LOW-ENVIRONMENTAL-IMPACT MONITORING OF CO_2 USING SEISMIC METHODS IN NORTH DAKOTA

KEY ELEMENTS

In 2021, the Energy & Environmental Research Center initiated a multiyear research project associated with Red Trail Energy's Carbon Capture and Storage Project.

- The research is based on the scalable automated sparse seismic array (SASSA), a lower-cost, less invasive seismic method that could replace the large-scale 3D seismic surveys by using four stationary seismic sources called surface orbital vibrators (SOVs) and a small number of seismic sensors deployed sparsely within the same 8-square-mile area investigated with a 3D seismic survey conducted in 2019.

GOAL| Demonstrate and qualify the use of the SASSA method combined with semiautonomous SOVs as a lower–impact method of monitoring the location of injected CO_2 for compliance with permit and incentive program requirements. The test is being conducted at RTE's commercial CO_2 storage site.

TECHNICAL PARTNERS| Plains CO_2 Reduction (PCOR) Partnership, with technical support from Research Institute of Innovative Technology for the Earth, Class VI Solutions, and Red Trail Energy

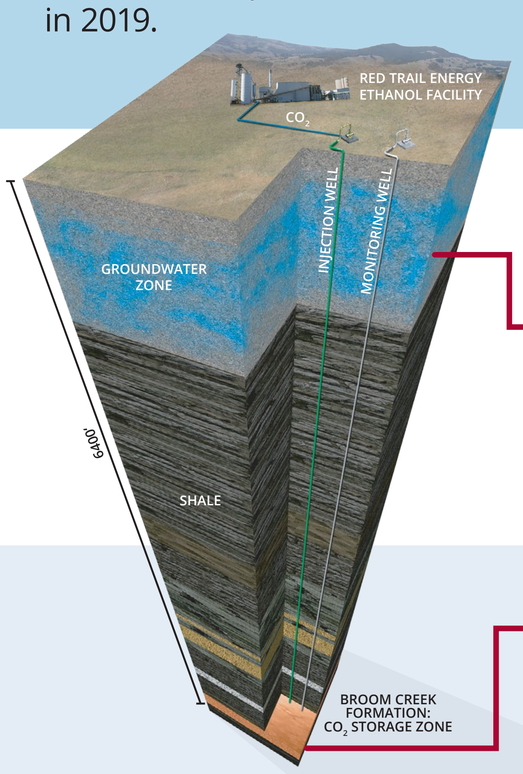
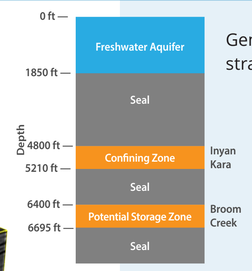
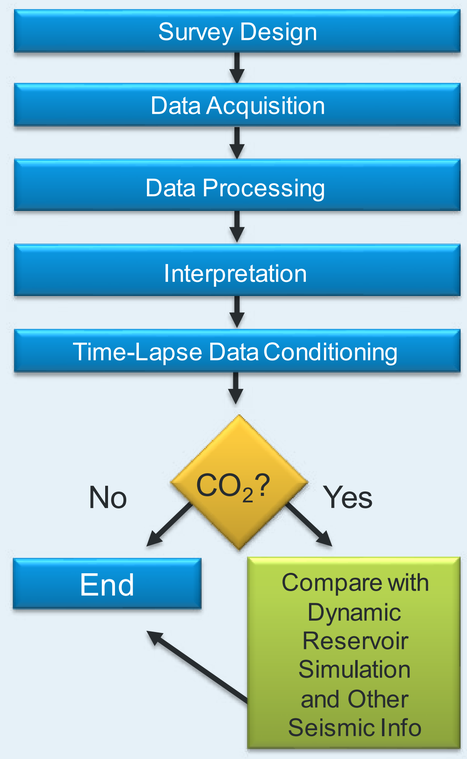


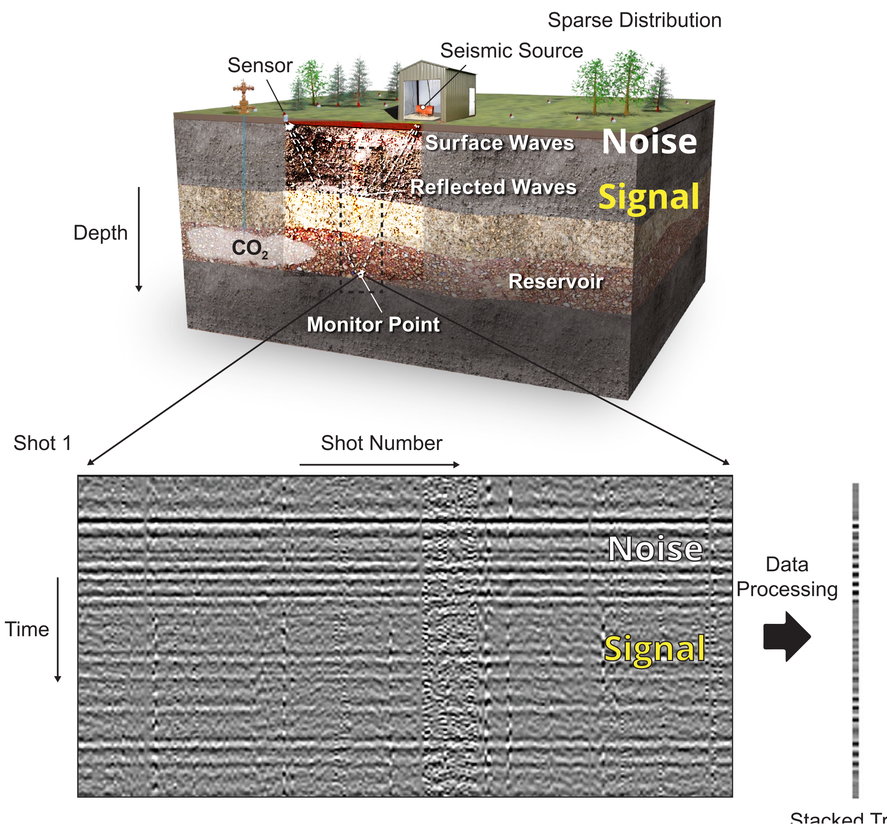
Diagram showing the portion of the surface imaged using 3D SEISMIC DATA.



Generalized schematic of the stratigraphic column



SASSA Workflow

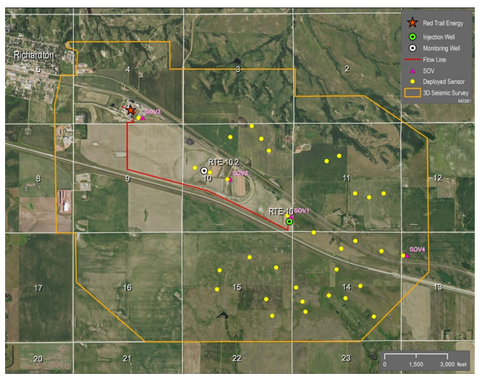


Schematic description of the basic SASSA concept. Bottom: a common receiver gather with AGC and a band pass filter applied and the stacked trace after the complete application of the data processing workflow.

Layout of 3D SEISMIC DATA acquisition conducted in 2019.

Location of seismic sensors deployed for a SASSA noise test within the same 8-square-mile area investigated with the 3D SEISMIC SURVEY CONDUCTED IN 2019.

Deployed Sensors



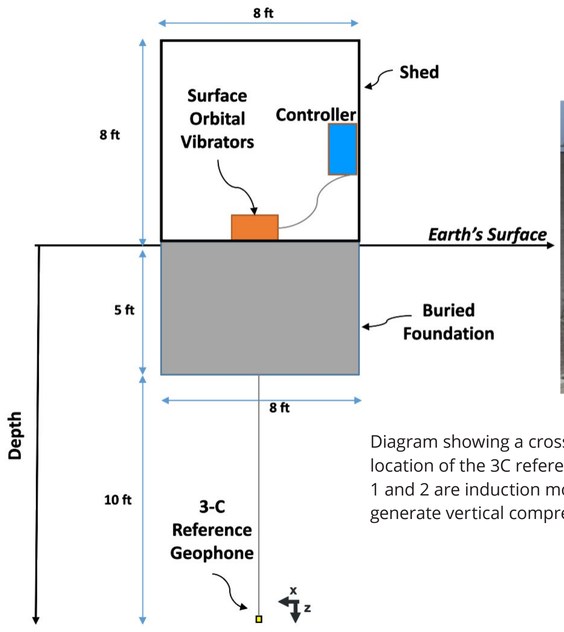
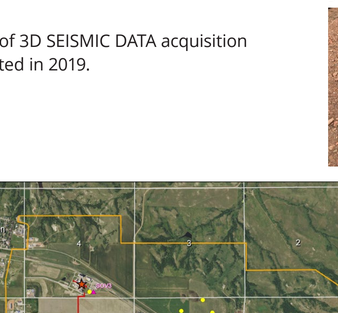
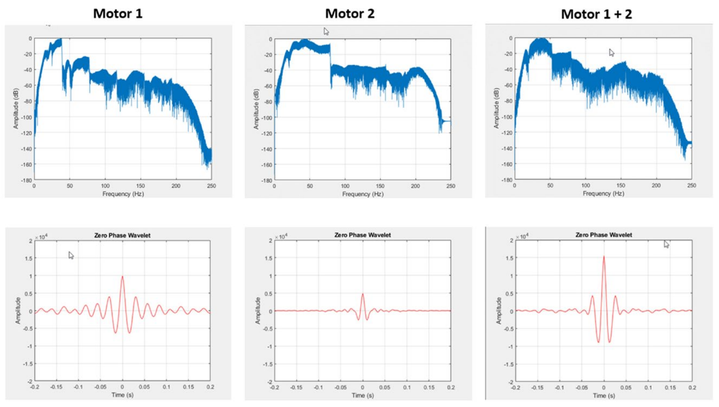


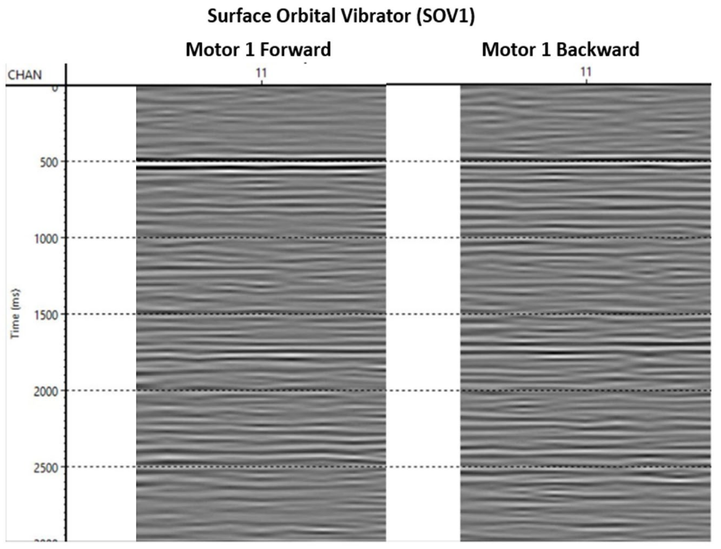
Diagram showing a cross section of the SOV setup and the location of the 3C reference geophone. Right: SOVs. Motors 1 and 2 are induction motors that spin eccentric weights to generate vertical compressive and horizontal shear forces.

Surface Orbital Vibrators (Motors 1 and 2)





Power spectra (top) and zero-phase wavelets of SOVs, Motor 1, 2, and combined 1 and 2 from a 3C sensor at SOV1. The sweep record length is 140 s.



Example of common receiver gathers using SOV1 from the noise test. Left: forward, right: backward. AGC and a band pass filter were applied.

UNDEERC.ORG/RESEARCH

Don Adams | Senior Geophysicist
dadams@undeerc.org | 701.777.5418

Energy & Environmental Research Center (EERC)
701.777.5000 | www.undeerc.org

DOE Disclaimer
This material is based upon work supported by the Department of Energy under Award No. DE-FE0031838. This was prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or presents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Government or any agency thereof.