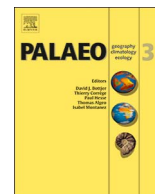




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Sedimentological and taphonomic observations on the “Dragon's Tomb” *Saurolophus* (Hadrosauridae) bonebed, Nemegt Formation (Upper Cretaceous), Mongolia

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ABSTRACT

The famous “Dragon's Tomb” *Saurolophus* bonebed at Altan Uul II preserves multiple complete skeletons with skin impressions, and is exceptional among Nemegt Formation dinosaur localities as the only mass accumulation of articulated individuals. Here, we present results from an on-going paleontological project focused on the Baruungoyot-Nemegt succession in order to document this unique locality. Sedimentological data allow us to confirm that the fossils and host sediments were deposited in the thalweg of a meandering paleochannel that experienced a variety of high and lower energy flow conditions. A variety of taphonomic data were collected from exposed fossils, including those displaced by poaching. Three-dimensional maps of the host sediments and fossils were generated, and 13 m² of exposed, in-situ bones were mapped. Previously undocumented portions of at least 13 additional *Saurolophus* individuals and a partial subadult *Tarbosaurus* skeleton were identified. The Dragon's Tomb is a monodominant bonebed with at least three size classes (juvenile, subadult, and large adult) of *Saurolophus* preserved. The bonebed has a minimum size of ~2000 m², suggesting that over 100 *Saurolophus* carcasses may have contributed to the thanatocoenose. Although the data provide evidence for a catastrophic mass death of a social group of *Saurolophus* and provide the first evidence of gregariousness in this taxon, the cause of death cannot be determined.

1. Introduction

Hadrosaurid dinosaurs (Ornithischia: Ornithopoda) are best known from the Late Cretaceous of North America, although recent discoveries demonstrate a notably diverse and abundant fauna in Asia. Recent fieldwork in central Asia, particularly in Kazakhstan and the Amur region of far eastern Russia and China, have provided new information on hadrosaur diversity and yielded a number of important new taxa including *Charonosaurus jiyinensis* (Godefroit et al., 2000, 2001), *Olorotitan aharensis* (Godefroit et al., 2003), *Kerberosaurus manakini* (Bolotsky and Godefroit, 2004), *Sahaliyana elunchunorum* (Godefroit et al., 2008), and *Wulagasaurus dongi* (Godefroit et al., 2008). Extensive monodominant bonebeds of *Charonosaurus* (Godefroit et al., 2000), *Amurosaurus* (Godefroit et al., 2004a; Lauters et al., 2008; Bolotsky

et al., 2014), *Sahaliyana* (Godefroit et al., 2008), and *Shantungosaurus* (Hone et al., 2014; Xing et al., 2014a) are known from this region, and at least two other species (*K. manakini*, *W. dongi*) comprise minor components of some of these bonebeds. The proliferation of new basal Asian taxa has also bolstered support for an Asian origin for both hadrosaurines and lambeosaurines (e.g., Godefroit et al., 2003, 2004a, 2004b, 2008; Tsogtbaatar et al., 2014; Xing et al., 2014b).

The fossil-rich, late Campanian-Maastrichtian terrestrial beds of Mongolia preserve only two hadrosaurid taxa, both from the Nemegt Formation; a solid-crested hadrosaurine (sensu Xing et al., 2014a, 2014b) *Saurolophus angustirostris*, and the enigmatic *Barsboldia sicinskii* (Norman and Sues, 2000; Prieto-Marquez, 2010; Tsogtbaatar et al., 2014). Maryańska and Osmólska (1981a) originally assigned the only known specimen of *Barsboldia* to Lambeosaurinae; however, a recent

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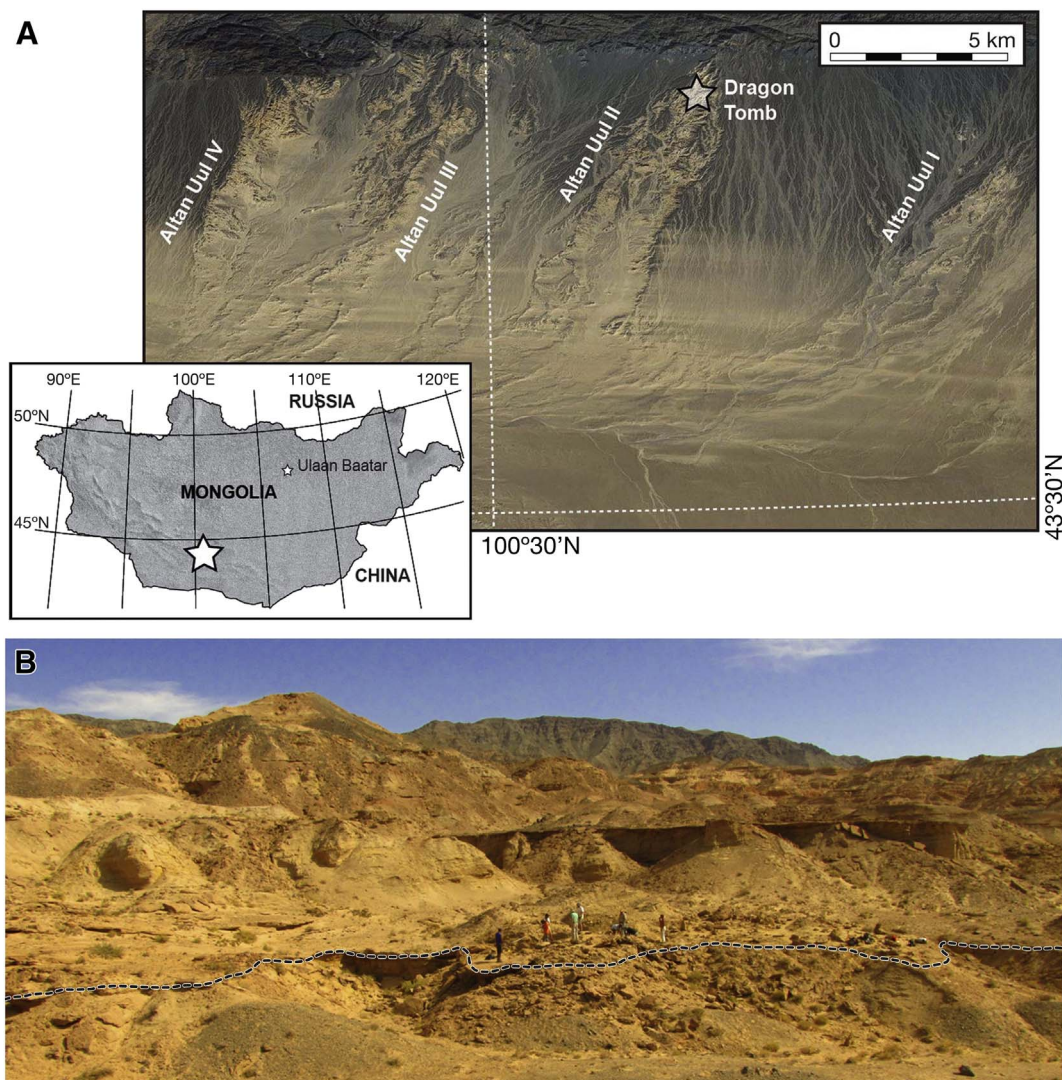


Fig. 1. Location of the Dragon's Tomb at Altan Uul II within the Nemegt Basin of Mongolia (A). B. Panorama looking north at the Dragon's Tomb. The top of the bone-bearing unit is marked by a dashed line. Note the large slabs of sandstone on the lower slope, many of which were displaced by poachers. People for scale. Photo by D. Lloyd.

revision of Hadrosauridae placed it among Hadrosaurinae (Prieto-Marquez, 2010; Tsogtbaatar et al., 2014). *Saurolophus angustirostris* is known from at least fifteen skeletons (Norman and Sues, 2000) and represents approximately 25% of the total number of dinosaurs collected from the Nemegt Formation (Currie, 2009, 2016). It is characterized by a solid, posterodorsally-directed, spike-like crest that is constructed of the nasals, frontals, and prefrontals (Maryańska and Osmólska, 1981b; Bell, 2011a).

In 1948, members of the Russian-Mongolian expedition to Mongolia's Gobi Desert, discovered a remarkable accumulation of well-preserved articulated skeletons of *Saurolophus* in badlands exposed on the southern flank of Altan Uul ("Golden Mountain") in south-central Mongolia (Figs. 1 and 2). An account of the discovery in Russian by Efremov (1958) noted seven nearly complete articulated skeletons exposed on the surface. Many of the specimens preserved skin impressions and the "sepulchral embankment" (Efremov, 1958, pg. 208) on which they were preserved led them to name the locality 'the Dragon's Tomb' (Fig. 2). In addition to the spectacular preservation, the assemblage represents one of the only large-scale dinosaur bonebeds in the Nemegt Formation (Gradzinski, 1970; Eberth, 2017, this volume). Surprisingly, this locality has received only passing mentions in the scientific literature (Colbert, 1968, 2000; Gradzinski et al., 1969; Maryańska and Osmólska, 1984; Coy, 1997; Kurochkin and Barsbold, 2000; Norman

and Sues, 2000; Bell, 2012; Currie, 2016), since its original, brief description by Efremov (1955).

The Dragon's Tomb occurs in rocks of the Nemegt Formation exposed at the sub-locality of Altan Uul II (Fig. 1; see also Eberth, 2017, this volume). Unfortunately, the reliability of this locality for yielding beautiful and complete specimens of *Saurolophus angustirostris* has made it a target of illegal fossil poachers (e.g., Long, 2002; see also Fanti et al., 2017, this volume), and in recent years untold numbers of specimens have been illegally plundered and/or destroyed. This study is the result of multiple excursions to the Dragon's Tomb as parts of the Korean International Dinosaur Project (2008–10), Montessori High School at University circle in cooperation with Nomadic Expeditions (2009), and National Geographic supported projects in 2010 and 2016, with the purpose of documenting the locality, and to provide preliminary observations and interpretations about the depositional history and taphonomy of the site. We also note the effects of poaching at this historically important Mongolian locality, which represents a rare occurrence of a monodominant dinosaur bonebed in the Nemegt Formation.

2. History of discovery and collection

Following World War II, an agreement between the former Soviet

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