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Lonsdaleite of a new genetic type and natural diaphite

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Lonsdaleite was widely known as a high pressure carbon polymorph of impact geological objects only. Here we report about find of lonsdaleite within regionally metamorphosed metasomatically altered rocks of Kumdykol diamond deposit (Kazakhstan) (Shumilova et al., 2011). Lonsdaleite was found and studied as independent monocrystalline particles, in a close accretion with cubic diamond forming coherent structures and as three-phase growths of lonsdaleite monocrystals with cubic diamond and graphite.

The lonsdaleite phase statement have been proven with a complex of high resolution methods – transmission electron microscopy, X-ray energy dispersion analysis and high resolution Raman spectroscopy. On the basis of monocrystalline lonsdaleite study a new methodology of diagnostics by thermostimulated splitting of Raman active lonsdaleite modes was produced which allowed investigate as independent lonsdaleite particles, as cubic diamond/lonsdaleite phases tight intergrowths too (Isaenko & Shumilova, 2011).

The co-following carbon mineralization is presented by graphite, amorphous diamond-like carbon, amorphous graphite-like carbon and a-carbyne. The last is presented by monocrystalline particles and is described for the first time for this geological object.

The detailed study of graphite by high resolution electron energy loss spectroscopy (EELS) allowed recognize for oxygen free and partly oxidized particles which had quite similar EELS spectra features. It is important to note that oxygen free graphite particles (similar to oxidized) provide unusual feature of high energy shift of the 1s to π * transition from the standard position 284 eV at the carbon K-edge to 287.0 eV and C-C σ* from the position 292 eV up to 294.4 eV. As for a low loss region the upper shift presents for the π plasmon and π to π * transition up to 2–3 eV. We think that the demonstrated spectral data could be a result of diaphite presence which has an intermediate state between graphite and diamond (Nishioka & Nasu, 2012).

The investigated carbon system with lonsdaleite in Kumdykol diamond deposit support nonequilibrium conditions of the carbon phases formation from fluid regime rather at quite low P-T-conditions described by Lavrova et al. (1999). The find of diaphite in nature is very large step for mechanism of lonsdaleite formation understanding and for fundamental science of carbon statement too.

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