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Hydrogeochemical modelling of geothermal systems in the Malm Aquifer

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The Malm sediments in the Bavarian Molasse Basin are very suitable for hydrogeothermal heat and energy production and for energy storage. With the conversion of the Pullach injection well to a production well it was possible to quantify the reactions in the reservoir and to validate the hydrogeochemical models. This data set was complemented by the results from a heat storage test.

The calibrated hydrogeochemical model was used to predict and optimize the long term behaviour of geothermal doublets. In facilities using more than two wells, mixing ratios for the production wells were assessed and optimized. Most of the simulations showed a benign long-term behaviour, even in more complex systems. Dissolution of carbonates at the injection wells propagates into the reservoir and contributes to an increase of the injectivity. It also seems to be possible to make use of the gas load which is otherwise crucial to maintain to prevent the formation of scalings.

The situation changes for geothermal heat storage systems, eg. a geothermal doublet in combination with a combined heat and power plant. The cyclic operation causes a significant increase of the carbonate concentrations. Consequently, the amount of eg. CO_2 that has to be added to the water to prevent precipitation of carbonates during the heating cycle, has to increase as well. The simulation results show that a doublet system for heat storage reaches an unstable situation after a few cycles. These results are supported by the data form a heat storage test and by the data from the conversion of the Pullach well. The model also shows that long-term operation is possible in a triplet setup.