

## **Classification scheme for acid rock drainage detection - the Hamersley Basin, Western Australia**

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In arid environment where precipitation and surface water are very limited, groundwater is the most important freshwater resource. For this reasons it is intensively exploited and needs to be managed wisely and protected from pollutants.

Acid rock drainage often constitutes a serious risk to groundwater quality, particularly in catchments that are subject to mining, large scale groundwater injection or abstraction. However, assessment of the potential acid rock drainage risk can be challenging, especially in carbonate rich environment, where the decreasing pH that usually accompanies pyrite oxidation, can be masked by the high pH-neutralisation capacity of carbonate minerals.

In this study, we analysed 73 surface and groundwater samples from different water bodies and aquifers located in the Hamersley Basin, Western Australia. Although the majority of samples had a neutral pH, there was a large spatial variability in the dissolved sulphate concentrations that ranged from 1 mg/L to 15,000 mg/L. Waters with high dissolved sulphate concentration were found in areas with a high percentage of sulphide minerals (e.g. pyrite) located within the aquifer matrix and were characterised by low  $\delta^{34}\text{S}_{\text{SO}_4}$  values (+1.2‰ to +4.6‰) consistent with signatures of aquifer matrix pyritic rock samples (+1.9‰ to +4.4‰). It was also found that the  $\text{SO}_4$  concentrations and acidity levels were not only dependent on  $\delta^{34}\text{S}_{\text{SO}_4}$  values and existence of pyrite but also on the presence of carbonate minerals in the aquifer matrix.

Based on the results from this study, a classification scheme has been developed for identification of waters impacted by acid rock drainage that also encompasses numerous concomitant geochemical processes that often occur in aqueous systems. The classification uses five proxies:  $\text{SO}_4$ ,  $\text{SO}_4/\text{Cl}$ , SI of calcite,  $\delta^{34}\text{S}_{\text{SO}_4}$  and  $\delta^{18}\text{O}_{\text{SO}_4}$  to improve assessment of the contribution that oxidation of sulphide minerals has to overall sulphate ion concentrations, regardless of acidity levels of the aqueous system.

This classification scheme enables a more direct monitoring regime for early detection of acid rock drainage processes and better groundwater quality management.

### References

Dogramaci S., McLean L., Skrzypek G., 2017. Hydrochemical and stable isotope indicators of pyrite oxidation in carbonate-rich environment; the Hamersley Basin, Western Australia. *Journal of Hydrology* 545, 288-298.