Treatment of high metal concentration AMD using Dispersed Alkaline Substrate (DAS), a novel passive treatment system

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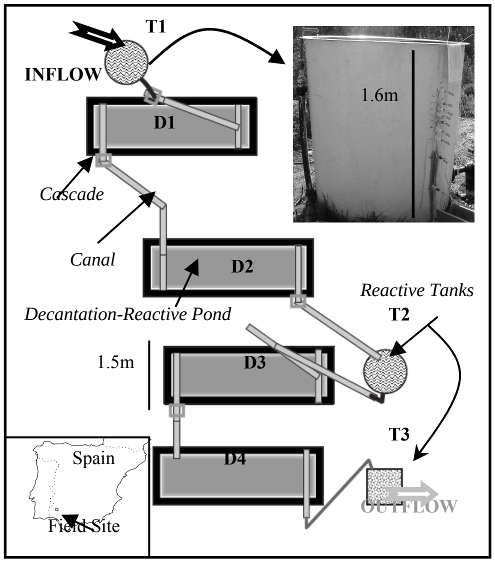
In spite of the existence of many Passive Treatment Systems used for remediation of Acid Mine Drainage (AMD), with moderate metal concentrations and acidity, all of these systems shown severe problems when exposed to high metal concentrations such as those present in AMD from sulfide mining districts. To overcome this problem we have developed a novel Dispersed Alkaline Substrate (DAS), consisting in a mixture of a fine-grained alkaline reactive (limestone sand in T1 and T2 and MgO dust in T3; Fig. 1) and a coarse inert matrix (wood chips). AMD at Monte Romero (Iberian Pyrite Belt, SW Spain) has a pH of 3-3.5, net acidity of 1400-1650 mg/L as $CaCO_3$, 320 mg/L Fe (95% Fe^{2+}), 310 mg/L Zn, 75 mg/L Al, 0.1-1 mg/L Cu, As, Pb, Co, Ni and Cd. The pilot-scaled field experiment (Fig.1) presents encouraging results. T1+D1+D2 remove 100% of Al, As, Pb and Cu, 50% of Fe, 15% of Cd and 5% of Zn from the inflow water. T2+D3+D4 remove almost 100% of Fe and T3 is designed to remove the remaining Zn and Cd, although results for T3 are not available jet.

Figure 1: Localization and schematic representation of the DAS pilot treatment plant developed at Monte Romero Field Site (SW Spain).



(Mg,Fe,Al)(Si,Al)O_3 post-perovskite and the D″ layer

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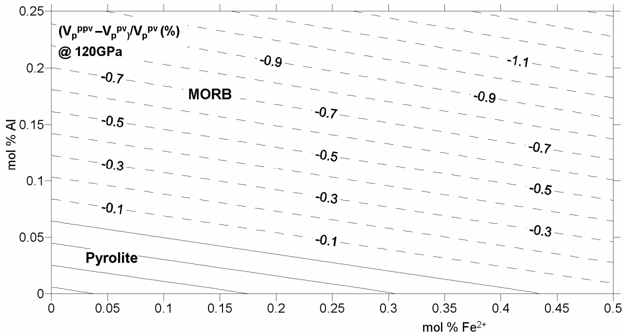
We perform frst-principles calculations based on density-functional theory to investigate the effects of Fe-Mg and MgSi-AlAl substitutions on the properties of $MgSiO_3$ perovskite (pv) and post-perovskite (ppv).

Our resutls show that Fe^{2+} partitions preferentially in ppv and significantly reduces the pv-ppv transition pressure. Fe^{2+} is in high-spin state; it decreases the seismic wave velocities and slightly decreases the seismic anisotropy of $MgSiO_3$. Al partitions preferentially in pv and increases the pv-ppv transition pressure. It decreases the seismic wave velocities and considerably increases the seismic anisotropy of post-perovskite. Consequently the D″ layer can be explained by the pv to ppv transition in pyrolite, suggesting that D″ is not only a repository of sunken slabs:



The variation of the physical properties of pv and ppv with chemistry also suggest that the regions where the D″ layer is thicker should be rich in iron. They should have lower seismic wave velocities than the Fe-poor regions and comparable shear wave splitting. The ultra-low velocity zones, situated at the base of the D″ layer may thus be even iron richer. The regions where the D″ layer is thinner should be poor in iron and richer in alumina. These regions will have lower seismic wave velocities and will show larger shear wave splitting. In a hot mantle regime the transition is narrower as the variation of the element partitioning is reduced compared to a cold mantle regime where the transition is broadened.

We can also correlate seimic anisotropy with the crystal orientation and the chemical composition of pv and ppv.