



Platinum-Group Element Mineralization in the Fedorovatundra layered intrusion, Kola Peninsula, Russia

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The 2526 to 2485 Ma Fedorovatundra layered mafic intrusion in the central part of the Kola Peninsula, Russia, is the western massif of the Fedorova-Pana Complex (2526-2446 Ma), which is situated along the northern contact of the Early Proterozoic Imandra-Varzuga rift and Archean granite gneiss. The Fedorovatundra intrusion of approximately 4 km thick has two major parts: (1) located at the bottom of the intrusion Taxitic series (10 to 900 m) and composing the main volume of the massif Layered series (4000 m). The Taxitic series is distinctive, due to its predominant vary-textured often quartz-saturated norites and gabbronorites (with fewer amounts of leucogabbro, melanorite and Ol-gabbronorite) and abundant pyroxenite, less harzburgite xenoliths. Medium to coarse-grained mottled or massive leucocratic gabbronorite and leucogabbro prevails in the Layered series with mesocratic gabbronorite, pyroxenite and troctolite as subordinate rocks.

Depending on its localization, geochemical features, mineral composition and economic value platinum-group element (PGE) mineralization of the Fedorovatundra intrusion is divided into 'marginal' (basal, contact) and 'reef' types. 'Marginal' type of mineralization is presented by irregular disseminated interstitial sulfides (1-2 vol. %) of pentlandite-pyrrhotite-chalcopyrite association ($Cu/Ni = 1.8$) in the Taxitic series. Less sulfides occur as uniformly disseminated aggregates, thin massive lenses and nests. PGE and base metals are concentrated in several ore horizons of 3.5 km long complicated structure. Thickness of ore horizons varies generally within 10–150 m, but it can rise up to 280 m in bulges. In the most common ore-bearing rock (taxitic gabbronorite) average Pt + Pd content is 1.6 ppm (Pd/Pt 4.5). The pyroxenite xenoliths occurring within the Taxitic series are practically barren of sulfide and can dilute higher PGE and base metal grades in the gabbronorite matrix. 'Marginal' mineralization of the Fedorovatundrovsky intrusion forms the largest Fennoscandian PGE deposit with several hundred tons of precious metals. PGE mineralization of a 'reef' type was found in rhythmically layered olivine-bearing horizons in the lower and in the middle part of the Layered series. The 'reef' PGE mineralization is closely associated with finely disseminated (up 0.5 vol. %) pentlandite, pyrrhotite and chalcopyrite ($Cu/Ni = 2.4$). Thickness of mineralized rocks varies from 1 to 3 m. It is continuous for over 500 m (with estimations up to 3 km). In the lower part of the Layered series average Pt + Pd content is 1.4 ppm (Pd/Pt 1.5), in the middle part – 0.4 ppm (Pd/Pt 0.8). The most common PGE-bearing minerals of 'marginal' mineralization are merenskyite, moncheite, kotulskite, sobolevskite, and michenerite; less common are sperrylite, stillwaterite and vysotskite-braggite. 'Reef' type mineralization includes the same minerals, but it is substantially more enriched in PGE arsenides and sulfides.

A two-phase process is postulated for the genesis of the economic PGE mineralization of the Fedorovatundra massif. This involves the intrusion of sulfur-saturated PGE-enriched gabbronorite magma of the Taxitic series (2493-2485 Ma) into already solidified mafic and ultramafic rocks of the Layered series (2526-2507 Ma).

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