

CO₂ Plume Monitoring Without Breaking the Bank

Peter M. Duncan
Michael A. Saunders
MicroSeismic, Inc.
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Who or What is **CO₂ SeQure**[®]

A MicroSeismic Inc. Company

- We are a subsidiary of **MicroSeismic, Inc.**, a 20-year-old Houston based oil field service company that is the industry leader in surface based passive seismic monitoring technologies.
- We have developed a turnkey, fit for purpose seismic monitoring service for carbon sequestration projects under a **DOE/SBIR** grant.

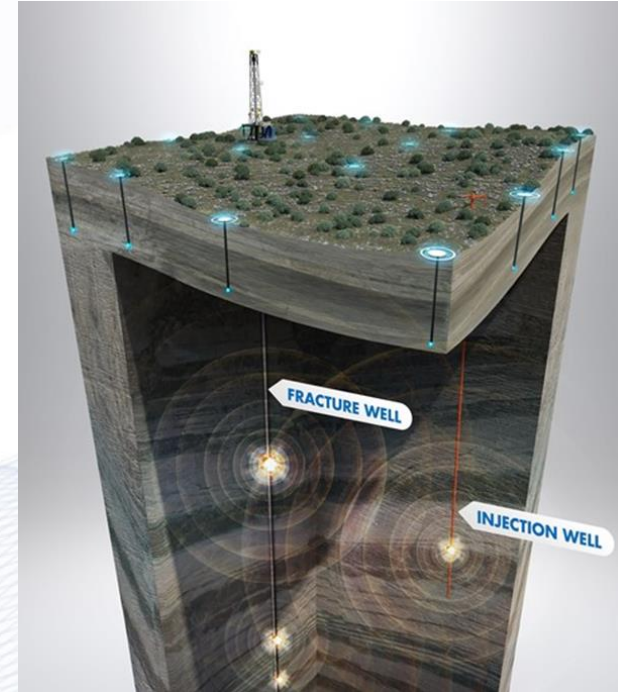


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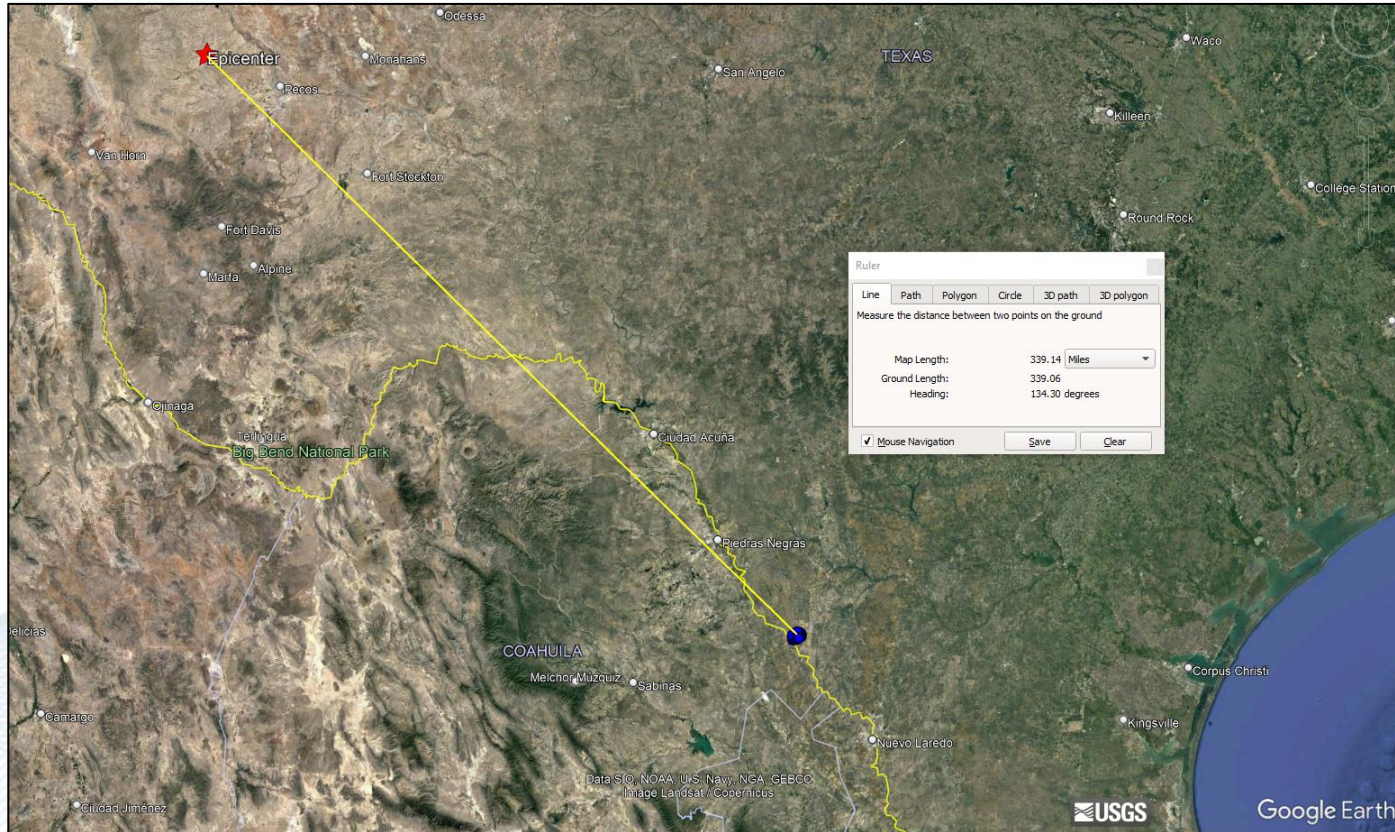
A MicroSeismic Inc. Company

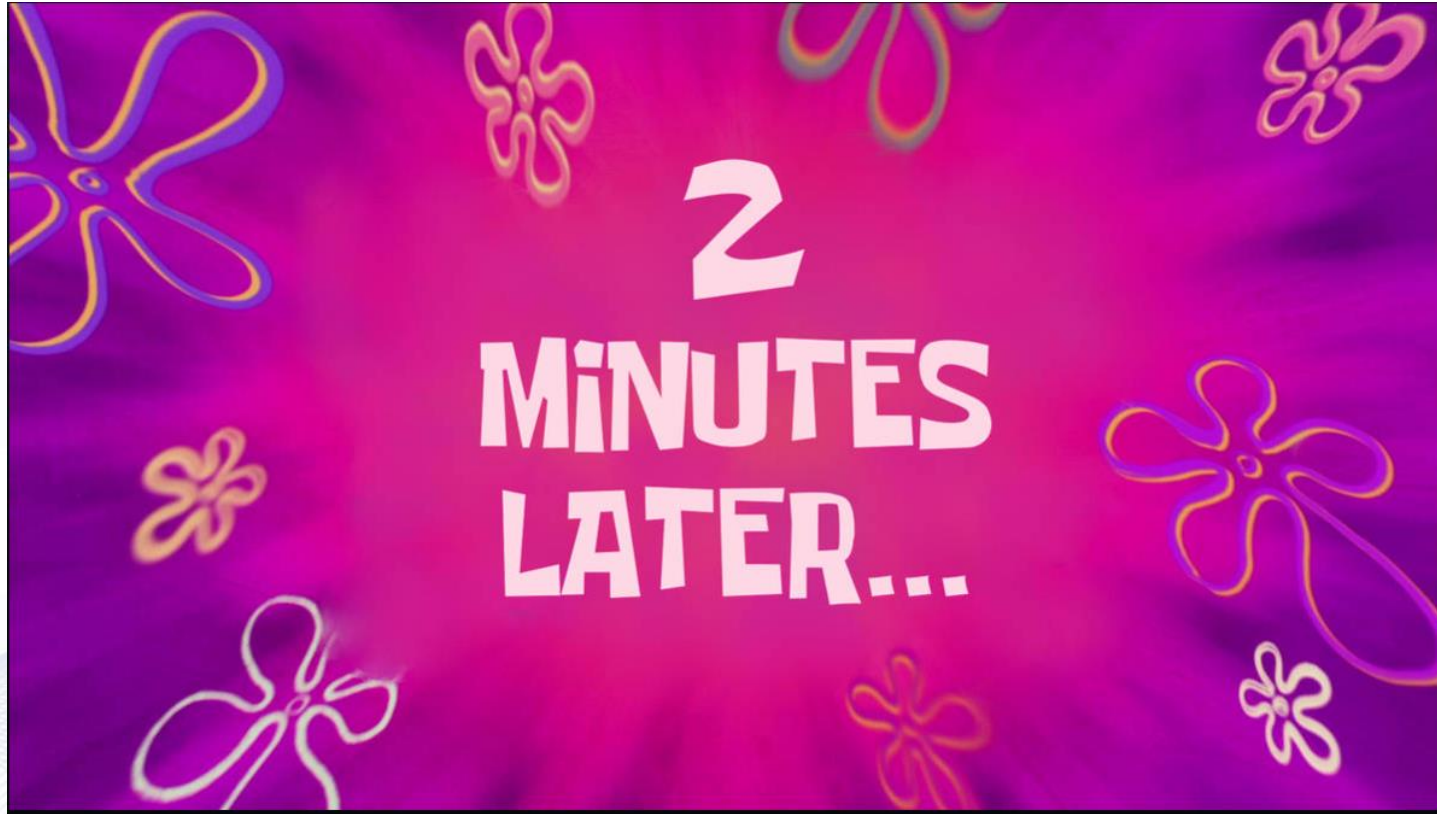
- ***BuriedArray[®] Microseismic Monitoring System***

- Mitigating induced seismic hazard
- Confirming caprock and reservoir integrity
- Tracking injected plume and pressure front



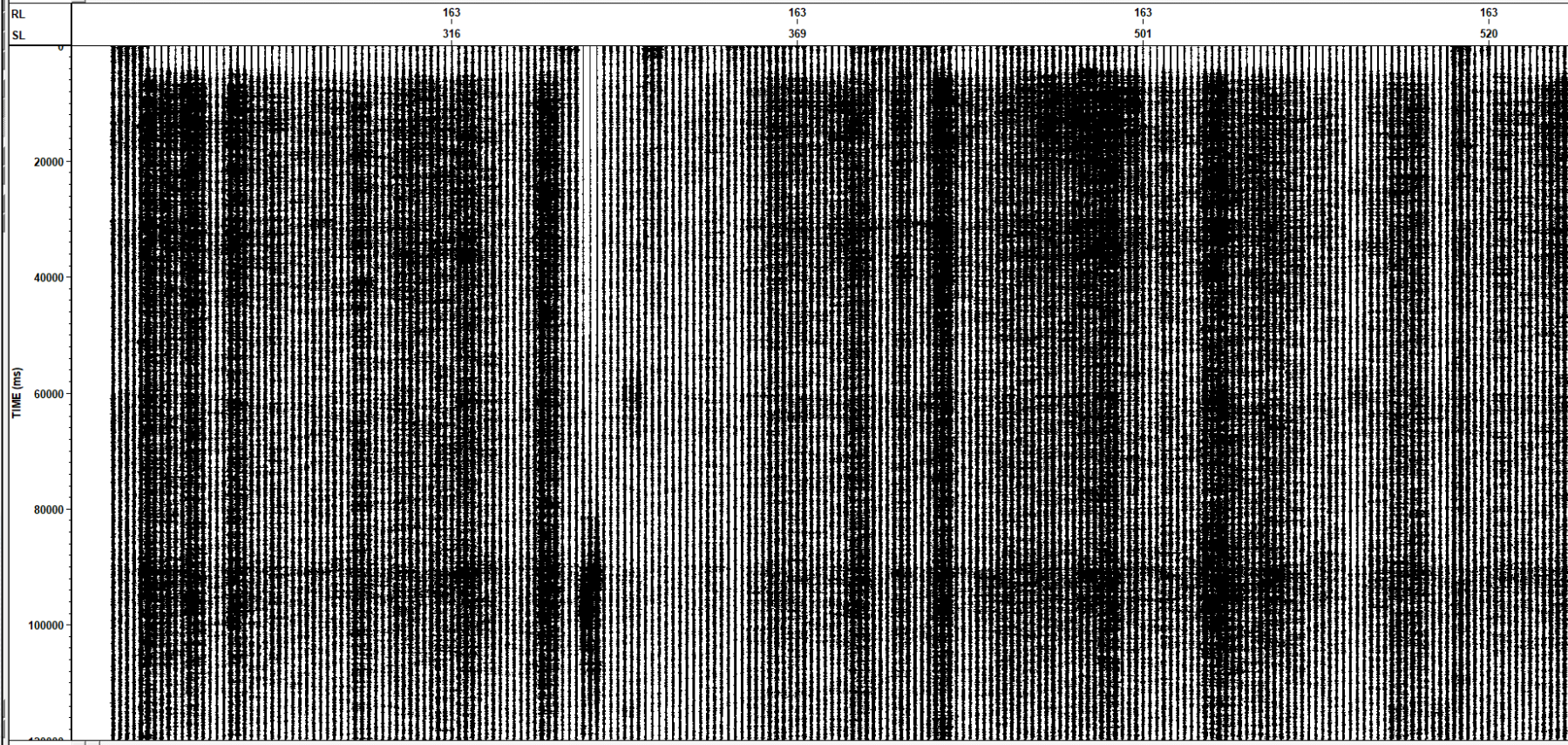
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Seismic Data: [38] - [7]: proc_2023312_102900_060000

MAIN SEISMIC

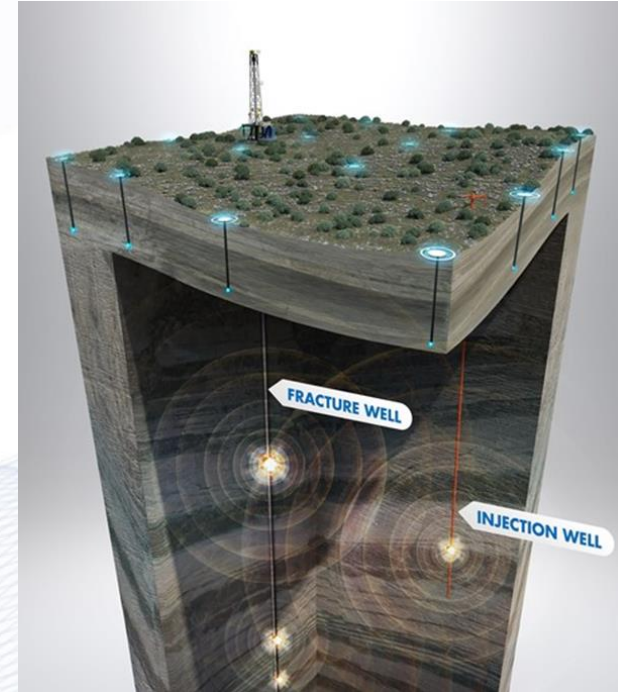


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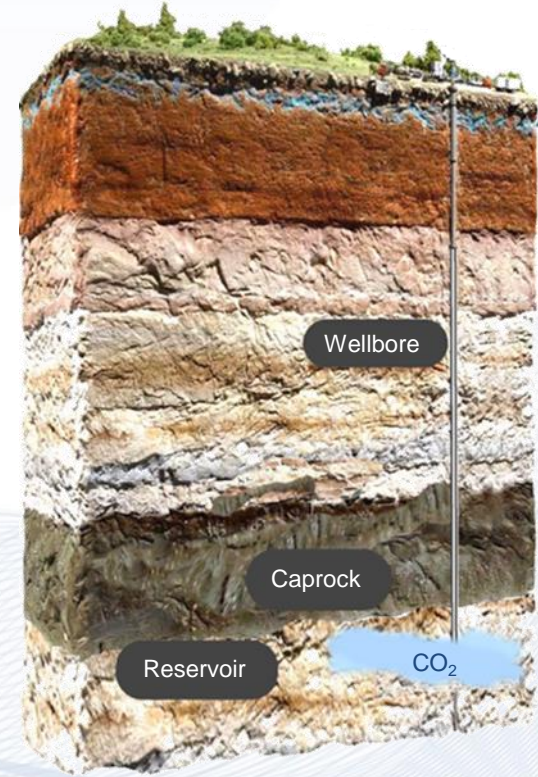
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Why Track the Plume?

- Confirm compliance with submitted and approved sequestration plan
- Confirm reservoir conformance
- Deny leakage concerns both shallow and deep
- Deny any pore space trespass
- Allocate royalties
- Verify tax credit qualification



Active 4-D Seismic is the Best Available Tool

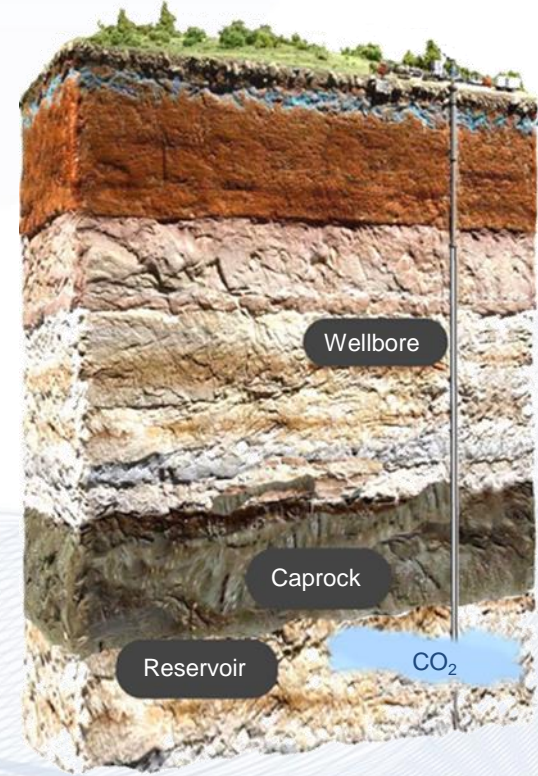
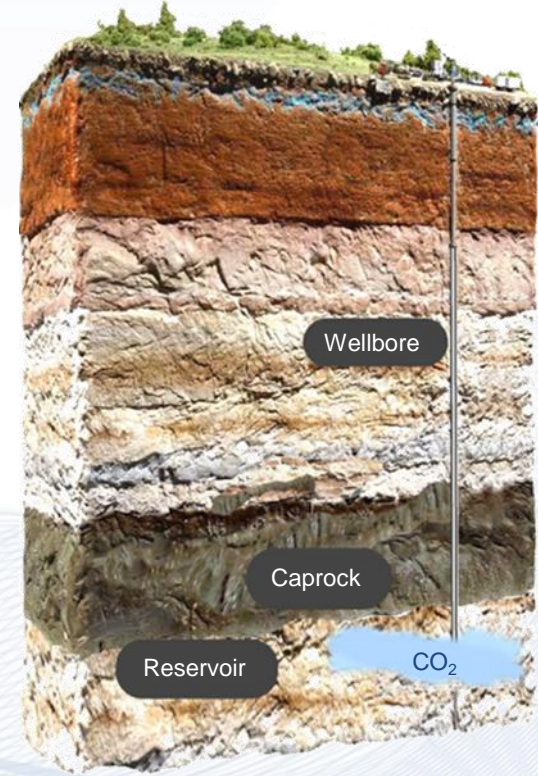
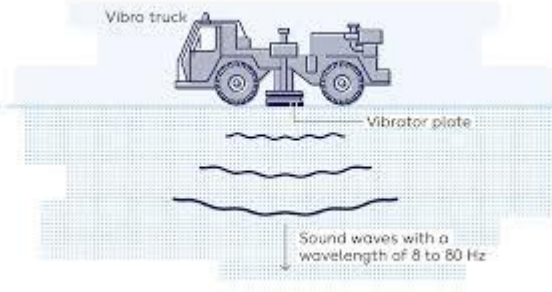


Photo Source: Wikipedia

Active 4-D Seismic is the Best Available Tool

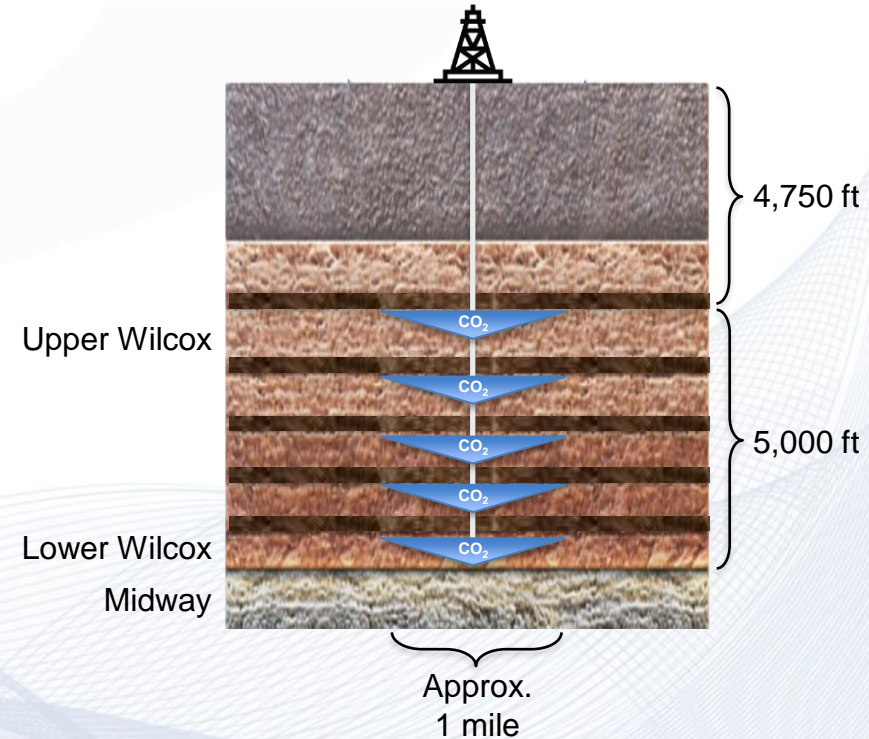




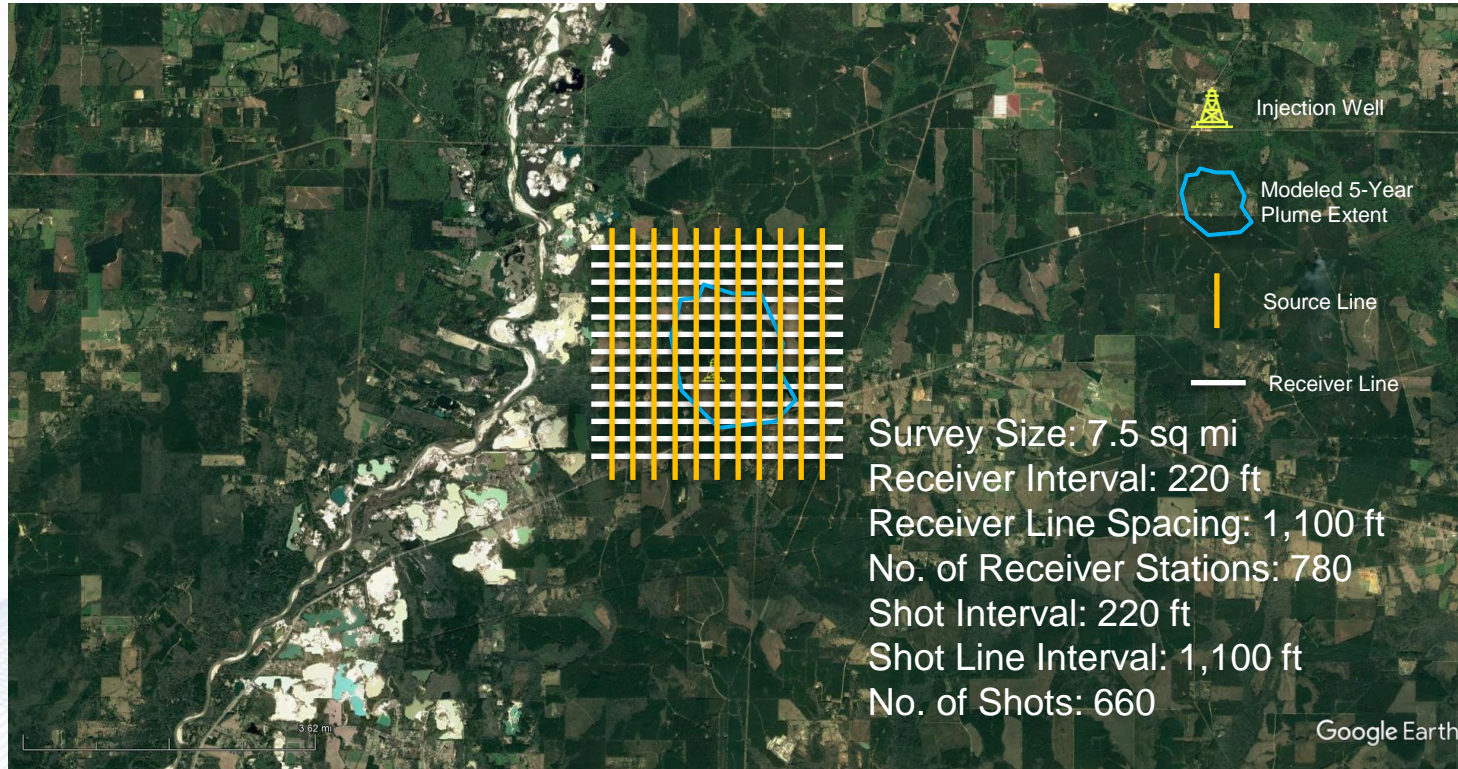




Hypothetical Injection Site – Stacked Wilcox Sands



Design – Conventional 3-D Seismic



Economics – Conventional 3-D Seismic

Personnel

- Survey Crew – 1 person
- Recording Crew (Observers and Layout) – 20 people
- Vibroseis Operators and Technicians (4 Vib) – 10 people
- Approx 4,800 man-hrs HSE Exposure

Cost

- Approx. \$50,000 / sq mi including \$25/acre permit
- Permitting in active commercial forestry acreage likely much higher

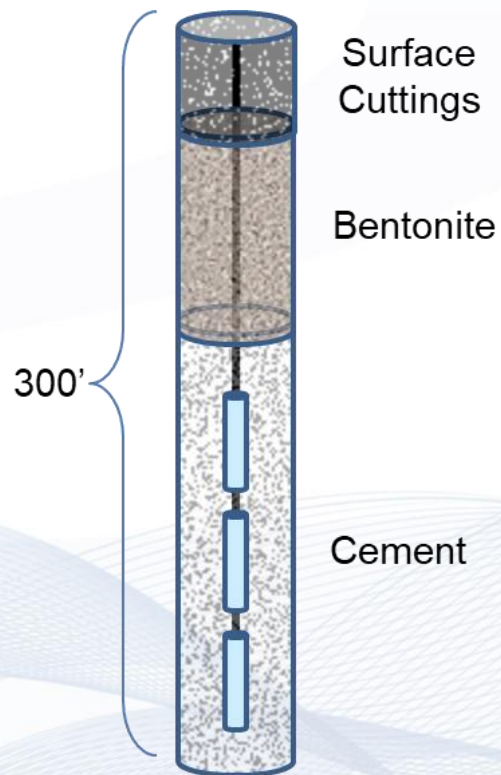
BuriedArray® Microseismic Monitoring System

This system includes:

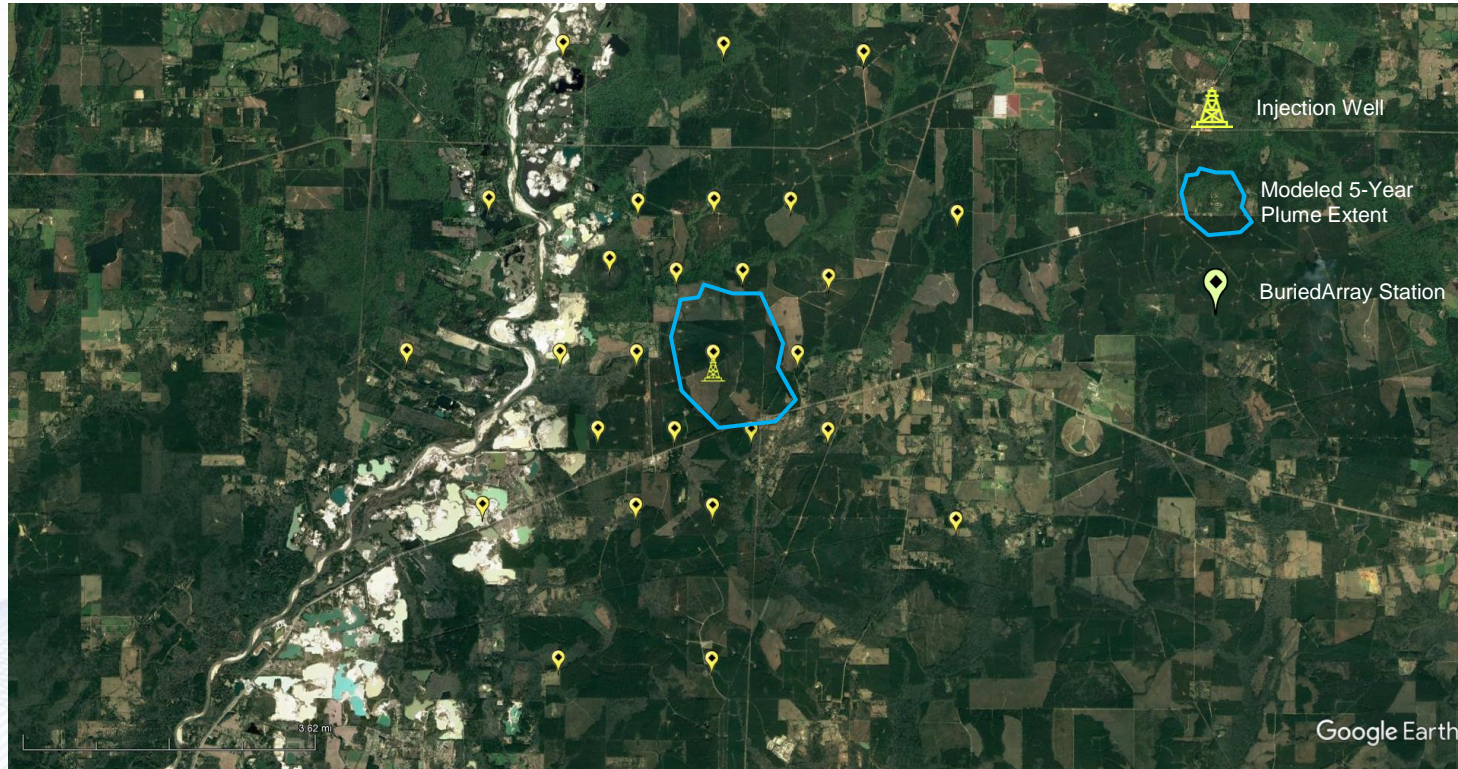
- Permanent array of shallow borehole geophones
- Autonomous data collection and telemetry
- Automated event detection and location
 - Events posted within 10 minutes of occurrence.
 - Automated alerts for critical events.
- Real-time results reviewed and screened by an analyst to ensure data consistency



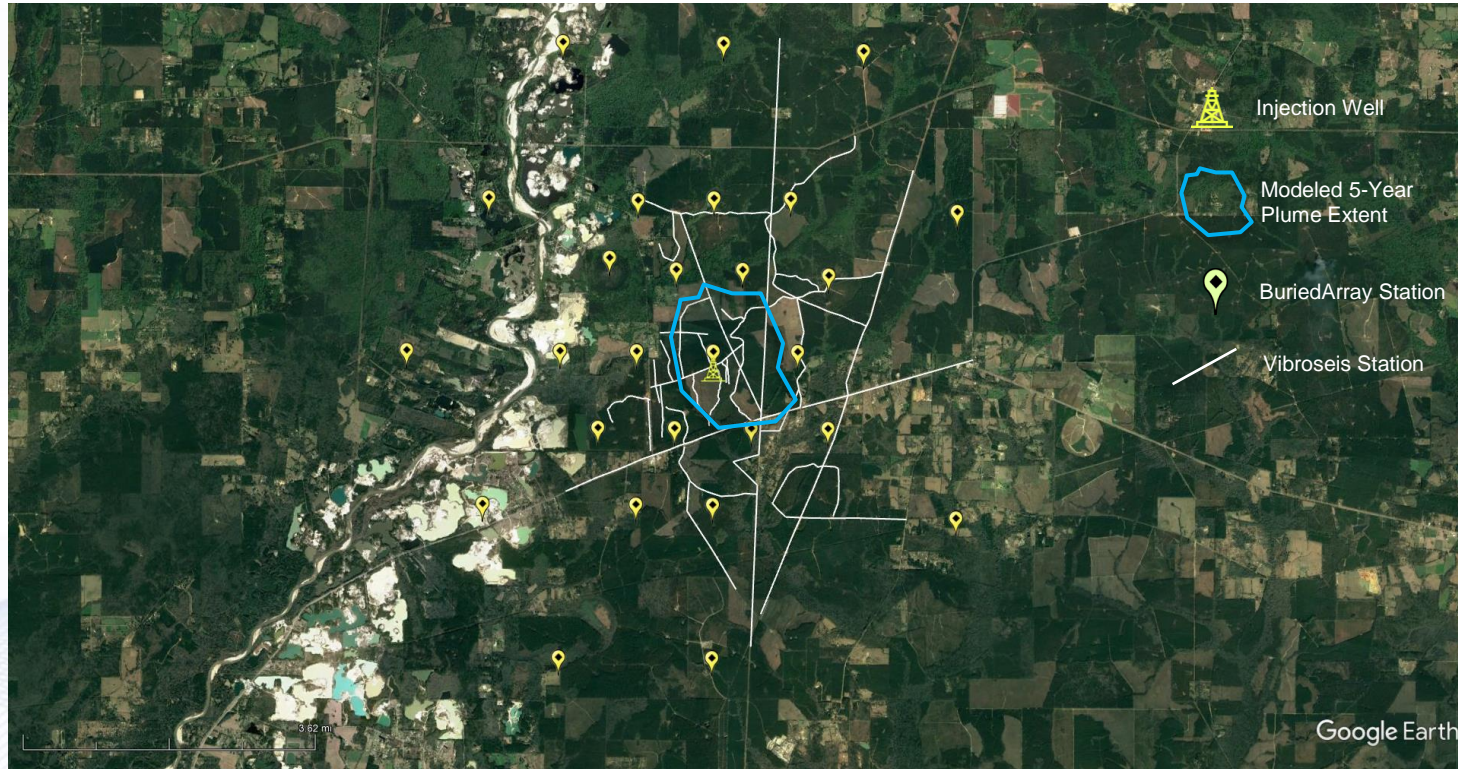
The Buried Array



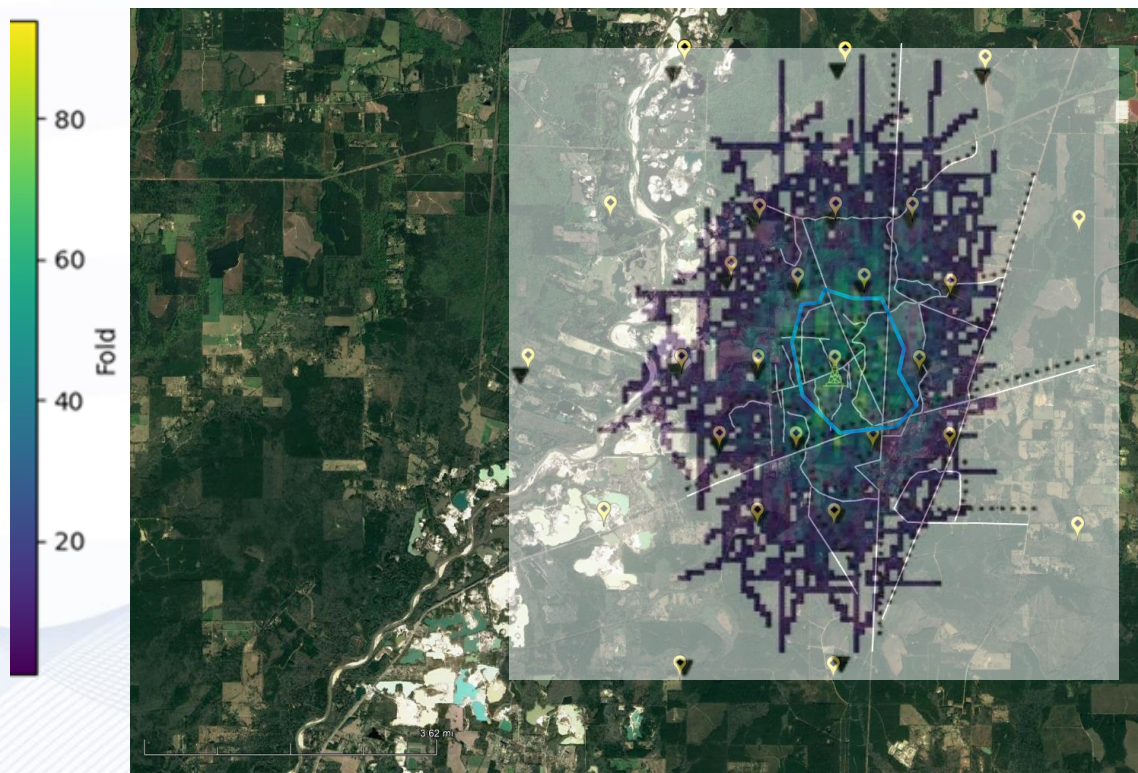
BuriedArray[®] for MRV



BuriedArray for Active 4-D Seismic

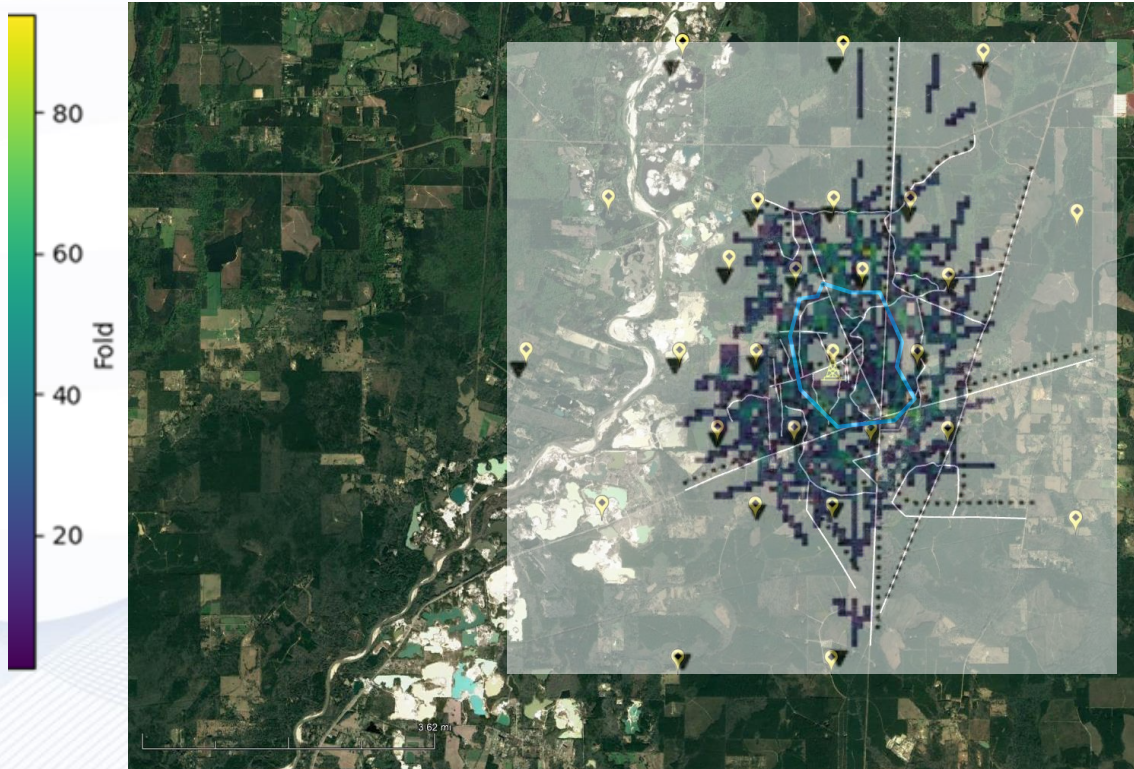


Fold-of-Coverage – 2,531 Vib Points



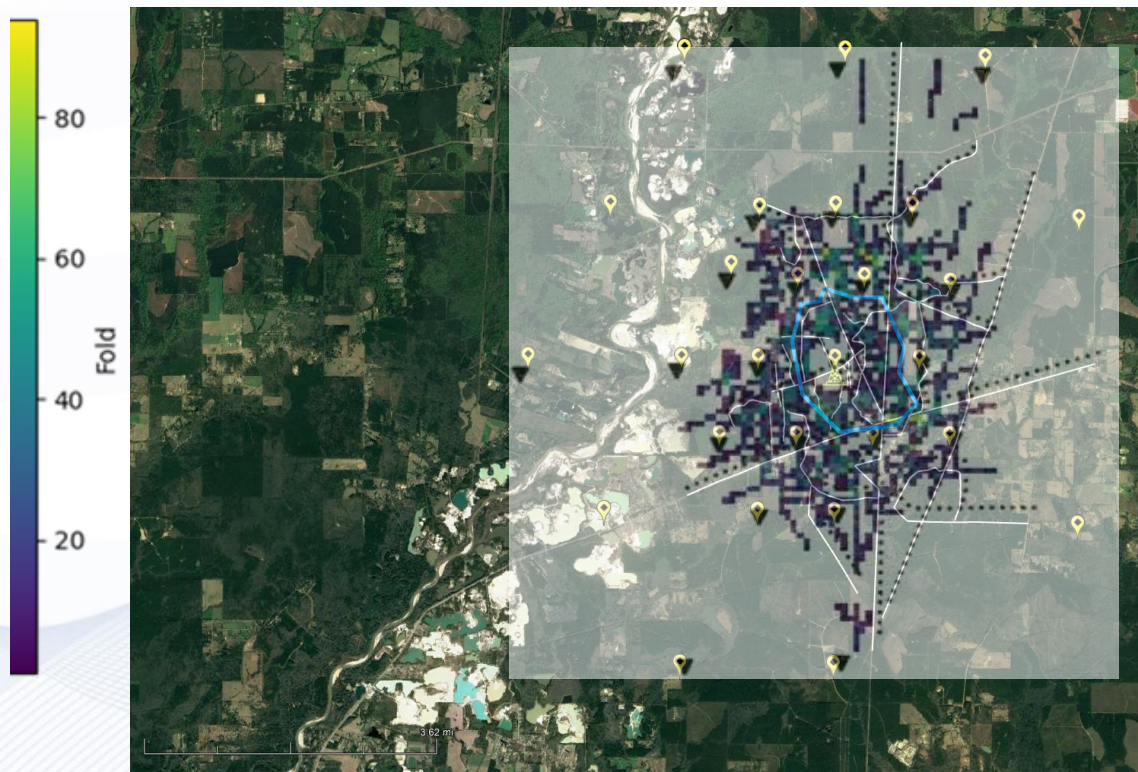
The CO₂ plume can be imaged with a significantly lower-fold 3-D survey than what might be necessary for an exploration 3-D survey.

Fold-of-Coverage – 2,531 Vib Points (Offsets < 8,000 ft)



The CO₂ plume can be imaged with a significantly lower-fold 3-D survey than what might be necessary for an exploration 3-D survey. Even limiting the offset to 8,000 ft provides sufficient illumination.

Fold-of-Coverage – 532 Vib Points (Offsets < 8,000 ft)



The CO₂ plume can be imaged with a significantly lower-fold 3-D survey than what might be necessary for an exploration 3-D survey. Even limiting the offset to 8,000 ft provides sufficient illumination. Further limiting the SP interval from 100 ft to 500 ft still provides acceptable illumination of the plume extent.

Economics – 3-D Seismic with Sparse Buried Array

Personnel

- Survey Crew – 0 people (GPS Navigation on Vibroseis Trucks)
- Recording Crew (Observers) – 2 people
- Vibroseis Operators and Technicians (2 Vib) – 3 people
- Approx. 240 man-hrs HSE Exposure (cf 4,800 man-hrs for conventional seismic)

COST

- Approx. \$10,000 / sq mi, including permitting
- No impact on commercial logging operations

Conclusions

- The sparse BuriedArray satisfies the requirements of a life of project injection monitoring plan.
- The BuriedArray is ideally suited for highly repeatable monitor 3-D (4-D) surveys.
- The use of existing roadways for Vibroseis source points significantly reduces the effort and time required to record a 3-D seismic image of the injected CO₂ plume.
- The cost reduction will be as much as 80%.
- HSE exposure and landowner intrusion are dramatically reduced.

Thankyou

pduncan@microseismic.com