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Effect of permeability heterogeneity on CO_2 injectivity and sweep efficiency based on numerical simulations

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We study effect of geological heterogeneity on the injection of supercritical CO_2 into a deep saline aquifer at the scale of a pilot test site, based on numerical modeling. The effect of heterogeneity on storage capacity is investigated by assessing the effect on sweep efficiency and on injectivity. Log-normally distributed random permeability fields characterized by their standard deviation (σ) and correlation length (λ) are generated and injection simulations conducted for each realization of the permeability fields with TOUGH2/ECO_2N code. A range of injection pressures is tested as well. The results indicate that injectivity increases with the increased horizontal correlation length given that the vertical correlation length is fixed and significant inter-realization variation is seen when changing the standard deviation. Sweep efficiency is favored by smaller horizontal correlation length. For cases with increased standard deviation, the sweep efficiency shows significant inter-realization variability. Finally, it can be shown that both sweep efficiency and injectivity can be expressed as simple functions of medium heterogeneity characteristics, standard deviation (σ) and correlation length (λ).