EGU22-6622
https://doi.org/10.5194/egusphere-egu22-6622
EGU General Assembly 2022

Numerical investigation of the effects of chemical dissolution and mineral reaction on reservoir performances in CO2-plume geothermal systems

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The increasing emission of greenhouse gases and increasing demand for energy supply are reasons to investigate geothermal energy systems where $scCO_2$ is the working fluid. However, the complex dissolution and reaction of minerals during the heat production processes affect the performance of geothermal reservoirs. Thus, a comprehensive numerical model that includes the Thermal-Hydraulic-Chemical (THC) coupled physical-chemical processes was implemented in the open-source simulator DuMu^X, to model the phase displacement, chemical dissolution, heat transport, and mineral reactions. The aim is to investigate the influence of these parameters on the overall geothermal reservoir performance. More precisely, this study investigates the effects of salt precipitation, mineral reactions, injection rate, injection temperature, and geothermal reservoir size on heat production rate and $scCO_2$ sequestration. The simulation results show that the scCO2- calcite reaction decreases the reservoir heat production rate but increase the sequestration of $scCO_2$. Moreover, its effects are proportional to the $scCO_2$ injection rate but inversely proportional to the geothermal reservoir size. On the other hand, the dissolution of $scCO_2$ in brine has the same influence as the reaction between $scCO_2$ and calcite, benefiting the CO_2 sequestration but minimizing the heat production rate of the geothermal reservoirs. Furthermore, the sensitivity analysis presents that the influence of chemical dissolution and mineral reactions are only significant when the injection rate is large and the reservoir size is small.