Late Eocene scyliorhinid sharks from the Trans-Urals, Russia

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Priabonian deposits from two localities, Kurgan and Derney, in the Trans-Urals (Western Siberia) have yielded numerous selachian teeth. The carcharhiniform family Scyliorhinidae is represented by three species, including two new: *Premontreia uralica* sp. nov., *Foumtizia zhelezkoi* sp. nov., and *F. pattersoni* (Cappetta, 1976). Both genera are recorded from the West-Siberian Basin for the first time. Presumably all three species (including the one morphologically mimicking *F. pattersoni*, a species recorded from Ypresian of England) are endemic for the Trans-Urals region (contrary to the cosmopolitan lamniforms recorded previously from the area. The known distribution pattern of extant scyliorhinids supports the probability of endemism of the cat sharks from the West-Siberian Basin, which has also been isolated geographically from the Peri-Tethys during the Late Eocene marine regression. The peculiar local environmental conditions due to the Priabonian climatic cooling in the Boreal realm might have also facilitated the speciation.

Key words: Elasmobranchii, Carcharhiniformes, Scyliorhinidae, *Premontreia*, *Foumtizia,* Eocene, West-Siberian Basin.

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Introduction

Late Palaeogene shark remains from the Trans-Urals have been known since the 18th century. Karpinskyi (1883) listed all the known shark remains from the region. These were: "*Notidanus serratissimus* Ag., *Lamna elegans* Ag., *L. cuspidata* Ag., *L.* (*Odontaspis*) *hoppei* Ag., *L. denticulata* Ag., *Otodus macrotus* Ag., *Galeocerdo minor* Ag., *Aetobatis* sp., *Mylliobates*" (original spelling; Karpinskyi 1883: 281, 282). Based on specimens from the Late Eocene of the Trans-Urals region, Menner (1928) described the genus *Jaekelotodus* and the lamniform taxa *Lamna vincenti* Woodward *uralica* Menner, *Lamna karpinski* Menner, *Odontaspis acutissima* Agassiz *inflata* Menner.

Victor Zhelezko published some papers on Priabonian sharks from the Trans-Urals localities of Kurgan, Kachar, and Sokolovskyi (Vassilieva et al. 1994; Zhelezko and Kozlov 1999). These works mainly concerned Lamniformes and need serious revision for some taxa. He also mentioned the occurrence of *Galeorhinus* sp., *Galeorhinus* ex. gr. *latus* Storms, and *Physogaleus latus* (Storms) attributing them to the Carcharhiniformes.

Thus, the Scyliorhinidae have not been recorded from the West-Siberian Basin.

Institutional abbreviations.—IGG UB RAS, Institute of Geology and Geochemistry of the Ural Branch of the Russian Academy of Science, Ekaterinburg, Russia; PIN, Palaeontological Institute of the Russian Academy of Science, Moscow; TRNM, Tiumen Regional Natural Museum, Tiumen, Russia.

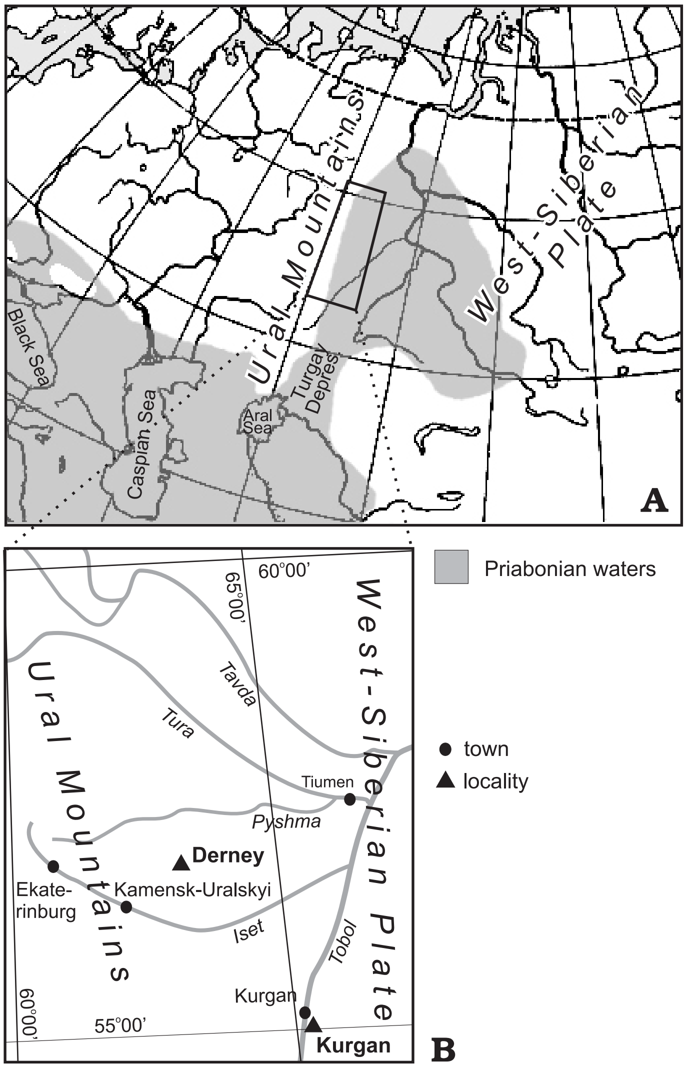
Geological setting

The West-Siberian Basin in the Eocene was a large epicontinental basin connected to Arctic waters to the North and with the Peri-Tethys to the South. These connections were repeatedly lost and restored during the Palaeogene (Leonov 1998; Yasamanov 1976). Marine conditions persisted across the Western Siberia until the Eocene–Oligocene boundary; the last, brief, southerly transgression occurred at the beginning of the Rupelian after the great Eocene regression. During the second half of the Palaeogene the size of the basin decreased with the loss of the northern connection. The Turgay Straights in the south persisted until the Eocene–Oligocene boundary (Fig. 1A). During the Bartonian and Priabonian stages, the basin had normal marine conditions.

The Tavda Formation accumulated in the West-Siberian basin in the Bartonian and Priabonian time and was deposited over most of the Trans-Urals and Western Siberia. It comprises grayish-green thin bedded non-calcareous clays and silty clays with the beds and lenses of silt and sand (Stratigraphical schemes of the Urals 1997). According to the dinoflagellate data, the lower part of the Tavda Formation contains *Rhombodinium draco* assemblage, and the upper part belongs to *Charlesdowinea clathrata angulosa* assemblage (Vassilieva 1990; Gurari et al. 2001a, b).

Localities.—The material described herein came from two localities (Fig. 1B).

The principal site is Kurgan, a clay pit 14 km south of Kurgan city. V. Zhelezko has discovered the locality at 1986 and collected there shark teeth with colleagues. The follow-



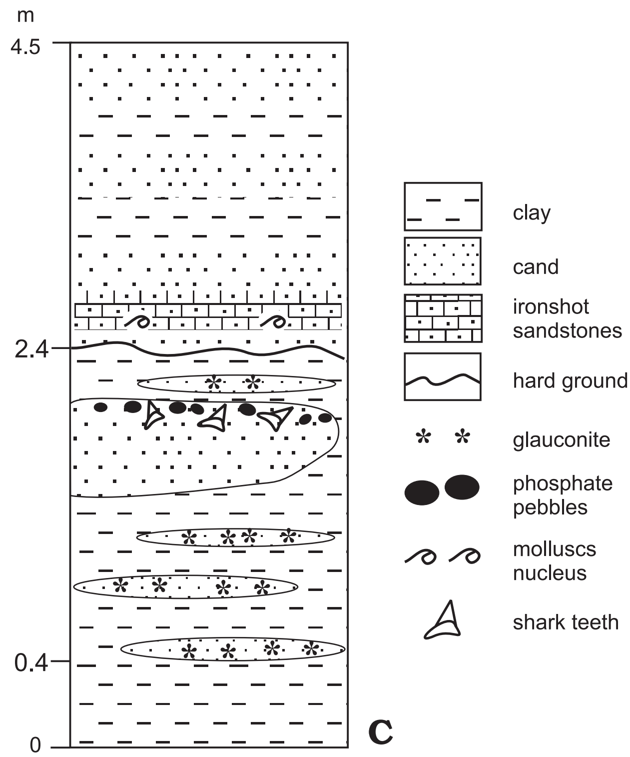


Fig. 1. Geographical position of the localities where the studied material came from. **A**. The distribution of the Peri-Tethyan and West-Siberian waters in Priabonian times. **B**. Localities studied. **C**. Schematic local lithostratigaphic section.

ing description is based on Akhmetiev et al. (2001) and Vassilieva et al. (1994); a schematic lithostratigraphic section (Fig. 1C) is compiled according to the descriptions.

Tavda Formation in the section consists of two beds. The basal 0.4 meter of the sediments are turquoise non-calcareous clays, overlain by bright green non-calcareous clays with numerous beds and lenses of poorly-sorted glauconitic quartz sand. In the upper part of the bed there is a 0.7 meter thick lens of poorly-sorted sand, with phosphate pebbles and nodules in the top. This lens contains a huge number of shark teeth, as well as the bones of bony fish and marine mammals. The clays below and above this lens contains a dinoflagellate assemblage with *Charlesdowniea clathrata angulosa* indicating a Priabonian age. The Tavda clays are covered by sands and clays of the Kurgan Beds with a hard ground at the boundary. The sandstone at the base of Kurgan Beds contains shells of Early Oligocene mollusks and a dinoflagellate assemblage with *Phtanoperidinium amoenum* also of Early Oligocene age (Akhmetiev et al. 2001).

Numerous shark teeth (more than 10,000) were collected by V. Zhelezko and recorded as coming from one of the beds in the upper part of the Tavda clay. He listed the following species (his spelling): *Jaekelotodus trigonalis* (Jaekel), *Borealotodus karpinskii* Zhelezko, *Tobolamna tobolensis* Zhelezko, *Striatolamia rossica* (Agassiz) *sibirica* Zhelezko, *Clerolamna umovae* Zhelezko, *Tobolamna laevinae* Zhelezko, *Odontaspis* ex. gr. *dubia* (Agassiz), *Galeorhinus* ex. gr. *latus* Storms, *Notorhinchus* sp., also small Odontaspididae indet. and Myliobatidae indet. (Vassilieva et al. 1994; Zhelezko and Kozlov 1999).

My revision of the Kurgan fauna (Malyshkina 2004) has shown that *Borealotodus karpinskii* (Menner, 1928) is a junior synonym of *Mennerotodus glueckmani* Zhelezko, 1994. *Tobolamna tobolensis* Zhelezko, 1999 (in Zhelezko and Kozlov 1999) and *Tobolamna laevinae* Zhelezko, 1999 (in Zhelezko and Kozlov 1999) are synonyms and actually are *Carcharias acutissima* (Agassiz, 1843). Teeth of *Striatolamia rossica* (Agassiz, 1843) *sibirica* Zhelezko in fact belong to very old (senile) *S. macrota* (Agassiz, 1843). All of the species are common for the Lower Eocene of Mangyshlak (Zhelezko and Kozlov 1999) and Uzbekistan (personal observation). Also restudying of the collection of V. Zhelezko lets to reveal *Noto-*

rynchus primigenius (Agassiz, 1843), *Squatina angeloides* Le Hon, 1871, *Carcharias cuspidata* (Agassiz, 1843), *Carcharias* sp., *Odontaspis* aff. *ferox* Risso, 1810, *Isurolamna bajarunasi* (Glückman and Zhelezko, 1985), and *Foumtizia zhelezkoi* sp. nov., *F. pattersoni* (Cappetta, 1976), *Physogaleus latus* (Storms, 1894), *Premontreia uralica* sp. nov., *Abdounia* sp., *Burnhamia* sp., *Myliobatis* sp., *Rhinoptera* sp. Joint presence of *Carcharias cuspidata* and *Isurolamna bajarunasi*, together with the dinoflagellate data, allows to determine the age as Priabonian. *I. bajarunasi* is known from Bartonian and Priabonian times (Glückman and Zhelezko 1985; Malyshkina 2000) and *C. cuspidata* appears in the Priabonian and begins wide dispersal later (Malyshkina 2004; Vassilieva and Malyshkina 2005).

Another locality, Derney (see Fig. 1B), is a series of a small cliffs on the Derney River, a tributary of Pyshma River, located in the Pyshminskyi area of the Sverdlov Region. It is 160 km north of the Kurgan pit. The numerous teeth from Derney are reworked from the Palaeogene into Pleistocene fluvial sediments. The locality has been known since the 18th century (Karpinskyi 1883), but the fauna has only recently been interpreted as reworked (Malyshkina 2003). The section is in two parts. The lower part is a vivianite-rich "blue clay" with the fossil remains of large late Pleistocene mammals: *Mammuthus primigenius*, *Coelodonta antiquitatis*, *Rangifer* sp., and *Equus* sp. The upper part of the section consists of gray, quartz sands, with lenses of silty clay, sand and coarser material, with a basal conglomerate. The fossil shark teeth are mainly concentrated in the basal conglomerate, but also occur throughout the sandy part of the section. The association comprises about 20 species of Elasmobranchii: *Notorynchus primigenius* (Agassiz, 1843), *Squatina* sp., *Carcharias acutissima* (Agassiz, 1843), *C. cuspidata* (Agassiz, 1843), *Carcharias* sp., *Odontaspis* ex. gr. *ferox*, *Odontaspis* sp., *Jaekelotodus trigonalis* (Jaekel, 1895), *Jaekelotodus* sp., *Mennerotodus glueckmani* Zhelezko, 1994, *Striatolamia macrota* (Agassiz, 1843), *Clerolamna umovae* Zhelezko, 1999 (in Zhelezko and Kozlov 1999) *Isurolamna bajarunasi* Glückman and Zhelezko, 1985, *Premontreia uralica* sp. nov., *Foumtizia zhelezkoi* sp. nov., *Physogaleus latus* (Storms, 1894), *Abdounia* sp., *Archaeomanta* aff. *melenhorsti* Herman, 1979 (in Herman and Crochard 1979), *Burnhamia* sp., *Myliobatis* sp., *Rhinoptera* sp. All the Lamniformes taxa are also present in the Kurgan collection, so the Derney collection can be also dated as Priabonian.

Material and methods

The material described in this paper was obtained from two sources. Samples from the Kurgan clay pit were collected by Victor I. Zhelezko, Olga N. Vassilieva, and Evgeniya S. Kandiano in 1987 by sieving with a 2.0 mm mesh. Only the teeth of large lamniform sharks were described in detail (see Zhelezko and Kozlov 1999). The small-sized teeth were recently sorted by the present author, resulting in expanding the ichthyfaunal list by adding the scyliorhinid taxa, *Premontreia uralica* sp. nov., *Foumtizia zhelezkoi* sp. nov., and *F. pattersoni* (Cappetta, 1976), described below. Samples from the Derney locality were collected by the local school children, staff of the Tiumen Regional Natural Museum and the author in 2002, and by members of the Institute of Plant and Animal Ecology UB RAS (Ekaterinburg) also with the author in 2003 using a 2.0 mm mesh sieve. For more information concerning the Derney fauna, see Malyshkina 2003.

The type series deposited in the PIN, Moscow (samples PIN 5088/01–5088/06). The Kurgan collection of V. Zhelezko have been located at the IGG UB RAS, Ekaterinburg, Russia (samples IGG 8SP/K-87/4–8SP/K-87/7). Specimens from Derney have been deposited at the TRNM, Tiumen, Russia and the IGG UB RAS (samples IGG 8SP/D-03/1).

All the type series and some other specimens were photographed using a Scanning Electronic Microscope at the PIN, Moscow. Others were photographed with Nikon CoolPix 4500 digital camera mounted on Zeiss binocular microscope. The photographic method is specified in the figure captions.

Identification of the tooth position in the fossil species of cat sharks is difficult because of sex heterodonty typical for Scyliorhinidae in addition to monognathic and dignathic ones. Considering that, the topology of the teeth described in the paper, is only approximate.

Systematic palaeontology

Subclass Elasmobranchii Bonaparte, 1838

Order Carcharhiniformes Compagno, 1973

Family Scyliorhinidae Gill, 1862

Genus *Premontreia* Cappetta, 1992

Type species: *Premontreia degremonti* Cappetta, 1992.

Remarks.—The genus includes scyliorhinid sharks with fairly large teeth. The lingual face of the crown is convex and smooth, the labial face is less convex and slightly overhangs the root. There are vertical enamel folds at the base of the labial face. One or two pairs of cusplets may be present. The root extends behind the crown, its basal surface is flat with a wide nutritive groove. The central foramen is lingually placed.

In the palaeontological record several species of *Premontreia* are known. Two species were recorded from Morocco: Danian–early Ypresian *P. subulidens* (Arambourg, 1952) and Thanetian *P. peypouqueti* Noubhani and Cappetta, 1997. The type species, *P. degremonti* Cappetta, 1992, was described from the late Ypresian of the Paris Basin. Kent (1999) recorded *Premontreia degremonti* Cappetta, 1992 in the early Ypresian of North America. *P. dachiardi* (Lawley, 1876) is known from the Oligocene up to the Pliocene of Europe (Baut 1993; Genault 1993; Reinecke et al. 2001). *P. gilberti* (Casier, 1946) was described from the Eocene of

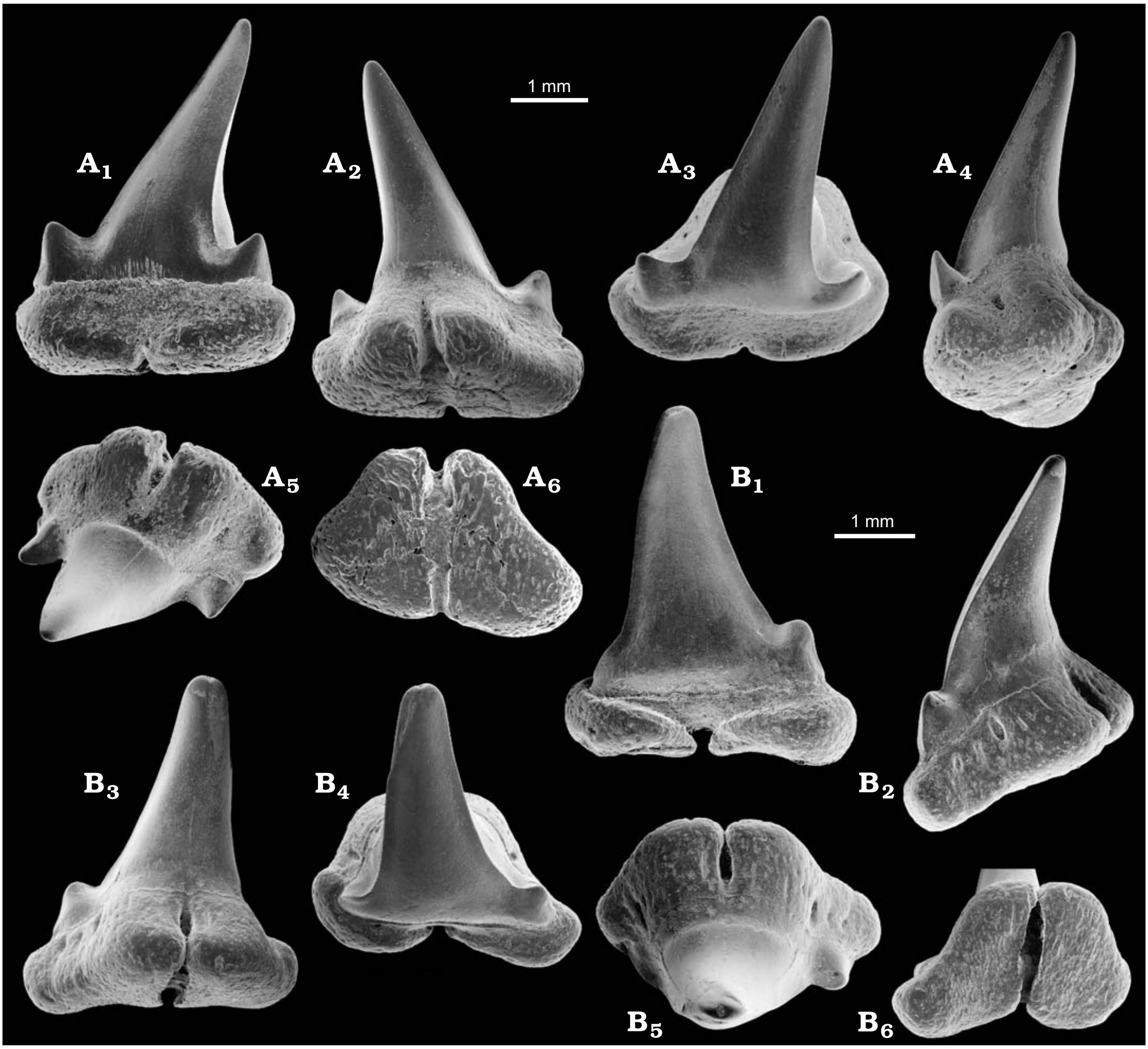


Fig. 2. *Premontreia uralica* sp. nov., Kurgan, Russia; Tavda Formation, Priabonian. **A**. Holotype. PIN 5088/01, anterior tooth; in labial (A_1), lingual (A_2), labially-occlusal (A_3), distally-basal (A_4), lingually-occlusal (A_5), and basal (A_6) views. **B**. Paratype. PIN 5088/02, anterior tooth; in labial (B_1), distally-basal (B_2), lingual (B_3), labially-occlusal (B_4), lingually-occlusal (B_5), and basal (B_6) views. SEM microphotographs.

France and Belgium; it is also known from the Thanetian of northern France (Moreau and Mathis 2000) and probably from the Ypresian of the USA (Kent 1999).

This paper provides the first record of *Premontreia* from the West-Siberian Basin.

Noubhani and Cappetta (1997) divided *Premontreia* into two subgenera: *Premontreia (Premontreia)* with the type species *Premontreia degremonti* Cappetta, 1992, and *Premontreia (Oxyscyllium)* with the type species *Premontreia subulidens* (Arambourg, 1952). The former, *Premontreia (Premontreia)*, has a convex crown labial face with short vertical, parallel, more or less flexuous folds, that never rise from the very base of the crown. The labial base of the crown does not form a border. There is one pair of cusplets, widely united with the main cusp, smooth, wide at the base. In some cases the cusplets are absent and the crown is indivisible in the labial view.

The latter, *Premontreia* (*Oxyscyllium*), is distinguished by well developed and sharp cusplets, quite deviated and sometimes divergent. The labial face of the crown is smooth with the straight pleats, sometimes forming a more or less prominent bulge in the base of the crown.

The morphological characters of the new species described below correspond to the subgenus *Premontreia*.

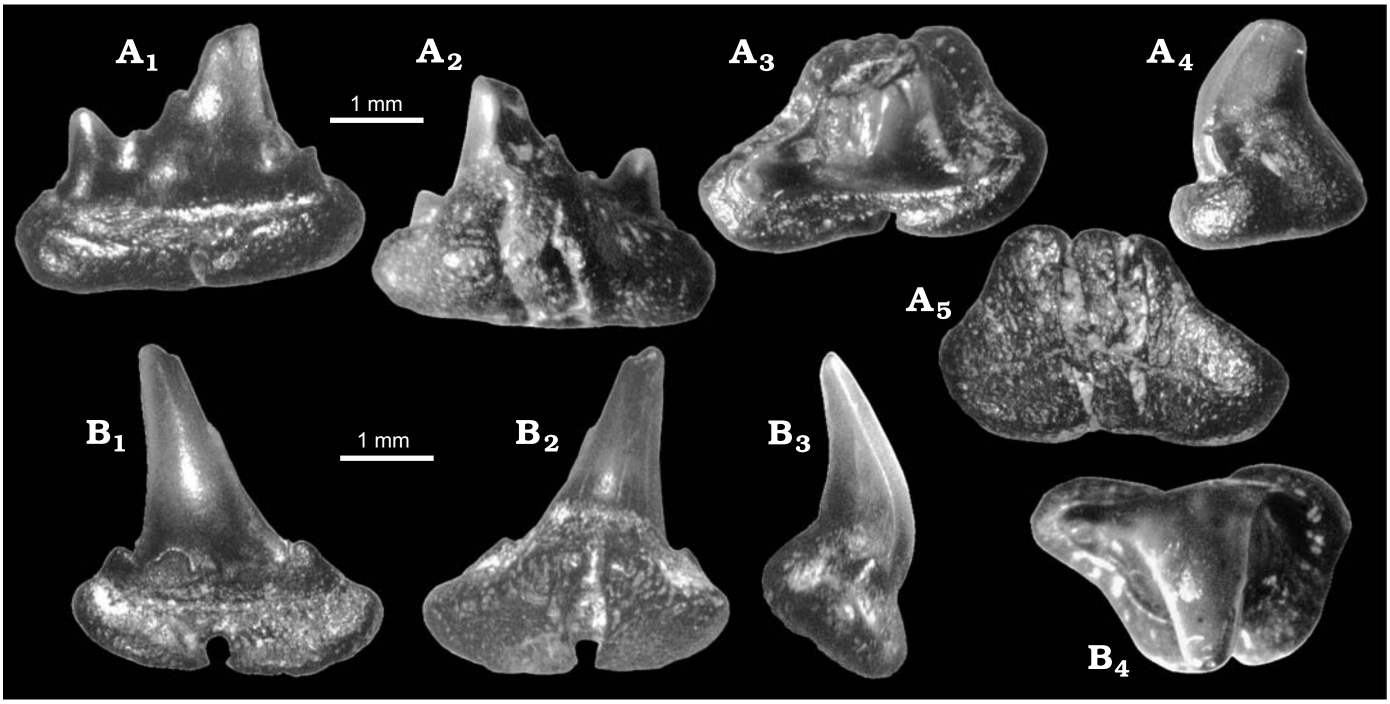


Fig. 3. *Premontreia uralica* sp. nov., Kurgan, Russia; Tavda Formation, Priabonian. **A**. 8СП/Ku-87/21, anterior tooth; in labial (A_1), lingual (A_2), occlusal (A_3), distal (A_4), and basal (A_5) views. **B**. Lateral tooth; in labial (B_1), lingual (B_2), distal (B_3), and occlusal (B_4) views. Digital photographs.

Premontreia (*Premontreia*) *uralica* sp. nov.

Figs. 2, 3, Table 1.

Derivation of the name: From the Urals, Latinised.

Type locality: Kurgan. The clay pit of the Kurgan brick factory in the northern part of Kurgan city, South Trans-Urals, Russia.

Type horizon: Upper part of the gray-green clays of the Tavda Formation.

Age: Priabonian, *Charlesdowinea clathrata angulosa* Dinoflagellate Zone.

Holotype: PIN 5088/01, lower anterior-lateral tooth (Fig. 2A).

Paratype: PIN 5088/02, upper anterior-lateral tooth (Fig. 2B).

Material. —Kurgan: 45 teeth, Derney: 8 teeth.

Diagnosis.—*Premontreia* species only known from isolated teeth. The teeth are up to 6.0 mm high. The principal cusps have rectilinear or almost rectilinear lateral edges, without a “waist”. The crowns, which bulge labio-lingually, are vertical in anterior teeth and slightly inclined in lateral teeth. The labial face of the crown is slightly convex, the lingual face is convex. The enameloid is smooth on the most of the teeth, sometimes with very short and barely distinct folds on the labial crown base. The cusplets are low, triangular in the labial view, closely set to the main cusp. The enameloid below the junction of cusp and cusplets is high, cutting edge is entire. The root is thick, protrudes over the crown, the basal face of the root is flat. The nutritive groove is wide and shallow. It divides the basal face of the root labio-lingually and appears lingually on the upper face of the root. There are number of small and some large foramina on the margino-lingual faces of the root. The central foramen is placed lingually in the nutritive groove.

Table 1. Measurements of the types series of *Premontreia* (*Premontreia*) *uralica* sp. nov.

Measurements	Holotype (mm)	Paratype (mm)
Tooth height	5.5	4.7
Tooth width	4.2	3.6
Crown base width	3.6	3.8
Cusp height	4.25	0.75
Height of the medial / distal cusplet	1 / 0.7	0.7 / 0

Description

Holotype (Fig. 2A).—PIN 5088/01, a lower anterior-lateral tooth. The main cusp is triangular, slightly bent distally, with rectilinear mesial and distal edges and has a slight labio-lingual sigmoid twisting. The labial crown base has a series of short, centrally-placed, vertical folds. There is a pair of triangular cusplets, whose axis slightly laterally deviates from the main cusp; a second small cusplet is placed distally of the mesial cusplet. The root is thick, with a smooth contour, the branches are not well developed. The root protrudes behind the crown and forms the “pedestal” surrounding crown base. The nutritive groove is more wide than deep, slightly widened from the center of the basal face to the lingual side. There are some large nutritive foramina on the lingual face of the root and one large labially-situated central foramen in the nutritive groove.

Paratype (Fig. 2B).—PIN 5088/02, upper anterior-lateral tooth. The main cusp is triangular, slightly bent distally, but upper third of the cusp is vertical. The main cusp has a weak

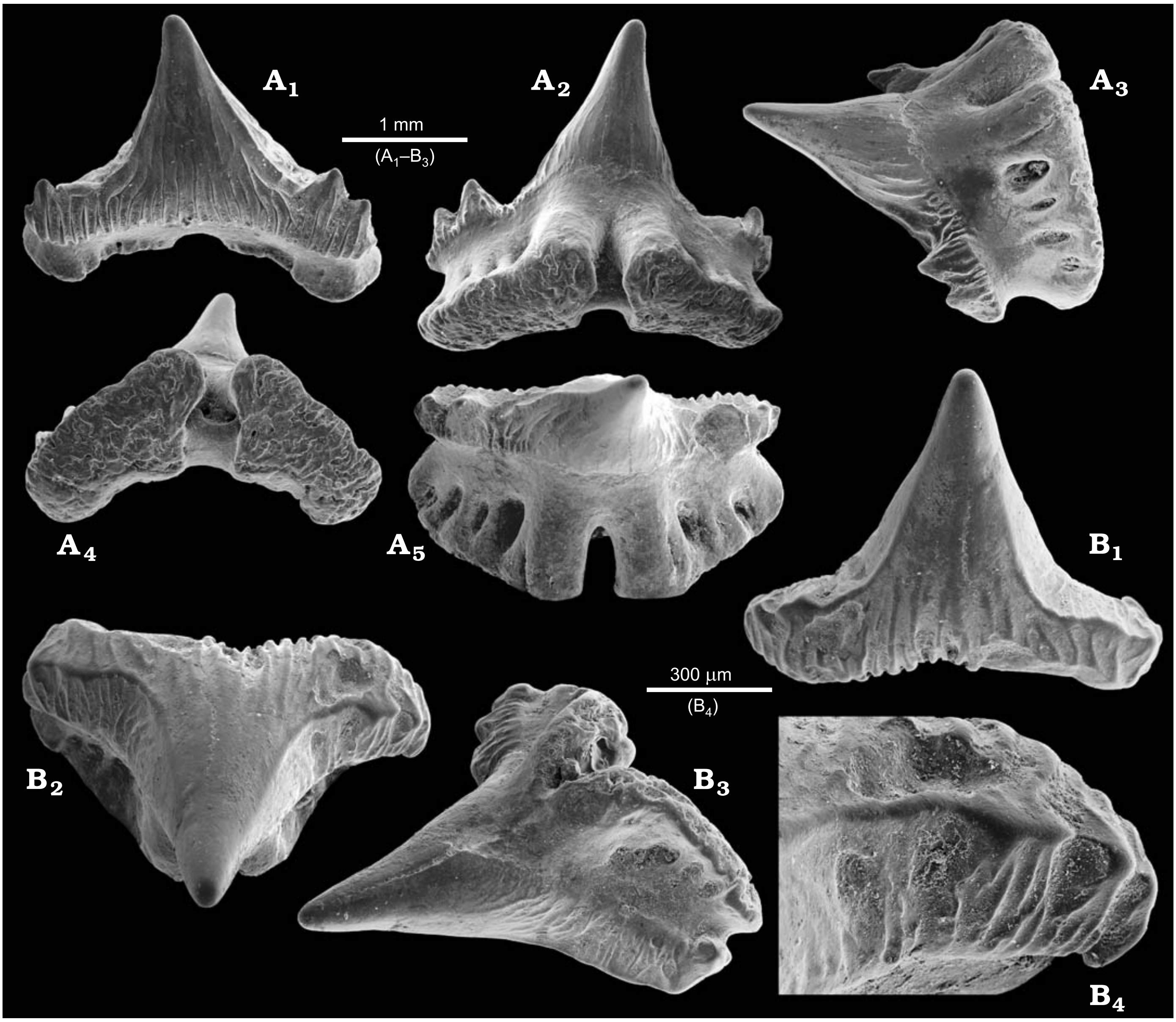


Fig. 4. *Scyliorhinus zhelezkoi* sp. nov., Kurgan, Russia; Tavda Formation, Priabonian. **A**. Holotype. PIN 5088/03, lateral tooth; in labial (A_1), lingual (A_2), medial (A_3), basal (A_4), and lingually-occlusal (A_5) views. **B**. Paratype. PIN 5088/04, anterior tooth; in labial (B_1), labially-occlusal (B_2), and lingually-mesial (B_3) views; distal cusplets, enlargement (B_4). SEM microphotographs.

labio-lingual sigmoid twisting. The mesial cusplet is less separated from the main cusp than that on the holotype, the tip is not sharp. The distal cusplet is reduced, there is just a smooth ledge. The root branches are more marked than in the holotype: there are pronounced bulges, separated by the depression under the central part of the crown base (Fig. 2B_1, B_4). The nutritive groove is widened in the central part and almost closed on the central protuberance. There are some large and small nutritive foramina on the lingual surface of the root. The central foramen is large, and lingually situated.

Anterior tooth (Fig. 3A).—IGG 8SP/Ku-87/21, shows the smooth enameloid on the both faces of the crown. There are one pair of the cusplets. The main cusp and distal cusplet are broken. The mesial cusplet is not high, acute-angled, slightly deviates laterally from the main cusp. The root is flat and thick, protrudes behind the crown and forms the “pedestal” round the crown. The basal face is flat. The root lobes are not developed, the root base in the labial view is straight. The nutritive groove is doubled (Fig. 3A_5), which is obviously an anomaly: there is a wide and shallow main nutritive groove displaced to the distal side of the root and another one almost equal to the main groove, but only the main groove extends on the labial and lingual faces of the root. There is a central foramen displaced lingually in the main groove and some smaller foramina in both grooves as well as on the lingual and labial faces of the root.

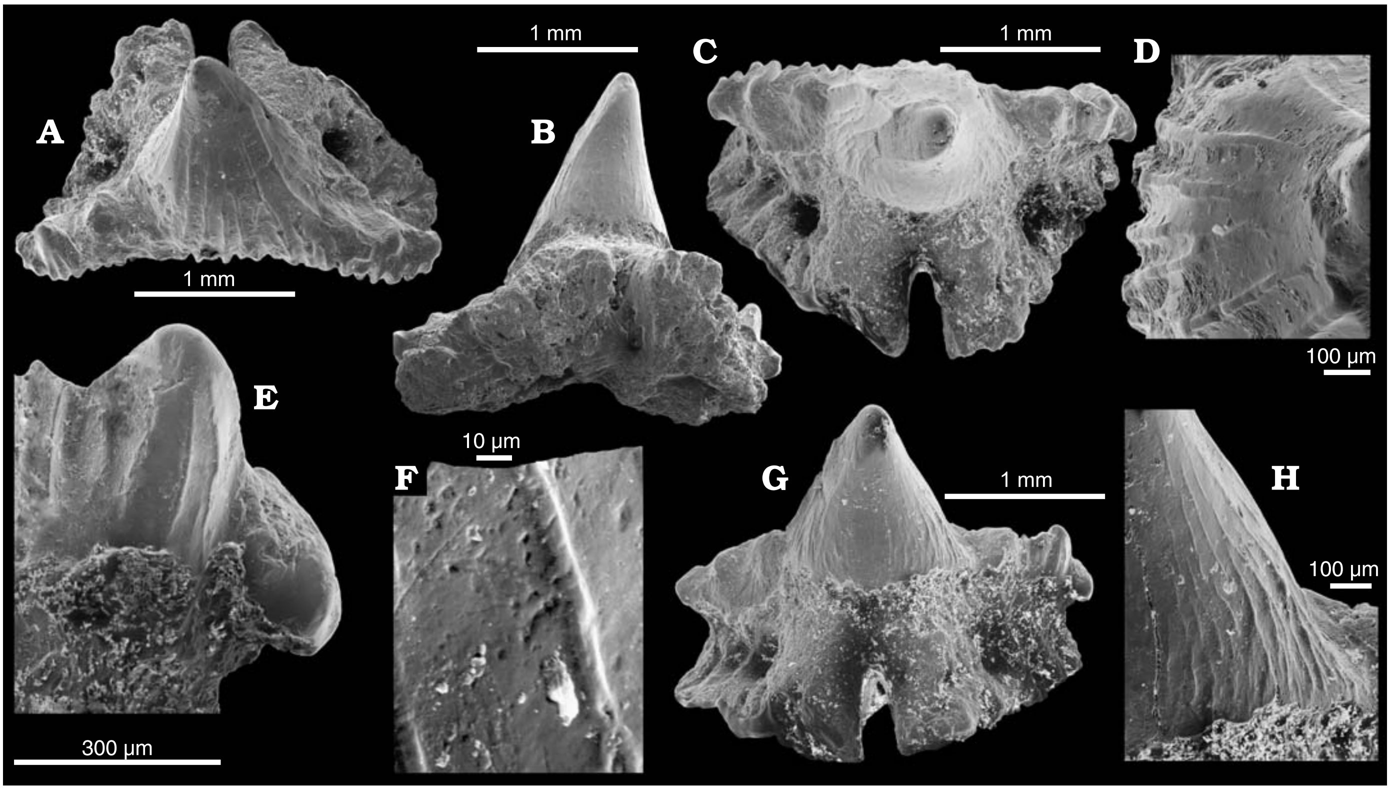


Fig. 5. *Scyliorhinus zhelezkoi* sp. nov., Derney, Russia; Tavda Formation, Priabonian. IGG 8CП/D-03/01, lower lateral tooth; in labially-occlusal (**A**), lingual (**B**), occlusal (**C**), and lingually-occlusal (**G**) views; ribs on the labial side of the crown (**D**), lateral cusplet in the lingual view (**E**), ribs on the lingual side of the crown (**F**, **H**). SEM microphotographs.

The lateral tooth (Fig. 3B).—IGG 8SP/Ku-87/22, shows the smooth enameloid with the slight striation on the base of the labial face. The labial face of the crown is convex, the lingual face is very convex. The main cusp is bent distally and has a strong labial-lingual bend. There is one pair of the cusplets. The cusplets are small, not sharp, closely set to the main cusp. The root has a flat base. The contour of the root base in the labial view as well as the line of the root-crown connection is arched. The root lobes are not well developed. There is a well-developed nutritive groove, slightly widened in the central part of the basal face of the root. There are some foramina of the oval shape on the labial and lingual faces of the root.

Comparisons and remarks.—The differences between *Premontreia uralica* sp. nov. and *P. subulidens* (Arambourg 1952: 121, pl. 23: 5–19; Noubhani and Cappetta 1997: 55, pl. 21) are that the teeth of *P. uralica* have: (1) labio-lingually and medio-distally thicker crowns, so that the contour of the main cusp is a triangle with a wider base; (2) rectilinear or subrectilinear mesial and distal edges of the cusp; (3) distinctive enameloid ornamentation on the labial crown base; (4) shorter and less acute-angled cusplets; their axes more deviate from the cusp; (5) the root is more massive and high. The same differences apply to *P. degremonti* (Cappetta 1992: 640, pl. 1), except for the cusplet characters and that *P. degremonti* has a more intensive striation near the base of its labial crown face.

Premontreia (*Oxyscyllium*) *gilberti* (Casier, 1946) differs from the *P. uralica* sp. nov. by more intensive striation on the labial face of the crown and overhanging of the root crown labial face, as well as by narrower main cusp in the lower teeth.

Premontreia (*Oxyscyllium*) *dachiardi* (Lawley, 1876) has a smooth enameloid overhanging the root labially and a different root shape.

Distribution.—Priabonian of the West-Siberian Basin.

Genus *Foumtizia* Noubhani and Cappetta, 1997

Type species: *Foumtizia abdouni* Noubhani and Cappetta, 1997.

Remark.—The genus includes small scyliorhinids with teeth having sharp crowns, well-developed pointed cusplets and holaulacorhize root replaced lingually. The lower part of the crown on the labial face is bulged, covered by enameloid folds and overhangs the root; the folds do not run up on the cup in the most specimens. The root has a well developed nutritive groove. In the palaeontological record there are some *Foumtizia* species in the Danian–Thanetian: *F. pattersoni* (Cappetta, 1976) from the Ypresian of the England; *F. abdouni* Noubhani and Cappetta, 1997 from the Thanetian of Morocco; *F. gadaensis* Noubhani and Cappetta, 1997 and *F. arba* Noubhani and Cappetta, 1997, both from the Danian of Morocco. This is the first record of the genus in the Priabonian and in the West-Siberian Basin.

Foumtizia zhelezkoi sp. nov.

Figs. 4, 5.

Derivation of the name: In honor of Doctor Victor I. Zhelezko, Russian geologist and palaeontologist, who advanced fossil shark research.

Type locality: Kurgan. The clay quarry of the Kurgan brick factory in the northern part of Kurgan city, South Trans-Urals, Russia.

Type horizon: Upper part of the gray-green clays of the Tavda Formation.

Age: Priabonian. *Charlesdowinea clathrata angulosa* Dinoflagellate Zone.

Holotype: PIN 5088/03, lateral tooth (Fig. 4A).

Paratype: PIN 5088/04, lateral tooth (Fig. 4B).

Material. —Kurgan: 11 teeth, Derney: 2 teeth.

Specific diagnosis.—The teeth are stocky. The central cusp is conical and rounded in cross-section. There are two pairs of lateral cusplets with small shoulders distally to them. The labial face of the crown is bulging and slightly overhangs the root. The enameloid of the cusp forms long, well-differentiated folds with two longitudinal edges, extending on the 3/4 of the height of the lingual and labial surfaces. The lateral cusplets are low. The enameloid of the main cusp and cusplets from the base upwards is covered by clear long vertical folds. The folds on the lingual face usually less marked than the labial ones, as they are on the lateral teeth. The folds on the labial face of the main cusp are strong, straight or slightly flexuous, and occupy 2/3 or more of the crown. Each fold has two longitudinal distinct edges, so that it is trapezoid-formed in cross-section. The folds on the lingual face are less pronounced, the longitudinal edges fairly prominent; the folds are flexuous, extend from the base to top or intermittent, or arise in the middle part of the cusp. They may bifurcate. The enameloid folds of the lateral cusplets are like to those on the main cusp. The cutting edge is complete on the lateral teeth or may absents on some lateral teeth. The root has a well-developed central protuberance and a flat base. Both are divided by a deep and wide nutritive groove which is continuous onto the upper side of the root. The central foramen is large and doubled for the most part of teeth. The root is lingually displaced, most markedly when seen in occlusal view. The lingual face of the root has some deep oval margino-lingual foramina. There are some margino-labial foramina.

Description

Holotype (Fig. 4A).—PIN 5088/03, lateral tooth. The tooth is slightly asymmetrical in labial view; the main cusp is slightly bent distally, as well as inclined lingually. The crown has a main cusp and two pairs of the cusplets. The main cusp is massive, bulging in the lower half (Fig. 4A_2, A_5). The cusplets are small and sharp, triangular in shape, with a broad base and rounded tip. Their axes are slightly divergent from the main cusp. The enameloid below the cusp and cusplets junction is high. The crown overhangs the root labially. The enameloid of almost all crown face excluding the cusp tip is covered by folds. The folds on the labial face of the main cusp are strong, straight or slightly flexuous, reaching up to 2/3 up the crown, trapezoidal in cross-section, due to two longitudinal sharp edges. The folds on the lingual surface are less pronounced, particularly in the medial part, and the longitudinal edges are prominent on part of them. The folds are flexuous and extend from the base to top or intermittent, or rise in a middle part of the cusp; they may dichotomize. The enameloid folds of the lateral cusplets are like to those on the labial surface. The cutting edge is well-developed and entire. The root is low, strongly prominent lingually in occlusal view. The nutritive groove is wide and deep. There is a double central foramen in a deep rounded slightly lingually displaced pit. The lingual face of the root has some deep oval margino-lingual foramina. There are some margino-labial foramina.

Paratype (Fig. 4B).—PIN 5088/04, anterior tooth. The main cusp is vertical, massive, more evenly widened from the top to the base than the holotype. The cusplets are reduced almost to shoulders on the both sides of the cusp. The enameloid of the lower half of the cusp and all of the shoulders are covered by the vertical folds. The folds of the labial side are strong, wide, straight or slightly flexuous. The folds of the lingual side are less strong, more flexuous, covering the shoulders and lateral parts of the crown in lower half. The crown overhangs of the root labially. The lingual part of the root is eroded, the remaining part shows a wide and deep nutritive groove with a doubled central foramen. There are some margino-lingual and margino-lateral foramina on the root, and a fairly prominent central protuberance.

Lateral tooth (Fig. 5).—IGG 8SP/D-03/01, shows the massive cusp, bulging in its lower part. There are two pairs of cusplets flanked by the distal shoulders. The enameloid on the labial and lingual sides is covered by the folds. The folds on the labial face are prominent, some of them are bifurcated, and persistent almost from the upper part of the cusp, excluding the tip, to the base. The folds on the lingual one are undulating and form the wave face. The cutting edges are low developed, they are represented by the outermost labial enameloid folds proceeding to the cusplets. The folds on the cusplets are similar to those on the cusp. The crown overhangs of the root labially forming the riffling border. The root is low, strongly prominent lingually in occlusal view, shows a wide and deep nutritive groove with a doubled central foramen. There are two large foramina in the groove (one lingually to another), one large margino-lingual foramen flanked by some smaller ones on the each side of the root lingual face, and some margino-lateral foramina.

Comparisons.—The teeth of new species *Foumtizia zhelezkoi* sp. nov. fit exactly the genus description, except the folds characters. The main difference between *F. zhelezkoi* sp. nov. and other members of the genus are that the new genus is represented by more stocky teeth with prominent folds covering most of both the labial and lingual faces of the enameloid. Another diagnostic character of the genus *Foumtizia* not always present in *F. zhelezkoi* sp. nov. is the

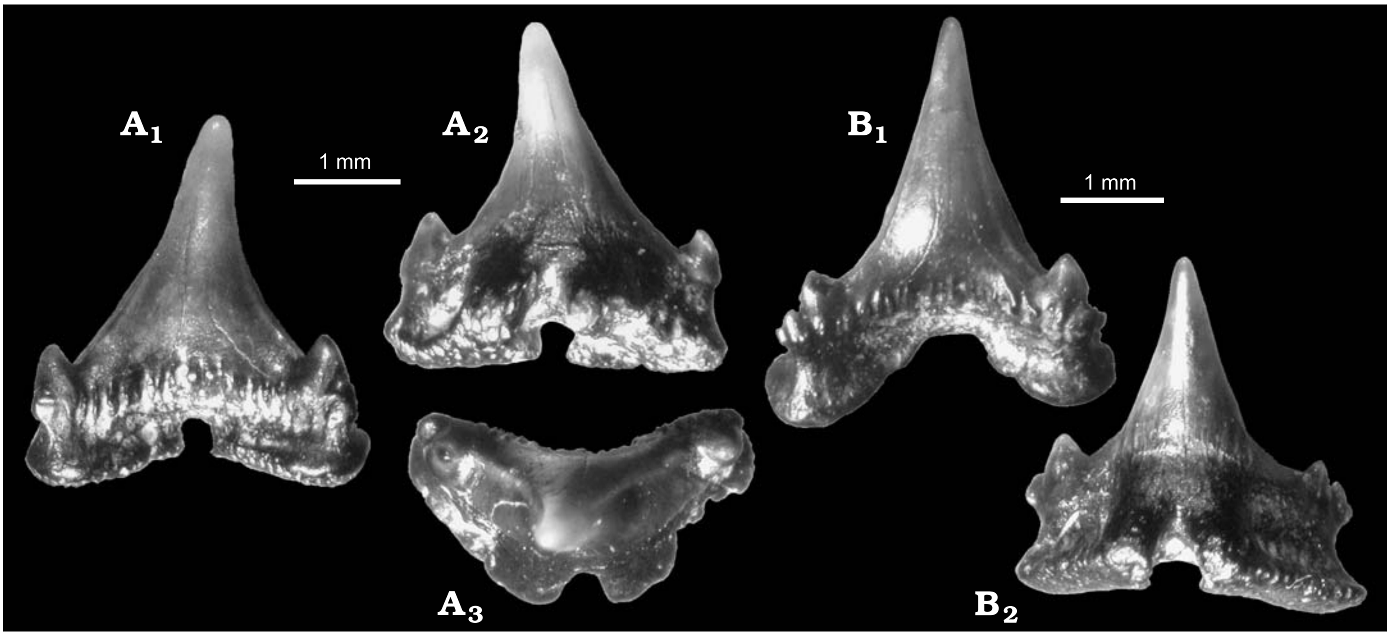


Fig. 6. *Foumtizia* aff. *pattersoni* (Cappetta, 1976), Kurgan, Russia; Tavda Formation, Priabonian. **A**. 8СП/Ku-87/02, lateral tooth; in labial (A_1), lingual (A_2), and occlusal (A_3) views. **B**. 8СП/Ku-87/03, anterior tooth; in labial (B_1), lingual (B_2), and occlusal (B_3) views. Digital photo.

whole cutting edge on all teeth. *F. zhelezkoi* sp. nov. has not the whole cutting edge on some lateral teeth, e.g., IGG 8SP/D-03/01 (Fig. 5).

In comparison with *F. pattersoni* (Cappetta, 1976), *F. zhelezkoi* sp. nov. has a thicker and more inflated cusp, more rectilinear line of the crown base on the labial side of the anterior teeth, much more striated enameloid on the main part of the crown, and a characteristic fold shape.

From *F. abdouni* Noubhani and Cappetta, 1997, *F. zhelezkoi* sp. nov. differs by having labio-lingually thicker crown and stronger main cusp on the anterior-lateral and lateral teeth, violently folded enameloid, less developed cutting edges, particularly on the lateral teeth, and smaller cusplets on the lateral teeth.

The same differences are more evident in comparison with *F. gadaensis* Noubhani and Cappetta, 1997 and *F. arba* Noubhani and Cappetta, 1997. Moreover, teeth of *F. gadaensis* have more bulging border at the base of enameloid on their labial side and mesio-distally longer lateral teeth with more cusplets. The teeth of *F. arba* have root branches more extended labially.

Foumtizia pattersoni (Cappetta, 1976)

Fig. 6.

1966 *Scyliorhinus* aff. *gilberti* Casier; Casier 1966: 67, pl. 3: 26–28.
1976 *Scyliorhinus pattersoni* Cappetta; Cappetta 1976: 559, 560, pl. 4: 1–5.
1996 *Galeorhinus* sp.; Case et al. 1996: 108, pl. 8: 144–147.

Material.—Kurgan: 23 teeth.

Description.—The teeth are rather robust. The main cusp is conical, rounded in the cross-section, basally inflated with a sharp apex. There are one or two pairs of cusplets. The labial face is slightly convex, the lingual one more so. The cutting edge is not sharp, displaced labially, so that the lingual face is visible in labial view. The enameloid is mainly smooth. There are distinct short enameloid folds on the base of the labial side, which originate a strongly waved border overhanging the root. The distal parts of the lingual face may be covered by fine, almost imperceptible flexuous striations. The root has a typical scyliorhinid shape. The basal face of the root is flat, the lingual side displaced occlusally and forms the prominent lingual protuberance. This is deeply divided by the nutritive groove which also transects the basal side of the root. The root of presumed anterior teeth forms well separated branches, prominent distally and basally in labial view, and less prominent in the lateral teeth.

Remarks.—Outside the Priabonian of the Trans-Urals, the teeth of a similar morphology are known from the English Ypresian (London Clay), where the species was described by Cappetta (1976). Ward (1980) noted *F. pattersoni* from the latest Ypresian to the early Bartonian (Barton Al-3). The teeth described by Case et al. 1996 (pl. 8: 144–147) as *Galeorhinus* sp. from the Eocene of Uzbekistan ("White Mountain Formation"), also belongs to *F. pattersoni*.

Discussion

The Priabonian Lamniformes fauna of the West-Siberian Basin consists of common species (see Geological Settings). Lamniform species from the Kurgan and Derney sites are relatively cosmopolitan; some of them, such as *S. macrota, O. winkleri*, are known from the Eocene of Australia (Kemp

1991) and Antarctic waters (Kriwet 2005). Thus, the lamniform assemblage does not includes sharks specific for the West-Siberian Basin.

As opposed to the Lamniformes, the Scyliorhinidae of the Trans-Urals Priabonian appear to be endemic. They are represented by three species: *Premontreia uralica* sp. nov., *Foumtizia zhelezkoi* sp. nov. and *Foumtizia pattersoni* (Cappetta, 1976). Both genera are recorded for the first time from the West-Siberian basin. Such a scarce record of fossil cat sharks taxa from the Trans-Urals may be due to insufficient study of small sharks of this area. A seemingly unique character of the scyliorhinid fauna of the Trans-Urals, indicated by the fact that two out of three species are new, might be illusory, and result from poor knowledge about Priabonian small sharks worldwide.

Actually, numerous Scyliorhinidae species inhabit the shelf and upper slope of all oceans and tend to have a small, rather endemic areas limited to a part of a single ocean and have not intraoceanic ranges. Some species of the same genus may have partially or almost completely overlapping geographic ranges (Compagno 1984; Compagno et al. 2005). In these cases, various mechanisms of reproductive isolation occur, such as preference for the substrate, depth, reproductive time, schooling, etc. Reif and Saure (1987) analyzed the global data of Compagno's species distribution data and inferred that the behavior of the sharks themselves was the most important biogeographical agent. It would appear that actually scyliorhinids have very narrow environmental requirements, which has led, in recent oceans, to a series of discrete populations, which has facilitated both allopatric and sympatric speciation.

The Priabonian Trans-Urals scyliorhinid fauna consists of two extinct genera. Nevertheless, in this case it seems reasonable to assume the same mechanisms controlling distribution patterns applied to fossil sharks as to their extant relatives. Besides the sampling bias, another reason of uniqueness of the Trans-Urals Scyliorhinidae species composition may lie in the biological particularies of the scyliorhinid sharks.

If the above reasoning is correct, the taxonomic range of the *Foumtizia pattersoni* (Cappetta 1976) described in this paper may be questionable. The dental morphology of *F. pattersoni* from Siberia is so close to the *F. pattersoni sensu stricto* (Cappetta 1976), that it was considered unwise to describe it as a new species. However, it is acknowledged that, considering the temporal and geographic separation of this population from the type area (Ypresian, NW Europe) and their putative distribution pattern, it might have represented a separate biological species. Apparently, the possible endemism of Scyliorhinidae fauna may be explained by palaeogeographical peculiarities of the West-Siberian Basin. During the Late Eocene, the Basin was sufficiently isolated from the Peri-Tethys to give rise to a unique assemblage of cat sharks.

The unique assemblage of the Trans-Urals Scyliorhinidae can be explained in terms of the normal geographic range of small carcharhiniform sharks and palaeogeographical conditions, as noted above, but may be also due the particular basin environmental characteristics during the Late Eocene regressive phase, and/or cooling climate of the Boreal realm in the Priabonian (e.g., Yasamanov 1986).

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