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Rising groundwater tables in partly oxidized pyrite bearing dump-sediments: Column study and modelling approach

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Abstract:

This paper reports the hydrogeochemical modelling of reactions that take place during the uptake of weathering products by a rising watertable into a partly oxidized pyrite bearing sediment. The anoxic material used for the column, which is 2 m long, was taken from a core while drilling into a pyrite bearing sediment with average pyrite content of 0.04 wt%. After packing the column it was drained an maintained in an unsaturated state over a period of 107 days to allow oxygen supply and pyrite weathering. During this period oxygen breakthrough curves were measured. After 108 days the column was flooded with distilled anoxic water from the bottom to the top with an average water table rise of 5 cm per day. The chemical composition of the pore water in the saturated zone as well as the water saturation and the oxygen contents have been monitored over the profile of the column. The compositions of the water samples at different depths of the column were modelled with PHREEQC, defining one-dimensional reactive transport model regarding the mixing process between the incoming flooding water and the residual pore water of the drained period. Kinetic relations were implemented to account for source terms of acids and acid generating components released during the drained period. This study showed that the evolution of the rising water table can be characterized by almost immediate uptake of gypsum and by kinetically controlled dissolution of pyrite weathering products in combination with mixing processes and dispersion.

Key-words: Acid mine drainage; Reactive transport; modelling; column study; Rising water table; Pyrite