Scalable Automated, Semi-Permanent Seismic Method for Detecting CO_2 Plume Extent During Geological CO_2 Injection

Award Number: DE-FE0012665

Project Summary:

This project had the primary objective of evaluating and demonstrating novel methods for scalable, semi-permanent seismic deployments that can be automated to show where and when a pressure front or carbon dioxide (CO_2) plume passes a particular subsurface location. This concept used a remotely operated seismic source. The GISCO ESS850 accelerated weight drop source was chosen for several reasons: the firing cycle could be operated remotely with a simple electrical contact closure provided by a Web-enabled relay; safe remote operation was possible with the source secured in a locked structure; the accelerated 850-pound weight produced sufficient energy for the distances required; and the source was mobile.

Prime Performer:
University of North Dakota Energy and Environmental Research Center

Principal Investigator:
Shaughn Burnison

Project Duration:
10/1/2013 – 10/31/2017

Performer Location:
Grand Forks, North Dakota

Field Sites:
Bell Creek field, Montana

Program:
Carbon Storage

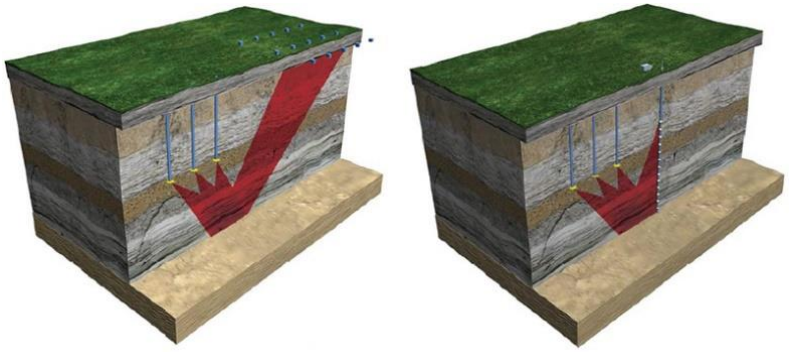

Figure 1: Three-component, autonomous, near-surface receiver array setup (left), and permanently installed downhole receiver array (right)

Project Outcomes:

The project developed and carried out initial field-testing of a scalable automated semi-permanent seismic method (SASSA) for detecting the CO_2 plume extent during CO_2 injection. The method uses a permanent surface source and sparse array of receivers. The location of the source and receiver array are determined in conjunction with reservoir modeling to focus seismic monitoring on portions of the subsurface of particular interest. At those locations, SASSA has the potential for a near real-time means of identifying deviations from the predicted injection response. The initial field-testing suggested that SASSA is a viable monitoring technology for certain geologic settings.

Presentations, Papers, and Publications

Final Report: ***Scalable, Automated, Semipermanent Seismic Array (SASSA) Method for Detecting CO_2 Extent During Geologic CO_2 Injection*** (December 2017) Shaughn A. Burnison, Amanda J. Livers-Douglas, Cesar Barajas-Olalde, Lu Jin, Olarinre Salako, Heidi M. Vettleson, John A. Hamling, Charles D. Gorecki