Reactive transport modelling of water quality changes during river bank filtration, Busan, South Korea

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Aquifer storage and recovery (ASR) was recently implemented and is under testing in Busan, South Korea. At this site, riverbank filtration through the unconfined aquifer is used to improve the quality of the water before injecting it into the deeper confined aquifer. However, unexpected high concentrations of iron and sulfate have been found in the riverbank-filtered water. Pyrite oxidation has been invoked as a possible mechanism, but doubts subsist about the possibility of different geochemical reactions being involved. Moreover, the dissolved oxygen present in the river water does not seem to be sufficient to explain the observed concentrations in the river-filtered water, and thus we formulated the hypothesis that oxygen might be captured during water table oscillations that occur in response to fluctuations in the pumping rate. In order to test these hypotheses, a reactive transport model of the river bank filtration was developed using PHT3D. Pyrite oxidation was implemented as the primary reaction, and various runs were performed to see if the model reproduces the measured concentrations for realistic parameter values. The results demonstrate the capability of the reactive transport modelling framework to capture the main changes in water quality during river bank filtration, as well as the value of reactive transport modelling for testing different geochemical processes that may occur in the subsurface.