Identification and understanding of colloidal destabilization mechanisms in geothermal processes

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Résumé

In this work, the impact of clay minerals on formation damage of sandstone reservoirs is studied in order to provide a better understanding to the problem of deep geothermal reservoirs clogging due to fine particle dispersion and migration.
Our study is carried out on cores from a Triassic reservoir in the Paris Basin (Feigneux, 60 km Northeast of Paris). Our goal being to first identify the clays responsible for clogging, a mineralogical characterization of these natural samples was carried out by coupling X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS). The obtained results show that the stratigraphic interval studied contains mostly illite and chlorite particles. Nevertheless, several parameters, notably the spatial arrangement of the clays in the rocks as well as the morphology and size of the particles, suggest that illite is more easily mobilized by the flow of the pore fluid than chlorite.

Thus, based on these results, illite particles are next used to carry out laboratory experiments in order to better understand the factors leading to the aggregation and deposition of this type of clay particles in geothermal reservoirs under variant physicochemical and hydrodynamic conditions. To do so, the stability of illite suspensions under geothermal conditions will be investigated using different characterization techniques including Dynamic Light Scattering (DLS) and Scanning Transmission Electron Microscopy (STEM). Various parameters such as the hydrodynamic radius, the morphology and surface area of aggregates are measured.

Then, core-flooding experiments are carried out using sand columns to highlight the permeability decline due to the injection of illite-containing fluids in sandstone reservoirs. In particular, the effects of ionic strength, temperature, particle concentration and flowrate of the injected fluid are investigated. In order to localize and quantify the particles retained in the columns, Nuclear Magnetic Resonance (NMR) and X-ray Tomography are used to obtain porosity profiles before and after the injection.
The correlation of the results obtained in static and dynamic conditions allows thus a better understanding of the clogging problem encountered in the Triassic reservoirs of the Paris basin.

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