

A Successful Case Study of CO₂ Saturation Imaging Using Surface Based Electromagnetics

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Summary

This work will show a successful case study using a variation on Controlled Source Electromagnetics (CSEM) to image CO₂ saturation at a CCUS project in North America. This variation on CSEM is referred to as S2CSEM, which includes Scatter Field and Streaming Potential, discussed below. To date, it has been used for almost a decade to image fluid associated with hydraulic fracturing options, with positive results up to 4000 m. The main objectives of this project were to prove the capabilities and refine the methodologies in imaging CO₂ plumes.

With this technology, two main things are being measured, change in resistivity (Scatter Field) and change in Streaming Potential. Streaming Potential is a secondary source created subsurface as a result of pressure and flow. To assess the feasibility of a given project, comprehensive modelling, assessing both parameters is conducted. In this case, modelling indicated the project results would be favorable. S2CSEM projects are conducted by putting a large amount of power in the ground, dispersed through two hydras, and a network of receivers. The array of receivers is placed directly above what is being imaged, in this case the expected CO₂ plume. The resolution can be adjusted depending on the receiver and associated antennae placement. Two S2CSEM recording methods have been used to collect CO₂ snapshots at this project; subtraction of snapshots during injection operations and snapshots when injection has been turning off. Results were observed for both methods, with more immediate results available when the injection was turned off. Recorded snapshots are collected over 1-2 days, where results as small as 20 psi were recorded. Results showed alignment with actual data. This technology has proven to be a powerful cost-effective tool for understanding the extent of CO₂ plumes for CO₂ injection projects.