Technical Session 3: Terrestrial Ecosystems – Early Cretaceous (Saturday, June 10, 2023, 9:00 AM)

A THERIZINOSAUR IN TROODONTID'S CLOTHING? REASSESSING THE TROODONTID *GEMINIRAPTOR SUAREZARUM* IN LIGHT OF NEW THERIZINOSAURIAN MATERIAL FROM THE LOWER CRETACEOUS YELLOW CAT MEMBER OF THE CEDAR MOUNTAIN FORMATION, UTAH, USA

Freimuth, William J.[1,2], Lively, Joshua R.[3], Zanno, Lindsay E.[1,2]
[1]Department of Biological Sciences, Campus Box 7617, North Carolina State University, Raleigh, North Carolina, USA 27695; [2]Paleontology, North Carolina Museum of Natural Sciences, 11 W. Jones St., Raleigh, North Carolina USA 27601, wfreimu@ncsu.edu, lindsay.zanno@naturalsciences.org; [3]Prehistoric Museum, Utah State University, 155 East Main, Price, Utah, USA 84501, josh.lively@usu.edu

The Crystal Geyser Quarry (CGQ) is an extensive ~1 m thick paucispecific bonebed from the Lower Cretaceous (Berriasian-Valenginian; Joeckel et al., 2020) lower Yellow Cat Member of the Cedar Mountain Formation. The CGQ preserves the disarticulated remains of the early-diverging therizinosaurian *Falcarius utahensis* and represents one of the largest maniraptoran bonebeds globally (Figure 1A-B; Kirkland et al., 2005; C. Suarez et al., 2007; M. Suarez et al., 2007; Zanno, 2010). A second bonebed ~1 km northwest of CGQ, the Suarez Site (SS), represents a second paucispecfic assemblage containing hundreds of therizinosaurian remains, potentially representing a distinct taxon (Kirkland et al., 2016; Zanno et al., 2014). In 2010, an isolated partial maxilla collected from the SS was described and interpreted as a troodontid, *Geminiraptor suarezarum*, the only Early Cretaceous representative of the clade from North America (Figure 1C; Senter et al., 2010). The lack of comparative *F. utahensis* materials from the CGQ available at the time of description and its recovery from a monodominant therizinosaurian site complicated this interpretation. Several discoveries since the initial description of *Geminiraptor*, including troodontids (e.g., Lü et al., 2010; Pei et al., 2017; Tsuihiji et al., 2014), therizinosaurians (Pu et al., 2013), and a recently collected well-preserved *F. utahensis* maxilla from CGQ (Figure 1B), permit a reassessment of *Geminiraptor* in a broader phylogenetic scope.

Several characteristics used to diagnose *Geminiraptor* are present in the new *F. utahensis* maxilla and other therizinosaurians, as well as troodontids. *Geminiraptor* possesses an inflated, pneumatized anterior body of the maxilla, a feature also present in the therizinosaurians *F. utahensis* and *Erlikosaurus*, and the troodontid *Byronosaurus*. The maxillary fenestra is large and elliptical in *Geminiraptor* and many late-branching troodontids, whereas it is large, dorsoventrally taller, and rounded in *F. utahensis* and *Jianchangosaurus*, and greatly reduced in size in *Erlikosaurus*. Other reported diagnostic features of *Geminiraptor* are more widely prevalent in therizinosaurians and troodontids, including craniocaudally narrow promaxillary and interfenestral bars and small, square maxillary alveoli separated by bony septa. Crucially, CT scans of the *Geminiraptor* maxilla reveal previously unknown replacement teeth that possess relatively bulbous, lanceolate, labially convex crowns with minute denticles on both the anterior and posterior carinae. These features of the maxillary dentition are consistent with the primitive therizinosaurs *F. utahensis* (Zanno, 2010) and *Jianchangosaurus* (Pu et al., 2013), and differ from the maxillary dentition of troodontids. Accordingly, we hypothesize that *Geminiraptor*, as well as the remaining material from the SS, belong to a single therizinosaurian taxon.

Despite the geographic and stratigraphic proximity of CGQ and SS, as well as ontogenetic and individual variation within each bonebed, differences in craniodental features suggest the SS therizinosaurian material may be taxonomically distinct from *F. utahensis*. These include a rostrocaudally longer, dorsoventrally lower maxillary profile in lateral view, a dorsoventrally short and elliptical maxillary fenestra, presence of a pneumatic excavation along the rostrodorsal margin of the maxillary fenestra, relatively straight symphyseal aspect of the dentary, reduced recurvature of the dentary teeth, and marked ventral displacement of the medial mandibular condyle of the quadrate.

A principal component analysis using an expanded dataset (Powers et al., 2020) of log-transformed linear measurements recovers substantial overlap in morphospace among troodontids and early-branching therizinosaurians in agreement with morphological similarities (Figure 1E), potentially suggesting broadly similar feeding ecologies, sensory capabilities, or other paleobiological functions. If the proposed interpretation of *Geminiraptor* and the Suarez material as a distinct therizinosaurian holds true, this would add a third potential therizinosaurian taxon to the basal Cedar Mountain Formation (*F. utahensis* and *Martharaptor greenriverensis*) and restrict the definitive occurrences of large-bodied North American troodontids to the latest Cretaceous.

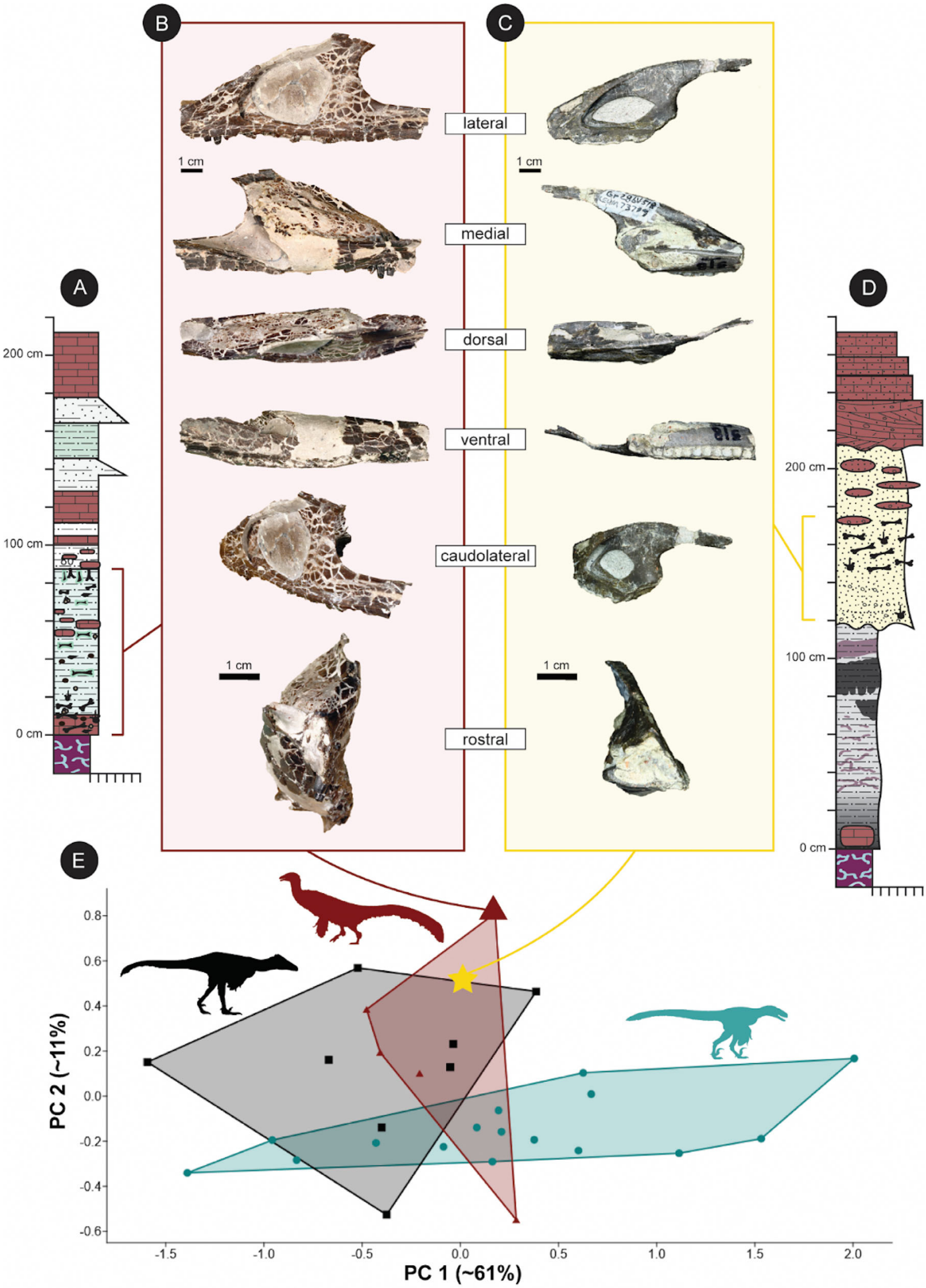

Figure 1. A) Generalized stratigraphic section through the Crystal Geyser Quarry, modified from Suarez et al., (2007a); brackets indicate bone-bearing units. B) Left maxilla of the *Falcarius utahensis*. C) Left maxilla of *Geminiraptor suarezarum*. D) Generalized stratigraphic section through the Suarez Site; brackets indicate bone-bearing units. E) Principal component analysis of different maniraptoran maxillae, including therizinosaurians (red triangles), troodontids (black squares), and dromaeosaurids (teal circles). Note *Falcarius utahensis* (large red triangle) and *Geminiraptor suarezarum* (gold star). Silhouettes modified from originals by: PaleoNeolithic (therizinosaurian), Jason Hogan (troodontid), Mette Aumala (dromaeosaurid).

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Theme Session: Greening of the Upper Jurassic Morrison Formation, USA: Huge advances in paleobotany with implications for dinosaur herbivory ecosystem reconstruction (Friday, June 9, 2023, 3:00 PM)

PALEOBOTANY OF THE UPPER JURASSIC MORRISON FORMATION: WHAT'S NEW AND WHAT'S TO COME?

Gee, Carole T.[1,2,]

[1]*Institute of Geosciences, Division of Paleontology, University of Bonn, Nussallee 8, 53115 Bonn, Germany, cgee@uni-bonn.de, ORCID 0000-0001-5926-2556;*
[2]*Huntington Botanical Gardens, San Marino, California, USA*

1 A TIMELINE OF PALEOBOTANICAL STUDIES

Never before have so many paleobotanists worked concurrently on the Upper Jurassic Morrison Formation in western North America (Figure 1a). Although brief reports of putative fossil plants from this formation appeared at the turn of the last century (Knowlton, 1907, 1916; Ward, 1900), it is unclear if these paleobotanical remains truly originated from the Upper Jurassic Morrison Formation as defined today (cf. Foster, 2020). In any case, the first detailed taxonomic descriptions of fossil plants, *Cupressinoxylon* wood (Lutz, 1930) and freshwater calcareous charophytes from Wyoming (Peck 1937), appeared nearly a century ago. It was 20 years after that, starting in 1957, when a series of studies on Morrison plants arose (Figure 1a). Among these 10 studies, nearly all major types of plant fossils came under investigation: freshwater calcareous algae (Peck, 1957; Ross, 1960), silicified stems and wood (Arnold, 1962; Medlyn &