Geochemistry of Rare Earth Elements in Acid Rock Drainage

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Lanthanides, scandium and yttrium (REE) are mobile in acidic waters and they are transferred to a solid phase when pH increases. A field survey conducted in streams from the Iberian Pyrite Belt, SW Spain, confirmed that REE and Al behave conservatively at pH lower than 4 whereas Fe does not, suggesting that REE are trapped in basaluminite and not in schwertmannite. These observations are consistent with the REE accumulation in the Al-rich precipitates in AMD treatment systems. Sorption experiments with synthetic basaluminite and schwertmannite under different pH conditions were performed in the laboratory. For Lanthanides and Y, sorption took place at pH higher than 5, whereas Sc sorption started at pH 4. Both schwertmannite and basaluminite showed similar sorption behavior. However, as schwertmannite formation occurred at pH lower than 4, no REE elements were sorbed on this phase. This pH control explains the REE mobility in water streams and allows their concentration in the Al-rich sludge of the mine water treatment plants.