

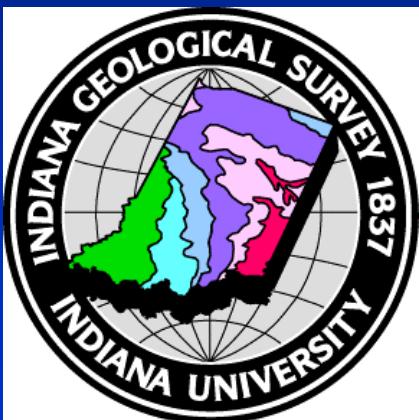
Estimating the CO₂ Sequestration Capacity of Deep Saline Aquifers in Indiana

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Charles W. Zuppann

Indiana Geological Survey



Outline

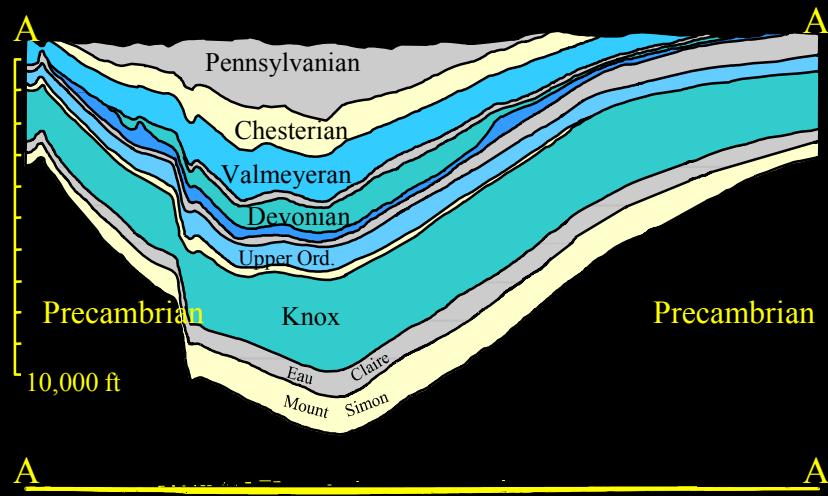
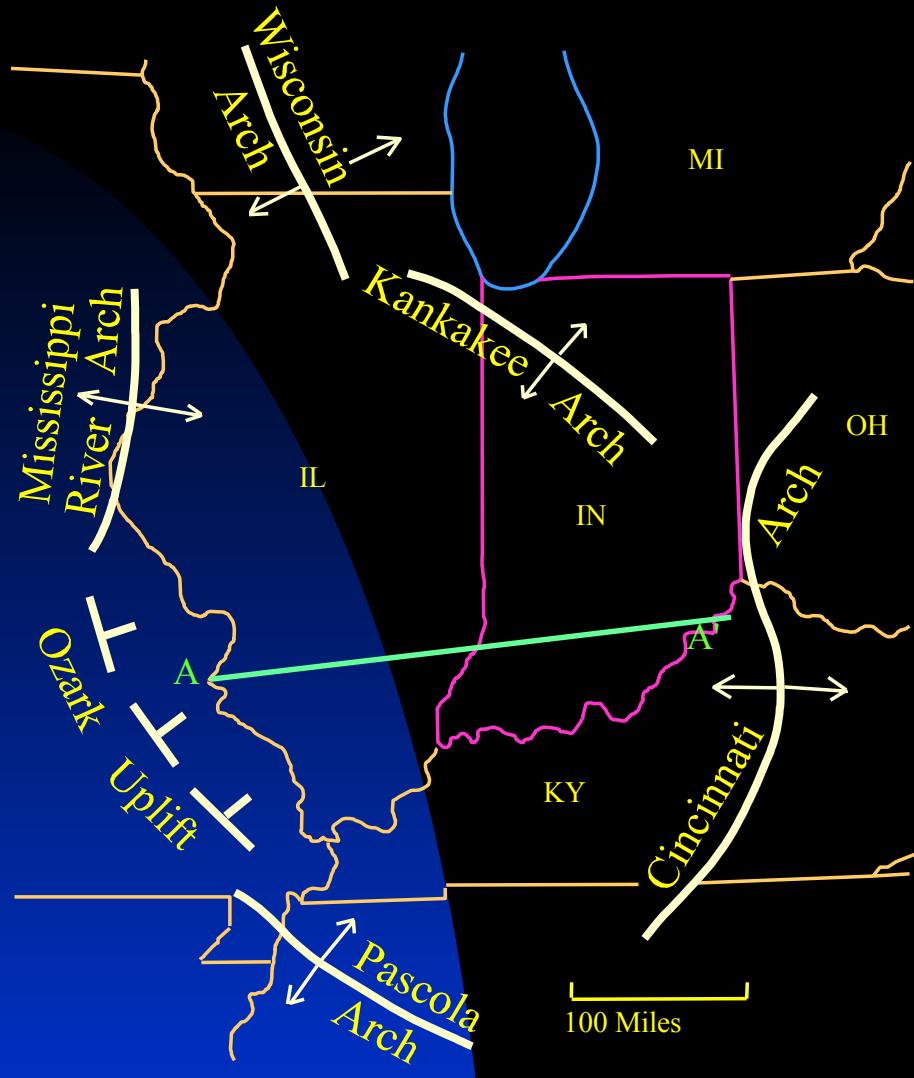
- MIDCARB Project
- Study Area
- Deep Saline Aquifers
- Devonian-Silurian Carbonates
- Aquifer Brine Chemistry
- Definition of porous zones
- Porosity of the Study area
- Digital Mapping
- CO₂ Sequestration Potential

MIDCARB Project

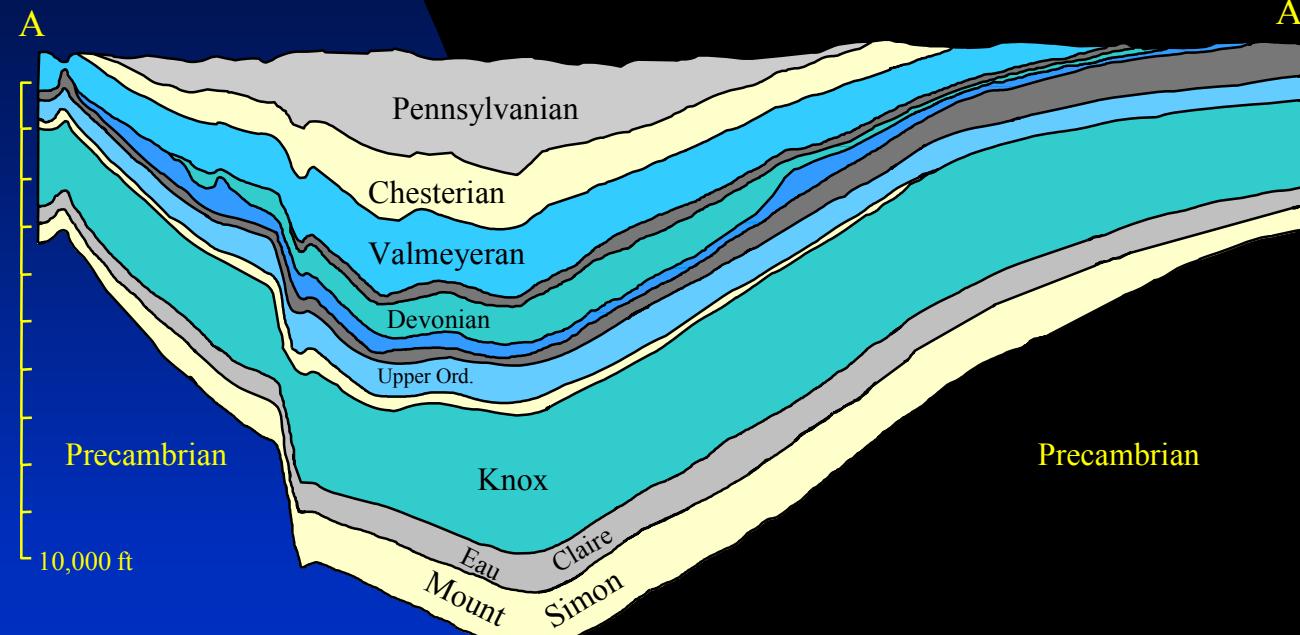
- M_{id}-continent
- I_{nteractive}
- D_{igital}
- C_{arbon}
- A_{tлас and}
- R_{elational}
- D_at_aB_{ase}



Study Area



Illinois Basin Rocks



{ Terrigenous facies

{ Calcareous facies

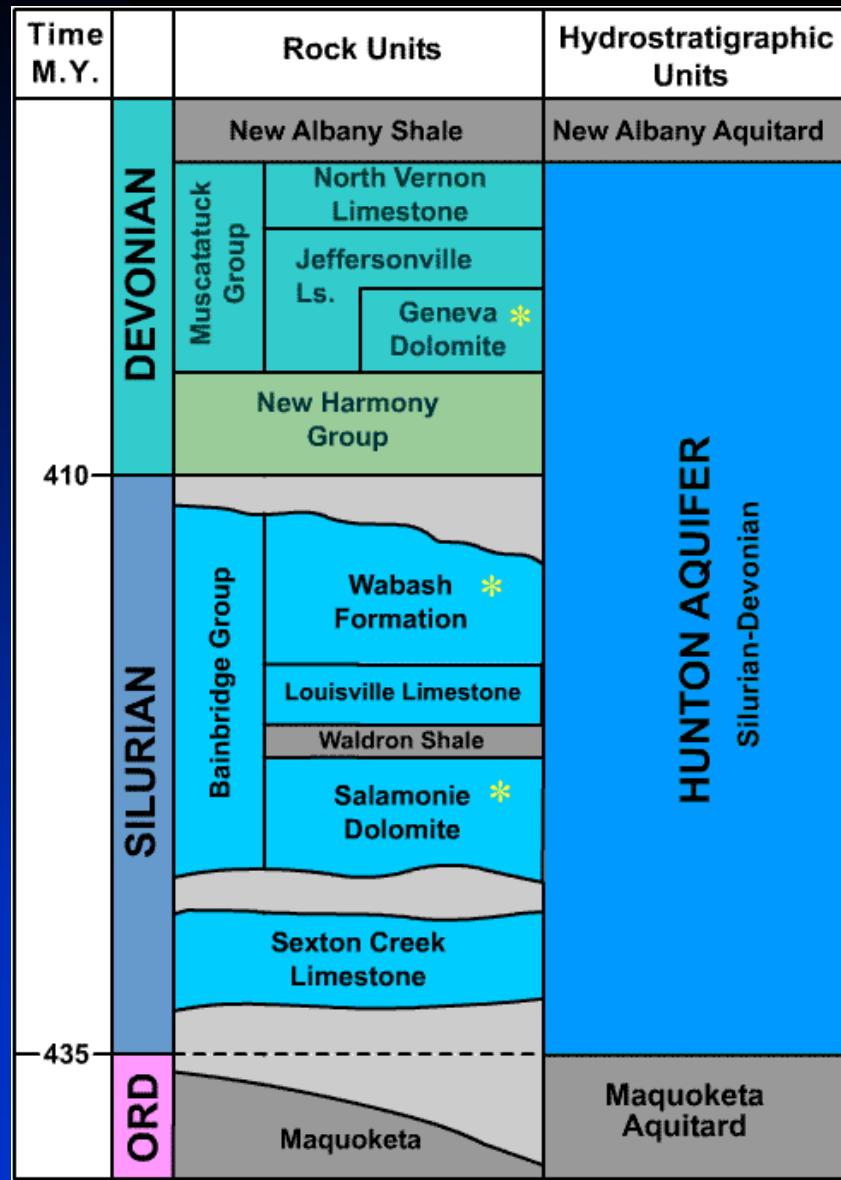
Deep Saline Aquifers

Why?

- Depth
- High TDS concentrations
- Laterally continuous
- Large aquifer systems

High potential for CO₂ storage for long periods of time

Silurian-Devonian Carbonates



Aquitards

Thick (0 – > 1,500 ft)

SWD

* Highly porous intervals - reefs

Aquifer brine chemistry

Average TDS for Hunton Aquifer

TDS (NaCl eq.)

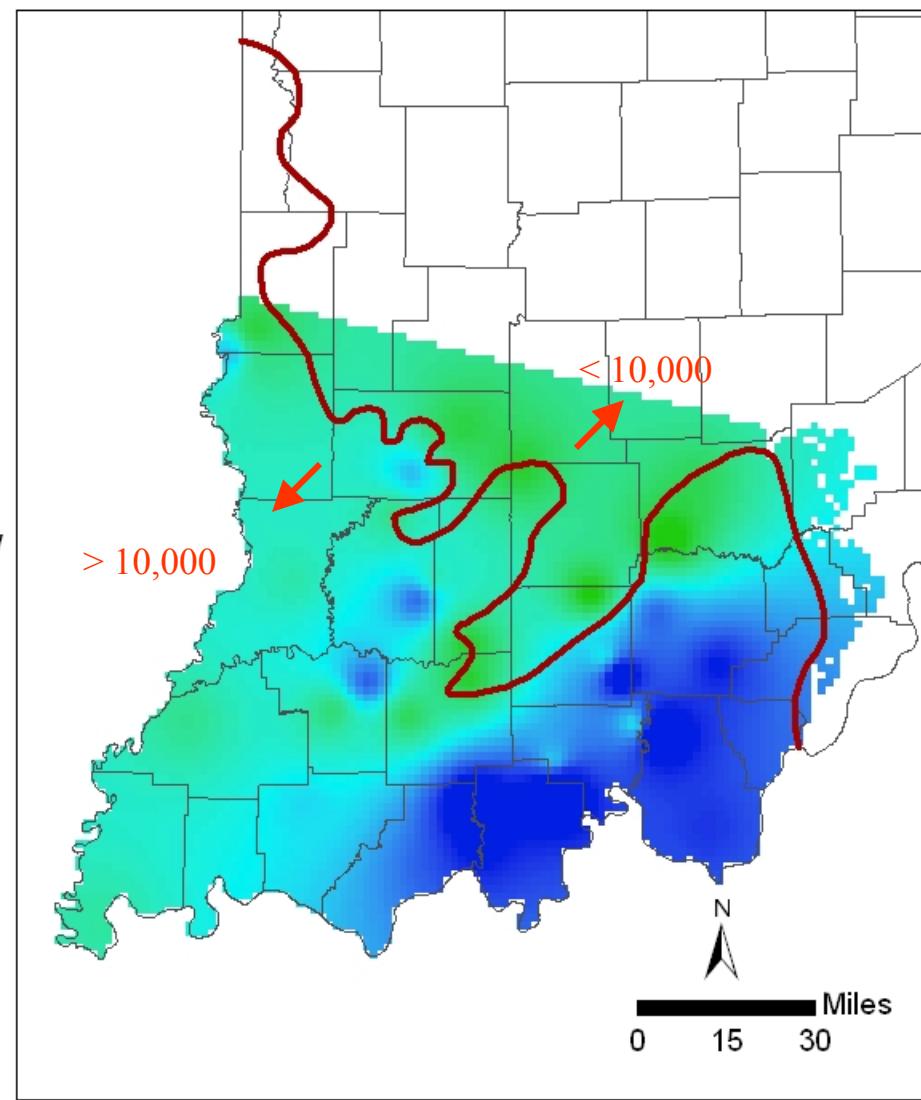
100,000

3,000

— 10,000 ppm TDS boundary

(Schnoebel et al 1995)

Average
60,000 – 90,000 ppm



Definition of Porous zones

Porosity logs

Four intervals selected for porosity:

North Vernon

Jeffersonville/Geneva

Upper Silurian

Lower Silurian

Three scenarios

average porosity

standard deviation

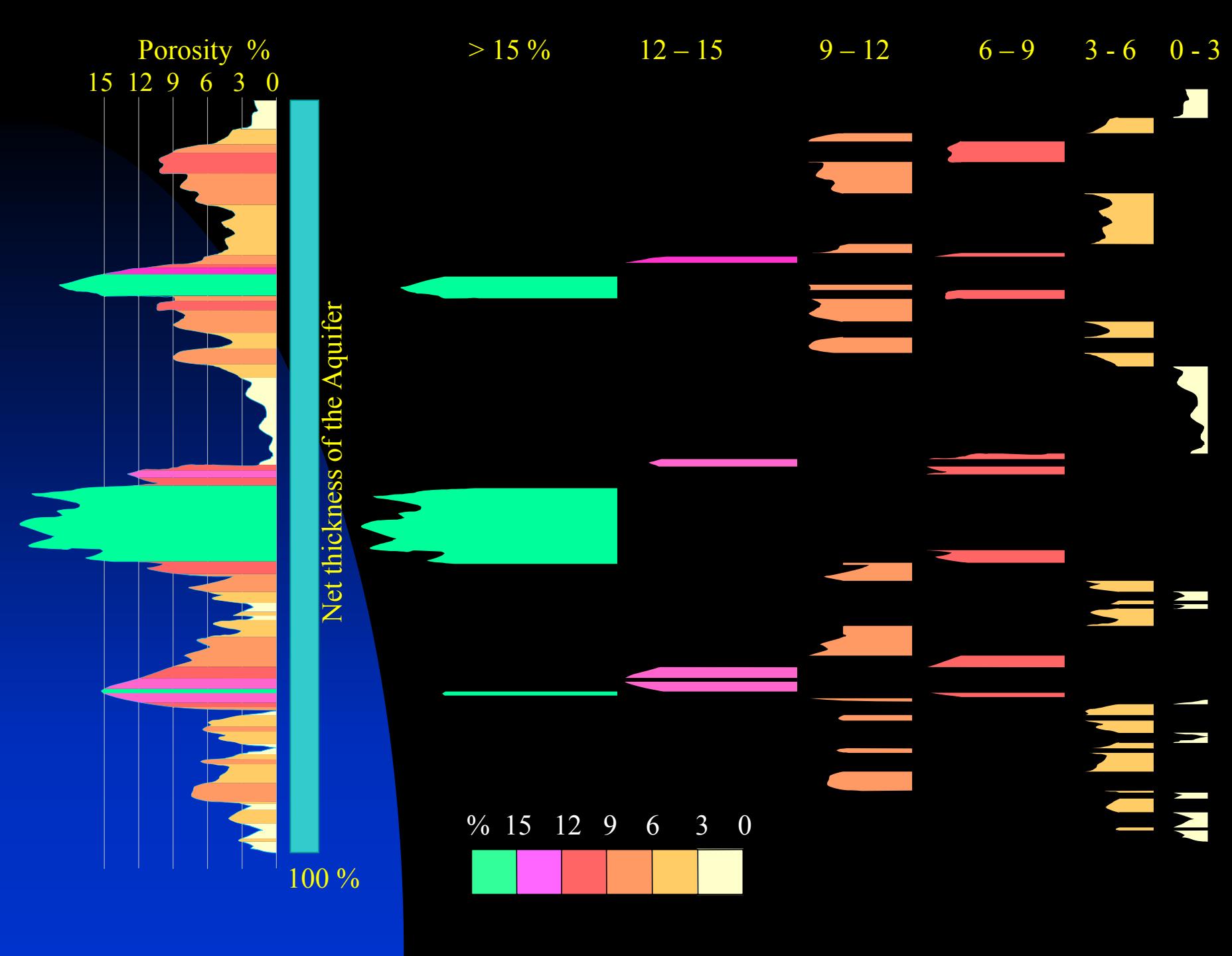
Preliminary analysis of these four units (using a 6% porosity cutoff) indicated:

- Minimum (0.27 TCF)
- Intermediate (0.62 TCF)
- Maximum (1.3 TCF)

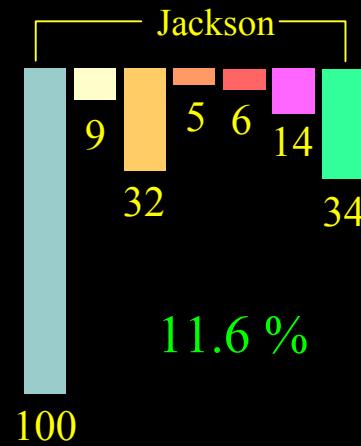
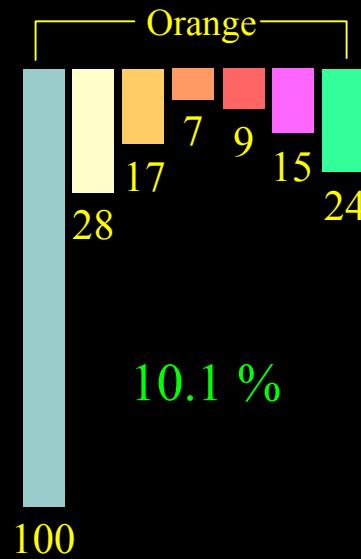
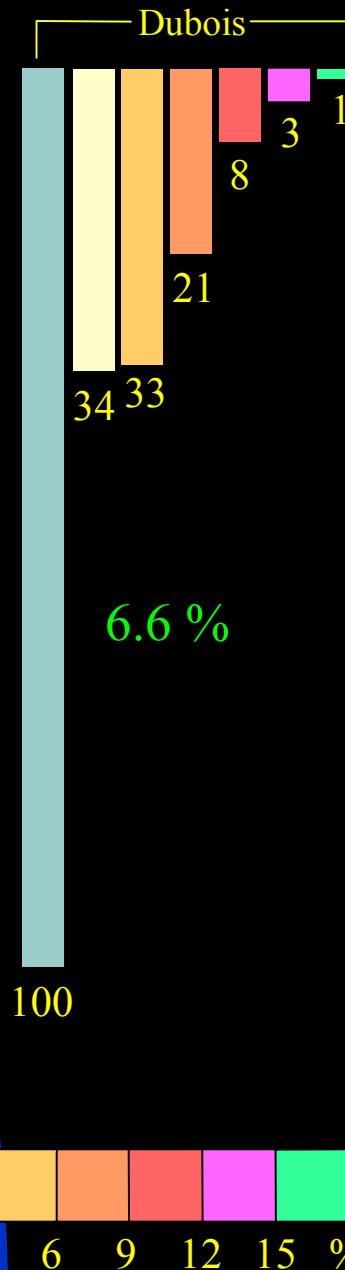
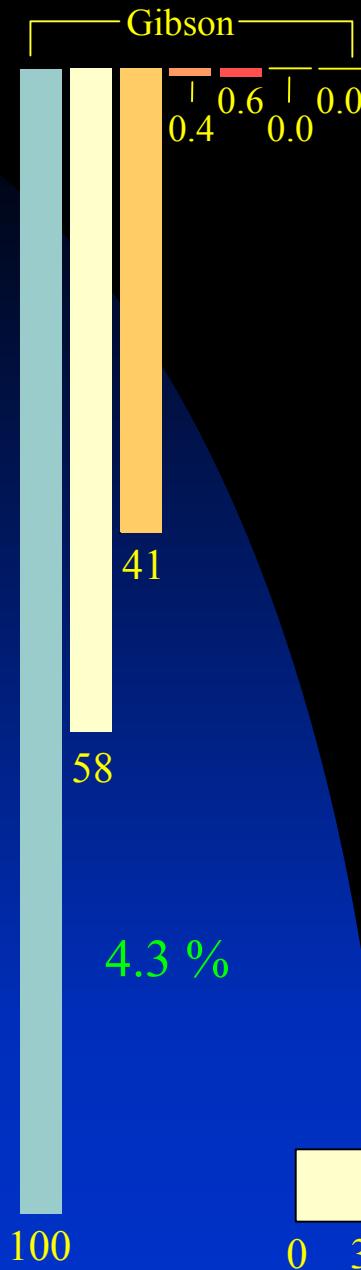
Overall Porosity Distribution

Porosity logs

- Unit was broken into 6 porosity intervals:
0 – 3 %, 3 – 6 %, 6 – 9 %, 9 – 12 %,
12 – 15 %, and >15 %
- Intervals with same porosity were added and normalized to the net thickness
- Average weighted porosity calculated



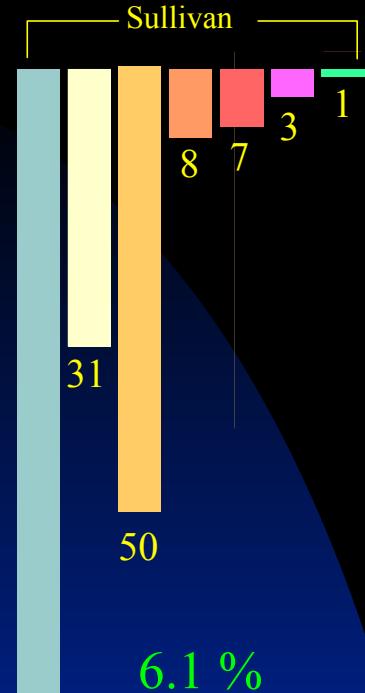
WSW



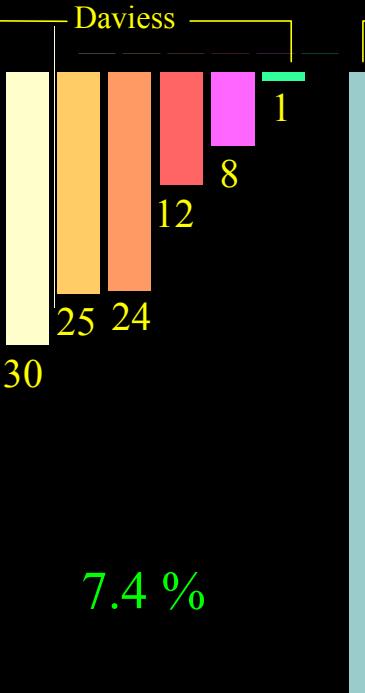
ENE



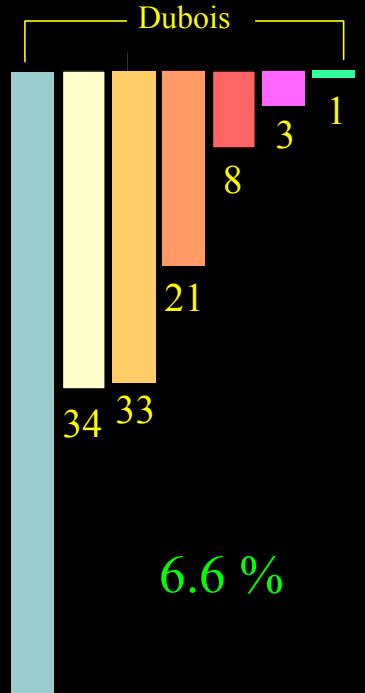
NNW



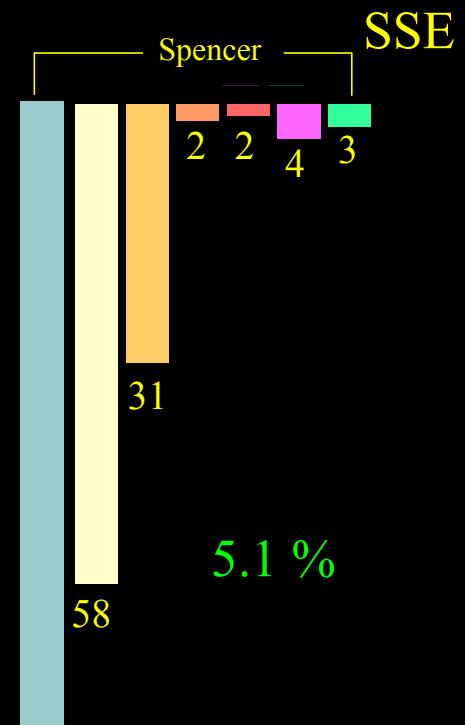
6.1 %



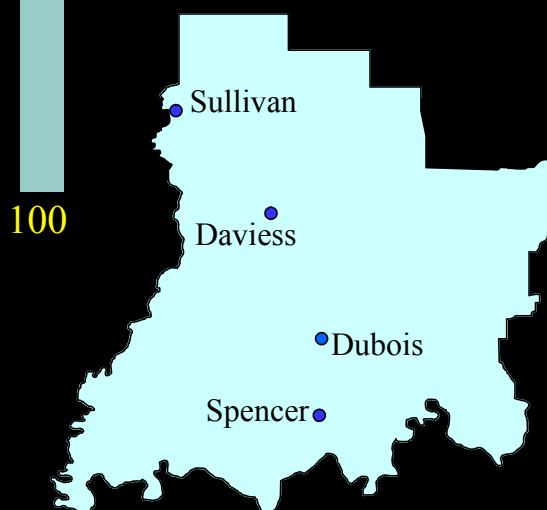
7.4 %



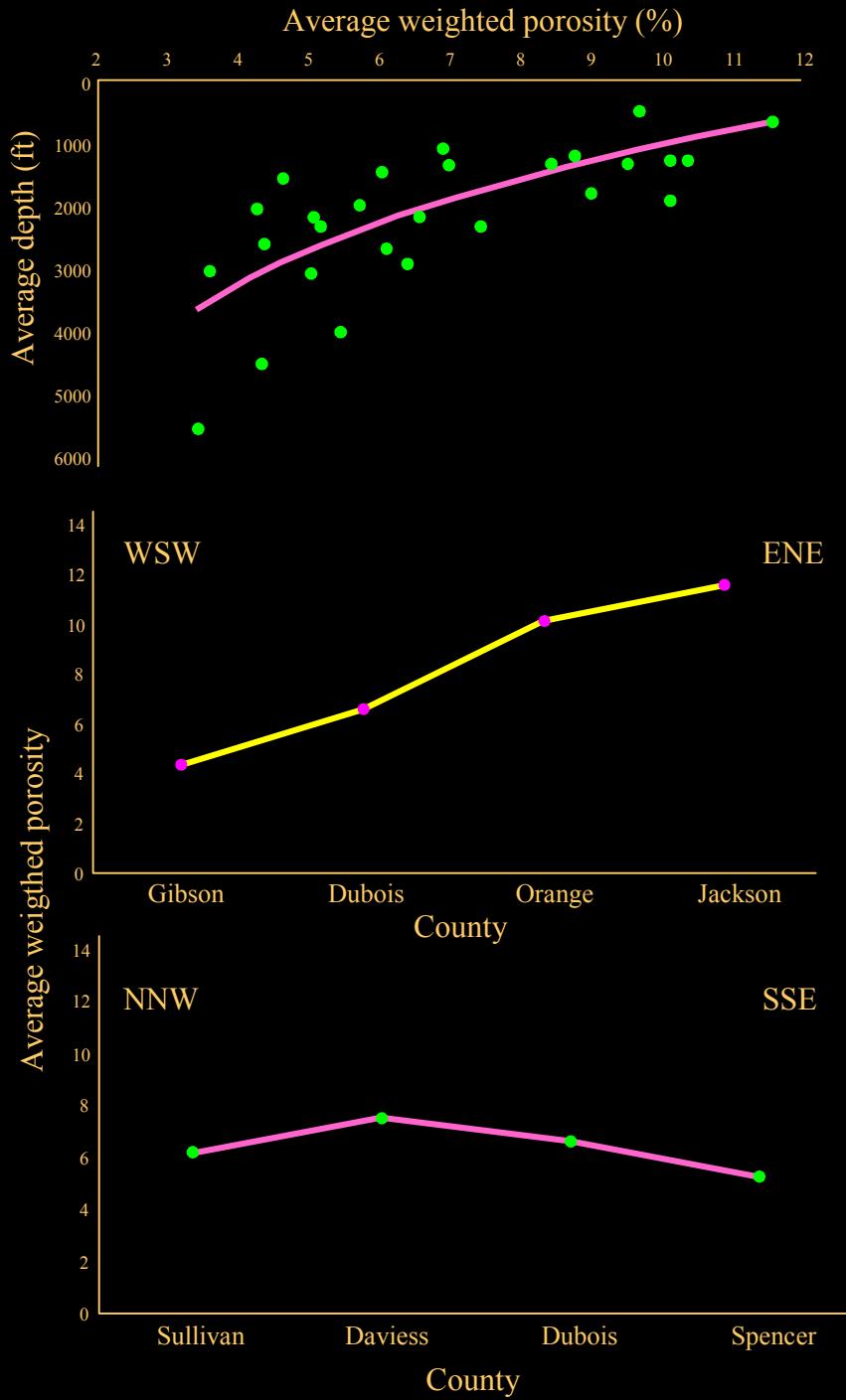
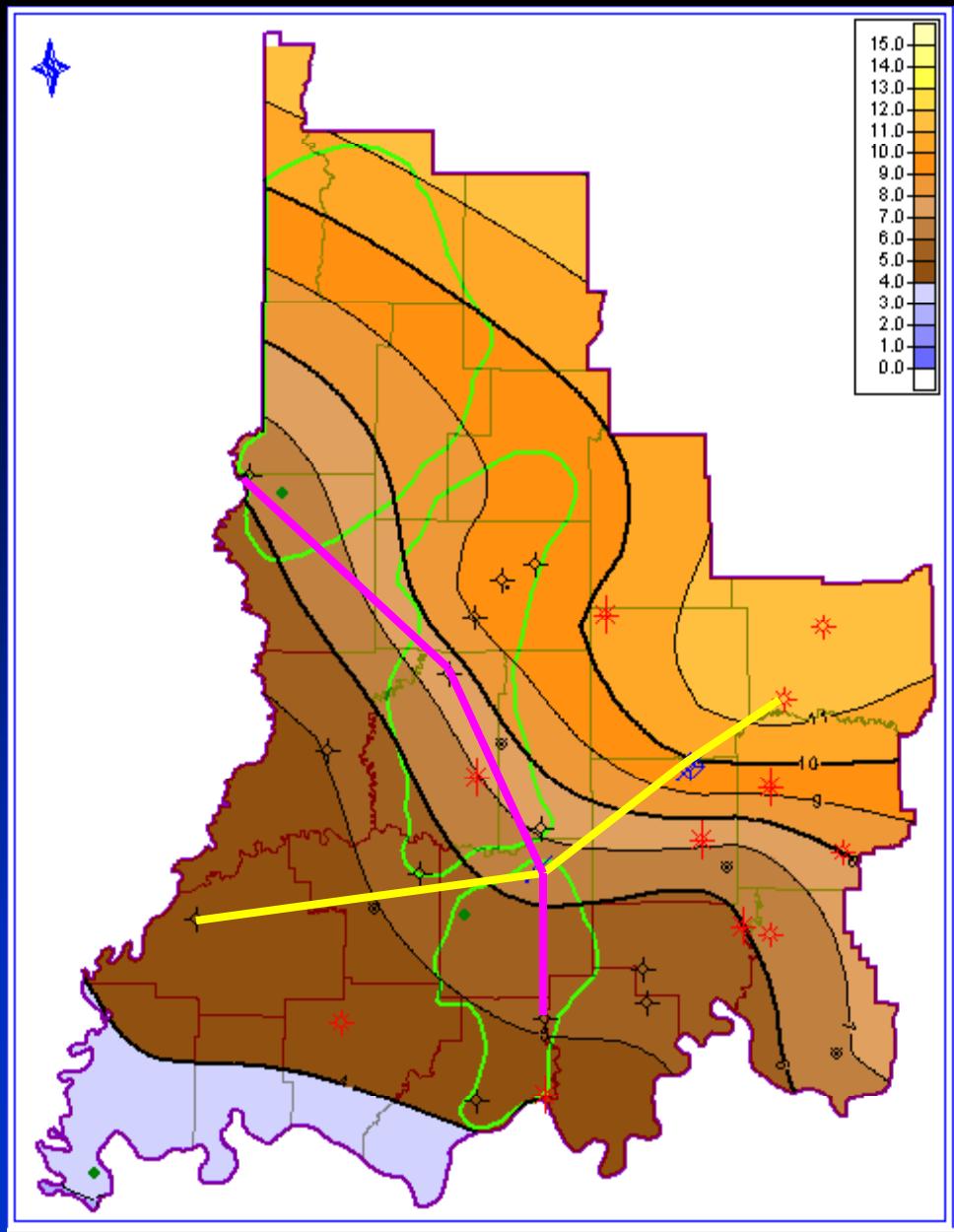
6.6 %



5.1 %



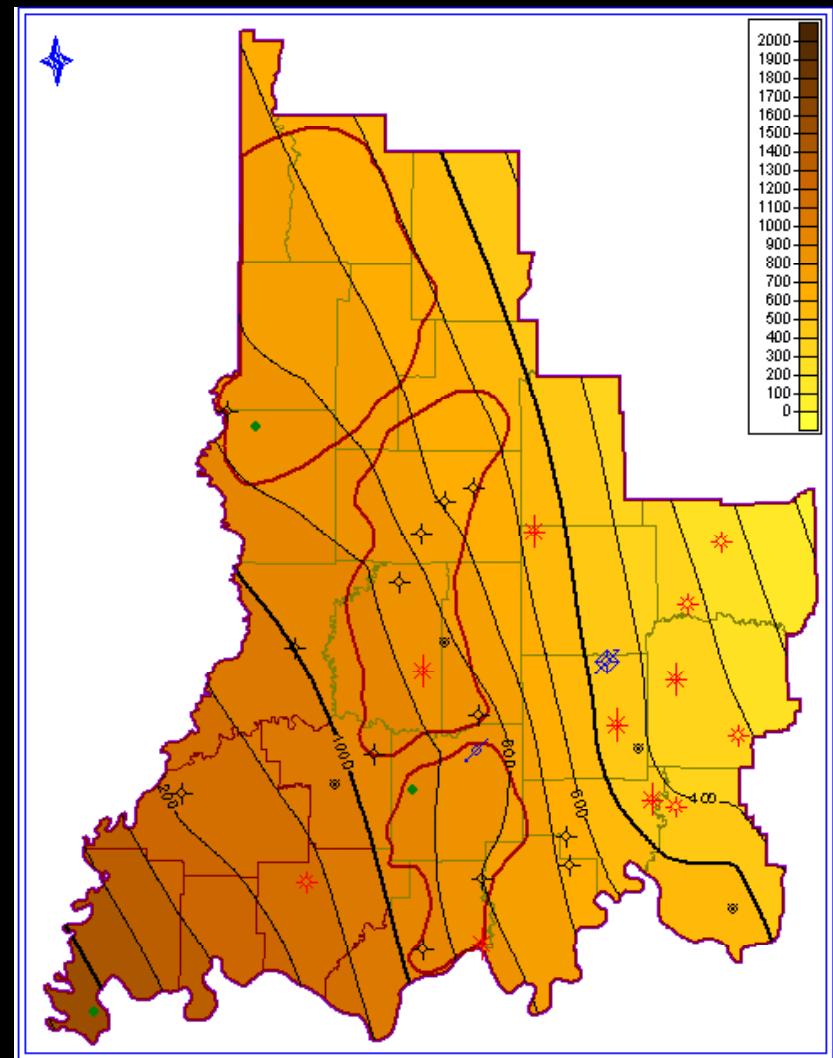
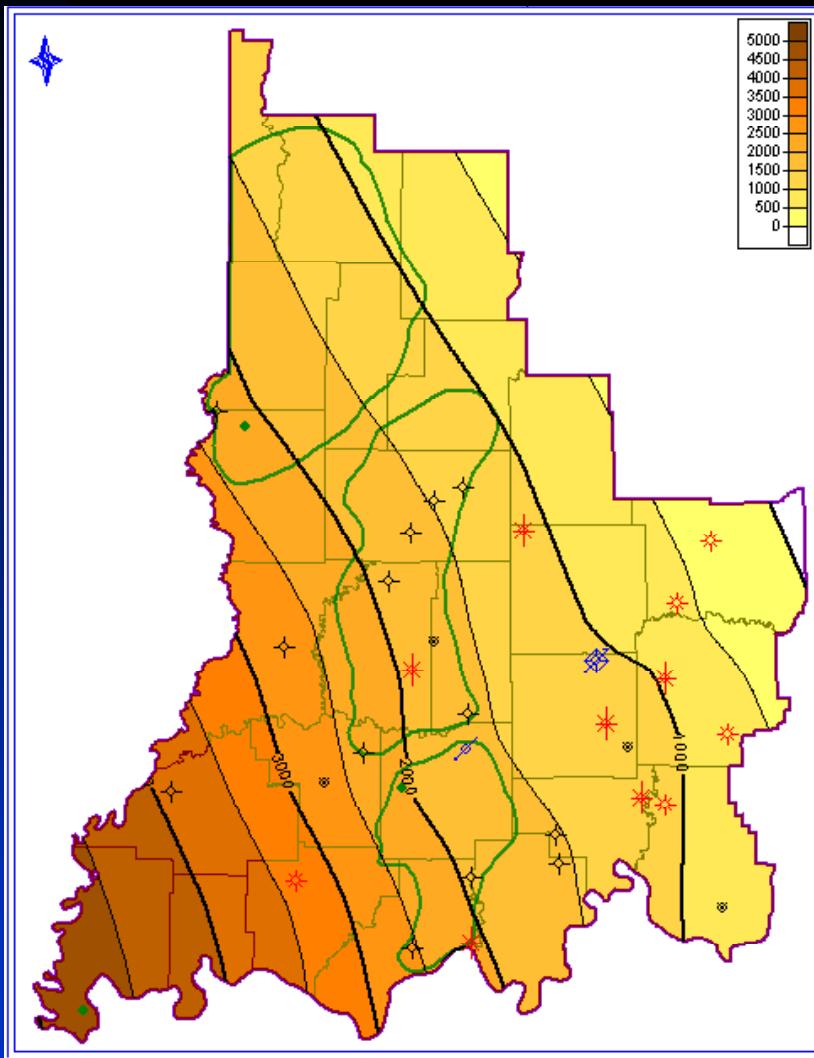
Average Weighted Porosity



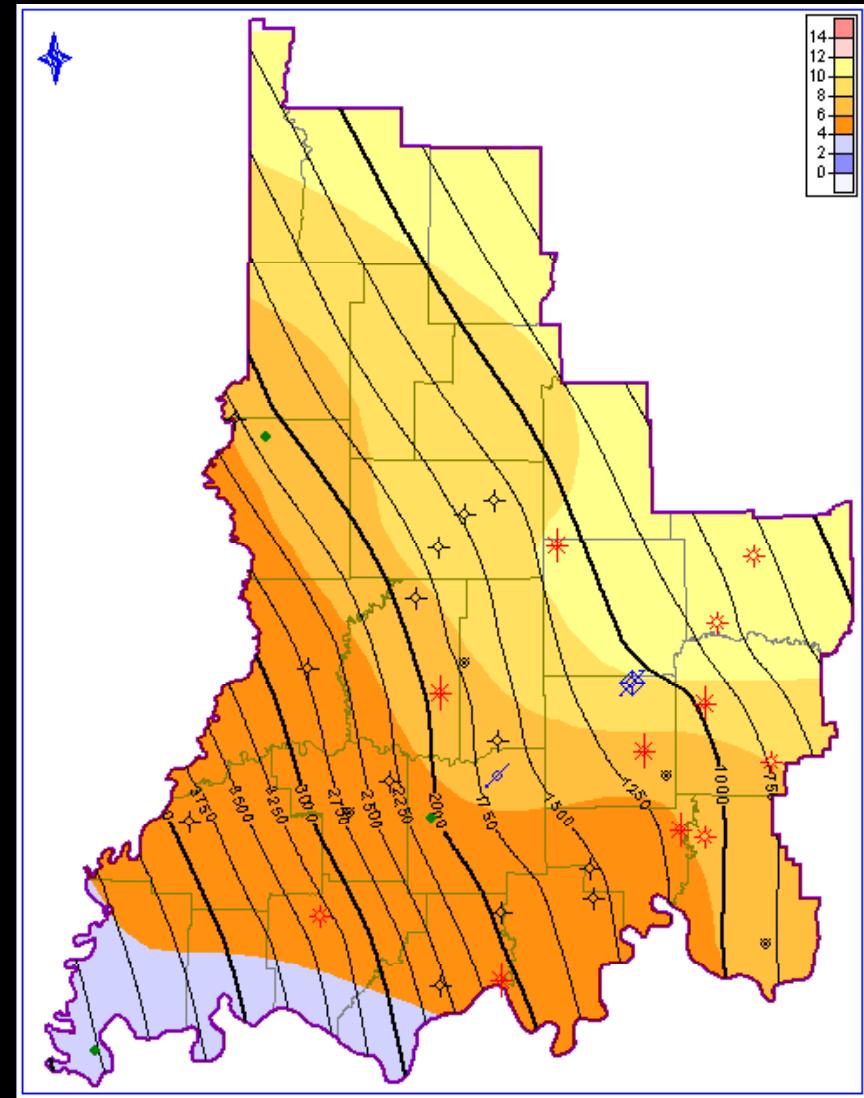
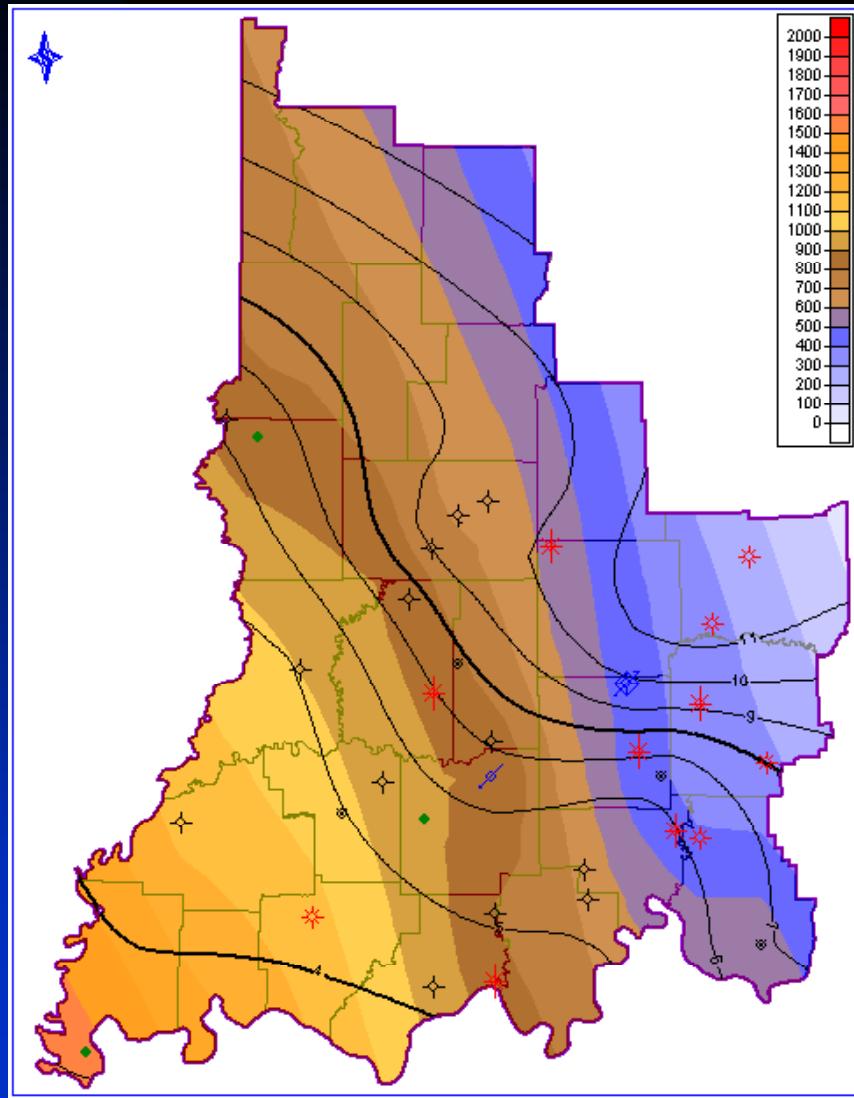
Digital Mapping

- Structural
- Isopach
- Volumetrics
- Geoplus (PETRA)

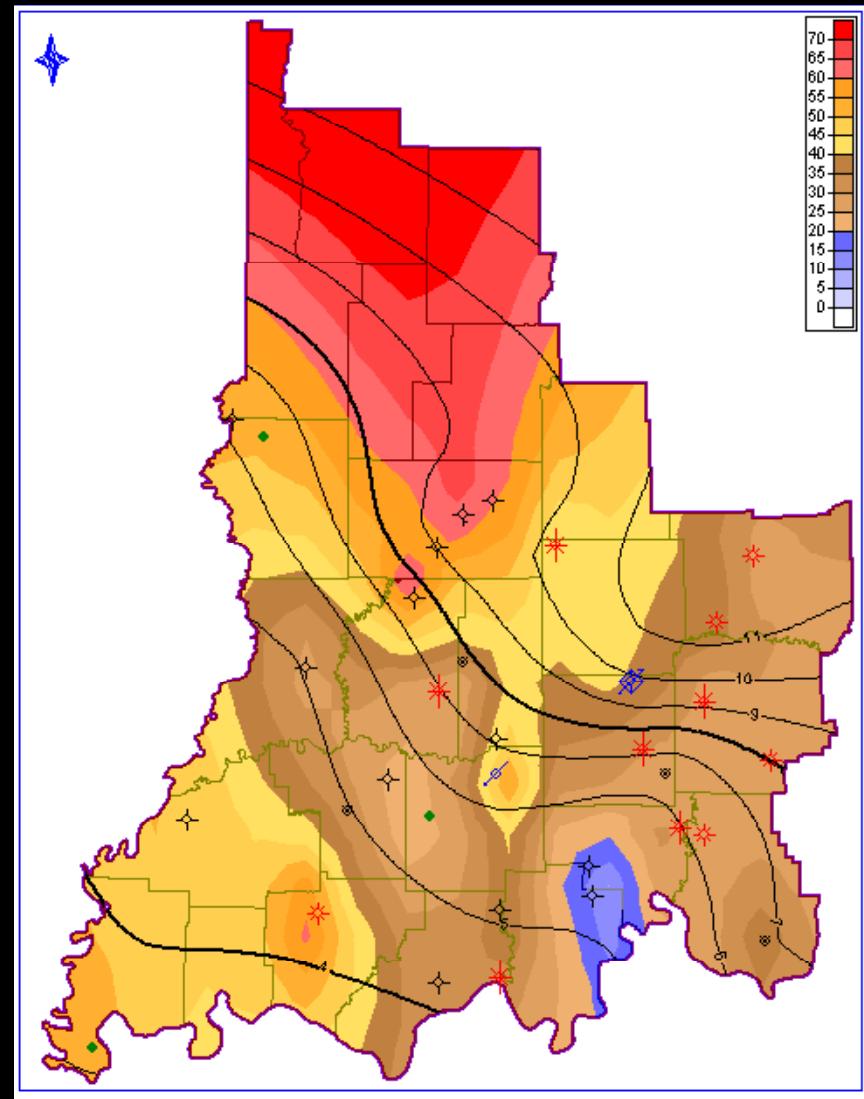
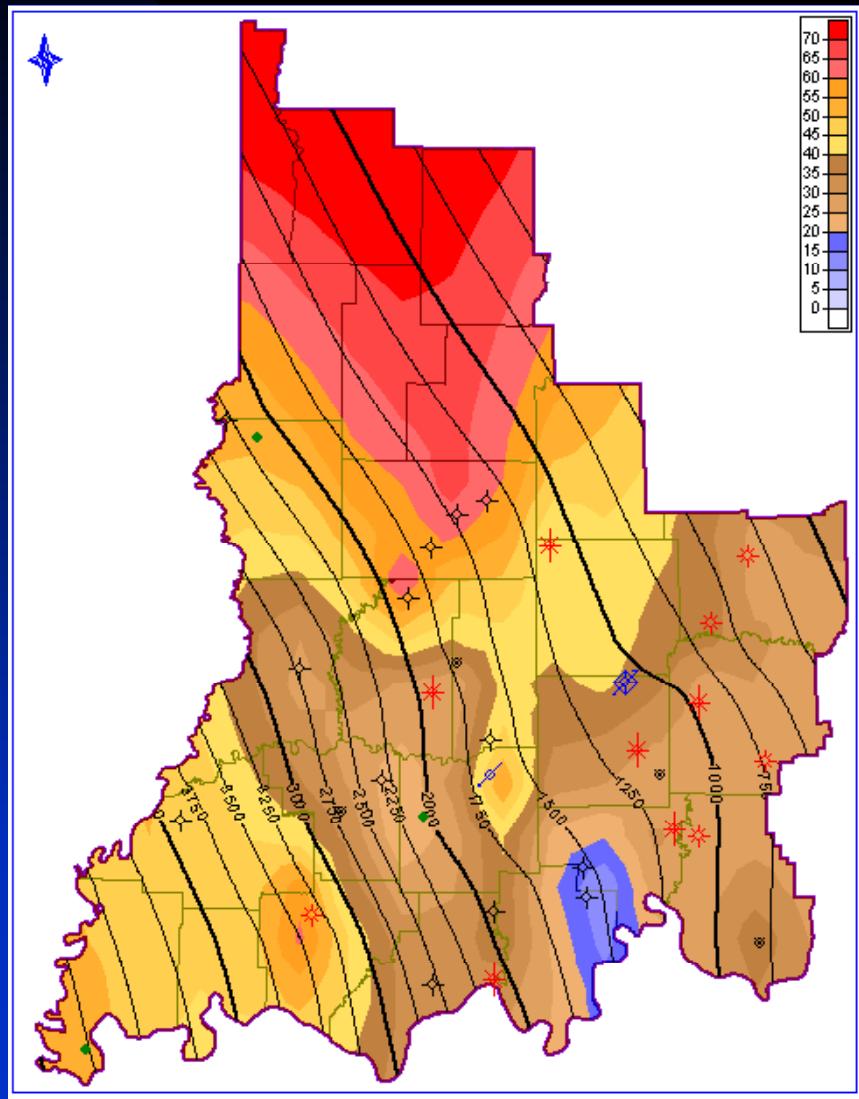
Devonian Structure and Aquifer Thickness

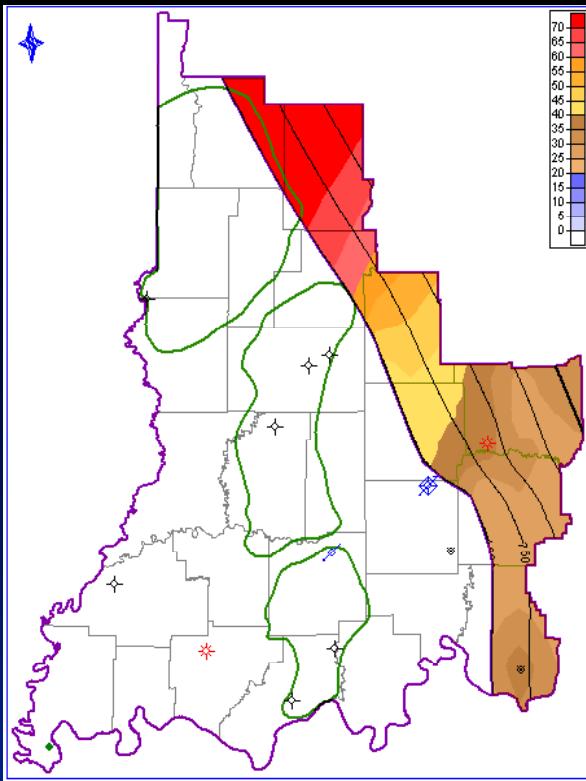


Aquifer Thickness, Porosity and Structure

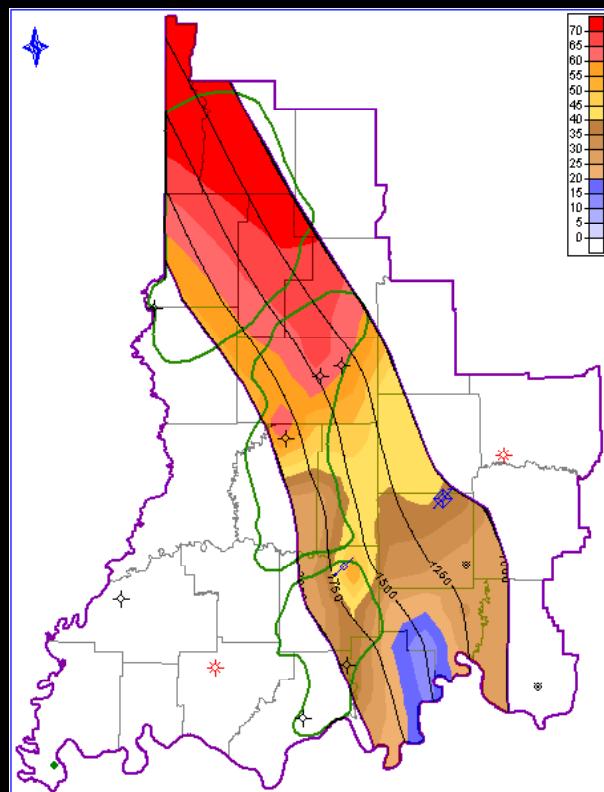


Devonian structure and Porosity vs. Net pore-thickness

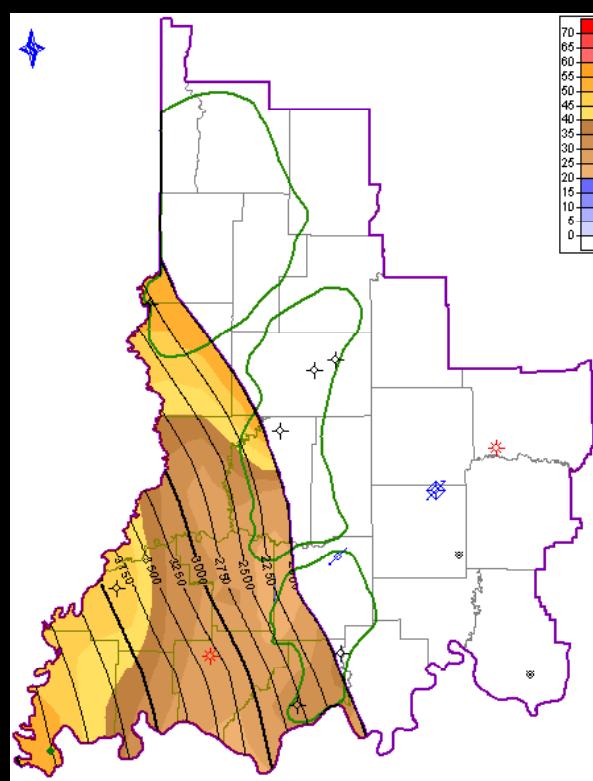




Depth 750 ft
Temp 65 °F
Pressure 22 atm



Depth 1500 ft
Temp 77 °F
Pressure 44 atm



Depth 3500 ft
Temp 112 °F
Pressure 103 atm

CO₂ Sequestration Potential - Summary

Depth, Temperature and Pressure data :

$$1 \text{ short Ton} = 0.059734 * \text{Temp (K)} / \text{P (atm)} \text{ MCF}$$

Annual CO₂ production in Indiana ~ 60MM Tons

- Four zones revisited (Billion short Tons CO₂)
 - ◆ Minimum: ~ 2.0 (~ 33 years)
 - ◆ Intermediate: ~ 3.3 (~ 55 years)
 - ◆ Maximum: ~ 4.8 (~ 81 years)

Net pore-thickness of the aquifer (Billion short Tons CO₂):

- ◆ Maximum: ~ 42.0 (~ 700 years)

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