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An eclogitic and deep mantle origin of Panna Diamonds, Madhya Pradesh, India: Evidence from morphological and Raman spectroscopic studies.

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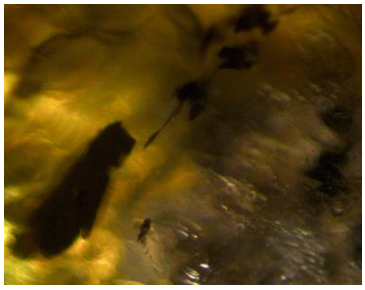
The composition of the Earth's mantle was originally inferred from the study of carbonaceous chondrites and other cosmic particles. However, lately diamonds and their encapsulated mineral inclusions are being studied intensively to provide interesting information not only on the lithospheric mantle but also parts of the deeper mantle up to depths of about 670 Km and more. In addition, study of diamonds has also indicated time of initiation of subduction, tracked transfer of materials through mantle transition zone and even further, Harte et al. [1] and Stachel et al. [2].

The present work attempts to decipher mantle composition and depth of origin of diamonds through morphological and mineral inclusion phase assemblage studies of 35 rough, uncut diamonds from Panna Diamond Belt, Madhya Pradesh, India. These diamonds occur within kimberlite and lamproite pipes intruding Proterozoic sediments of Vindhyan Super Group and also within recent gravel beds occurring nearby. All samples were mono-crystalline, with shapes mostly ranging from dodecahedroids to highly distorted dodecahedroids, and colours from colourless, pale yellow to brown. Presence of microlaminations, trigons, etch pits, frosting, pyramidal hillocks, and etch channel on diamond surfaces indicates rapid etching/dissolution from corrosive fluids at temperatures of about 1000°C during their ascent [3]. In addition, the highly distorted, type II, brown diamonds indicate presence of deformation lines, "tatami graining" and plastic deformation.



The mineral inclusions are completely enclosed within diamonds, with either well-developed crystal faces or with rounded margins and seem to have crystallized before or simultaneously with the diamonds (Figure 1). Raman spectroscopic studies of these inclusions within diamonds indicate two definite mineral assemblages 1: rutile, magnesite, sanidine, calcite, graphite, magnetite, barite, and chalcopyrite and, 2: Ca-perovskite, Mg- perovskite, and wustite.

Figure 1: Mg-Perovskite inclusions in diamond

Presence of euhedral magnesite inclusion within Panna diamonds is considered as an unambiguous evidence for the existence of a major carbon reservoir in the mantle [4], and the occurrence of Mg-Ca and CO_3 rich phases within diamonds indicates subduction of oceanic basalts and their subsequent conversion to eclogites under high-pressure conditions. Rutile, sanidine and calcite inclusions within Panna diamonds also point towards an eclogitic affinity. Further, the presence of sub-rounded Ca-

perovskite within diamond samples indicates its depth of origin in the transition zone with crystallization from carbonated melts [5]; and, occurrence of Mg-perovskite inclusions in several brown distorted diamonds hints towards a further deeper origin in the lower mantle.

References:

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