Analysis of potential leakage pathways at the Cranfield, MS, USA, CO2 sequestration site

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Abstract:

A 1.5-million-ton CO2 sequestration project took place in a 3000-m-deep historical oilfield, combined with a CO2-EOR flood. The Cranfield reservoir is found within a multikilometer domal structure related to a deep-salt diapir and consists of fluvial sediments of the Tuscaloosa Formation. An earlier analysis determined that plugged and abandoned wells provide the most likely leakage pathways to aquifers and potentially to the ground surface. Fourteen Cement Bond Logs (CBL's) were used to assess the risk. The present quality of the cement bond ranges from excellent to poor.

Geological insights, stochastic numerical modeling of the pressure field, analysis of the CBL's, and application of a wellbore flow model were used to conclude that the limited pressure increase and mostly intact wellbores result in a low CO2- and brine-leakage risk. Statistical estimates of well properties suggest that at most two (and possibly none) could be capable of conveying a total of 1800 kg/yr CO2 to the surface (0.0002% of annual injection rate). Given that the oilfield is an active operation, it is improbable that well leakage to the surface will go unnoticed and certain that risks will be managed through active risk mitigation and remediation if necessary.