

## More about the energy intelligent behaviour of secondary iron sulphates in AMD

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The environmental behaviour of secondary iron sulphates formed by acid mine drainage (AMD) in abandoned mines of polymetallic sulphide ores has currently a negative connotation because these newly-formed minerals concentrate heavy metals and other toxic elements.

Despite apparently so penalizing, this feature may yet configure a very positive contribution to the bulk energy consumption if an analysis is performed on the exergetic life cycle assessment (ELCA) of many sulphate minerals as exemplified by jarosite, copiapite and voltaite – three recently analysed type-cases of secondary hydroxylated and/or hydrated iron sulphates [1]. Indeed, due to a favourable atomic arrangement within its crystal structure, jarosite – with ideal formula  $K(Fe,Al)_3(SO_4)_2(OH)_6$  – is a preferential host for lead in AMD processes, sequestering this toxic metal and significantly reducing its environmental spread in soils and rivers. Copiapite –  $MFe_4(OH)_2(SO_4)_6 \cdot 20H_2O$ , where  $M$  is a divalent metal – efficiently sequesters other toxic metals (e.g., cadmium), while voltaite,  $K_2Fe^{II}_5Fe^{III}_4(SO_4)_{12} \cdot 18H_2O$ , may encourage the fixation of micro-organisms in the surface of its nanoparticles and develop an environmental-friendly behaviour in AMD eco-systems [2].

The mineralogy and the geochemistry of ochreous sediments in the abandoned mine of S. Domingos, southern Portugal (Iberian Pyrite Belt of polymetallic sulphide ores) is revised. A brief analysis is made on the environmental behaviour of the oxy-hydroxide pair schwertmannite-ferrihydrite [3] and on its role in “green rust” formation. A synopsis is presented on the structural features and geochemical tendencies of secondary iron sulphates liable of being exploited to promote their possible role as energy-savers within the particularly aggressive environment of abandoned sulphide-ore mines.

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[1] Figueiredo M.O. & Silva T.P. (2007) *Europ. Mtg. Point Energy for Development 2007*, October 10-12, Beja/Portugal. Extended abstract, 3pp. [2] Hertweck B., Giester G. & Libowitzky E. (2001) *Amer. Min.* **86**, 1282-1292. [3] Regenspurg S., Brand A. & Peiffer S. (2004) *Geochim. Cosmochim. Acta* **68**, 1185-1197.

## Petrogenesis of dacites from the southern Juan de Fuca Ridge

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Dacites and hi-silica andesites recovered from constructional domes at the ridge-transform intersection (RTI) of the Cleft Segment of the southern Juan de Fuca Ridge (JdFR) provide a rare glimpse into the complexity MORB evolution likely to occur at many mid-ocean ridges (MOR) but difficult to recognize. Complexly zoned and disequilibrium phase assemblages in the glassy lavas are dominated by microphenocrysts of ferroaugite and ferropigeonite, with lesser amounts of sodic plagioclase and FeTi oxides. Zircon, apatite, fayalite and fragments of myrmekite and basalt are also present. Crystal zoning patterns (normal and reverse) in mafic phases and the presence of basaltic inclusions together with linear trace element variation trends suggest some evolved lavas are the result of magma mixing between relatively evolved MORB and rhyodacitic melts. Identical incompatible element ratios, similar Sr, Nd, and Pb isotope ratios, and slightly lower O-isotopes in andesites and dacites compared to MORB also suggest extensive fractional crystallization of similar parental basalts but including minor assimilation of altered crust.

Based on petrography, trace element chemistry, and Ti-in-zircon thermometry, we suggest that JdFR zircons crystallized *in situ*, and are unlikely inherited from oceanic plutonic rocks. The presence of *in situ* crystallized zircon allows new insights into the rates of melt differentiation of oceanic magma systems. SIMS U-Th zircon ages in combination with thermal ionization mass spectrometry measurements of whole-rocks yield a model age for zircon crystallization of  $27 \pm 3$  ka that is concordant with the SIMS zircon isochron age of  $33 \pm 7$  ka from five lava samples.  $(^{230}\text{Th})/(^{232}\text{Th})_0$  ratios of dacites at the time of zircon crystallization are indistinguishable from modern basaltic magmas erupted within the axial zone of the S Cleft segment. This requires that magmatic differentiation occurred within a few ka after MORB extraction from the mantle probably facilitated by a diking event followed by rapid cooling with only limited basalt magma recharge in the ridge transform environment.