



Pyrite oxidation in porous media: flow-through experiments and reactive transport modeling

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Key words: pyrite oxidation, geochemical heterogeneity, reactive transport modeling, flow-through experiments

Pyrite is one of the most abundant minerals in the environment. The oxidative dissolution of pyrite is often linked to the geogenic contamination of groundwater from trace elements, since the reaction plays a key role in elements mobility in the subsurface. For instance, one of the major causes of arsenic contamination in natural and managed aquifers has been identified in the oxidation of arsenic-bearing pyrite.

We performed laboratory experiments in different setups including, batch, 1-D columns and 2-D flow-through systems. The flow-through experiments were performed in physically homogenous but chemically heterogeneous porous media. In fact, both the 1-D columns and the 2-D flow-through chamber were filled with homogeneous sand with embedded reactive pyrite inclusions with the same grain size. The setups were initially maintained under anoxic conditions, and subsequently flushed with an inflowing oxic solution. A non-invasive optode technique (e.g., Haberer et al., 2011 and 2015) was used for high-resolution monitoring of oxygen consumption and transport along the 1-D columns and in selected cross sections of the 2-D flow-through chamber. Water quality analysis of iron and sulfur were carried out during the batch experiments and at the outlet of the flow-through setups.

The results show different patterns of oxygen consumption in the flow-through setups. The spatially distributed measurements of oxygen concentration allowed capturing the effects of the reactive pyrite inclusions in both 1-D and 2-D systems. The experimental data were quantitatively interpreted with reactive transport simulations including the main physical processes occurring in the flow-through systems, as well as a reaction network with the kinetics of pyrite oxidation.

References

- Haberer, C. M., Rolle, M., Liu, S., Cirpka, O. A., & Grathwohl, P. (2011). A high-resolution non-invasive approach to quantify oxygen transport across the capillary fringe and within the underlying groundwater. *Journal of contaminant hydrology*, 122(1), 26-39.
- Haberer, C. M., Rolle, M., Cirpka, O. A., & Grathwohl, P. (2015). Impact of heterogeneity on oxygen transfer in a fluctuating capillary fringe. *Groundwater*, 53(1), 57-70.