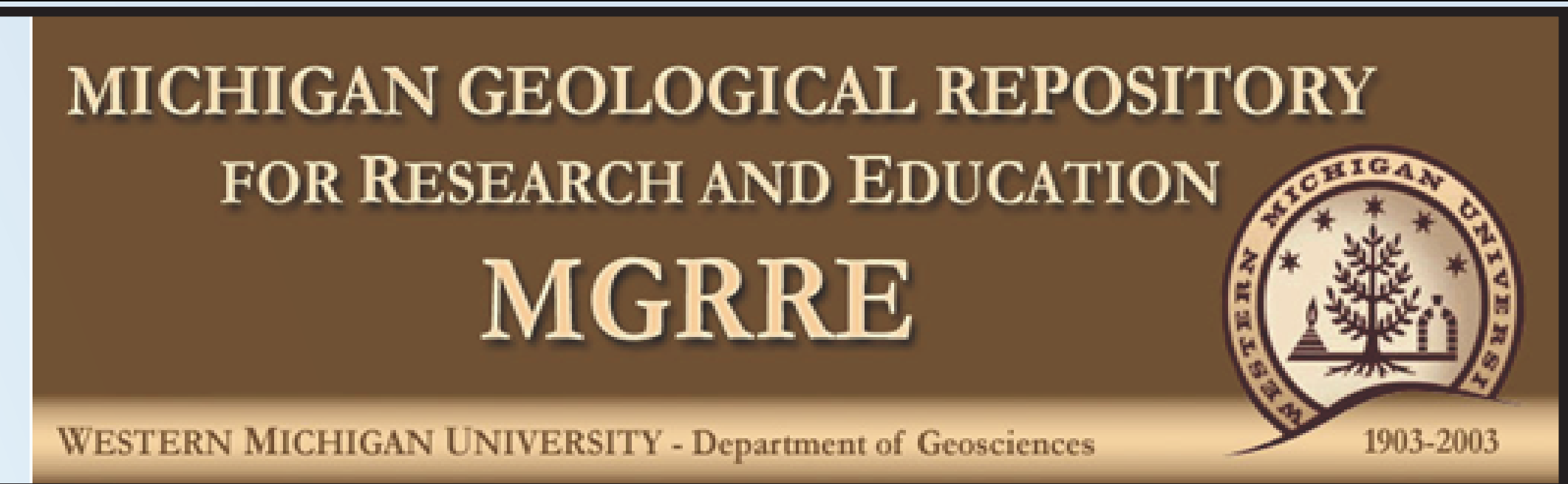




The importance of geologic study for the application of carbon capture and storage (CCS) in Otsego County, Michigan

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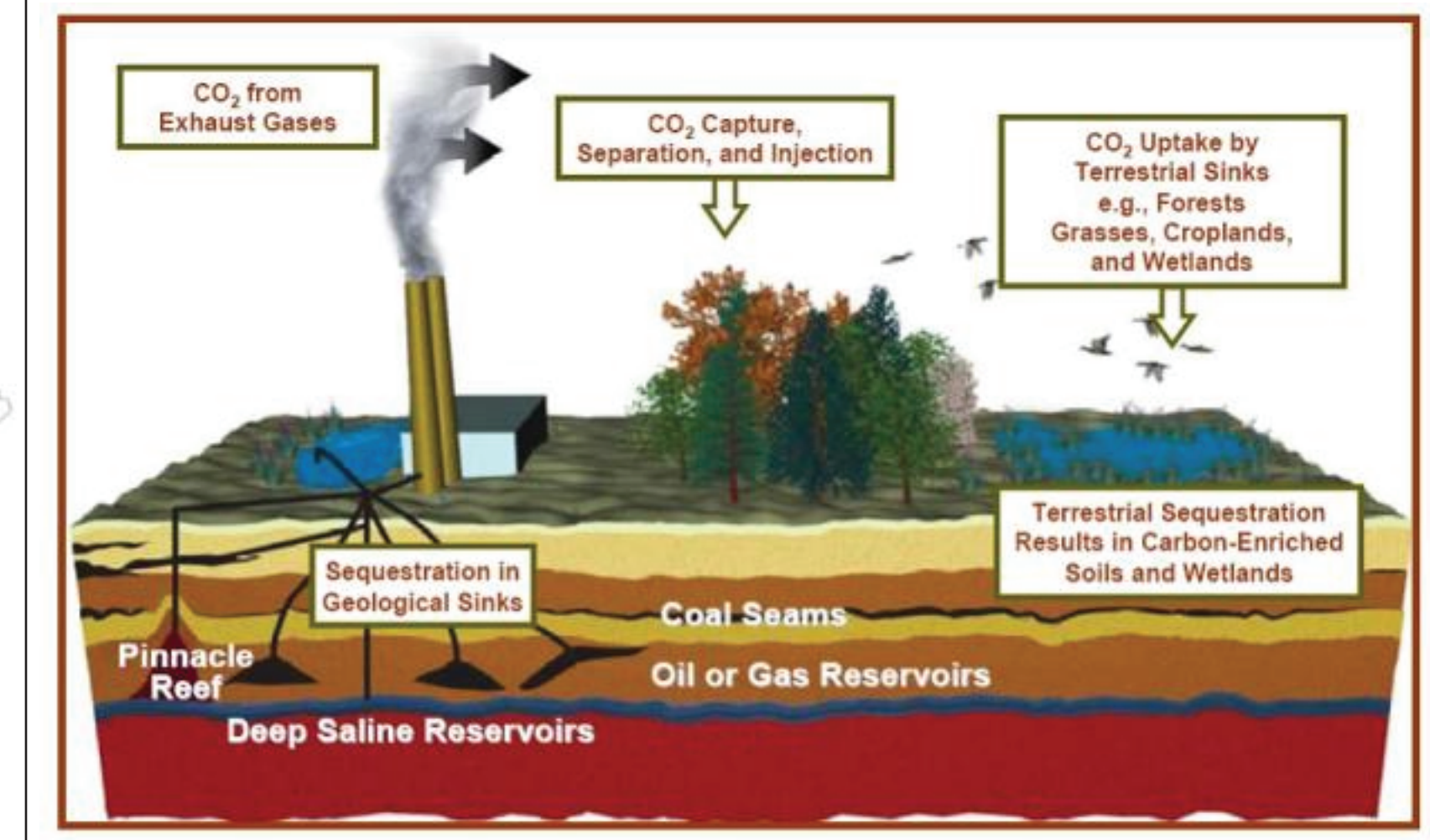
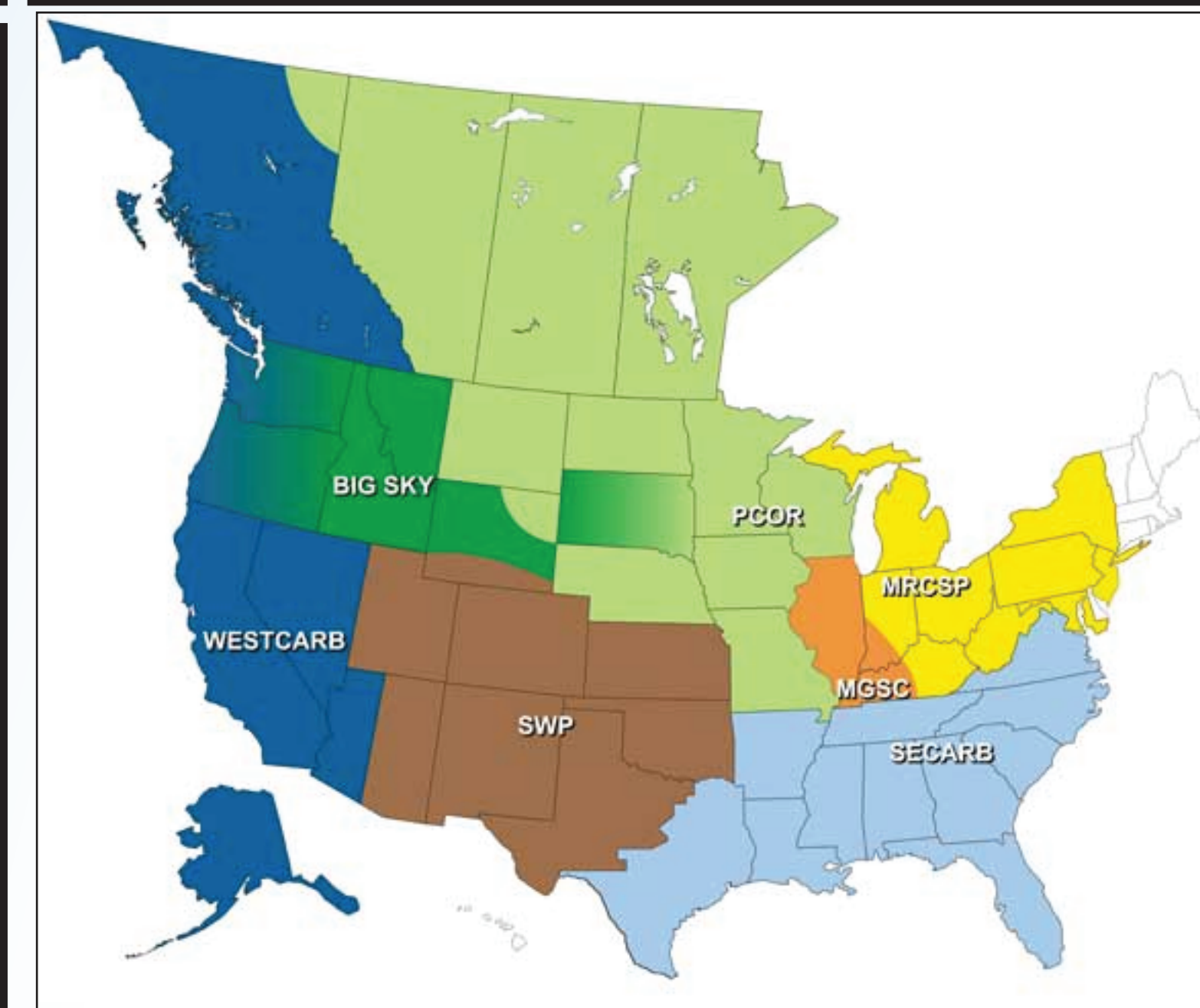
ABSTRACT

The most recent Paris climate talks emphasized the importance of reducing carbon dioxide pollution associated with burning fossil fuels. In an attempt to mitigate CO₂ emissions, carbon capture and storage (CCS), which is a process by which CO₂ is pulled from a smokestack before it is released into our atmosphere and buried deep underground, is currently underway in Otsego County, Michigan. In order to safely and effectively store CO₂ into deep geologic formations, it is critical to gain a better understanding for the geologic “storage tank” in which these fluids will be stored. As part of this research effort, CO₂ flooding of reservoirs has been proven to be an effective means to increase the recovery of oil bypassed during primary production. In Michigan, the juxtaposition of the Devonian Antrim Shale natural gas trend, one that contains high levels of associated CO₂, with the mature Niagaran (Silurian) reef oil play, has led to opportunities of combined enhanced oil recovery efforts with the geological sequestration of CO₂.

OBJECTIVES

- 1) Create robust geologic models of pinnacle reefs in Michigan utilizing available core data at the MGRRE facility at WMU
- 2) Use the geologic models to accurately predict the flow properties for individual reef reservoirs
- 3) Utilize the resultant “flow unit” models for the simulation of CO₂ injection and fluid migration

CO₂ SEQUESTRATION



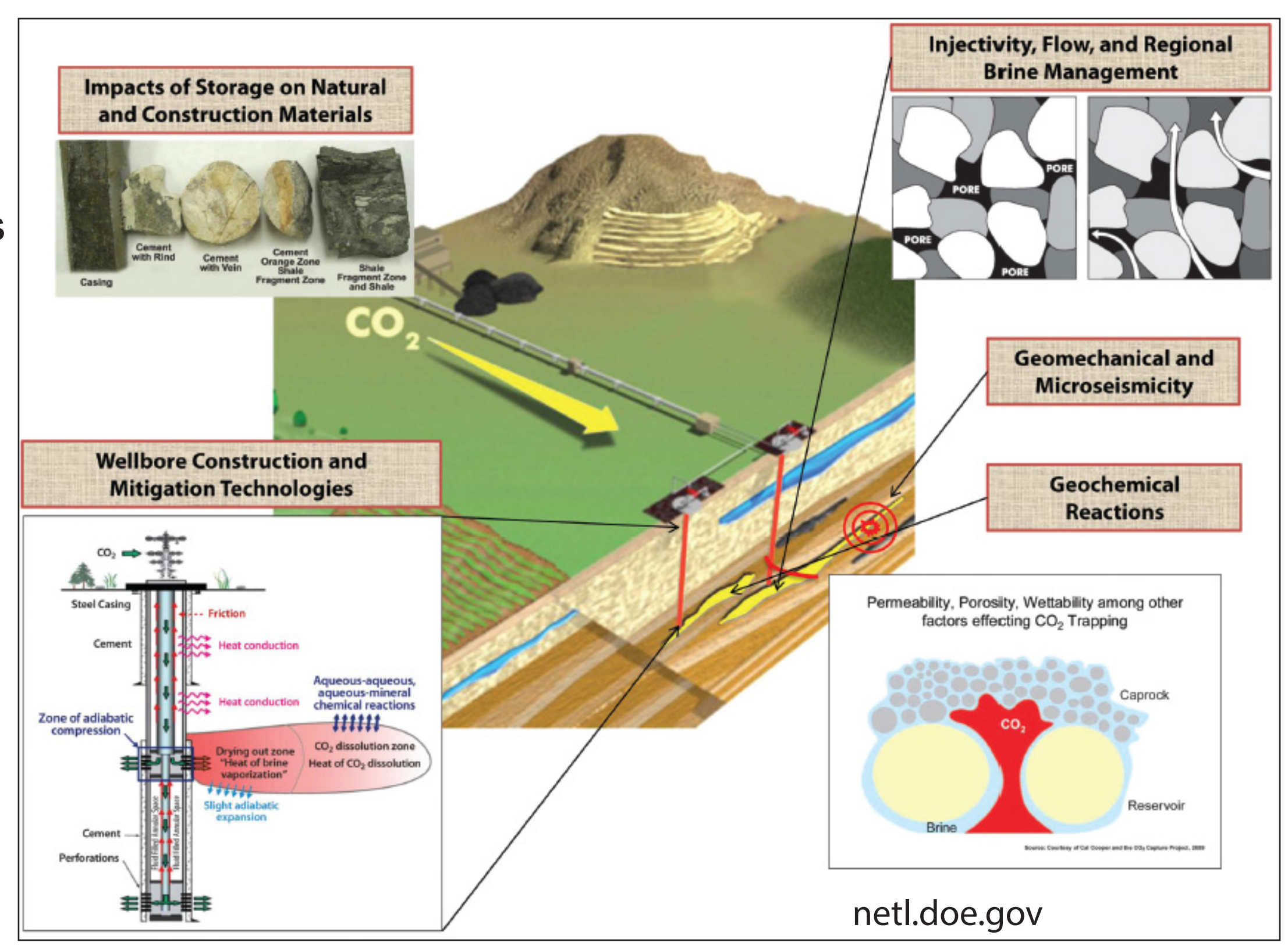
Source: Block diagram provided from the Plains CO₂ Reduction (PCOR) Partnership Regional Atlas (2005). Modified from Oak Ridge National Laboratory (2000). Original rendering by LeJean Hardin and Jamie Payne.

Carbon Dioxide Storage Options

DOE has established 7 regional partnerships comprised of 350 state agencies, universities, private companies and non-governmental organizations

Our research team at WMU is the state representative for Michigan

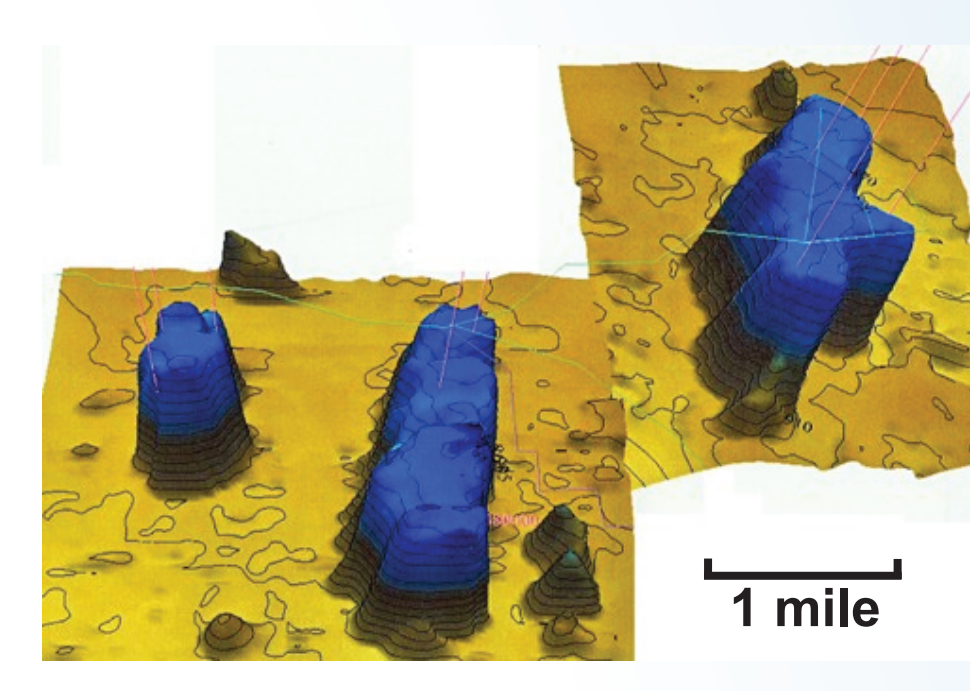
Carbon sequestration holds promise as one option for mitigating climate change



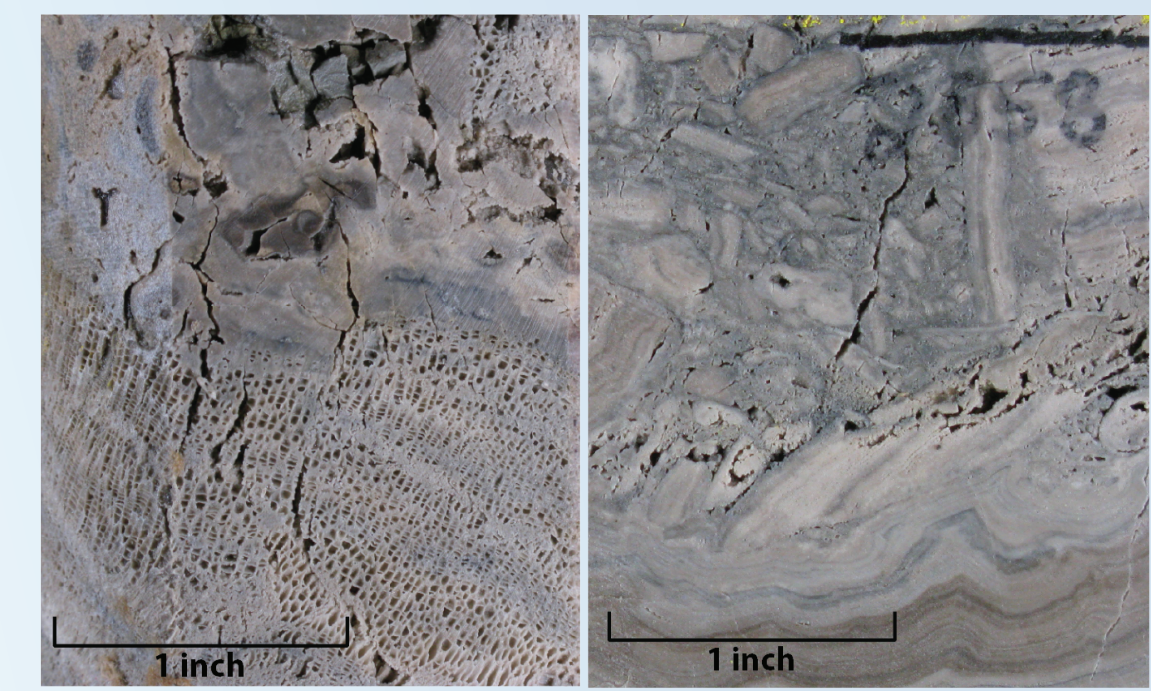
netl.doe.gov

RESEARCH METHODS

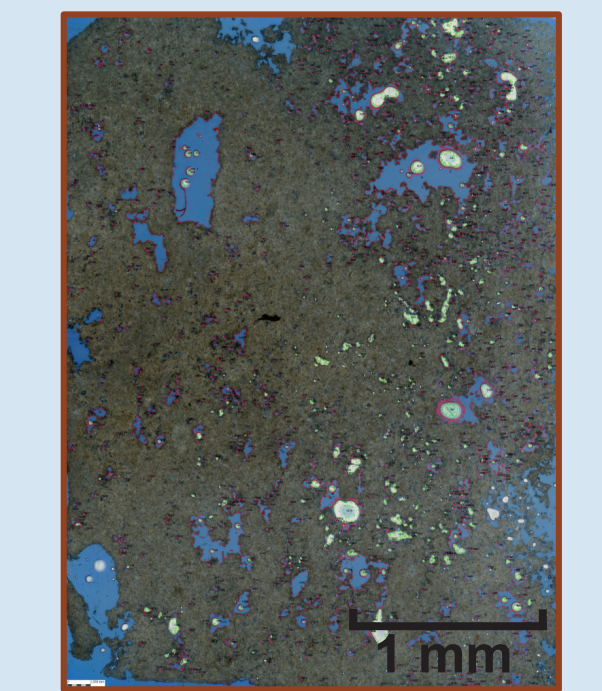
3D SEISMIC



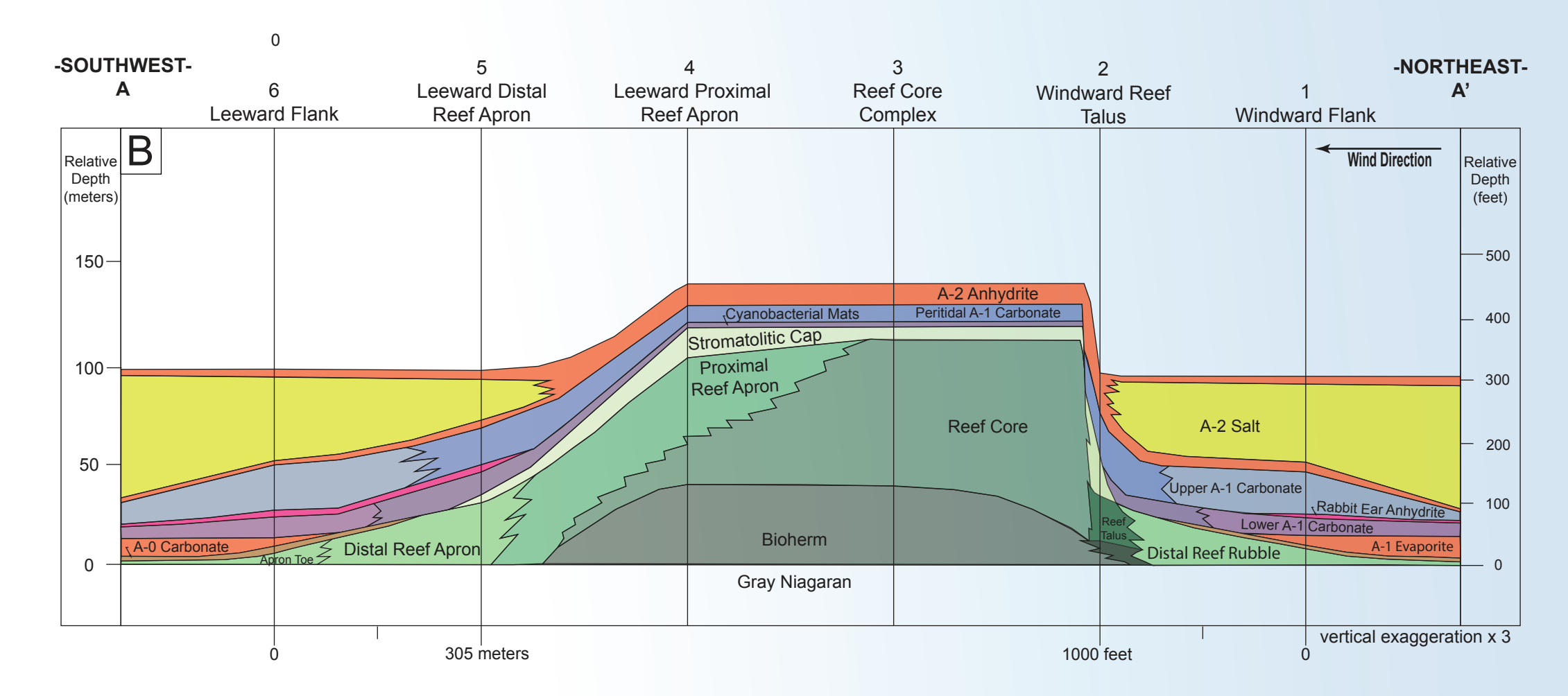
HAND SAMPLE



THIN SECTION



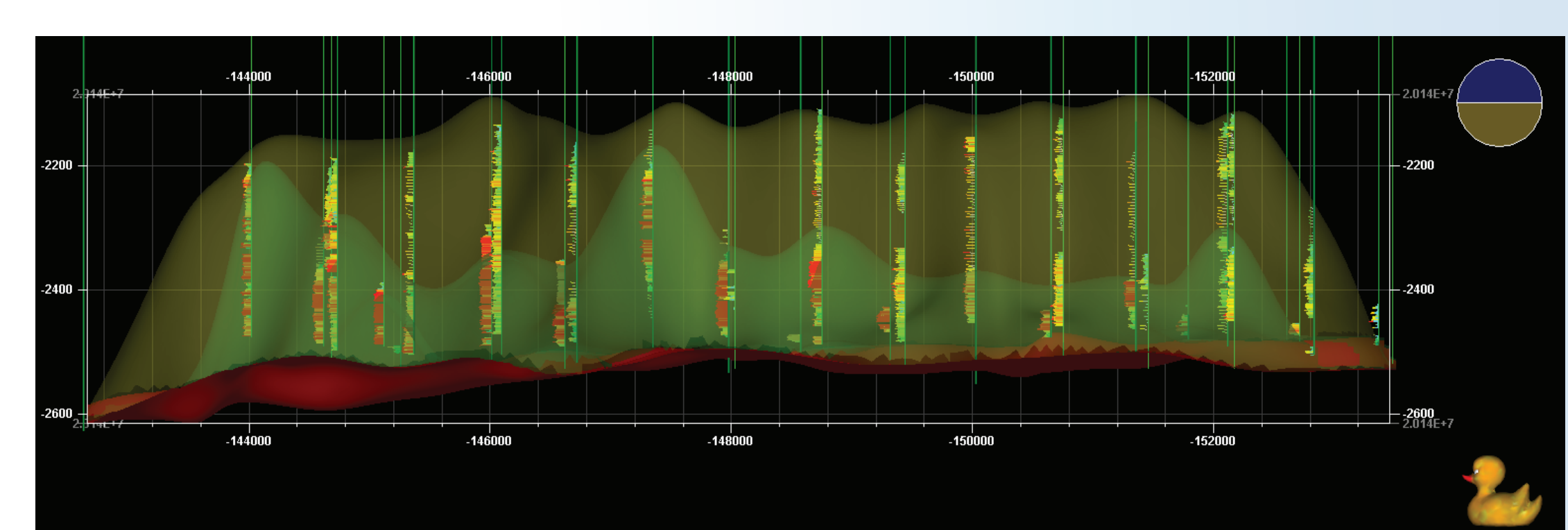
SCALE



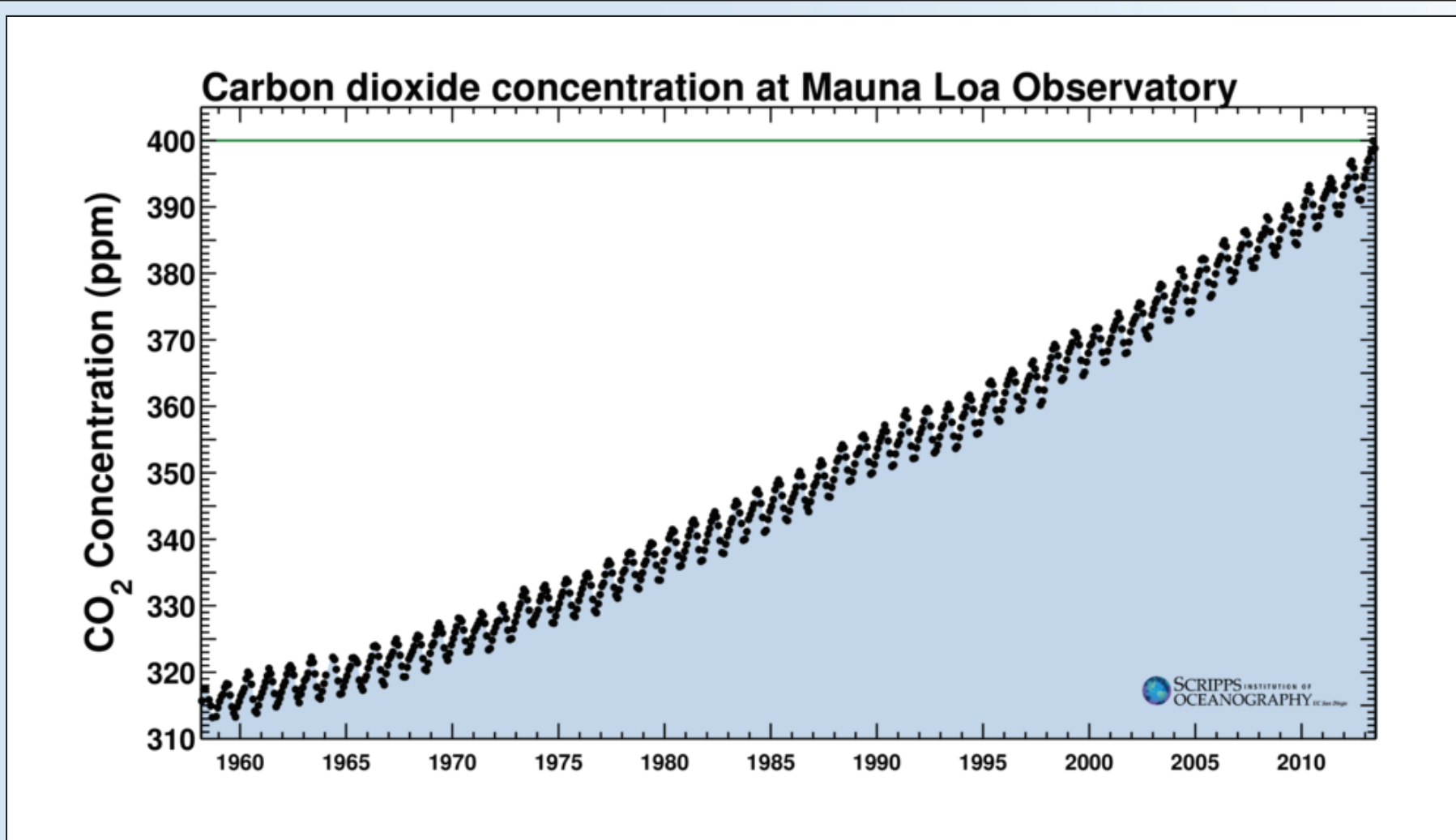
Conceptual geologic models are created using available rock data and geologic concepts

These geologic models result in predictive power for other reefs

Creation of 3D models use a combination of seismic, a conceptual geologic model, and rock properties



CLIMATE CHANGE



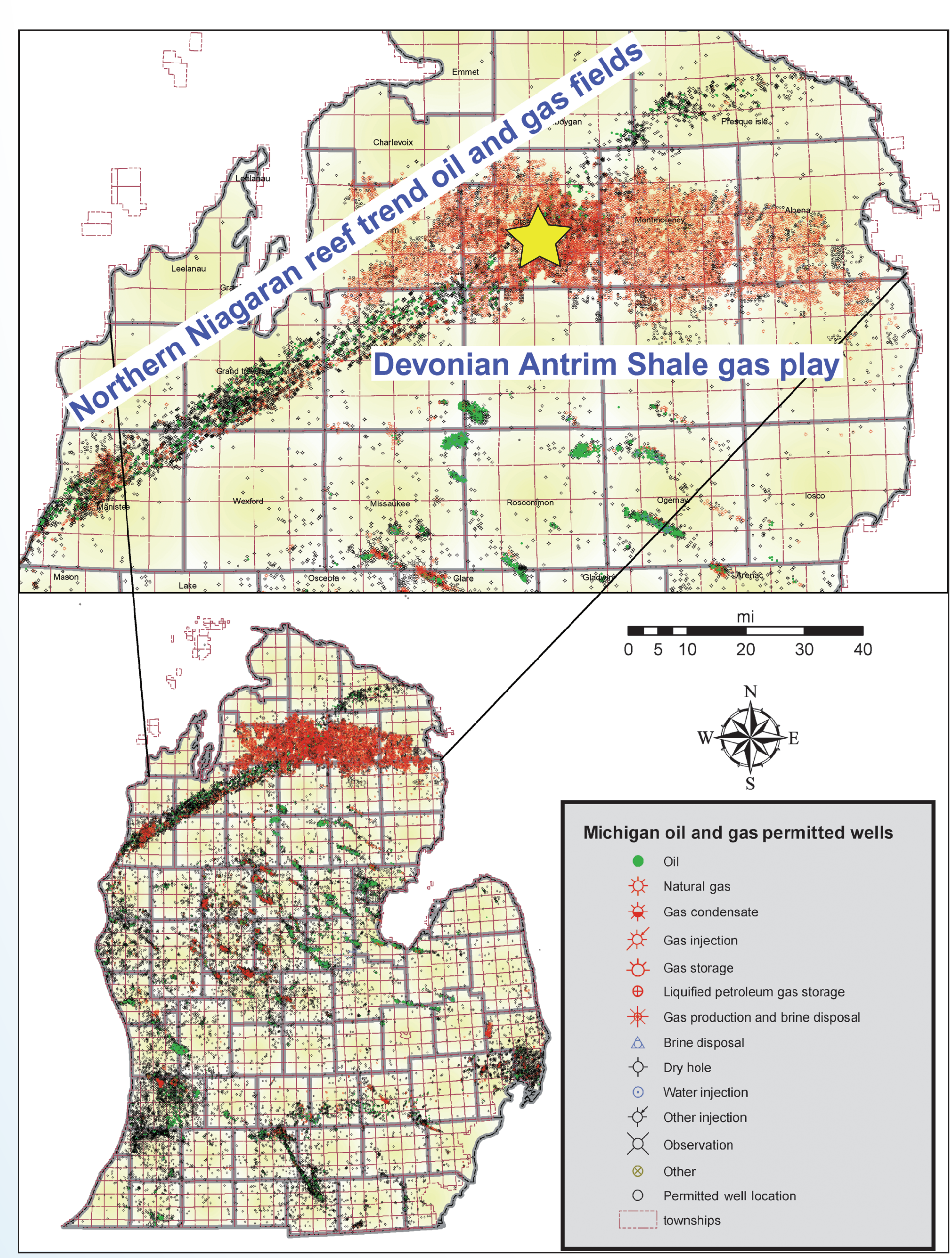
PARIS CLIMATE CONFERENCE AGREEMENT
In December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal

Governments agreed:

- 1) a long-term goal of keeping the increase in global average temperature to **well below 2°C** above pre-industrial levels
- 2) to aim to limit the increase to **1.5°C**, since this would significantly reduce risks and the impacts of climate change
- 3) on the need for **global emissions to peak as soon as possible**
- 4) to undertake **rapid reductions** thereafter in accordance with the **BEST AVAILABLE SCIENCE**

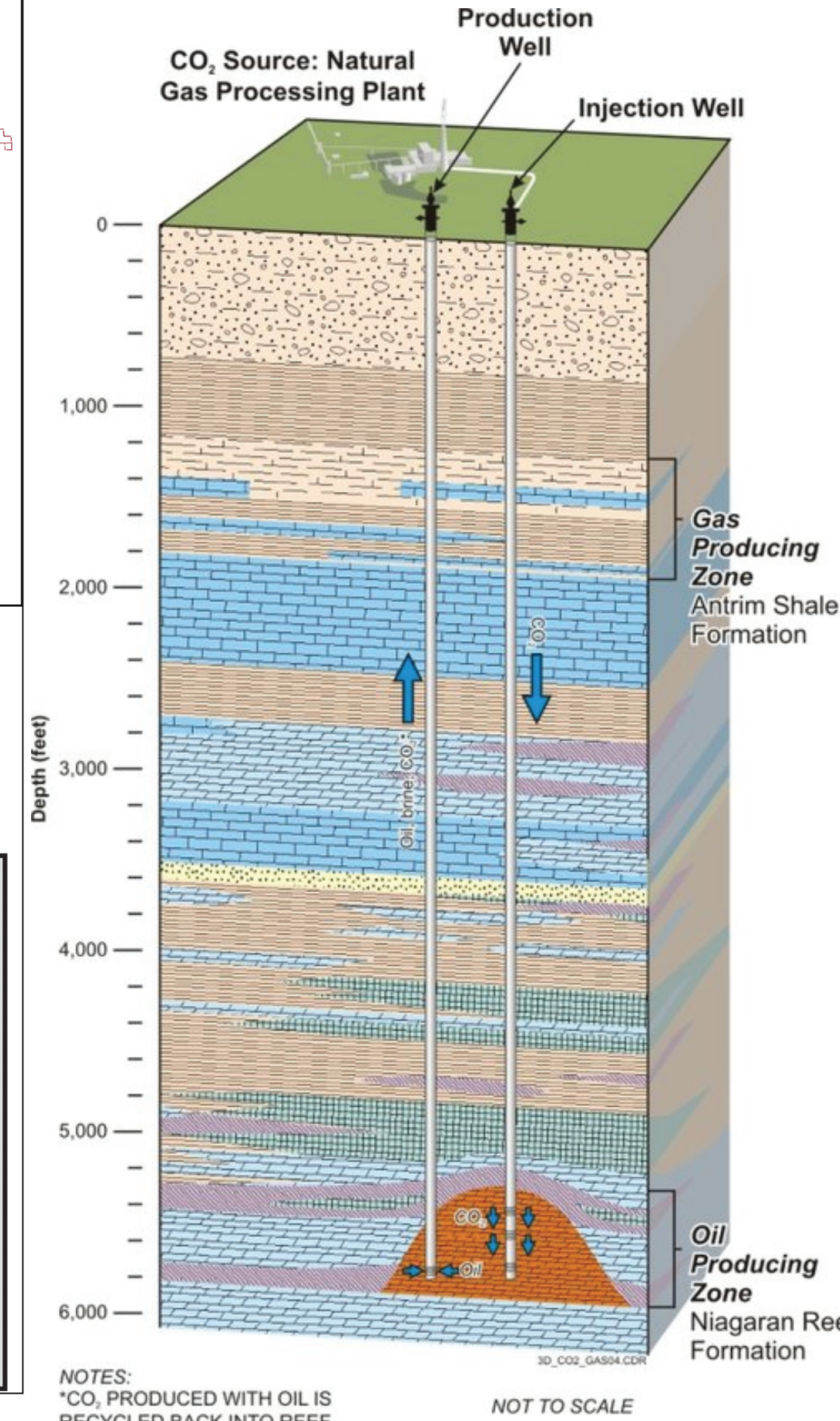
Our research addresses the science necessary to make these changes!

CO₂ SEQUESTRATION IN MICHIGAN



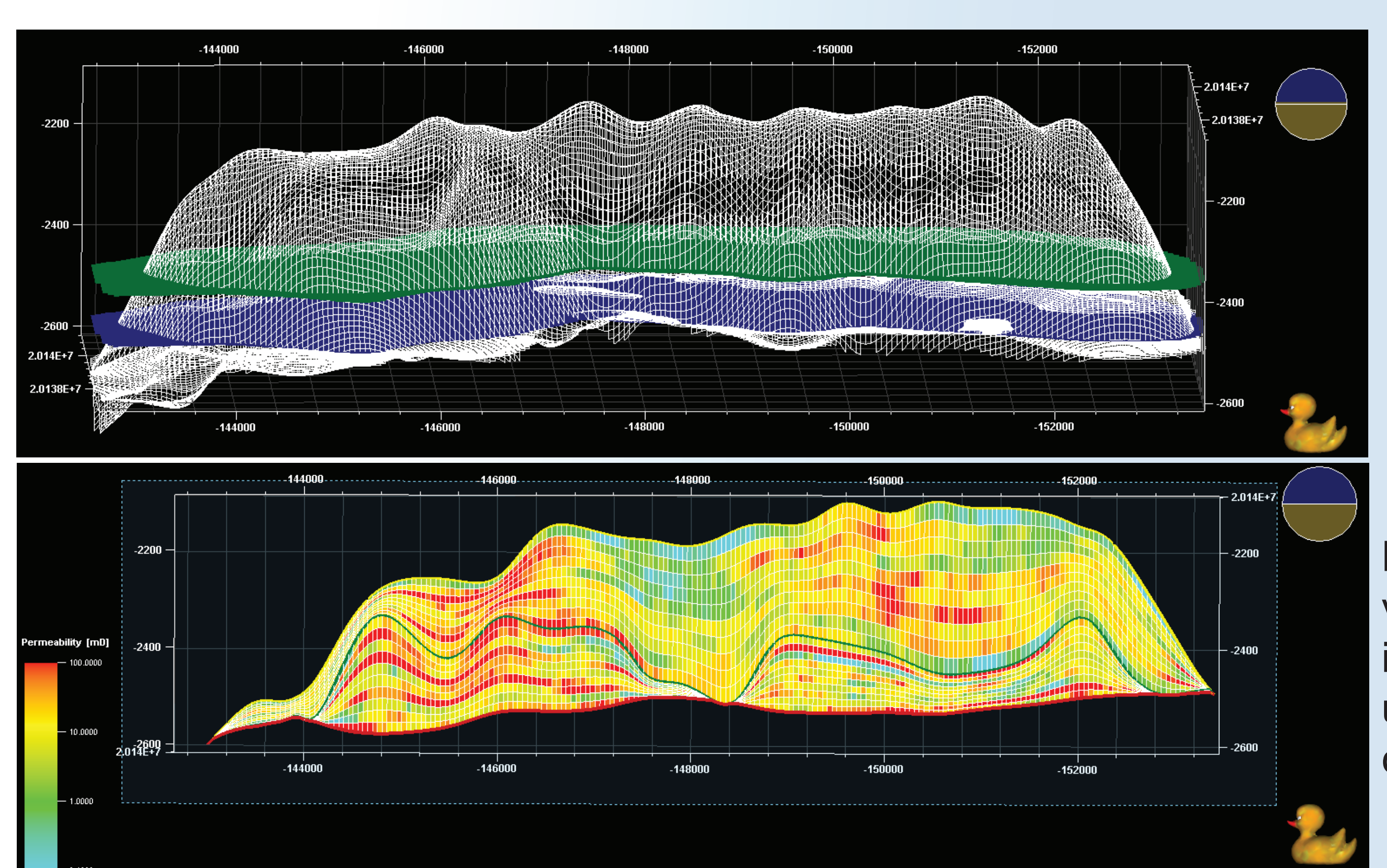
Grammer et al. 2008

“PERFECT STORM”



NOTES: CO₂ PRODUCED WITH OIL IS RECYCLED BACK INTO REEF. ALL LOCATIONS ARE APPROXIMATE.

RESULTS



Fluid contacts:
Oil (green),
and Water
(blue)

Permeability
values
interpolated
using 29
cored wells

MODEL VOLUME VALIDATION

	Net Volume [*10 ⁶ ft ³]	Pore Volume [*10 ⁶ ft ³]	HCPV oil [*10 ⁶ ft ³]	HCPV gas [*10 ⁶ ft ³]	HCPV total [*10 ⁶ ft ³]
Petrel 3D Grid	5445	302	112	174	286
BWGS Estimates	---	---	112	175	287

IMPLICATIONS:

- The resultant geologic models are used by reservoir engineers for fluid-flow modeling
- The predictive power of the conceptual geologic model can be applied elsewhere for upcoming reef targets for CO₂ injection