Daniela Meier: Silica precipitation under geothermal conditions

Silica scaling is a common and costly phenomenon in many geothermal systems. One way to mitigate the problem is the use of (in)organic additives that may act as inhibitors for the precipitation of silica. However, most compounds described in the literature so far show poor performance as silica inhibitors. To develop more effective silica inhibitors, the mechanism of silica scaling and the effect of additives on silica formation have to be quantified first.

In my PhD I will mimic the formation of silica nanoparticles as it occurs in geothermal environments by following the same process through the use of a geothermal flow-through simulator (Figure 1). My ultimate aim is to quantitatively describe the reactions occurring in the pure silica system (i.e. no additives present) as well as in the presence of specific (in)organic compounds. During the first 6 months my work focused on setting up the geothermal simulator and performing initial running tests. In addition, I carried out preliminary experiments assessing the qualitative effect of common organic substances (e.g. proteins, carbohydrates, lipids) on silica precipitation have been conducted. The results suggest that the presence of some of these additives (e.g. lysozyme) strongly affects the behaviour of silica. However, the tested additives do not act as inhibitors but enhance silica precipitation. In a next step, a series of other (in)organic compounds will be tested for their role in silica precipitation.

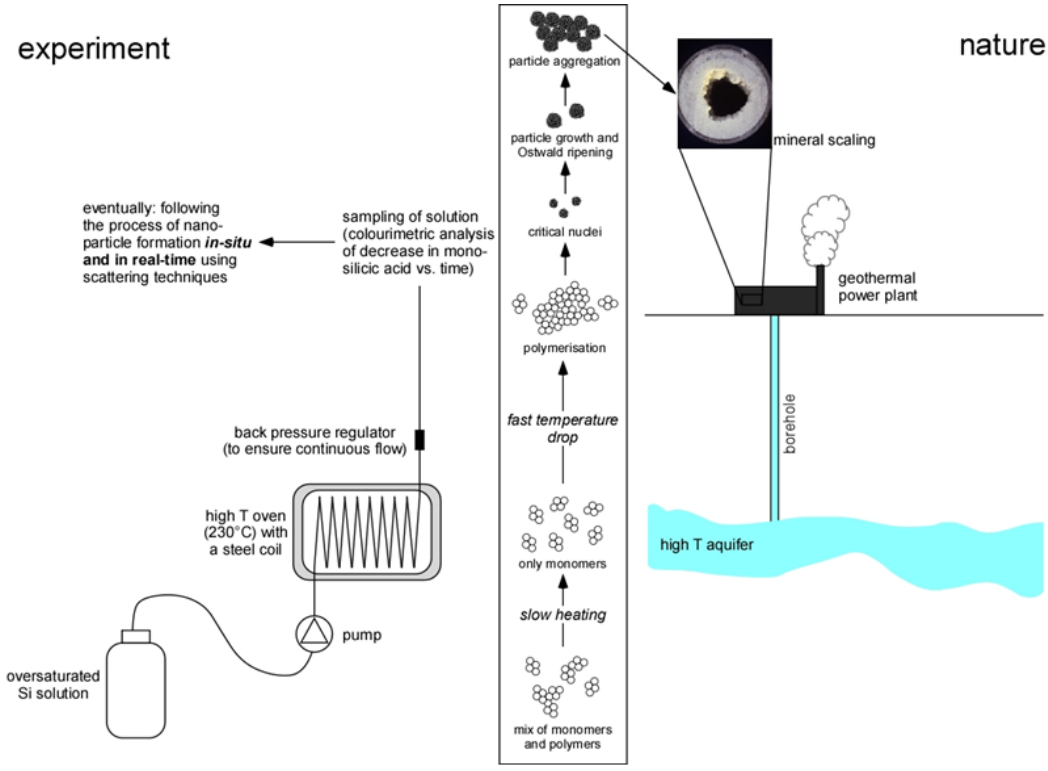

Figure 1: Schematic illustration of the geothermal simulator (left) and a system producing geothermal energy (right). The hot, pressurised silica solution in the experiment corresponds to a geothermal fluid within the Earth's crust. The instantaneous temperature drop upon emergence from the oven mimicks what happens in a geothermal system when the fluid is cooled during energy production. The central column represents the mechanism of silica polymerisation and the formation of nanoparticles leading to the formation of mineral scales.