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Comportment of Chalcophile Elements in a Pd-Pt-Ag rich vein of the Allard Cu-porphyry stock, La Plata Mountains, SW Colorado

WOLFGANG MAIER[1], **PROF. SARAH-JANE BARNES, PHD**[2], DANY SAVARD[2] AND DUNCAN MUIR[1]

[1]Cardiff University
[2]Universite du Quebec a Chicoutimi (UQAC)

The Allard stock of SW Colorado, is a Cu-bearing syenitic porphyry intrusion, emplaced ca. 66.7-68.5 Ma, containing an inferred resource of 181Mt at 0.33% Cu and 2ppm Ag including a subset of the resource of 45Mt with 0.18 Pt+Pd+Au for a total of 1.31Blb Cu, 17Moz Ag and 272 Koz PGE+Au. Some sulfide rich veins in the intrusion contain high concentrations of Ag, Pd, Pt and Au. Element maps, using a combination of SEM and LA-TOF-MS across one of these veins have been carried out to study the paragenesis of the vein and the comportment of the elements.

The vein is ~ 2.5 cm wide and shows compositional zonation. One edge of the vein consists of a pyrite-rich zone, the center is bornite-rich and the other edge chalcopyrite-rich. In all zones ankerite and an As-Zn-Cu-S mineral, possibly tennantite are present. Based on the textural relationships the paragenesis was pyrite+quartz, followed by introduction of Cu to form chalcopyrite, then bornite and lastly deposition of ankerite and tennantite at the margins of the sulfides.

Concentrations of Pd are highest in the pyrite from the pyrite-rich zone (41ppm). However, the concentrations are extremely variable with many grains showing oscillatory zoning pattern with values ranging from 0.5 to 100 ppm. There are also a few small grains with values of up to 2000ppm Pd. The highest Pt contents are found in the rims of the Pd-rich pyrites at 1 to 2ppm. None of the other minerals contain significant amounts of Pd or Pt. Mass balance calculations suggest that most of the Pd is present in pyrite, but the major host of Pt was not located. As has been observed at New Afton the Pd-rich pyrites are also rich in Co and Ni suggesting a mafic source for these elements.

High Ag concentrations are associated with the fluid that transformed chalcopyrite to bornite. The Pd-rich pyrite and tennantite contain the highest levels of Au at 5ppm and 1 to 3ppm, respectively. Tennantite contains high levels of Ge, Mo, Cd, In, Sn, Sb, Te, Tl, Pb, Bi. these elements were late additions to the system.