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Acceptance of Subsurface Heat Storage in Germany – Assessing the Impacts on Ground Water Quality

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Subsurface heat storage in terms of building climatisation and storage of excess solar thermal energy is a meaningful subject to recent energy management concepts, especially in times of climate change and scarcity of fossil fuels. In the sense of comprehensive regulation, administrative guidelines are required and for their elaboration and integration into the European Water Framework Directive reliable findings about the influences of heating on ground water quality are essential. Shallow subsurface heat storage is mainly a subject to urban areas, for which transferable knowledge, particularly of the temperature influence on subsurface redox systems, including contaminants such as LHKW and BTEX, is important.

Our presentation will quantify the changes in main solution constituent concentrations in an aquifer due to a temperature increase, studied in column experiments with natural aquifer sediment and tap water at 10, 25, 40, and 70°C. Here, no long-term changes were found with heating; effects on pH and major cations found at 70°C were limited to 40 days or less. Further, the effects of heating on redox-processes and microbial population will be evaluated. A shift of redox zoning was found in the columns from oxic conditions at 10°C towards nitrate and iron reducing conditions at 25 and 40°C and rudimental sulfate reduction at 70°C, attributed to (a) higher microbial activity and (b) an enhanced C_org release from the sediment at increased temperature. The constant addition of sodium acetate in a second experimental step led to the development of sulfate reduction at all temperatures, with the highest reduction rates at 40°C. Temperature adopted populations established, with higher degradation activity compared to an in situ ground water temperature of 10°C.

The results point out, that redox systems and their associated microbial populations sensitively react on subsurface temperature increase. If and how far these effects can be utilized to actually combine contaminated aquifer remediation with subsurface heat storage in urban areas is subject of our current research. The temperature dependent degradation of toluene is studied in the column experiments; the results will also be presented.