

# Spatial Seal Database for Prospective Storage Resources in the USA

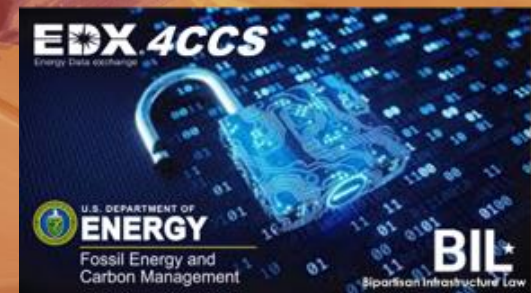


**Scott Pantaleone**

*Computational Geo-scientist/NETL Support Contractor*

*2024 FECM/NETL Carbon Management Research Project Review Meeting*

*Aug. 6, 2024*



# Disclaimer



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# Authors and Contact Information



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# Collecting Prospective Seal Data

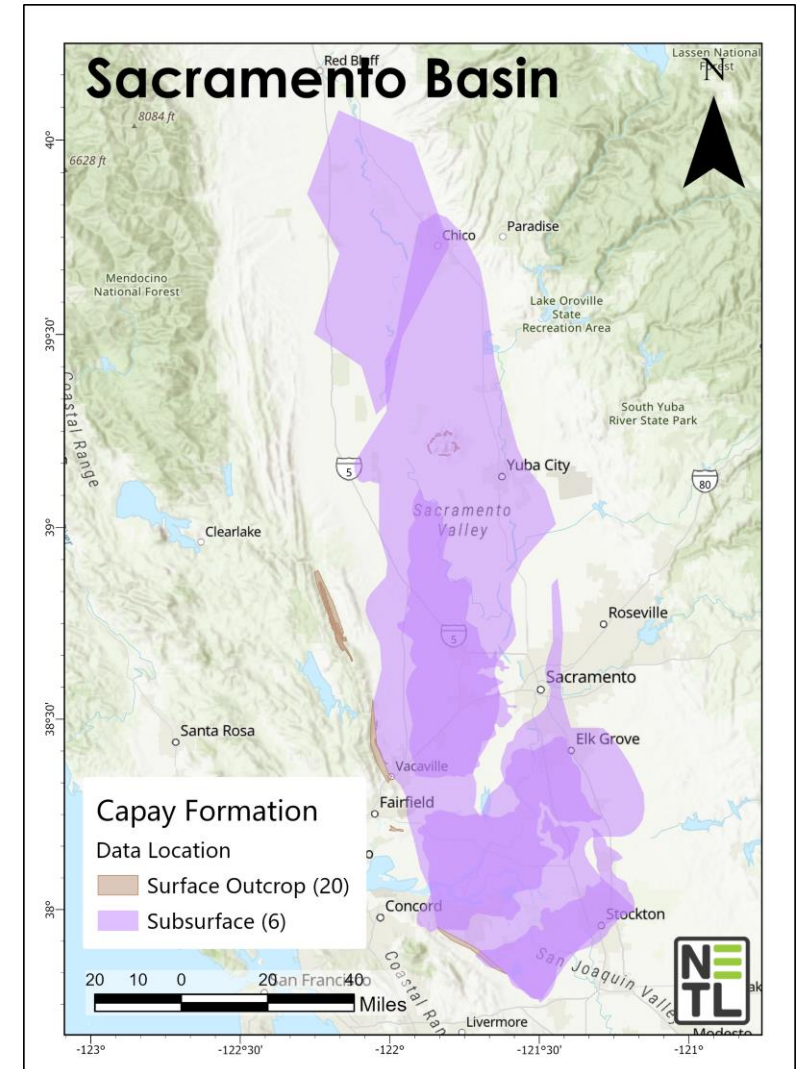
## Objective:

Guide stakeholders to relevant information on prospective confining units for carbon storage projects

1. Develop a **data catalog**
  - Seal unit names
  - Relevant properties
2. Develop a **database**
  - Seal rock units' spatial extent

## Challenge

- A lack of aggregated information available that focuses on the seal units needed for carbon storage-based assessments
- EPA Class VI permits requires an assessment of the confining zone (seal “caprock” unit)





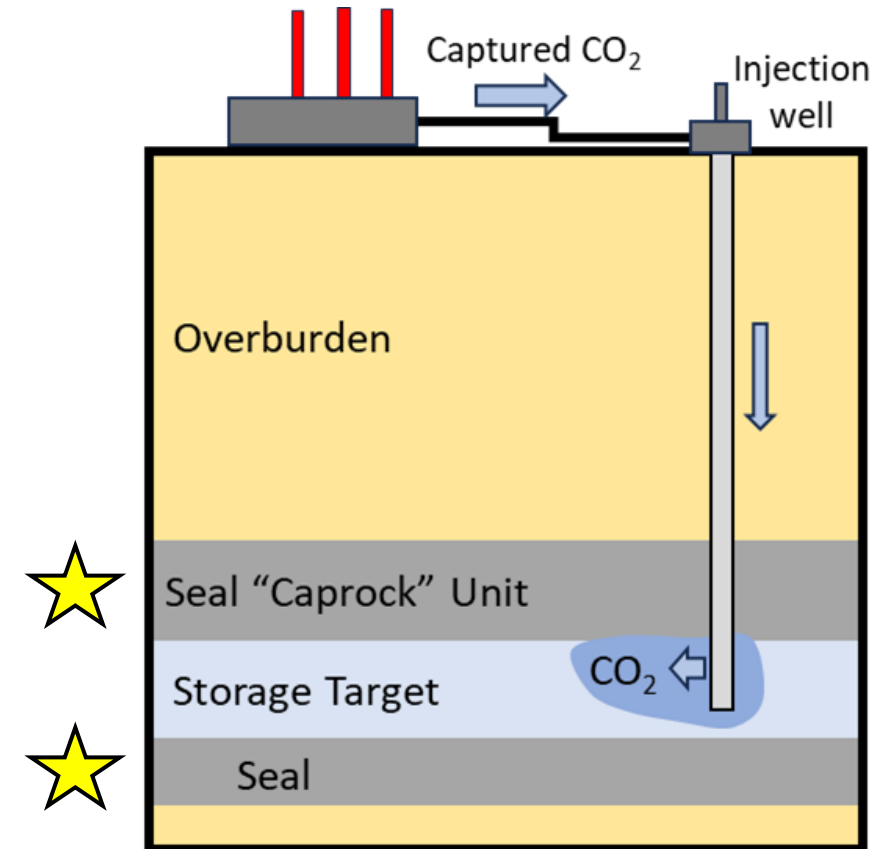
## Injection zone

- Geologic formation, group of formations, or part of a formation that is of sufficient areal extent, thickness, porosity, and permeability to receive CO<sub>2</sub> through a well

## Confining zone

- Geologic formation, group of formations, or part of a formation stratigraphically **overlying** and **underlying** the injection zone that acts as a barrier or **seal** to fluid movement

Injection and Confining Zones Diagram

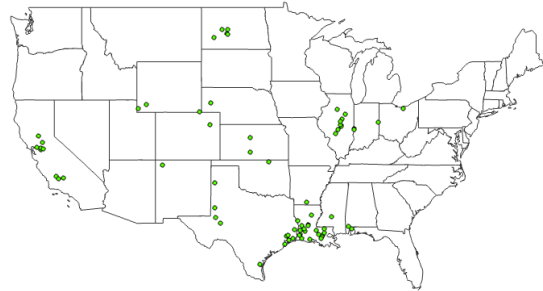


Definition Source: EPA UIC Program Class VI  
Well Site Characterization Guidance, 2013

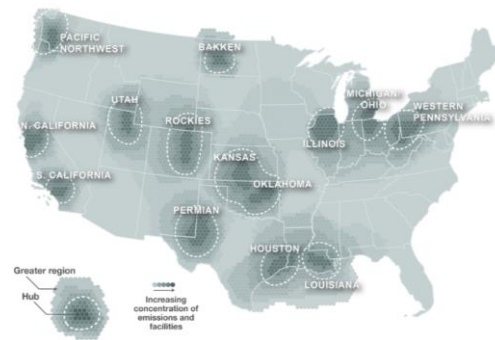
# Where to Search for Seal Data?

## High-priority areas

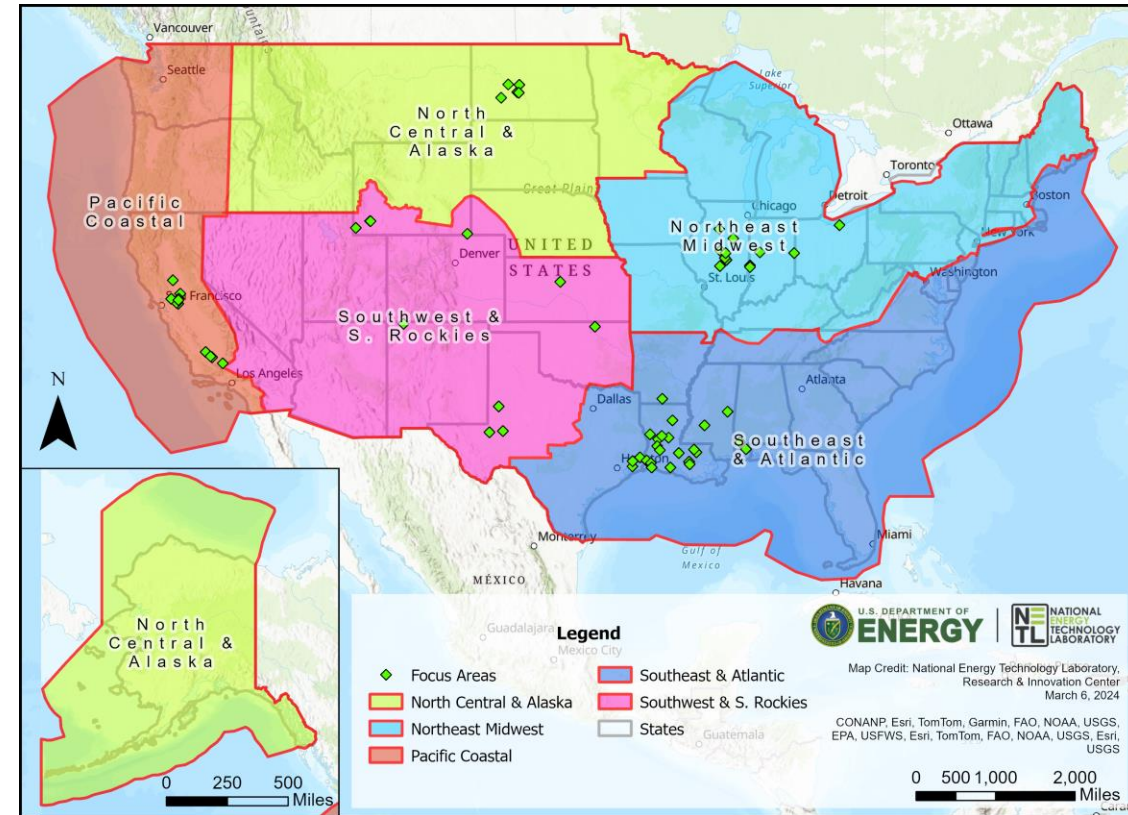
- Basins with current Class VI well projects
- Proximity to the Great Plains Institute (GPI) Hydrogen and CO<sub>2</sub> hubs



+



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EPA Class VI Project locations (Permit Applications as of July 2024).

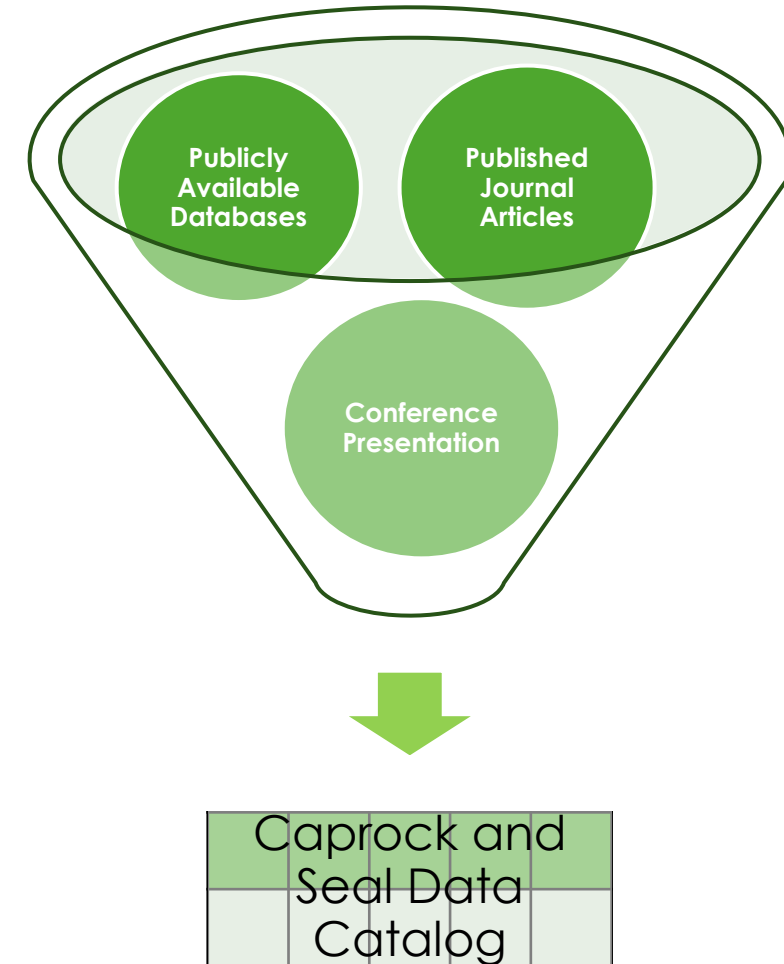
Atlas of Carbon and Hydrogen Hubs (Great Plains Institute, 2022).

Regional areas of high-priority basins for literature search.

# Aggregating Caprock and Seal Data for Data Catalog

## Method Overview

1. Leverage information on prospective **storage injection targets** to help form the initial seal unit name list
  - NATCARB
  - USGS National Assessment of Geologic Carbon Dioxide Storage Resources
2. Define rock properties most relevant to stakeholders
  - Porosity
  - Permeability
  - Depth
3. Start the literature search for data collection
  - Publicly available databases
  - Journal articles

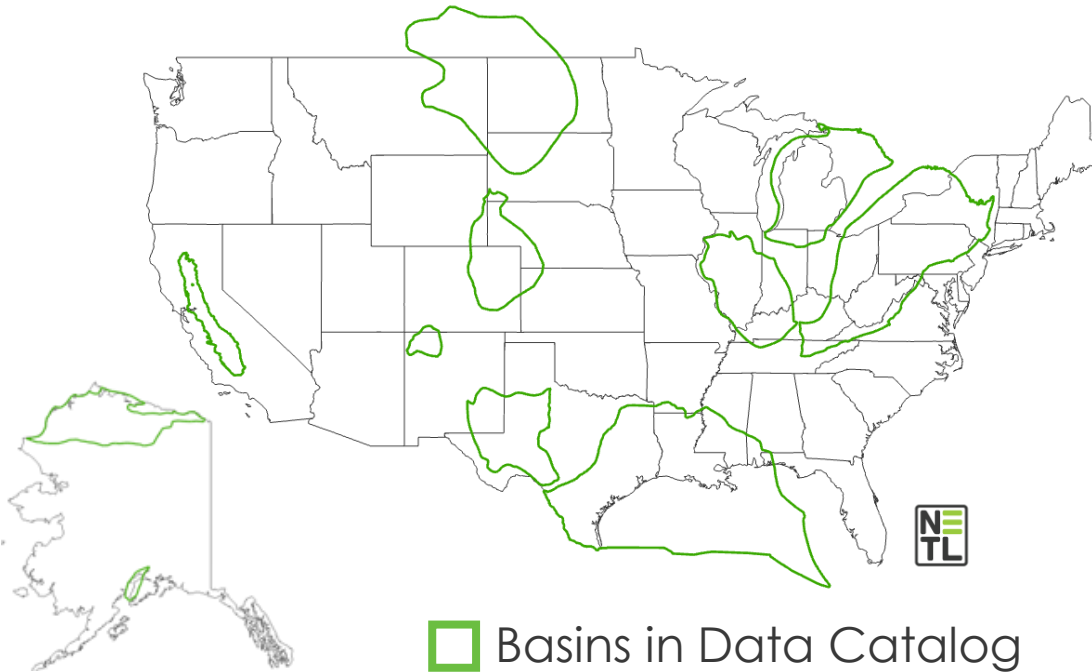


# Accomplishments to Date

- **Published** "Prospective Seal Name Catalog for U.S. Sedimentary Basins V1.0" on EDX
  - Describes **seal unit names** and **key properties**
  - Documents all **data citations** to guide stakeholders to original source



(February 2024)



Seal Rock Properties			
• Seal Unit Names	• Seal Lithology	• Field Test Data and Location	• Trap Type
• Associated Reservoir	• Seal Position (Overlying, underlying, etc.)	• Monitoring Zone (Min/Max)	• Capillary Pressure
• Basin	• Proximity (Primary/Secondary)	• Depth (Min, Average, Max)	• Porosity
• <b>Data Source</b> (Citation, Date, Type)	• Seal Age	• Thickness (Min, Average, Max)	• Permeability (Min, Average, Max)



# Project Timeline

Prospective Seal Name Catalog for U.S. Sedimentary Basins V1.0 published to EDX



February 2024

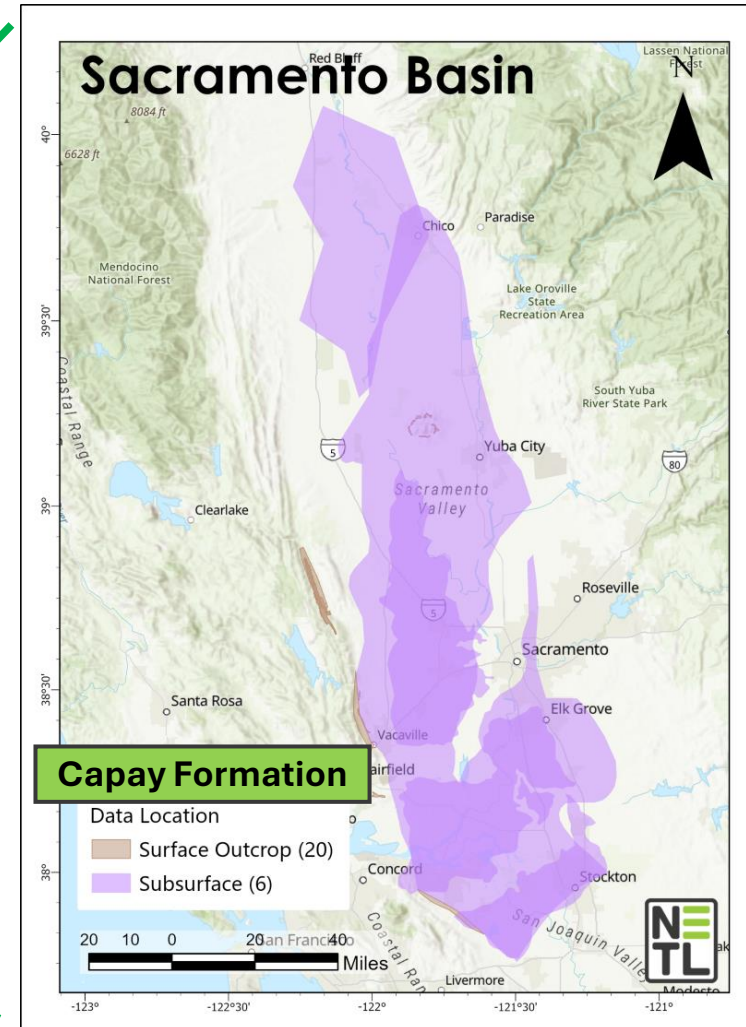
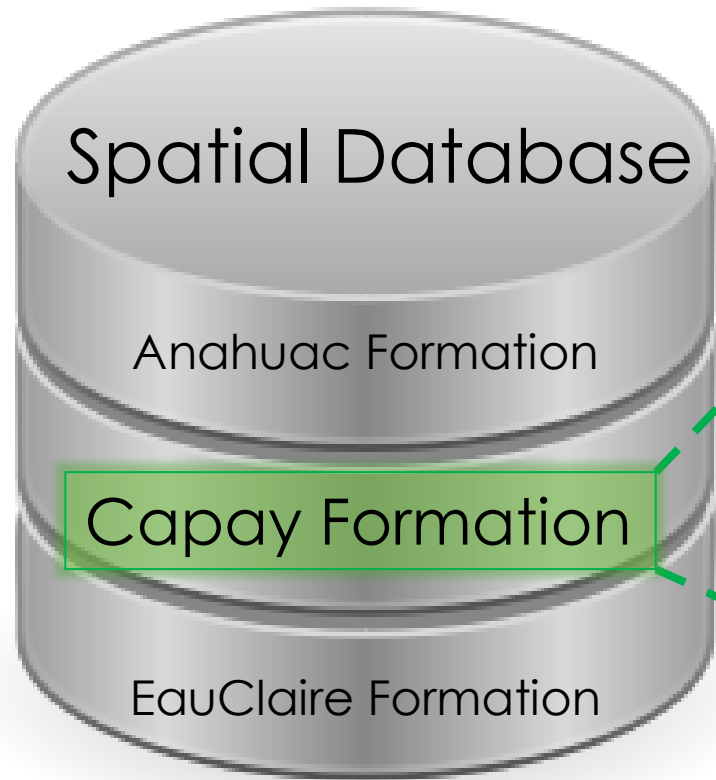
August 2024

Prospective Seal Unit Spatial Database for U.S. Sedimentary Basin V1.0 (ready to publish to EDX)

Publish updated Catalog and Spatial Dataset

Early 2025

# Prospective Seal Unit Spatial Database



# Building a Multi-Source Seal Spatial Database

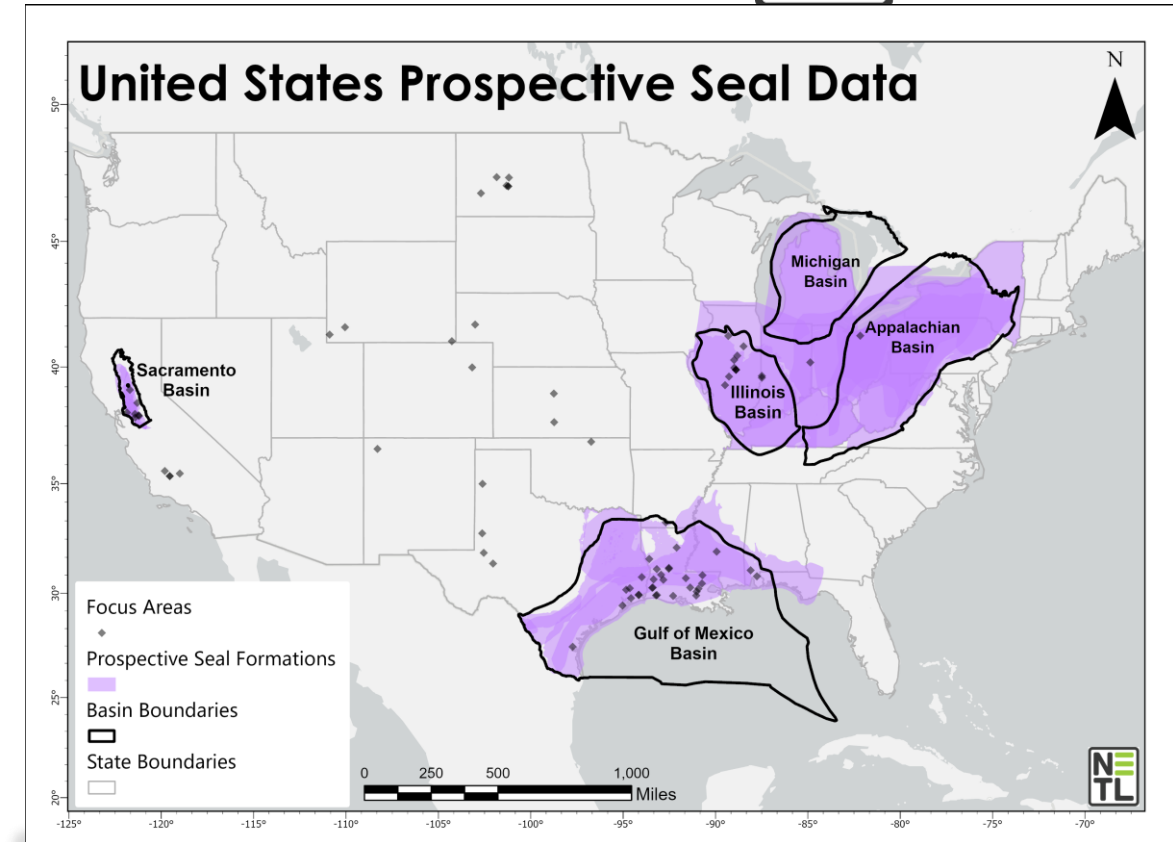
## Organized by **seal formation**

- Combines all individual datasets from multiple sources together by geologic formation

Enables users to select a spatial dataset to view:

- **Data type** of the original source
  - Known spatial data published
  - Georeferenced maps and cross-sections from literature
- **Citation** of the original source

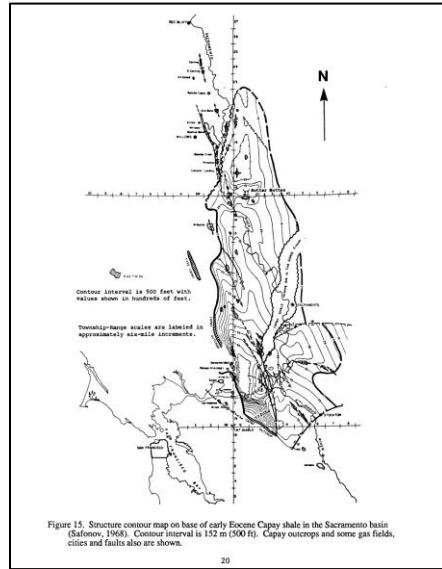
Database can guide stakeholders to the original **data source** to **view**, conduct further **research**, and download supplementary data (if applicable)



\*Will include additional basins with future updates (Williston, San Juan, San Joaquin, Alaska, etc.)

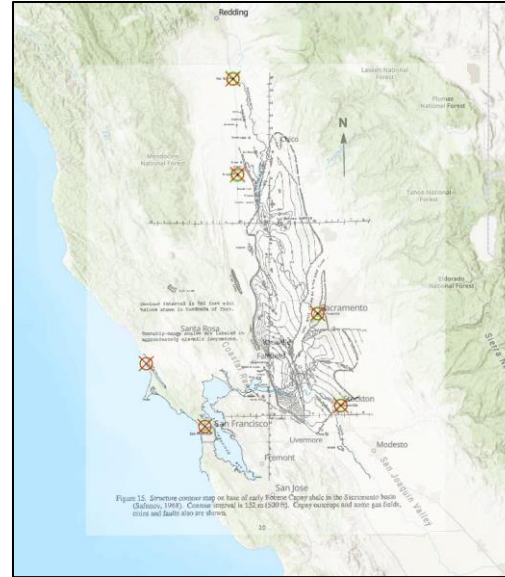
# Georeferenced Data Workflow

## Capay Formation Example



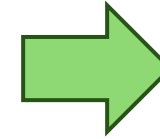
### Raw data from literature

1. Extract map figure from source report



### Georeferencing step

2. Import into ArcGIS Pro and "georeference" image using spatial reference information and anchor points



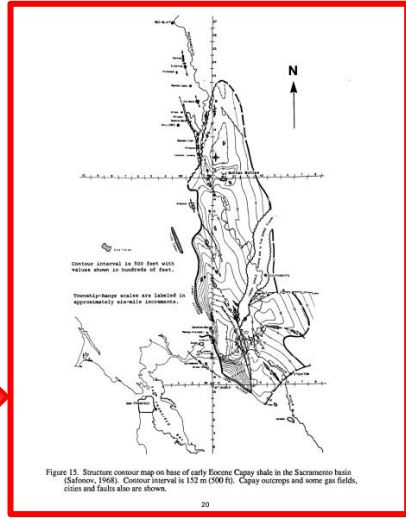
### Turn map into a polygon layer

3. Generate feature outline representing spatial extent of formation
4. Combine layer with spatial extents for the same formation



# Guiding Stakeholders Back to the Original Source

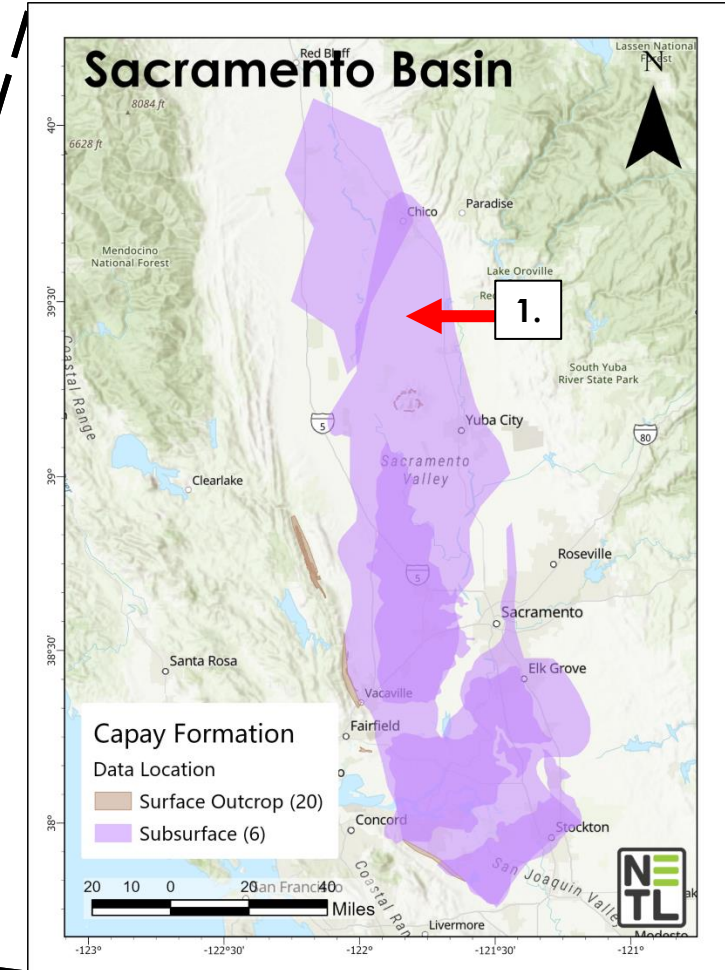
## Original Source



## How the database can act as a guide:

1. Select an individual layer within a formation
2. View attribute table (selected layer is highlighted)
  - a. Formation Name
  - b. Is the data subsurface or outcrop
  - c. Data Type
  - d. Spatial Quality
  - e. Geologic Age
  - f. Original **Source Link** and **Citation**
3. Visit original data source

## Processed Combined Layer



## Attribute table showing individual layers for the Capay Formation

Shape *	Formation	Basin	SubBasin	SubsurfaceData	Data_Type	Spatial_Quality	Sources_Table	GeoAge
Polygon	Lower Princeton and C...	Sacramento Basin	N/A	Yes	Cross-Section	Approximate Georefer...	Data_Sources.csv	Eocene
Polygon	Capay Shale	Sacramento Basin	N/A	Yes	Map Figure	Approximate Georefer...	Data_Sources.csv	Eocene
Polygon	Capay Shale	Sacramento Basin	N/A	Yes	Map Figure	Approximate Georefer...	Data_Sources.csv	Eocene
Polygon	Capay Shale	Sacramento Basin	N/A	Yes	Map Figure	Approximate Georefer...	Data_Sources.csv	Eocene
Polygon	Capay Shale	Sacramento Basin	N/A	Yes	Map Figure	Approximate Georefer...	Data_Sources.csv	Eocene
Polygon	Capay Formation	Sacramento Basin	N/A	Yes	Structure Contour Map	Approximate Georefer...	Data_Sources.csv	Early Eocene
Polygon	Capay Formation	Sacramento Basin	N/A	No	Field Data	Approximate Georefer...	Data_Sources.csv	Eocene
Polygon	Capay Formation	Sacramento Basin	N/A	No	Quadrangle	Approximate Georefer...	Data_Sources.csv	Eocene

3.

2.

1.

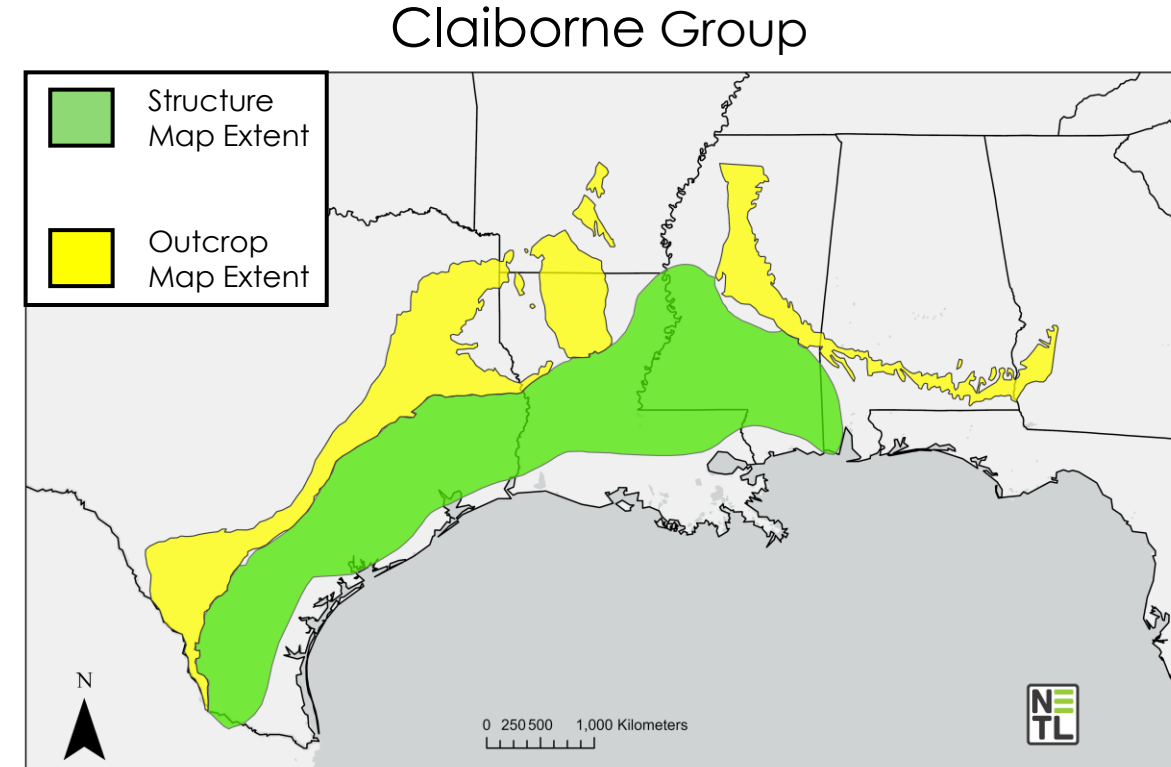
# Spatial Data Types

## Subsurface Data

- Extent of the confinement zone
- Extent of formation overall
- Seal formation depth structural map
- Seal formation isopach (thickness) map

## Surface Data

- Spatial extent of formation in outcrop
- Surface representation provides contextual information valuable to geo modelers
  - Outcrop provides higher resolution than remotely sensed or wellbore data and is a better proxy for dynamics associated with depositional environment



Map Extents Georeferenced from Hackley, 2012

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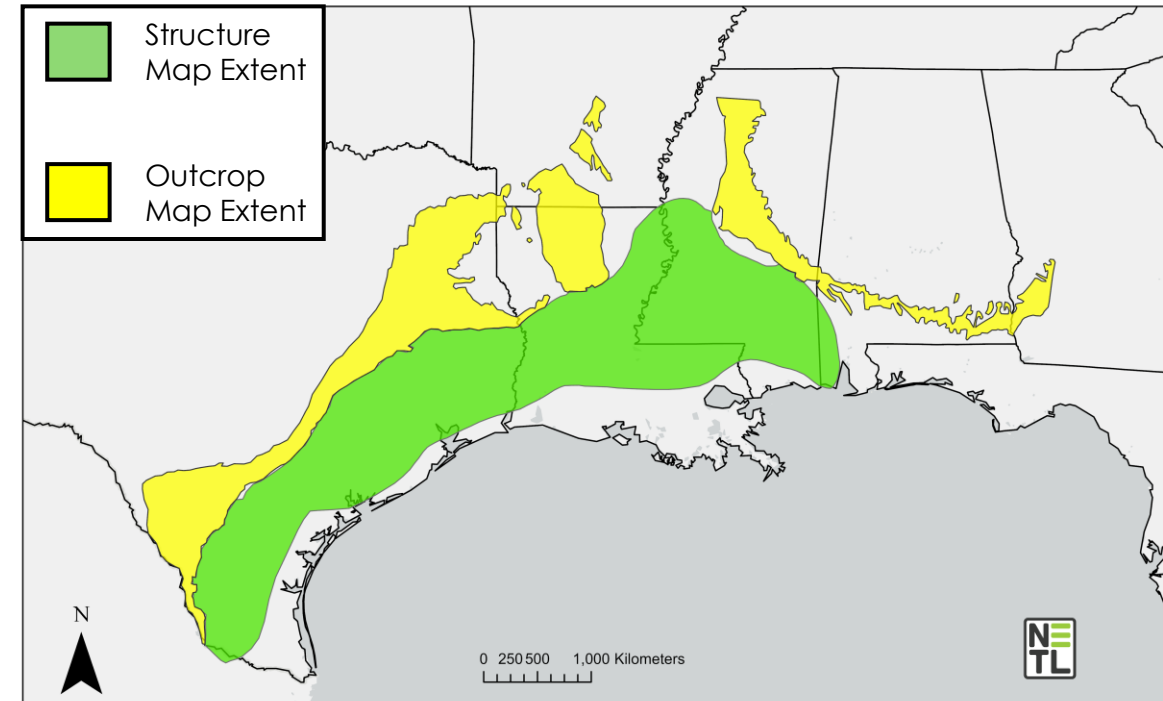
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## Claiborne Group

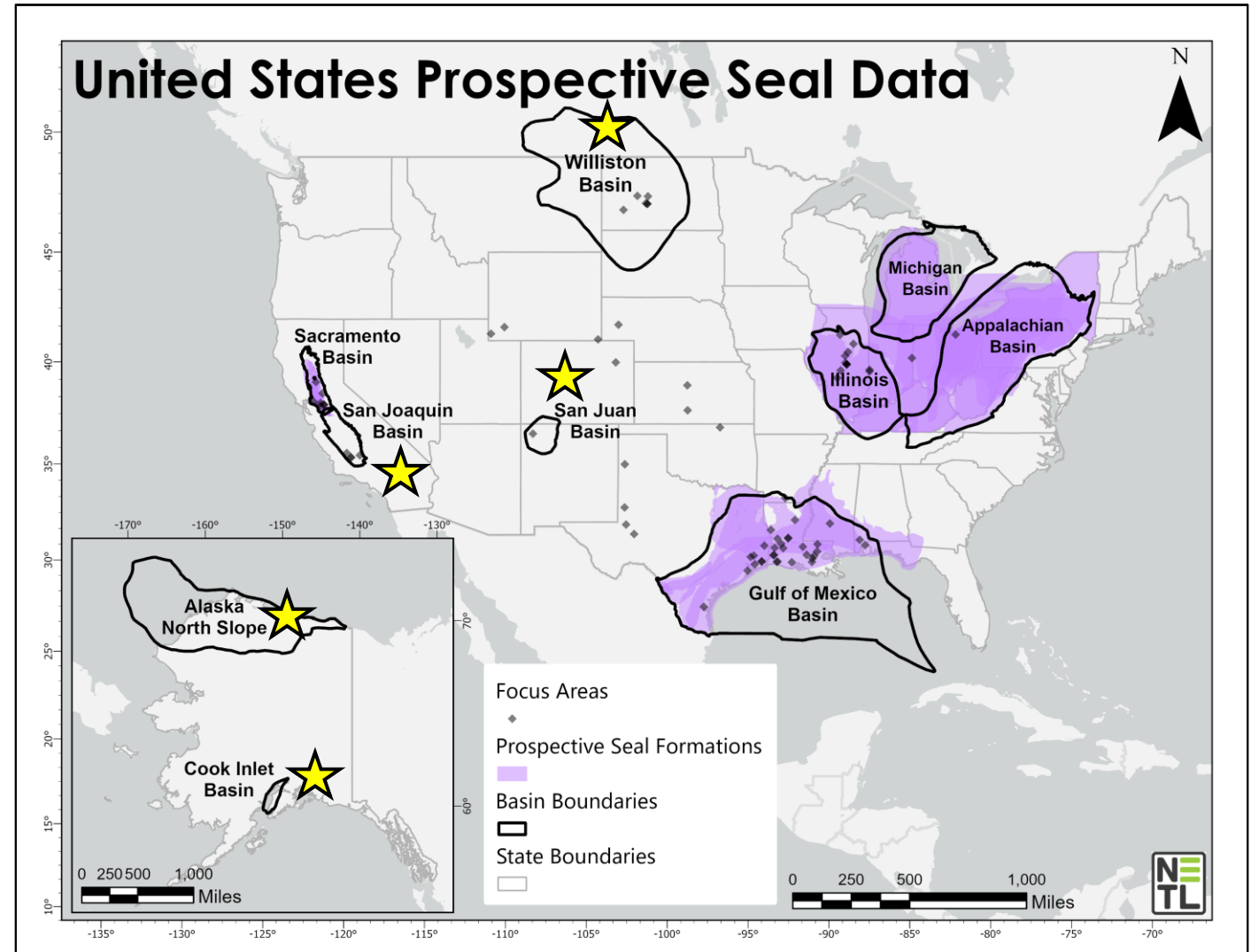


Map Extents Georeferenced from Hackley, 2012

# Prospective Seal Spatial Extent Database V1.0

## Next Steps

- Publish Prospective Seal Spatial Extent Database V1.0 to EDX (8/31/2024)
- Update the database with datasets from additional areas of interest
  - ★ Williston
  - ★ San Juan
  - ★ San Joaquin
  - ★ Alaska North Slope
  - ★ Cook Inlet
    - And more!



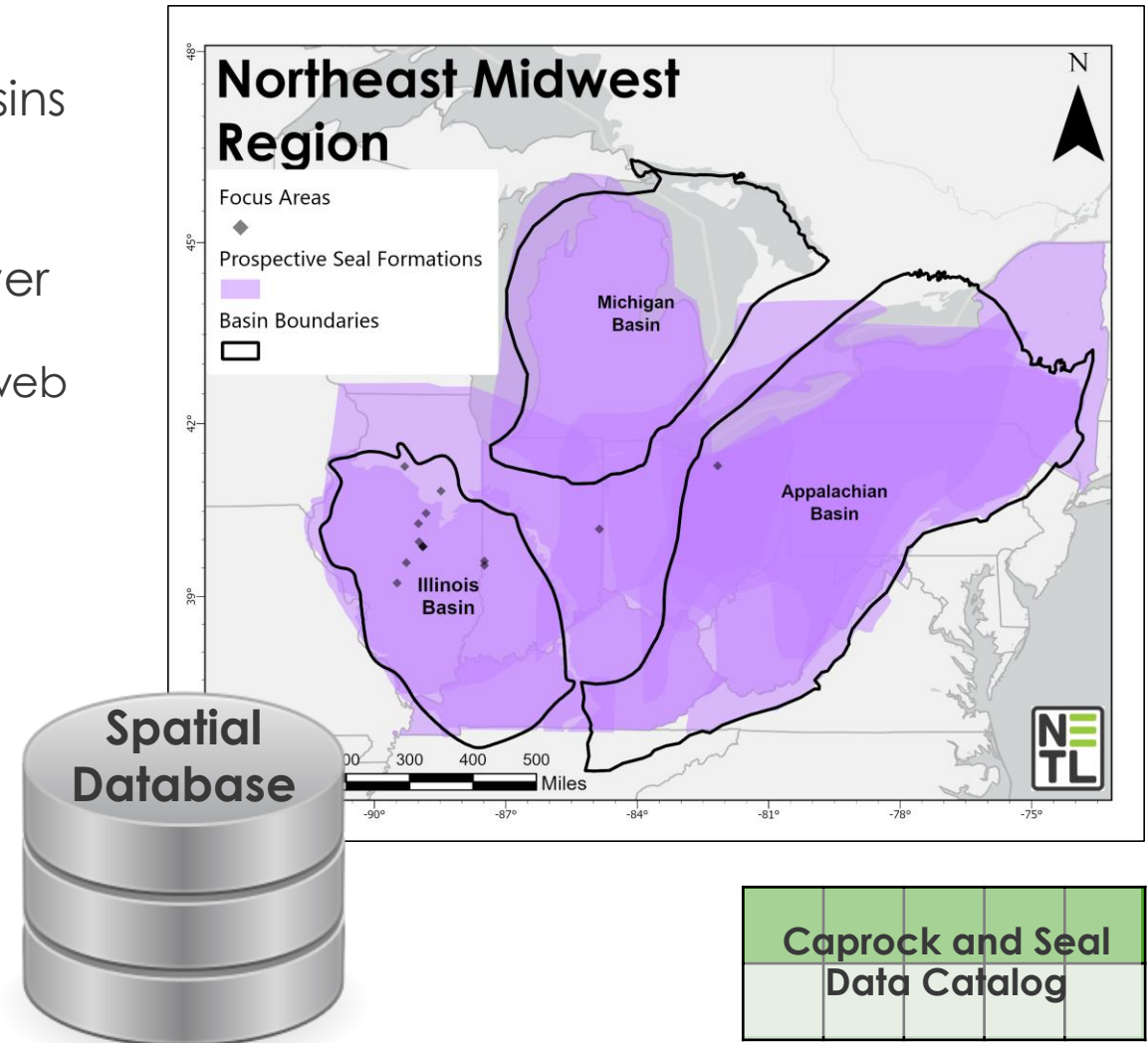


## Ultimate Outcomes

- Provide **seal data** for high-priority sedimentary basins
  - **Data Catalog** of seal names and key properties
  - **Database** showing seal unit spatial extent
- Publish an updated database to the EDX DisCO<sub>2</sub>ver platform
  - Access and explore seal data within an interactive web application

## Benefits to Stakeholders

- Providing **seal data** for high-priority sedimentary basins helps in carbon storage assessments
  - Guide stakeholders to the original data sources
- Complementary resource to prospective storage datasets (e.g., NATCARB)
- Assists with the identification of data gaps for seal rocks



- Geologic Sequestration of Carbon Dioxide; Underground Injection Control (UIC) Program Class VI Well Area of Review Evaluation and Corrective Action Guidance, EPA 2013
- Hackley, P.C., 2012, Geologic assessment of undiscovered conventional oil and gas resources—Middle Eocene Claiborne Group, United States part of the Gulf of Mexico Basin: U.S. Geological Survey Open-File Report 2012-1144, 87 p., available only at <http://pubs.usgs.gov/of/2012/1144/>.
- Schlumberger Energy Glossary, 2024 <https://glossary.slb.com/en/terms/s/seal>.

# Acknowledgments

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# DEMO & POSTER SESSION

TUESDAY, AUGUST 6, 2024

5:45 PM - 7:45PM

BALLROOM GALLERY



CARBON TRANSPORT & STORAGE DATA AND  
INNOVATION TO BRIDGE THE DIGITAL DIVIDE





# NETL Carbon Storage Outreach Example

## 2024 FECM/NETL Carbon Management Research Project Review Meeting

### 100+ DOE-sponsored CTS presentations

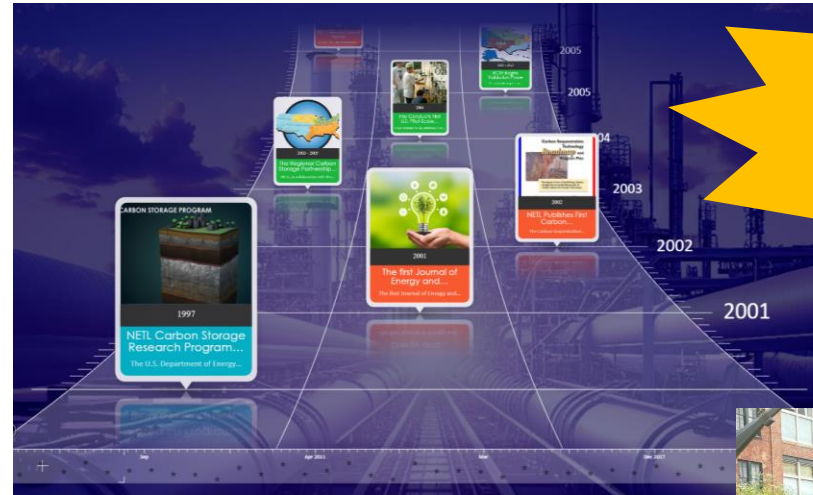
Presentations on EY23 CTS work:

- Advanced Storage FWP
- Carbon Storage Data FWP
- Carbon Storage Analysis FWP
- Multi-Modal Transportation FWP
- EDX4CCS
- NRAP
- SMART

### Open to the public

Attendees from government agencies, utilities, research, universities, industry

Poster and tool/app demo session – Tuesday Aug. 6<sup>th</sup> evening

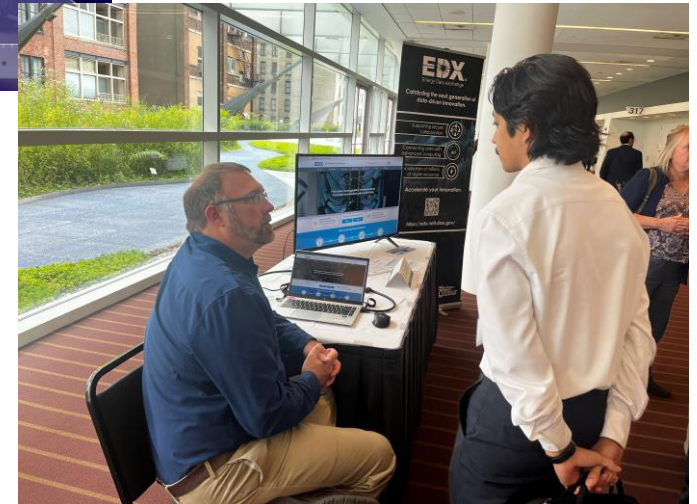


Carbon Storage Timeline summarizing field, lab and computational contributions to CTS' digital future  
Live, interactive demo at the booth!

Source: NETL

**Stop by the CTS booth in the exhibit hall to learn more!**  
**Take-aways, information, expertise in one stop shop**

**Aug. 5-9, 2024  
Pittsburgh  
Convention  
Center**



Multiple tool demos will be hosted  
Source: NETL

# NETL RESOURCES

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VISIT US AT: [www.NETL.DOE.gov](http://www.NETL.DOE.gov)

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