



# **Subsurface Geology Maps and Cross-Sections**

## **Visualization - Evaluation**

**PE 4553 Class  
February 6, 2008**

# Sedimentary Rocks

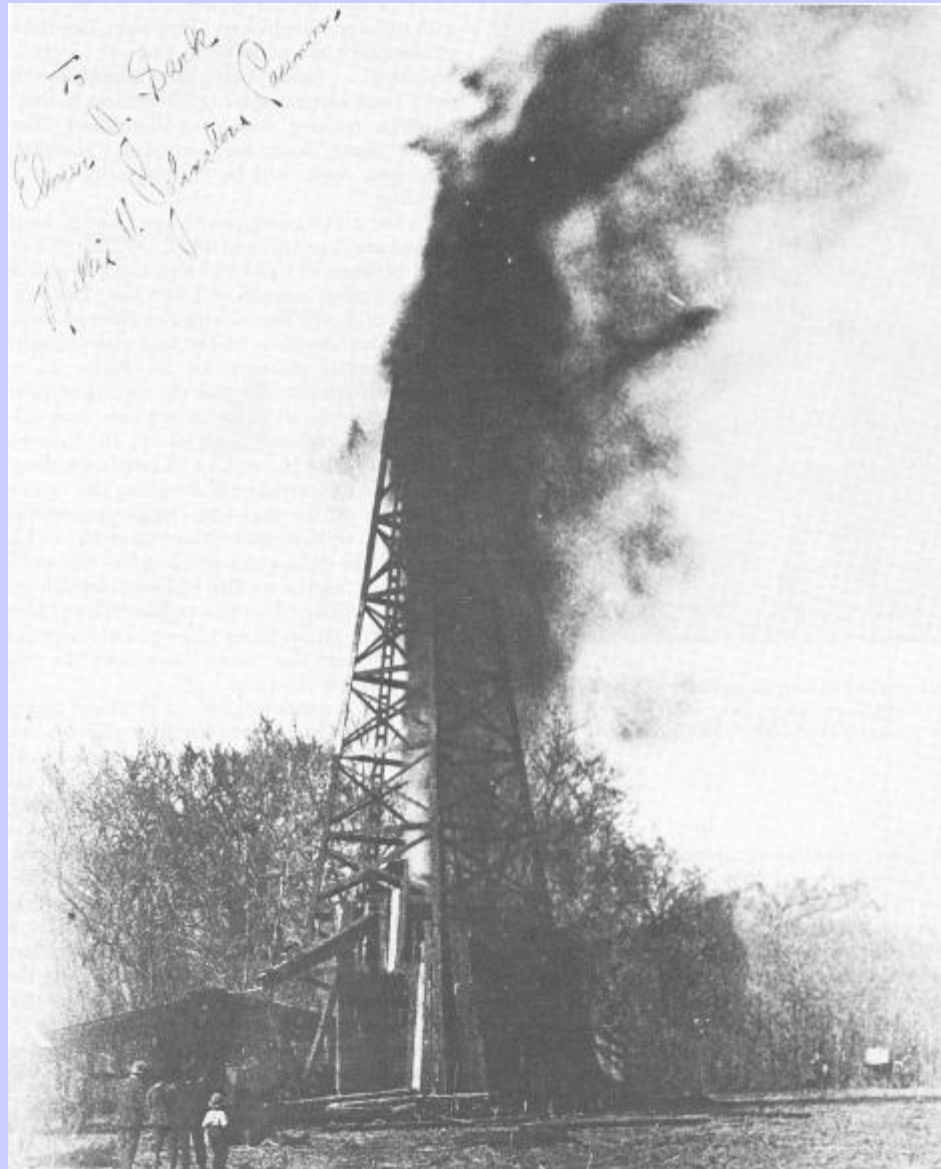
## 3-D Exposure







**Oil seep in Stanley Fm. (U.Miss) 20 miles south of McAlester. Photo by Jock Campbell.**



The Nellie Johnstone #1, drilled in 1897 just south of Bartlesville, established the first economic production in the State.  
Photograph taken from Franks, 1980.

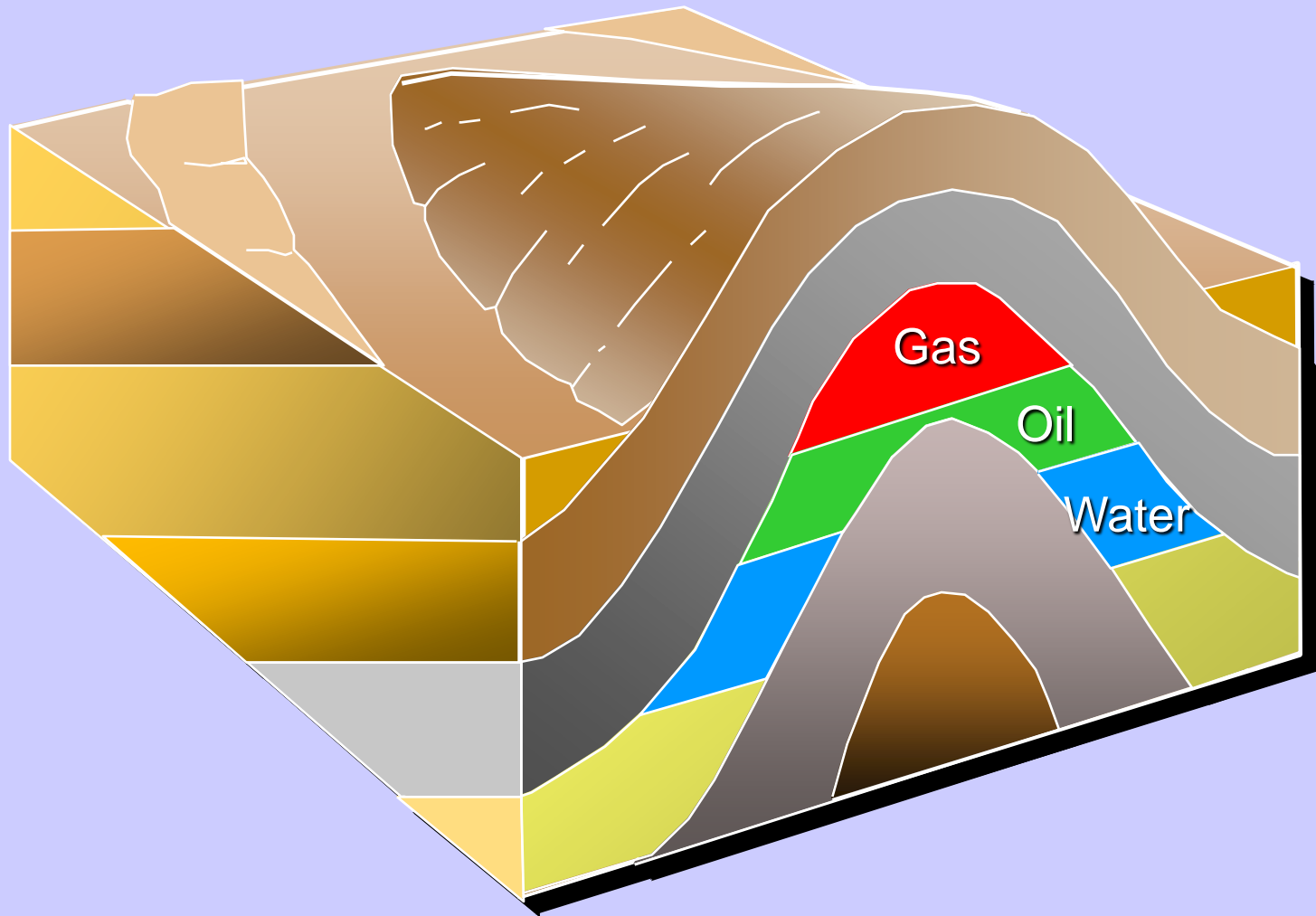


# Surface Anticline



# Anticlinal Theory

Petroleum Accumulates in Structural Closure



# Signal Hill Oil Field

Discovered 1921



**A view of Signal Hill, just north of Long Beach, California, in 1930. The "forest" of oil derricks were drilled in the 1920's.  
*photo courtesy of the Los Angeles Public Library***

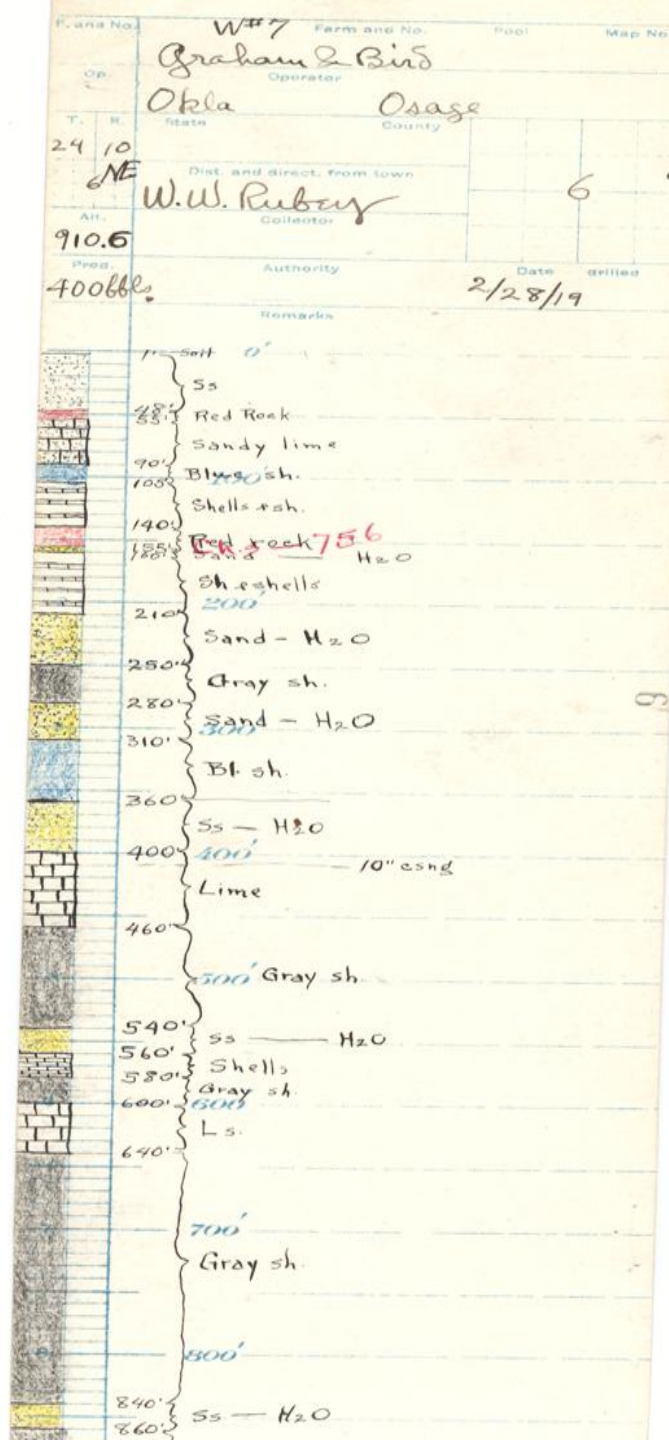
From the Paleontological Research Institute <<http://www.priweb.org/ed/pgws/history/pennsylvania/pennsylvania.html>>



A platform on which there are several  
cable tool bits







# Example Strip Log

Graham & Bird #7 Rubey  
 Sec 6 24N-10E

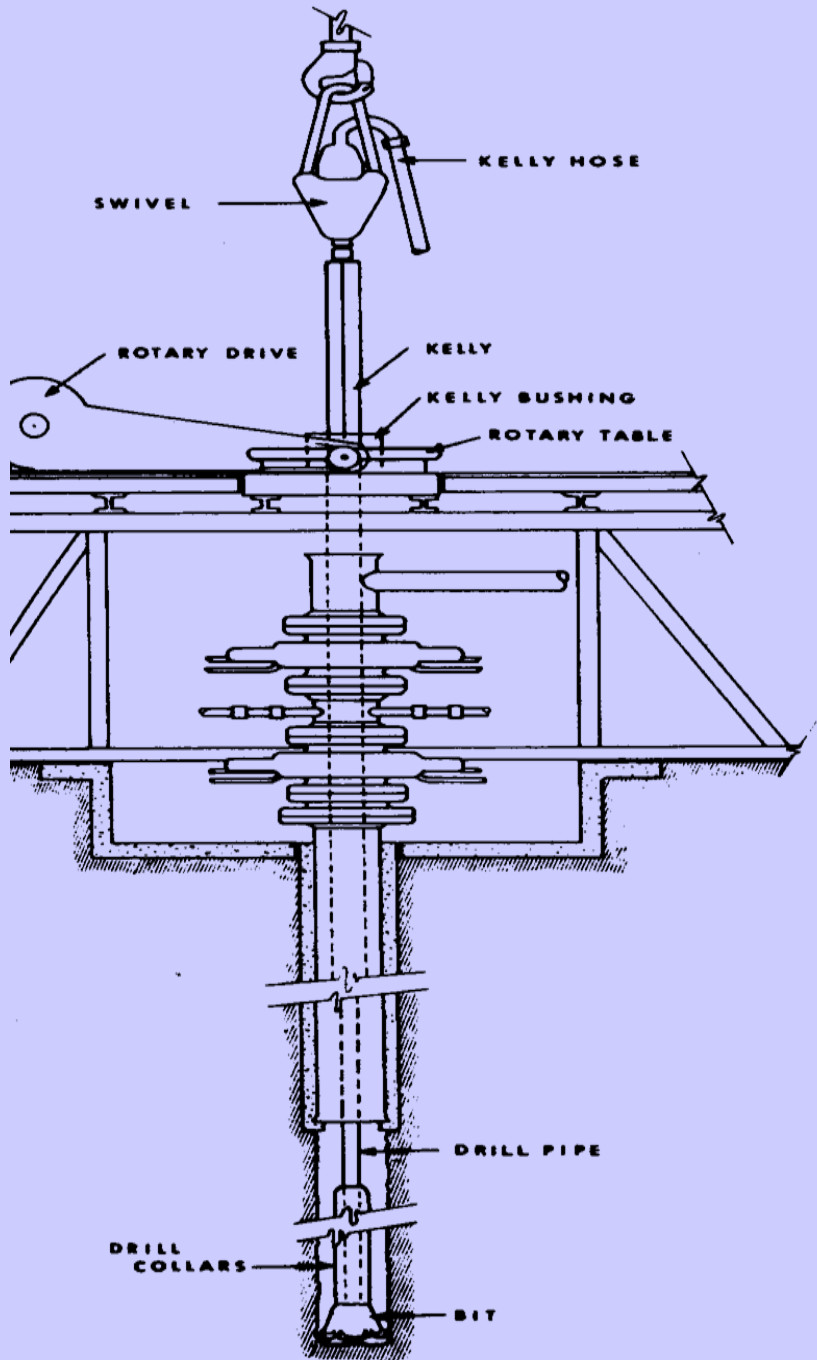
Pershing Field  
 Osage County, Oklahoma

Bartlesville Producer (2,100')



7853. A Gusher in the  
Glenn Pool Oil Field,  
Tulsa, Okla.

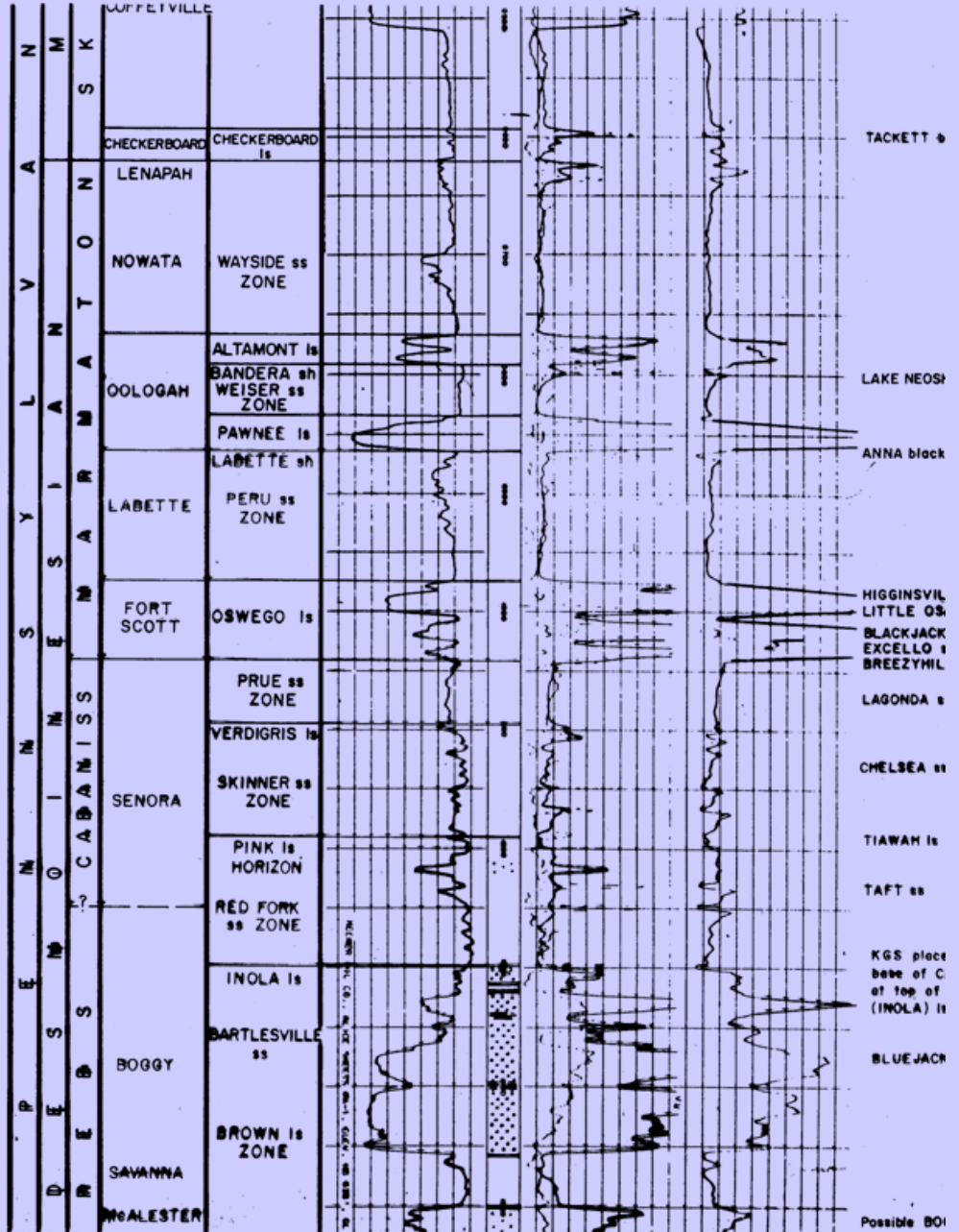
**Glenn Pool Oil Field:  
#1 Ida E. Glenn Discovery – November 1905  
Sec 10-17N-12E  
Tulsa County, Oklahoma**

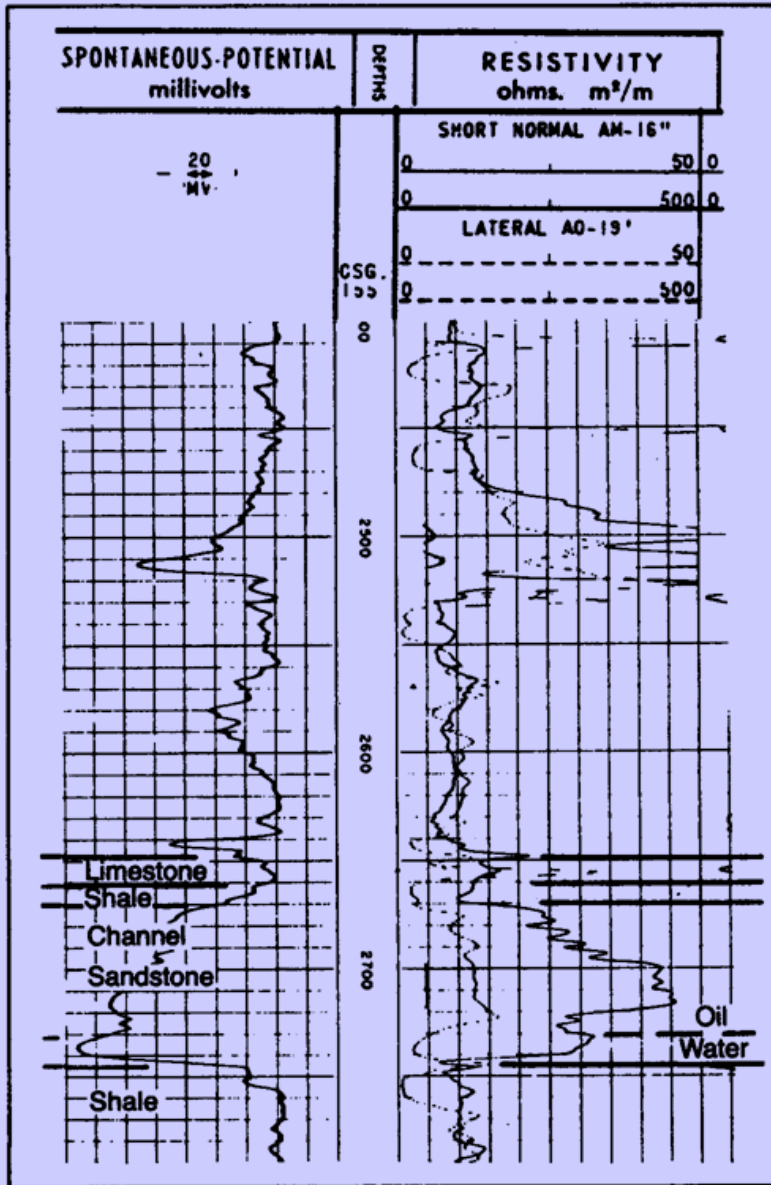


**Rotary Drilling  
Rig Schematic**



# Annotated 1950s Vintage Electric Log



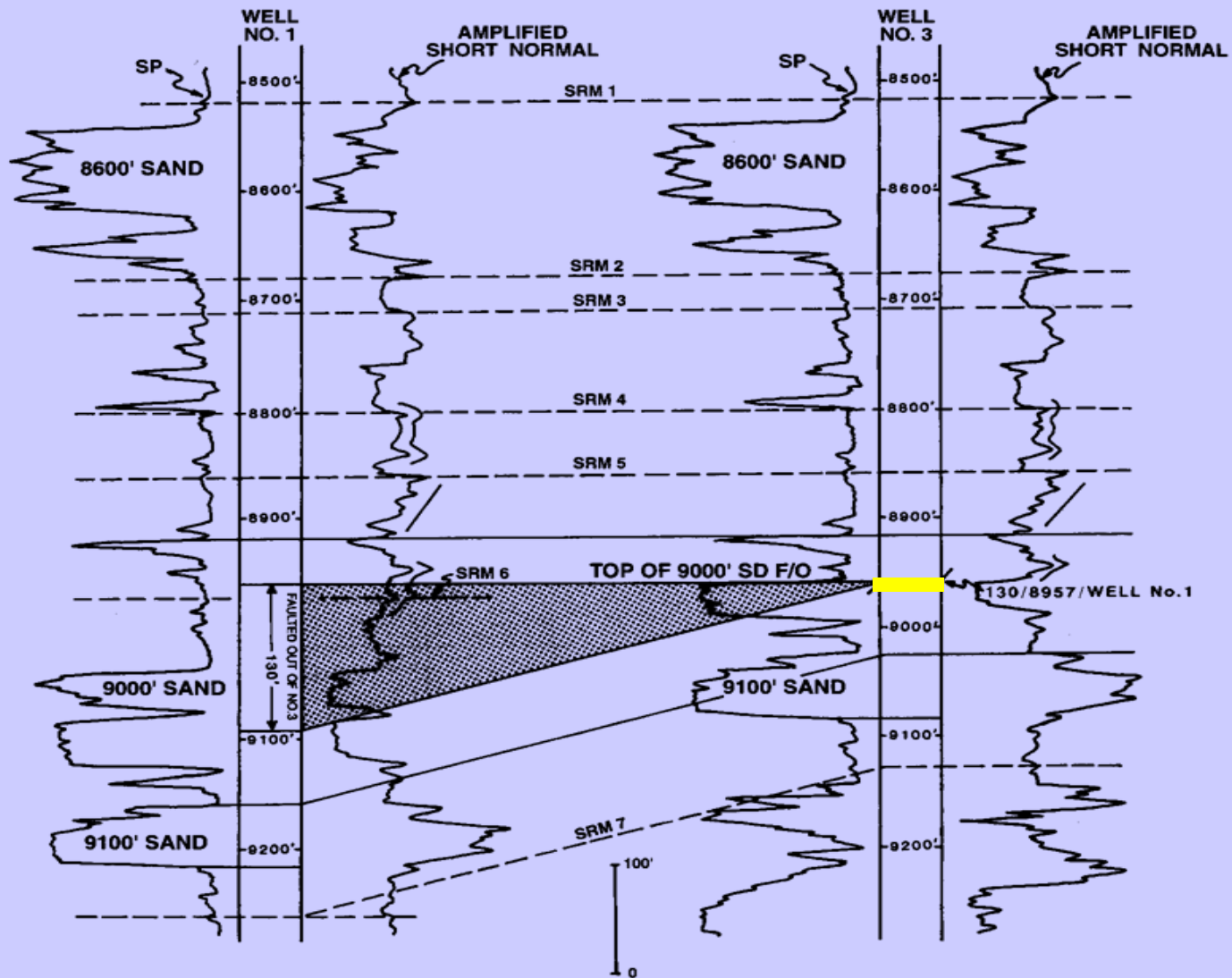


## Reservoir Interpretation:

- Environment of Deposition
- Fluid Contacts (and saturations)

Fig. 103. Electric log response of channel sandstone

# Direct Fault Identification



**Figure 4-10** Detailed correlation of the two vertical wells shown in Fig. 4-9 using all recognizable correlation markers to determine the depth and missing section for a fault in Well No. 3. Notice that the top of the 9000-ft Sand and SRM 6 are faulted out of Well No. 3.



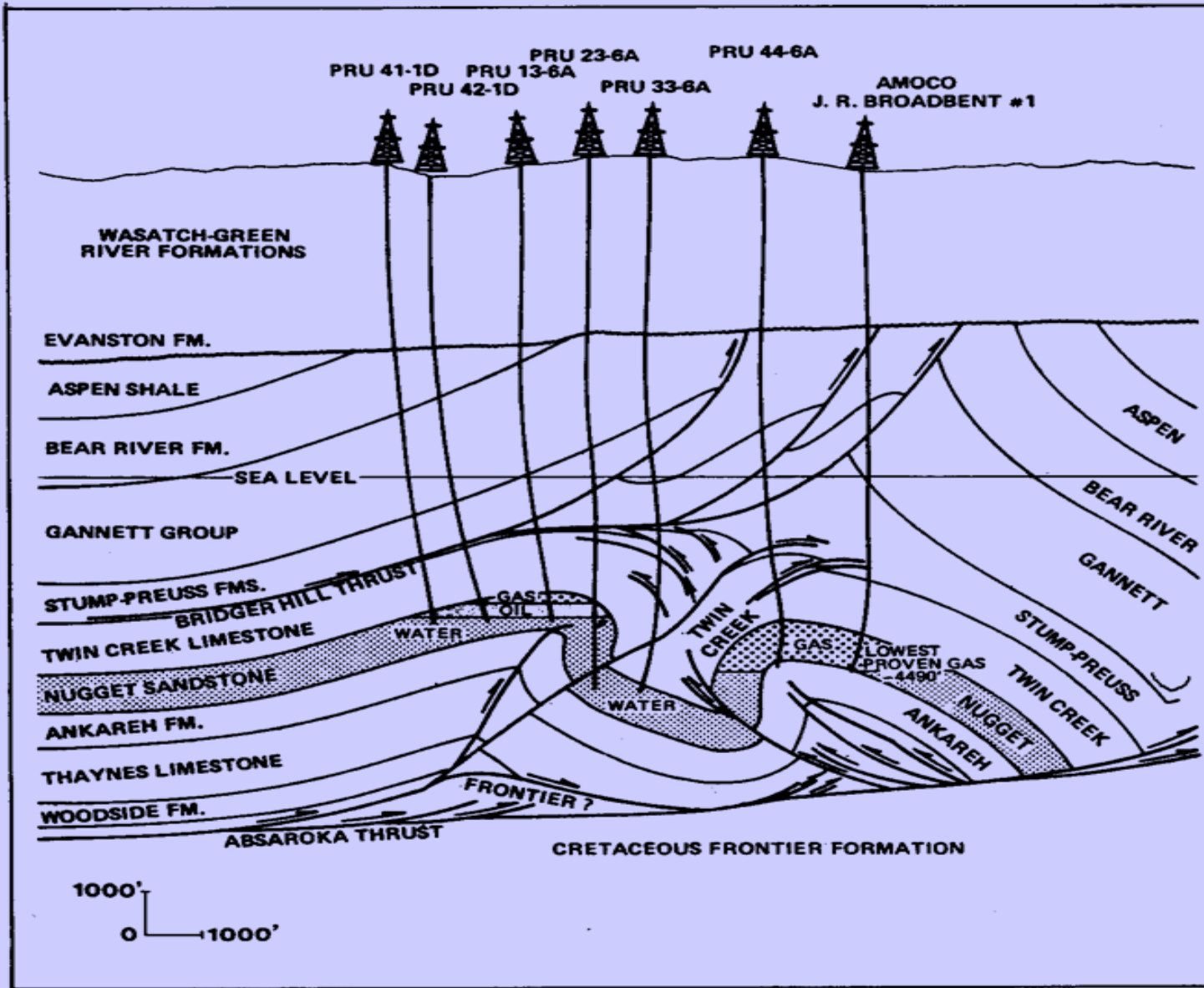


Fig. 219. Structure section, Painter Reservoir, Wyoming. Permission to publish by Chevron.

## Structural Traps in a Complex Compressional Terrain

# Regional Unconformity

NORTH

SOUTH

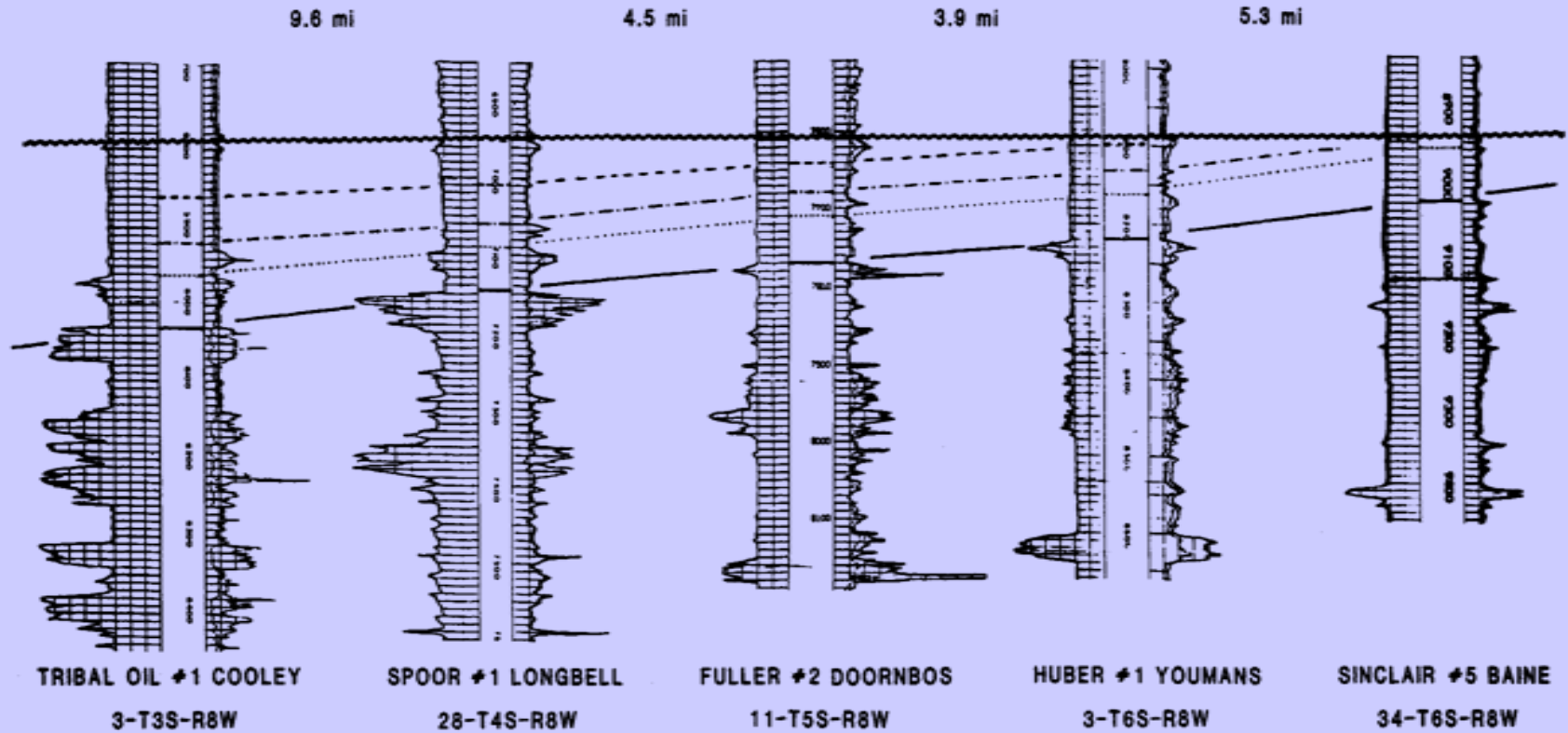
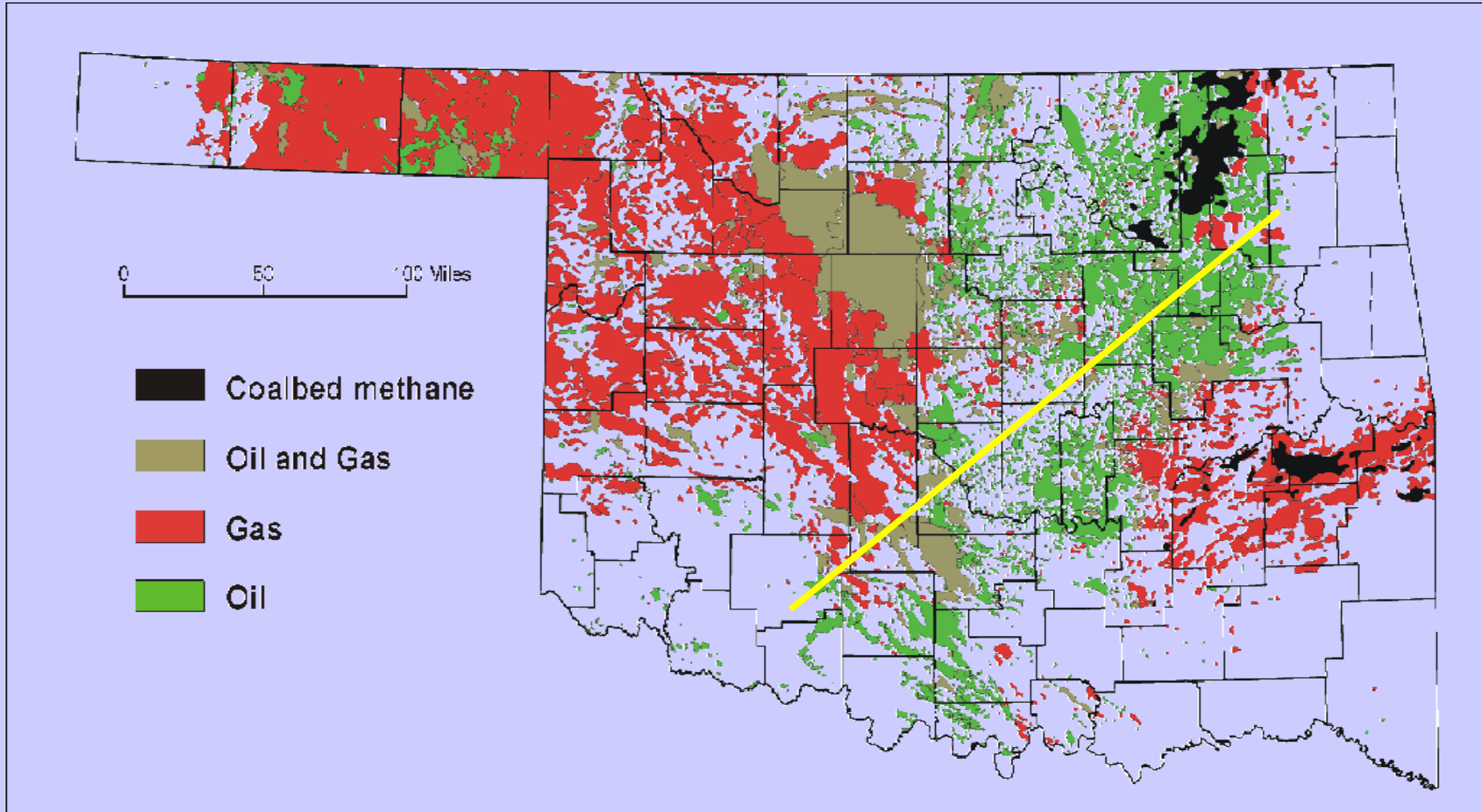


Figure 8-42 Example of an angular unconformity recognized by electric log correlation. (From Lock and Voorhies 1988. Published by permission of the Gulf Coast Association of Geological Societies.)

# Regional Interpretation

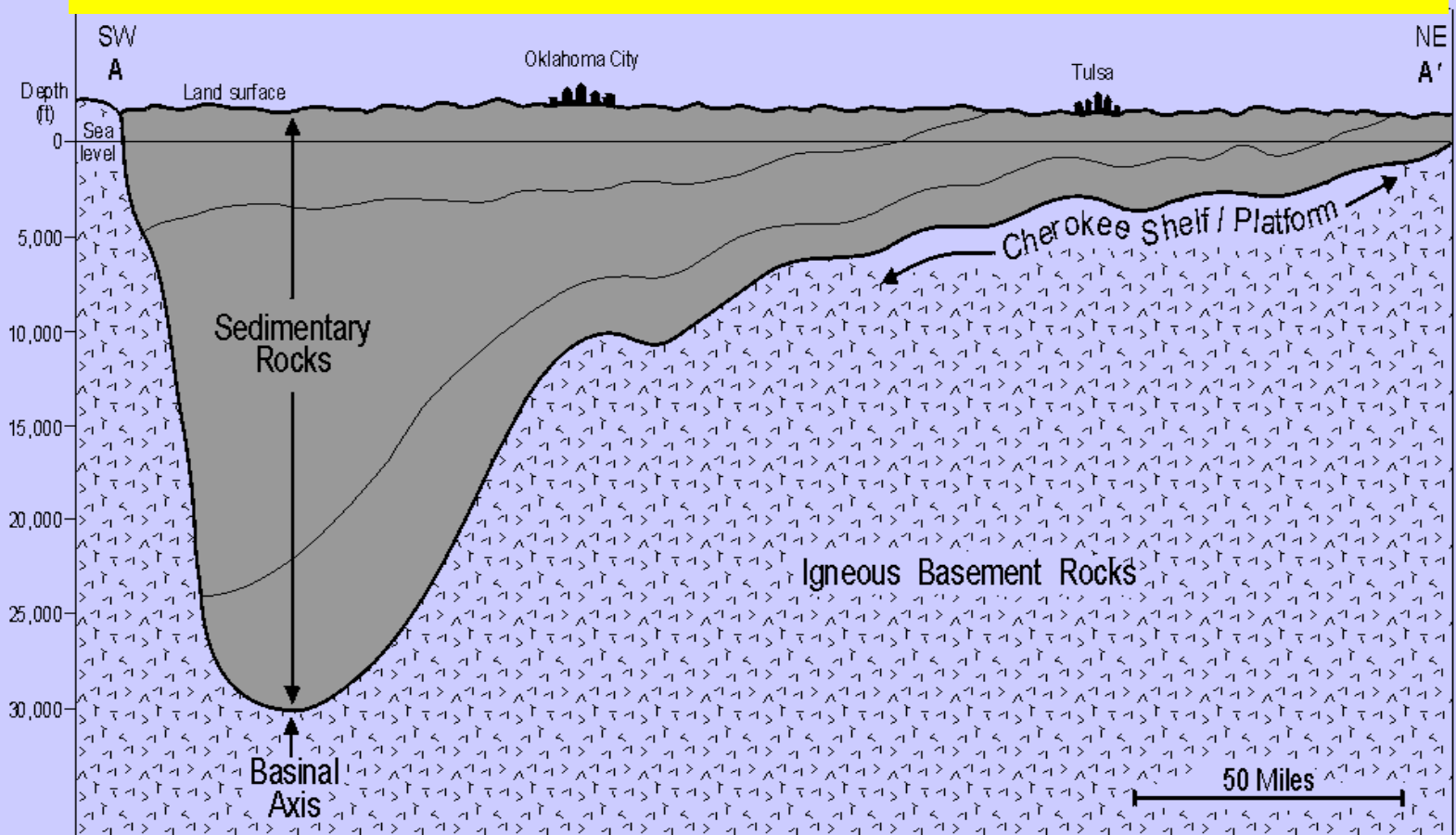


Map of Oklahoma Oil and Gas Fields; Distinguished By GOR and Coalbed Methane Production. From Boyd (2002)  
(GOR Cutoffs: Oil <5,000; Oil and Gas 5,000-20,000; Gas > 20,000)



# Schematic Structural Cross-section of the Anadarko Basin

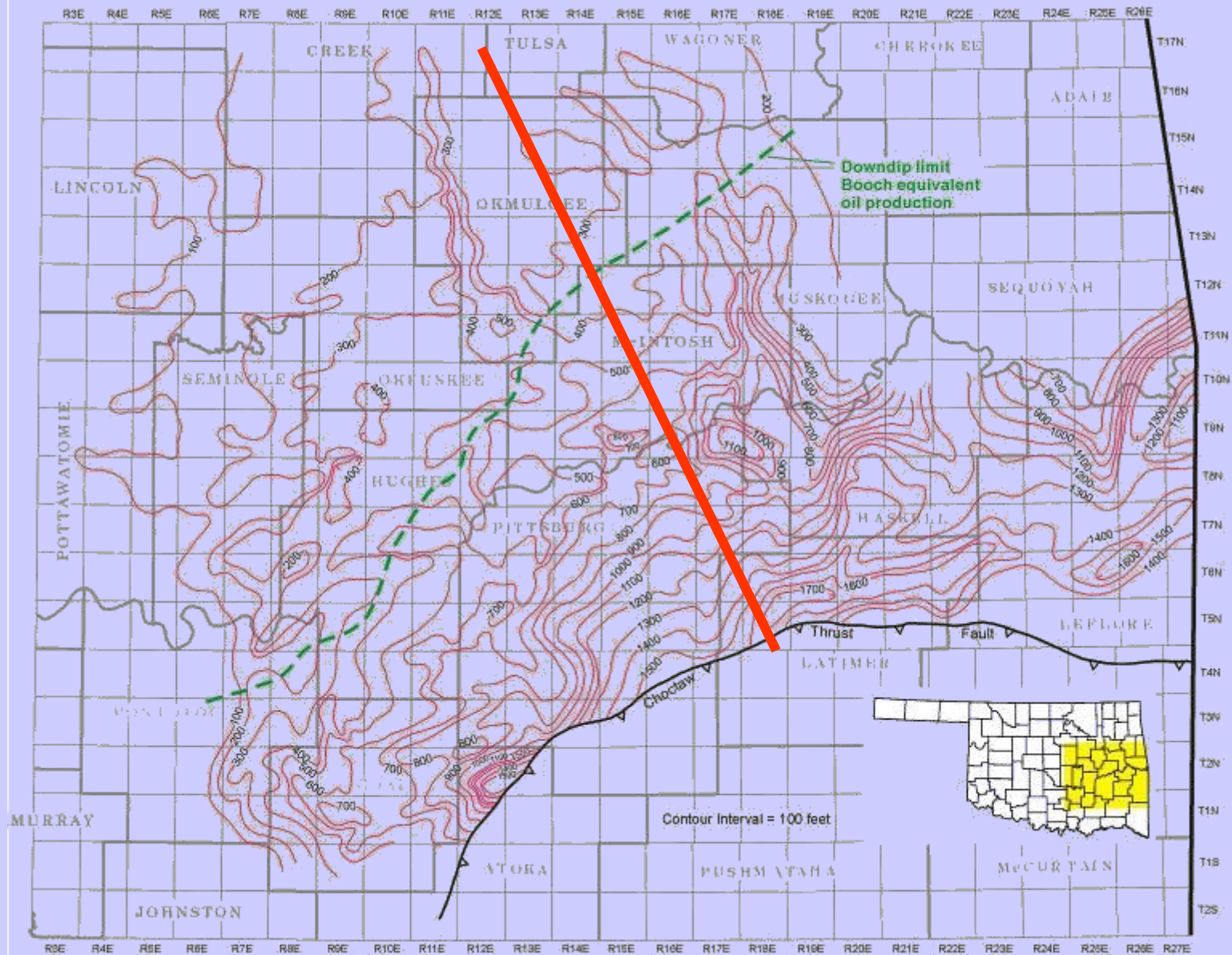
Modified from Witt and others (1971).



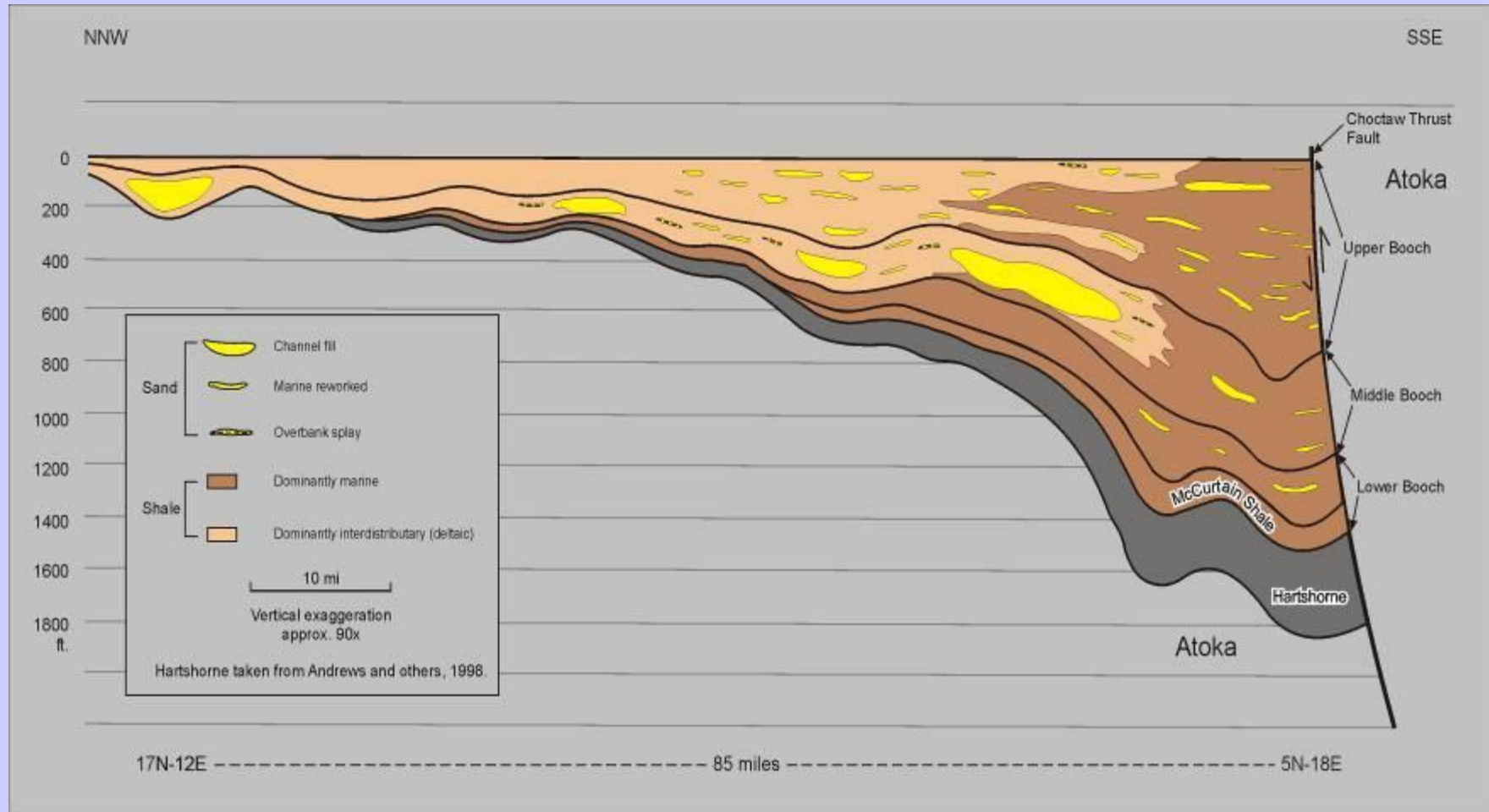
## Regional Structural Interpretation

# Basin – Scale Interpretation

## Booch Gross Interval Isopach



# Regional Stratigraphic Cross-Section (Hung from Top of Booch) Oklahoma Arkoma Basin (Booch)



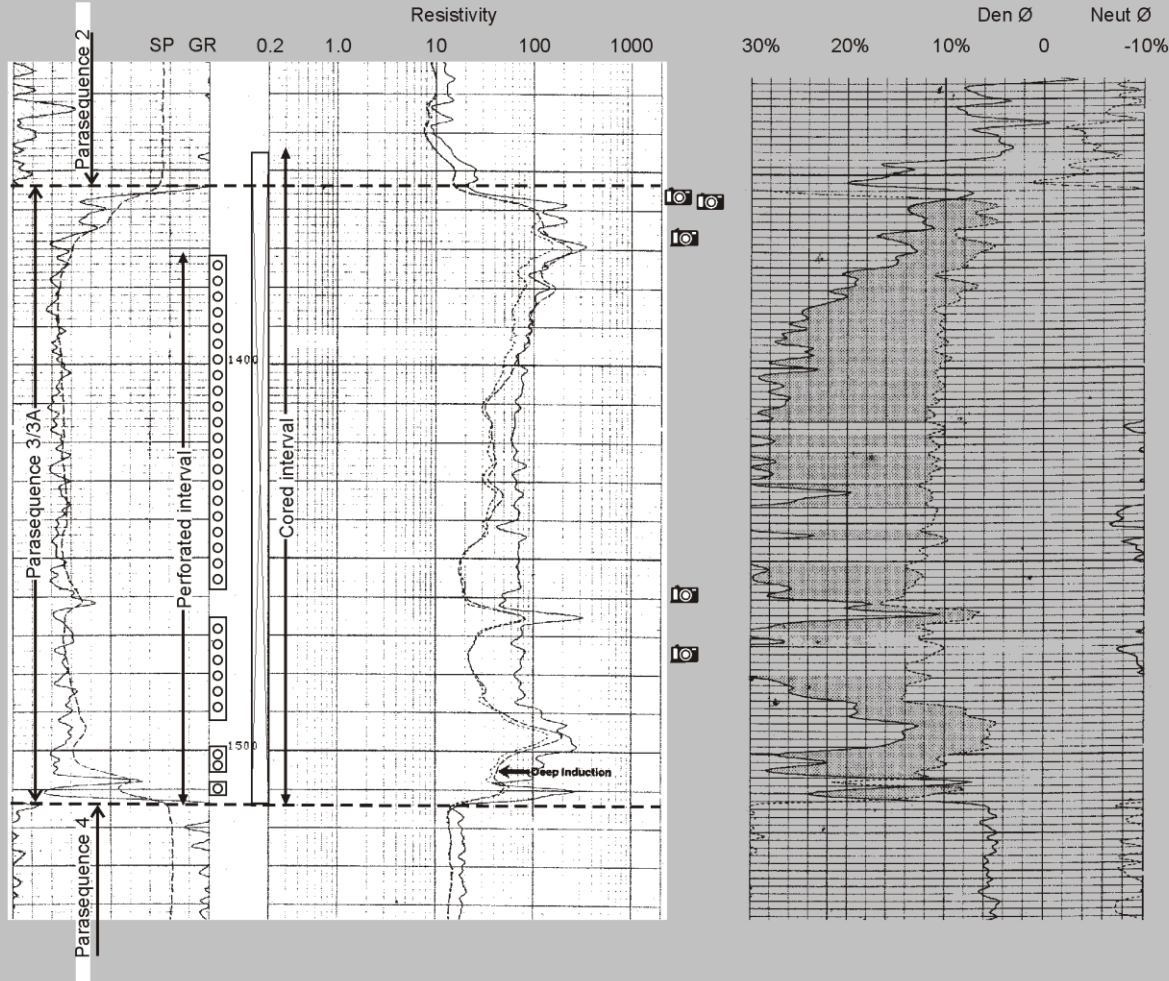
**(Present burial depth not maximum burial depth)**



# Well Log of Incised Valley-Fill Sandstone Oklahoma's Broken Field (Booch)

APPENDIX 4  
Mason A-1  
TD 1609'  
Comp. Date 4/82

Photos- [ ]



## Interpreting Environment Of Deposition

**Outcrop of Incised Valley Fill  
Hartshorne Sandstone**



**Modern Analog  
Mahakam Delta Plain  
East Kalimantan, Indonesia**

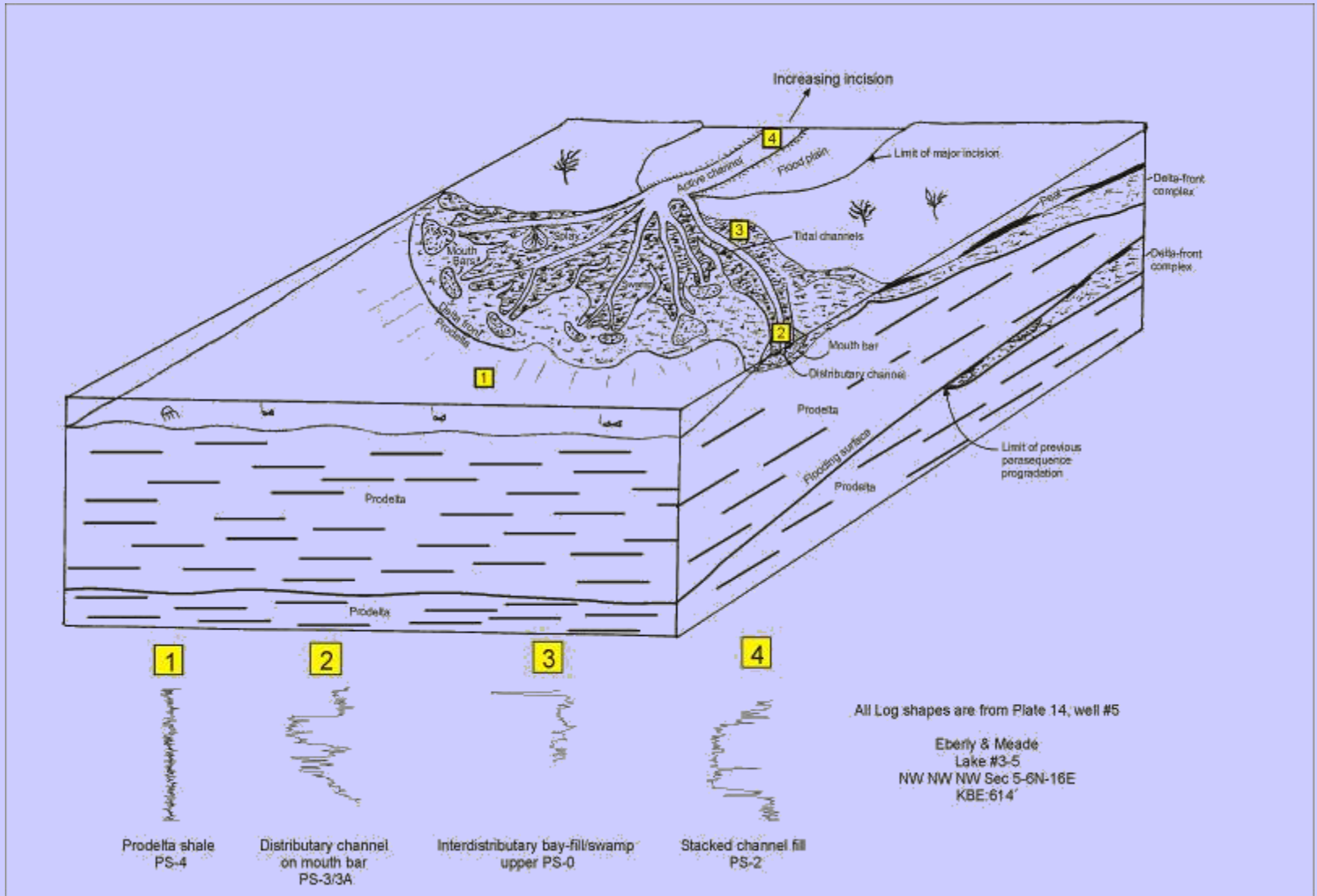




# Integrating Subsurface with Modern Analog

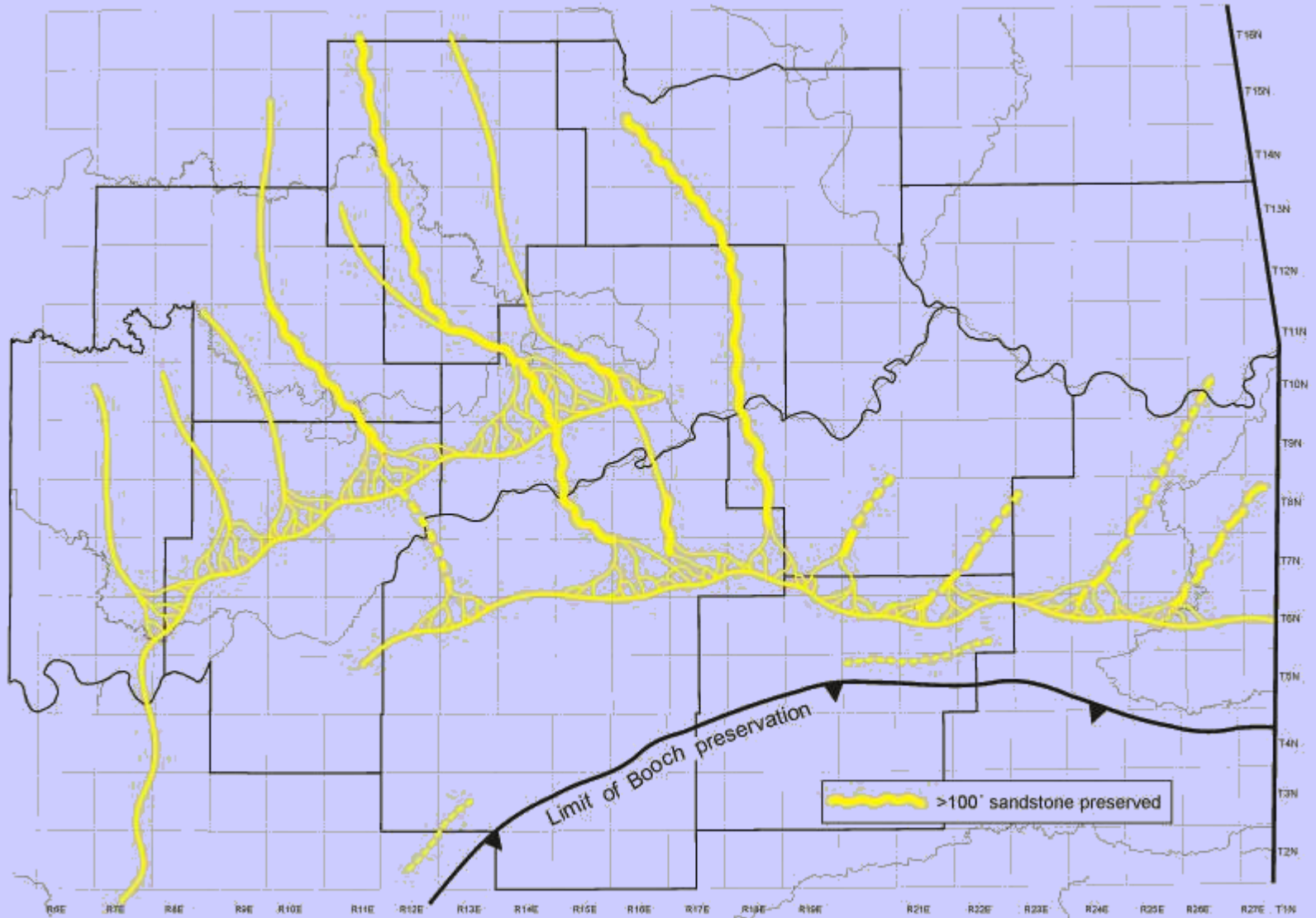
## Idealized Tidal Delta

### Oklahoma (Booch)





# Inferred Middle Booch Depositional Environments Arkoma Basin in Oklahoma

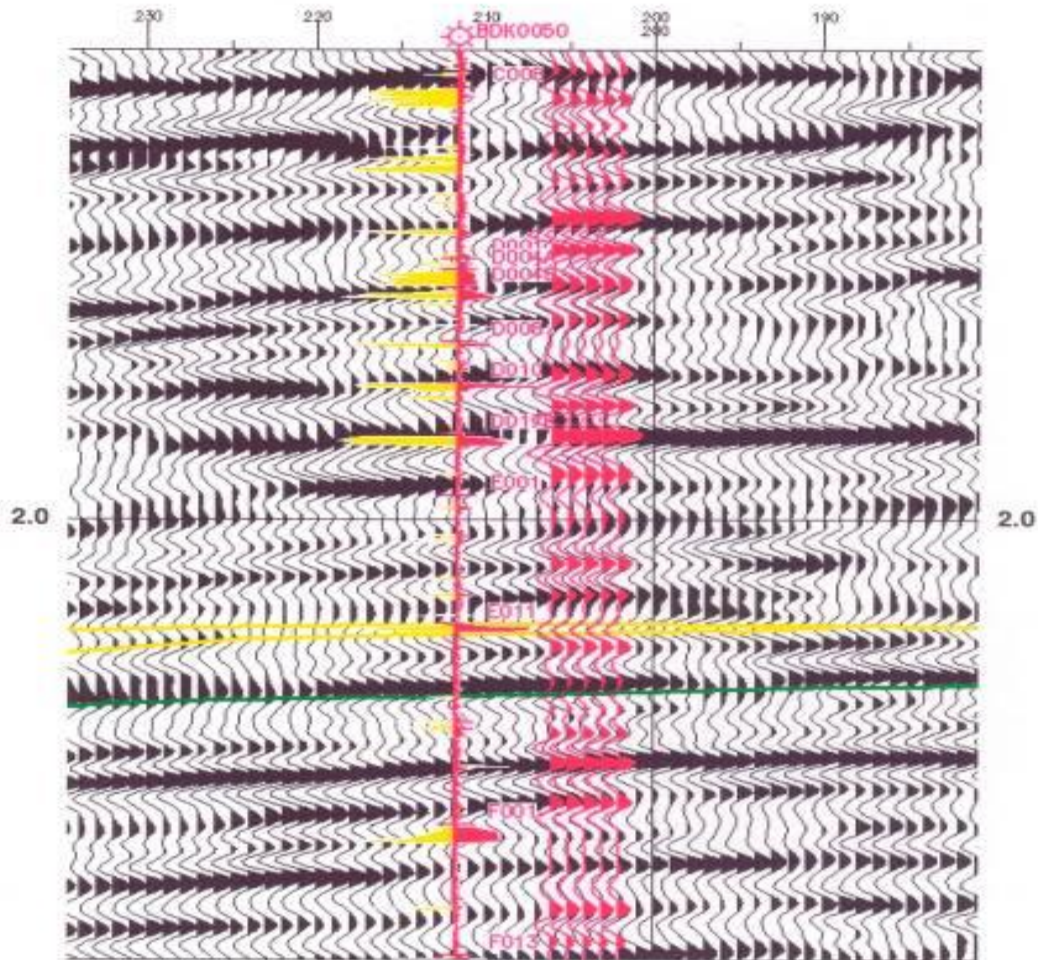




NORTHERN DELTA REGION 3D SEISMIC PROPOSAL

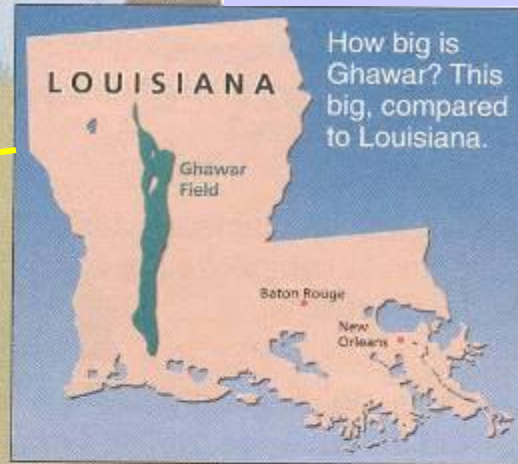
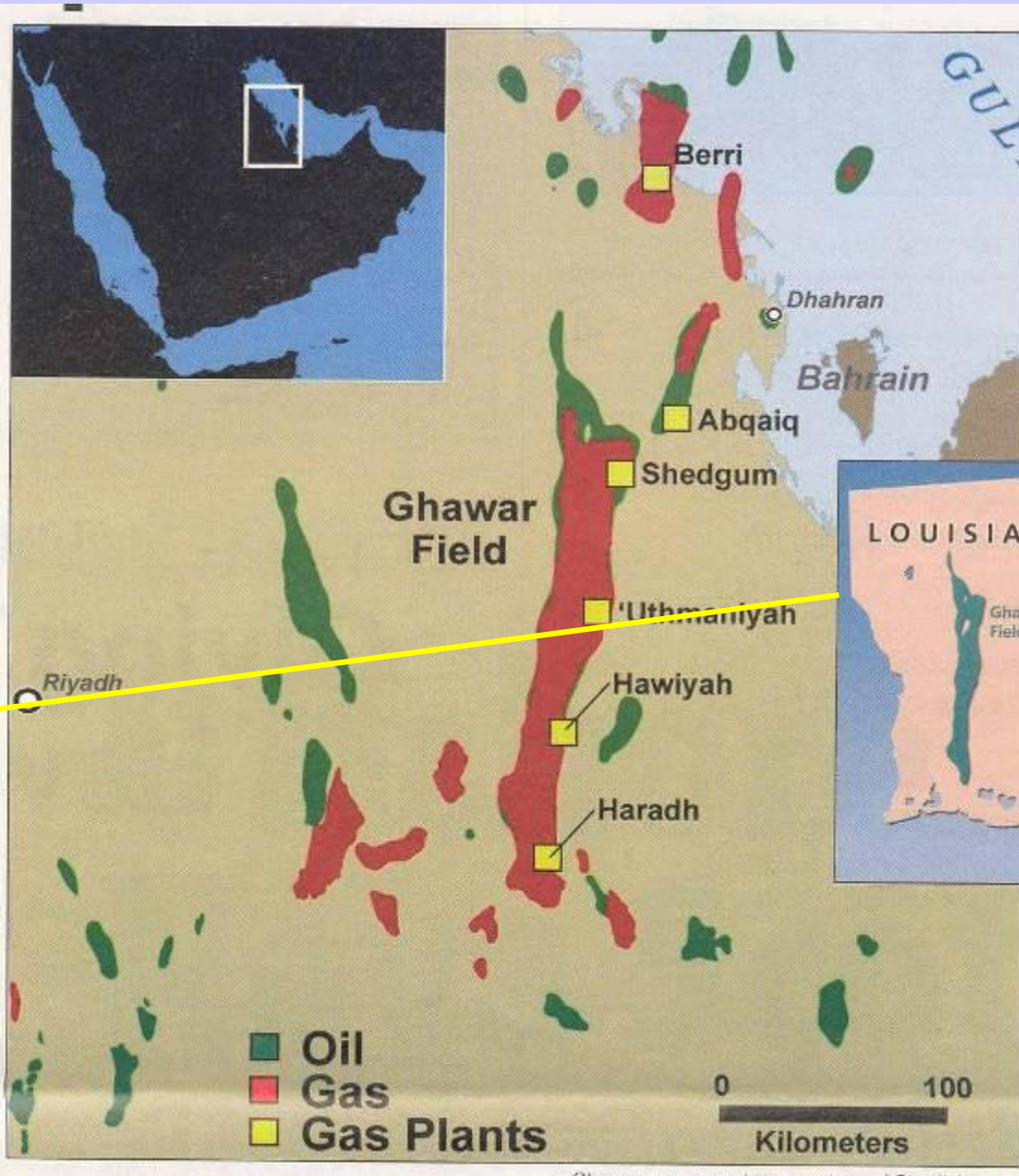
**BDK0050**

SYNTHETIC TIE WITH SEISMIC LINE K75



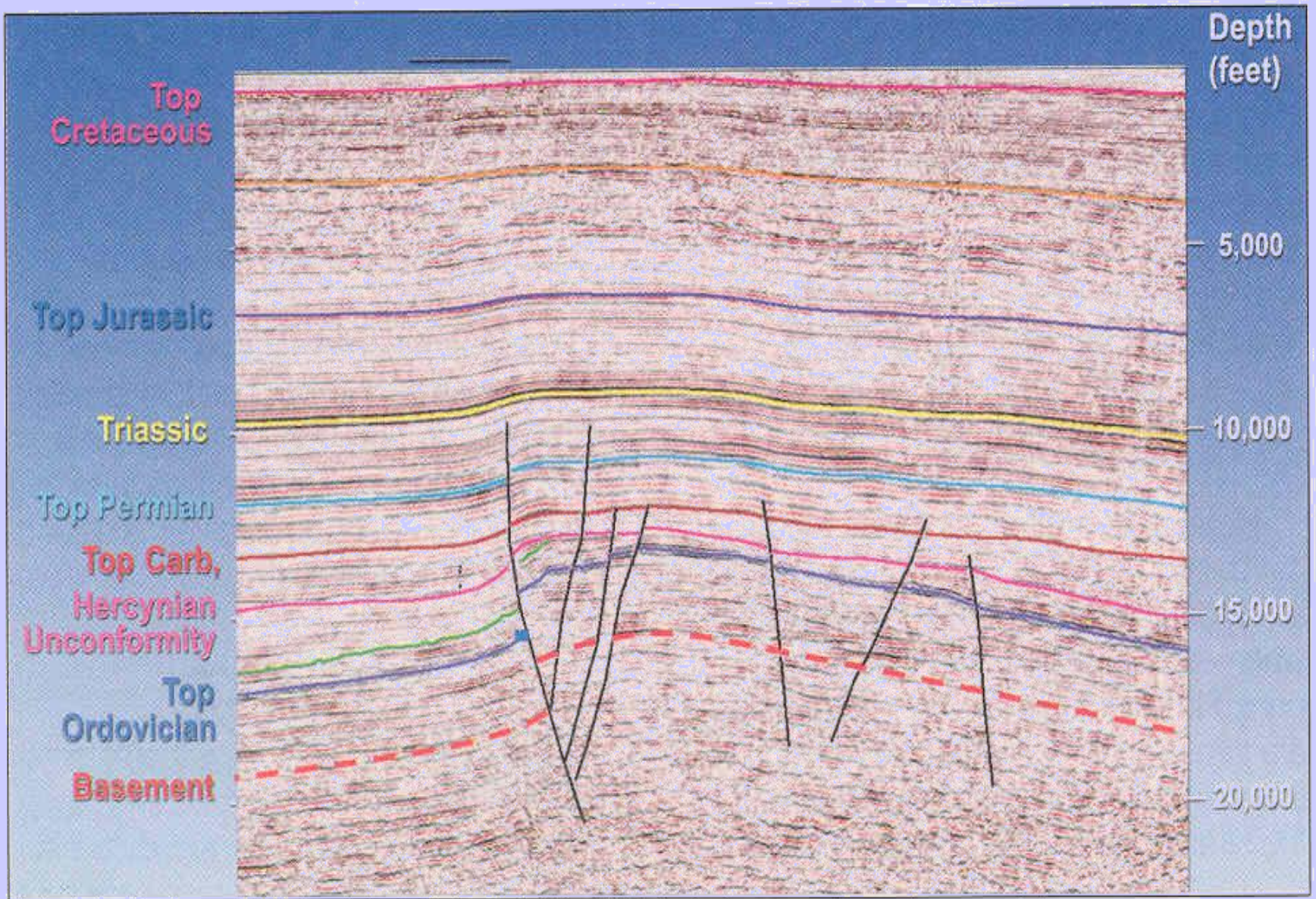
**Correlating Logs  
With  
Seismic Response**

# The Elephant



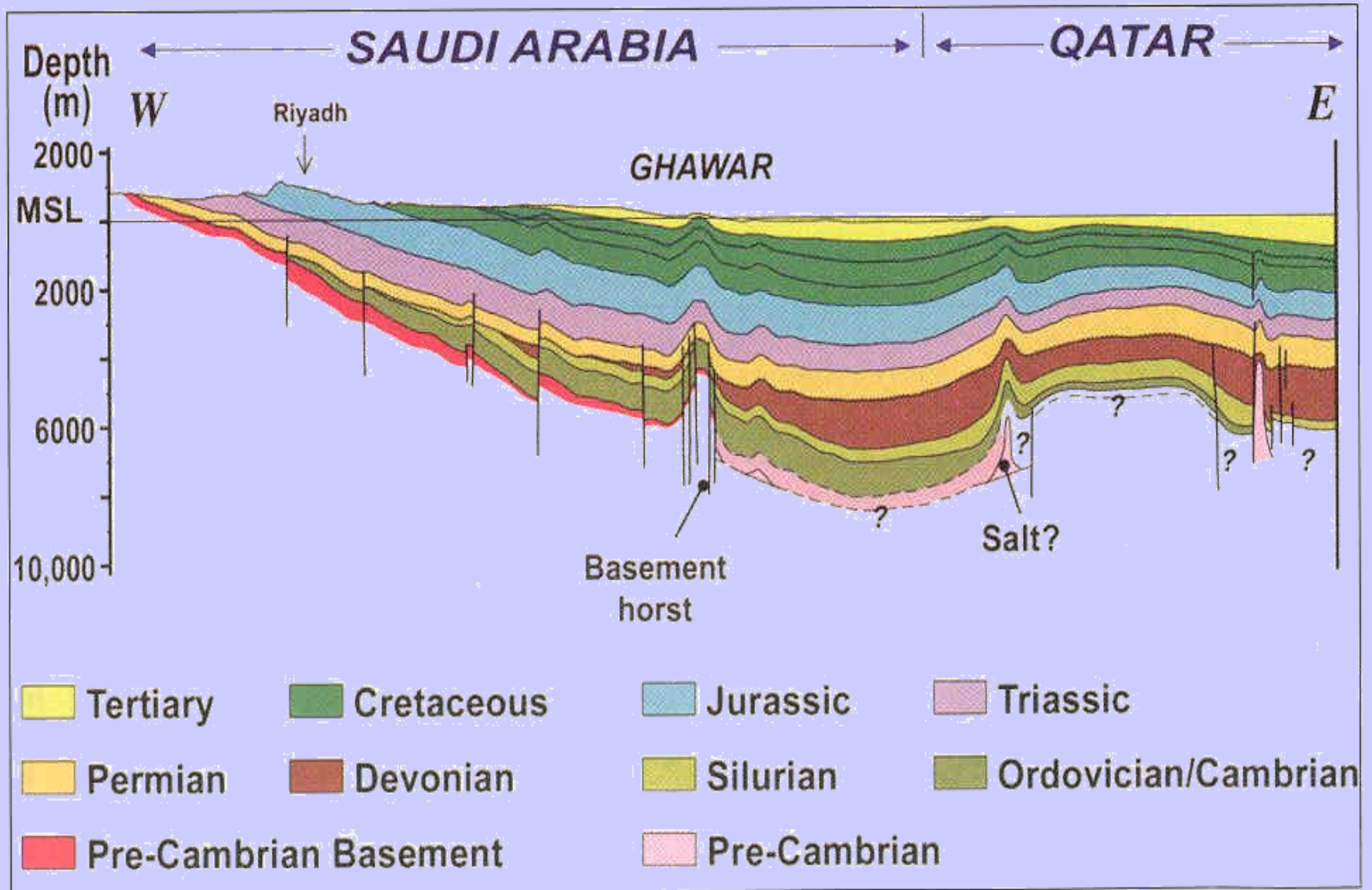


East-west seismic depth section, south Ghawar.





Regional east-west cross section.



**Regional Structural Cross-Section**

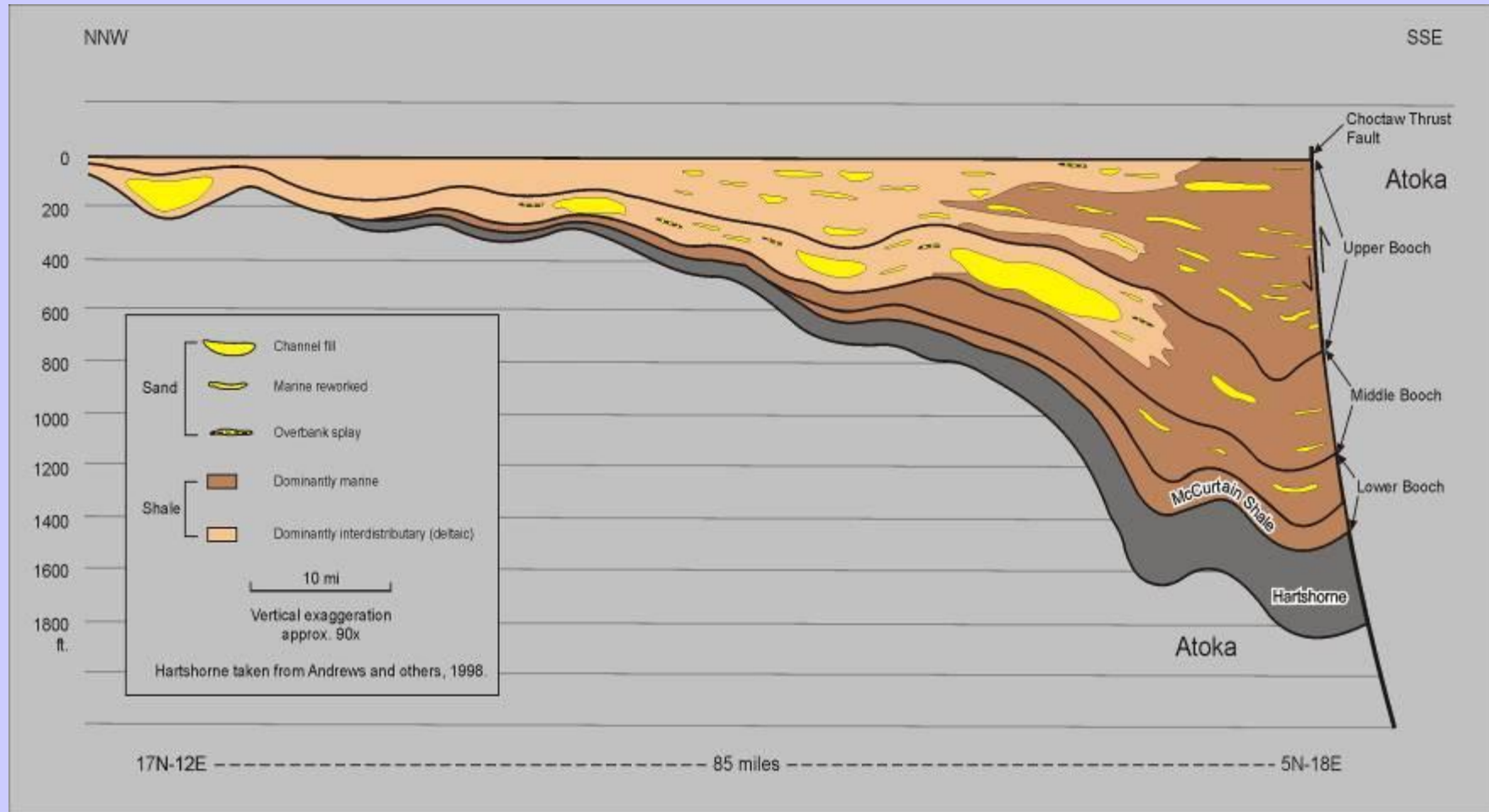
# Mechanics

- Cross-Sections
  - Structural
  - Stratigraphic
- Maps
  - Structure
  - Isopach (Iso-X)
  - Other

# Cross-Sections

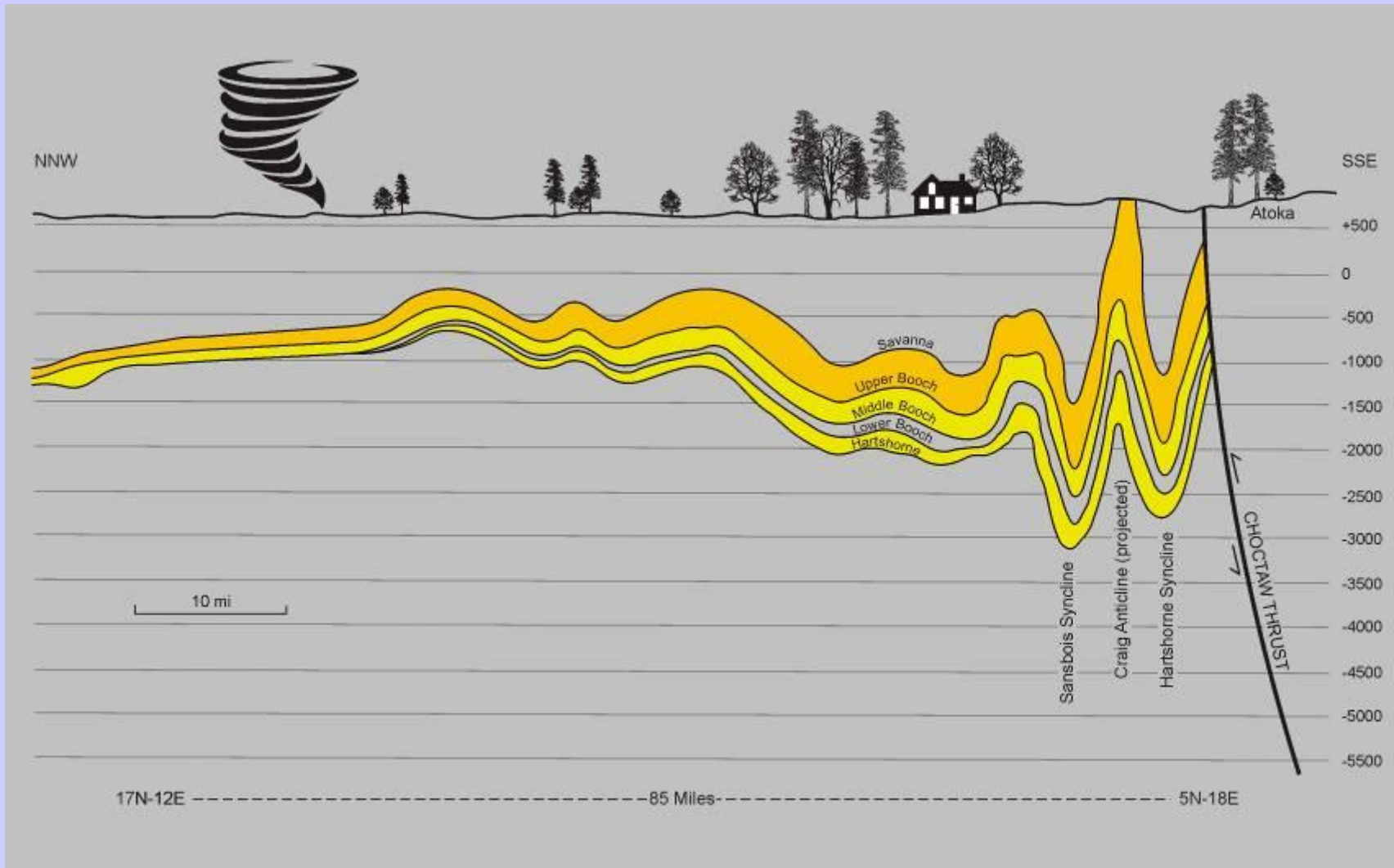


# Regional Stratigraphic Cross-Section (Hung from Top of Booch) Oklahoma Arkoma Basin (Booch)

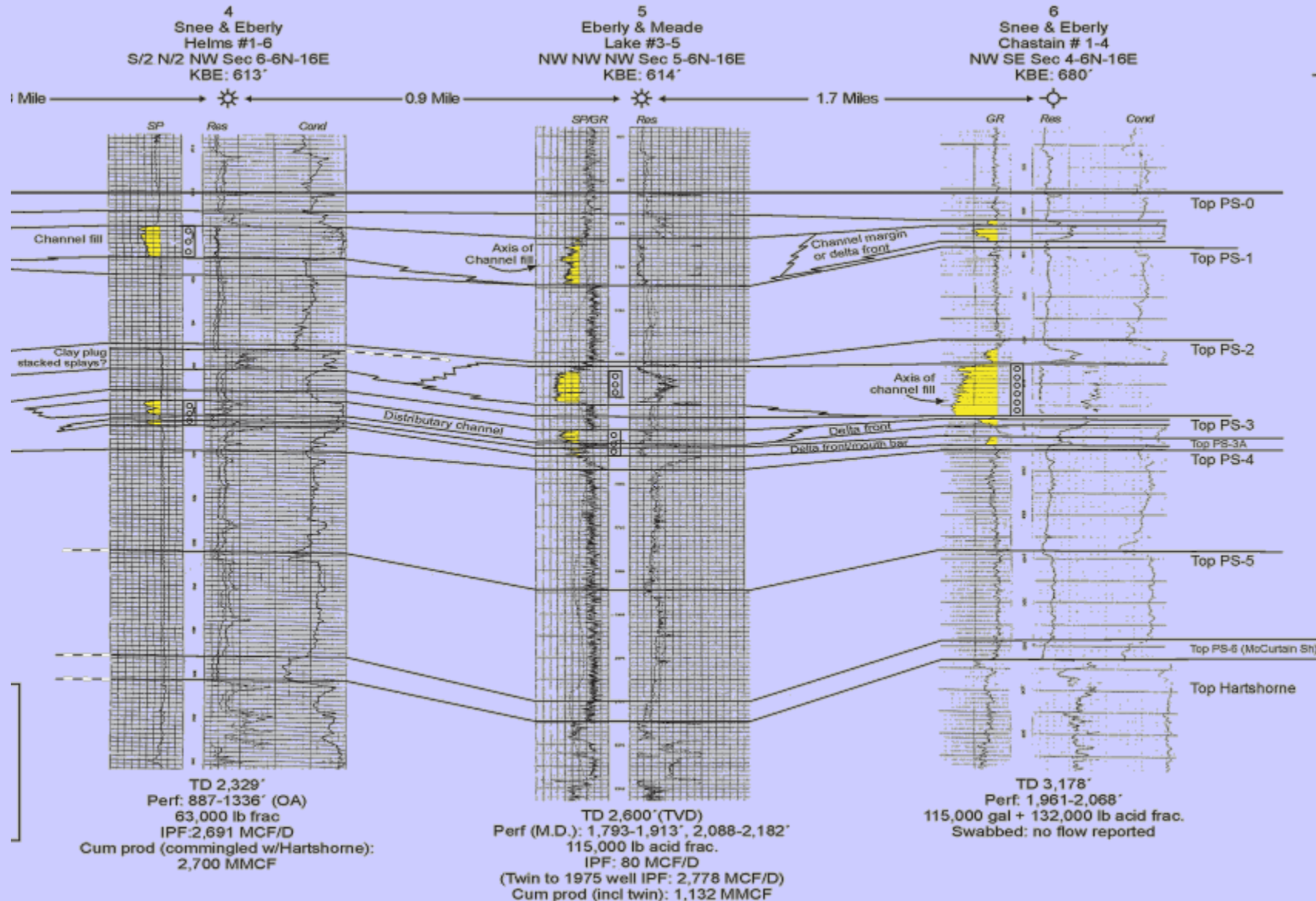


**(Present burial depth not necessarily maximum burial depth)**

# Regional Structural Cross-Section Oklahoma Arkoma Basin (Booch)



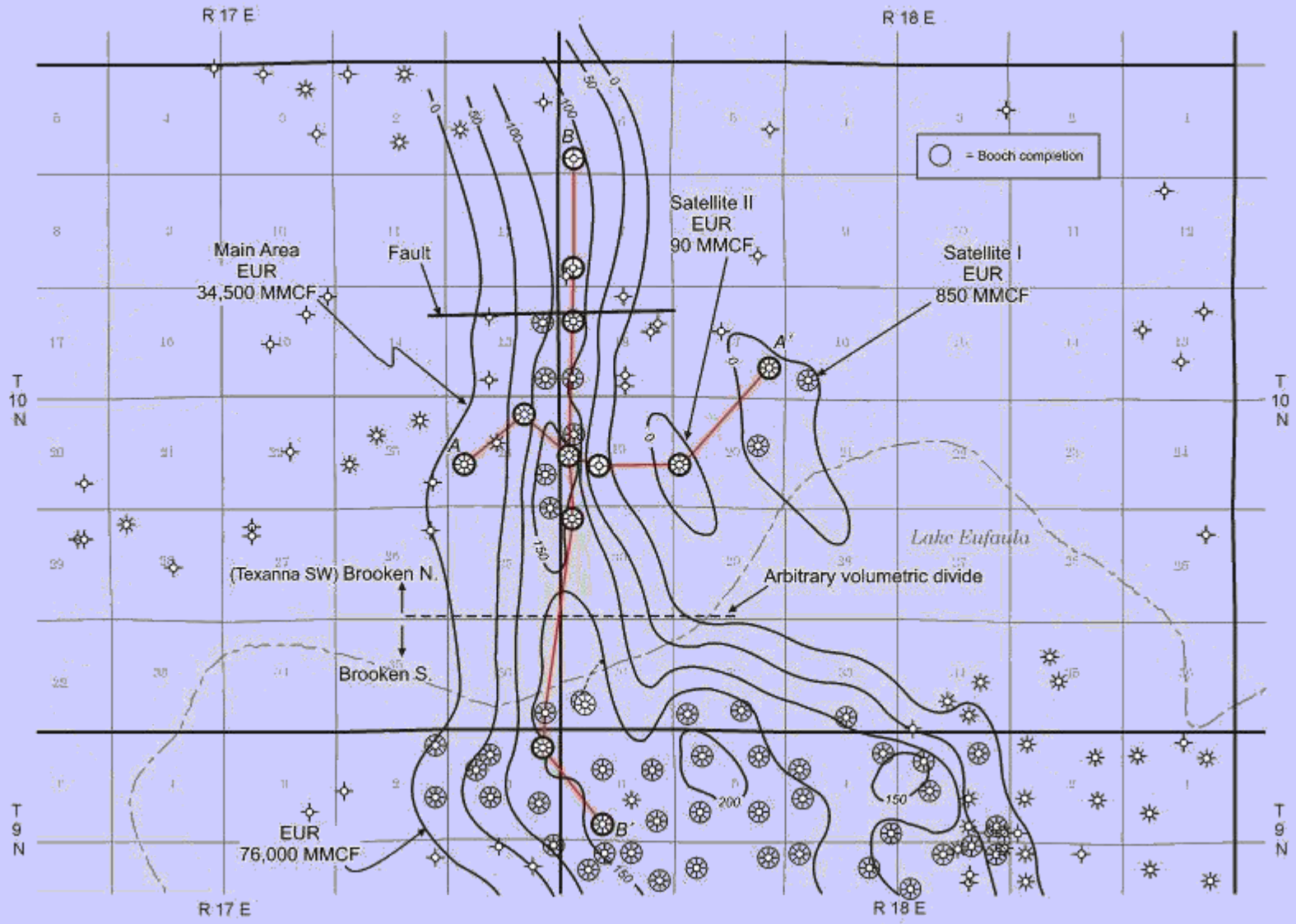
# Reams Southeast Field Study Stratigraphic Cross-Section B-B'



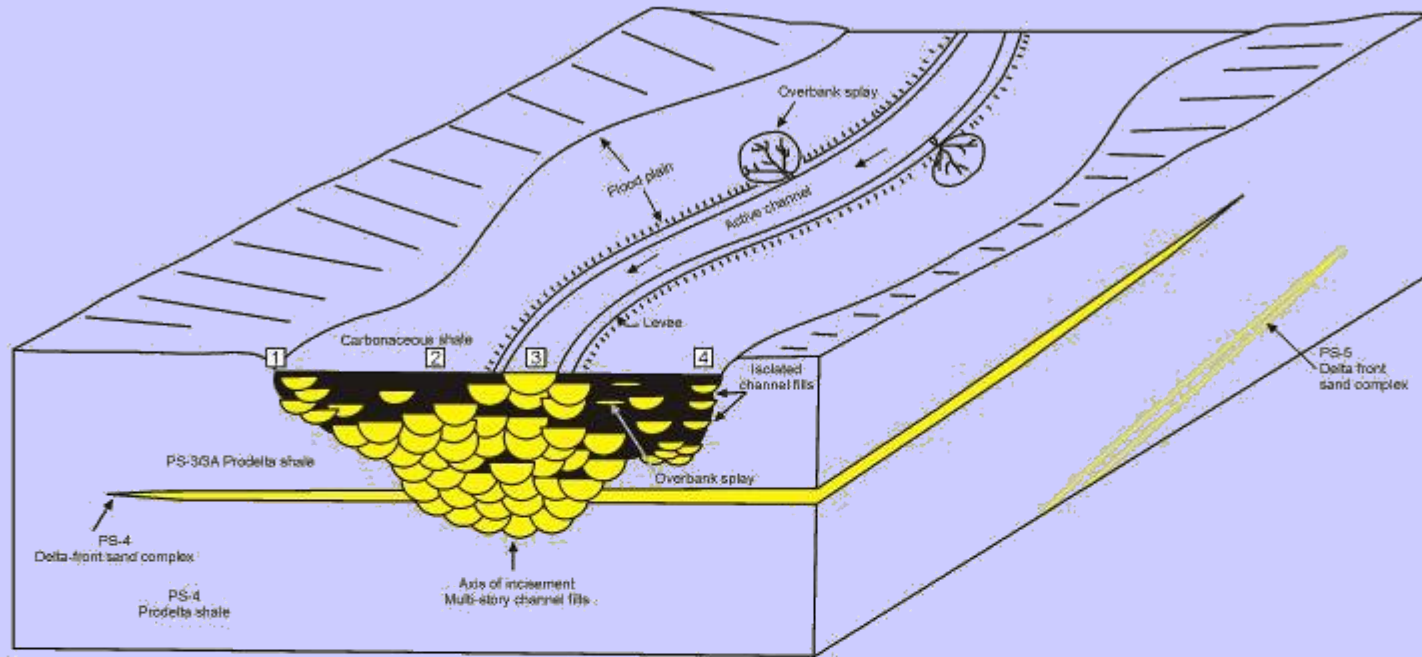


# Brooken Field Study

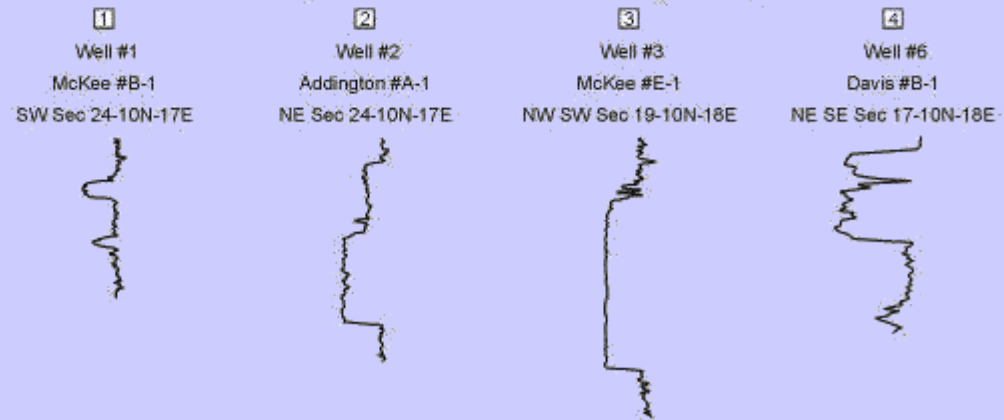
## Volumetrics – Net Sand Isopach



# Incised Valley Block Diagram Modeled After Brooken Field



Log signatures from cross section A-A' (Plate 10)

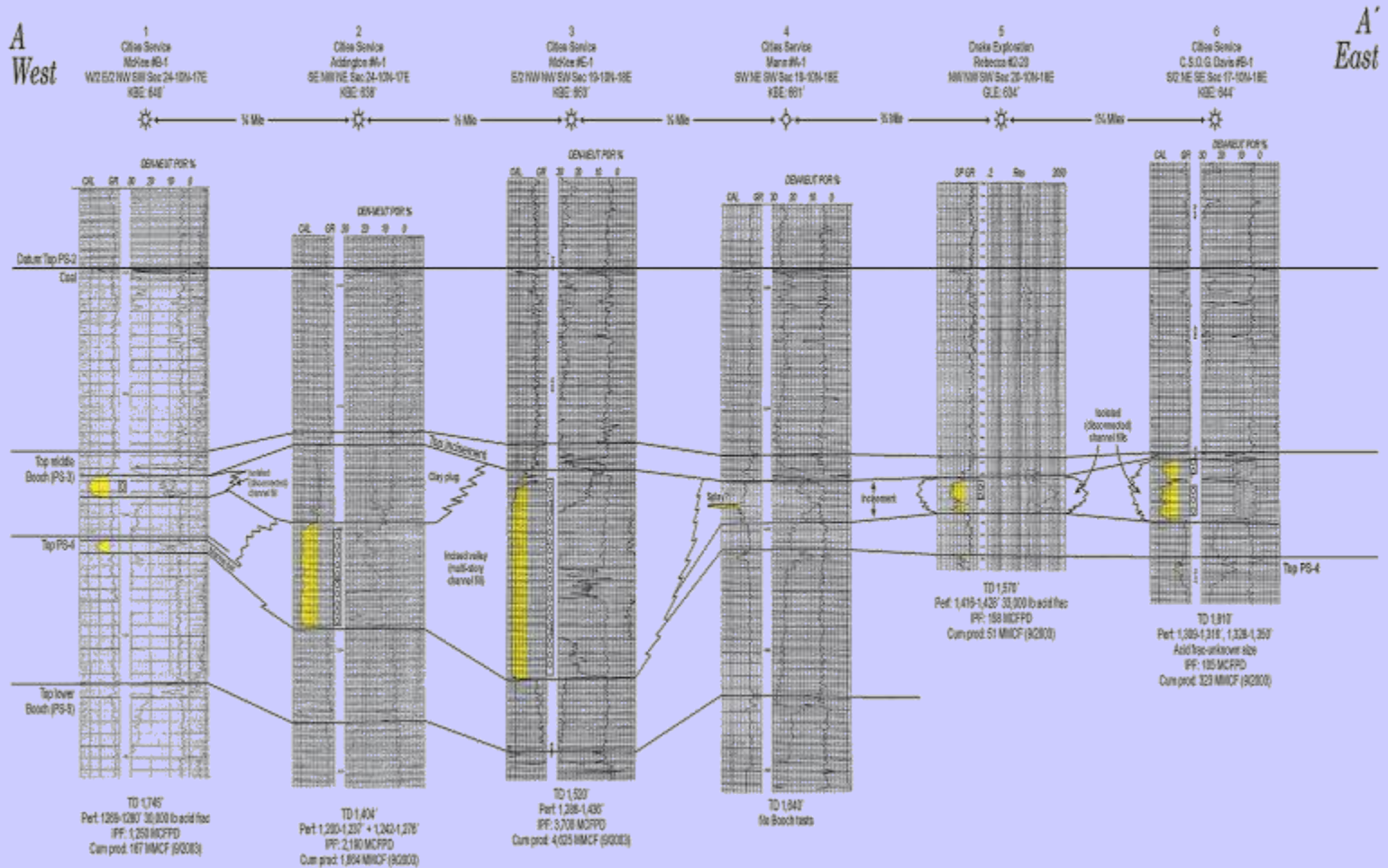


# Brooken Field Stratigraphic Cross-Section A-A'

OKLAHOMA GEOLOGICAL SURVEY  
Charles J. Hankin, Director

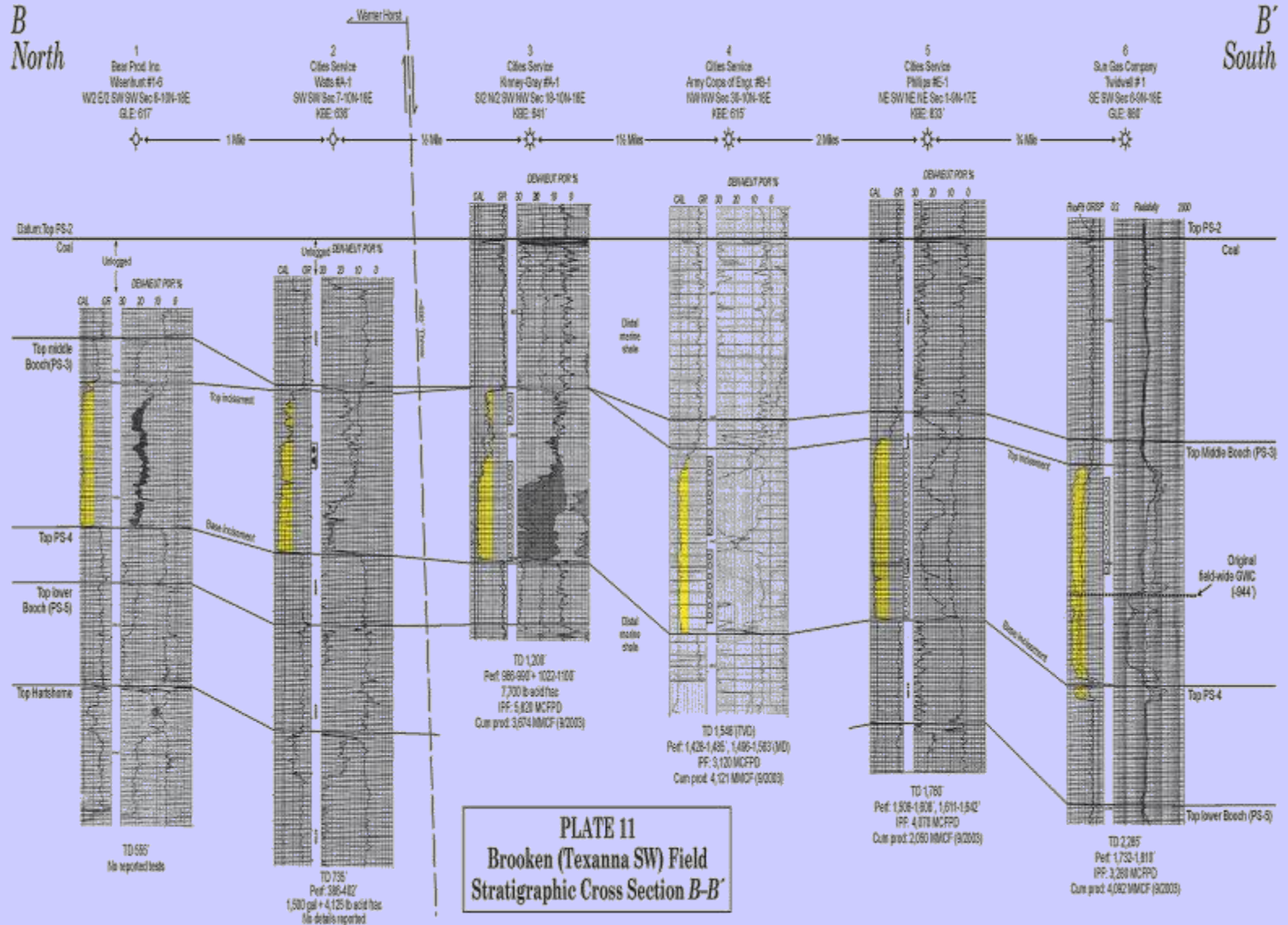
SP 2005-1, PLATES 10 and 11 of 16  
Brooken Field Stratigraphic Cross Section A-A' and B-B'  
Bock Gas Play in Southeastern Oklahoma

## PLATE 10 Brooken (Texanna SW) Field Stratigraphic Cross Section A-A'





# Brooken Field Stratigraphic Cross-Section B-B'

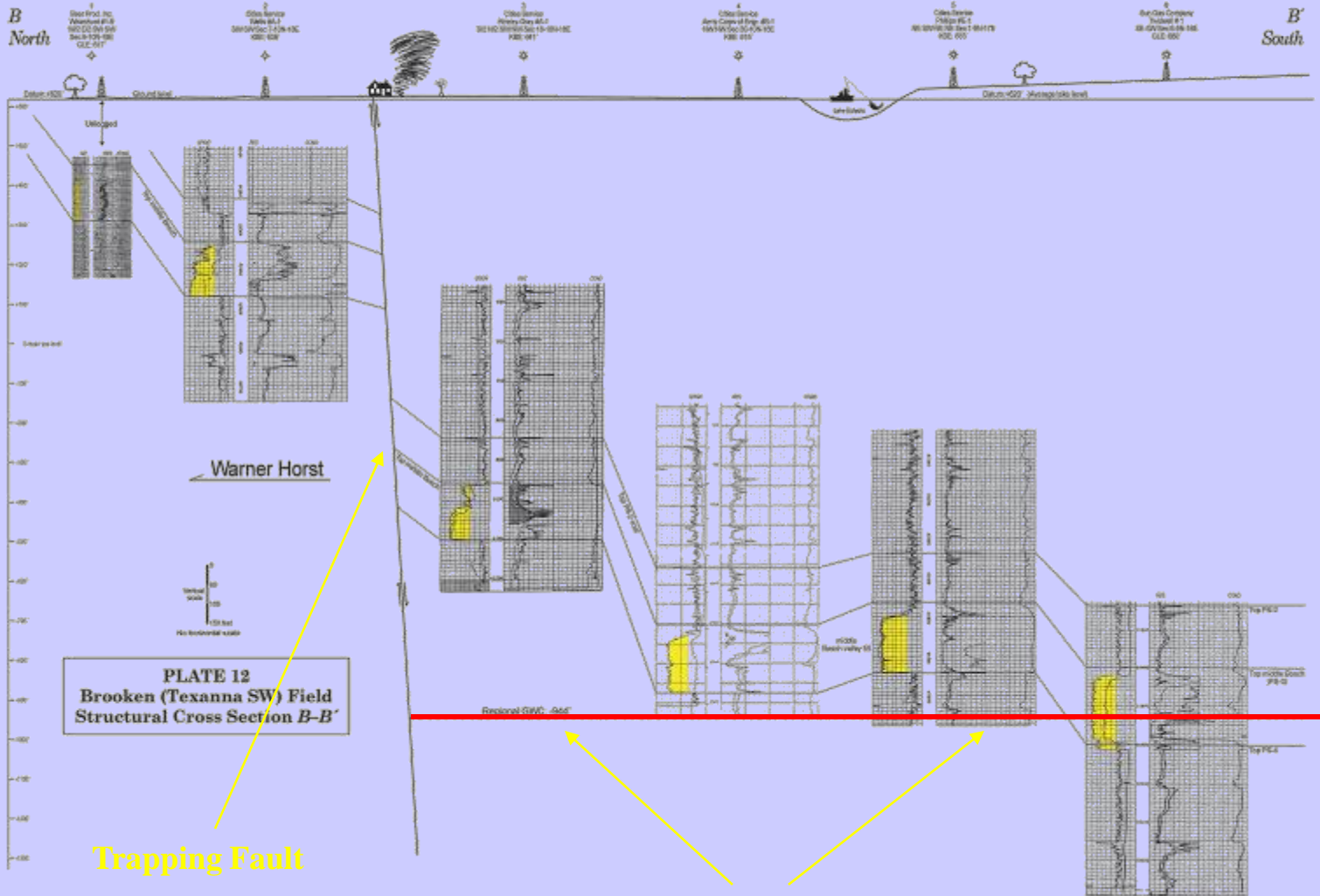


**PLATE 11**  
**Brooken (Texanna SW) Field**  
**Stratigraphic Cross Section B-B'**

# Brooken Field Structural Cross-Section B – B'

OKLAHOMA GEOLOGICAL SURVEY  
Charles S. Mackin, Director

SF-2005-1, PLATE 12 of 16  
Brooken Field Structural Cross Section B-B'  
North-Cross Plot in Southeastern Oklahoma

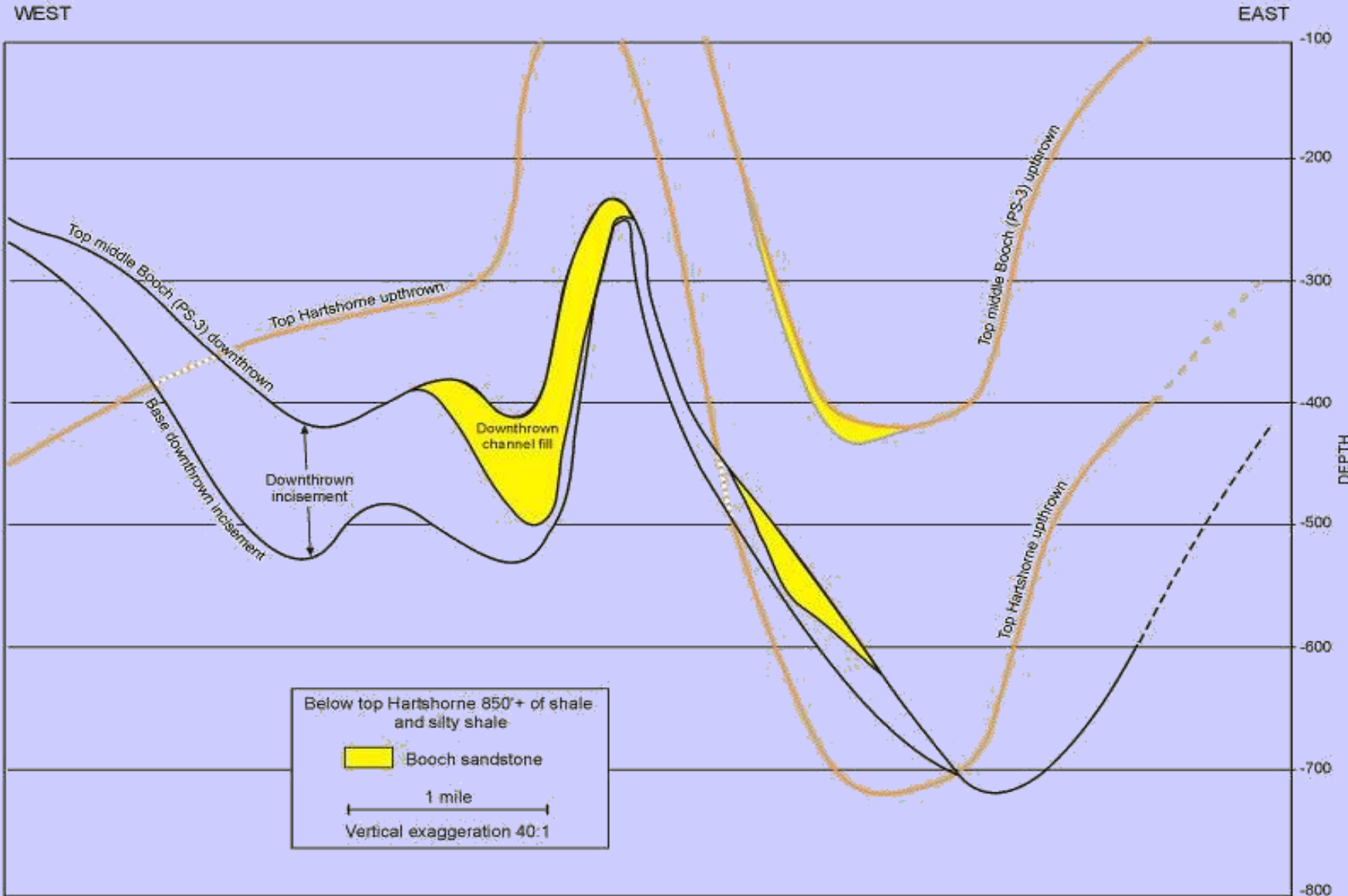


**Trapping Fault**

**Original Gas-Water Contact**

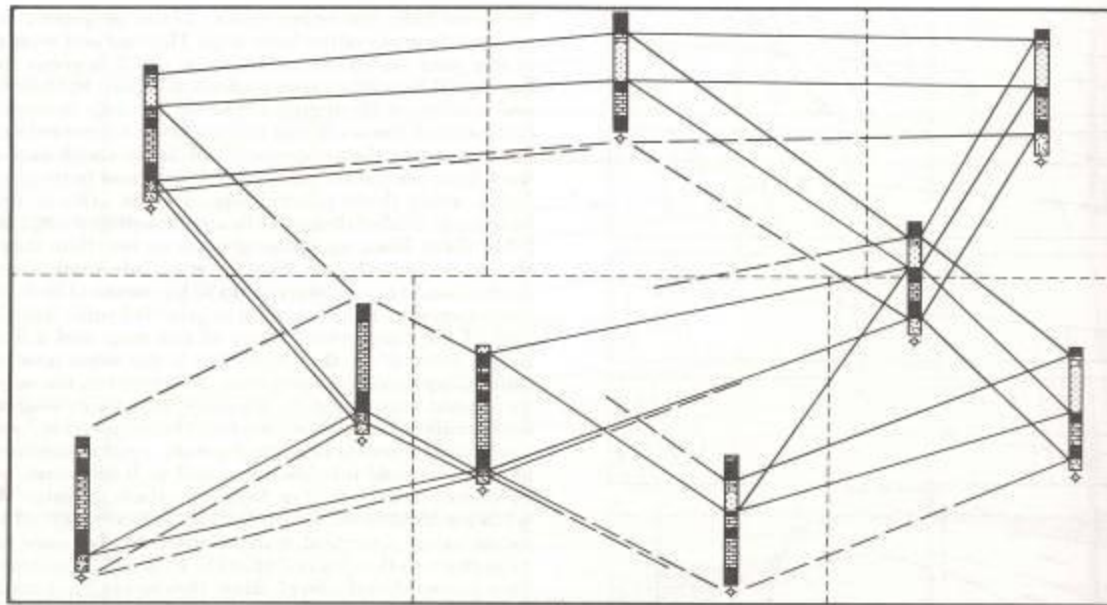
# Brooken Field Study

## Trapping Fault Plane Section

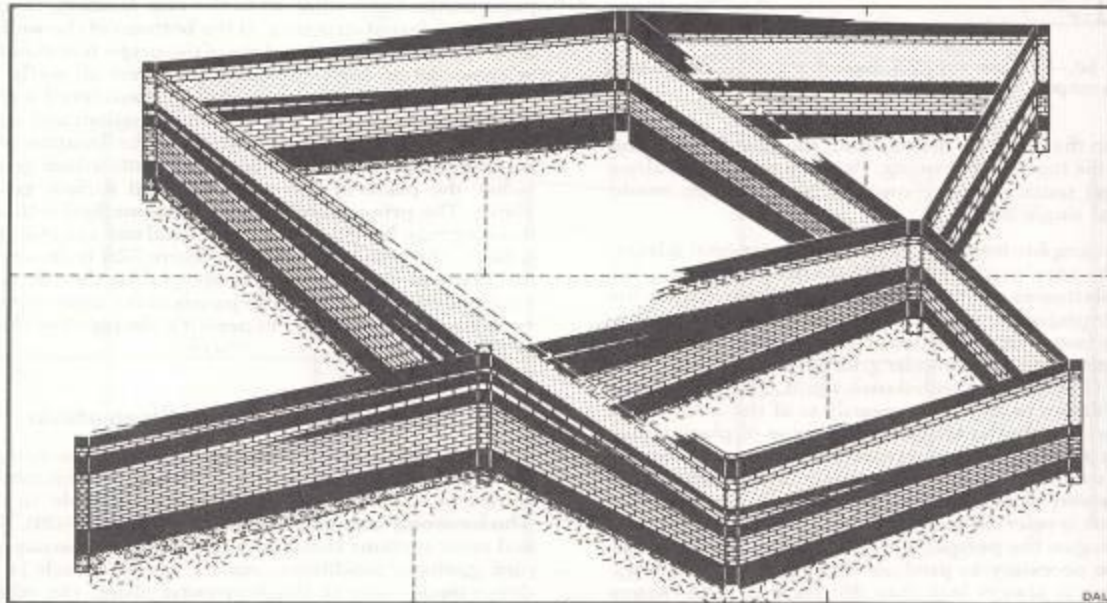




# Fence Diagram (Pseudo-3D)



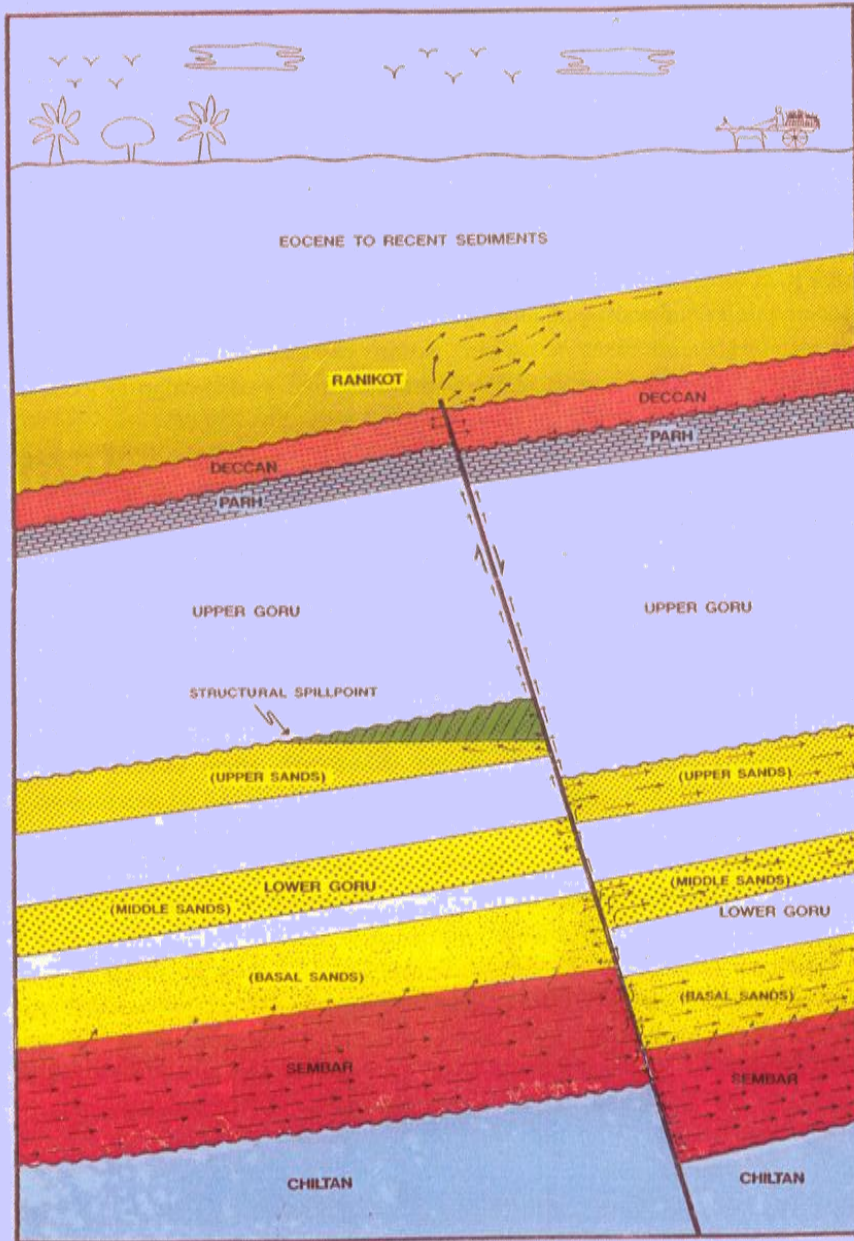
A



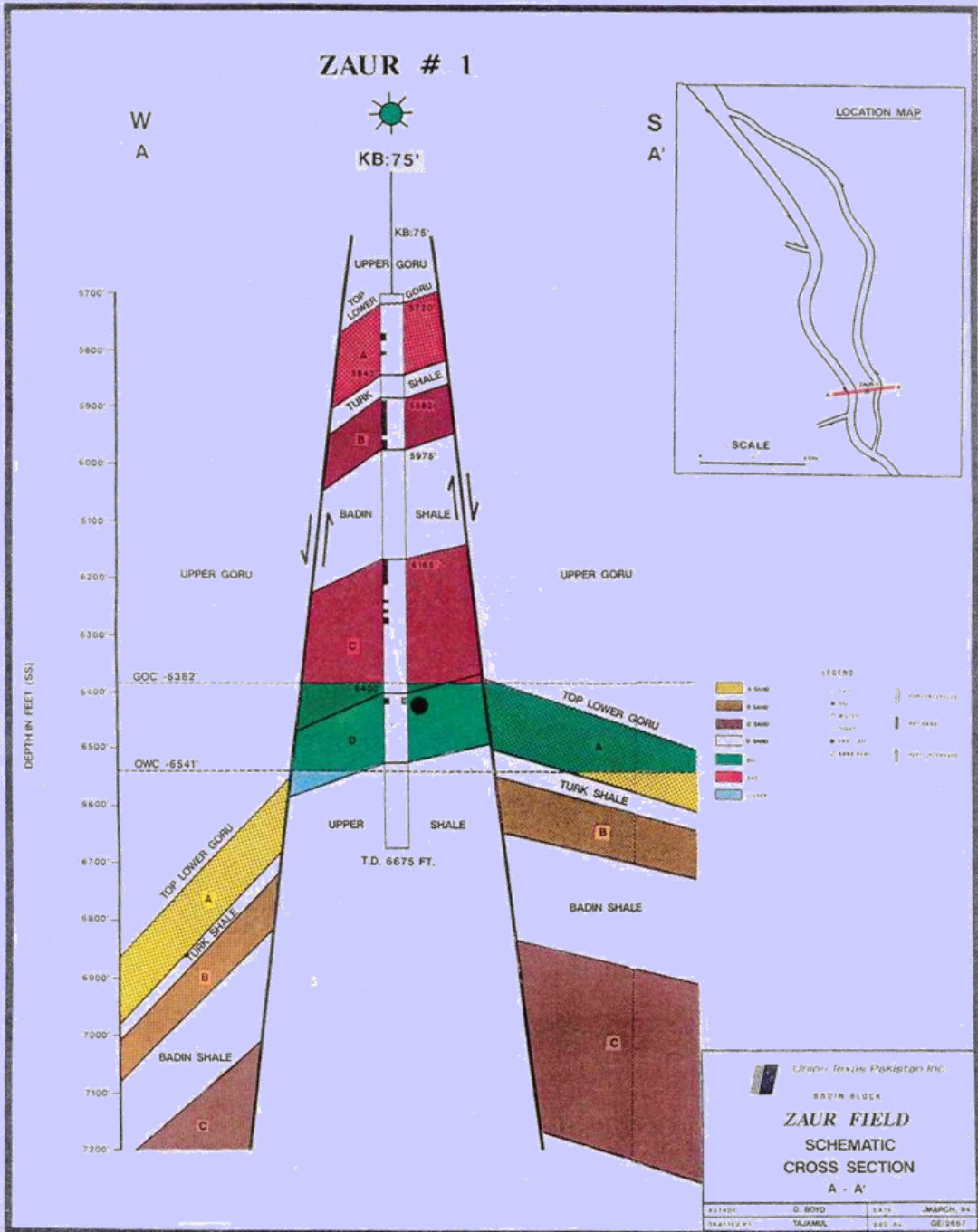
B

Figure 51.—(A) Log diagram. (B) Panel diagram.

**SCHEMATIC CROSS - SECTION  
BADIN BLOCK EXPULSION/MIGRATION STYLE**



# Schematic Structural Cross-Section



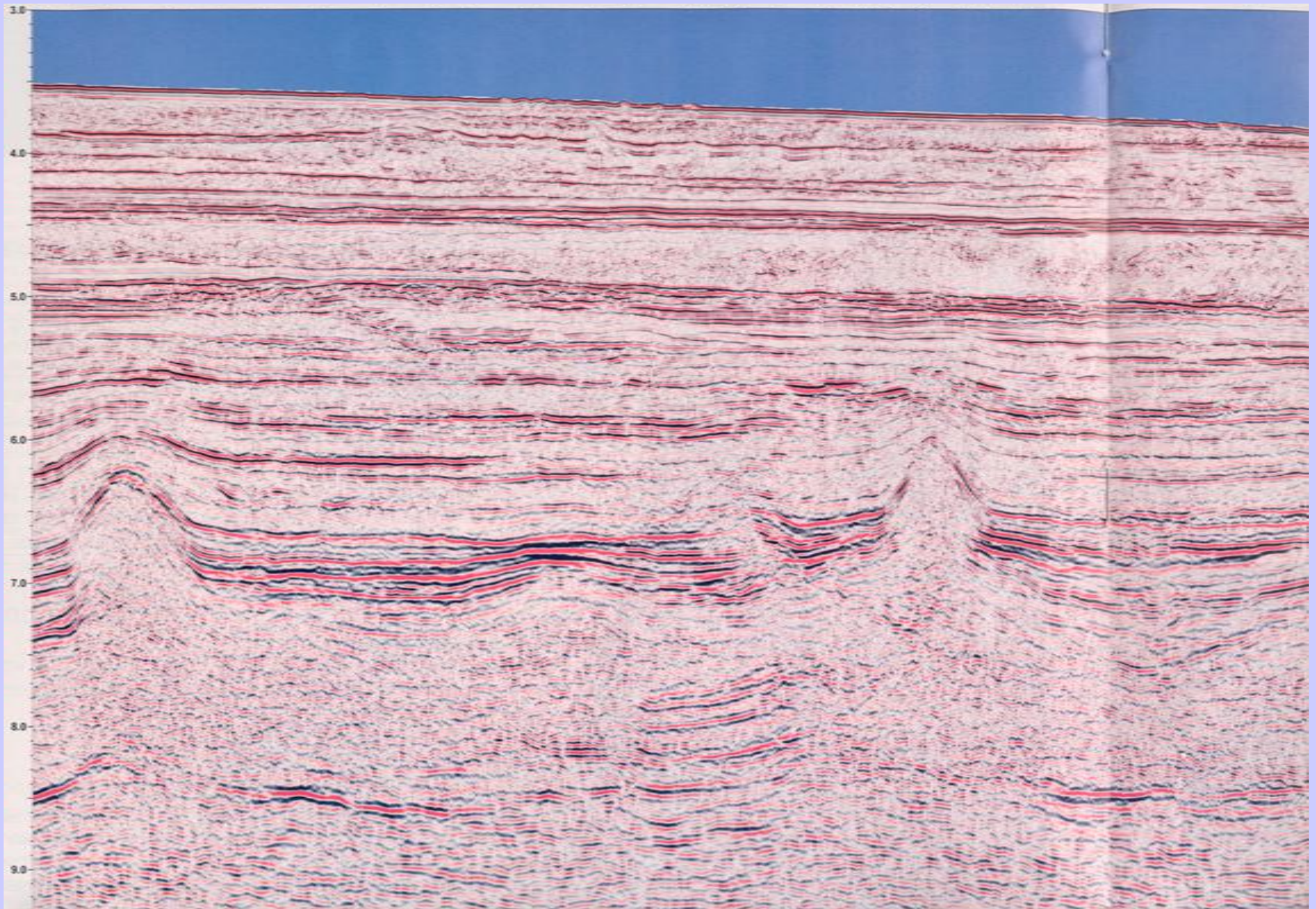
# Schematic Structural Cross-Section

(66 x Vertical Exaggeration)

Simple Fault Trap  
(Narrow Horst)  
Extensional



# Deepwater Seismic Line (Showing Affects of Diapirs)



# Maps

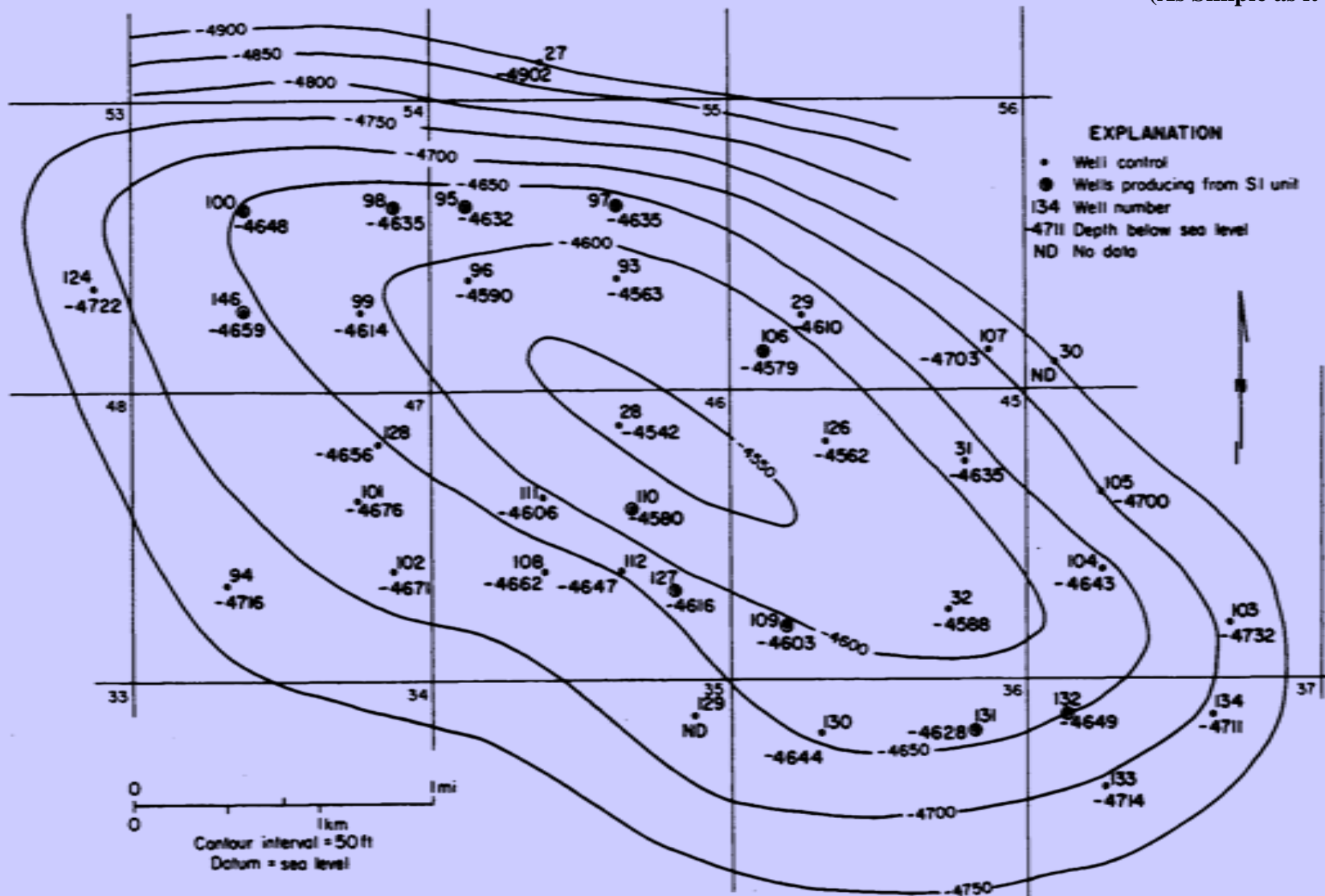
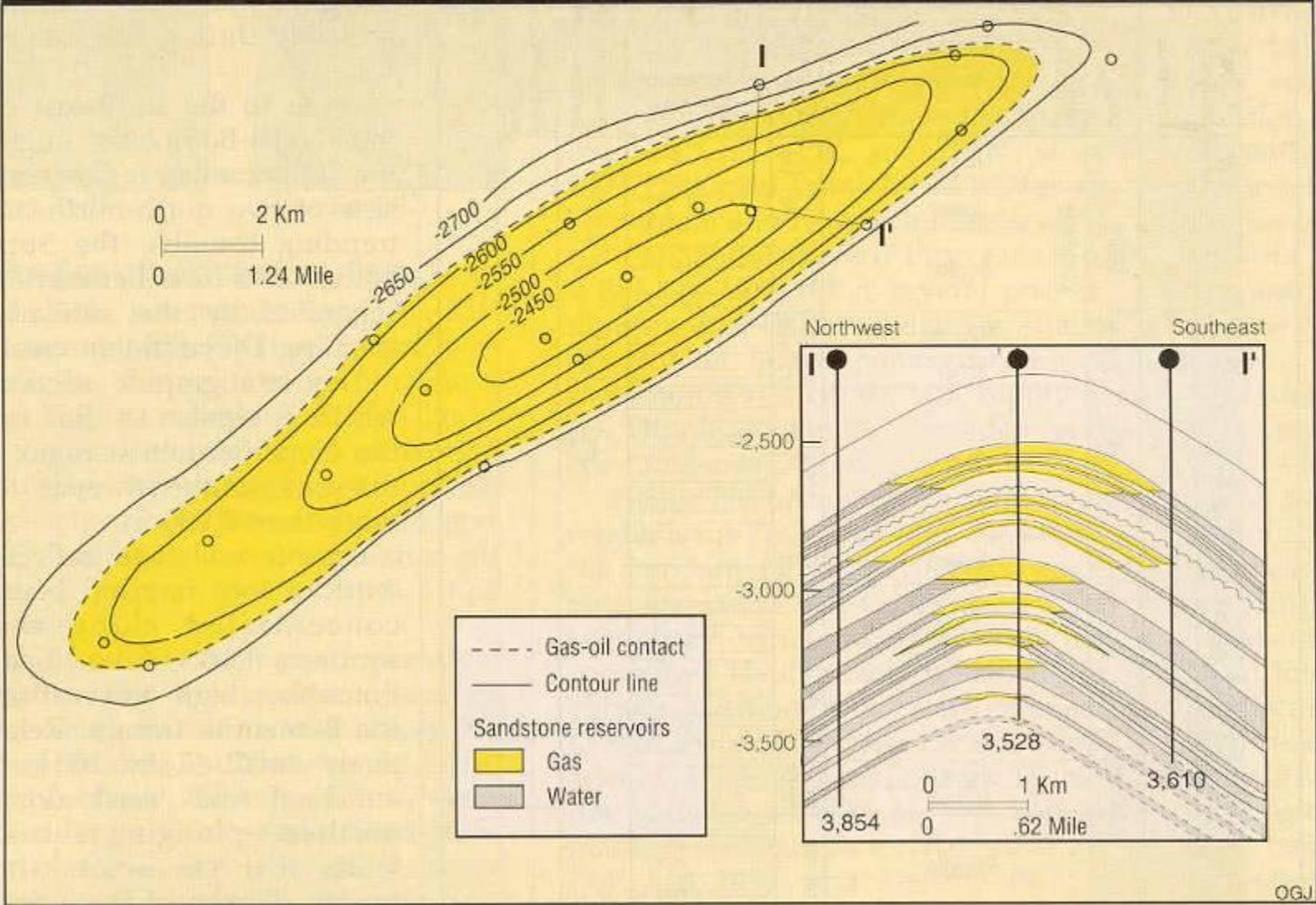


Fig. 214. Missourian sandstone structure map, Mobeetie field. From Dutton, 1982. Permission to publish by AAPG.

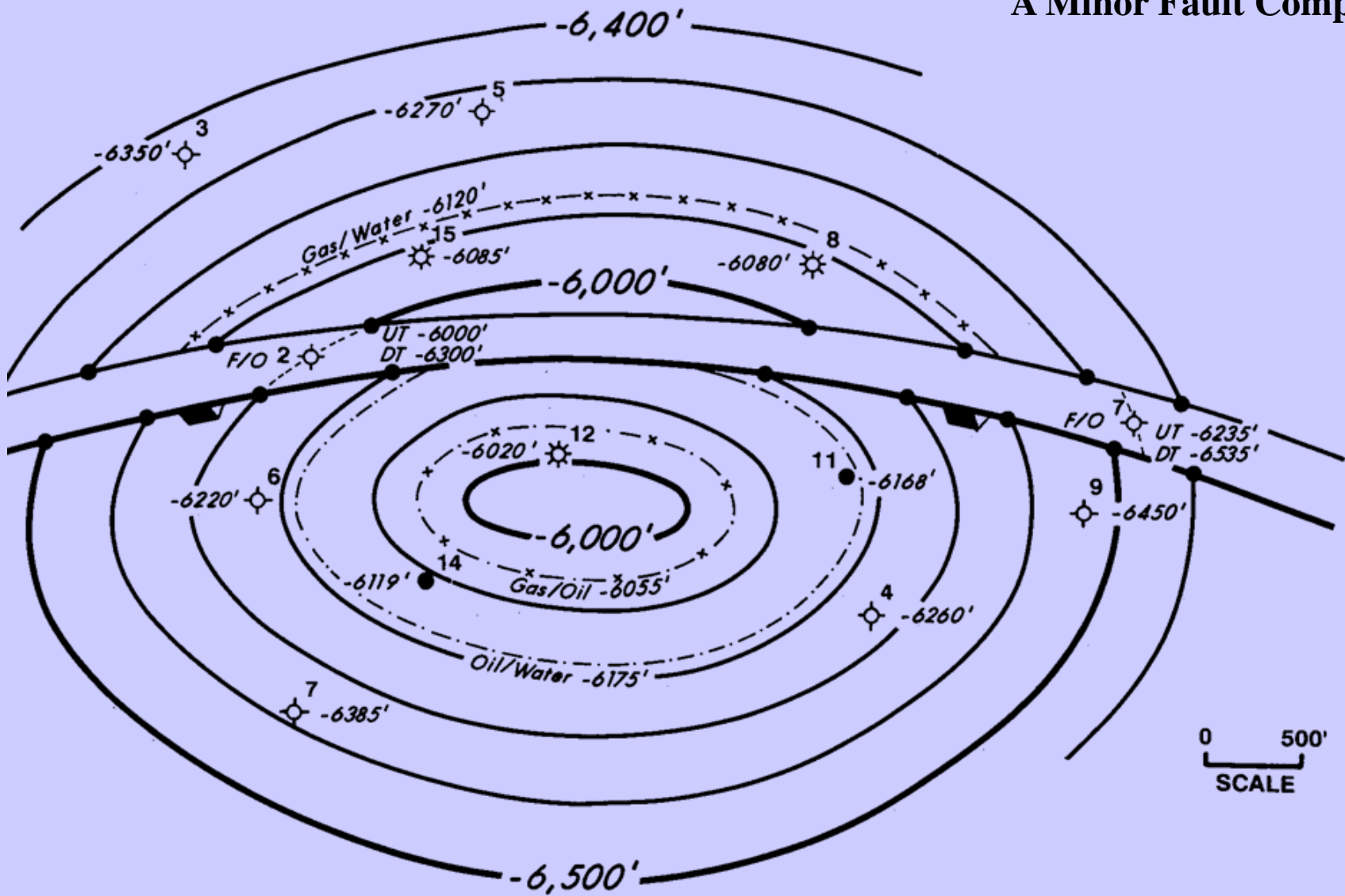


# SREDNETYUNG GAS FIELD



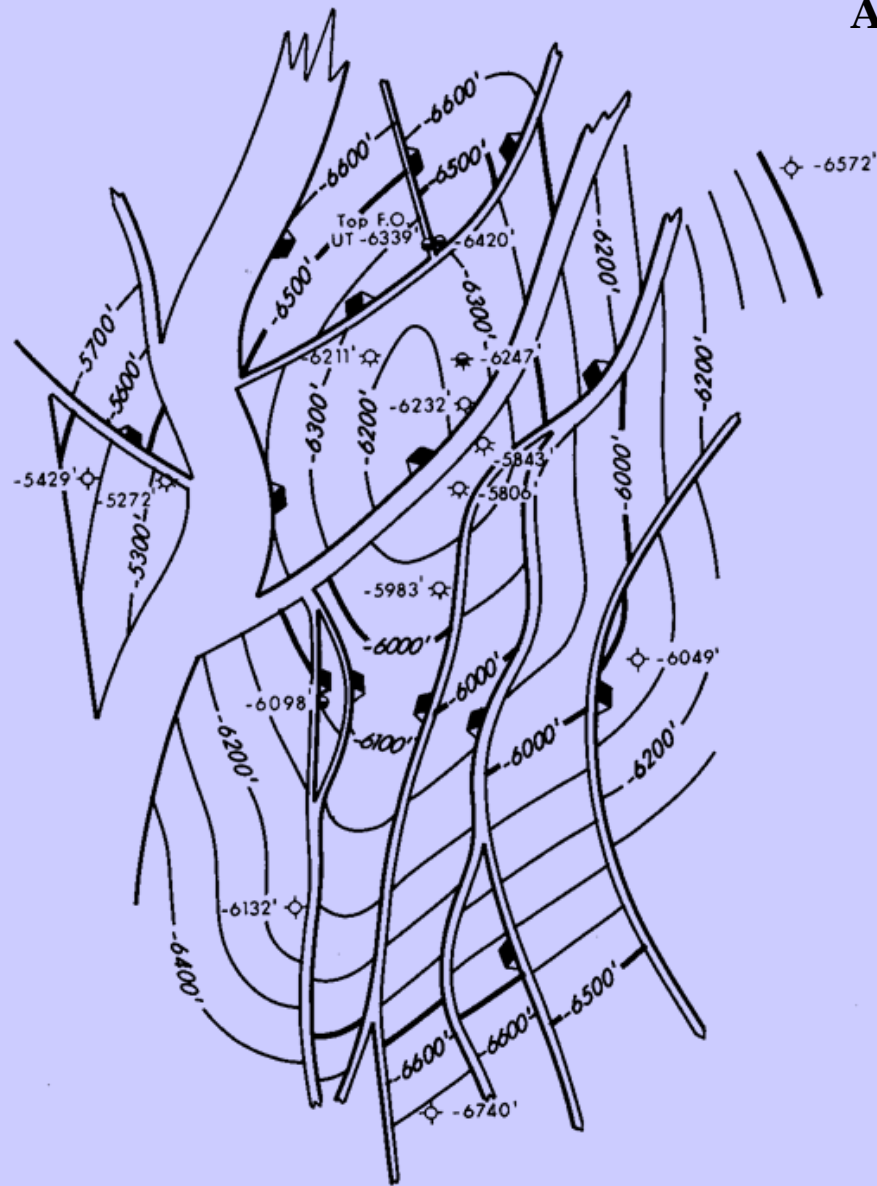
**Siberian Gas Field**

# A Minor Fault Complication



**Figure 8-10** Integrated fault and structure map for the 6000-ft Horizon. The darkened circles delineate the intersection of each structure contour with the fault contour of the same elevation.

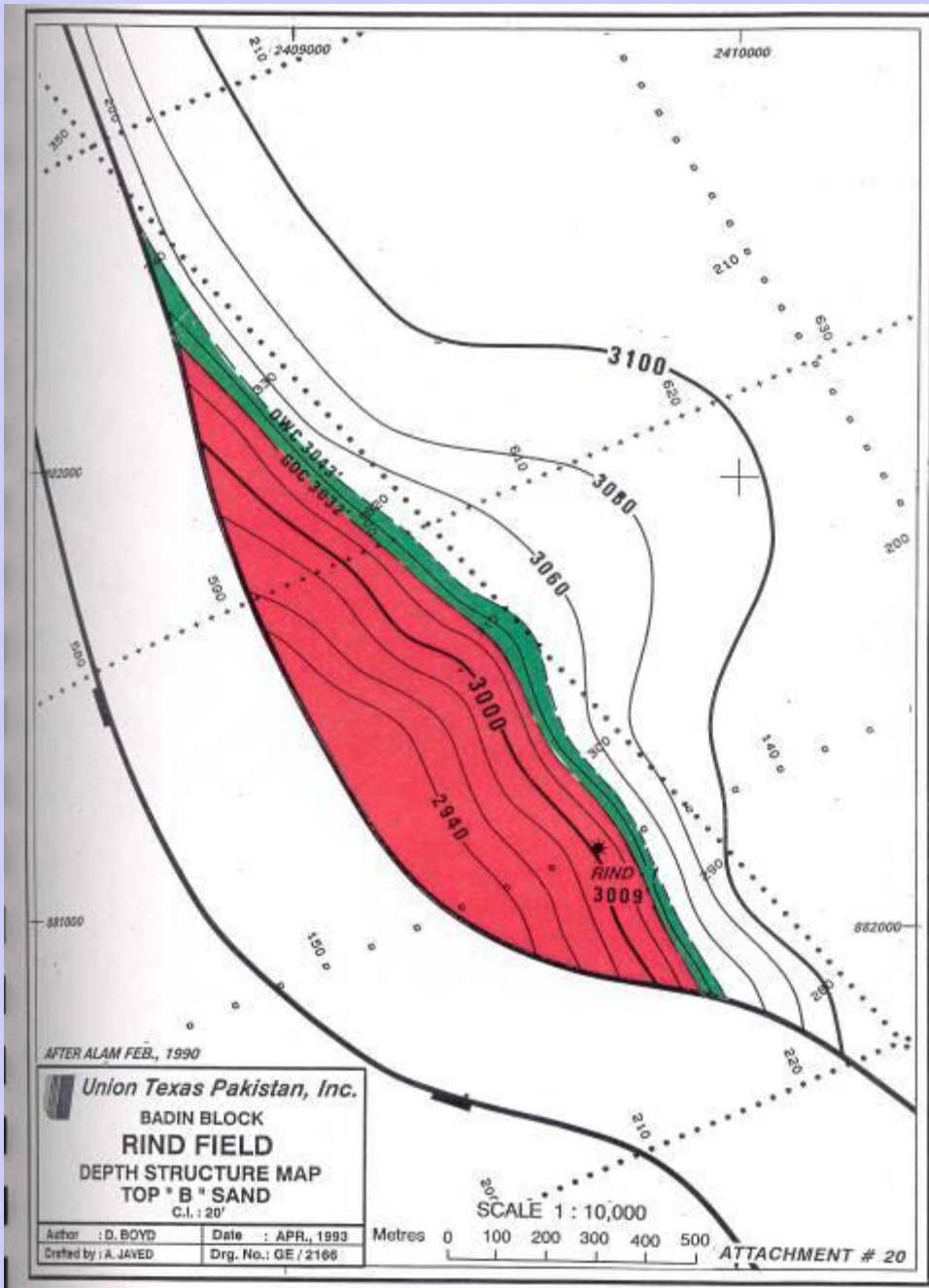
## A Major Fault Complication



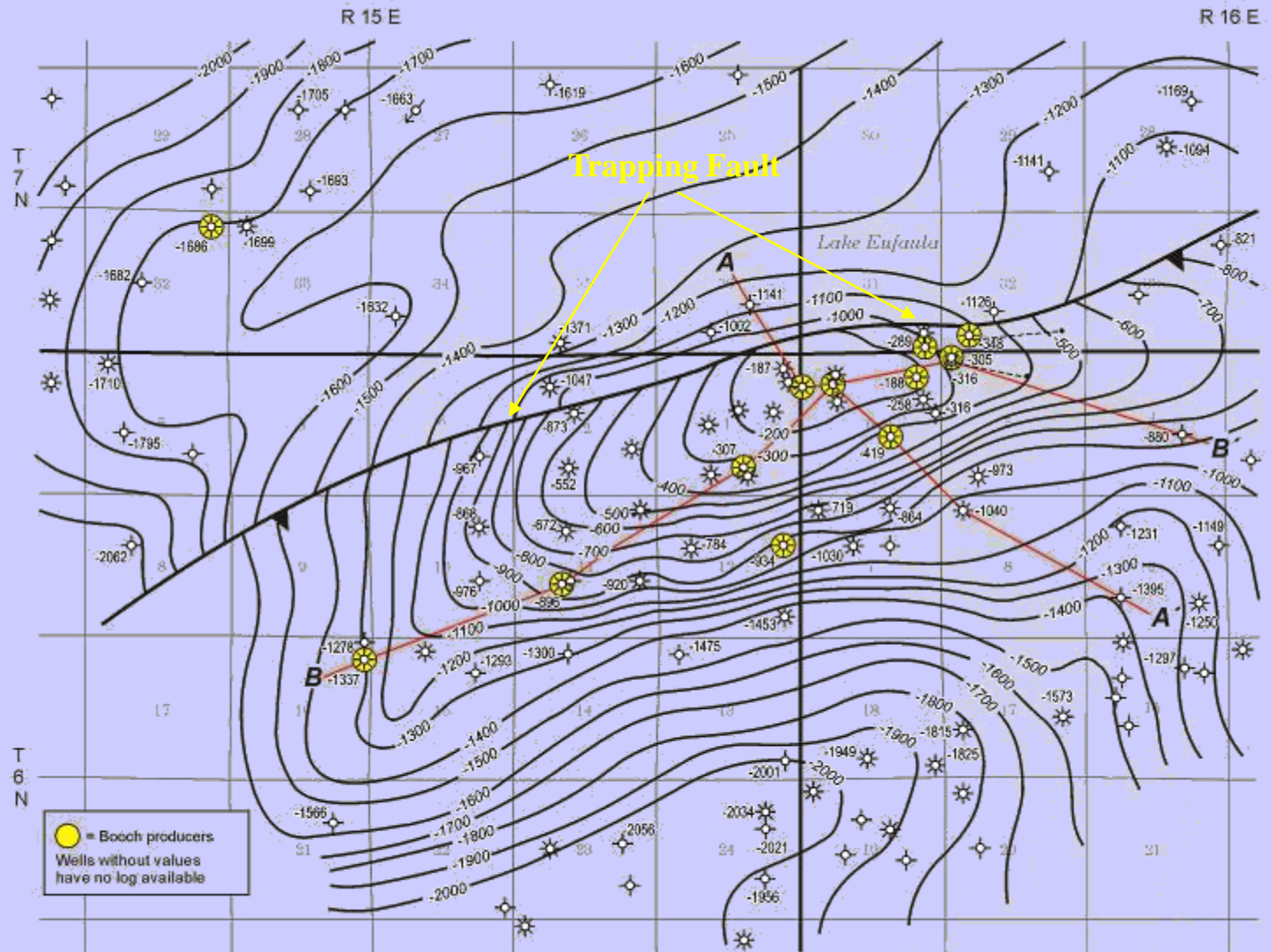
**Figure 8-22** An integrated structure map of a very complexly faulted anticlinal structure. Each fault was integrated with the structural interpretation as shown in Fig. 8-21.



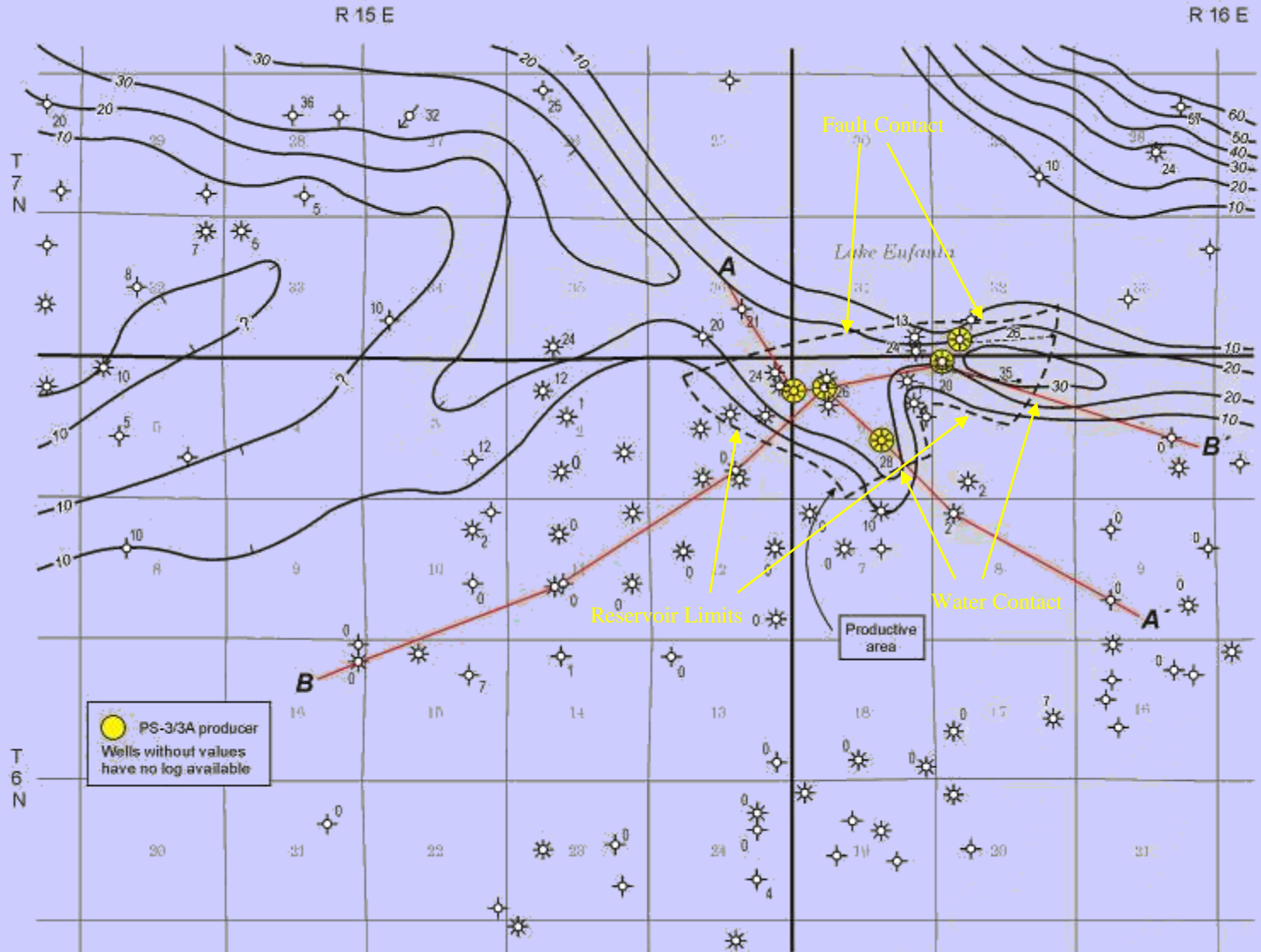
# Simple Fault Trap (Upthrown Normal Fault) Extensional



# Reams Southeast Field Middle Booch Structure Map

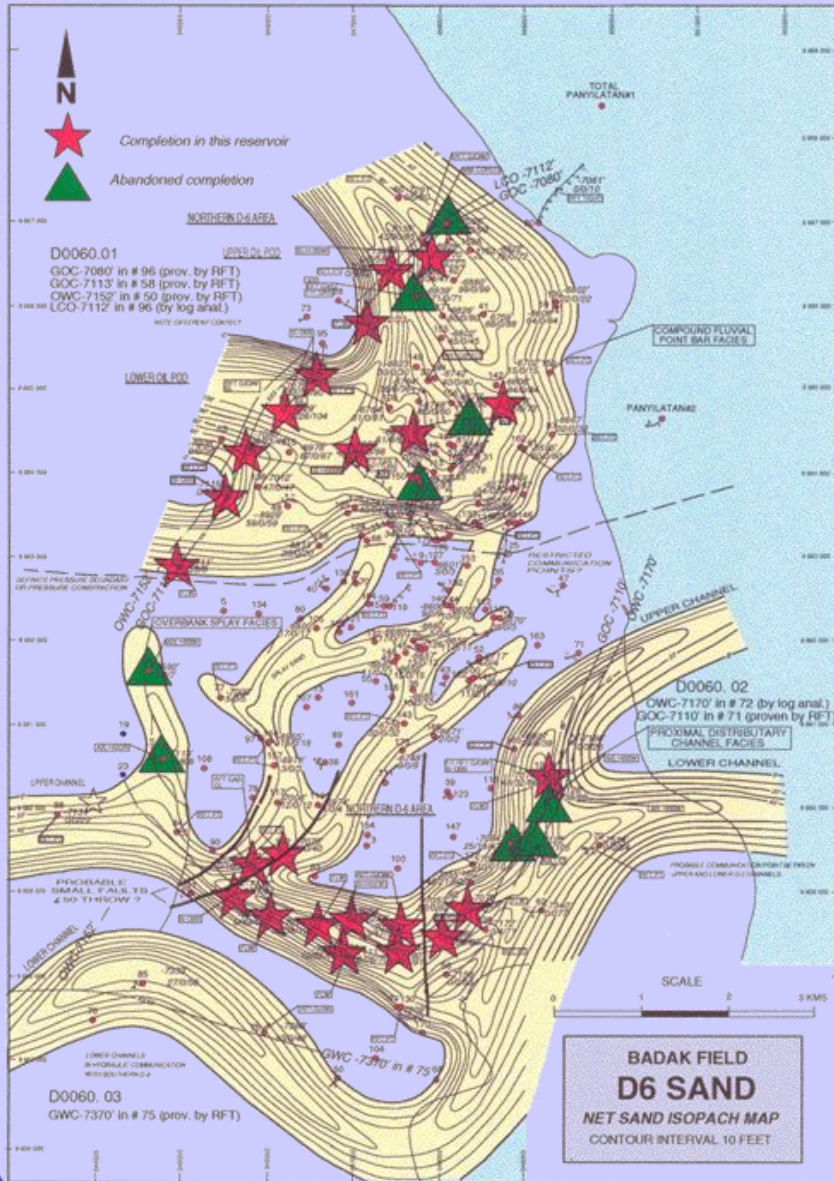


# Reams Southeast Field Middle Booch Net Sandstone Isopach (Showing Combination Trap)





NORTHERN DELTA REGION 3D SEISMIC PROPOSAL

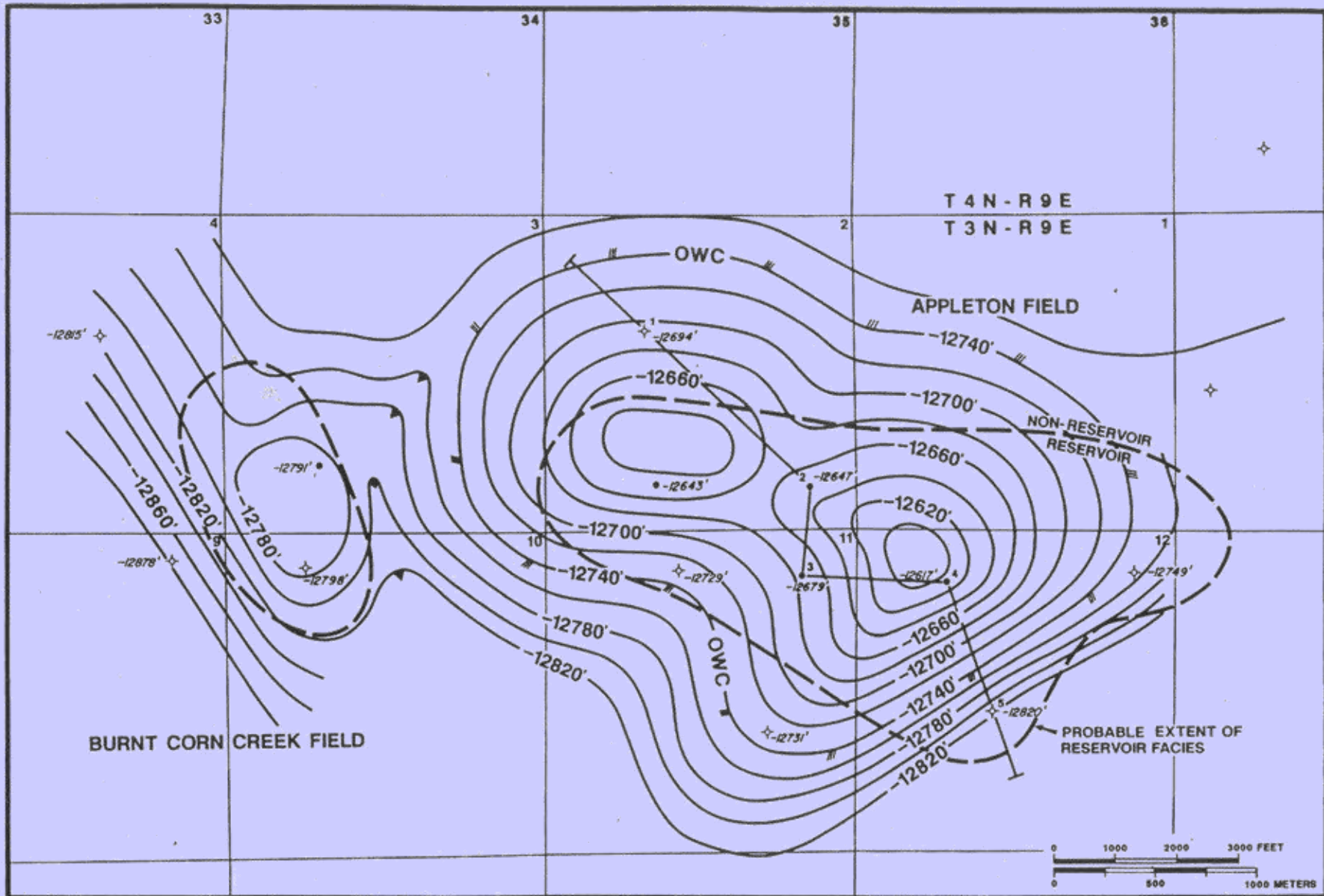


# Badak Field

## Structural – Stratigraphic Trap

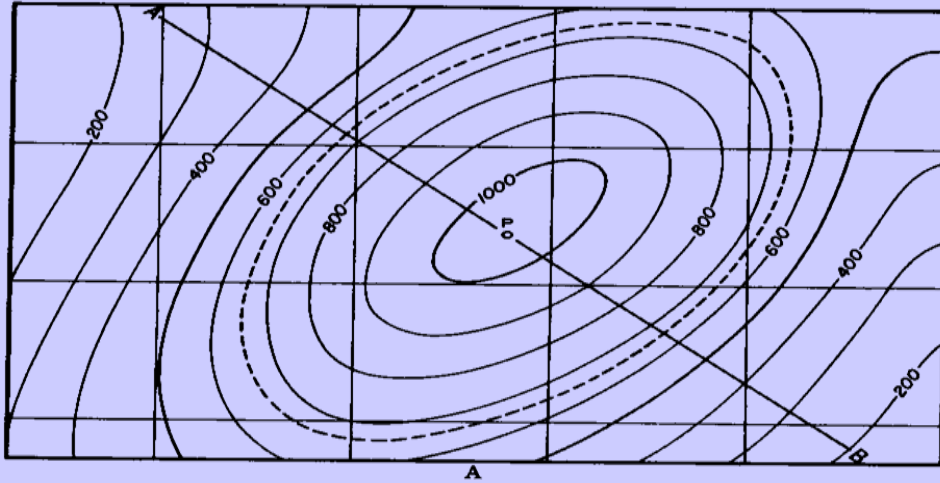
(East Kalimantan, Indonesia)

FIGURE 3.3.5

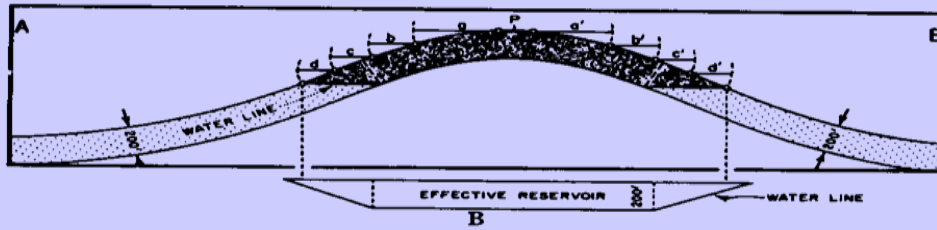


**Figure 5.** Structure map: top of the Smackover porous facies. Slightly over 120 ft (37 m) of closure is present. Contour interval is 20 ft (6 m).

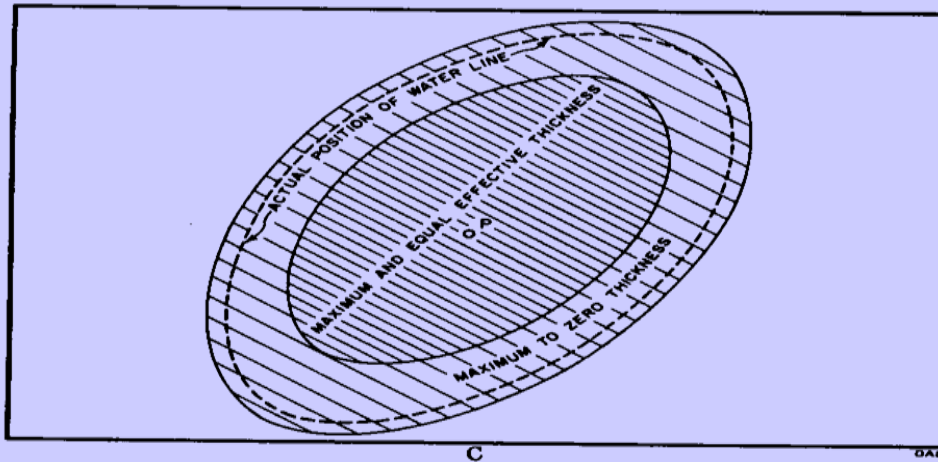
Structure



Structural  
Cross-Section



Volumetric  
Areas

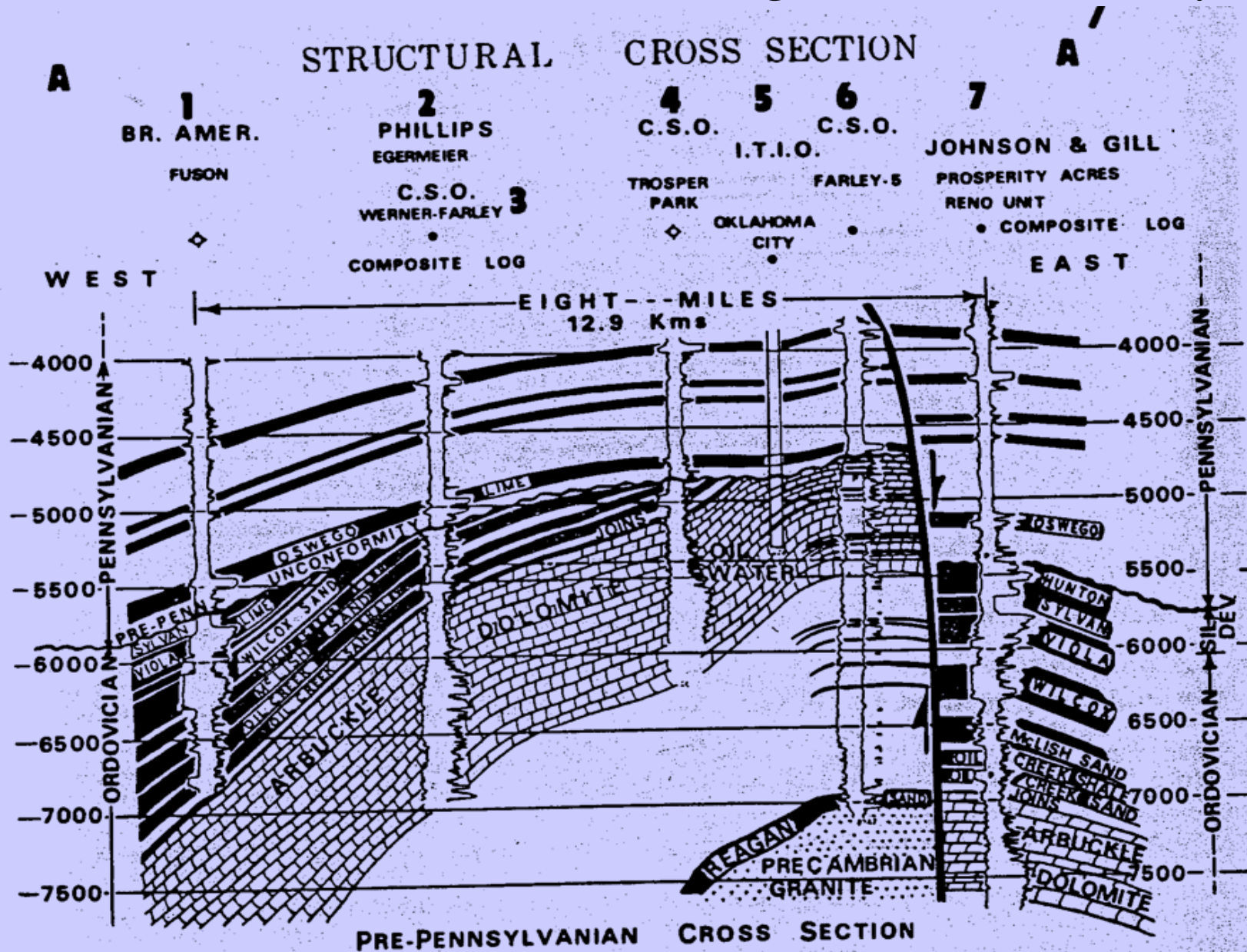


## Volumetric Assessment Net Reservoir Isopach Superimposed on Structure

Figure 22.—Method of computing oil-reservoir volume (Case II).



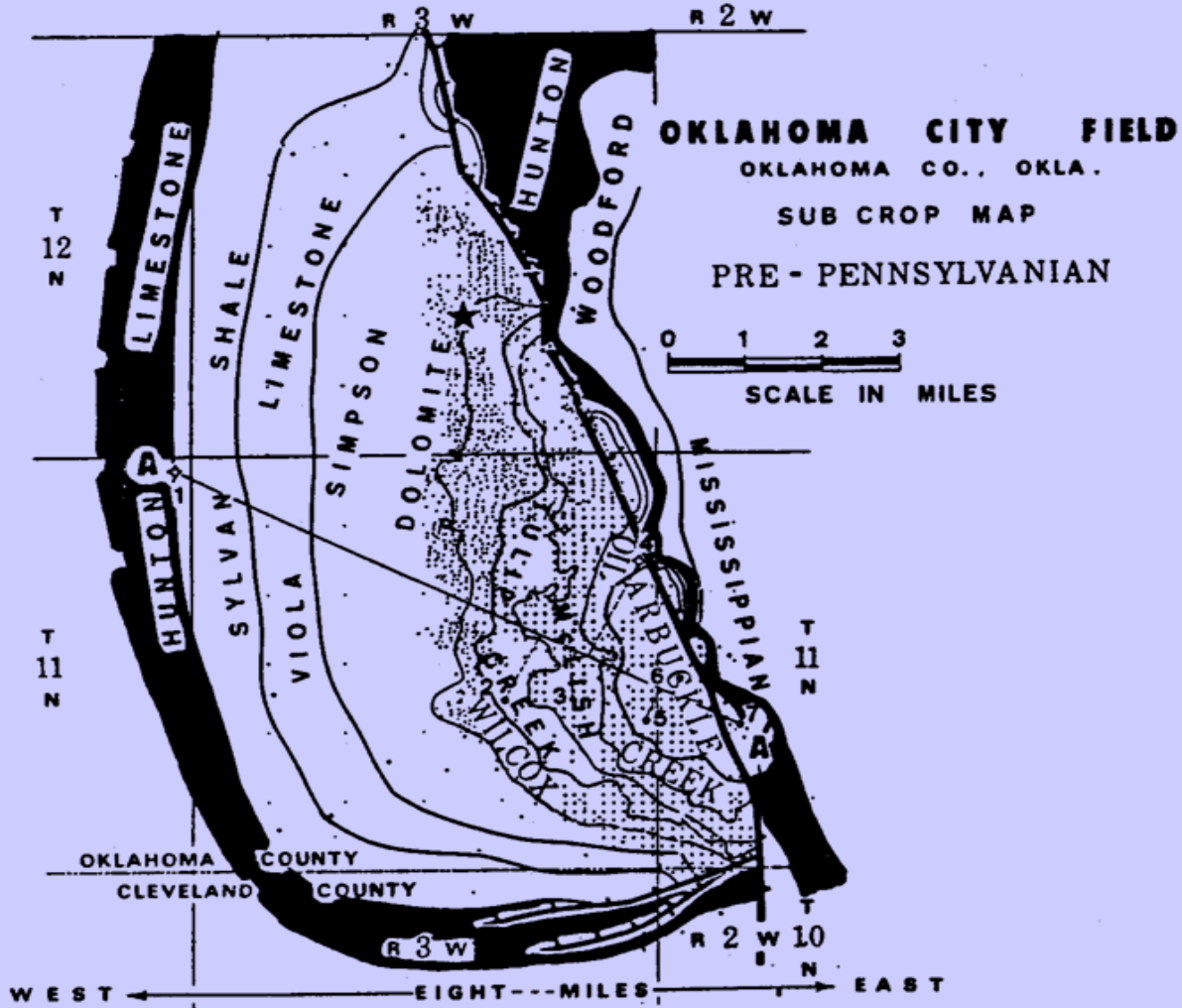
# OKC Field Structural Cross-Section showing Pre-Penn Unconformity



**Oklahoma City Field (Largest in Oklahoma)**

# Another Map Type

## Oklahoma City Field—Anatomy of a Giant



Lloyd E. Gatewood - 1969

FIG. 7.—Pre-Pennsylvanian subcrop map illustrating large areal extent of erosion and truncated shape Ordovician Simpson and Arbuckle preserved at unconformity surface. A-A' is line of sections in Figures 6 and

### Oklahoma City Field Sub-Crop Map (Pre-Penn Unconformity)

# Arkoma Basin Estimated Overburden Removal

