NEW SEM-CL DATA ON THE POPIGAI, RIES AND LAPPAJARVI IMPACT DIAMONDS.

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Introduction: this study concerns paramorphs of Popigai (Arctic Russia), Ries (Germany) and Lappajarvi (Finland) impact diamonds, derived from parental graphite in crystalline rocks of the targets. The diamonds were separated by means of thermochemical treatment of impact melt rocks from the given astroblemes [1,2,3].

The diamonds are small (170 - 320 µm, Popigai; 140 - 260 µm, Ries; 120 - 220 µm, Lappajarvi) grains of various coloration (from light-yellow to yellow, yellow-gray, grey, gray-brownish and black colour); moreover they are policrystalline (<0.1 - 1 µm in size) aggregates with various level of preferred orientation of crystallites. Most of the diamonds investigated in our study are rectangular flattened plates or shapeless volume-xenomorphic grains. Following to previous data [2], flattened grains are the result of phase transformation and fragmentation of thin plates of precursor graphite, whereas the volume-xenomorphic ones are the result of the same process for the thick aggregates of the parental graphite. Impact diamonds in the rocks of given impact structures are the result of phase transformation of precursor graphite by means of martensitic or diffusion processes at ~700 to 4000 K residual temperatures and ~30 to 140 GPa shock pressures. Some of the impact diamonds investigated, especially those from the Ries and Lappajarvi craters, exhibit traces of intensive dissolving corrosion, which took place in a host high-temperature impact melt, possibly due to action of OH/H₂O volatiles.

Experimental: CL (Cathodoluminescence) data were obtained, on the spectral range 200 – 900 nm, using a SEM Leica Stereoscan mod. 420 (energy 5 keV, current 200-1000 pA) equipped with a MONO-CL produced by Oxford Instruments. The instrumental conditions were as follows: voltage of phototube set at 65 % and integration time 400 ms. The spectra were corrected for the spectral response of the instrument and peak locations were obtained through a fitting procedure.

Results and discussion: the most luminescent grains are those light yellow or yellow in colour. The intensity of luminescence of impact diamonds correlates inversely with the amount of carbonaceous material: the greater the amount, the less intense is the coloration. As the light diamonds show a strong charge effect, it can be argued that black material inside the dark ones is constituted mainly by graphite that prevents the charge effect on them.

Several peaks have been observed in studied diamonds: at 2.8 eV (443 nm), at 2.3 eV (539 nm), at 2.0 eV (622 nm) and at 1.7 eV (725 nm). The band at 2.8 eV is probably related to vibronic levels located in correspondence with dislocation defects. Regarding the peak at 2.3 eV, according to [4], it may be related to H3 centers due to a vacancy trapped between two nearby nitrogen atoms (N-V-N). The peak at 2.0 eV was previously observed in nitrogen-rich diamonds grown by flame deposition technique and is associated with a nitrogen-vacancy (N-V) couple.