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Isotope composition of magmatic calcite from kimberlite pipe Udachnaya-Vostochnaya, Yakutia, Russia

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Calcite (54.5-54.9 mas.% CaO; 0.2-0.3 mas.% Sr; 44.0 mas.% CO_2) is the dominant mineral phase of the kimberlite in the Udachnaya-Vostochnaya pipe (Yakutia, Russia). Melt inclusions found in this calcite indicate its magmatic origin. Calcite in microlites and in the kimberlite groundmass show relatively bright red luminescence under CL. Calcite microlites with melt inclusions typically occur as idiomorphic crystals arranged to form a fluidal texture, suggesting flow of crystallizing melt. Based on SEM and ICP-MS studies, melt inclusions are predominantly composed of the NaCl and KCl (Na/K = 1.3 to 0.3) and also contain the interstitial fluid phase. Some inclusions host Ti-enriched phlogopite as a xenogenic phase. The salt melts in calcite homogenize at ca. 900°C. Compared to the host kimberlite, melt inclusions in calcite are enriched in heavy REE ((La/Yb)n = 31 to 39 and 100 to 148 respectively; ICP-MS data).

Isotope compositions of several microlites containing melt inclusions was determined using micro-milling. They showed δ^{18}O values ranging from -14.5 to – 13.0 per mill V-PDB and relatively uniform δ^{13}C values of -1.0 to -1.5 per mill. Two xenoliths of the bedrock limestone embedded in kimberlite melt showed δ^{18}O values of -15.4 to -15.0 per mill V-PDB, whereas the δ^{13}C values clustered tightly between 0 and -0.4 per mill for one xenolith and between -1.8 and -2.2 per mill for another. Isotopic “mapping” of a calcite veinlet in kimberlite groundmass (ca. 2-3 mm-thick and 25 mm-long) showed values intermediate between those of the calcite microlite with melt

inclusions and one of the bedrock limestone xenoliths. Isotope values appear to be zoned in the veinlet with both δ^{18}O and δ^{13}C becoming somewhat more negative (by 1 to 1.5 per mill and 0.5 to 1 per mill, respectively) from axis of the venlet toward contact with kimberlite. Near the contact, the veinlet calcite also becomes enriched with fluid inclusions. This might reflect crystallization of calcite at the late stage of magmatic process from predominantly fluid system; alternatively, this part of calcite could be post-magmatic. Noteworthy, calcite in the veinlet showed uniform granular texture of luminescence with no apparent zonation under CL.

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