United States Department of Energy Sponsored:

Study of the West Carney Hunton Field: Lincoln & Logan Co., Oklahoma: A Preliminary Report



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The U.S. Department of Energy

National Petroleum Technology Office

Contract DE-FC26-00BC15125

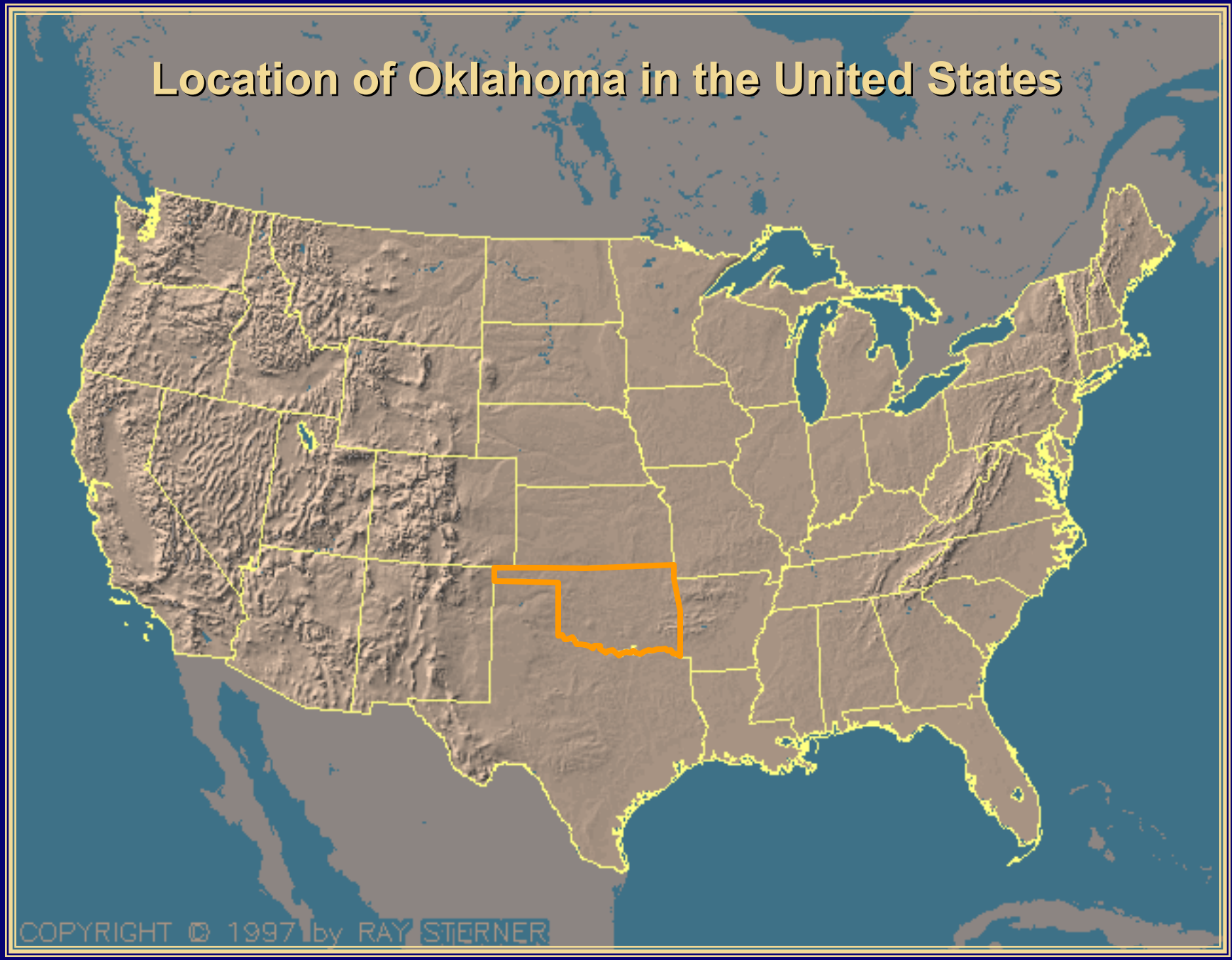
Awarded To

University of Tulsa
Petroleum Engineering Department

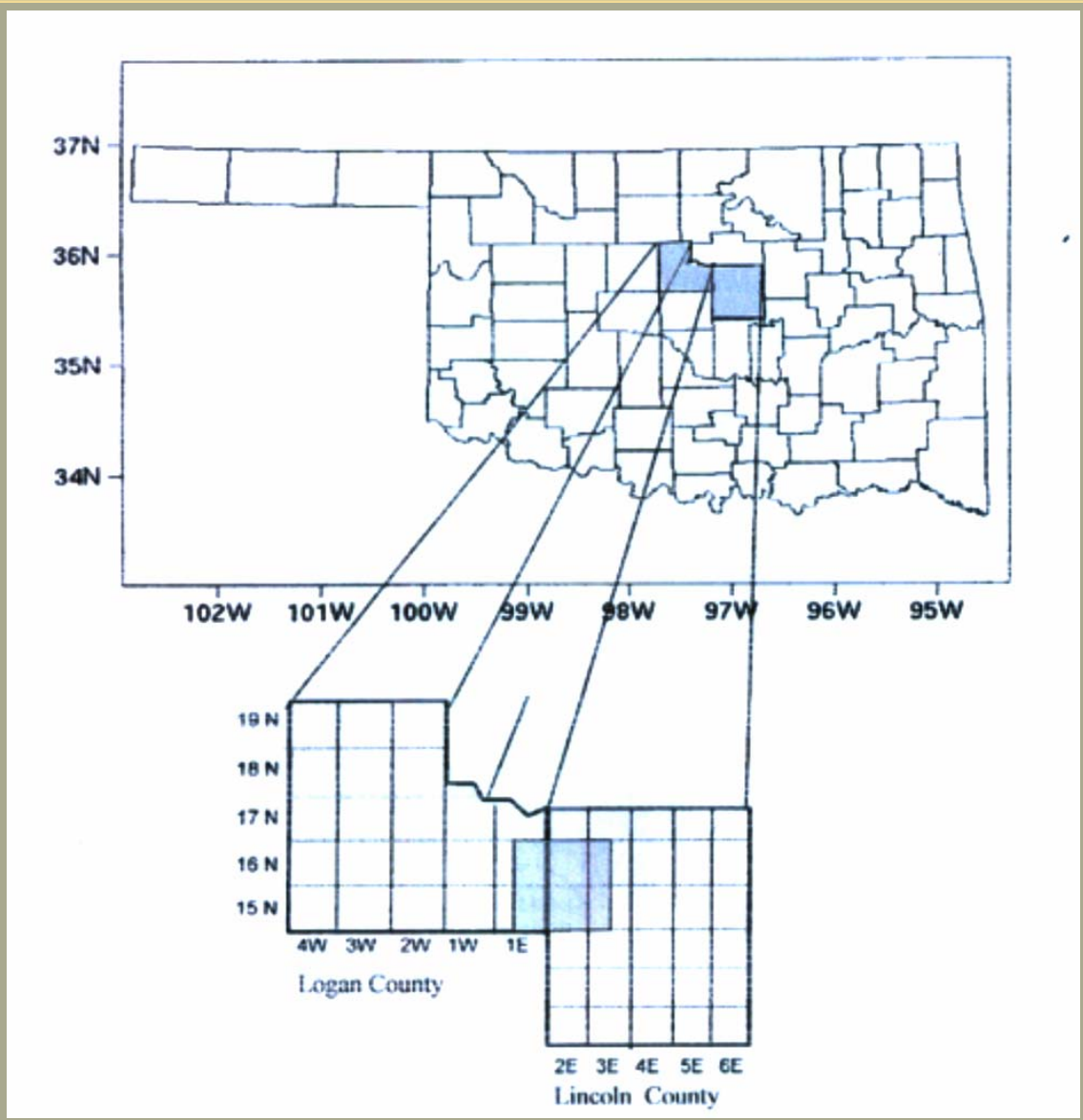
For the Study of…

"Exploitation and Optimization of Reservoir Performance in the Hunton Group, Oklahoma"

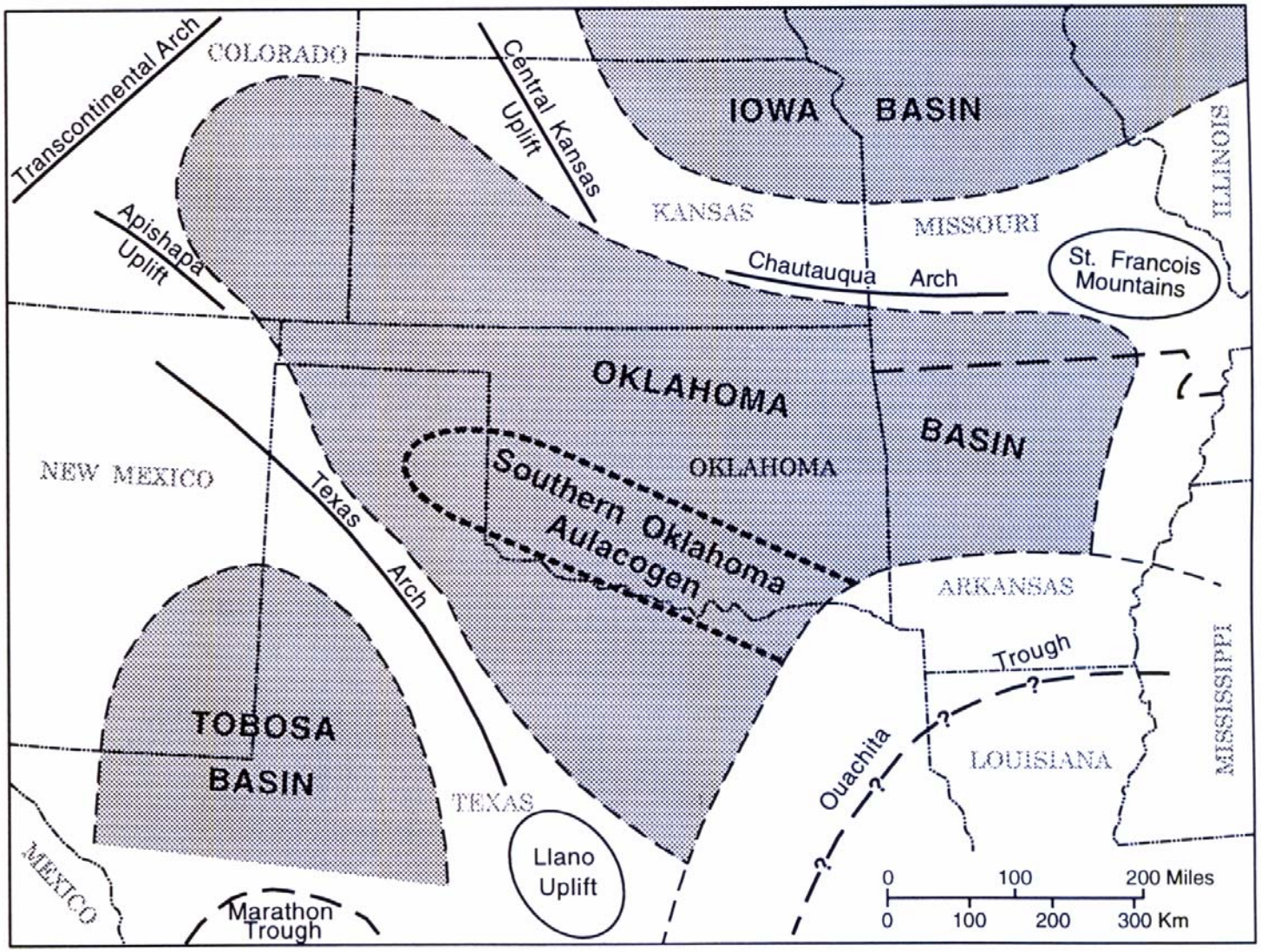
Principle Investigator and Project Director: Dr. Mohan Kelkar

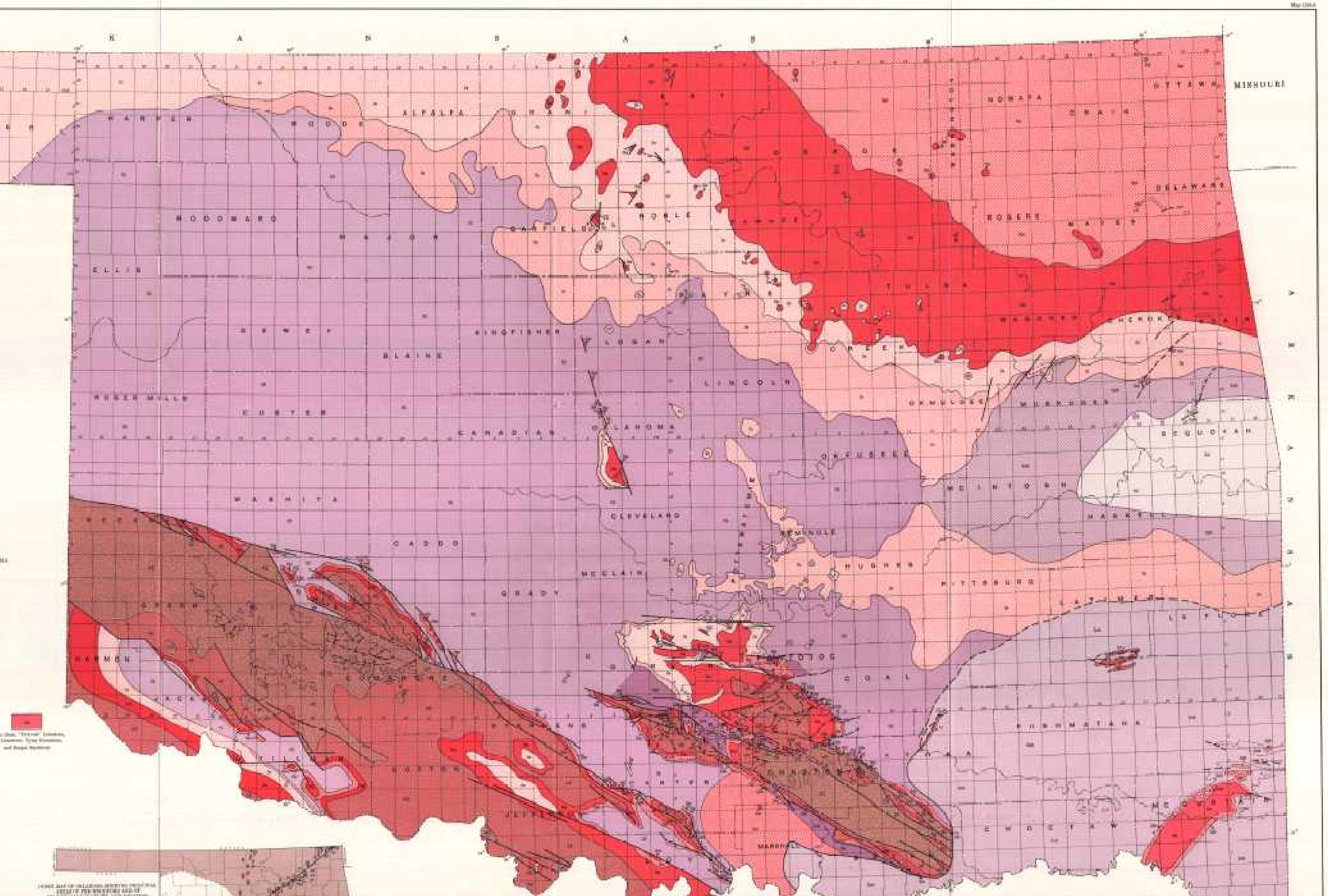

Location of Oklahoma in the United States
COPYRIGHT © 1997 by RAY STERNER

Location of West Carney Hunton Field in Oklahoma, USA



Oklahoma Basin in Late Paleozoic Time (Northcutt & Johnson 1997)





GEOLOGIC MAP AND SECTION OF PRE-WOODFORD ROCKS IN OKLAHOMA

SHOWING SURFACE AND SUBSURFACE DISTRIBUTION

by

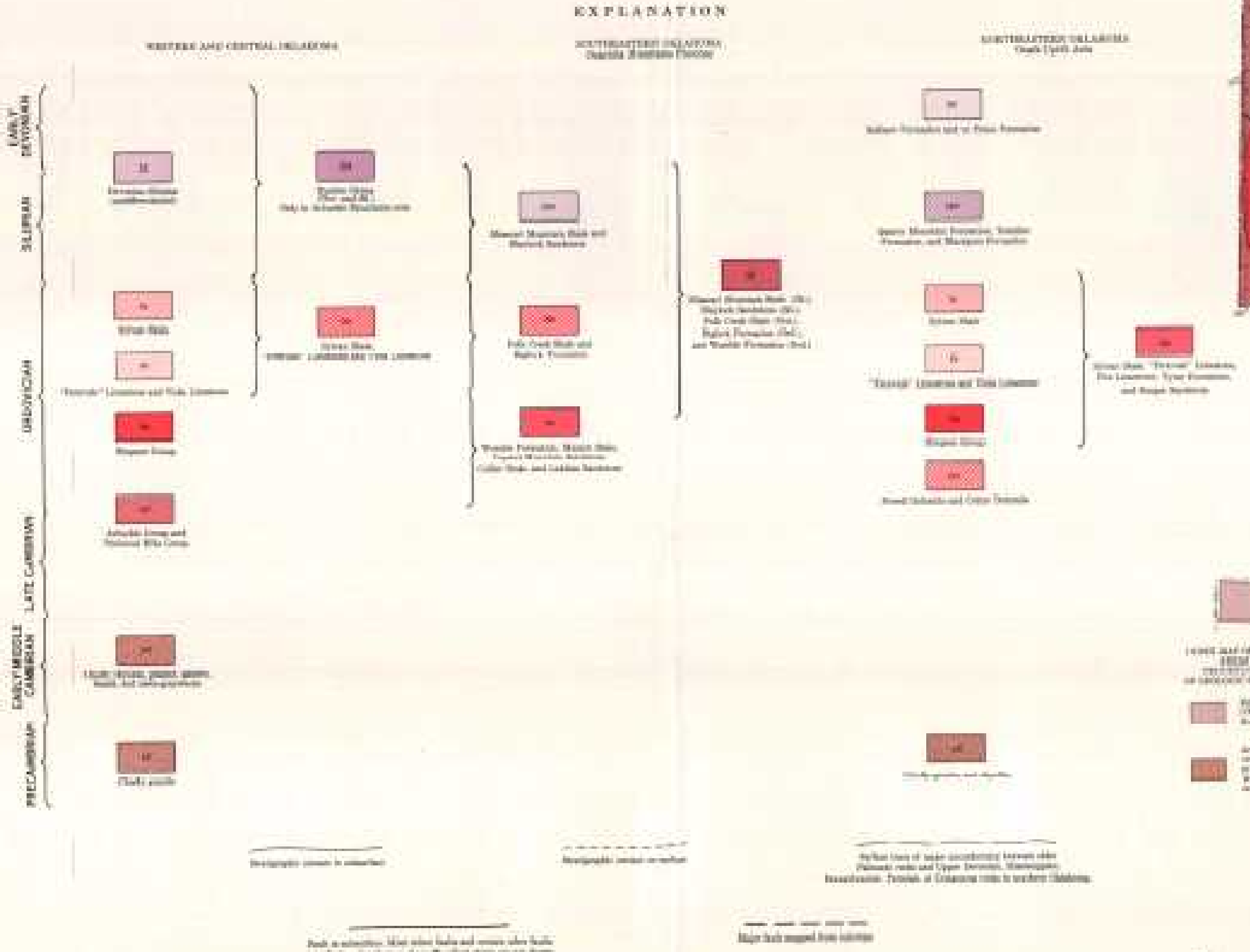
RUSSELL S. TARR, LOUISE JORDAN, AND T. L. ROWLAND

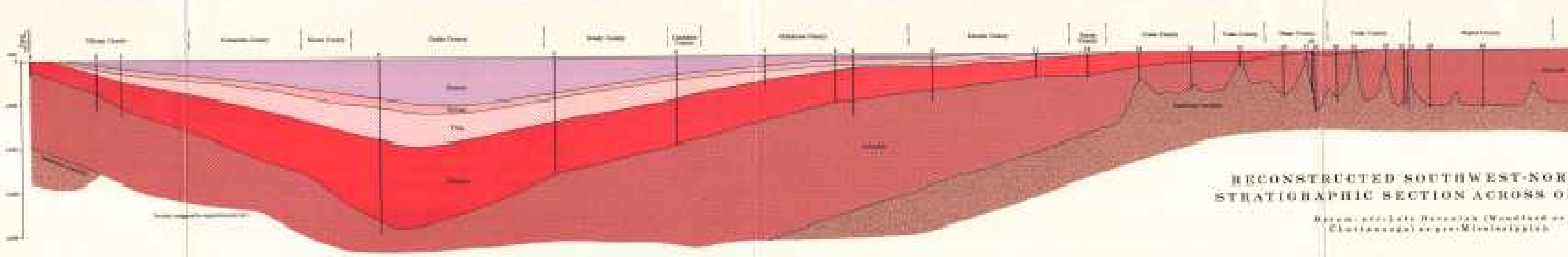
Prepared in collaboration with oil companies and geologists of Oklahoma

1965
Second Printing, [illegible]

Surface geology modified from Geologic Map of Oklahoma, 1954, by Hugh D. Miser, and from other published sources. Small areas of complex structure are exaggerated and simplified. Datum at most places is the unconformity at base of Upper Devonian rocks. Over most of the State this regional unconformity is at the base of the black shale of the Woodford Formation, but locally in southern Oklahoma, it is at the base of pre-Woodford brown carbonate. In northern Oklahoma the unconformity is at the base of the Noel (Chattanooga) Shale or at the base of the underlying sandstone called Misener in the subsurface and Sylamore in outcrop. In southeastern Oklahoma and locally in northern Oklahoma pre-Woodford rocks are unconformably overlain by Mississippian rocks or at places over structures by Pennsylvanian rocks. Datum over much of the Ouachita Mountains region of southeastern Oklahoma is at the base of the Arkansas Novaculite.

EXPLANATION

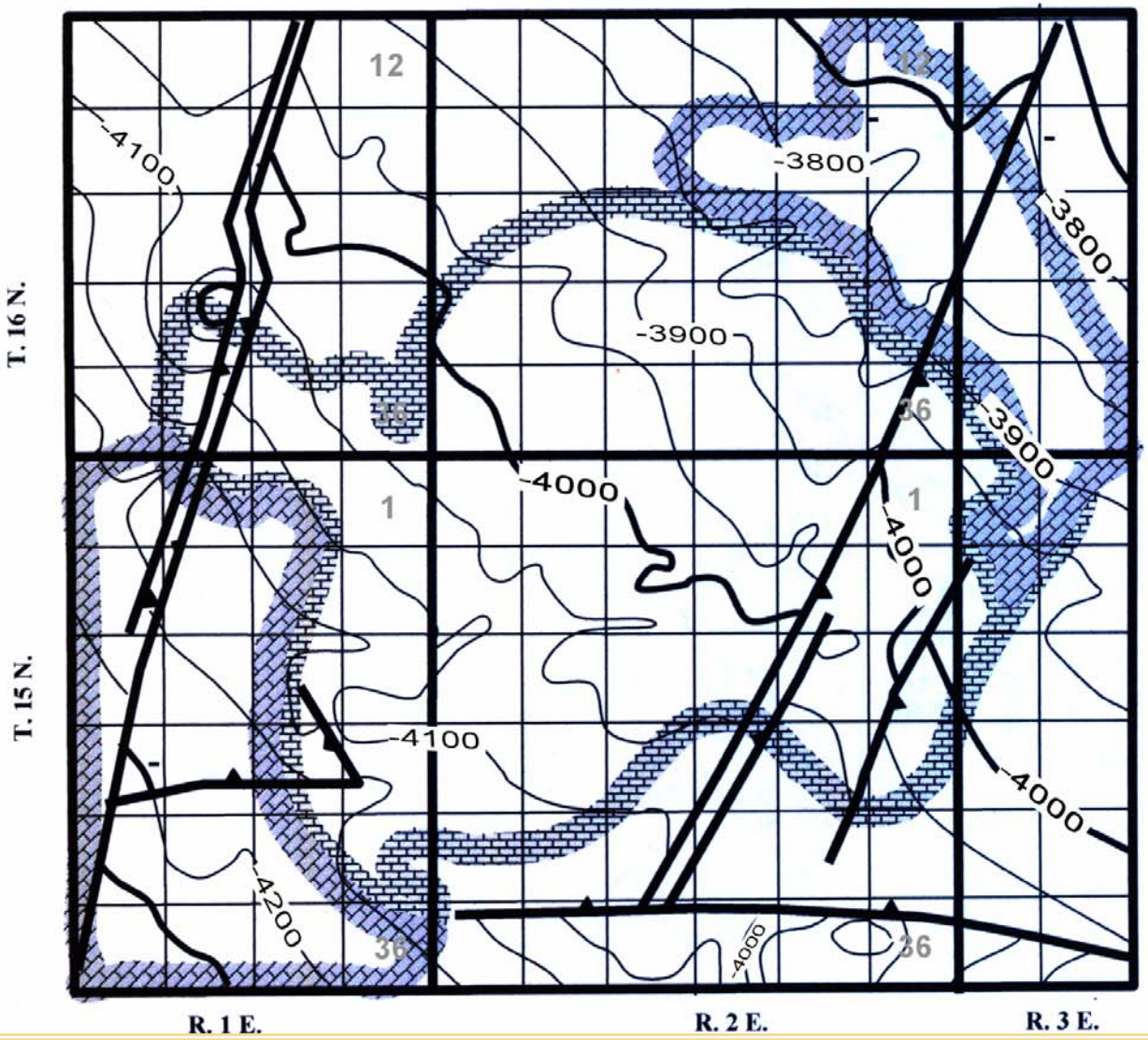




RECONSTRUCTED SOUTHWEST-NORTHEAST STRATIGRAPHIC SECTION ACROSS OKLAHOMA

Datum: pre-Late Devonian (Woodford or Chattanooga) or pre-Mississippian

Structural contour Map of WCHF



Base of the Hunton Group

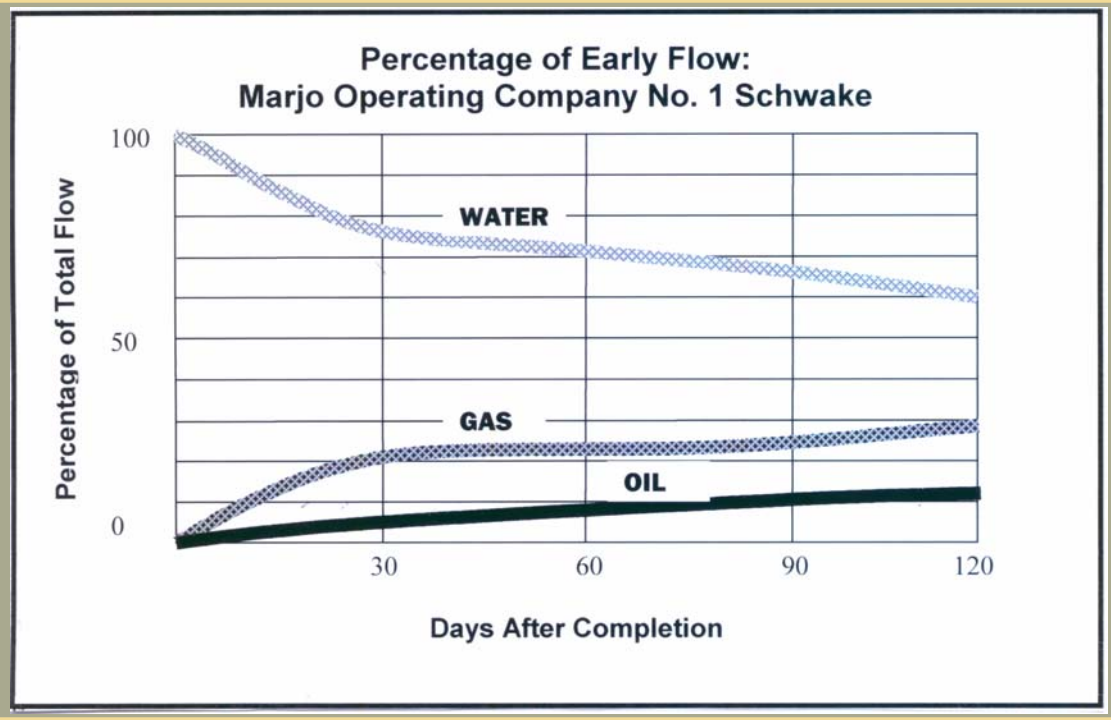
C.I.=50 ft.=15.2 m.

West Carney Hunton Field
General Facts

- Reservoir: Chimney Hill Subgroup
- Reservoir Thickness: 24 ft. to 146 ft.
- Structural Dip Rate: 40 ft/mile to the SW
- Type of Trap: Stratigraphic
- Size: 30,000 Acres

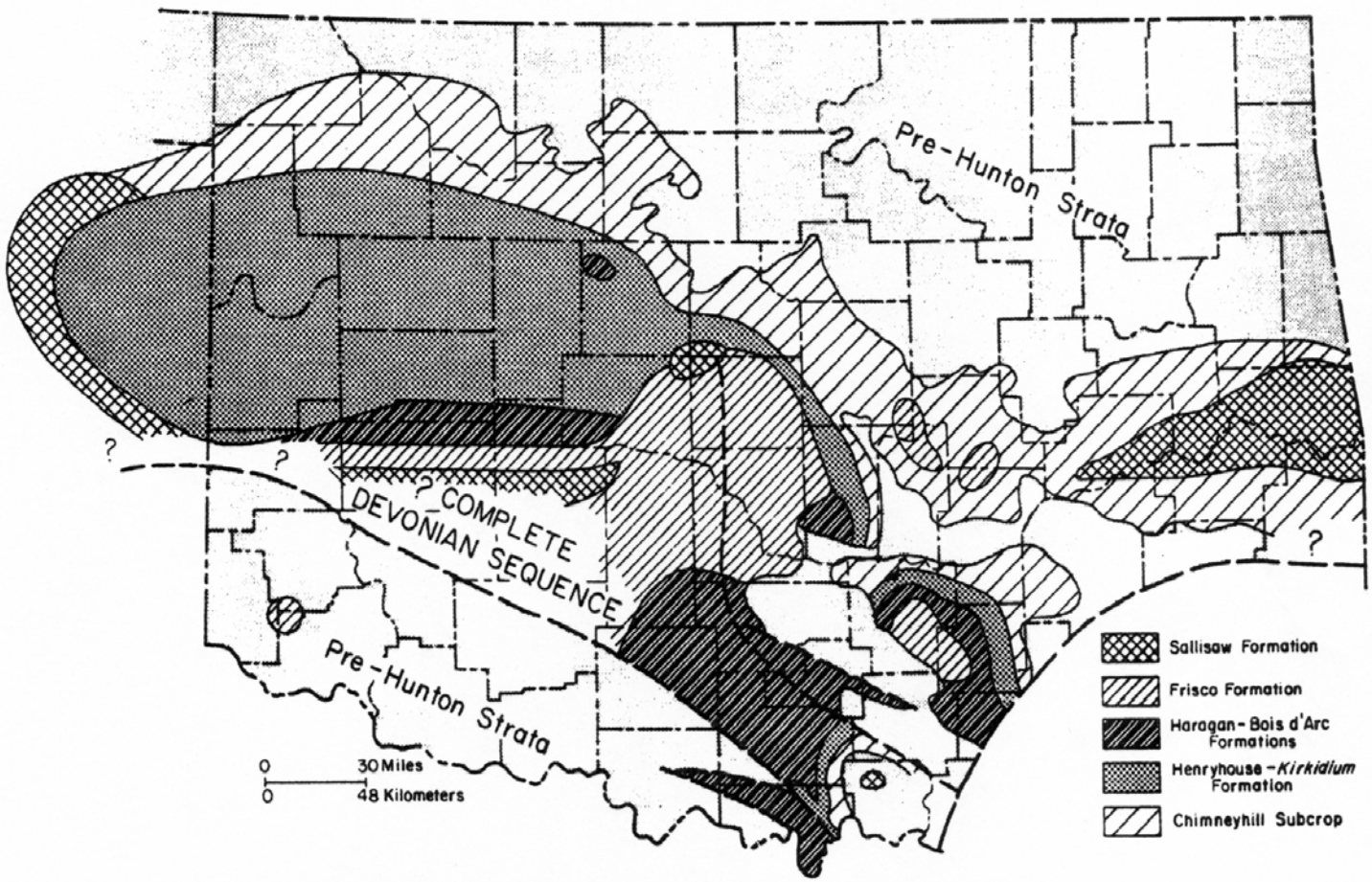
Unique Field Characteristics

1. Large initial Water rate
2. Increasing Gas Volume
3. Increasing Oil Cut



STRATIGRAPHIC SECTION IN WEST CARNEY AREA

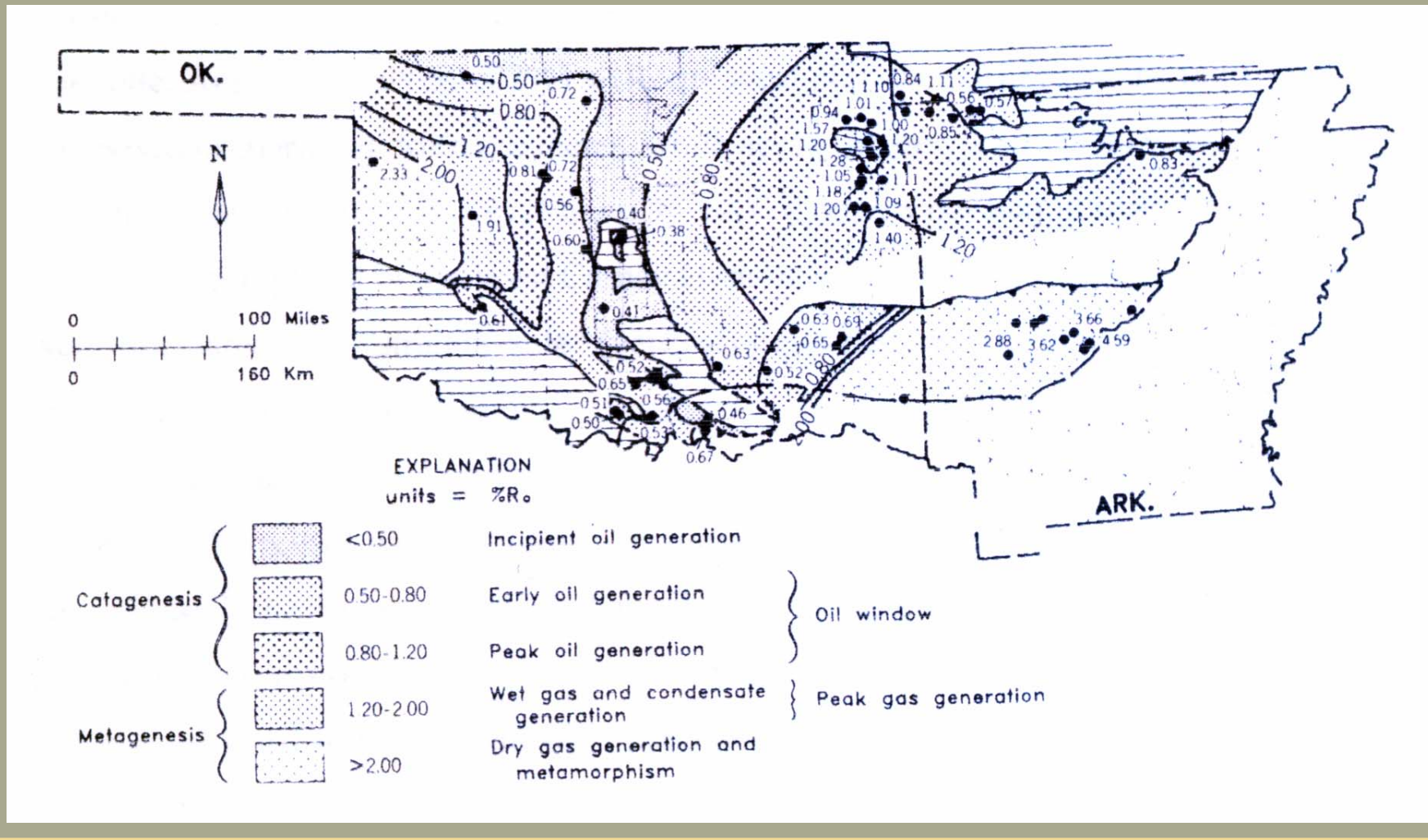
AGE	FM. Or GROUP		LITHOLOGY	THICKNESS
Permian	Sumner-Admire Groups		Mixed: dom. Shale	Combined = 4800 Feet
Pennsylvanian	Complete sequence		Sh, Ss, Ls	
M. & Lt. Miss.	*(Largely missing-Major Unconformity)*			
E. & Mid. Miss.	Osage & Meramec Fms.		Limestone	0-100 Feet
Lt. Dev.-E. Miss.	Woodford Fm		Shale, black, source rock	30-100 Feet
E. & M. Devonian	*(Missing- Major Unconformity)*			
Lt. Ord, Silurian	Hunton Group		Ls, Dolomite	0-140 Feet, avg. 60
Lt. Ordovician	Sylvan Shale		Marine shale	100 Feet
	Viola Group		Dol. & Ss	150-250 Feet
Mid. Ordovician	Simpson Group	Bromide	Ss ("2nd Wilcox")	150 Feet
		McLish	Ss, Sh, Ls	300 Feet
	(Major Unconformity)			
Lt. Camb-E. Ord.	Arbuckle Group		Dolomite	1500 Feet
	(Major Unconformity)			
Pre-Cambrian	Basement Rocks			



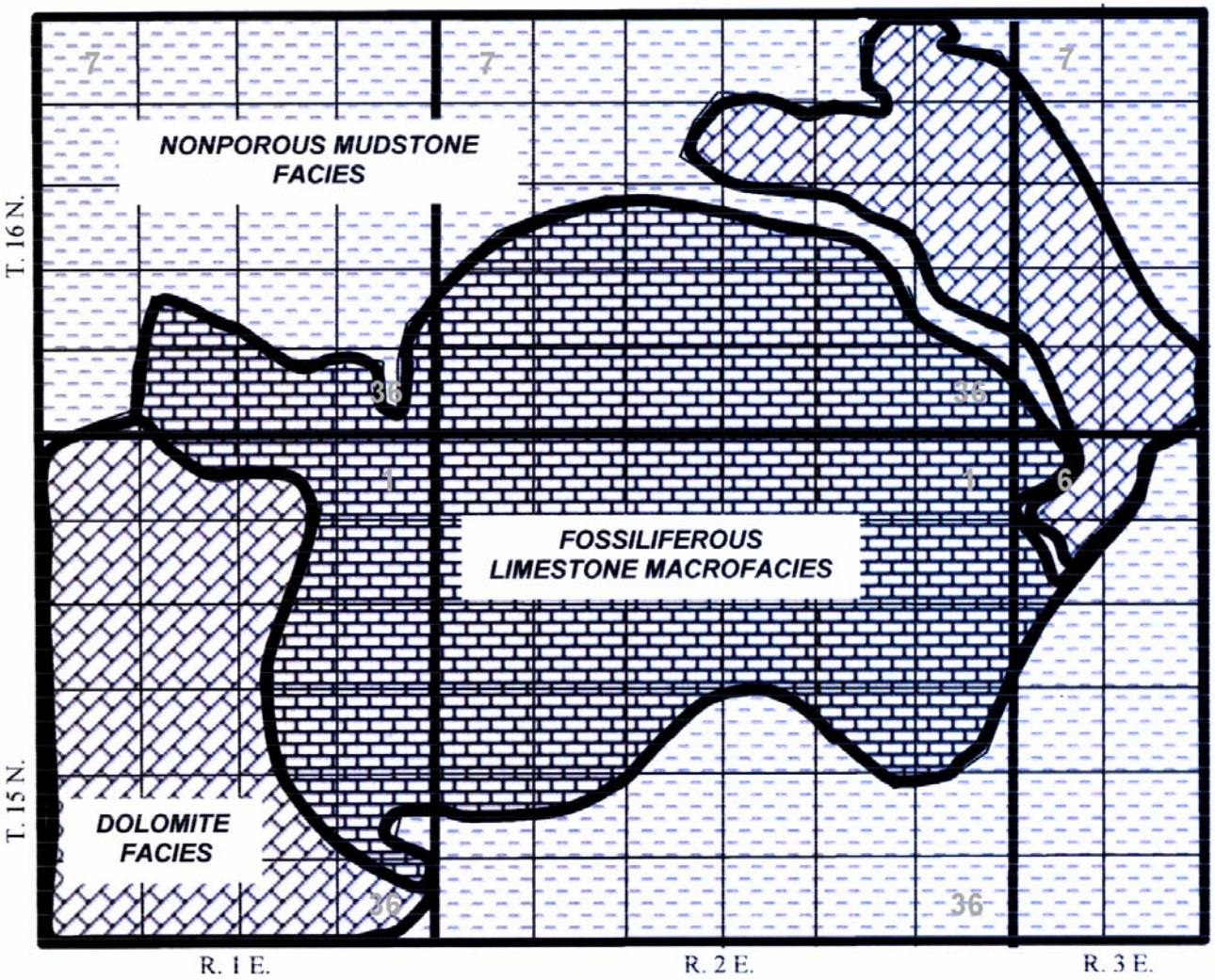
Pre-Woodford Subcrop Map of Hunton Group

(from Amsden, 1980)

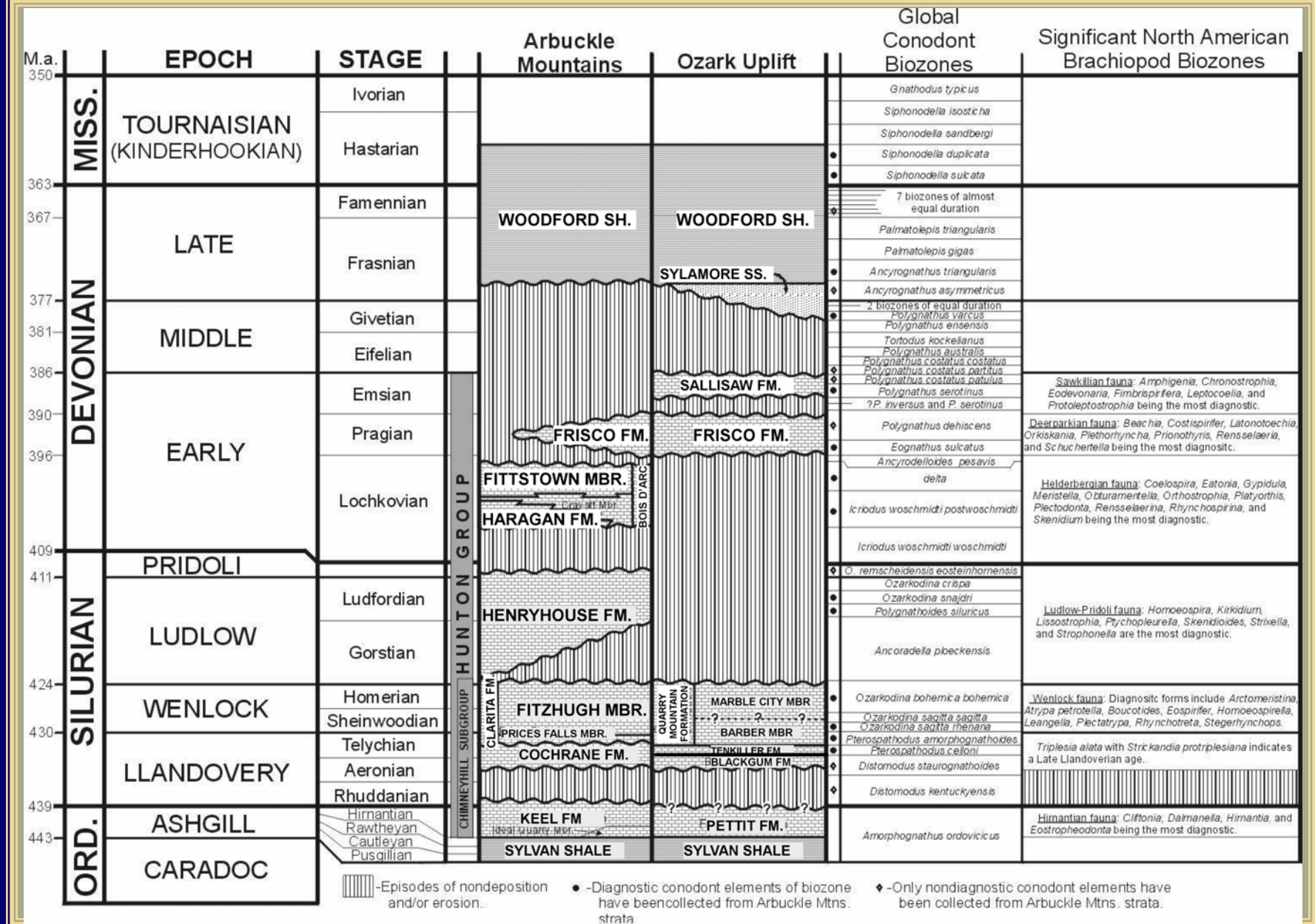
Vitrinite Reflectance of Woodford Formation (From Comer, 1992)

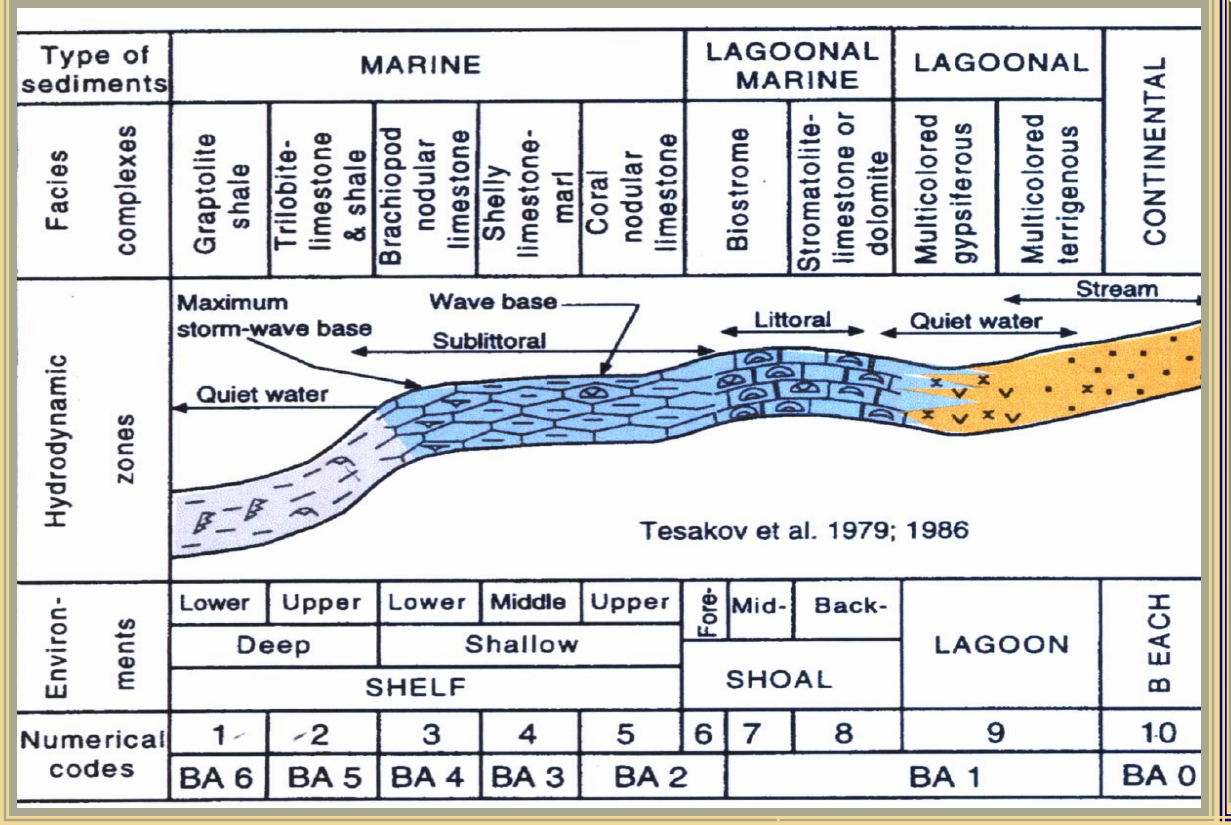


Map of Generalized Hunton Facies in the WCHF



Time-Stratigraphy of the Hunton Group, Oklahoma (From Stanley 2001)





Facies Model for Early Silurian

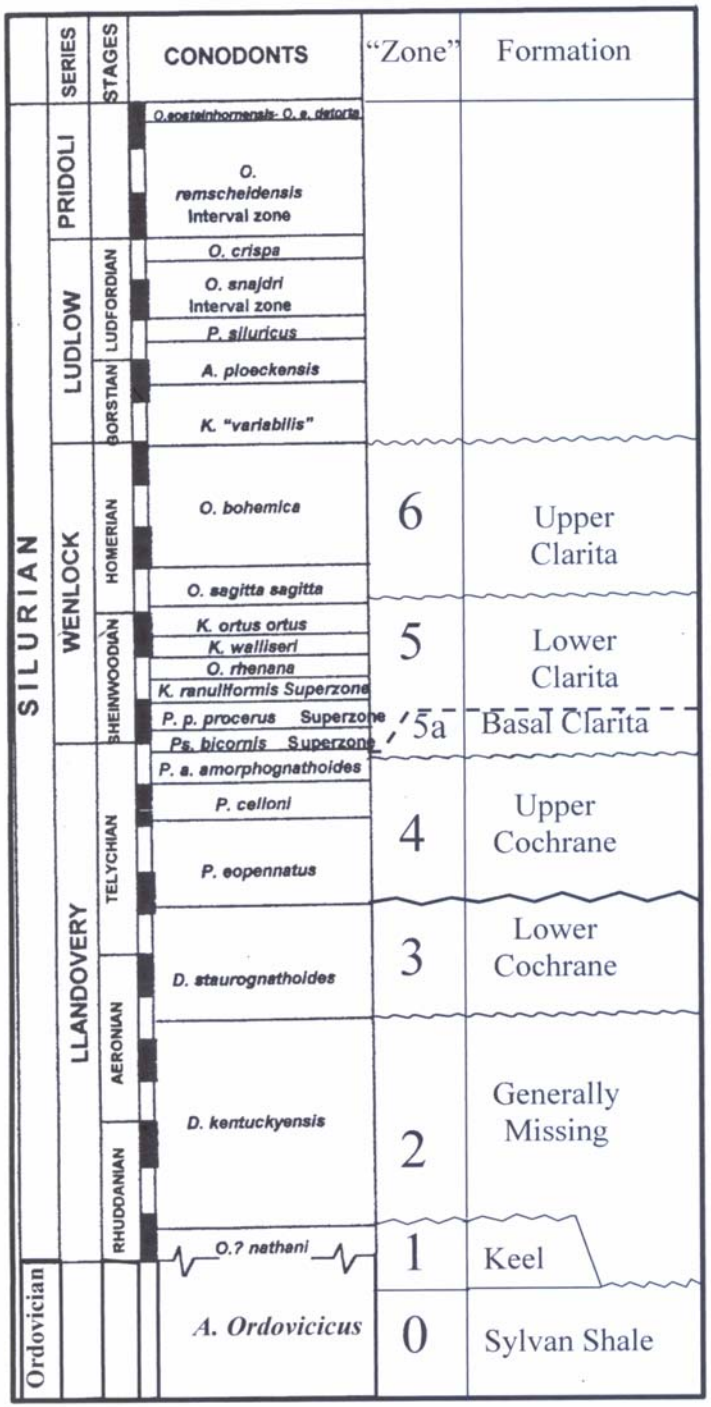
(From Johnson, et al, 1997)

BATHYMETRY OF EARLY SILURIAN MARINE COMMUNITIES

Welsh Basin (Ziegler (1965))		Williston Basin (Johnson & Lescinsky (1986))		Michigan Basin (Johnson & Campbell (1980))		East Iowa Basin (Johnson (1980))		depth (m)
0	Rocky shore	0	Red beds & frosted sands					0 ±
1	Lingulid	1	Stromatolite	1	Stromatolite			0–10
2	Eocoeliid	2	Coral–Stromatoporid	2	Coral–Stromatoporid	2	Coral–Stromatoporid	10–30
3	Pentamerid	large	size variation	3	Pentamerid	3	Pentamerid	30–60
4	Stricklandiid	small	in Cyclocrinitid algae			4	Stricklandiid	60–90
5	Clorindid		lower photic zone limits					90–120
6	Graptolite		Beadle & Johnson (1986)					120–?

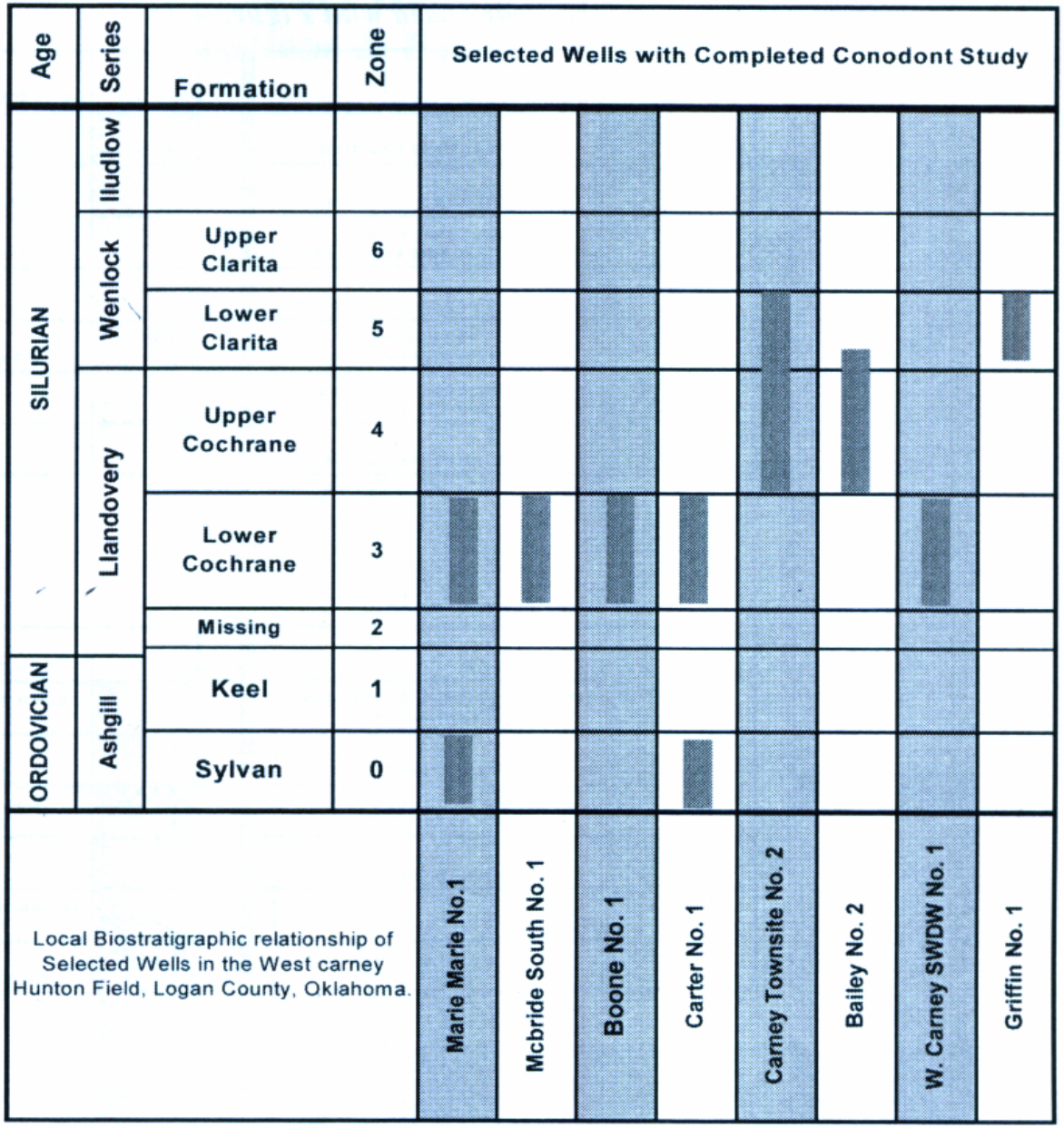
Sedimentary Environments

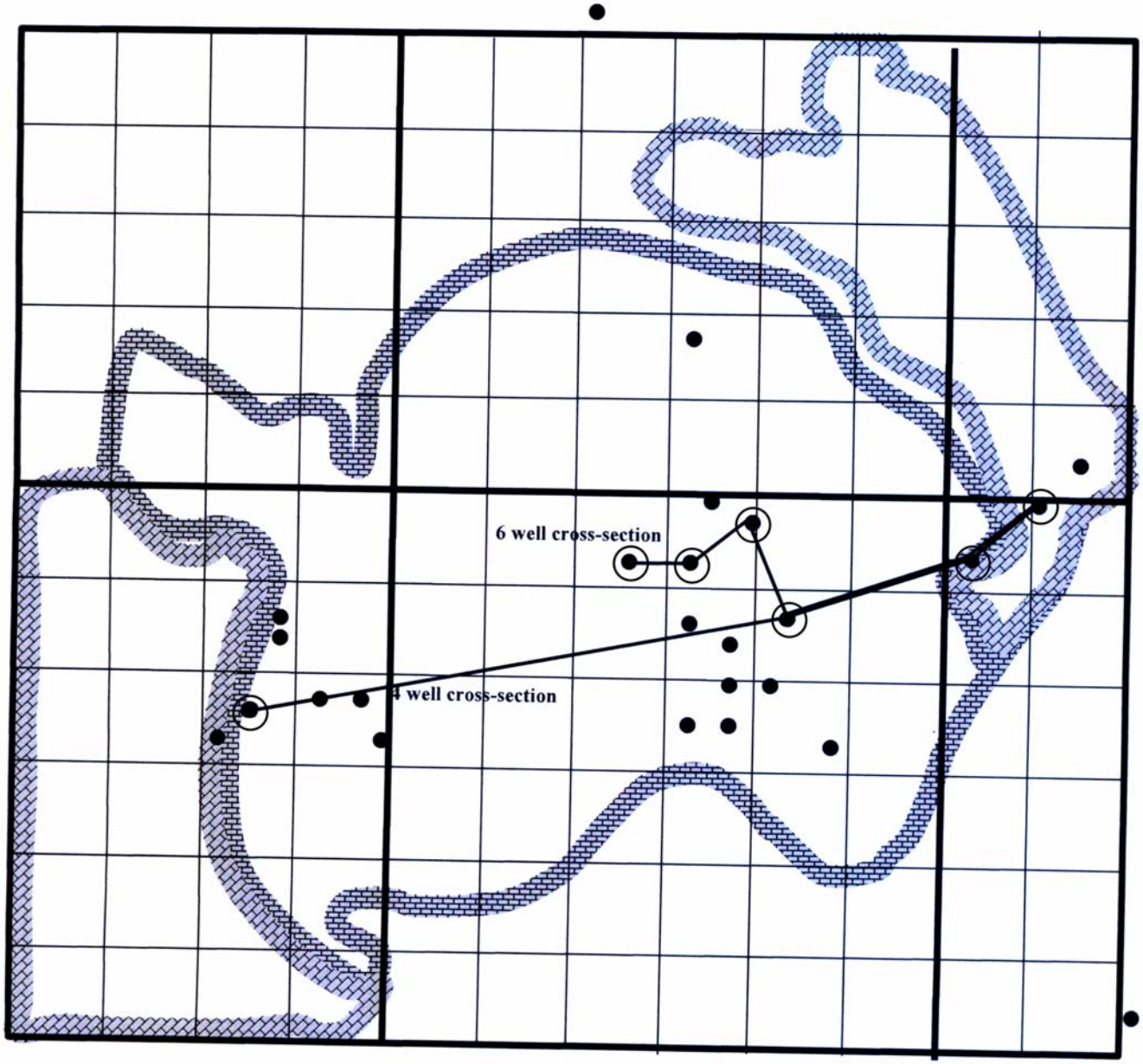
← clastics | platform carbonates →



Generalized Zonation of Late Ordovician-Silurian Conodont Faunas, Oklahoma

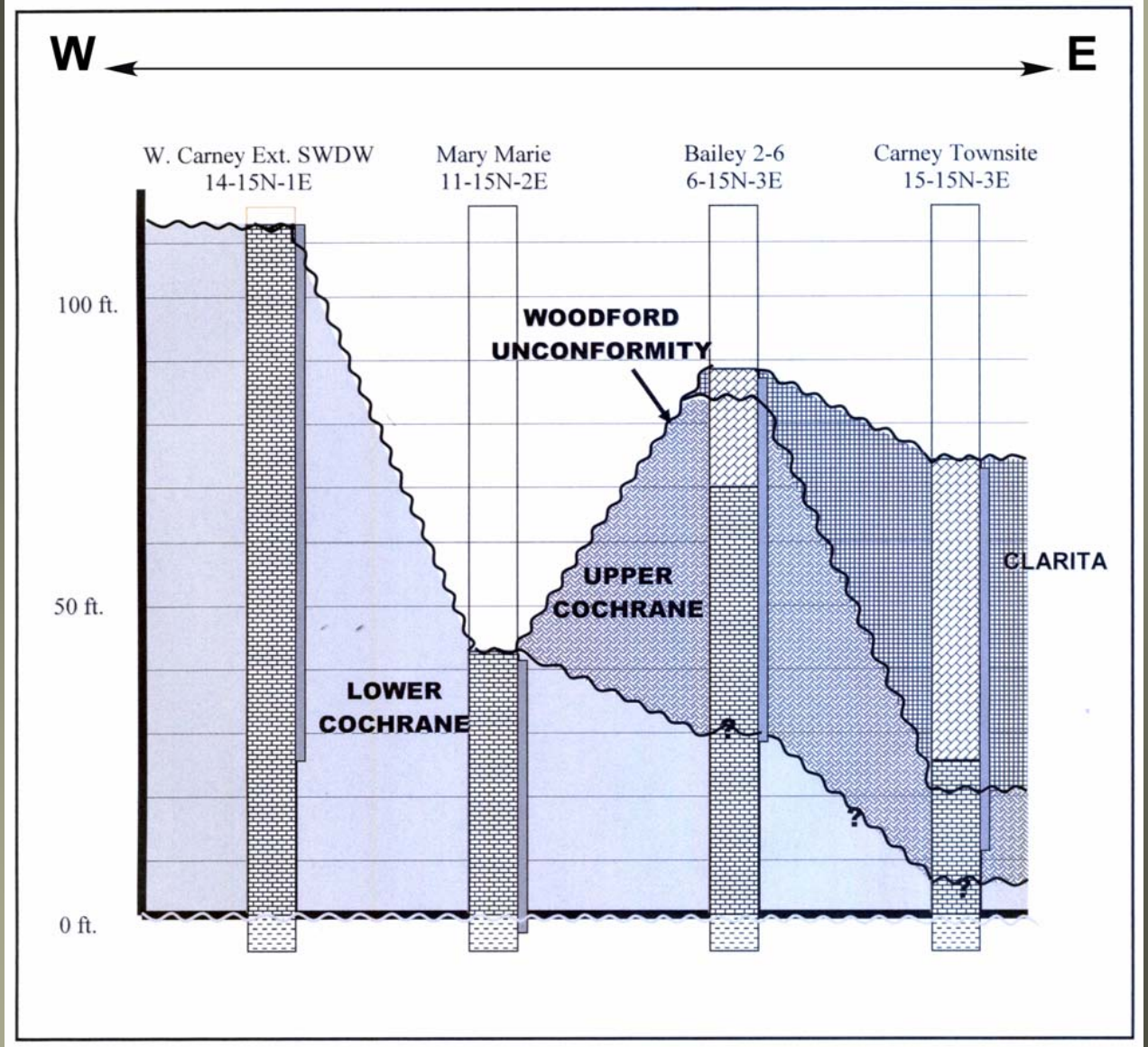
(From James Barrick 2000)


Age
Series
Formation
Zone
Selected Wells with Completed Conodont Study
SILURIAN
ORDOVICIAN
Iludlow
Wenlock
Llandovery
Ashgill
Upper Clarita
Lower Clarita
Upper Cochrane
Lower Cochrane
Missing
Keel
Sylvan
6
5
4
3
2
1
0
Local Biostratigraphic relationship of Selected Wells in the West carney Hunton Field, Logan County, Oklahoma.
Marie Marie No.1
Mcbride South No. 1
Boone No. 1
Carter No. 1
Carney Townsite No. 2
Bailey No. 2
W. Carney SWDW No. 1
Griffin No. 1



Location of cored wells and cross sections

West- East cross-section, Hunton Formations and Generalized lithology, WCHF



Local Stratigraphy: Chimney Hill Subgroup

- Clarita: Dolomite

  Dolomitized Limestone

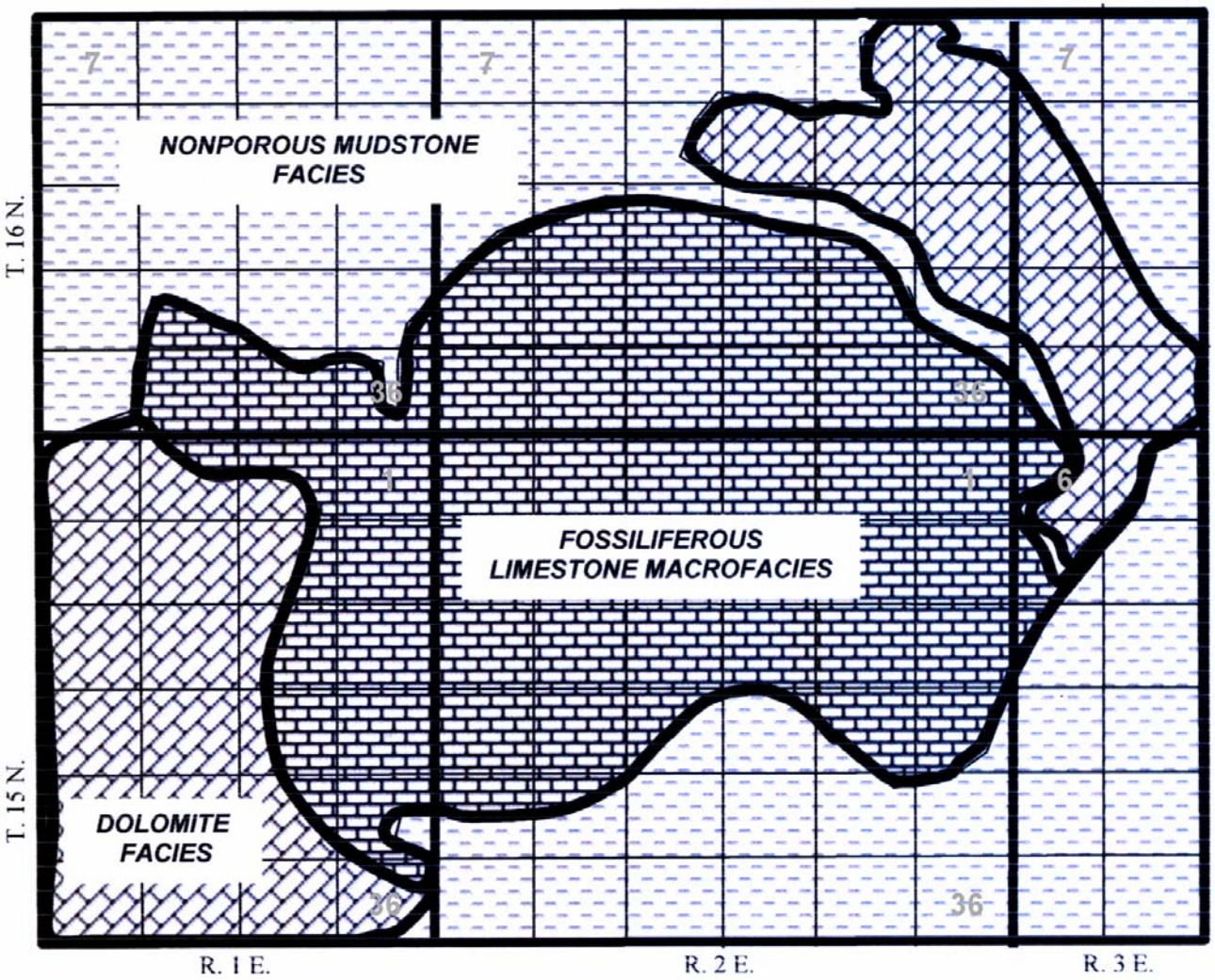
- Cochran: Limestone Facies

  Karsted

  - Localized Dolomitization
  - Brachiopods, Crinoids, Corals, carbonate mud, grainstone

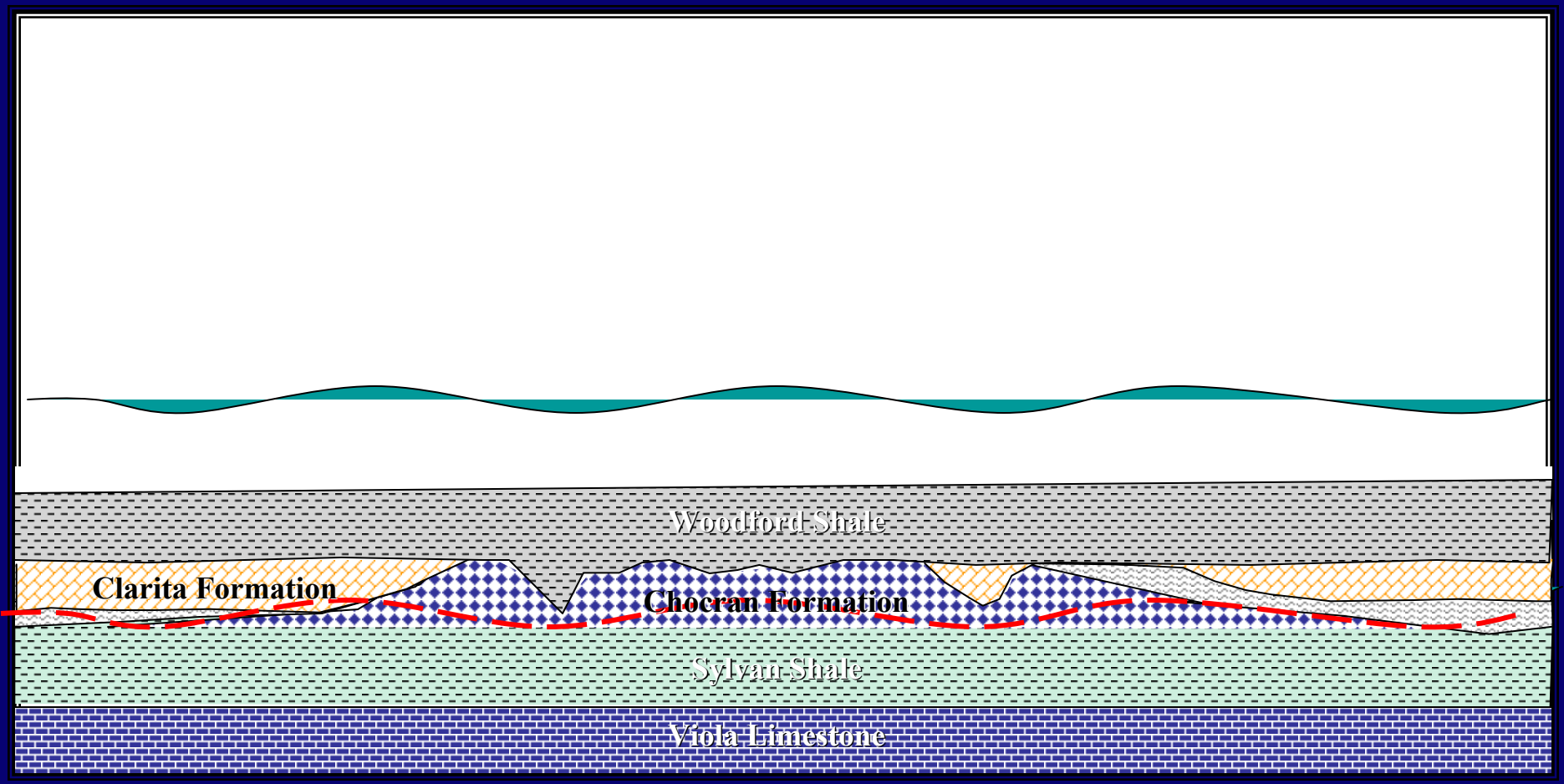
- Keel: Absent

Map of Generalized Hunton Facies in the WCHF

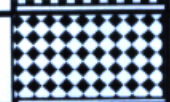


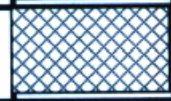
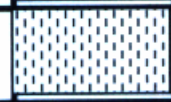
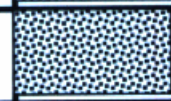
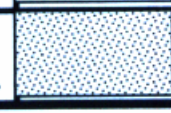
A brief depositional history of the Hunton Group in the WCHF.

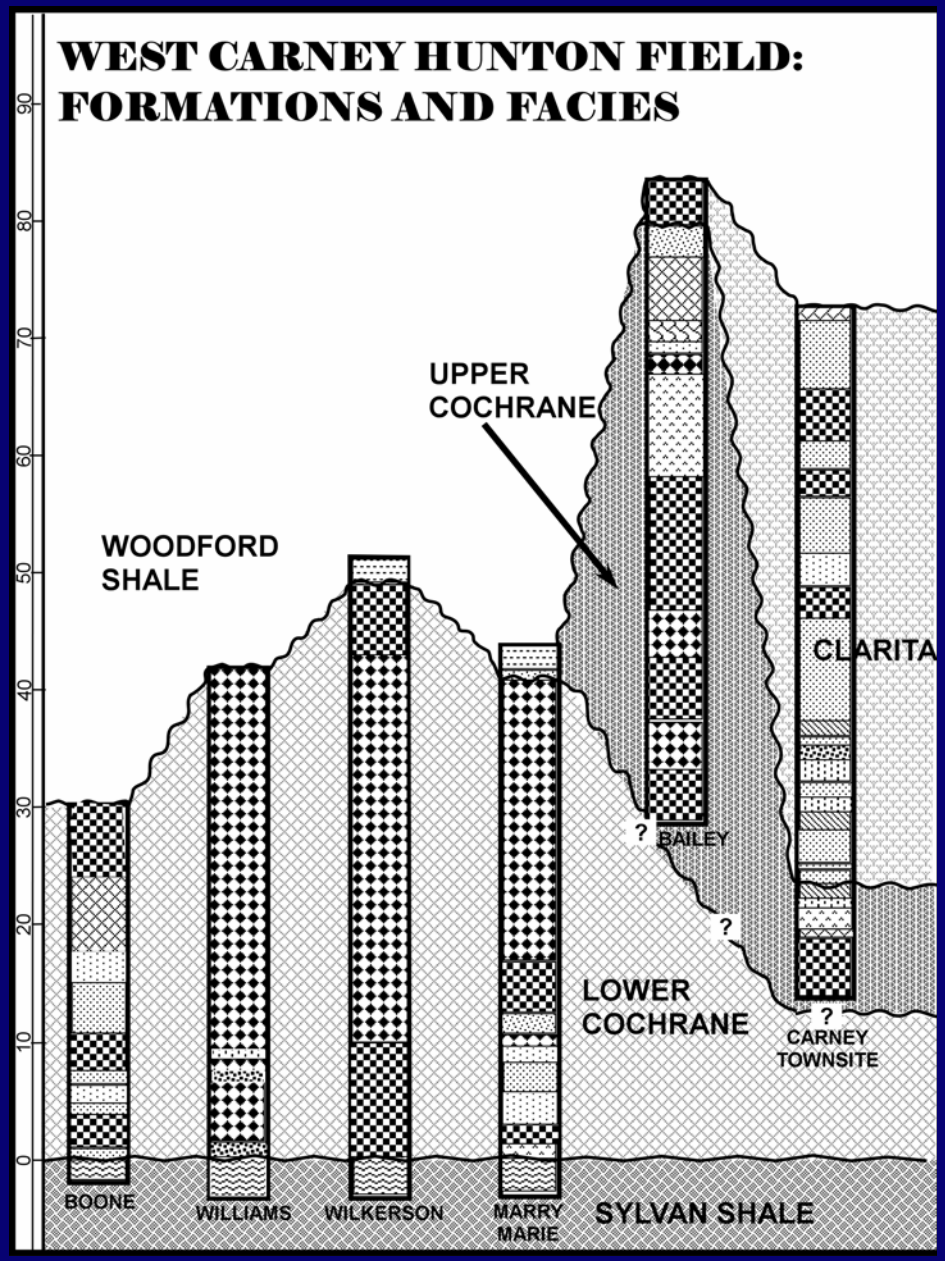
Rise in Sea Level and deposition of Woodford Shale.



Explanation of Symbols used in the Next Slide

CODE	SYMBOL	DESCRIPTION
1		ARGILLACEOUS DOLOMITE
2		CRYSTALLINE DOLOMITE
3		SMALL BRACHIOPOD GRAINSTONE/PACKSTONE/WACKESTONE
4		FINE CRINOID GRAINSTONE/PACKSTONE
5		COARSE CRINOID GRAINSTONE/PACKSTONE
6		MIXED CRINOID-BRACHIOPOD GRAINSTONE/PACKSTONE/ WACKESTONE
7		BIG PENTAMERID BRACHIOPOD

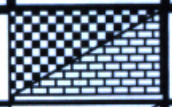
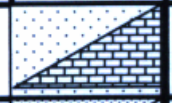
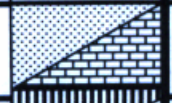
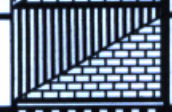
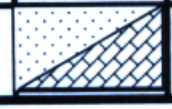
CODE	SYMBOL	DESCRIPTION
8		CORAL AND DIVERSE FAUNA
9		CORAL AND CRINOID GRAINSTONE/WACKESTONE
10		SPARSE FOSSIL WACKESTONE
11		CARBONATE MUDSTONE
12		FINE TO MEDIUM GRAINSTONE
13		SHALE
14		FINE SANDSTONE

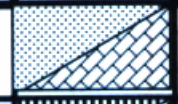
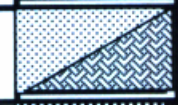
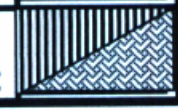


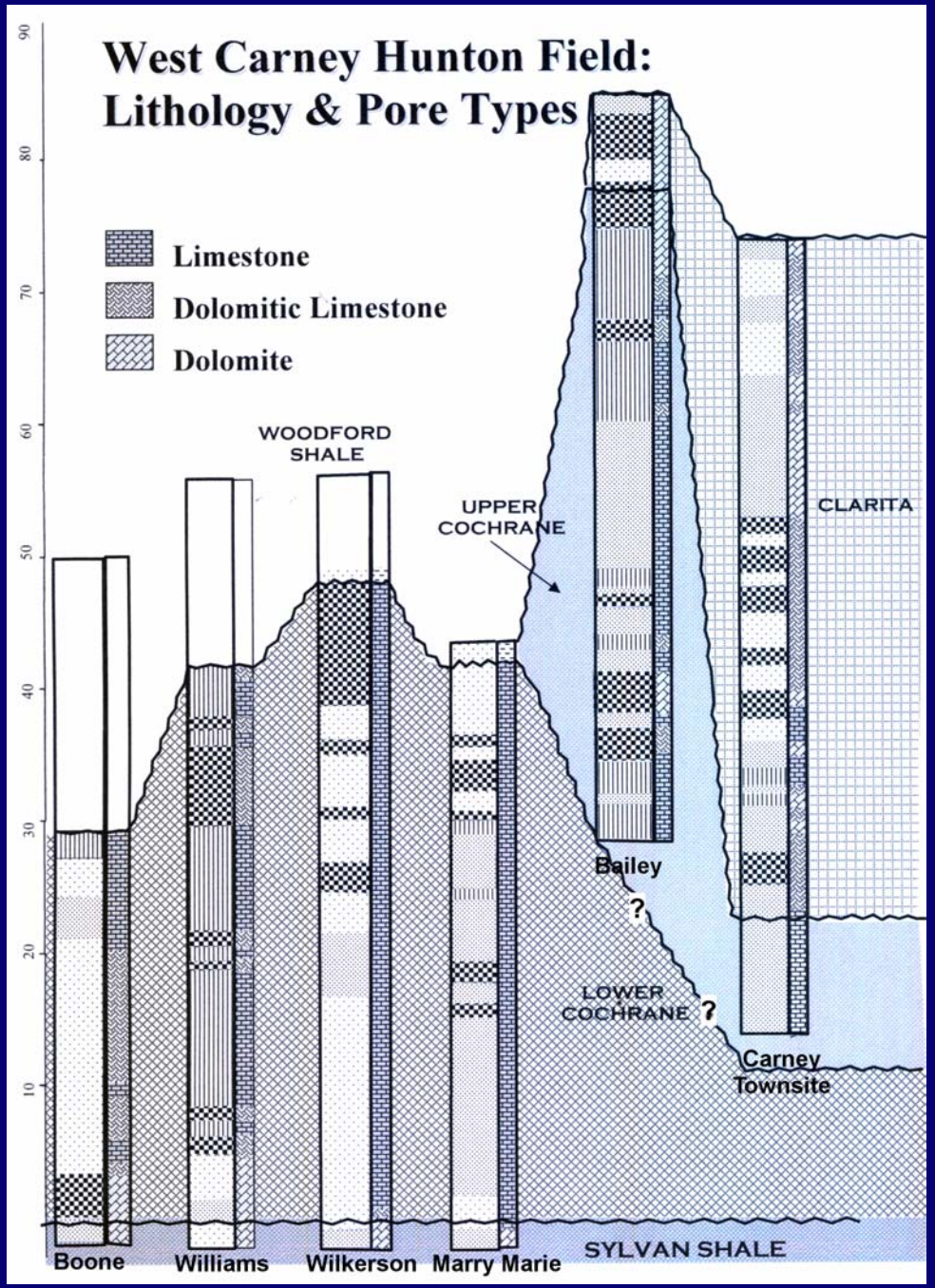
Formation Boundaries derived from Conodont Study

Facies derived from detailed core examination

Explanation of Symbols used in the Next Slide

CODE	SYMBOL	DESCRIPTION
1		INTERCONNECTED VUGGY POROSITY/ LIMESTONE
2		COARSE MATRIX POROSITY/ LIMESTONE
3		FINE MATRIX POROSITY/ LIMESTONE
4		FRACTURE/ LIMESTONE
5		VUGGY OR MOLDIC POROSITY/DOLOMITE
6		COARSE CRYSTALINE POROSITY/ DOLOMITE

CODE	SYMBOL	DESCRIPTION
7		MEDIUM TO FINE CRYSTALINE POROSITY/ DOLOMITE
8		FRACTURE/ DOLOMITE
9		VUGGY OR MOLDIC POROSITY/ DOLOMITIC LIMESTONE
10		COARSE CRYSTALINE POROSITY/ DOLOMITIC LIMESTONE
11		MEDIUM TO FINE CRYSTALINE POROSITY/ DOLOMITIC LIMESTONE
12		FRACTURE/ DOLOMITIC LIMESTONE



Formation Boundaries derived from Conodont Study

Pore and Lithology types derived from detailed core examination

Porosity System

High Permeability Component

- Solution-enlarged fractures
- Interconnected macro-vugs

K > 1000 md

Low Permeability Component

- Limestone: Mostly secondary, Fossil Moldic, dissolution of mud matrix, dissolution of intergranular cement

K < 10 md

- Dolomite: Intercrystalline, Fossil Moldic, Karst microvugs

K : 50-200 md

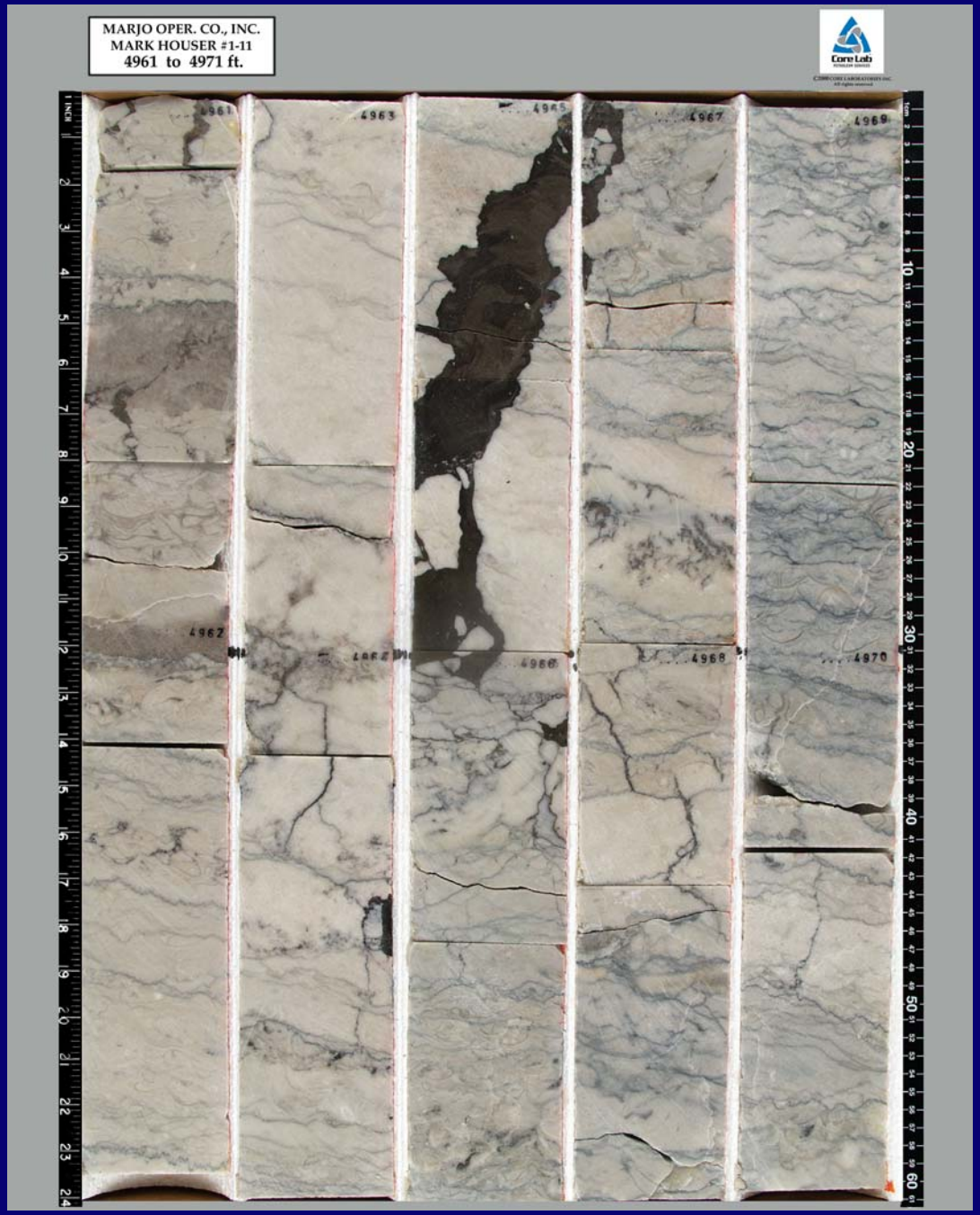
Karst in WCHF

Entire Thickness of the Hunton Group in WCHF is Karsted

- Terra Rosa
- Solution-enlarged fractures
- Breccias: Crackle, Mosaic, Chaotic
- Breccia-filled Caverns
- Cavern and Fracture-Filling Sediments:
  - Quartzose Sand
  - Clay
  - Carbonate mud, silt, grains
- Solution Collapse

Karst: Example 1

Solution-Enlarged Fracture filled with dark clay sediment from the overlying Woodford Shale



Houser 1-11 4961-71

Karst: Example 2

- Terra Rosa
- Crackle Breccia
- Sediment-filled solution cavities

Houser 1-11 5041-51

Karst: Example 3

- ► Cavern filled with breccia
- ► Top of Cavern at 5061.5 ft., base of cavern at 5072.1 ft.
- ► 100 To 111 feet below top of Hunton

Houser 1-11 5061-75

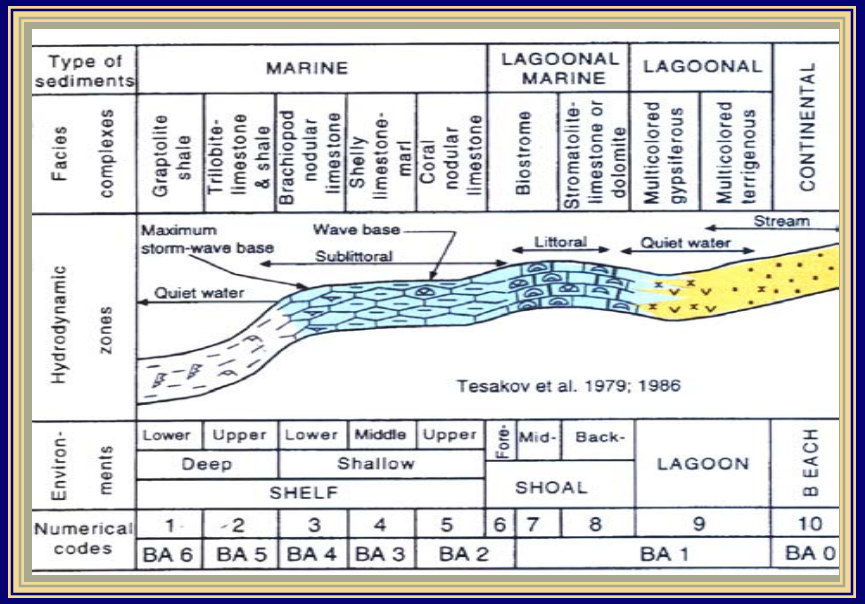
Karst: Example 4

- ► Dipping beds formed by cavern collapse
- ► Crackle Breccia
- ► Solution enlarged fracture

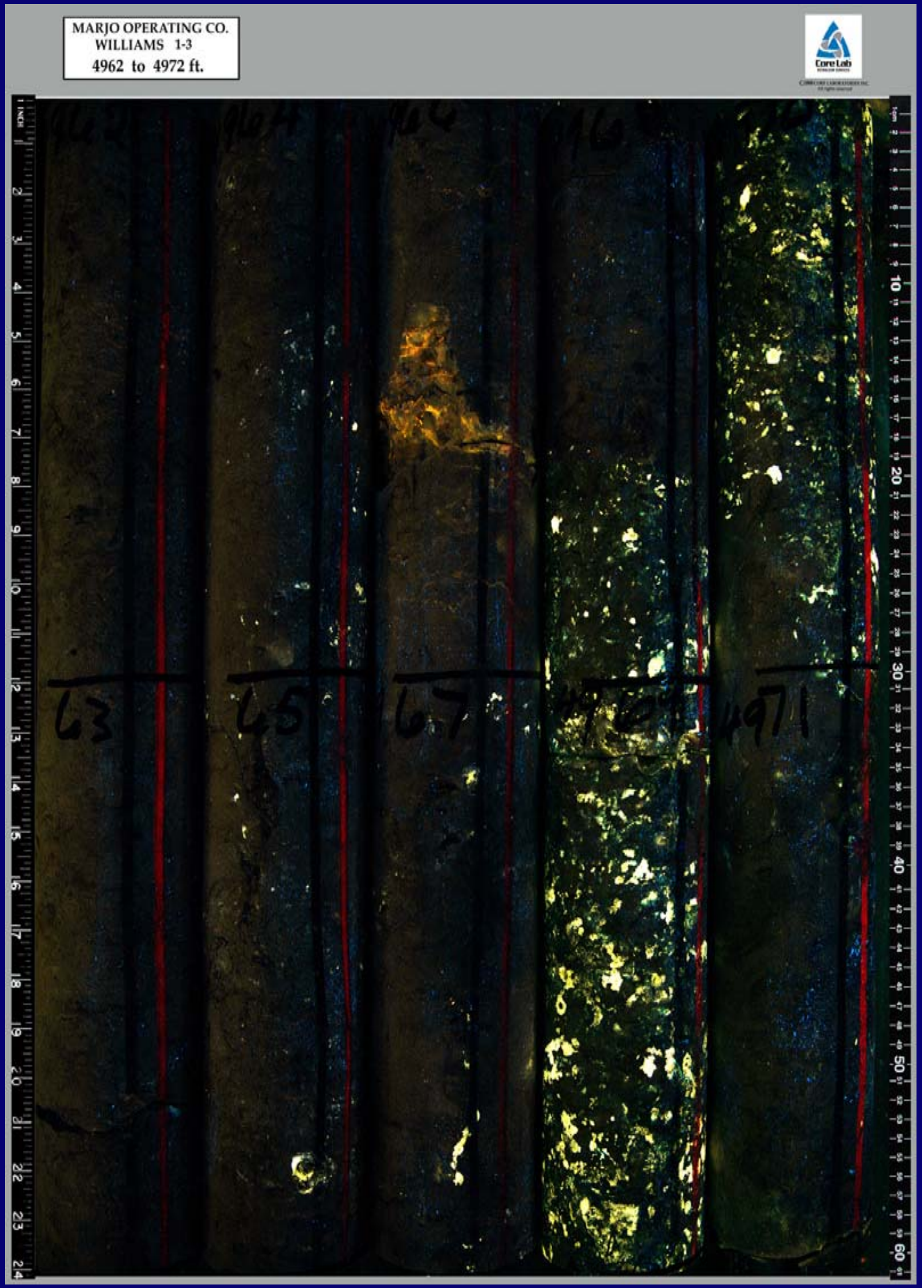
JB 1-13 5011-21

Example of Facies # 7

- ► Big Pentamerid Brachiopod Coquina
- ► Benthic Assemblage BA 3
- ► Outer Shallow Shelf Facies



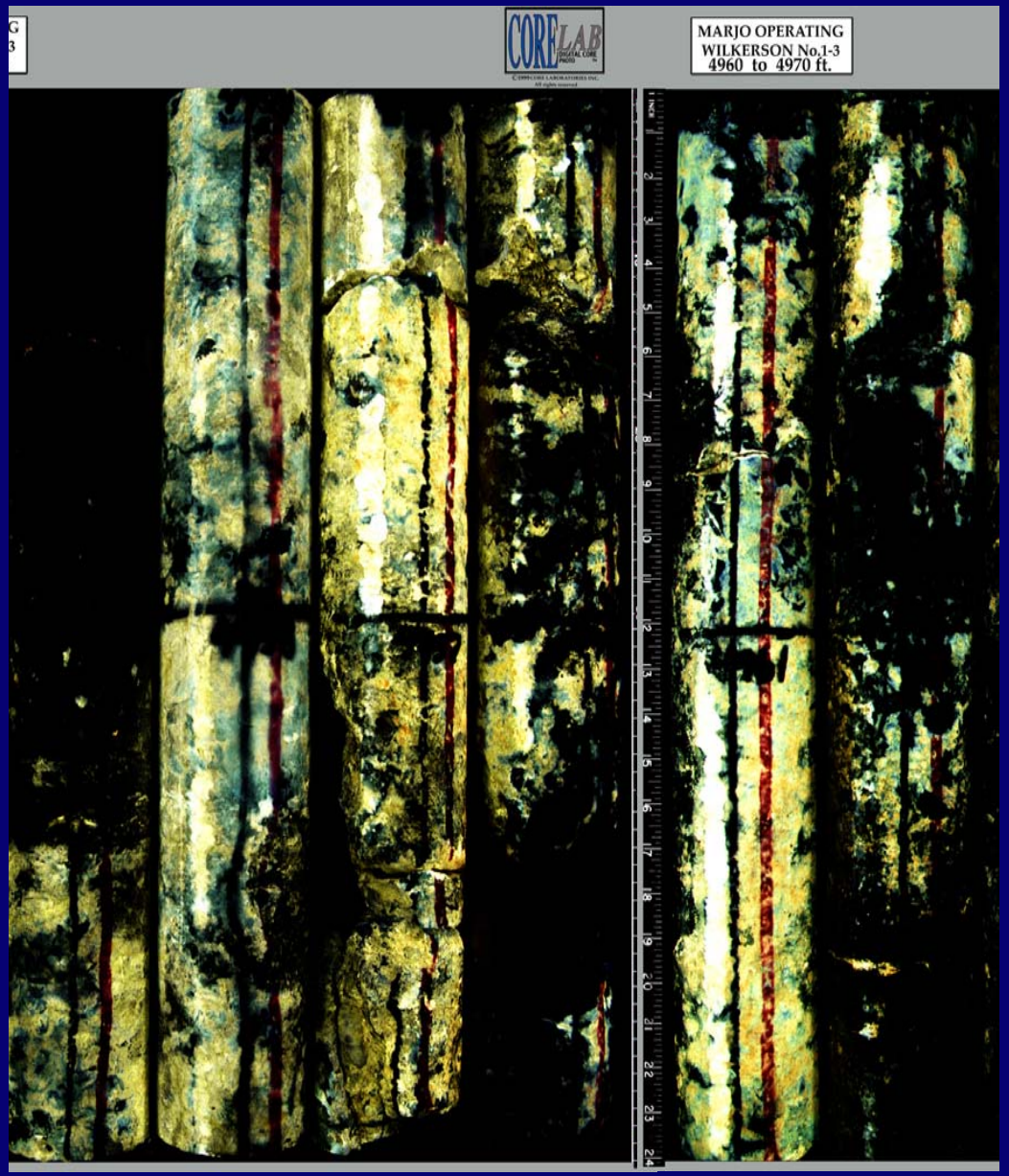
Williams 1-3, 4962-72


MARJO OPERATING CO.
WILLIAMS 1-3
4962 to 4972 ft.

Example of Facies # 7

- ► “Good” porosity and permeability
- ► Lower Cochrane: Pentamerid Brachiopod Coquina

Wilkerson 1-3, 4950-64


CORE LAB
MARJO OPERATING
WILKERSON No.1-3
4960 to 4970 ft.

Example of Facies # 4,5,6

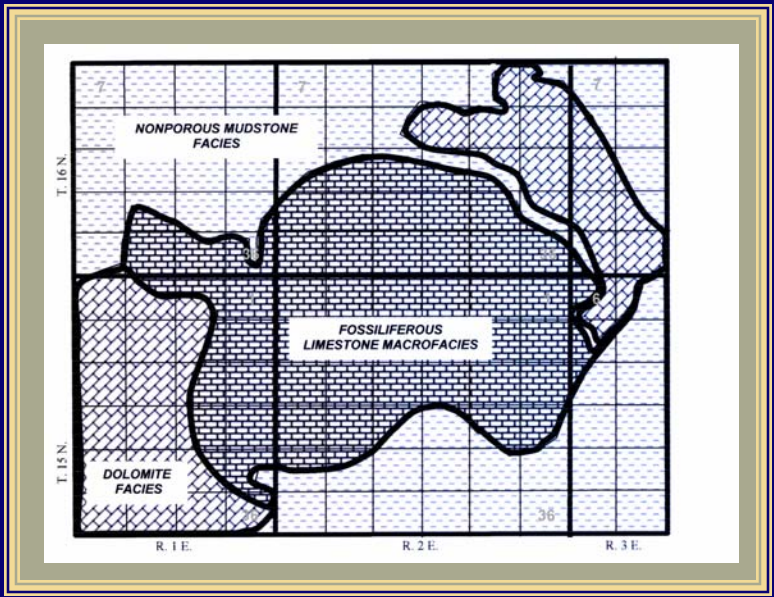
- ► “Good” porosity
- ►“Moderate” permeability
- ► Lower Cochrane: Crinoidal Packstone

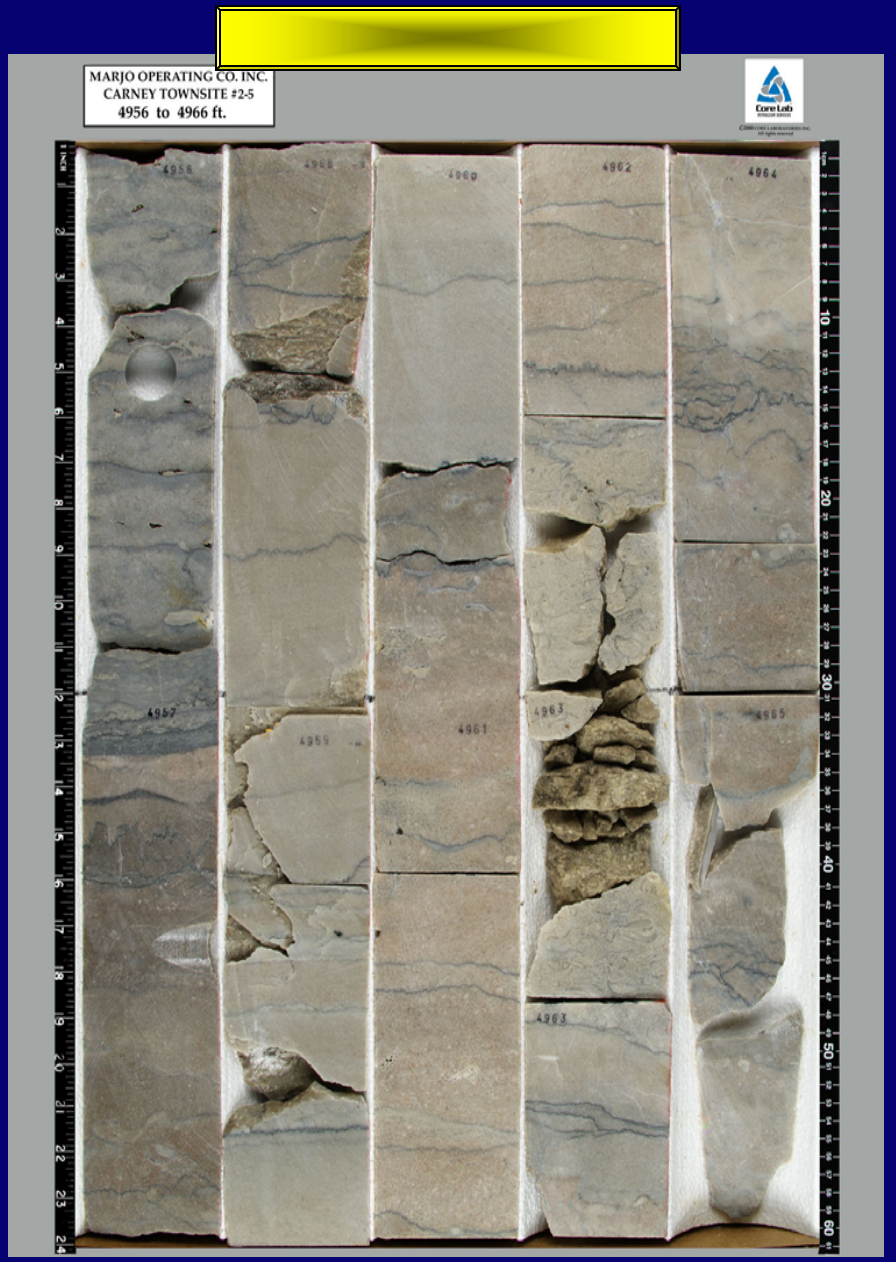
Boone 1-4, 5057-67


MARJO OPER. CO.
BOONE #1-4
5057 to 5067 ft.

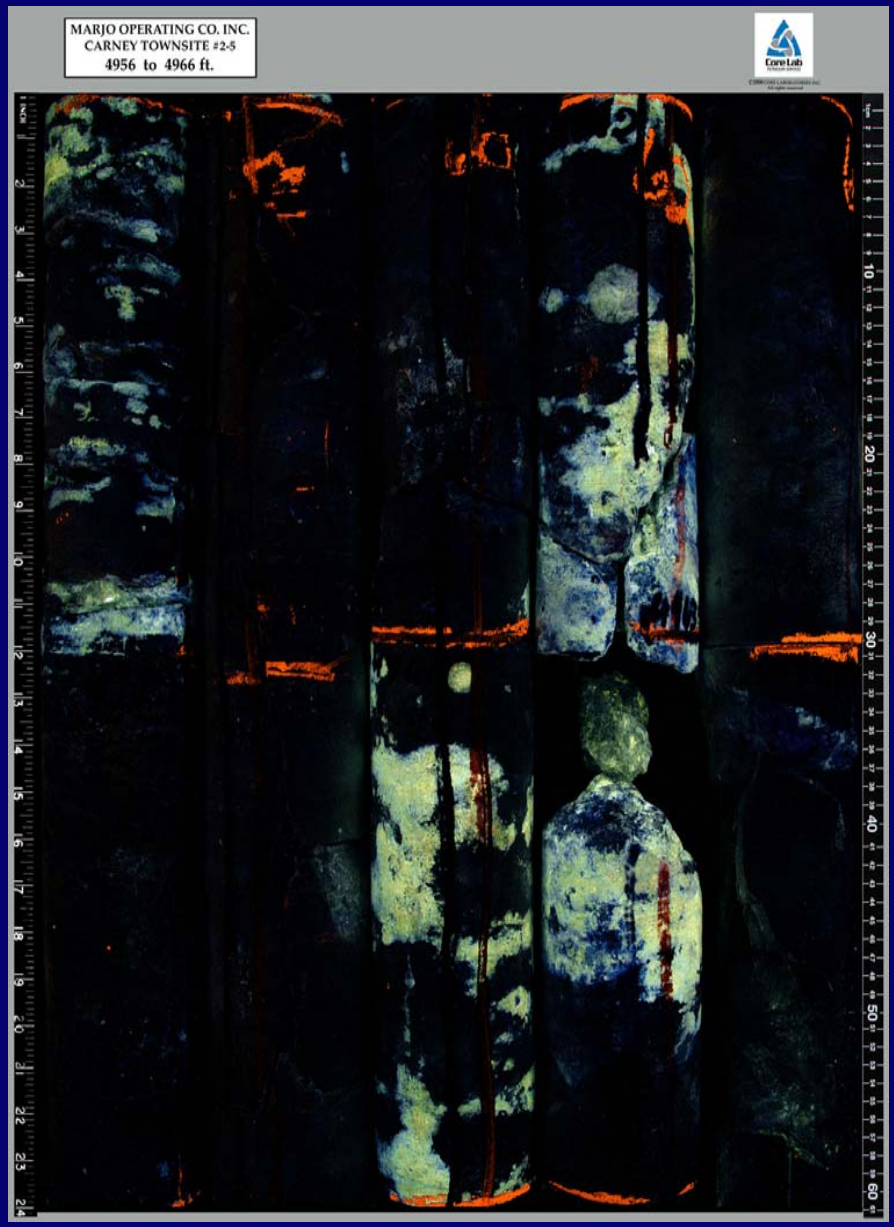
Example of Facies # 11

- ► Lower Clarita Fine dolomite Mudstone (with karst solution)
- ► Upper Cochrane fine Brachiopod Packstone





Carney Townsite 2-5, 4956-66


MARJO OPERATING CO. INC.
CARNEY TOWNSITE #2-5
4956 to 4966 ft.
Core Lab

Production Facts

- **Producing Wells: 230**
  - **Limestone Facies Wells: 180**
  - **Dolomite Facies Wells: 50**
  - **Horizontal Wells: 8**
  - **Arbuckle Salt Water Disposal Wells: 16**

Current Dailey Production

FIELD:

- OIL: 6,000 BO/D
- GAS: 55,000 MCF/D
- WATER: 86,000 BW/D

AVERAGE WELL:

- OIL: 26 BO/D
- GAS: 239 MCF/D
- WATER: 374 BW/D

Field Economics

- Current Cost of Producing Well: $375,000- $450,000
- Current Cost of Disposal Well: $450,000- $600,000
- Monthly Operating Cost Per Well: $2,000 -$6,000

Average Producing Well ROI:

2:1 to 3:1

Conclusions:

- Both Reservoir types, Clarita and Cochran, have a high permeability and low permeability system.

- The Higher Permeabilty "water" system dominates when initially tested and in early production.

- Hydrocarbons are probably stored in the "Lower Permeability" matrix porosity.

- Complex fluid migration history, could be the "key" to this type of trap.