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Kimozero massive of diamondiferous rocks: formation of Early Proterozoic rift-related magmatism in Karelia, NW Russia

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The Kimozero diamondiferous rocks occur within a complex of dolerite intrusions of Ludikovian age in Karelia, NW Russia. The rocks belong to the Proterozoic formations of the Onega supracrustal intracratonic basin. The Kimozero rocks were dated as 1986 $\pm$ 4 Ma, which make them the oldest diamondiferous rocks on the East-European platform and among the oldest diamondiferous rocks in the world. When they were described for the first time, the rocks were inferred to be kimberlites. Recent detailed mapping combined with structural, thin section, geochemical and isotopic studies, however, indicate that the rocks show some features that are characteristic for kimberlites, but also a number of features that indicate a different origin.

Mapping of the Kimozero diamodiferous rocks shows that they form an elongated NW striking oval-shaped body, approximately 2 km x 800 m in size. The host rocks include gently dipping bodies of dolerites and amygdaloidal basalts, as well as much less common shungite-bearing schists. Diamondiferous rocks contain two varieties: 1) a stratified subcomplex resting conformable on amygdaloidal basalts, lavas, tuffs and tuffites, and 2) a subvolcanic subcomplex, characterized by NW striking linearly elongated narrow feeding channel, as well as dikes and diatremes, which crosscut the structure.

The mineral assemblages of the Kimozero diamondiferous rocks are very diverse and almost completely represented by secondary minerals, which probably were formed during autometasomatism. For example, typical igneous textures and structures that can be observed on weathered surfaces of lavas and tuffs are generally composed of secondary minerals like chlorite, actinolite and only relics of chloritized phlogopite. Further, porphyritic phlogopite-chlorite-magnetite-serpentine bearing autometasomatized lavas can be observed. Tuffites and tuff breccias are characterized by layering and a finely laminated clastic structure, containing clasts of different rock types. Their mineral composition is dominated by carbonate, serpentine and magnetite. The steeply dipping hypabyssal bodies of the diamondiferous rocks are mostly represented by breccias with matrix enriched in carbonate, serpentine, tremolite and relics of phlogopite. Due to large variations in the mineral content of the diamondiferous rocks, the major element chemistry of the rocks show large variations: SiO_2 = from 8 to 50%, CaO = 0-50%, MgO = 3-35%, Al_2O_3 = 0,3-0,6% and P_2O_5 = 0,05%-1.3%. REE analyses show that all of the diamondiferous rocks are characterized by an enrichment in LREE relative to HREE, suggesting that the rock belongs to the alkaline-ultramafic class, despite the current lack of potassium, which probably was removed from the rock during chloritization of phlogopite.

Sr- and Nd-isotopic study shows variation of ε_{Nd}(t) from -0.9 to +1.6 and ε_{Sr}(t) from 11 to 41.2. These results suggest that the Kimozero diamondiferous rocks were derived from a mantle source close to BSE.

The age and geochemistry of the diamondiferous rocks and their underlying units suggest that alkaline-ultramafic magmatism responsible for the formation of the Kimozero diamondiferous rocks and the preceding basaltic volcanism may be linked to a stage of Lyudikovian within-plate rifting, prior to the opening of the Svekofennian Ocean. Geochemical evidence shows that the primary ultramafic-alkaline formation of the Kimozero diamondiferous rocks includes not only kimberlite explosive breccias, but also lavas, tuffs and tuffites, which formed subsequent to basaltic volcanism.