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Microbial investigations in geothermal used groundwater systems

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The relevancy of alternative energy resources is still increasing because of limited fossil fuels and the negative effects of climate change due to the accumulation of CO2 in the atmosphere. Therefore the utilization of subsurface stored energy arouses increasing interest of scientists. The research project AquiScreen investigates the operational reliability of geothermal used groundwater systems under microbial, geochemical, mineralogical, and petrologic aspects. Microbiological analyses based on fluid and solid phase of geothermal systems are utilized to evaluate the impact of microbial populations on such systems. The goal of the project is to develop a monitoring concept for an assessment of the microbial and geochemical effects on the geothermal utilization of aquifers. The presentation focus on first microbial results of three investigated geothermal plants that use water with very different chemical und physical characteristics: heat storage in Neubrandenburg (depth 1250 m), cold storage in Berlin (Reichstag building, depth 300 m) and geothermal plant in Unterhaching (drilling depth 3300 m). Fluid and filter samples were investigated based on 16S rDNA to characterize the microbial biocenosis of the geothermal aquifer. The identification of microorganisms enables the correlation to metabolic classes and provides information about the biochemical processes in the deep biosphere. The quantification and determination of microbial metabolic activity give further information about the aquifer.

Genetic fingerprinting analyses of fluid samples revealed significant differences in microbiological community structures between warm side and cold side of the heat

storage in Neubrandenburg. At the warm side of the aquifer the detected bacteria are closely related to *Variovorax* and *Sphingomonas*. These organisms are characterized by diverse metabolism. Therefore specific investigations are necessary for a detailed overview about the metabolic reactions at the warm side of the aquifer. At the cold side of the heat storage in Neubrandenburg sulphate reducing and fermentative bacteria were detected. These identifications correlate with local observations of sulphide precipitation and oxygen free conditions. Beside investigations of both aquifer sides, the microbial biocenosis of the cold side was studied over a period of 1.5 years. Thereby seasonal changes in the abundance of identified sulphate reducing and fermentative bacteria, depending on the operational mode of the geothermal plant, were observed. The microbial community structure of the cold storage in Berlin differs to that of Neubrandenburg. In the cold storage iron and sulphur oxidating bacteria closely related to *Gallionella sp.* and *Thiotrix unzii* were detected. The local observation of iron hydroxide formation and precipitation in sections of the plant conform to the abundance of iron oxidising bacteria. Despite of a fluid temperature of 130˚C, bacteria were detected in samples out of the geothermic depth well in Unterhaching. The identified microorganisms are closely related to organism detectable in hot wells (*Thermus scotoductus*) and other bacteria that are typical for aquifers or water and sediment samples from aqueous regions.