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Mineral inclusions in garnets from the Upper Triassic diamondiferous tuffites of the Siberian platform: data on the depth of diamondiferous magma formation

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Unique association of diamonds represented by crystals and growths with light carbon isotopic ratio (diamonds of V and VII varieties by Orlov classification, that have not found in any kimberlite pipe in Yakutia) is recognized in the Carnian (Upper Triassic) basal horizon of the north-eastern Siberian platform.
Basal horizon in mouth of the Lena river is represented by volcanogenic-sedimentary rocks 0,1-1 m thick. There are no signs of mechanical wear in diamonds and garnets from these rocks (S.A. Grakhanov, A.P. Smelov, 2011). Garnets are full of numerous inclusions, the study of which may allow to determine features of diamond formation and depth of magma origin.
Garnets of almandine-pyrope series are represented by three color varieties: orange, red and pink-purple. In chemical composition they belong to lherzolite, wehrlite, dunite-harzburgite (including diamondiferous), as well as to eclogite paragenesis.
The biggest amount of inclusions was identified in orange garnets of eclogite paragenesis, lower amount – in garnets of red color, and single grains with inclusions occur in pink-purple garnets of ultramafic paragenesis. Inclusions are varied enough. The morphology records the following: i- thin needle-like inclusions (up to 1 mm long and 1-2 μ wide); ii- elongated- and short-prismatic inclusions; iii - euhedral and partially faceted inclusions. The following mineral phases were diagnosed: rutile, apatite, SiO_2, ilmenite, srilankite, kyanite, majorite. Oxide inclusions (rutile, ilmenite) are usually oriented in garnet structure, that allows to consider them as the result of exsolution. According to some researchers, garnets with exsolution microstructures of rutile and ilmenite are the result of disintegration of the original super-titanic UHP garnet, analogous to high-silica majoritic garnets, stable in diamond formation conditions (B.J. Barron, L.M. Barron, 2008).
Srilankite usually occurs as inclusions (size of 1-2 μ) in rutile or ilmenite, and it is enriched in Nb and Ta. In single garnets, inclusions of rutile and ilmenite are enriched in Zr (0,27-5,35 wt%ZrO_2). Similar contents of zircon (2,6-4,3 wt%) were earlier determined in rutile in cavity in a diamond from this tuffites (O.B. Oleynikov et al, 2007). It may indicate close crystallization conditions of garnets and diamonds with light carbon isotopic composition.
Majorite inclusions was identified in complex polymineral inclusion together with rutile and srilankite. Majorite (Si pfu – 3,29-3,4) is characteristic with high TiO_2 (up to 3,17 wt%), but low Na2O content (0,04 wt%). Inclusions of majoritic garnet allows to pre-estimate TP-conditions of its crystallization. Based on ratio Si pfu vs Al+Cr pfu in majorite, it was formed at 14-18 GPa, i.e. at depths of 410-500 km, corresponding to transitional zone (T. Stachel et al, 2005).