ARSENIC-ENRICHED Cu-Ni-PGE MINERALIZATION IN WETLEGS, DULUTH COMPLEX, ST. LOUIS COUNTY, MINNESOTA, USA

Raič, S.[1], Mogessie, A.[1], Benkó, Z.[1], Molnár, F.[2], Hauck, S.[3] & Severson, M.[3]

[1]University of Graz, Universitätsplatz 2, 8010 Graz, Austria
[2]Geological Survey of Finland, Helsinki, Finland
[3]NRRI, University of Minnesota, 5013 Miller Trunk Highway, Duluth MN 55811, U.S.A
e-mail: sara.raic@edu-uni.graz.at

As one of the biggest layered mafic intrusions worldwide, the Duluth Complex (1.1 Ga) in NE Minnesota, USA, is known for its Cu-Ni-PGE (platinum group elements) mineralization in magmatic sulphide ore deposits along its western margin. The investigation area in deposit Wetlegs, located in the Partridge River intrusion is of great interest, due to the highly mineralized zones up to the top units of the drill cores. Three drill cores were sampled for a detailed stratigraphic and petrographic study, chemical analyses of silicate phases and ores in mineralized horizons. The drill core lithology consists of troctolites (Pl, Ol, Px rich rocks) with alternating layers of anorthositic, gabbroic and ultramafic rocks. Mineralization occurs in the basal troctolites. Sulphide mineralogy is characterized by pyrrhotite, chalcopyrite, pentlandite, as well as cubanite-chalcopyrite segregations ± bornite, covellite, sphalerite and molybdenite. Oxides are primarily ilmenite and magnetite. Mineralization hosted by hydrothermal alteration phases mainly contains chalcopyrite associated with fibrous to fine grained chlorite and amphibole. Additional ore minerals related to this type of mineralization are Ni-arsenides, Ni-Co-sulpharsenides and Ni-antimonides including nickeline [(Ni, Co, Fe)As], maucherite ($Ni_{11}As_8$), safflorite [(Co, Fe, Ni)As_2], cobaltite [(Co, Fe, Ni)AsS], gersdorffite [(Ni, Co, Fe) AsS], alloclasite [(Ni, Co, Fe)AsS] and ullmannite [(Ni, Co, Fe)SbS]. All these phases show large variations in their Ni-Co-Fe distribution. Ni-arsenides (maucherite, safflorite and nickeline) mainly occur as inclusions in Ni-Co sulpharsenides (cobaltite) in hydrothermally altered ultramafic rocks where they are associated with hydrous silicates such as chlorite and amphibole. This may indicate an earlier formation of Ni-arsenides followed by Ni-Co sulpharsenides. Sulpharsenides and arsenides containing significant concentrations of Pd and Rh are documented. These Pd-Rh-enriched phases occur as inclusions in Ni-Co sulpharsenides, Ni-arsenides, chalcopyrite and pyrrhotite. Pt-arsenides are associated with hydrous silicates. The presence of Ni-Sb-arsenides in footwall rocks may suggest the metasedimentary Virginia formation as a potential source of arsenic and antimony. These elements were mobilized by hydrothermal fluids and introduced in the crystallizing magma to form arsenic-enriched Cu-Ni-PGE mineralization within the basal ultramafic rocks. $\delta^{34}S$-data of sulphides from representative samples of the Wetlegs drill cores vary between 2.04 and 22.80 ‰. This suggests the involvement of crustal materials in addition to the magmatic source of sulphur in the Cu-Ni-PGE mineralization as has also been documented in previous studies (MOGESSIE et al., 1991, MOGESSIE & STUMPFL, 1992). *FWF (P23157-N21) financial support to A. Mogessie and from the Dean of Students, University of Graz to S. Raič is acknowledged.*

MOGESSIE, A., STUMPFL, E., WEIBLEN, P. (1991): Econ. Geol., 86, 140-152.
MOGESSIE, A., STUMPFL, E. (1992): Australian Journal of Earth Sciences, 39, 315-325.