

Oklahoma CUSP Progress

June 21, 2023

Agenda

- Acknowledgement
- Project Overview
- OK Focused Project
- New Optimization Software for CO₂ Transport

Acknowledgement

- Karen Ochie
- Ayomide Hamzat
- Benmadi Milad
- David Nnamdi
- Jamal Daneshfar
- FNU Suriamin
- Sean Yaw
- Hamed Goddusi
- Tom Mueller
- Mike McGinnis
- Saba Tahmassebi
- Lloyd Kirk
- William Lynn
- Carbon Solutions LLC
- LANL
- RZG LLC
- Department of Natural Resources-
Osage Nation

Achievements

- CUSP promoted & enabled CCUS dialogues among stakeholders in Oklahoma
- Working closely with an operator for a Class VI application
- Numerous publications (published & pending)
- Three completed MS thesis and a PhD dissertation (ongoing)
- Upgrading SimCCS to include existing pipelines
- Osage CO₂ Storage Hub CarbonSAFE proposal

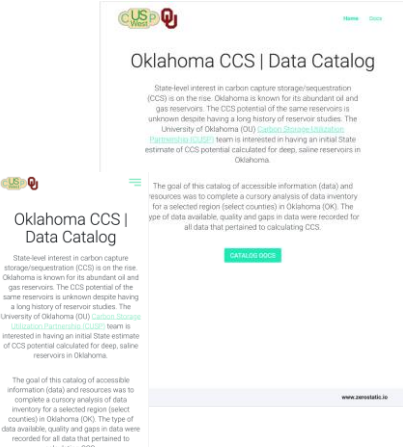
CUSP – Original Scope of Work

- Focus on collecting, synthesizing, and using existing data sets.
- Data to be incorporated into analytical and optimization models to evaluate CCUS potential and readiness. Goals include:
- State organizations assessing, updating, augmenting, and verifying data used in data analysis and modeling
- Strong emphasis on technology transfer and outreach

OK CCUS Catalog and Scoping Project

Data Catalog

(responsive, interactive, evergreen doc)



<https://cusp.oucreate.com/catalog>

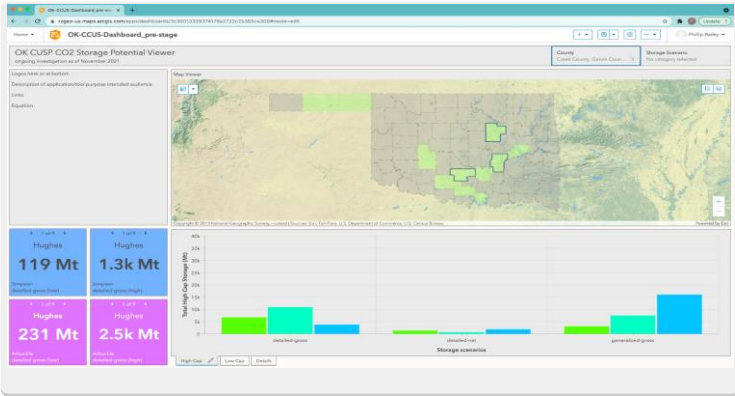
Workflows, Database, and Report for Oklahoma CO₂ Storage Potential Calculations based on the following

Methods:

- Generalized Gross
- Detailed Gross
- Detailed Net

CO₂ Storage Potential Viewer Application

(browser-based, future mobile enabled)



not public
under construction

CUSP-Focused Goals for Oklahoma (2020-2022)

Main goal: *Develop a two-step roadmap to help accelerate CCUS deployment in Oklahoma, focusing on a designing and permitting a novel stacked storage CCUS complex:*

Field site development: *Support operators to develop a plan to submit a Class VI well permit application for a stacked storage CCUS complex*

Roadmap: *deliver a roadmap for industry, state government, and other stakeholders to jumpstart CCUS development in Oklahoma based on stacked storage.*

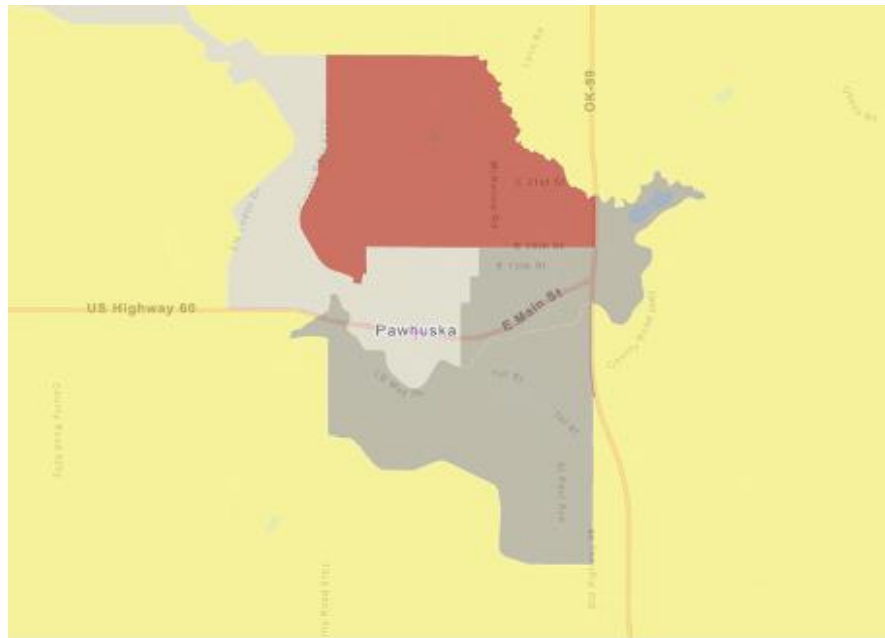
Deliverables

- **Deliverable 1:** A comprehensive economic feasibility of a stacked storage site, combining CO₂-EOR and CO₂ sequestration operations in the Osage Reservation
- **Deliverable 2:** A representative geological model based on knowledge and understanding of the Arbuckle saline formation in the Osage Reservation
- **Deliverable 3:** The significant outcome of the proposed work, when appropriate, will be disseminated to the public through journal articles, conference papers, and webinars

Project Specific Tasks

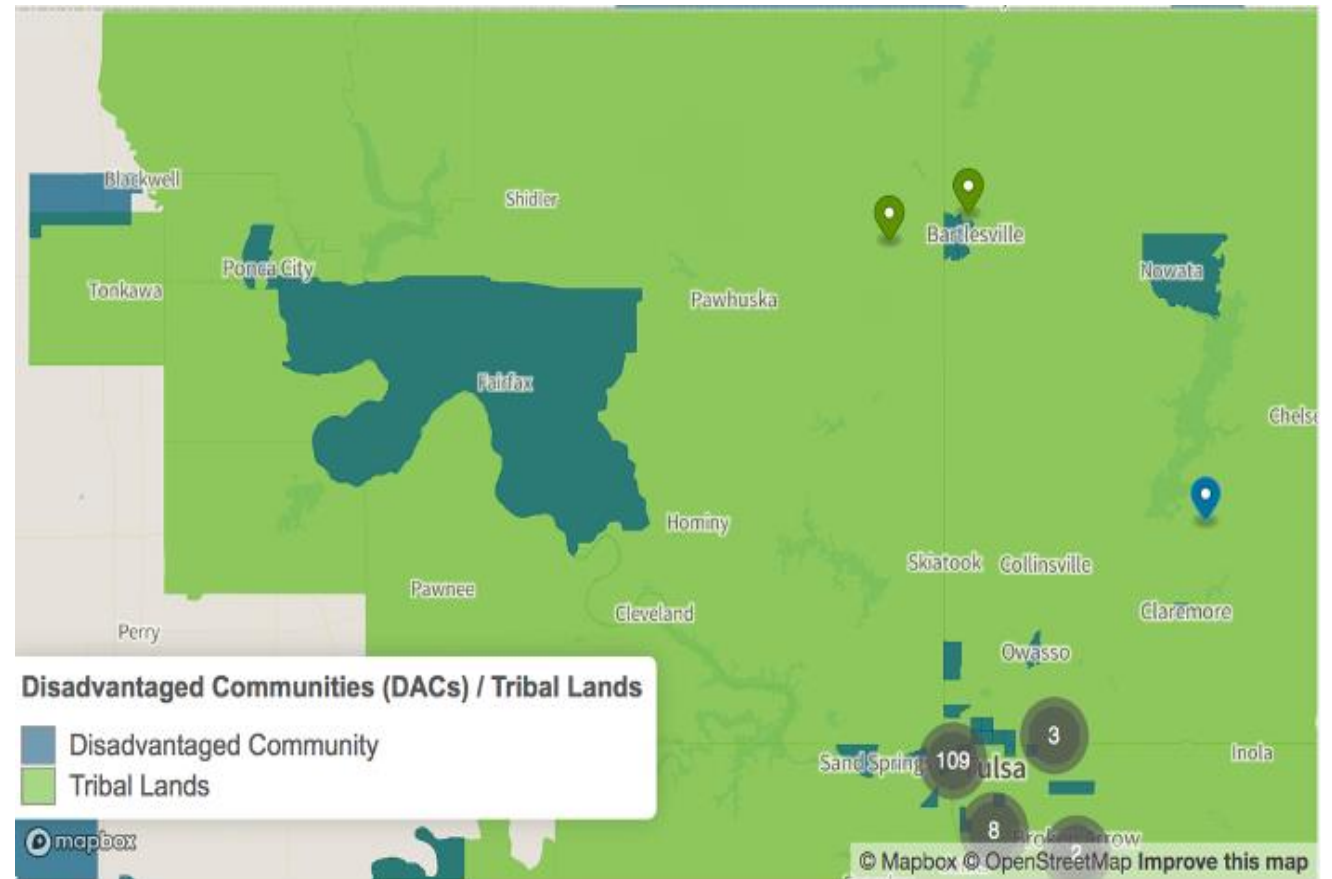
- **Task 1:** A thorough formation evaluation of Arbuckle formation in Osage county
- **Task 2:** Determine the economic feasibility of a stacked storage site, combining CO₂-EOR and CO₂ sequestration operations using the same surface facility unit in Osage county.
- **Task 3:** Develop a representative geological model based on knowledge and understanding of the Arbuckle saline formation in Osage county and perform flow simulations of CO₂ plume.
- **Task 4:** Develop a multi-pathway CCUS roadmap for Oklahoma centered on the stacked storage concept
- **Task 5:** Evaluation of Environmental and Social Justice parameters in Osage county

Societal Impacts of CCUS Projects in Osage Project



Unemployment

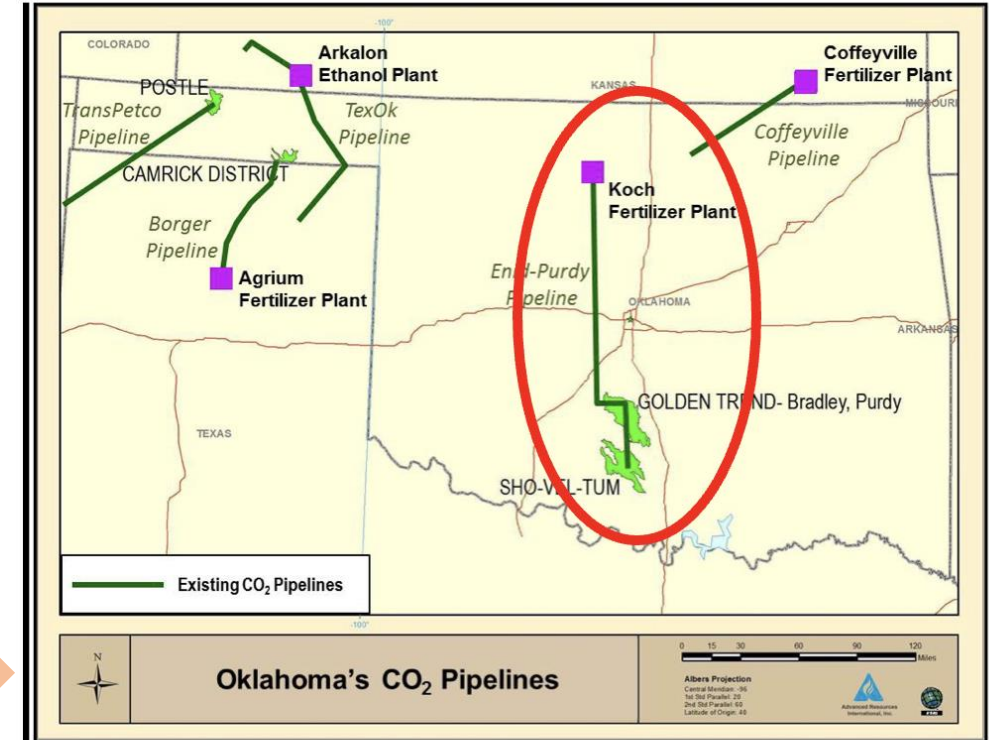
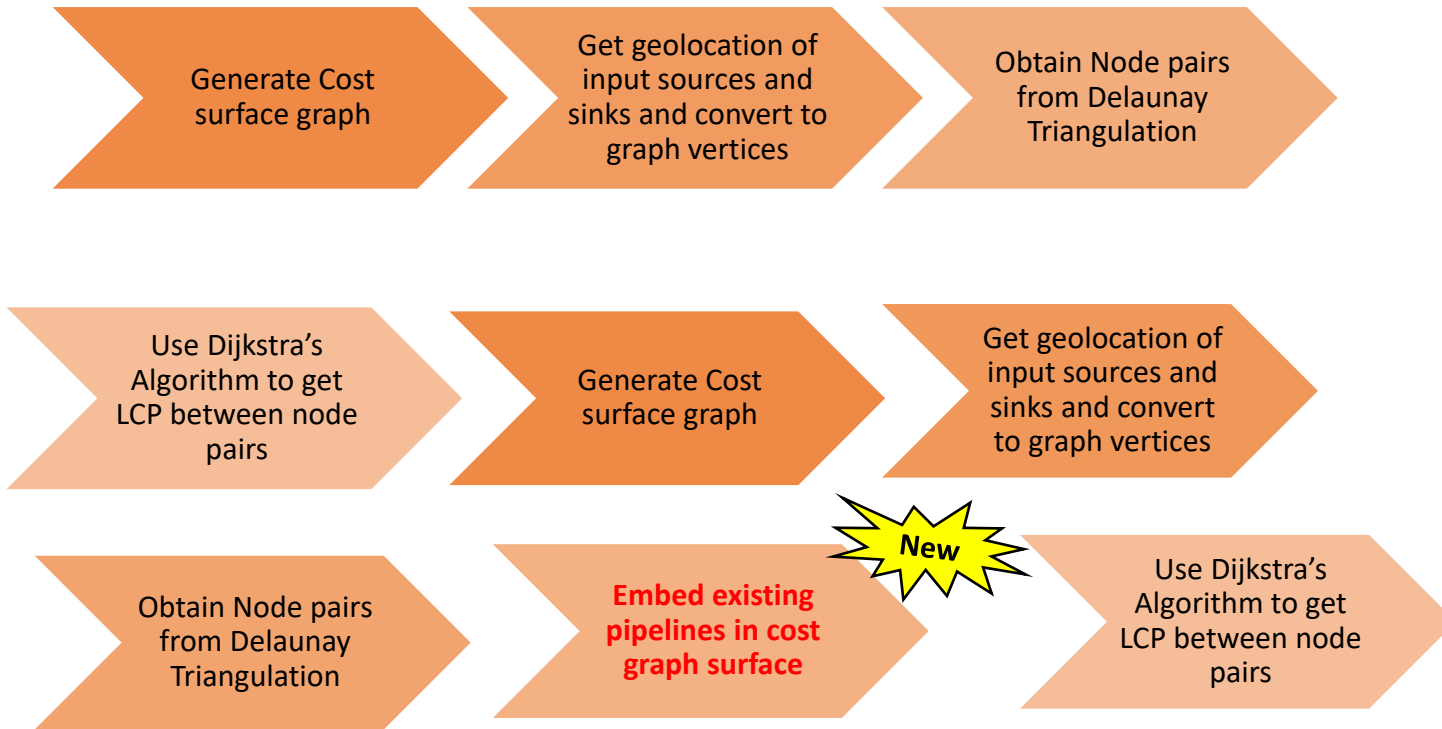
Sample of EJ Indicators for Pawhuska (darker colors mean higher than the national average)



Motivations for Upgrading SimCCS

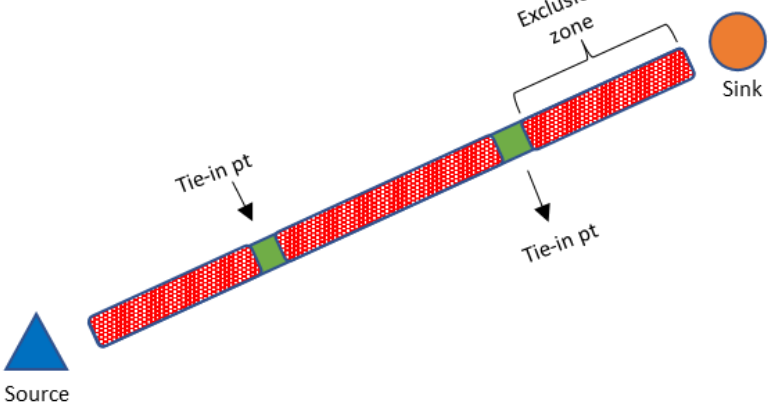
- There are a few available solutions for network optimization of CO2 pipelines:
 - ✓ **GETCO** (Gale et. al., 2001)
 - ✓ **SimCCS** (Middleton et. al., 2009)
 - ✓ **JRC InfraCCS** (Morbee et. al., 2011)
 - ✓ **SiMCCS^{2.0}**
 - ✓ **SimCCS^{Pro}**
- Limitation of SiMCCS:
 - ✓ Limited to suggesting new pipeline construction routes
 - ✓ Cannot accommodate existing pipelines in alternate route generation
 - ✓ Cannot limit flow capacity of existing pipelines to user specifications
 - ✓ Cannot allow user specified transport costs along existing pipelines

New Software Workflow

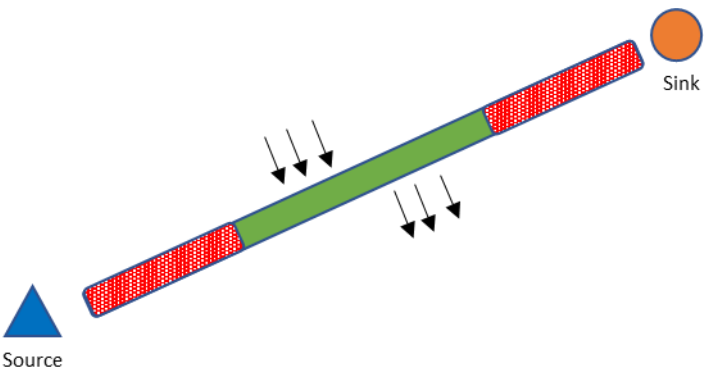


Mid-Continent CO₂ pipeline infrastructure spanning Oklahoma and lower Kansas
(Callahan et al., 2014)

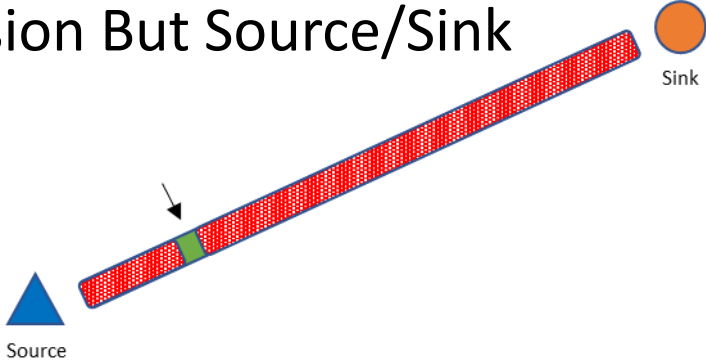
Case 1: 2 Tie-in Points Along a Pipeline, Exclusion Elsewhere



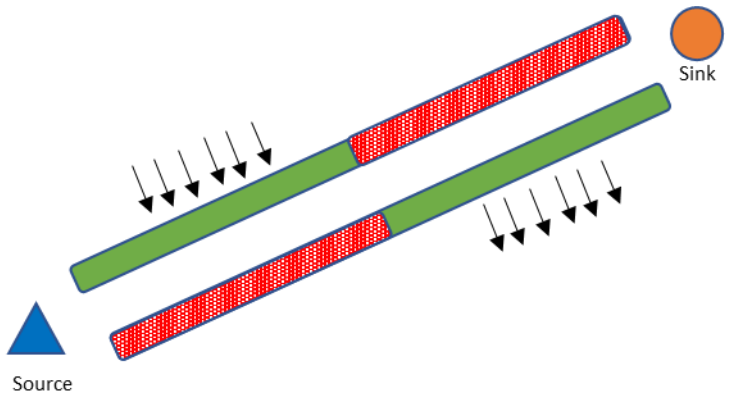
Case 2: 2 Tie-in Points With Exclusion At Ends



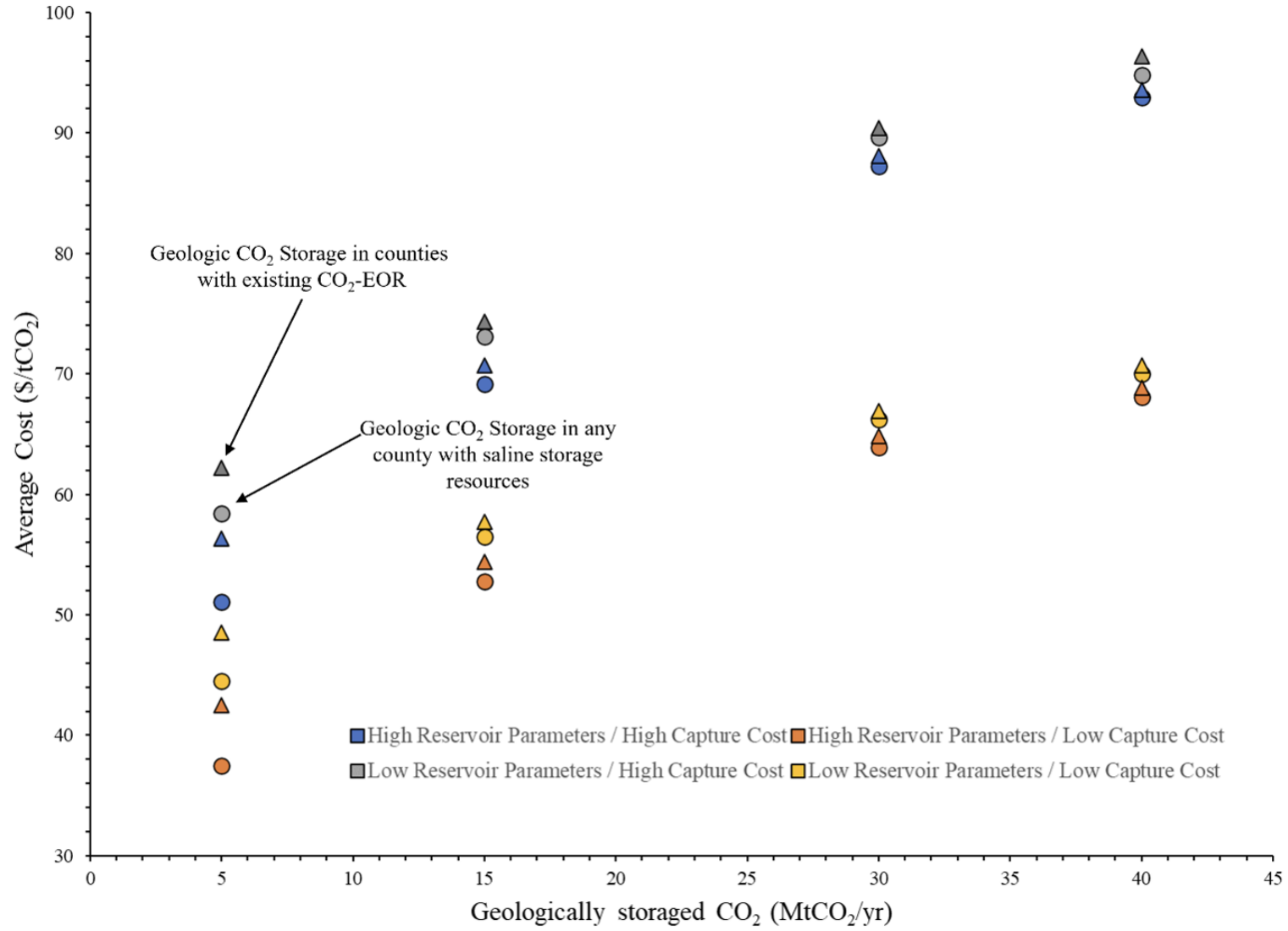
Case 3: Single Tie-in Point with All Exclusion But Source/Sink

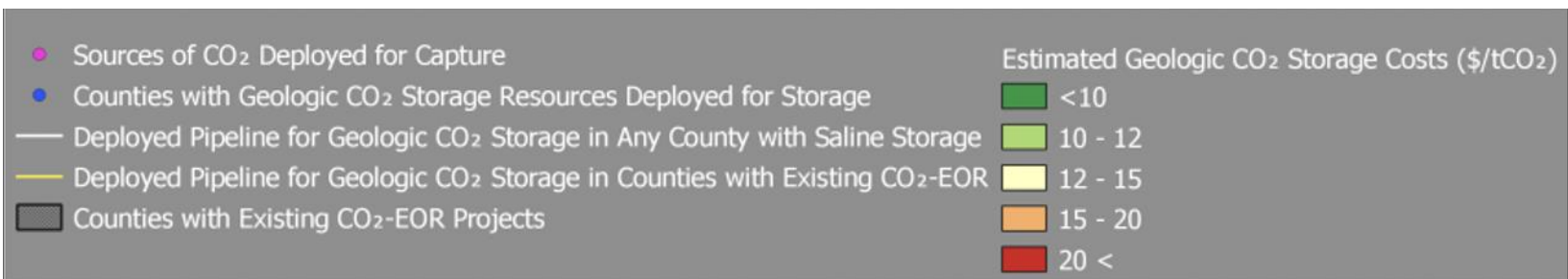
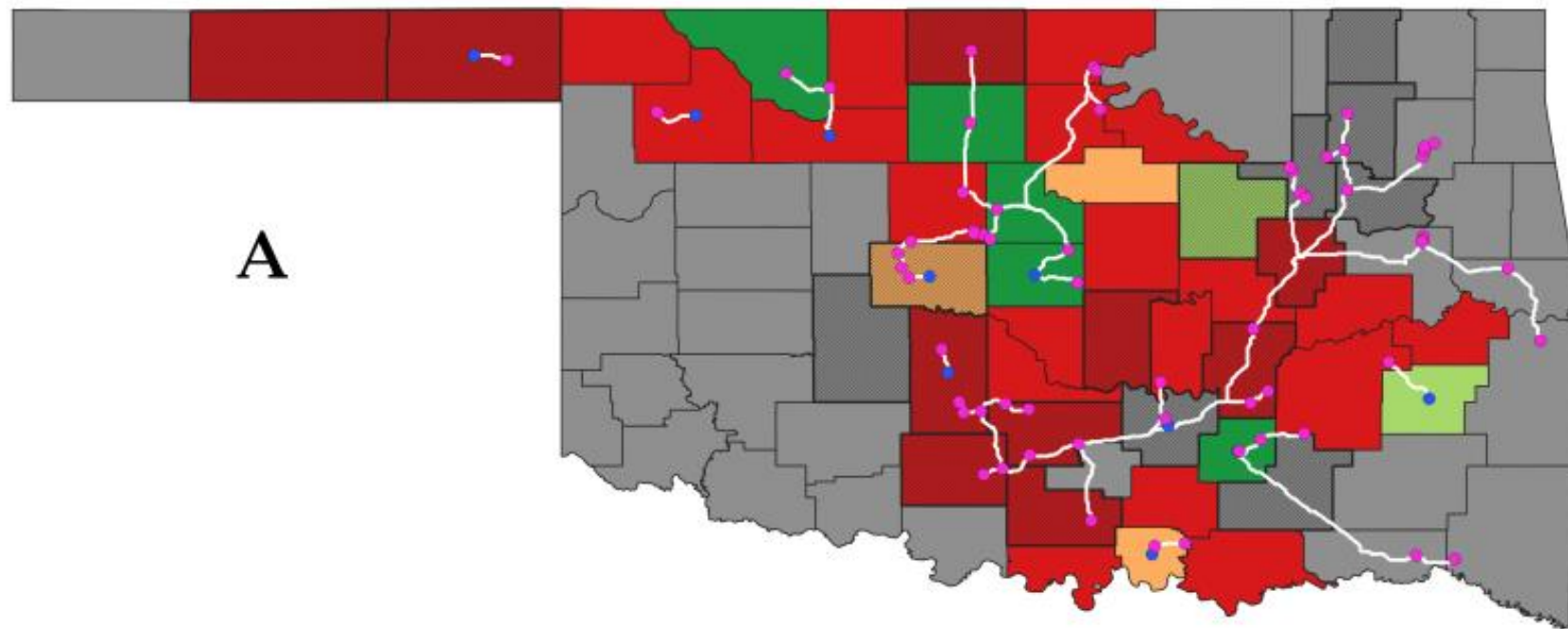


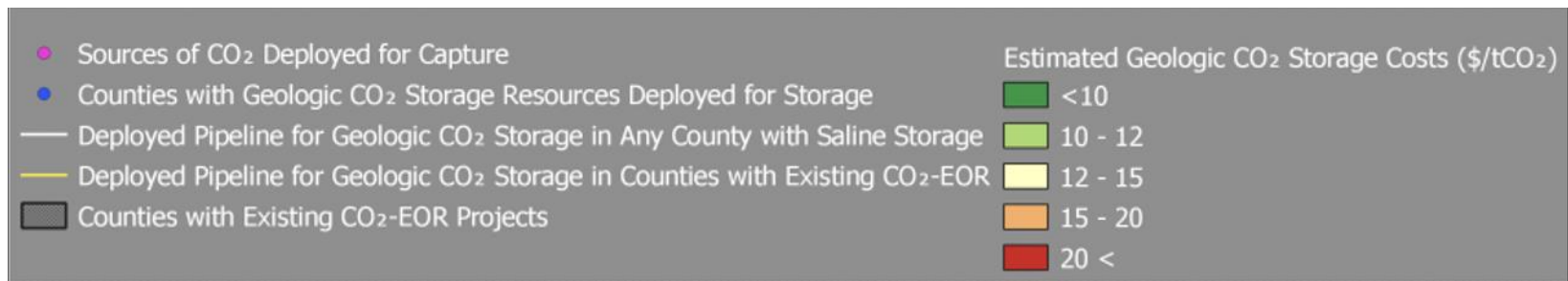
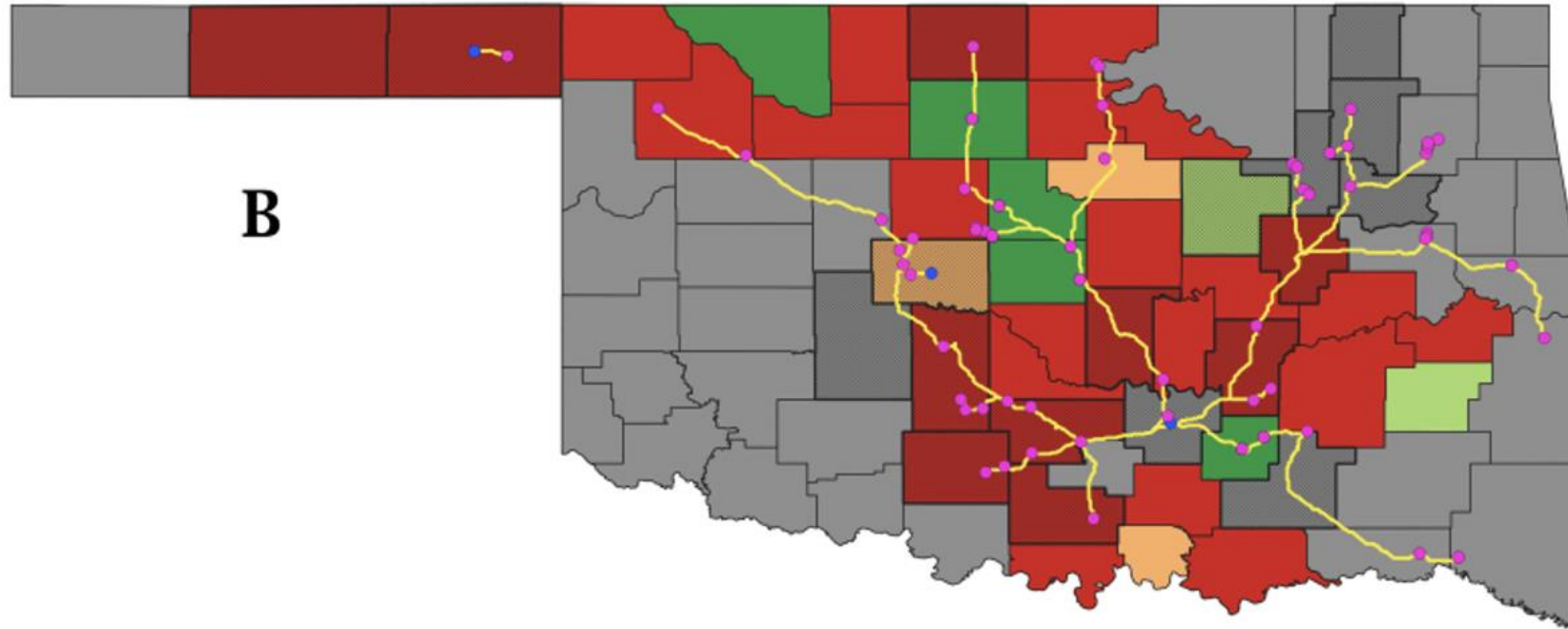
Case 4: Single Tie-in Point With Exclusion Before/After



Thank You!







Geological Setting—Type Log

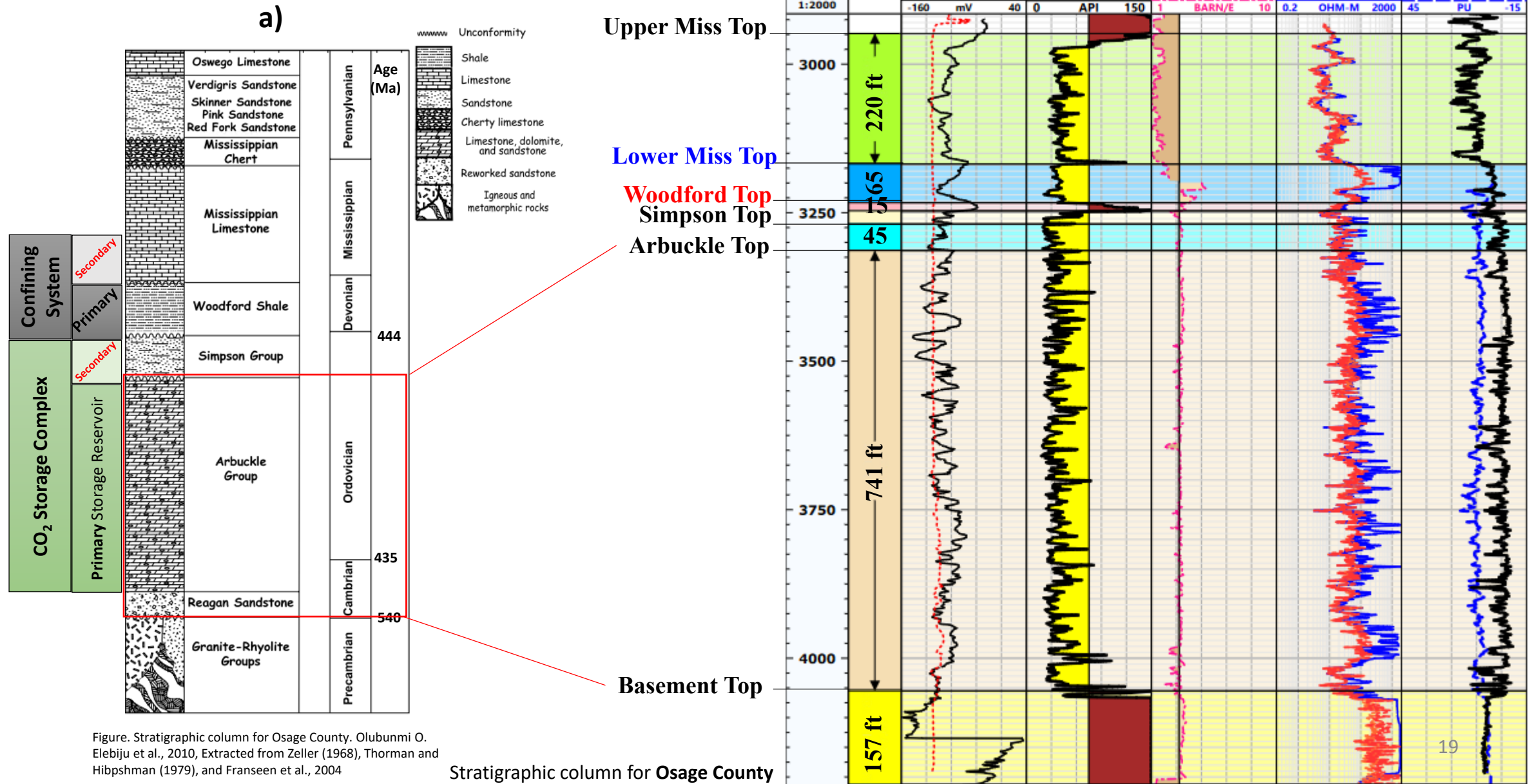


Figure. Stratigraphic column for Osage County. Olubunmi O. Elebiju et al., 2010, Extracted from Zeller (1968), Thorman and Hibpshman (1979), and Franseen et al., 2004

Stratigraphic column for Osage County