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Origin of the Monchegorsk Pluton and associated ores: Evidence from the Nd isotope composition of rocks and trace-element composition of olivine

Maria Bogina (1), Evgenii Sharkov (1), Alexey Chistyakov (1), and Valerii Zlobin (2)

(1) Institute of Geology of Ore Deposits, Petrography, Mineralogy, and Geochemistry, RAS, Moscow, Russian Federation (bogina@igem.ru), (2) Institute of Geology, RAS, Moscow, Russia (vzlobin@bk.ru)

The ∼2.5 Ga Monchegorsk mafic—ultramafic layered pluton is located at the Kola Craton, eastern Fennoscandian Shield. It is ascribed to the Early Paleoproterozoic LIP, which was formed in relation with plume activity and is made up of the rocks of SHMS (siliceous high-magnesian series). The massif hosts PGE-Cu-Ni ores (massive ores of the Nittis and Nyud mounts, Sopcha Ore Layer represented by 2-3 m thick horizon of thin-layered peridotites among a pyroxenite zone) and chromitite ores (Sopcheozero deposit) associated with a dunite lens. The origin of these ores is frequently thought to be related to the intense contamination by host rocks. To determine whether crustal contamination was a significant process in the formation of this massif and associated ores, Sm-Nd isotope composition was analyzed throughout the vertical section of the pluton in the following rocks: peridotite from the lower part of the layered dunite-peridotite zone, dunites from the ore-bearing Sopcha Layer, orthopyroxenites (beneath and above ores), peridotite and dunite from dunite lens (beneath and above chromitites), and chromitite from the chromitite horizon of the Sopcheozero chromitite deposit), critical horizon Nyud, and contact gabbroids from the lower zone. It was revealed that the eNd in the studied rocks vary from -2.5 to -0.2, which is much lower than that of DM at that time and suggests the input of crustal rocks or recycled material. The values of eNd show upward increase (up to -2.5 in the orthopyroxenite zone) and negative correlation with Nd content, which points to insignificant assimilation of host rocks during long-term cooling and crystallization (AFC model). A sufficiently homogeneous Nd isotope composition of rocks from the peridotite zone between -0.2 and -0.8 suggests that these characteristics were acquired by a melt at the earlier stages of its evolution, prior to the emplacement in the crystallization chamber. The rocks of the Sopcha Ore Layer have eNd within the same range (from -0.6 to -0.8). At the same time, surrounding rocks are represented by barren orthopyroxenites with eNd -2.5. This indicates that the formation of the ore layer was related to the additional influx of more primitive magma already bearing ore components. The fact that a new melt already contained ore components is supported by the trace-element composition of olivine, which as compared to olivine from barren rocks, was enriched in Zn, Mn, Co, and Cu. All olivines are characterized by enrichment in Ni (up to 4000 ppm in olivine from the lower part of the dunite-peridotite sequence, around 2500-3000 ppm in olivine from the Sopcha Ore Layer, and widely varying from 3800 to 5800 ppm in the dunite lens and chromitite horizon) as compared to olivine in equilibrium with mantle peridotites. Two models may be proposed for explanation of Ni enrichment of olivine and "crustal" Nd signatures of the rocks: (1) contribution of olivine-free pyroxenite formed by the interaction of recycled crust and peridotite (Sobolev et al., 2007) or (2) assimilation of ore-bearing komatiites during magma ascent.
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