Evaluating time-lapse borehole gravity for CO_2 plume detection at SECARB Cranfield

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Abstract

Monitoring of CO_2 storage processes provides a renewed challenge of adapting oil and gas monitoring technology to provide measurements required of operator, regulatory authorities and the public. These requirements include providing measurements that will support an understanding of safe containment of the CO_2 plume, and inform evidence that injected CO_2 remains in the storage complex for the purposes of green house gas accounting, cost effectively. These roles for monitoring demand a re-evaluation of deep reading measurements besides seismic, such as gravitational and electromagnetic technologies, sensitive to density and electrical properties of the fluids. In particular this paper explores the operational and interpretational challenges of borehole microgravity in a CO_2 timelapse survey in two wells at the SECARB Cranfield injection site.

The Southeast Partnership (SECARB) test at Cranfield, Mississippi, was the first of the commercial scale projects comprising a staged array of field deployments testing key issues of capacity and best methods for assuring storage permanence. More than 3 million metric tons of injected CO_2 will have been injected since the start of injection in July of 2008. The site is an historic oilfield at a depth of 2500 m in the Cretaceous fluvial Tuscaloosa Formation, developed by Denbury Onshore LLC. The project was unique in deploying a range of geophysical measurements including cross-well seismic and electrical resistivity tomography, from two monitoring wells positioned in line from the injector and several 100 ft down-dip in the Tuscaloosa. The CO_2 Capture Project (CCP) took advantage of the multiple field acquisitions of borehole data during the injection phase of this project to acquire timelapse borehole gravity in the two monitoring wells. The objective was twofold; the first to understand the operational aspects and design of the acquisition, while the second was to assess the ability of the surveys to detect the injected CO_2. The baseline acquisition occurred in October 2009 and the repeat survey in September 2010.