Tyrannosaurs were giant predatory dinosaurs occupying the apex of Late Cretaceous food chains. Little is known about their early life due to the extreme rarity of juveniles. We describe hatchling remains (< 1 yr) of Tyrannosauridae, weighing ~2.5 kg respectively, <0.1% adult mass. From hatchling mass it is possible to estimate egg size; adult mass is tightly correlated with clutch mass. From egg size and clutch mass it becomes possible to estimate clutch size; clutches were likely large (est. 25-60 eggs) suggesting an r-selected reproductive strategy. Synchrotron scans reveal remodeling and intensive loading of pedal elements, showing tyrannosaurs moved soon after hatching. Hatchling tyrannosaurs' small size and precociality suggest limited parental care. Tyrannosaurs had proportionately larger offspring than ancestral Archosauria, but relatively smaller hatchlings than Maniraptora, suggesting a reproductive strategy intermediate between basal archosaurs and birds. Multiple dinosaur lineages evolved large eggs and hatchlings, suggesting an evolutionary trend towards increased parental investment in the Mesozoic.

Technical Session 3: Terrestrial Ecosystems – Late Cretaceous (Saturday, June 10, 2023, 2:15 PM)

CENTROSAURINE CERATOPSID MATERIAL FROM THE LATE CRETACEOUS (CAMPANIAN) MENEFEE FORMATION OF NORTHWEST NEW MEXICO

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Recent paleontological survey work undertaken by the North Carolina Museum of Natural Sciences (NCMNS) in the Late Cretaceous (Campanian) Allison Member of the Menefee Formation of northwest New Mexico is yielding new information on the diversity of ceratopsians from the Western Interior Basin (WIB). Newly recovered specimens include the associated skeletons of two ceratopsian individuals. One skeleton pertains to a large individual similar in size to some chasmosaurine species (e.g., *Triceratops*); however, referral to a particular subfamily (i.e., chasmosaurine or centrosaurine) is difficult due to the state of preservation of this material. Recovered elements to date include a scapula, several dorsal vertebrae, a partial sacrum, several caudal vertebrae, and several partial dorsal ribs.

The smaller individual is well-preserved and is represented by a combination of articulated and disarticulated elements. Thus far, these include elements of the axial skeleton (i.e., cervical, dorsal, sacral, caudal vertebrae, and ribs), forelimb (humerus), partially articulated pelvic girdle (ilium, pubis, ischium), and most of the hind limb (femur, tibia, fibula, and astragalus). The recovered skeletal elements appear to derive from a single skeletally immature individual based on overall skeletal size and degree of sutural closure noted in the recovered elements of the axial column. The specimen is preserved in a moderately calcareous, silty mudstone containing numerous calcareous nodules and abundant carbonized and broken plant materials (i.e., plant hash). Considered together, the disarticulated nature of the skeleton and abundant plant hash layers suggests the specimen was deposited in a low to moderate energy flooding event within a fluvial floodplain or were transported into a fluvial associated catchment basin (e.g., pond).

Despite a long history of geological and paleontological exploration, the ceratopsian fossil record from the Menefee Formation has remained relatively enigmatic as compared to other contemporaneous to penecontemporaneous southern WIB fossiliferous formations (e.g., Wahweap Formation, Grand Staircase Escalante National Monument, southern Utah), with only one named taxon (i.e., *Menefeeceratops sealeyi*). The recently recovered ceratopsian materials preliminarily appear to be referable to Centrosaurinae based on observed synapomorphies of the postcranial skeleton including humeral characters (i.e., humerus generally long and slender, smaller mid humeral shaft diameter, deltopectoral crest occupying nearly half the total length of the humerus, and the distal end modestly expanded and rugose) and ischial characters (i.e., relatively straight ischial shaft, ischial shaft terminates in an acute apex, ischial pubic peduncle more broadly expanded, and ischial shaft mediolaterally compressed). However, comparison with *Menefeeceratops* is limited due to the dearth of diagnostic elements, cranial or postcranial, shared between these two specimens. Given that the cervical ribs and vertebrae are near the back wall, further field collection of this specimen may ameliorate this issue by providing overlapping skull elements. Regardless, these new specimens increase the known ceratopsian material from the southern WIB generally and the Menefee Formation specifically and may either increase the known material referable to *Menefeeceratops* and add unknown skeletal element descriptions to that taxon (e.g., pubis and ischium) or increase the known diversity of Late Cretaceous (Campanian) ceratopsids from southern Laramidia. If the latter is true, this specimen will add key information for testing current paleobiogeographical hypotheses

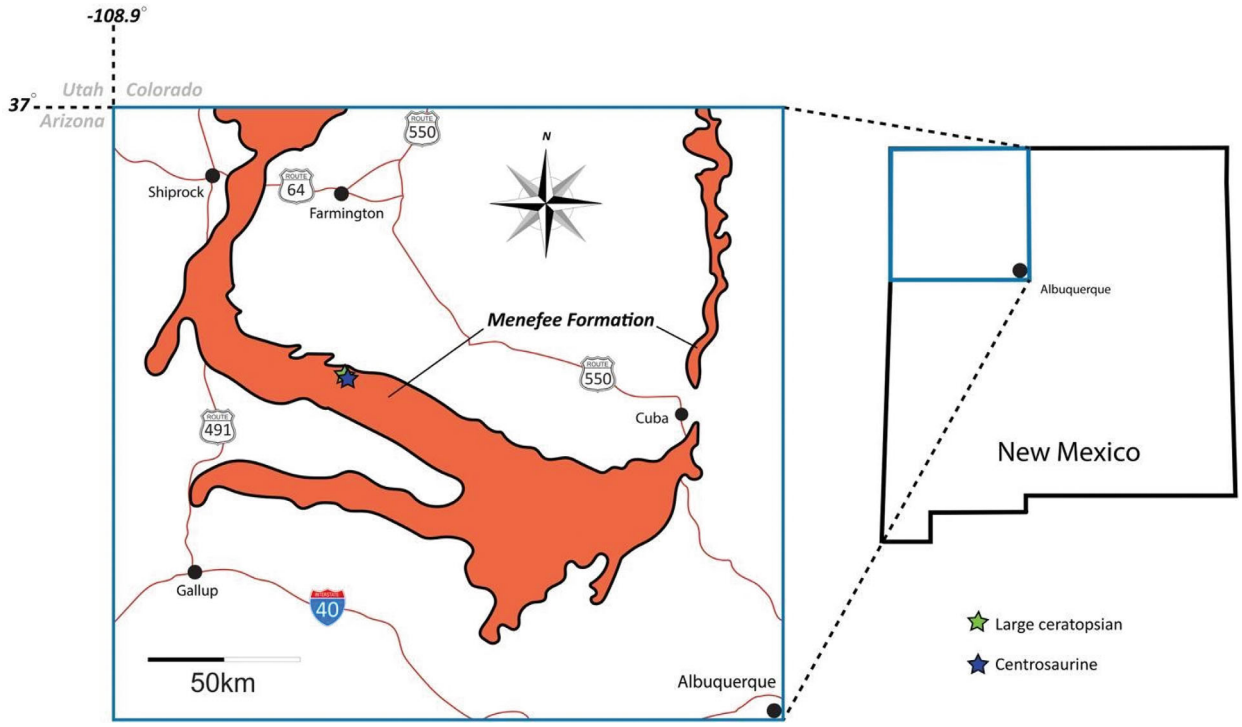

Figure 1. Approximate location of NCSM ceratopsid localities (colored stars) within surface exposure of the early Campanian Menefee Formation (orange) in northwestern New Mexico, United States. Modified from Dalman et al., 2021.

regarding the possibility of distinct northern and southern centers of endemism in the WIB and expounds the paleoecological, paleobiological, and paleogeographical understanding of an important Late Cretaceous geologic basin in southern Laramidia.

Reference

Dalman, S. G., Lucas, S. G., Jasinski, S. E., Lichtig, A. J., & Dodson, P. (2021). The oldest centrosaurine: A new ceratopsid dinosaur (Dinosauria: Ceratopsidae) from the Allison Member of the Menefee Formation (Upper Cretaceous, early Campanian), northwestern New Mexico, USA. *Paläontologische Zeitschrift, 95*(2), 291-335.

Technical Session 2: Paleoecology (Thursday, June 8, 2023, 1:45 PM)

AN INTERCONTINENTAL ASSOCIATION OF DRAGONFLY OVIPOSITION ON A FLOATING AQUATIC PLANT FROM THE LATE CRETACEOUS OF NORTH AMERICA AND ASIA

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Odonate (dragonfly & damselfly) oviposition on the floating aquatic angiosperm *Quereuxia* spp. from the Campanian of western North America and northeastern Asia represent a rare intercontinental plant–insect association in deep time. Fossil plant material from the Kaiparowits Formation (Utah, USA) (Maccracken, 2020; Miller et al., 2013) and Kundar Formation (Amur Oblast, Russia) (Enushchenko & Frolov, 2020; Vasilenko, 2008) provide abundant evidence for this highly specialized plant–insect association spanning two continents during the Late Cretaceous.

Quereuxia is a morphogenus of extinct aquatic angiosperm with heterophyllus leaves, sometimes preserved as a rosette of small, circular leaves or as detached leaves (Hickey, 2001). The taxonomic affinities of *Quereuxia* are unknown at present, although recent work has indicated that the previous placement within Lythraceae (formerly Trapaceae) may not be valid (Liang et al., 2021). Regardless of affinity, *Quereuxia* spp. are an important floating aquatic angiosperm in a range of Late Cretaceous to Paleocene deposits in the Northern Hemisphere