Leaching of trace metals from anaerobic sediments by nitrate induced oxidation

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Leaching of metals from sediments is a general concern to water quality and of high importance for risk assessment in the context of drinking water reservoirs. Introduction of nitrate into reduced aquifers may lead to the indirect or direct oxidation and subsequent mobilization of metals. While the general mechanism of nitrate induced iron mobilization by the oxidation of ferrous sulphides has been described before (Postma et al. 1991, Jørgensen et al. 2009), knowledge on the release of trace metal during Fe-mineral dissolution is scarce. For uranium (U), field studies suggest mobilization of U due to nitrate input, with negative effects on the usability of groundwater for drinking water supply (Van Berk & Fu 2017).

To quantify heavy metal leaching from anaerobic cores of fine grained sand as a function of input water composition, we conducted column experiments. Different water matrices and nitrate concentrations from 0 to 200 mg/L were used. Using ICP-MS and GF-AAS analyses of leaching water and digested sediments, we followed trace metal evolution during operation of anoxic columns.

Preliminary results show diverting results from duplicate columns suggesting minor initial differences in natural sediment and microbial community to lead to differing reaction trajectories. Columns developed either on an acidic path, with only minor nitrate depletion or on a neutral pH path leading to strong nitrate depletion. Trace metals could be divided in three groups according to their preferential leaching (1) in the beginning of the experiments, (2) under acidic conditions and (3) under nitrate reducing conditions.

Literature:

Jørgensen, C.J.; Jacobsen, O.S.; Elberlin, B. and Aamand, J.: Microbial Oxidation of Pyrite Coupled to Nitrate Reduction in Anoxic Groundwater Sediment (2009) Environ. Sci. Technol., 43 (13)

Postma, D.; Boesen, C.; Kristiansen, H. and Larsen, F.: Nitrate Reduction in an Unconfined Sandy Aquifer: Water Chemistry, Reduction Processes, and Geochemical Modeling (1991) Water Resour. Res., 27 (8)

Van Berk, W.; Fu, Y.: Redox Roll-Front Mobilization of Geogenic Uranium by Nitrate Input into Aquifers: Risks for Groundwater Resources (2017) Environ. Sci. Technol., 51 (1)