SIGNIFICANCE OF MINERAL AND FLUID INCLUSIONS IN DIAMONDS AND THEIR INDICATOR MINERALS

Sobolev, N.V.

V.S. Sobolev Institute of Geology and Mineralogy, Siberian Branch of Russian Academy of Sciences,
Koptyug Ave., 3, 630090, Novosibirsk, Russia
e-mail: sobolev@igm.nsc.ru

Diamond mineral inclusions studies established two main types of Earth's mantle environment for diamond formation within subcratonic lithosphere: ultramafic (peridotitic) and eclogitic, i.e., U/P and E types (MEYER & BOYD, 1972; SOBOLEV et al., 1969a; SOBOLEV et al., 1971). These types were confirmed by the study of chemical compositions of garnet found in xenoliths of diamondiferous serpentinite (SOBOLEV et al., 1969b) and eclogite (SOBOLEV et al., 1972) in Siberian kimberlites. For diamonds of any size, from micro- (< 1 mm) up to large crystals (> 10.8 cts and up to 200 cts), and quality, including gems, the U/P type dominates in Siberian kimberlites (more than 90 %), and is considerably lower in northern Siberia and Ural placers (< 30 %). Key minerals for the U/P type are represented by coexisting subcalcic Cr-pyrope and chromespinel (Cr# > 80) as members of clinopyroxene-free peridotite and dunite-harzburgite (SOBOLEV, 1971; SOBOLEV et al., 1969a). Evidence of deep hydrocarbons and CO_2 sources for diamond formation was suggested by SOBOLEV (1960). Volatile components in diamonds and associated minerals were analysed by GC-MS using a Focus GC/DSQ II MS (Thermo Scientific, USA). It is concluded that saturated hydrocarbons (pentane to hexadecane) and their derivatives are the dominant species in fluid inclusions in diamonds and associated minerals from kimberlites and diamond placers. It is suggested that such hydrocarbons are among the major species in some mantle fluids (e.g., SOBOLEV et al., 2019; SOKOL et al., 2017, 2019). Microdiamonds from the Kokchetav Massif (Kazakhstan) occur in a wide variety of ultrahigh pressure metamorphic rocks (SOBOLEV & SHATSKY, 1990; SCHERTL & SOBOLEV, 2013). All morphological types specific for diamonds from kimberlites are found. Their average size is about 12 μm by counting in thin sections and the maximal size reaches up to 300 μm. The significance of zircon as a perfect mineral container was confirmed by the identification of coesite, garnet, diopside and magnesite inclusions and polymineralic (touching) coesite-diamond and diopside-diamond inclusions, probably suggesting ultrahigh pressure conditions. Nitrogen isotope data and negative $\delta^{13}C$ values of diamonds indicate a metasedimentary origin.

MEYER, H.O.A., BOYD, F.R. (1972): Geochim. Cosmochim. Acta, 36, 1255-1273.
SCHERTL, H-P., SOBOLEV, N.V. (2013): J. As. Earth Sci., 63, 5-38.
SOBOLEV, N.V., et al. (1969a): Dokl. Akad. Nauk SSSR, 189, 62-165.
SOBOLEV, N.V. (1971): Geol. Geofiz., 12, 70-80.
SOBOLEV, N.V., et al. (1971): Dokl. Akad. Nauk SSSR, 198, 190-193.
SOBOLEV, N.V., et al. (2019): Engineering, 5, 451-478.
SOBOLEV, N.V., SHATSKY, V.S. (1990): Nature, 343, 742-746.
SOBOLEV, V.S. (1960): Geol. Geofiz., 1, 27-22.
SOBOLEV, V.S., et al. (1969b): Dokl. Akad. Nauk SSSR, 188, 1141-1143.
SOBOLEV, V.S., et al. (1972): Dokl. Acad. Nauk SSSR, 207, 164-167.
SOKOL, A.G., et al. (2017): Earth Planet. Sci. Lett., 460, 234-243.
SOKOL, A.G., et al. (2019): Phys. Earth Planet. Inter., 291, 12-23.