

Design considerations to test sealing capacity of saline aquifers

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Abstract:

The geological storage of carbon dioxide (CO₂) provides the possibility of maintaining access to fossil energy, while reducing emissions of CO₂ to the atmosphere. One of the essential concerns in geologic storage is the risk of CO₂ leakage from the storage formations. The leakage occurs through possible pathways in the seal. Characterization of the CO₂ leakage pathways from the storage formations into overlying formations is required. The aquifer cap-rock may be characterized before CO₂ storage. This will allow for the determination of proper storage aquifers and locations for the injection wells. In a comparison paper, a flow and pressure test has been suggested for characterization of leakage pathways in aquifer cap-rock. Water is injected in the target aquifer, and the pressure is observed in an overlying aquifer. The pressure data are analyzed to characterize the leakage pathways in the cap-rock. In this work, design considerations to maximize the capability of leakage characterization are presented.

A leakage pathway can be characterized by the leak transmissibility and location parameters. A successful test should be able to provide sufficient information to evaluate the leakage parameters. In this work, different strategies are evaluated in order to achieve a successful test. The strategies include increasing the sampling frequency, use of pulsing, and increasing the number of monitoring/injection wells and utilization of prior information. Prior information on the leak is provided through analysis of the pressure derivative curve.

Estimation of the leakage parameters is actually an inverse problem that is generally ill-conditioned and very sensitive to noise. The information provided by different strategies is evaluated, based on their effects on well-posing the inverse problem. The effects are studied based on information and correlation matrices, as well as the confidence interval.

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