View Abstract

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TITLE: A Feasibility Study of DAS VSP Full Wavefield Imaging for Bayou Bend Offshore CCS Monitoring

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ABSTRACT BODY:

Abstract Body: The Bayou Bend carbon capture and sequestration (CCS) project site, planned for the shallow state waters of offshore Jefferson County, near Beaumont and Port Arthur, Texas, is the first major offshore carbon sequestration site in the U.S. The area is increasingly drawing attention as a site for carbon storage because of its excellent geology and proximity to industrial emission sources. This offshore lease with the Texas General Land Office (GLO) is expected to have a sequestration capacity between 225 million and 275 million metric tons of CO_2.

With both a stratigraphic test well and an injection well being planned in Bayou Bend, there is an accompanying need for well-site monitoring technology that tracks CO_2 movement after injection to ensure its retention underground. A wide variety of seismic based monitoring technologies that were developed for the oil and gas industry are available and readily applicable to CO_2 storage to monitor the CO_2 within the storage interval. Among them, DAS VSP (Distributed Acoustic Sensing based Vertical Seismic Profiling) technology was identified as a reliable and cost-effective approach for early CO_2 front migration monitoring during the planning stage of the Bayou Bend CCS project.

A drawback of using DAS VSP for CO_2 injection monitoring is that it cannot provide the same level of reservoir illumination as conventional surface seismic in terms of lateral extent. Traditional VSP imaging methods generally only image primary reflection wavefield from the recorded full wavefield data and thus do not account for other wavefields (such as sea surface-related multiples, internal multiples, etc.) which can potentially provide extended subsurface illumination. A three-dimensional (3D) DAS VSP feasibility study was performed which included the modeling of two wells by integrating seismic velocity, well logs, and reservoir and fault interpretations from the Bayou Bend site. We also tested a novel full wavefield imaging technology that utilizes a broader portion of recorded DAS VSP wavefields beyond primary reflections. While traditional VSP imaging result shows that the maximum distance illuminated by primary reflections is approximately 700 m away from each well, full wavefield imaging result demonstrates significant enhancements in reservoir illumination and shows a maximum of approximately 3 km in diameter illumination at the injection interval.