Mobility of trace elements in phosphogypsum leachates during seawater mixing

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The Estuary of Huelva (Spain) is greatly affected by the phosphate industry through the leachates from their phosphogypsum wastes stockpiled in adjacent stacks [1]. Estuarine systems are responsible for the mass flux of elements entering the coastal areas and the deep ocean, serving as transition zones between freshwater and seawater. During mixing, important geochemical processes occur altering the elemental concentration [2] hence, the phosphogypsum leachates in the study area are subjected to seawater mixing, and subsequently to geochemical transformations.

This research reports the effect of pH increase on the mobility of the phosphogypsum contaminants during seawater mixing. Several experiments were carried out by mixing acidic phosphogypsum leachates and seawater to different ratios with the aim of obtaining pH values of 3, 4, 5, 6 and 7. Stable isotope techniques and ICP-MS for trace elements were performed on the resulted solutions, whereas solid precipitates were collected for mineralogical analysis by XRD and SEM.

The acidity of the leachates (pH=1.4 to 2.1) obstructed the rise of the pH, requiring large amounts of seawater to reach circumneutral values, i.e. mixing ratios of up to 30 mL of leachates to 13.5 L of seawater. Initial concentrations were up to 100 mg/L of Zn, 50 mg/L of As and 20 mg/L of Cd. More importantly, these toxic elements behave conservatively during seawater mixing; around 100% of As and Cd and 50% of Zn are kept into solution at seawater pH. It is therefore urgent to adopt effective restoration measures to minimize the impact of the phosphogypsum stack on the estuarine.

[1] Pérez-López *et al*. (2016). Sci. Total Environ., **553**, 42-51. [2] Asta *et al*. (2015). Mar. Pollut. Bul., **91**, 295-305.