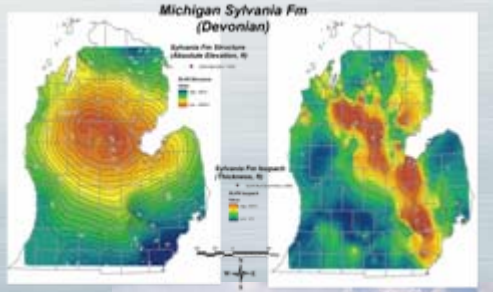
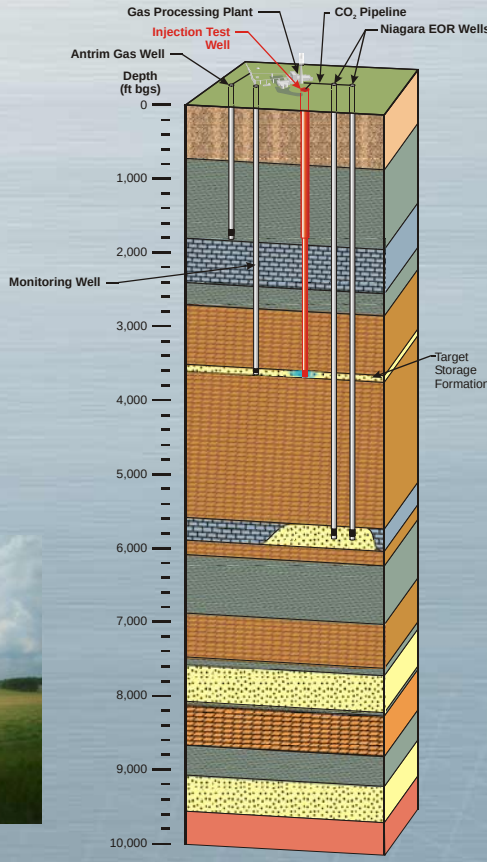
Battelle

The Business of Innovation





MRCSP Otsego County Site

Geologic Field Tests in the Michigan Basin

Presented By: Neeraj Gupta, Battelle

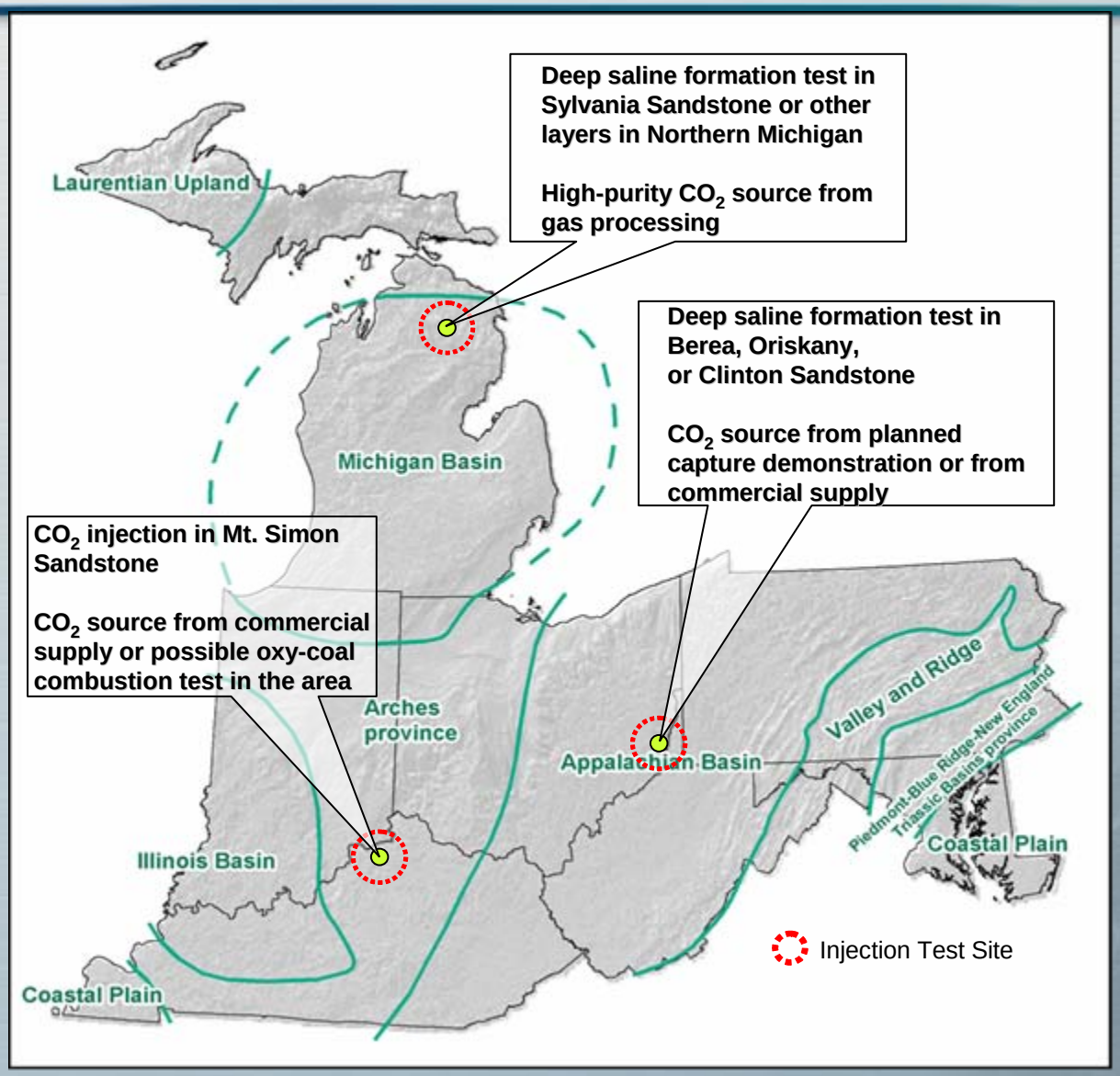
DOE/NETL Regional Partnership Annual Meeting

October 3-4, 2006, Pittsburgh, PA

U.S. Department of Energy/NETL

MRCSP
MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP

MRCSP Geologic Field Tests



Michigan Basin- Otsego County Test Site Project Team

Abed Houssari and Becky Cook

Dave Barnes and Bill Harrison

Dave Ball, Neeraj Gupta, Phil Jagucki, Joel Sminchak, Danielle Meggyesy, Judith Bradbury, Bob Janosy, Jackie Gerst, Diana Bacon

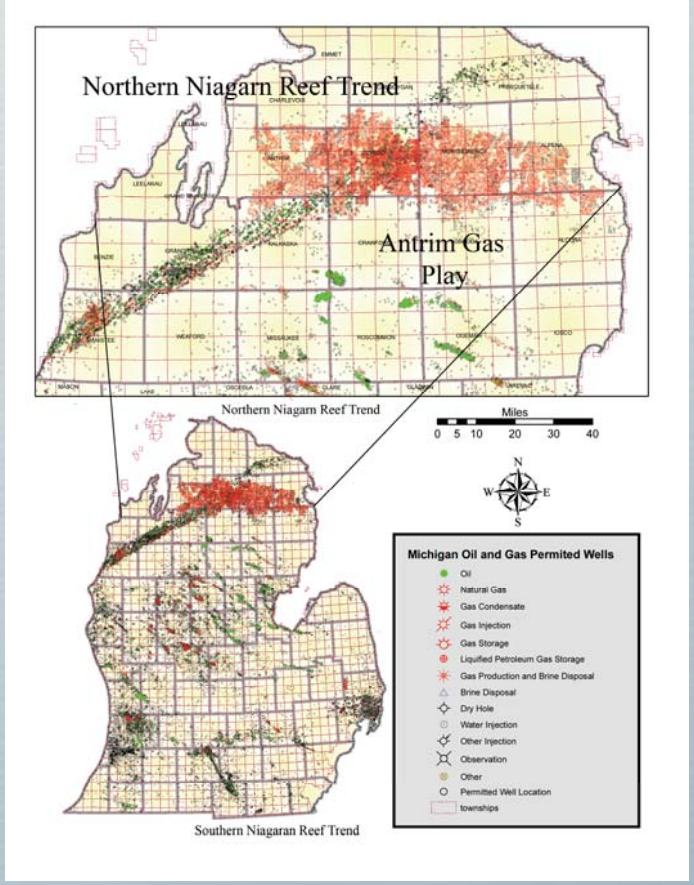
Charlie Byrer

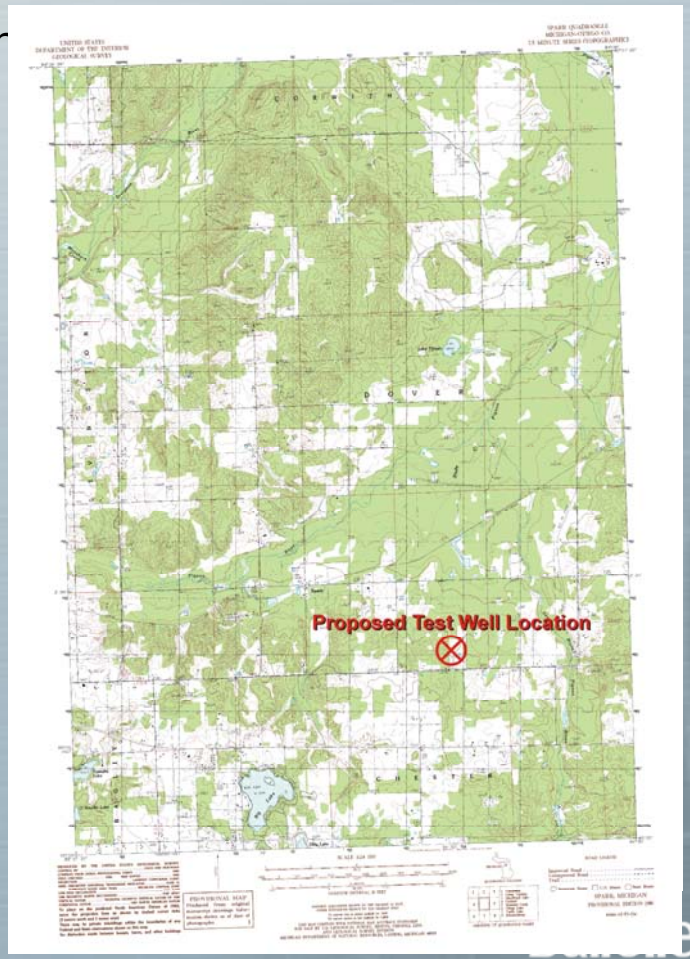
Core Energy LLC ***Robert Mannes***

Additional Contributions by Numerous Other MRCSP Team Members

Michigan Basin- Otsego County Test Site

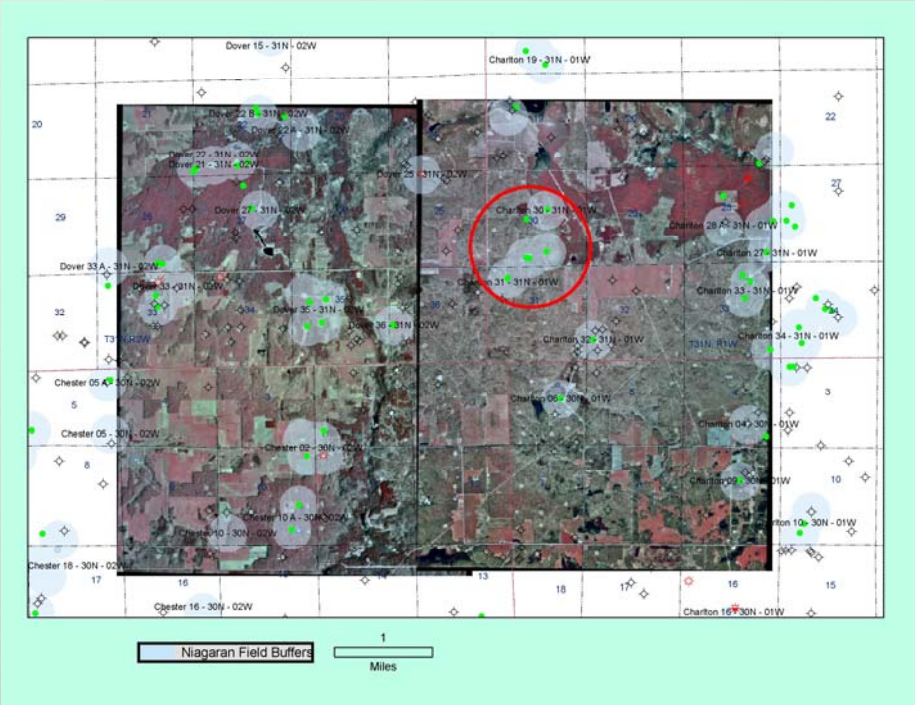
- Charlton 30/31 field, S. Dover/N. Chester Township, Otsego County, Michigan
- The location is at Core Energy gas fields in the vicinity of a DTE gas processing plant outside of Gaylord, Michigan
- Michigan Basin has significant sequestration poter





The Business of Innovation

Michigan Basin- Otsego County Test Site

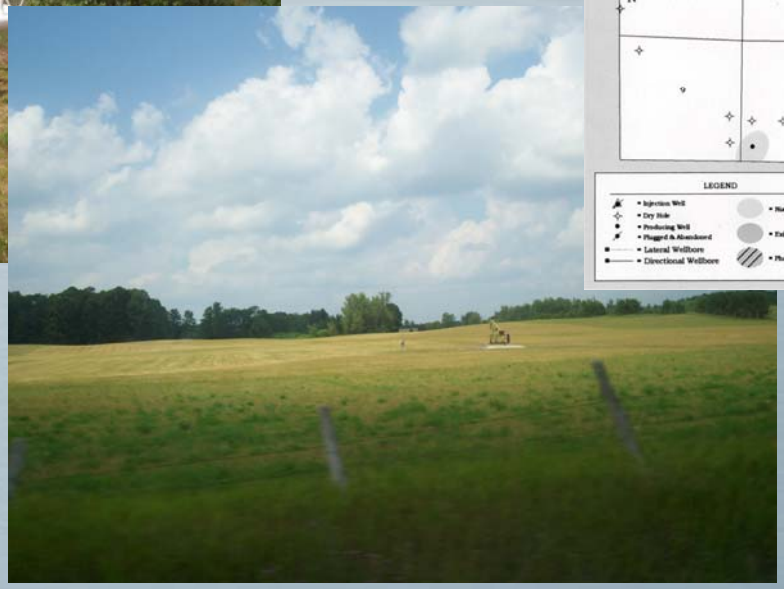


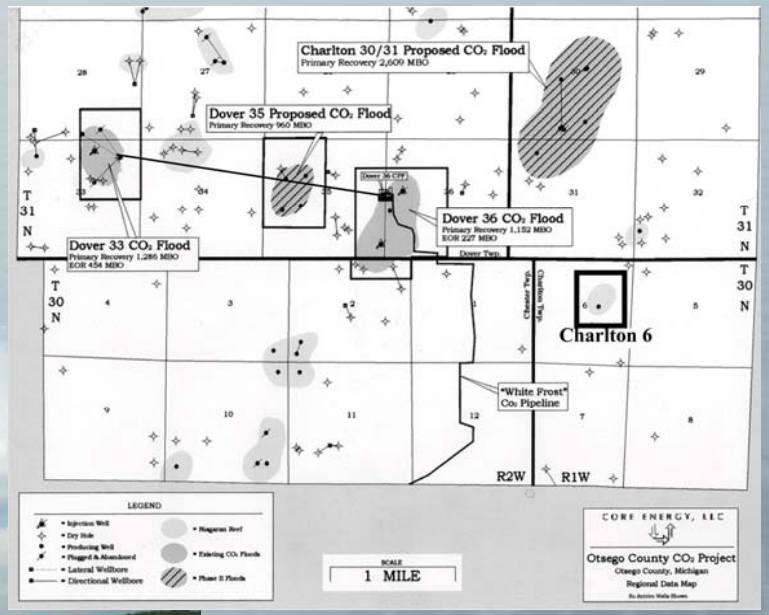
- Near DTE gas processing plant
- Gas produced from Antrim Shales
- 8-mile CO_2 pipeline for EOR in Niagaran Reefs

- Charlton 30/31 Field

Michigan Basin- Otsego County Test Site

- The plant is a rural setting, with minor development.
- Antrim gas fields, currently 10th most prolific gas play in continental U.S.
- 8-mile long CO2 pipeline in place for EOR





Battelle
The Business of Innovation

Michigan Basin- Otsego County Test Site Public Outreach

- Solidified working team for each geologic pilot consisting of staff from host company and MRCSP
- Planned outreach according to MI site located in an active CO_2 EOR flood area with seismic data already available
- Developed a series of site-specific fact sheets, video clips, briefing materials for each geologic field test
- Ensured that state and local officials and nearby residents received notice about the planned pilot and seismic survey (if applicable) in person, via letter or telephone call

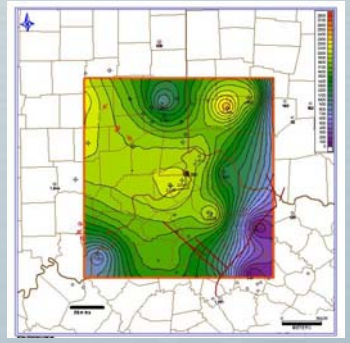
Michigan Basin- Otsego County Test Site Public Outreach

•Coordinated with DTE and Core Energy in identifying and scheduling limited interactions with officials and nearby residents prior to applying for drilling permit, with drilling scheduled for October

• Project outreach, to date, has been low key, but now beginning planning with host site for subsequent project phases, including more extensive outreach prior to permit application

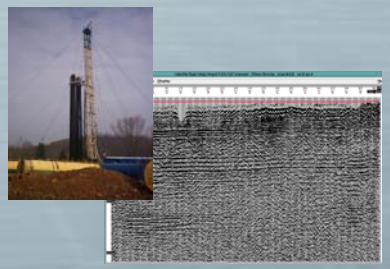
Phase II: Geologic Field Test Plans

Preliminary Geologic Assessment



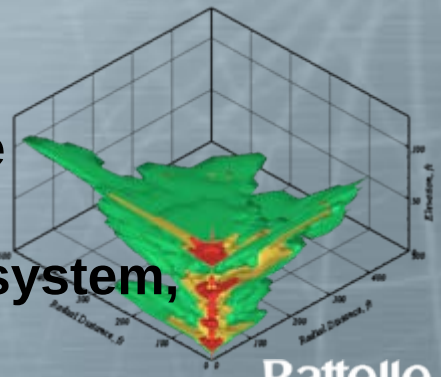
- **Site specific assessment of target storage reservoirs and geologic setting.**
- **Performed by state Geologic Surveys.**

Site Characterization/Field Work



- **Seismic surveys, test-well drilling, reservoir tests, brine sampling, other field work at the demo sites.**
- **Site characterization data will be used to design injection well and monitoring programs.**

CO_2 Injection Tests and Monitoring



- **CO_2 injection testing and monitoring/verification.**
- **Objectives vary by location due to different storage targets, CO_2 sources, and system design.**
- **Monitoring will be completed to evaluate injection system, CO_2 migration, and health & safety.**

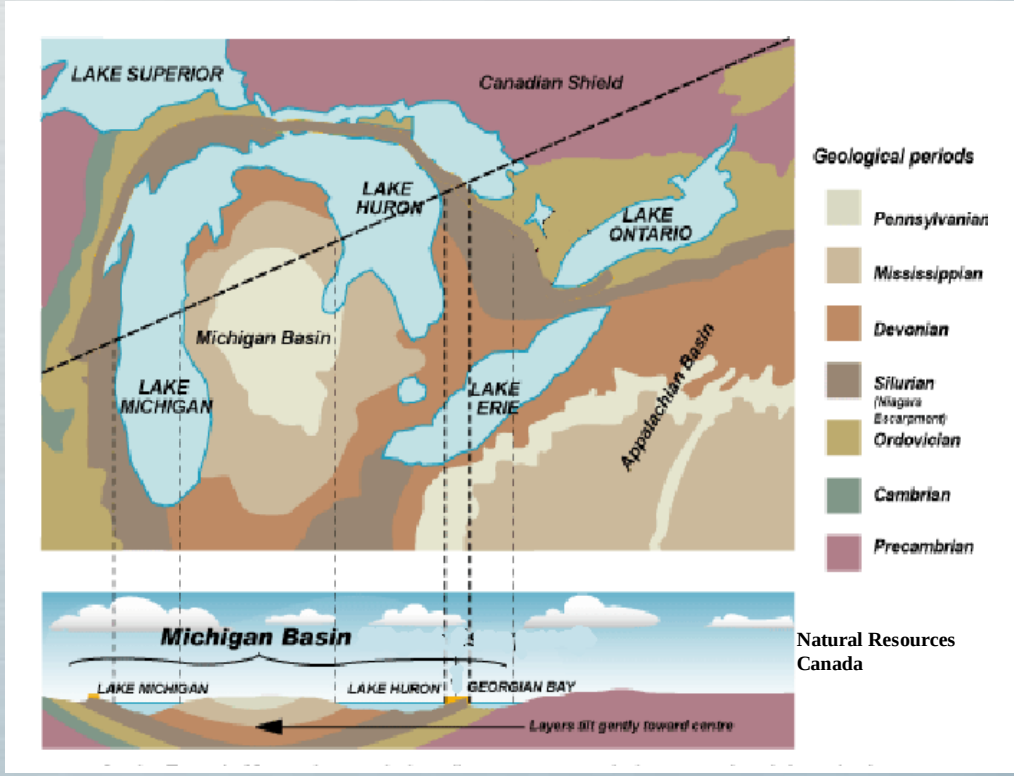
Battelle
The Business of Innovation

Geologic Setting- Michigan Basin

- Preliminary geological assessment completed by Michigan Basin Core Research Library, Western Michigan University

Michigan Basin Core Research Laboratory
Western Michigan University 1903 · 2003

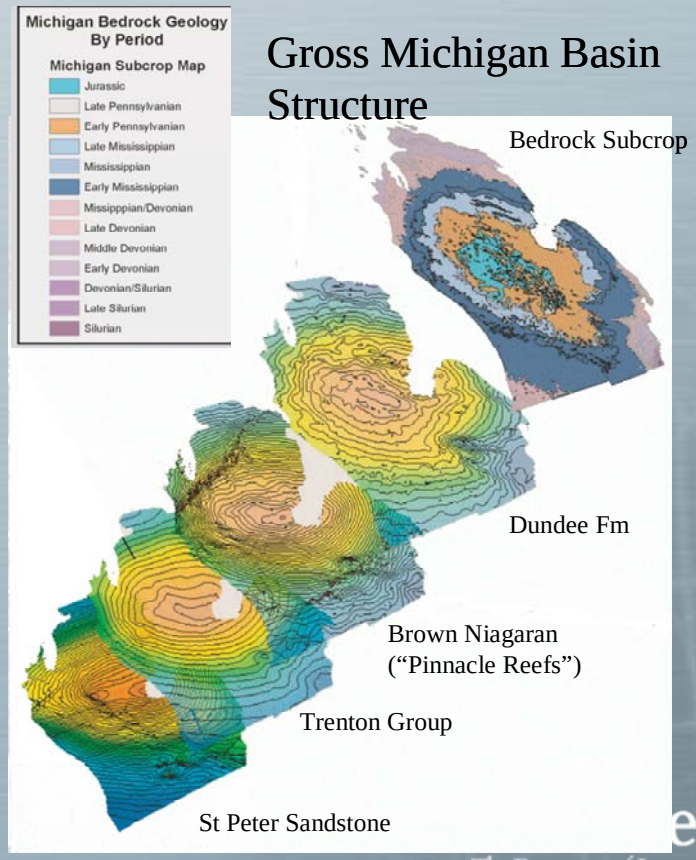
General Regional Geology



Natural Resources Canada

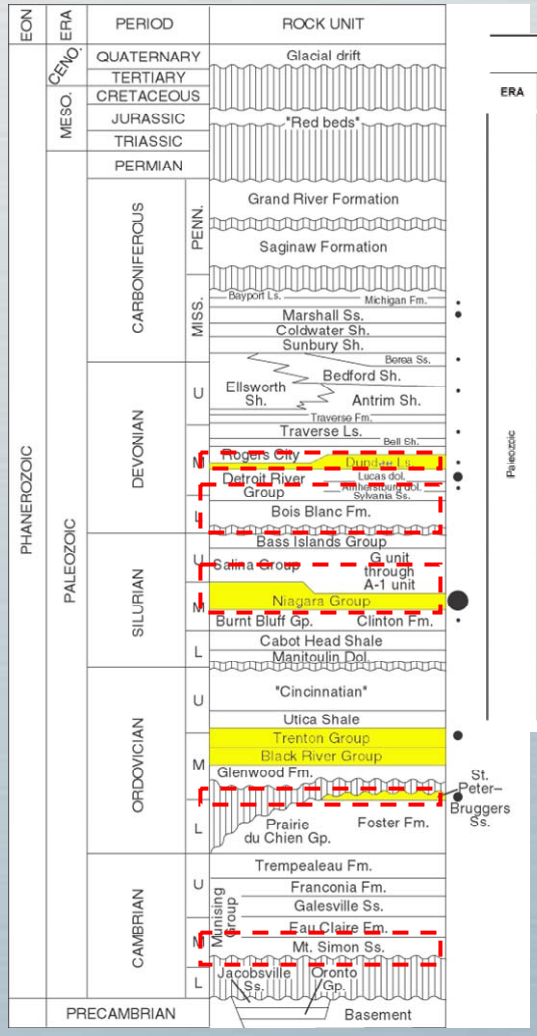
Structure

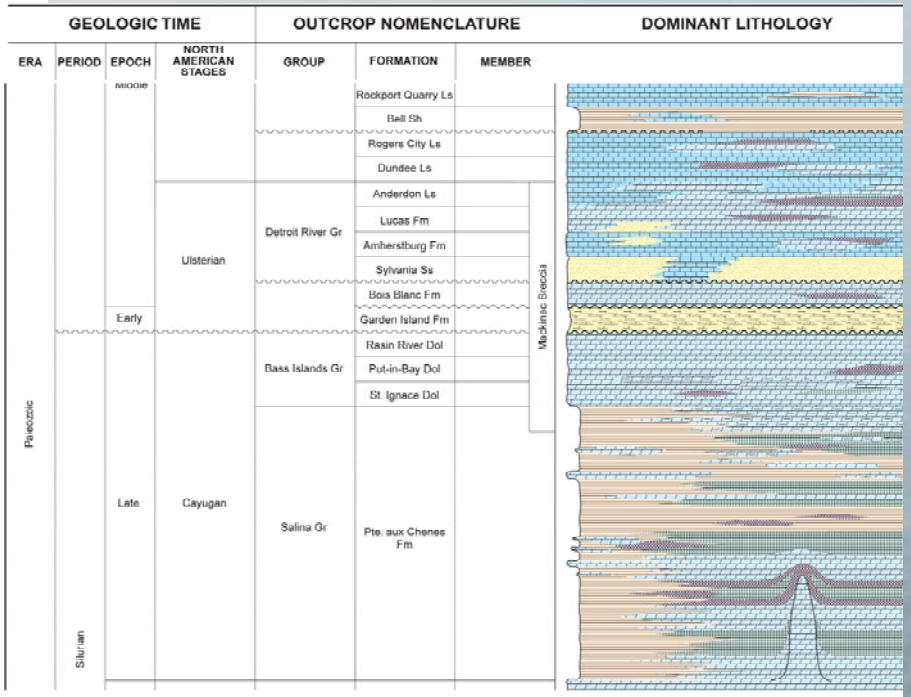
Gross Michigan Basin Structure

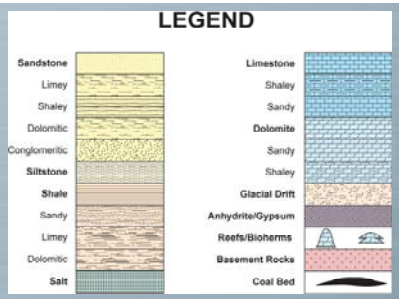


Michigan Basin Stratigraphy

- Many targets, large sequestration capacity in Michigan Basin



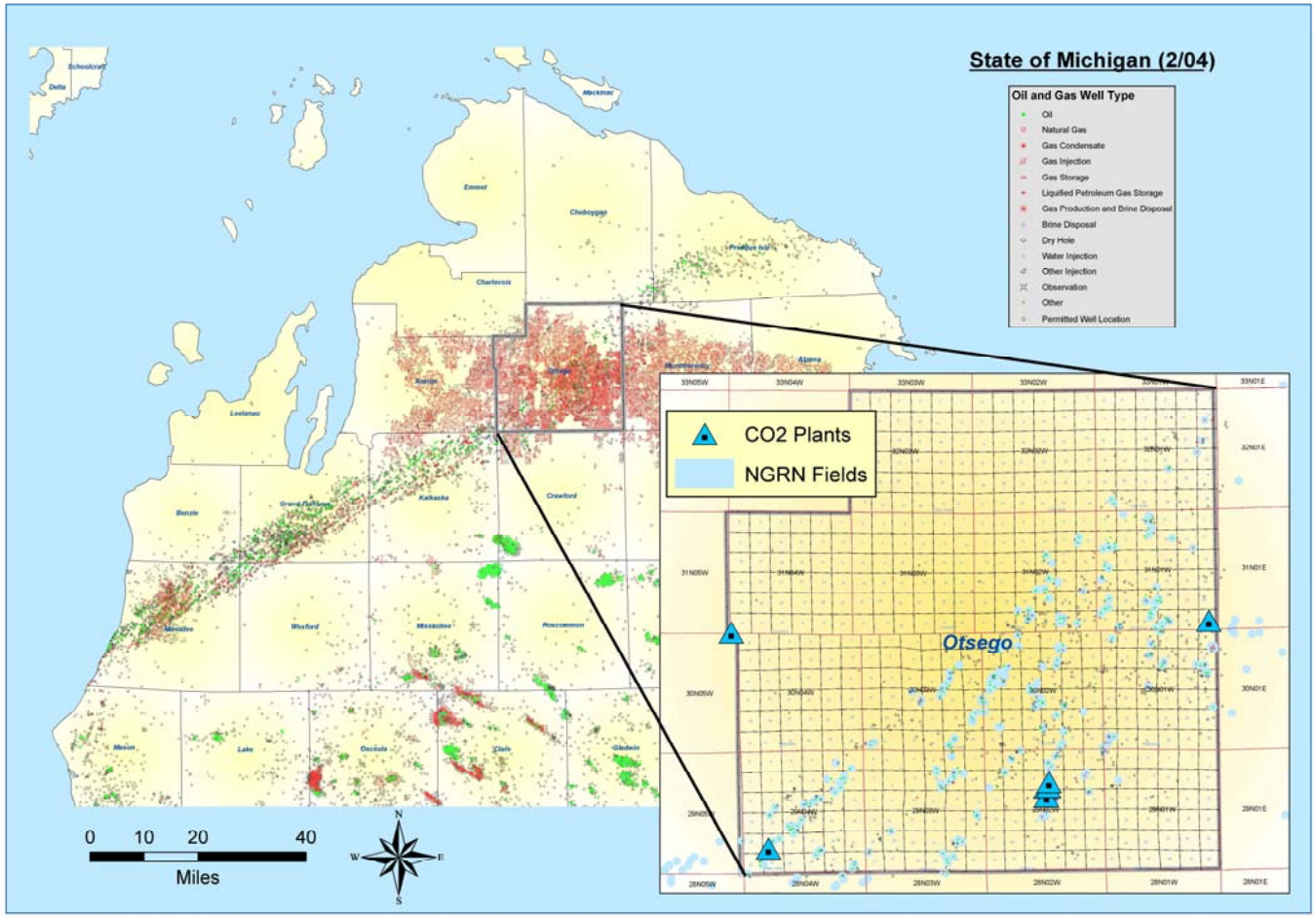




Battelle
The Business of Innovation

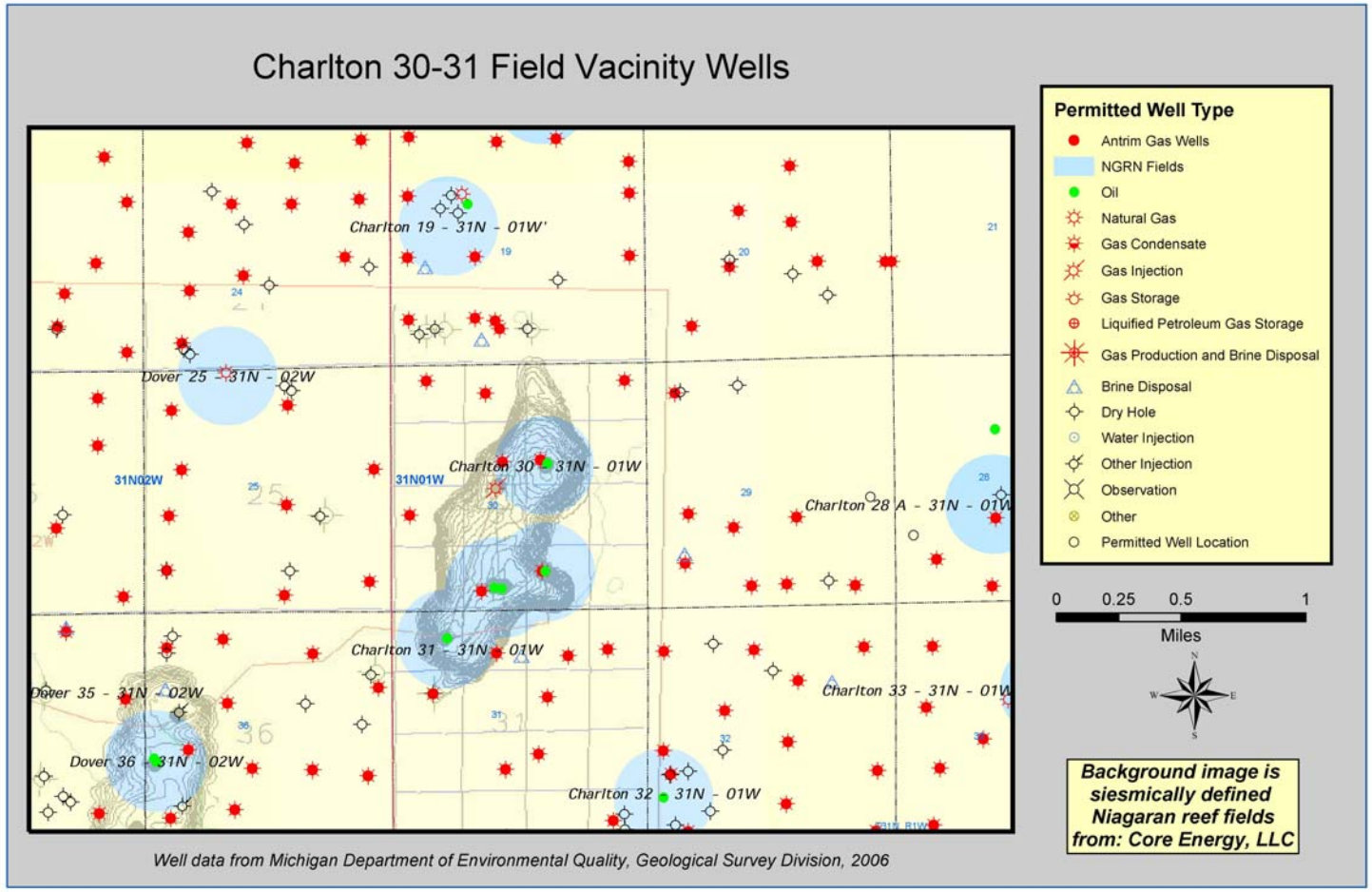
Geologic Setting- Oil and Gas Fields

- Significant oil and gas exploration near the study site.

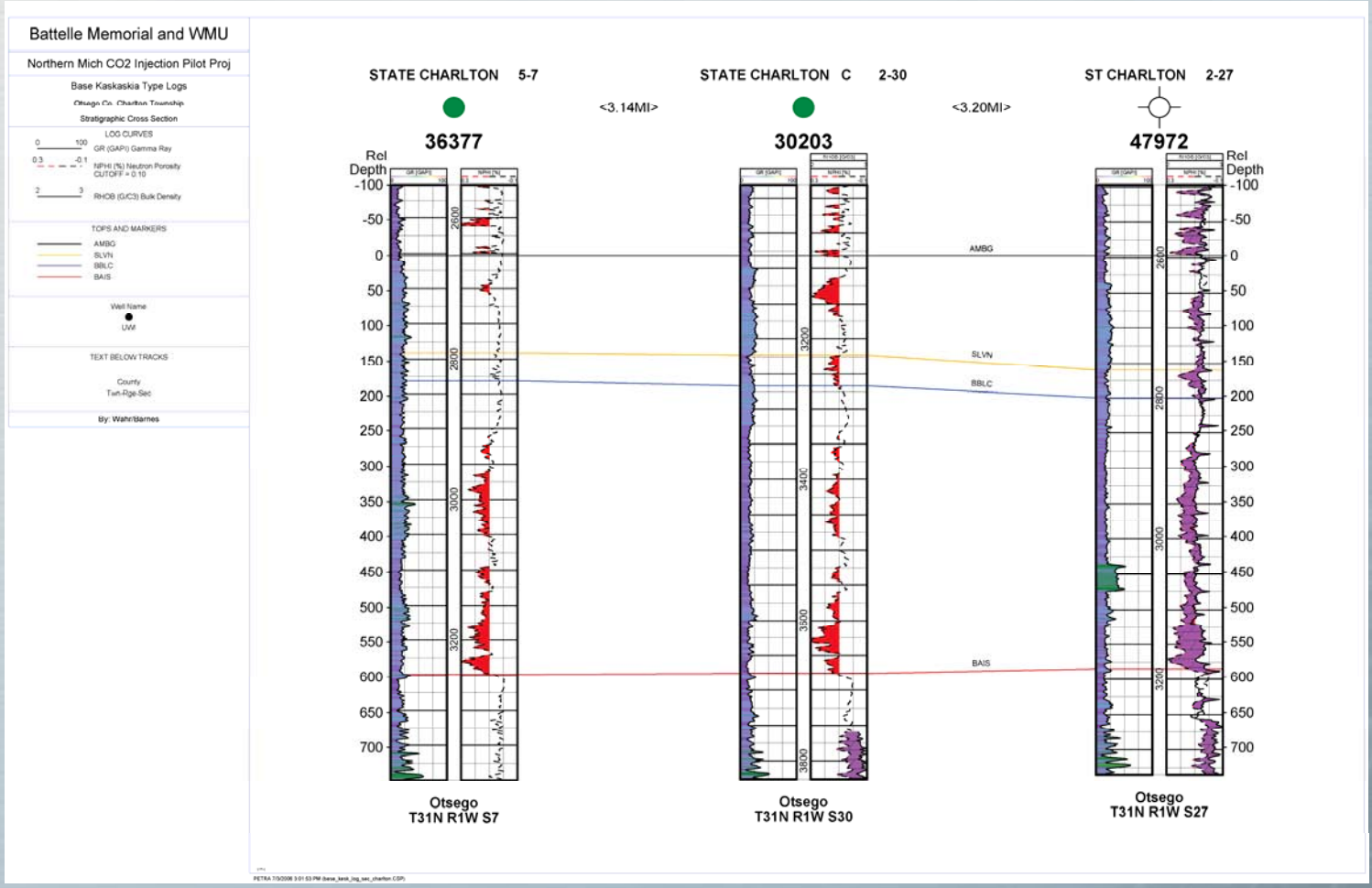


Geologic Setting- Oil and Gas Fields

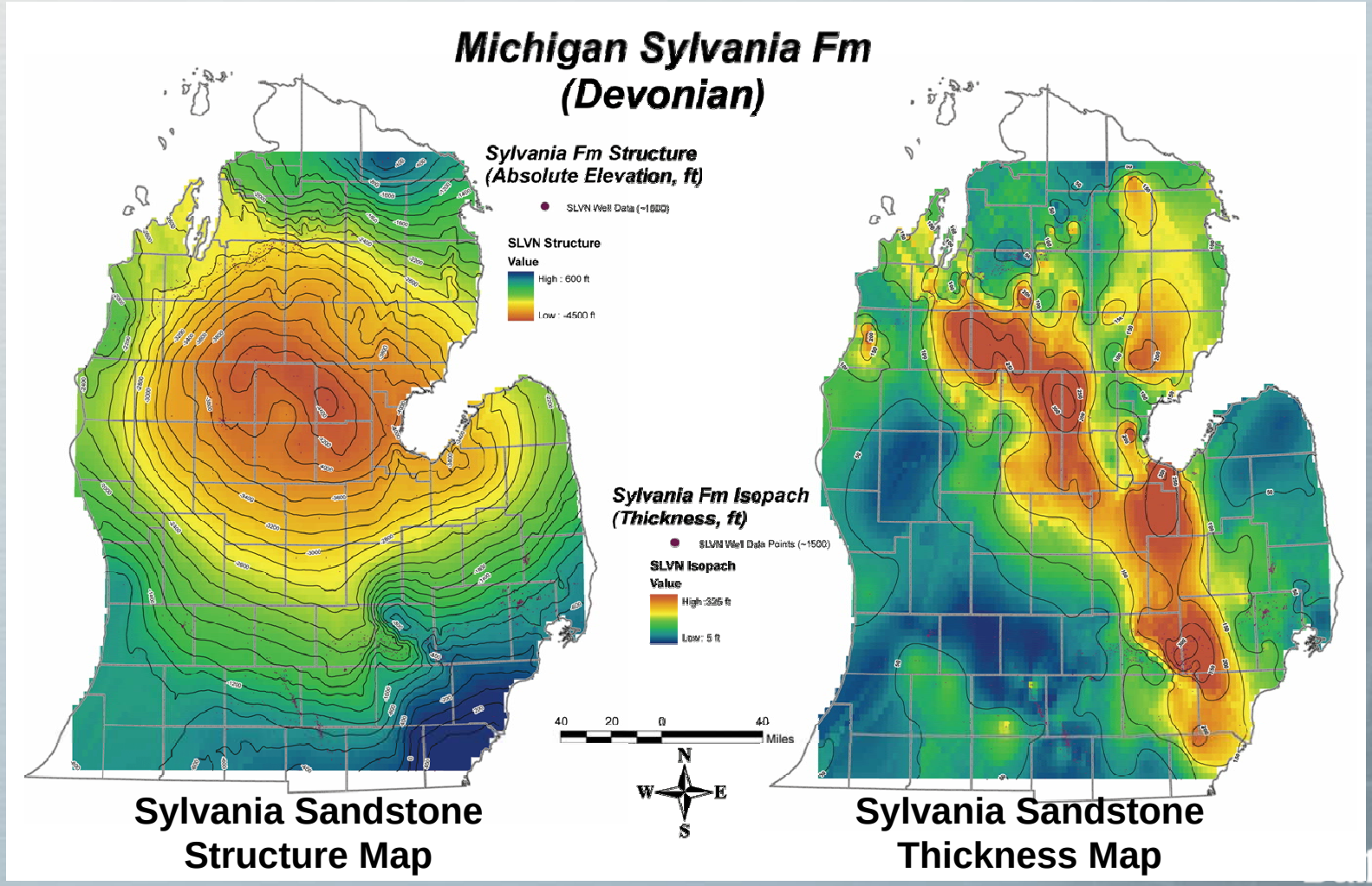
- Significant oil and gas exploration near the study site.



Geologic Cross-Section Through Study Area



Maps of Target Formations

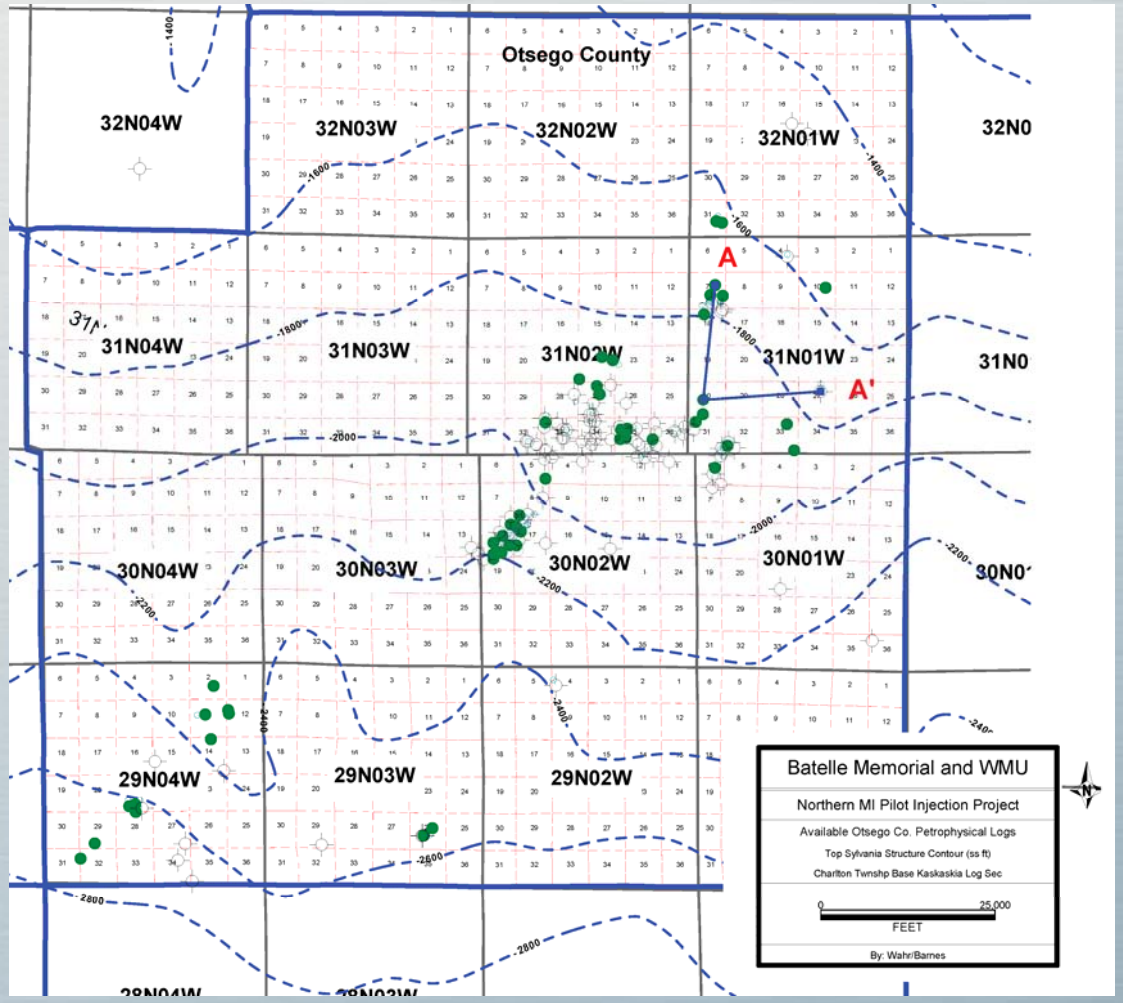


Sylvania Sandstone Structure Map

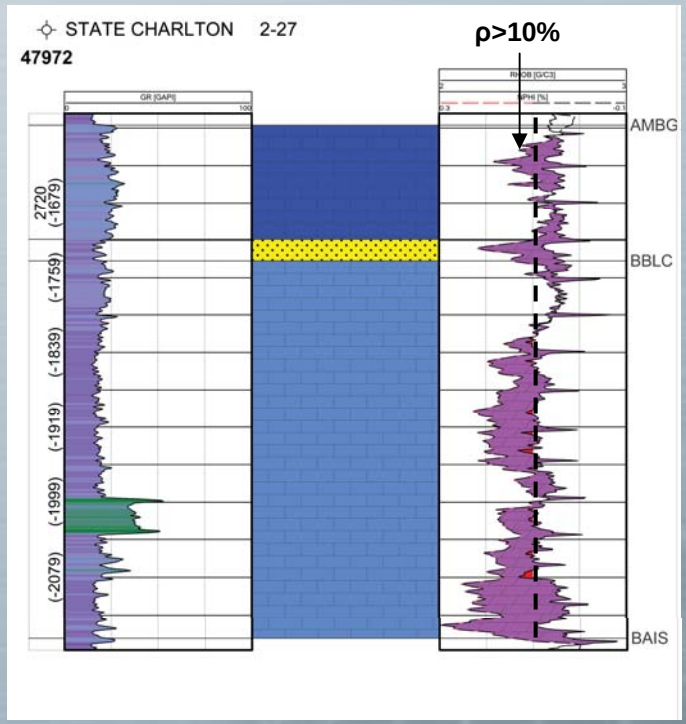
Sylvania Sandstone Thickness Map

Maps of Target Formations

Sylvania Sandstone Structure Map



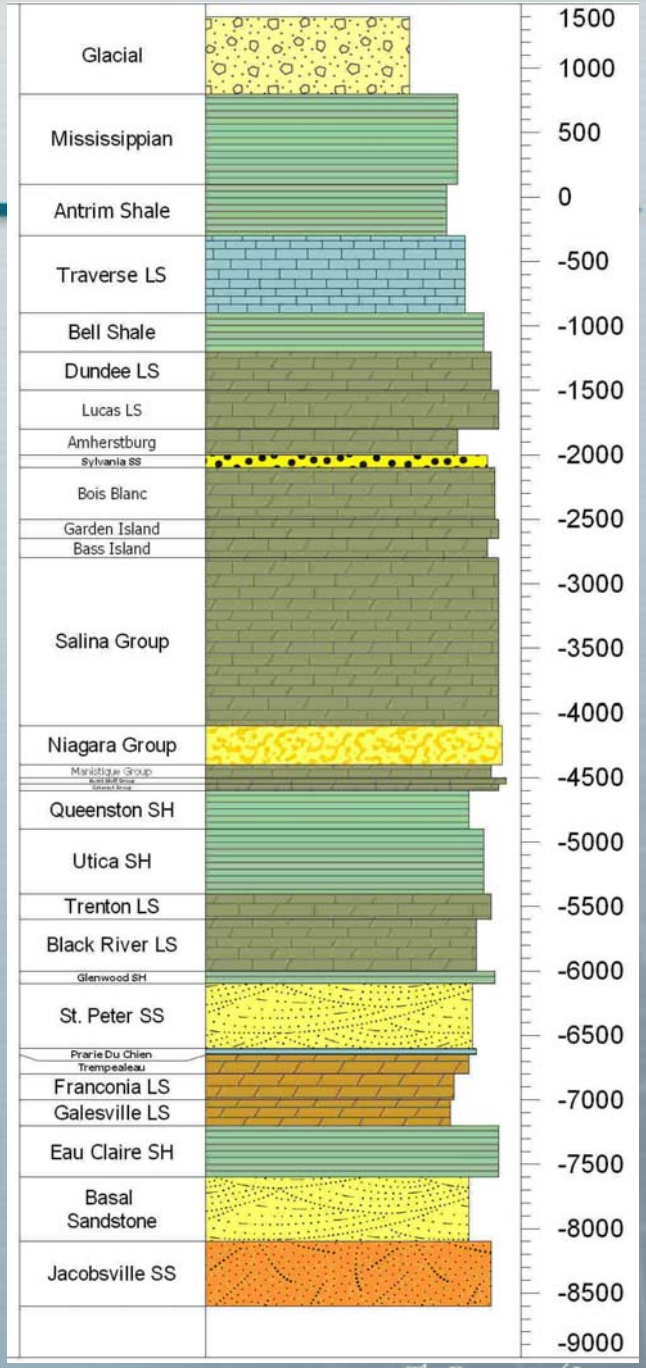
Typical Log through Sylvania-Bois Blanc



Preliminary Geology Prognosis

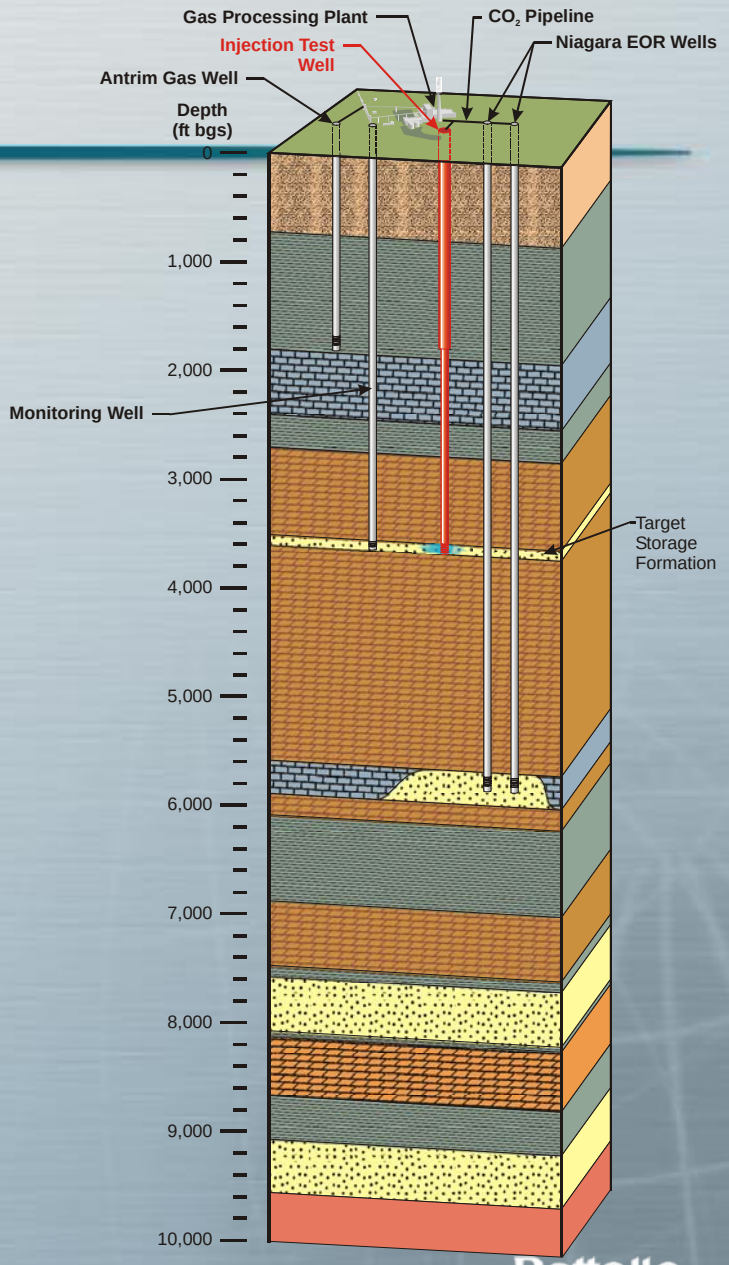
- Sedimentary rocks ~9,500 ft deep and overlie Precambrian bedrock.

- Primary targets include Sylvania Sandstone-Bois Blanc (significant deeper targets include Niagaran Reefs, St. Peter Sandstone, and Mt. Simon Sandstone)



Preliminary Conceptual Injection System

- Sylvania Sandstone-Bois Blanc deep saline formations primary target
- Detroit Group shale and salt layers provide containment
- Drill new injection well and retrofit dry well for monitoring



Battelle
The Business of Innovation

Regulatory Track

- Pursuing UIC Class V injection permit under Region V EPA UIC program (also working with Michigan DNR Div. of Oil and Gas for any state requirements)

- Held several conference calls and meetings with regulatory officials including one site visit in August 2006

- Initial drilling to be conducted under state oil and gas permit to be converted to injection well permit from Region V EPA before injection
- Class V injection permit being prepared for Region4EPA
- Issues:
    - Well construction requirements
    - CO_2 stream characterization (not required if commercial CO_2)
    - Need for any public meetings?

Injection System Design

- CO_2 injection testing and monitoring- The overall plan for the Otsego County site is to inject a fairly significant volume of CO_2 (10,000s tons) because a clear source is available from nearby gas processing plant.

- This should allow for more meaningful monitoring of the injected CO_2 such as 4-D seismic and/or cross-well seismic. In addition, we plan on retrofitting an abandoned well at the site for monitoring.

- This site may offer the opportunity to optimize CO_2 injection operations, whereas the other two MRCSP geologic test sites are more exploratory in nature.

CO_2 Source

- CO_2 available from DTE gas processing plant
- Antrim Shale gas contains 15-30% CO_2 and is removed in amine based separation process
- Relatively pure CO_2 (99%) stream
- CO_2 periodically used for EOR floods in Niagaran Reef oil fields

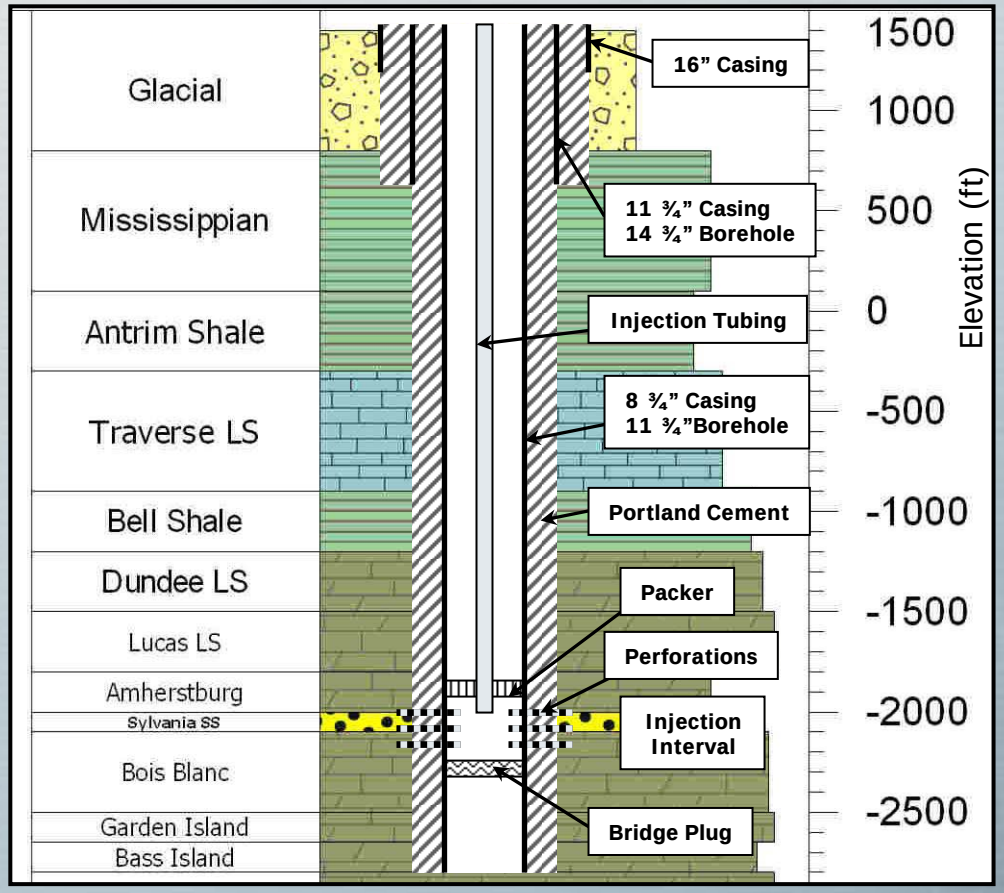
MMV – Potential Options for this Site

- Monitoring options were reviewed and a subset of options was selected based on the proposed injection system specifications and geologic setting.
- Complete monitoring plan and schedule will be determined after site characterization efforts are finished.
- Site has potential for seismic monitoring (X-well or 3D seismic)

Michigan Basin										
Time (Months)	-6	-4	-2	0	2	4	6	2	4	6
Phase	Pre-demo			Active Injection				Post-Injection		
Injection System (PVT)				X	X	X	X			
Health and Safety (O_2)				X	X	X	X			
Wireline (CMR, Nuetron/RST, PEX)	X				X		X			X
X-well Sesimic (3-4 Mon. Wells)			X					X		
Reservoir Sampling (MDT)	X							X		
Well Indicator sensors (PT)			X	X	X	X	X	X	X	X
4-D Seismic (with WMU program)		X							X	

DRAFT

Preliminary Well Design



***Final specifications TBD.**

Timeline and Next Steps for the Michigan Basin Otsego County Test Site

- Site characterization (in progress)
- Permitting (in progress)
- Test Well Drilling/retrofitting (late Sept-early Oct)
- Injection testing and monitoring
- Post injection and closure