Stratigraphy and Age of the Dinosaur-Dominated Fossil Assemblage of the Upper Cretaceous Hall Lake Member of the Mcrae Formation, Sierra County, New Mexico

Spencer G. Lucas¹, Sebastian Dalman¹, Asher J. Lichtig¹, Scott Elrick², W. John Nelson² and Karl Krainer³

¹New Mexico Museum of Natural History, 1801 Mountain Road N.W., Albuquerque, NM, 87104, spencer.lucas@state.nm.us
²Illinois State Geological Survey, 615 East Peabody Drive, Champaign, IL, 61820
³Institute of Geology, Innsbruck University, Innsbruck, Austria

The Upper Cretaceous McRae Formation is fluvial sediments exposed in south-central New Mexico in Sierra County, primarily across the Cutter sag, between the Fra Cristobal Mountains to the north and Caballo Mountains to the south. Total thickness of the McRae Formation is at least 1 km, and it is divided into a lower, Jose Creek Member up to 120-m thick overlain by an upper, Hall Lake Member at least 850-m thick. Dinosaur fossils have been known from the Hall Lake Member for more than a century and have been long regarded as of late Maastrichtian (Lancian) age. Recent collecting has augmented the Hall Lake Member dinosaur fauna, and stratigraphic analysis puts many of the dinosaur fossils into a precise and detailed lithostratigraphic framework. These fossils are from a nonmarine facies composed of commonly crossbedded conglomerate and sandstone representing fluvial channel fills, and thick siltstone-mudstone intervals, representing floodplain or overbank deposits, locally containing pedogenic carbonate beds. Most of the dinosaur fossils come from a thin stratigraphic interval 23-43 m above the base of the Hall Lake Member. This includes *Tyrannosaurus rex*, a new ceratopsian genus similar to *Torosaurus* and an abundance of indeterminate ceratopsid fossils. Stratigraphically higher fossils, about 140-150 m above the base of the Hall Lake Member include the titanosaur *Alamosaurus*. Other dinosaurs, mostly indeterminate ceratopsids and hadrosaurids, are also known from Hall Lake Member localities that cannot be placed into the detailed stratigraphic framework because of faulting and/or Quaternary cover. *Tyrannosaurus* and *Alamosaurus* are not known from pre-Lancian strata, so their presence reaffirms a Lancian age for the lower part of the Hall Lake Member. Fossil turtles from the Hall Lake Member include *Compsemys* and an indeterminate bothremydid and only indicate a Campanian to Maastrichtian age. A recently reported ²⁰⁶Pb/²³⁸Pb age of a tuff bed 9 meters above the base of the Hall Lake Member is 74 Ma, about 7 million years older than the biostratigraphic age based on the dinosaur fossils. We thus question the accuracy of this radioisotopic age, and of other Campanian ages in the 74-76 Ma range on tuffs in the Jose Creek Member. It seems likely that the McRae Formation is mostly of late Maastrichtian age, though its maximum and minimum ages remain undetermined based on present data.


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