18) reveals that it is not a proximal left pubis but instead is a distal right pubis possessing a pubic boot with a slight anterior component and large posterior component. We compared UMNH VP 20211.18 with the

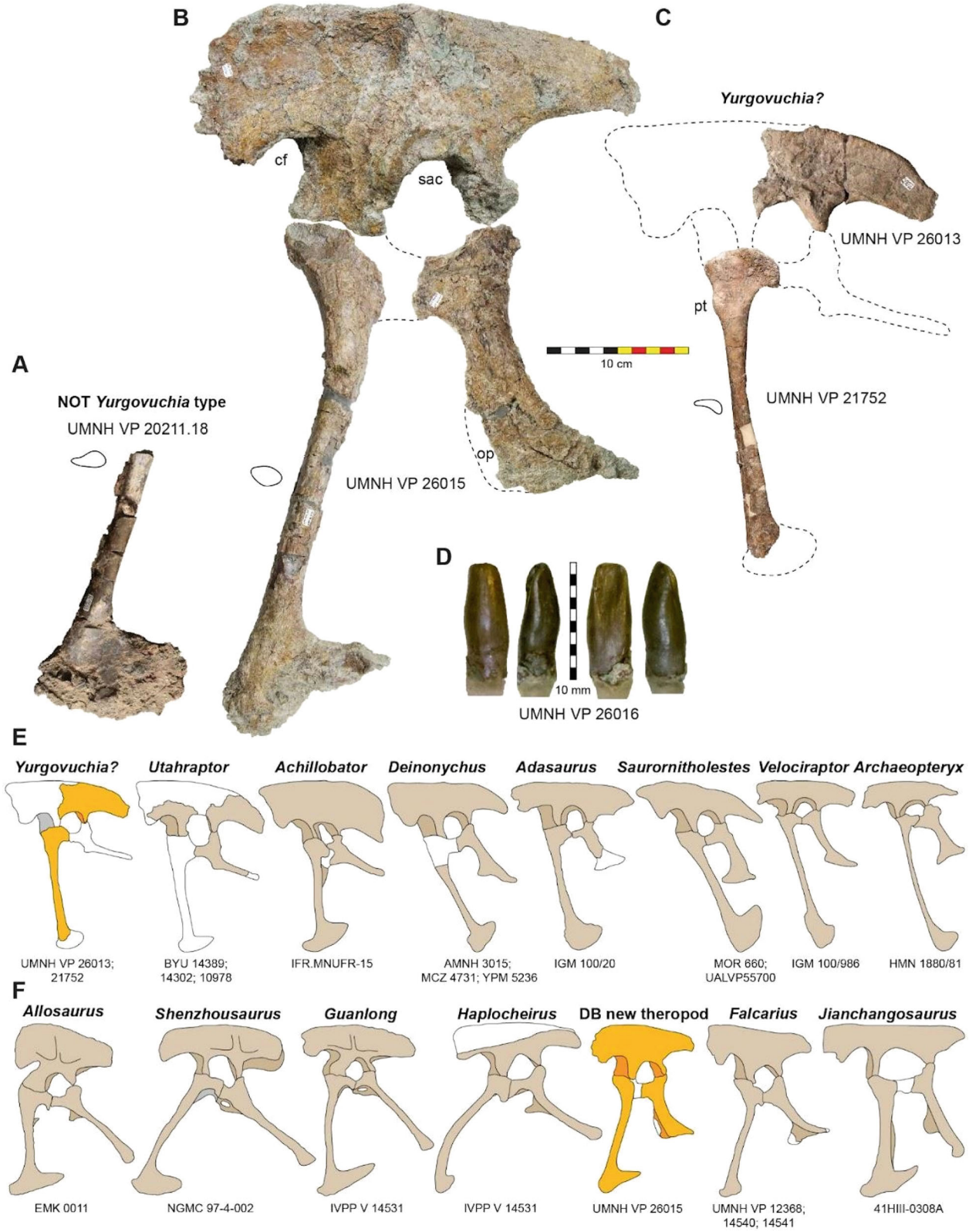

Figure 1. Theropod pelvic material from Doelling's Bowl. A. Misidentified right pubis (photoreversed) of *Yurgovuchia*. B. UMNH VP 26015 in left lateral view. C. Doelling's Bowl dromaeosaurine pelvis (photoreversed). D. Large therizinosaurine tooth (UMNH VP 26016). E.-F. Comparisons of theropod pelves, with missing in black and white. Midshaft cross-section indicated. cf, cappedicus fossa; pt, pubic tubercle; op, obturator process; sac, supraacetabular crest. Scale bar equals 10 cm.

pubis of UMNH VP 26015 and they differ in that the pubic boot of UMNH VP 26015 has no anterior component and the angle of the boot is oblique rather than at right angles to the pubic shaft. The cross-sectional shapes of both pubic shafts also are different. Both UMNH VP 26015 and 20211.8 are roughly the same size suggesting that UMNH VP 20211.8 is too large to be the same individual as the type specimen of *Yurgovuchia* as it implies sacral vertebrae that are at least 64 mm and the longest vertebrae preserved in *Yurgovuchia* is 42 mm. The pubis UMNH VP 20211.18 should be excluded from the type of *Yurgovuchia*. The pubis of UMNH VP 21752 has a straight opisthopubic shaft with a slight expansion of the distal end that is similar to *Saurornitholestes* and velociraptorines likely does represent a dromaeosaurine pubis. UMNH VP 26013 is an ilium with a long medially placed brevis fossa on the postacetabular blade that lacks a supraacetabular hood. UMNH VP 26013 is similar in outline, proportions, and the form of the brevis fossa to an ilium from the upper Yellow Cat Member of the Cedar Mountain Formation assigned to *Utahraptor* (BYU 14389). UMNH VP 26013 and UMNH VP 21752 are from a pelvis (likely the same individual) of the same size as, and may actually belong to the type of *Yurgovuchia*, but at present there is no way to definitively assign them to that individual or material.

The theropod diversity of the lower Yellow Cat Member is unsurprising because the upper Yellow Cat Member also includes the therizinosaurine *Martharaptor*, a dromaeosaurine with hemicaudothecan tail in *Utahraptor* (CEUM 1250) and dromaeosaurine a distinct caudothecan tail in UMNH VP 20209 from the same stratigraphic level. The three distinct pubes present in the quarry suggest that there is a basal maniraptoran, a dromaeosaurine, and a third theropod taxon are present in the Doelling's Bowl assemblage in addition to the large allosauroid, and more work needs to be done to reveal their affinities.

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Poster Session 1 (Thursday, June 8, 2023)

PCO_2 CALCULATIONS FROM CLOVERLY FORMATION IN NORTHERN WYOMING USING PEDOGENIC CARBONATE NODULES

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The Early – Late Cretaceous transition in Western North America recorded a period of rapid climatic and tectonic change in Earth's history. Major climate events associated with large igneous province eruptions caused several instances of ocean anoxic events (OAE) and perturbations to the global carbon (C) – cycle. These perturbations to the global C-cycle are recorded in the bulk organic C record of both marine and terrestrial deposits and can be used to correlate units across major depositional basins. Major efforts are being made to generate time-constrained palaeontologic and paleoclimate information