GEESS as a Mechanism to Facilitate the Commercialization of Geologic Carbon Sequestration

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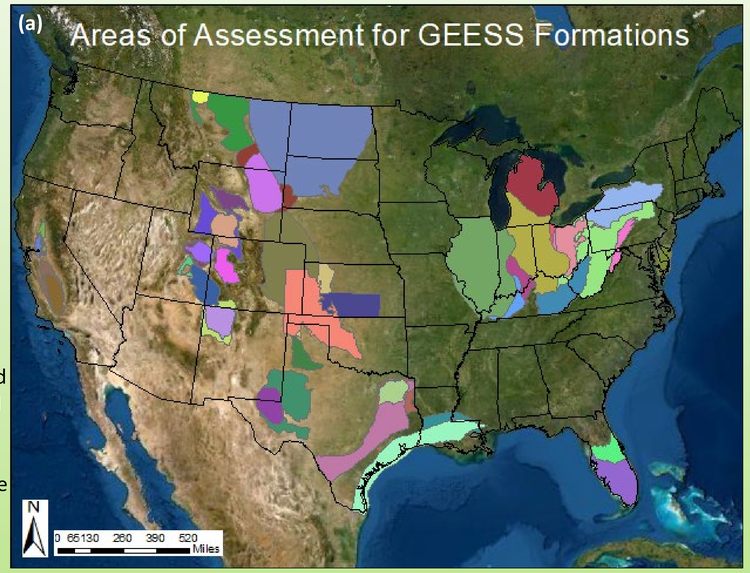
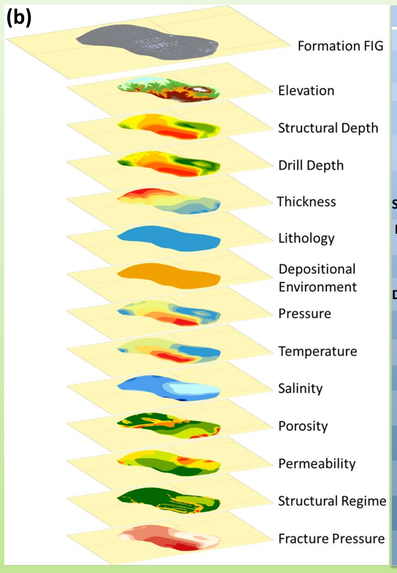
Overview

The Geoanalytical Economic Evaluation of Saline Storage (GEESS) project objectives are to characterize 57 geologic saline formations targeted for geologic carbon sequestration (GCS) using publicly available datasets. The GEESS system consists of high spatial resolution datasets (up to a 5 km grid spacing) that characterize critical geologic parameters such as depth, thickness, porosity, permeability, fracture pressure, and more. Further, GEESS geologic data were exercised using the FECM/NETL Saline Storage Cost Model (CO2_S_COM) to estimate CO_2 plume sizes and the first-year break-even price of CO_2 at the grid point level. GEESS is now available on NETL's Energy Data Exchange (EDX).

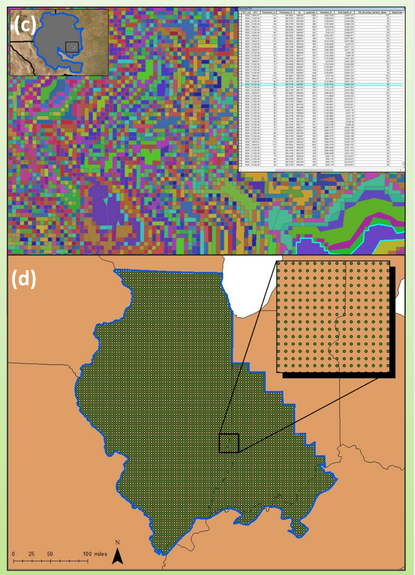
Methodology

- 57 saline formations across the lower 48 states (a) are analyzed for the geologic parameters shown in (b).
- GEESS is based on a Fully Integrated Geodatabase (FIG), often consisting of tens of thousands of individual polygons with discrete data values (c).
- The FIG is sampled with a grid (d). The gridded geologic data were exercised through NETL's CO2_S_COM to estimate the CO_2 plume sizes for each point, which provided a formation-unique grid spacing to reflect hypothetical project independence.



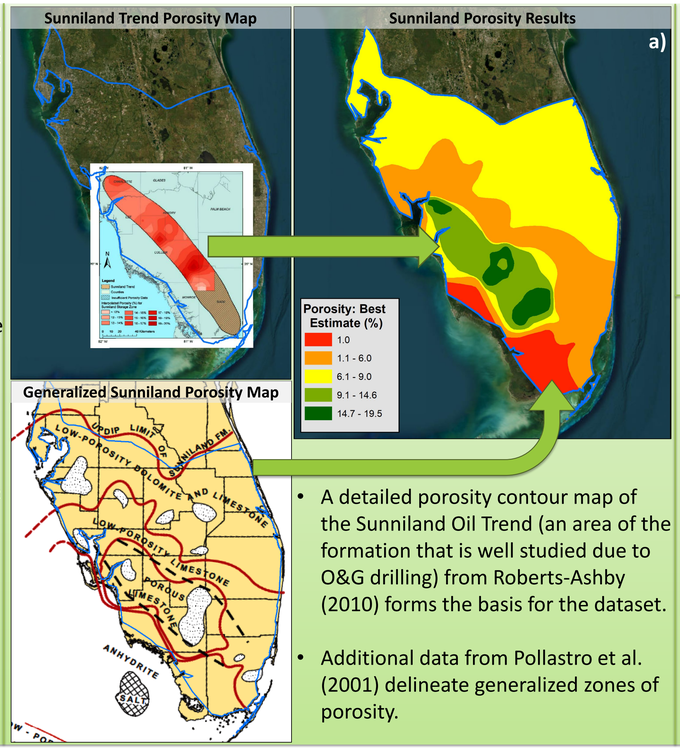


GEESS Phase 5 Data Fields	
Formation Number	Porosity: Best Estimate
Formation Identifier	Porosity: Minimum
Formation Name	Porosity: Maximum
State	Permeability: Best Estimate
Basin	Permeability: Minimum
Regional Carbon Sequestration Partnership	Permeability: Maximum
Reservoir Type (saline vs. brackish)	Salinity
Lithology	Dome Structure
Depositional Environment	Anticline Structure
Geologic Age	5 Degree Incline
Area of Analysis	10 Degree Incline
Grid Pt. Long.	Flat Structure
Grid Pt. Lat.	Fracture Pressure: Best Estimate
Depth - top	Fracture Pressure: Minimum
Thickness	Fracture Pressure: Maximum
Formation Pressure	Plume Uncertainty Diameter
Formation Temperature	First-Year Break-Even Price of CO_2

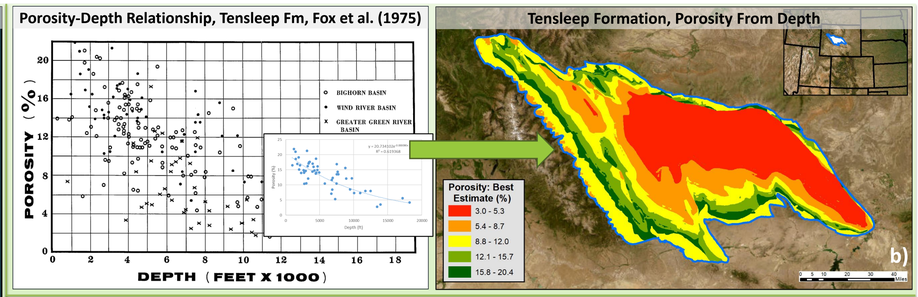


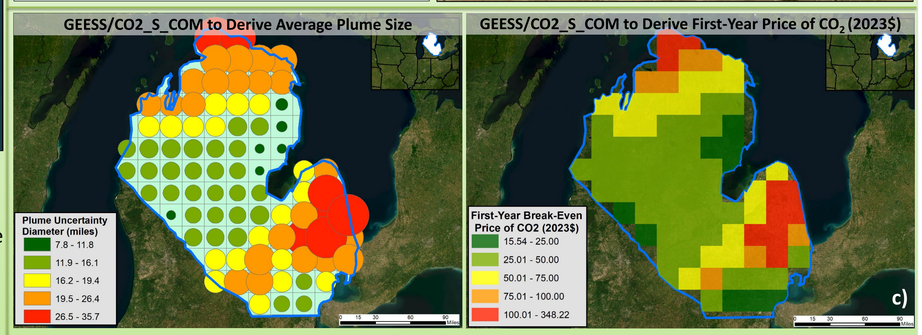
Example Results

- Geologic data were incorporated into the FIG by digitizing maps, contouring, regressions, pressure and geothermal gradients, digital datasets, etc.
- (a) – porosity in the Sunniland Fm, FL
- (b) – porosity in the Tensleep Fm, Wind River Basin, WY
- (c) – estimated CO_2 plume uncertainty diameter and first-year break-even price of CO_2 in the Mount Simon Fm, Michigan Basin (derived from CO2_S_COM)



- A detailed porosity contour map of the Sunniland Oil Trend (an area of the formation that is well studied due to O&G drilling) from Roberts-Ashby (2010) forms the basis for the dataset.
- Additional data from Pollastro et al. (2001) delineate generalized zones of porosity.

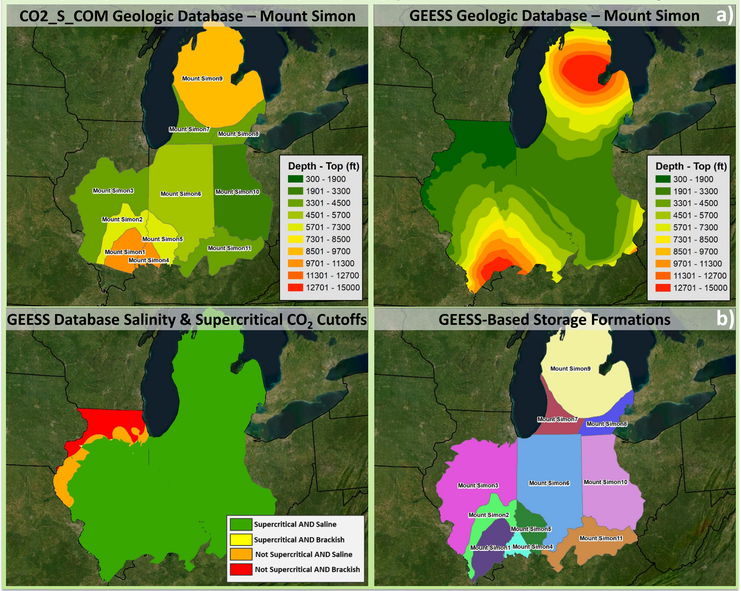




- GEESS geologic data were exercised through CO2_S_COM to estimate CO_2 plume sizes and the first-year break-even price of CO_2.
- The average plume size was used to define the new formation-specific grid sizing, meant to reflect hypothetical independent project locations.

Work In Progress

- The GEESS database contains a high degree of geologic granularity (a).
- GEESS is being used to create an alternative version of the existing CO2_S_COM geologic database (b) including 1) refined storage formation areas (must be > 1,000 sq mi, contiguous and separated by state, fit salinity and supercritical CO_2 conditions) and 2) representative values for each geologic parameter with min/max/median and $10^{th}/25^{th}/75^{th}/90^{th}$/ percentile values from GEESS grid data.



Lessons Learned to Date

- The quality and quantity of public domain data varies among GEESS formations.
- Data can be concentrated in legacy O&G assets (typically having the best reservoir quality); we make diligent efforts to ensure that parameter values are representative.
- Geologic formations are heterogeneous and complex.
- There is variability in the ability to store carbon and the estimated first-year break-even price of CO_2 among the various formations, as well as within the formations themselves.

Next Steps

- The GEESS database is being used to create an alternative version of the CO2_S_COM geologic database, providing refined geologic values and storage formation areas derived from the detailed spatial characterization in GEESS
- Contemplated future work: detailed characterization of traps and spill points, rationalize areas of assessment between GEESS and CO2_S_COM, and adding additional formations into the GEESS system

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