# A review of the Early Cretaceous fossil vertebrates of the Shestakovo Assemblage (south-east Western Siberia, Russia)

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**Abstract:** This paper reviews the Early Cretaceous vertebrate remains, first discovered in 1953 in the southeastern part of Western Siberia, beside the Kiya River in the village of Shestakovo (Kemerovo region). In the Ilekskaja suite, a local lithostratigraphic unit, at the Shestakovo-I site, a steep river bank, two fragmentary dinosaur skeletons, later assigned to *Psittacosaurus mongoliensis* OSBORN were recovered. In 1995, two new sites in the same area (Shestakovo-2 and Shestakovo-3) were discovered. Since 1998 a great deal of small vertebrate remains have been recovered by washing coarse-grained deposits (sands and gravels).

During the five-year study, many new fossils have been found, and this has resulted in new data on the morphology and systematics of fish, reptiles and other vertebrates and the reconstruction of two *Psittacosaurus* skeletons. Essentially all classes of continental vertebrates have been found in the Shestakovo assemblage: 1) fishes: Sinamiidae indet, *Palaeonisciformis* indet. 2) reptiles: tritylodonts (*Xenocretosuchus sibiricus* TATARINOV & MASHCHENKO), turtles (*Kirgizemys* sp.), lizards (Xenosauridae gen. & spec. nov.), crocodiles *(Kyasuchus saevi* EFIMOV & LESHCHINSKY; *Tagarosuchus kulemzini* EFIMOV), dinosaurs (Velociraptorinae indet.; Dromaeosauridae indet.; Sauropoda indet; *Psittacosaurus sibiricus* VORONKEVICH & AVERIANOV); 3) mammals: triconodonts (*Gobiconodon borissiaki* TROFIMOV, *G. hoburensis* TROFIMOV), symmetrodonts (Amphidontidae genus et sp. nov.).

**Keywords:** Early Cretaceous, Vertebrates, Siberia, Russia

## 1. INTRODUCTION

In 1953, the fragments of two skeletons of the Early Cretaceous dinosaur *Psittacosaurus* were found in deposits of the Ilekskaya suite (a local lithostratigraphic unit) exposed in a high bank of the Kiya River near the village of Shestakovo, Kemerovo region (Figs 1, 2). Subsequent work in the area, in 1954, detected no new vertebrate remains (ROZHDESTVENSKIY, 1960), but early in the 1960's, the bones of a larger dinosaur were found in the high river bank at Shestakovo (BULYNNIKOVA & TRUSHKOVA, 1967). The fragments of the *Psittacosaurus* skeletons detected in 1953 are now deposited in the Palaeontological Institute of the Russian Academy of Sciences (PIN RAS), Moscow.

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Subsequently, Early Cretaceous vertebrates were found near Shestakovo in 1994, when, in the debris of the Shestakovo river bank, a cheek tooth of a therapsid reptile (*Tritillodontus*) and a phalanx of a sauropod were detected (Tatarinov & Mashchenko, 1999). This was the first find of tritillodontids in Cretaceous deposits; previously, they had been considered to have become extinct in the Middle to Late Jurassic (Tatarinov & Mashchenko, 1999). In 1995, sauropod bones were found in sandstones in the Shestakovo high bank and two new fossil sites of Early Cretaceous vertebrates were discovered: Shestakovo-2 (3 km downstream on the Kiya river from Shestakovo-1) and Shestakovo-3 (1 km south-eastward from the village of Shestakovo; Sayev & Leshchinskiy, 1997). In the same year, a fragment of a tooth from the mammal *Gobiconodon borissiaki* Trofimov was found at Shestakovo-1, the first find of a Mesozoic mammal in Russia (Mashchenko & Lopatin, 1998, Mashchenko, 1999). In 1996, excavations at the Shestakovo-3 locality began (Leshchinskiy et al., 1997), since when continuous excavations have been performed at the locality, simultaneously with the search for Early Cretaceous vertebrate remains in other districts. During 1998–1999, large-scale washing of the bone-bearing deposits (about 4 tons) at Shestakovo-1 was performed, resulting in much new and important material from mammals, tritillodontids, lizards, turtles and other vertebrates.

The present work outlines the preliminary results of the studies concerning the Early Cretaceous vertebrates remains from Shestakovo-1, 2, and 3. The material, which has been deposited in the collection of the Siberian Paleontological Scientific Center of TSU, allows the previously known results from the Shestakovo assemblage to be supplemented and refined (Alifanov et al, 1999; Voronkevich, 1998; Yefimov & Leshchinskiy, 1998; Rozhdestvenskiy & Khozatskiy, 1967; Faingerts & Leshchinskiy, 2000).

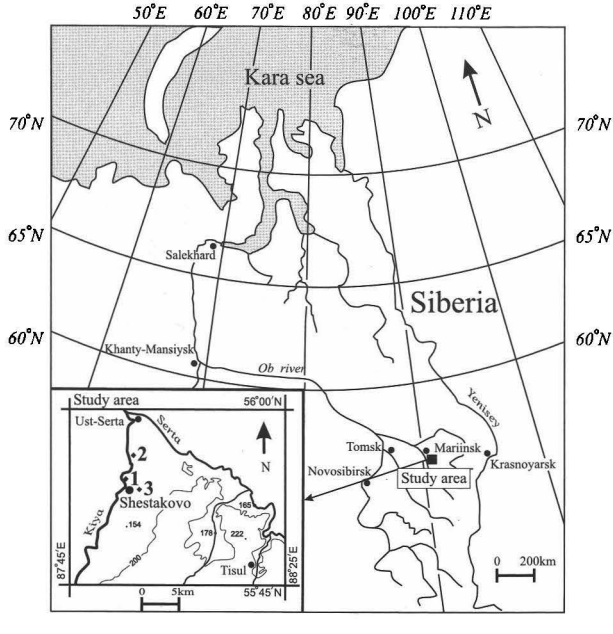


Fig. 1:
Schematic map of the localities of the Shestakovo assemblage in the south-east of Western Siberia. 1 – locality Shestakovo-1; 2 – locality Shestakovo-2; 3 – locality Shestakovo-3.

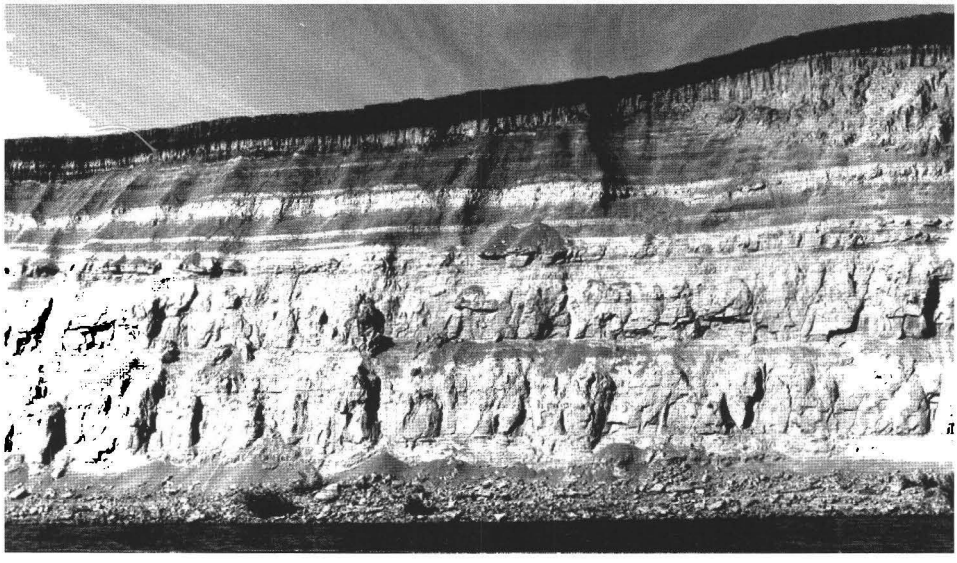

Fig. 2: The Shestakovo-1 high bank cutting (~ 37 m high). View from the Kiya river.

## 2. THE LITHOSTRATIGRAPHICAL POSITION OF THE SHESTAKOVO ASSEMBLAGE

The Early Cretaceous vertebrate localities near Shestakovo are confined to the Ilekskaya suite, a local lithostratigraphic subdivision with a stratotype described by RAGOSIN (1936) from the right bank of the Chulym in the Bolshoy Ilekh outcrop, near the town of Achinsk (Krasnoyarsk Territory). The suite occurs unconformably above Jurassic and Paleozoic deposits and is in turn overlain by Early Cretaceous rocks of the Kiyskaya, Simonovskaya and Pokurskaya suites. The rocks of the Ilekskaya suite, which are of Valanginian-Aptian(?) age (BULYNNIKOVA & SURKOV, 1962), crop out only in the south of the Chulym-Yenisey district, in the the basins of the Kiya, the Chulym, the Kemchug and the Kem, where they are represented by greenish-grey and yellowish-green sands, with calcareous sandstone concretions, interbedded rhythmically with packets of thin-laminated greenish-grey and brown-red siltstones and clay marls. The Vartovskaya suite in the north and the Kiyalinskaya suite in the west and north-west of Western Siberia are facies analogues of the Ilekskaya suite. Until recently, the Ilekskaya suite has been considered to be essentially barren of organic remains; a poor palinospectra, common to the Aptian-Albian, was obtained from the upper part of the suite and of its facial analogues as well and a spores and pollen spectrum dated to the Neocomian was obtained from the Kasskaya reference borehole, in the middle part of the Ilekskaya. On the Uryup river, a tributary of the Chulym river, pelecypods and gastropods were isolated from the base of the Ilekskaya suite, justifying the Valanginian age, and higher throughout the section, Barremian ostracods and pelecypods were detected (BULYNNIKOVA & TRUSHKOVA, 1967). Gastropods and pelecypods characteristic for the Hauterivian to Barremian interval were identified in the specimens from the Chulym reference borehole from the upper part of the suite (BULYNNIKOVA & SURKOV, 1962).

## 3. THE PALEOGEOGRAPHIC SETTING AND CONDITIONS OF SEDIMENTATION

At the end of the Late Jurassic and up to the Early Cretaceous in the Chulym-Yenisey district, a depositional landscape with oxidizing conditions may have existed. Most likely, the terrain was a low relief semi-desert plain, having a scarce vegetation cover, producing variegated terrigenous deposits with poor sorting, weak roundness and a polymict composition in which a red-earth type of weathering predominated. Erosional processes at sites of ablation might have given the bulk of the terrigenous material which was deposited in subsiding lowlands. Thus, there was no substantial redeposition of the sediment, this being a key factor in forming the accumulations of vertebrate fossil remains.

## 4. REVIEW OF VERTEBRATE REMAINS IN THE SHESTAKOVO COMPLEX

### 4.1. Fishes

The material, most of which was obtained by washing coarse unsorted sands at Shestakovo-1, included rhombic scales and fragmentary dental plates of bowfishes Sinamiidae indet., as well as scales of paleoniscs (*Palaeonisciformis* indet.) (Leshchinskiy et al., 2000).

### 4.2. Reptiles

#### *4.2.1. Tritylodonts*

The Tritylodont remains from Shestakovo-1 and -3 are the first findings of this group in the Cretaceous of Asia. Previously, the group was thought to have become extinct in the Late Jurassic. The Tritylodont remains include separate mandible and maxilla teeth, mandible incisors and a fragmentary mandible with an incisor (a total of more than 50 remains) as well as separate postcranial bones. The new tritylodont genus and species, *Xenocretosuchus sibiricus* Tatarinov & Mashchenko, which was found at Shestakovo-1, is a modest-sized *Tritylodontidae* type, with a simplified histology of cheek teeth, having only two full rows of relatively narrow ridge-like denticles (Tatarinov & Mashchenko, 1999). These recent finds suggest that "biserial" tritylodonts were abundant during the Cretaceous in the south-eastern part of the West-Siberian plain (Shestakovo-1, -3) and in Japan (Nakuru Formation, Setoguchi et al., 1999).

#### *4.2.2. Turtles*

A few, mostly fragmentary, carapace plates and postcranial skeleton bones of a modest-sized freshwater turtle of the Macrobaenidae family have been found. This is close to the *Kirgizemys* generic type and is here confidently determined as *Kirgizemys* sp. (Leshchinskiy et al., 2000). The *Kirgizemys* genus has been previously described from the Transbaikalian Barremian-Aptian and the Aptian-Albian of Central Asia, Mongolia and China (Nessov, 1995, 1997).

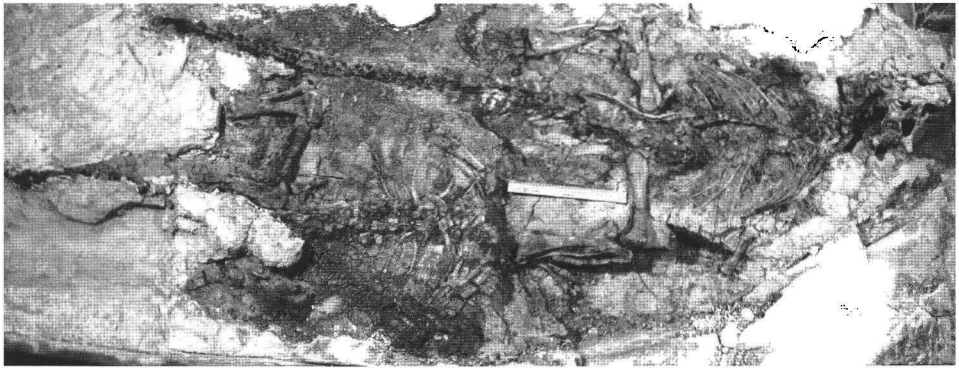

Fig. 3: Two skeletons of *Psittacosaurus sibiricus* VORONKEVICH & AVERIANOV (PM TSU 16/4–20, holotype).

### *4.2.3. Lizards*

Lizards are represented by tens of fragmentary jaws, vertebral columns and elements of postcranial skeletons of 3 to 4 forms: Xenosauridae gen. et spec. nov., *Paramacellodus* sp., *Scincomorpha*? indet. (AVERYANOV & FAINGERTS, 2001). This assemblage closely matches the one from the Mongolian locality of Khobur.

### *4.2.3. Crocodiles*

Crocodiles are represented by numerous fragmentary jaws, bones of postcranial skeletons and teeth. As well as this, two craniums have been found at Shestakovo-3, belonging to modest-sized forms. One of those belongs to *Kyasuchus saevi* YEFIMOV & LESHCHINSKY; a holotype (a cranium with a mandible detected in the 1996 excavations) has been deposited in the Paleontological Museum of Tomsk State University [PM TSU] – No. 16/I-184 (YEFIMOV & LESHCHINSKY, 2000). The other one, which was found in 1997, belongs to *Tagarosuchus kulemzini* EFIMOV (ALIFANOV et al., 1999). *Kyasuchus saevi* of the Shartegosuchidae (Notosuchia) family most closely resembles *Shartegosuchus* from the Mongolian locality Shar-Teg (Upper Jurassic). *Tagarosuchus kulemzini* is assigned to the Protosuchia, the most archaic group.

### *4.2.4 Dinosaurs*

At the Shestakovo localities the remains of sauropods, therapods (dromeosaurids) and ceratops (psittakosaurs) have been detected to date.

Dromeosaurids

There have been found several teeth of a relatively large *Velociraptorinae* indet. with front denticles ranking considerably below rear ones in size. Dromeosaurids were widely distributed throughout the Early Cretaceous in Asia. Their remains (usually isolated teeth) are reported from the Berriassian-Valanginian (Velociraptorinae indet.) and the

Hauterivian-Aptian and Albian (Dromaeosauridae indet.) of Japan, as well as from the Late Barremian (*Sinornithosaurus*) and Albian (?) of China, and the Barremian-Aptian of Transbaikalia (LESHCHINSKIY et al, 2000).

In Shestakovo-3 ALIFANOV et al. (1999) detected the existence of a fragmentary skeleton of a small-sized carnivorous dinosaur of the Troodontidae family. There are no troodontid remains in our materials. In the Early Cretaceous of Asia troodontids were reported from China (*Sinornithoides*, end of Early Cretaceous) and from the Mongolian Aptian-Albian (Troodontidae indet.).

Sauropods

ALIFANOV et al. (1999) ascertained the presence of a Titanosauridae form based on the find of a rounded peg-shaped tooth. Similar teeth are also typical for some forms of the Diplodocidae. In our materials there is presented a juvenile species' tooth with a spoon-form crown having no denticles, as well as a vertebra and an incomplete foot of Sauropoda indet. with no less than 3 ungual phalanxes.

Fig. 4: The skull of *Psittacosaurus sibiricus* VORONKEVICH & AVERIANOV, lateral view. PM TSU 16/4–20, holotype.

Ceratops

The most part of bone materials available, two skeletons in that number, belongs to a small-sized ornithischian dinosaur of the Ceratopsia group – *Psittacosaurus sibiricus* Voronkevich & Averianov (PM TSU holotype 16/4–20 – a skeleton with a cranium; Figs. 3, 4). This species differs from the known Psittacosaurs in a number of features (Leshchinskiy et al., 2000), being the greatest and most advanced Psittacosaurs type.

### *4.2.5. Mammals*

Most of the numerous mammalian remains (more than 40 fragmented jaws, isolated teeth and the postcranial skeleton bones) of the Shestakovo localities are assigned to amphilestid "triconodonts" (Amphilestidae). Three Goboconodontinae species have been determined at the Shestakovo-3 locality: *Gobiconodon borissiaki* Trofimov, *G. hoburensis* Trofimov, *Gobiconodon* sp., all differing in size and details of molar teeth histology. A species of *Amphilestinae* gen. et sp. indet. represented by a single tooth having the denticulate formula a>b~c>d and a weakly developed lingual cingulum has also been found. At Shestakovo-3, a fragmented maxilla of a symmetrodont of the Amphidontidae genus et sp. nov. (Maschenko & Lopatin, 1998; Maschenko et al., 2000) has been found. This form differs from other Amphidontidae symmetrodonts in having a poor degree of the molar teeth triangularity. In the course of the 2000 fieldwork, fossil remains (fragmented jaws with teeth) of new mammalian genera and species were found. These are now under investigation at the SPSC.

## 5. AGE ASSIGNMENT FOR THE SHESTAKOVO ASSEMBLAGE

The Shestakovo assemblage of vertebrate remains most closely resembles the Mongolian Khobur locality, of Aptian-Albian age. What the localities have in common are the presence of such fossils as Macrobaenidae (*Hangaiemys*?) turtles, lizards (Paramacellodidae as well as, probably, Dorsetisauridae and Gekkota), Dromaeosauridae and *Psittacosaurus* dinosaurs, *Gobiconodon borissiaki*, *G. hoburensis* as well as Amphidontidae mammals. However, at Shestakovo, Tritillodontidae and Protosuchia have also been found; these are absent from Khobur. On the other hand, in the Khobur mammalian fauna, the placentals are dominant and multituberculate species are rather common, whereas at Shestakovo they have not yet been found. The differences may stem from the position of the localities in different zoogeographical and/or climatic realms, but most likely from the more arid conditions of the Shestakovo area (Leshchinskiy et al., 2000).

Alifanov et al. (1999) assigned the Shestakovo vertebrate assemblage to the beginning of the Early Cretaceous, probably to the Early Berriasian. However, there is insufficient proof for this age estimation, except for the similarity of the Shestakovo assemblage to the mammalian fossil one from the Tatal locality (north-west of Mongolia), the latter having been dated to the Berriasian-Valanginian (Bakhurina & Unwin, 1995). In detail, it is scarcely reasonable to argue that the localities are similar. The Tatal mammalian fauna includes *Dsungaripterus* pterosaurs, an undefinable sauropod and theropod, as well as an unspecified *Psittacosaurus* (Bakhurina & Unwin, 1995). Hence, common to

the Tatal and Shestakovo localities are Sauropoda, Theropoda and *Psittacosaurus;* these occur in a number of other mammalian fossil asemblages throughout the whole Early Cretaceous.

In our opinion, the Shestakovo assemblage can be dated to the end of the Early Cretaceous [Barremian-Aptian (?)]. Several facts provide support for this view, namely: the similarity of the Shestakovo fauna to the Aptian-Albian vertebrates of the Khukhtyk fauna from Mongolia, the great size of *Psittacosaurus sibiricus* VORONKEVICH & AVERIANOV, and the more advanced stage of its evolution, as well as the occurrence of *Gobiconodon* in the Aptian-Albian Cloverly Formation of the USA (JENKINS & SCHAFF, 1988)

Subsequent investigations of the of the Early Cretaceous vertebrates of the Shestakovo outcrops will allow to refine the age interpretation of the Ilekskaya suite and to introduce an amendment to the regional stratigraphic chart and paleogeographical structures.

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