New Crustacean Coprolites from the Upper Paleocene of North Caucasus

Neue Crustaceen-Koprolithen aus dem Nord-Kaukasus (O. Paleozän)

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with 4 figures and 2 plates

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Abstract

Two new species of the ichnogenus *Palaxius* are described from Upper Paleocene deposits of North Caucasus. Coprolites were found in phosphate nodules occurring within the black argillites of the Goryachiy-Klyuch Formation. The new coprolites can be differentiated from similar species of *Palaxius* by the arrangement pattern of the longitudinal canals.

Zusammenfassung

Aus dem Paleozän vom Nordkaukasus werden zwei *Palaxius*-Arten *P. darjaensis* und *P. kumaensis* neu beschrieben. Die Koprolithen wurden in Phosphatkonkretionen gefunden, die in der Goryachiy-Klyuch-Formation auftreten. Die neuen Koprolithen unterscheiden sich von den ähnlich aussehenden *Palaxius*-Arten durch die Anordnung der Längskanäle.

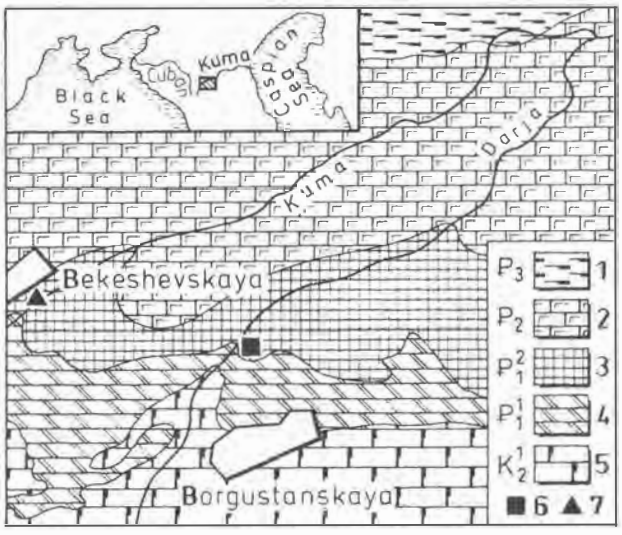

Fig. 1: General and geological map showing the localities of the coprolites described in this paper.
1) Clays (lower part of Majkopskaya series, Oligocene).
2) Marls and limestones (Beloglinskaya, Kumskaya, Cherkesskaya formation, Eocene).
3) Dark grey and black argillites with rare beds of opal-cristobalite rocks in the upper part (Goryachiylyuch and Abazinskaya formation, Upper Paleocene).
4) Marls (Elburganskaya formation, Lower Paleocene).
5) Limestones (Upper Cretaceous).
6) The locality of *Palaxius darjaensis* SILANTIEV, n. sp. 7) The locality of *Palaxius kumaensis* n. sp.

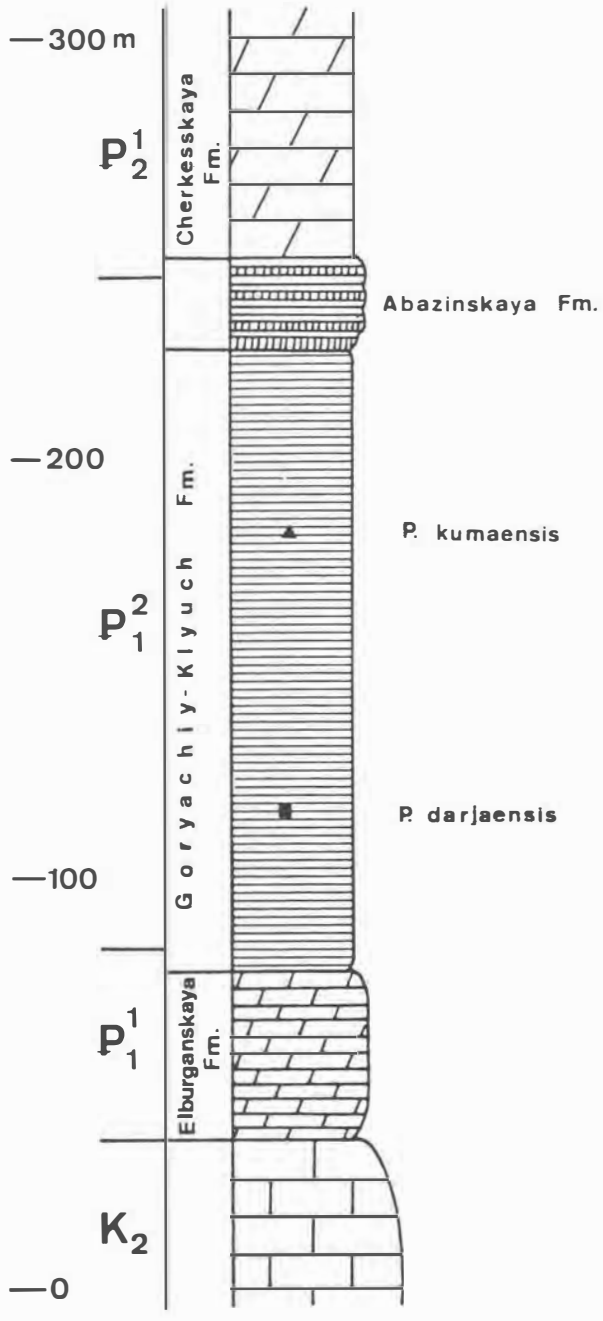

Fig. 2: Columnar section of the Goryachiy-Klyuch formation showing the locations of the fossil microcoprolites (for legend see fig. 1).

Introduction

Crustacean coprolites have been reported by several workers from different localities, especially from the Tethyan realm (MOLINARI PAGANELLI et al., 1980, 1986). MASLOV (1960, 1973) described the first crustacean coprolites (*Favreina salevensis* PAREJAS) from Paleogene deposits of Tadjik depression, USSR. Later, VIALOV (1978) reported the occurrence of *Favreina martellensis* BRÖNNIMANN &

ZANINETTI within Turonian deposits of the lower Amudaria-river in Turan Platform (Uzbekistan).

Two new species of the genus *Palaxius* BRÖNNIMANN & NORTON described herein were collected from Upper Paleocene deposits of the North Caucasus at two localities on the Darja and Kuma Rivers (text-fig. 1). These coprolites were found in phosphate nodules which are lithified crustacean burrows (pl. 1, fig. 1). The nodules occur within the dark grey and black argillites of the Goryachiy-Klyuch Formation (text-fig. 2). The argillites are approximately 120 m thick. The presence of a nannoplankton assemblage of the *Fasciculites tympaniformis* Zone (MUZYLÖV, 1980) and planktonic foraminifers of the *Acarinina djanensis* and *A. subsphaerica* Zones (ZHIZHENKO & REZZNIKOV, 1968) testify to a Upper Paleocene age for the formation.

Paleontological Description

Phyllum Arthropoda SIEBOLD & STANNIUS, 1845
Class Malacostraca LATREILLE, 1806
Order Decapoda LATREILLE, 1803
Family Glypheidae? WINKLER, 1883

Genus *Palaxius* BRÖNNIMANN & NORTON, 1960

Type species: *Palaxius habanensis* BRÖNNIMANN & NORTON, 1960.

Palaxius darjaensis SILANTIEV, n. sp.
(pl. 1, fig. 2–6, text-fig. 3/C)

Derivatio nominis: Named for the Darja River.

Holotype: The transverse section of the specimen illustrated in pl. 1, fig. 2 (thin section 104–6/1).

Locus typicus: North Caucasus, the right bank of the Darja River, about 3 km north of Borgustanskaya (see fig. 1).

Stratum typicum: Upper Paleocene.

Repository: Kazan State University, Geological Museum (coll. No. 35); Kazan, USSR.

Material: About 30 specimens in thin sections 104–6/1, 104–6/2, 104–6/5, 902–3/2, 902–3/3.

Diagnosis: The rod-shaped coprolite penetrated by two simmetrically located longitudinal canals. The cross section of the canals are dumb-bell-like. The canals are directed with their convex side away from the center of the coprolite.

Differentialdiagnosis: *Palaxius darjaensis* SILANTIEV n. sp. has two canals as also seen in the Anisian species *Palaxius rhomboideus* BRÖNNIMANN, ZANINETTI & BAUD (1972) and Lower to Middle Liassic species *Palaxius montemeranoensis* BLAU & GRÜN (1989). The new species can be distinguished from *P. rhomboideus* by the subcircular trace of the coprolite in transverse section and also by the position of the canals; the convex sides of the canals in *Palaxis rhomboideus* are directed towards the center of the coprolite (see text-fig. 3/A) but away from the center in *Palaxius darjaensis*. *P. darjaensis* differs from *P. montemeranoensis* by the size and arrangment of the canals; the canals of *P. darjaensis* are smaller (relative to the coprolite's diameter) and are located closer to the center of the coprolite. The differences between the three mentioned coprolites are shown in text-fig. 3.

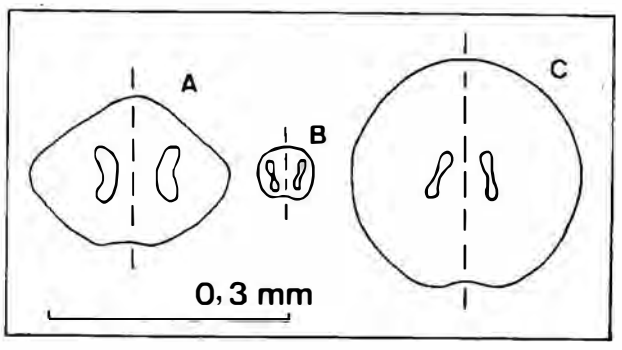

Fig. 3: Position and arrangement of canals in the plane of symmetry in A) *Palaxius rhomboideus* BRÖNNIMANN, ZANINETTI & BAUD, B) *Palaxius montemeranoensis* BLAU & GRÜN and C) *Palaxius darjaensis* SILANTIEV, n. sp.

Description

It is a rod-shaped coprolite with two longitudinal canals, 0.28–0.31 mm in diameter. The outline of the coprolite's transverse section is subcircular with a slightly concave "ventral" margin. The canals are situated close to the coprolite's center and have the appearance of slightly curved, dumb-bell-shaped pores. The medial portion of the canal is thin and drop-shaped extensions are observed at either end. The convex sides of the canals are directed toward the outside of coprolite. By connecting the symmetrical ends of the canals by straight lines an equilateral trapezium is formed, the base of which is directed towards the "ventral" margin of coprolite. The canals transverse sections are approximately 0.04–0.05 mm in length and about 0.01 mm in width in the central part. The diameter of the drop-shaped extensions is approximately 0.02 mm. The ratio of canal length to

diameter of coprolite is 0.16–0.22. The angle between the canals and the plane of symmetry is 15–20°.

Remarks

The cooprolites are composed of very fine-grained, yellow, phosphatic material, while the longitudinal canals are usually filled by microcrystalline pyrite. Due to deformation, the outline of the canals in cross section may appear to be hook-shaped or crescent-shaped pores.

Palaxius kumaensis n. sp.
(pl. 2, fig. 1–12, text-fig. 4/C)

Derivatio nominis: Named for the Kuma River.

Holotype: The transverse section of the specimen illustrated in pl. 2, fig. 1 (thin section 901–1).

Paratypes: All specimens illustrated in pl. 2, fig. 2–12.

Locus typicus: North Caucasus, the left bank of the Kuma River on the east side of Bekeshevskaya (fig. 1).

Stratum typicum: Upper Paleocene.

Repository: Kazan State University, Geological museum (coll. No. 35); Kazan, USSR.

Material: 12 specimens in thin section 901–1, 901–2, 901–3, 901–4.

Diagnosis: A species of *Palaxius* with four longitudinal canals. The transverse section of the canals are hook-shaped. The convex sides of the canals are directed away from the center of the coprolite. The canals are arranged in two bilaterally symmetrical groups, each consisting of two canals. The longer parts of the canals of each group lie on the same line, the interval between them is rather small.

Differentialdiagnosis:
From all known species of *Palaxius* only *P. salataensis* BRÖNNIMANN, CROS and ZANINETTI (1972) and *P. tetraochetarius* PALIK (1965) have four canals as seen in the new species. *P. salataensis* was originally described from the Infraliassic or Rhaetian deposits of the Dolomites (Italy), but it occurs also in Permian and Cretaceous deposits and seems to have a long stratigraphic range (SENOWBARI-DARYAN & GRÖTSCH, in press; SENOWBARI-DARYAN, WEIDLICH & FLÜGEL, in press). *P. tetraochetarius* is known only from the Lower Cretaceous of Hungary.

Palaxius kumaensis n. sp. can be distinguished from *P. salataensis* BRÖNNIMANN, CROS and ZANINETTI and from *P. tetraochetarius* PALIK by the pattern of arrangement of the canals, and also by the hook-shaped outline of the canals in cross section (see text-fig. 4).

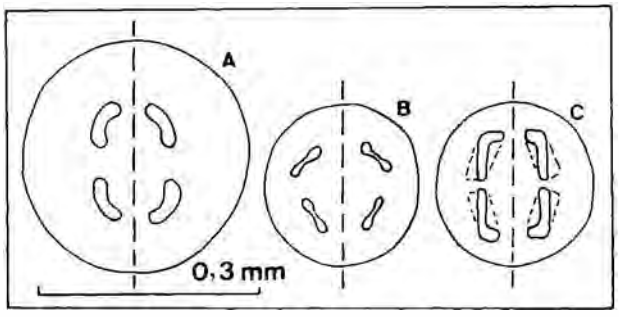

Fig. 4: Position and arrangement of canals in the plane of symmetriy in A) *Palaxius salataensis* BRÖNNIMANN, CROS & ZANINETTI, B) *Palaxius tetraochetarius* PALIK and C) *Palaxius kumaensis* n. sp. (dotted line shows the outlines of canals which arose during extensive pyritization of the coprolite).

Description

This small rod-shaped coprolite, characterized by four longitudinal canals, has a subcircular outline in transverse section. The diameter of the coprolite varies from 0.11 mm to 0.22 mm. The canal's cross section is hook-shaped. The convex side of the canals are directed away from the center of the coprolite. Canals are arranged in two bilaterally symmetrical groups, each with two canals. The longer portions of the canals run more or less parallel to the plane of symmetry. In each group, the longer parts of the canals lie on the same line and the interval between them ranges from 0.005 to 0.01 mm. Canals are approximately 0.04–0.06 mm in length and approximately 0.01–0.02 mm in width.

Remarks

Palaxius kumaensis n. sp. was found in phosphate nodules which contain many inclusions of microcrystalline pyrite. Coprolites are well-preserved only in the pyritic portions of the nodules and are composed of very fine-grained, yellow phosphatic material. The longitudinal canals consist of microcrystalline pyrite. In the cases where the coprolites have been strongly pyritized, the original hook-shaped outline of the canals becomes rectangular (in cross section).

For this reason, the canals of each symmetrical groups may be fused, and it may appear that the coprolite is penetrated only by two canals (pl. 2, fig. 4–5, 7).

Discussion

Crustacean coprolites are typically trace fossils of shallow-water environment. The oldest occurrence of coprolites represented by the genus *Favreina* has been documented in a Devonian boulder from the Rif Mountains, Northern Marocco (FLÜGEL & HERBIG, 1984; HERBIG, in press). The oldest report of the genus *Palaxius* comes from the Permian shallow-water carbonates of Oman (SENOWBARI-DARYAN, WEIDLICH & FLÜGEL, in press). *Palaxius* is a cosmopolitan trace fossil, known from several Mesozoic and Caenozoic localities (MOLINARI PAGANELLI et al., 1986, SENOWBARI-DARYAN & STANLEY 1986). There are no reports of Paleocene crustacean coprolites. The occurrence of *Palaxius* within the Upper Paleocene deposits of Caucasus is evidence of the presence of this genus during this time and therefore it ranges at least from the Permian to the Paleocene.

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Plate 1

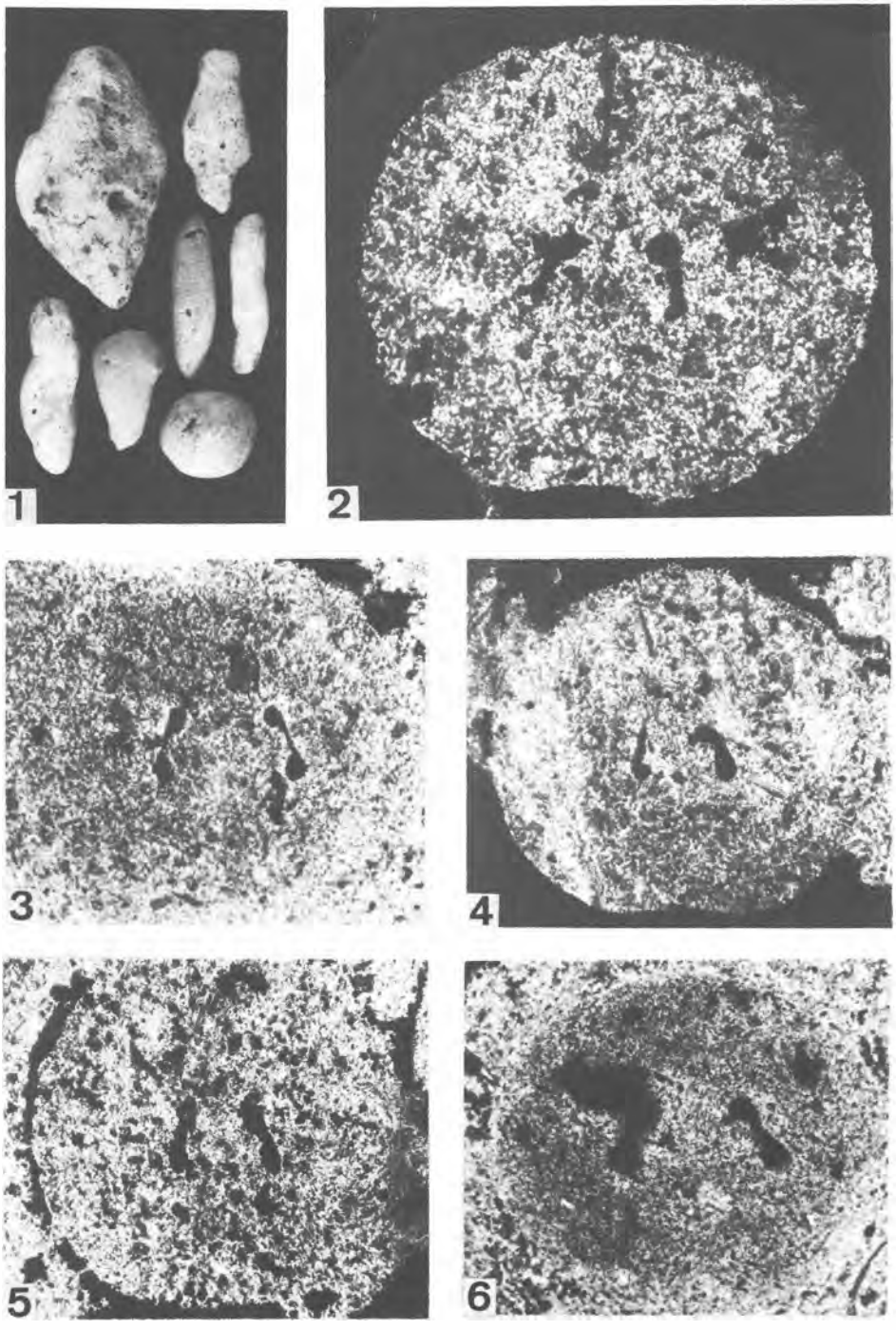

Fig. 1: Phosphate nodules containing crustacean coprolites. 0,75x.

Fig. 2–6: *Palaxius darjaensis* SILANTIEV, n. sp.

Fig. 2: Holotype. Transverse section showing two canals arranged in the plane of bilateral symmetry. Thin section 104-6/1, 235x.

Fig. 3, 6: Transverse section. Thin section 902-3/2, 175x.

Fig. 4, 5: Transverse section. Thin section 104-6/1, 175x.

Plate 2

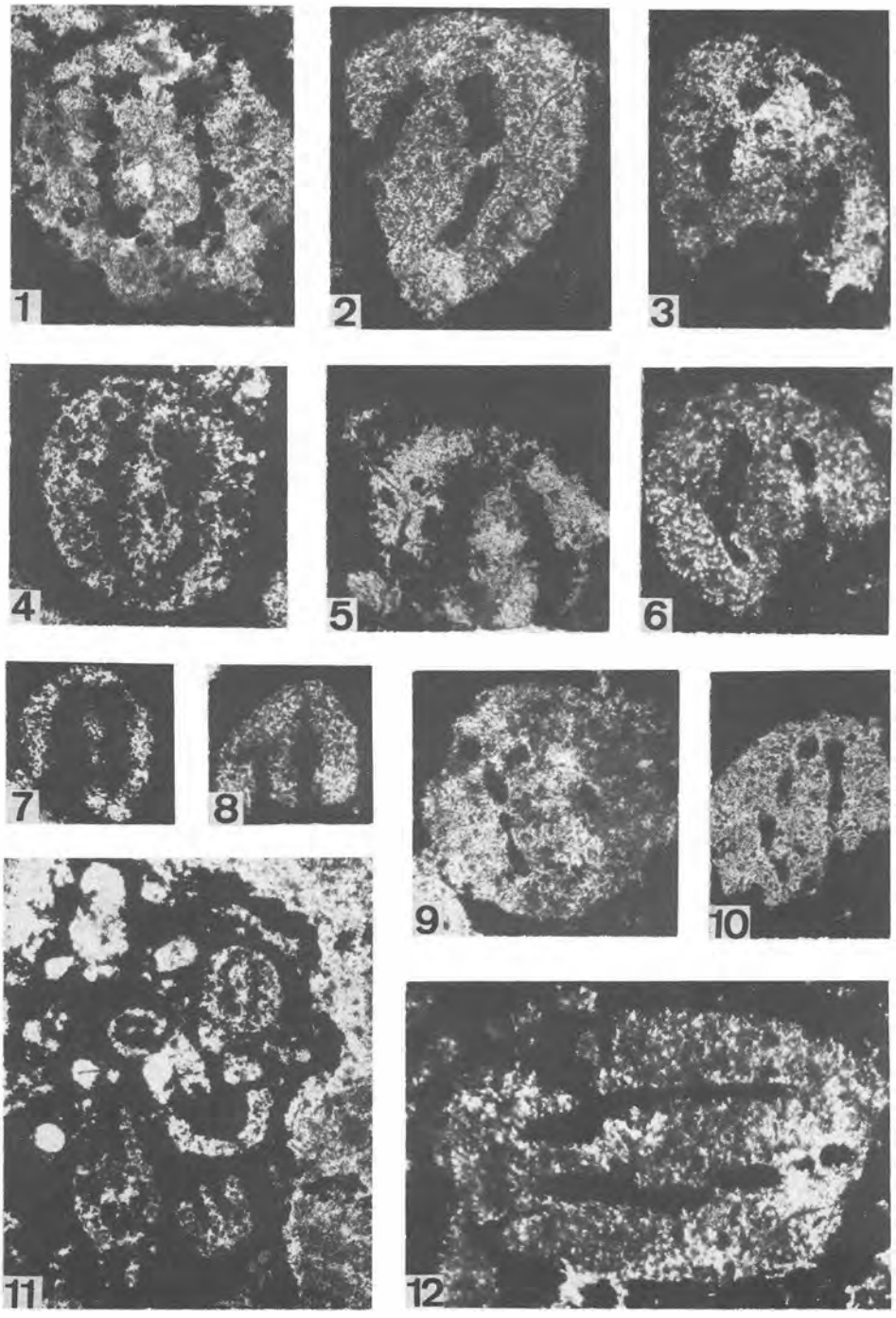

Fig. 1–12: *Palaxius kumaensis* n. sp.

Fig. 1: Holotype. Transverse section showing four hook-shaped canals arranged in two groups in the plane of bilateral symmetry. Thin section 901-1, 180x.

Fig. 2: Transverse section. Because of intensive pyritization the hook-shaped canals look rectangular. Thin section 901-2, 180x.

Fig. 3, 6: Transverse sections. thin section 901-3, 180x.

Fig. 4, 7: Transverse sections. Because of intensive pyritization the canals of each symmetrical groups are fused. Thin section 901-2, 180x.

Fig. 5, 9, 10: Transverse sections: Thin section 901-4, 180x.

Fig. 8, 12: Tangential sections. thin section 901-3, 180x.

Fig. 11: General view of transverse and longitudinal sections of coprolites in the pyrite burrow. Thin section 901-2, 72x.