

4-D Seismic--Application for CO₂ Sequestration Assurances.

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CO₂ sequestration in aquifers and oil reservoirs requires some level of confidence that the nature of gas distribution, its transport paths, and its long-term fate can be ascertained with reasonable confidence. Sequestered CO₂ needs to be reliably monitored during injection and while dormant during storage. Movement of CO₂ outside geologic traps is a major concern and obstacle to the acceptance and widespread use of CO₂ sequestration. Time-lapse seismic is sensitive to changes in the imaged volume and could provide the necessary transport and fate assurances. Key to time-lapse monitoring of CO₂ sequestration is effective reservoir modeling constrained by reasonable geologic characteristics and adapted to measured changes in the reservoir between monitor well locations. Understanding this evolution of the CO₂ plume permits the necessary advancement in the complexity of reservoir models.

The DOE-sponsored CO₂ enhanced recovery project in central Kansas illustrates the feasibility of 4-D seismic to map CO₂ as it advances through a mature oil reservoir. Injection of CO₂ for enhanced recovery, begun in December 2003, exhibited delayed breakthrough response and different well response than predicted by models. Lateral heterogeneities consistent with well interference testing were revealed on baseline 3-D seismic. 4-D seismic revealed that injected CO₂ was constrained in its motion both in response to the observed heterogeneities and the interaction of pressures generated by water containment injectors. Information provided by 4-D seismic can play a key role in developing accurate reservoir models and mapping the movement and stability of CO₂ during sequestration.