The corrosivity of geothermal fluids and their scale-forming potential

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Due to financial constraints in the material selection for geotechnical applications, especially in geothermal industry, corrosion has to be accepted as a necessary evil. Although commonly regarded as a pure engineering issue, it also has a strong geochemical aspect due to the complex chemistry of geothermal fluids, their corrosivity, and their scale-forming potential. Scaling is a vaguely defined term, as it includes not only precipitates from the fluid, but also products that formed by ion release via corrosion. Often disregarded in existing studies, the strong interrelation between corrosion and scaling distinguishes geothermal environments from “conventional” corrosive environments. Two types of scales are of major relevance in geothermal utilization: Fe-carbonate (siderite) can often be observed in CO_2-containing environments where it presents a diffusion barrier for the species involved in corrosion. It has been found to significantly slow down the corrosion process [1]. Mixed sulfides are also commonly found on metal substrates and known to incorporate naturally occurring radionuclides, such as ^{210}Pb [2]. Given the relevance of scales, their formation under varying conditions has to be adequately researched.

This research bridges the gap between corrosion science and geochemistry to establish an improved understanding of the behavior of commonly used mild steels and CrNiMo alloys subjected to synthetic “close-to-nature” environments at elevated temperatures (<250°C). But instead of prioritizing the macroscopic corrosion resistance, a special emphasis is laid upon the interfacial reactivity as a system behavior. Hydrothermal experiments in mixed-flow reactors with metal coupons will be conducted for varying durations with a constant flow rate of 0.5 ml/min. Besides mass loss measurements, vertical scanning interferometry will be used in order to obtain a corrosion rate (masking of samples) and the type of corrosion, a critical factor in the material selection process. The newly-formed scales will be analyzed for their identity using SEM/EDX. Thickness measurements and element mapping will help to quantify the kinetic and understand the dynamic of scale deposition. The results improve the predictability of scaling on various metal surfaces. Due to the choice of experimental conditions, the results prove relevant for a wide range of geotechnical applications.

[1] Mundhenk *et al.* (2013) *Corr. Sci.* 70, 17–28.
[2] Scheiber *et al.* (2012) *Proc. Stanford Geothermal Workshop.*