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VSP and Crosswell Seismic Monitoring of a CO₂ Injection
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The U.S. Department of Energy is conducting a small scale CO₂ injection to test issues related to the geologic sequestration of CO₂. The injection is taking place in southeast Texas in the Frio Formation. As part of this injection test, Lawrence Berkeley National Laboratory is conducting time-lapse seismic monitoring. Both VSP and crosswell surveys have been acquired as pre-injection baselines with a repeat post-injection survey planned.

The VSP used an 80 level, 3-component geophone string and explosive source. Eight source shot points were acquired. The sensors were interleaved to give spacings of 1.5 to 7.5 m. The shotpoints were offset 100 to 1500 m from the sensor well. The location of the shotpoints was designed to monitor the estimated CO₂ plume location and to provide structural information at the injection site. VSP data have good quality direct and reflected events. Upgoing and downgoing wavefields will be shown. Data repeatability is investigated because up to 8-10 shots were used at each shot point. Initial results show good repeatability for separate explosive shots.

The crosswell survey also used the 80 level, 3-component geophone string along with an orbital vibrator borehole source. The orbital vibrator is capable of generating both P- and S-wave direct arrivals with frequency content of about 70 - 350 Hz. For the crosswell survey, both source and sensor spacing was 1.5 m. The crosswell survey was conducted using the planned injection well (for sensors) and a nearby monitoring well (for source) which is about 30 m offset. Crosswell source locations spanned about 75 m, centered on the injection interval. The crosswell sensors spanned about 300 m., also centered on the injection interval. The planned injection interval is the 6-7 m thick, upper C sand in the Frio formation which is at a depth of about 1500 m. Initial analysis of the crosswell data shows good quality P- and S-wave direct arrivals. Tomographic imaging is planned for both P- and S-waves. Current results, probably including data from post-injection surveys, will be presented.