

PGE distribution in the Aguablanca Ni-Cu sulfide deposit, Spain: Evidence from LA-ICP-MS

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The concentrations of PGE have been determined in magmatic sulfides (pyrrhotite, pentlandite and chalcopyrite) and hydrothermal pyrites from the Aguablanca Ni-Cu sulfide deposit (SW Spain) [1] by LA-ICP-MS at the University of Quebec, Chicoutimi, Canada. The whole-rock PGE contents, the PGE concentrations in the sulfides and the PGE mineralogy [1] suggest that the PGE distribution among the sulfides is primarily controlled by their partitioning behaviour during the fractional crystallization of a base metal sulfide liquid.

With the exception of Pt, all PGE have been identified in the sulfides. The PGE contents vary as a function of the sulfide host and the ore-type. Os, Ir, Ru and Rh are present in Po and Pn and are much more abundant in those sulfides of semi-massive ore than in those of disseminated and chalcopyrite-veined ores. Pd is, by far, the main PGE found within Pn (> 85% of the PGE in Pn) and is relatively more abundant in Pn of disseminated and chalcopyrite-veined ores than in that of semi-massive ore. These data are in agreement with the initial hypothesis that semi-massive ore represents a *mss* cumulate and has preferentially concentrated IPGE, whereas the disseminated ore represents an original, unfractionated sulfide liquid or a more evolved sulfide liquid [1]. Mass balance calculation indicates that IPGE mostly occur as solid solution in the exsolution products of *mss* (Po and Pn). Whole-rock analyses indicate Pd is incompatible with the semi-massive ore (*mss* cumulate) and concentrates in the Cu-rich ore (fractionated liquid). Surprisingly, it is not concentrated in Ccp, but rather in Pn. Pd contents in Pn from Sudbury and Noril'sk Ni-Cu deposits have been attributed to Pd diffusion into Pn from the surrounding sulfides during cooling [2]. At Aguablanca, since chalcopyrite veins are interpreted as a Cu- and Pd-rich fractionated sulfide liquid [1], this diffusion mechanism would explain the high Pd content of the Pn in this ore-type.

[1] Piña *et al.* (2010) *GSA Bulletin*, in press. [2] Barnes *et al.* (2006) *Contr. to Min. and Petrol.* **152**, 187-200.

²⁴Mg/²⁶Mg Isotope fractionation in silicate minerals through first principles calculations

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Understanding the partitioning of Mg within planetary bodies can help to constrain their histories of accretion and differentiation. Mg is an abundant element and with its intermediate volatility should help in understanding the origin of the planet. Nevertheless the constraints on the Earth's Mg isotope composition are still only poorly understood. Fractionation factors are also important in recognising open-system exchange of Mg isotopes in mantle rocks [1].

We have used first principles atomistic calculations to study the structure, dynamics and thermodynamic properties of the silicate minerals forsterite, enstatite and diopside. Advances in the calculation of free energies allow prediction of fractionation factors under conditions of thermodynamic control. Thus we have extended this study to the fractionation of ²⁴Mg and ²⁶Mg isotopes in silicate minerals as a function of temperature and pressure. Here we show orders of fractionation for ²⁴Mg/²⁶Mg of 0.05‰ between olivine (forsterite) and the orthopyroxene (enstatite) with fractionation slowly decreasing with pressure. As expected partitioning becomes negligible at very high temperatures. We have also explored the partitioning effects between orthopyroxenes and clinopyroxenes where we have seen that ²⁴Mg/²⁶Mg partitioning is slightly enhanced with a approximate fractionation of 0.1‰.

[1] Young, Tonui, Manning, Schauble & Macris (2009) *Earth & Planet. Science Letters* **288**, 524–533.