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Stress-sensitivity Modeling during CO2 Flooding and Storage in Tight Sandstone Core

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Understanding the influence of CO2 injection on rock stress is one of the key elements to analyze CO2 Enhanced gas recovery and long term CO2-storage in tight sand gas reservoirs. Producing natural gas from reservoir and injecting CO2 to the tight reservoir causes a change in pore pressure, which in turn, changes the three dimensional effective stress state. The stress path followed by the reservoir controls the evolution of the effective stress state, and with it the changes in deviatoric stresses which cause reservoir rock deformation and permeability changes. In order to depict these effects, a new experiment and modeling method-CO2 flooding considering the Interaction between CO2 and Rock - are required. This paper presented a series of stress-sensitive experiments during CO2 flooding. A total of twenty-eight sandstone rock samples, which include sand stones with natural fissures, shear fissures and artificial sanding crack fissures, were selected to study stress-sensitivity during gas production and CO2 flooding. Core flooding experiments were conducted in these rocks. The flow regime used was first depleted follow by injecting CO2. After the experiments, the numerical simulations coupled with nonlinear geo-mechanic model with fluid flow were performed. The simulation results give a detailed understanding of the experimental geo-mechanic system. It is concluded that the experimental and simulation methods can be used in combination to evaluate the potential for stress changes during CO2 flooding in tight gas reservoir. The results show that the evolution of the stress state, captured as a stress path, significantly affects the gas production profile and CO2 storage capability. This research of spatial and temporal changes in stress state laid the basis for studying CO2 storage and enhanced gas recovery.

References

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