The alteration sequence of PGM in the gossan of the Aguablanca Ni-Cu-(PGE) sulphide deposit, SW Iberia

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The gossan outcrops overlying the Aguablanca magmatic deposit [1] (situated in the Ossa-Morena Zone in SW Iberia) host significant total PGE contents of up to 5 ppm, with Pt and Pd dominant over Rh, Os, Ir and Ru. A detailed survey of the PGE distribution was carried out in this gossan in order to understand the processes that change primary magmatic PGM during weathering in an oxidising, low-T environment. PGE were investigated in host relic PGM (by SEM-EDS) and as traces in the host Fe-oxides and oxyhydroxides that form the gossan (by LA-ICP-MS) [2].

The study showed a gradual alteration of the PGM and release of PGE during the gossan formation, including: (i) initial breakdown of the already slightly altered, primary PGM [3] (24% of the total PGM located); (ii) formation of partially oxidised Pt-Pd-phases (3%), with a composition close to 'Pt_2O' and "(Pt, Pd)O'; (iii) formation of numerous oxidised Pt- and Pd-(±Cu-Fe, Bi-Te)-phases (68%), with a composition usually close to "$(Pt, Pd)O_2$" and "$(Pt, Pd)_3O_4$". Palladium-rich hydroxides were also identified. These phases all appear to have formed from alteration of earlier PGM to form pseudomorphs. Among them, Pt-rich PGM are more frequent and always appear better preserved than Pd-rich PGM; (iv) formation of Fe-Ni-Cu-(±Pt-Pd)-oxides (5%), mainly in patches that may include relic precursor PGM; and lastly, (v) incorporation of PGE into ferruginous supergene products, with a greater dispersion of Pd than for the other PGE. LA-ICP-MS analyses showed that Pt, Ir and Rh in oxides are mainly located close to sulphide relicts. In contrast, Pd accompanied by Cu, Ni, Bi or Te, occur widely distributed within the different generations of Fe-oxides.

These observations suggest that the sequence of alteration of igneous PGM in a gossan is likely to be one of PGE-oxide formation followed by dispersion of the PGE into the Fe-oxides. This work adds to the understanding of the evolution of PGM in the surface environment.

[1] Tornos *et al*. (2006) *Miner Deposita* **41**, 737–769.
[2] Suárez *et al*. (2010) *Miner Deposita* **45**, 331–350.
[3] Ortega *et al*. (2004) *Can Mineral* **42**, 325–350.

Late-Cretaceous alkaline continental magmatism associated with Deccan Continental Flood Basalt sequences of Saurashtra in Western India

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The Saurashtra region in Western India consists of seven volcano-plutonic complexes (plugs) occurring within the Deccan Continental Flood Basalts of WDVP. The three major plugs occurring at Junagadh (Girnar), Barda and Alec Hills pipe-like igneous intrusions located along the E-W trending Narmada-Son lineament. Alkaline magmatism is represented by lamprophyres and nepheline syenites forming as minor composite intrusions which are spatially and temporally related and occur chiefly within the diorites in the upper part of the Girnar Complex. Nepheline syenite is generally cream coloured, spotted black and pinkish red with pyroxene and nepheline respectively and consists of a granitoid aggregate of alkali feldspar, nepheline, sodalite, cancrinite and aegerine. In lamprophyric sills, Cpx occurs as microphenocrysts of small rounded to prismatic crystals which show the characteristic oscillatory zoning (X_{Mg} = 0.65–0.77) and amphiboles which are of calcic variety (X_{Mg} = 0.48 to 0.65). X_{An} in plagioclase varies from 25 to 96. These alkaline rocks have higher concentration of total alkalies (8.0 to 14.57wt %), Al_2O_3 (22.2wt %), LILE and ΣREE as well as highly fractionated REE patterns. The available data suggest that they are products of fractionation of an alkali basic magma from which early crystallization of lamprophyres took place under high PH_{20} conditions followed by nepheline syenites which crystallized at lower PH_{20} under relatively dry conditions from the residual liquids. The occurrence of high MgO dykes (olivine tholeiites, Opx bearing pyroxenite dykes and ankaramite dyke), the essexite pluton and deep-seated lineaments coupled with the presence of strong positive gravity anomalies in the Saurashtra region reflect prevalence of an underlying sub-surface high density component in the Girnar and most of the other plugs in the region.