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Microbiological monitoring in geothermal plants and a cold storage

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Enhanced process understanding of engineered geothermal systems is mandatory to optimize plant reliability and economy. In the scope of the research project "AquiScreen" we investigated geothermally used groundwater systems under microbial, geochemical, mineralogical and petrological aspects. Geothermal systems located in the North German Basin and the Molasse Basin were analyzed by sampling of fluids and solid phases. The investigated sites were characterized by different temperatures, salinities and potential microbial substrates. The microbial population was analyzed by the use of genetic fingerprinting techniques based on PCR-amplified 16S rRNA genes. Sequencing of dominant bands of fingerprints from different sites and the subsequent comparison on public databases enables a correlation to metabolic classes and provides information about the biochemical processes. In all investigated geothermal plants covering a temperature range from 45˚ to 120˚C microorganisms were found. Phylogenetic gene analyses indicate a broad diversity of microorganisms adapted to the specific conditions in the engineered system. Beside characterized bacteria like *Thermus scotoductus*, *Siderooxidans lithoautotrophicus* and the archaeon *Methanothermobacter thermoautotrophicus* a high number of so far uncultivated microorganisms was detected. As it is known that -in addition to abiotic factors- microbes like sulfate-reducing bacteria (SRB) are involved in the processes of corrosion and scaling in plant components we identified SRB by specific analyses of dissimilatoric sulfite reductase genes. The SRB detected are closely related to thermotolerant and thermophilic species of *Desulfotomaculum*, *Thermodesulfovibrio* and *Thermodesulfobacterium,* respectively. Overall, the detection of microbes known to be involved in biocorrosion and examined precipitation products like iron sulfides are indicating that microorganisms play an important role for the understanding of processes in engineered geothermal systems. Furthermore, an observed reduction of the filter operation times in a cold storage could be traced back to an enhanced growth of a filamentous iron-oxidizing bacterium related to *Thiotrix*. The further identificaton of crucial process parameters that are influencing microbial activities will help developing appropriate counter measures against microbial induced clogging and corrosion.