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High-resolution chemical composition of geothermal scalings from Hungary: Preliminary results

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Geothermal fluids originating from several hundreds to thousands meters depth mostly hold a high potential for secondary mineral precipitation (scaling) due to high total dissolved solid contents at elevated temperature and pressure conditions. The precipitation of e.g. carbonates, sulfates, sulfides, and silica has shown to cause severe problems in geothermal heat and electric power production, when clogging of drill-holes, downhole pumps, pipes and heat exchangers occurs (e.g. deep geothermal doublet systems). Ongoing scaling reduces the efficiency in energy extraction and might even question the abandonment of installations in worst cases.

In an attempt to study scaling processes both temporally and spatially we collected mineral precipitates from selected sites in Hungary (Bükfürdo, Szechenyi, Szentes, Igal, Hajduszoboszlo). The samples of up to 8 cm thickness were recovered from different positions of the geothermal systems and precipitated from waters of various temperatures (40-120 °C) and variable overall chemical composition. Most of these scalings show fine lamination patterns representing mineral deposition from weeks up to 45 years at our study sites. Solid-fluid interaction over time captured in the samples are investigated applying high-resolution analytical techniques such as laser-ablation mass-spectrometry and electron microprobe, micromill-sampling for stable isotope analysis, and micro-XRD combined with hydrogeochemical modeling.

A detailed investigation of the processes determining the formation and growth of precipitates can help to elucidate the short-term versus long-term geothermal performance with regard to anthropogenic and natural reservoir and production dynamics. Changes in fluid chemistry, temperature, pressure, pH, degassing rate (CO_2) and flow rate are reflected by the mineralogical, chemical and isotopic composition of the precipitates. Consequently, this high-resolution approach is intended as a contribution to decipher the environmental conditions during the formation of the investigated scalings and to increase our knowledge on retarding and preventive measures of scaling for geothermal applications.