Oklahoma Carbon Management

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CUSP, Sept. 11, 2024

Summary

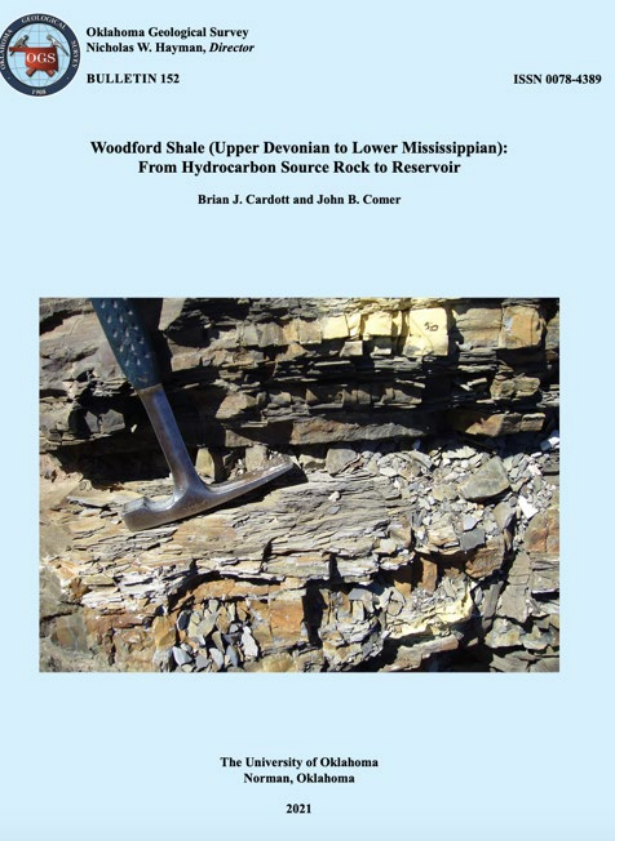
1. Comments about OGS & roles of Geological Surveys
   - Regulatory support (inc. Class-VI Primacy)
   - Education & Outreach (inc. Community Benefits Plan efforts)
   - Data Management & Technical Resources (inc. to other states & entities)
   - Geophysics Monitoring (e.g. Seismic Network)
2. Oklahoma CO2 Storage
   - Geological & Resource Setting
   - Arbuckle Formation: Where & Why?
   - Induced Seismicity & Flow
3. Thank You CUSP!

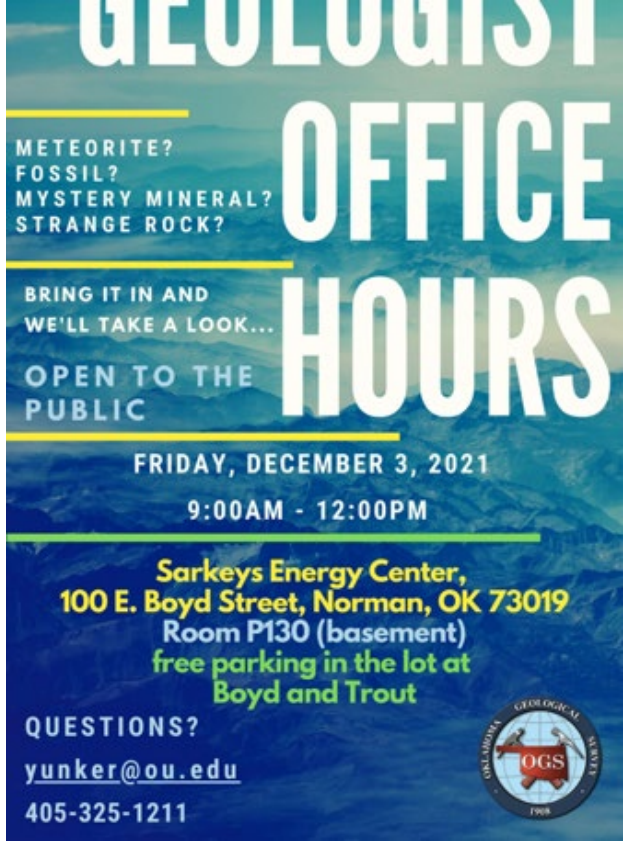
Currently 33 staff, 16 Ph.D.s.

~$2.2-2.7M base budget, ~1:1 internal:external (and growing)

"One of the smaller big surveys"

Annual Report & other tools/data available at OGS.OU.EDU





Education & Outreach

The Oklahoma Geological Survey is a state agency for research and public service located on the Norman Campus of The University of Oklahoma and affiliated with the OU Mewbourne College of Earth and Energy. The Survey is chartered in the Oklahoma Constitution (70 OK Stat § 70-3310 (2014) (RTF)) and is charged with investigating the state's land, water, mineral, and energy resources, and **disseminating the results of those investigations to promote the wise use of Oklahoma's natural resources consistent with sound environmental practices.**

Oklahoma Petroleum Information Center (OPIC)

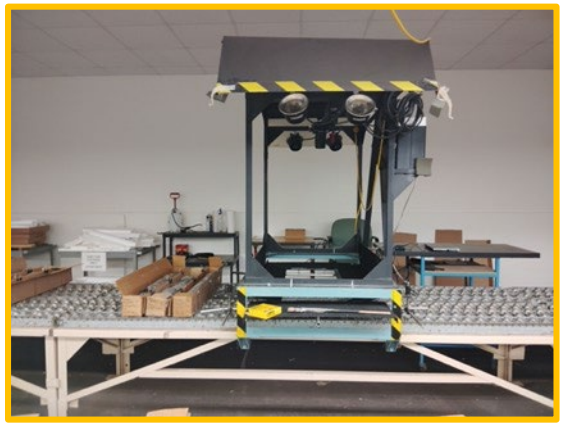
~4 football fields of core & well-log (paper) storage, layout rooms, & other facilities

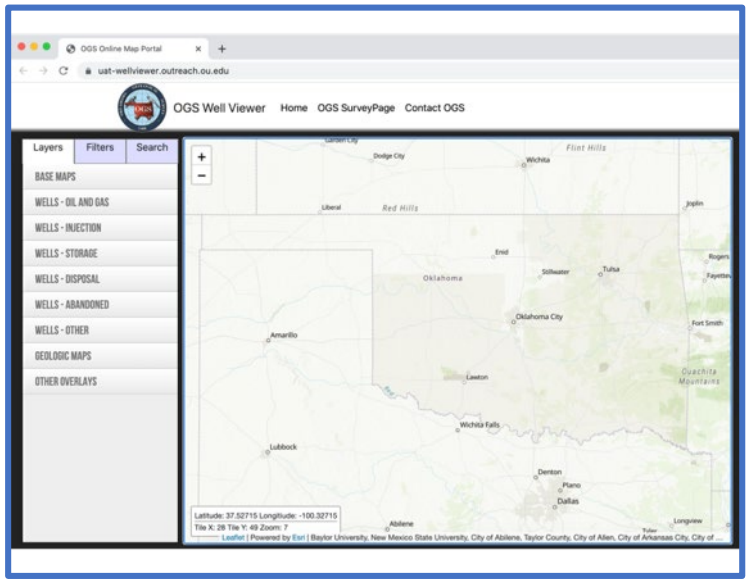
Digitizing much of the data into an on-line well-viewer:

https://uat-wellviewer.dig.ou.edu/

Before (SLR camera mount)

After (unique core scanning capabilities)

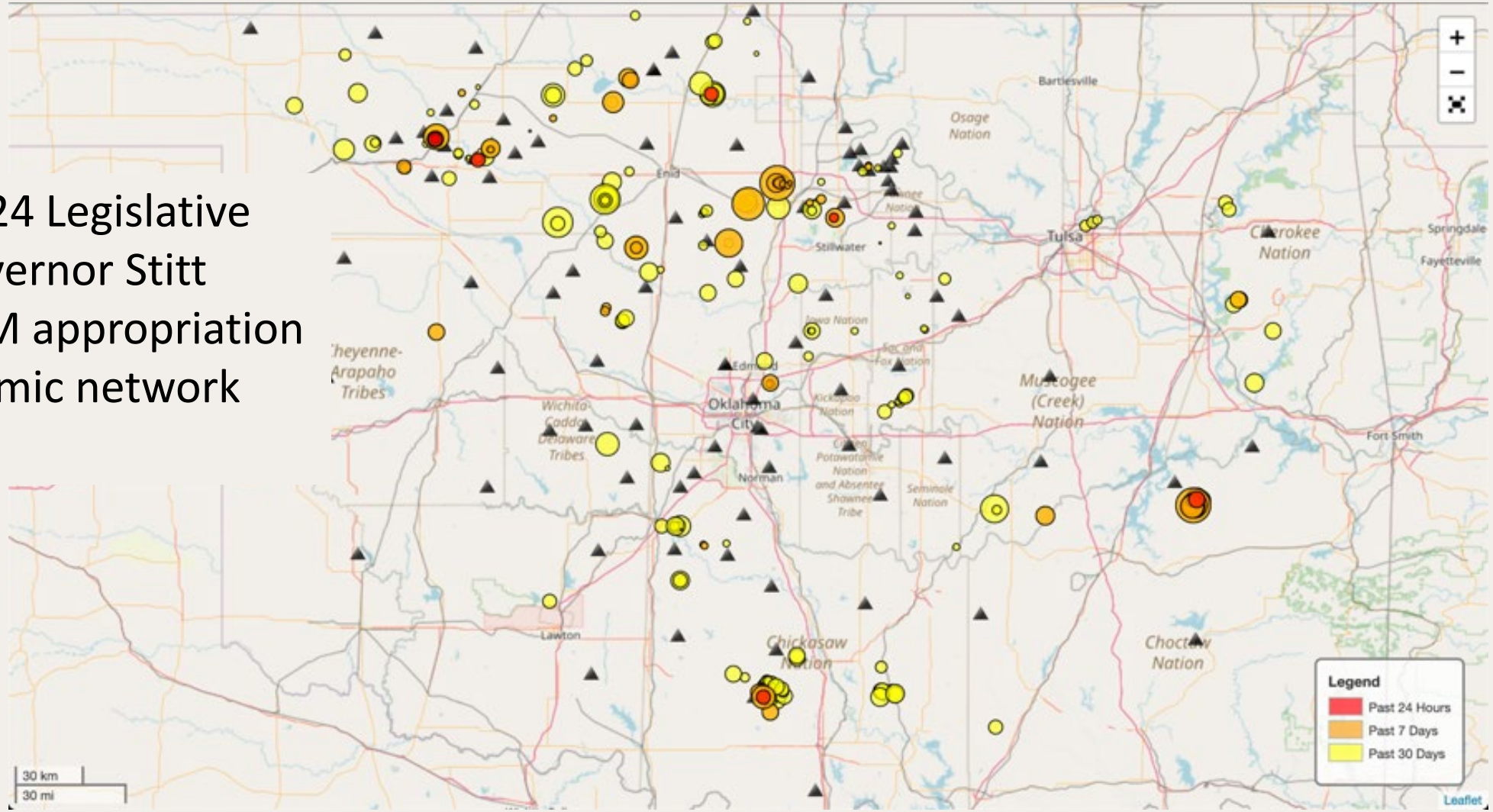




NEWS!!!
Baker-Hughes Core CT lab coming to OPIC

OGS Earthquake Monitoring Network

NEWS!!! 2024 Legislative Session, Governor Stitt signed a $4M appropriation for OGS seismic network upgrades!!!



https://wichita.ogs.ou.edu/staff/earthquake/events.html

Class-VI Primacy

By 2022 Oklahoma Secretary of Energy (OSEE) Ken McQueen had worked with OGS, DEQ (Env. Quality), and OCC (Class-II regulator) to have the Governor submit a letter of intent for Class-VI to EPA

By Spring of 2024 draft legislation required to proceed to primacy, but not brought to floor

Why not?: Issues surrounding unitization between Ag and O&G; different POVs within O&G community on wide range of issues

Assuming legislation & permit application gets ironed out, there remains a challenge about Arbuckle Storage & Induced Seismicity

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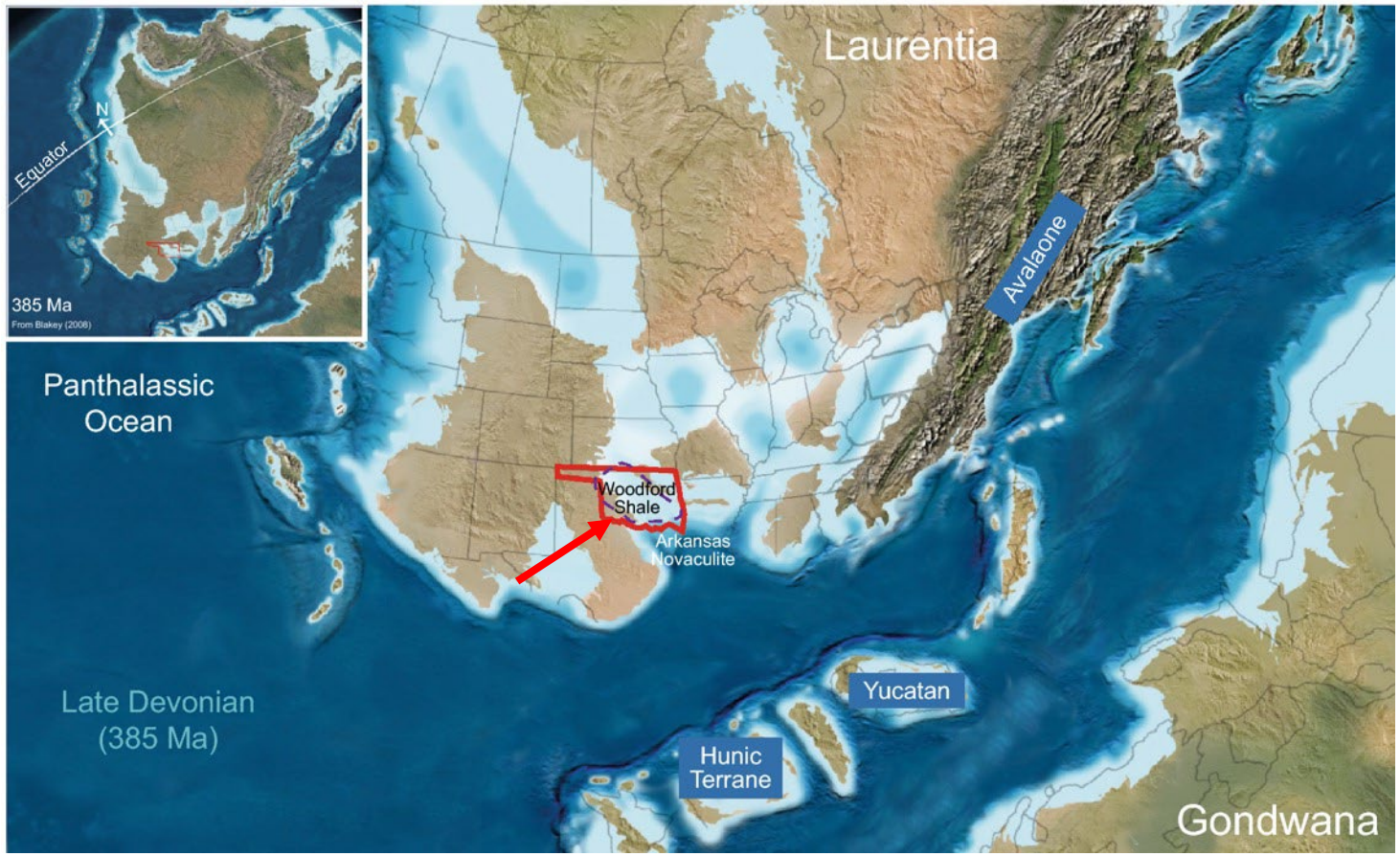
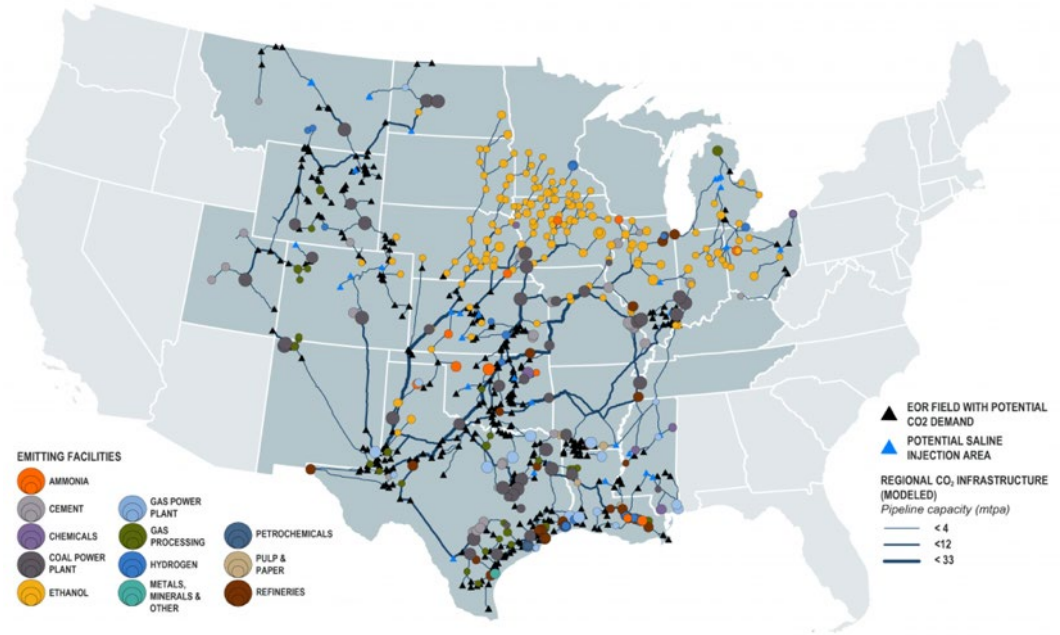


385 Million Years Ago

Blakely, 2013 Plate Reconstruction, from Wang & David, 2019

Oklahoma at the crossroads of the Net Zero economy



From: Great Plains Institute

- Pipeline infrastructure from Kansas Fertilizers to OK EOR fields
- NS Enid pipeline for CO2 to Ardmore Basin EOR
- Planned H2 pipelines
- Anadarko Basin & other areas with storage resource but low infrastructure density

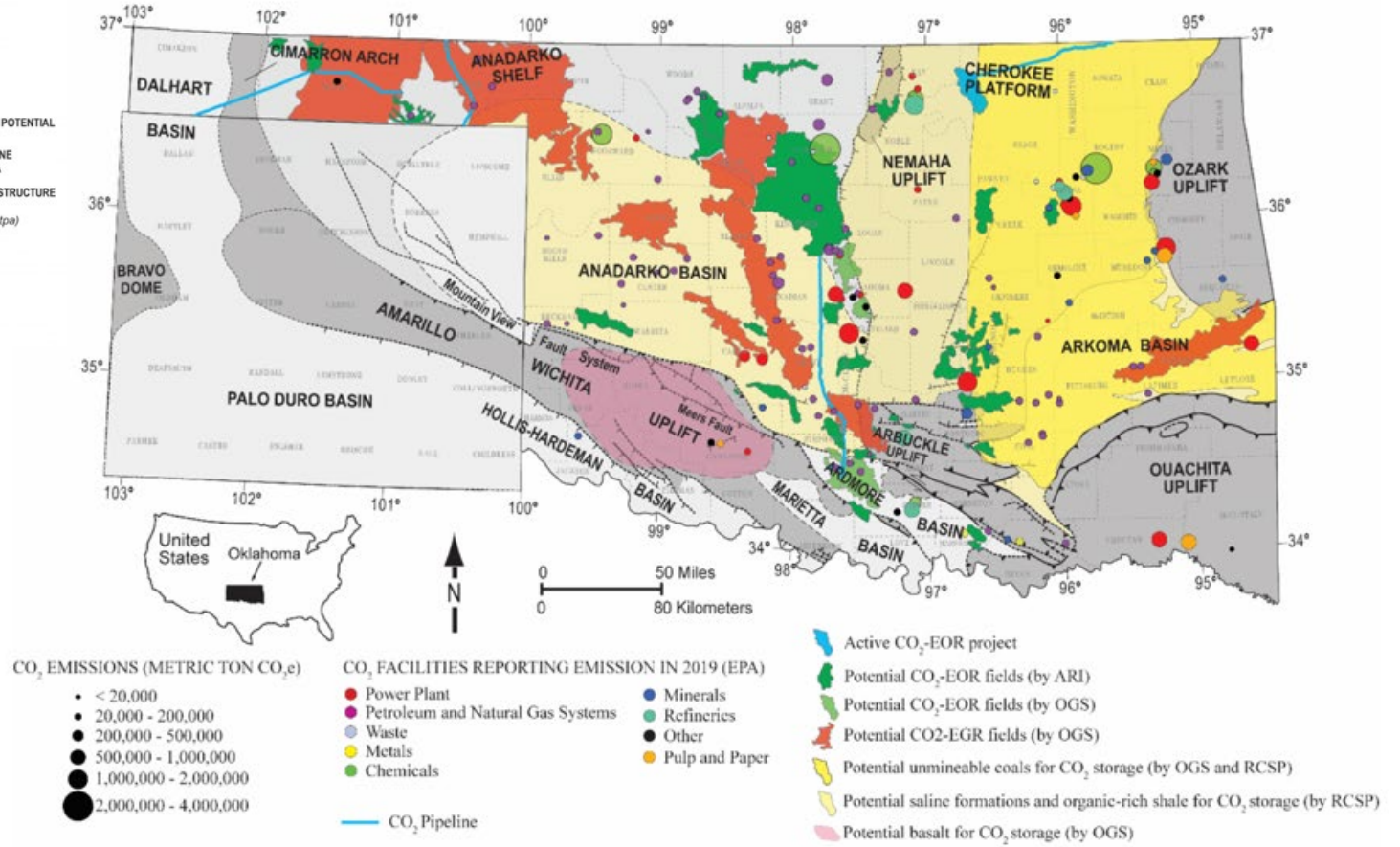
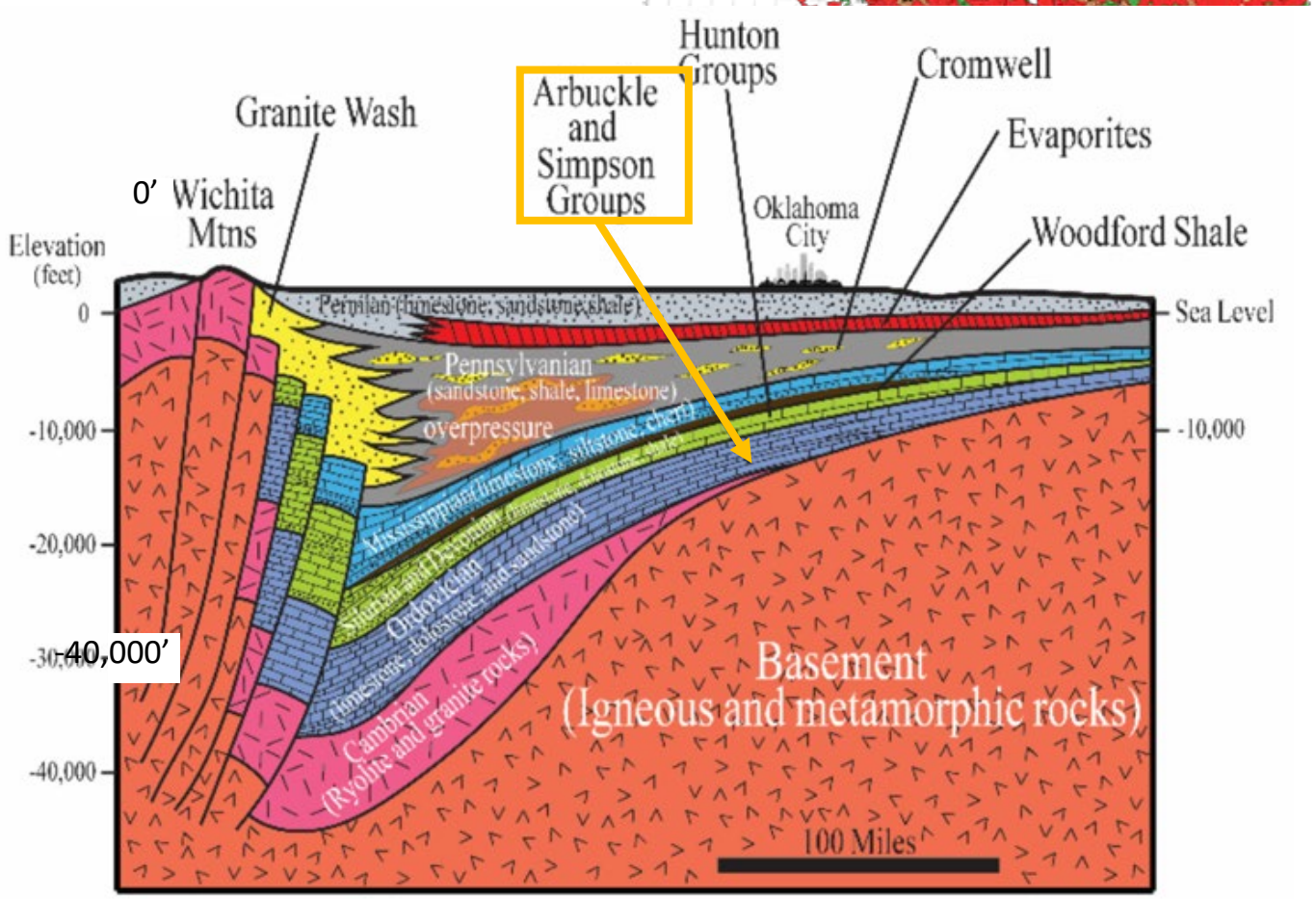
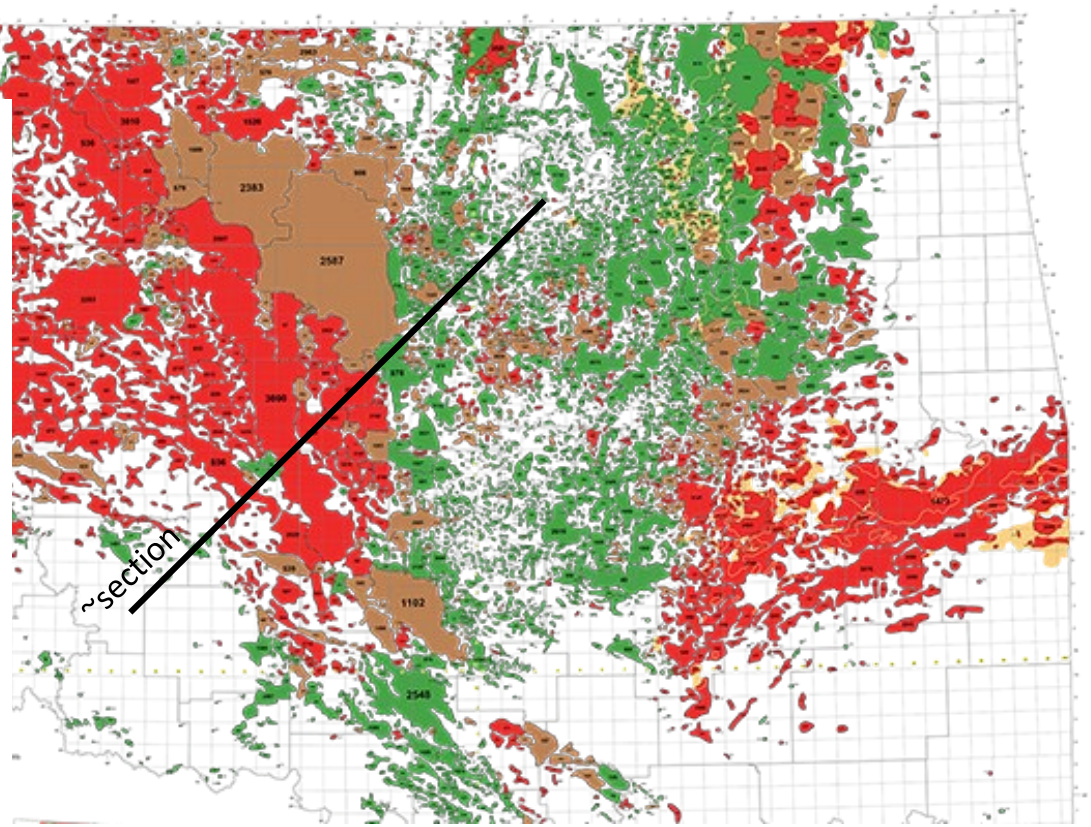


Figure 2. Geological provinces and prominent carbon emissions and facilities [12,22-27]. Major CO_2 emissions are illustrated for the year 2019 along with known CO_2 pipelines, geological provinces, and some major oil and gas fields.

- Basins determined by Ancestral Rockies (Pennsylvanian Age)
- Many Gt storage in Sedimentary sections, but also mafic units (CCS mineralization)

The subsurface is a massive region of potential resources both for production & storage





Green = Oil

Red = Gas

Beige = Oil & Gas

(SCOOP/STACK)

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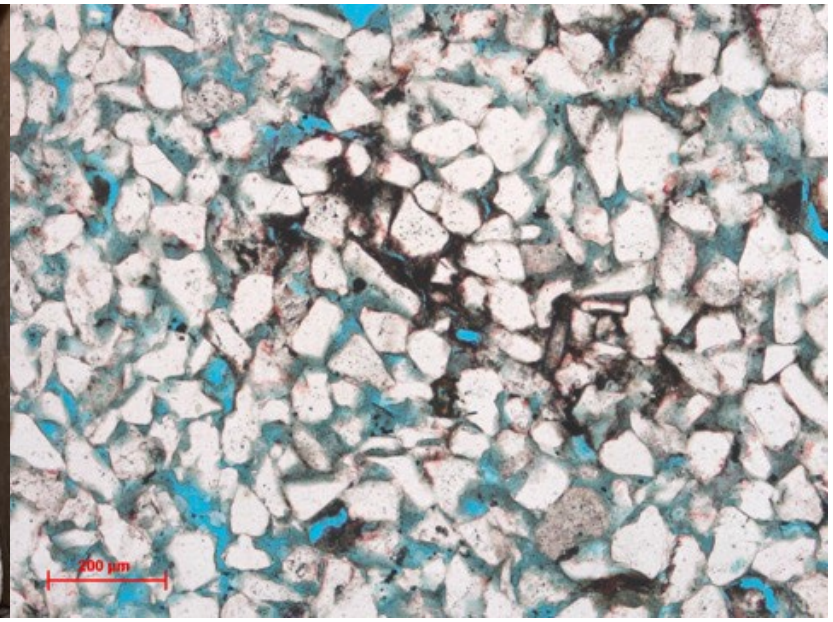
Arbuckle-Simpson-Woodford

Reservoirs (Arbuckle Carbonate)

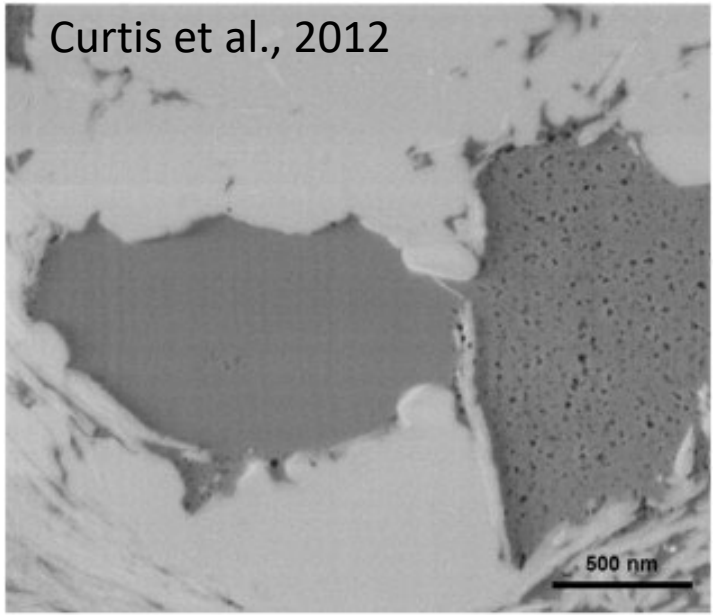
Reservoirs (Simpson Sandstone)

Seals (e.g. Woodford Shale)

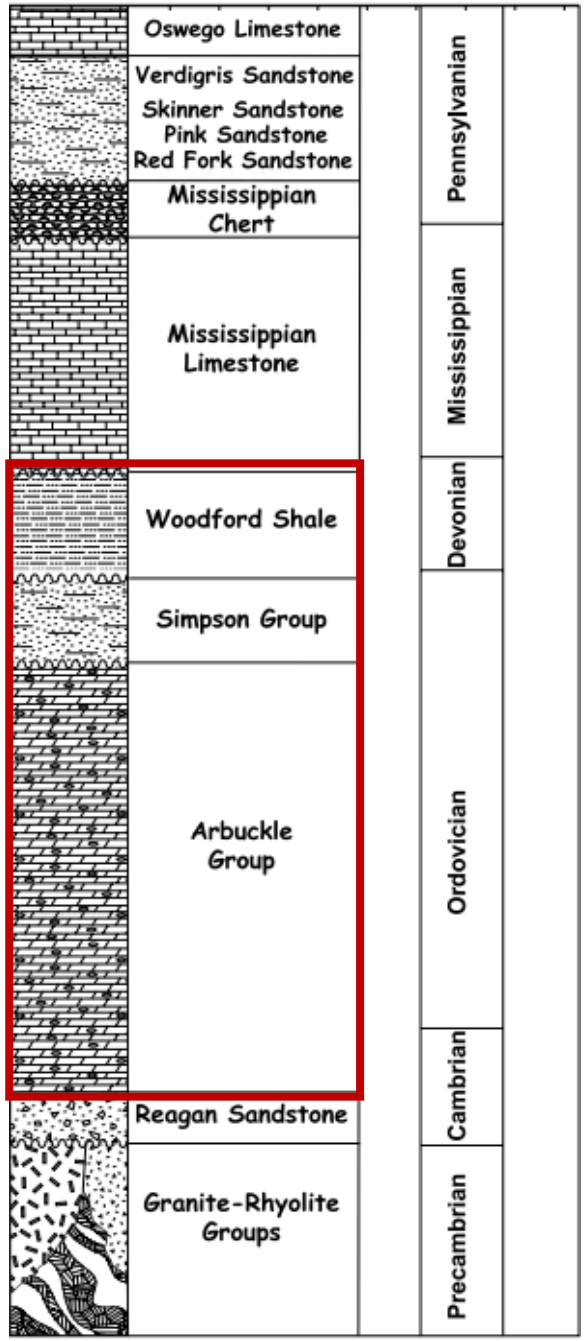
Penny for scale



200 micron scalebar



500 nanometer scalebar

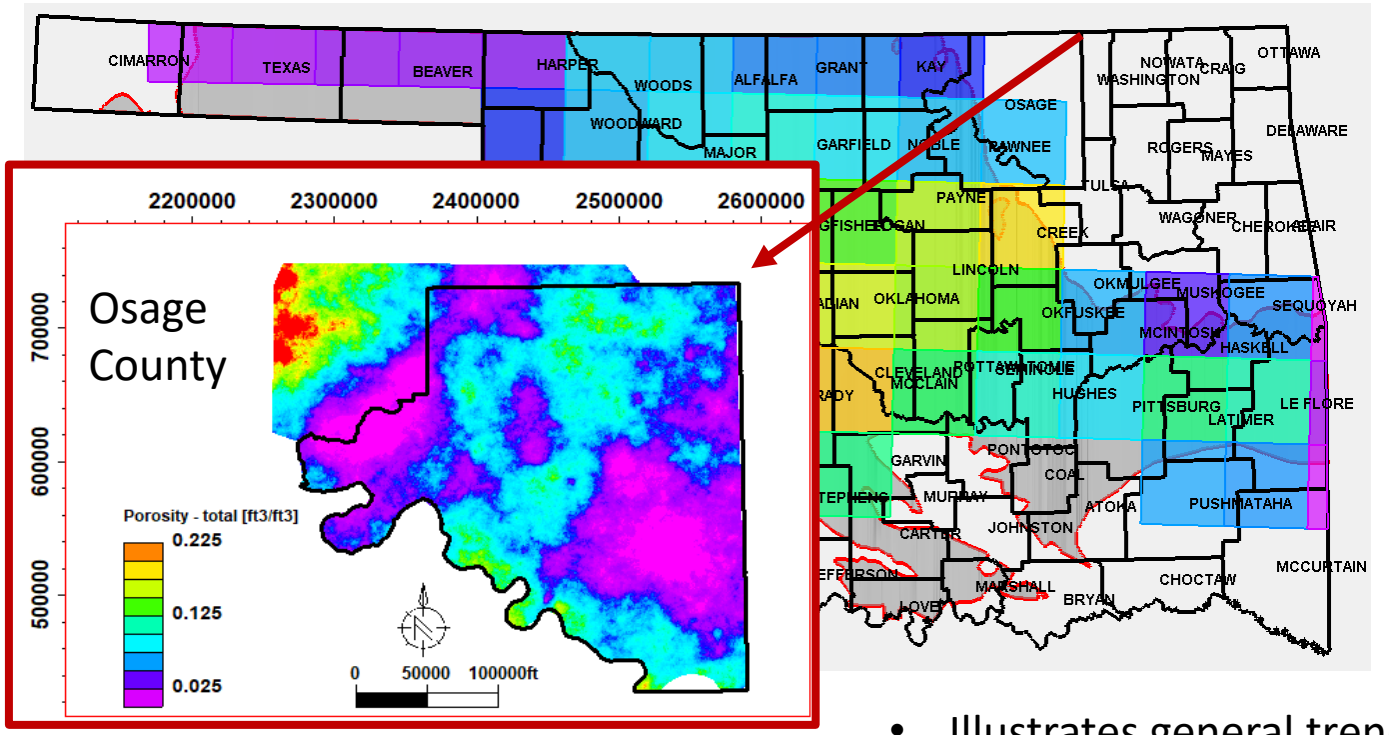


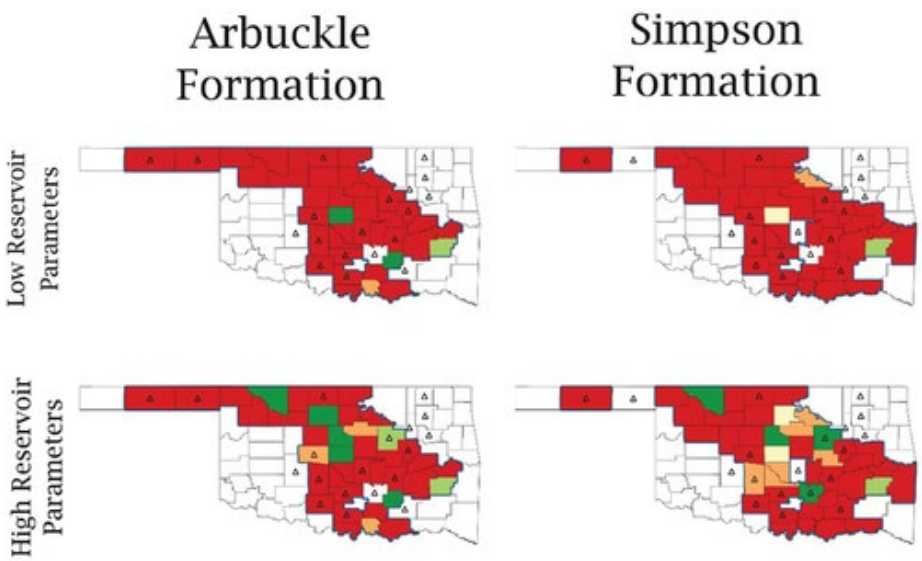
CUSP Focus on Arbuckle & Simpson

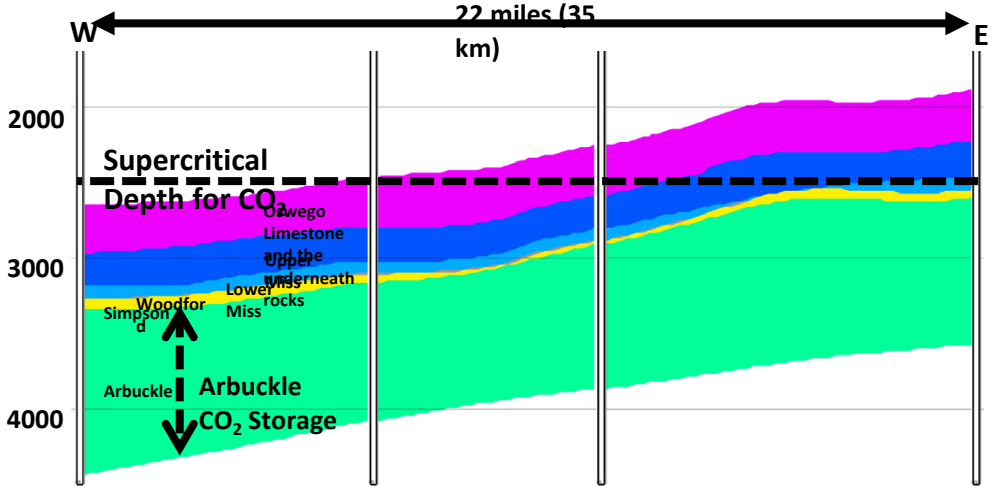
OGS effort: Contribution to SCO_2T database

Osage effort: resulting in CarbonSAFE proposal in review (Pranter, OU, lead PI): https://doi.org/10.1016/j.fuel.2023.129323

Carbon Solutions statewide effort: Miranda et al.,2023, https://doi.org/10.1002/ghg.2244

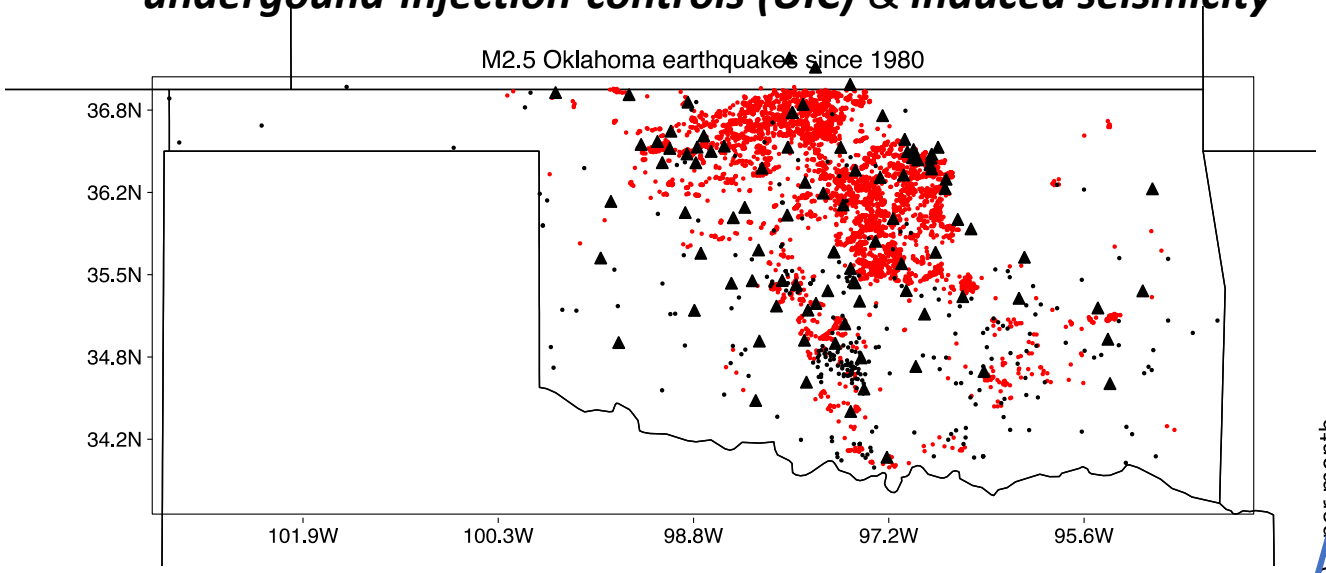






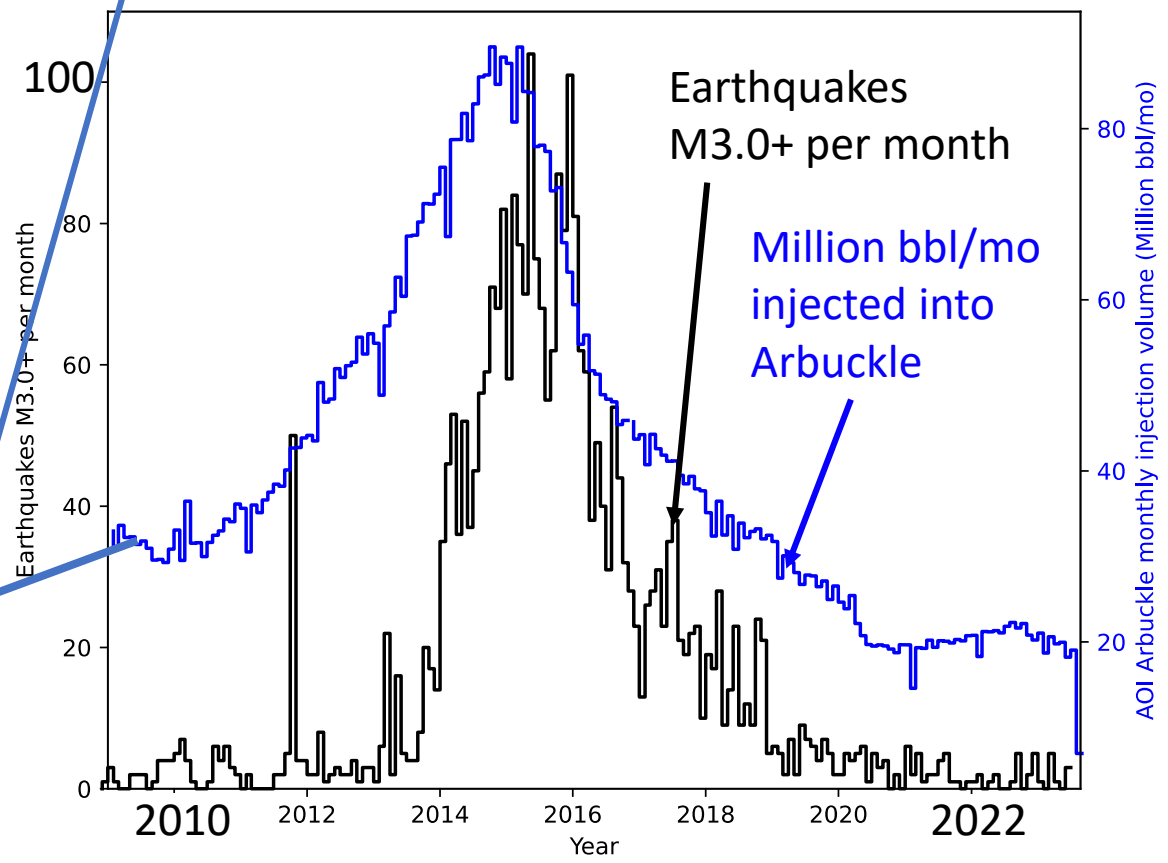
- Illustrates general trend from NE to SW for Arbuckle
- Belt of high storage capacity in central part of state
- "Flat earth" assessments to **100's of GT CO2**

Produced water (PW), salt-water disposal (SWD), undergound-injection-controls (UIC) & induced seismicity



Earthquakes have been more concentrated within SCOOP/STACK where injection has been concentrated. Also geological controls.

At peak injection >80 million barrels (>5000 Olympic pools or just under 1 Lake Thunderbird) of SWD into the Arbuckle ***every month***.



Question: would injection of CO2 away from the seismic belt face a lower hazard?

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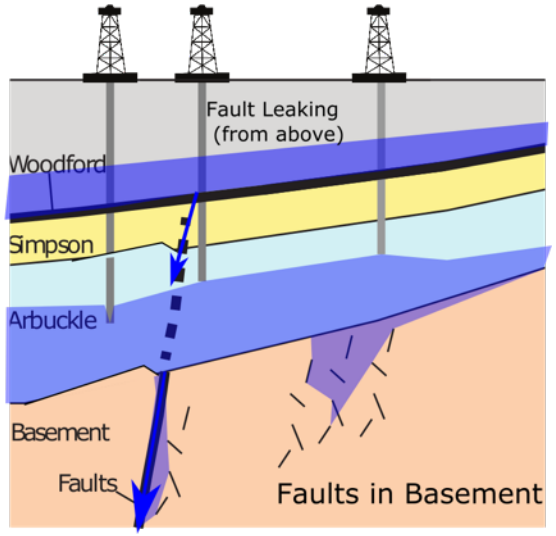
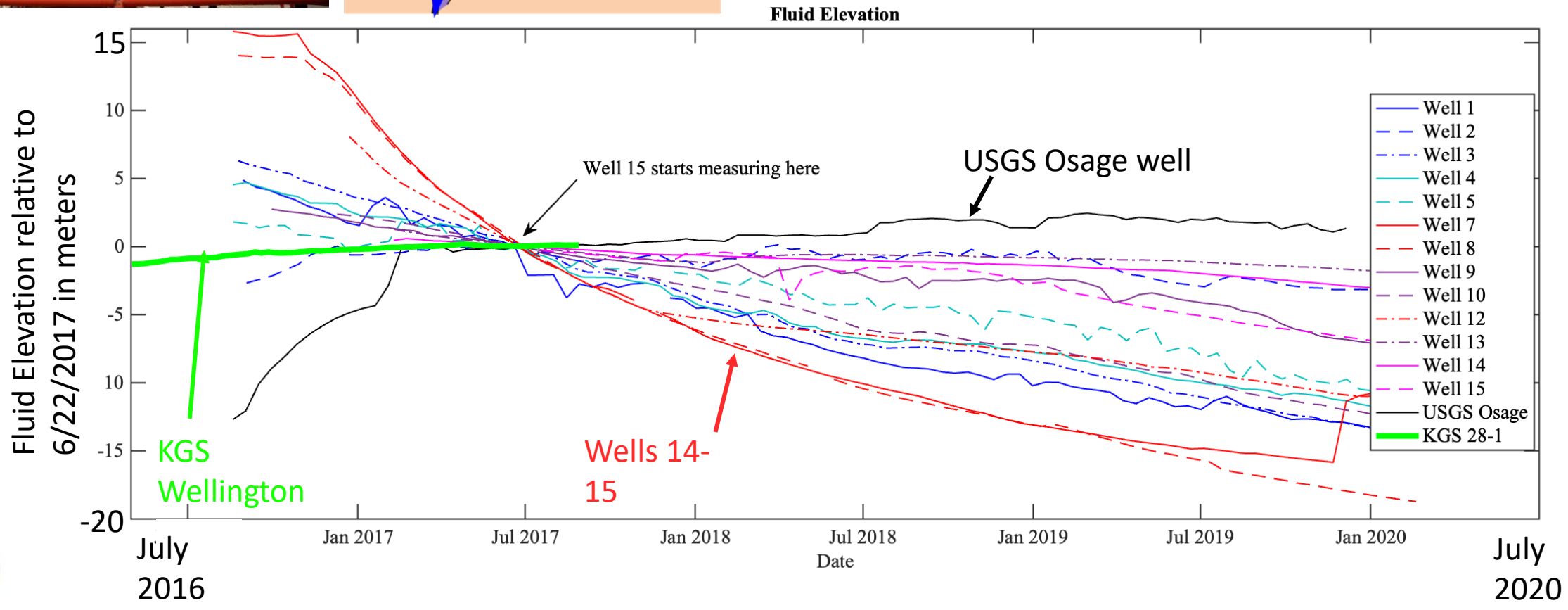


Allen et al., ”Minor Revisions” at Journal of Geophysical Research:

- Pressure monitoring of Arbuckle wells found long term declines (and lots of short-term transients).
- Clearly flow, but note these are DENSE fluids and not a buoyant CO2 plume.



FINAL SLIDE

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- DOE -2799 award to State Surveys is helping us get up to capacity
- Industry connections from CUSP are invaluable for our mission
- CUSP projects w/ Utah and Kansas have inspired us in our technical strategies
- Welcome future collaborations with CUSP members and beyond!