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First Finds of Permian Ammonoids in the Kotel'nyi Island

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Abstract—First ammonoid remains are found in the Lower Permian Munugudzhak Horizon, the northwestern coast of the Kotel'nyi Island (New Siberian Islands). They are used to define more precisely the age of host deposits and to clarify their paleontological characteristics. Stratigraphic distribution of the distinguished ammonoid taxa and similar forms in the Permian sections of the Urals and Verkhoyansk region is analyzed. New paleontological data substantiate the Sakmarian Stage presence in the Permian System of the Kotel'nyi Island. Two ammonoid species *Preshumardites bogoslovskyi* Andrianov and *Tabantalites etchiensis* Andrianov are described.

Key words: ammonoids, Permian System, Sakmarian Stage, New Siberian Islands, Kotel'nyi Island.

INTRODUCTION

Ammonoids represent a faunal group rarely occurring in the Permian deposits of northeastern Asia. Most of the known localities of Permian ammonoids are situated in the northern and western parts of the Verkhoyansk region, but these fossils are scarce in the Okhotsk, Kolyma, and Omolon median masses (Andrianov, 1985). Although the Permian ammonoids are less widespread in northeastern Asia than bivalves and brachiopods, their stratigraphic potential is very important for correlation of regional stratigraphic schemes with the general scale of the Permian System and for the stage subdivision of host deposits (Ustritskii, 1971; *Osnovnye cherty...*, 1984; Andrianov, 1985).

In the New Siberian Islands, Permian ammonoids have been unknown until now, and the age substantiation of Permian strata was based on distribution of foraminifers and brachiopods in the sections (Vol'nov *et al.*, 1974; *Resheniya...*, 1978; *Osnovnye cherty...*, 1984). Ammonoids collected from the Lower Permian deposits of the Kotel'nyi Island determine more precisely the strata age and enable recognition of the Sakmarian Stage in the local Permian section.

STRATIGRAPHIC POSITION OF FOUND AMMONOIDS

In the Kotel'nyi Island, Permian deposits were recognized at the northwestern coast of the island and in its central part, where they are exposed in the Balyktakh River middle courses (Vol'nov *et al.*, 1974). The deposits correspond to the terrigenous sequence of predominant shales and siltstones intercalated with sandstone interlayers and limestone lenses. The most complete section of these rocks was described at the northwestern coast of the island (Fig. 1) to the west of the polar station "Kotel'nyi" (Vol'nov *et al.*, 1974).

Permian deposits, the lower boundary of which has not been established, are of a distinct rhythmical structure. They are divided into two members (Fig. 2).

The basal portion (35 m) of the lower member is composed of unconsolidated clay grading upward into shales and clayey siltstones. The upper half of the member consists of shale and siltstone beds intercalated with interbeds of feldspar–quartz and polymictic sandstones, and also with limestone lenses. Limestones located in the middle of the member yield brachiopods *Jakutoproductus verchoyanicus* (Fredericks). Siltstone and sandstone beds bear plant detritus. The member is 100 m thick.

The upper member consists of shales intercalated with siltstone and fine-grained sandstone interbeds. In the lower interval of the member, foraminifers *Nodosaria bella* Gerke, *N.* ex gr. *bradyi* (Spandel), and *N.* ex gr. *ustritskyi* Sossipatrova coexist with brachiopods *Anidanthus rugoses* Licharew. Foraminifers *Nodosaria* cf. *crassiformis* Igonin and *Frondicularia* aff. *pseudotriangularis* Gerke are characteristic of the upper part of the member, where they associate with brachiopods *Achunoproductus achunovensis* (Stepanov) and *Spiriferella lita* Fredericks. Sandstones and siltstones again contain the plant detritus. The upper member is 100 m thick.

Relationships between Permian and overlying Triassic deposits are unclear, and it is assumed that these systems are separated by a hiatus spanning the uppermost Permian horizons. The basal interval of the Lower Triassic, conditionally attributed to the Induan Stage, consists of alternating greenish gray thin-laminated and black gypsum-bearing shale up to 30 m thick, which

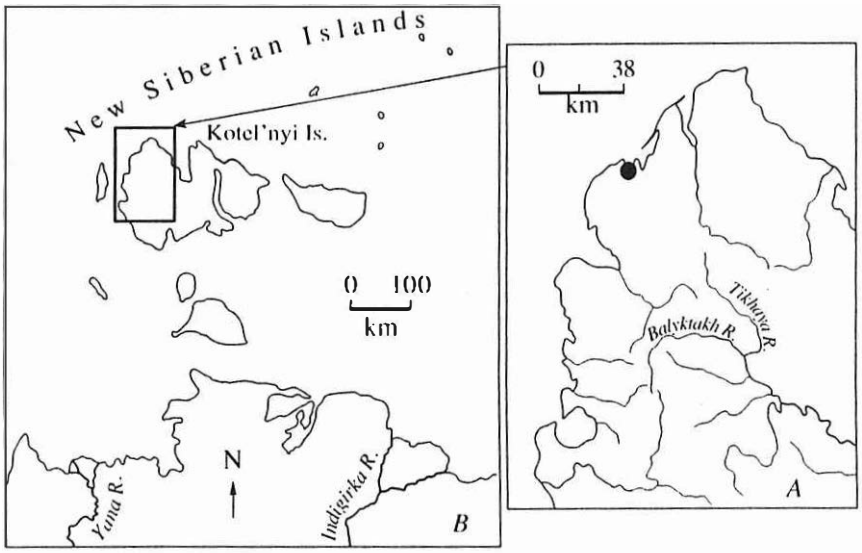

Fig. 1. Geographic position of the study area (rectangle) and sampling sites (black dots) of Permian ammonoids in the northwestern coast of the Kotel'nyi Island.

enclose bun-shaped siderite concretions (Preobrazhenskaya *et al.*, 1975; Egorov *et al.*, 1987).

Owing to the presence of characteristic brachiopod species *Jakutoproductus verchoyanicus* (Fred.), the lower member is correlated with the Munugudzhak Horizon distinguished in the regional Permian stratigraphic scheme of the Kolyma–Omolon province (Vol'nov *et al.*, 1974; *Resheniya...*, 1978). As it was accepted (*Osnovnye cherty...*, 1984), this horizon spans the summary interval of the Asselian and Sakmarian stages coupled with the lower Artinskian Substage. The upper member yields foraminifers widespread in the Dzhigdala and Omolon horizons of the Kolyma–Omolon province, which include the age analogues of the upper Artinskian Substage and Kungurian Stage of the Lower Permian, and also of the Ufimian Stage of the Upper Permian.

Thus, the brachiopod and foraminiferal fauna from Permian deposits of the Kotel'nyi Island was previously used to distinguish here the upper and lower series of the system, which were divided into the Munugudzhak, Dzhigdala, and Omolon horizons.

In 1984, I found for the first time the ammonoid species *Preshumardites bogoslovskyi* Andrianov and *Tabantalites etchiensis* Andrianov in the middle part of the Munugudzhak Horizon exposed at the northwestern coast of the Kotel'nyi Island. Both species were recovered from one stratigraphic level (50 m above the section base) in small pyritized concretions, which are set in the bed of firm coarse-grained siltstone. These finds better elucidating the stage interval of host deposits can be used a basis for the interregional correlation.

The collection of recovered fossils is stored under no. 988 at the paleontological department of the Central Siberian Geological Museum (Joint Institute of Geol-

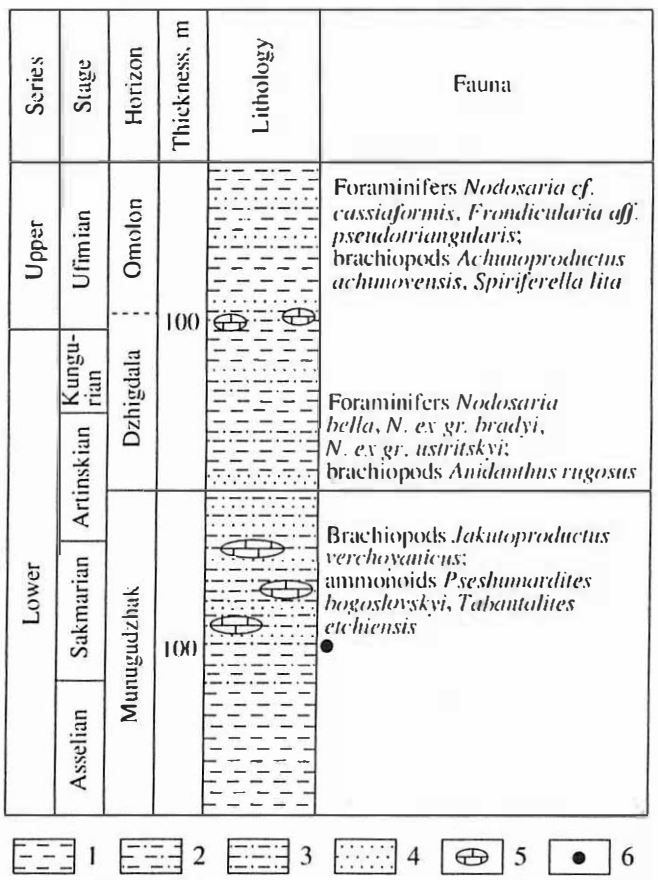

Fig. 2. Lithostratigraphy of Permian deposits in the northwestern coast of the Kotel'nyi Island: (1) shale; (2) clayey siltstone; (3) siltstone; (4) sandstone; (5) carbonate nodules and lenses; (6) levels of sampled ammonoids; distribution of brachiopods and foraminifers is shown on the basis of published data (*Resheniya...*, 1978).

ogy, Geophysics, and Mineralogy, Siberian Division, Russian Academy of Sciences, Novosibirsk). In ammonoids description presented below, I use the following abbreviations: (D) shell diameter; (W) width of the last whorl; (H) height of the last whorl; (DU) diameter of umbilicus.

BIOSTRATIGRAPHIC ANALYSIS AND AGE SUBSTANTIATION

Ammonoid species from the middle part of the Munugudzhak Horizon of the Kotel'nyi Island are counterparts of those originally described by Andrianov (1985), who discovered them in the Lower Permian of the northern and western Verkhoyansk region. *Preshumardites bogoslovskyi* Andrianov is widespread in the lower part of the Tuora-Sis Formation of the Kharaulakh Range and in the Endybal-Echii Formation of the Dulgalakh River basin, where it coexists with ammonoids of the genus *Metapronorites*. In opinion of Andrianov, *Preshumardites bogoslovskyi* Andr. is very similar to *P. sakmarae* Ruzhencev from the Sterlitamak Horizon of the Urals (Ruzhentsev, 1938; p. 283; Plate VI, figs. 22 and 23; Plate VII, figs. 5–8), but differs from the latter owing to the less developed cusps at the external lateral lobe, peculiar shape of umbilical lobe, and different orientation of cusp in the latter relative to the umbilical margin. Single specimen of the described *Tabantalites etchiensis* Andrianov was collected in the Lena River lower courses from the banded siltstone bed situated in the lower part of the Tuora-Sis Formation. At this level, it coexists with two other ammonoids *Bulunites juferevi* Andrianov and *Juresanites maximovae* Andrianov.

The complete ammonoid assemblage from the lower part of the Tuora-Sis Formation consists of the following species collected at different localities of the Kharaulakh Ridge: *Metapronorites vladimiri* Andrianov, *Neopronorites* sp., *Agathiceras verchoyanicum* Andrianov, *Bulunites mezhvilki* Andrianov, *B. juferevi* Andr., *Preshumardites bogoslovskyi* Andr., *Tabantalites etchiensis* Andr., *Menneroceras menneri* Andrianov, and *Juresanites maximovae* Andr. Another assemblage of comparable composition is known from the Khorokyt Formation and coeval strata of the western Verkhoyansk region, where it consists of *Metapronorites* sp., *Neopronorites* aff. *milleri* Ruzhencev, *Somoholites* sp., *Bulunites* aff. *mezhvilki* Andr., and *Paragastrioceras* sp. These ammonoids were originally dated back to the Asselian–Sakmarian time interval (Andrianov, 1985). As it was established afterward, the partial correlation of the Tuora-Sis Formation with the Asselian Stage is misleading, because species *Juresanites maximovae* Andr. and *Menneroceras menneri* Andr. belong most likely to the genus *Eoasianites* being similar to its later (Sakmarian) forms (Kotlyar *et al.*, 1987).

Ammonoids *Preshumardites bogoslovskyi* Andr. and *Tabantalites etchiensis* Andr., occurring at one level in the Kotel'nyi Island, are unknown as coexisting in the Kharaulakh Ridge. From this standpoint, it seems doubtful to suspect that the Tuora-Sis Formation, the lower part of which should be attributed to the Sakmarian Stage, includes chronoequivalents of the Asselian Stage.

The last conclusion is favored by occurrence of *Preshumardites* forms only in ammonoid assemblages exclusively typical of the Sakmarian Stage (Ruzhentsev, 1951). In particular, *Preshumardites sakmarae* Ruzh., which was considered by Andrianov as most similar to *P. bogoslovskyi* Andr. from the Verkhoyansk region, is the guide taxon of the Sakmarian Stage (Ruzhentsev, 1950, 1951, 1952). In the type area of southern Urals at the Sakmara River, the stratigraphic range of *P. sakmarae* Ruzh. spans the upper part of the Tastuba Horizon and the entire Sterlitamak Horizon. Ammonoids from this stratigraphic interval represent an assemblage of the *Preshumardites sakmarae–Synartinskia principalis* Zone (*Osnovnye cherty...*, 1984).

The genus *Tabantalites* existed in the late Asselian–early Sakmarian time. *T. bifurcatus* Ruzhencev, the type species of the genus, is characteristic of the upper Asselian Substage and of the lower Tastuba beds of the Sakmarian Stage in the Aktyuba district of the southern Urals (Ruzhentsev, 1952), being most abundant exactly in the Tastuba Horizon. Outside the Urals, *T. bifurcatus* Ruzh. was identified in the upper part of the Jungle Creek Formation, the Peel River basin of northern Canada (Nassichuk, 1971), where it associates with ammonoid species *Prothalassoceras bostocki* Nassichuk, *Properrinites furnishi* Nassichuk, *? Uraloceras* sp., *Svetlanoceras* cf. *S. irwinense* (Teichert et Glenister), *Eoasianites* aff. *E. trapezoidales* Maximova, *Somoholites* cf. *S. beluensis* (Haniel), and *Medlicottia* sp. As the genus *Medlicottia* do not occur in pre-Sakmarian deposits, age of this fauna is defined as corresponding to the early Sakmarian (Tastuba) time (Nassichuk, 1971, 1995).

As compared to *T. bifurcatus* Ruzh., Siberian representatives of the genus *Tabantalites* have wider whorls, and the stage of involute shell appears earlier in their ontogeny. This may indicates that *Tabantalites etchiensis* Andr. characterizes a higher evolutionary stage, and, consequently, its host deposits may be younger.

In general, ammonoids found in the middle part of the Munugudzhak Horizon of the Kotel'nyi Island suggest that their host rocks correspond to the Sakmarian Stage and can be correlated with the lower beds of the Tuora-Sis Formation of the Kharaulakh Ridge, and also with the Khorokyt Formation and basal strata of the Endybal-Echii Formation of the western Verkhoyansk region.

DESCRIPTION OF AMMONOIDS

Family Somoholitidae Ruzhencev, 1938

Genus *Preshumardites* Plummer et Scott, 1937

Preshumardites bogoslovskyi Andrianov, 1985

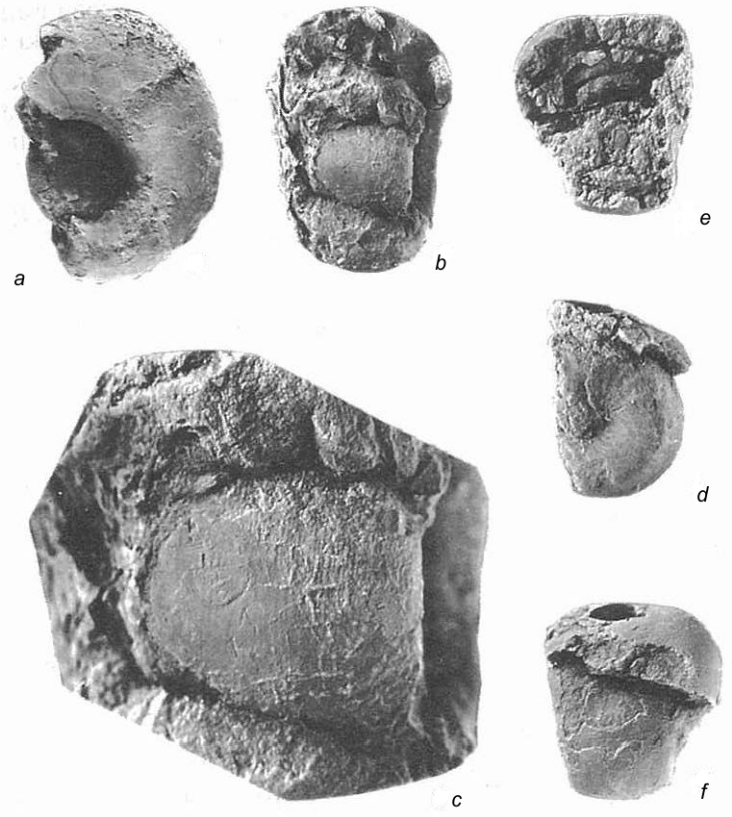

Plate. Ammonoids from Permian deposits of the Kotel'nyi Island.

(a–c) *Preshumardites bogoslovskyi* Andrianov. Specimen no. 1/988: (a) lateral side, ×1; (b) apertural side, ×1; (c) view of inner whorl, ×3; middle part of the Munugudzhak Horizon, Sakmarian Stage.

(d–f) *Tabanalites etchiensis* Andrianov. Specimen no. 2/988: (d) lateral side, ×3; (e) apertural side, ×3; (f) ventral side, ×3; the same locality and age.

Plate, figs. a, b, c; Fig. 3, drawings a and b

Preshumardites bogoslovskyi: Andrianov, 1985; p. 123; Plate IV, figs. 1 and 2; Plate V, fig. 1.

Holotype: no. 55/562; Andrianov, 1985, Plate IV, figs. 1 and 2; Yakut Branch Museum, Siberian Division, Russian Academy of Sciences; northern Verkhoyansk region, Kharaulakh Ridge; left side of the Lena River southward of the Chekurovka Settlement; Tuora-Sis Formation, Sakmarian Stage.

Shape. Inner whorls are missing. When the shell diameter is 16 mm, the whorl cross sections are oval. The ventral side is gently convex, merged with more convex lateral sides. When its diameter is 35 mm, the shell of the pachycone type is swollen, semi-involute, and displaying the moderately growing height of whorls. Ventral and lateral sides form a single convex surface. The umbilical shoulder is distinct and rounded. The umbilical wall is fairly high and slightly convex. Umbilicus is moderately wide, deep, and step-wise in configuration. The living chamber is not preserved.

Specimen no.	D	H	W	DU	H/D	W/D	DU/D
1/988	35	13	27	13	37	77	37

Sculpturing. Ventral and lateral sides of the shell are decorated with thin longitudinal striae. The internal mold is smooth. When the shell diameter is 14 mm, there is clearly seen a constriction that forms shallow sinuses on lateral sides and a wide prominent embossing on the ventral side.

Lobe line. The ventral lobe is subdivided by a rather high and wide siphonal saddle into two narrow cusped branches widening in the middle (Fig. 3a). The first lateral lobe is compressed at the top and widens downward forming rounded projections on sides and a long wedge at the base (Figs. 3a and 3b). At the early growing stages, the lateral projections are more distinct. The umbilical lobe is wide, and its projection is situated close to the umbilical shoulder.

Comparison. Species *P. bogoslovskyi* is different from the most similar *P. gorbunovi* (Andrianov, 1985; p. 125; Plate VI, fig. 2), because its first lateral lobe is symmetrical, and the umbilical lobe is wide. As compared to *P. sakmarae* (Ruzhentsev, 1938; p. 283; Plate VI, figs. 22 and 23; Plate VII, figs. 5–8), the described species has the narrower shell with the more convex ventral side and high medial saddle.

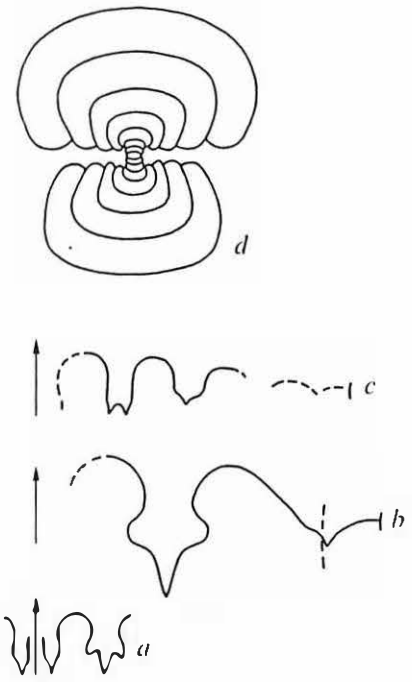

Fig. 3. Lobe lines and cross section of ammonoid shells. *Preshumardites bogoslovskyi* Andrianov. Specimen no. 1/988: (*a*) W = 14 mm, ×2.4; (*b*) W = 22 mm, ×2.8, H = 13 mm. *Tabantalites etchiensis* Andrianov. Specimen no. 2/988; (*c*) W = 5.4 mm, H = 3.9 mm, ×16; (*d*) shell cross section of this specimen (sampling site and age as in the Plate).

Distribution: Sakmarian Stage, Tuora-Sis Formation of the Kharaulakh Ridge, Endybal-Echii Formation of the western Verkhoyansk region, and Munugudzhak Horizon of the Kotel'nyi Island.

Material: one specimen from the northwestern coast of the Kotel'nyi Island (middle part of the Munugudzhak Horizon).

Family Vidrioceratidae Plumer et Scott, 1937

Subfamily Vidrioceratinae Plumer et Scott, 1937

Genus *Tabantalites* Ruzhentsev, 1952

Tabantalites etchiensis Andrianov, 1985

Plate, figs. e, f, g; Fig. 3, drawings c and d

Tabantalites etchiensis: Andrianov, 1985, p. 158, Plate VI, fig. 3.

Holotype: no. 55/730; Andrianov, 1985, Plate VI, fig. 3; Yakut Branch Museum, Siberian Division, Russian Academy of Sciences, Yakutsk; northern Verkhoyansk region, Kharaulakh Ridge; left side of the Lena River upstream of the Kubalakh River mouth; Tuora-Sis Formation, Sakmarian Stage.

Shape. Within the first three whorls, the evolute shell having weakly to moderately overlapping whorls is of the ophiocone type (Fig. 3d). Beginning from the fourth, the whorls envelope each other more deeply, and diameter of umbilicus is decreasing. Within the period of fifth to seventh whorls, the shell is involute, strongly swollen, and pachycone in shape. These whorls are almost completely enveloping one another, slowly growing in height. The wide, slightly convex ventral side is merged with gently convex lateral sides, which slope toward umbilicus forming a kind of depression around it. The umbilical shoulder is rounded. The umbilical wall is rather high and convex, having the incrassate shell layer. The cylindrical umbilicus is almost closed.

Specimen no.	Number of whorls	D	H	W	DU	H/D	W/D	DU/D
2/988	6	7.8	4.3	6.9	0.6	51	88	8
	5.5	6.2	3.2	5.2	0.47	50	81	7
	5	5.3	2.7	4.1	0.44	51	77	8
	4.5	4.2	2	3	0.47	49	72	11
	4	3.4	1.6	2.4	0.64	47	71	19
	3.5	2.8	1.1	1.9	0.76	40	68	28
	3	2.2	0.8	1.5	0.88	37	66	39
	2.5	1.8	0.5	1	0.76	30	60	43
	2	1.5	0.4	0.9	0.58	28	60	40

Sculpturing. Shell is decorated with very fine radial striae forming clusters on lower parts of lateral sides (six clusters in one fourth of the sixth whorl). On the ventral side, they form the almost imperceptible sinus.

Lobe line. The lobe line is poorly preserved (Fig. 4c). The first lateral lobe is bicusped, and the second one is tripartite.

Comparison. In contrast to *T. bifurcatus* (Ruzhentsev, 1952, p. 77, Plate VI, figs. 3–7), *Tabantalites etchiensis* has wider whorls and less distinct sculpturing; its evolute stage in ontogeny is shorter (3–3.5 versus 4–4.5 whorls of *T. bifurcatus*).

Distribution: Sakmarian Stage; Tuora-Sis Formation of the Kharaulakh Ridge and Munugudzhak Horizon of the Kotel'nyi Island.

Material: one specimen; northwestern coast of the Kotel'nyi Island; the middle part of the Munugudzhak Horizon.

Reviewers A.S. Alekseev and T.B. Leonova

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