



## **Experiments on different materials (polyamide, stainless & galvanized steel) influencing geothermal $\text{CaCO}_3$ scaling formation: Polymorphs & elemental incorporation**

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Thermal water is increasingly used for heat and electric power production providing base-load capable renewable and virtually unlimited geothermal energy. Compared to other energy sources geothermal facilities are less harmful to the environment, i.e. chemically and visually. In order to promote the economic viability of these systems compared to other traditional and renewable energy sources, production hindering processes such as corrosion and scaling of components arising from the typically high salinity thermal waters have to be considered as important economic factors. In this context, using proper materials being in contact with the thermal water is crucial and a playground for further improvements.

Aim of the study presented, are basic experiments and observations of scaling and corrosive effects from hydrothermal water interacting with different materials and surfaces (stainless steel, polyamide, galvanized steel) and in particular the nucleation and growth effects of these materials regarding the precipitation of solid carbonate phases. The incorporation of Mg, Sr and Ba cations into the carbonate scalings are investigated as environmental proxy. For this purpose, hydrothermal carbonate precipitating experiments were initialized by mixing  $\text{NaHCO}_3$  and Ca-Mg-Sr-Ba-chloride solutions at temperatures ranging from 40 to 80 °C in glass reactors hosting artificial substrates of the above mentioned materials. The experiments show a strong dependence of the precipitation behaviour of calcium carbonate polymorphs on the particular material being present. Stainless steel and polyamide seem to restrict aragonite formation, whereas galvanized steel supports aragonite nucleation. Vaterite formation is promoted by polyamide surfaces. Importantly, vaterite is more soluble (less stable) compared to the other anhydrous calcium carbonate polymorphs, i.e. vaterite can be more easily re-dissolved. Thus, the use of polyamide components might reduce the amount and durability of the scaling deposits. Regarding calcite formation the (Sr/Ca)/(Ba/Ca) solid ratio stays more or less constant in dependency of temperature. Aragonite formation is easily traced by an increase of Sr and Ba concentrations in the precipitates. Our experimental results clearly indicate that crystal nucleation/growth and elemental fractionation depend significantly on the materials used for geothermal applications.