

New PGE-reef mineralization of the Sotkavaara pyroxenite intrusion, Rovaniemi, northern Finland

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Introduction

The Sotkavaara intrusion is located around 25 km E-SE of Rovaniemi, in the Kuluskaira area of the Peräpohja schist belt. This small intrusion was intruded into sulphide bearing metasedimentary and -volcanic rocks, thus being favourable S-source for mineralization in mafic-ultramafic magma. Recent studies have revealed that the intrusion hosts a PGE mineralization which may represent a new age group for PGE deposits in the Northern part of Finland.

Geology of the Sotkavaara Intrusion

The local bedrock (Figs. 1 and 2) is composed of mica schists and gneisses with thin black schist horizons, belonging to the Pöyliövaara Formation (Paakkola Group). Quartzites and amphibolites belonging to the Oikaraisenvaara formation (Kivalo group) occur close by to the south and west. The ca. 1.5 x 2.5 km sized and rounded mafic-ultramafic body was intruded into these metasedimentary and -volcanic rocks. The central part of the intrusion consist of mainly pyroxenites. Some thin (Ø 1-5 m) serpentine altered peridotite layers/dykes occur within pyroxenite. The outer parts of the intrusion consist of gabbros and amphibolites (i.e., gabbro-amphibolite zone). The pyroxenite is a small-medium grained rock composed mostly of clinopyroxene and amphibole. Often the rock contains ca. 1 mm sized orthopyroxene ± olivine ± plagioclase spots. Diamond drillings have revealed that the pyroxenitic part of the intrusion is only ca. 300 m thick in depth, surrounded by up to 100 m thick gabbro-amphibolite zone.

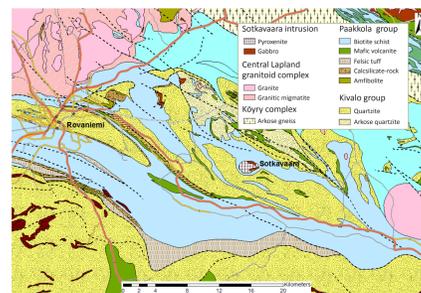


Figure 1. Location of the Sotkavaara intrusion on geological map (Bedrock of Finland-DigiKp).

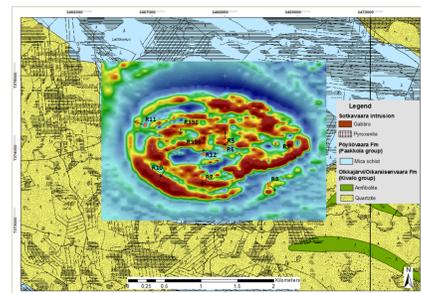


Figure 2. Ground magnetic map of Sotkavaara intrusion and location of drill holes. Gabbroic rocks around the margins of intrusion show as magnetic highs.

Geochemistry of the intrusion

Pyroxenites have low Al_2O_3 (2-4 wt.%), moderate MgO (16-20 wt.%), TiO_2 (0.4-0.6 wt.%) and Cr (0.1-0.2 wt.%) contents, and low sulfur (100-600 ppm) and nickel (300-500 ppm) contents. Peridotites have high MgO (ave. 37 wt.%), but low TiO_2 (ave. 0.15 wt.%), Al_2O_3 (ave. 1.1 wt.%) compare to pyroxenites. However, Cr content of serpentinites is outstandingly low (ave. 0.02 wt.%). The gabbro-amphibolite zone rocks can be classified into three groups by their composition and texture: i) Low- TiO_2 gabbros, ii) high- TiO_2 gabbros, and iii) amphibolites. The low- TiO_2 gabbros contain also lower iron and vanadium, but higher SiO_2 contents than the high- TiO_2 gabbro, but otherwise they are similar by their compositions.

For example, their chondrite-normalized REE-patterns are identical (flat LREE and sloping MREE to HREE), which also resemble the REE-patterns of the pyroxenites.

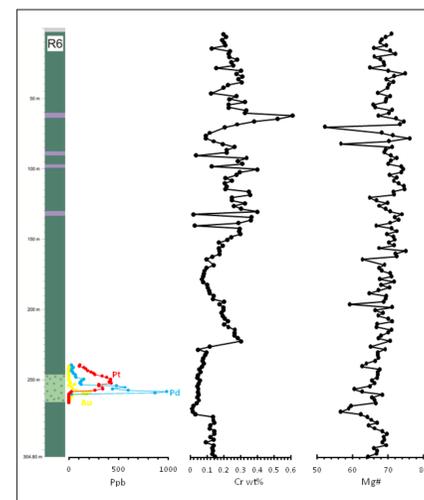


Figure 3. Stratigraphic column of DDH R6 with PGE-reef, Mg# and Cr content. Mg# and Cr based on pxf analyses, recalculated against laboratory XRF analyses.

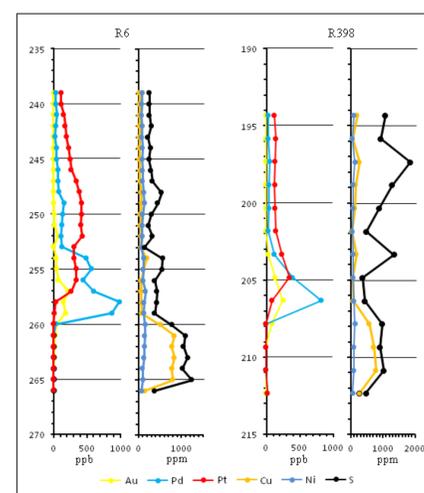


Figure 4. Detail of Pt-Pd-Au and Cu-Ni-S contents of the PGE-reef from two DDH's (R6 and R398) from Sotkavaara intrusion.

PGE-reef

Visible sulfides are rare in the pyroxenites, whereas the gabbros locally contain sparse disseminated sulfides. However, one hole intercepted ca. 25 cm thick massive sulfide vein containing 2.1 wt.% Ni, 0.47 wt.% Cu, 0.26 wt.% Co and trace PGEs (79 ppb Pd). Some trace sulfides (e.g., pyrrhotite, chalcophyrite, pentlandite and pyrite) has been detected to be closely associated with an "mottled" textured pyroxenite. This texturally distinguishable rock was studied within a 3 meter interval of one diamond drill core (R6) and this section revealed to contain elevated precious metals (Au+Pd+Pt between 0.86-1.16 ppm) with very low S and base metal values (ca. 400 ppm S, 65 ppm Cu and 150 ppm Ni). Analysis showed a up to 15 m thick PGE anomalous zone with a very sharp lower "contact" where PGEs drop from 1 ppm to some tens of ppms over one meter interval. Upwards, PGE values gradually diminish to anomalous levels (>100 ppb). So far, this reef-type PGE occurrence has been located from three drill cores (R6, R12 and R398). The best intersection (in drill core R6) contains 6 m @ 0.99 ppm Au+2PGE. At this high grade interval, the Pt-Pd ratio varies across the mineralization, with very low ratio (<0.1-0.5). Upwards, Pd concentration decline rapidly and Pt-Pd ratio increases to ca. 5 and moderate 2PGE values and then decrease again to values between 1 to 3, as PGE contents drop to below 150-200 ppb. Analytical data shows that the reef is marked by low whole-rock Cr. This Cr poor zone has been located cost efficiently by portable XRF analyzer (i.e., pxf), (Fig. 3 and 4).

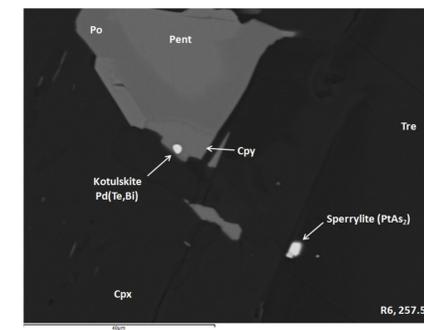
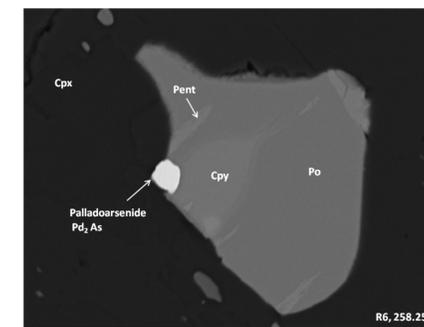


Figure 5. Backscattered SEM-images of platinum-group phases in Sotkavaara samples.

Conclusions

The only known host-rock for reef-type PGE mineralization in northern Finland is represented by the 2.44 Ga layered intrusions (e.g., Alapieti & Lahtinen 2002; Iljina & Hanski 2005). In these intrusions, reef type mineralizations are usually associated with border of Cr-rich and Cr-poor unit. There is no direct age data from the Sotkavaara intrusion, but age data for the country rocks indicate a maximum age of ca. 1.98 Ga (Hanski et al. 2005), representing a new potential age group for PGE deposits in the Northern part of Finland.



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