NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

New Mexico Tech
Petroleum Recovery Research Center

New Mexico Bureau of Geology and Mineral Resources
NEW MEXICO TECH
Earth Science for the 21st Century

New Mexico

CUSP West

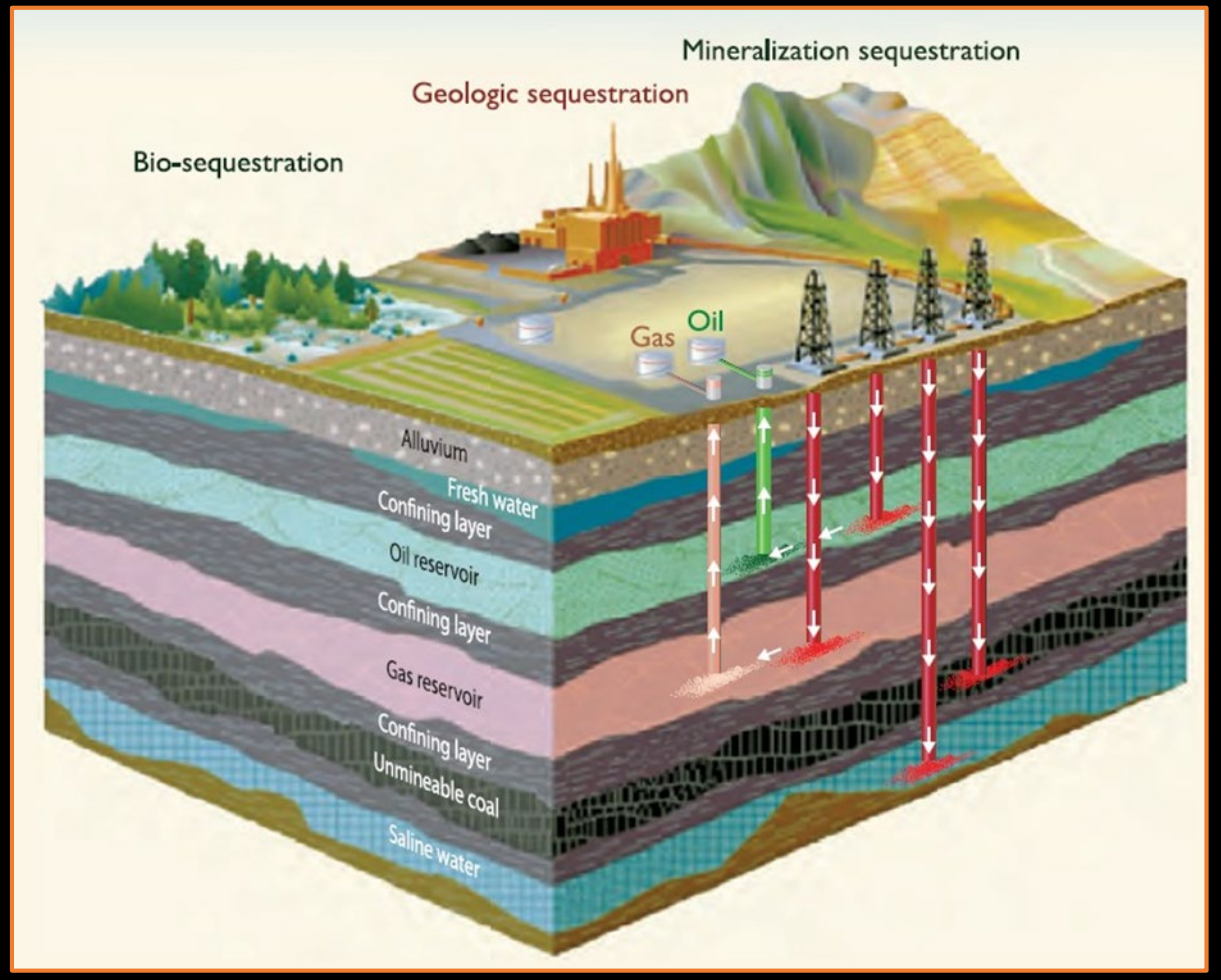
Dana Ulmer-Scholle – *PRRC & NMBGMR*
Kip Carrico - *Dept. of C&EE*

Milestones & Deliverables

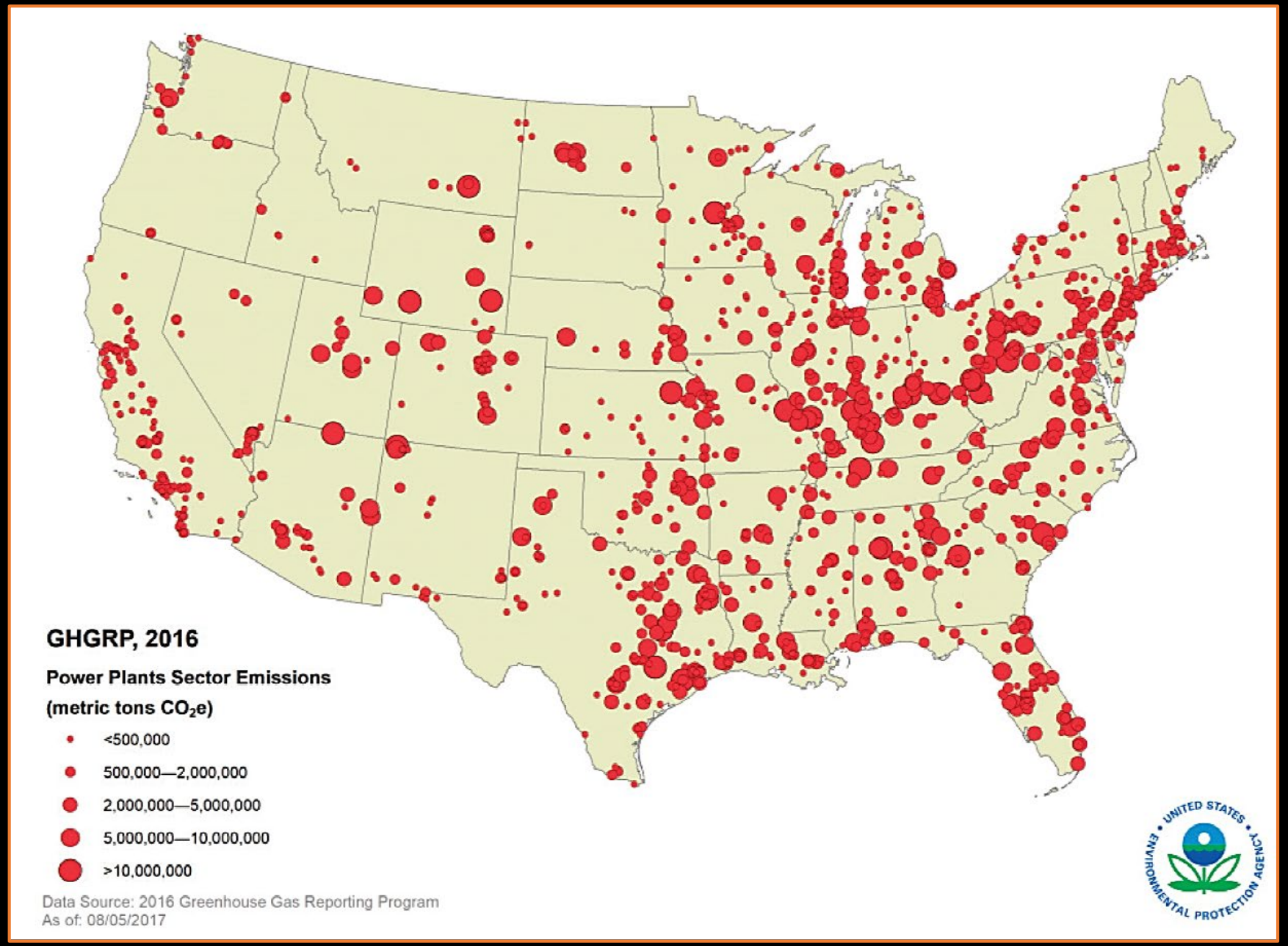
- Identification of the best CCUS sites in New Mexico
- Determine the key characteristics of the selected aquifers and seals
- Development of database of the variables needed for modeling
- Evaluate major CO_2 sources and create a database of key sources in NM and nearby states
- Contribute to reports

Scope of Work - NM Data

- Geologic challenges:
  - Stratigraphic nomenclature (within the aquifers/basins as well as with regional partners)
  - Multi-generational well data
  - Access to seismic data
  - Identifying multiple reservoirs and seals and their capacity for CCS

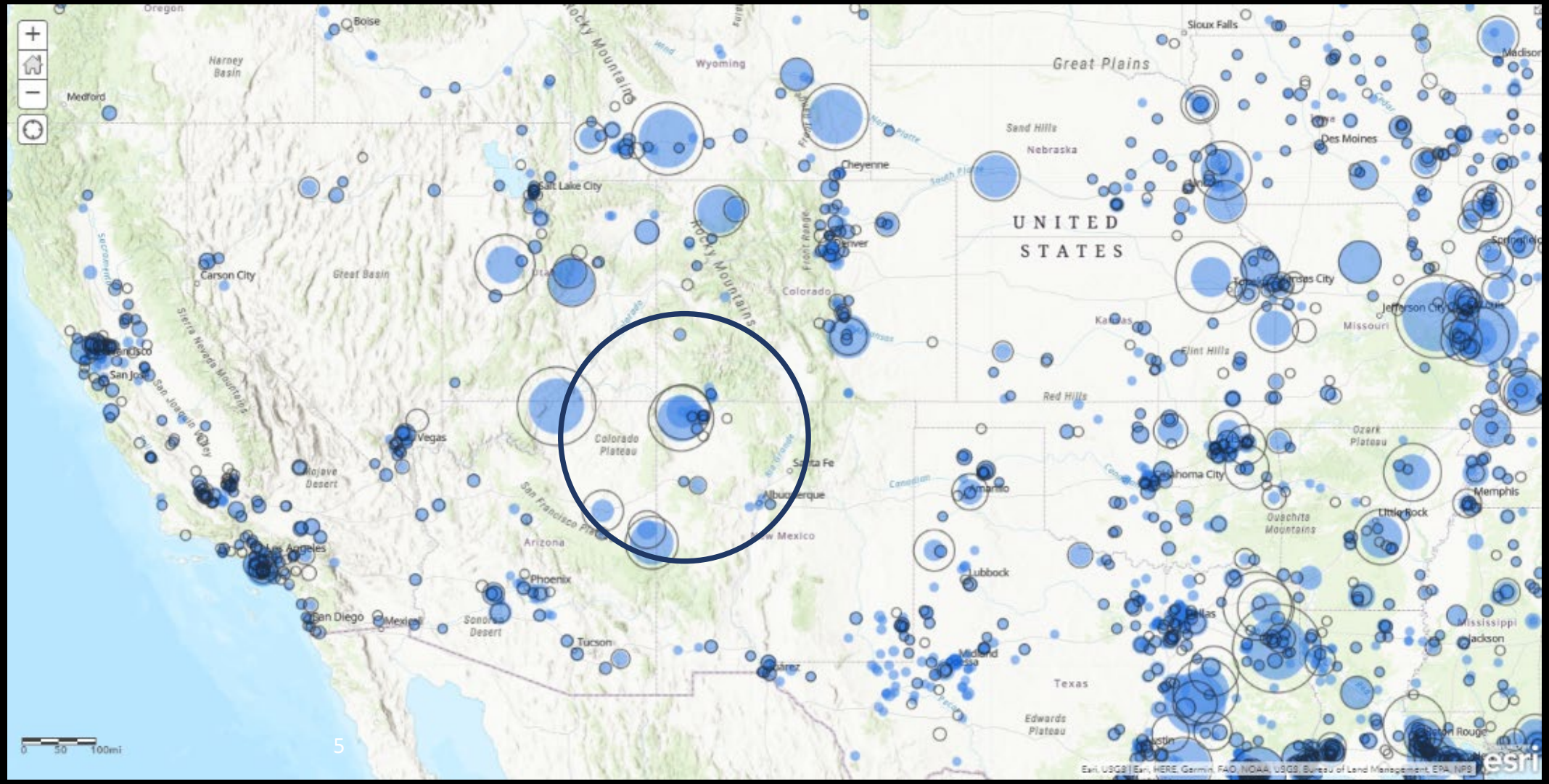


Greenhouse Gas Emissions from US Power Plants (2016)



New Mexico Tech
Petroleum Recovery Research Center

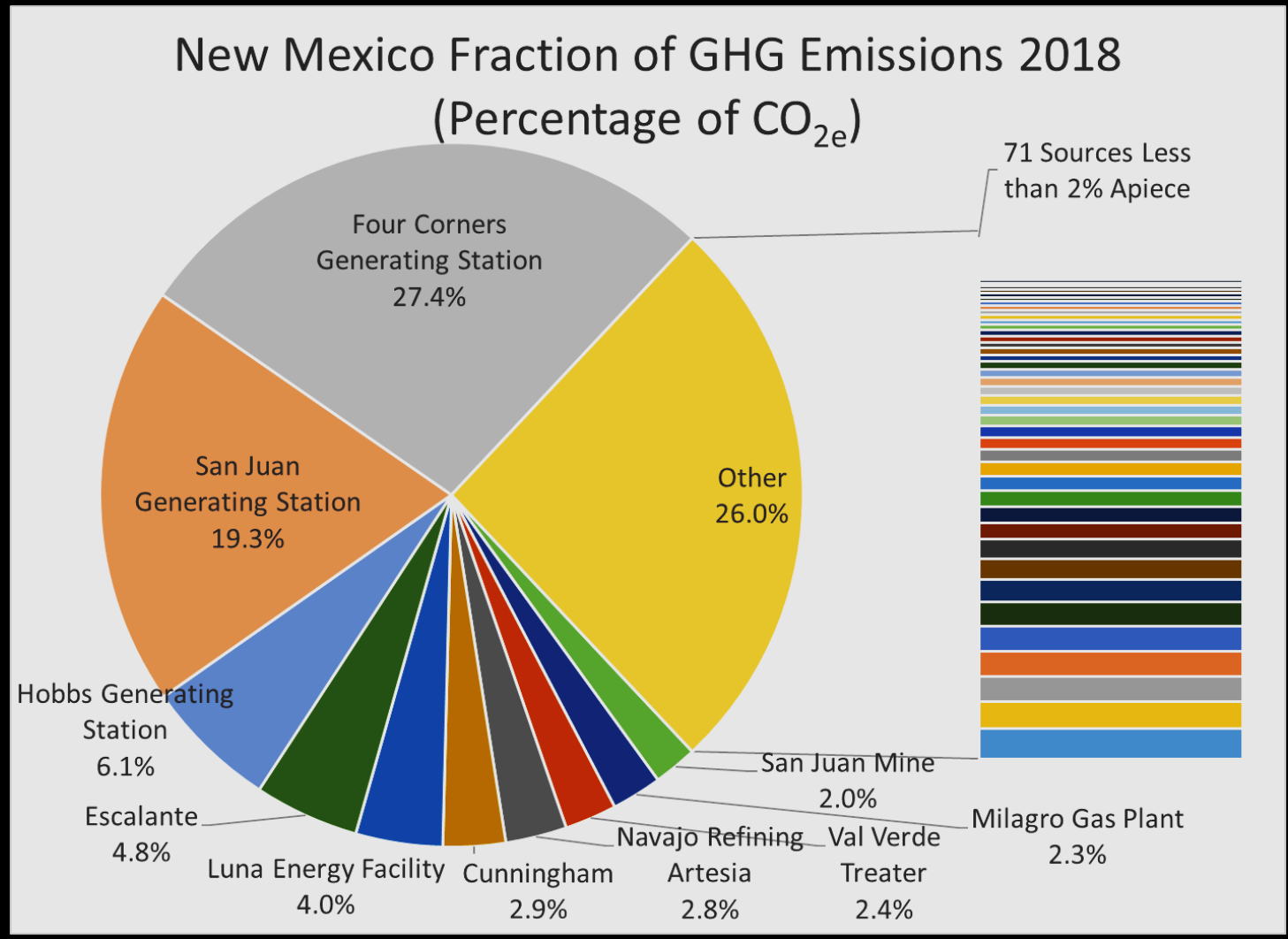
EPA FLIGHT Annual CO_2 Emissions Changes



2010 (Open Circles)- 2019 (Filled Circles)

New Mexico Tech
Petroleum Recovery Research Center

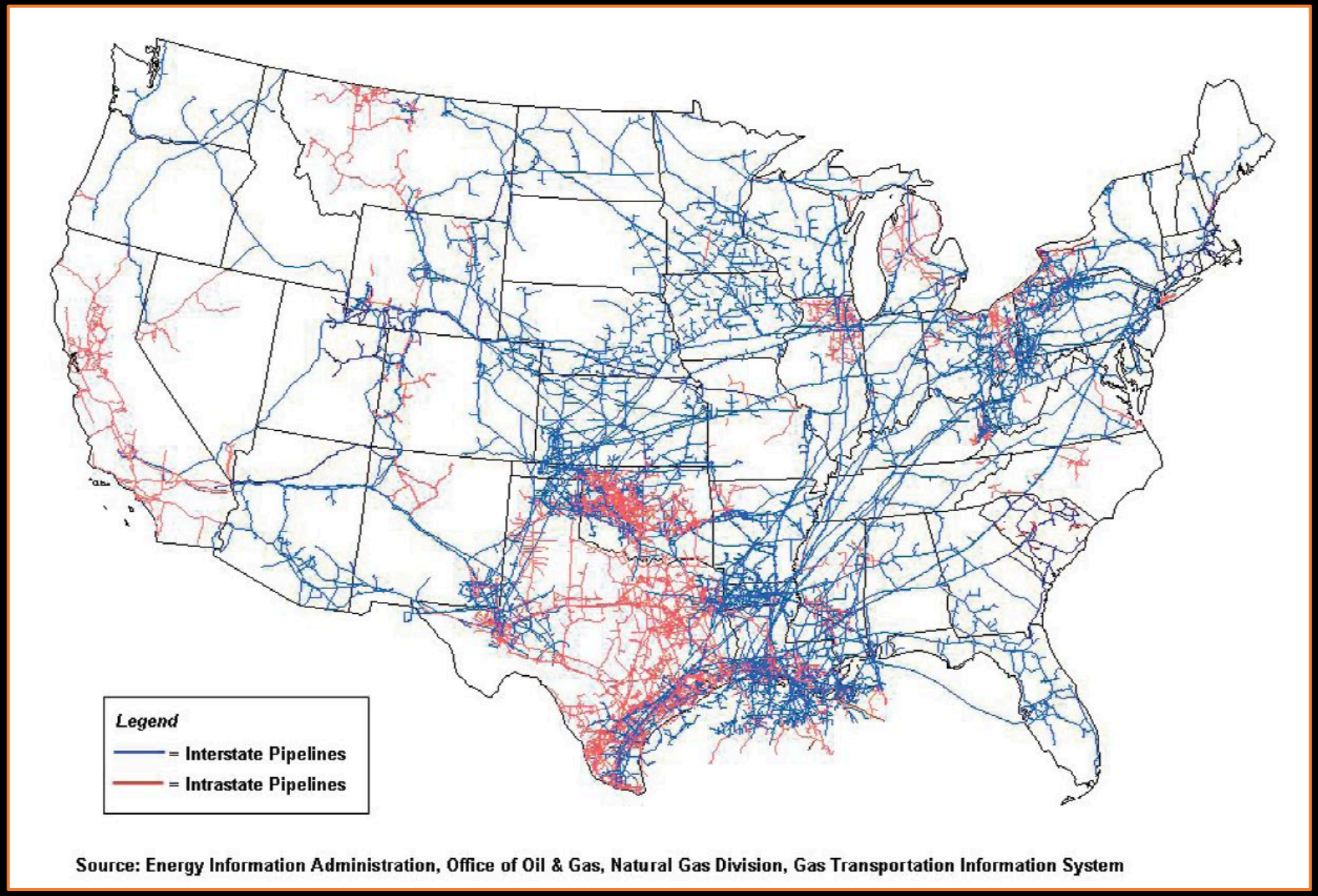
NM Top CO_2 Sources 2018



Breakdown of largest CO2 Emission Sources in NM (2018). Top ten sources are identified and other sources constitute <2% apiece of NM emissions.

New Mexico Tech
Petroleum Recovery Research Center

US Natural Gas Pipeline Network (2009)



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

New Mexico Tech
Petroleum Recovery Research Center

US CO_2 Pipeline Network (2019)

New Mexico Tech
Petroleum Recovery Research Center

Overview & Potential targets

New Mexico Tech
Petroleum Recovery Research Center

- The plan for each of the selected basins:
  - Identify both the reservoirs and associated seals within that basin,
  - For those units develop a database that includes the following well data:
    - Depth & Thickness
    - Porosity & Permeability (if available)
    - Formation temperature, density and pressures (if available)
    - Production information
    - Status of the well
    - Availability of well logs (and types), seismic, core and cuttings
    - Water information including TDS (and other analyses) and formation source (if possible)
    - For sand-rich targets, determine the % of sand in the reservoir units of interest
    - Other data needed by modelers
  - Create regional geologic models in IHS Kingdom and port it out to Schlumberger Petrel

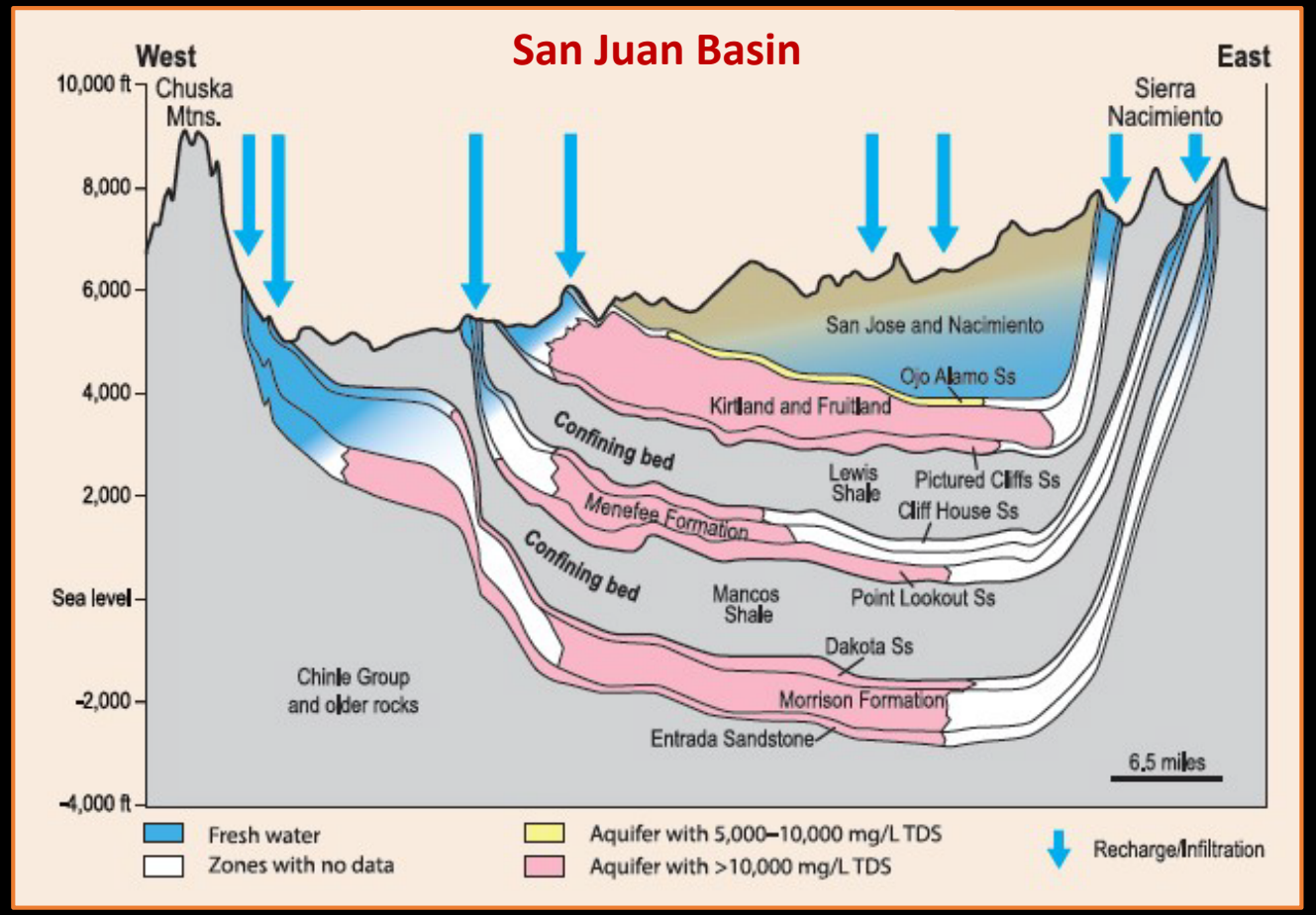
Sources of Data?

- NMBGMR
  - NM Well Database:
    - Porosity & permeability,
    - Lithology,
    - Geothermal information
    - Misc. other data …..
  - Cores (>2,150 cores)
  - Cuttings (>15,400 cuttings)
  - Water Chemistry Database (mostly surface and water well data)
- PRRC
  - ***GoTech*** site
    - Produced waters
    - Well data
    - Well production info
- EMNRD-OCD
  - Well logs
  - Well reports
    - Porosity & permeability,
    - Tops
    - Water quality
  - Well data sheets
- USGS-USDW Database
- NatCarb Atlas
- Reports by NMBGMR, PRRC, USGS and others

Overview & Potential targets

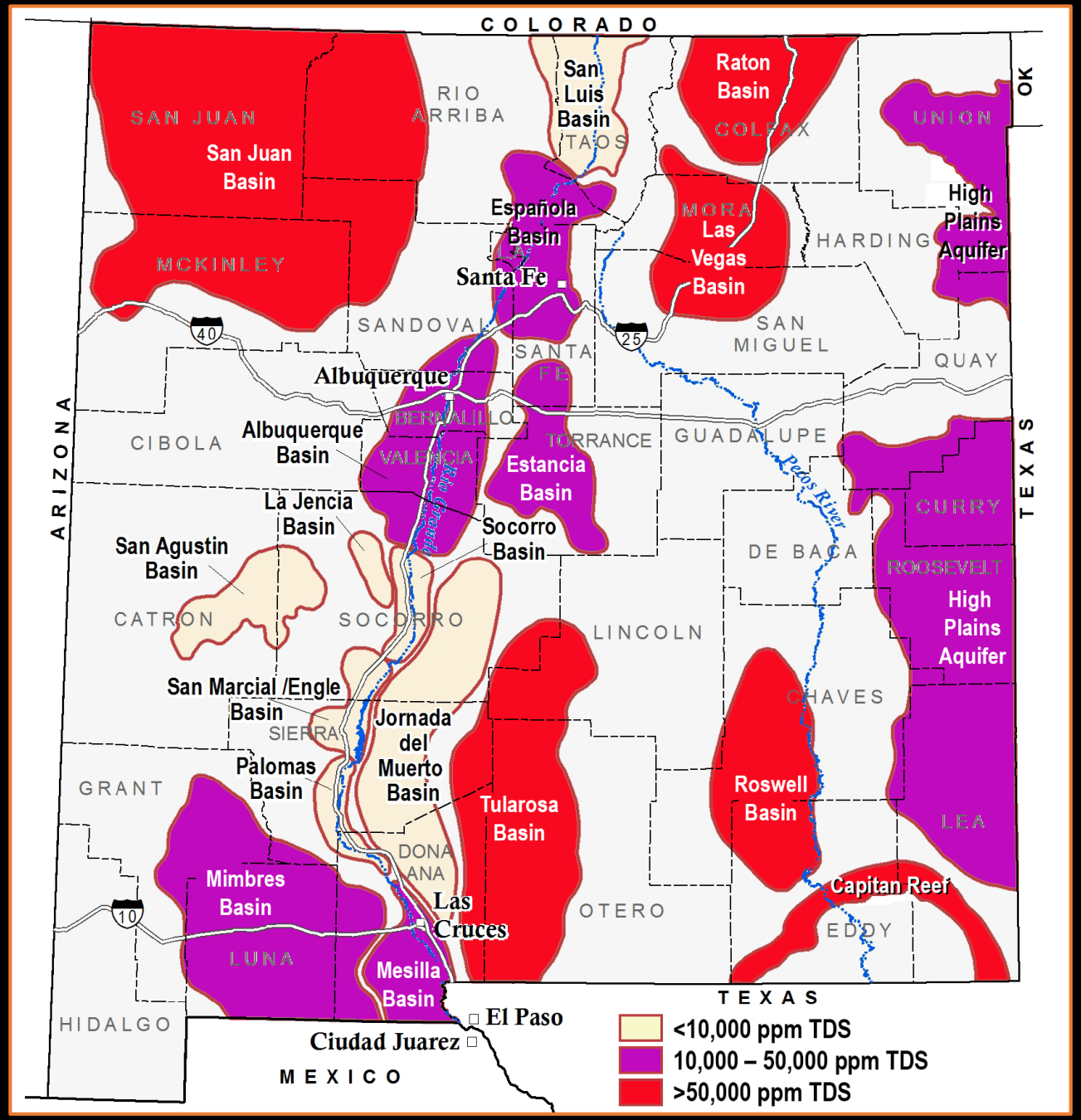
New Mexico Tech
Petroleum Recovery Research Center

- Numerous basins and aquifers exist in New Mexico and adjacent areas that have CCS potential.
- In particular, the San Juan Basin, the largest basin, has stacked storage potential (as well as EOR potential), its hydrology is relatively straight forward (increasing salinities with depth and proximity to the basin center), and is close to sources.
- Currently, we have a CarbonSafe III project nearing drilling



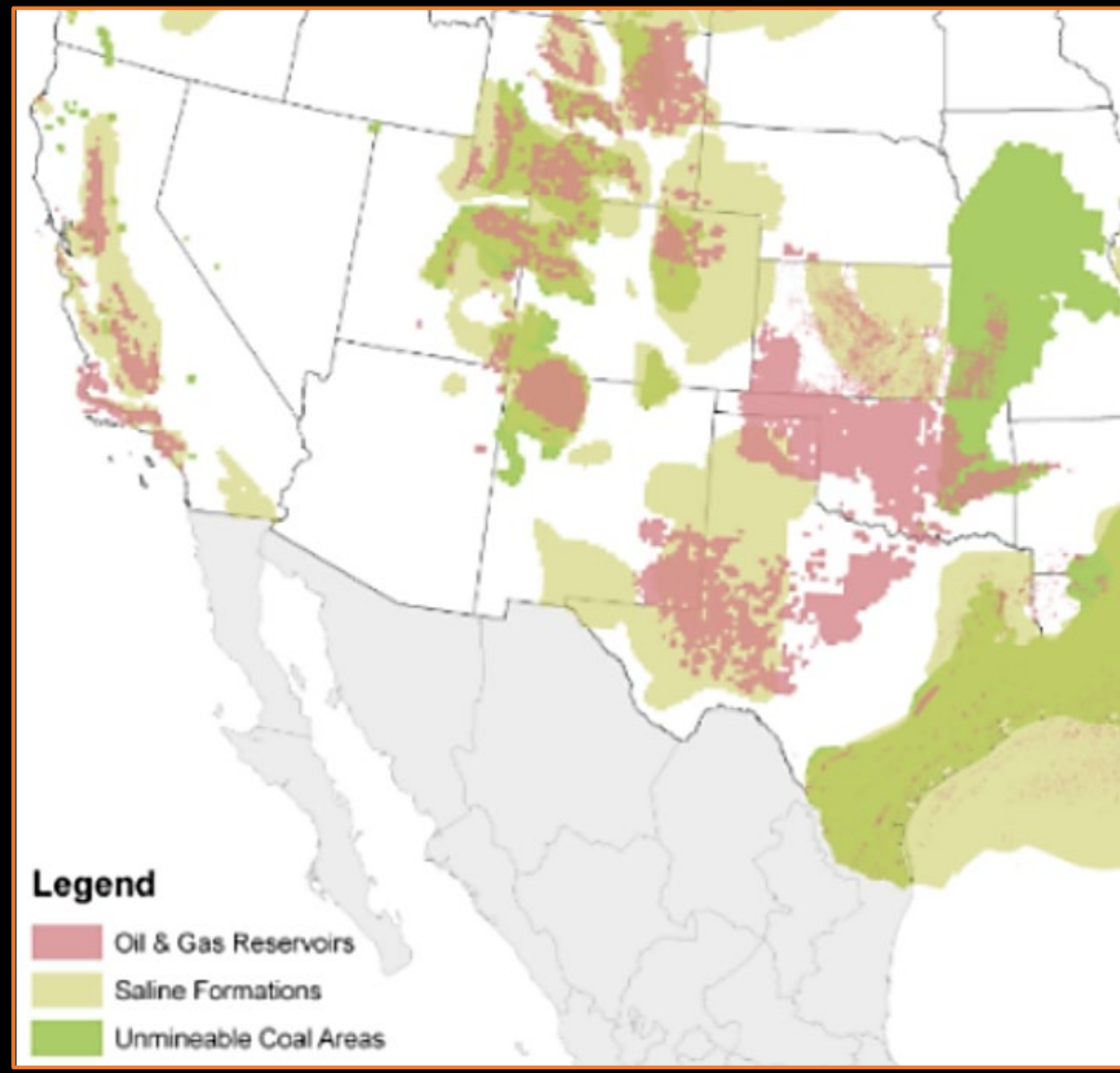
Possible Targets:

- Based on water well data (and a few data points from produced waters)
- Six areas that exhibit high TDS (red areas)
  - San Juan Basin
  - Raton Basin
  - Las Vegas Basin
  - Tularosa Basin
  - Roswell Basin
  - Capitan Reef (even w/high TDSs, it is not viable since it is an active aquifer)
- Six areas that have moderate to high TDS (purple areas)
  - Mimbres Basin
  - Mesilla Basin
  - Albuquerque Basin
  - Estancia Basin
  - Espanola Basin
  - High Plains Aquifer (not viable since it is an active aquifer)



Potential targets

- Besides these basins, other possible sinks are as EOR within deep production in the Permian Basin and possibly the San Juan Basin
- Coals and coal-bed methane deposits
- Exhausted oil and gas fields
- Direct capture and reinjection into the subsurface from activities related to gas production



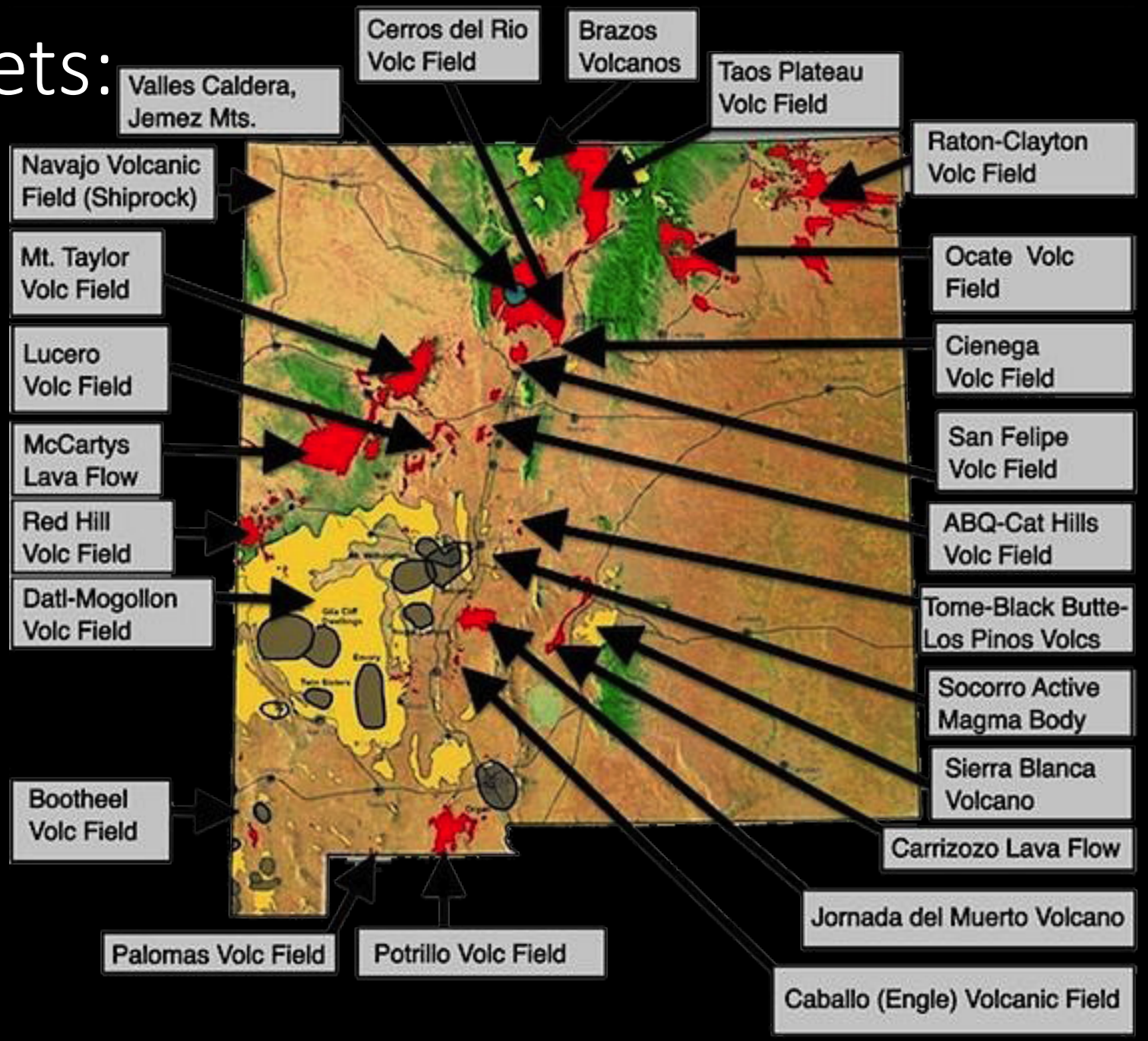
Geologic CO_2 Storage Potential

New Mexico Tech
Petroleum Recovery Research Center

Other Possible Targets:

Volcanics in NM

- Numerous volcanic fields
- Resources include both surficial and buried volcanics
- Extensive collection of samples for characterization and bench testing

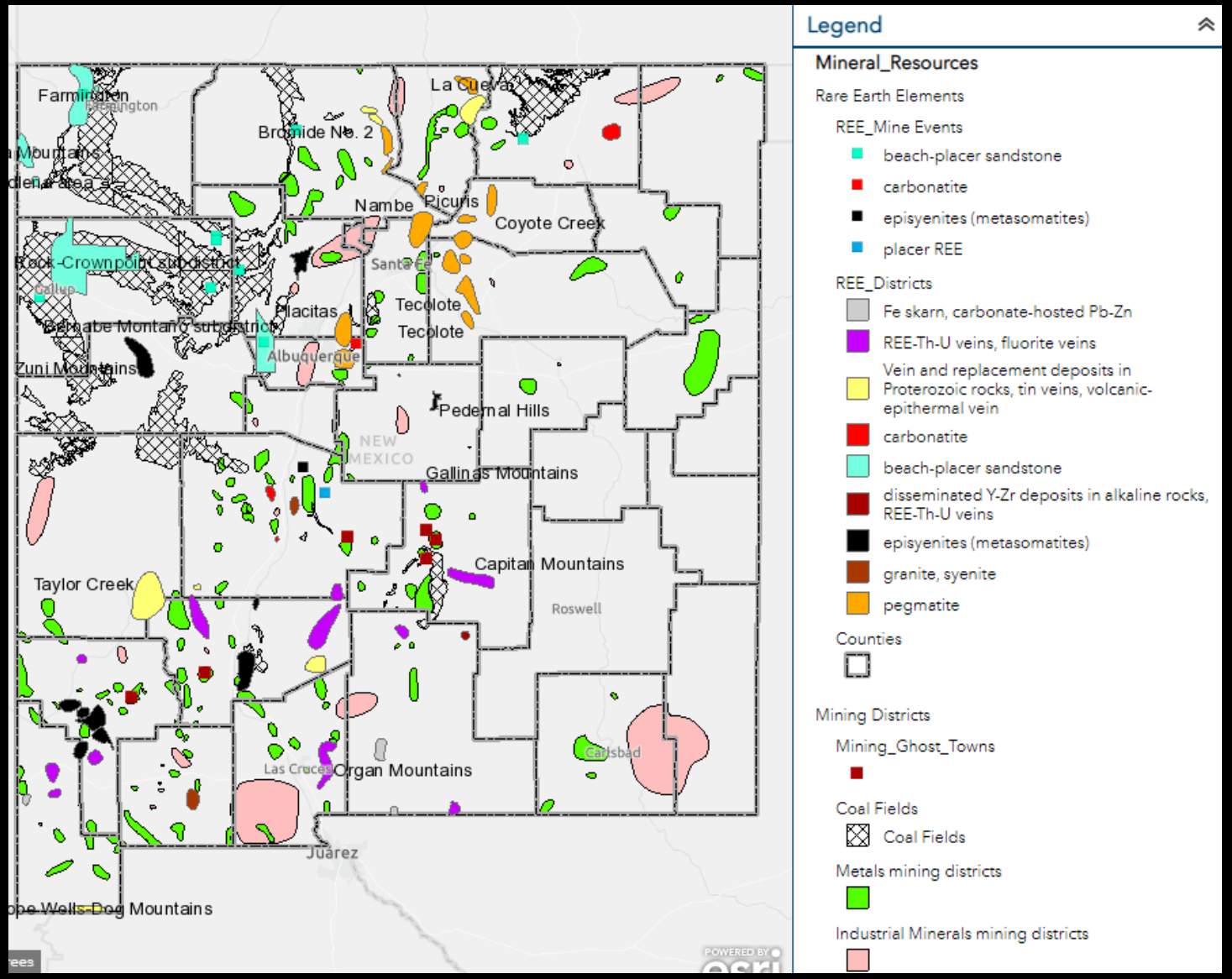


New Mexico Tech
Petroleum Recovery Research Center

Other Possible Targets:

Mine Waste in NM

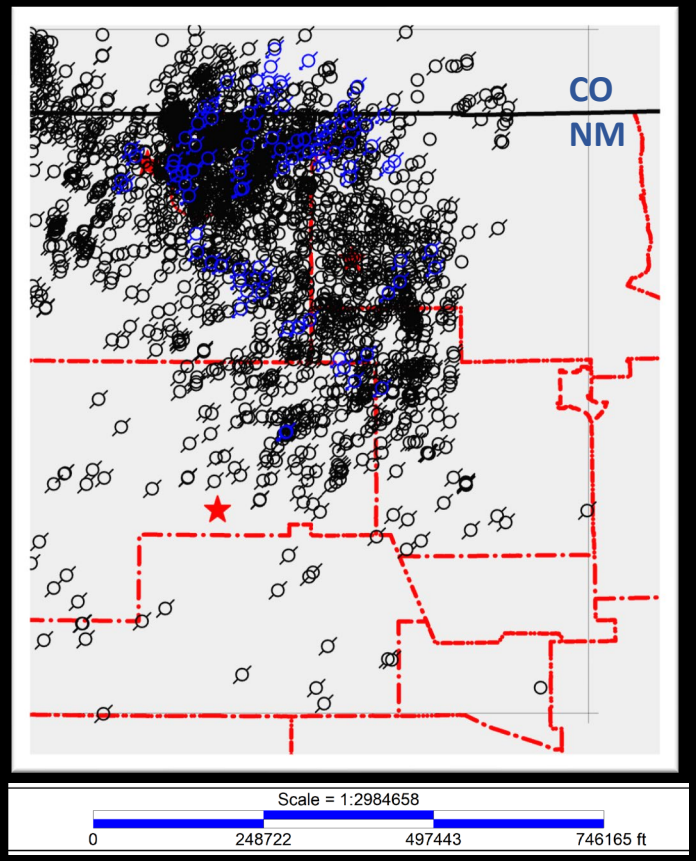
- Abundant abandoned mine waste in the state (unfortunately)
- Ranges from resources in sedimentary rocks to hard-rock deposits

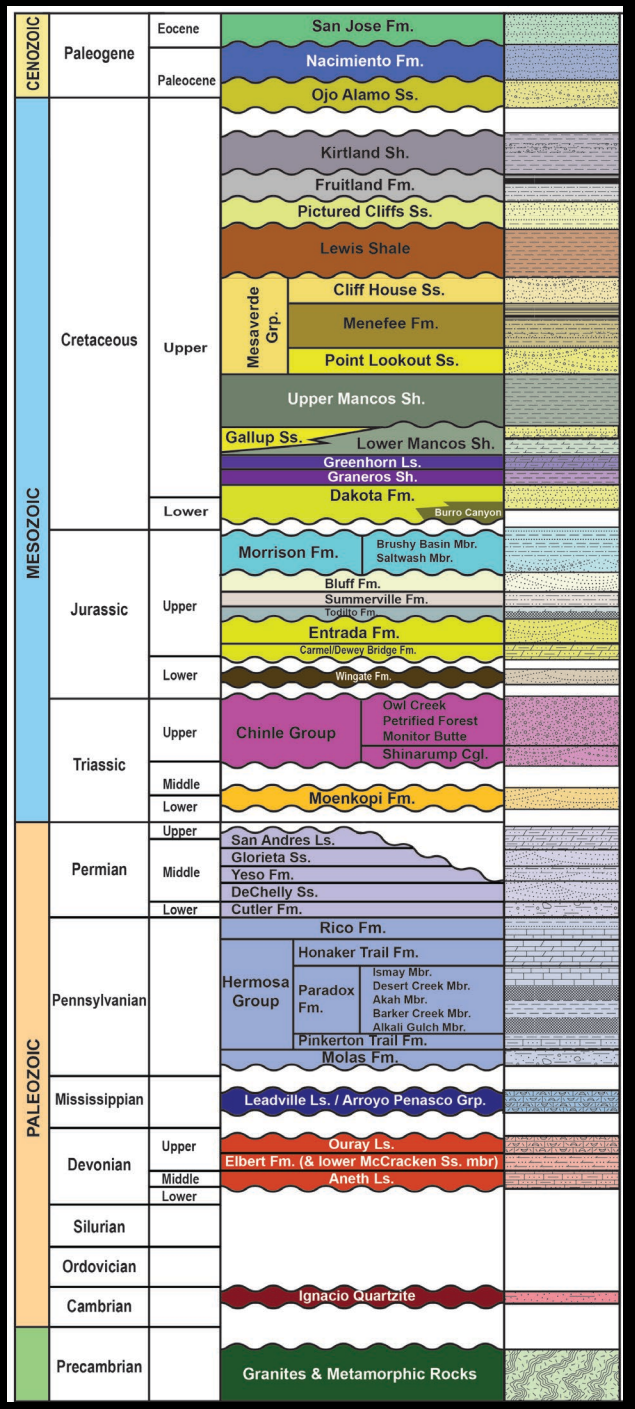


New Mexico Tech
Petroleum Recovery Research Center

San Juan Basin

- Have created a regional geologic model for the SJB from the Precambrian to the Paleocene
- Over 2400 hand picked wells with 27,000 formation tops
- Determine regional extent of reservoirs and seals
- Developed a structural model for the basin

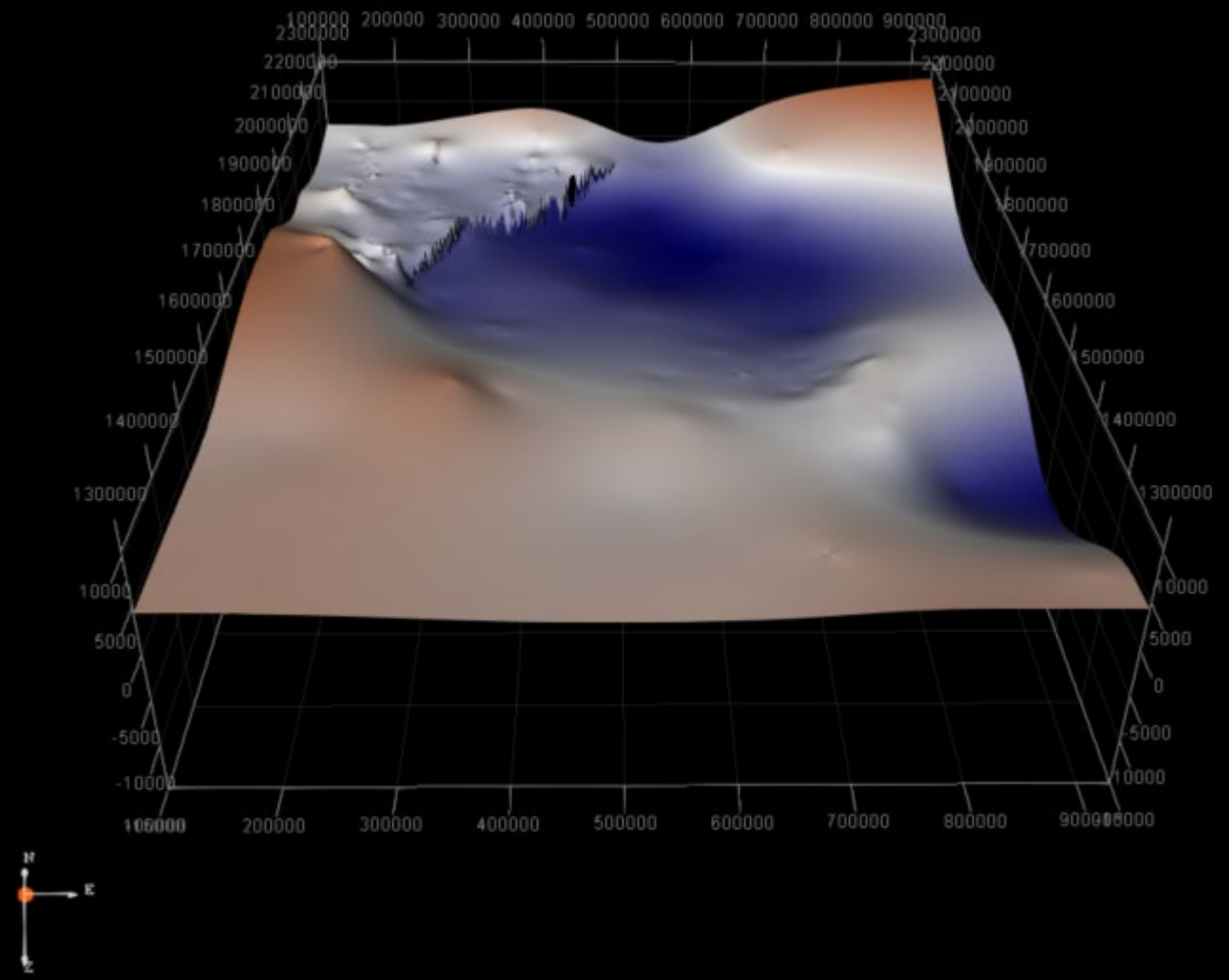




New Mexico Tech
Petroleum Recovery Research Center

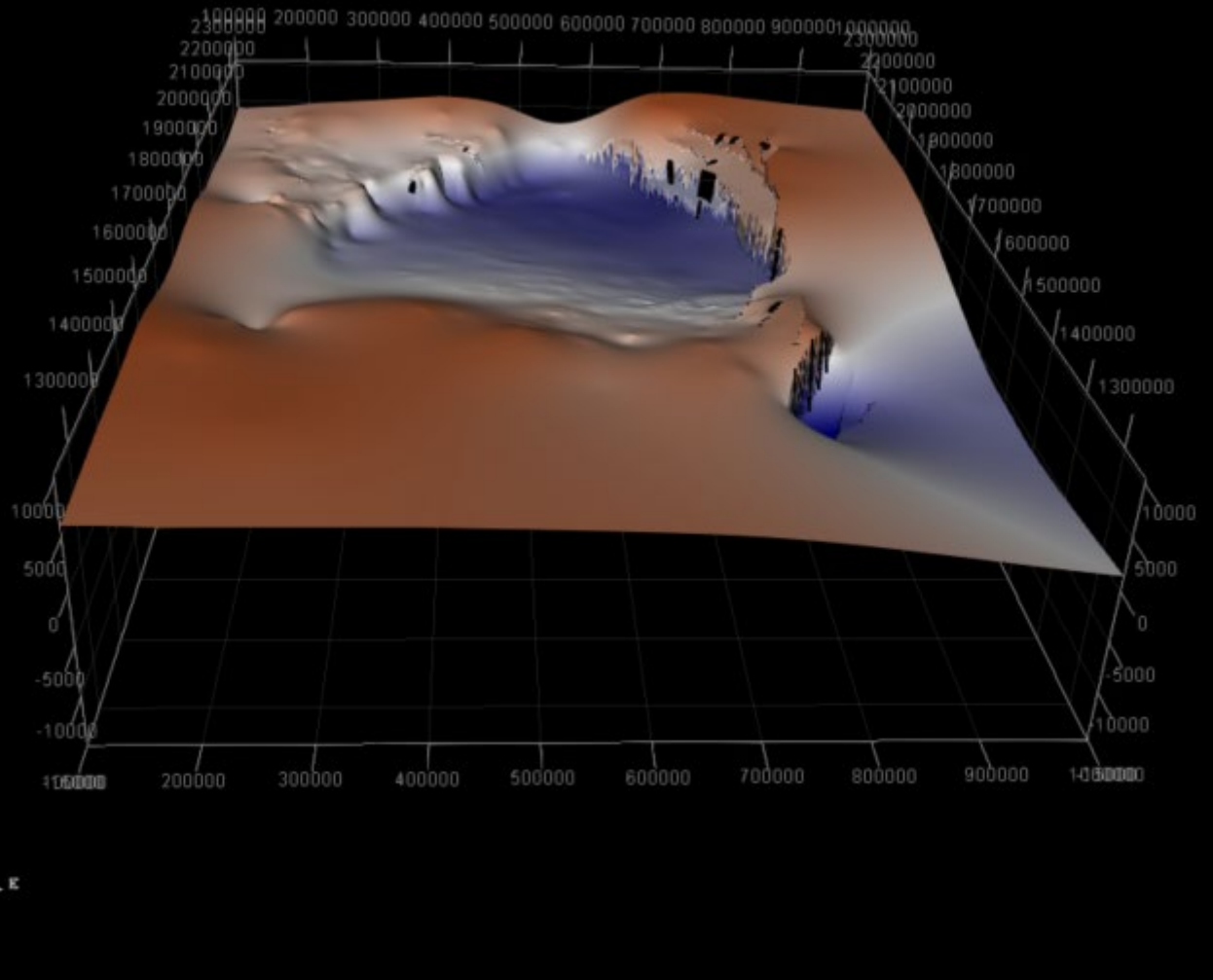
San Juan Basin

Pennsylvanian Honaker Trail Formation



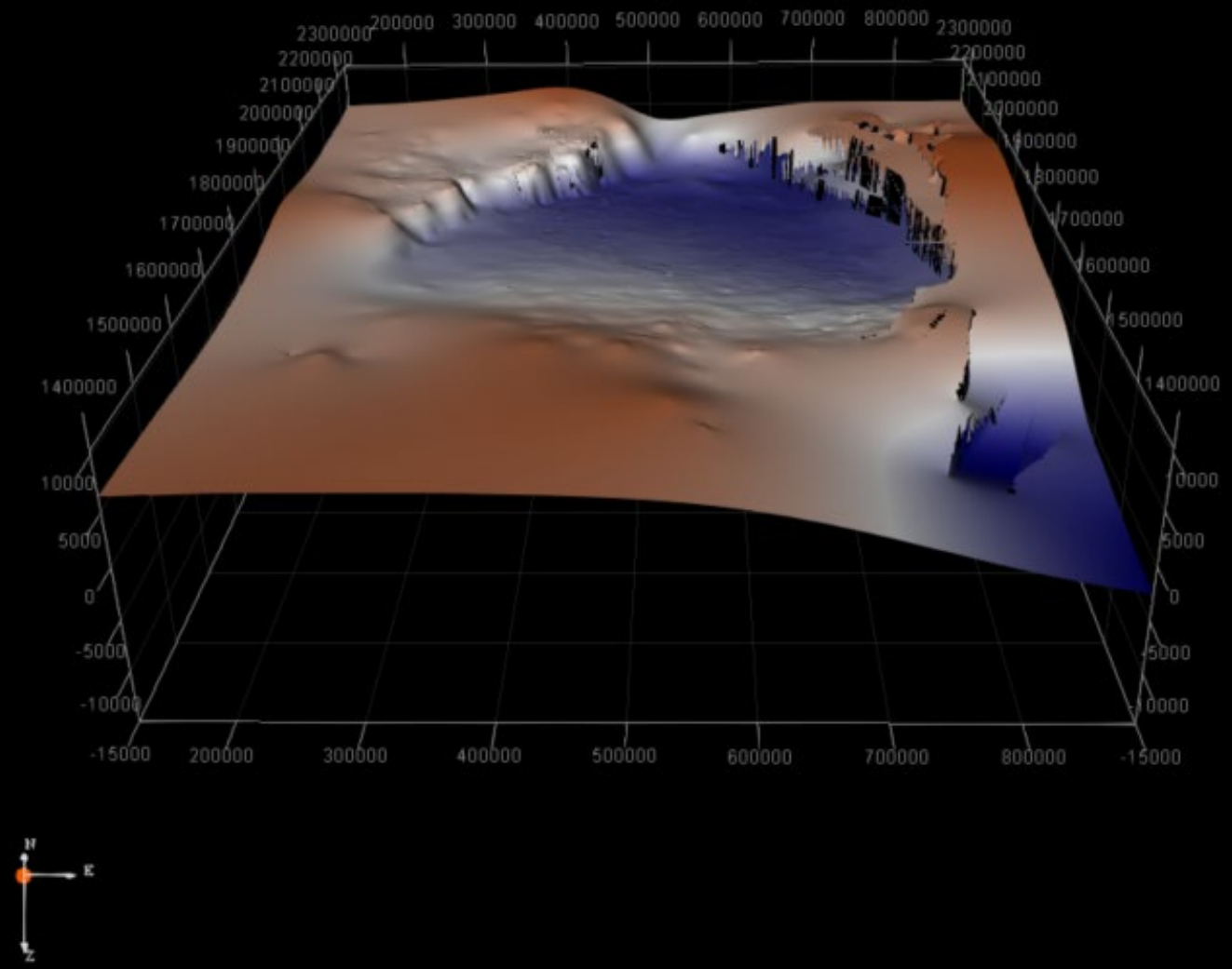
San Juan Basin

Jurassic Entrada
Sandstone

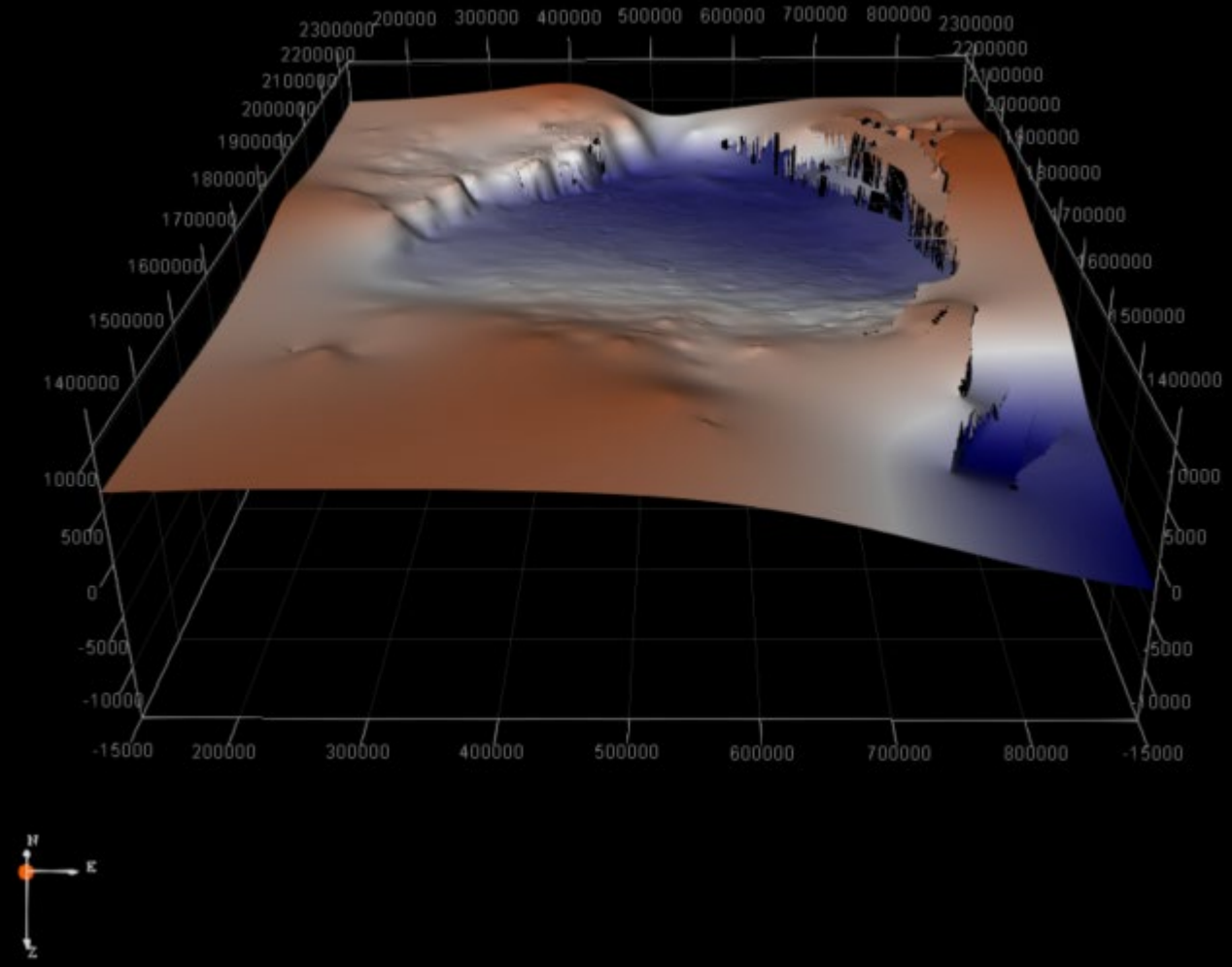


San Juan Basin

Lower Cretaceous
Dakota Sandstone



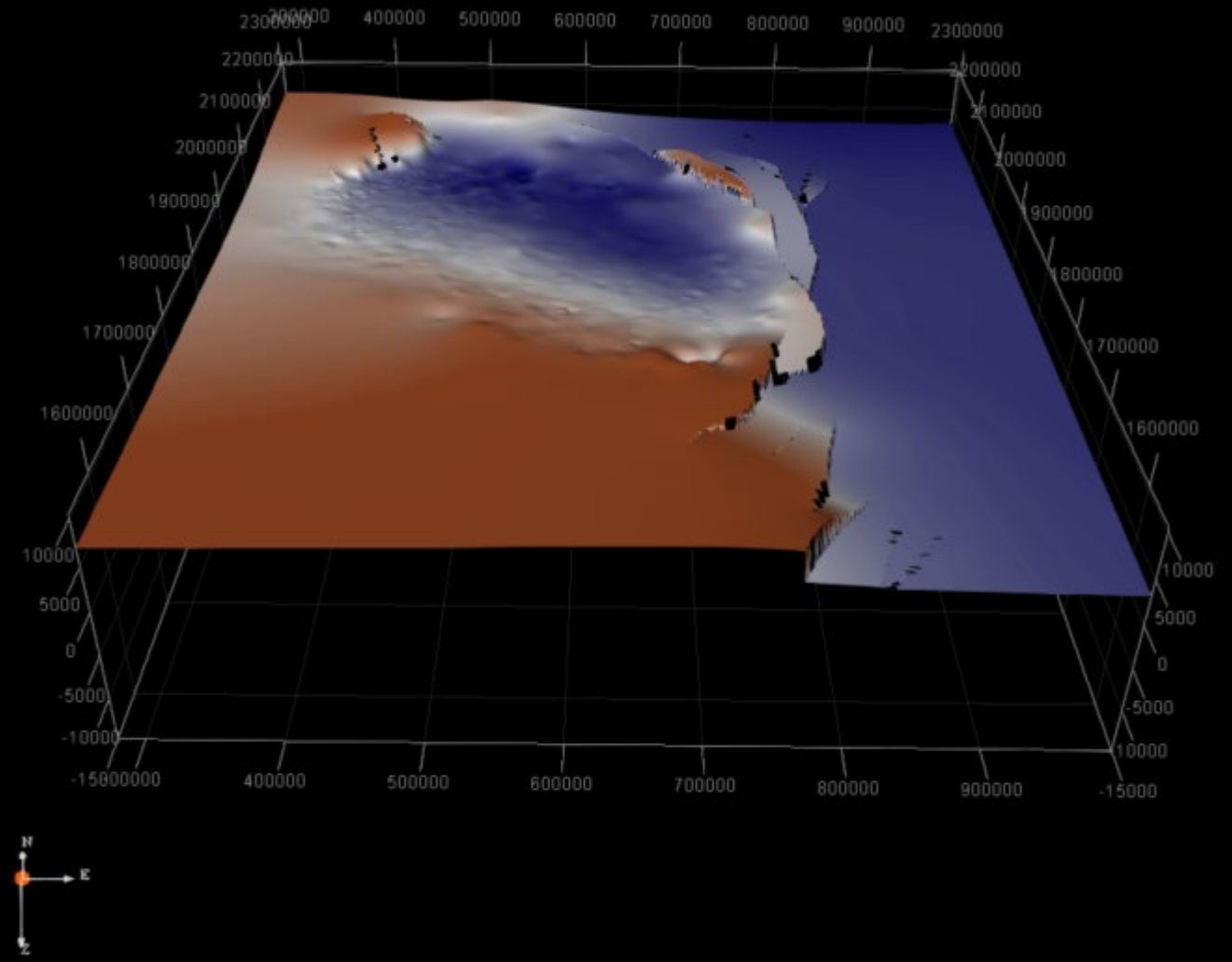
San Juan Basin



Upper Cretaceous
Mancos Shale

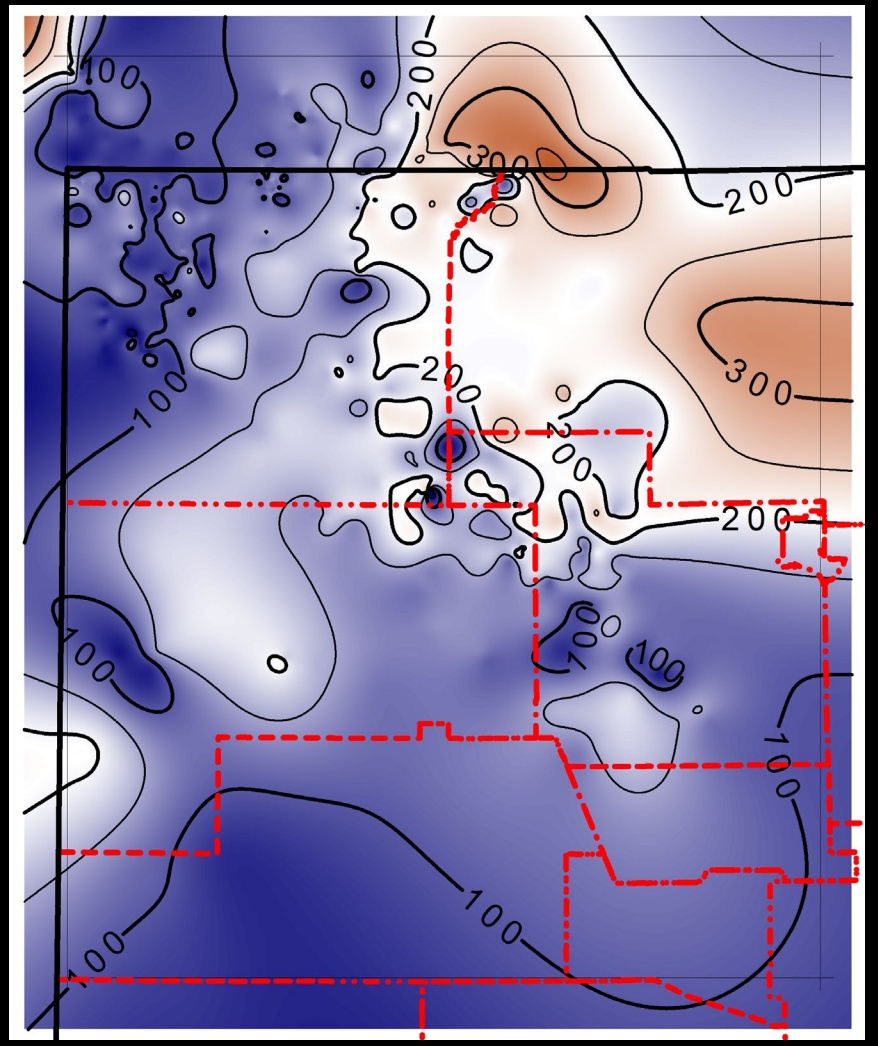
San Juan Basin

Upper Cretaceous
Lewis Shale

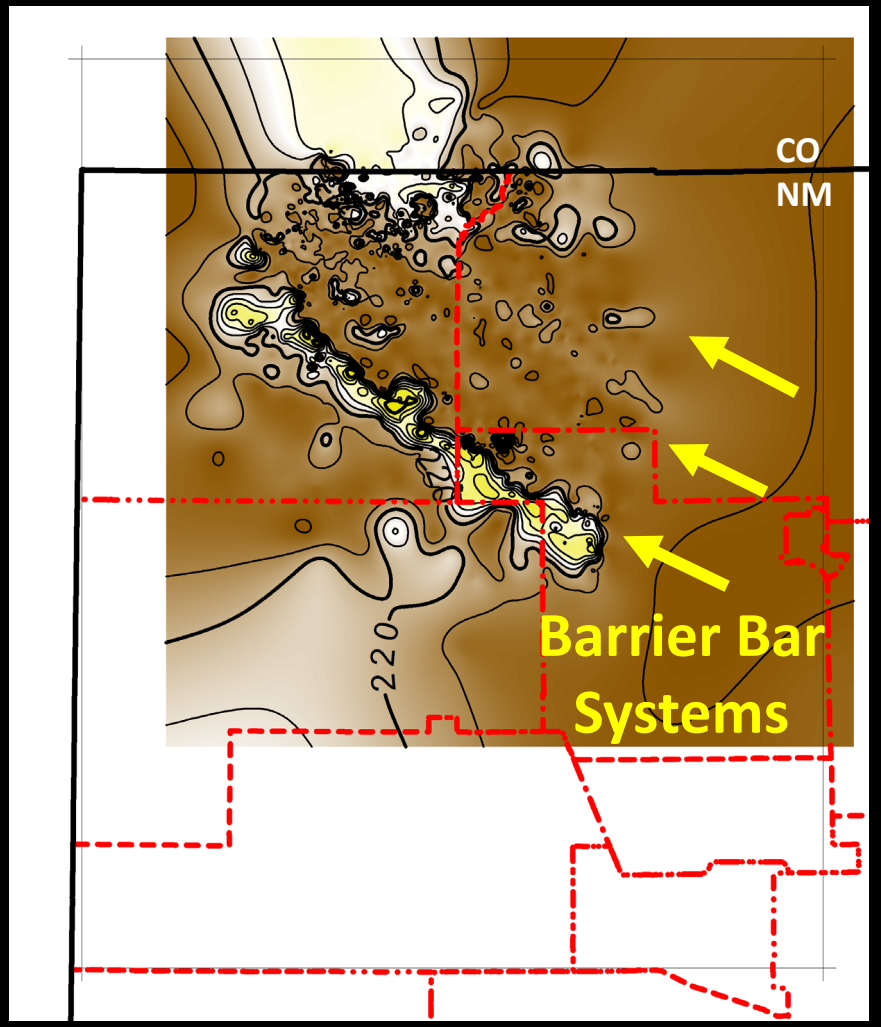


San Juan Basin

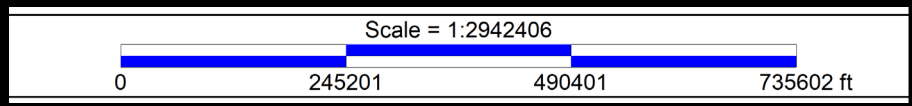
- Thickness of reservoirs
- Provides information depositional environments



Entrada Sandstone: Isopach



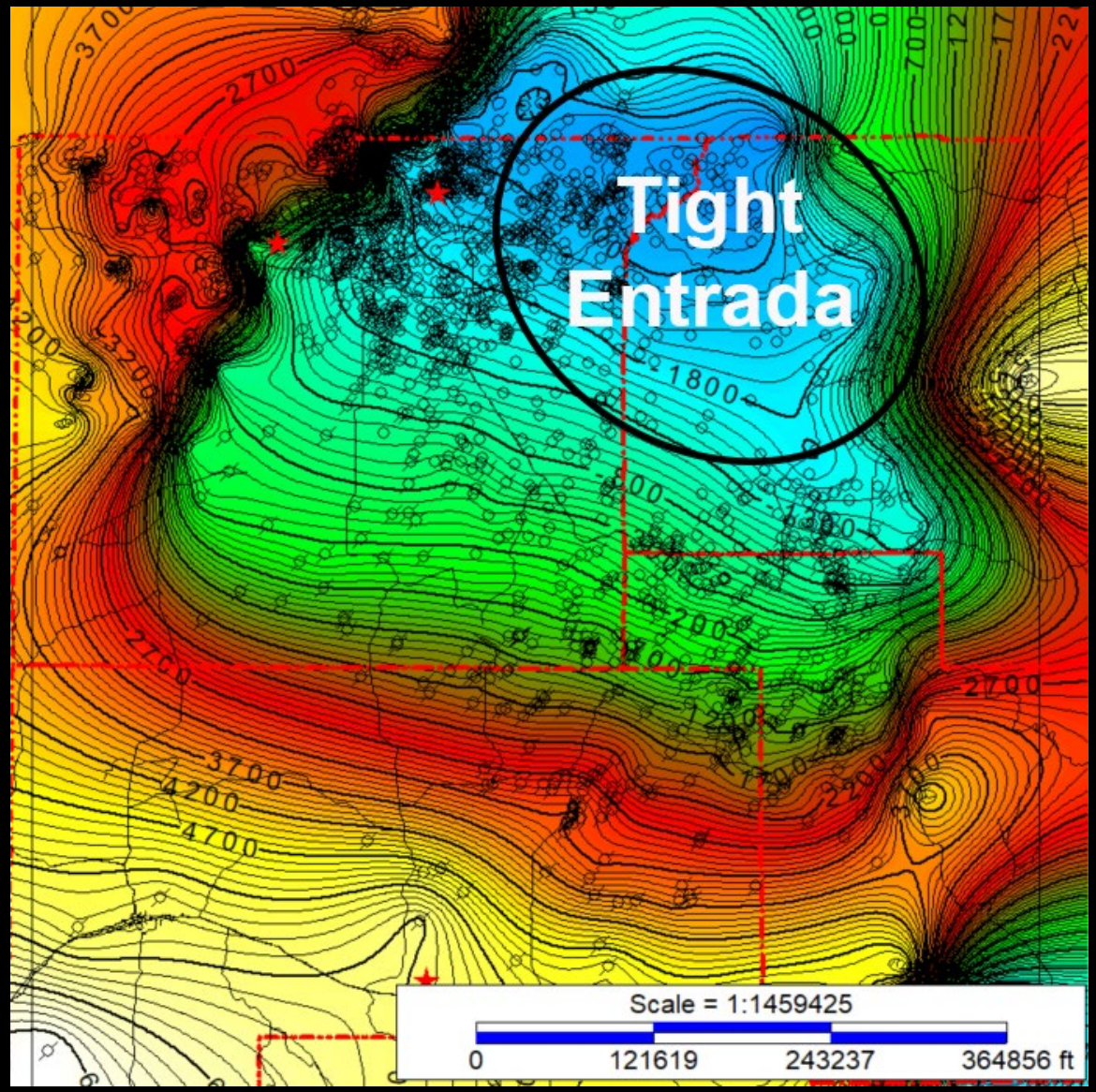
Cliff House Sandstone: Isopach



New Mexico Tech
Petroleum Recovery Research Center

San Juan Basin

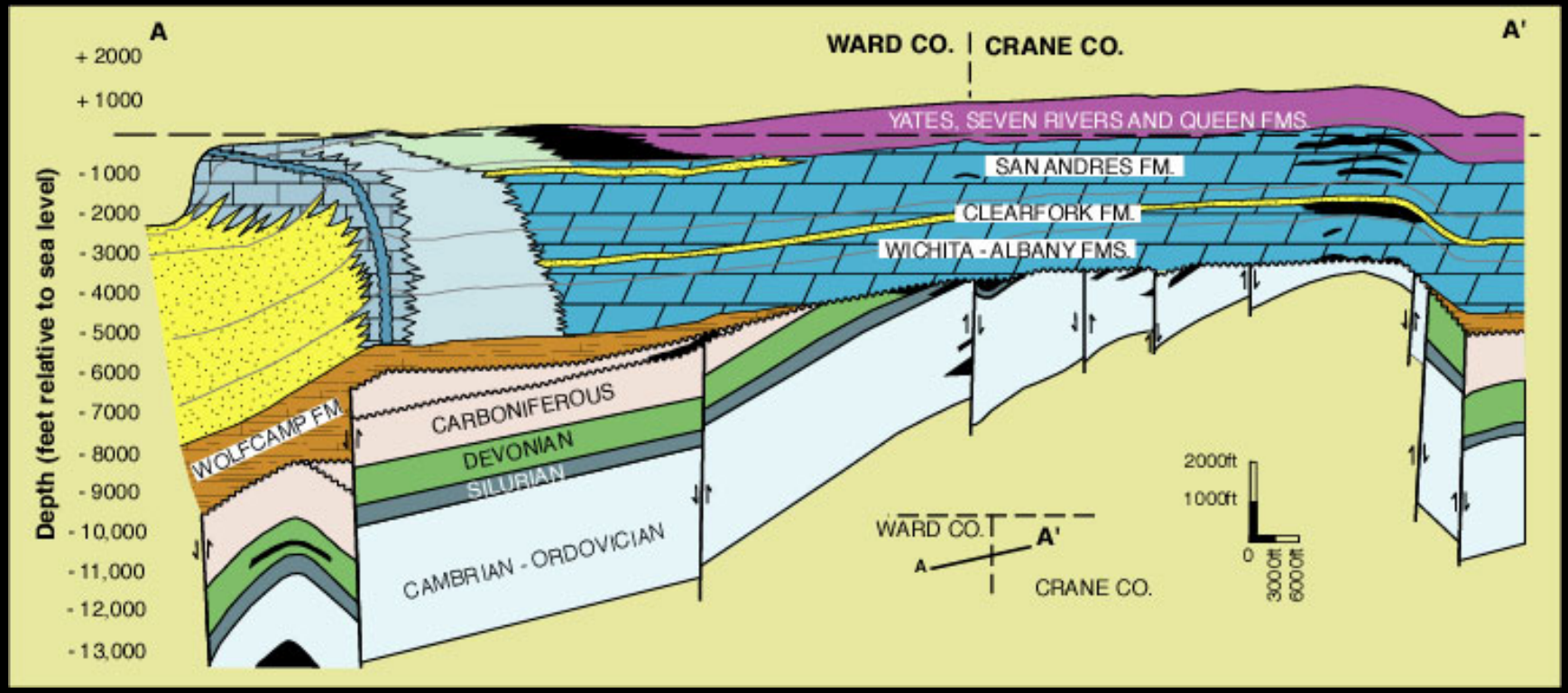
- Model provides fast initial information for future CO_2 sequestration projects
- Working on adding known reservoirs in SJB including porosity and permeability data



New Mexico Tech
Petroleum Recovery Research Center

Delaware Basin

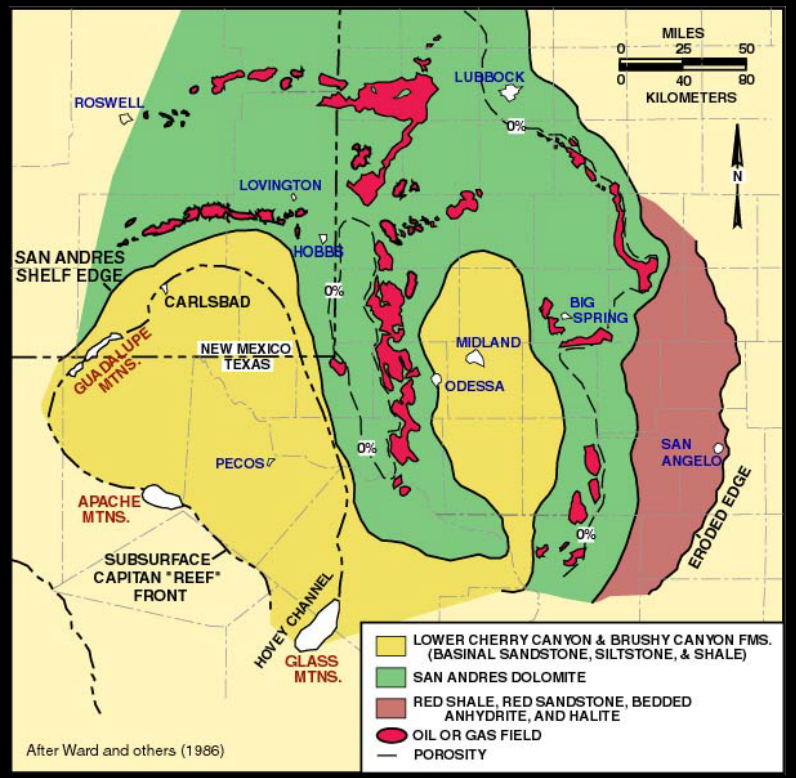
- Precambrian to Mississippian geology: carbonate shelves and deep water shales
- Pennsylvanian geology: Siliciclastic and carbonates deposits influenced by glacial eustatic sea-level changes

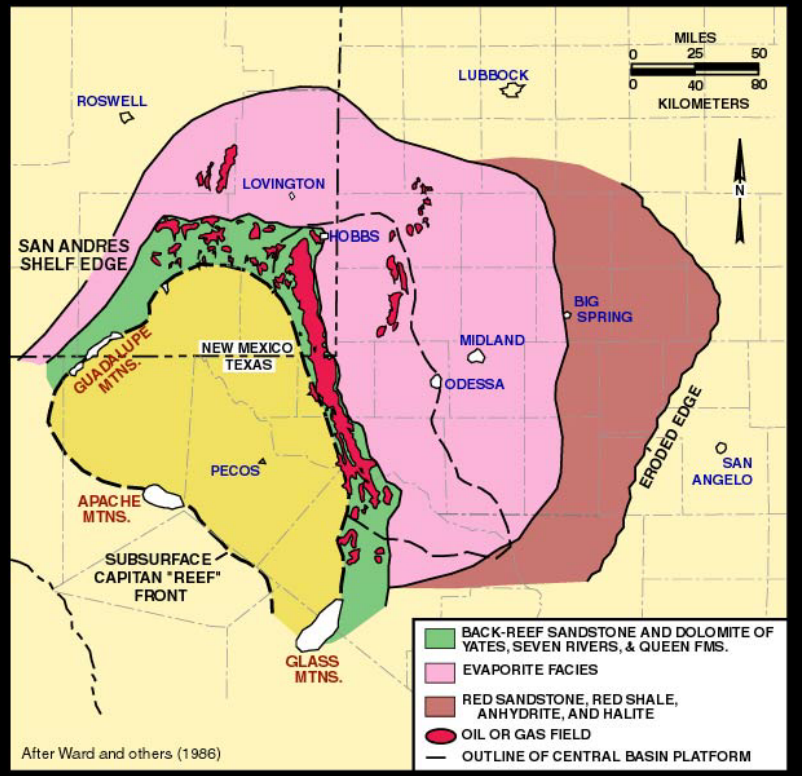


New Mexico Tech
Petroleum Recovery Research Center

Delaware Basin

- Complex Permian geology: 2 Lower Guadalupian basins (Delaware & Midland) with wide shelves going to only the Delaware Basin in the Upper Guadalupian with narrow shelves

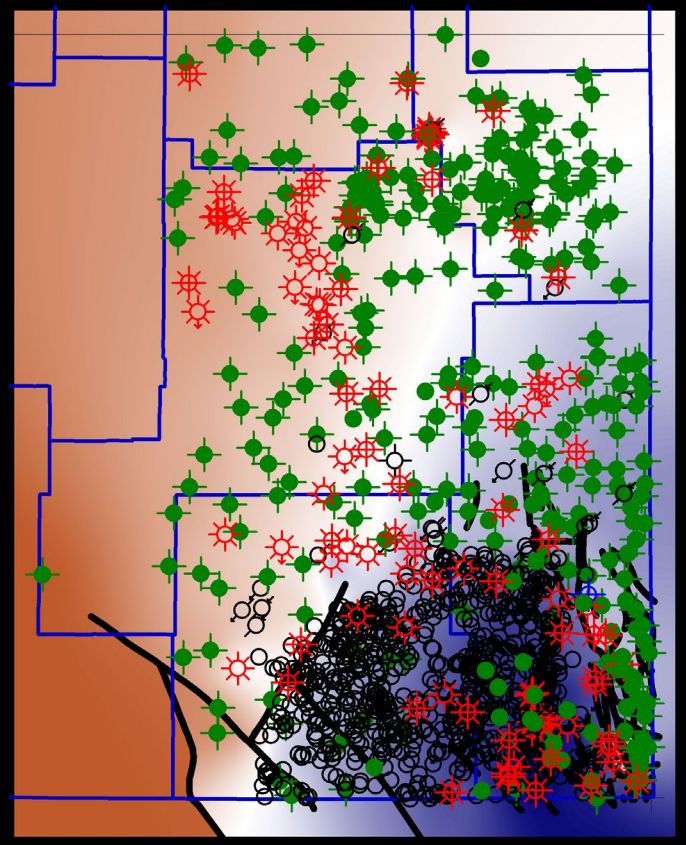


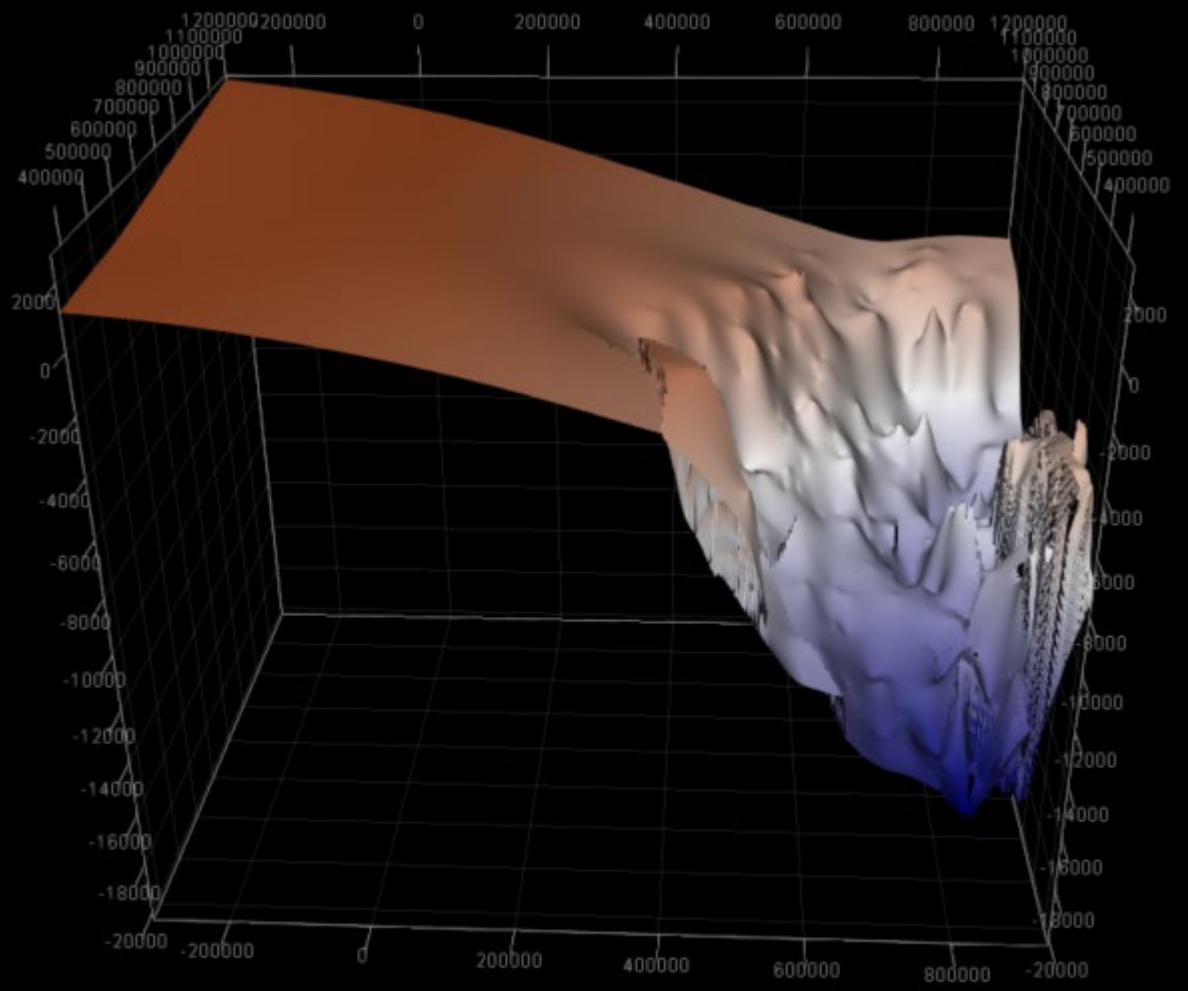


New Mexico Tech
Petroleum Recovery Research Center

Delaware Basin

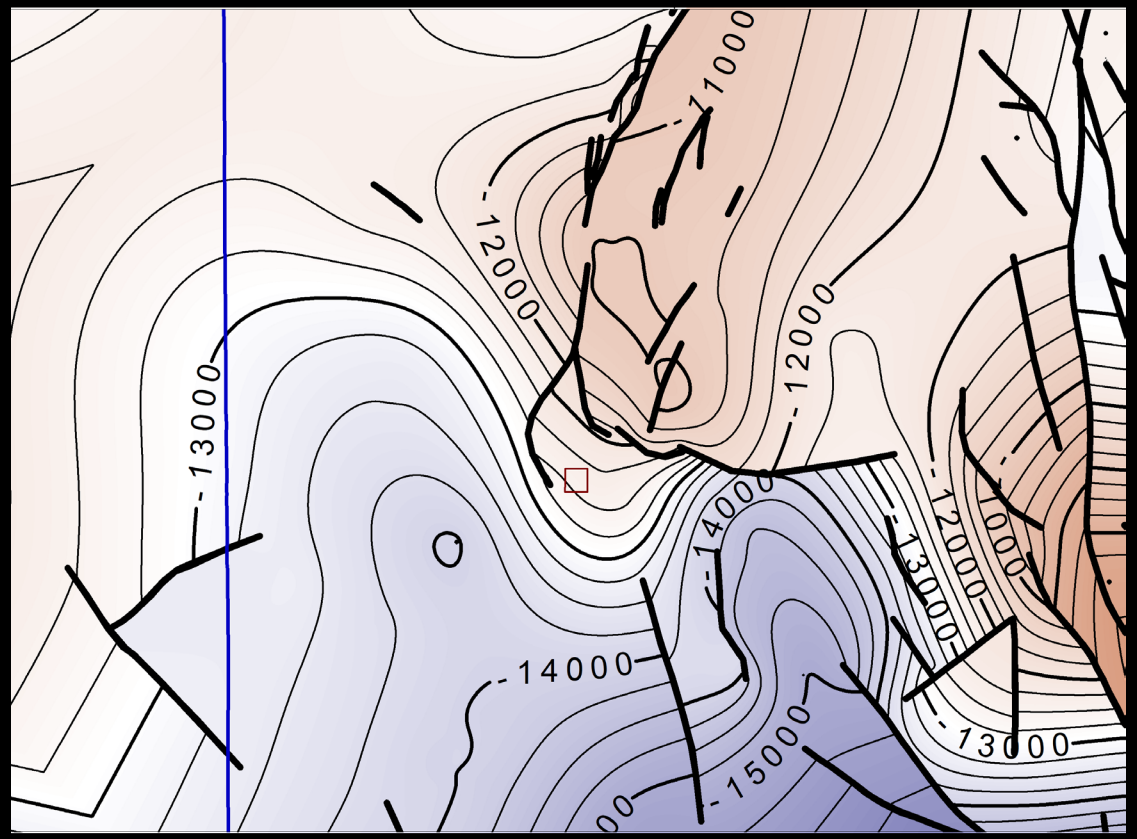
- Starting the geologic model

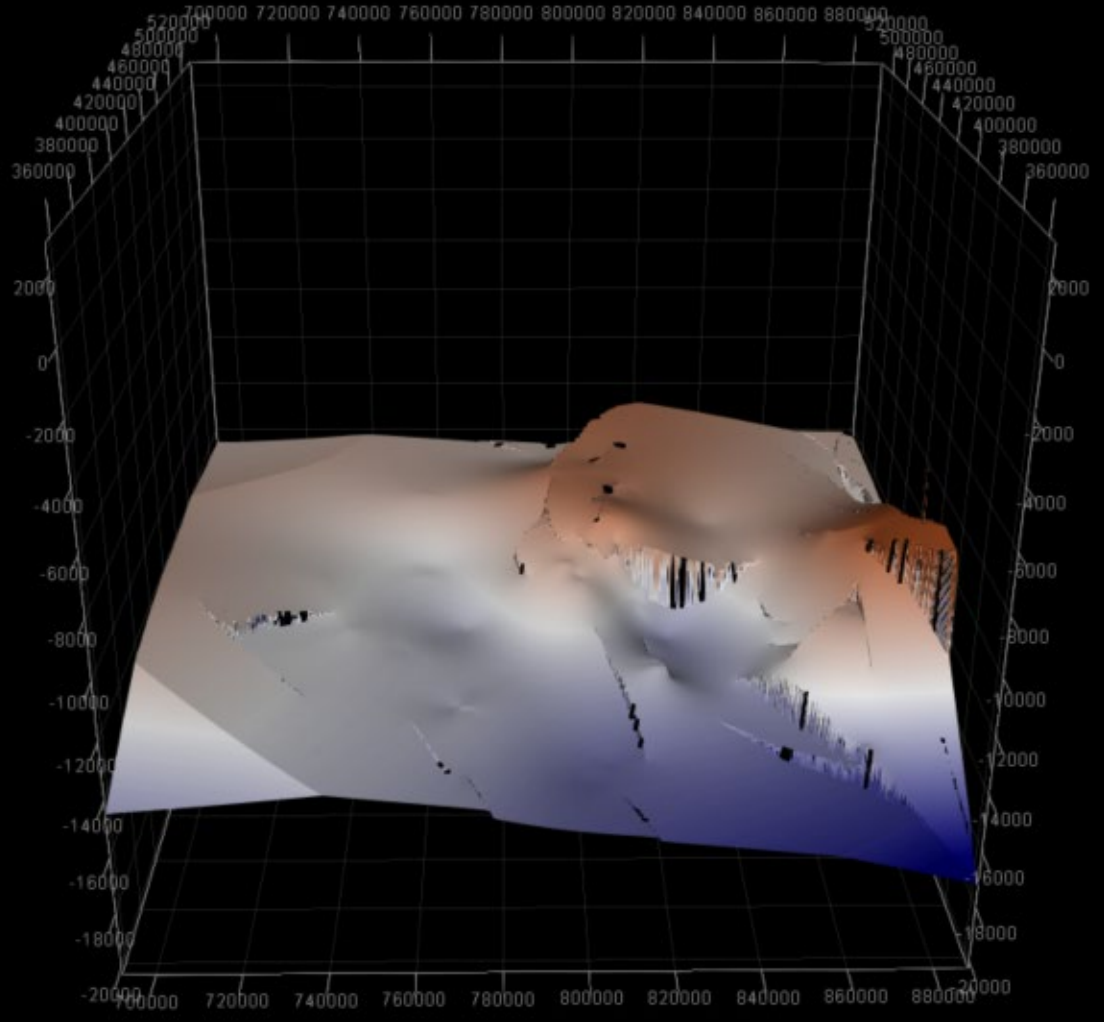




3-D surface on Siluro-Devonian strata

Delaware Basin





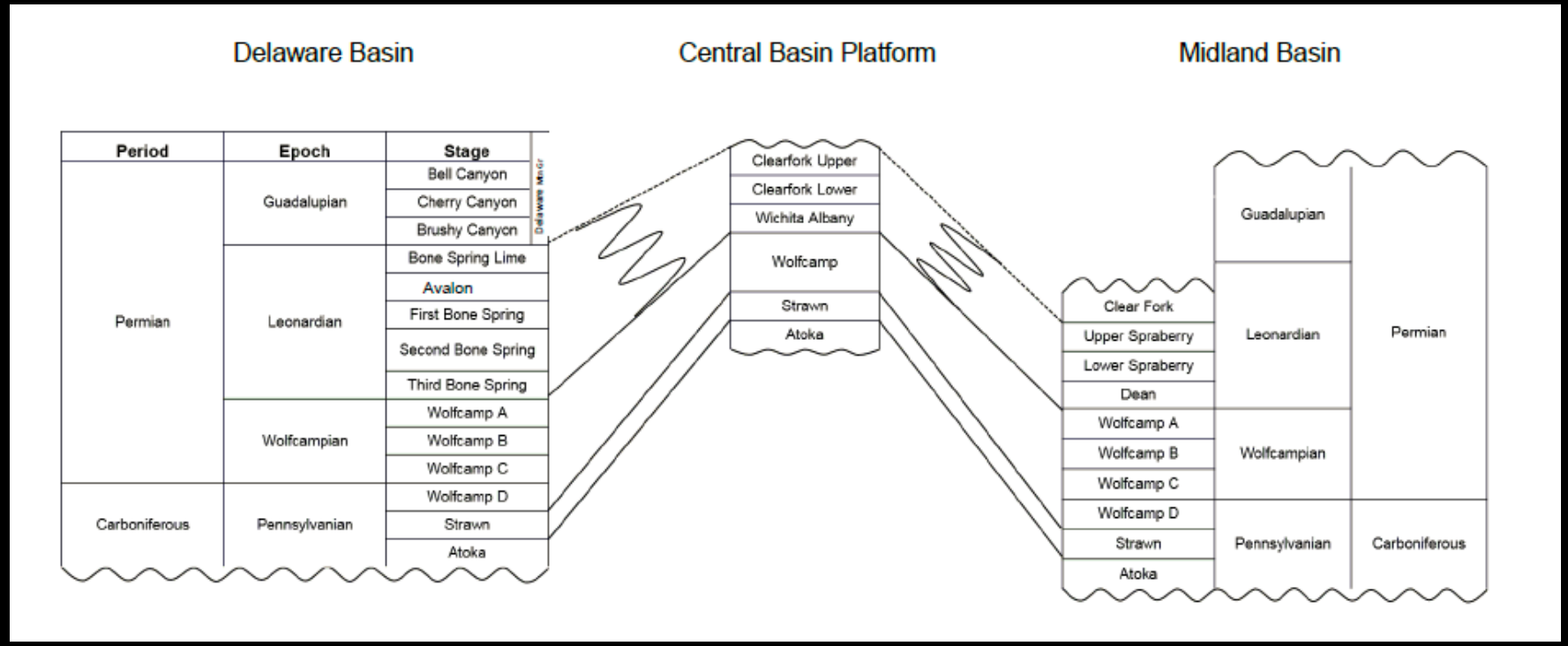
Scale = 1:452151

0 37679 75359 113038 ft

Thirtyone Formation

Delaware Basin

- Just starting this basin
- The complexity of both the tectonic and sea-level fluctuations during Pennsylvanian/Permian sedimentation will make this area more difficult to build a whole basin model (shelf to basin)



Future Models:

- Areas with high TDS (red areas)
  - San Juan Basin
  - Raton Basin
  - Las Vegas Basin
  - Tularosa Basin
  - Roswell Basin
  - Capitan Reef (not viable since it is an active aquifer)
  - Delaware Basin (green)
  - Tucumcari Basin (green)
- Areas with moderate to high TDS (purple areas)
  - Mimbres Basin
  - Mesilla Basin
  - Albuquerque Basin
  - Estancia Basin
  - Espanola Basin
  - High Plains Aquifer (not viable since it is an active aquifer)