Divalent metal removal from highly metal polluted acid mine drainage, Iberian pyrite belt

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Complete removal of trivalent metals like Fe and Al and other elements like As, Cu, Pb and Cr from waters affected by acid mine drainage (AMD) has been achieved in field passive remediation experiments by the use of limestone sand dispersed in wood shavings (Dispersed Alkaline Substrate, Limestone-DAS) [1]. However, it was observed that achievement of divalent metal removal (Zn, Mn, Cd, Ni or Co) required not only a pH increasement to values around 8-9 by the use of a different alkaline reagent (MgO) [2] but also a complete Fe and Al removal previous to the new MgO treatment [3].

The acid effluent from Monte Romero mine (Iberian Pyrite Belt, SW Spain) is channeled into a $100 m^3$ dam built in the vicinities of the mine shaft. After this natural pretreatment the AMD is forced to flow through three in series reactive tanks. The two first reactive tanks were filled with Limestone-DAS while the third one was filled using MgO-DAS.

AMD treated at Monte Romero has a pH of 3, net acidity over 1800 mg/L as $CaCO_3$ equivalents and contains 440 mg/L Zn, 330 mg/L Fe, 100 mg/L Al, 15 mg/L Mn and 0.1-3 mg/L Cu, As, Pb, Cr, Cd, Co and Ni. Inflow water at the MgO-DAS reactive tank has a pH of 6, a net acidity over 770 mg/L as $CaCO_3$ equivalents and contained 420 mg/L Zn, 15 mg/L Mn, 500 μg/l Cd, 820 μg/L Co and 830 μg/L Ni.

Although the system is under operation, some encouraging results have been observed during the first two months of operation. The system has worked with a constant flow of 0.5 L/min, promoting total removal of the inflow net acidity and obtaining a complete water remediation for trivalent (Fe, Al), divalent (Zn, Mn, Cd, Co and Ni) and other inorganic contaminants (Cu, As, Pb and Cr).

[1] Macías *et al.* (2009) *Geochimica Cosmochimica Acta* **73**, A811. [2] Rötting *et al.* (2008) *Environ. Sci. Technol.* **42**, 9370–9377 [3] Caraballo *et al.* (2009) *Applied Geochemistry* **24**, 2301–2311.

Skarn mineralization in Damak Cu-porphyry deposit (Shir-kuh), Central Iran

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Damak area is a part of Cenozoic magmatic belt of Central Iran which is contact in West of Yazd province & North-West margin of Shir-kuh batholite granite. Nayband terigenous formation is the oldest rock unit as bed rock and has undergone weak contact metamorphism by Shir-kuh granite in middle Jurassic. The young intrusive bodies which are mainly leucocrate are granite to granodiorite with Cu-porphyry mineralizations. They have widespread fractures & alterations. Those intrusive have intruded Shir-kuh granite, arcosic sandstones & conglomerates of Sangestan Formation (lower Cretaceous). Skarns are formed in expense of carbonate huge pebbles of Sangestan conglomerates. The critical mineral assemblage which is determined skarn is as follow:

Garnet + epidote + quartz + calcite + pyrite + iron oxides.

Chacolate garnets are the characteristic mineral. EPMA analysis has shown that the chemical composition of garnet belong to andradite-grossular solid-solution with more andradite component. The high permeability and presence of carbonate parts in conglomerate are two important factors for fluid flow and genesis of garnets. Distinct oscillatory zoning in garnets is resulted from the change of fO2 in fluids [11]. The evolution of Damad skarn is took place in the range of 380 to 530 °C, 0.5 Kbar pressure and high fO2. Also close association of this skarn with Damad intrusive bearing Cu-porphyry mineralization shows that this skarn is a kind of Cu-porphyry skarn.

[1] Jamtveit, Wogelius & Fraser (1993) ‘Zonation patterns of skarn garnets, records of hydrothermal system evolution.’ *Geo.* **21**, 113–116.