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Short communication

Dentaries of a caenagnathid (Dinosauria: Theropoda) from the Nemegt Formation of the Gobi Desert in Mongolia

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ABSTRACT

A symphyseal region of the fused dentaries of a caenagnathid theropod is described from the Upper Cretaceous Nemegt Formation at the Bugin Tsav locality in the Mongolian Gobi Desert. In contrast to the high diversity of Caenagnathidae in the upper Campanian to Maastrichtian in North America, only specimens of a single caenagnathid, *Elmisaurus raurus*, have been reported in the coeval strata in Asia. Although dentaries are commonly-found bones in the fossil record of Caenagnathidae, the present specimen is the first discovery of caenagnathid dentaries from the upper Campanian to Maastrichtian in Asia. The Nemegt Formation is unique for its diverse oviraptorosaurian fauna that includes both Caenagnathidae and Oviraptoridae as well as the non-caenagnathoid *Avimimus portentosus*. Hypothesized coexistence of eolian and fluvial environments in the Gobi Basin during the deposition of the Nemegt Formation might explain such co-occurrence of Caenagnathidae and Oviraptoridae.

1. Introduction

Caenagnathidae is a clade of oviraptorosaurian theropods known from the Upper Cretaceous of North America and Asia (e.g., Osmólska, 1981; Currie et al., 1993; Longrich et al., 2013; Lamanna et al., 2014). Recent studies have started revealing anatomical details and phylogenetic relationships of caenagnathids, especially North American forms (Longrich et al., 2013; Lamanna et al., 2014). Most described specimens of this clade are based on fragmentary or partial specimens, with the lower jaw, especially the fused symphyseal part of the dentaries, relatively common (e.g., Sternberg, 1940; Currie et al., 1993; Longrich et al., 2013; Funston and Currie, 2014). In fact, the dentaries are considered highly diagnostic for caenagnathids (Longrich et al., 2013), allowing taxonomic identification and even establishment of new species (Currie et al., 1993).

In North America, the taxonomic diversity of caenagnathids was high during the late Campanian and Maastrichtian. For example, at least three taxa are present in the upper Campanian Dinosaur Park Formation in Alberta, Canada (Currie, 2005; Longrich et al., 2013) whereas each of the Kaiparowits and Aguja formations of similar ages in U. S. A. has also yielded at least one distinct caenagnathid taxon (Zanno and Sampson, 2005; Longrich et al., 2013). Distinct species of caenagnathids have also been described from the slightly younger Horseshoe Canyon Formation in Alberta, Canada and Ojo Alamo Formation in New Mexico, U. S. A. (Sues, 1997; Sullivan et al., 2011). In comparison, the known diversity of caenagnathids in Asia is rather low. Caenagnathid taxa that have been described from the Upper Cretaceous of Asia include *Elmisaurus rarus* Osmólska, 1981 from the Nemegt Formation (upper Campanian-lower Maastrichtian to Maastrichtian) of Mongolia (Osmólska, 1981), *Caenagnathasia martinsoni* Currie et al., 1993 from the Bissekty Formation (Turonian) of Uzbekistan and *Gigantoraptor erlianensis* Xu et al., 2007 from the Iren Dabasu Formation in Inner Mongolia of China. In addition, a symphyseal region of large, fused dentaries that may represent a taxon closely related to *G. erlianensis* was reported from the Bayn Shire Formation (Cenomanian–Santonian) of Mongolia (Tsuihiji et al., 2015). With the age of the Iren Dabasu Formation debated (e.g., Van Itterbeeck et al., 2005; Averianov and Sues, 2012), *E. rarus* is the only caenagnathid definitely discovered from the upper Campanian to Maastrichtian of Asia. With new referred material reported recently, the currently known specimens of *E. rarus* include various postcranial bones and a single frontal (Osmólska, 1981; Currie et al., 2016) but lack the dentaries.

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In the present study, we report a symphyseal region of fused dentaries of a caenagnathid from the Nemegt formation found at Bugin Tsav (Fig. 1) by the Mongolian Paleontological Center-Hayashibara Museum of Natural Sciences Joint Expedition in 1994. This specimen represents the first caenagnathid dentaries found from the interval of the upper Campanian to Maastrichtian in Asia. This specimen came from the Nemegt Formation, from which *Elmisaurus rarus* has been described. Whereas the all known specimens of *E. rarus* came from the Nemegt locality, the present specimen was found at Bugin Tsav, approximately 100 km northwest to Nemegt. This specimen, therefore, represents the first caenagnathid material recovered from the Nemegt Formation outside the type area.

Institutional Abbreviations: CMN, Canadian Museum of Nature, Ottawa, Ontario, Canada; MPC, Institute of Paleontology and Geology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia; TMP, Royal Tyrrell Museum of Palaeontology. Drumheller, Alberta, Canada.

2. Material

MPC-D 102/107, an isolated symphyseal region of fused dentaries (Fig. 2).

3. Locality and age

Bugin Tsav is located in the western part of the Gobi Desert (Fig. 1). This locality is one of the most fossiliferous dinosaur localities in Mongolia (e.g., Barsbold, 1983; Kurochkin and Barsbold, 2000). The Upper Cretaceous Nemegt Formation crops out at this locality (e.g., Gradzínski et al., 1977), consisting mostly of deposits of a meandering fluvial system (e.g., Gradzínski, 1970; Weishampel et al., 2008). The estimated age of the Nemegt Formation ranges from late Campanian–early Maastrichtian to Maastrichtian (e.g., Gradzínski et al., 1977; Jerzykiewicz and Russell, 1991; Jerzykiewicz, 2000).

4. Description

MPC-D 102/107 consists of fused left and right dentaries (Fig. 2A–F). Only the anterior (mesial) part is present on the left side. The more posterior (distal) part is preserved on the right side although the margin of the external mandibular fenestra is missing. The bone surface shows extensive cracking (Fig. 2B, C), corresponding to Stage 1 of bone weathering (Behrensmeyer, 1978). This indicates that the specimen was likely exposed on a dry soil for a certain amount of time before burial.

The dorsal margin of the bone is concave in lateral view, terminating anteriorly to form a beak-like projection (Fig. 2B) as in other caenagnathids (e.g., Currie et al., 1993). The lingual surface of the anterior-most part of the symphyseal region bears a midline depression, the anterior occlusal groove (A1; Currie et al., 1993), bounded laterally by low, longitudinal symphyseal ridges (Fig. 2A, D). Lateral to each ridge lies a large (approximately 1.5 mm in diameter), round foramen near the dorsal margin in a shallow concavity, the anterior occlusal groove (A2) of Currie et al. (1993). Posterior to these ridges and the anterior occlusal grooves is a thick, horizontal symphyseal shelf (Fig. 2A), which is well-developed as in other caenagnathids (Currie et al., 1993; Longrich et al., 2013). Laterally, the symphyseal shelf is bounded by the lingual ridge, demarcated from the latter by a shallow, longitudinal vascular groove (Fig. 2A, D) described by Currie et al. (1993) and Funston and Currie (2014). This groove anteriorly ends in a foramen (Fig. 2A, D) as described by Funston and Currie (2014). The right and left lingual ridges are widely separated anteriorly by the symphyseal shelf (Fig. 2A). The medial surface of the lingual ridge is rounded and is ventrally bounded by a shallow sulcus along most of its length (Fig. 2F).

Labial to the lingual ridge and lingual to the occlusal margin of the bone lies a longitudinal depression called the lateral groove (Fig. 2A; Sternberg, 1940; Currie et al., 1993). As in North American caenagnathids (Currie et al., 1993), the lateral groove houses several foramina. Series of vertically oriented lateral occlusal grooves and ridges are present along the labial margin of the bone as in other caenagnathids. Six lateral occlusal grooves are present on the better-preserved right dentary (Fig. 2A).

The symphyseal shelf is ventrally incised by the Meckelian groove on each side (Fig. 2D, E). On the midline of the ventral surface, a shallow depression is present, demarcated anteriorly by a low prominence (Fig. 2E). This depression corresponds to an "hourglass- or dumbbell-shaped depression" regarded as the origin of the genioglossus muscle in North American caenagnathids by Currie et al. (1993) and Funston and Currie (2014).

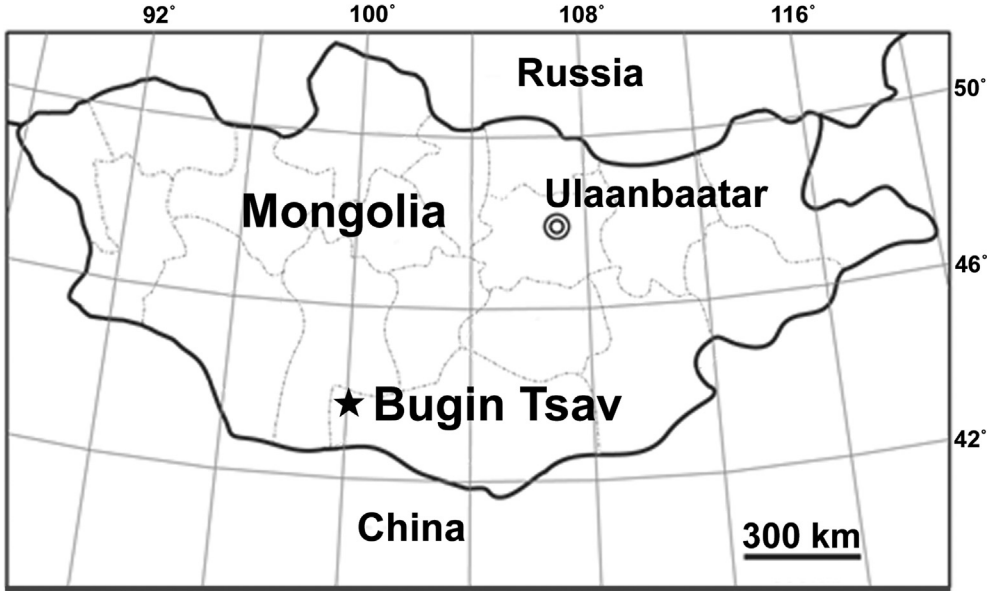

Fig. 1. Map of Mongolia showing the Bugin Tsav locality (modified from Tsubamoto et al., 2010).