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Geology and taphonomy of a unique tyrannosaurid bonebed from the upper Campanian Kaiparowits Formation of southern Utah: implications for tyrannosaurid gregariousness

Alan L. Titus[1], Katja Knoll[1], Joseph J.W. Sertich[2], Daigo Yamamura[3], Celina A. Suarez[3], Ian J. Glasspool[4], Jonathan E. Ginouves[1], Abigail K. Lukacic[1], Eric M. Roberts[5]

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1 Paria River District, US Bureau of Land Management, Kanab, UT, USA
2 Department of Earth Sciences, Denver Museum of Nature and Science, Denver, CO, USA
3 Department of Geosciences, University of Arkansas at Fayetteville, Fayetteville, AR, USA
4 Department of Geology, Colby College, Waterville, ME, US
5 Department of Earth and Environmental Sciences, James Cook University of North Queensland, Townsville, QLD, Australia

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Photo courtesy of Dr. Alan Titus

Abstract

Tyrannosaurids are hypothesized to be gregarious, possibly parasocial carnivores engaging in cooperative hunting and extended parental care. A tyrannosaurid (cf. *Teratophoneus curriei*) bonebed in the late Campanian age Kaiparowits Formation of southern Utah, nicknamed the Rainbows and Unicorns Quarry (RUQ), provides the first opportunity to investigate possible tyrannosaurid gregariousness in a taxon unique to southern Laramidia. Analyses of the site's sedimentology, fauna, flora, stable isotopes, rare earth elements (REE), charcoal content and taphonomy suggest a complex history starting with the deaths and transport of tyrannosaurids into a peri-fluvial, low-energy lacustrine setting. Isotopic and REE analyses of the fossil material yields a relatively homogeneous signature indicating the assemblage was derived from the same source and represents a fauna living in a single ecospace. Subsequent drying of the lake and fluctuating water tables simultaneously overprinted the bones with pedogenic carbonate and structurally weakened them through

wet-dry cycling. Abundant charcoal recovered from the primary bone layer indicate a low temperature fire played a role in the site history, possibly triggering an avulsion that exhumed and reburied skeletal material on the margin of a new channel with minimal transport. Possible causes of mortality and concentration of the tyrannosaurids include cyanobacterial toxicosis, fire, and flooding, the latter being the preferred hypothesis. Comparisons of the RUQ site with other North American tyrannosaur bonebeds (Dry Island-Alberta; *Daspletosaurus horneri*-Montana) suggest all formed through similar processes. Combined with ichnological evidence, these tyrannosaur mass-burial sites could be part of an emerging pattern throughout Laramidia reflecting innate tyrannosaurid behavior such as habitual gregariousness.

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