Characterization and Preliminary Feasibility Assessment of CO_2 Storage and Containment Resources in Deep Saline Cambrian-Ordovician Formations in Eastern Ohio

Priya Ravi Ganesh (raviganeshp@battelle.org), Shuvajit Bhattacharya, Andrew Burchwell, Amber Conner, Isis Fukai, Autumn Haagsma, Mark Kelley, Glenn Larsen, Joel Main, Samin Raziperchikolaee, Mackenzie Scharenberg, Caitlin McNeil and Neeraj Gupta
Battelle, Columbus, OH

ABSTRACT

The poster discusses the systematic development of a regional geologic storage framework using pre-existing and new data on potential storage reservoirs and caprocks to investigate preliminary CO_2 storage capacity, injectivity and containment integrity.
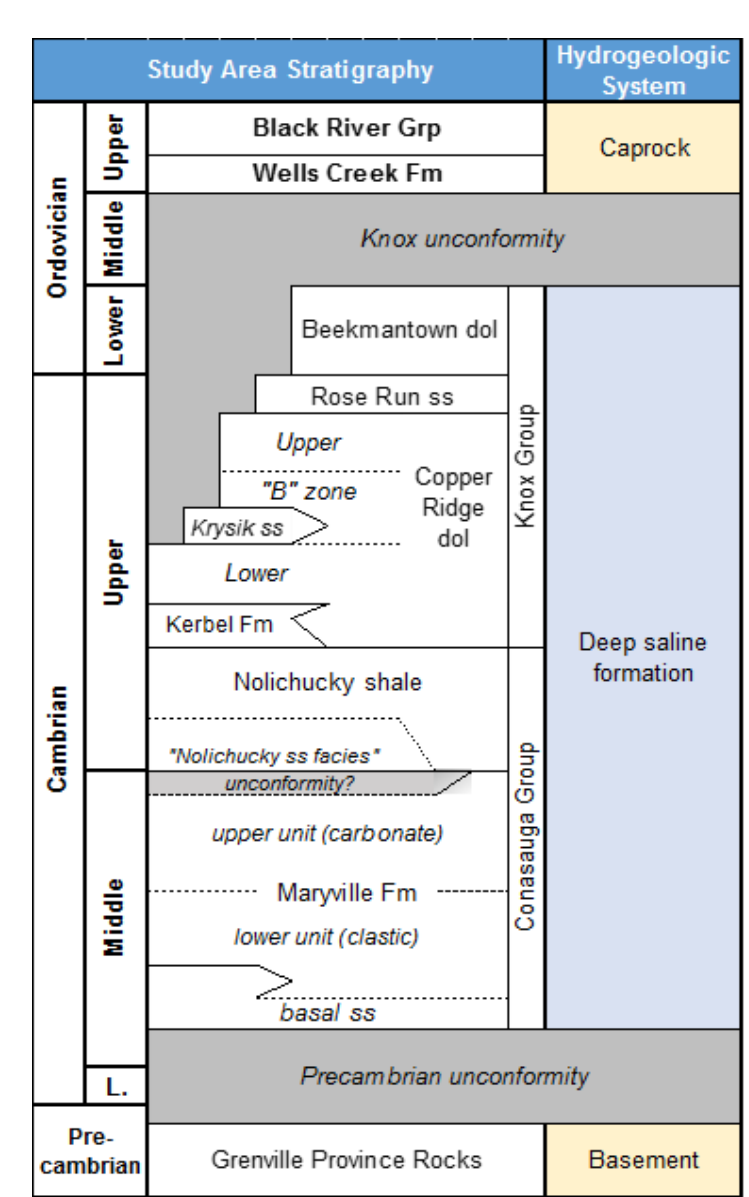
INTRODUCTION

- Background:
  — In 2015, 113 Mt of CO_2 was reportedly emitted with nine of the largest emitters being coal-fired power plants in eastern Ohio.
  — Oil and gas-associated activities such as commercial-scale brine disposal operations suggest the potential of these formations for CCUS.
- The overall goal of the project was to facilitate better understanding of the potential of deep saline formations and overlying caprocks for geologic storage of CO_2 in Ohio.
- A significant amount of geologic and petrophysical data was collected and analyzed for the characterization and assessment of identified reservoirs and caprocks in the eastern Ohio study region.


(Source: Modified from ODNR, 2016)
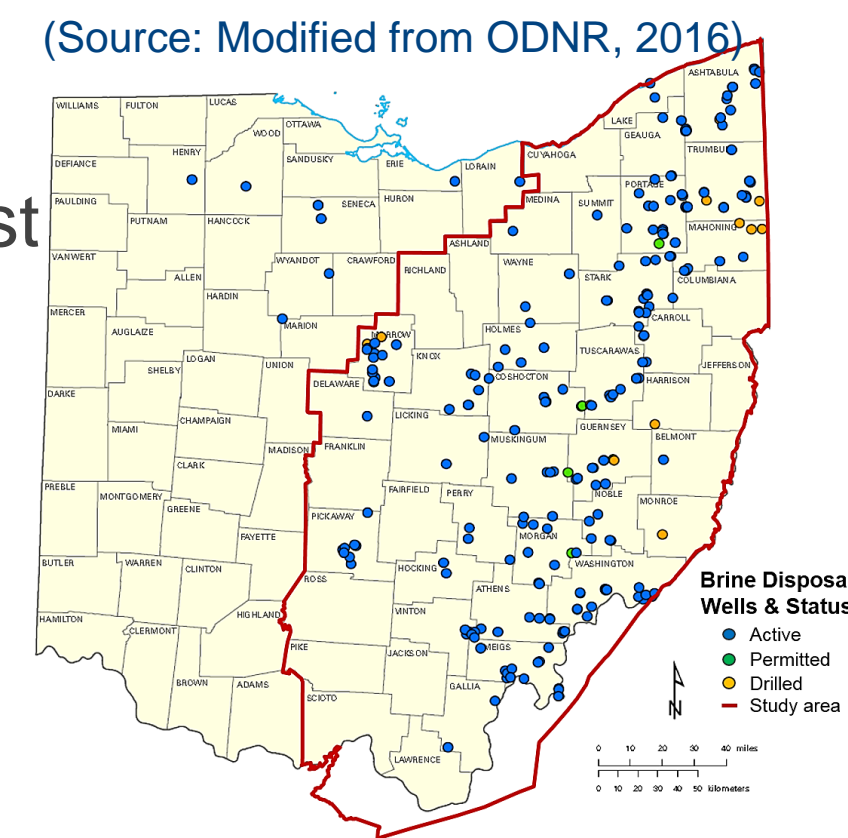
TECHNICAL APPROACH

A complete geologic database with fewer data gaps helped establish trends from advanced data. This regional-scale data made possible preliminary numerical modeling analyses of long-term storage capacity and overall system integrity.

Integrated advanced geologic characterization of potential reservoirs and caprocks help establish preliminary geologic storage framework and evaluate feasibility and scale of CCUS in the study region.
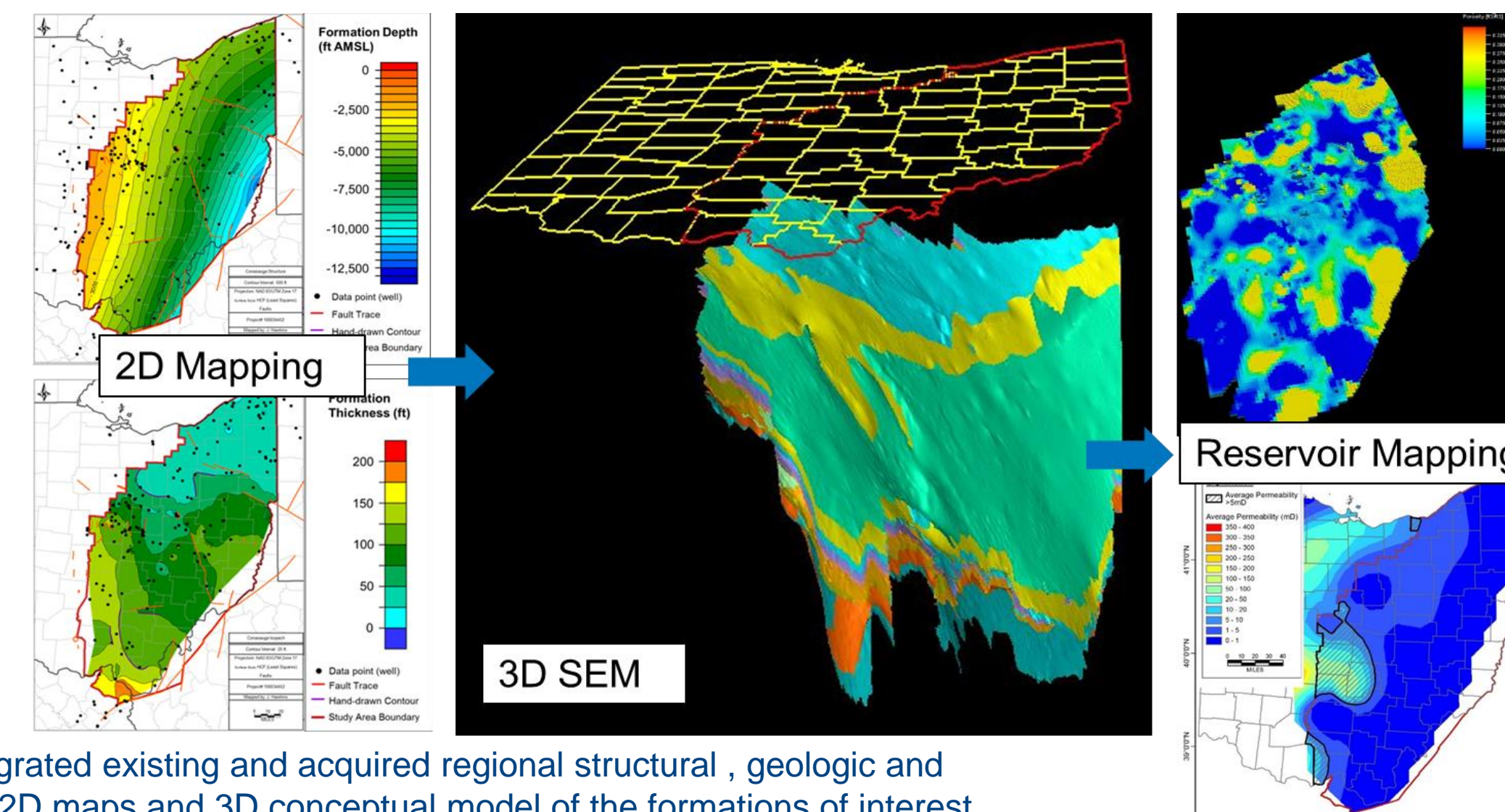
Simplified stratigraphic column of formations of interest in the study region.
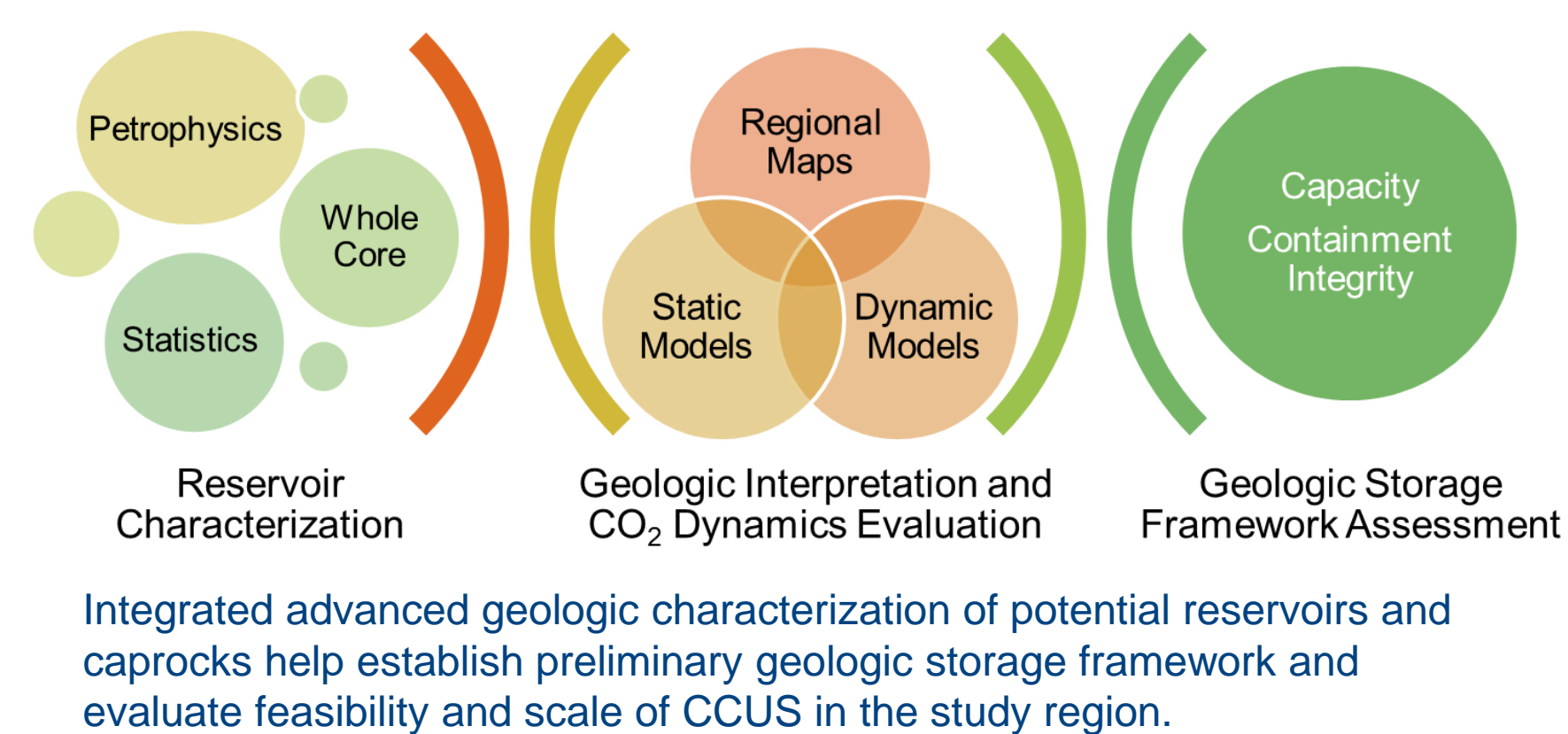
Advanced wireline log data, core data and field injection test data guided the development of geologic storage framework in the region.

RESULTS – GEOLOGIC CHARACTERIZATION

Regional database of Cambrian-Ordovician geology was developed for eastern Ohio.

Geologic characterization integrated existing and acquired regional structural, geologic and petrophysical data to develop 2D maps and 3D conceptual model of the formations of interest.
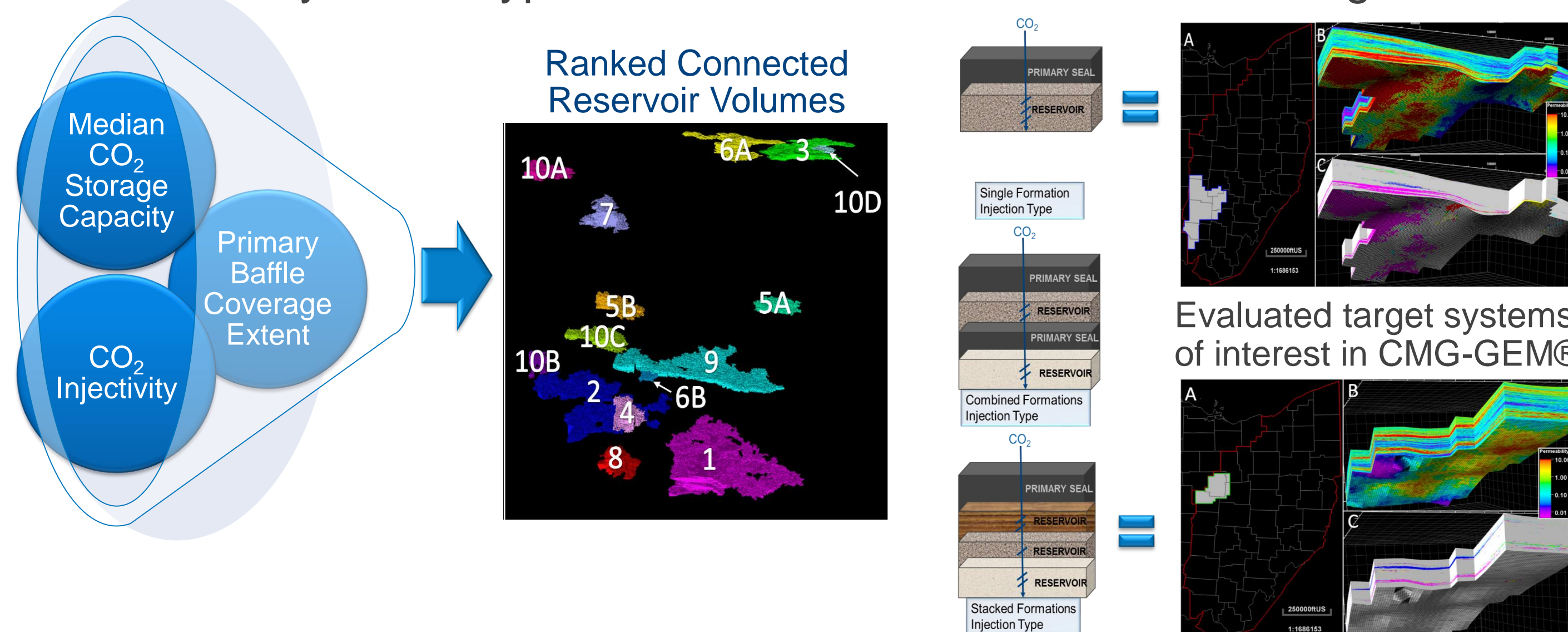
RESULTS – STORAGE RESERVOIR ASSESSMENT

Reservoir feasibility analysis successfully compared volumetric and dynamic resource estimates to evaluate deep saline Cambrian-Ordovician target formations in eastern Ohio with respect to CO_2 storage capacity and injectivity.
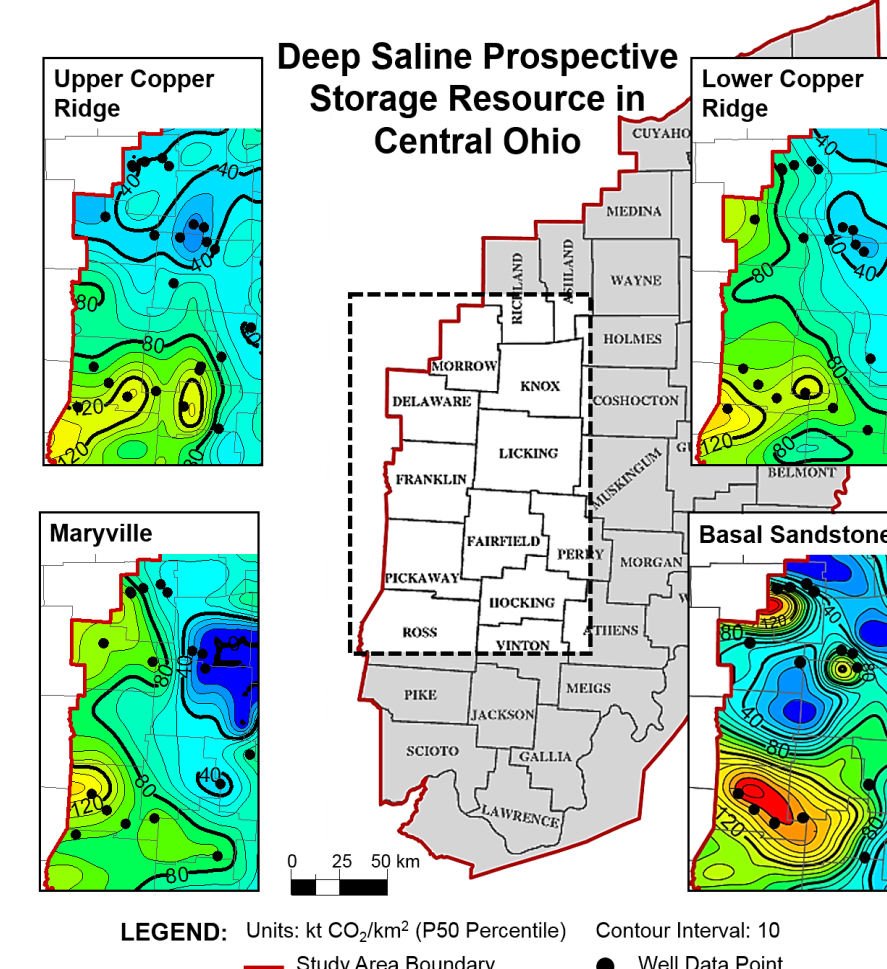

Prospective CO_2 Storage Resource maps (P50) showing storage potential contribution by different formations along the western margin of the study are in central Ohio. These formations have the highest regional resource potential with an estimated median 3-4 gigatonnes each.

Potential storage target areas were systematically screened to assess subsurface dynamics typical of realistic site conditions in the region.

Evaluated target systems of interest in CMG-GEM®

RESULTS – CONTAINMENT ASSESSMENT

- Assessment of sealing and mechanical integrity effectiveness of the primary caprock for the candidate Cambrian-Ordovician CO_2 storage reservoirs of interest
- Analysis of image and acoustic log data concurrently with core data

STIMPLAN 2-D Model Example for Fracture Mapping Model
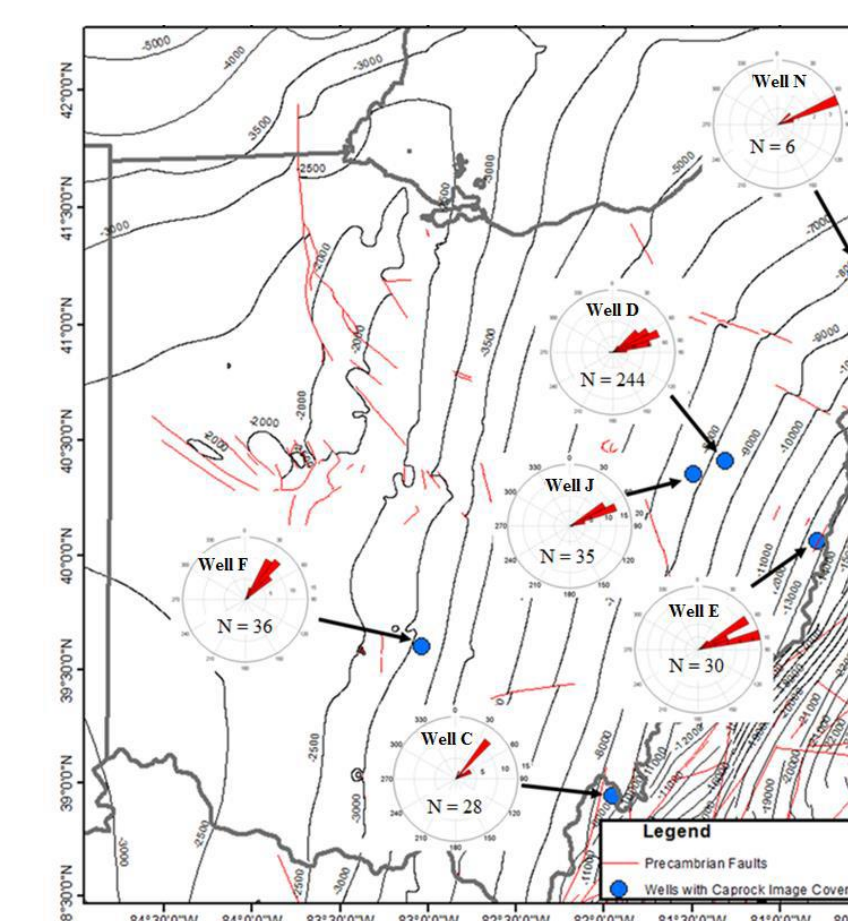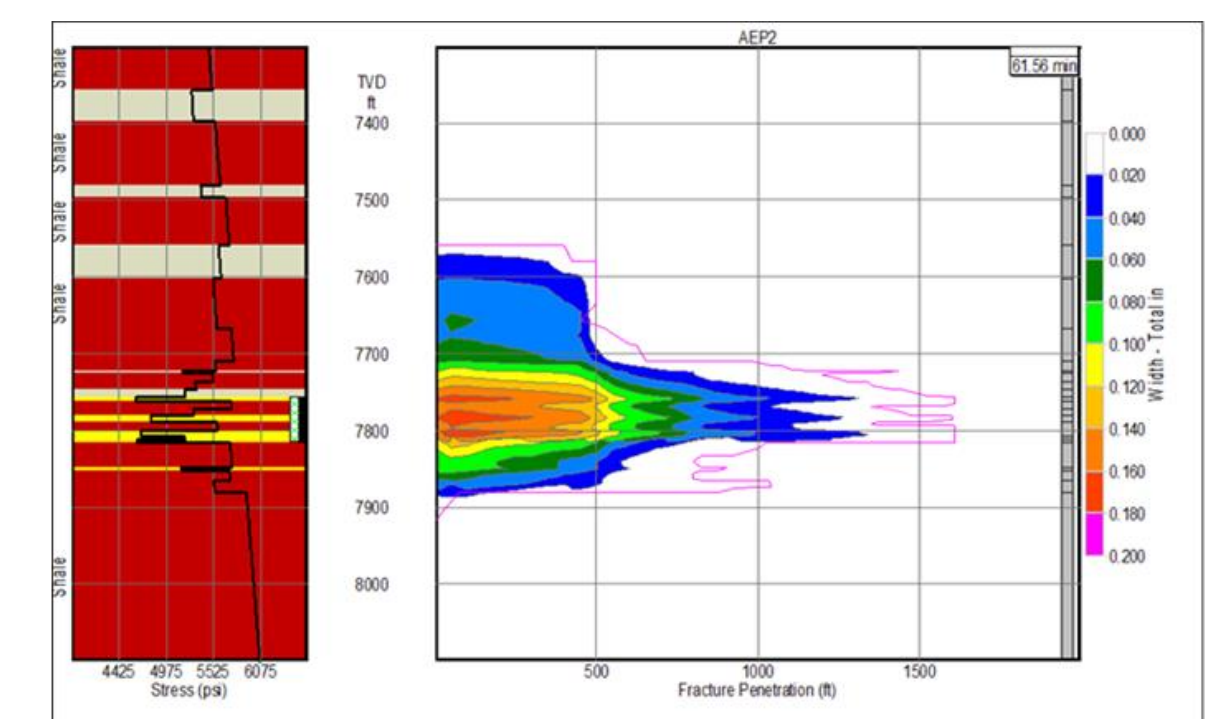
Spatial distribution of S_{Hmax} orientation within the study area caprock (black River Group and the Wells Creek formations combined).

- Regional stress regime was successfully characterized
- Static and dynamic modeling of caprock behavior
- Fracture analysis

CONCLUSIONS

- Successful development of regional geologic storage framework conceptualization and a systematic methodology for effectively screening prospective storage locations in the study region.
- Detailed mapping and capacity estimates show suitable options for CO_2 storage and help narrow down candidate storage areas.
- Primary caprocks overlying the Cambrian-Ordovician rocks are sufficient to prevent CO_2 leakage from the target reservoirs in the eastern Ohio region.
- Preliminary feasibility assessment of both single formation and stacked reservoir systems emphasize the need for carefully designed optimal field configuration based on detailed site characterization.
- Numerical models offer insights into realistic CO_2 storage capacity portion of the theoretical storage resource available in a given site when operational constraints are accounted for.

ACKNOWLEDGEMENTS