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Reactive transport modeling of chemical stimulation processes for an Enhanced Geothermal System (EGS)

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Enhanced Geothermal System (EGS) is a kind of artificial geothermal system, which can economically exploit geothermal energy from deep thermal rock mass with low permeability by artificially created geothermal reservoir. At present, the main methods of stimulating artificial reservoirs include hydraulic fracturing, thermal stimulation and chemical stimulation. Chemical stimulation refers to a reservoir permeability enhancement method that injects chemical stimulant into the fractured geothermal reservoir , to improve the formation permeability by dissolving minerals. However, due to the complexity of reaction conditions in deep underground fractures space and scale effect, the role of chemical stimulation technology in the actual reservoir enhancement process is difficult to predict.

In this study, the hot dry rock of granite is chosen as the research reservoir, which is from Archean dantazi group in Matouying uplift area in Hebei Province, China. TOUGHREACT code was used to analyze and predict the enhancement effect of chemical stimulation. A reactive solute transport model was established based on the reaction kinetic parameters determined by dynamic simulation experiments at high temperature and high pressure.

The results show that chemical stimulation with mud acid as stimulant can effectively improve the permeability of fractures near the injection well, the effective penetration distance can reach more than 20m after 5 days. The improvement of porosity and permeability was mainly caused by the dissolution of feldspar and chlorite. The permeability enhancement increased with injection flow rate and HF concentration in stimulant, which was weakly affected by the change of injection temperature. The method of chemical enhancement processes can provide reference for subsequent EGS engineering design.

Keywords: EGS, chemical stimulation, reactive transport modeling, TOUGHREACT.