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Biostratigraphic Subdivision of Mesozoic Deposits Penetrated by the Tyumen Superdeep Borehole

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Abstract—The Tyumen superdeep borehole (TSB-6) drilled in north-western Siberia was the first that penetrated through Mesozoic deposits and probably entered the uppermost Paleozoic sediments. In the course of drilling, a clear succession of stratigraphic units, established formerly in separate Mesozoic sections of western Siberia, was revealed. The complete section of Triassic volcano-sedimentary deposits underlying the Jurassic sedimentary strata with no visible unconformity was recovered for the first time. Paleontological remains, which had recently been obtained from the borehole section, was used to substantiate biostratigraphic subdivision of the Mesozoic deposits penetrated by TSB-6, and to constrain the age of stratigraphic units and their stratigraphic ranges. Palynospectra characteristic of the Middle–Late Triassic, Jurassic, and earliest Cretaceous time allowed a wide chronostratigraphic correlation to be carried out within and beyond the Urengoi region. On the basis of macrofossil plant assemblages, the correlation of the TSB section with the reference borehole sections of the Urengoi area is suggested. Microfauna assemblages from coastal-marine interlayers occurring inside the Mesozoic continental sequence suggest the peculiar dynamic environments during the whole period of the Mesozoic sedimentation.

Key words: *superdeep borehole, Urengoi area, biostratigraphy, Mesozoic, palynospectra, microfauna, plant macrofossils, correlation, stratigraphic units, formations.*

The Tyumen superdeep borehole (TSB) is located in the north of western Siberia, in the Urengoi oil-bearing area of the Nadum–Pur oil-and-gas province. The drilling was commenced in 1987 to reach in 1994 the depth of 7502 m, the maximum one for sedimentary basins. Down to the depth of 3698 m, the drilling proceeded without core sampling. The depth interval of 3698–4100 m was sampled completely, and deeper, the core recovery was 80%. The drilling resulted in obtaining unique material that allows a reliable verification of many questions, including the litho- and biostratigraphic characteristics of the Mesozoic deposits in the Urengoi area perspective for oil-and-gas deposits.

The TSB section interval of 3698–7502 m is represented by continental, marine, and coastal sediments of the Cretaceous, Jurassic, and Triassic age, as well as, probably, by Upper–Middle Triassic and Permian volcanogenic deposits. Initial data on the stratigraphic subdivision of the deposits in the depth interval of 3698–6194 m were published by Ekhlakov *et al.* (1991). According to the stratigraphic scheme, adopted for the Urengoi area at the Interdepartmental Stratigraphic Conference (ISC) held in Tyumen in 1990 (see table), the penetrated sequence is subdived from the base upward into the following units: the Tampei Group with the Varenga-Yakha and Vityutino formations (the latest Middle–Late Triassic); the Zavodoukovskaya Group with the Novyi Urengoi, Beregovka[1], Kotukhta (Early Triassic), Tyumen (Middle Jurassic) formations; the Poludino Group with the Abalakovo (Middle and the beginning of the Late Jurassic), Bazhenovo (Late Jurassic, earliest Cretaceous), and Megion (the Achimovka Member) formations of the Early Cretaceous (Berriasian). These stratigraphic units were dated on the basis of preliminary data on spore–pollen assemblages studied by S.I. Purtova.

In February, 1995, the Roskomnedra, NPP "Nedra," and KamNIIKIGS initiated a meeting devoted to the TSB drilling results, which was held in Perm. Problems of drilling equipment and technology, the deep structure, and oil-and-gas potential were the subject of wide discussion at the meeting. The stratigraphic subdivision of the penetrated sequence, especially, biostratigraphy, age substantiation, and correlation of deposits within the region, were almost missing from discussion. Only abstracts presented by Ekhlakov, Ugryumov, Sedykh, and Kazanskii (*Rezul'taty...*, 1995) were devoted to subdivision (table) of the lower volcano-sedimentary part of the sequence into lithostratigraphic units on the basis

[1] The names of the formations were used loosely by the cited authors, and, according to the scheme adopted at the ISC in Tyumen in 1990, the lower unit of the Jurassic sequence is the Beregovka Formation (the name *Novyi Yrengoi* appeared to be preoccupied), and the unit overlying it is the Yagel Formation.

Subdivision of the Mesozoic deposits penetrated by TSB-6

Borehole TSB-6	Ekhlakov *et al.*, 1991		Ekhlakov and Ugryumov, *Rezulltaty...*, 1995			Ugryumov, *Rezulltaty...*, 1995		Sedykh, *Rezulltaty...*, 1995			Kazanskii *et al.*, *Rezulltaty...*, 1995		Nesterov *et al.*, 1995			This paper		
	groups, sequences, formations																	
3680	K_1	Megion Formation		Marine terrigenous sequence												K_1	Poludino Group	Megion Formation
	J_3	Bazhenovo Formation														J_3		Bazhenovo Formation
																		Abalakovo Formation
		Vasyugan Formation														J_2		
4160	J_2	Tyumen Formation	J	Subcontinental sequence	Tyumen Formation												Zavodoukovskaya Group	Tyumen Formation
4640		Kotukhta Formation			Kotukhta Formation											J_1		Kotukhta Formation
					Yagel Formation													Yagel Formation
5120	J_1	Beregovka Formation			Beregovka Formation													Beregovka Formation
		Novyi Urengoi Formation											J_1^1		Novyi Urengoi Formation			
5600	T_3	Vityutino Formation	T_3		Vityutino Formation								T_3	Tampei Group	Vityutino Formation	T_3	Tampei Group	Vityutino Formation
6080		Varenga-Yakha Formation			Varenga-Yakha Formation								T_2^2		Varenga-Yakha Formation			
			T_{1-2}		Pur Formation			T_{1-2}	Tampei Group	Pur Formation			T_{1-2}		Pur Formation	T_2^2		Varenga-Yakha Formation
6560			T_1	Volcano-sedimentary sequnce		Krasnoselkup Group	Lava, sedimentary rocks	T_1	Krasnoselkup Group	I volcanogenic	T_1^1	Khadyr-Yakha Formation		Krasnoselkup Group	Korotchaevo Formation	T_2^1	Krasnoselkup Group	Khadyr-Yakha Formation
							Lava			II volcanogenic								
7040										III volcanogenic		Korotchaevo Formation	T_1^1			T_1		Korotchaevo Formation
							Lava, tuff			IV volcano-sedimentar								
								P_2		V volcanogenic	P_2	Evo-Yakha Formation	P_2		Aimal Formation	P_2		Evo-Yakha Formation
7520																		

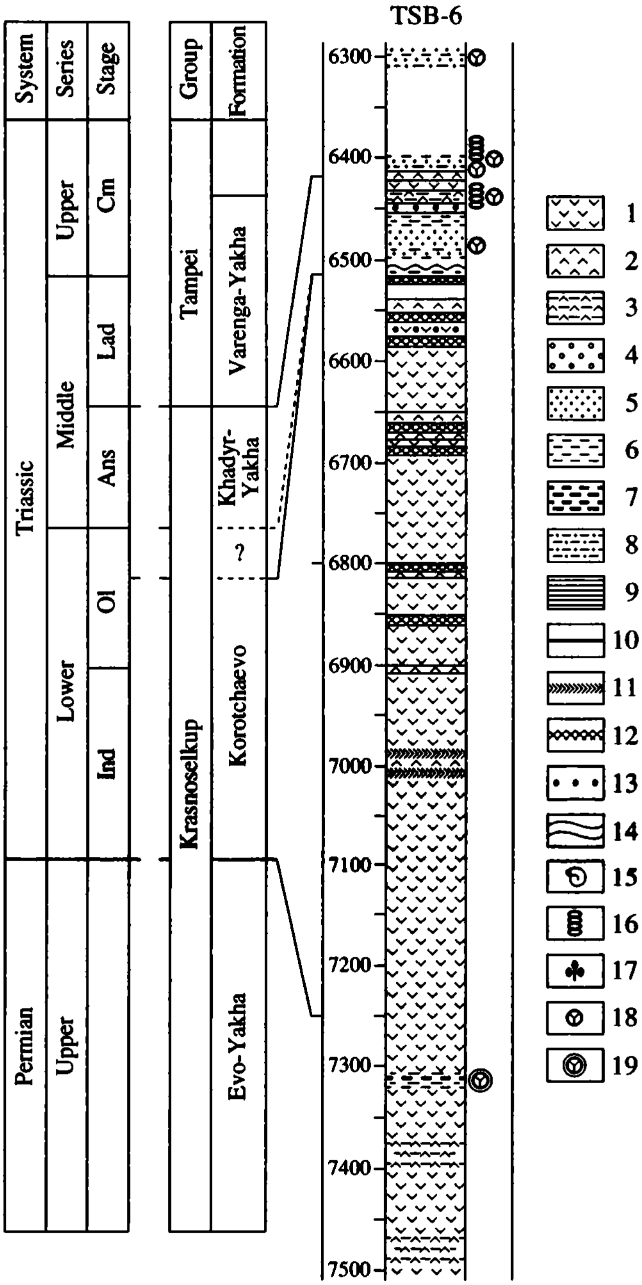


Fig. 1. Subdivisions of Permian–Triassic deposits penetrated by TSB-6:
(1) extrusive rocks; (2) tuff; (3) tuffite; (4) conglomerate; (5) sandstone; (6) mudstone; (7) coaly mudstone; (8) siltstone; (9) clay; (10) coal; (11) quartz–epidote rocks; (12) weathering crust; (13) laterite; (14) void; (15) ammonites; (16) foraminifers; (17) plant macroflora; (18) microphytofossils; (19) Permian palynoassemblage (after Purtova).

of palynological data (communication by Purtova in *Rezul'taty* ..., 1995).

The paper by Nesterov *et al.* (1995), which appeared a bit later, presented a subdivision scheme, where the lower part of the TSB sequence was divided into two units (table): the Krasnoselkup Group with the Aimal and Korotchaevo formaions, and the Tampei Group with the Pur, Varenga-Yakha, and Vityutino formations. Age of these stratigraphic units was again determined on the basis of palynological data. Unfortunately, the paper presents only general characteristics of pollen assemblages and their names. This hampered the use of palynological data for the biostratigraphic analysis and age determination of deposits.

In recent years, by the courtesy of A.A. Dikovskii, chief geologist of the Tyumen Prospecting Expedition on Superdeep Drilling, NPP "Nedra," we also were supplied with geological maps and cross sections; we were also given the opportunity to examine and describe the TSB core and to take paleontological samples. The investigation and subsequent analysis of the material with due regard for the data published are used as a basis for the work presented.

The lithologic column (Figs. 1–3) was compiled on the basis of core description involving the data presented by geologists from the Tyumen Prospecting Expedition. The data processing, especially, the identification of paleontological samples, appeared to be the most time-consimung procedure. The high-grade metamorphism of rocks often represented by coarse-grained sandy varieties, as well as peculiar conditions of sedimentation, affected greatly the extent of fossil preservation. This is especially true of microfossils—spores, pollen, microphytoplankton and microfauna. Plant macrofossils have suffered the destructive effect of metamorphism as well. Separate interlayers comprise only imprints of stems and leaves but no phytoleims (mummified leaves), which prevented the study of epidermal structure of Gymnospermae leaves.

PERMIAN(?), TRIASSIC

The *Krasnoselkup Group* of the TSB section comprises a volcano-sedimentary sequence more than 1000 m thick occurring at the base of Mesozoic strata (*Rezul'taty* ..., 1995). There is no consensus regarding the subdivision of the group. Nesterov *et al.* (1995) proposed to subdivide the group into two formations (table): the Aimal (the Late Permian) and Korotchaevo (the Early Triassic, Induan) formations. We consider the suggestion by Kazanskii and co-authors as more justified (*Rezul'taty* ..., 1995; Kazanskii *et al.*, 1995). They subdivide the Krasnoselkup Group into three units: the Evo-Yakha, Korotchaevo, and Khadyr-Yakha formations.

The *Evo-Yakha Formation* is basal in the group (the depth interval of 7502–7250 m, Fig. 1). It is represented by lava and tuff beds with sills, dikes, and thin intercalations of tuffites and coaly mudstone. Purtova identified the Permian assemblage of palynomorphs within the depth interval of 7317–7307 m (Kazanskii *et al.*, 1995).

The *Korotchaevo Formation* conformably overlying the Evo-Yakha Formation (Kazanskii *et al.*, 1995)

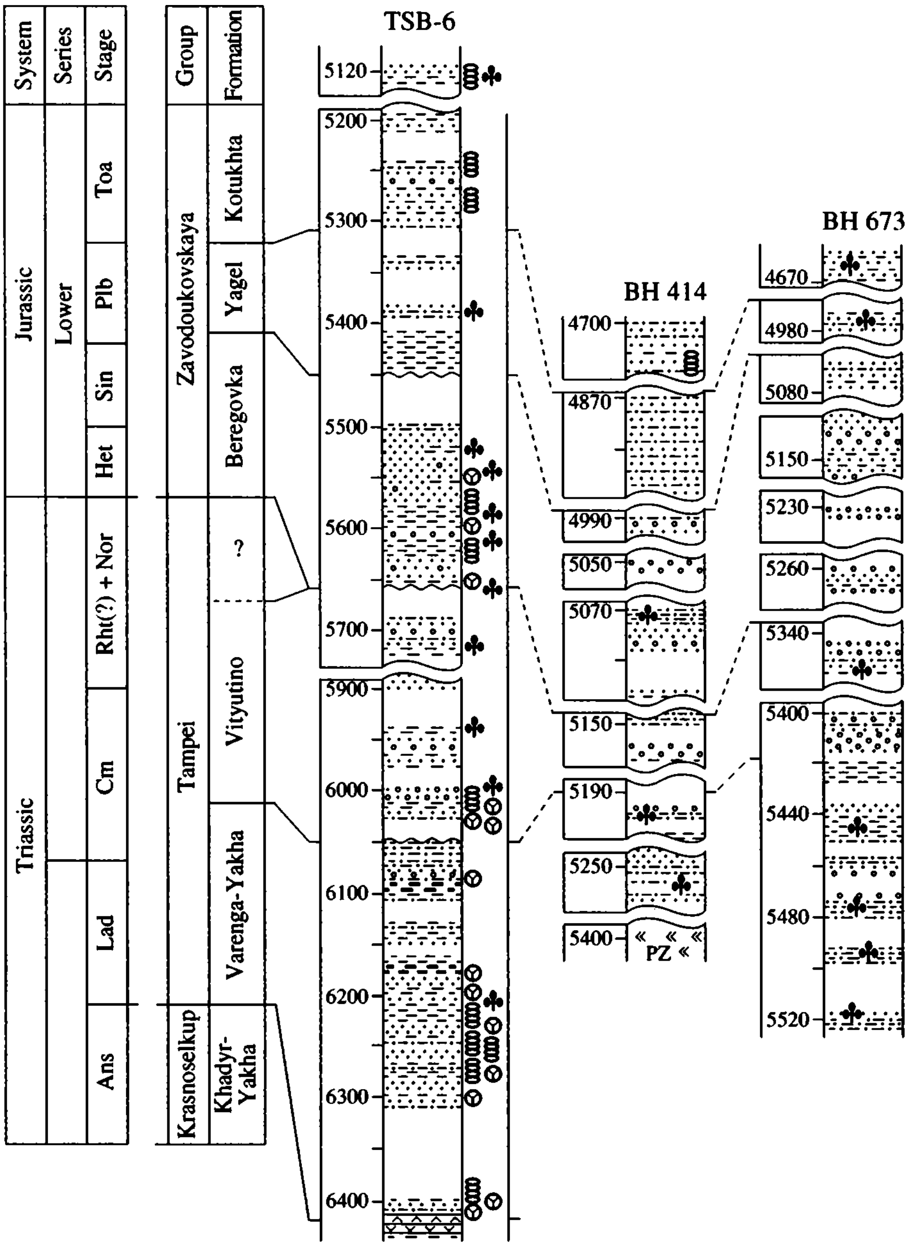
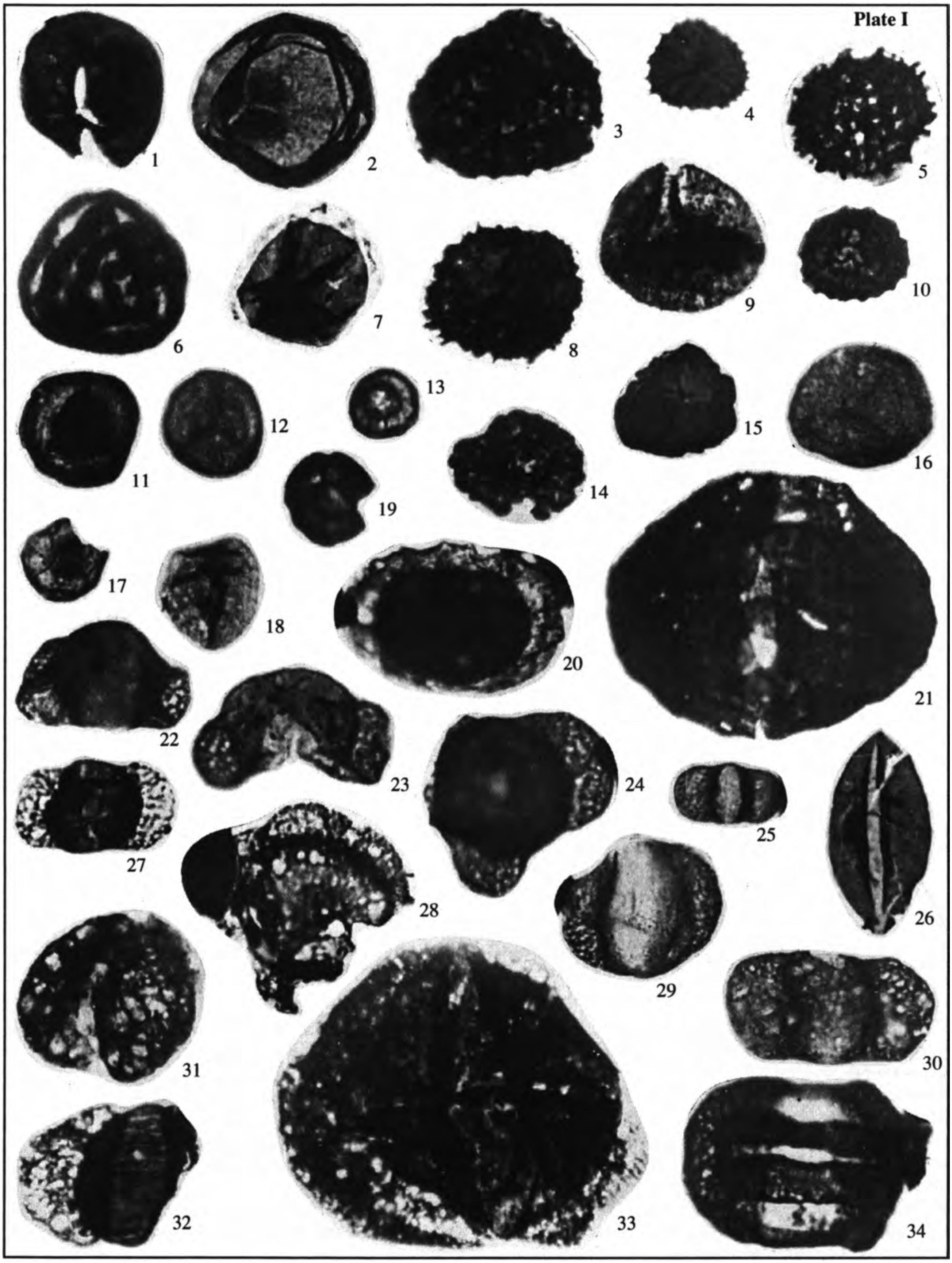


Fig. 2. Subdivision scheme of Triassic and Lower Jurassic deposits penetrated by TSB-6 and correlation with the reference borehole sections of the Urengoi area (symbols as in Fig. 1).

is distinguished within the depth interval of 7250–6520 m. The formation consists of two units. The lower subformation (depth interval of 7250–6800 m) is represented by altered extrusive rocks and tuffs with interlayers of weathering crust and quartz–epidote rocks; the upper subformation (the depth interval of 6800–6520 m) is composed of the same rocks and laterites (Kazanskii *et al.*, 1995). The formation was attributed to the Induan stage of the Lower Triassic, though, as is shown below, the lower beds of the Khadyr-Yakha Formation overlying the Korotchaevo Formation are characterized by the Middle Triassic spore–pollen assemblage (arbitrarily the Anisian). Most likely, the Korotchaevo Formation spans not only the Induan, but also certain Olenekian strata of the Lower Triassic.

The *Khadyr-Yakha Formation* is distinguished by Kazanskii *et al.*, (1995) within the depth interval of 6520–6421 m. The formation occurs discordantly over the Korotchaevo Formation. It is represented by alternating claystone and graywacke sandstone beds at the base, which are overlain by alternating tuffs, tuffites, and altered extrusive rocks. On the basis of palynological data by Purtova, Kazanskii *et al.* (1995) referred the formation to the Lower Triassic Induan Stage,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although palynological data obtained by Kulikova for almost the whole section of the Khadyr-Yakha Formation (Fig. 1) prove the Middle Triassic age of the formation. The prevalence of pollen of conifers over spores is characteristic of palynomorphs from this formation (Plate 1). Dominant pollen species are *Alisporites* sp. and *Latosaccus latus* Mädler; they associate with *Platysaccus reticulatus* Mädler, *Umbrosaccus* sp., *Sulcatisporites kraeuseli* Mädler, *Colpectopollenites ellipsoides* Visscher, *Falcisporites snopkovae* Visscher, *Stellapolenites thiergartii* (Mädler) Clement-Westerhof, *Klausipollenites* sp., *Striatoabietites aytugii* Visscher, and *Taeniaesporites pellucidus* (Goubin) Balme. Spores of the assemblage are represented by *Calamospora* sp., *Punctatispora* sp., cf. *Spinotriletes echinoides* Mädler, *Perotriletes minor* (Mädler) Clement-Westerhof, *Duplexisporites* sp., *Cyclotriletes* sp., *Densoisporites* sp., *Nevesisporites fossulatus* Balme, *Retusosporites mesozoicus* Klaus, *Apiculatisporites* sp., *Rugulatisporites mesozoicus* Mädler, and *Aratrisporites* sp. The stratigraphic range of many defined species is mainly confined to the latest Early–Middle Triassic, whereas species *Stellapollenites thiergartii, Perotriletes minor, Platysaccus reticulatus, and Latosaccus latus* are known in western Europe only from the Middle Triassic beds (Mädler, 1964; Visscher and Brugman, 1981). Moreover, in the taxonomic aspect, the Khadyr-Yakha palynological assemblage is similar to that from the Anokhino Formation (Assemblage V) of the Tura Group of the Anokhino depression of the eastern Urals, which was referred by Tuzhikova (1973) to the Anisian Stage of the Middle Triassic. These are grounds to assign the Khadyr-Yakha Formation to the Middle Triassic as well (arbitrarily, to the Anisian).

Fossil macrofauna of poor preservation was found in the middle part of the Khadyr-Yakha Formation. L.L. Ovchinnikova identified *Ostracoda* sp., *Hyperammodiscus* (?) sp., and rare undeterminable foraminifers within the depth interval of 6488.4–6480.2 m, as well as *Hyperammina* sp. and *Ortovertella* ? cf. *coctilis* Schleifer within the depth interval of 6457–6447 m. The remains of ostracodes and foraminifers are found mainly in volcanogenic deposits and indicate a short existence period of a shallow sea in the Urengoi region even in the Middle Triassic.

Volcano-sedimentary deposits of the Krasnoselkup Group are overlapped by the continental sedimentary sequence with rare interlayers of coastal-marine sediments. The deposits are subdivided into the Tampei (the latest Middle–Late Triassic), Zavodoukovskaya (the Early–Middle Jurassic), and the Poludino (the latest Middle–Late Jurassic—earliest Cretaceous) groups.

The *Tampei Group* is distinguished within the depth interval of 6421–5660 m (Fig. 2). The group name was first suggested by Bochkarev *et al.*, (1989) for the Ladinian–Carnian deposits of the Urengoi region, which occur between the Lower Triassic volcanogenic sequence penetrated by Borehole (BH) 46 within the Chernichnyi field and the Jurassic terrigenous deposits. The section of Borehole 414-P in the Urengoi area, the depth interval of 5287.1–5130 m, was assumed to be the stratotype of the group. The age of the group (Ladinian–Carnian) was determined on the basis of palynological data. We subdivided the group into two units, the lower Varenga-Yakha and upper Vityutino formations. The lower one is characterized by intercalation of fine-grained sediments and rare conglomerate beds. The upper formation is composed predominantly of coarse-grained sandstone and conglomerate beds with rare siltstone interlayers. In the TSB section, the Tampei Group is also of the two-unit structure. The idea that the third Pur Formation of the Middle Triassic age is present at the base of the group (Ekhlakov *et al.*, 1995; Nesterov *et al.*, 1995) is not justified, as is shown below. In terms of lithology, deposits from the depth interval of 6424–6011 m (Pur Formation) are similar to the Varenga-Yakha Formation from the stratotype section of BH 414 in the Urengoi area (Bochkarev *et al.*, 1989) and are characterized by the Ladinian–Carnian palynological assemblage.

The *Varenga-Yakha Formation* in the TSB section is distinguished within the depth interval of 6421–6050 m. It is represented by gray, dark-gray, and black mudstone and siltstone beds, alternating with light-gray sandstone and rare, especially in the lower part, conglomerate and coaly mudstone interlayers. The unit is characterized by spore–pollen assemblages in its lower (depth interval of 6409.6–6290.9 m) and upper (depth interval of 6120.8–6076 m) parts (Fig. 2, Plate II).

Pollen essentially dominates over spores in the assemblage from the lower part of the formation. Indicative pollen forms are bisaccate *Alisporites* and *Mono-*

Plate I. Khadyr-Yakha Formation, depth interval of 6490–6488 m: (1) *Punctatisporites* sp.; (2) *Calamospora* sp.; (5) *Spinotriletes echinoides* Mädler; (7) *Perotriletes minor* (Mädler) Clement-Westerhof; (8) *Spinotriletes* sp.; (10) *Lycopodiacidites* sp.; (12) *Densoisporites* sp.; (14) *Leptolepidites* sp.; (15) *Uvaesporites* sp.; (16) *Cyclotriletes* sp.; (21) *Colpectopollis ellipsoides* Visscher; (23) *Microchachryidites* sp.; (24) *Triadispora obscura* Scheuring; (25) *Caytonipollenites latus* Mädler; (26) *Cycadopites* sp.; (27) *Chordasporites* sp.; (29) *Falcisporites snophovae* Visscher; (30) *Alisporites* sp.; depth interval of 6447–6457 m: (4) *Apiculatisporites* sp.; (11) *Densoisporites* sp; (13) *Annulispora* sp.; (19) *Polycingulatisporites* cf. *densatus* (de Jersey) Playford et Dettmann; (20) *Umbrosaccus* sp.; (22) *Alisporites* sp.; (33) *Colpectopollis ellipsoideus* Vischer; (34) *Taeniaesporites pellucidus* (Goubin) Balme; depth interval of 6412.9–6426.8 m: (17) *Nevesisporites limatulus* Playford; (18) *Aratrisporites saturni* (Thiergart) Mädler; (28) *Stellapollenites thiergartii* (Mädler) Clement-Westerhof; (31) *Sulcatisporites kraeuseli* Mädler; (32) *Striatoabietites aytugii* Visscher.
The Varenga-Yakha Formation. depth interval of 6290.9–6277.9 m: (3) *Rugulatisporites mesozoicus* Mädler; (6) *Duplexisporites* sp.; (9) *Cyclotriletes triassicus* Mädler.


Plate II
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sulcites associated with *Microchachryidites* sp., *Triadispora crassa* Visscher, *Heliosaccus dimorphus* Mädler, *Succinctisporites grandior* Leschik, *Striatoabietes aytugii* Visscher, and *Caytonipollenites*. Among spores of the assemblage, there are found diverse spiny forms *Osmundacidites* sp., *Apiculatisporites parvispinosus* (Lesch.) Schulz, and *Spinotriletes* sp. in association with *Calamospora* sp., *Punctatisporites* sp. (cf. *P. subcarpaticus* Pautsch), *Aratrisporites* sp., *A. scabratus* Klaus, *A. fischeri* Klaus, and *Leiotriletes* spp. Very rare are individual grains of *Duplexisporites* sp., *Kraeuselisporites* sp., *Cyclotriletes triassicus* Mädler, *Converrucosisporites* aff. *conferteornatus* Pautsch, and *Camarozonotriletes rudis* (Lesch.) Klaus. In the upper part of the formation, the abundance of *Leiotriletes* and spiny forms slightly increases, while that of *Calamospora* and *Punctatisporites* sharply decreases; *Anapiculatisporites telephorus* (Pautsch) Klaus, *Annulispora microanulata* de Jersey, and *Limbosporites lunndbladii* Nilsson are common taxa present here. In general terms of taxonomy, this spore–pollen assemblage is similar to the Varenga-Yakha assemblage from the stratotype section of BH 414 in the Urengoi area (Bochkarev *et al.*, 1989), where it is dated back to the Ladinian–Carnian stages, and to assemblage from the Chernyshovskii Formation of the Transurals (Tuzhikova, 1973). The fact that the Varenga-Yakha assemblage includes *Heliosaccus dimorphus*, the marker of the Ladinian Stage in western Europe (Mädler, 1964; Visscher and Brugman, 1981; Orlowska-Zwolinska, 1983), as well as *Anapiculatisporites telephorus* and *Succinctisporites grandior* abundant in the Ladinian–Carnian deposits of many regions, allows us to surely assign it to the Ladinian–Carnian time.

The fossil plant assemblage of the Varenga-Yakha Formation from the depth interval of 6060–6477 m is comprised of *Paracalamites* sp., *Neocalamites* sf. *carerrei* (Zeil.) Halle, *Neocalamites* sp., *Equisetites* sp., *Cladophlebis* sp., *Sphenopteris* sp., *Desmiophyllum* sp., *Carpolithes* sp. and is typical of the Ladinian–Carnian. The prevalence of horsetail stems representing genera *Paracalamites* and *Neocalamites* among plant fossils makes this assemblage similar to those from the stratotype (BH 414) and reference (BH 673) sections of the Urengoi area (Kirichikova and Travina, 1995).

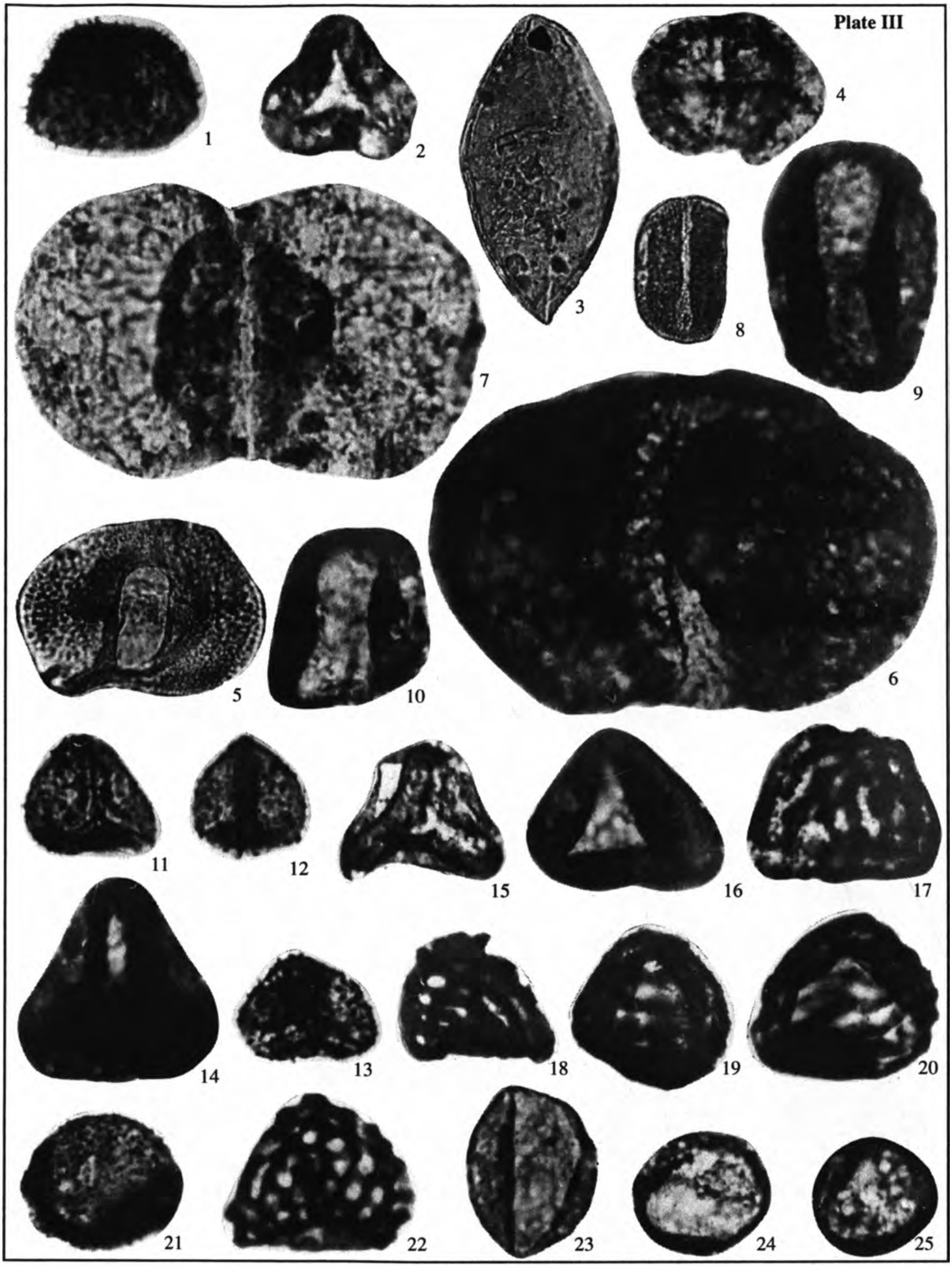
The *Vityutino Formation* was recognized within the depth interval of 6050–5660 m. It is represented by alternating coarse-clastic rocks, mainly by medium- and coarse-grained sandstones (Fig. 2) intercalated with scarce conglomerate and gritstone interlayers as thick as 4 m at the base of the formation.

The spore–pollen assemblage was macerated from a siltstone interlayer (the depth interval of 6028–6010.9 m) at the base of the formation and studied by Kulikova. Among dominant *Leiotriletes* forms (*Concavisporites* and *Dictyophylides*; Plate II), there are *Duplexisporites gyratus* Playt. et Dett., *Anapiculatisporites spiniger* (Lesch.) Reich., *A. telephonus* (Pautsch) Klaus, *Annulispora microanulata* de Jersey, *Cingulizonates* sp., *Camarozonotriletes rudis* (Lesch.) Klaus, *Kyrtomisporites speciosus* Mädler, *K. laevigatus* Mädler, *Zebrasporites laevigatus* Schulz, and *Tigrisporites microrugulatus* Schulz. Common among the pollen are grains of *Alisporites australis* de Jersey, *Cycadopitys*, and *Chasmatosporites* (*C. apertus* Nilss., *C. hians* Nills.), accompanied by *Ovalipollis* sp., *Minutosaccus* sp., *Duplicisporites* cf. *gramlatus* Scher., and *Taeniaesporites rhaeticus* Schultz. Almost all species of the Vitytino assemblage are widespread and mark clear stratigraphic levels in many Triasic sections of Europe. For instance, species *Camarozonotriletes rudis, Anapiculatisporites spiniger*, and *Annulispora microanulata* are known from the Carnian–Rhaetian deposits in Germany and Poland (Schultz, 1967; Orlowska-Zwolinska, 1983); *Kyrtomisporites speciosus, Kyrtomisporites laevigatus, Zebrasporites laevigatus, Chasmatosporites apertus*, and *Taeniaesporites rhaeticus* occur in the uppermost Upper Triassic deposits (Rhaetian) of Europe. In the Tsvetkov Cape section of the Taimyr Peninsula, the first occurrence level of listed taxa is in the Carnian (Romanovskaya. 1989). This allows us to assign the Vityutino Formation to the Late Triassic (the Carnian–Norian).

Horsetail stems of genera *Paracalamites, Neocalamites* and *Equisetites* [*Paracalamites* sp., *N.* cf. *carerrei* (Zeil.) Halle, *Neocalamites* sp., *E.* cf. *turgaicus* (Vladim.) Kiritch., the depth interval of 5743–6050 m] and individual ferns mainly of the *Cladophlebis* genus are abundant among macroflora of the Vityutino Formation. This plant assemblage is basically similar to

Plate II. The Varenga-Yakha Formation, depth interval of 6488–6410.2 m: (1) *Dictyophyllidites mortonii* (de Jersey) Playford et Dettman. The same unit, depth interval of 6290.9–6277 m: (7) *Converrucosisporites* aff. *conferteornatus* Pautsch; (9) *Camarozonotriletes rudis* (Leschik) Klaus; (13) *Aratrisporites fischeri* (Klaus) Playford et Dettmann; (18) *Aratrisporites scabratus* Klaus; depth interval of 6277.9–6290.9 m: (2) *Concavisporites tumidus* Playford; (4) *Anapiculatisporites* sp., (11) *Stereisporites* sp.; (14) *Selagosporis mesozoicus* Schulz; (21) *Limbosporites lundbladii* Nilsson; (29) *Alisporites* sp.; (32) *Cycadopites* sp.; depth interval of 6080.8–6076.3 m: (5) *Apiculatisporites* sp.; (26) *Alisporites australis* de Jersey.

The Vityutino Formation, depth interval of 6038–6028.2 m: (3) *Dictyophyllidites mortoni* (de Jersey) Playford et Dettmann; (10) *Camarozonotriletes rudis* (Leschik) Klaus; (27) *Triadispora* sp.; (30) *Duplicisporites* sp.; depth interval of 6028.2–6019.4 m: (8) *Camarozonotriletes rudis* (Leschik) Klaus; (15) *Tigrisporites microrugulatus* Schulz; (16) *Kluperisporites baculatus* Schulz; (20) *Annulispora microannulata* de Jersey; depth interval of 6019.4–6010.9 m: (6) *Spinotriletes* sp.; (12) *Duplexisporites gyratus* Playford et Dettmann; (17) *Duplexisporites* sp.; (19) *Kyrtomisporis speciosus* Mädler; (22) *Cingulizonates* sp.; (23) *Zebrasporites laevigatus* (Schilz) Schulz; (24) *Kyrtomisporis laevigatus* Mädler; (25) *Taeniasporites rhaeticus* Schulz; (28) *Minutosaccus* sp.; the depth interval of 5769.5–5757.1 m, (31) *Alisporites* sp.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the Varenga-Yakha macroflora and has no difference from that of the Tampei Group penetrated by BH 414, 673, and 410 in the Urengoi area (Kirichkova and Travina, 1995). Moreover, the Tampei Group macroflora is identical in abundance of horsetail forms to the that of the Bulanash and Kalachevo formations of the eastern Urals (Kirichkova, 1990, 1993), and of the Nemtsov Formation of Tsvetkov Cape in Taimyr Peninsula (Mogucheva, 1982, 1984); all dated back to the Late Triassic (the Carnian–Norian).

JURASSIC

The *Zavodoukovskaya Group* comprises the Lower–Middle Jurassic deposits. According to Resolution of the Interdepartmental Stratigraphic Conference, it is subdivided (from the base upward) into the Beregovka, Yagel, Kotukhta and Tyumen formations.

The *Beregovka Formation* (the depth interval of 5660–5450 m), like in the hypostratotype section of BH 414 in the Urengoi area (Bochkarev *et al.*, 1989), is represented by coarse-grained sandstones with rare conglomerate and siltstone–shale interlayers (Fig. 2). The Early Jurassic palynological assemblage studied by Timoshina was recovered from siltstone interlayers of the lower part of the formation (the depth interval of 5660–5555 m). The assemblage (Plate III, images 1–10) includes abundant pollen of *Coniferales* and *Disaccites* associated with larger *Podocarpidites* grains *Quadraeculina* (*Q. limbata* Mal., rarely *Q. anellaeformis* Mal.), *Cycadopites, Ovalipollis, Chordasporites, and Platysaccus*. Identified among spores are species *Neoraistrickia* sp., *Duplexisporites* sp., *Leiotriletes* spp. (smaller forms), *Apiculatisporites, Osmundacidites* sp., and *Lycopodiumsporites* sp. Such a combination of taxons is characteristic of palynofloras from the lowermost Lower Jurassic of the Siberian paleofloral province, which are known from the Raspad Formation in Kuzbass, the lower Makarovo and Pereyaslovka subformations of the Kansk–Achinsk basin, and the lower beds of the Zimnee Formation of the Ust-Yenisei region; these palynofloras are dated back to the Hettangian–Sinemurian and, probably, early Pleinsbachian (Il'ina, 1985; Bochkarev *et al.*, 1989).

Among fossil plants, horsetail stems of the genus *Neocalamites* [*N.* cf. *carrerei* (Zeil.) Halle, *Neocalamites* sp.] and peculiar large-leaved Ginkgoales of the genus *Sphenobaiera* are encountered primarily in the Beregovka Formation. We have found similar divided leaves of *Sphenobaiera–Sphenobaiera magnifolia* Aksarin in a higher part of the section, namely, in the lower part of the Kotukhta Formation penetrated by BH 410 in the Urengoi area (Kirichkova and Travina, 1995). In general, the improverished plant assemblage from the Beregovka Formation is consistent in age with the dating based on palynological evidence. We recognized the boundary between the Triassic and Jurassic in the TSB section at a depth of 5660 m.

Poorly preserved microfauna, almost undeterminable even at the genus level, was found in the lower part of the Beregovka Formation. Species *Saccamina* sp. and *Ostracoda* sp. were encountered within the depth interval of 5592.9–5600 m, and only rare shell fragments were found within the depth interval of 5583.5–5591.5 m.

The *Yagel Formation* (the depth interval of 5450–5330 m) is represented in the TSB section by shale beds with siltstone and fine-grained sandstone interlayers. The formation yielded little or no fossil remains. Stem remains of horsetails *Neocalamites* sp. and *Equisetites* sp. (Fig. 2) are encountered in the middle part of the formation. Spores and pollen appeared to be of poor preservation, and only rare specimens of *Neoraistrickia* sp., *Cycadopites* sp., and *Disaccites* sp. were identified. The formation is assumed to be the Pleisbachian in age on the basis of its stratigraphic position between the Beregovka Formation (the lowermost Lower Jurassic) and the Kotukhta Formation, the lower part of which is assigned to the Toarcian.

The *Kotukhta Formation* (the depth interval of 5330–4610 m), which overlies the Yagel Formation, is represented in the lower part by irregularly alternating sandstone, siltstone, and mudstone beds (the depth interval of 5330–5120 m) intercalated with rare and thin (up to 10–14 cm) conglomerate and gritstone interlayers. A sequence of thin-bedded siltstone with subordinate siltstone and sandstone interlayers (probably the Togur unit) is distinguished within the depth interval of 5038–4980 m (Fig. 3). Upsection, polymictic small- to medium-grained thick sandstone beds alternate with black mudstone and siltstone interlayers bearing the irregularly distributed coaly material and plant remains (Ekhlakov *et al.*, 1991).

Plate III. The Beregovka Formation, depth interval of 5636–5623.5 m: (3) *Cycadopites medius* (Bolch.) Iljina; depth interval of 5600.1–5591.5 m: (1) *Spinotriletes* sp.; (4) *Chordasporites* sp.; (5) *Paleoconiferus rotundus* Odints.; (6) *Alisporites pergrandis* (Bolch.) Iljina; (8) *Quadraeculina anellaeformis* Mal.; (9, 10) *Quadraeculina limbata* Mal.; depth interval of 5591.5–5583.5 m: (2) *Leiotriletes* sp.; (7) *Podocarpidites* sp.

The Kotukhta Formation (the lower part), depth interval of 5046.8–5035.2 m: (11–13) *Dictyophyllum minutus* Mensh. et Timosh.; (16) *Leiotriletes* sp.; (21) *Osmundacidites* sp.; (22) *Klukisporites variegatus* Couper; (25) *Classopollis* sp.; depth interval of 5035.2–5021.9 m: (14) *Matonisporites* sp.; (18) *Duplexisporites* sp.; (24) *Classopollis* sp.; depth interval of 5021.9–5015.2 m: (19, 20) *Contignisporites problematicus* (Couper) Dor.; 23. *Chasmatosporites elegans* Nilsson; depth interval of 5015.2–5008.7 m: (15) Dipteridaceae gen. sp.; (17) *Duplexisporites* sp.

Magnification for all images is ×600.

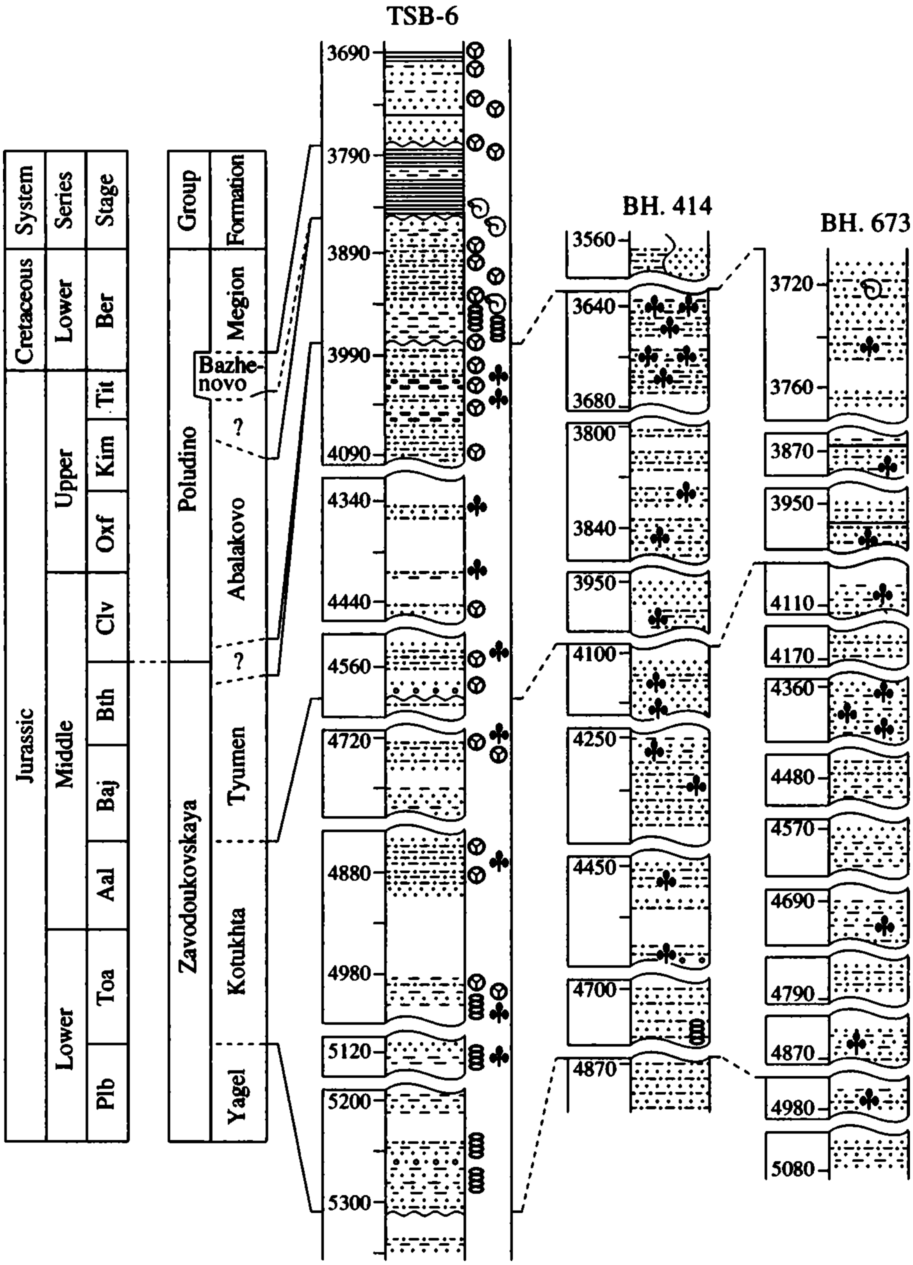

Fig. 3. Subdivision of the Jurassic and Lower Cretaceous deposits penetrated by TSB-6 and correlation with sections from reference boreholes of the Urengoi area (symbols as in Fig. 1).

Palynospectra are studied at different stratigraphic levels of the formation. In Timishina's opinion, the most representative is the palynological assemblage from the depth interval of 5046.8–4997 m. It includes low-abundant *Disaccites*, *Podocarpites*, larger *Cycadopites* grains, and individual specimens of *Quadraculina limbata* Mal. *Classopollis* pollen is abundant. Spores are diverse and abundant. Large- and medium-sized *Leiotriletes* forms dominate; *Contignisporites* sp., *Dictyophyllum* (spiny), and *Klukisporites variegatus* Couper are common; rare specimens represent Dipteridaceae gen. sp., *Tripatina variabilis* Mal., *Stereisporites* sp., *Cyathidites minor* Couper, *Microlepidites crassirimosus* Timosh., and *Osmundacidites* spp. (abundant in some sprectra). *Chasmatosporites* pollen was also encountered in places (Plate III, images 11–25). Timoshina identified a palynocomplex similar in composition, but more diversed in terms of taxonomy, within the lower half (the Togur Member) of the Sherkalinskoe Formation of the Krasnoleninskii arch in western Siberia and in the Ilanskii Formation of the Kansk basin; following Il'ina, she dated it back to the latest Early Jurassic (the Toarcian).

Although palynospectra from the depth intervals of 4873.0–4863.7 and 4734.5–4744.9 m are similar in composition to that described above, they lack *Classopollis* pollen and do not allow a confident conclusion on their Early Jurassic age. The palynospectrum from the depth interval of 4722.2–4734.5 m is rich in miospores. The spectrum includes larger *Podocarpidites* and *Quadraecula anellaeformis* Mal. characteristic of the Early Jurassic; encountered among abundant Coniferales is *Dipteralla oblatinoides* Mal. associated with spores of diverse *Leiotriletes* (including *L. karatauensis* Timosh.), *Osmundacidites* cf. *O. jurassicus* (K.-M. Kuz.), and *Lycopodiumsporites* (very abundant) of the Middle Jurassic type; also present are *Tripartina variabilis* Mal., *Stereisporites incertus* (Bolch.) Sem., *S. bujargiensis* (Bolch.) Schulz, *Hymenozonotriletes bicycla* (Mal.) Sach. et Fradk., *Cyathidites minor* Couper, Dipteridaceae, and a considerable amount of *Cycadopites* specimens characteristic of the Middle Jurassic. In its taxonomic composition, this assemblage correlates with palynospectra peculiar of the Kamala Formation of the Kansk basin and upper beds of the Sherkalinskoe Formation of the Krasnoleninsk arch, both identified by Timoshina as the Aalenian in age.

Scarce macroflora from the Kotukhta Formation is of a low diversity and concentrated in the Togur Member (the depth interval of 5046–5008 m, Fig. 3). *Neocalamites* sp., *Equisetites* sp., *Coniopteris murrayana* (Brongn.) Brongn., and *Cladophlebis* sp. represent this macroflora comparable with the fossil plant assemblage from lower beds of the Kotukhta Formation penetrated by BH 673 and 414 in the Urengoi area (Kirichkova and Travina, 1995). We consider the recovered flora as attributable to the latest Early Jurassic (presumably the Toarcian).

The upper part of the Kotukhta Formation in the TSB section (the depth interval of 4873–4722 m) yielded *Neocalamites* sp., *Equisetites lateralis* (Phill.) Phill., *E. beanii* (Bunb.) Sew., *Coniopteris* cf. *simplex* (L. et H.) Harris, *Cladophlebis nebbensis* (Brongn.) Nath., *Cladophlebis* sp., *Heilungia* ? sp., *Nilssonia* sp., *Carpolithes* sp., and *Pityophyllum* sp. The upper Kotukhta assemblage of the TSB section corresponds to palynospecra detected in the upper Kotukhta Subformation of the Urengoi area and in the upper Khudoseya Subformation of the Ob River and Tomsk regions, where they are attributed to the initial Middle Jurassic, arbitrarily to the Aalenian (Kirichkova and Travina, 1995). The boundary between the Early and Middle Jurassic in the TSB section is placed inside the Kotukhta Formation at the level of 4890 m.

Microfauna of the Kotukhta Formation is concentrated in its lower part within the depth interval of 4927–5297.9 m, where we detected such forms as *Saccamina* cf. *ampullacea* Schleifer, *Saccamina* sp., *Hyperammina* sp., *Ammodiscus* cf. *glumaceus* Gerke et Soss., *Ammodiscus* sp., *Glomospira* cf. *gordialis* (Parker et Jones), *Haplophragmoides* sp., *Ammobaculites* ex gr. *lobus* Gerke et Soss., *Ammobaculites* sp., *Trochammina* ? sp., *Lenticulina* (*Astacolus*) ex gr. *pallida* Schleifer var. *pallida* Schleifer, *Lenticulina* sp., *Ostracoda* ? sp., and also abundant but poorly preserved agglutinated foraminifers. According to the conclusion by Ovchinnikova, these microfossils are useless for stratigraphy. Their presence indicates only peculiar sedimentation environments during the Kotukhta time.

The *Tyumen Formation* overlaps with a minor unconformity the Kotukhta Formation. It is distinguished within the depth interval of 4610–3980 m (Fig. 3). In the lower part, the formation is composed of thick fine- to medium-grained sandstone beds alternating with thin interlayers of dark-gray, locally silty mudstone. The upper part of the formation shows the more regular alternation of sandstone, siltstone, mudstone, coaly siltstone, and thin coal beds.

Timoshina believes the age of palynospectrum characterizing the lower part of the Tumen Formation (the depth interval of 4564.2–4415.5 m) to be most likely the Bajocian. Abundant, poorly preserved *Disaccites* pollen and diverse spores are typical of the spectrum. Spores are represented by abundant and diverse *Leiotriletes*, *Osmundacidites* cf. *O. jurassicus* (K.-M.) Kuz., and *Lycopodiumsporites* spp. associated with less abundant *Hymenozonotriletes bicycla* (Mal.) Sach. et Fradk., *Tripartina variabilis* Mal., *Stereisporites* sp., *Cyathidites minor* Couper, *Microlepidites crassirimosus* Timosh., Dipteridaceae, and Middle Jurassic *Neoraistrickia rotundiformis* (K.-M.) Taras., *Dicksonia densa* Bolch., *Acanthotriletes* sp. (larger), and *Zonalopollenites dampieri* Balme; rare specimens of phytoplankton are also encountered. The assemblage is similar to those distinguished by Timoshina in deposits of the Borodin Formation in the Kansk basin and of the Tyumen Formation (its lower and middle parts) in the Tomsk, Ob River, and Krasnoleninsk arch regions. All these assemblages are attributed to the Middle Jurassic; arbitrarily, to the Bajocian.

The upper part of the Tyumen Formation (the depth interval of 4087–4002 m) is characterized by the palynospectrum dated by Timoshina as the Bathonian in age. The spectrum includes the following taxa: abundant but poorly preserved Coniferales and *Disaccites*; diverse and numerous *Leiotriletes, Osmundacidites*, and *Lycopodiumsporites*; less abundant *Neoraistrickia rotundiformis* (K.-M.) Taras., *Stereisporites incertus* (Bolch.) Sem., and *Tripartina variabilis* Mal.; characteristic *Klukisporites variegatus* Couper, *Matonisporites* sp., *Quadraeculina limbata* Mal., *Seiadopityspollenites* sp., and rare *Classopollis*; individual specimens of *Eboracia*. Scarce microphytoplankton specimens are persistent components. A similar assemblage was distinguished by Timoshina in the upper part of the Tyumen Formation in the Tomsk, Ob River, and Krasnoleninsk arch regions as characterizing the Bajocian microflora because of its similarity to that from the lower part of the Malyshevka Formation (the Ust-Yenisei region), where it coexists with foraminiferal fauna (Rovnina, 1972; Bulynnikova and Yasovich, 1972).

Macroflora from the Tyumen Formation is scarce and confined mainly to its upper part. Its typical components are *Neocalamites* sp., *Equisetites lateralis* (Phill.) Phill., *Equisetites* sp., *Coniopteris* cf. *burejensis* (Zall.) Sew., *C.* cf. *simplex* (L. et H.) Harris, *C. depensis* E. Lebed., *Cladophlebis* cf. *williamsonii* (Brongn.) Brongn., *Raphaelia stricta* Vachr., *Sphenobaiera* sp., *Pityophyllum* sp., and *Desmiophyllum* sp. The combination of such forms as *Equisetites lateralis* (Phill.) Phill., *Coniopteris depensis* E.Lebed., *C.* cf. *burejensis* (Zall.) Sew., and *C.* cf. *simplex* (L. et H.) Harris allows a confident correlation of the upper Tumen macroflora of the TSB section with the Bajocian flora of the Urengoi, Ob River, and Tomsk regions (Kirichikova and Travina, 1995).

The *Poludino Group* is subdivided into the Abalakovo, Bazhenovo, and Megion formations.

The *Abalakovo Formation* (the depth interval of 3980–3840 m) of the marine genesis unconformably overlies the Tyumen Formation. Its lower part is composed of alternating dark-gray siltstone and mudstone beds with siderite lenses and pyrite inclusions. The upper part consists of gray polymictic sandstone overlapped by a thin (about 10 m) member of mudstone, siltstone, and sandstone beds with interlayers of greenish–gray to green glauconite siltstone (Ekhlakov *et al.*, 1991). The formation yielded macro- and microfauna and associated microphytofossils. Macrofauna was identified by Vyachkileva, Lebedev, and Turbina (ZapSibNIGNI). Ammonites *Quenstedtoceras (Soaniceras)* sp. indet, *Arctica* sp. (aff. *A. humiliculmina* Schur.), and *Bivalvia* gen. ind. (the late Callovian) were found within the depth interval of 3967–3928 m. *Dorsoplanites* sp. (the middle Volgian), along with bivalves *Buchia* cf. *mosquensis* (Bach) and *Inoceramus* ex gr. *vereschagini* Poch. (the middle Volgian), was encountered within the interval of 3825–3831 m.

The Callovian foraminiferal assemblage was studied by Ovchinnikova. Foraminifers are recovered from two intervals. The depth interval of 3976.6–3989.7 m yielded *Ammodiscus* sp., *Harlophragmoides* sp., *Recurvoides* cf. *scherkalyensis* Levina, *R.* cf. *tagaensis* Levina, and *Trochammina* sp. ind. Taxa from the interval of 3967–3976 m are *Saccamina* sp., *Ammodiscus uglicus chremcevae* Dain, *Haplophragmoides* sp., *Recurvoides scherkalyensis* Levina, *Ammobaculites* sp., *Dorothia* ? sp., *Lenticulina* sp. ind., and *Astacolus* ? sp.

The Callovian palynomorphs identified by Timoshina within the depth interval of 4000–3888.8 m include abundant pollen of Coniferales and *Disaccites*, along with *Sciadopityspollenites*, *Quadraeculina limbata* Mal., *Alisporites bisaccus* Rouse, and common *Classopollis* is (abundant in some spectra). Spores are more diverse and represented by *Leiotriletes* spp., *Osmundacidites jurassicus* (K.-M.) Kuz., *O.* spp., *Cyathidites minor* Couper, *Neoraistrickia rotundiformis* (K.-M.) Taras., *Lycopodiumsporites* sp., *Duplexisporites* sp., *Eboracia* sp., and *Klukisporites variegatus* Couper. Distinctive forms of the assemblage are large spores *Cyathidites australis* Couper, *Uvaesporites argentaeformis* (Bolch.) Schulz, and associate Selaginellacea and smaller *Acanthotriletes* spores. Microphytoplankton is persistently present, scarce in places, but often abundant and diverse, though poorly preserved. When compared, the Abalakovo assemblage from the superdeep borehole and those from the Vasyugan and Naunak formations of the Tomsk and Ob River regions display obvious similarity, although microphytoplankton occurs in the Vasyugan Formation only sporadically as single specimens.

The *Bazhenovo Formation* (the depth interval of 3840–3780 m) overlies the Abalakovo Formation. It is represented by gray to dark-gray mudstone and bituminiferous, pyritized shale. The Volgian (the lowermost part of the stage excluded) to early Berriasian age of the Bazhenovo Formation in the Urengoi area is substantiated in detail by ammonite, *Buchia*, and foraminiferal fauna (Braduchan *et al.*, 1986).

Microphytofossils studied by Fedorova were sampled from the upper part of the Bazhenovo Formation within the depth interval of 3778.3–3798.6 m (Fig. 3). Abundant specimens from this interval are represented by large cigar-shaped and globular particles probably of the algal origin. Individual prasinophytes (*Pterospermella* aff. ? *marginulata* Theod., *P.* aff. ? *griazevae* Theod.) and rare bisaccate pollen Coniferae gen. sp. indet. (including probably *Piceapollenites* sp. and problematic *Podocarpidites* sp.) were also identified among other specimens. The presence of algal remains of unknown taxonomy and rare transitory forms of Coniferae do not elucidate the age of enclosing rocks. It should be pointed out, however, that some prasinophyte species similar to those mentioned above were described by Fedorova (1990) from the Jurassic–Cretaceous boundary beds of the Russian platform in the Oka River basin (the central Volga region), where their stratigraphic range was identified as the middle–upper Volgian Substage of the Berriasian.

The *Megion Formation, Achimovka Member* (the depth interval of 3780–3690 m) is represented by light-gray to gray, polymictic sandstone with rare siltstone and mudstone interlayers. Fedorova identified microphytofossils from deposits in the depth interval of 3765.6–3698.2 m. The medium-sized and smaller pollen of *Pinuspollenites* spp., *Piceapollenites* spp., and *Podocarpidites* sp. dominate among Coniferae at this level. Most frequent spore taxa are *Leiotriletes*, *Cicatricosisporites minutaestriatus* (Bolch.) Pocock., problematic *C. australiensis* Pot. et Gell., and *C.* aff. *minor* (Bolch.) Pocock. Individual grains of *Sphagnumsporites* sp., *Densiosporites velatus* Weyl. et

Kireg., *Lycopodiumsporites* sp., *Osmundacidites* sp., problematic *Ishyosporites–Klukisporites* spp., ?*Lygodium* spp., and *Lophotriletes* sp. are almost persistently observed. The depth interval of 3765.8–3778.3 m yielded problematic *Aequitriradites* aff. *spinulosus* Delc. et Sprum. and *Foraminisporis* sp. in association with aff. *Tripartina* sp. and the more rare *Cupressacites* sp., *Caythonipollenites* sp., *Sciadopityspollenites* sp., and *Leptolepidites ? verrucatus* Coup. New-comers, such as problematic *Gnetaceaepollenites* sp., *Zonalapollenites* sp., *Leiotriletes* ? aff. *incertus* Bolch., *Selaginella* ? aff. *tenuispinulosa* Krasn., *Cicatricosisporites* ? *ludbrooki* Dett., *Lygodium* aff. *valanjinense* K.-M., *Lygodium* (*Impardecispora* ?) ? *triangulatum* E.Iv., problematic *Classopollis* sp., and *Stachycarpus* sp., appear in the depth interval of 3719.0–3731.9 m. Microphytoplankton from the lower part of the member is represented by scarce dinoflagellates: (?) *Muderongia* aff. *simplex* Alb., (??) *Gonyaulacysta* aff. *jurassica* (Defl.) Novik. et Sarj, (??) *Cribroperidinium* aff. *globatum* (Gitmez et Sarj) Helenes, *Tubotuberella* spp., *Gochteodinia* ? ex gr. *villosa* Norris, (?) *Dingodinium* sp., and (??) *Imbatodinium* aff. *kondratjevi* Vozzhen., as well as by individual prasinophyte species aff. (?) *Lancettopsis* sp., aff. (?) *Eupoikilofusa* sp., and *Pterospermella* ? aff. *parva* Theod.

Upsection, microphytoplankton appears to be more diverse in the composition of prasinophytes and dinocysts. Identified among them are *Tasmanites*, *Pterospermella* (including *P.* ? *helios* Sarj, *P.* ? aff. *magnicorpulenta* Theod., *P.* ? aff. *marginulata* Theod.) *Pleurozonaria* sp., *Pterosphaeridia* (forms with a large reticulum), *Eupoikilofusa* spp., *Paragonyalacysta* ? aff. *borealis* Brideauz, *P.* ?aff. *capillosa* Brideaux, *Cribroperidinium* sp., *Wallodinium krutzchi* Alb., Sentusidinium sp., *Hystrichodinium* aff. *voigthi* Alb., *Microdinium* ? *opacum* Brideaux, *Gochteodinia* ex gr. *villosa* Norris., and aff. (?) *Tubotuberella* sp. Microphytofossils from the Achimovka Member are similar in composition to their assemblages from the Berriasian deposits of central Siberia (Urdyuk-Khaya Cape, Paksa Peninsula; Il'ina, 1985) and arctic Canada (Brideaux and Fisher, 1976).

SUMMARY

The comprehensive study and analysis of biostratigraphy of Mesozoic deposits penetrated by TSB-6 resulted in the following:

(1) The complete Mesozoic section was first penetrated by a single borehole and revealed a succession of its lithological and biostratigraphic units.

(2) Biostratigraphy of the lower volcano-sedimentary part of the section was refined, and, following Kazanskii and co-authors (*Rezul'taty*..., 1995; Kazanskii *et al.*, 1995), the Krasnoselkup Group was diveded into three units: the Evo-Yakha (tentatively Permian), Korotchaevo (Induan–Olenikian of the Lower Triassic ?), and Khadyr-Yakha (Anisian of the Middle Triassic) formations. The boundary between the Permian and Triassic is arbitrarily placed at the level of 7250 m.

(3) The subdivision into formations and age of the sedimentary Tampei Group are refined. The two-unit structure of the group and its Ladinian–Carnian age in the TSB section are substantiated using correlation with the type and reference sections of the group in the Urengoi area boreholes (Bochkarev *et al.*, 1989; Kirichkova and Travina, 1995).

(4) Nomenclature of formations from the Lower Jurassic part of the TSB section is verified in accordance with the Resolutions of the Interdepartmental Stratigraphic Conference on West Siberia, Tyumen, 1990. A break in sedimentation at the end of the Late Triassic between the Vityutino and Beregovka formations is revealed.

(5) The Middle and Upper Jurassic Abalakovo and Bazhenovo formations of marine sediments and the lowermost Lower Cretaceous deposits (the Achimovka Member of the Megion Formation) was first characterized in detail by microphytofossils.

(6) The time succession of palynological assemblages characteristic of continental deposits is distinguished for the first time in the integral Mesozoic section. The revealed assemblages were used as a basis for extensive chronostratigraphic correlations within and outside the Urengoi region. The boundary between the Anisian and Ladinian in the TSB section is placed at a depth of 6421 m, and that between the Triassic and Early Jurassic, at a depth of 4890 m.

(7) The comprehensive biostratigraphic study on Mesozoic deposits penetrated by TSB-6 showed that their section can be considered as the reference one in the northern part of western Siberia.

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