Effects of Dip-angle on the CO2-Enhanced Water Recovery Efficiency and Reservoir Pressure Control Strategies

Zhijie Yang1,2, Zhenxue Dai2, Tianfu Xu1, Fugang Wang1, and Sida Jia2

1Key Laboratory of Groundwater Resources and Environment, Ministry of Education, Jilin University, Changchun, 130021, China
2College of Construction Engineering, Jilin University, Changchun, 130026, China

CO2 geological storage (CGS) proved to be an enormously significant mid-to-long-term solution for mitigating and even nullifying the net greenhouse gas emissions, and CO2-enhanced water recovery (CO2-EWR) technology may improve the efficiency of CO2 injection and saline water production with potential economic value as a means of storing CO2 and supplying cooling water to power plants. The strata with dip-angle are common in nature, because of the effects of geological structure and diagenesis. It is of great significance to study the influence of the dip-angle on the efficiency and safety of CO2-EWR. Based upon the typical formation parameters of the China Geological Survey CO2-EWR test site in the eastern Junggar Basin, a series of three-dimensional (3D) injection-extraction models with fully coupled wellbores and reservoirs were established to evaluate the effect of dip-angle on the enhanced efficiency of CO2 storage and saline production, considering geochemical reactions. Numerical simulation results show that the dip-angle has a regular influence on the formation pressure field, the CO2 transport distance in the reservoir and the CO2 sealing capacity, and the influence of dip-angle strata on the total storage amount of CO2 changed in a non-monotone mode compared with the CO2 geological storage in horizontal strata at the same injection condition. The effect of water chemical characteristics on the migration of CO2 in different phases and the transformations of major sequestered carbon minerals were determined from the resulting mechanism. Because non-horizontal strata are predominant in deep saline aquifers in nature, regardless of the influence of formation dip, CO2 leakage risks in geological storage will be greatly underestimated, and the stratum dip angle must be considered in research related to CO2 geological storage. Overall, the results of analysis provide a guide and reference for the CO2-EWR site selection.