Geophysical Research Abstracts
Vol. 15, EGU2013-12532, 2013
EGU General Assembly 2013

Microbial composition in a deep saline aquifer in the North German Basin –microbiologically induced corrosion and mineral precipitation affecting geothermal plant operation and the effects of plant downtime

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The microbial composition in fluids of a deep saline geothermal used aquifer in the North German Basin was characterized over a period of five years. The genetic fingerprinting techniques PCR-SSCP and PCR-DGGE revealed distinct microbial communities in fluids produced from the cold and warm side of the aquifer. Direct cell counting and quantification of 16S rRNA genes and dissimilatory sulfite reductase (dsrA) genes by real-time PCR proved different population sizes in fluids, showing higher abundance of Bacteria and sulfate reducing bacteria (SRB) in cold fluids compared to warm fluids. Predominating SRB in the cold well probably accounted for corrosion damage to the submersible well pump, and iron sulfide precipitates in the near wellbore area and topside facility filters. This corresponded to a lower sulfate content in fluids produced from the cold well as well as higher content of hydrogen gas that was probably released from corrosion, and maybe favoured growth of hydrogenotrophic SRB.

Plant downtime significantly influenced the microbial biocenosis in fluids. Samples taken after plant restart gave indications about the processes occurring downhole during those phases. High DNA concentrations in fluids at the beginning of the restart process with a decreasing trend over time indicated a higher abundance of microbes during plant downtime compared to regular plant operation. It is likely that a gradual drop in temperature as well as stagnant conditions favoured the growth of microbes and maturation of biofilms at the casing and in pores of the reservoir rock in the near wellbore area. Furthermore, it became obvious that the microorganisms were more associated to particles then free-living.

This study reflects the high influence of microbial populations for geothermal plant operation, because microbiologically induced precipitative and corrosive processes adversely affect plant reliability. Those processes may favourably occur during plant downtime due to enhanced biofilm formation.