Cretaceous Research 85 (2018) 95–108

Contents lists available at ScienceDirect

Cretaceous Research

journal homepage: www.elsevier.com/locate/CretRes

The lizard genera *Bainguis* and *Parmeosaurus* from the Upper Cretaceous of China and Mongolia

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ARTICLE INFO

Article history:
Received 26 August 2017
Received in revised form
10 December 2017
Accepted in revised form 11 January 2018
Available online 31 January 2018

Keywords:
Parmeosaurus
Bainguis
Late Cretaceous
Gobi desert
China
Taxonomy

ABSTRACT

The lizard genus *Bainguis* was originally described from the Upper Cretaceous of Mongolia and attributed to Anguimorpha. The same genus was later reported from the Upper Cretaceous of Bayan Mandahu, Nei Mongol, China on the basis of a partial skeleton showing some similarities in osteoderm morphology. Re-examination of this specimen with the aid of μCT scanning suggests that it is, in fact, attributable to *Parmeosaurus*, a scincoid lizard described from the Ukhaa Tolgod locality, Mongolia, as do two new specimens from Bayan Mandahu. Moreover, some of the Mongolian material originally attributed to *Bainguis* appears also to belong to *Parmeosaurus*. And our new phylogenetic analysis confirms that *Parmeosaurus* is positioned on the stem of Scincoidea. Taken together, these specimens add new data to our understanding of *Parmeosaurus* but also raise questions as to the affinities of *Bainguis*.

1. Introduction

In 1984, Borsuk-Białynicka described several new lizard taxa from the Upper Cretaceous locality of Bayn Dzak, Mongolia, and attributed them to Anguimorpha. One of these, interpreted as a stem-anguimorph ('pre-anguimorph grade'), was *Bainguis parvus*. The designated holotype skull (Institute of Paleobiology, Polish Academy of Sciences, Warsaw, ZPAL MgR-II/46) has osteodermal encrustation on the cranial bones and rectangular osteoderms covering the dorsum of the neck. A second, juvenile, skull (ZPAL MgR-II/90) was referred to the same species on the basis of proportional similarities with the holotype. In addition, Borsuk-Białynicka attributed three postcranial fragments (ZPAL MgR-II/9, II/10, II/11) to *Bainguis* based on osteoderm shape. These postcranial fragments were not described in the journal article, but vertebrae and osteoderms from ZPAL MgR-II/11 were figured (Borsuk-Białynicka, 1984: plates 2:1e and 13:5, respectively [but note that the figure caption on p.99 denoted the first of these as 2:2]). In 1996, Gao and Hou described new lizard material from the Chinese Nei Mongol locality of Bayan Mandahu (Upper Cretaceous, Campanian). Among these specimens was an incomplete postcranial skeleton (Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, IVPP V 10080) enclosed in rectangular, imbricate osteoderms, but with parts of the axial skeleton, pectoral and pelvic girdles, and limbs exposed. On the basis of the rectangular osteoderms, Gao and Hou referred the skeleton to *Bainguis* and, therefore, to Anguimorpha. In 2000, Gao and Norell described a new Late Cretaceous (Campanian) lizard from the Ukhaa Tolgod locality, Mongolia, under the name *Parmeosaurus scutatus* (holotype, Institute of Geology, Mongolian Academy of Sciences, Ulaanbaatar, IGM 3/138). *Parmeosaurus* also had rectangular osteoderms, with those of the dorsum being described as twice the width of those on the venter. Gao and Norell referred *Parmeosaurus* to the Scincoidea, a position supported by the analyses of Gauthier et al. (2012), Reeder et al. (2015), and Pyron (2017), although Conrad (2008) placed it in a more stemward position.

Two different lizard taxa, with similar rectangular osteoderms, have therefore been described from the Campanian of Mongolia

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https://doi.org/10.1016/j.cretres.2018.01.002
0195-6671/

and Chinese Nei Mongol: a putative stem-anguimorph, *Bainguis*, and a stem-scincoid, *Parmeosaurus*. This raises the possibility of misattribution if incomplete specimens are identified on the basis of osteoderm shape. Herein, we re-describe IVPP V 10080, incorporating new μCT scan data, and reassess its attribution to *Bainguis*. We also describe two new osteoderm-bearing specimens from Bayan Mandahu.

2. Abbreviations

acet, acetabulum; add.fs, adductor fossa; aip, anterior inferior process of prootic; am.pr, anteromedial process (of coronoid); an, angular; an.ft, angular facet; an.pr, anterior process (of interclavicle); ar.pro, alar process of prootic; a.san.f, anterior surangular foramen; asca, astragalocalcaneum; a.vc, anterior opening of vidian canal; bo.co, basioccipital condyle; bpt, basipterygoid process; b.tb, basal tubera; ch.ty.n, chorda tympani nerve opening; cla, clavicle; co, coronoid; cr.pro, crista prootica; cr.se, crista sellaris; den.ft, dentary facet; ds.pr, dorsal process (of coronoid); dt3, distal tarsal 3; dt4, distal tarsal 4; ecpt, ectopterygoid; ept, epipterygoid; fem, femur; fib, fibula; f.6, foramen for abducens nerve; f.7, foramen for facial nerve; f.12, foramen for hypoglossal nerves; f.ed, foramen for the endolymphatic duct; fs.c, fossa columellae; f.vb, fenestra vestibuli; hsc, horizontal semicircular canal; hum, humerus; icf, internal carotid foramen; icla, interclavicle; icond.gv, intercondylar groove; il, ilium; isc, ischium; isc.tb, ischial tubercle; ju, jugal; L, left; la.pr, lateral process (of astragalocalcaneum); lrst, lateral opening of recessus scalae tympani; man.co, mandibular condyle; md.cr, median crest (of supraoocipital); mrst, medial opening of recessus scalae tympani; mt, metatarsal; mt5, metatarsal V; obtu.f, obturator foramen; oc.r, occipital recess; osd, osteoderm; pa, parietal; pacet.pr, preacetabular process; pa.f, parietal foramen; p.as, processus ascendens; p.vc, posterior opening of vidian canal; p.co, primary coracoid emargination; pect.tb, pectineal tubercle; pm.pr, posteromedial process (of coronoid); pob, postorbital; pocc, paroccipital process; psp, parasphenoid; pt, pterygoid; pt.lp, pterygoid lappet (of quadrate); pub, pubis; pub.l.pr, pubic lateral process; p.san.f, posterior surangular foramen; qu, quadrate; R, right; rad, radius; rap, retroarticular process; san+ar, surangular+articular; sa.v, sacral vertebrae; scco, scapulocoracoid; scco.f, scapulocoracoid foramen; spl.ft, splenial facet; sq, squamosal; st, supratemporal; stg.pr, supratrigeminal process; st.pr, supratemporal process (of parietal); tib, tibia; tr.v, trunk vertebrae; ty.cr, tympanic crest.

3. Material and methods

Bayan Mandahu (Fig. 1) is one of several Upper Cretaceous localities in the Gobi Basin of China, and Mongolia that have yielded lizards, including the enigmatic burrowing *Sineoamphisbaena* (Wu et al., 1996). The fossiliferous beds at Bayan Mandahu are referred to the Djadochta Formation which is considered to be Campanian in age (~75 Ma, Jerzykiewicz et al., 1993), although there are debates as to the correlation between the Mongolian Djadochta fossil-bearing beds and the Bayan Mandahu beds. Some researchers have argued that the beds at Bayan Mandahu are equivalent to the lowest Upper Cretaceous red beds exposed in the Gobi area of the Mongolian Plateau (i.e., Bayan Mandahu fossiliferous beds are lower than those in Mongolia) based on the faunal composition (Makovicky, 2008; Xu et al., 2013). The environment has been reconstructed as arid or semi-arid (Eberth, 1993), and the locality has yielded turtles (e.g. Brinkman and Peng, 1996), dinosaurs (e.g. You and Dong, 2003; Pittman et al., 2015), dinosaur eggs (Dong and Currie, 1996), and mammals (Ladevèze et al., 2010; Meng, 2014), as well as lizards (Gao and Hou, 1996). The lizard fauna shows similarities to that from the Mongolian Gobi Basin, with the genera *Priscagama*, *Mimeosaurus*, *Adamisaurus* and *Carusia* present at both localities (Gao and Hou, 1996; Gao and Norell, 2000). However, three genera, *Xihaina*, *Anchaurosaurus*, and *Sineoamphisbaena* (Wu et al., 1993; Gao and Hou, 1995) are known only from Bayan Mandahu, whereas some common lizards from the Mongolian Gobi Basin, such as *Slavoia* (Tałanda, 2016) are unrecorded from Bayan Mandahu.

IVPP V 10080 (Fig. 2) is the postcranial skeleton (including the integument) of a medium-sized lizard, in which the pectoral girdles and part of a humerus have been prepared free from the rest of the skeleton which is covered by osteoderms. More recent (2012) fieldwork at Bayan Mandahu yielded two small blocks (IVPP V 23897, V 23898) (both under the same field number 12WL-7) from the site of E106°44′45.9″, N41°44′18.5″. Both specimens bear

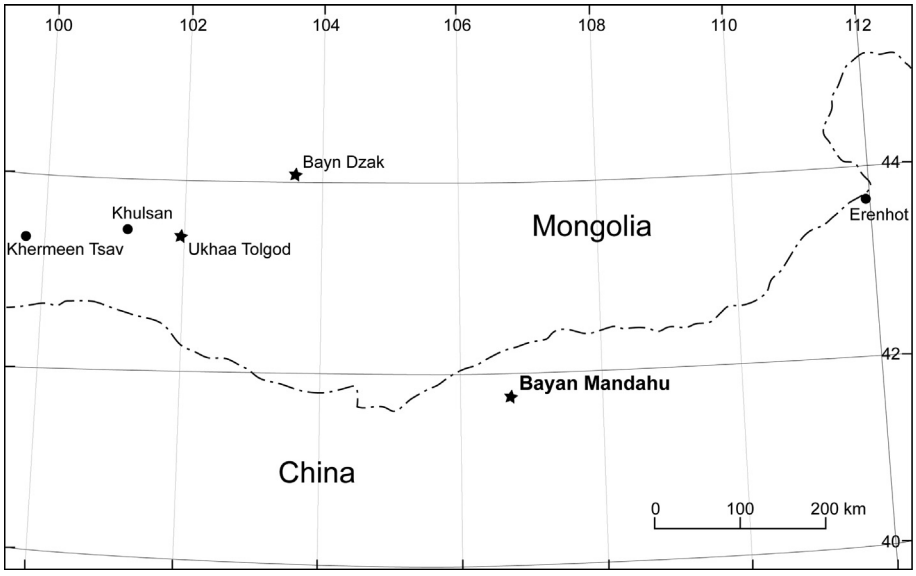

Fig. 1. Map of fossil localities that yield *Bainguis* and *Parmeosaurus* material (indicated by stars). The *Parmeosaurus* material reported by Gao and Norell (2000) is from Ukhaa Tolgod, Mongolia; The new *Parmeosaurus* material here in this paper is from Bayan Mandahu, China; The *Bainguis* material (Borsuk-Białynicka, 1984) is from Bayn Dzak, Mongolia.