# $CO_2$ Storage and EOR Resource Assessment of the Cypress Sandstone Residual Oil Zone in the Illinois Basin

**Nathan D. Webb, Nathan P. Grigsby, and Scott M. Frailey**

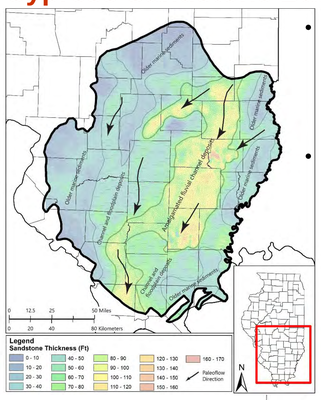
**Illinois State Geological Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, ndwebb2@Illinois.edu**

## Project Description

The thick Cypress Sandstone in the Illinois Basin is being investigated to determine the $CO_2$ storage and EOR resource potential of a siliciclastic residual oil zone (ROZ). Criteria for identifying the Cypress ROZ across the region include oil indicators (oil shows, saturation in core, etc.) similar to those successfully used in the Permian Basin. Nearly 18,000 wells with Cypress oil indicators, were found in the Illinois State Geological Survey oil field database. The locations of these wells and additional wells with oil saturations interpreted from well log analyses are being mapped to delineate the extent of the Cypress ROZ. A number of brownfield ROZs have been identified that underlie and extend beyond the boundaries of established oil fields and evidence of greenfield ROZs, or ROZs that lack a main pay zone, has also been found.

Regional correlation and mapping of the Cypress Sandstone using log data from around 4,500 wells has resulted in the creation of a new net-sandstone isopach map for the Illinois Basin. Conventional core analysis data and porosity log data from nearly 2,000 wells were combined with the isopach map to create a new regional isoporosity map. By delineating the lateral extent and thickness of ROZ accumulations with porosity and saturation maps, volumetric estimations of the Cypress Sandstone ROZ resource will be made. Combining the estimate of the Cypress ROZ oil resource with storage efficiency and oil recovery factors derived from reservoir simulation, an estimate of the $CO_2$-storage and EOR resource of the Cypress will be possible.

## Cypress Sandstone Background




- Thick sandstones are Nonconventional $CO_2$-EOR target and have potential for residual oil zones (ROZs)
- The Cypress Sandstone is a major carrier bed with significant oil production

*Left: Map of Cypress Sandstone depositional facies and productive areas (Modified from Nelson et al., 2002)*

- Understanding how petroleum migrated through the Cypress (e.g. Lewan et al., 2002) and how ROZs may have formed in the Illinois Basin (e.g. Webb et al., 2016) provide the framework for identifying potential Cypress Sandstone ROZs

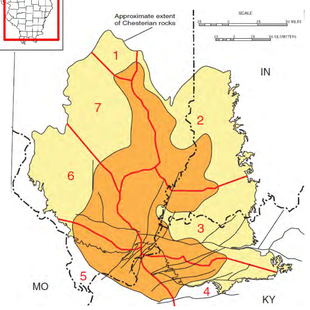
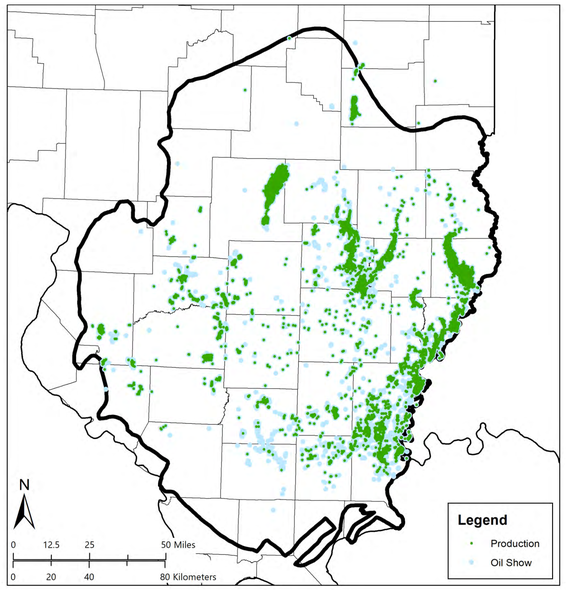


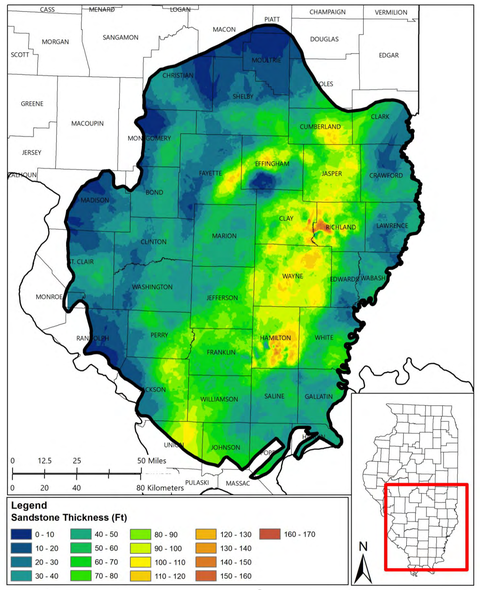

*Diagram showing secondary petroleum migration catchments in the Illinois Basin petroleum system (from Lewan 2002)*

## Methodology: ROZ Identification and Mapping

- Documenting and reinterpreting existing data (e.g. Trentham and Melzer, 2016) and mapping the results



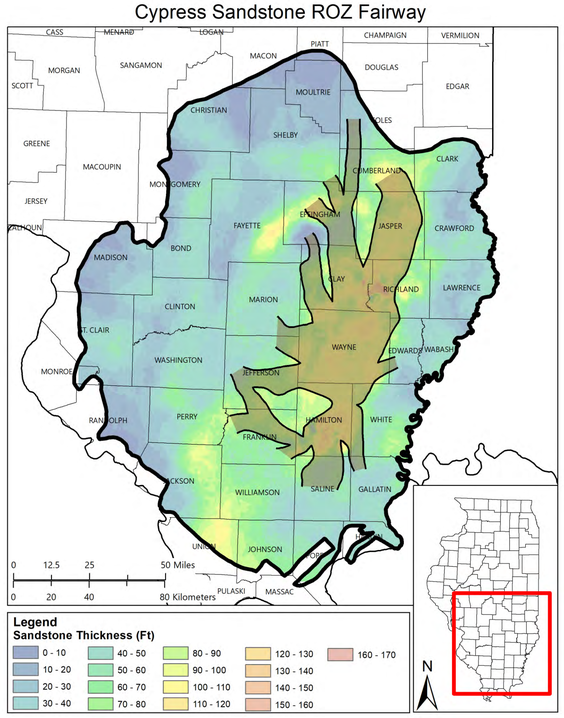

- ~18k wells with oil indicators (shows, core So, DSTs)




- Regional isopach map for volumetric calculations

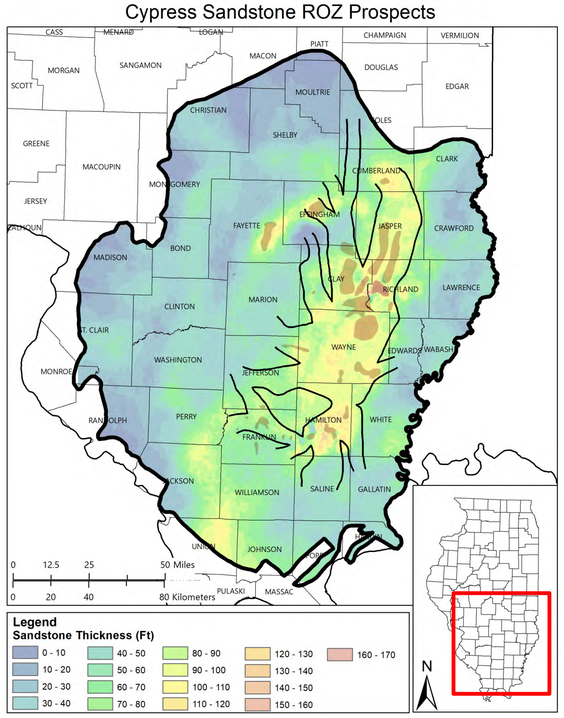
## Cypress Sandstone ROZ Resource in the Illinois Basin

Cypress Sandstone ROZ Fairway




- Mapped extent of Cypress ROZ fairway (shown in brown)
  - Based on isopach, structure, occurrence of oil indicators from well data, and well log analysis

Cypress Sandstone ROZ Prospects




- Mapped ROZ prospects within the fairway
  - Based on occurrence of unproduced oil indicators and well log analysis

## Resource Estimate

- Preliminary estimate of oil in place for all ROZ prospects
  - Oil in place may or may not be technically recoverable
  - ROZ fairway likely contains oil beyond the boundaries of the prospects defined here

| ROZ Saturation at 16% | ROZ saturation @ 23% | ROZ saturation @ 30% |
|---|---|---|
| 1.3 billion barrels | 1.9 billion barrels | 2.4 billion barrels |

- Based on well log analysis, the median So within Cypress ROZs is 23%, with +/- one standard deviation of 16% and 30%
- MGSC (2005) estimated the total original oil in place for Cypress Sandstone main pay zones in the Illinois Basin to be 2.65 billion barrels
  - Identified ROZ prospects may contribute an additional 49% to 91% to oil in place values for the Cypress Sandstone

## Next Steps

- Continued refinement of ROZ fairway and prospect maps
  - Better define boundaries based on available data
  - Screen for remaining overlooked areas
- Additional well log analyses to improve confidence in
  - Spatial distribution of ROZ fairway and prospects
  - ROZ thickness, porosity, and saturation
  - Volumetric calculations of oil in place
- Application of $CO_2$-EOR recovery and $CO_2$ storage factors based on simulation and published results to determine economic viability of the ROZ play

## References

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