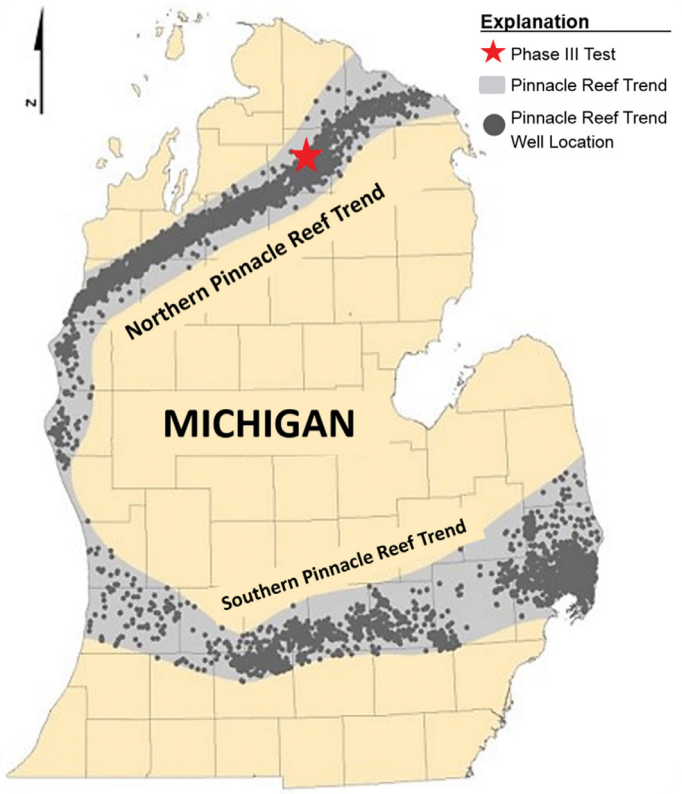
MICHIGAN BASIN PROJECT

Niagaran Pinnacle Reef Trend, Michigan

Midwest Regional Carbon Sequestration Partnership



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BACKGROUND

The Midwest Regional Carbon Sequestration Partnership's (MRCSP) Michigan Basin Project is injecting one (1) million metric tons of CO_2 in collaboration with enhanced oil recovery (EOR) operations, which provides an opportunity to research concurrent utilization of CO_2.

The Niagaran Pinnacle Reef Trend along the northern flank of the Michigan Basin is a regionally significant resource for hydrocarbon (i.e., oil and natural gas) production and potential CO_2 storage. MRCSP is injecting high-purity CO_2 removed from natural gas at a nearby gas processing facility. Site characterization, monitoring, and modeling performed during the project provide insight into CO_2 storage potential of carbonate reservoirs and generate valuable case-study data that can be applied to future carbon capture, utilization and storage (CCS) projects.

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PROJECT OVERVIEW

The large-scale CO_2 injection project is being carried out across oil-bearing pinnacle reefs in differing oil production life cycles, including early stage CO_2-EOR flood (two reefs), active CO_2-EOR (six reefs), and late stage (one reef). The CO_2-EOR operation in these nine reefs behaves as a closed-loop recycling system where produced CO_2 is compressed and dried, co-mingled with pure CO_2 from the natural gas processing facility, and re-injected back into the early stage and active reefs. The Michigan Basin Project encompasses 11 injection wells and 11 active producing wells.

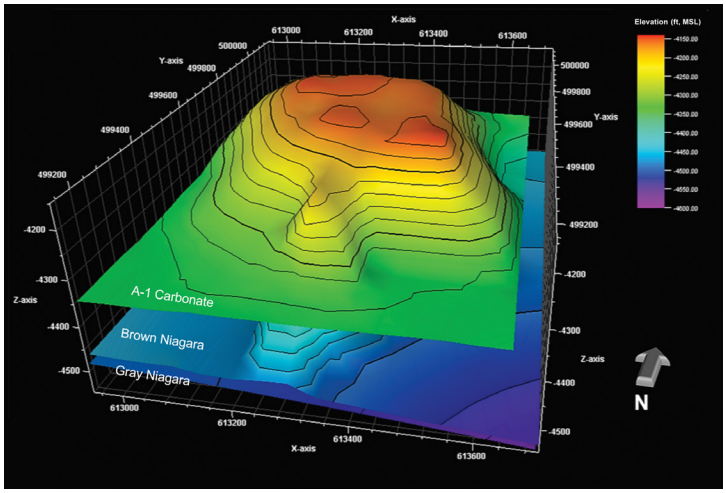
Since monitoring operations began in February 2013, MRCSP has successfully injected and monitored the storage of more than 590,500 metric tons of new CO_2.

Monitoring, verification, accounting (MVA) technologies are collecting data before, during, and at the end of the active injection phase. The reservoir provides an ideal system to test the ability of MVA technologies to track and monitor CO_2 in the subsurface and improve understanding of using depleted hydrocarbon reservoirs for permanent CO_2 storage.

The MRSCP region has many large stationary CO_2 sources located in close proximity to geologic storage resources. Geologists from MRCSP member states are collaborating to define carbon storage formations suitable for existing and future sources of CO_2, collaborating with oil and gas drillers and operators to fill-in data gaps, and supporting industry in evaluating CO_2 storage options. The research will benefit the regional economy by helping to develop a robust and cost-effective means for reducing greenhouse gas emissions.

PROJECT SUCCESSES

The Michigan Basin Project is providing a wealth of data to increase knowledge of CO_2 behavior in the subsurface, improve understanding of using hydrocarbon reservoirs for permanent CO_2 storage, and optimize carbon storage and MVA technologies. The tools developed and implemented in the Michigan Basin Project are helping increase capabilities for commercial deployment of CCS.



Research highlights resulting from this project include: a detailed study of induced seismicity in a CO_2-EOR flood, successful evaluation of the sequestration potential of compartmentalized reservoirs, and high-resolution monitoring of ground surface movement during reservoir pressure buildup. The findings from these studies demonstrated the safety and effectiveness of CO_2 storage and provide information that can be used to optimize future MVA programs.

The site characterization methodologies implemented in the Michigan Basin Project have established a reference data set to provide a robust approach for characterizing reef formations. These methodologies include vertical seismic profiles, pulsed neutron capture logs, interferometric synthetic aperture radar, borehole gravity surveys, pressure monitoring and fluid sampling.

The project is providing insight into the impacts of geologic heterogeneity and hydrocarbon production history on CO_2 storage potential. Prior to MRCSP injection, more than 1 million metric tons of CO_2 were already retained in the reefs due to past CO_2-EOR flooding. Data obtained from this project will help develop strategies for optimizing future CO_2 storage projects.

The Michigan Basin Project is also developing validated reservoir models that can be used to estimate CO_2 capacity for EOR reefs at the end of the oil production life cycle. Data from the project has determined reservoir parameters that are critical for numerical modeling and other analyses.

Lastly, the Michigan Basin Project has garnered interest for additional research on the CO_2 storage potential of the MRCSP Region. Geologic formations in eastern Ohio are now being characterized as part of a long-term, collaborative effort to assess the CO_2 storage potential in and near the Ohio River Valley.

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