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Early Cretaceous choristoderes (Diapsida, Choristodera) from Siberia, Russia

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ABSTRACT

There are ten known Lower Cretaceous localities for skeletal remains of choristoderes in Siberia (Russia). Choristoderan remains at all these localities are represented by isolated bones, usually by isolated vertebrae of Choristodera indet. Three choristoderan taxa in two geological units were identified: the non-neochoristodere *Khurendukhosaurus* sp. (possibly closely related to the long-necked Sino-Japanese hyphalosaurids) from the Murtoi Formation, Transbaikalia; cf. *Khurendukhosaurus* sp. and the "Shestakovo choristodere" with possible neochoristoderan affinities from the Ilek Formation, Western Siberia. All these three choristoderan taxa had a microanatomical organization of vertebrae similar to that of in advanced large neochoristoderes (vertebral centra with tight spongiosa). The Siberian fossil record includes the westernmost (Shestakovo locality, Ilek Formation) and the northernmost (Teete locality, the Sangarian Group) occurrences of the Early Cretaceous choristoderes in Asia. Like in other regions of Asia, Siberian localities are characterized by the absence of neosuchian crocodyliforms.

1. Introduction

Choristodera is a clade of freshwater diapsid reptiles known from the Middle Jurassic to Miocene of Laurasia and characterized by a unique combination of characters (e.g., dorsoventrally depressed cordiform skull, prefrontals meeting along the midline, conical subthecodont marginal teeth, neurovascular foramina in the lateral surface of the dentary opening in longitudinal grooves; midline crest on the dorsal surface of the vertebral centrum, figure–of-eight-shaped articular surface of the synapophysis of the dorsal vertebrae, articular surface of the synapophysis passes through the suture between the neural arch and vertebral centrum) (Gao and Fox, 1998; Evans and Klembara, 2005; Averianov et al., 2006a; Matsumoto and Evans, 2010, 2015). Choristoderes were most taxonomically and morphologically diverse during the Early Cretaceous: seven of the eleven unquestionably valid choristoderan genera (*Hyphalosaurus* Gao, Tang et Wang, 1999, *Shokawa* Evans, Manabe, 1999, *Khurendukhosaurus* Sigogneau-Russell, Efimov, 1984, *Monjurosuchus* Endo, 1940, *Philydrosaurus* Gao and Fox, 2005, *Tchoiria* Efimov, 1975 and *Ikechosaurus* Sigogneau-Russell, 1981b) and all choristoderan morphotypes (short-necked long-irostrine, short-necked brevirostrine and long-necked brevirostrine) are known from this interval of time (Matsumoto et al., 2007, 2013, 2015; Matsumoto and Evans, 2010, 2015). The Early Cretaceous choristoderes were represented by members of the most derived choristoderan clade Neochoristodera (*sensu* Evans and Hecht, 1993) and by diverse more basal taxa (non-neochoristoderes). The Early Cretaceous neochoristoderans are known from the Asia (*Tchoiria* and *Ikechosaurus*) and North America (Neochoristodera indet.), while all Early Cretaceous non-neochoristoderans (namely *Hyphalosaurus*, *Shokawa*, *Khurendukhosaurus*, *Monjurosuchus* and *Philydrosaurus*) are known only from Asia (Britt et al., 2006; Matsumoto and Evans, 2010, 2015).

During last two decades our knowledge of the Early Cretaceous vertebrate life of Siberia (huge territory of the Asiatic part of Russia, see Fig. 1) has greatly increased due to the discovery of several rich localities containing diverse terrestrial vertebrate assemblages (e.g., Leshchinsky et al., 2003; Averianov et al., 2006b, 2015; Averianov and Lopatin, 2015). Remains of choristoderes were found in all those localities and now choristoderes can be considered as a common component of Early Cretaceous Asiatic vertebrate faunas. However, the choristoderan remains from the Lower Cretaceous of Siberia have only been described and figured from two localities – Mogoito in Transbaikalia (south part of Eastern

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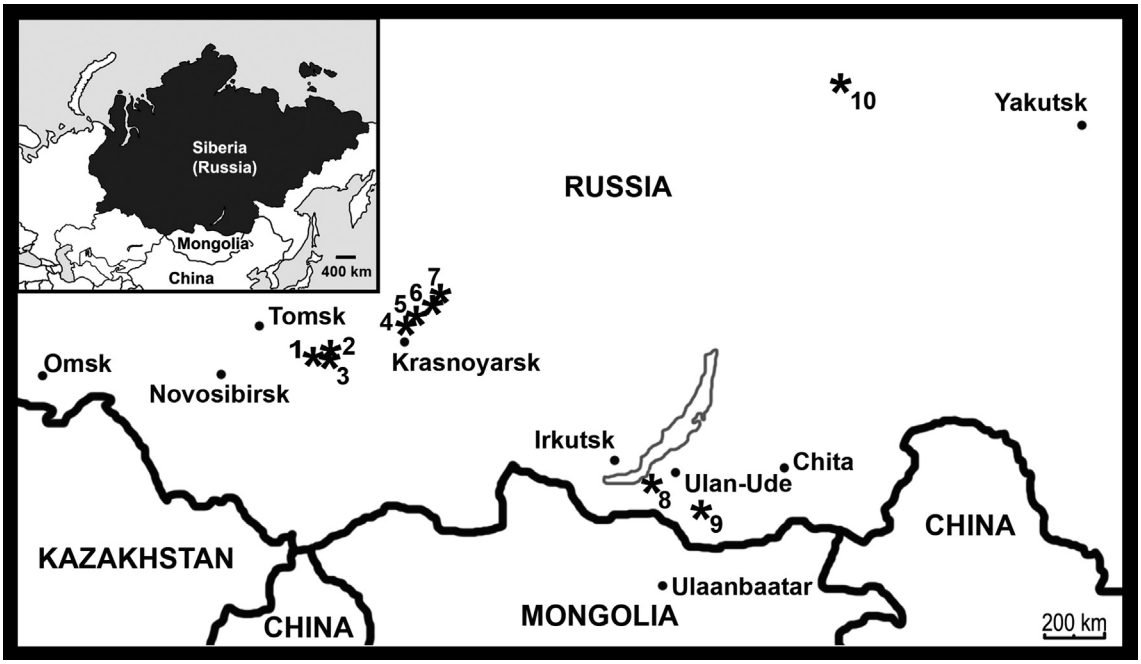

Fig. 1. Map showing Early Cretaceous choristoderan localities in Siberia. Inset map of central and northern portions of the Asian continent depicting the territory of Siberia in dark grey. 1 – Shestakovo, 2 – Smolenskii Yar, 3 – Ust'-Kolba, 4 – Bol'shoi Kemchug 3, 5 – Bol'shoi Kemchug 4, 6 – Bol'shaya Terekhtul' 2, 7 – Bol'shaya Terekhtul' 4, (Ilek Formation; Lower Cretaceous), Western Siberia; 8 – Mogoito (Murtoi Formation; Barremian?–Aptian), 9 – Krasniy Yar (Khilok Formation; Barremian–Aptian), Transbaikalia; 10 – Teete (Sangarian Group), Yakutia.

Siberia) (Efimov, 1996; Skutschas, 2008) and Shestakovo in Western Siberia (Skutschas and Vitenko, 2015). To fill this gap, we provide here updated information on the records of Early Cretaceous choristoderes from Siberia (focussing on new findings and previously undescribed material) and discuss some aspects of phylogeny, anatomy (bone microstructure), and palaeobiogeography of the Early Cretaceous choristoderes from this region (Table 1).

Institutional Abbreviations. LMCCE, Laboratory of Mesozoic and Cenozoic Continental Ecosystems, Tomsk State University, Tomsk, Russia; PIN, A.A. Borissyak Palaeontological Institute, Russian Academy of Sciences, Moscow, Russia; ZIN PH, Paleoherpetological collection, Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia.

2. Review of choristoderan localities in Siberia

Siberian choristoderes are known from several localities in four Lower Cretaceous geological units: the Ilek Formation in Western Siberia, Murtoi and Khilok formations in Transbaikalia (south part of Eastern Siberia) and the Sangarian Group in Yakutia (north part of Eastern Siberia) (Fig. 1). The choristoderan localities of the Ilek Formation of Western Siberia are concentrated in two regions, the Kiya River Basin in Kemerovo Province (Shestakovo, Smolenskii Yar, Ust'-Kolba localities) and Kemchug River Basin in Krasnoyarsk Territory (Bol'shoi Kemchug 3, Bol'shoi Kemchug 4, Bol'shaya Terekhtul' 2 and Bol'shaya Terekhtul' 4 localities)) (Fig. 1).

2.1. Shestakovo

Geographic position: Natural outcrop on the right bank of the Kiya River (GPS coordinates: N 55°54.6′, E 87°56.9′), 1.5 km downstream from Shestakovo village, in Chebula District, Kemerovo Province, Western Siberia, Russia.
Stratigraphy: Ilek Formation.
Age: Aptian–Albian (Averianov et al., 2006b).

Associated vertebrate assemblage: Palaeonisciform and amiiform actinopterygians, stem and crown salamanders, "macrobaenid" turtles, diverse lizards, "protosuchian" and shartegosuchid crocodyliforms, various ornithischian and saurischian dinosaurs, pterosaurs, birds, tritylodontids and diverse mammals (see Averianov et al., 2006a, 2006b and references therein).
Previously referred material. ?Neochoristodera indet. ("Shestakovo choristodere" in this paper): fragmentary dentaries LMCCE 2-3/4, cervical vertebra LMCCE 4/4, dorsal vertebrae LMCCE 5-8/4, proximal rib fragments LMCCE 9-10/4 (Skutschas and Vitenko, 2015).
Newly referred material. ?Neochoristodera indet. ("Shestakovo choristodere" in this paper): dorsal vertebra LMCCE 11/4; Fig. 2A–F.
Comments. The material previously referred to Choristodera indet. from the Shestakovo locality was described in and figured by Skutschas and Vitenko (2015). The choristodere from the Shestakovo locality has a suite of vertebral characters that are widely distributed among non-neochoristoderes such as closed vertebral notochordal canals, the absence of small spinous processes below the presacral postzygapophyses and the ventromedial crest on dorsal vertebrae, closed neurocentral sutures, elongated amphiplatycoelus vertebral centra, the absence of a dorsal expansion of the neural arch (with a rugose dorsal area) of the dorsal vertebrae, and pronounced ventral longitudinal keels on the cervical vertebrae (Skutschas and Vitenko, 2015; Fig. 2). One of the most diagnostic characters of the choristodere from Shestakovo (that distinguishes this form from other Siberian choristoderes) is the presence of slit-like depressions between the zygapophyses (Skutschas and Vitenko, 2015; Fig. 2). Among choristoderes with described vertebral morphology, similar slit-like depressions between the zygapophyses are present in the advanced neochoristodere *Simoedosaurus* Gervais, 1877 (Sigogneau-Russell, 1981a; pers. obs.). Despite the presence of the above-mentioned diagnostic features, we avoid naming a new taxon pending the discovery of additional and more informative material.