Hydrous silicates within black cloudy zone in diamonds

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Is there the existence of a water-rich zone in the mantle, currently one of the most discussed problem in mantle petrology? There are recent studies of low-water content in nominally anhydrous minerals in diamonds [1] and the chemistry of exceptionally rare phlogopite inclusions coexisting with peridotitic and eclogitic minerals in kimberlite-hosted diamonds [2]. Previous studies have shown that some rapidly formed diamonds reflect the composition of the environment in which they formed [3]. The minerals trapped during nucleation stage remain shielded from any changing conditions during further diamond growth or later mantle metasomatism. Thus, the analysis of diamond microinclusions is a major tool for the direct study of mantle high-density fluids (HDFs) from which the diamonds have precipitated [4].

Using transmission electron microscopy (TEM) techniques, we have investigated hydrous silicates inside nanometer-scale, polyphased unclusions, especially in dark cloudy alluvial and kimberlite diamonds. Clinohumite, phlogopite, and phengite were detected. Hydrous silicate phases are accompanied by Ba-Sr-Ca -Fe-Mg carbonates, in addition to sulfides, oxides (magnetite, rutile, ilmenite), F-apatite, KCl, graphite, and fluid bubbles. A contrast occurs between clinohumite associated with phlogopite, F-apatite and high-Mg carbonates, but phengite, accompanied by a Al, K-bearing, unidentified silicate. These inclusions reflect the composition of fluid from which the host diamond crystallized. The mica composition, in most cases, has excess Si, similar to the high-silica mica identified within diamond microinclusions from Diavik [5]. The fluid-bearing carbonatitic-silicic diamonds grew in water-rich environments with extremely high K-activity, compared to most diamonds, which grew only within limited zones in the Earth's mantle.

References:

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