

# **Feasibility Investigation and Modeling Analysis of CO<sub>2</sub> Sequestration in the Arbuckle Formation Utilizing Salt Water Disposal Wells**

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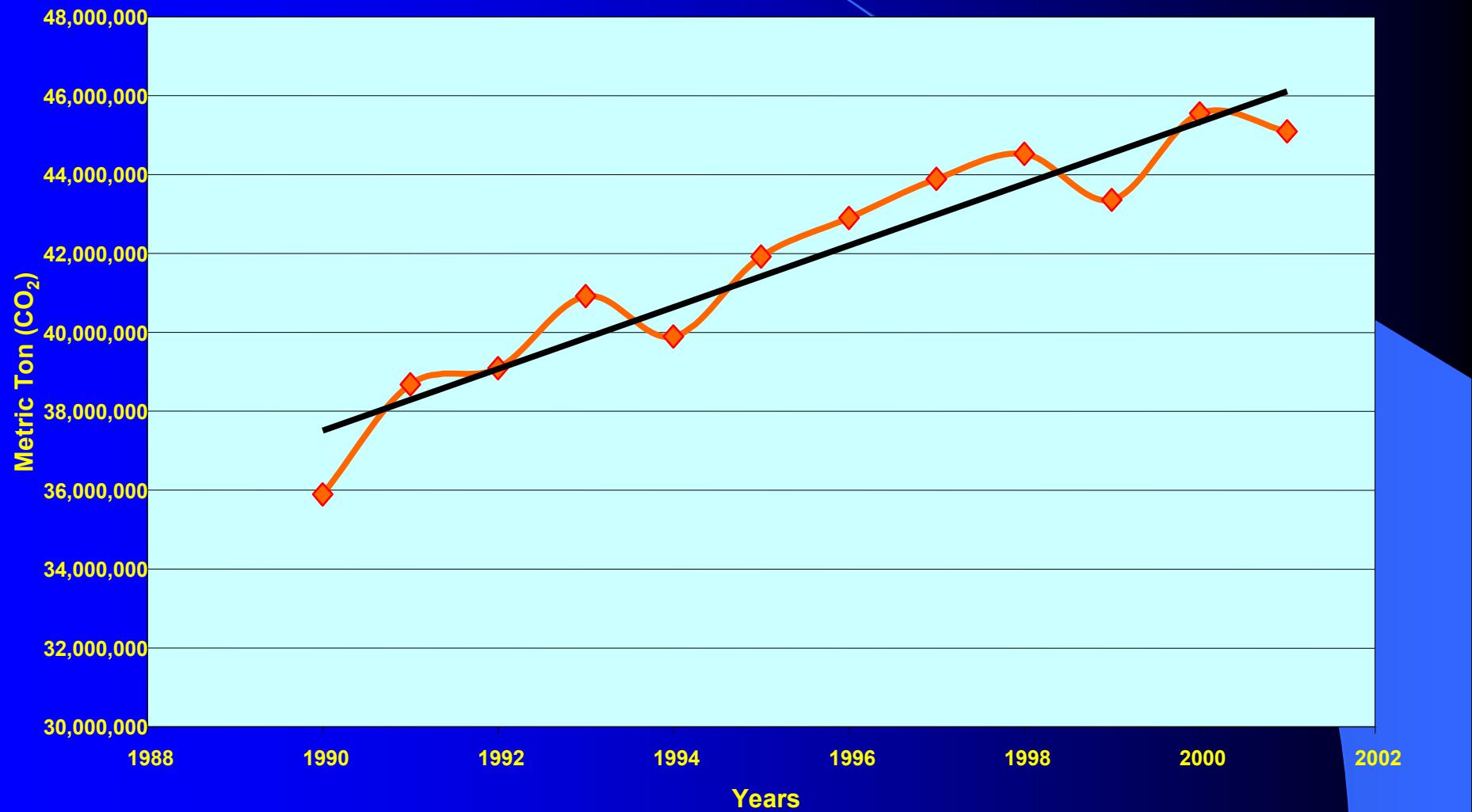
# Outline

- **Objective**
- **Introduction**
- **Site Selection Criteria**
- **Field Case**
- **Chemistry of Reaction**
- **Simulation Models**
- **Final Remarks**

# Objective

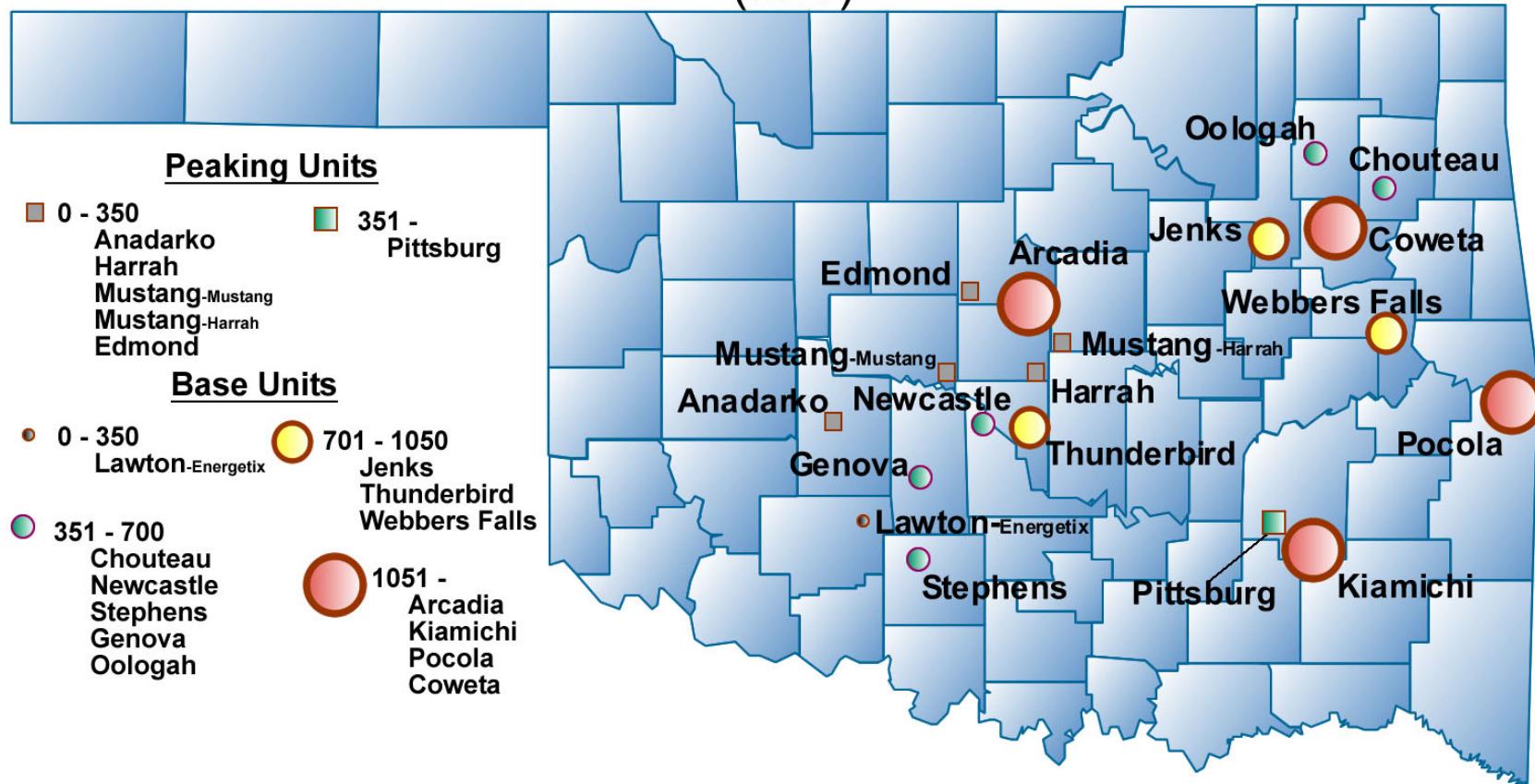
- To examine the effects of an initial oil saturation on reaction chemistry of sequestration as applied to the Arbuckle formation, Oklahoma

# Oklahoma CO<sub>2</sub> Emissions



# Power plant locations in Oklahoma

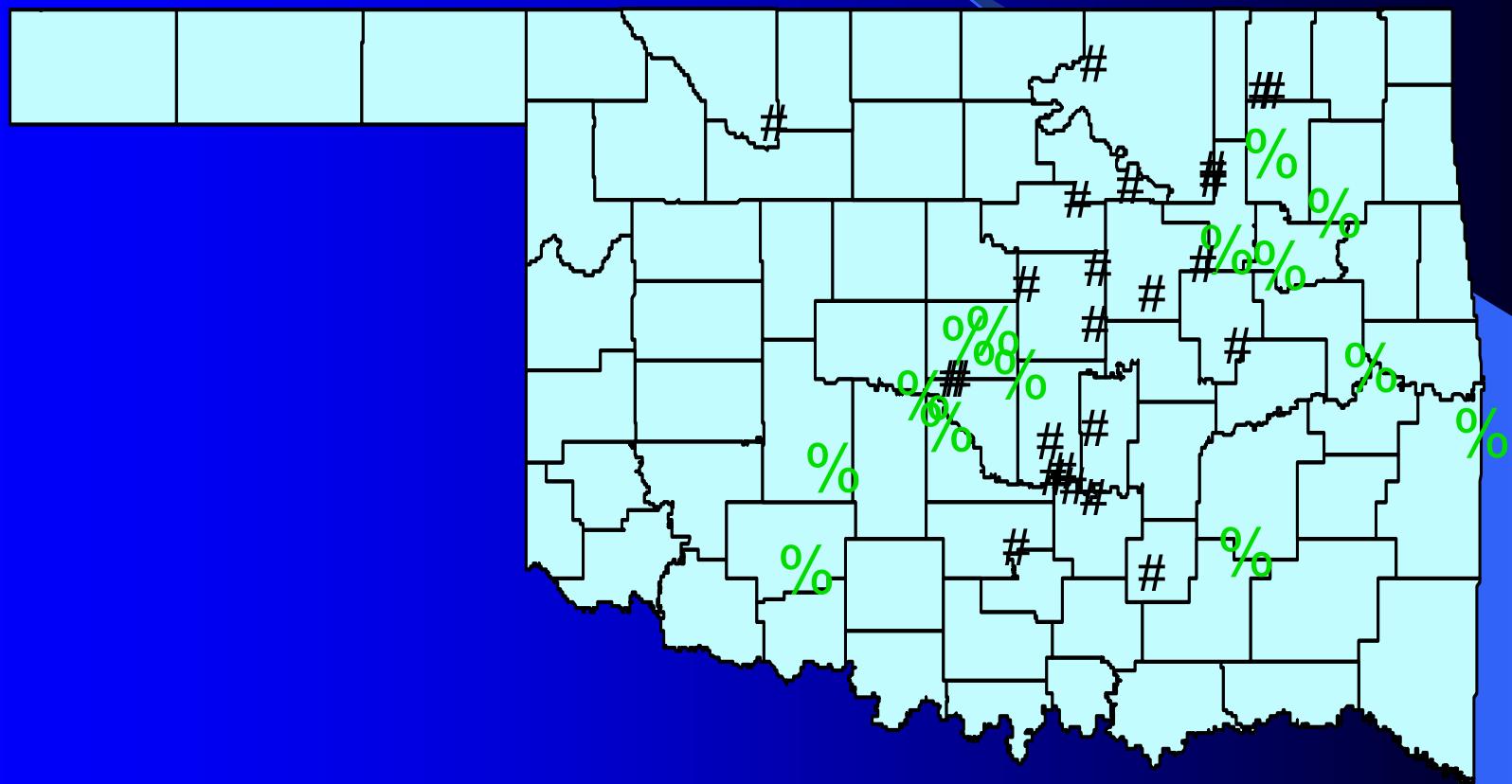
Generating Capacity from New Electric Power Plants  
(MW)



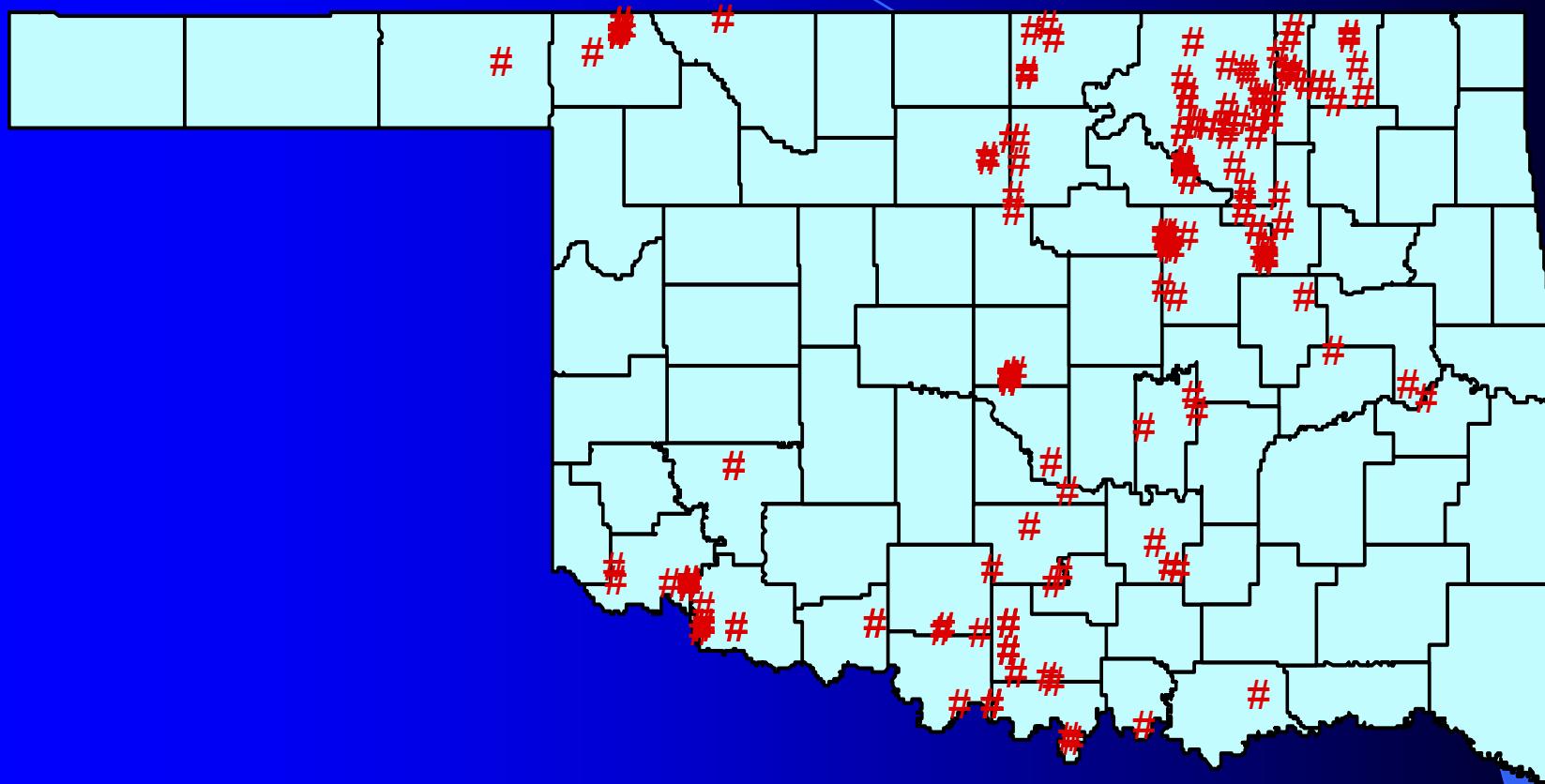
Updated 10/22/03

Courtesy: DOE

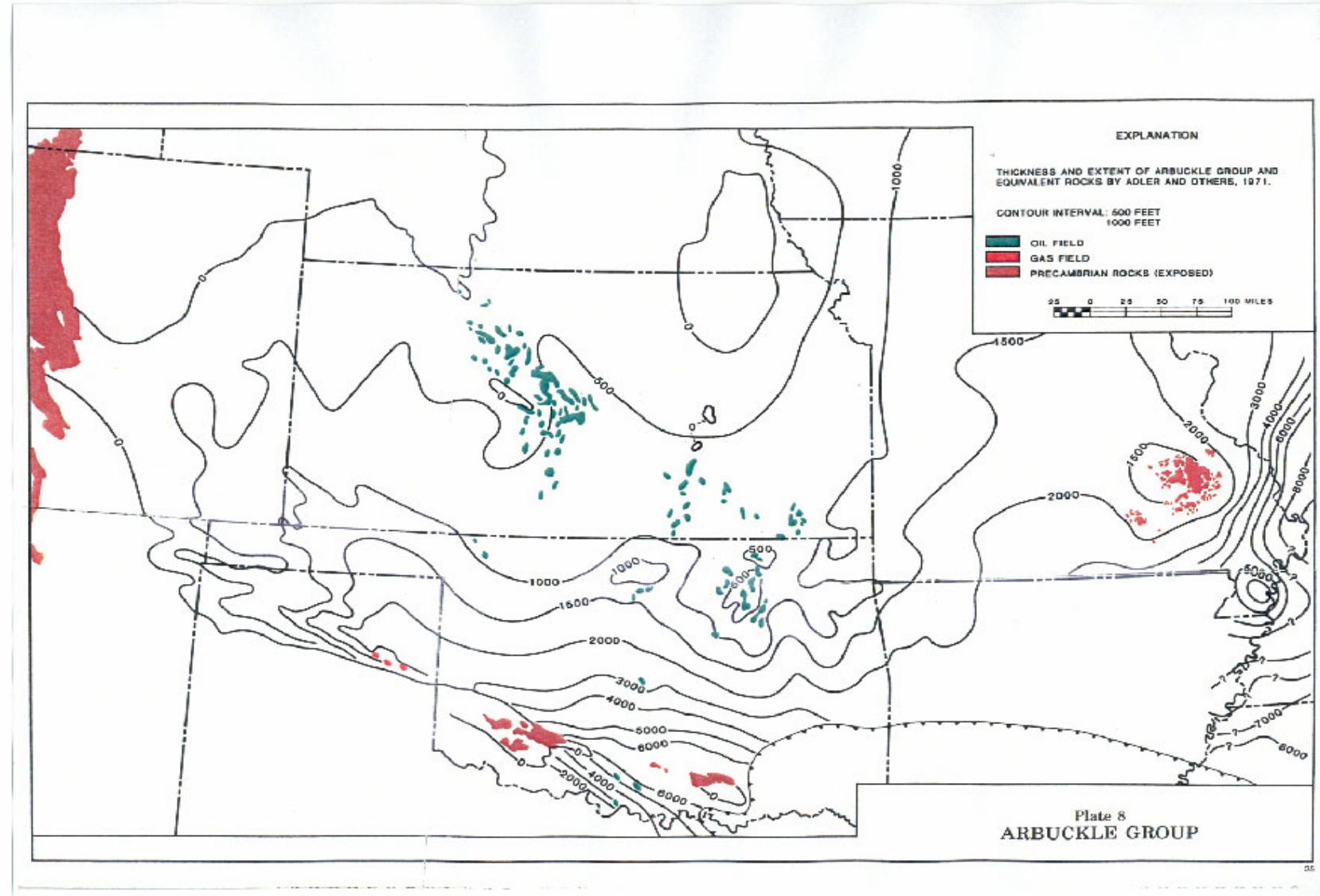
# Location Of Commercial Disposal Wells and Power Plants



# Location of Brine Wells In Oklahoma



# **Oil and Gas Producing Fields from Arbuckle Group in Mid Continent (Adler others 1977)**



# Potential Seal for the Arbuckle Formation (Johnson 1991)

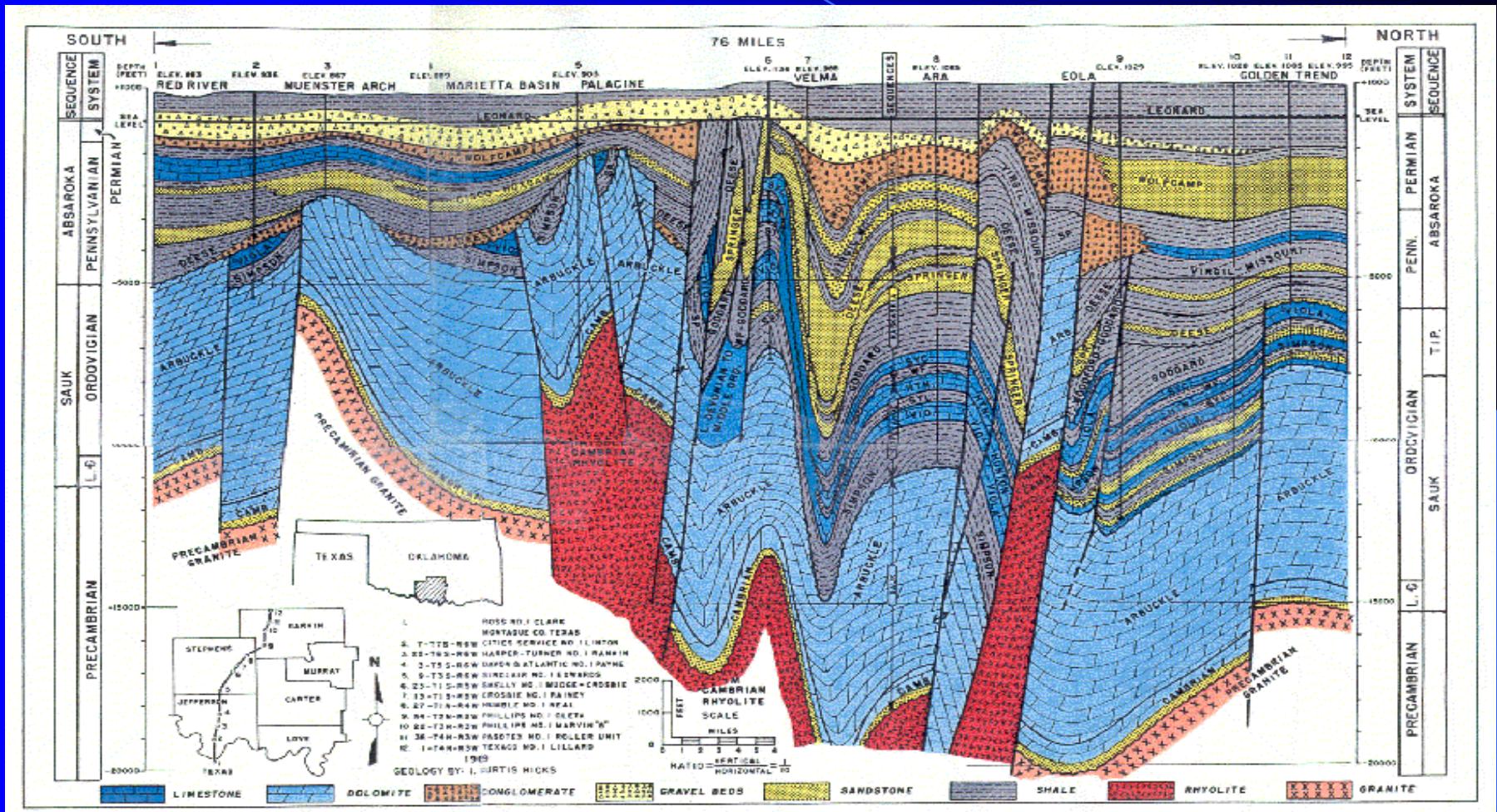
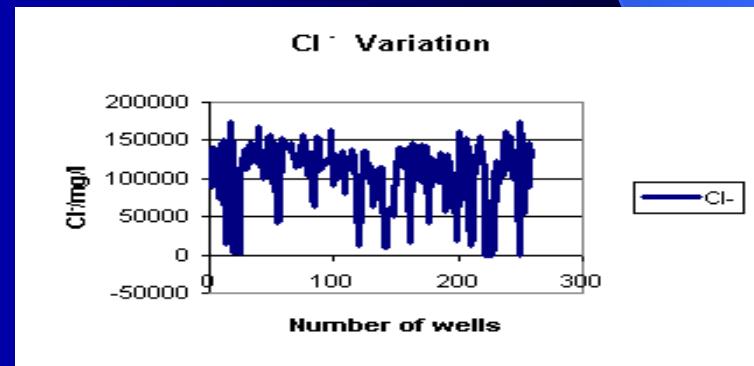
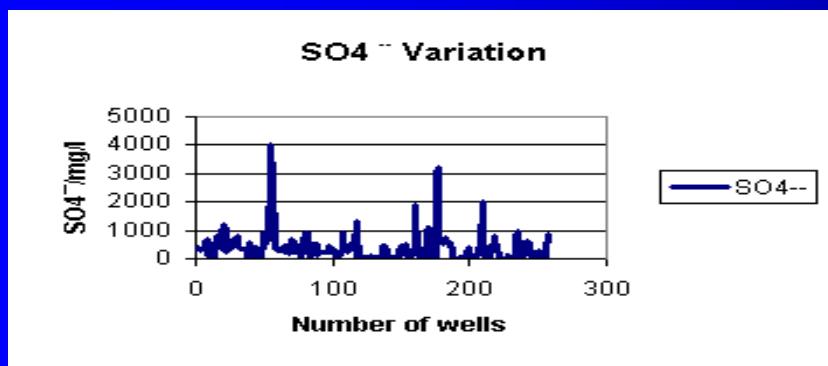
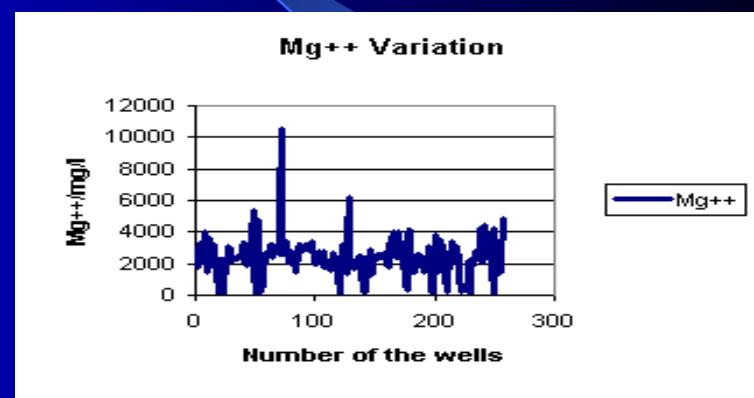
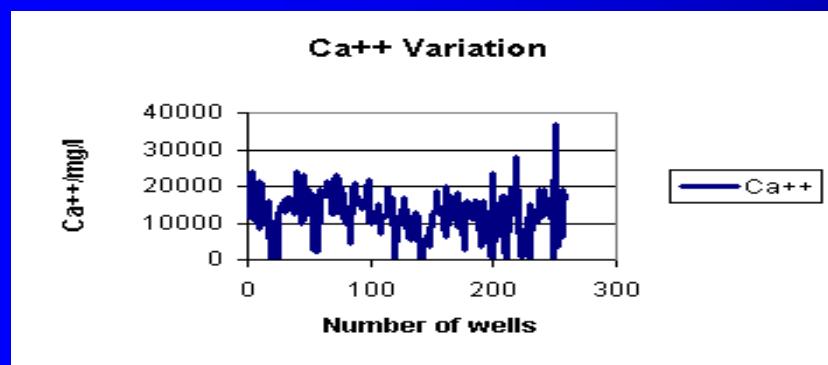
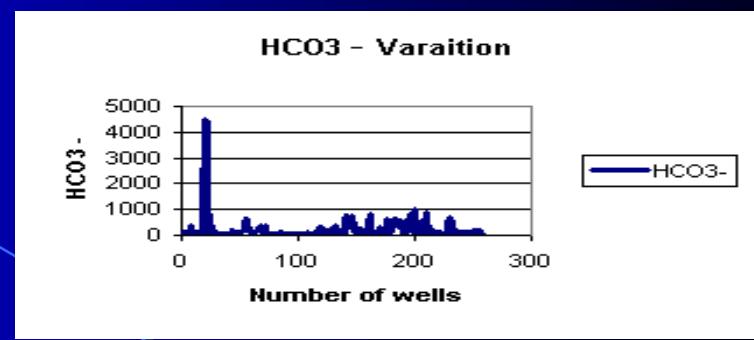
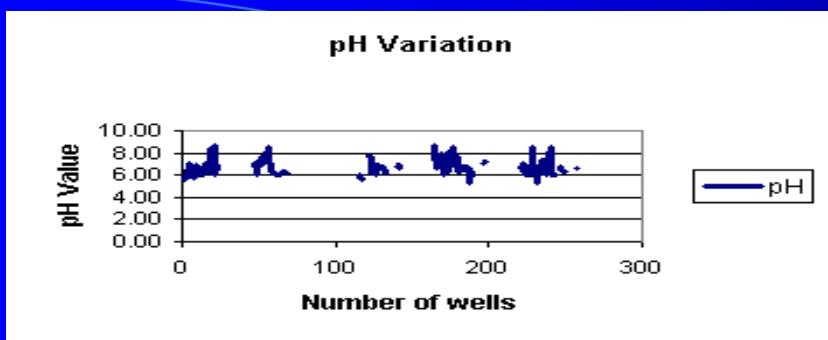
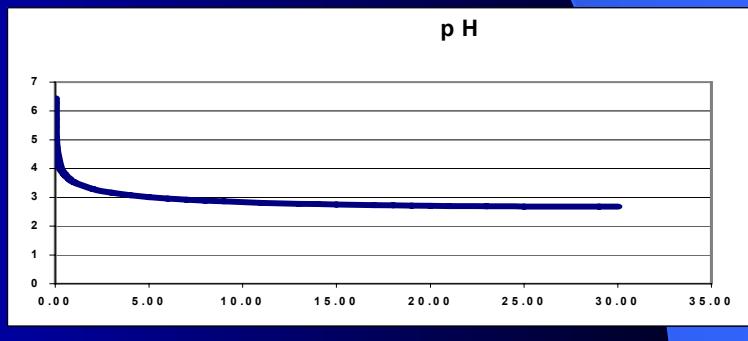
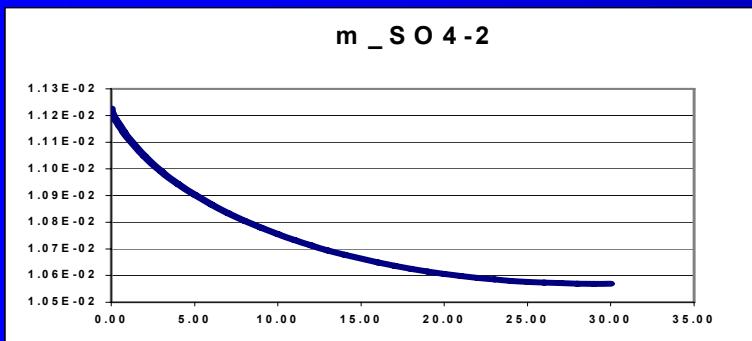
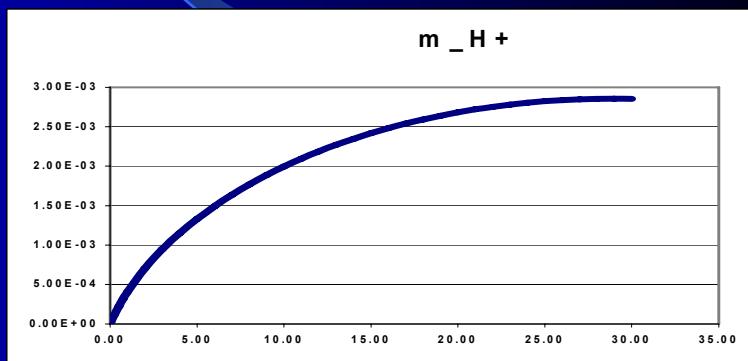
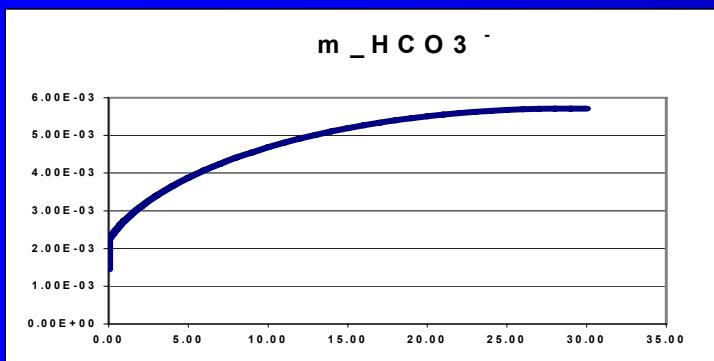
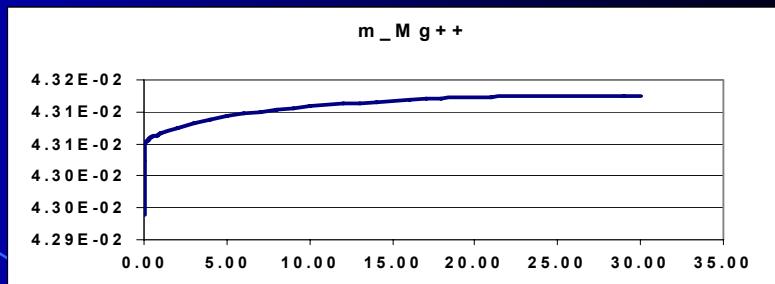
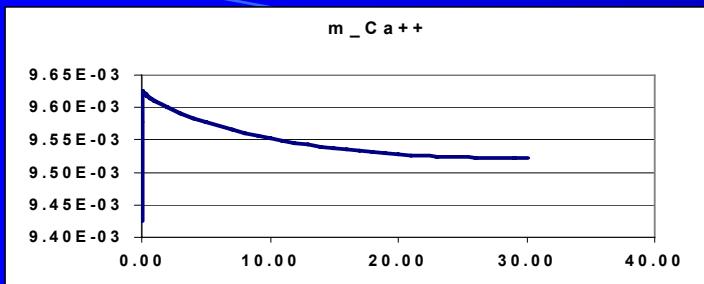


Plate 28  
**CROSS SECTION: SOUTHERN OKLAHOMA  
 FOLDED BELT**



Average Ion Concentration Before injection



**Ion Concentration Variations after CO<sub>2</sub> Injection**

# Field Cases:

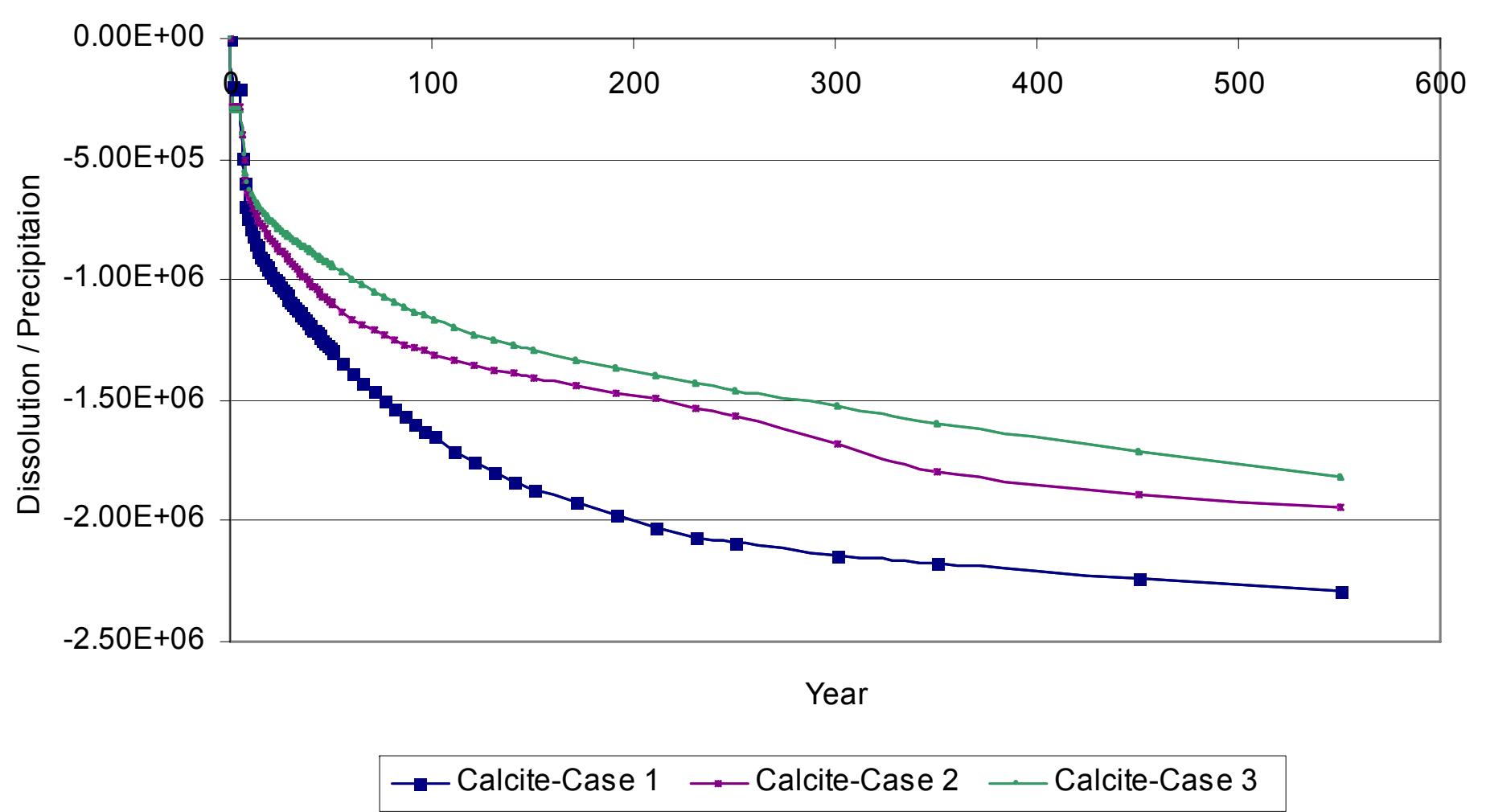
## Three Different Cases Examined

**Case 1: Oil Saturation =0, Water Saturation = 0.99**

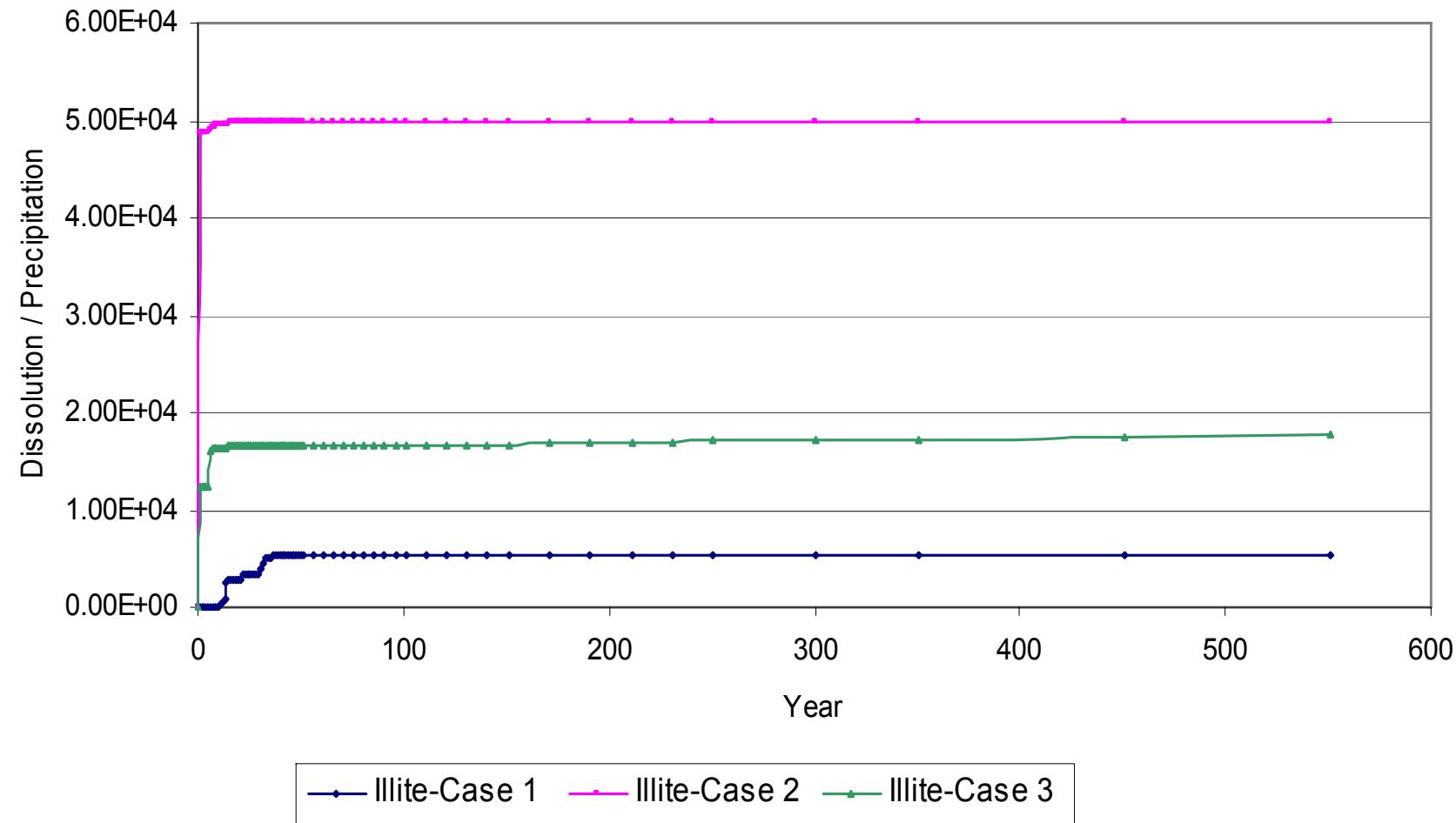
**Case 2: Oil Saturation=0.05, Water Saturation =0.95**

**Case 3: Oil Saturation =0.1, Water Saturation =0.90**

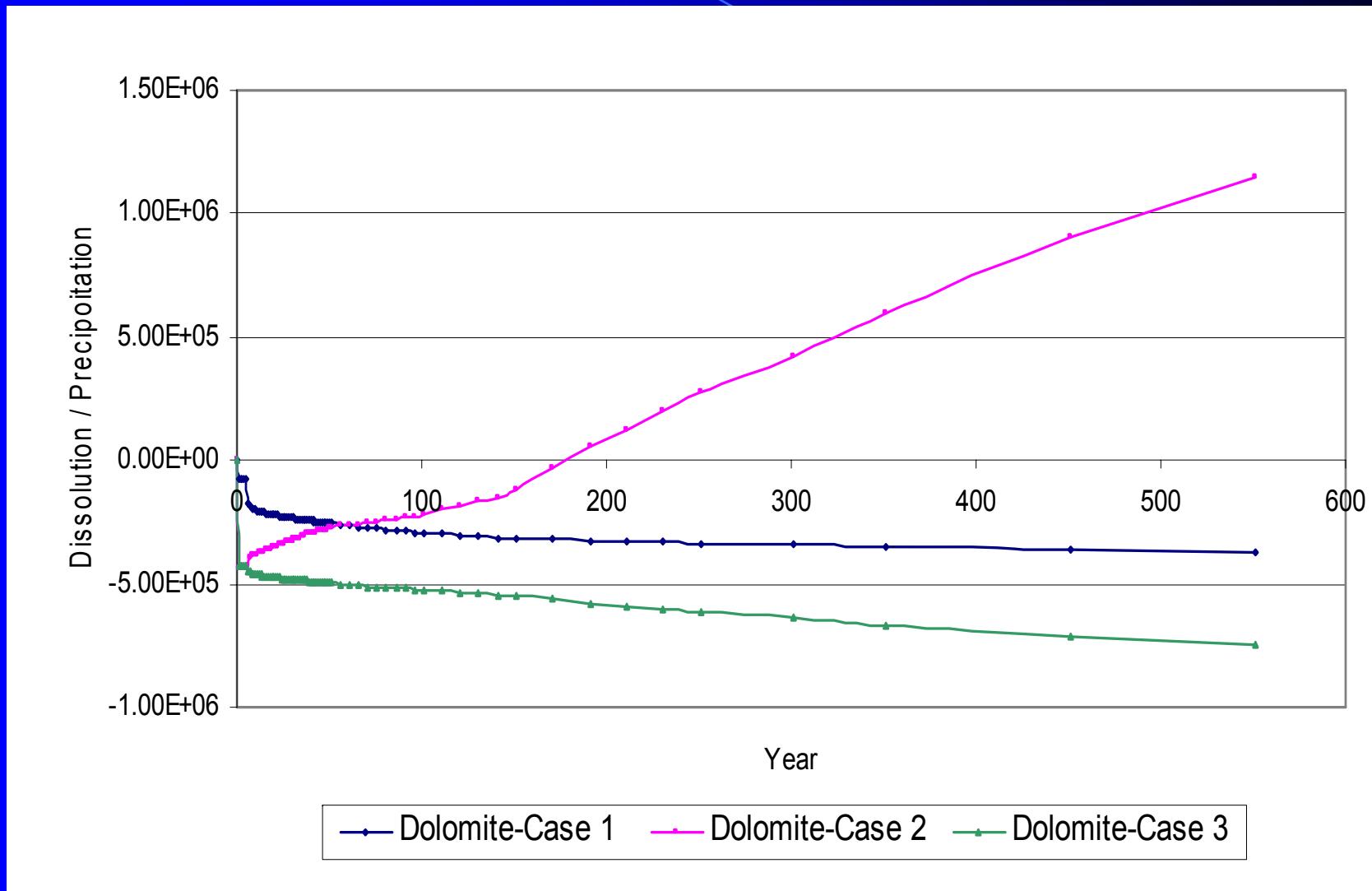
# Overall Calcite Dissolution/Precipitation in 500 Years



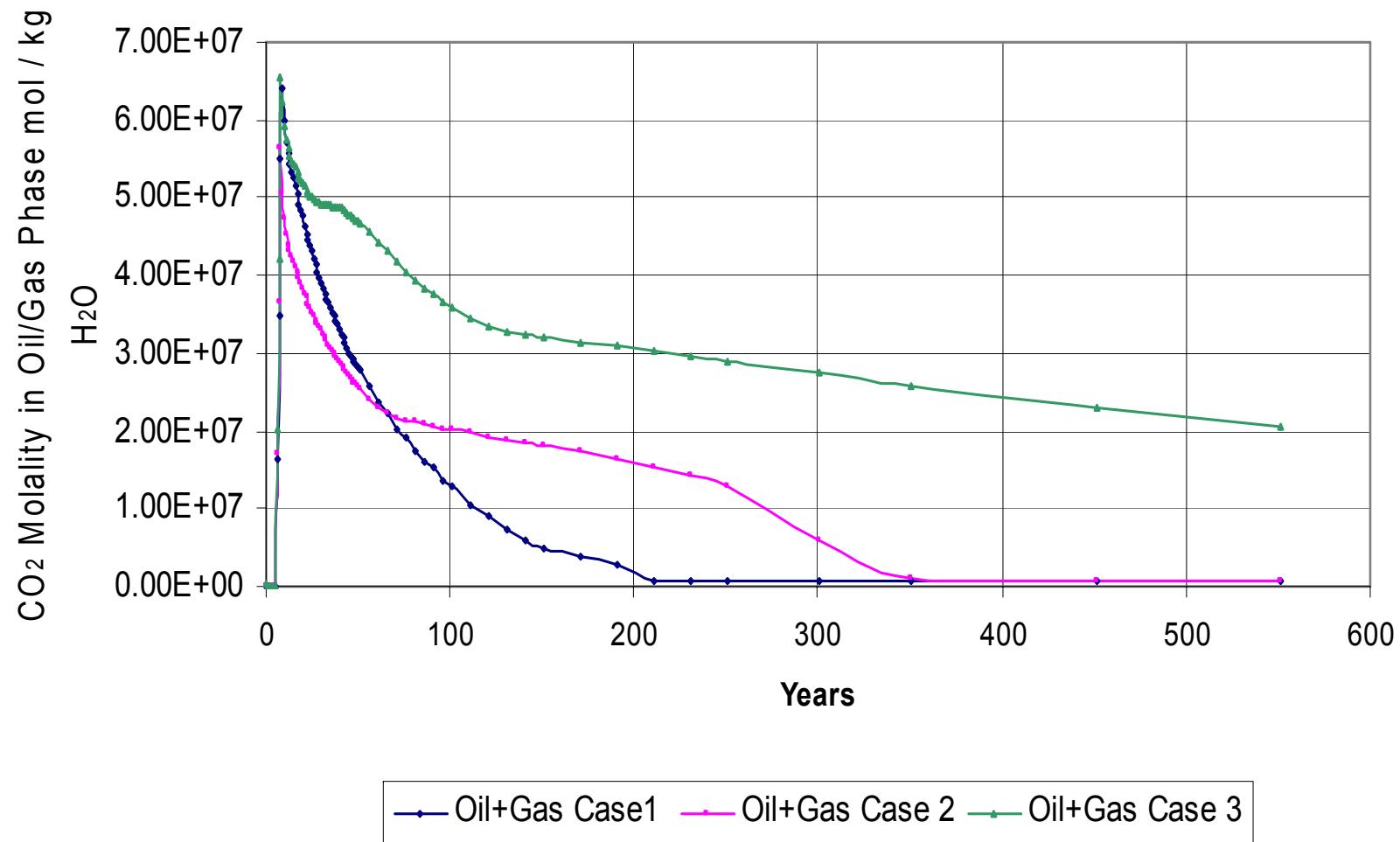
# Overall Illite Dissolution/Precipitation in 500 Years



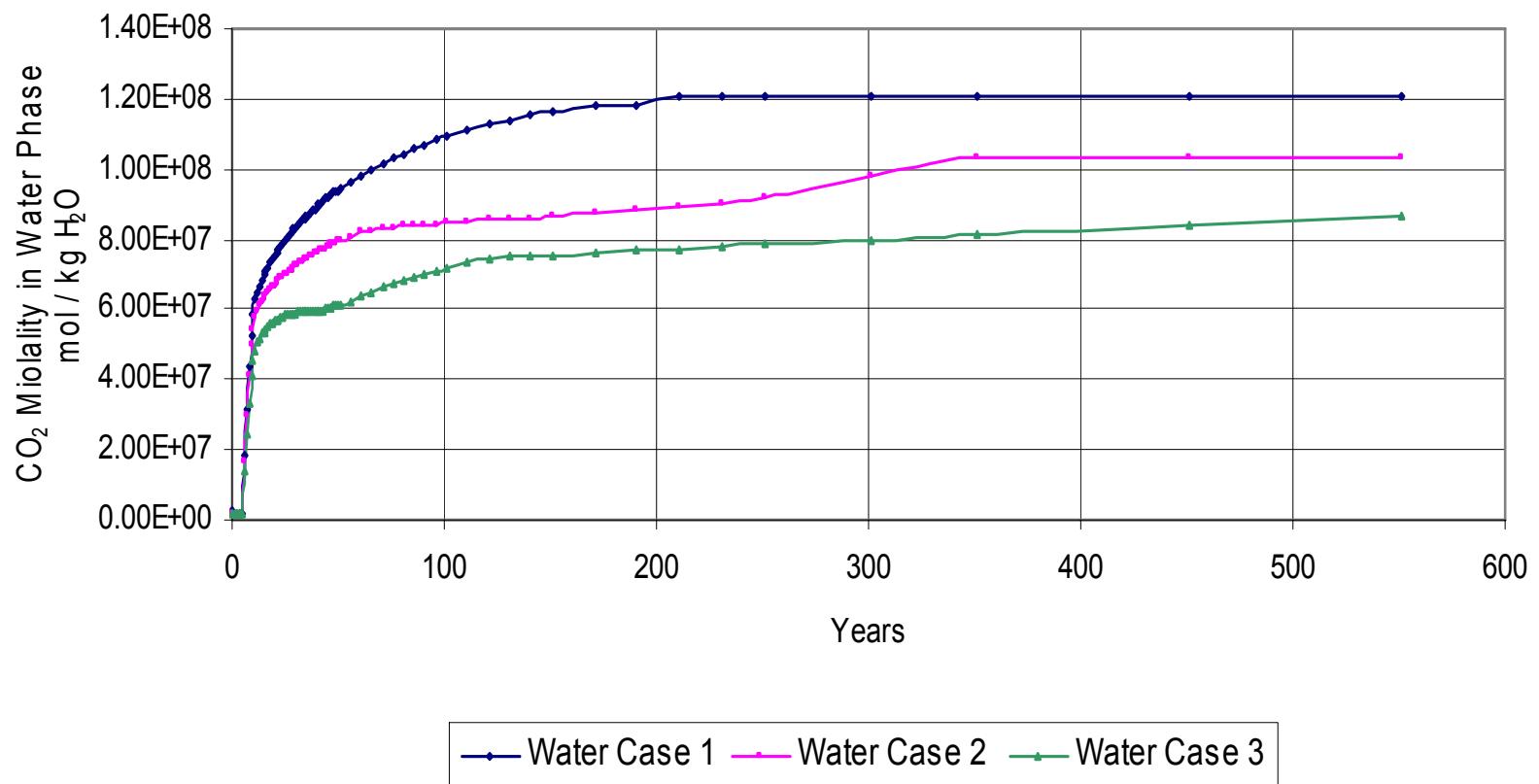
# Overall Dolomite Dissolution/Precipitation in 500 Years



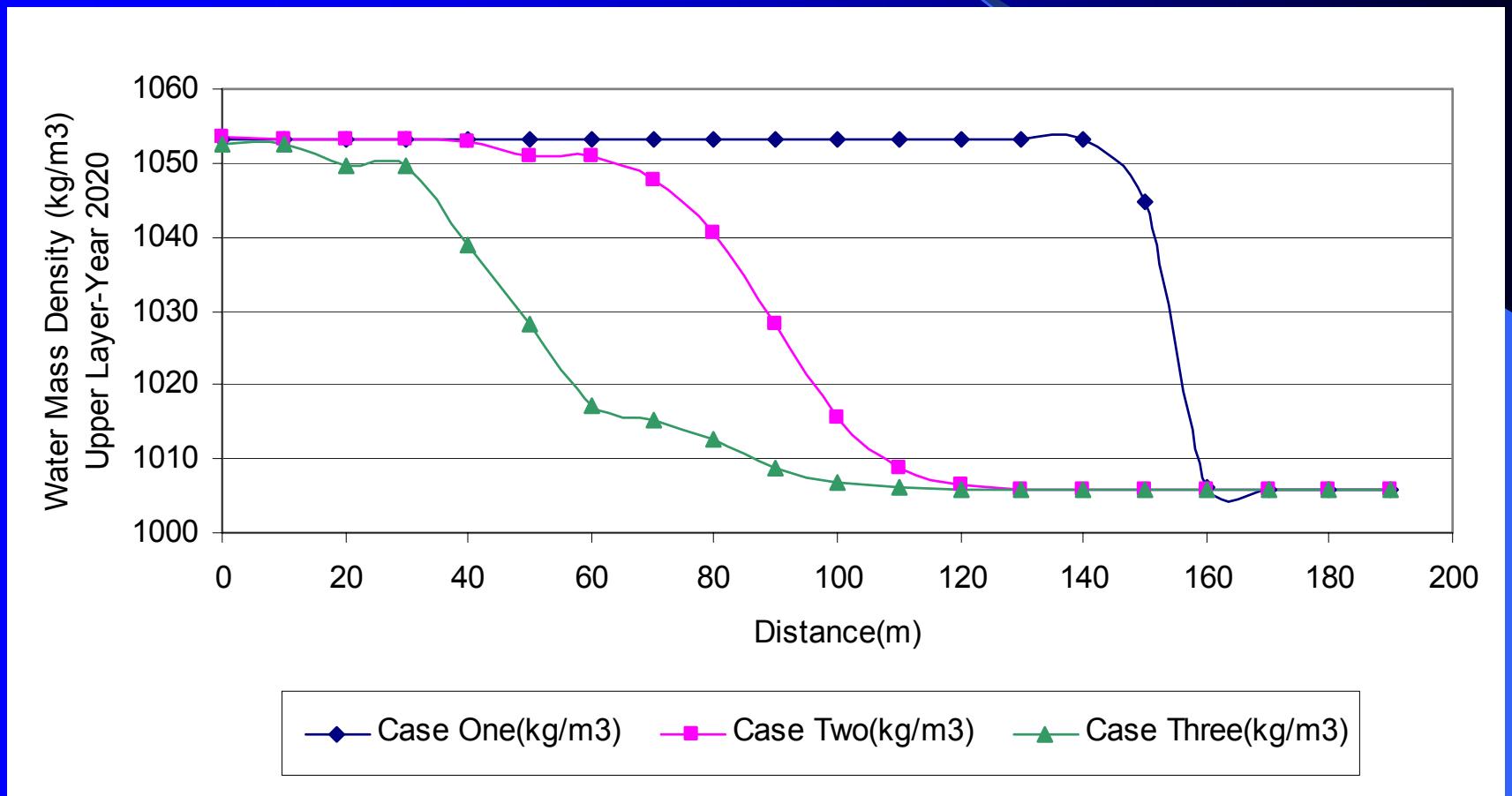
## Overall CO<sub>2</sub> Molality in Oil / Gas Phase- All Cases



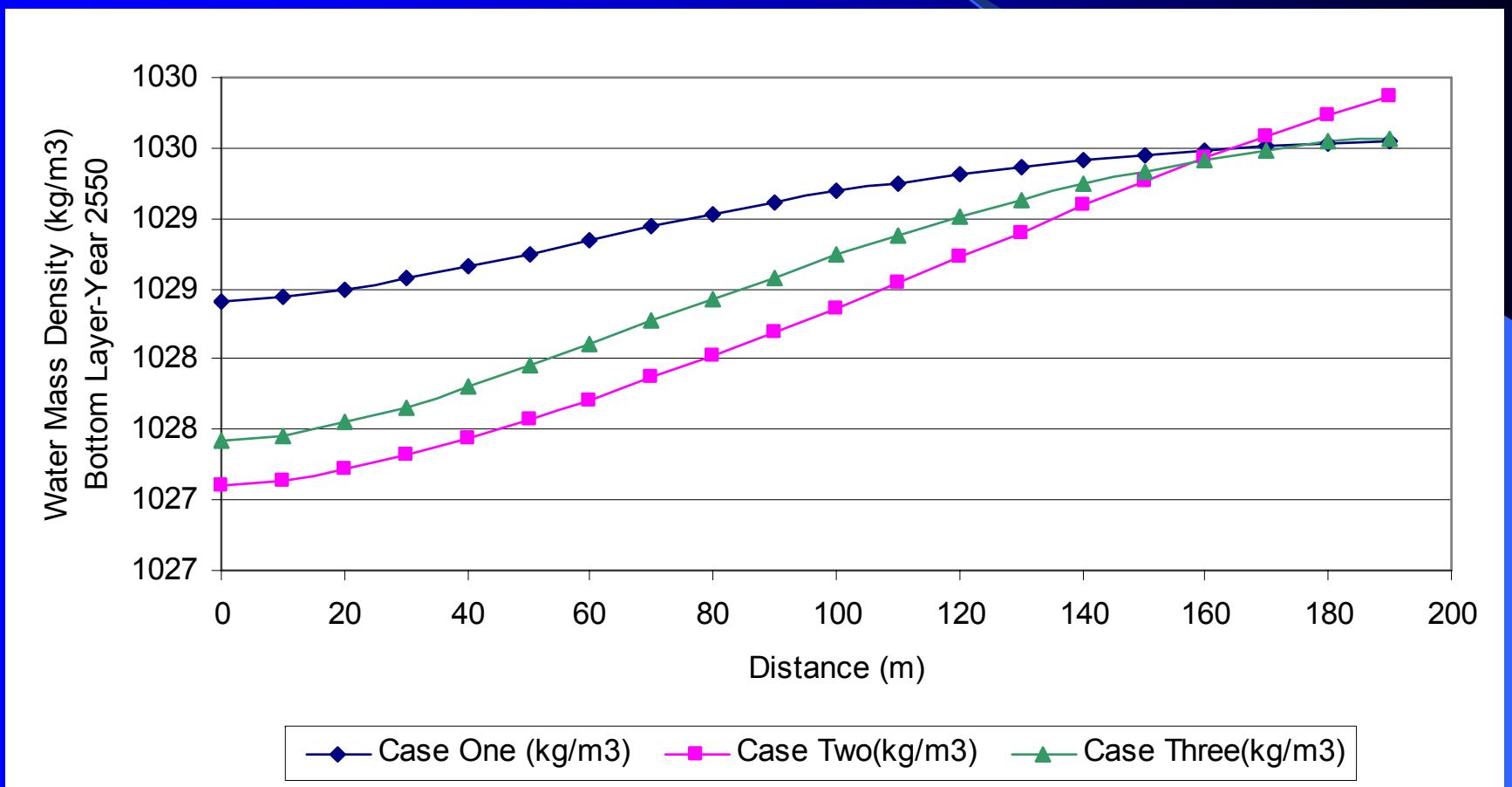
## Overall CO<sub>2</sub> Molality in Water Phase- All Cases



# Water Mass Density-Upper Layer



# Water Mass Density-Lower Layer



# Conclusions

- The effects of residual oil on reaction chemistry of the Arbuckle formation during sequestration has been examined
  - The reaction front is in the vicinity of the wellbore and moves toward the bottom of formation at later times
  - There is less mineral dissolution as residual oil saturation increases.
  - The presence of residual oil delays mineral dissolution and reduces the gas saturation in the vicinity of the wellbore.
  - Dolomite begins precipitating after 200 years when an oil saturation is introduced. The precipitation could not be correlated with oil saturation (too few cases)
  - The total amount of dolomite precipitated is less than the amount dissolved
  - Calcite dissolution is reduced as oil saturation increases, but never causes precipitation

# Acknowledgement

- We appreciate the Canadian Society of Petroleum Engineers for the permission to present the slides in the Sixth Annual Carbon Capture and Sequestration

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