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On an Ornithomimid Dinosaur (Saurischia, Ornithomimosauria) from the Cenomanian of Fergana

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Abstract—A fragmentary coracoid of Ornithomimidae indet. from the Lower Cenomanian of the Abshir River (Kyrgyzstan) is described. This is the first record of this group in a Cenomanian locality of Fergana. The coracoid from the Abshir locality is similar in the lateral deflection of the glenoid to an endemic group of Asiatic Ornithomimidae that includes *Anserimimus, Gallimimus*, and taxa from the Cenomanian and Turonian of western Uzbekistan. It is most similar to the unnamed ornithomimid from the Cenomanian of Karakalpakia in having a distinct vertical crest that borders anteriorly a depression for the coracobrachialis brevis muscle. Dinosaurs recorded in the Cenomanian of Fergana are reviewed.

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Key words: Dinosauria, Ornithomimosauria, Cenomanian, Asia, Kyrgyzstan, Fergana Depression.

INTRODUCTION

Dinosaur remains are diverse and widespread in the Fergana valley (Kyrgyzstan, Uzbekistan, and Tajikistan) in the Yalovach Formation, which is dated Santonian (Rozhdestvensky and Khozatsky, 1967; Rozhdestvensky, 1970, 1977; Nessov, 1980, 1988, 1995, 1997; Nessov and Verzilin, 1983; Alifanov and Averianov, 2006). At the same time, only little is known about the Late Cretaceous dinosaur fauna from the earlier Cenomanian deposits. In Fergana, the Cenomanian is represented by thick strata, mostly continental red beds occurring below the Oyster (= *"Exogyra"*) Member, which dates a transgression of the Fergana Gulf in the Early Turonian (Poyarkova, 1969). A total of 13 localities with Cenomanian dinosaurs are known in the Fergana valley and adjacent foothills of the Tien Shan (Fig. 1):

(1) Abshir locality, Osh Region, Kyrgyzstan. Dinosaur bones were found in red sandstones and clays of the Tokubai Formation of the Albian–Cenomanian (Sochava, 1968; Martinson, 1968, 1989; Nessov, 1995, 1997). In 1985, D.V. Borkhvardt found a dinosaurian bone in a Cretaceous section on the left bank of the Abshir River opposite a coal pit, which was not mentioned in regional reviews (Nessov, 1995, 1997). I have determined this bone as a coracoid of an ornithomimid dinosaur and describe it in the present paper. It comes from the level 40–50 m below the Lower Turonian Oyster (= *"Exogyra"*) Beds, which corresponds to beds with *Plicatotrigonoides simakovi* of the local section, assigned to the Lower Cenomanian (Poyarkova, 1969). The bone was enclosed in a piece of gray, dense, coarse-grained sandstone with clayey pebble, which is characteristic of these beds.

(2) Kylodzhun 2 locality, Osh Region, Kyrgyzstan. Bones of hadrosaurids were recorded in the lower strata of the Sharikhan Formation (Verzilin et al., 1970; Verzilin and Nessov, 1978; Nessov, 1995, 1997; Averianov and Bakirov, 2000).

(3) Gulcha locality, Osh Region, Kyrgyzstan. A large accumulation of dinosaur bones, including presumable sauropods, was discovered by G.G. Martinson in 1962 in the middle layers of thick strata (more than 100 m thick) of red sandstones and clays assigned to the lower part of the Sharikhan Formation (Verzilin, 1967; Rozhdestvensky and Khozatsky, 1967; Martinson, 1968, 1989, 1990; Rozhdestvensky, 1969, 1973; Nessov, 1995; Averianov and Bakirov, 2000).

(4) Sufikurgan locality, Osh Region, Kyrgyzstan. A large femur of a "carnosaur" was found by P.V. Fedorov in the Sharikhan Formation (Nessov, 1995, 1997; Averianov and Bakirov, 2000).

(5) Karakul'dzha locality, Osh Region, Kyrgyzstan. Dinosaur bones were recorded in the Sharikhan Formation (Verzilin, 1976; Nessov, 1995, 1997). Bones of a dinosaur (Verzilin, 1976) and a hadrosaurid ("a fragmentary crus," Martinson, 1968) were also found in another locality on the Karakul'dzha River in the Kara-Alma Formation of the Cenomanian (Nessov, 1995, 1997; Averianov and Bakirov, 2000).

(6) Kurshab locality, Osh Region, Kyrgyzstan. Hadrosauridae indet. were recorded in red sandstones of the Kurshab (= Sharikhan = Kara-Alma) Formation (Nessov, 1995, 1997; Averianov and Bakirov, 2000). The locality was dated within the interval from the Upper Albian to the Lower Turonian (Nessov, 1995); however, like

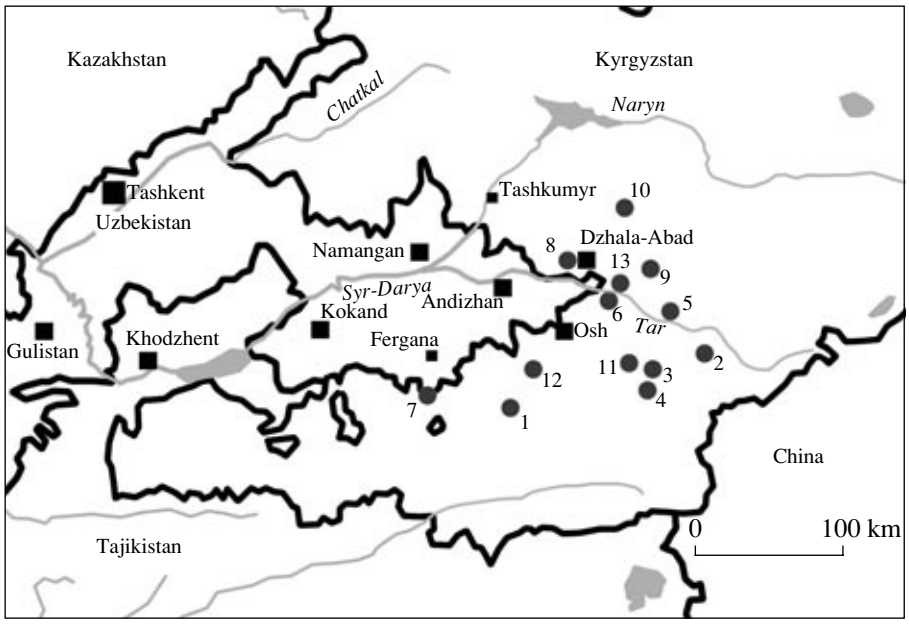

Fig. 1. Localities of Cenomanian dinosaurs in the Fergana valley: (1) Abshir, (2) Kylodzhun 2, (3) Gulcha, (4) Sufikurgan, (5) Karakul'dzha, (6) Kurshab, (7) Lyagan, (8) Suzak, (9) Changet 3, (10) Kara-Alma, (11) Aldyyar, (12) Aravan, and (13) Kampyr-Ravat.

other localities of the Sharikhan Formation, it should be assigned to the Cenomanian.

(7) Lyagan locality, Fergana Region, Uzbekistan. Dinosaur bones were recorded in the Sharikhan Formation (Verzilin, 1976; Nessov, 1995, 1997).

(8) Suzak locality, Dzhala-Abad Region, Kyrgyzstan. Skeleton fragments (incomplete pelvic girdle with a sacrum and a femur) of a sauropod were found by A.K. Rozhdestvensky in 1964 in red sandstones, clays, and gravelstones of the lower strata of the Sharikhan Formation located stratigraphically below the Turonian Oyster (= *"Exogyra"*) Beds (Rozhdestvensky and Khozatsky, 1967; Rozhdestvensky, 1973; Nessov, 1995, 1997; Averianov and Bakirov, 2000).

(9) Changet 3 locality, Dzhala-Abad Region, Kyrgyzstan. Remains of a large theropod and a hadrosaurid were found in sand and gravelstone beds of the Sharikhan Formation (Nessov, 1995, 1997; Averianov and Bakirov, 2000).

(10) Kara-Alma locality, Dzhala-Abad Region, Kyrgyzstan. Hadrosaurid bones were recorded in the Sharikhan Formation (= Upper Changet Group) (Simakov et al., 1957; Nessov, 1995, 1997; Averianov and Bakirov, 2000).

(11) Aldyyar locality, Osh Region, Kyrgyzstan. Gravelstones and sandstones tentatively assigned to the Sharikhan Formation have yielded a tooth of the theropod cf. Tyrannosauridae indet. (Nessov, 1997).

(12) Aravan locality, Osh Region, Kyrgyzstan. Dinosaur bones were recorded in red beds composed of friable clays, sandstones, gravelstones, and conglomerates (Martinson, 1989; Nessov, 1995, 1997).

(13) Kampyr-Ravat locality, Osh Region, Kyrgyzstan. A bone bed breccia composed of dinosaur bone fragments is at the base of the *"Exogyra"* Beds of the Lower Turonian (Yur'ev, 1954; Simakov et al., 1957; Nessov, 1995; Averianov and Bakirov, 2000). The first dinosaur specimens were found there by P.D. Trusov in 1928. The bones could have been redeposited from the Cenomanian beds.

The above review shows that dinosaurian remains are rather common in the Cenomanian beds of Fergana. However, the overwhelming majority of these specimens have not been investigated in detail nor published, and their depository is presently unknown. The only exception is a fragmentary coracoid of an ornithomimid from the Abshir locality, which is described in the present paper. I prepared the bone enclosed in dense sandstone both mechanically and chemically, using 7% acetic acid solution. The specimen examined is housed in the Paleoherpetological collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg (ZIN PH); collection no. 1/28.

DESCRIPTION AND DISCUSSION

Description (Fig. 2). The posterior process, glenoid region, and, partially, the scapular articular facet are only preserved in the coracoid fragment described. The external surface of the coracoid is convex, while the internal surface is concave. This concavity on the medial surface of the coracoid was probably the origin of the subcoracoideus muscle, if the subcoracoscapularis muscle of dinosaurs was divided into the subscapularis and subcoracoideus muscles (Osmólska et al., 1972; Coombs, 1978; Dilkes, 2000). On the medial

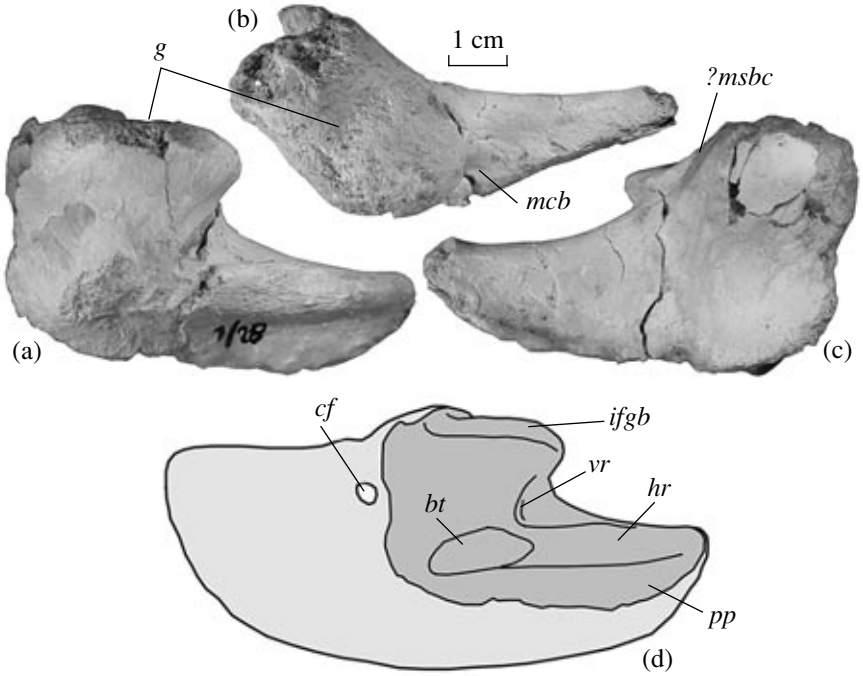

Fig. 2. Ornithomimidae indet., ZIN PH, no. 1/28, fragmentary left coracoid: (a) lateral, (b) dorsal, and (c) medial views and (d) reconstruction in lateral view; Abshir River, Kyrgyzstan; Lower Cenomanian. Scale bar for (a–c), 1 cm. Designations: (*bt*) biceps tubercle, (*cf*) coracoid foramen, (*g*) glenoid, (*hr*) horizontal crest, (*ifgb*) infraglenoid buttress, (*mcb*) area for a tendon of the coracobrachialis brevis muscle; (*?msbc*) groove presumably for an aponeurosis of the subcoracoideus muscle, (*pp*) posterior process, and (*vr*) vertical crest.

side, the ventral margin of the infraglenoid buttress has a clear groove, which probably contained an aponeurosis of the subcoracoideus muscle. The posterior process is relatively long, projects far posteriorly beyond the glenoid. The process is thickened abruptly along the dorsal margin and abruptly narrows towards the ventral margin. Ventral to the glenoid, the dorsal side of the posterior process has a relatively deep depression, which narrows posteriorly and is bordered anteriorly by a distinct vertical crest. This depression is treated as the origin of the coracobrachialis brevis muscle (Nicholls and Russell, 1985). The ventral part of the posterior process is slightly disrupted; however, it is evident that no more than half of the bone height is lost, so that the process was relatively low dorsoventrally. The lateral side of the posterior process has a stout horizontal crest, which is connected anteriorly to a large biceps tubercle (for the biceps brachii muscle). This tubercle is located close to the base of the posterior process. The glenoid is deep, with a massive infraglenoid buttress. The long axis of the infraglenoid buttress is inclined laterally at an angle of about 55° to the axis of the posterior process, i.e., the glenoid faces posterolaterally.

Discussion. The assignment of specimen ZIN PH, no. 1/28 to ornithomimosaurs is supported by two characters: (1) the ventral blade of the coracoid is low dorsoventrally and (2) the posterior process of the coracoid is long. The first character is typical for coelurosaurs that are more primitive than the Dromaeosauridae, Avialae, Troodontidae, Therizinosauroidea, and Oviraptorosauroidea, i.e., for Ornithomimosauria and Alvareszauridae (Norell et al., 2001; Clark et al., 2002). The second character is regarded as a synapomorphy of Ornithomimosauria (Kobayashi and Lü, 2003). In the Alvareszauridae, in contrast to ornithomimosaurs and specimen ZIN PH, no. 1/28, the coracoid lacks a biceps tubercle (Perle et al., 1994; Novas, 1996). This tubercle is well developed in ornithomimosaurs, which have relatively long, unreduced forelimbs. Thus, it is reasonably safe to suggest that specimen ZIN PH, no. 1/28 belongs to Ornithomimosauria. The ornithomimid from Abshir is phylogenetically intermediate in coracoid structure between *Archaeornithomimus* Russell, 1972 and *Sinornithomimus* Kobayashi et Lü, 2003 (Cenomanian–Turonian? of China), resembling them in the presence of a massive horizontal crest connected to the biceps tubercle; it is similar to *Anserimimus* Barsbold, 1988 and *Gallimimus* Osmólska, Roniewicz et Barsbold, 1972 (Maastrichtian of Mongolia) in the laterally turned infraglenoid buttress relative to the axis of the posterior process. In *Anserimimus* and *Gallimimus*, the horizontal crest is less developed and is not connected to the biceps tubercle; in addition, the posterior process of the coracoid of *Gallimimus* is considerably reduced. A similar phylogenetic position is occupied by an ornithomimid from the Turonian of the central Kyzyl Kum, which was originally described as *Archaeornithomimus*

(?) bissektensis Nessov, 1995 (Nessov, 1995; Averianov and Sues, 2004). A related ornithomimid taxon is also present in the Cenomanian of Karakalpakia (unpublished data of the author and H.-D. Sues). Specimen ZIN PH, no. 1/28 is similar to ornithomimid coracoids from the Lower Cenomanian of Karakalpakia (ZIN PH, nos. 864/16 and 904/16) in the presence of a distinct vertical crest that borders anteriorly a depression for the coracobrachialis brevis muscle. This crest is absent from the ornithomimid from the Turonian of the Kyzyl Kum. It is possible that the ornithomimids found in the Cenomanian of Karakalpakia and Fergana belong to the same taxon, while the ornithomimid from the Turonian of Kyzyl Kum represents a different taxon.

Previously, ornithomimid remains have not been recorded in the Cenomanian of Fergana. Taking into account preliminary determinations of unpublished materials, the dinosaur fauna from the Cenomanian of Fergana includes at least four taxa: Sauropoda indet., large Theropoda indet. ["carnosaurs" and cf. Tyrannosauridae indet.], Ornithomimidae indet., and Hadrosauridae indet. This fauna deserves further investigation. In particular, hadrosaurids from the Cenomanian of Fergana are among the earliest members of this group, and the ornithomimid described probably belongs to a distinct taxon.

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