Diamonds from Timan placers: morphology, spectroscopy and genesis

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The collections of 55 diamond crystals from Timan placers was studied by method of scanning electron microscopy on SEM JSM - T20 (JEOL, Japan) and spectroscopic method on absorption spectra in visible and ultraviolet ranges on the MPS - 2000 spectrophotometer (Shimadzu, Japan). Morphological discription was done on the basic Yu.L. Orlov classification (1984).

Morphology

Diamonds of the I morphological type prevail (52.7 %). Rombododecahedron are widely distributed among investigated crystals. Usually they are colorless crystals and have clear deformated features. The isometric crystals occur less often. There are marked diverse the sculptures of solution on the surfaces of crystals: knob-like structure is formed by hillocks; mosaic sculpture consist of separate blocks similar to false sides, forming entering corners: ribbing hatching is formed by concentric lines, enviromental axis L_3 , as well as traces of plastic deformation. Transition O-D crystals with hatching and mosaic-block ornament occupy the second place in abundance. Octahedral diamonds are rare. They have ribbing and serrate relief, triangular growth platelets and different corrosion sculptures (triangular pits, cracks and etch channels).

Diamonds of the II type (1.8 %) are submitted by fragments of tetrahexahedra with characteristic knobby relief on the faces (hko) and tetragonal pits on the cubic faces.

Diamonds of the III type (7.3 %) are rare. Crystals of this morphological type were observed as small-sized fragments, translucent or opaque, mosaic-blocked, knobby rombododecahedra. They are grey, smoky. There are numerous corrosion pits and etch chanells on the surfaces of such diamonds.

Diamonds of the IV type (3,6 %) are represented by fragments of the unregular shape of dark-grey diamonds. They have a hatching surfaces. Their internal transparent nucleus is surrounded by thin rim with fibrous structure. There are numerous fine black inclusions in this outer part of crystals.

Diamonds of the V type (29.1 %) are rather numerous. The rounded rombododecahedra with knobby surfaces are most popular among this type of crystals.Octahedral ribbing crystals, transition combinational O-D crystals and tetrahexahedra are less often. Usually they are presented by colorless, transparent or translucent diamonds, with yellow or smoky colored zone crystals and aggregates, which are saturated by dark-grey or black graphite-liked inclusions in external yranslucent zones. The significant share is represented by twins and polycrystalline aggregates predominary of octahedral crystals. There are marked cavities of solution, induction cavities and bands of plastic deformation on some crystals. The small-sized, vectorially correct corrosion pits and various kinds of hatching are founded frequently

Diamonds of the VI type are not discovered among studied collection.

Diamonds of the VII type are unregular aggregates of rounded crystals with knobby and hatching surfaces of faces and bands of deformations. The largest part of these diamonds is colorless, some of them has yellow or smoky color. They are saturated by black inclusions, cracks and secondary outgrowthes (Bovkun et al..,1996).

By comparison of morphology of diamonds from Timan placers with diamods from kimberlite pipes of the Arkhangelsk kimberlite province and Ural placers (Degtyareva et al., 1994; Kuharenko. 1955; Makhin et al., 1992) similarity of their morphological features was established. Prevalence colorless rounded rombododecahedron crystals of the **I type** at relatively high contents of the diamonds of the **V-th and VII-th types** and at low contents of octahedra, and only on small-sized classes (less then 0.5 mm) are common morphological features of diamonds from these different regions. Also practically all diamonds have sculptures of solution and traces of corrosion.

Spectroscopy

The majority of investigated crystals are shown absorbtion spectra of **type P-1**. Diamonds with an edge of absorption on the UV-range (300 nm) and series of bands **N3, N2 and N4** belong to this type according to physical diamond classification, They contain **A-defects** and **B- defects**. Usually they are transparent and colorless crystals.

Following on friquency are transparent crystals of diamonds with the **P-2 type** of spectrum. Their spectra have an edge of absorption close to 300 nm, and spectra have not system of lines **N3, N2 and N4**. Such crystals have **A-defects** only.

The small group of crystals refers to intermediate type (between **P-1** and **P-2**). The spectra of this type of diamonds has the absorption edge at 300 nm, and **N3** line is a extremely weak. There are low concentrations of **B-defects** and rather high content of **A-defects**.

Small group of crystals has a spectrum of the **P-3 type**.The crystals of this type have spectra with the edge of absorption at 225 nm (for diamonds of **IIa type**) or shift to the range 260-270 nm (for diamonds of the **type Ia - IIa**); **N3, N2 and N3** lines are apsent on their spectra.

Rather the significant share belong to diamonds of yellow and smoky-grey color (the **J- type** of spectrum). There are yellow diamonds of cubic habit and diamonds in "shells".Their spectra are characterized by intensive short-wave absorption which is stipulated by **C-defects**.

It is interesting to note that in distribution of crystals with various type of absorption spectra in the visible and UV-ranges and on coloring are also scheduled features of similarity with diamonds from Timan ,Ural, Northern Yakutiya placers and from Arkhangelsk kimberlite pipes. This prevailling types of spectra **P-1, P-2 and J-types**, and on the coloring - transparent, colorless with yellowish and smoky-grey shadows.

Genesis

All set of estabshed data shows that diamonds from peripherical parts of European and Siberian platforms have general conditions of formation,namely, they have undergone resorbtion conditions with higher oxidizing potential at slower rising of kimberlite melts in compare with central diamondiferous fields of Yakutiya kimberlite province.It should be outline that in having sited of Yakutiya on a background of commercial placers are present a numerous diamond-bearing pipes and non-diamond-bearing ones. For Arkhangelsk kimberlite province clear law in position and mineral composition of diamondiferous and non-diamond-bearing pipes is revealed. All facts of diamond grade differences in the peripherical parts of kimberlite provinces can be explained from conception of vertical and horizontal zoning of provinces (Garanin et al., 1991). From position of this conception it is possible to propose that diamondiferous placers of Timan were formed at erosion of kimberlite bodies which were crystallized at phisical-chemical conditions with relatively higher oxidizing potential. The alcaline and temperature conditions had changed with depth, and it was a one main reason of decreasing of diamond grade with depth in the kimberlite pipes. The processes of erosion were responsible for placer formation predominary from diamondiferous upper parts of kimberlite pipes, which nowdays have roots with low diamond grade, By similar way commercial industrial diamond placers were formed in the Northern Yakutiya.

These facts need to be considered for prospecting and seaching of diamondiferous kimberlite on the Northern European part of Russia and Northen Yakutiya.

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