Numerical evaluation of arsenic and molybdenum mobilisation following well installation in a limestone aquifer

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Mo and As are known to accumulate in pyrite and organic matter, two redox sensitive phases commonly present in aquifers. Recent research in limestone aquifers has shown that groundwater pumping can draw oxygen-rich near surface water deeper into nominally anoxic aquifers, causing the oxidation of As-rich pyrite and the release of As into the aqueous phase (e.g., Jones and Pichler, 2007). The introduction of oxygen-rich water into an anoxic aquifer could also potentially mobilize Mo from the aquifer matrix. One such scenario is presently known for the municipality of Lithia in central Florida where strongly elevated Mo concentrations were measured in newly installed irrigation wells (Pichler et al., 2017).

In this study, mineralogical analysis and geochemical time dependant data from newly drilled monitoring well clusters in Lithia, central Florida are used to test several conceptual models of arsenic and molybdenum mobilization under natural flow conditions. At the site, As and Mo release is observed following the introduction of oxygen during drilling into the anoxic limestone aquifer.

A reactive transport model was developed to explore physical and geochemical interactions that influence arsenic and molybdenum mobility. The conceptual/numerical model investigates As and Mo release following pyrite oxidation and organic matter mineralisation triggered by the ingress of oxygenated water via the drilling process. Once released, complexation to neo-formed hydrous ferric oxides as well as dilution due to background natural groundwater flow alter concentrations over time. Time dependant hydrochemical data following drilling were used to evaluate the model and an evaluation of the temporal evolution of elevated arsenic and molybdenum concentrations in dependence on groundwater flow velocities is presented.

Jones, G.W.and Pichler, T., 2007. ES&T, 41(3): 723-730
Pichler, T., et al. ., 2017. Applied Geochemistry, 77: 68-79.