Geologic factors controlling CO_2 storage capacity and permanence: case studies based on experience with heterogeneity in oil and gas reservoirs applied to CO_2 storage

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Abstract:
A variety of structural and stratigraphic factors control geological heterogeneity, inferred to influence both sequestration capacity and effectiveness, as well as seal capacity. Structural heterogeneity factors include faults, folds, and fracture intensity. Stratigraphic heterogeneity is primarily controlled by the geometry of depositional facies and sandbody continuity, which controls permeability structure. The permeability structure, in turn, has implications for CO_2 injectivity and near-term migration pathways, whereas the long-term sequestration capacity can be inferred from the production history. Examples of Gulf Coast oil and gas reservoirs with differing styles of stratigraphic heterogeneity demonstrate the impact of facies variability on fluid flow and CO_2 sequestration potential. Beach and barrier-island deposits in West Ranch field in southeast Texas are homogeneous and continuous. In contrast, Seeligson and Stratton fields in south Texas, examples of major heterogeneity in fluvial systems, are composed of discontinuous, channel-fill sandstones confined to narrow, sinuous belts. These heterogeneous deposits contain limited compartments for potential CO_2 storage, although CO_2 sequestration effectiveness may be enhanced by the high number of intraformational shale beds. These field examples demonstrate that areas for CO_2 storage can be optimized by assessing sites for enhanced oil and gas recovery in mature hydrocarbon provinces.

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