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Analysis of CO_2 migration during nanofluid based supercritical CO_2 geological storage in saline aquifers

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Abstract

CO2 geological storage is a novel issue relevant to climat change, facing a variety of challeges, of which is how to enhance the CO2 effective storage capacity by using nano material and technology.In present study, the preliminary model is proposed for simulation of CO2 migration during nanofluid based supercritical CO2 geologcial storage.The model incoporates effects of Brownian motion, thermophoresis, thermal energy transfer and interfical tension, which couples the mechanism of nanofluid with the multiphase flow model. Based on the high resolution space-time conservation element and solution element (CE/SE) method, the model is applied to simulate CO2 migration and distribution in the heterogeneous saline reservoir. It's infered that the involvement of nanoparticles decreases the shear stresses opposing the flow, and enhances the CO2 mobility in the flow boundary layer. Additionally, nanoparticles increase the shear stresses outside of the boundary layer, and retard CO2 velocity. These competitive mechanisms promote homogeneous migration of CO2 in saline formation. We preliminarily suggest that nanofluids enhance CO2 homogeneous transport in the reservoir, and mitigate the negative effects of stratigraphic heterogeneity on the migration and accumulation of CO2 plume. CO2 effective storage capacity may be greatly elevated by means of nanofluid based CO2 geological sequestration. The concept of nanofluid based CO2 geological storage may be potentially conducive for large scale commercial CO2 geological storage, and useful for exploration of geothermal resources in deep-seated hot rocks, especially for shale gas. Meanwhile, it should devote to promoting researches on application of nanomaterial and technology to environmental protection and renewable resource utility, and improving researches on nanofluid multiphase flow in porous media.