Full-scale Three Dimensional Reactive Transport Modelling at the CarbFix2 Reinjection Site, Hellisheiði Geothermal Power Plant, SW-Iceland

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Non-condensable gases are being injected at the Husmuli reinjection site of the Hellisheiði Geothermal Power Plant in Iceland using the CarbFix method to dispose and permanently store CO2 and H2S by underground mineral storage. At current rate, about 10,000 tonnes of CO2 are injected annually along with about 5,000 tonnes of H2S. The injection of CO2 and H2 takes place in the Húsmúli reinjection area and has been an integral part of the operations at the Hellisheiði Geothermal Power Plant since 2014.

Coupled modelling of fluid flow and reactive transport using the TOUGH2/iTOUGH2 and TOUGHREACT simulators is being developed to validate in situ carbonation and sulfur mineralization of of dissolved CO2 and H2S in basaltic rocks under reservoir conditions. The target reservoir is an altered fractured olivine tholeiitic lava extending from the Husmuli reinjection site to the Skardsmýrarfjall production zone at depths ranging from -700 to -2000 masl.

A three-dimensional full-scale reactive transport model of the CarbFix injection of a CO2-H2S fluid mixture in the fractured reservoir between the CarbFix reinjection site to the Skardsmýrarfjall production zone is developed. The hydrogeological model is based on a transport model calibrated with the tracer injection and test and regular sampling of the wells at Skardsmýrarfjall. The initial chemistry of the background reservoir chemistry as well as the primary and secondary minerals present in the basaltic reservoir are included in the model. The simulations use the updated thermodynamic databases for mineral carbonation compiled at the University of Iceland as part of the CarbFix2 project. The simulation results show successful mineral sequestration of CO2 and H2S under reservoir condition at the CarbFix site. CO2 is mainly mineralized into calcite and to a lesser extent ankerite and H2S into pyrite. The results also show competition mechanism in form of clays and epidote precipitation.