

## Prediction of the Diamond Potential of Triassic Rocks in Taimyr

S. A. Grakhanov<sup>a</sup> and A. V. Yadrenkin<sup>b</sup>

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The diamond potential of Taimyr was first predicted by V.S. Sobolev and G.G. Moor after study of samples of micaceous kimberlites discovered by N.N. Urvantsev in 1929. Alkaline basic rocks, similar to the kimberlite-associated melilitic basalts of South Africa, were discovered in Taimyr by Sobolev [1] and Moor (based on consultations with Sobolev) [14]. Sobolev made recommendations pertaining to the prospecting for kimberlites and diamonds in a special report submitted to Classified Report Funds of the Karpinskii All-Russia Research Institute of Geology, St. Petersburg in 1941 (inventory no. 1773). A significant portion of this report was later published in [2].

Subsequently, M.G. Ravich, L.A. Chaika, and A.P. Romanov discovered lamproites in Gornyi Taimyr. The issue of the origin of lamproites has been discussed in many works [3–6]. Findings of diamonds in Quaternary and Cretaceous sediments significantly supported the existing hypothesis [3].

Based on study and comparison of the lithology of rocks in the northeastern Siberian Craton and eastern Taimyr, we came to the conclusion that Carnian (Upper Triassic) rocks of Taimyr can contain diamonds. This is suggested by the following fact: diamonds have been found in temporally analogous rocks of the northern Siberian Craton extending from western spurs of the Verkhoyansk Range to the Anabar Inlet [7]. Triassic rocks were not sampled and examined for diamonds in the western area. Indirect signs suggest that Triassic rocks developed between the Anabar and Khatanga inlets can contain diamonds. In this region, diamonds and indicator-minerals of kimberlites have been found in exposures of Carnian rocks among recent channel and beach deposits (mouth of the Gurimiskai River,

middle reaches of the Gurimiskai River, and the Urung-Tumus Peninsula) [7]. Thus, the Carnian rock zone with various grades of diamond potential has been traced over more than 500 km to the west of the Verkhoyansk Mountains. This zone is separated from Taimyr only by the Khatanga Inlet.

The diamond potential of all sectors of the Siberian Craton mentioned above is associated with the basal unit of the Osipai Formation, the stratotype section of which is located in eastern Taimyr (Cape Tsvetkov).

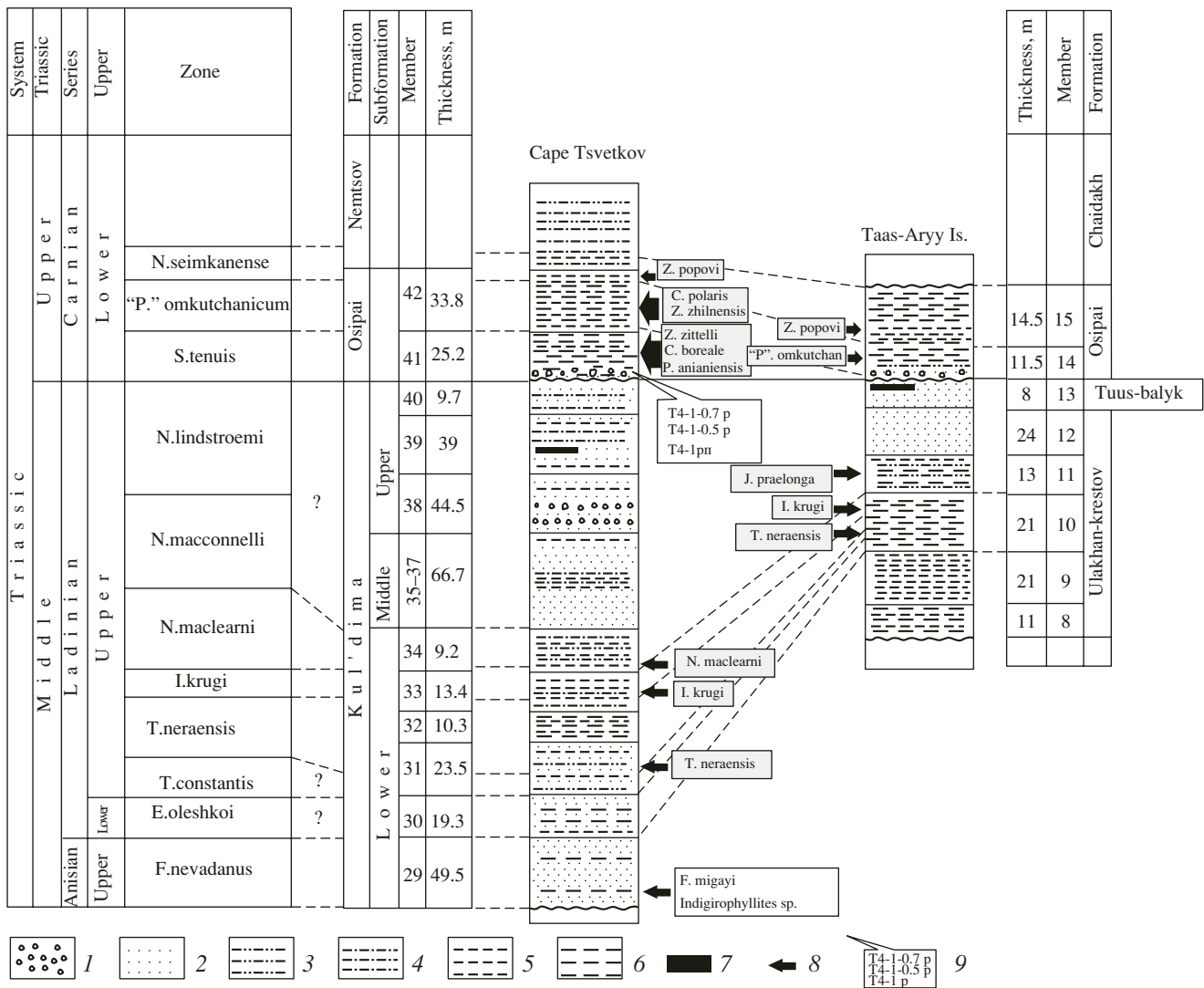
The results of the paleontological and stratigraphic correlation of sections show that the productive layer in various areas of the study region was formed at approximately the same time (initial Carnian age) [8, 9] (Fig. 1).

The reference section of Triassic rocks in eastern Taimyr (Cape Tsvetkov) is characterized by a high degree of exposure and stratigraphic completeness. They also contain numerous flora remnants accompanied by marine macro- and microfauna fossils [8, 9]. The base of the Osipai Formation (member 41) includes a “debris” layer (0.7 m thick) of inequigranular sand and clay with a gravel-pebble material of quartz, siliceous rocks, siltstones, sandstones, basaltic porphyrites, redeposited carbonate concretions, and coalified wood fragments. In the heavy fraction, magnetite and ilmenite are the major components; zircon, garnet, and spinel are subordinate; and apatite, tourmaline, and chloritoid are rare. Authigenic minerals (anatase, pyrite, and siderite) are rather abundant. The light fraction is composed of quartz, feldspars, and some biotite. This layer (*tenuis* zone) corresponds to the lowest Carnian stage [8, 9].

Basal rocks of the Osipai Formation are slightly exposed in the northeastern Siberian Craton. Bedrocks are exposed at Cape Tumul, the mouth of the Olenek River, Cape Ystannakh-Khocho (Olenek Bay), and Taas-Aryy Island at lower reaches of the Lena River (here, N.I. Gogina discovered the first diamond grain in the Osipai Formation [10]). In these sections, the major lithological components of the basal unit of the Osipai Formation are represented by loose inequigranular sand

<sup>a</sup> OAO Nizhne-Lenskoe, ul. Kurashova 43, Yakutsk, 677000 Russia; e-mail: s.grakhanov@rambler.ru

<sup>b</sup> Institute of Oil and Gas Geology and Geophysics, Siberian Branch, Russian Academy of Sciences, pr. akademika Koptyuga 3, Novosibirsk, 630090 Russia



**Fig. 1.** The Ladinian–Carnian fragment of Triassic sections at Cape Tsvetkov (eastern Taimyr) and Taas-Aryy Island (lower reaches of the Lena River). Adopted from [8, 9]. (1) Conglomerate, pebble, and gravel; (2) sandstone; (3) coarse-grained siltstone; (4) siltstone; (5) fine-grained siltstone; (6) mudstone; (7) coal interlayers and lenses; (8) findings of index fauna; (9) sampling site.

with grus, gravel, rubble, and pebbles with a variable amount of cement composed of gritstone and conglomerate. Gravels and pebbles have a more diverse petrographic composition: sandstones, siltstones, limestones, dolomites, cherts, metamorphic rocks, and vein quartz. Igneous rocks can be divided into three groups: rhyodacites and their tuffs; andesites and their tuffs; and basalts and their tuffs. The heavy fraction of the Ospai Formation is characterized by the chromite–garnet association with leucoxene and chlorite.

Indicator-minerals of kimberlites are widespread in the Ospai Formation within the northeastern Siberian Craton. They are mainly represented by pyrope and chrome spinels. Picroilmenite, zircon, and olivine are less common. The typomorphic features and chemical composition of pyrope are rather well studied [7, 11].

More than 1000 grains were analyzed. The pyrope grains mainly belong to the lherzolite association of the low-Cr (~70%) and high-Cr (25%) types [12, 13]. One to two grains fall into the field of garnets of the diamond association [12, 13].

We analyzed the mineral composition of the basal unit of the Ospai Formation in eastern Taimyr based on small samples (total mass ~200 g) left after the microfaunal analysis of bulk samples taken by geologists of the Institute of Oil and Gas Geology and Geophysics (Novosibirsk) in 1992. These samples were taken from the basal layer of the Ospai Formation (Fig. 1, member 41). Although the mass of the samples was small, we could extract 11 garnet grains, including 10 pyrope grains (table).

Results of the microprobe analysis of garnets

Analysis no.	SiO <sub>2</sub>	CaO	Cr <sub>2</sub> O <sub>3</sub>	MgO	FeO	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	NiO	Na <sub>2</sub> O	MnO	Total
1	40.44	5.93	7.04	19.91	7.46	16.22	1.01	0.01	0.07	0.30	98.38
2	41.74	4.76	2.99	21.32	7.45	20.63	0.21	0.00	0.00	0.37	99.47
3	41.23	5.67	6.57	21.04	6.29	17.82	0.38	0.04	0.07	0.26	99.35
4	41.12	5.04	3.41	20.68	8.01	18.77	1.04	0.00	0.13	0.31	98.52
5	41.52	4.65	1.99	20.14	9.31	21.72	0.07	0.00	0.03	0.43	99.85
6	41.64	4.54	3.43	21.47	7.26	19.93	0.40	0.03	0.07	0.31	99.07
7	41.82	4.53	1.75	21.66	7.45	20.73	0.63	0.00	0.04	0.25	98.85
8	38.77	7.58	0.06	8.00	24.18	21.23	0.13	0.00	0.10	0.46	100.52
9	41.24	5.33	5.75	20.80	6.81	18.74	0.13	0.00	0.00	0.31	99.09
10	41.81	2.08	7.90	23.78	5.95	17.07	0.04	0.02	0.03	0.28	98.95
11	41.59	4.50	3.63	21.16	7.92	19.38	0.89	0.00	0.13	0.33	99.55

Note: Analyses were carried out with a JXA-8800R microanalyzer in the Central Analytical Laboratory of the Botuoba Expedition of the ALROSA Joint-Stock Association (A.S. Ivanov, analyst).

The wide compositional range of the 10 pyrope grains suggests the closeness of their bedrock source (Fig. 2). They mainly belong to the lherzolite association of the following types: high-Cr garnet (1 grain), moderate-Cr garnet (1 grain), low-Cr garnet (3 grains), high-Cr and high-Ti garnet (1 grain), and low-Cr and high-Ti garnet (3 grains). The garnet field of the dunite-harzburgite (diamond) association [12, 13] includes grain no. 10 (table). It should be emphasized that grain no. 8 belongs to the typical eclogitic garnet known in diamonds and eclogite xenoliths from kimberlite pipes [12]. The high-pressure nature of the latter garnet grain is also indicated by the high content of Na<sub>2</sub>O.

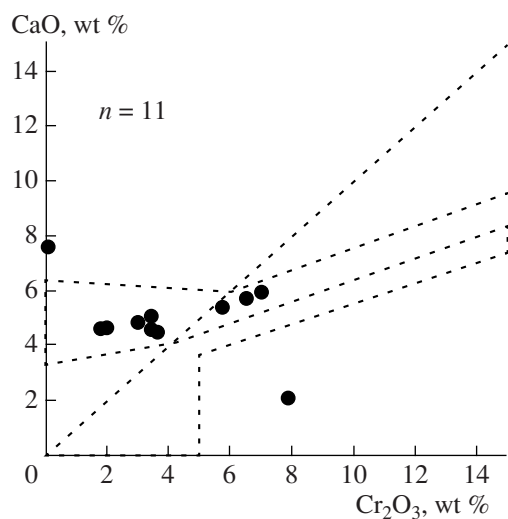


Fig. 2. Diagram (according to [12, 13]) of the chemical composition of pyropes from the Osipai Formation (Cape Tsvetkov, eastern Taimyr).

Pyrope is developed as red, pink, and violet unrounded grains approximately 0.5 mm in size. Some grains have a secondary coating (Fig. 3).

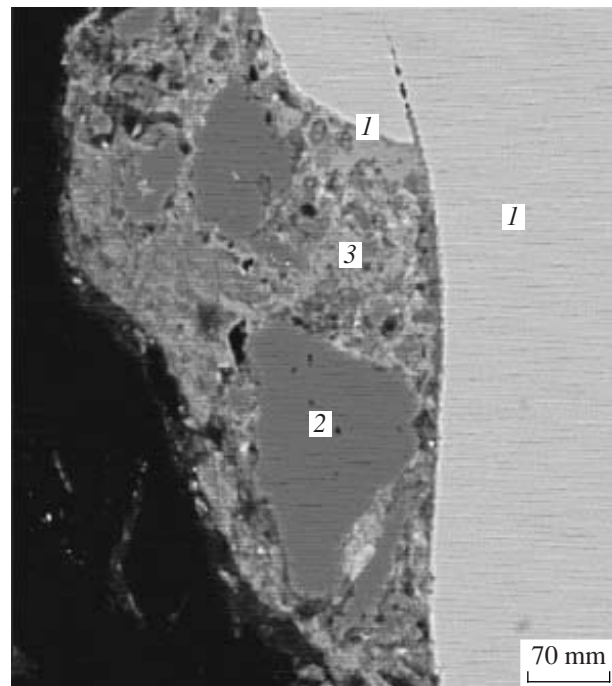


Fig. 3. Coating on pyrope grain. Image in phase contrast regime. Dots show minerals detected in the rim of coating on the pyrope grain. Minerals were identified with an ISIS Link-3 X-ray spectrometer. (1) Pyrope; (2) quartz; (3) carbonate-chlorite matrix with titanite grains. Analyses were carried out with a JXA-8800R microanalyzer in the Central Analytical Laboratory of the Botuoba Expedition of the ALROSA Joint-Stock Association (A.S. Ivanov, analyst).

## CONCLUSIONS

(1) Indicator-minerals of kimberlites in the Osipai Formation of the Siberian Craton and Taimyr indicate the presence of a regional halo related to the washout of numerous bedrock sources. Unrounded pyrope grains in the Carnian rocks of eastern Taimyr support the hypothesis of Sobolev [1] and Moor [14] about the existence of the Mesozoic kimberlite province in northern Siberia.

(2) Findings of pyrope grains of the diamond association indicate the diamond potential of basal units of the Carnian Formation and bedrock sources.

(3) In order to confirm the diamond potential of the Osipai Formation at Cape Tsvetkov, it is necessary to carry out a large-scale sampling of the region.

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