Downhole Passive Microseismic Observations During Continuous CO2 Injection at Cranfield, Mississippi

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The Southeast Regional Carbon Sequestration Partnership (SECARB) Phase 3 field project at Cranfield Field, Mississippi operated by Denbury Onshore LLC is conducted by the Gulf Coast Carbon Center at the Texas Bureau of Economic Geology with support from the National Energy Technology Laboratory (NETL) and the U.S. Department of Energy (DOE) and managed by the Southern States Energy Board (SSEB). In September 2009 a down-hole 12-level micro-seismic tool string was deployed to observe CO2 injection that began the following week into the Tuscaloosa Formation at 10,300 feet. The aims of the deployment were to monitor for any micro-seismic events caused by CO2 injection in a well approximately 1200 ft (360 m) from the observation well. The data collection duration is intended to last for three months, and is being conducted by Pinnacle Technologies. Secondary sensors deployed in support of the experiment include a semi-permanent 10 level hydrophone array, a tool used primarily in active source measurements, and a surface micro-array of 3C geophones. Microseismic results have important implications for assessing the potential for induced seismicity related to industrial-scale sequestration projects, as well as for understanding CO2 migration and pressure evolution within a reservoir.

A reservoir-scale normal fault occurs between the injection well and observation well, and this fault has been mapped in detail in 3D seismic data. Continuous pressure monitoring for over 15 months in the reservoir interval elsewhere in the field to the north indicates this fault to be sealing to pressure at the timescales observed. For the microseismic experiment, as pressure from the CO2 injection builds it is anticipated that the distribution of any microseismic events recorded will illustrate the interaction of pressure and CO2 with this fault. Standard fault stability calculations predict that the fault should remain stable given the anticipated injection pressures and orientation of the fault.