

Cathodoluminescence investigations on the Popigai, Ries, and Lappajärvi impact diamonds

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ABSTRACT

Twenty impact diamond samples from the Popigai, Ries, and Lappajärvi astroblemes were analysed using cathodoluminescence (CL) at room temperature (RT). Five of the samples were further investigated at liquid nitrogen temperature (LNT). Cathodoluminescence images allowed for the discrimination of diamond from graphite, thus contributing to a better understanding of the reciprocal relationships between these carbon polymorphs and their overall textural features.

Cathodoluminescence spectral measurements of the diamonds revealed emission bands and peaks located at 1.8 eV (688 nm), 2.23 eV (556 nm), 2.32 eV (534 nm), 2.39 eV (519 nm), 2.49 eV (498 nm), and 2.8–2.9 eV (443–427 nm). The bands at 2.8–2.9 eV and at 1.8 eV, observed at RT, were related respectively to vibronic levels (involved in electronic transitions), located at dislocation defects and to dislocations. Regarding the other lines, which were only visible at LNT, there may be a relationship between the peaks at 2.32 eV, 2.23 eV, and 2.39 eV, and the content of amorphous carbon phases.

Some spectral features may be considered a possible signature of impact diamonds. In particular, the band at 1.8 eV, which is uncommon in terrestrial natural diamonds, and the peaks at 2.23 eV and 2.32 eV, are present in all the samples studied.