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Effectiveness of Using CO_2 as a Stimulation Agent for Enhanced Geothermal Systems (EGS)

NA Jin, XU Tianfu, WANG Fugang, FENG Bo* and BAO Xinhua

Key Lab of Groundwater Resources and Environment, Ministry of Education, Jilin University, Changchun 130021, China

Enhanced Geothermal Systems (EGS) is an engineered reservoir that have been created to extract economical amounts of heat from geothermal resources of low permeability and/or porosity. A major concern in the development of an EGS is achieving and maintaining adequate injection, while avoiding the development of preferential short-circuiting flow paths. Past researches have tended to focus primarily on thermal and hydraulic stimulation. Recent studies suggest that chemical stimulation, which involves injecting aqueous chemical agents such as mineral acids into enhanced reservoir, may improve the performance of EGS reservoirs.

The chemical interactions between injected fluids and rocks could be effective for mineral dissolution and porosity enhancement at distances of several meters around a well. An alternative to treatment with strong acids is the use of supercritical (SC) CO_2 as stimulation agent for an aqueous-based EGS. Comparing with the traditional chemical stimulation agents (such as mud acid , NTA and NaOH mixed solution) , the acidity of CO_2 stimulation agent is weaker and it can penetrate larger extent along the flow path. In this paper, Numerical simulation and laboratory experiment are used to investigate the effectiveness of this method.

A number of reactive transport simulations are performed to study CO_2-induced mineral dissolution and porosity enhancement. Geophysical parameters and geochemical parameters are extracted from a well of Xingcheng oilfield in Xujiaweizi of Songliao basin. The effect of chemical stimulation in the reservoir of different formation pressure and temperature are investigated. Ways in which chemical composition of water within CO_2 can be injected to enhance porosity are examined. Modeling results indicate that the increases in porosity of fractured channel caused mainly by calcite dissolution.

Laboratory experiments on chemical interaction between CO_2 stimulation agent and calcite（a major carbonate mineral）are also conducted under different temperature，pressure and water chemistry conditions with a high-temperature reactor. The information currently available for the mineral alteration at laboratory experiment is generally consistent with our simulation.

Key words: Enhanced Geothermal Systems; stimulation agent; CO_2; reactive transport simulations; Laboratory experiments

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* Corresponding author. E-mail: fengbo82@126.com