

What's new in the Sunflower State?



8-Sep-2024



Recent KGS growth

- Over 80 years of industry experience
- Subsurface expertise
- Unique and relevant energy skillset
- Reproduced PNNL STOMP simulations @KGS
- Soon...STOMP v Eclipse



Brendan Bream, Ph.D.

Modeling, Assessment, Structure, Simulation

- 16 years ExxonMobil (7 years Esso Australia)
- 5 years as faculty Vanderbilt University
- Equity Redetermination expert



Souvik Bhattacharjee, Ph.D.

Modeling, Forward stratigraphic modeling

- 3.5 yrs Shell; 1.5 Derrick Petroleum Services
- Experience working NWS (Australia), GoM, and S. China



Jason Gumble, Ph.D.

Geophysics, Geomechanics, Petrophysics

- 20+ years working O&G including mid-con
- Seismic acquisition and interpretation
- Petrophysical expert



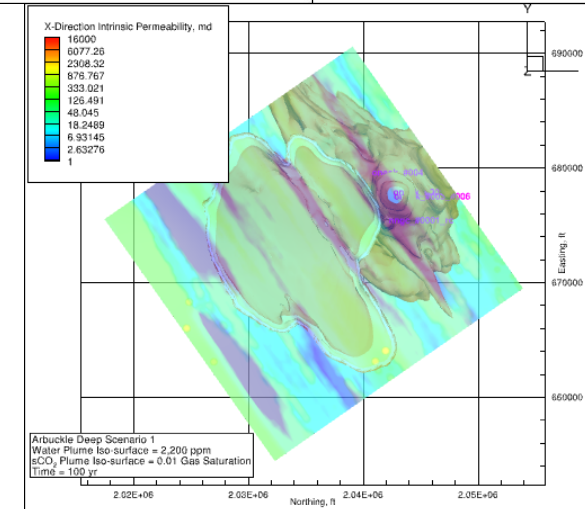
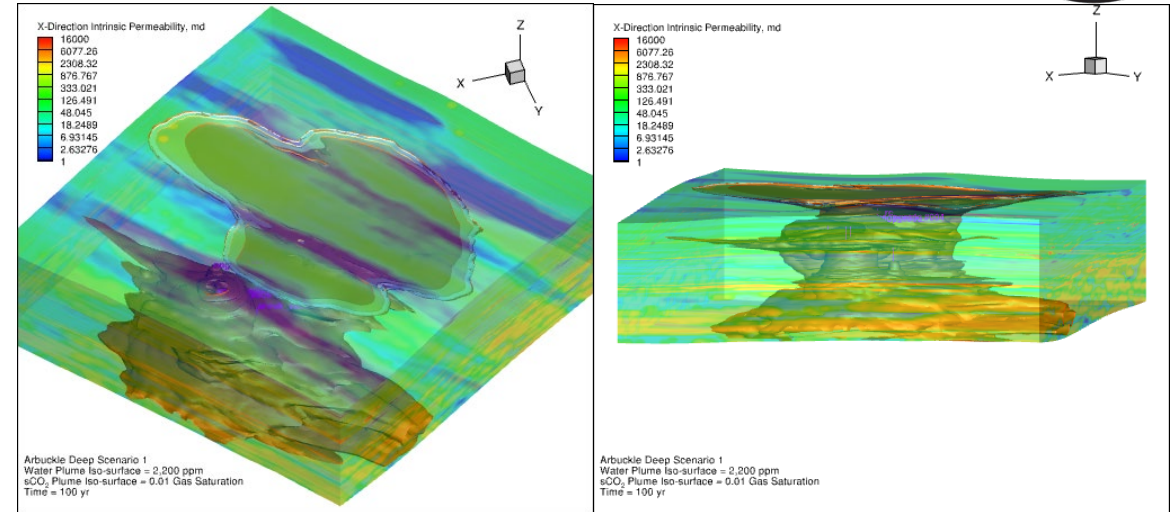
Mark White, Ph.D.

Reservoir Engineer, Reactive Transport Simulation

- Nearly 35 yr career with PNNL
- Developed world-class, multifluid, coupled-process numerical simulator (STOMP)

Kansas: Arbuckle Deep

- Domain:
 - 107 x 105 x 133 (4.5 million unknowns)
 - Depth range = 3152 to 4136 ft bgs
 - Areal extent = 36,720 ft x 36,703 ft
- Scenarios:
 - Class 1 (0 ppm) + 0.34 psi/ft
 - Class 1 (0 ppm) + 0.34 psi/ft + closed domain
 - Class 1 (220k ppm) + 0.4 psi/ft
 - Class 1 (0 ppm) + Class 6 (center) + 0.34 psi/ft
 - Class 1 (0 ppm) + Class 6 (offset) + 0.34 psi/ft
 - Class 1 (0 ppm) + Class 6 (mid) + 0.34 psi/ft
 - Class 1 (220k ppm) + Class 6 (center) + 0.4 psi/ft
 - Class 1 (220k ppm) + Class 6 (offset) + 0.4 psi/ft
 - Class 1 (220k ppm) + Class 6 (mid) + 0.4 psi/ft
 - Class 1 (220k ppm) + Class 6 (center) + 0.4 psi/ft + 100 yr

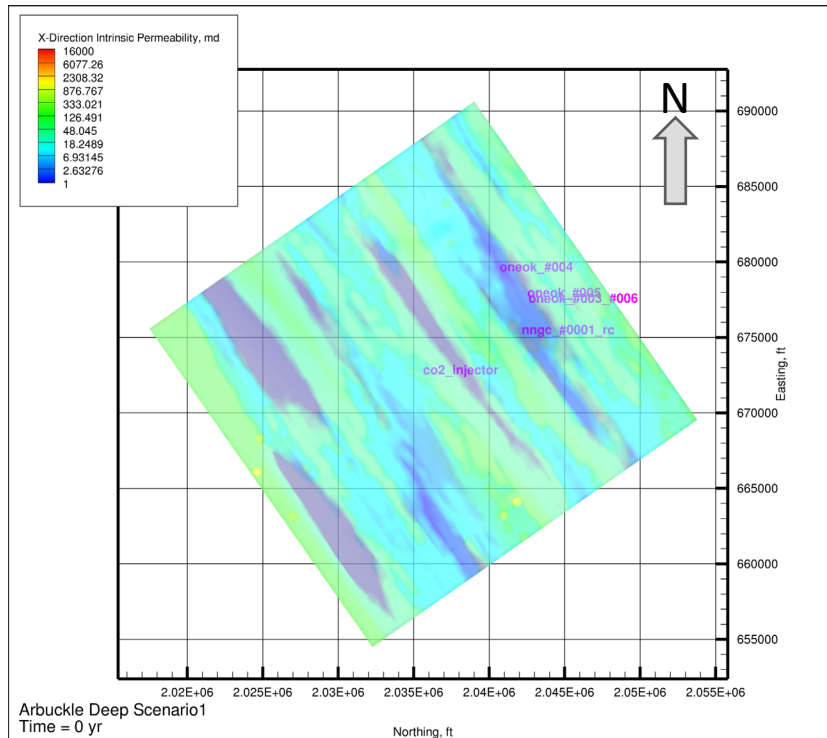


Arbuckle Reference Case Simulation

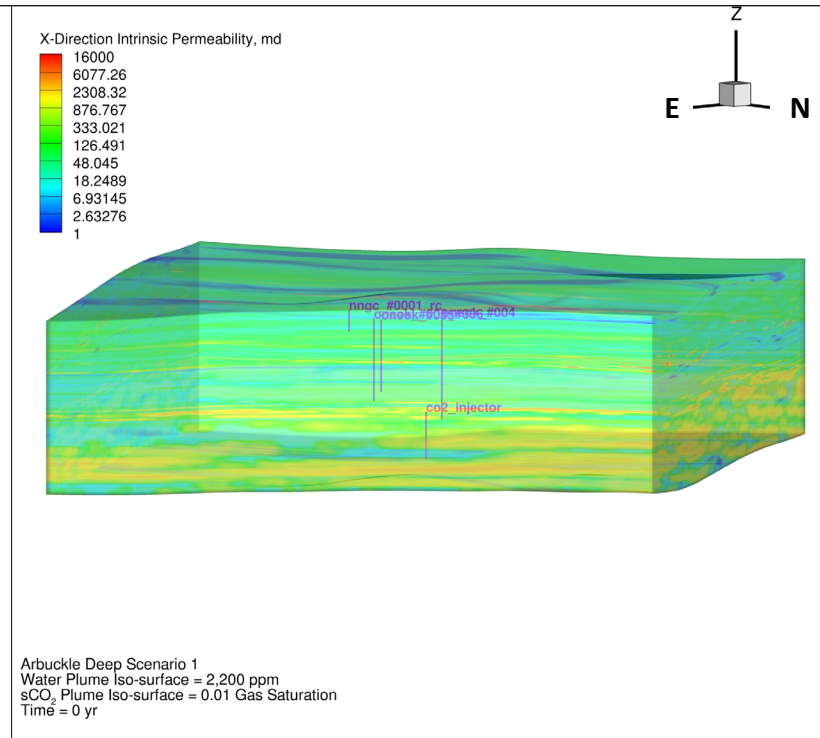
CO2 injector placed in center of model



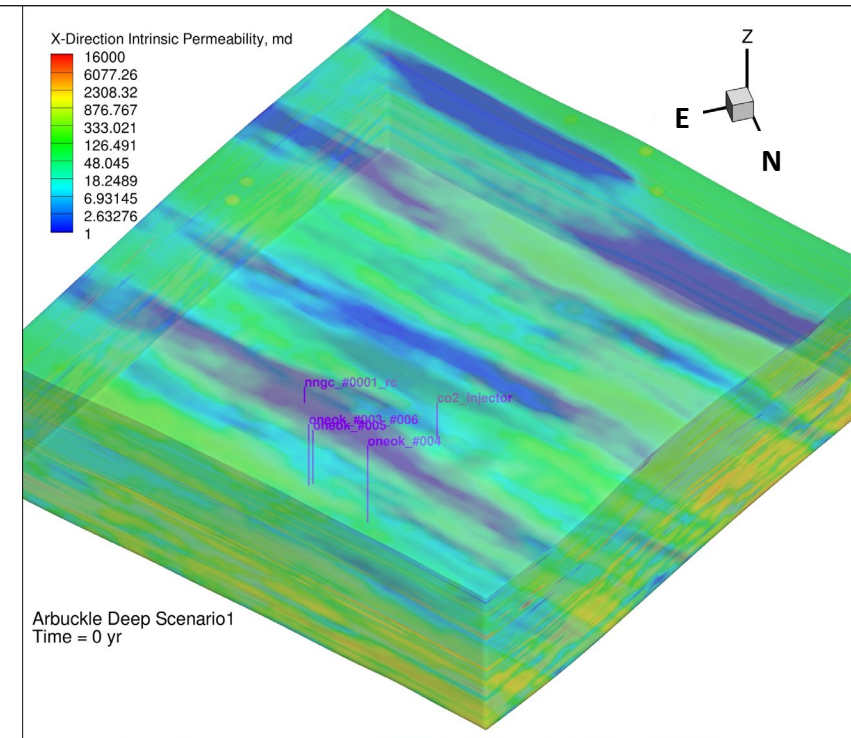
Year Zero Map View



Year Zero View from North



Year Zero Oblique View from NW

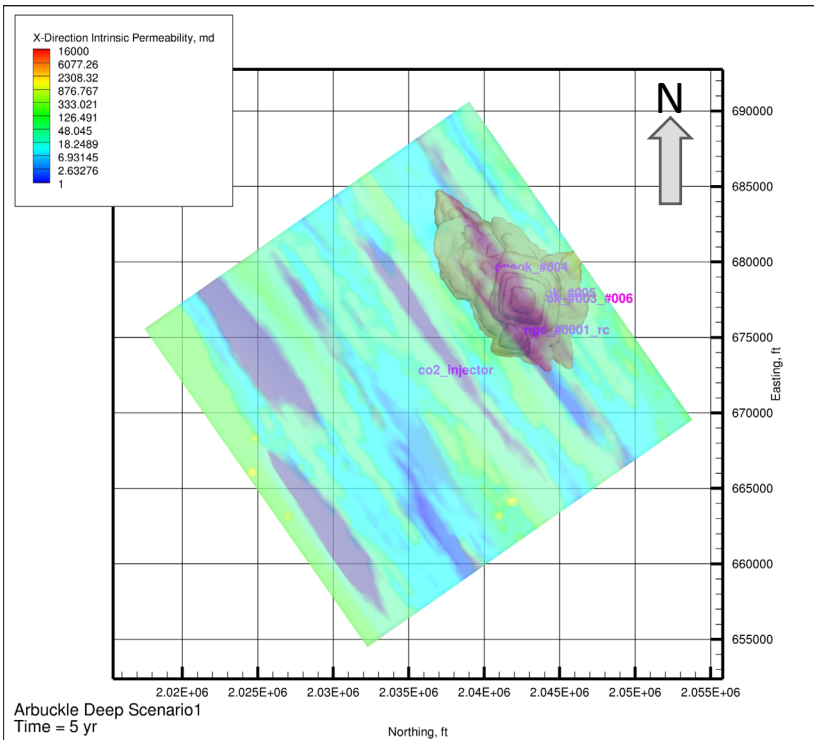


Arbuckle Reference Case Simulation

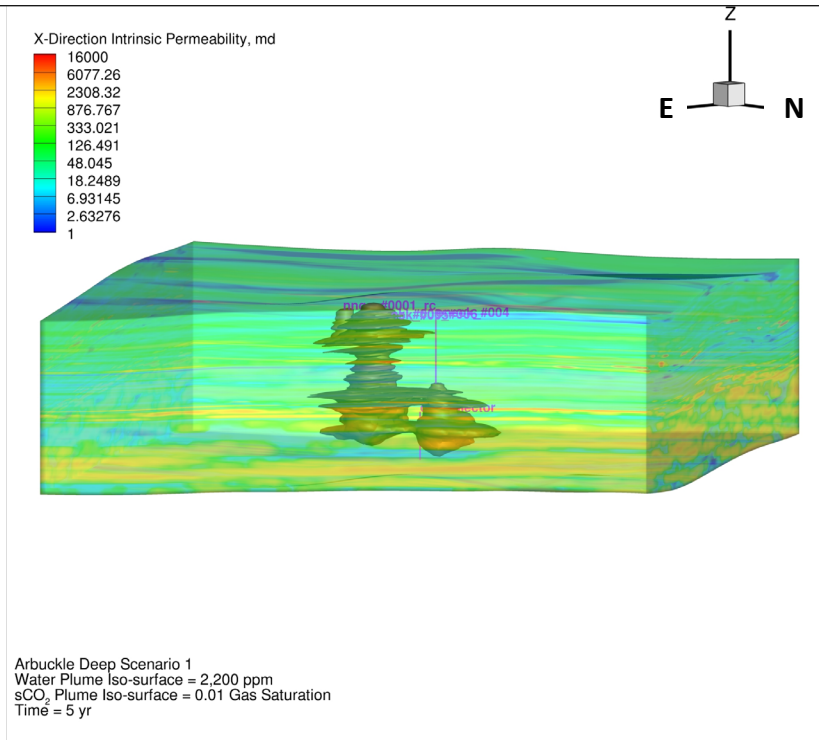
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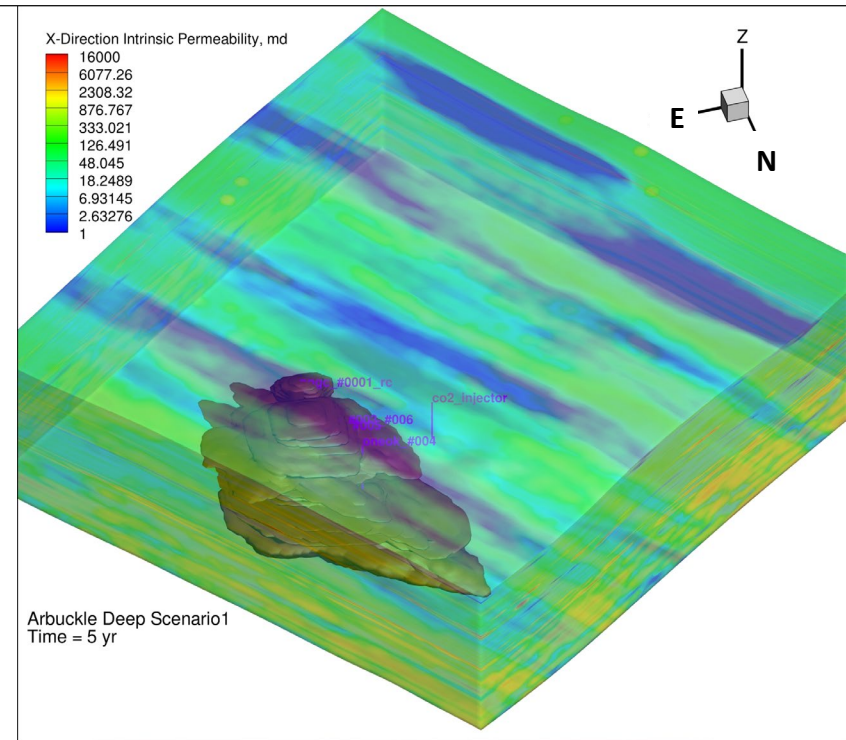
Year 5 Map View



Year 5 View from North



Year 5 Oblique View from NW

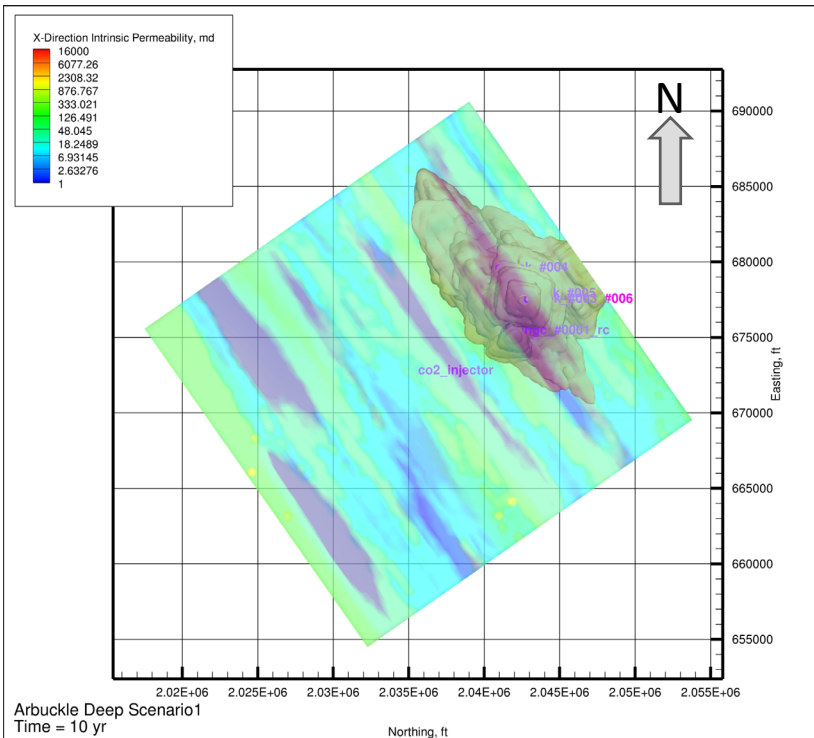


Arbuckle Reference Case Simulation

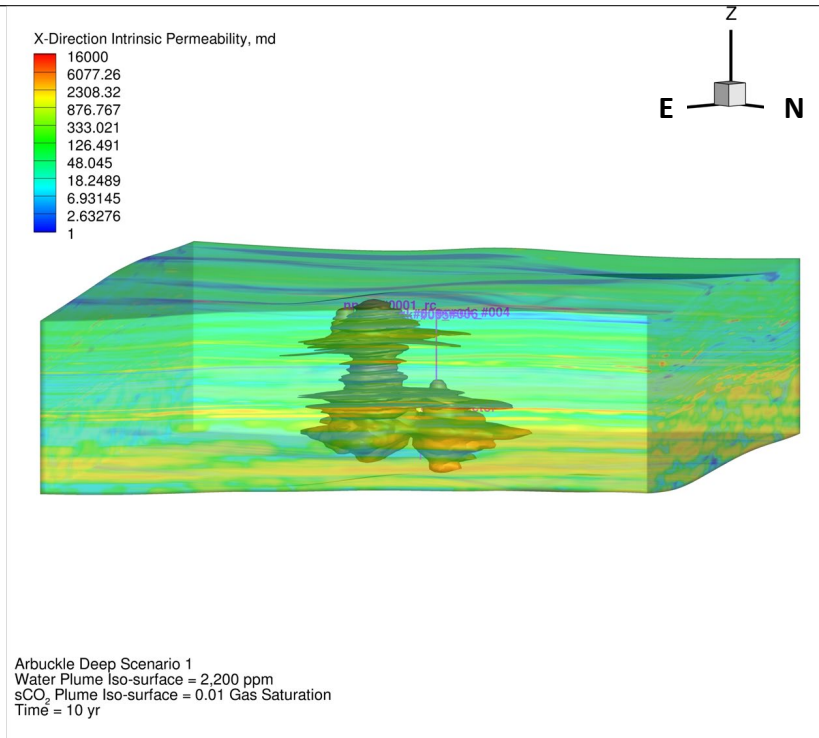
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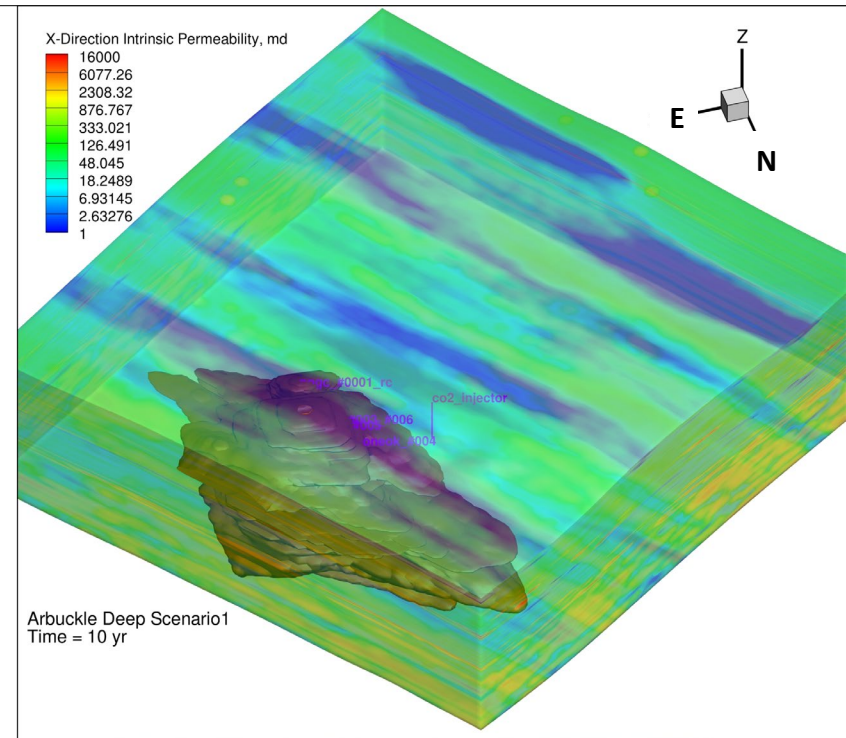
Year 10 Map View



Year 10 View from NE



Year 10 Oblique View from NW

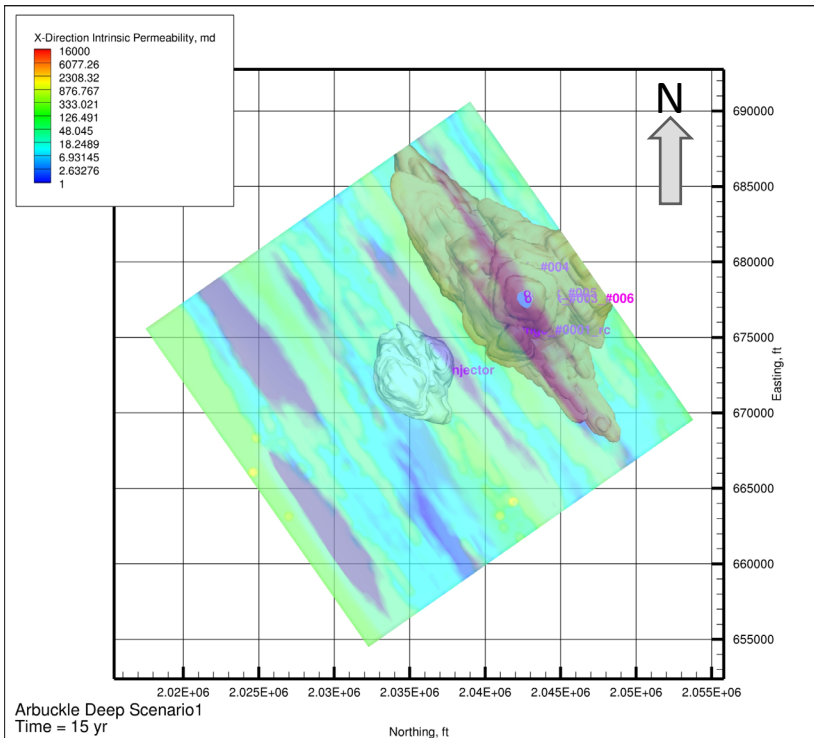


Arbuckle Reference Case Simulation

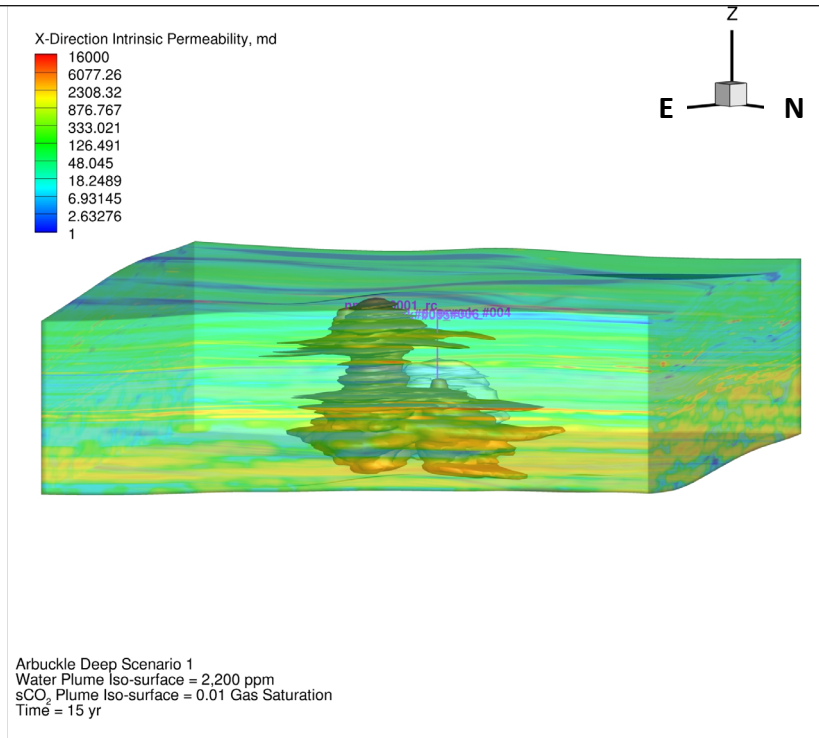
CO2 injector placed in center of model



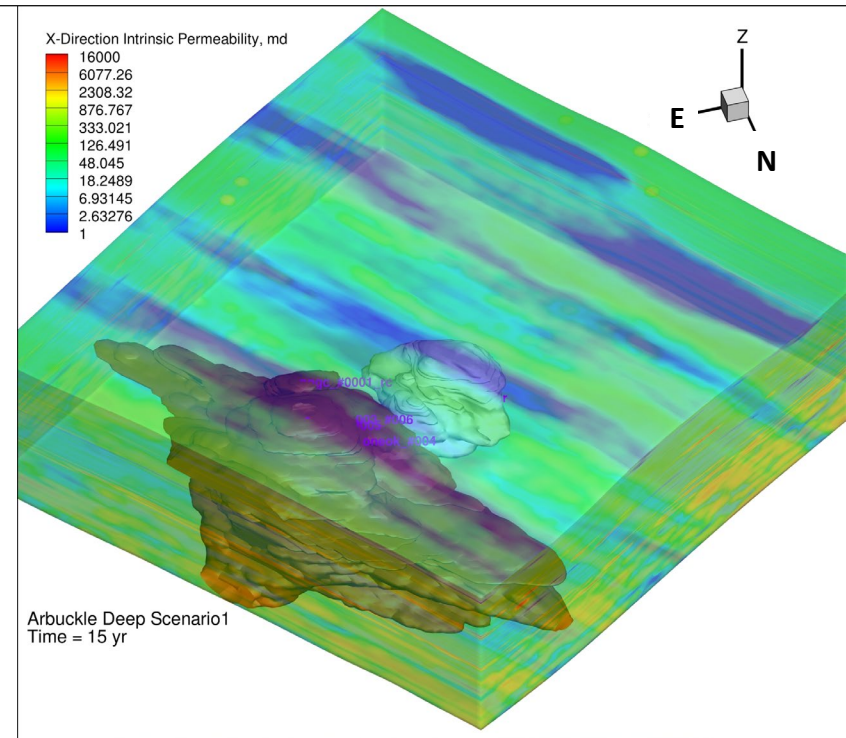
Year 15 Map View



Year 15 View from NE



Year 15 Oblique View from NW

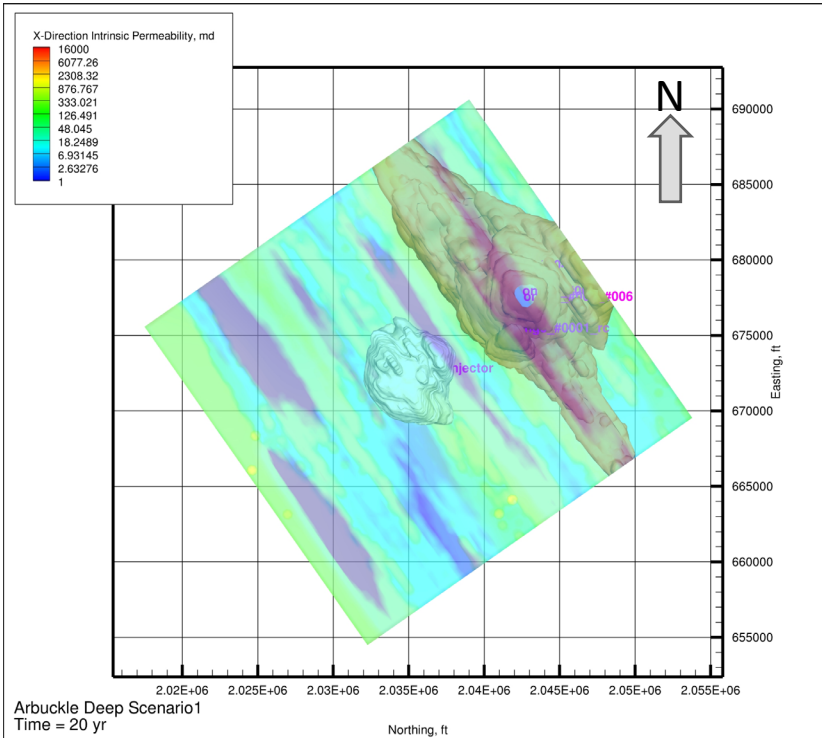


Arbuckle Reference Case Simulation

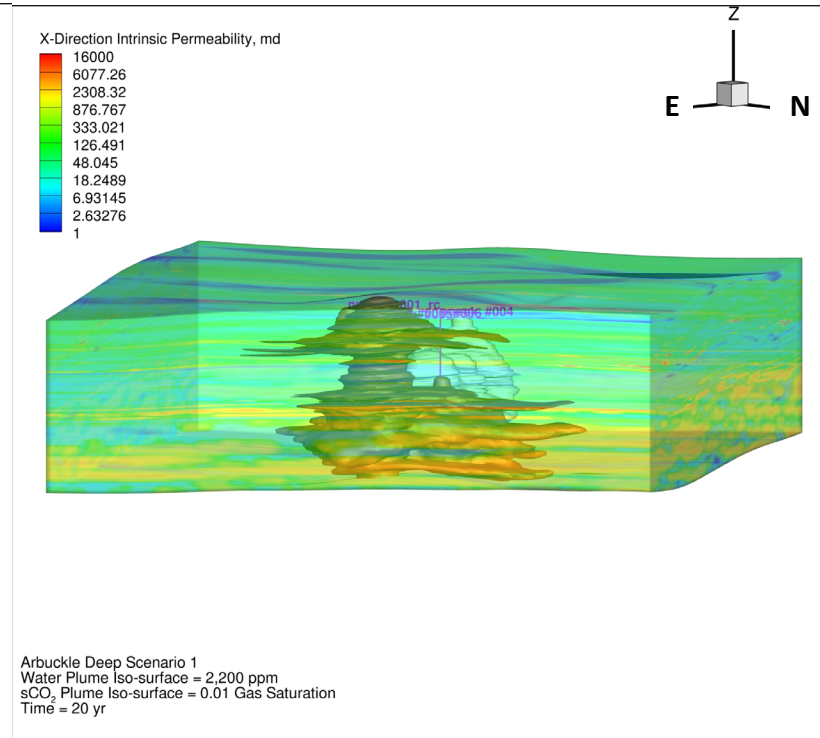
CO2 injector placed in center of model



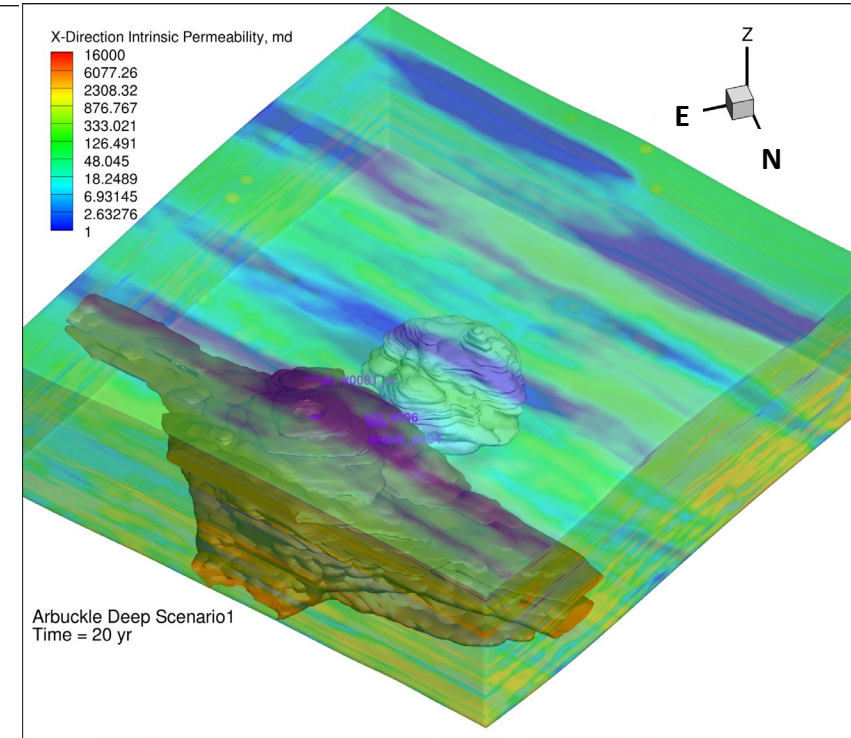
Year 20 Map View



Year 20 View from NE



Year 20 Oblique View from NW

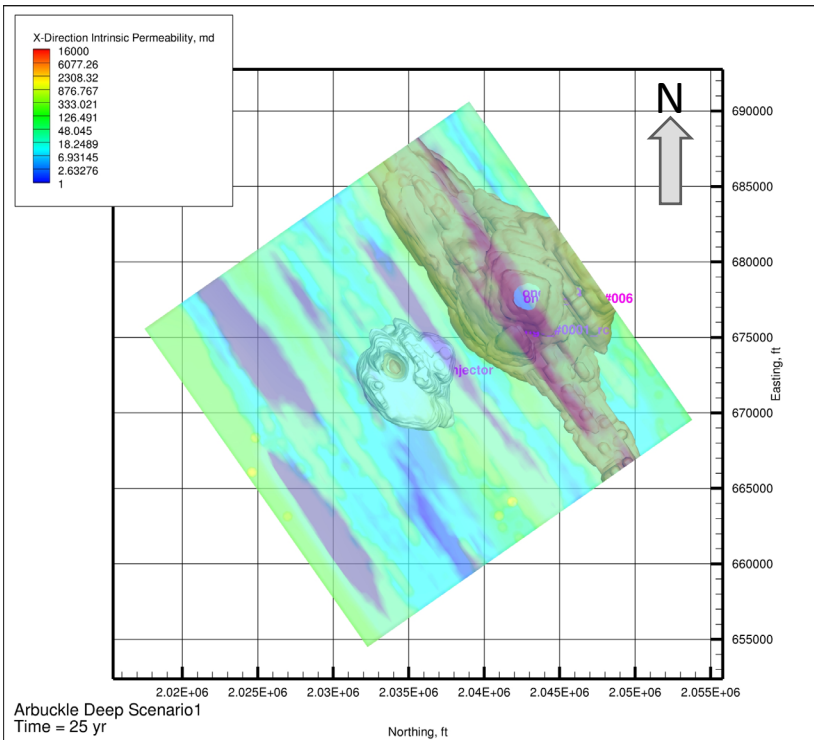


Arbuckle Reference Case Simulation

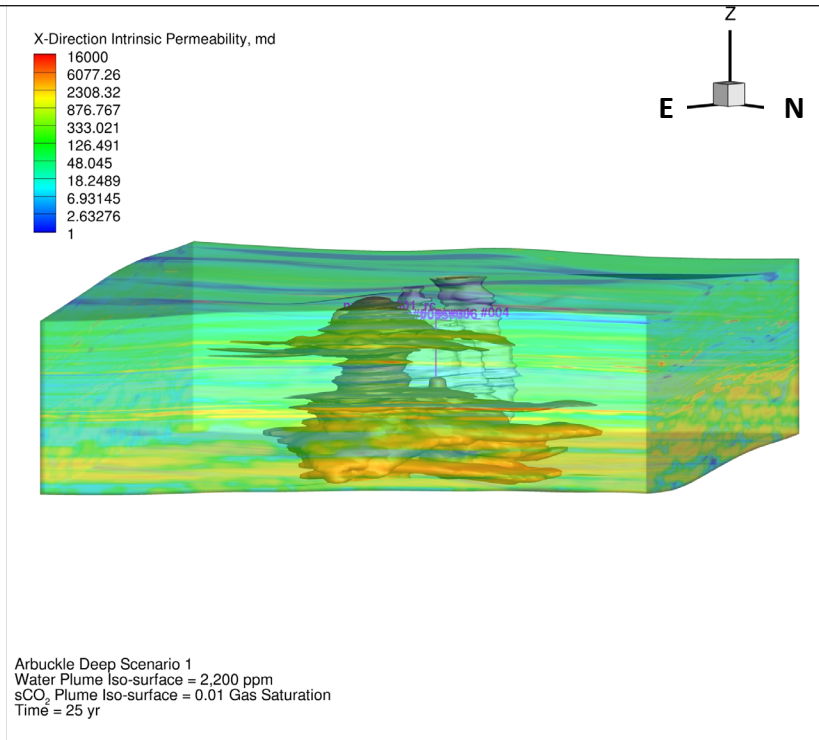
CO2 injector placed in center of model



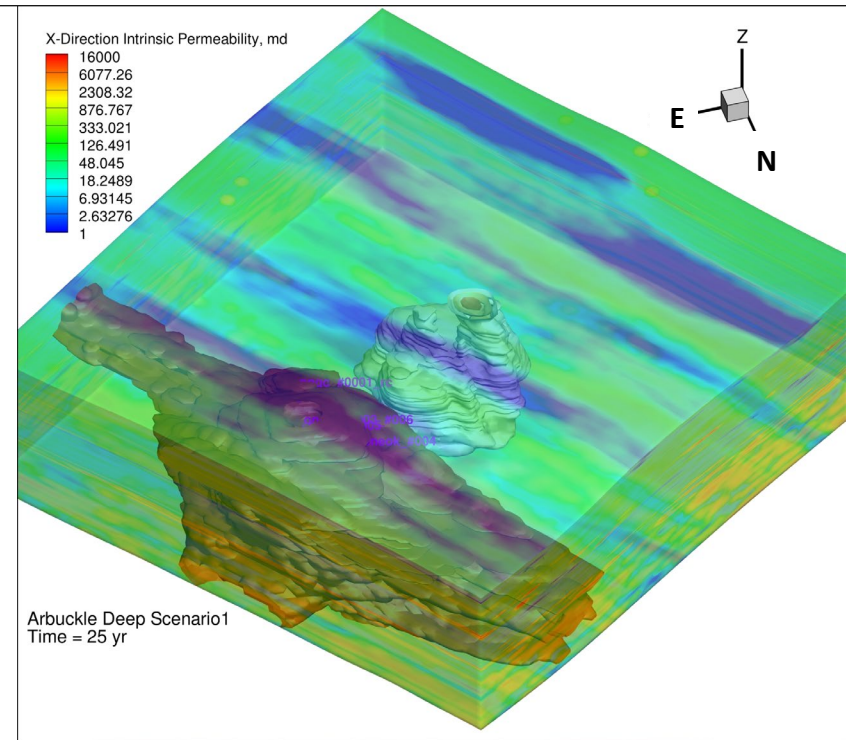
Year 25 Map View



Year 25 View from NE



Year 25 Oblique View from NW

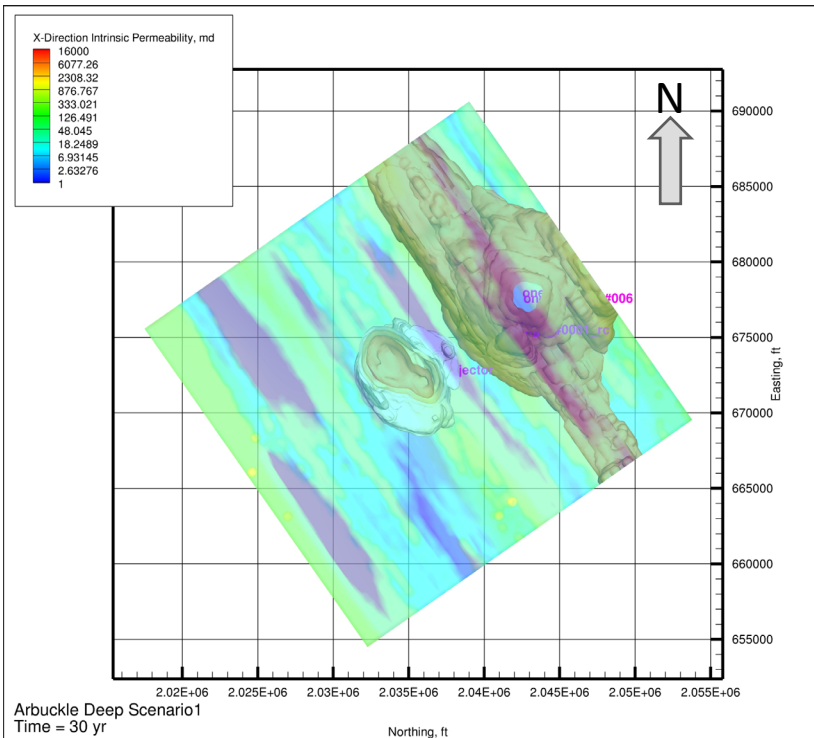


Arbuckle Reference Case Simulation

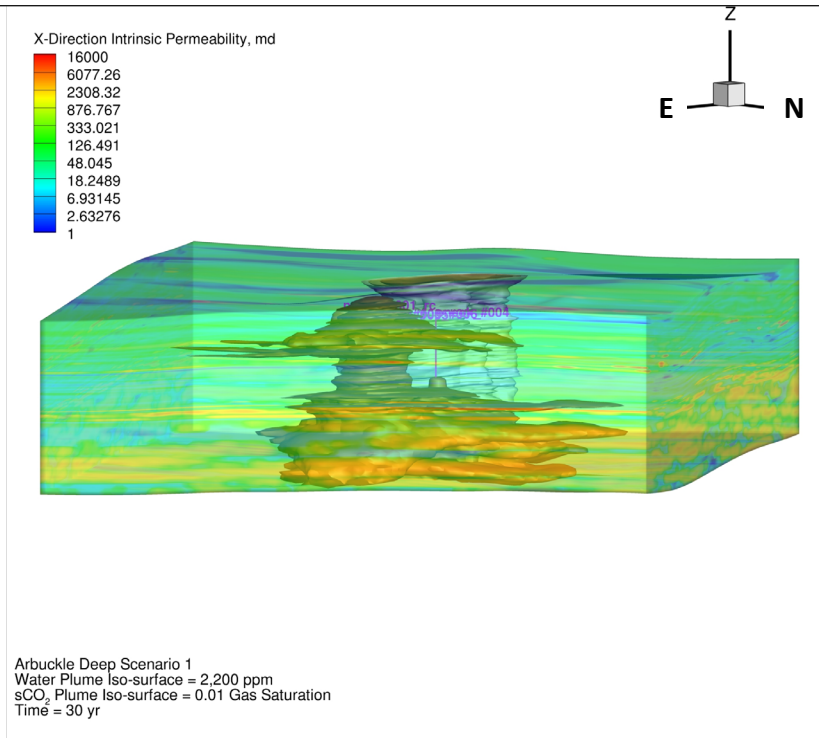
CO2 injector placed in center of model



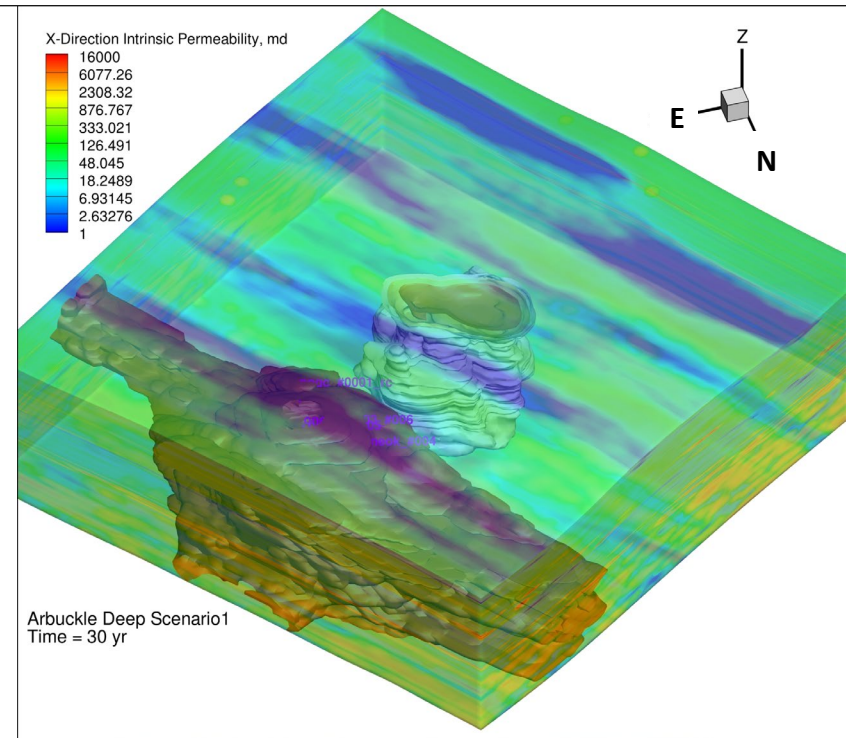
Year 30 Map View



Year 30 View from NE



Year 30 Oblique View from NW

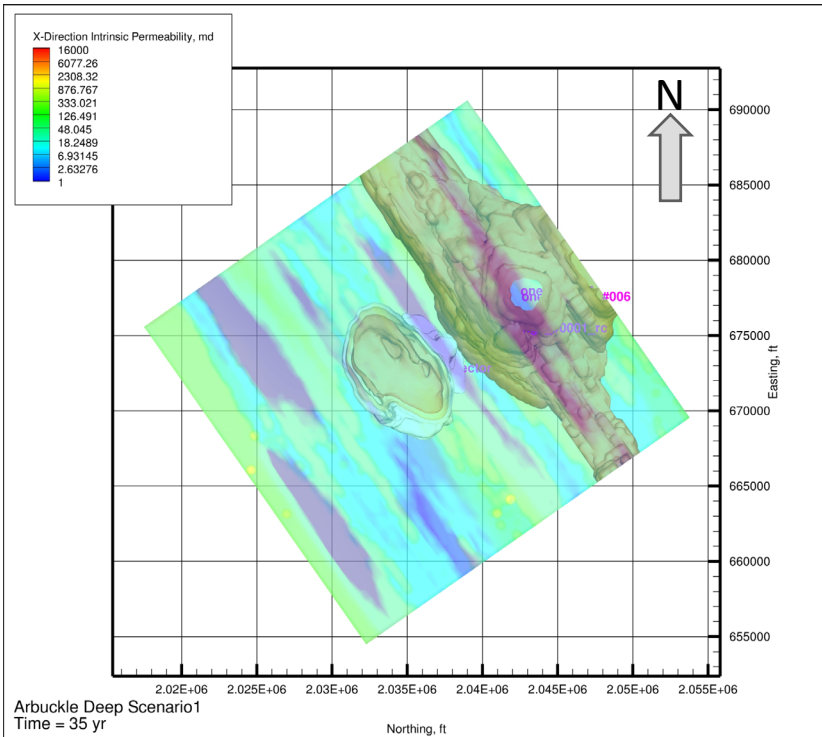


Arbuckle Reference Case Simulation

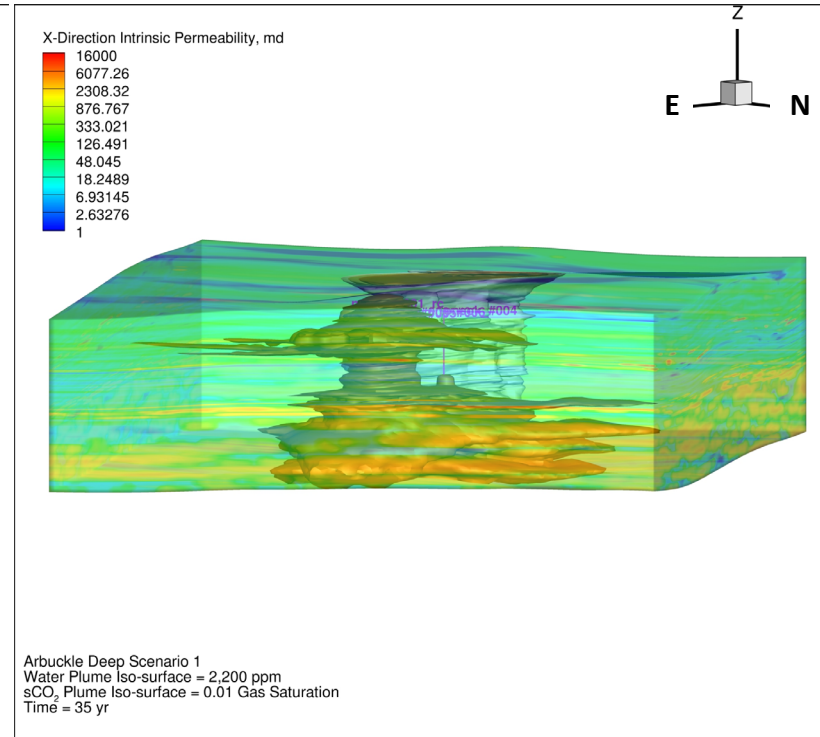
CO2 injector placed in center of model



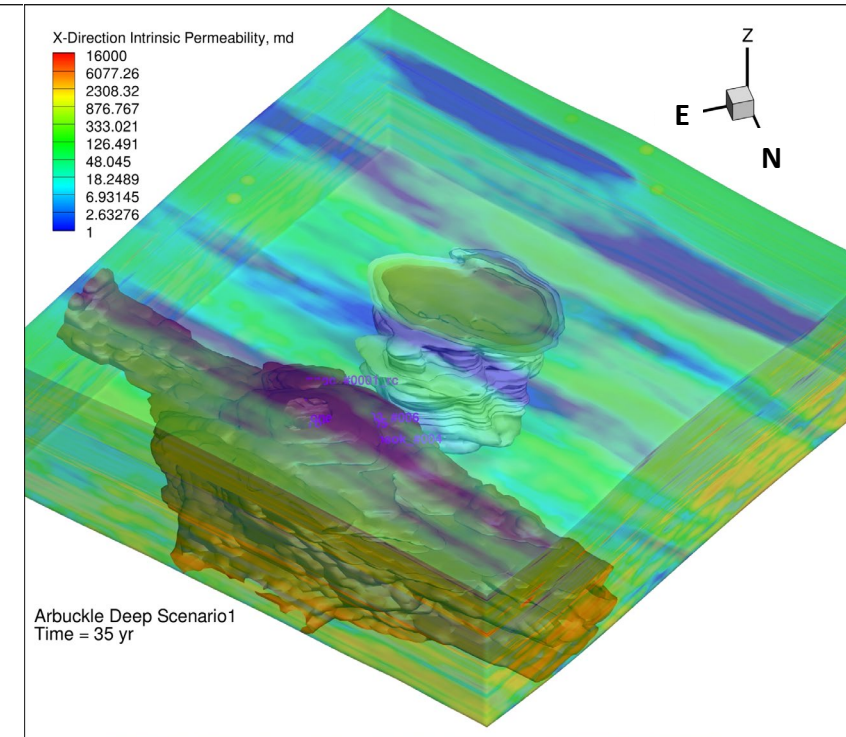
Year 35 Map View



Year 35 View from NE



Year 35 Oblique View from NW

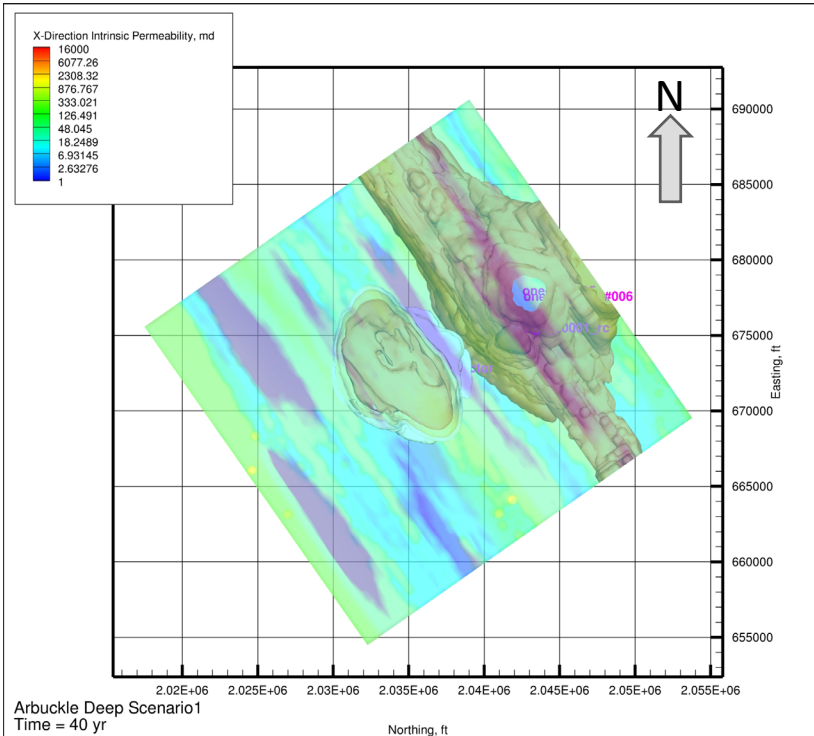


Arbuckle Reference Case Simulation

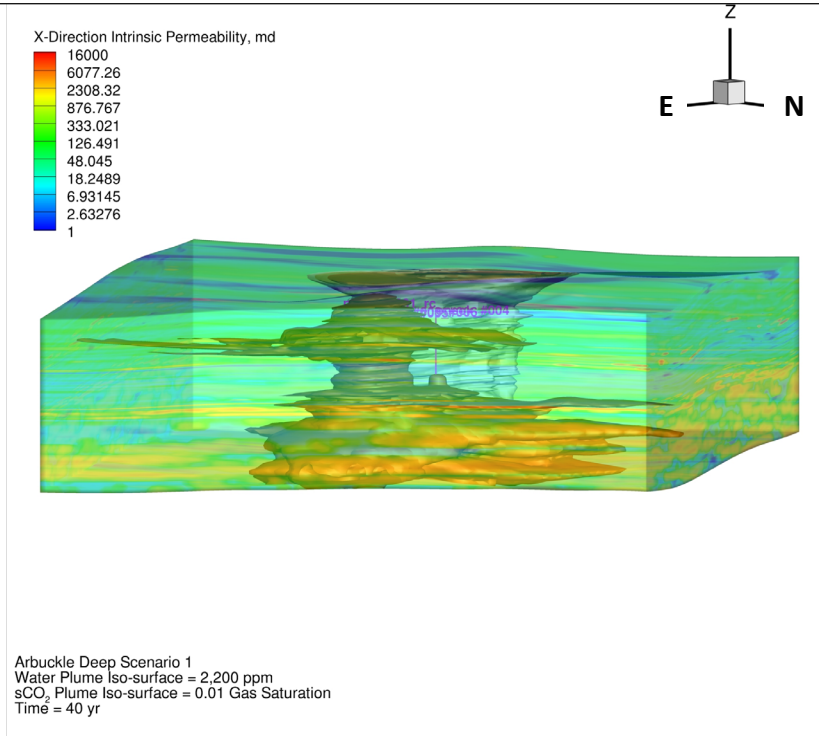
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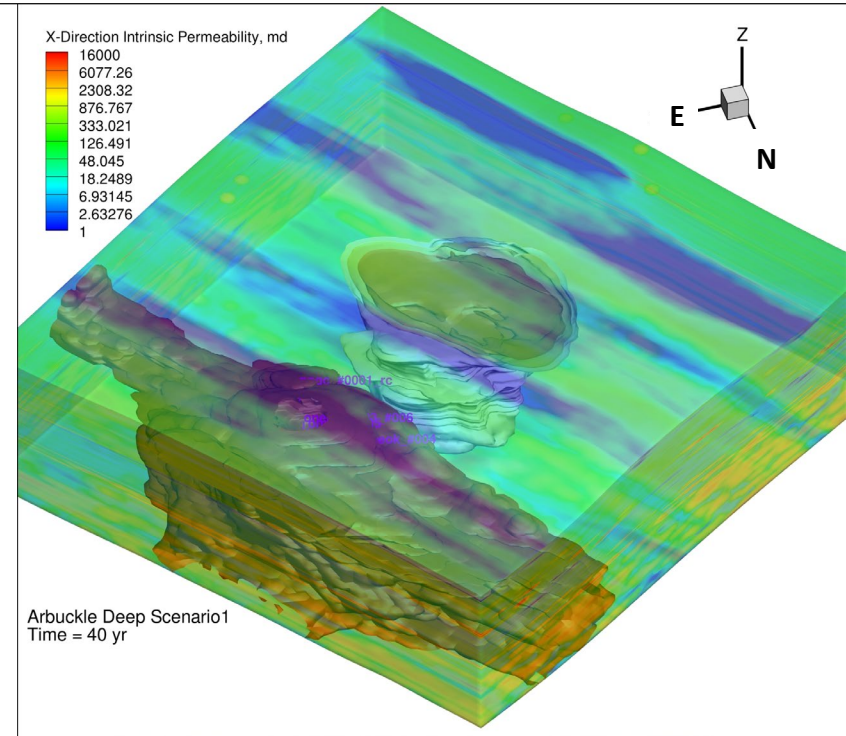
Year 40 Map View



Year 40 View from NE



Year 40 Oblique View from NW

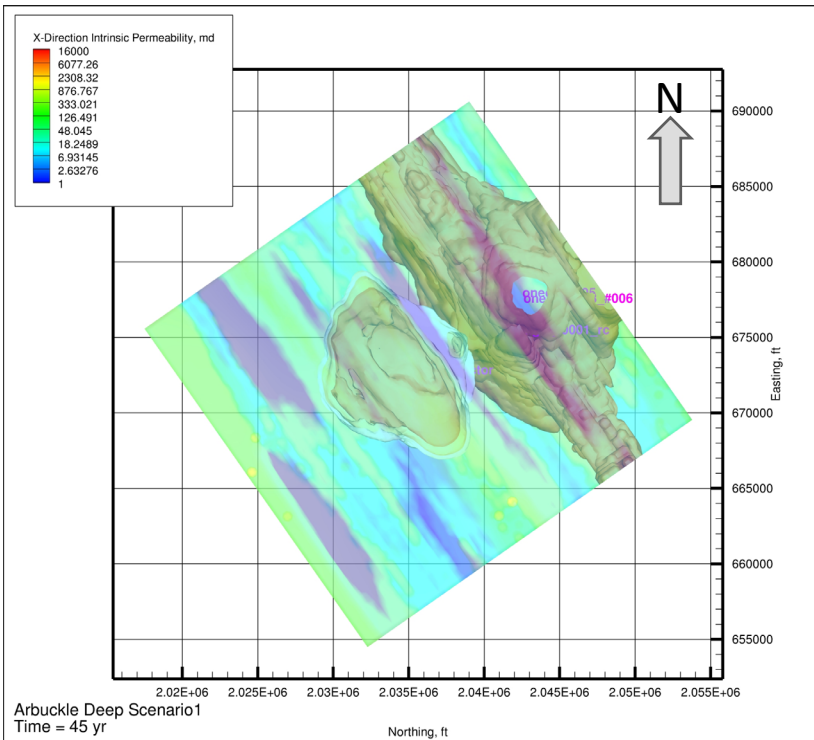


Arbuckle Reference Case Simulation

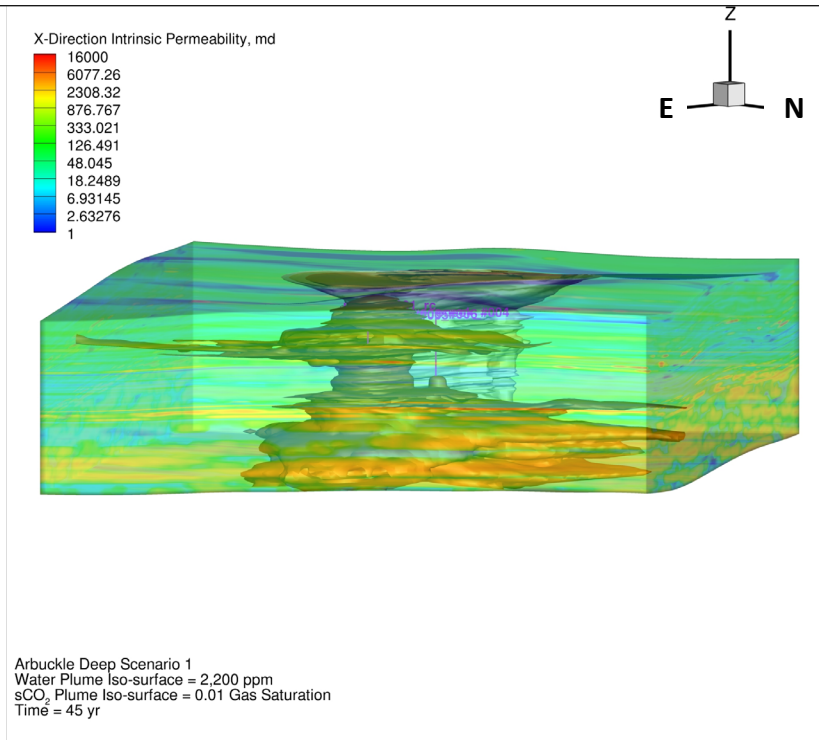
CO2 injector placed in center of model



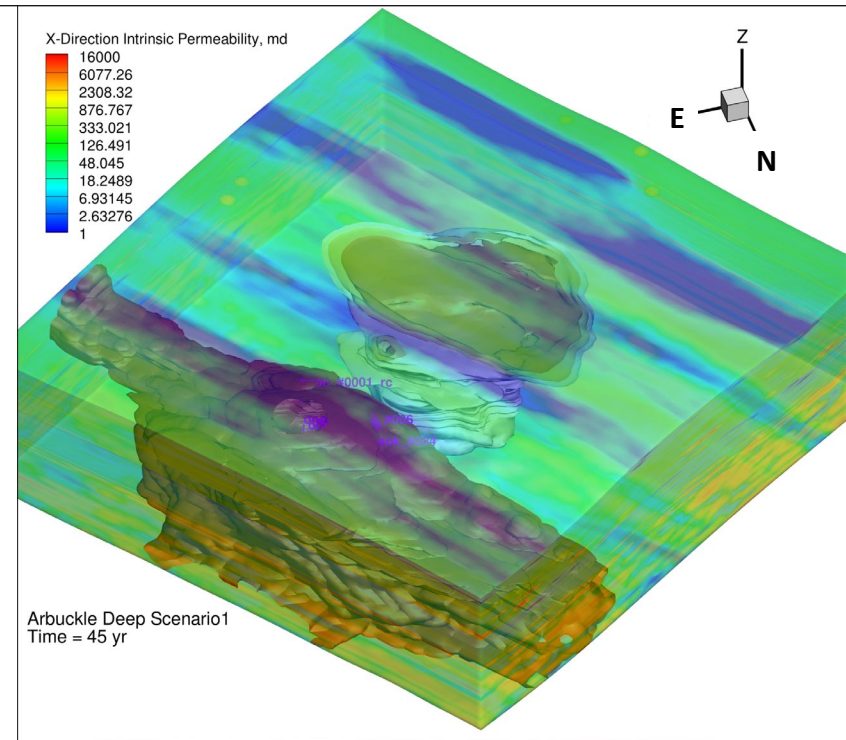
Year 45 Map View



Year 45 View from NE



Year 45 Oblique View from NW

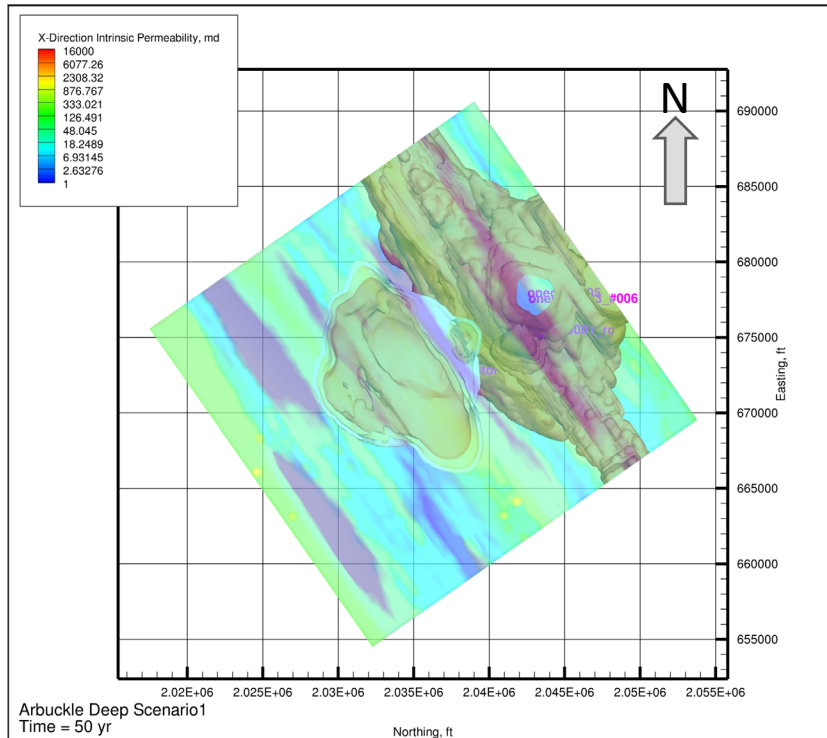


Arbuckle Reference Case Simulation

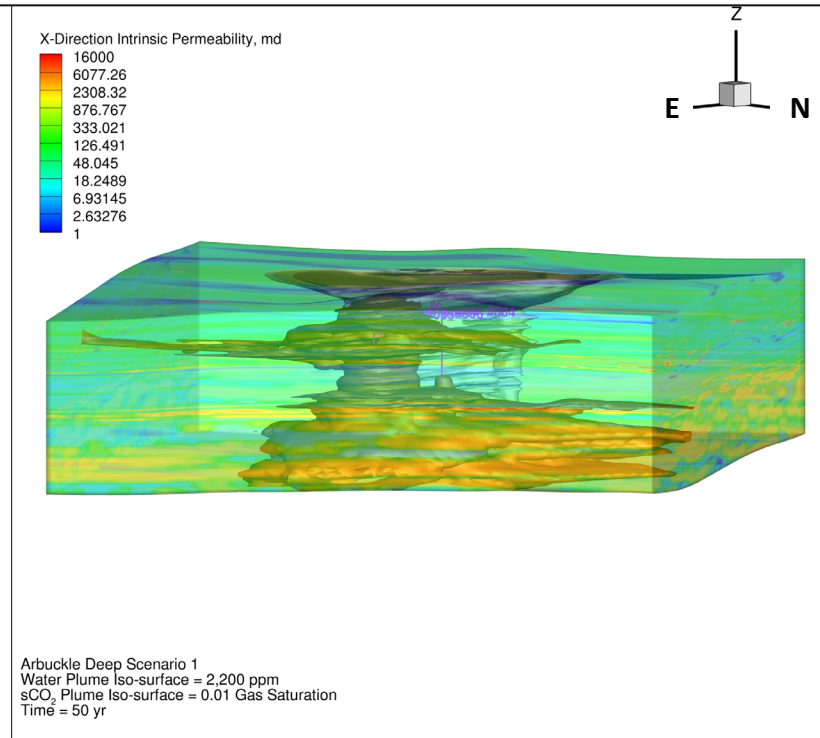
CO2 injector placed in center of model



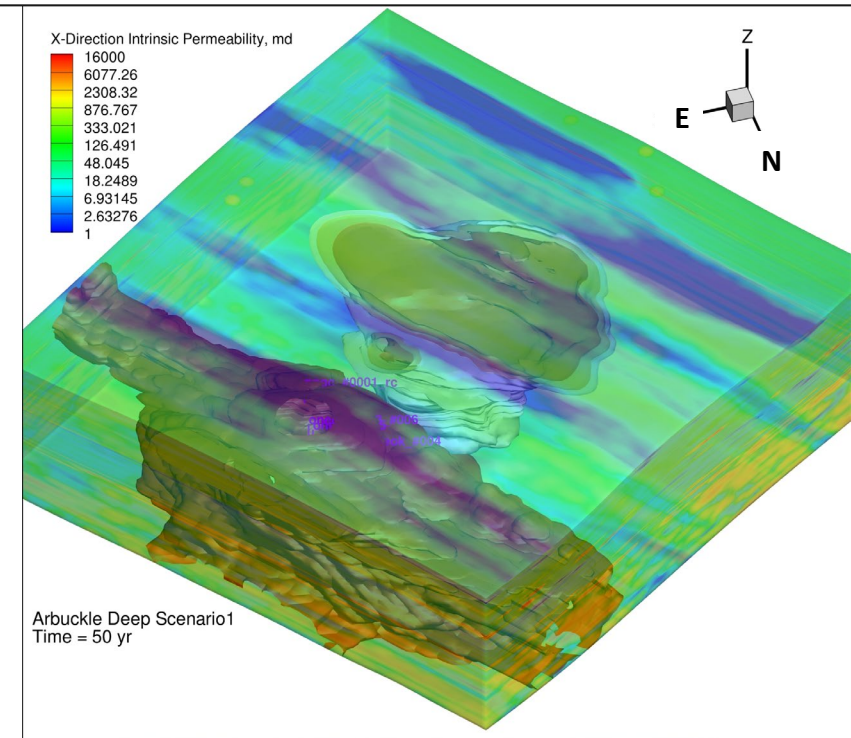
Year 50 Map View



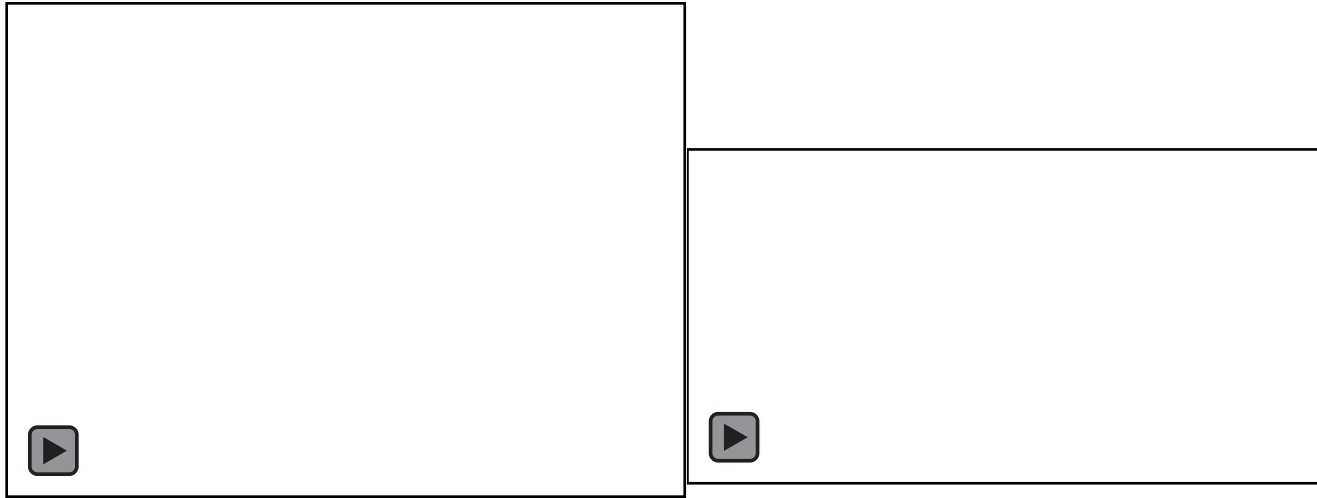
Scenario 1, Year 50 View from NE



Year 50 Oblique View from NW



CCS subsurface “Play” Elements



Products from 3 months of work

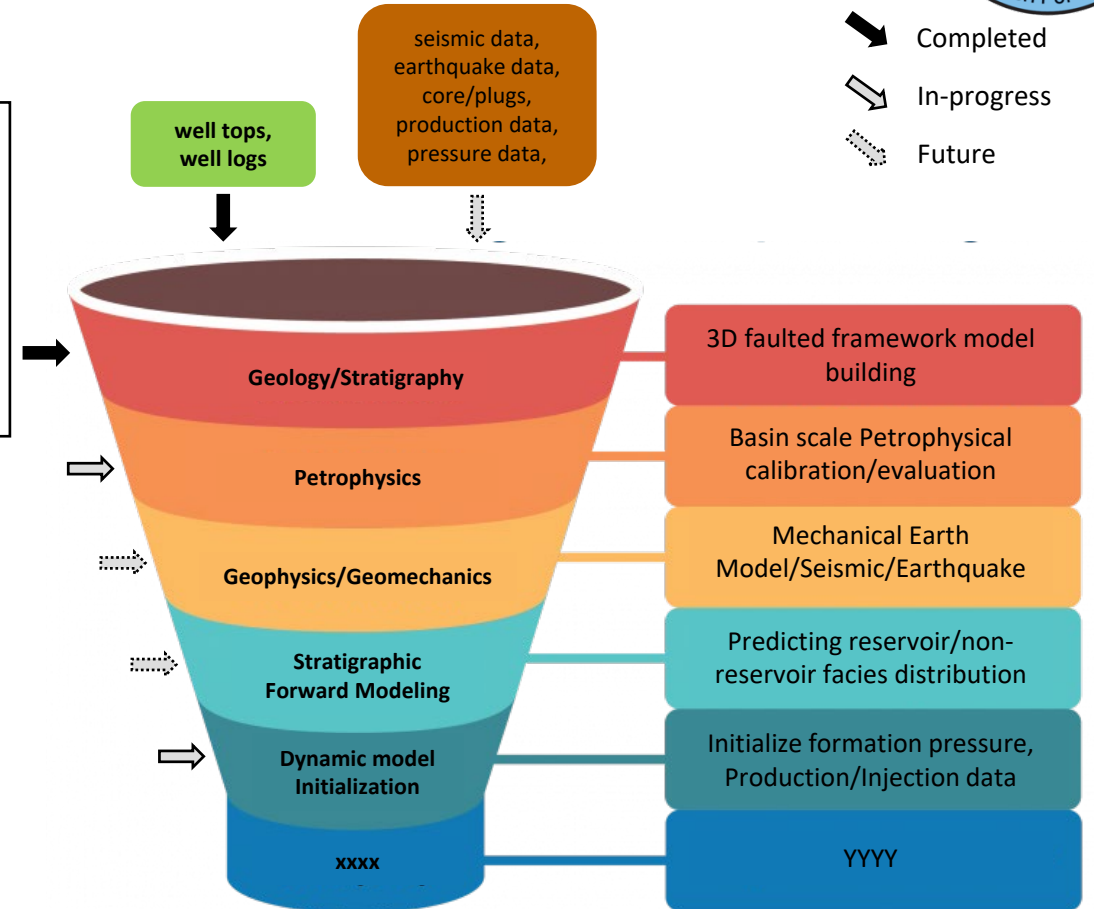
- Faulted framework model
- 2000*2000 ft cell size, 149 layers in Arbuckle
- Regional CCS potential map and considerations

Data used

- Well tops: ~6000 Precambrian Basement & ~70,000 Arbuckle
- Well logs: ~220 wells (~3-4 per county)

Other data available

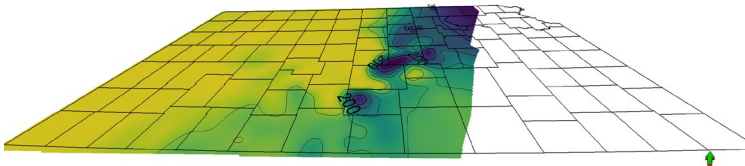
2D/3D seismic, Earthquake, Gravity, cores/cuttings, DST & production data,



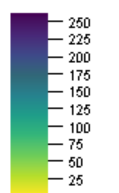
Regional/Basin Scale Subsurface CCS Screening Workflow

CCS "Play" Elements - Seal COA (leakage)

Seal thickness (composite)

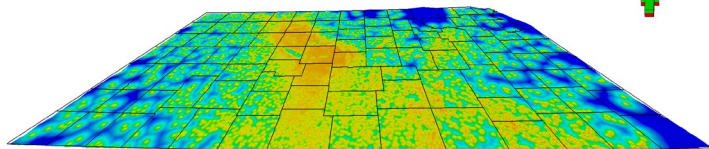


Thickness composite
Thickness depth [ft]

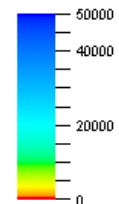


↑ thickness

Well Distance

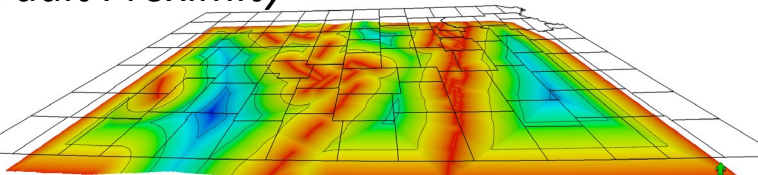


Distance to Wells (Arbuckle)
Distance [ftUS]

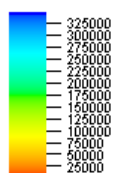


↑ distance

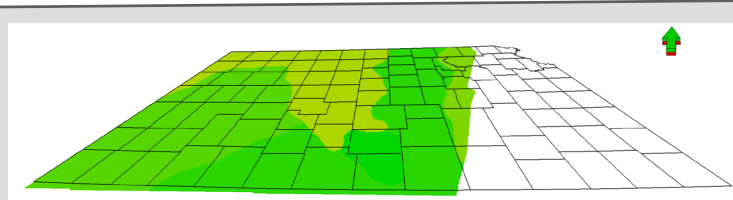
Fault Proximity



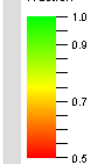
Quality assurance (Distance from
Faults [Average] [Filter ON])
Distance [ftUS]



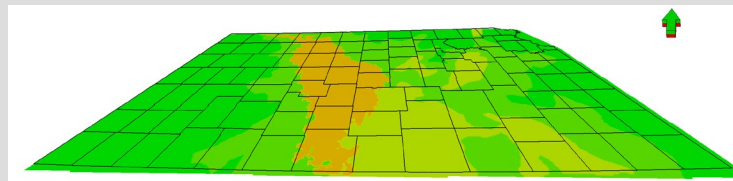
↑ distance



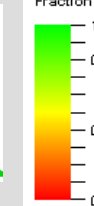
Seal_thickness_COA
Fraction



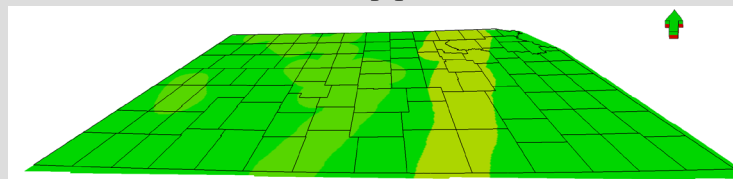
X



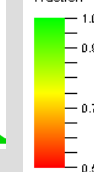
Well_Dist_COA
Fraction



X

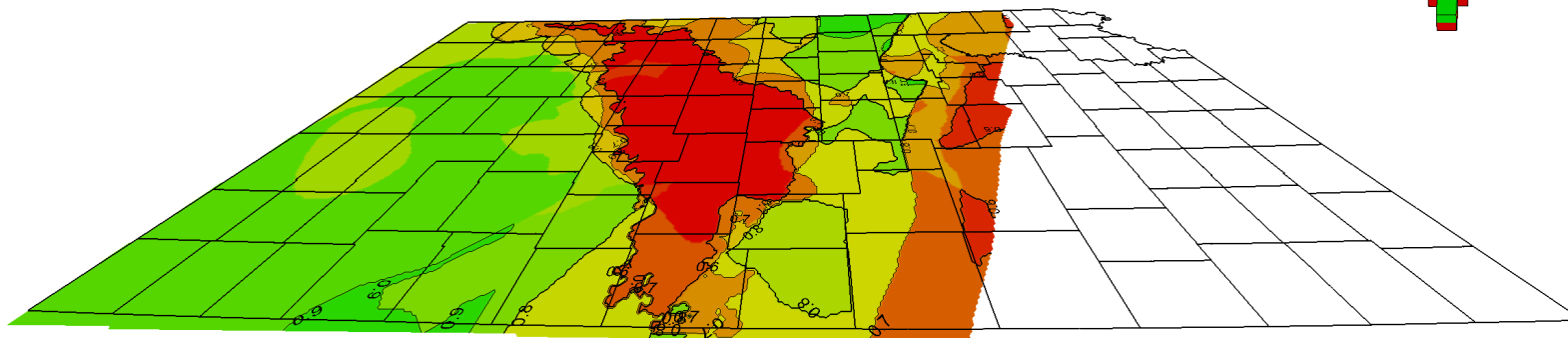
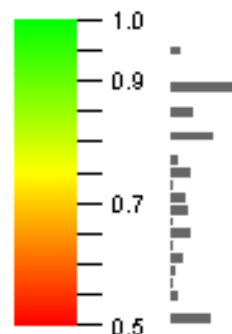


Fault Proximity COA
Fraction

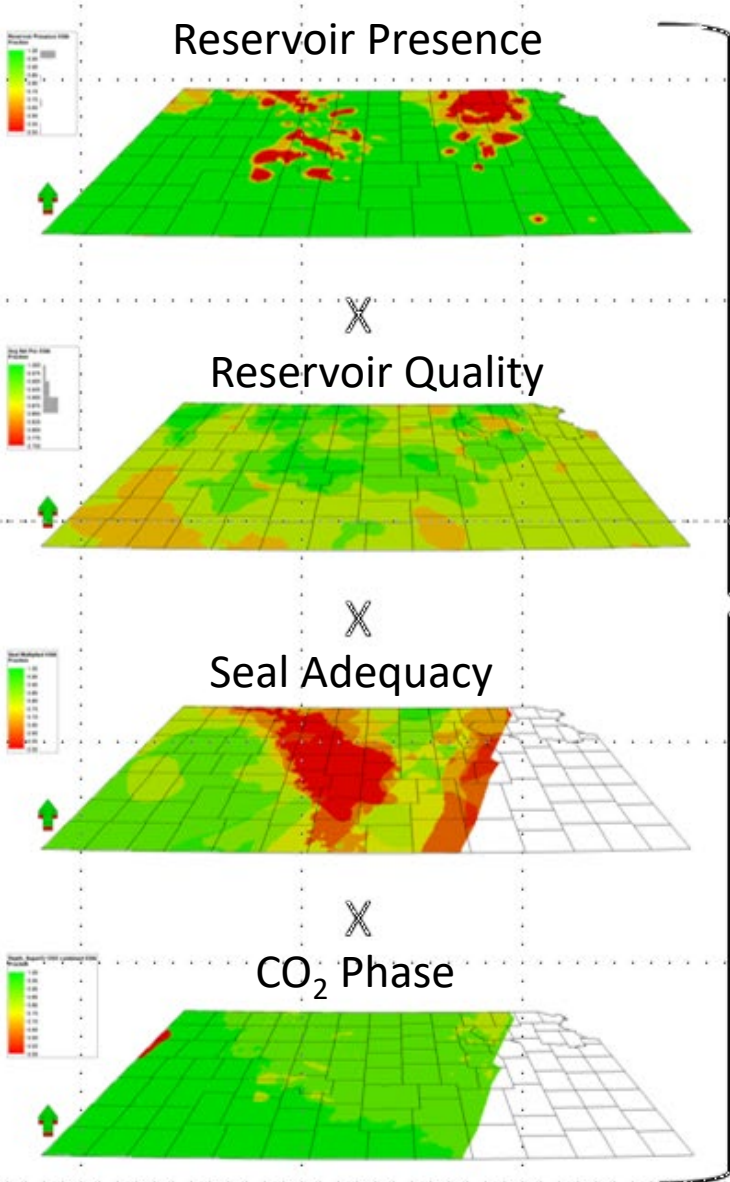


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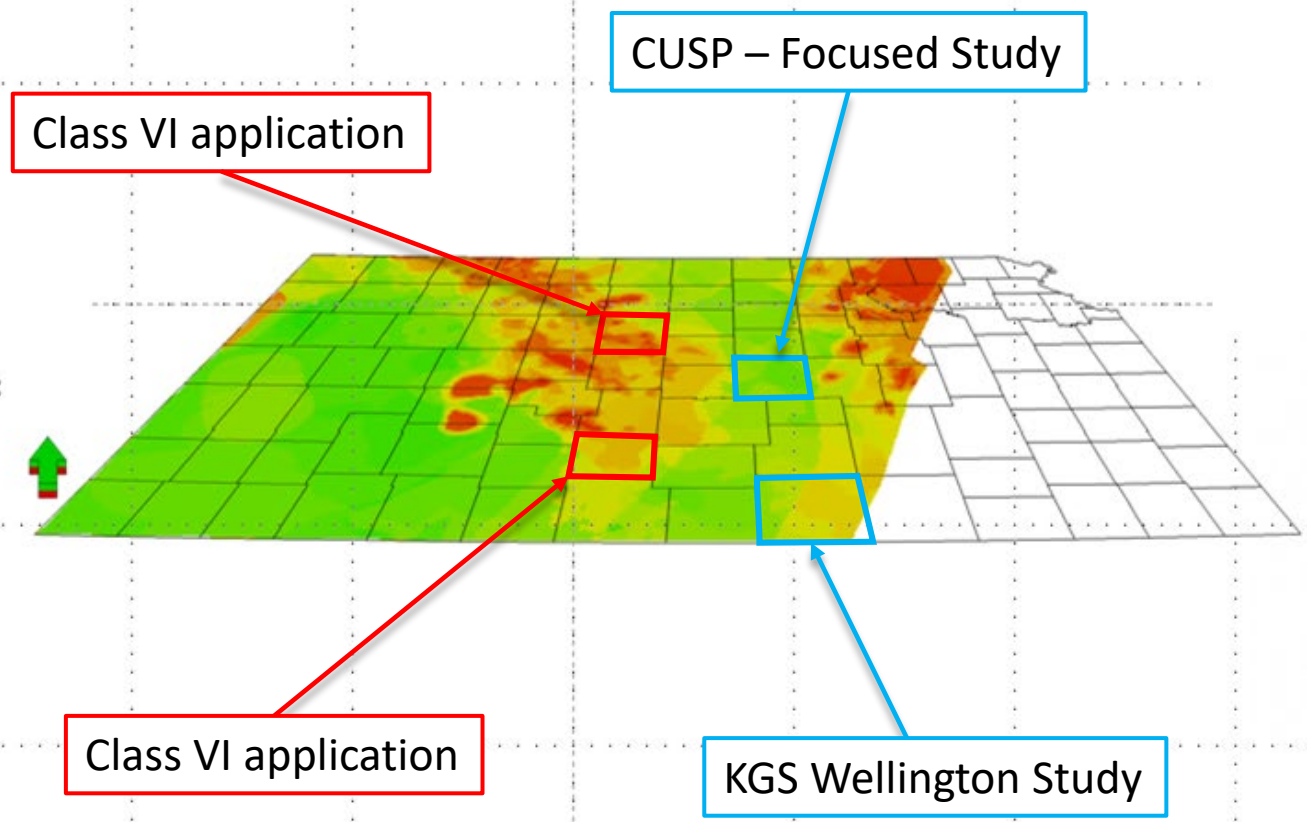
Seal Multiplied
Fraction



CCS "Play" Elements – Working Output



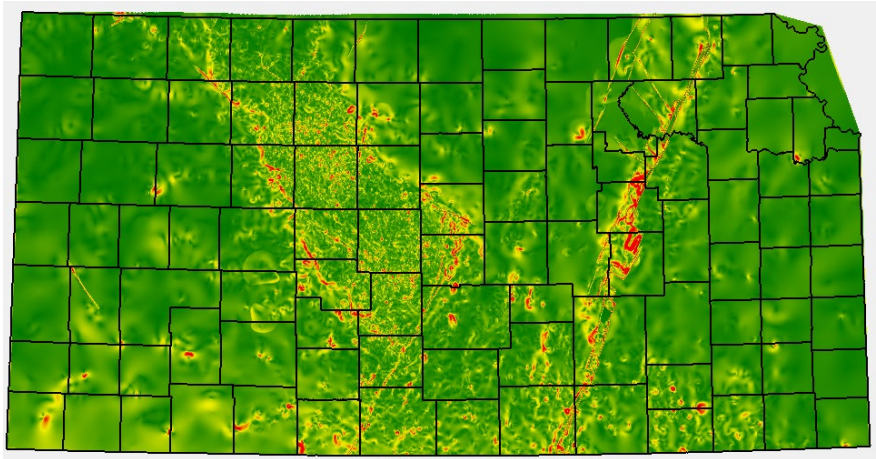
NOTE: Challenged play elements don't preclude a successful CCS project/prospect



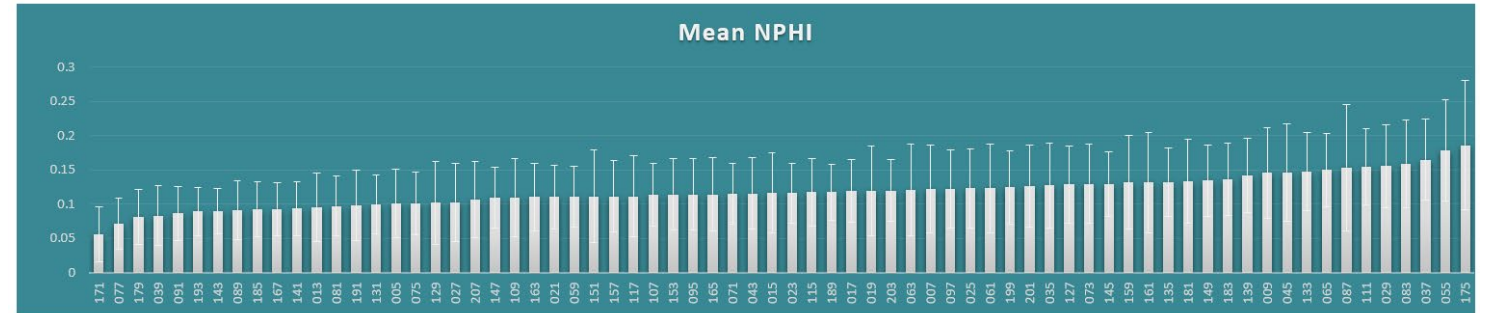
What's new in the Sunflower State?



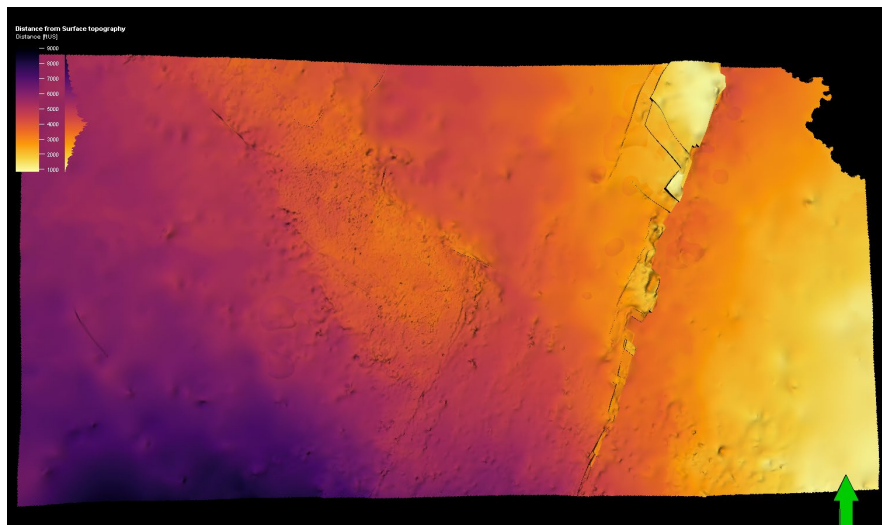
Dip Magnitude (Top Arbuckle) - degrees



Geometric and Petrophysical property modeling by county



Depth to Basement - feet



KGS Team and Structure...significant change in the last year+

Other Energy activity at the KGS

- DOE Core-Critical Minerals...we drilled a well!!
- Natural H₂ exploration (+/- He)
- Midcontinent Rift geochemistry
- Dusting off the Wellington CCS Study with Berexco