Geochemical Modeling Of The Kevitsa Cu-Ni-Pge-Au Deposit, Northern Finland

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The Keivitsa 2.058±4 Ga old Ni-Cu-PGE-Au deposit in northern Finland consists of disseminated Ni-Cu-Fe sulfides, Platinum Group Minerals (PGM) and native gold in a layered mafic-ultramafic complex with vertical ore bodies of elevated contents of Platinum Group Elements (PGE) in the NE part of the intrusion. The chemical major, base metal and PGE+Au compositions of the host rocks were analyzed by XRF, aqua regia+AAS or ICP-OES, and Ni sulfide fire assay with MS-ICP finish. The CIPW norms were calculated from the whole rock analyses and plotted in the Streckeisen triangle Ol-OPX-CPX showing most of the host rocks in the fields of olivine clinopyroxenite, olivine websterite, wehrlite and lherzolite. The vertical high PGE bearing fault zones consists of hydrothermally altered olivine pyroxenite and olivine websterite with serpentine, tremolite, chlorite and minor phologopite, which contain elevated F- and Cl-contents. Cu-PGE-Au bearing crosscutting veins have been occasionally found in the drill cores and along the margins in the gabbros and the country rock. Geochemical and structural deposit modeling was carried out by the senior author (J.P.) using the Surpac software and a database of ca. 500000 base metal analyses. The structure of the Kevitsa intrusion shows sub horizontal magmatic mega cyclic layering that has been cut by N-S trending vertical faults. In the horizontal section the intrusion is circular with ultramafic pyroxenites in the northern part and gabbro in southern part with two large dunite bodies in the center of the intrusion and in some places along the basal contact. The Ni-Cu-PGE disseminated ore is located in the NE part of the intrusion. The olivine clinopyroxenites have a magmatic cumulus texture with olivine and clinopyroxene as cumulates. Orthopyroxene, actinolitic amphibole, serpentine, chlorite, phologopite and base metal sulfides are as intercumulus minerals. The major sulfides are pentlandite, pyrite, pyrrhotite, and chalcopyrite. The average amount of olivine is 22.8%, clinopyroxene 53.8%, and orthopyroxene 9.2%. The PGM are mostly found as monomineralic anhedral grains 1-75 µm in size included in hydrosilicates or attached to the grain boundaries of sulfides. Only a few PGM grains are included in sulfides. The PGM include 22 phases the most frequently found being cooperite-braggite, sperrylite, geversite, moncheite, merenskyite, kotulskite-sobolevskite-sudburyite series, and palladian melonite. The experimental sulfide and PGE mineralogy suggest primary crystallization temperatures around 1100-900ºC, with final equilibration temperatures as low as 240ºC. The graphic intergrowths of pentlandite, chalcopyrite, and pyrite suggest crystallization from *iss* on cooling below 557ºC, and in chalcopyrite free assemblages formation of pyrite-pentlandite-millerite-heazlewoodite intergrowths at 240ºC. The Pt/Pd ratio is on average 1.77 (N=4217) in the metapyroxenitic PGE-rich zones. The mineral assemblages and textures result from serpentinization, hydrothermal alteration, and metamorphism of the pre-existing, low-grade disseminated Ni-Cu-Fe sulfides formed during the crystallization