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A coupled wellbore-reservoir model of CO2 flow and heat transfer during a push-pull experiment at Heletz, Israel

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To quantify in-situ CO2 residual trapping for CO2 geological storage, dedicated push-pull experiments have been carried out at the Heletz, Israel pilot CO2 injection site. The site is well characterized and instrumented for CO2 injection and sophisticated sampling and monitoring (Niemi et al., 2016) and residual trapping experiments have been carried out during 2016-2017. The objective of the present work is to develop a simulation model capturing the CO2 transport and trapping behavior consistent with the recorded pressure and temperature data at the injection well, with special focus on the coupled wellbore-reservoir flow. For this purpose, the simulation of the CO2 push-pull (injection-withdrawal) experiment is carried out with the numerical simulator T2Well/ECO2N (Pan et al., 2011) to account for the role of wellbore-reservoir coupling. Of particular interest in this work is to accurately model the period when the well is self-producing fluids and to analyze what conditions are causing the observed gas-release behavior. Comparison of numerical model simulations and the measured data suggests that the gas saturation in the reservoir at the onset of the self-release period is only slightly above the residual gas saturation of the formation. In addition, the results indicate that the effective permeability in the reservoir is small enough to be the controlling factor for the gas inflow rate into the wellbore. This detailed modeling of the well self-release behavior allows a more reliable overall estimation of the in-situ residual trapping at the site.

References

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