Section 4. Geology

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Moissanite, Native Si and Iron Silicide from the Lower Paleozoic sandstones of the Polar Urals

Abstract: At the Lower Paleozoic sandstones of the Manitanyrd Ridge ($Є_3$–O_1 mn) moissanite have been recently found. It is established that moissanite is presented by two varieties — crystal fragments and grains with aggregate texture. The last ones are composed of hexagonal moissanite crystals cemented by native Si. In one of such grains the inclusion of iron silicide have been found. Association of moissanite, native Si and iron silicide with iron sulphides and chromite allow to suppose that its formation depended on the presence of unknown bodies of basic and ultrabasic volcanites as a sourcer of gold mineralization.

Keywords: moissanite, native Si, iron silicide, volcanites.

Moissanite, iron silicide and native silicon have been found in the sandstones of the Manitanyrd series ($Є_3$–O_1 mn) at studying contact of the Riphean-Vendian basement and Paleozoic cover in the Polar Urals (Manitanyrd Ridge). The sandstones are composed of quartz (78.0%), feldspars (12.7%), stilpnomelane (4.0%), muscovite (3.2%) and chlorite (1.0%). The presence of stilpnomelane is unusual for the Lower Paleozoic terrigenous rocks of this region and indirect sign of presence of the basic pyroclastics [5]. The heavy fractions always contain rutile, zircon, hematite, tourmaline, ilmenite, apatite, pyrite. Rarer — epidote, sphene, leucoxene, moissanite, chromite, chalkopyrite, barite and amphibole. Very seldom — garnet, magnetite, galenite.

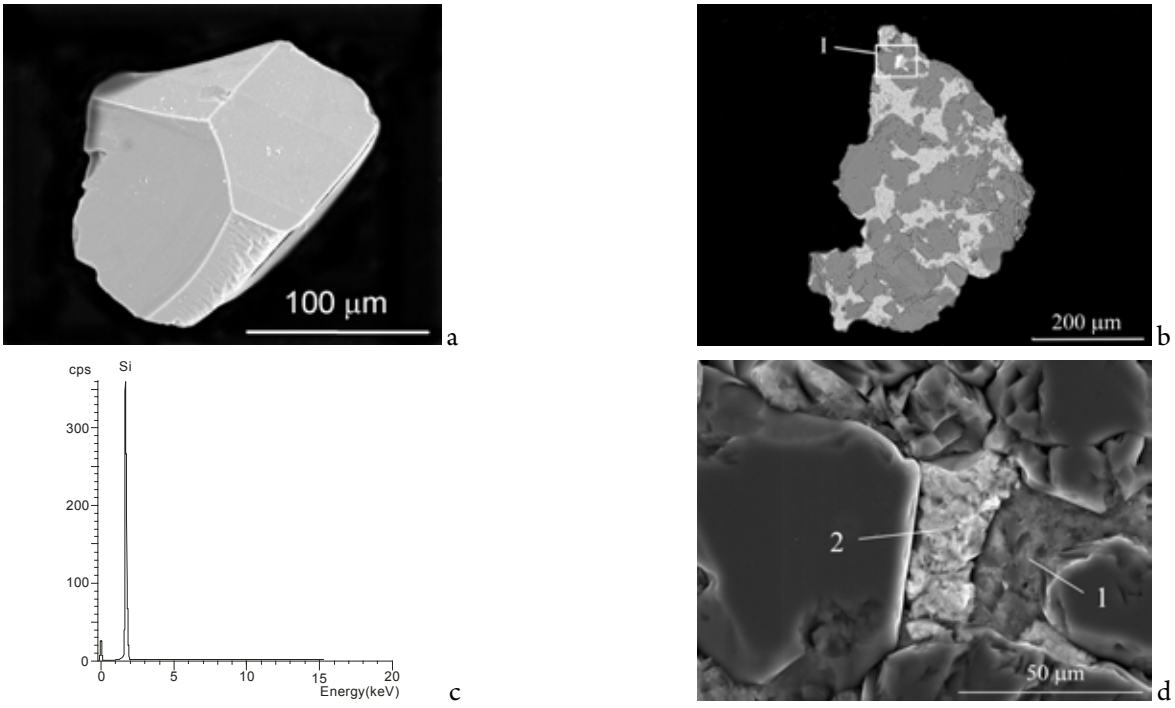

Fig. Moissanite from sandstones of Manitanyrd series:
a — crystal fragment with relics of planes; b — grain with microaggregate structure, light — silicon silicide, dark — moissanite; c — energy spectrum of native silicon; d — crystals of moissanite, native silicon (1) and iron silicide (2), fragment I fig. 2, b. The researches are executed with the use of scanning electron microscope JSM-6400 with X-ray energy dispersive spectrometer Link.

Moissanite is represented by fragments of transparent blue, dark blue, rarer yellow and pink crystals (fig. a) and dark blue grains with microaggregate structure. It is determined that these grains are composed of hexagonal moissanite crystals «cemented» by native Si (fig. b-d). An inclusion of iron silicide was found in one of the grains (fig. d) with composition (mass%): Si 49.58, Fe 40.98, Al 2.66.

The presence of moissanite and native silicon was diagnosed also by X-ray method (symmetric method without standard at X-ray device URS-55 A (RKD camera), radiance $Cu_{\alpha+\beta}$, V=30 κV, I=mA, exposition 8 hours). The moissanite interplanar distances are as follows (Å, intensity in brackets): 2,5164 (0), 2,3660 (4), 1,5406 (8) 1,3168 (7), for native silicon — 3,1620 (5), 1,9241 (6) 1,6354 (3). The mineral is represented by the most frequent low-temperature hexagonal polytype modification 6 H.

Moissanite in association with native silicon, iron silicide, some native metals, intermetallides and carbides are known in the Lower Carboniferous complexes of the central part of the Dnepr-Donetsk depression [2, 293–296], in tails of fumarole «Tube» of the Great Fissure Tolbachik volcano in Kamchatka [1, 796–799], in igneous-sedimentary rocks of the Fadeevsky ore-placer distric the Primorski Region [3, 536–538], in kimberlites and limestones [4, 152–164]. The presence of such associations is related to the activation of endogenic processes accompanied by migration and fractionation of abyssal fluids, separated from the basalt melt or the result of their fast introduction into sediments.

Morphological and chemical features of the moissanites, studied by us, allow assuming their formation as a result of crystalline degassing in the reducing conditions of the closed system. Their greatest resemblance is marked with the moissanites from kimberlites [4, 152–164].

Moissanite and associated minerals could arrive to the sedimental strata from the basic and ultrabasic volcanites, dated to horst-graben structures of riftogenic uralide stage forming level-by-level bodies in the lower part of the Paleozoic section. The closest formations, which could be the sourcer of moissanite, — ultrapotassium basaltoids, located in about 40 km westward from the studied section, but they do not contain moissanite. It is possible to assume the presence of unknown, hidden, overlying Paleozoic and Quarternary deposits igneous formations that became the sourcer of detrital material into the Lower Paleozoic sandstones. The finds of moissanite are confined to a certain dimensional interval of the section and, accordingly, to the time interval when volcanites were driven to the surface, and in the process of coastal line advance eastward, they were buried under newly formed sediments.

References:

1. Glavatskikh M. F, Generalov M. E. Cohenite from mineral associations related to high-temperature gas jets of Great Fissure Tolbachik eruption (Kamchatka)/FEAS, 1996. V. 346, № 6. P. 796–799. (in Russian).
2. Lukin A. E. Particles of native elements, carbides and silicides in the secondary collectors of oil and gas — traccers of abyssal superfluids/Degassing of the Earth: geodynamics, geofluids, oil, gas and their paragenesises: Proceedings of the All-Russia meeting. M: GEOS 2008. P. 293–296. (in Russian).
3. Molchanov V. P., Hanchuk A. I, Medvedev E. I, Plyusnina L. P. Unique association of natural amalgam of gold, cinnabar, native elements and carbides of Fadeevsky ore-placer district, Primorski Krai/FEAS, v. 422, # 4, 2008. P. 536–538. (in Russian).
4. Shiryaev A. A., Griffin W. L., Stoyanov E. Moissanite (SiC) from kimberlites: polytypes, trace elements, inclusions and speculations on origin//Lithos, 2011, vol. 122. P. 152–164.
5. Yudovich Ya. E, Ketris M. P. Basics of lithochemisty. SPb.: Nauka, 2000. 479 p. (in Russian).