MONOCRYSTALLINE LONSDALEITE IN REGIONALLY METAMORPHIC METASOMATICALLY ALTERED ROCKS

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Lonsdaleite, aka hexagonal diamond, has been known since 1966. But despite its relatively old history of discovery, the disputes about stability and possibility of independent existence of lonsdaleite continue. It always forms tight intergrowths with cubic diamond; its isolated varieties have not been found either in nature, or in experimental conditions. Recently it was theoretically calculated that the hardness of hexagonal diamond is higher than the hardness of cubic one at 58%, in this connection the interest to lonsdaleite resulted in the new strong interest of researches in material science.

It should be noted that the diagnostics of lonsdaleite causes various complications and demands a complex approach, because other phases can be erroneously accepted for lonsdaleite for example such as nanodiamonds and graphite oxide. Such wrong diagnostics were repeatedly met in previously published works. Due to these problems the diagnostics of lonsdaleite requires a special approach allowing reliable interpretation of the phase.

Previously by fragmentary data we assumed the possibility of lonsdaleite presence related to the carbon mineralization of the Kumdykol diamond deposit (Northern Kazakhstan) [1, 2]. However the data available at those time and resolution of the used methods were insufficient to confirm the presence of the phase.

During our detailed studies of carbon mineralization of the Kumdykol diamond deposit we determined monocrystalline lonsdaleite with the complex of high resolution research methods of the studies including transmission electron microscopy, electronic diffraction, high resolution electron energy loss spectroscopy, high resolution Raman spectroscopy.

Monocrystalline lonsdaleite forms independent particles with the size to the first micrometers, coherent structures with diamond and three-phase growths with cubic diamond and graphite. Some typomorphic features and physical-chemical properties of monocrystalline lonsdaleite were determined.

The work resulted in the new type of lonsdaleite not related to impact processes, but confined to regionally metamorphic metasomatically altered rocks. For the first time independent monocrystalline particles of hexagonal diamond were detected. The obtained results have a considerable importance not only for natural diamond formation modeling, but also are especially value for the development of the diagram of carbon phase state, material science and development of superhard materials methods production.

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References

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