

The Mississippian of the Mid-Continent; An Overview

Steve Hadaway, Consultant
Kurt Rottmann, Consultant

1. How important it is to understand Mississippian Deposition

2. Review of the Stratigraphic and Structural Development of the Mid-Continent

A. Pre-Miss Paleogeologic Surface
B. Kinderhook/Woodford Relations
C. Compton/Northview
D. Pierson
E. Comparison of Anadarko Basin and Illinois Basin
F. Reeds Spring

G. Keokuk/Burlington
H. Cowley
I. Post-Cowley/Pre-Meramec
J. Osagean/Meramecian Unconformity
K. Meramecian Deposits
L. Chester
M. Post-Meramec/Pre-Penn

3. Importance of Understanding the Boundaries to Help Exploration and Development

THE PROBLEM

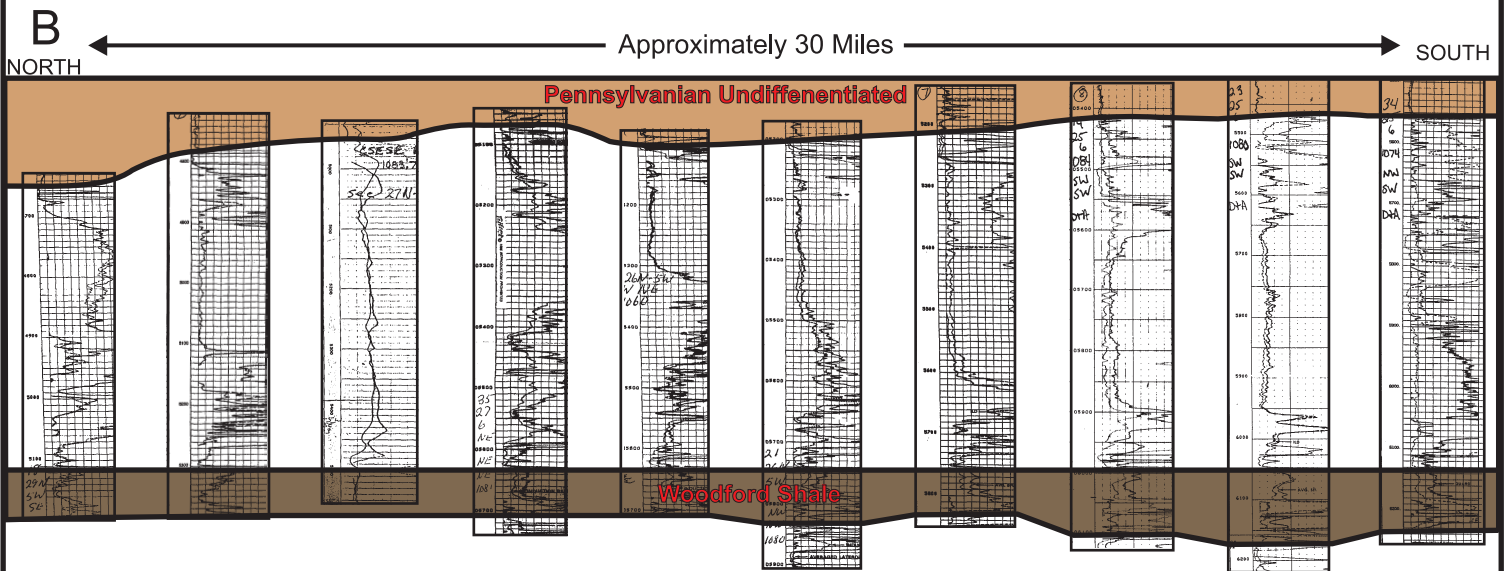
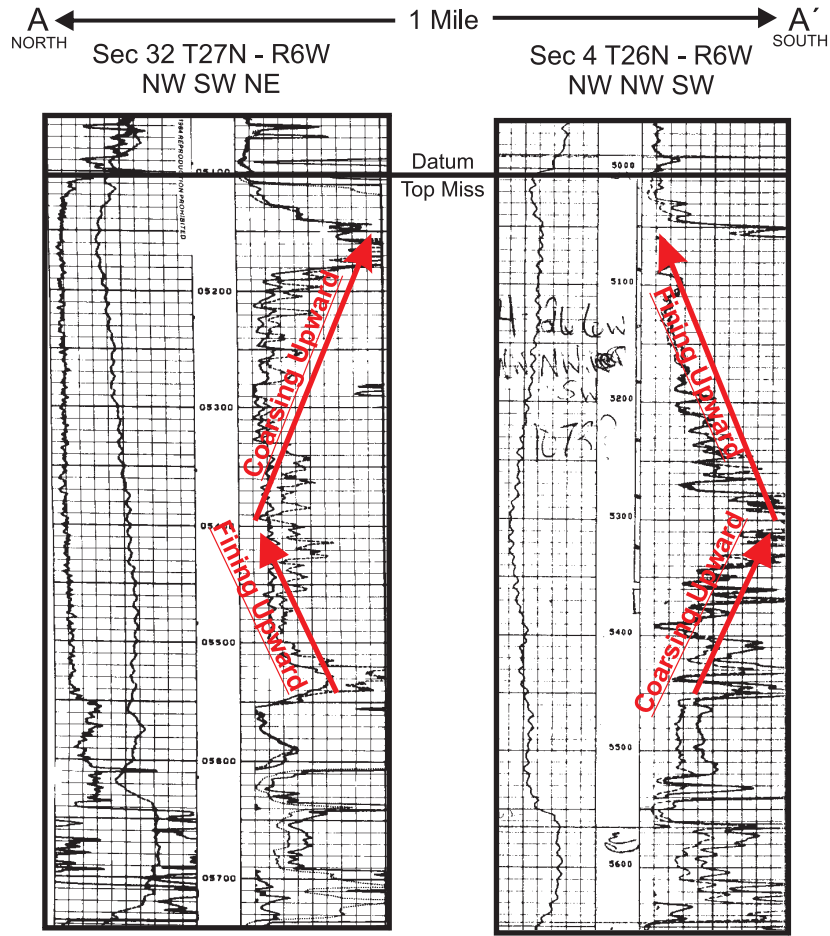


Fig 2

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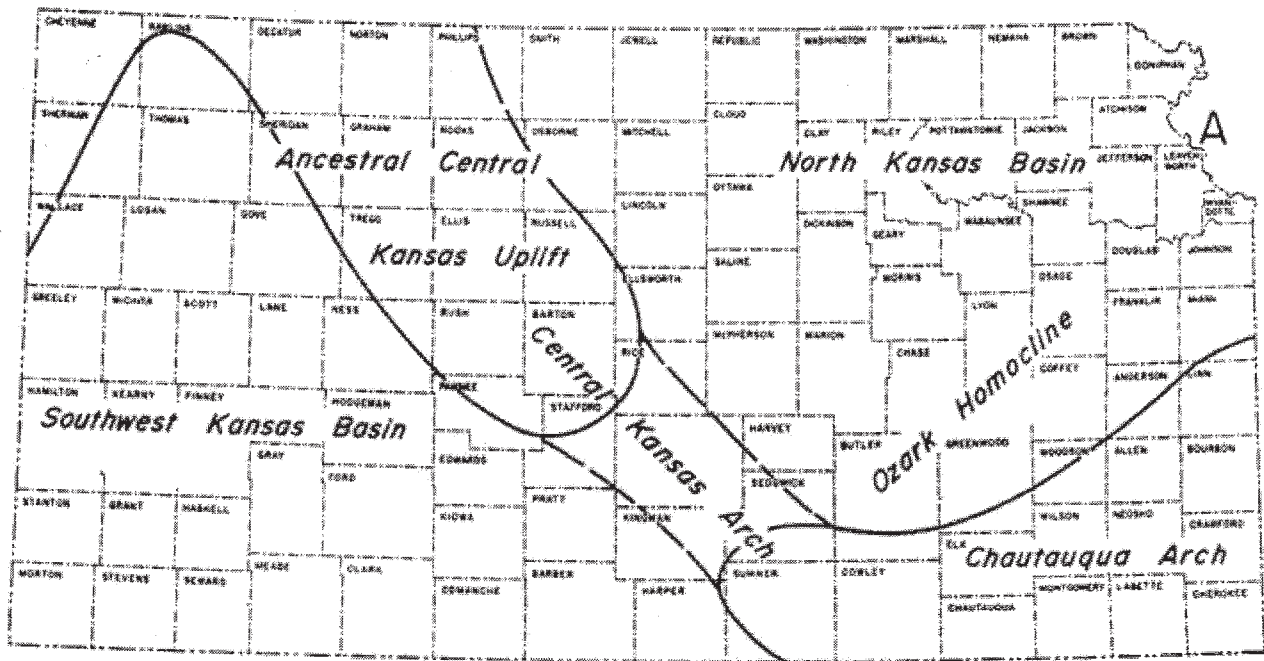


Fig 4 Tectonic Features of Kansas, Merriam,
www.kgs.ku.edu/publications/bulletins/162/05_tect.html

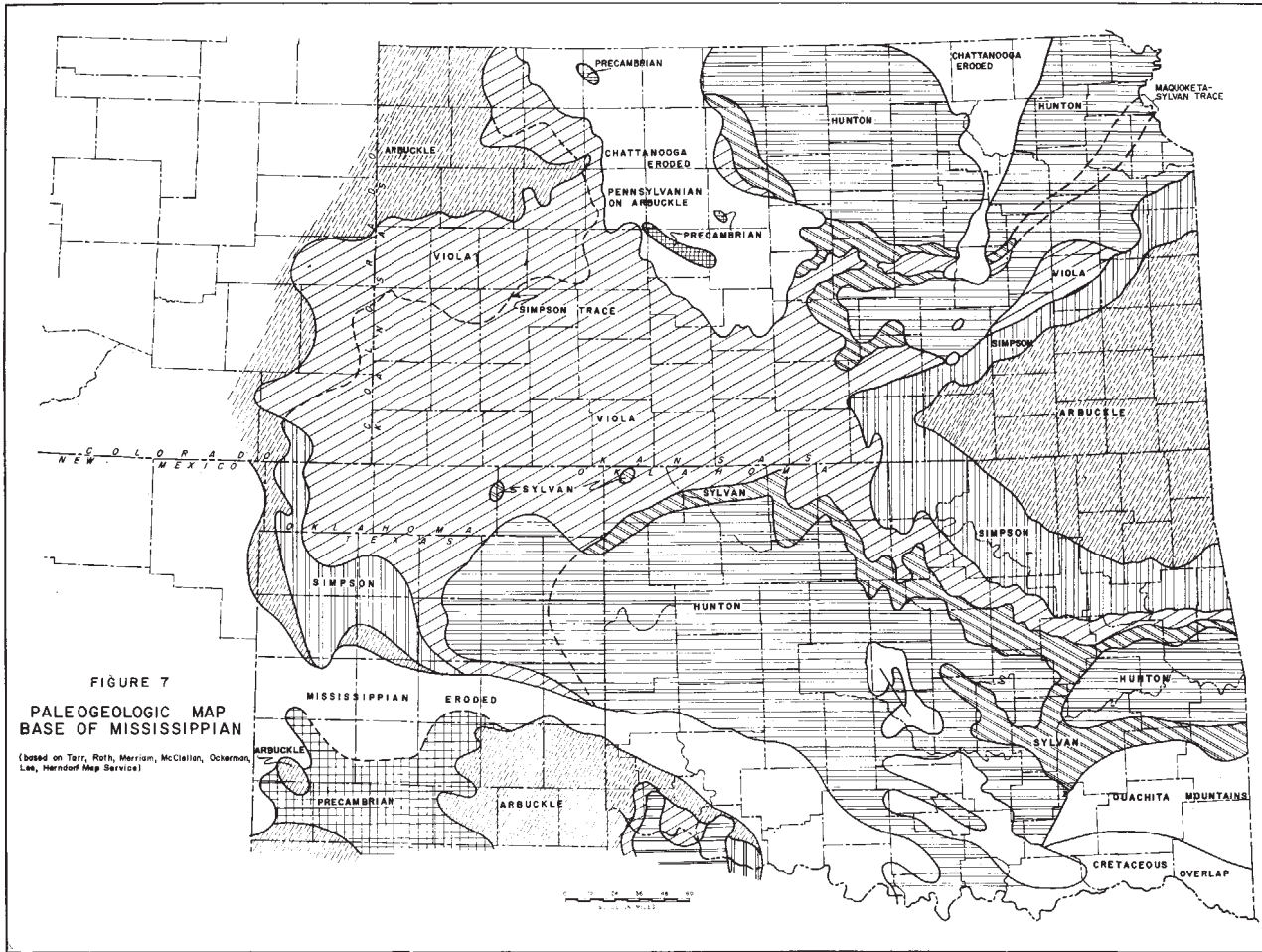


FIGURE 7
PALEO GEOLOGIC MAP
BASE OF MISSISSIPPIAN

(based on Tarr, Roth, Merriam, McClellan, Ockenfels, Lee, Harndorf Map Services)

Fig 5 Paleogeologic Map, Base of Mississippian, Huffman, 1959, AAPG Bulletin, v 43 No. 11, November 1959

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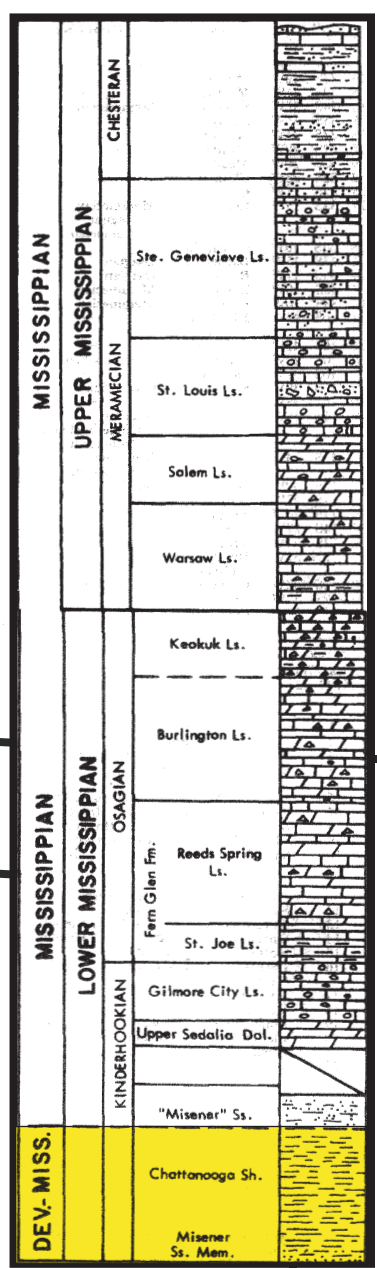
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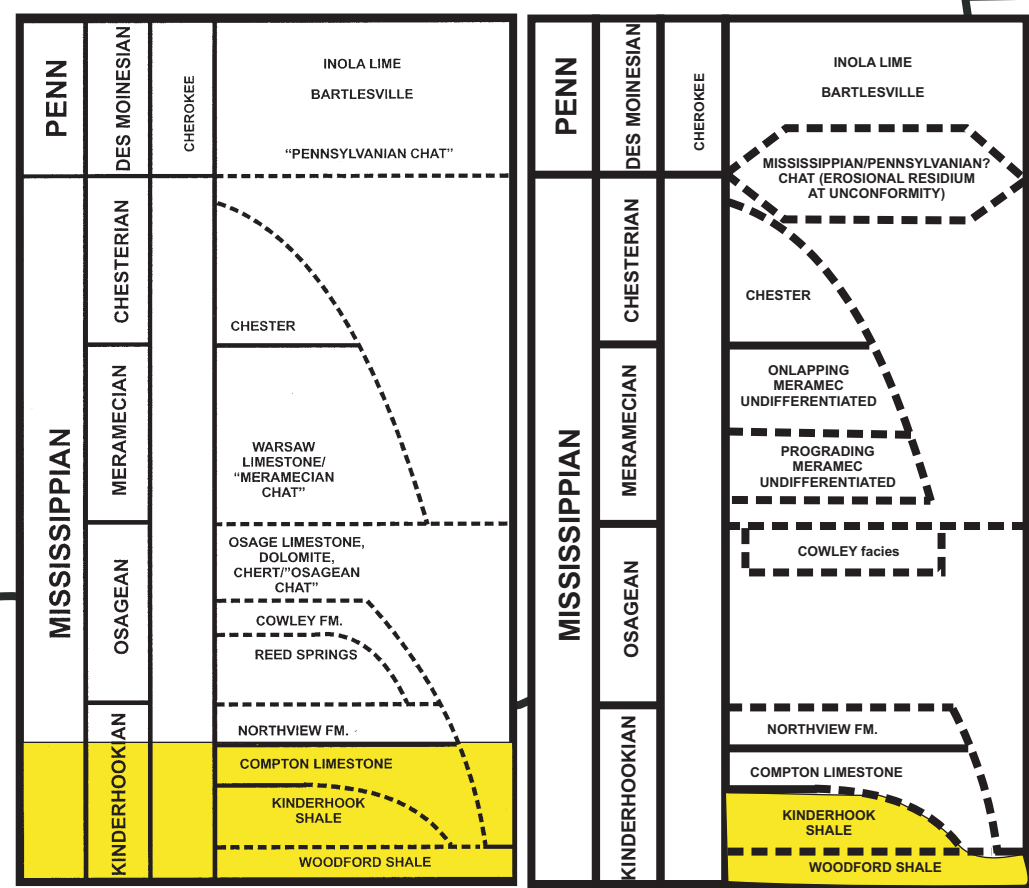
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Goebel, 1968

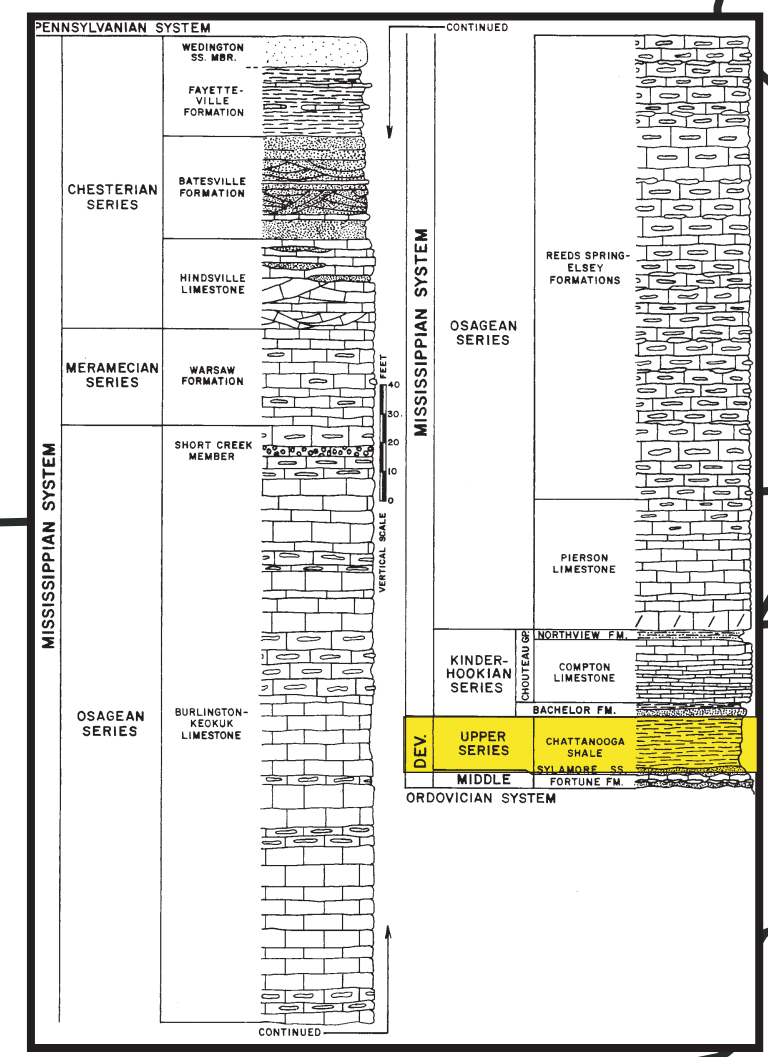


Period	Stage	Formations/Members (Goebel, 1968a, b)	Formations/Members (Maples, 1994)	Period	Stage	
Chesterian		unnamed unit(s)	Shore Airport Formation	Chesterian		
		Ste. Genevieve Limestone	Ste. Genevieve Limestone			
Meramecian		St. Louis Limestone	St. Louis Limestone / Stevens Mbr. / Hugoton Mbr.	Meramecian		
		Salem Limestone	Salem Limestone			
		Warsaw Limestone	Warsaw Limestone			
Osagean		Keokuk Limestone	Keokuk Limestone / Short Creek Oolite Mbr.	Osagean		
		Burlington Limestone	Burlington-Keokuk Limestone			
		Fern Glen Limestone	Reed Spring Ls. Mbr. / Eisey Fm.			
		Gilmore City Limestone	Gilmore City Limestone / Pierson Limestone			
Kinderhookian		Sedalia Dolomite (Northview Shale)	Sedalia Dolomite / Northview Formation	Kinderhookian		
		Chouteau Limestone / Compton Limestone	Compton Limestone			
		Boice Shale	Hannibal Shale			
DEVONIAN		Chattanooga Shale	Chattanooga Shale	DEVONIAN		

Watney, Guy and Byrnes, 2001



Thompson, 1986

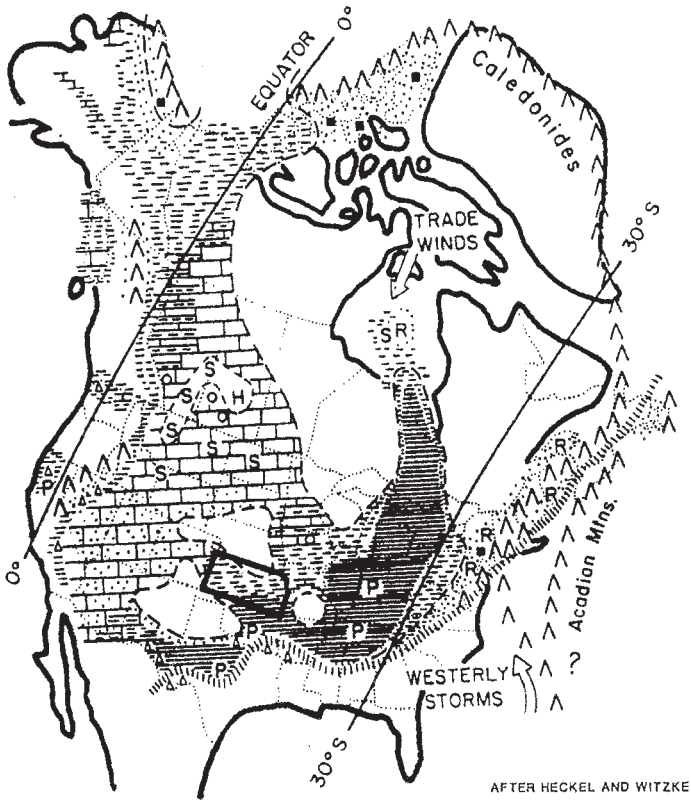


Goebel, 1968
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Watney, Guy and Byrnes, 2001
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Thompson, 1986
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Fig 8 Kindeerhookian/Woodford Relationship



AFTER HECKEL AND WITZKE

Fig 9 Woodford Deposition

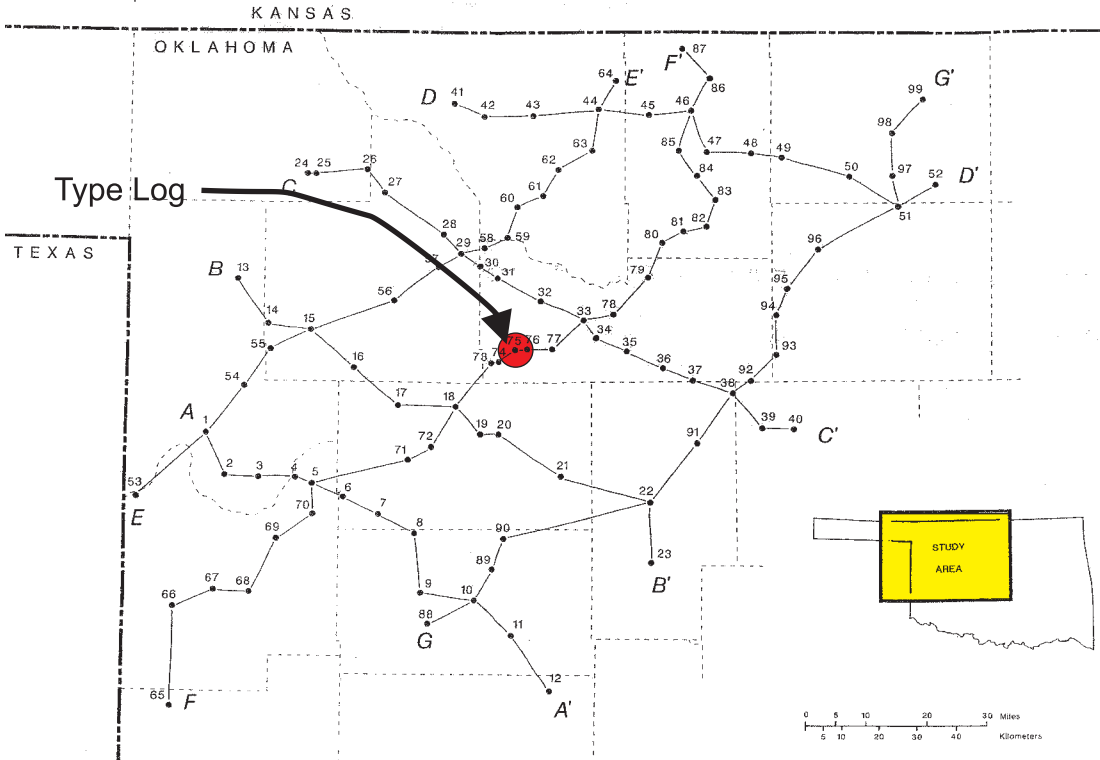


Fig 10 Location of type log for Woodford, (Hester, Sahl and Schmoker, 1988)

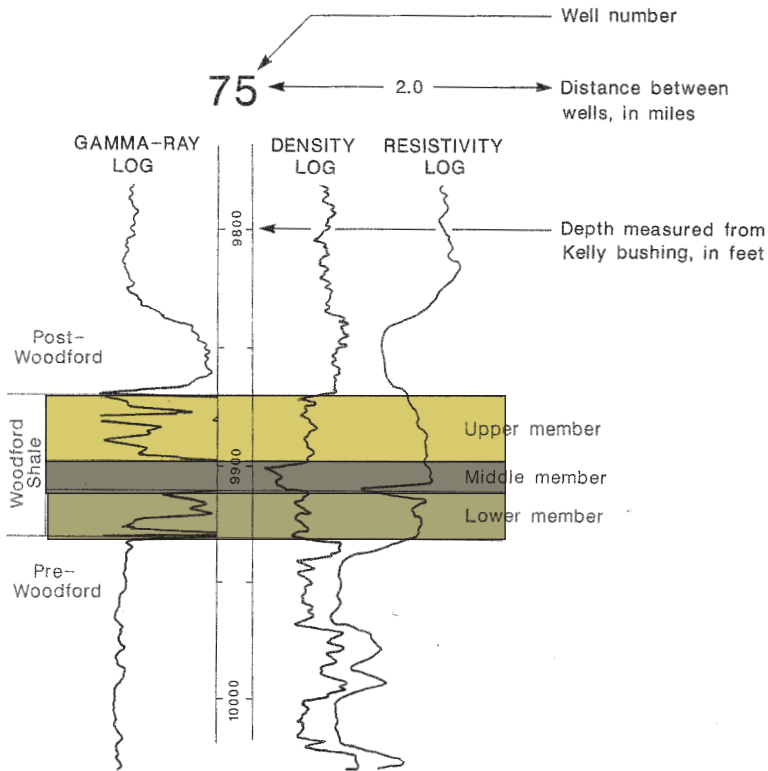


Fig 11 Type log for Woodford, (Hester, Sahl and Schmoker, 1988)

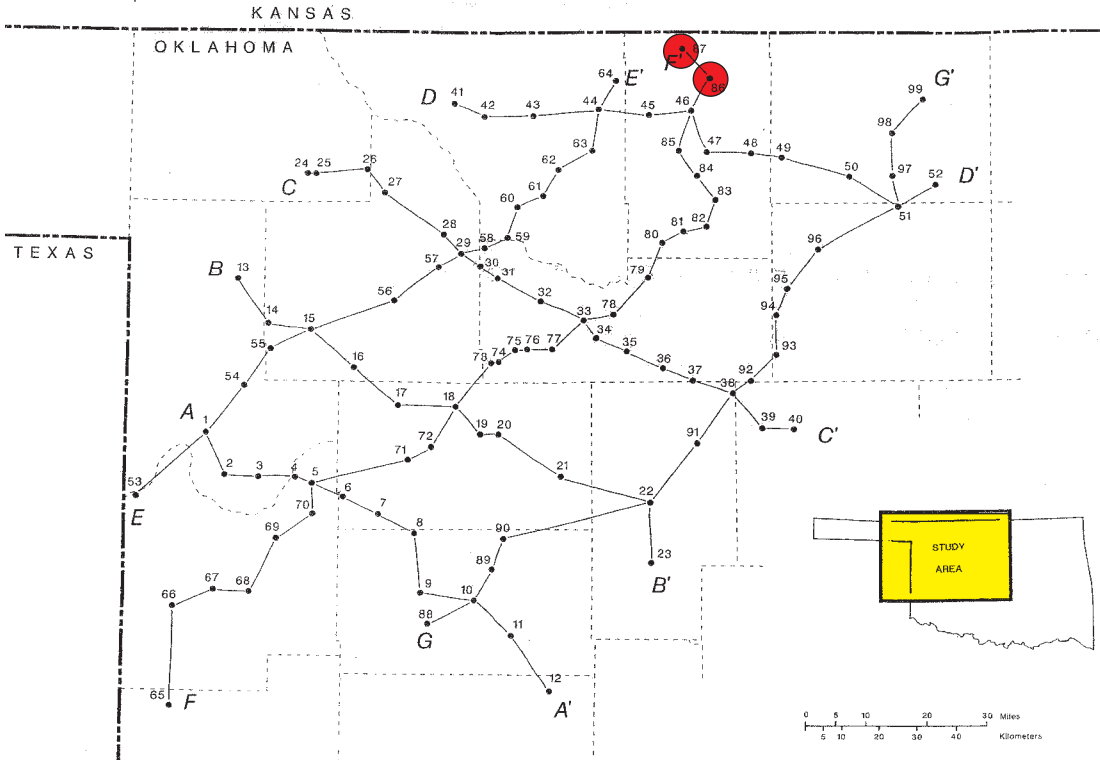


Fig 12 Location of Woodford/Kinderhook wells in North Central Oklahoma, (Hester, Sahl and Schmoker, 1988)

86

6.7

87

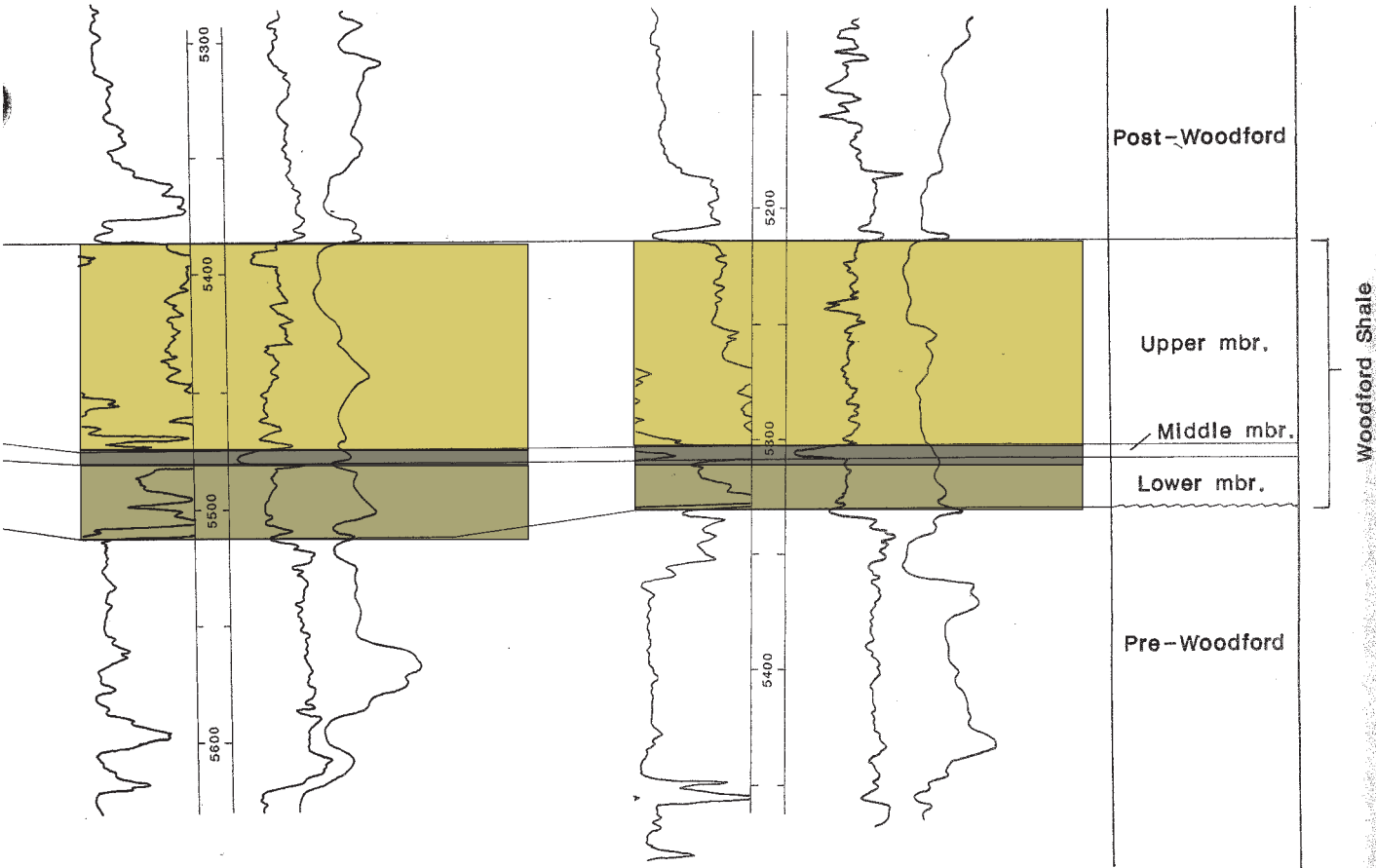


Fig 13 Example of Woodford correlation in Oklahoma vs Kinderhook Correlation in Kansas, (Hester, Sahl and Schmoker, 1988)

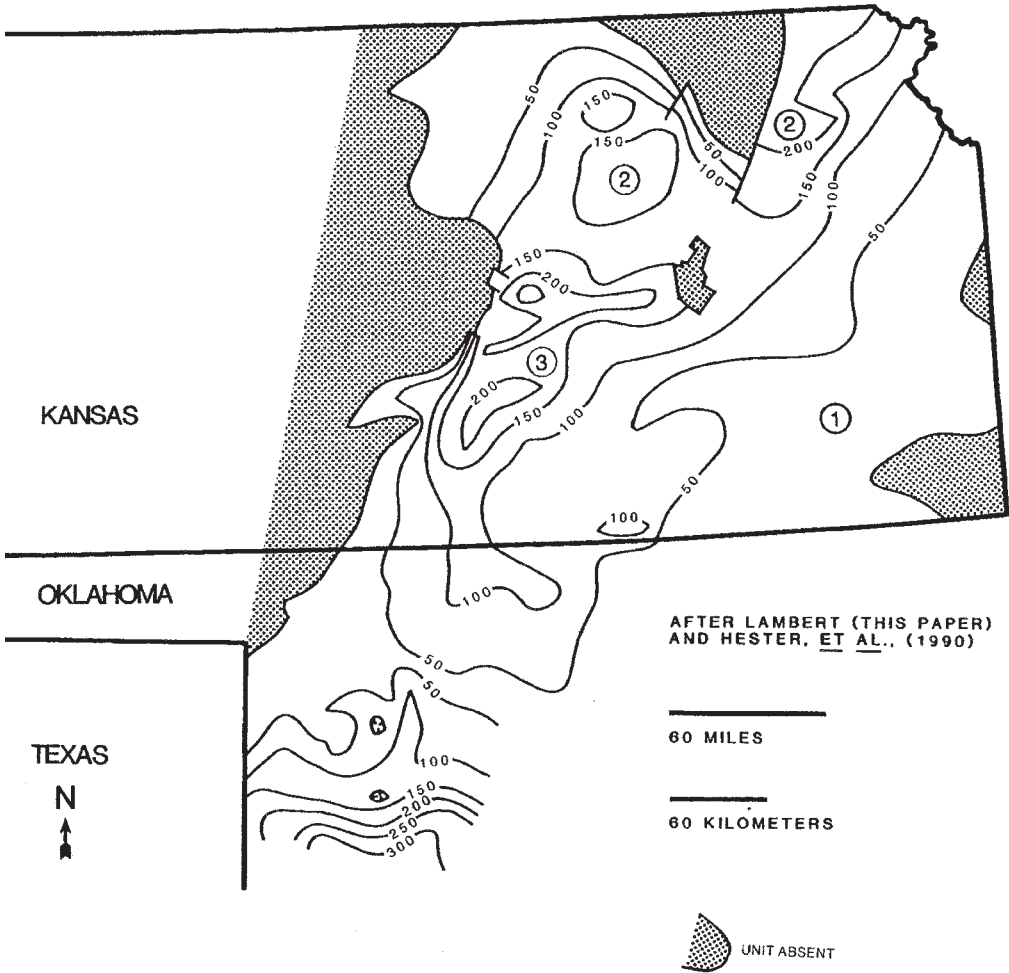


Fig 14 Isopach of Woodford/Chattanooga in Kansas and Oklahoma, Lambert

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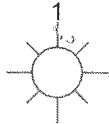
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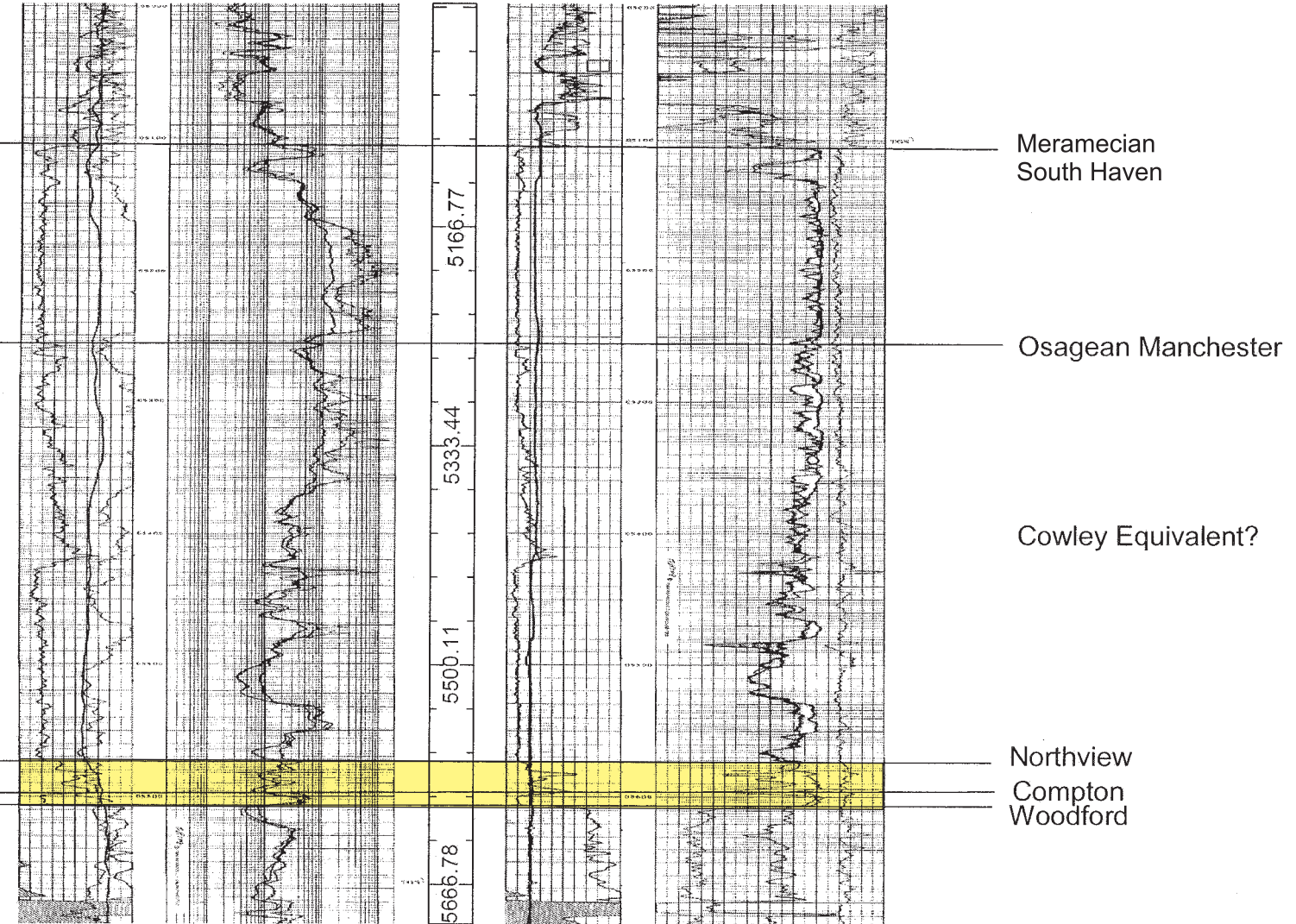
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STEFFEN



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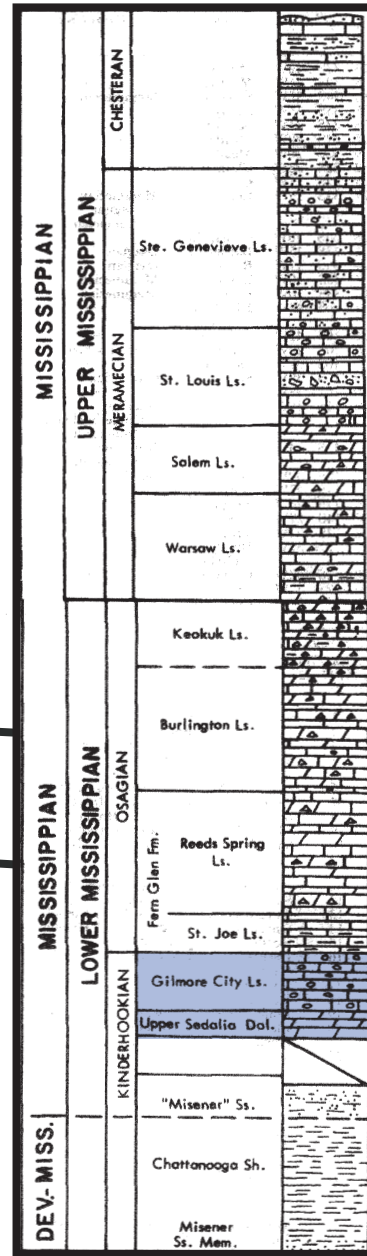
NE SW



Deposition of Northview/Compton

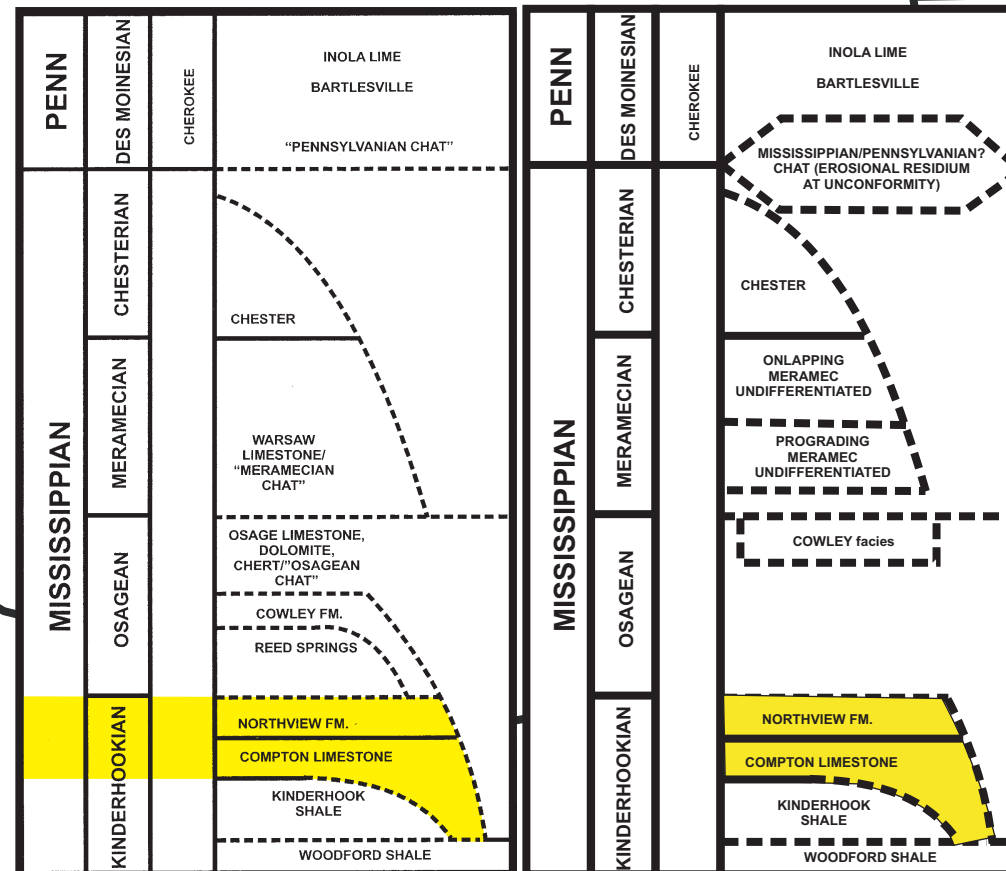
Fig 16

Goebel, 1968

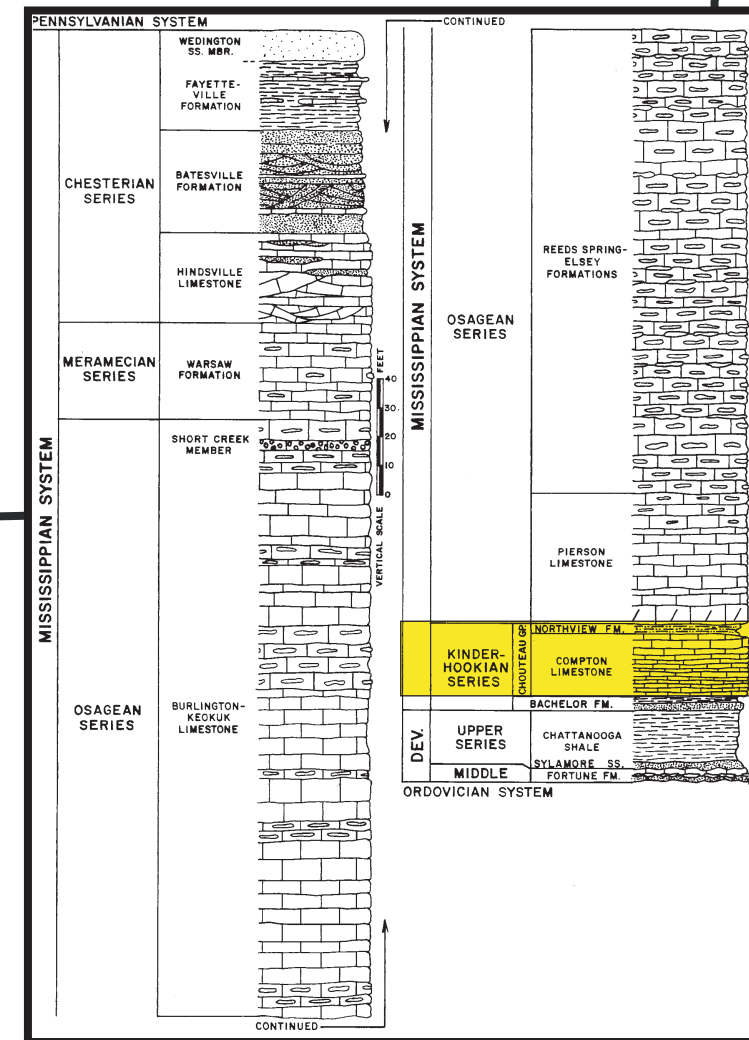


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Watney, Guy and Byrnes, 2001



Thompson, 1986



Goebel, 1968
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Fig 17 Correlation for Northview/Compton age Rocks

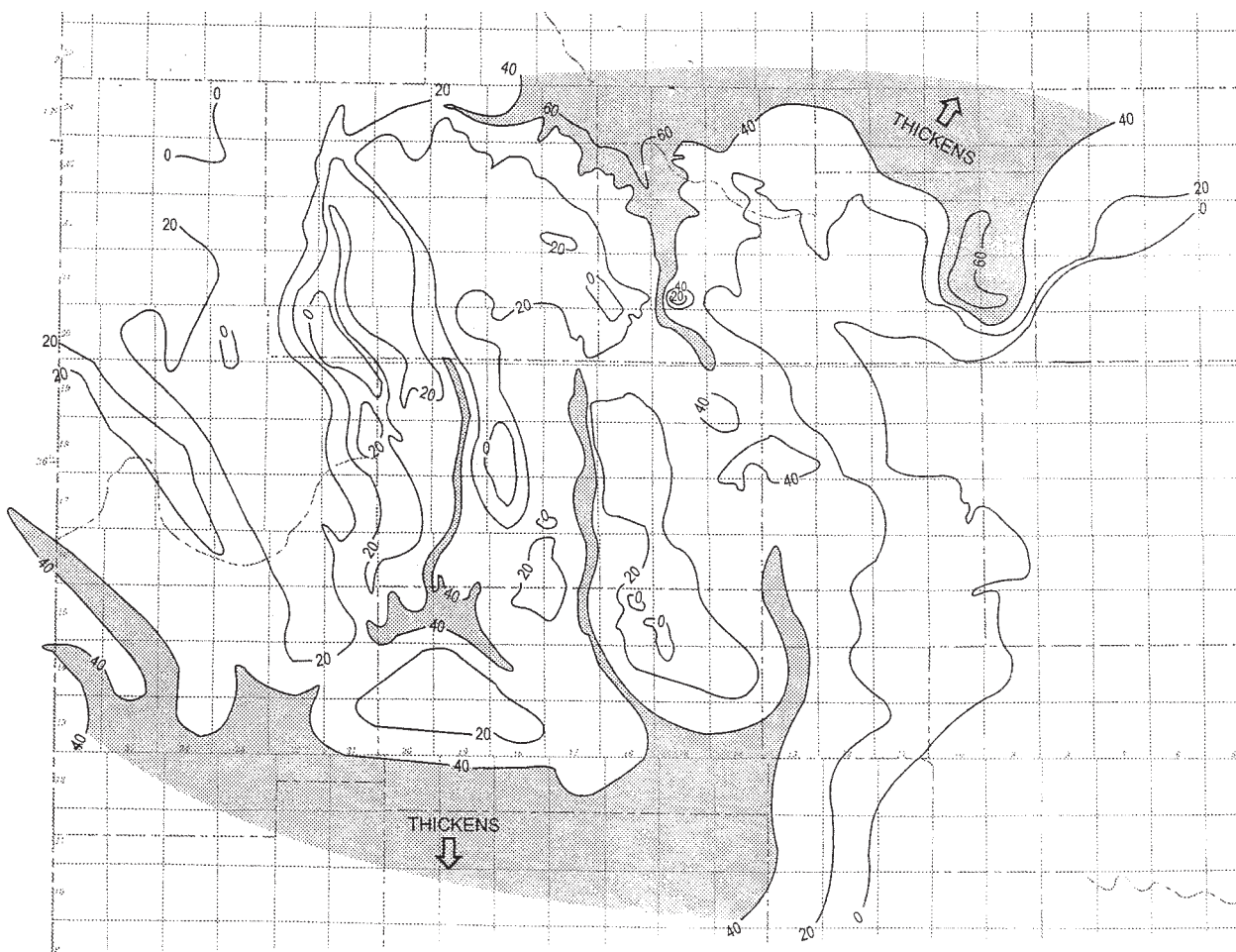


Fig 18 Isopach of Northview/Compton in Western Oklahoma

Rottmann, 2002

Regional Map of Compton-Northview

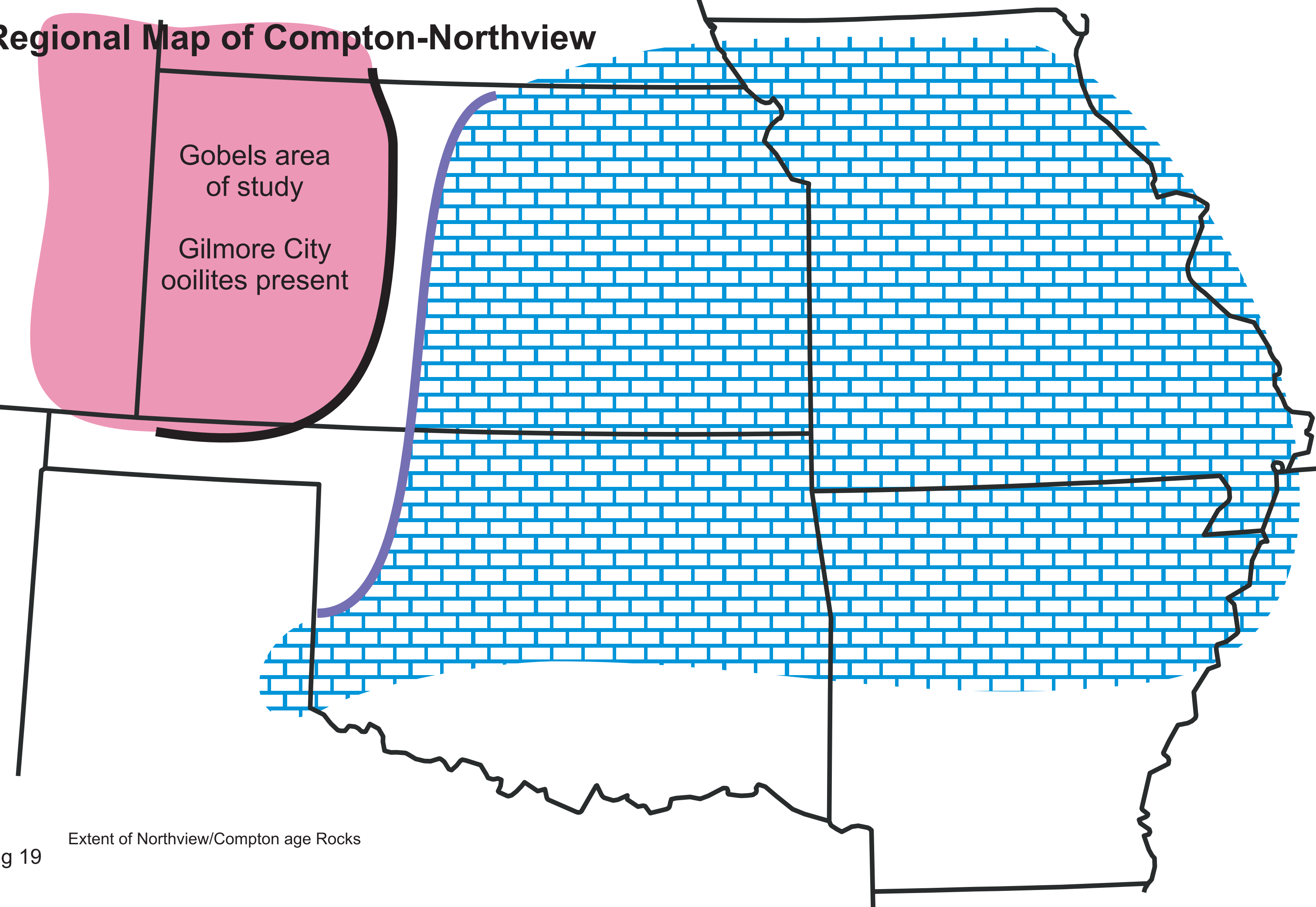


Fig 19 Extent of Northview/Compton age Rocks

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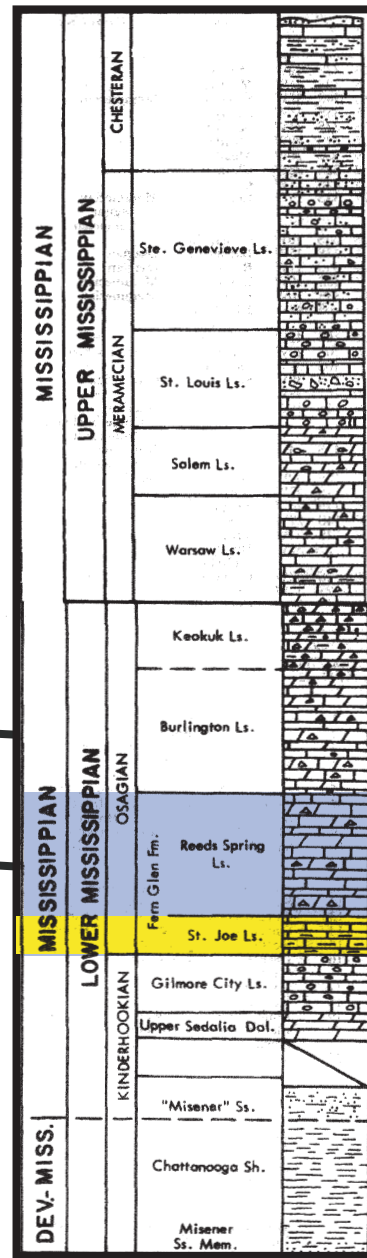
Description of Pierson Rocks

Crinoidal mudstone to grainstone, bedded chert, with fossiliferous shale beds, up to 100 ft thick.

At Tahlequah, no Pierson was present. (Boardman, Mazzullo and Wilhite, 2010)

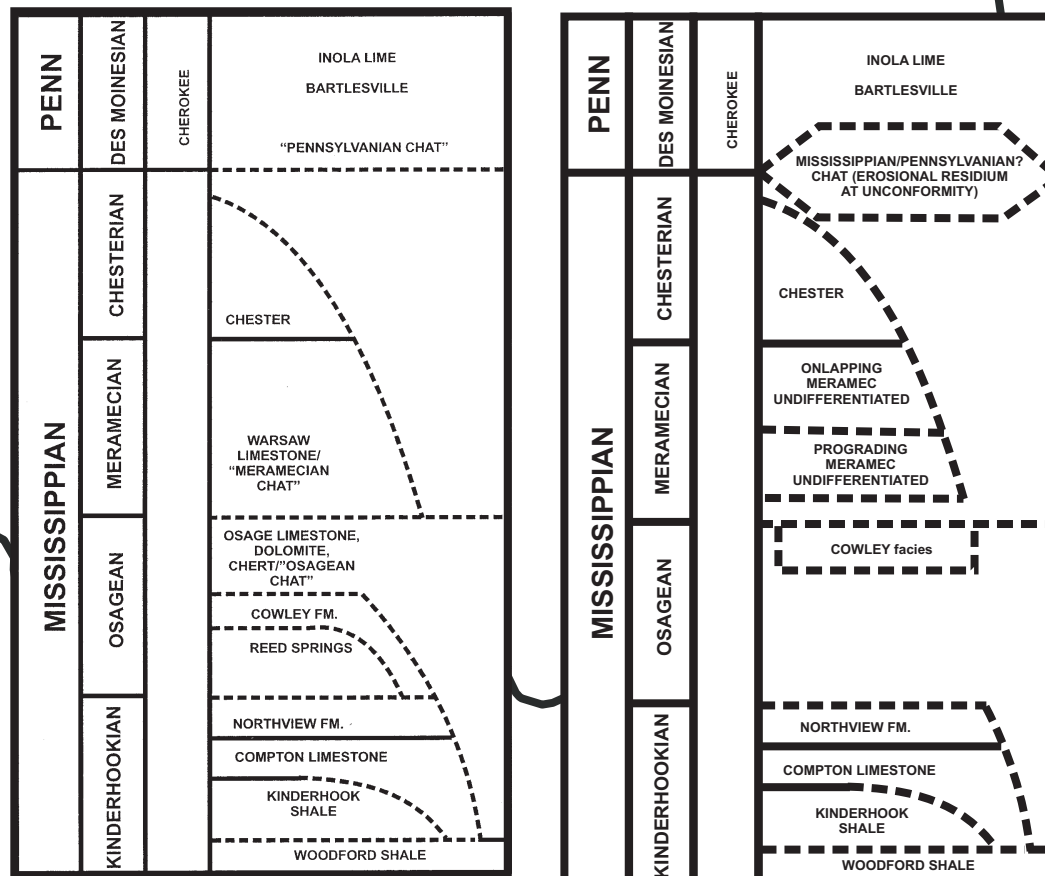
Fig 21

Goebel, 1968

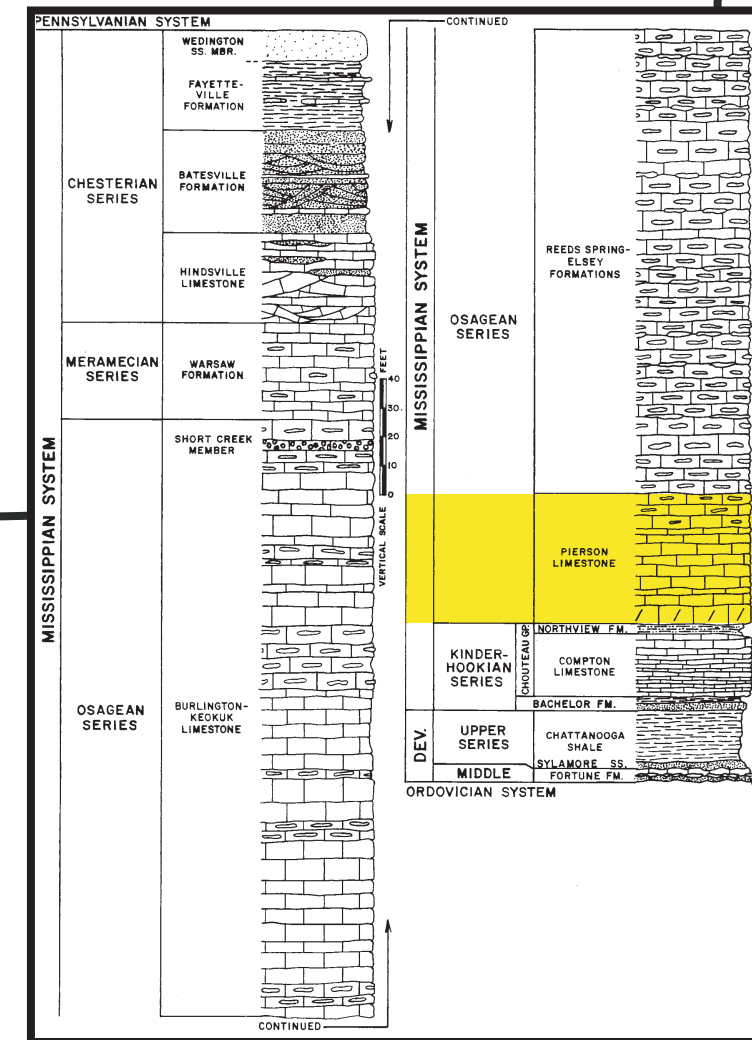


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		Boice Shale	Hannibal Shale		

Watney, Guy and Byrnes, 2001



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Goebel, 1968
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Fig 22 Correlation for Pierson

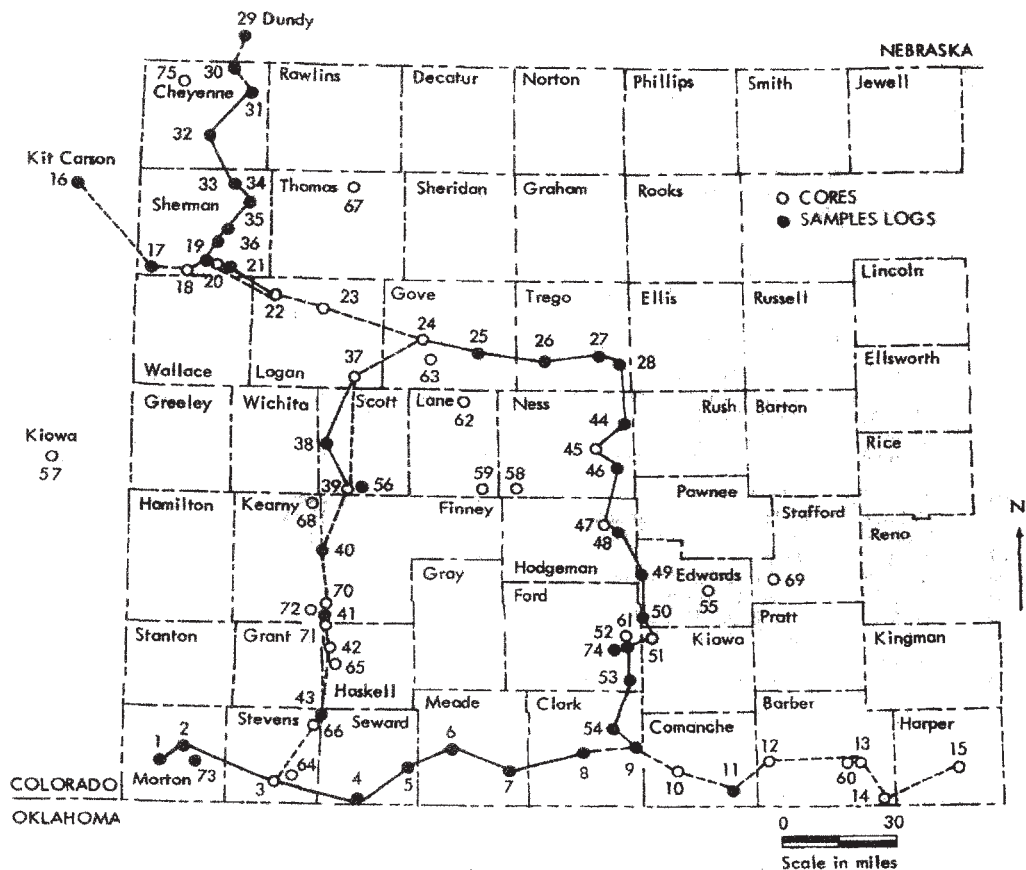


Fig 23 Goebel's Area of Study, (Goebel, 1968)

Regional Map of Pierson

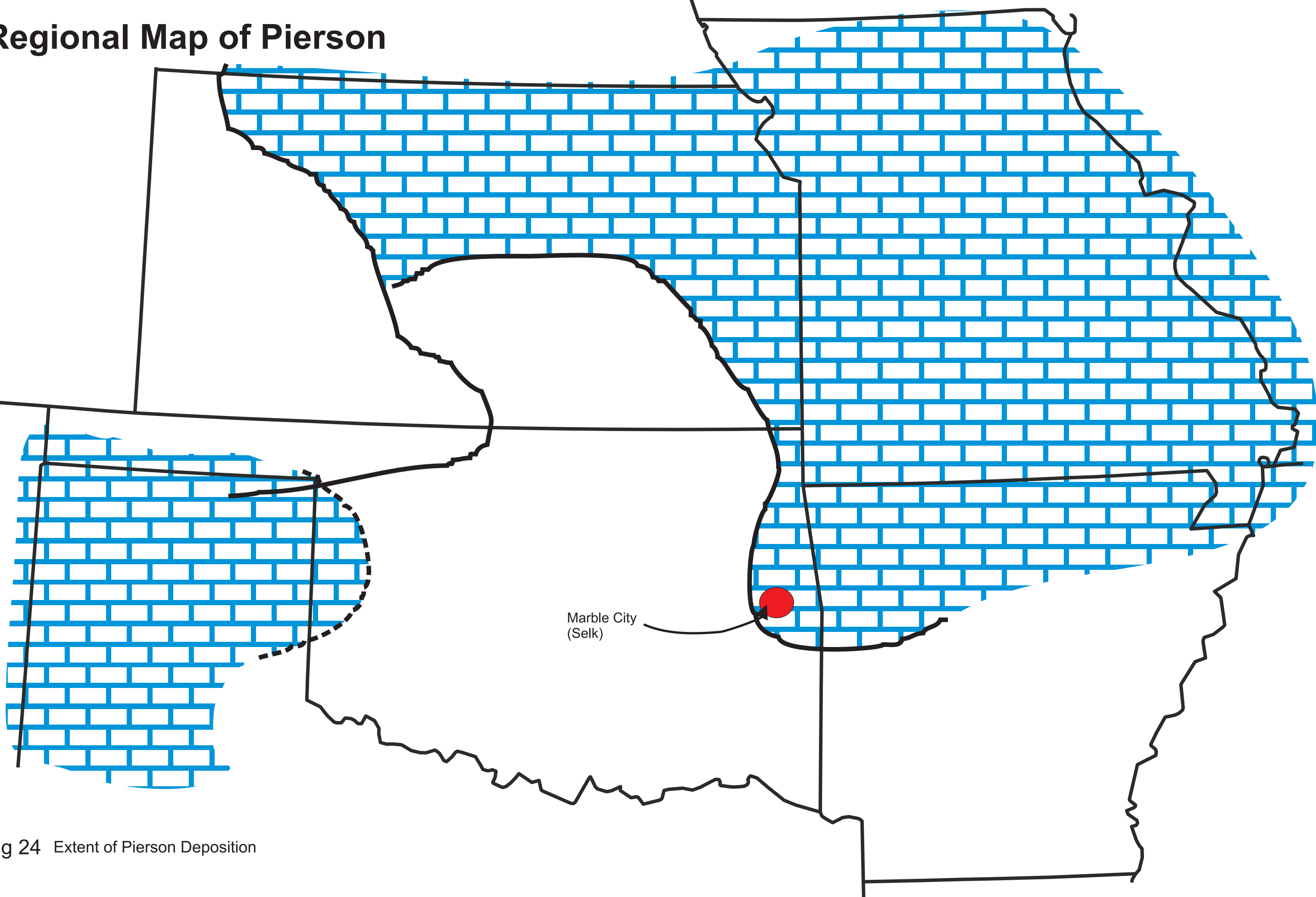


Fig 24 Extent of Pierson Deposition

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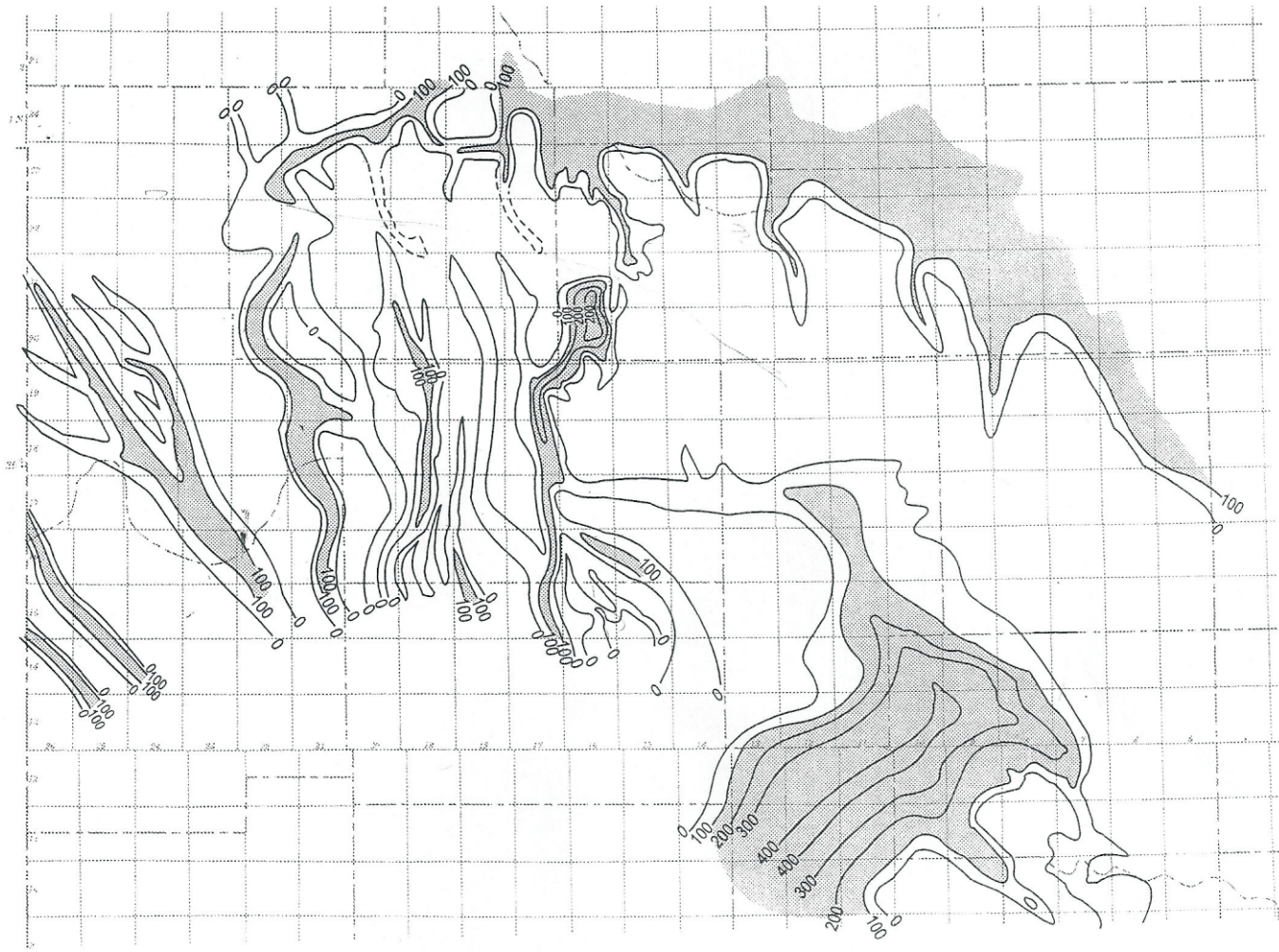


Fig 27 Isopach of incised channels within Hunton and filled with Woodford Shale, Rottmann 2002

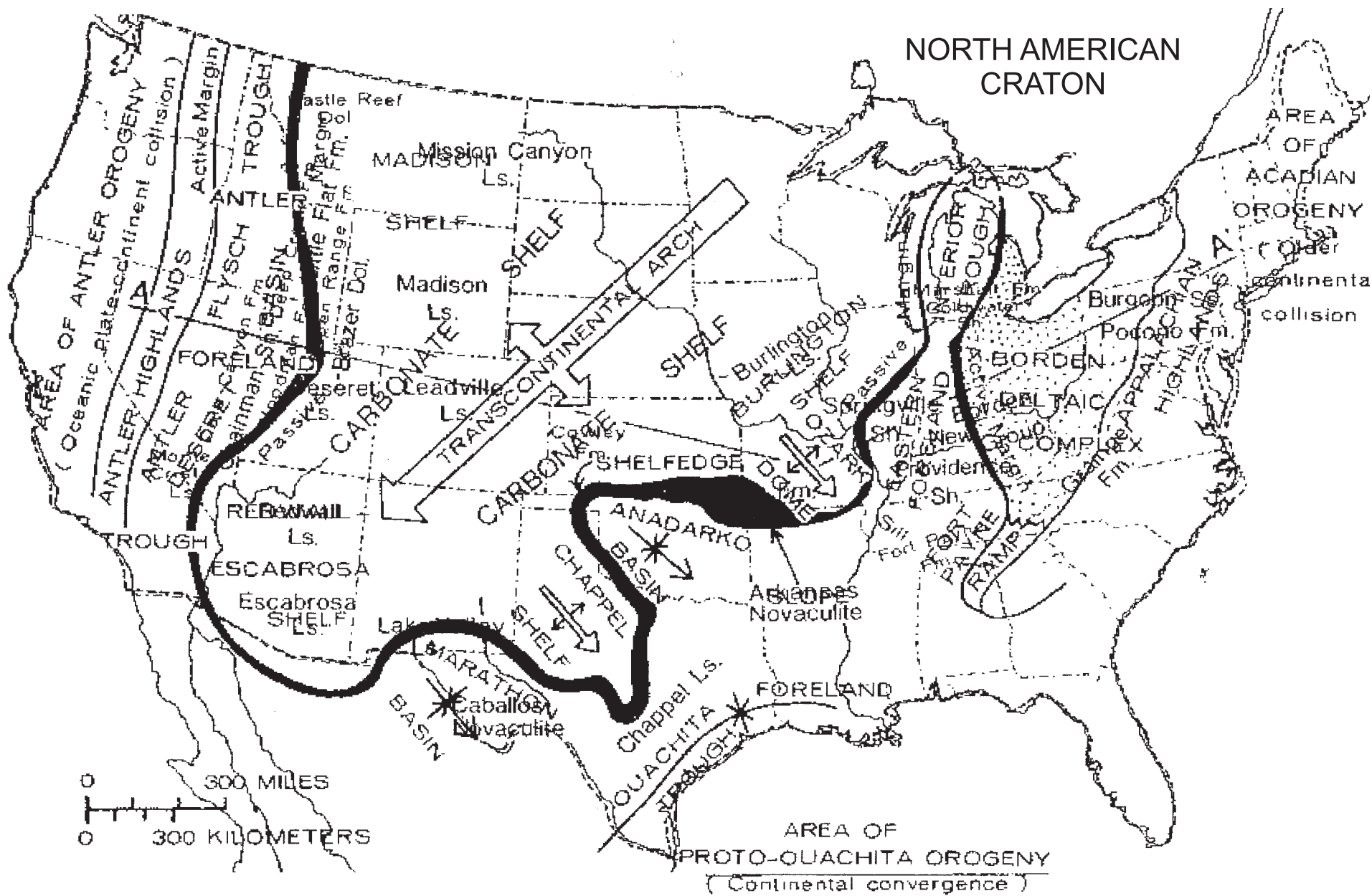


Fig 28

Overlay of Osagean paleogeographic surface with local formation names, (Gutschick and Sandberg, 1983)

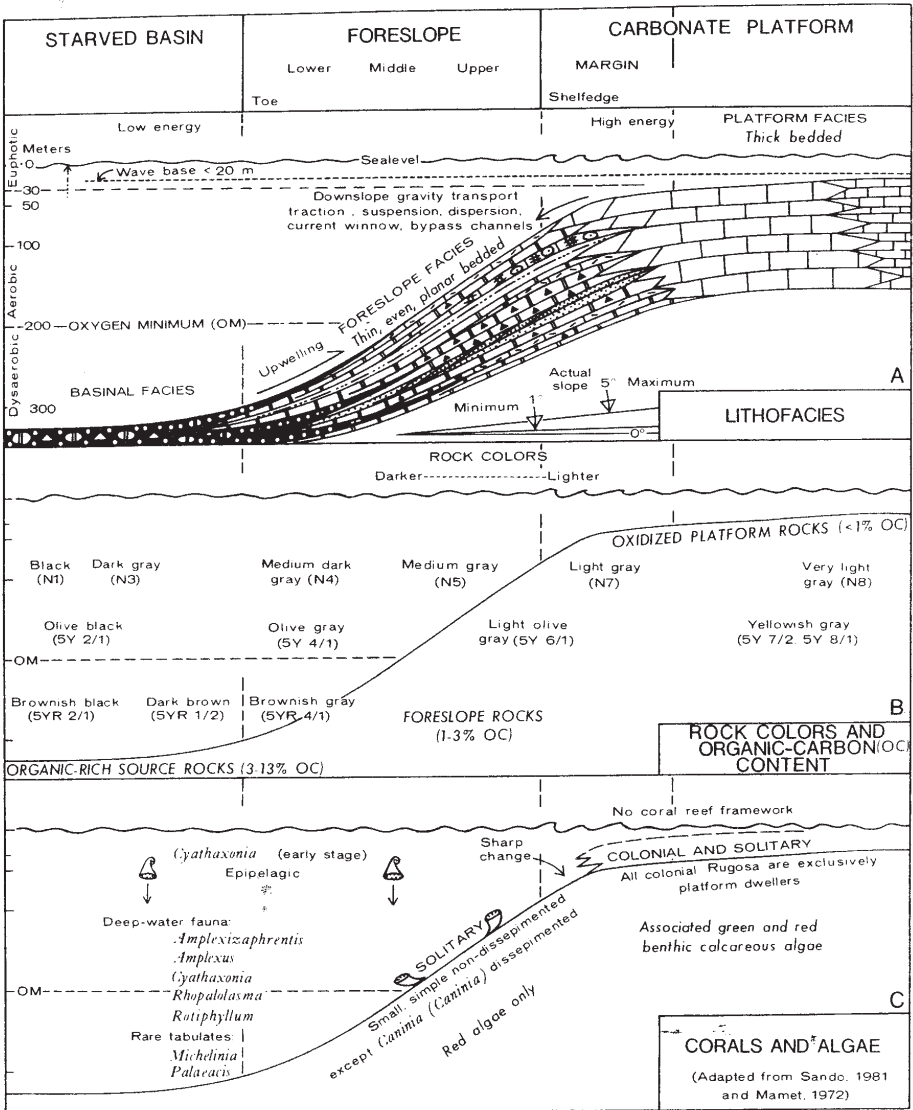


Fig 29 Paleoecologic Model for Starved Basin, (Gutschick and Sandberg, 1983)

WEST

EAST

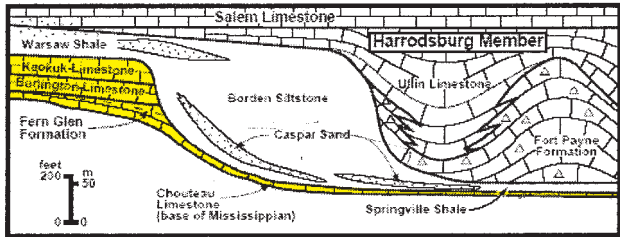


Fig 30 Illustration of shelf edge in Illinois Basin (Jobe and Saller, 1995)

Deep Water Scenario

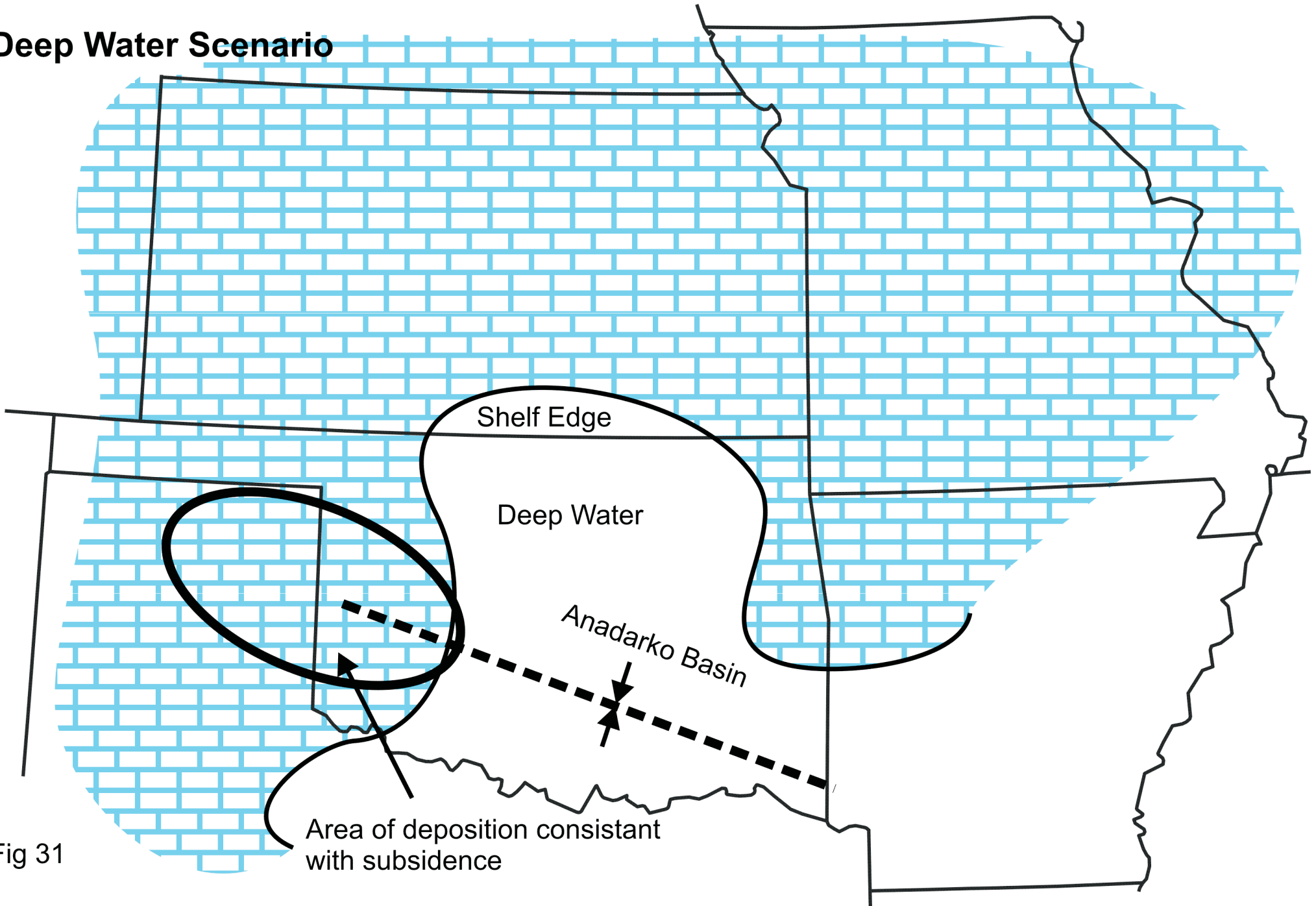
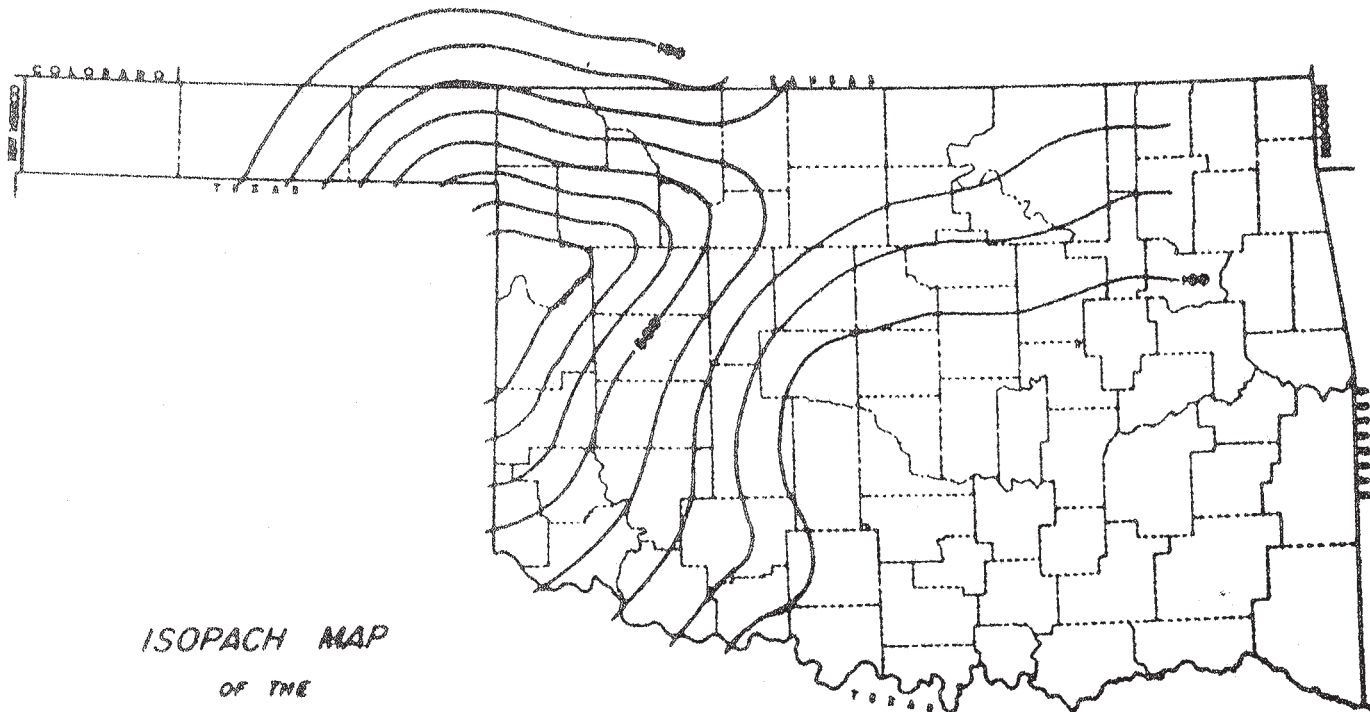


Fig 31



ISOPACH MAP

OF THE

OSAGEAN SERIES

D.M. CURTIS AND STEVE C. CHAMPLIN

1:100,000

1980

Fig 32 (Curtis and Champlin)

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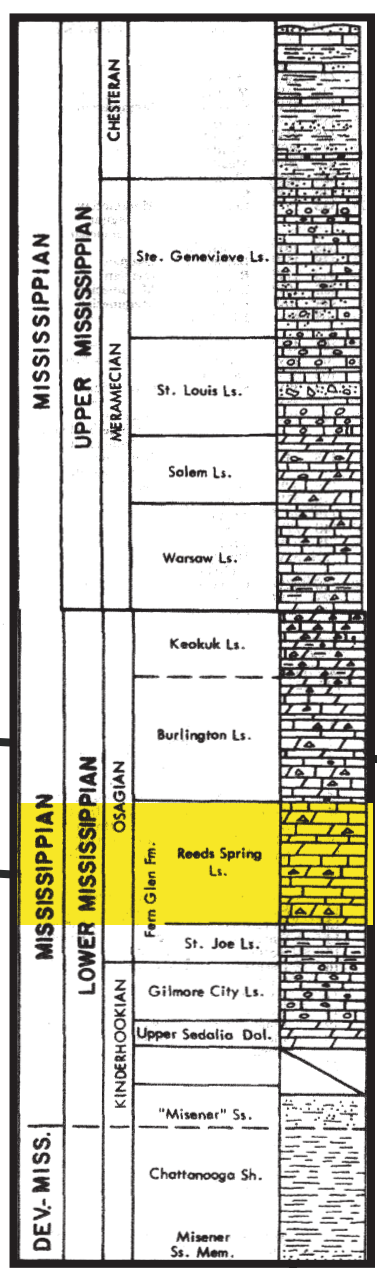
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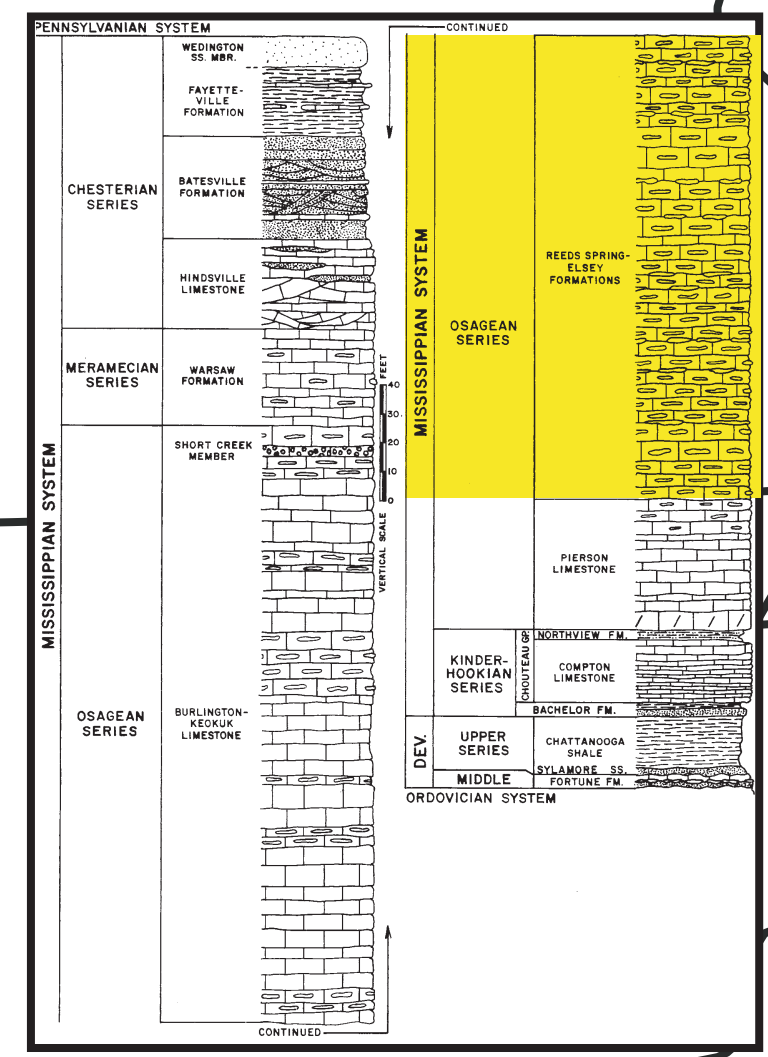
Goebel, 1968



Period	Stage	Formations/Members (Goebel, 1968a, b)	Formations/Members (Maples, 1994)	Period	Stage
DEVONIAN	Kinderhookian	Chattanooga Shale	Chattanooga Shale	DEVONIAN	Kinderhookian
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		Chouteau Limestone	Compton Limestone		
		Chouteau Limestone	Compton Limestone		
MISSISSIPPIAN	Meramecian	Keokuk Limestone	Keokuk Limestone	MISSISSIPPIAN	Meramecian
		Burlington Limestone	Burlington Limestone		
		Salem Limestone	Salem Limestone		
		Warsaw Limestone	Warsaw Limestone		
MISSISSIPPIAN	Chesterian	Ste. Genevieve Limestone	Ste. Genevieve Limestone	MISSISSIPPIAN	Chesterian
		unnamed unit(s)	Shore Airport Formation		

Watney, Guy and Byrnes, 2001

Thompson, 1986

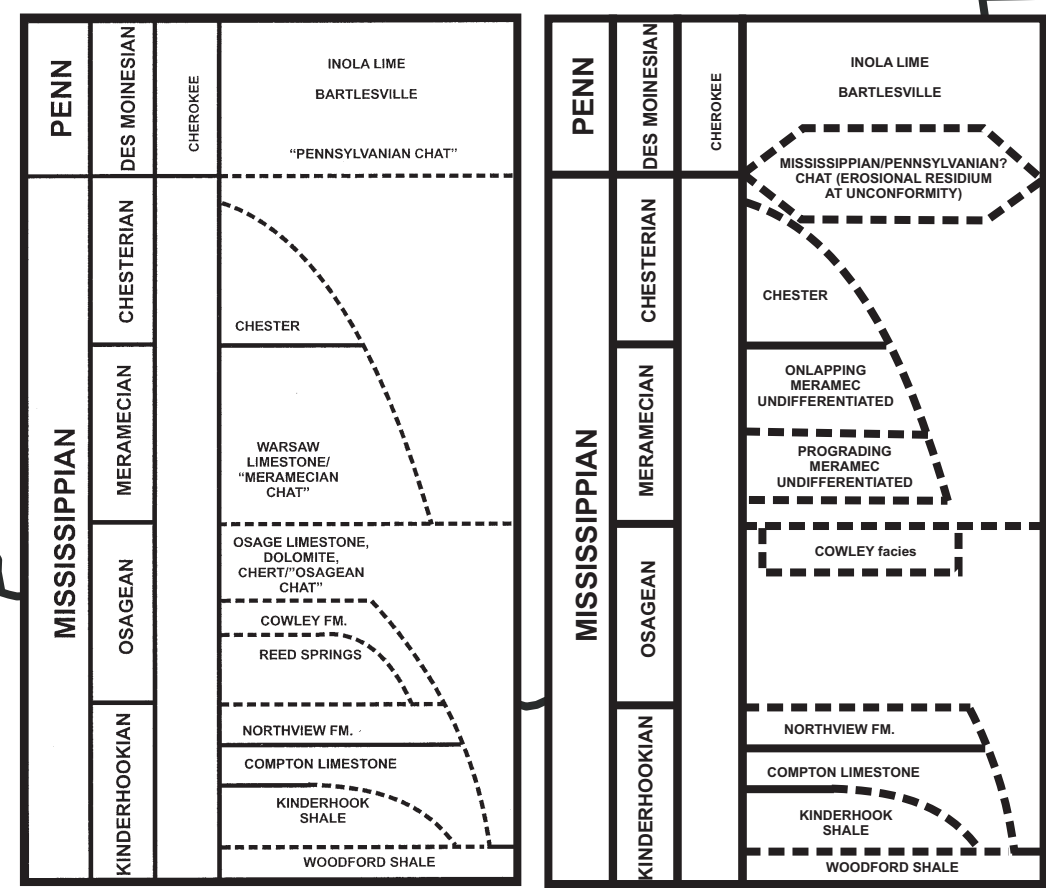


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Fig 34 Correlation for Reeds Spring



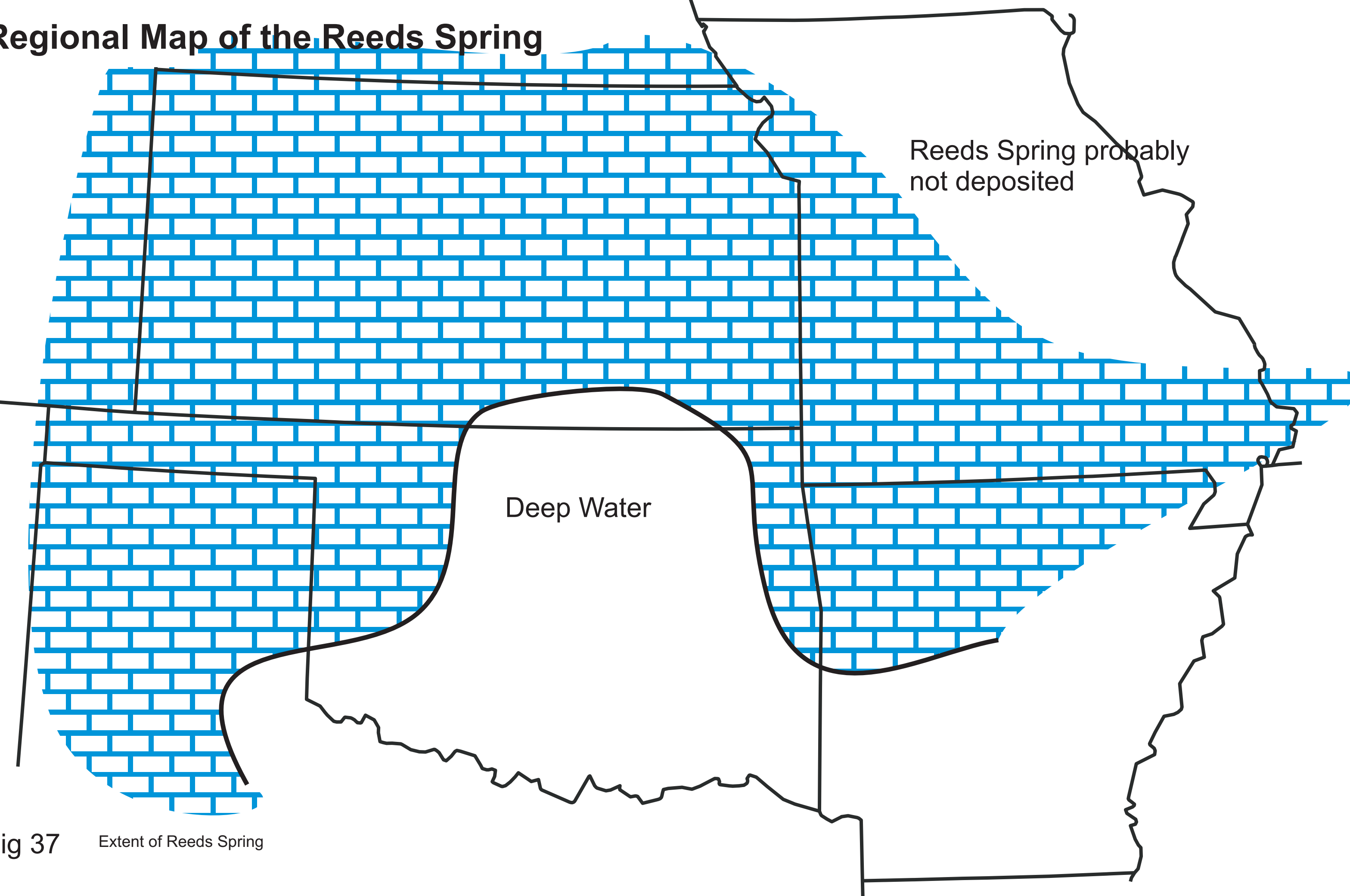
Description of Reeds Spring Rocks (upper Fern Glen)

Missouri - Cherty Limestone, some shaly limestone beds with chert both bedded and discontinuous, some burrows
Pinches out north of Springfield Missouri (Boardman, Mazzullo, and Wilhite, Field Conference, GSA meeting 2010, Branson, Missouri)

Western Kansas - Semi granular and fine textured limestone with silica and sponge spicules common. (Goebel, 1968)

Fig 36

Regional Map of the Reeds Spring



Reeds Spring probably
not deposited

Deep Water

Fig 37 Extent of Reeds Spring

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Description of Keokuk/Burlington

Missouri- Crinoidal wackestone to packstone-can be thick bedded

Brachiopods, ramos bryozoans and rare sharks teeth

Slightly less chert than Reeds Spring- Oolites at top called Short Creek Oolite.- can have gradational contact with Reeds Spring (Boardman, Mazzullo, and Wilhite, 2010)

NW Kansas -

Keokuk- Large amount of chert >50%- Tripolitic in upper member - chert is pitted, porous, calcareous and tripolitic - Absent to east in Barber County (south central KS) from Morton County where it is 150 ft thick

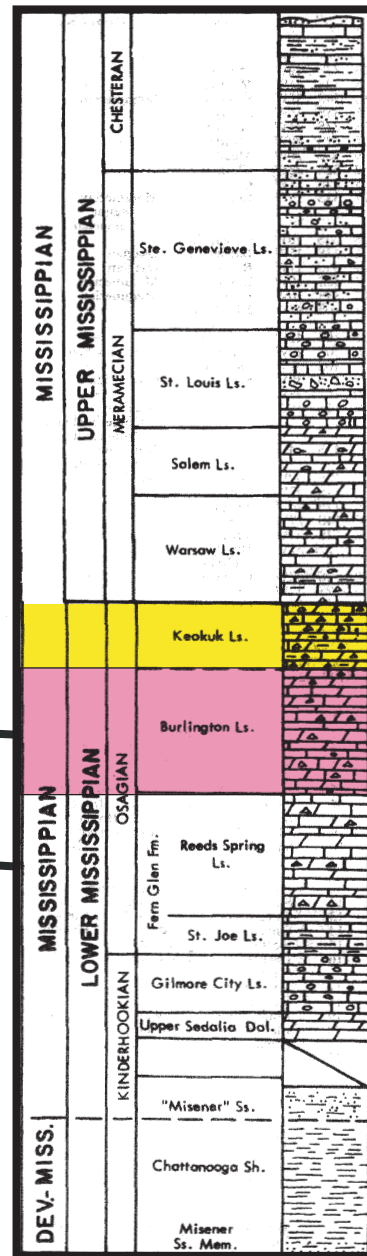
Burlington- White and gray simi-crinoidal limestone interstratified with relatively thin beds of gray dolomite and limestone - large quantities of large chert are locally present but the amount of chert is variable

Goebels could not assign samples to Burlington with reasonable certainty (Goebel, 1968)

Fig 39

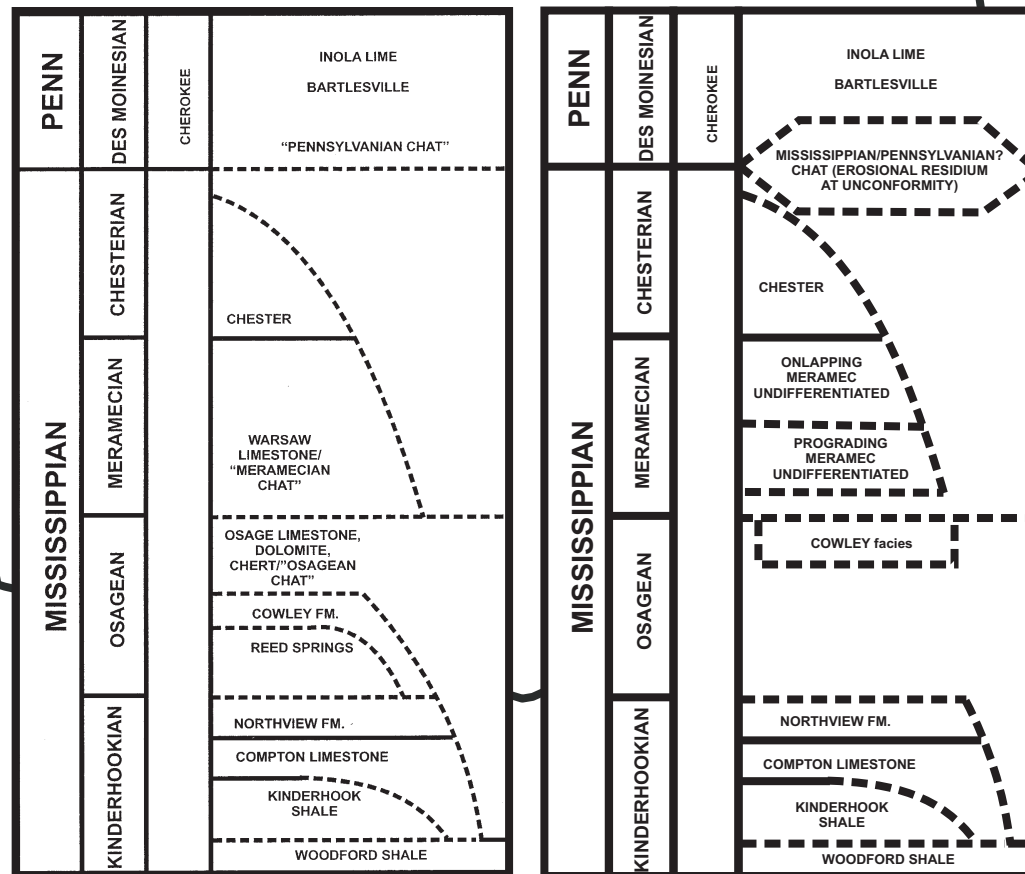
Correlation for Burlington/Keokuk

Goebel, 1968

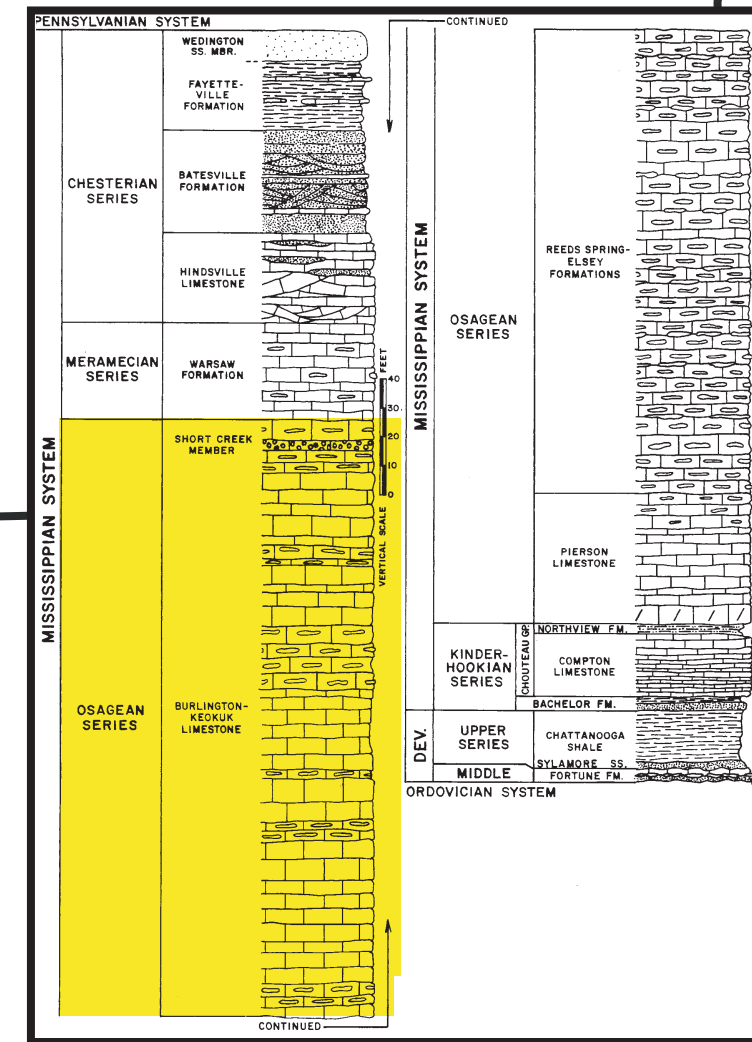


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		Chouteau Limestone Compton Limestone	Compton Limestone				
		Sedalia Dolomite (Northview Shale)	Sedalia Dolomite Northview Formation				
MISSISSIPPIAN	OSAGEAN	Fern Glen Limestone	Reed Spring Ls. Mbr. St. Joe Ls. Mbr.	MISSISSIPPIAN	OSAGEAN		
		Burlington Limestone	Burlington Limestone				
		Keokuk Limestone	Keokuk Limestone				
		Keokuk Limestone Burlington-Keokuk Limestone	Keokuk Limestone Burlington-Keokuk Limestone				
MISSISSIPPIAN	MERAMECIAN	Warsaw Limestone	Warsaw Limestone	MISSISSIPPIAN	MERAMECIAN		
		Salem Limestone	Salem Limestone				
		St. Louis Limestone	St. Louis Limestone Stevens Mbr. Hugoton Mbr.				
		Ste. Genevieve Limestone	Ste. Genevieve Limestone				
CHESTERIAN	CHESTERIAN	unnamed unit(s)	Shore Airport Formation	CHESTERIAN	CHESTERIAN		

Watney, Guy and Byrnes, 2001



Thompson, 1986



Goebel, 1968
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Geology and Land Survey, Report of
Investigations 70.

Regional Map of the Burlington/Keokuk

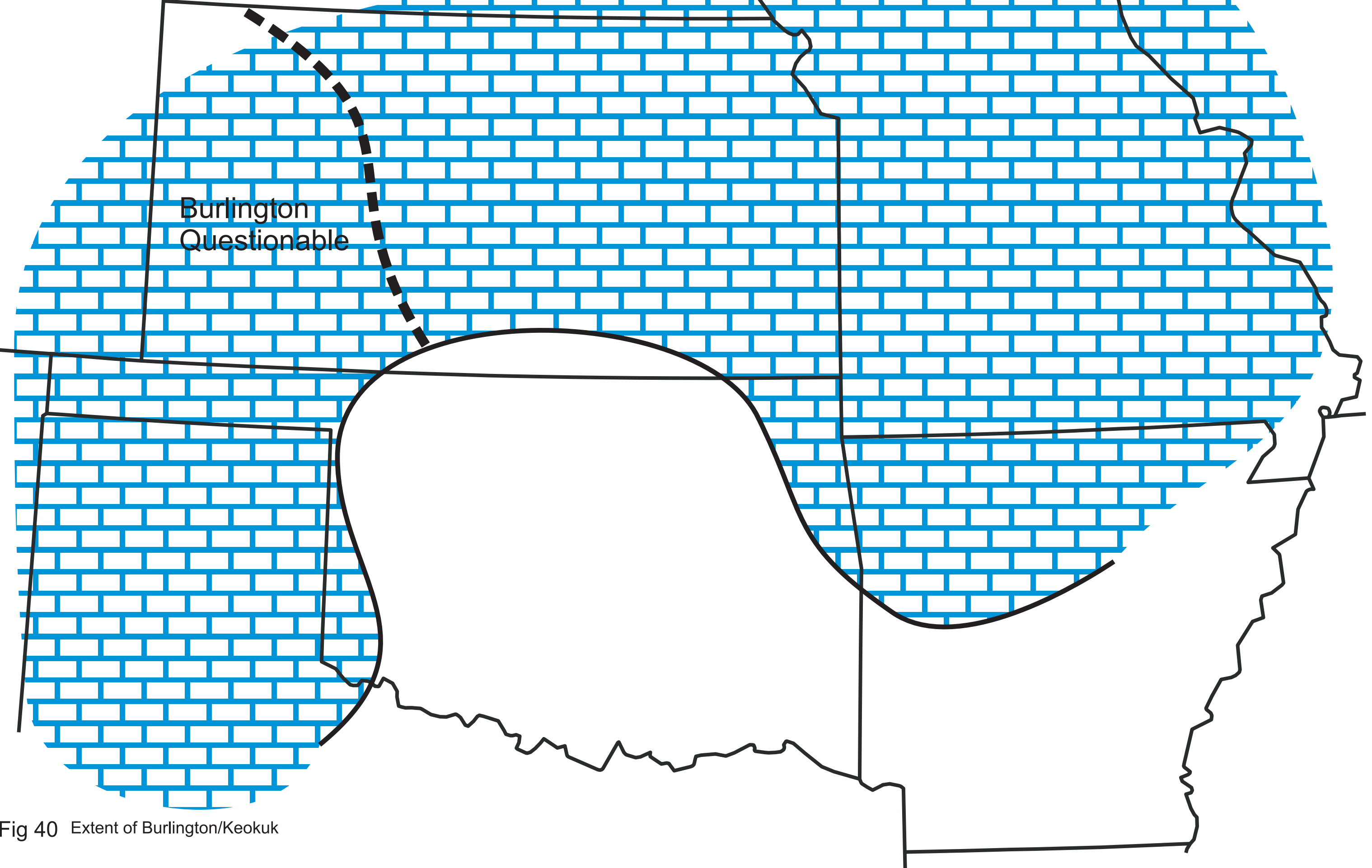


Fig 40 Extent of Burlington/Keokuk

The Mississippian of the Mid-Continent; An Overview,

Kurt Rottmann, Consultant
Steve Hadaway, Consultant

1. How important it is to understand Mississippian Deposition

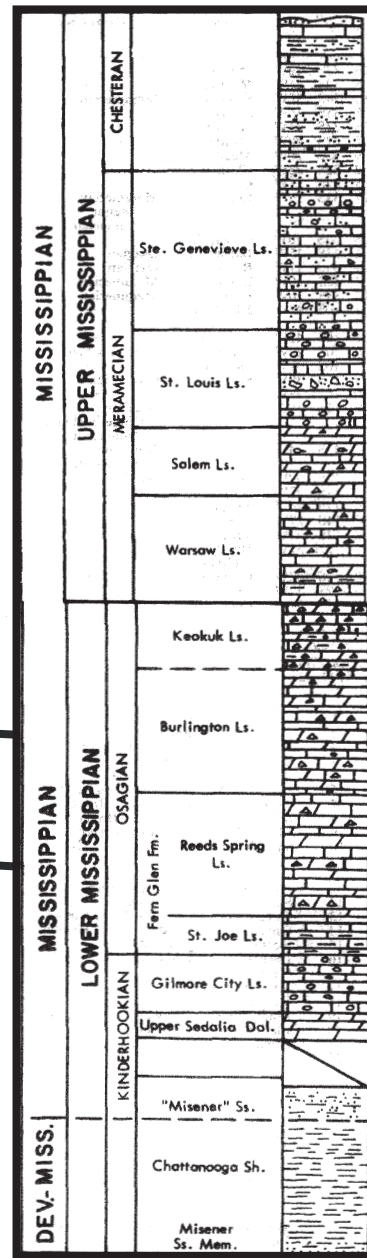
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3. Importance of Understanding the Boundaries to Help Exploration and Development

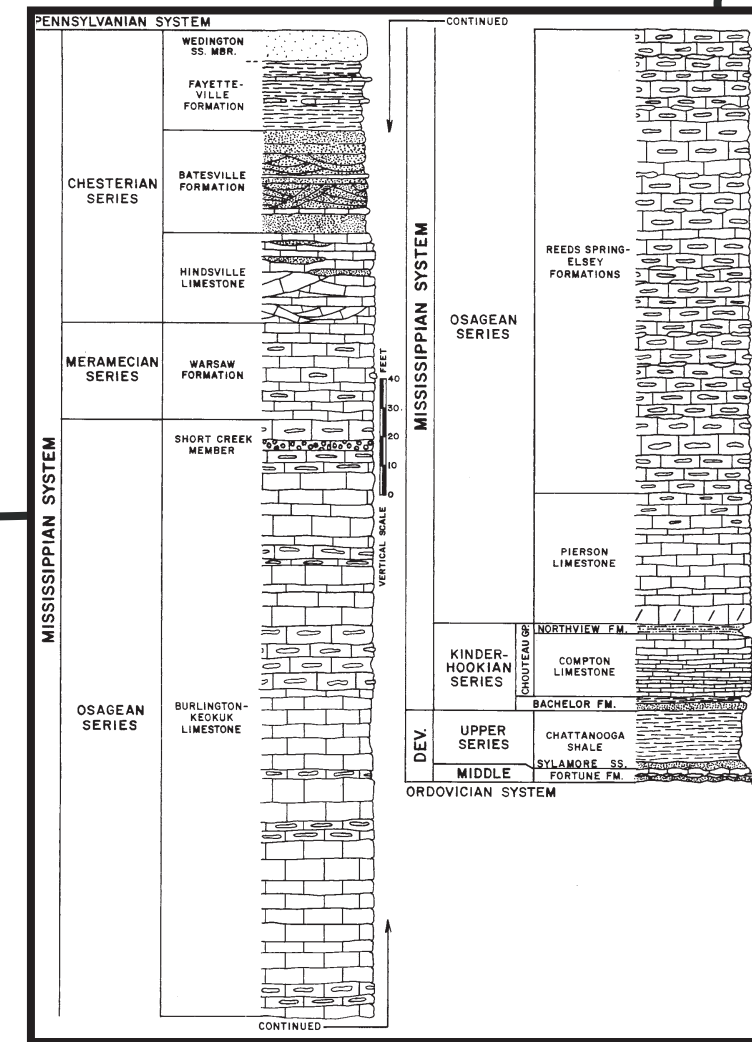
Goebel, 1968



Period	Stage	Formations/Members (Goebel, 1968a, b)	Formations/Members (Maples, 1994)	Period	Stage	
CHESTERIAN		unnamed unit(s)	Shore Airport Formation	CHESTERIAN		
		Ste. Genevieve Limestone	Ste. Genevieve Limestone			
MERAMECIAN		St. Louis Limestone	St. Louis Limestone / Stevens Mbr. / Hugoton Mbr.	MERAMECIAN		
		Salem Limestone	Salem Limestone			
		Warsaw Limestone	Warsaw Limestone			
OSAGEAN		Keokuk Limestone	Keokuk Limestone / Short Creek Oolite Mbr.	OSAGEAN		
		Burlington Limestone	Burlington-Keokuk Limestone			
		Fern Glen Limestone	Reed Spring Ls. Mbr. / Eisey Fm.			
		Reed Spring Ls. Mbr.	Reed Spring Ls. Mbr.			
KINDERHOOKIAN		Gilmore City Limestone	Gilmore City Limestone / Northview Formation	KINDERHOOKIAN		
		Sedalia Dolomite (Northview Shale)	Sedalia Dolomite			
		Chouteau Limestone / Compton Limestone	Compton Limestone			
DEVONIAN		Boice Shale	Hannibal Shale	DEVONIAN		
		Chattanooga Shale	Chattanooga Shale			

Watney, Guy and Byrnes, 2001

Thompson, 1986



Goebel, 1968
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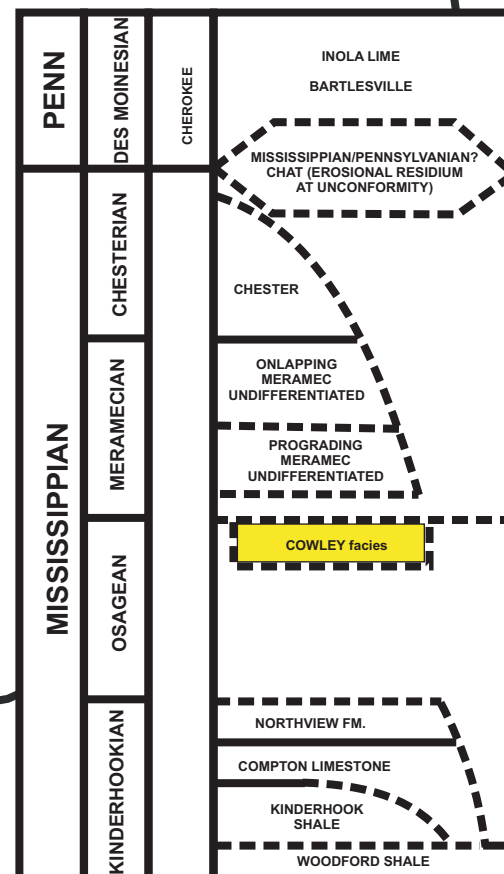
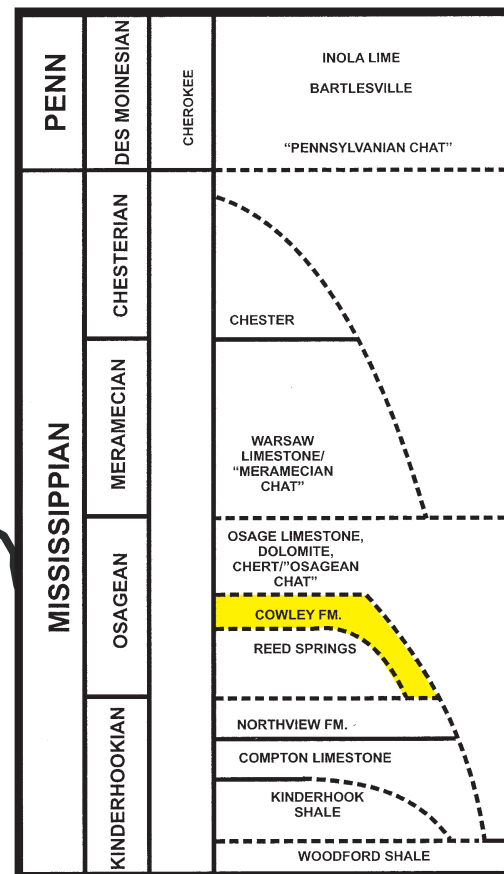


Fig 44 Correlation of Cowley

Description of Cowley

NW Kansas- Wide variation of rock type exist in Cowley- Dolomitic gray green, siliceous, argillaceous shale containing scattered chert (no conodonts in residue), Thick gray and dark colored silty and cherty dolomitic limestone beds, below Warsaw

Locally, patches of unaltered rock remain in the Cowley - cut out Osage rocks

Not present in Missouri (Goebel, 1968)

Mazzullo- Spiculite and associated shale with a very minor carbonate rock component - always deposited on Osagean rocks
Diagenesis from multiple periods of subaerial meteoric exposure

Four lithologies-

1. Bedded Spiculite
2. Lenticular to flaser to nodular bedded spiculite and shale
3. Dark grey shale
4. Limestone (Mazzullo, 2009)

Fig 50

WEST

EAST

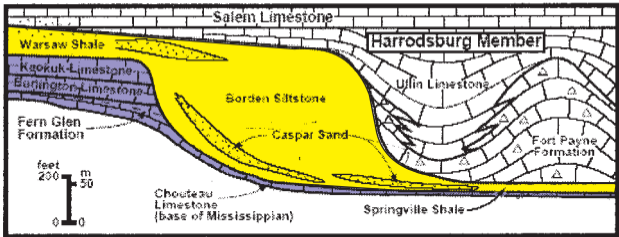


Fig 45 Borden siltstone delta for Illinois Basin (Jobe and Saller, 1995)

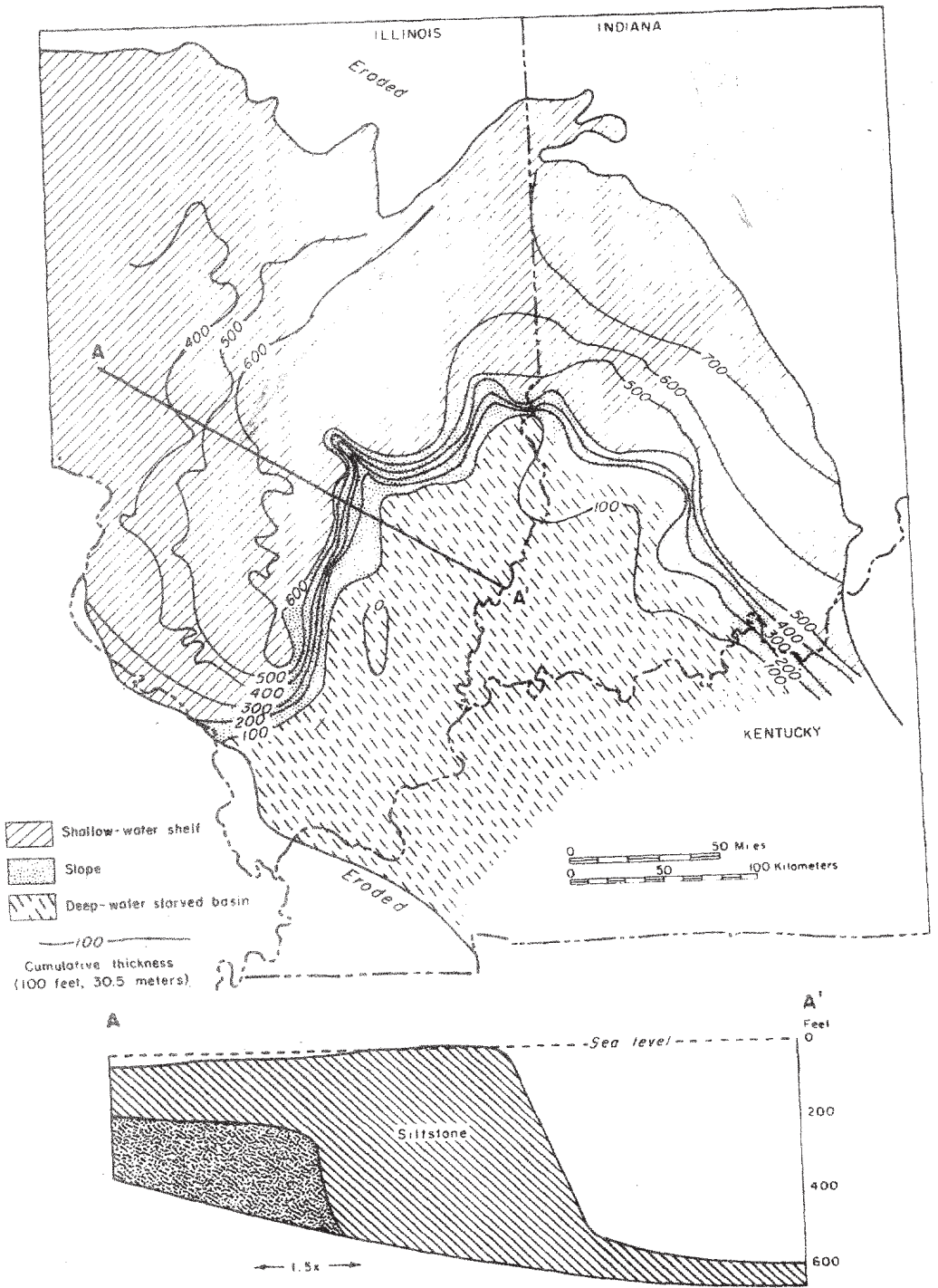


Fig 46 Borden progradation in the Illinios Basin (Lineback, 1969)

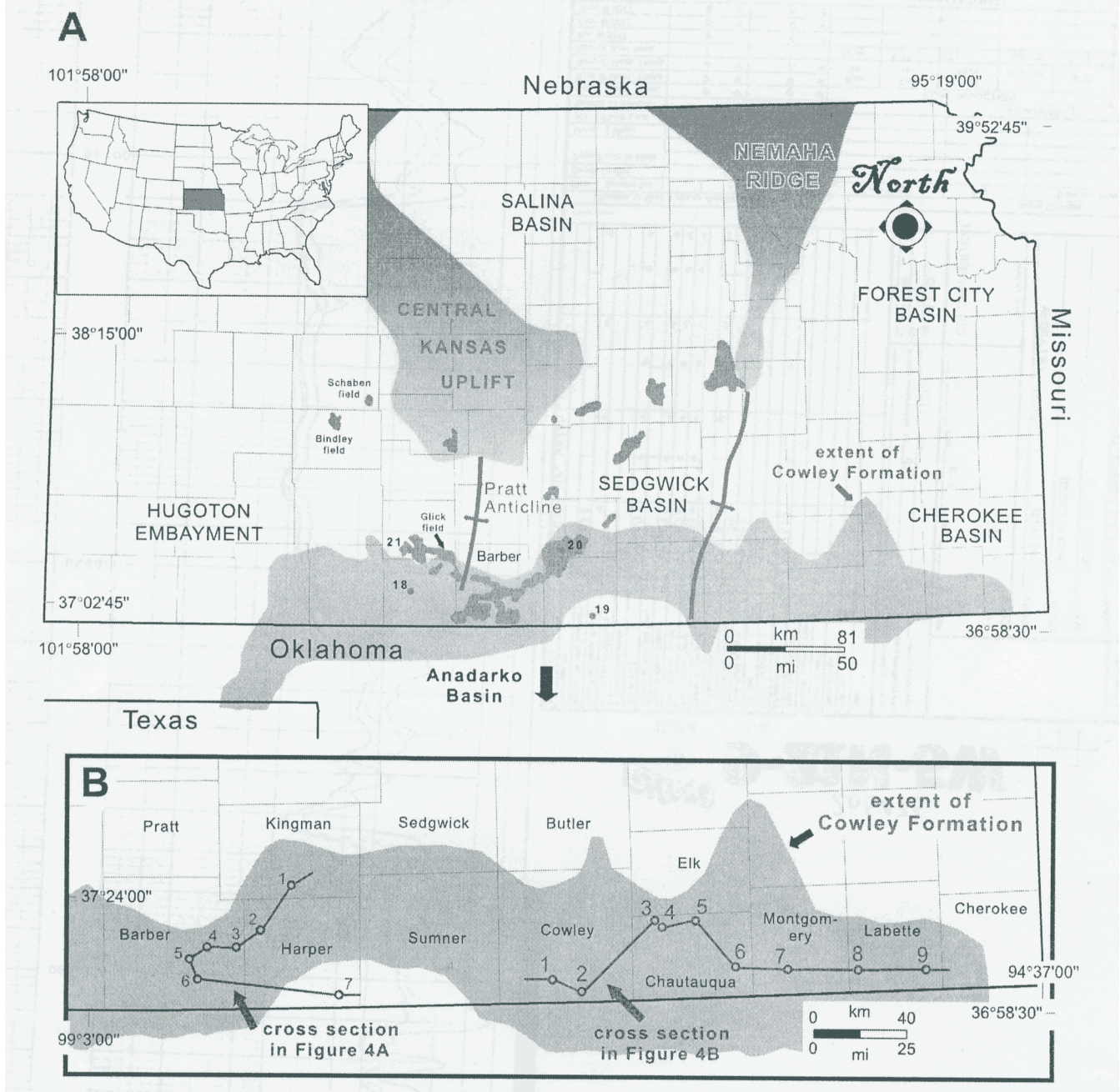


Fig 47 Extent of Cowley Deposition (Mazzullo, Wilhite and Woolsey, 2009)

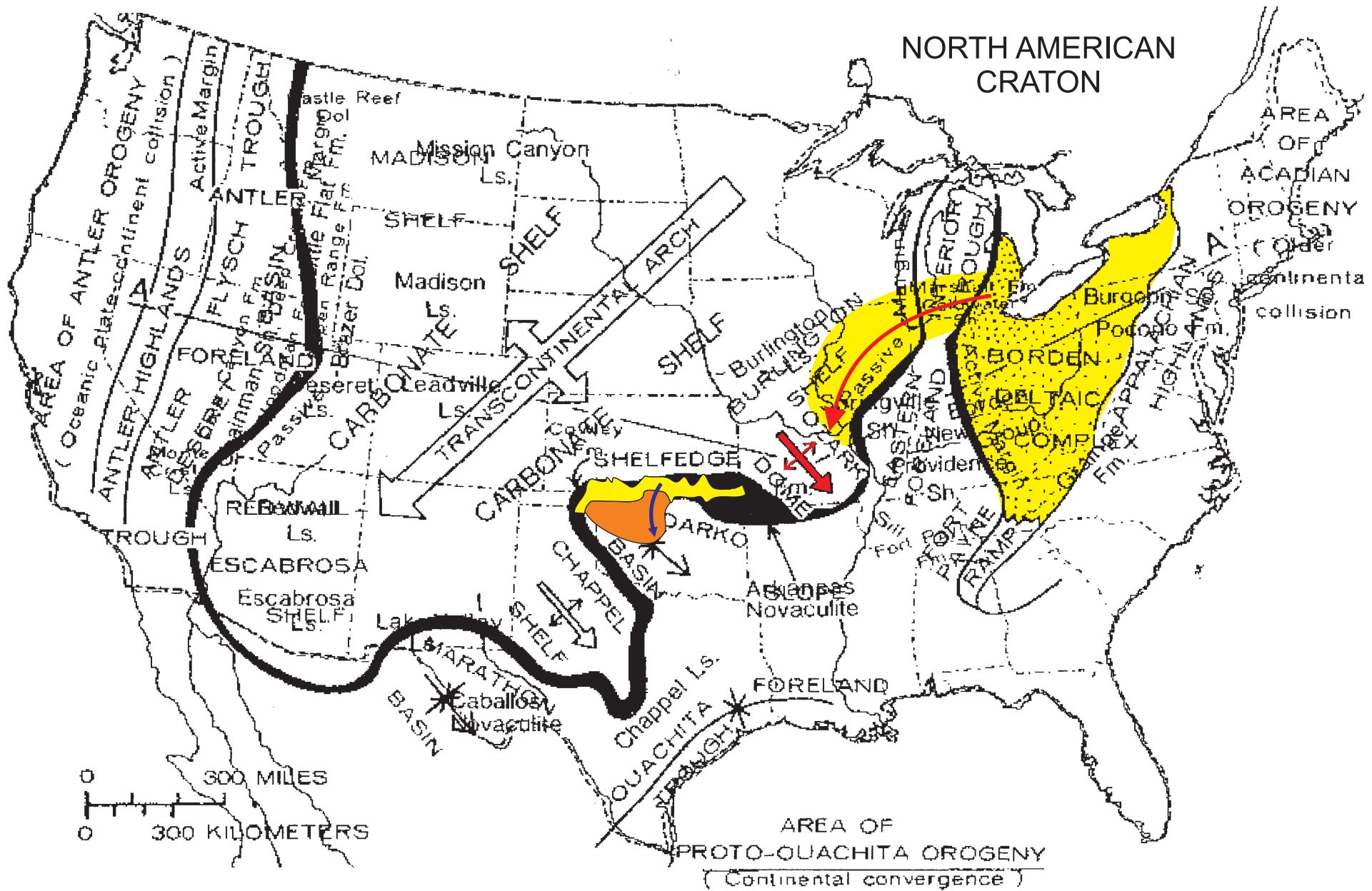
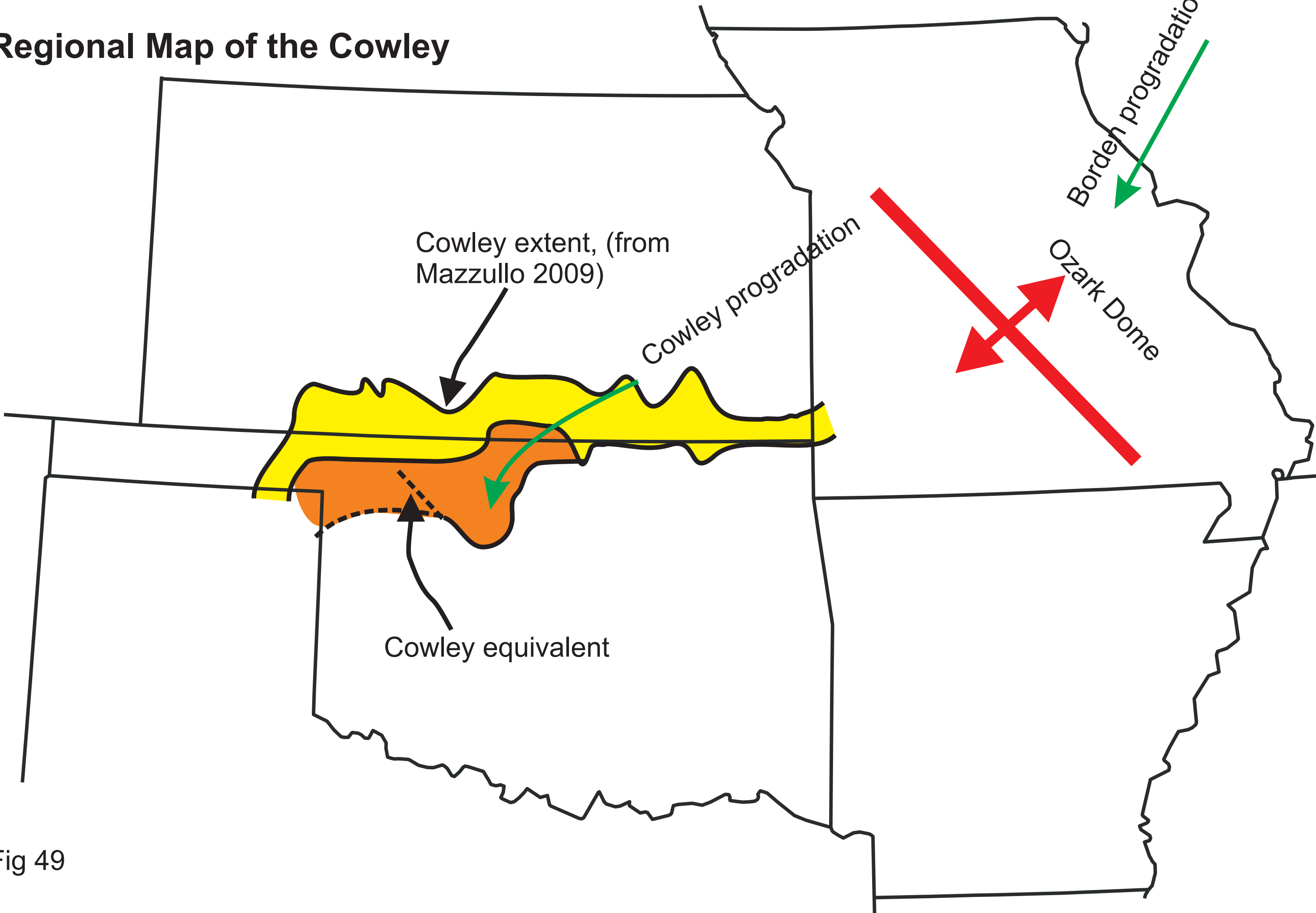


Fig 48 Possible Cowley Borden Relationship (Modified from Gutschick and Sandberg, 1983)

Regional Map of the Cowley



Cowley extent, (from Mazzullo 2009)

Cowley progradation

Ozark Dome

Borden progradation

Cowley equivalent

Fig 49

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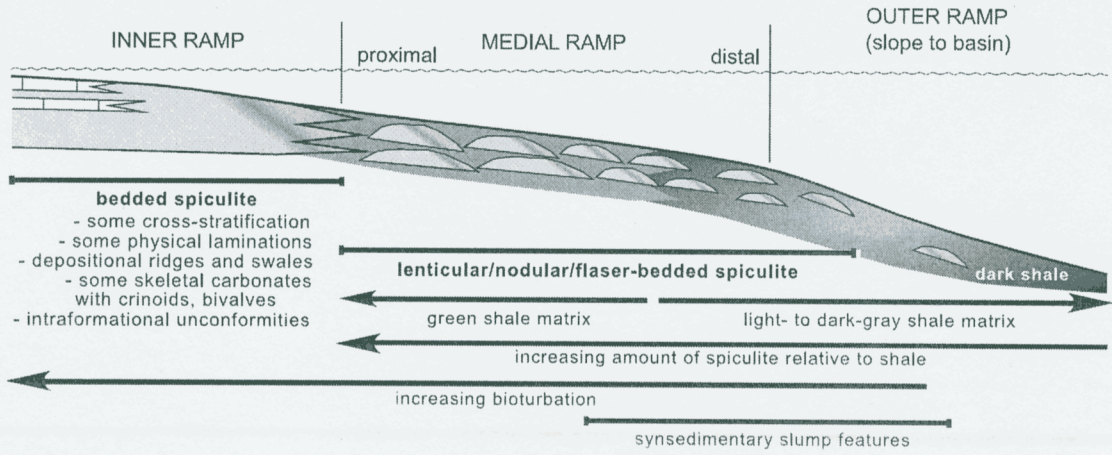
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“Cores from wells in Noble, Payne, Pawnee, and Osage Counties yielded conodont and brachiopod faunas of St. Louis age correlative with the Bayou Manard. Continuous cores of Pre-Chester Mississippian in Major County yielded a Meramecian fauna, from St. Louis to Warsaw in age, and had one hundred and seventy-five feet of faunally barren beds overlying thin Kinderhookian beds. The barren zone correlates lithologically with the argillaceous Osagean facies in southwestern Kansas and northwestern Oklahoma. In a Grant County well the complete Mississippian section was cored yielding St. Louis conodonts from the upper and lower parts. The only other Mississippian conodonts found in the section were Chester in age from a very thin section at the top, and Kinderhookian from a very thin section at the base overlying Woodford shale. No Osagean beds were present in this well.”

Fig 52 (Selk)

A



B

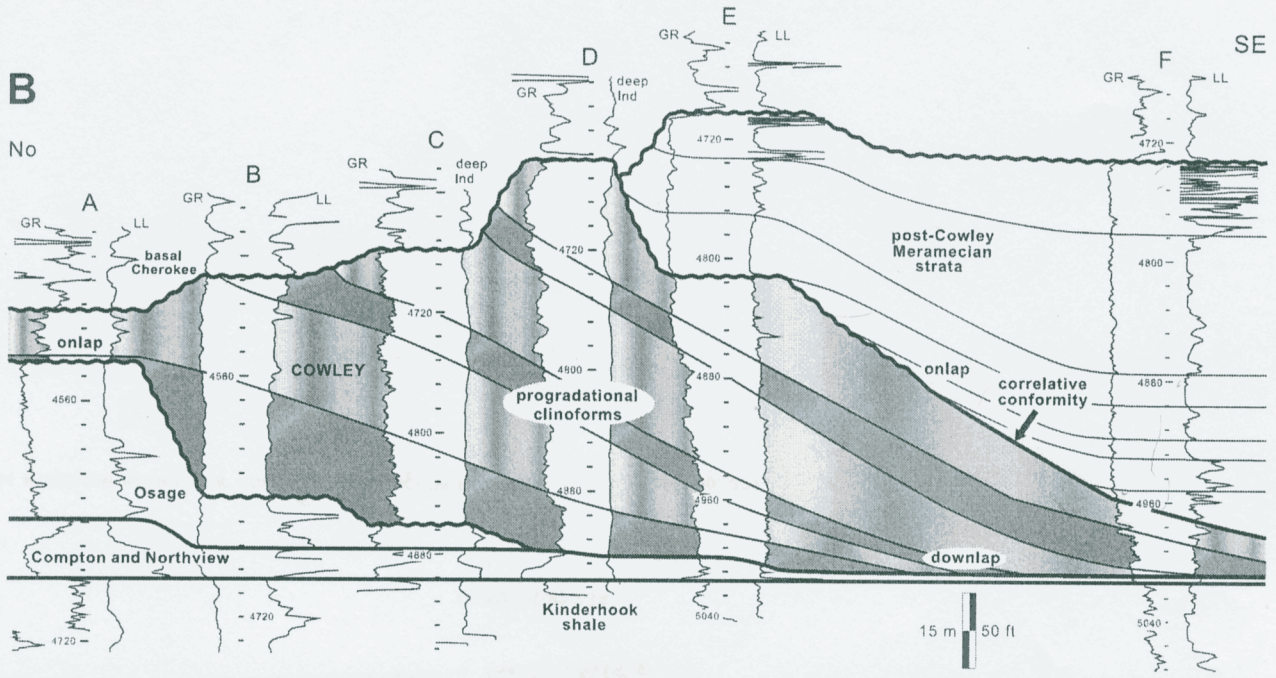


Fig 53 Presence of Meramecian strata in South Central Kansas (Mazzullo, Wilhite and Woolsey, 2009)

Central Oklahoma Mississippian Regional Study

North

South

Regional Cross Section

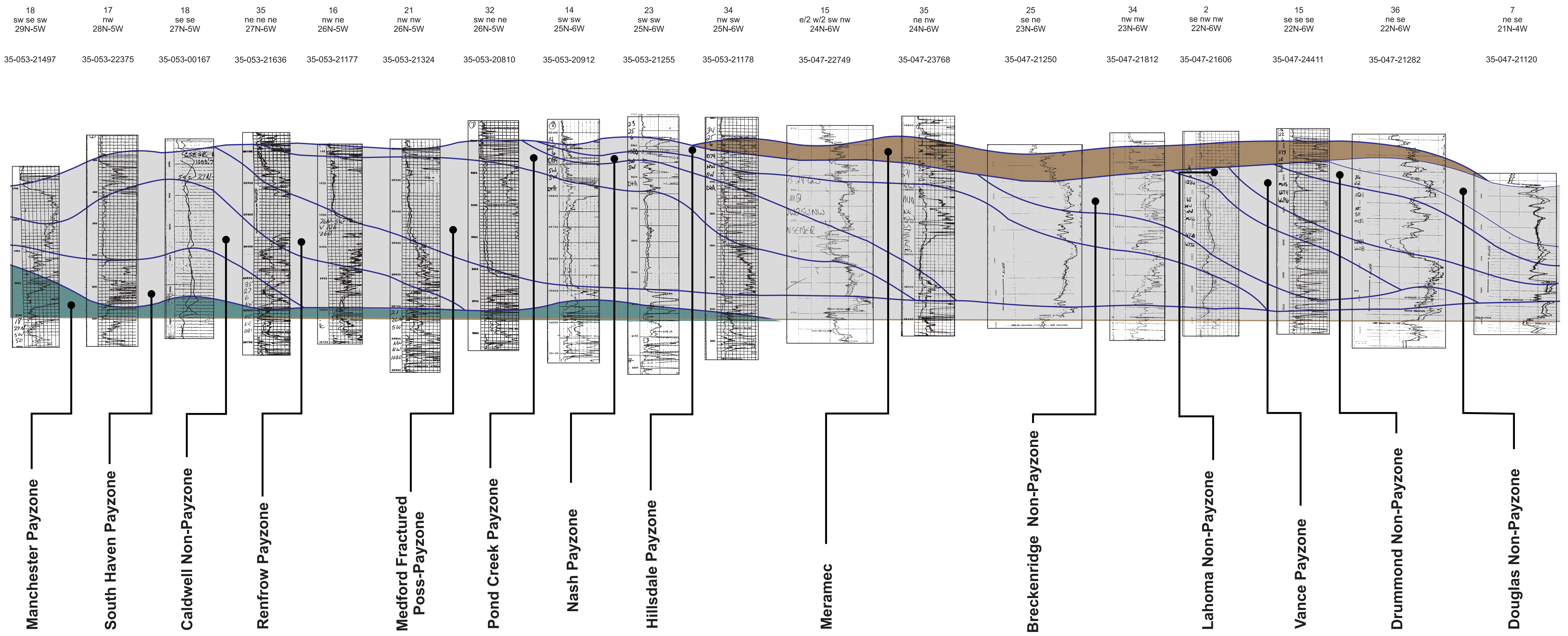


Fig 54 North-South cross section illustrating post Cowley geometry of deposition

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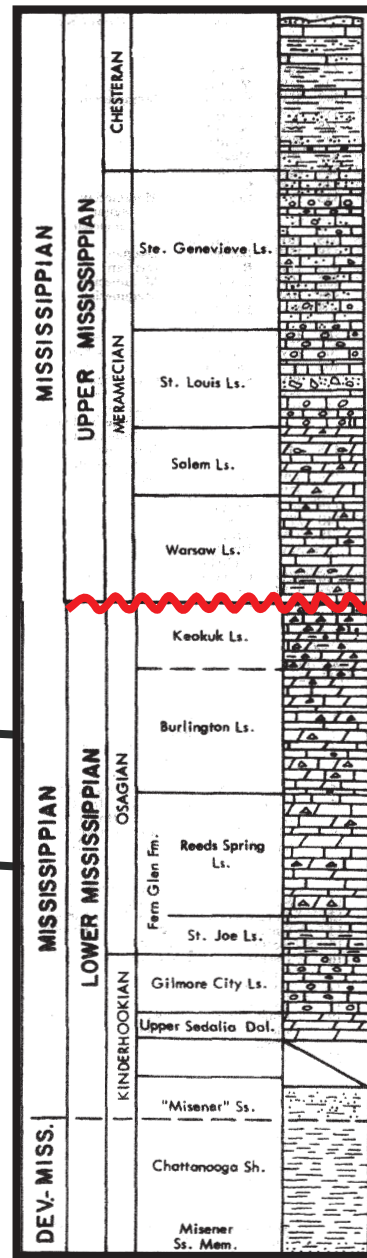
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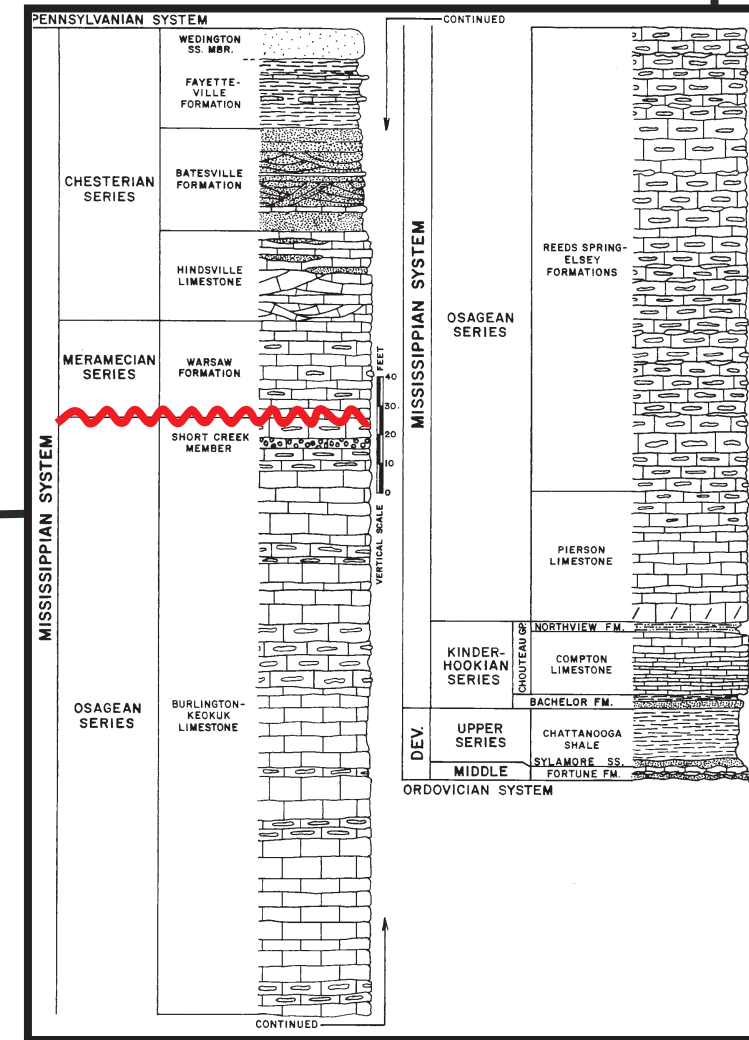
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Goebel, 1968



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		Salem Limestone	Salem Limestone			
		Warsaw Limestone	Warsaw Limestone			
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		Burlington Limestone	Burlington-Keokuk Limestone			
		Fern Glen Limestone	Reed Spring Ls. Mbr. / St. Joe Ls. Mbr. / Pierson Limestone			
		Gilmore City Limestone	Gilmore City Limestone / Northview Formation			
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		Boice Shale	Hannibal Shale			
DEVONIAN		Chattanooga Shale	Chattanooga Shale	DEVONIAN		

Watney, Guy and Byrnes, 2001



Thompson, 1986

PENN	DES MOINESIAN	CHEROKEE	INOLA LIME	BARTLESVILLE
			"PENNSYLVANIAN CHAT"	
MISSISSIPPIAN	CHESTERIAN		CHESTER	
	MERAMECIAN		WARSAW LIMESTONE / "MERAMECIAN CHAT"	
	OSAGEAN		OSAGE LIMESTONE, DOLOMITE, CHERT / "OSAGEAN CHAT"	
			COWLEY FM.	
			REED SPRINGS	
			NORTHVIEW FM.	
			COMPTON LIMESTONE	
KINDERHOOKIAN			KINDERHOOK SHALE	
			WOODFORD SHALE	

Fig 57

Extent of Meramecian-Osagean Unconformity

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Description of Meramecian Rocks

Missouri-Limestone- crinoidal mudstone to grainstone, some chert, burrows, fenestrat bryozoans, brachiopods, tripolite at top of unit (Warsaw)

Shales- interbedded mudstone to wackestone beds, grayish green and green shale beds, siltstone beds (Moorefield)
(Boardman, Mazzullo, and Wilhite, 2010)

NW Kansas-Goebel- Carbonates dominate but quartz sandstone is common and small quantities of chert are present- breccia in Warsaw and residue of Warsaw, in some places masses of sponge spicules were deposited, glauconite at base

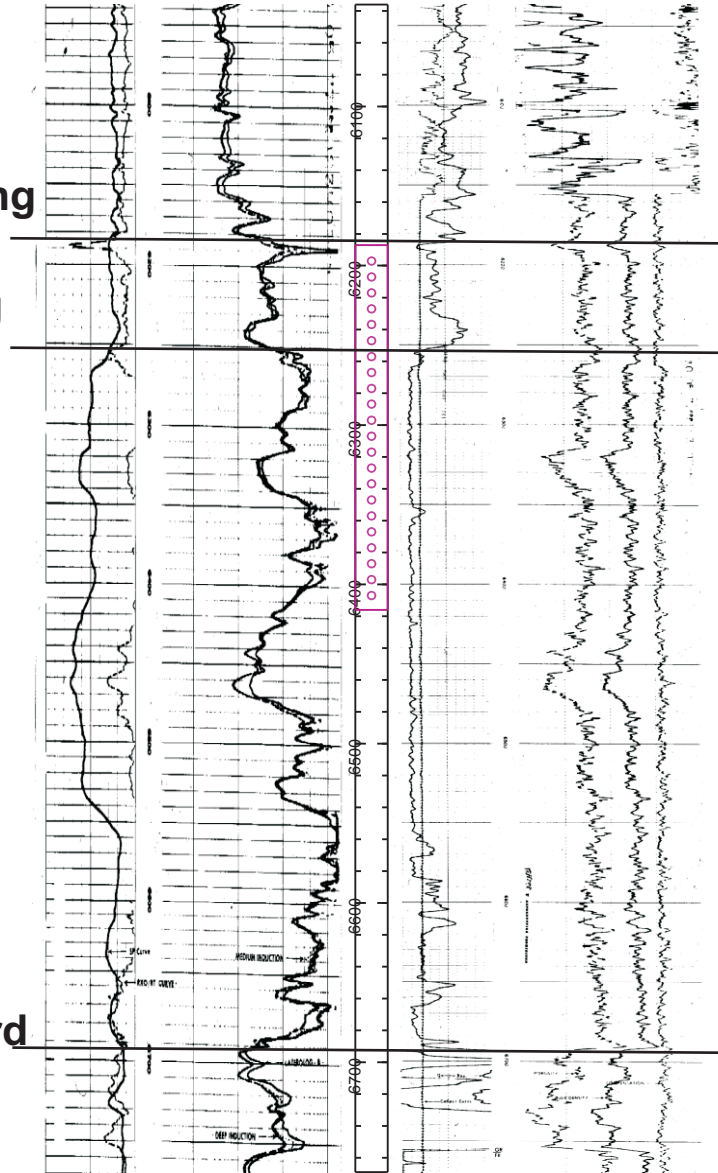
Ooids in St. Louis and Salem are difficult to distinguish
(Goebel 1968)

Jordan and Rowland (-North Central Oklahoma- Medium to coarse crystalline limestone grey -tan to buff color

35047213580000
T21N R6W S1
C SW NW
1,116
359MSSP

Top of Onlapping
Meremac
Top Prograding
Meramec

Top Woodford



2,046
66,655
8/23/1977

Fig 61 Type log to distinguish prograding from onlapping Meramecian beds

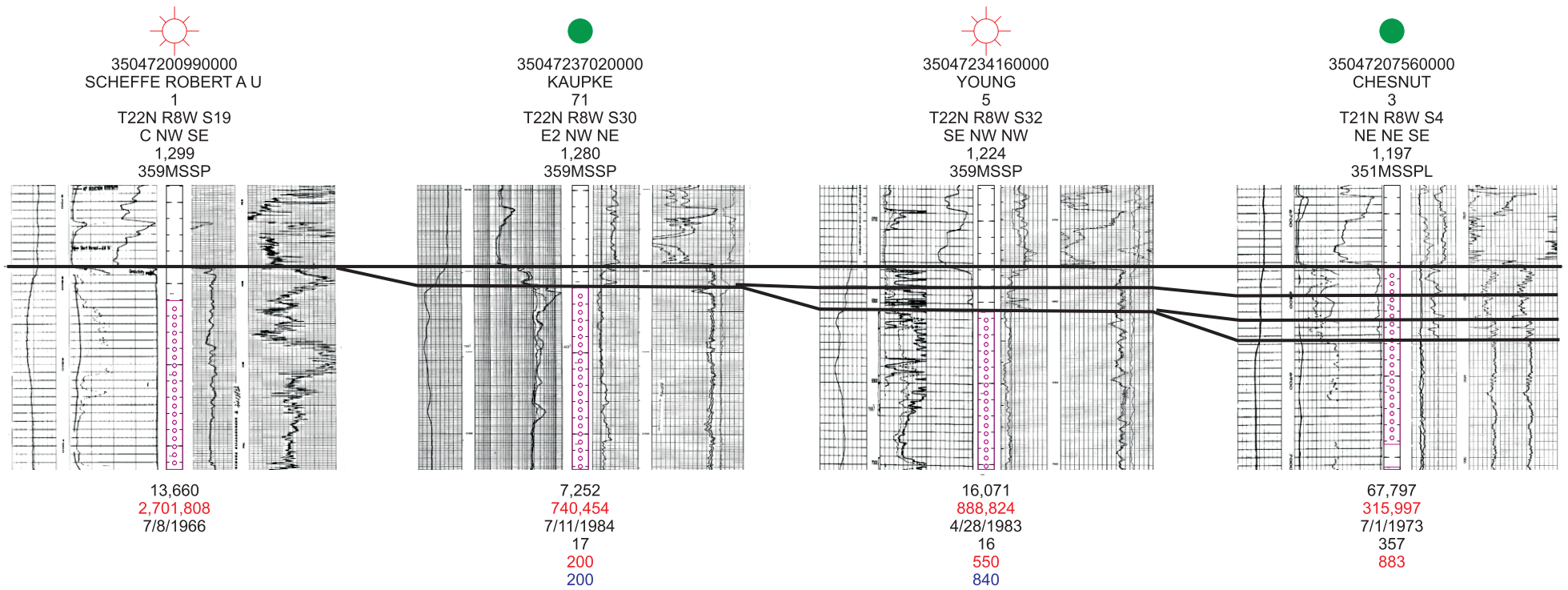


Fig 61 a Illustration of onlapping Meramecian strata

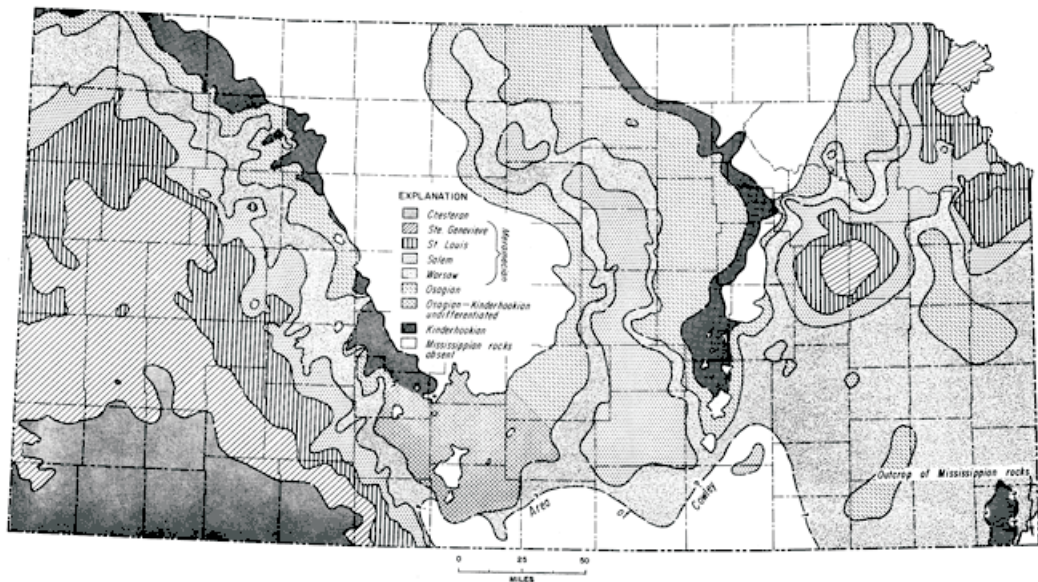


Fig 62 Subcrop map of post- Mississippian, Merriam,
http://www.kgs.ku.edu/Publications/Bulletins/162/04_uncomf.html

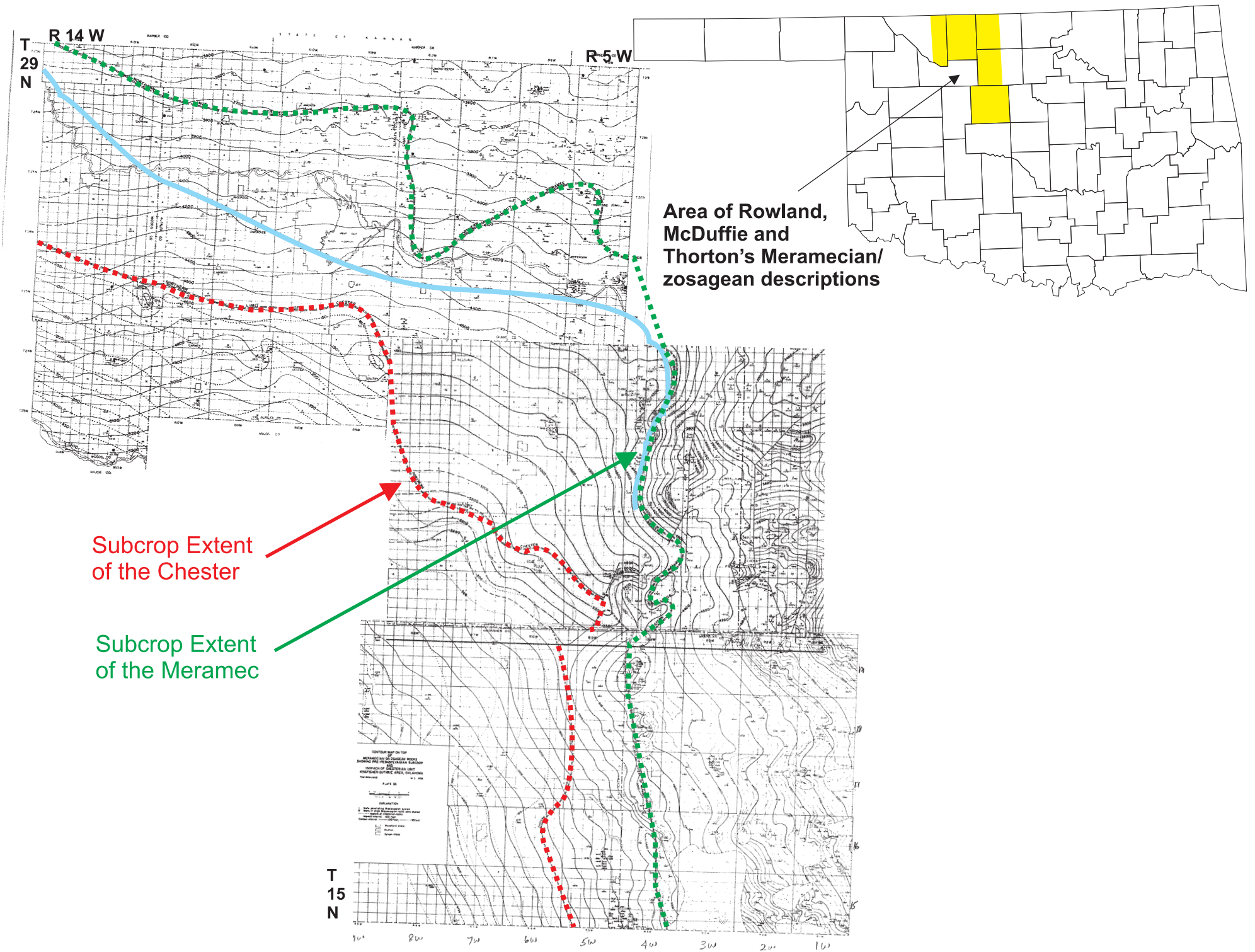


Fig 63 Extent of onlapping Meramec- North Central Oklahoma

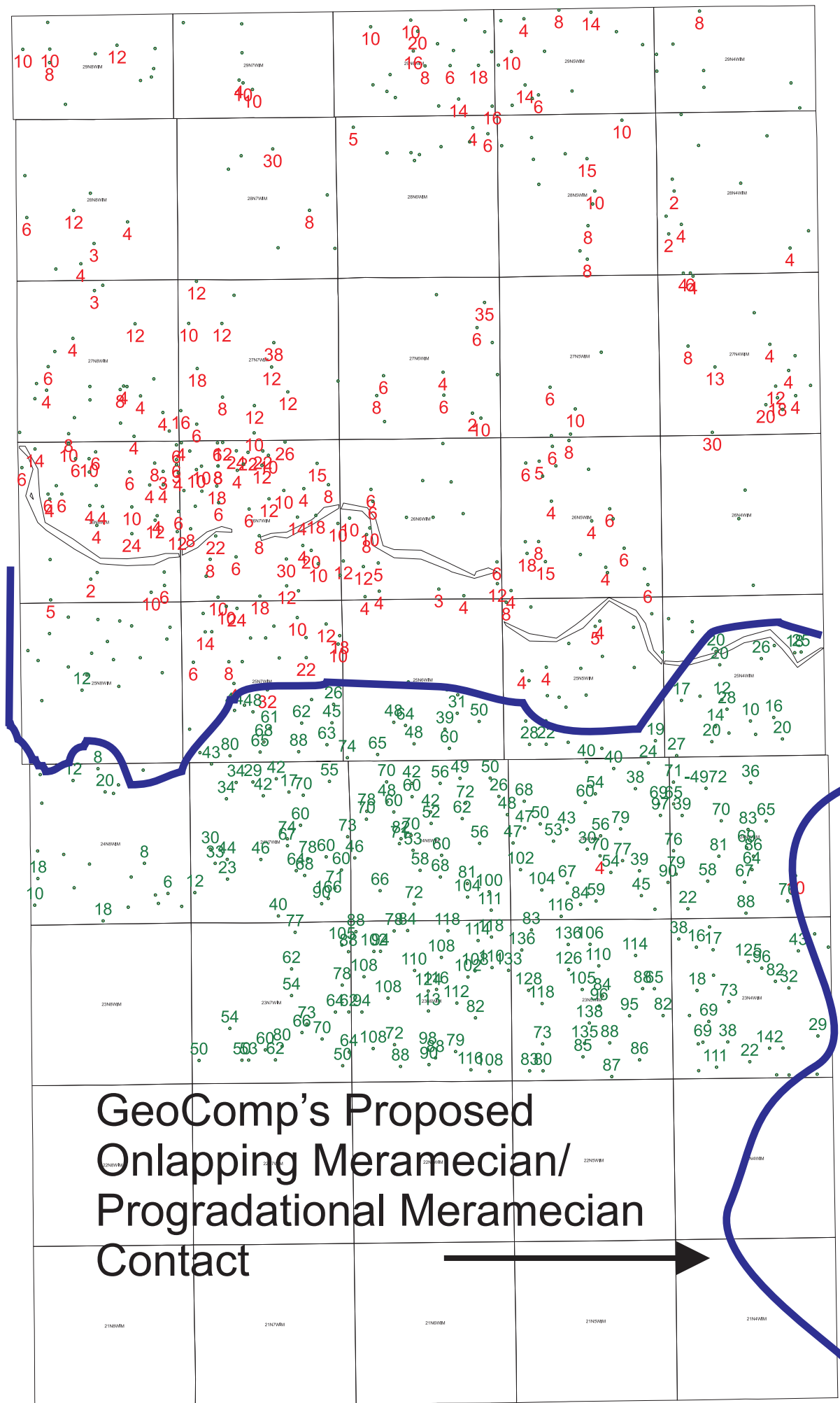


Fig 63 a Isopach of onlapping Meramecian strata

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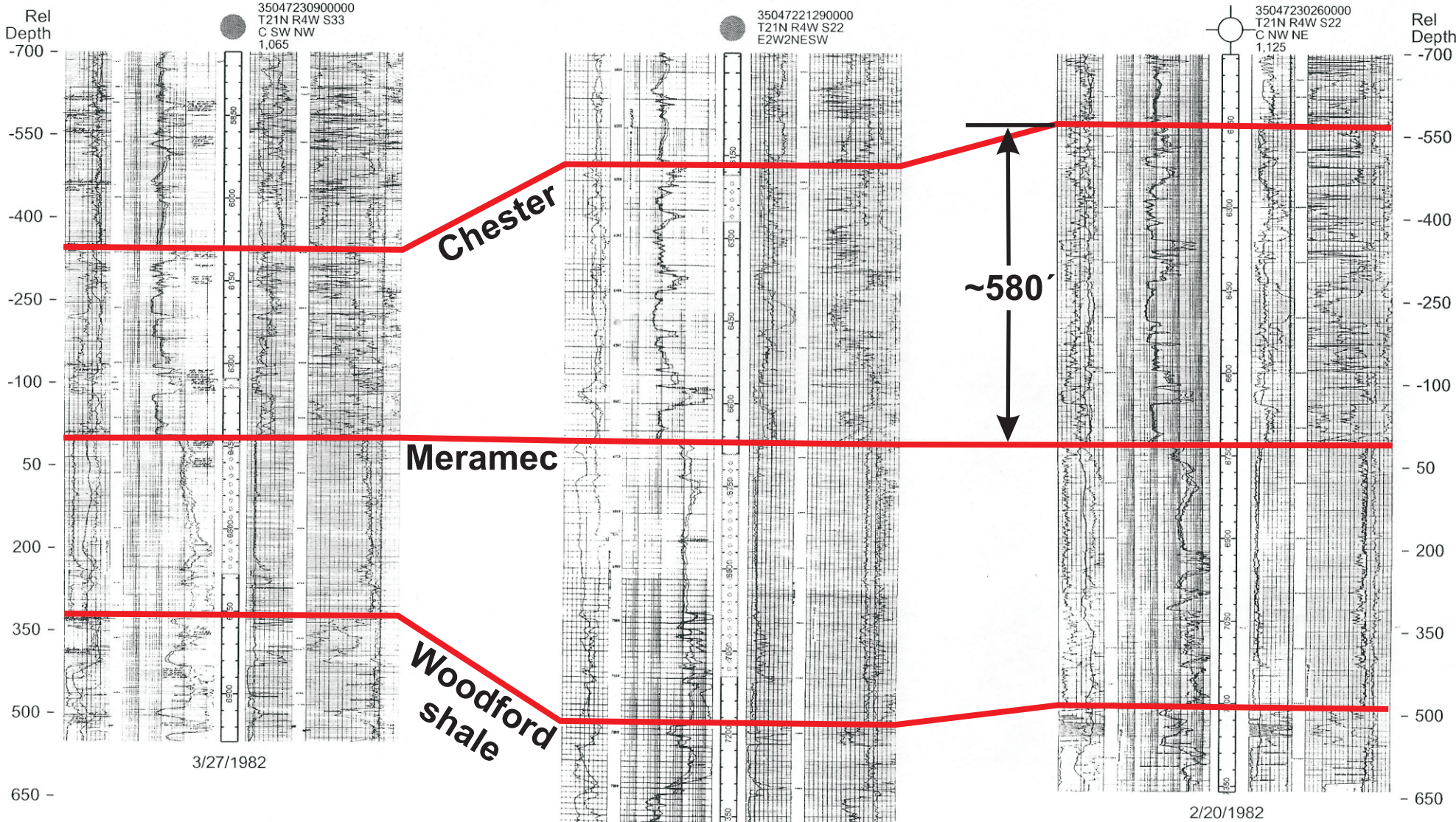


Fig 65 Thickness of Chester within a Graben, Garber Field, Oklahoma

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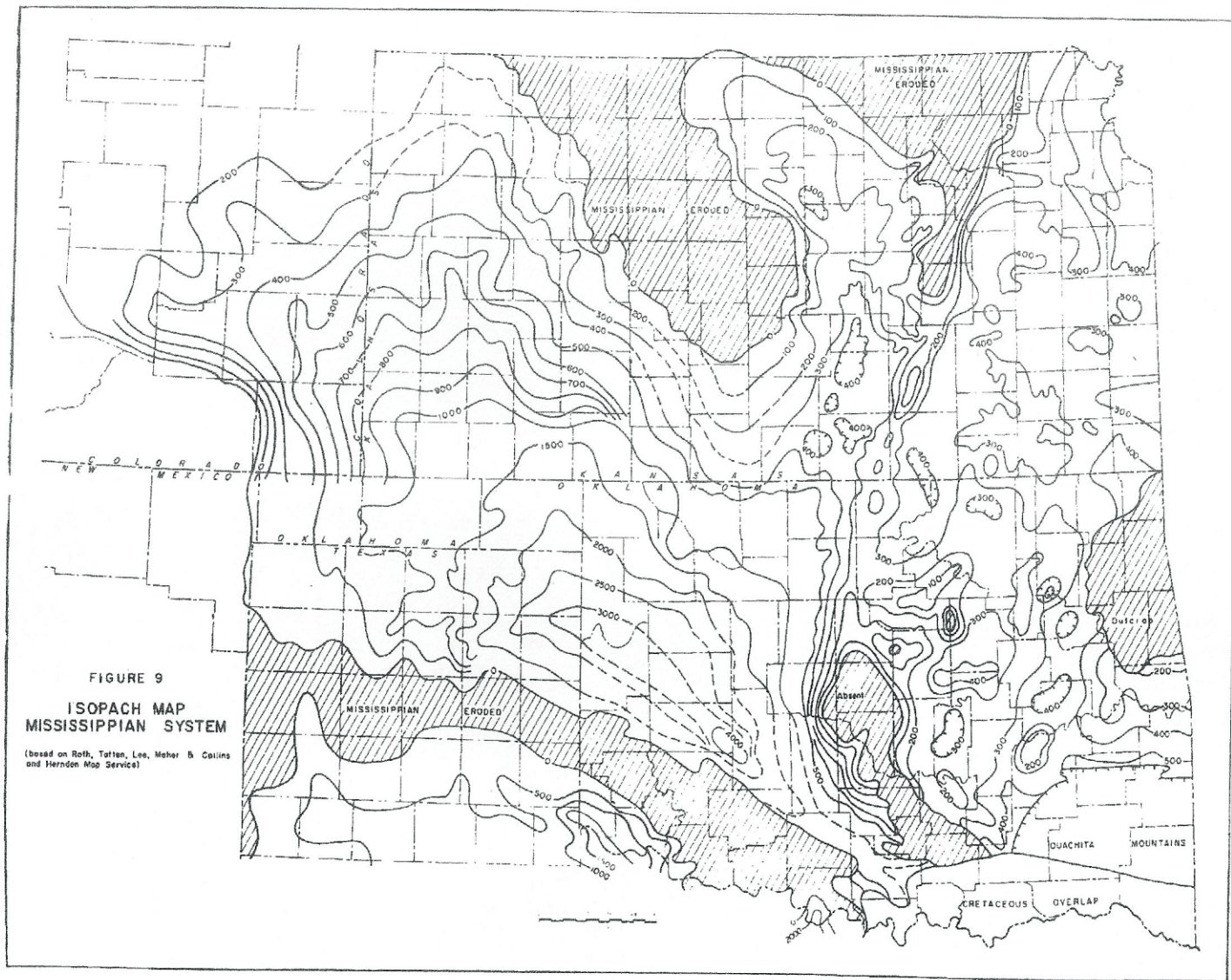


FIGURE 9
ISOPACH MAP
MISSISSIPPIAN SYSTEM

(based on Roth, Tatten, Lee, Meher & Collins
 and Herndon Map Service)

Fig 68 Isopach Map of the Mississippian System (Huffman, 1959)

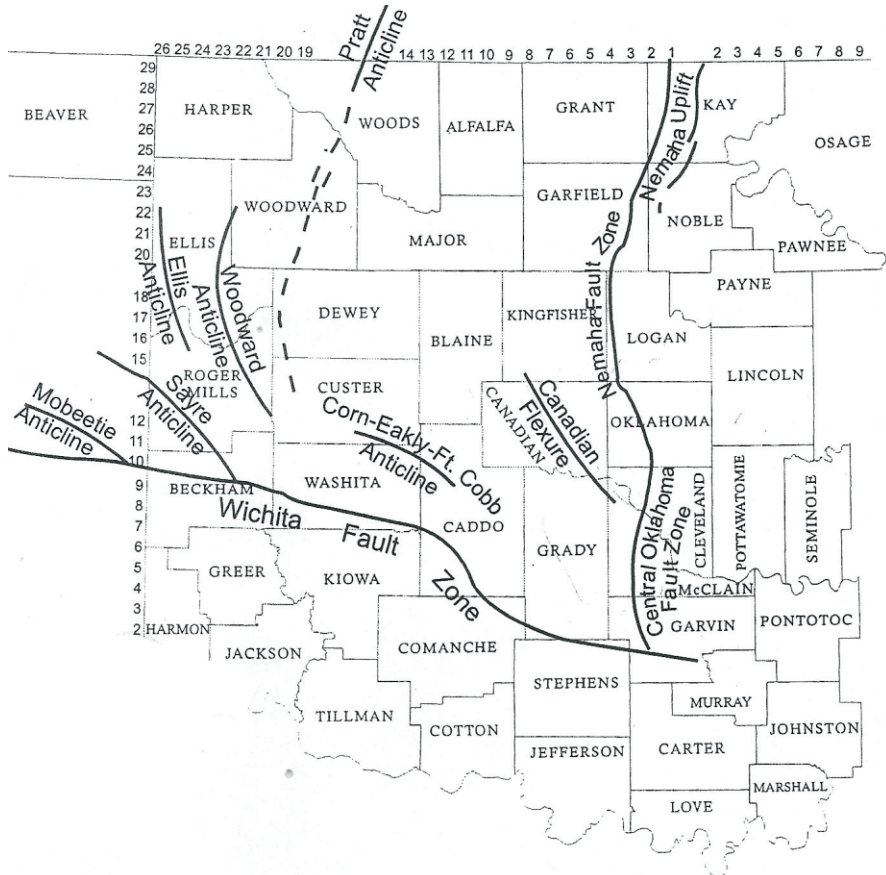


Fig 70 Tectonic Features of Western Oklahoma, Rottmann, 2002

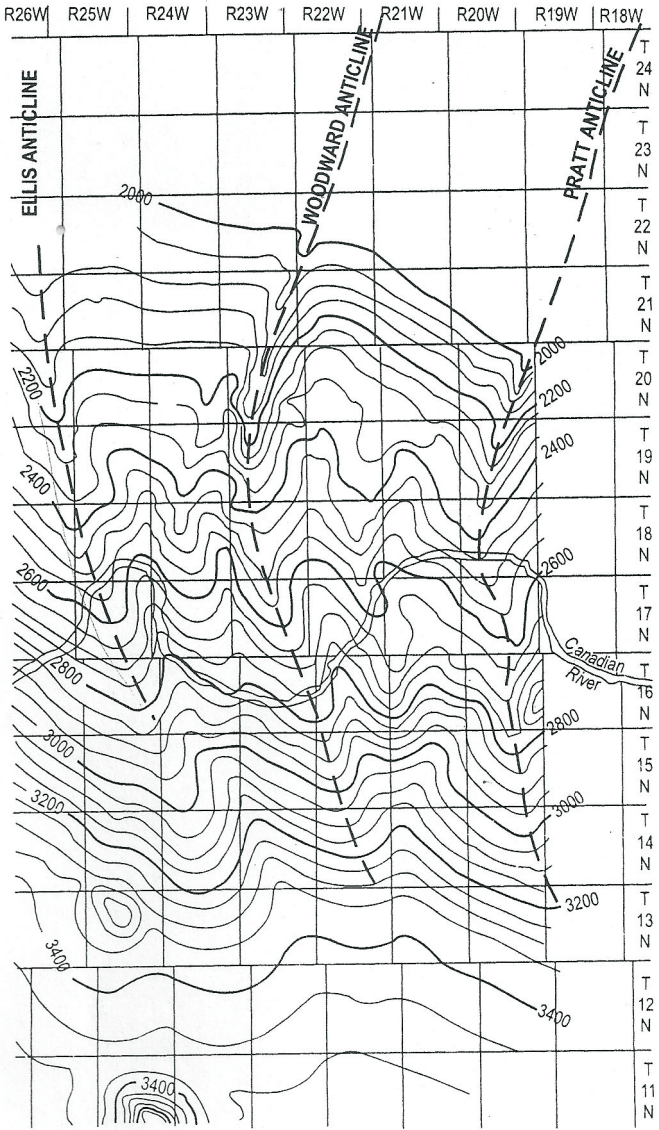


Fig 71 Post Mississippian Features, Rottmann, 2002

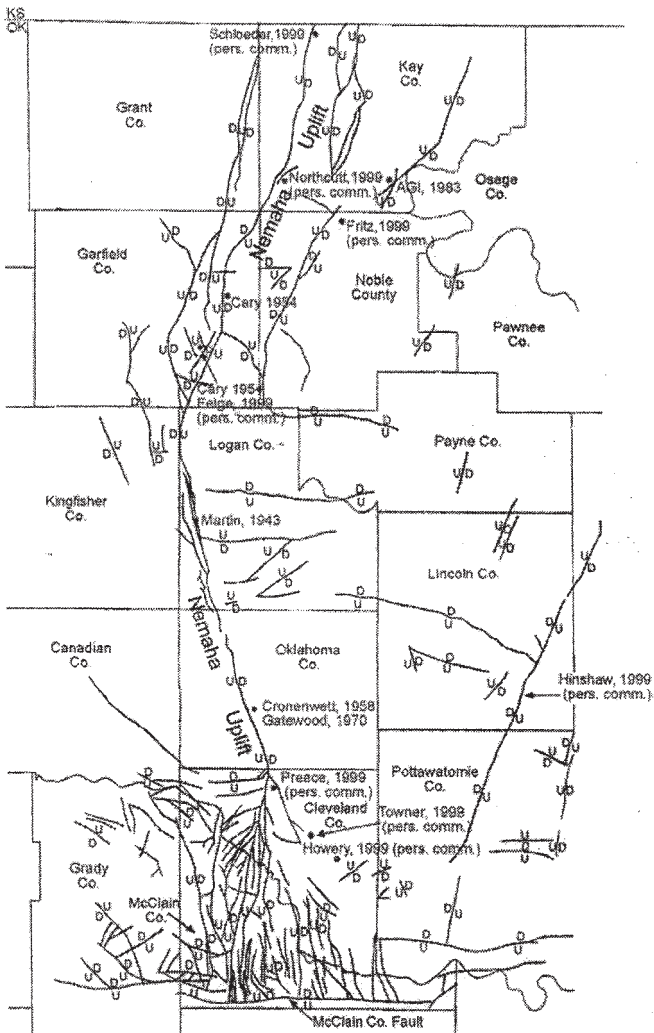


Fig 72 Tectonic Features of North Central Oklahoma, (Gay, 2003)

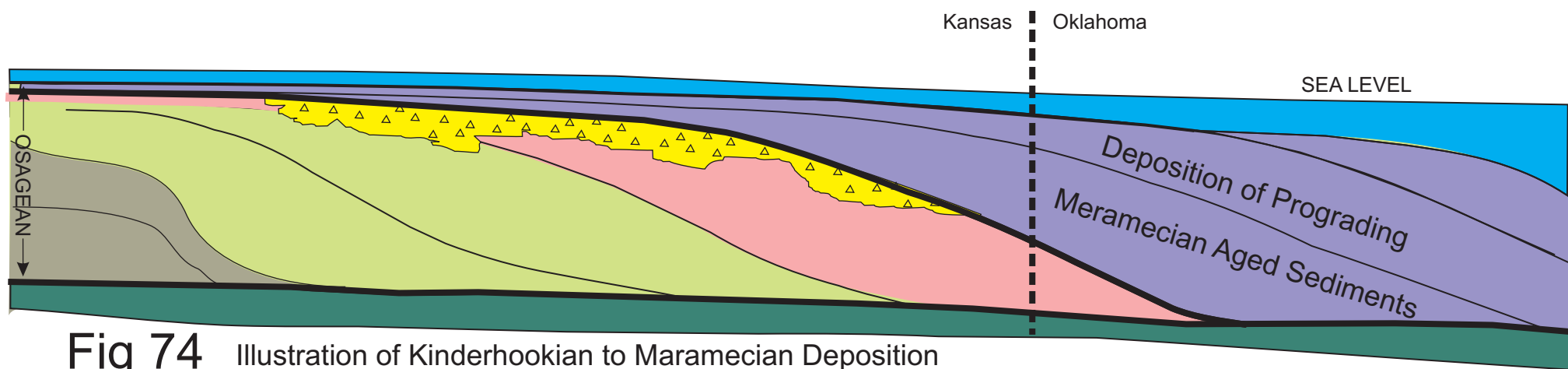
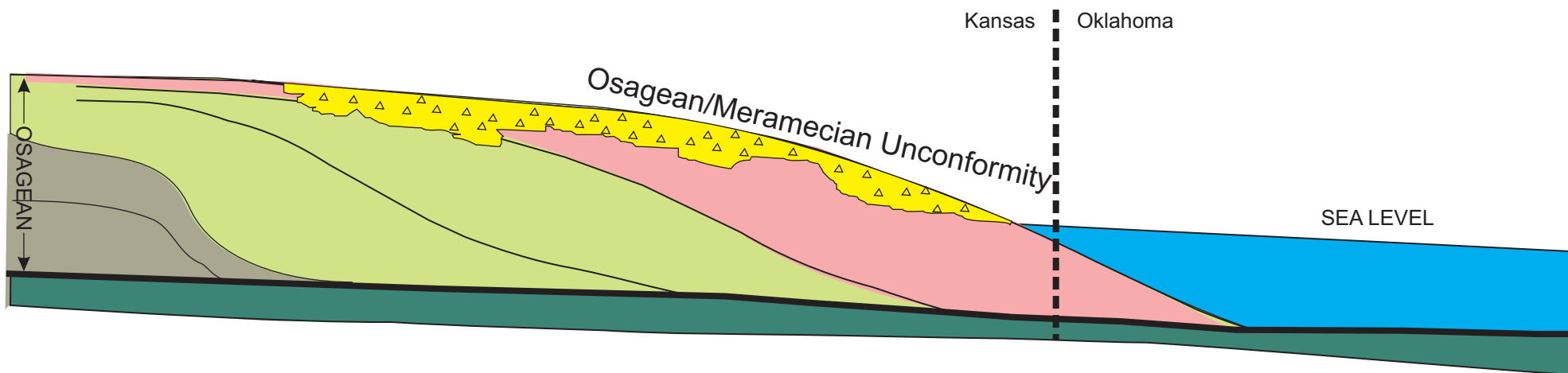
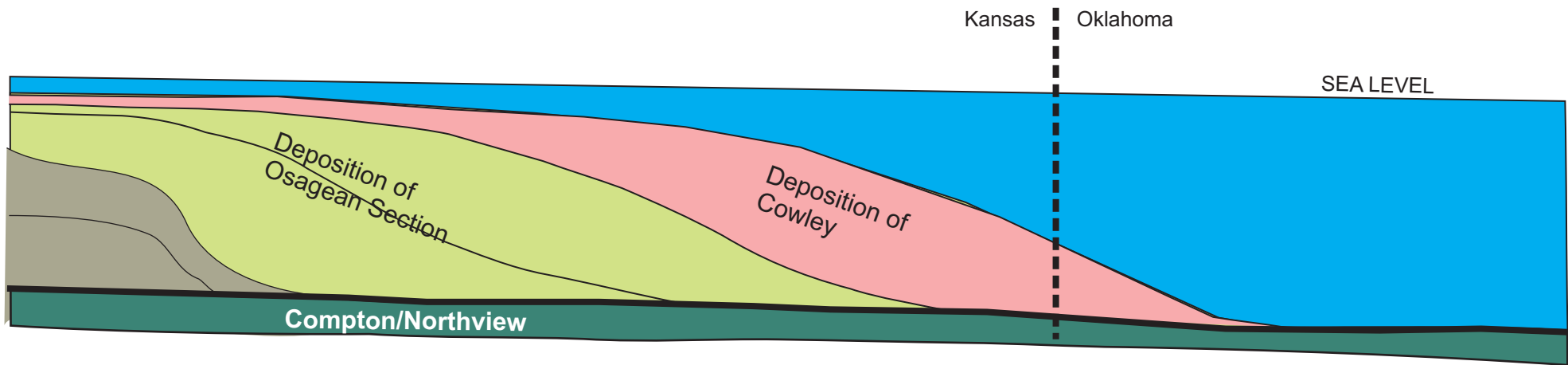


Fig 74 Illustration of Kinderhookian to Meramecian Deposition

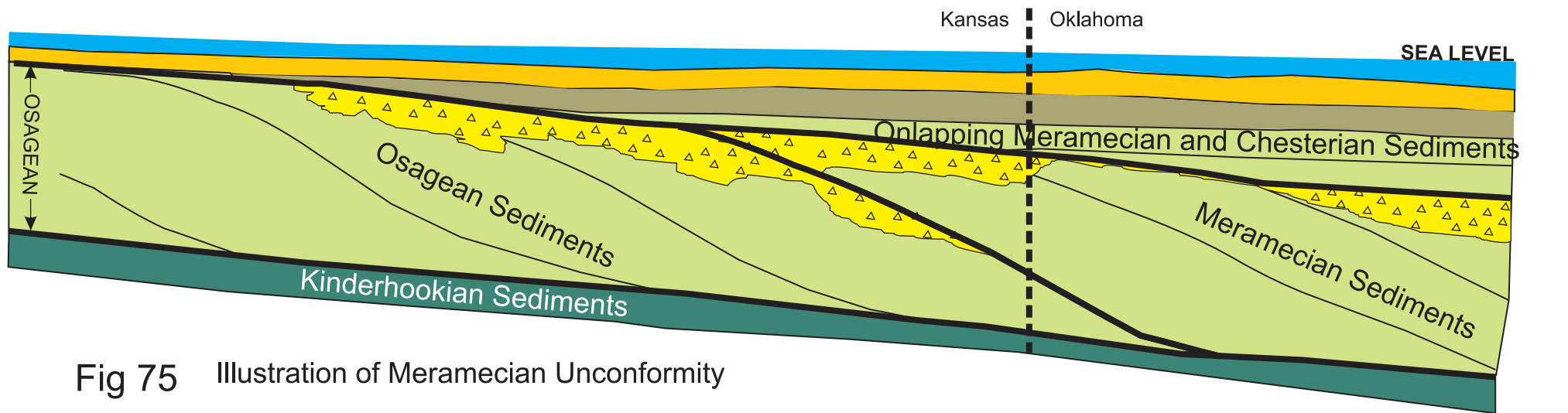
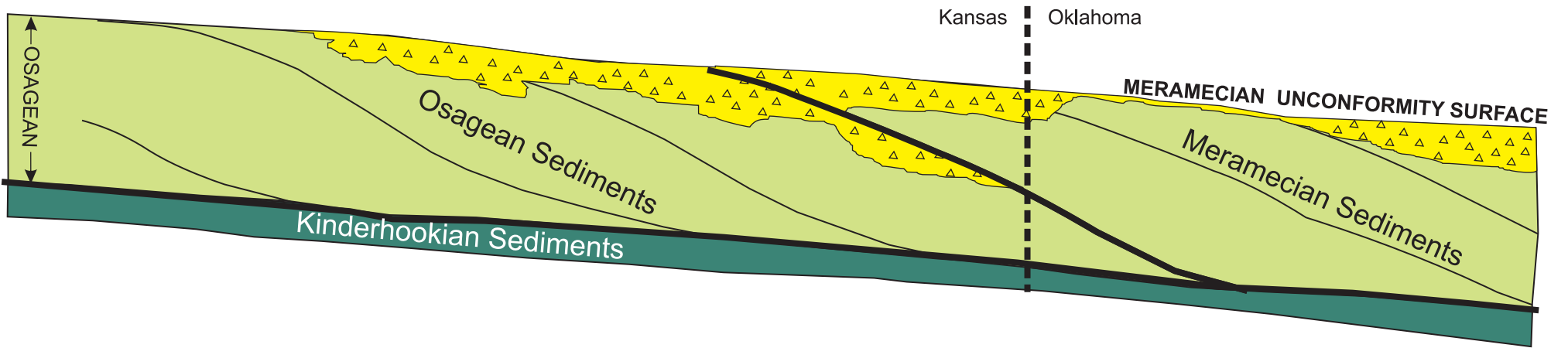
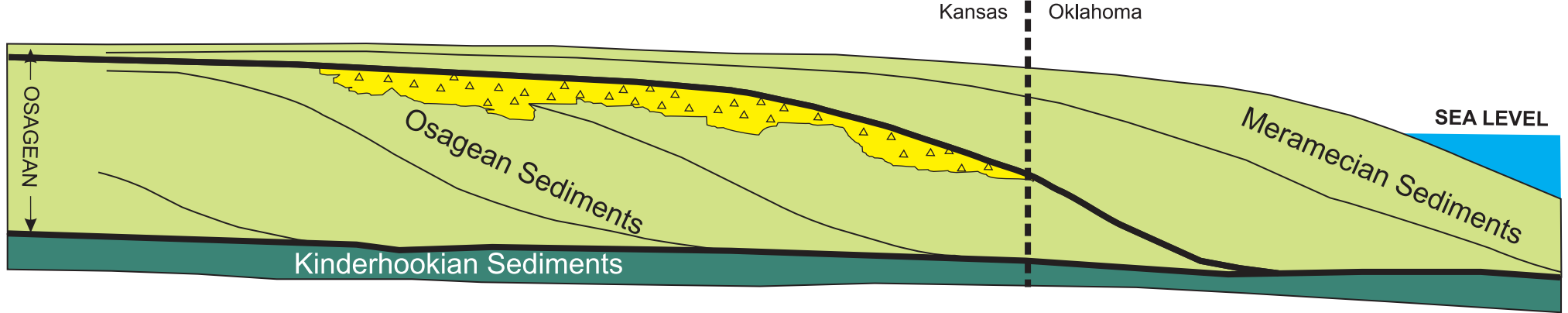


Fig 75 Illustration of Meramecian Unconformity

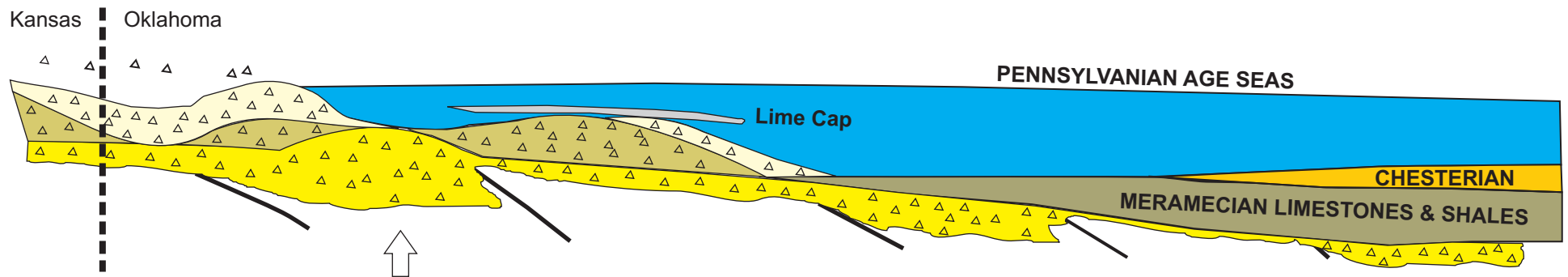
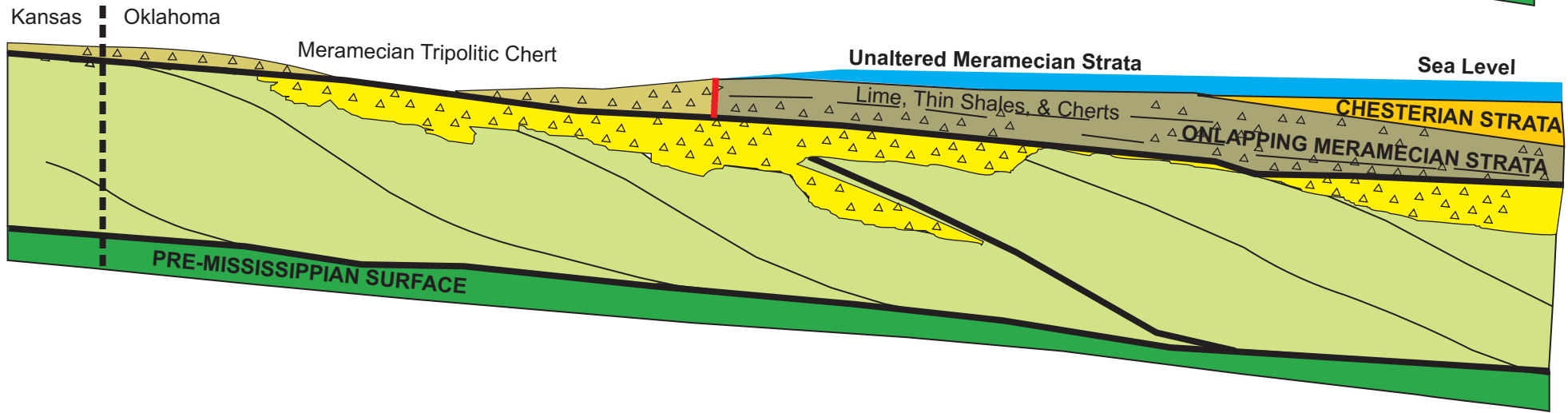
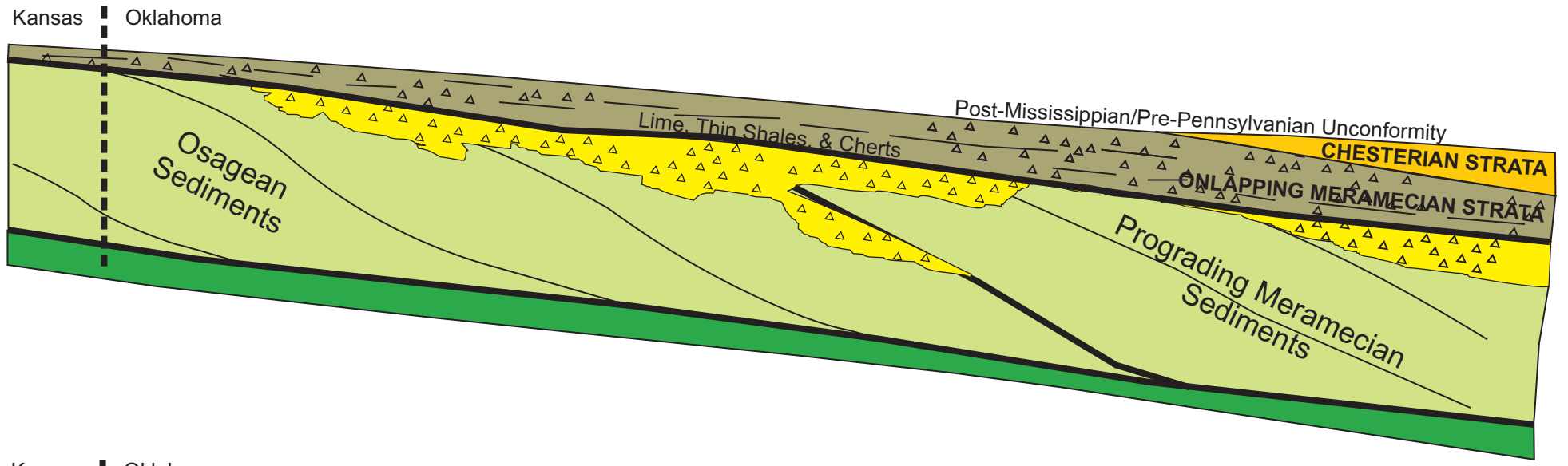


Fig 76 Illustration of chat strand line- between Meramecian Tripolitic Chert and Unaltered Meramecian Strata

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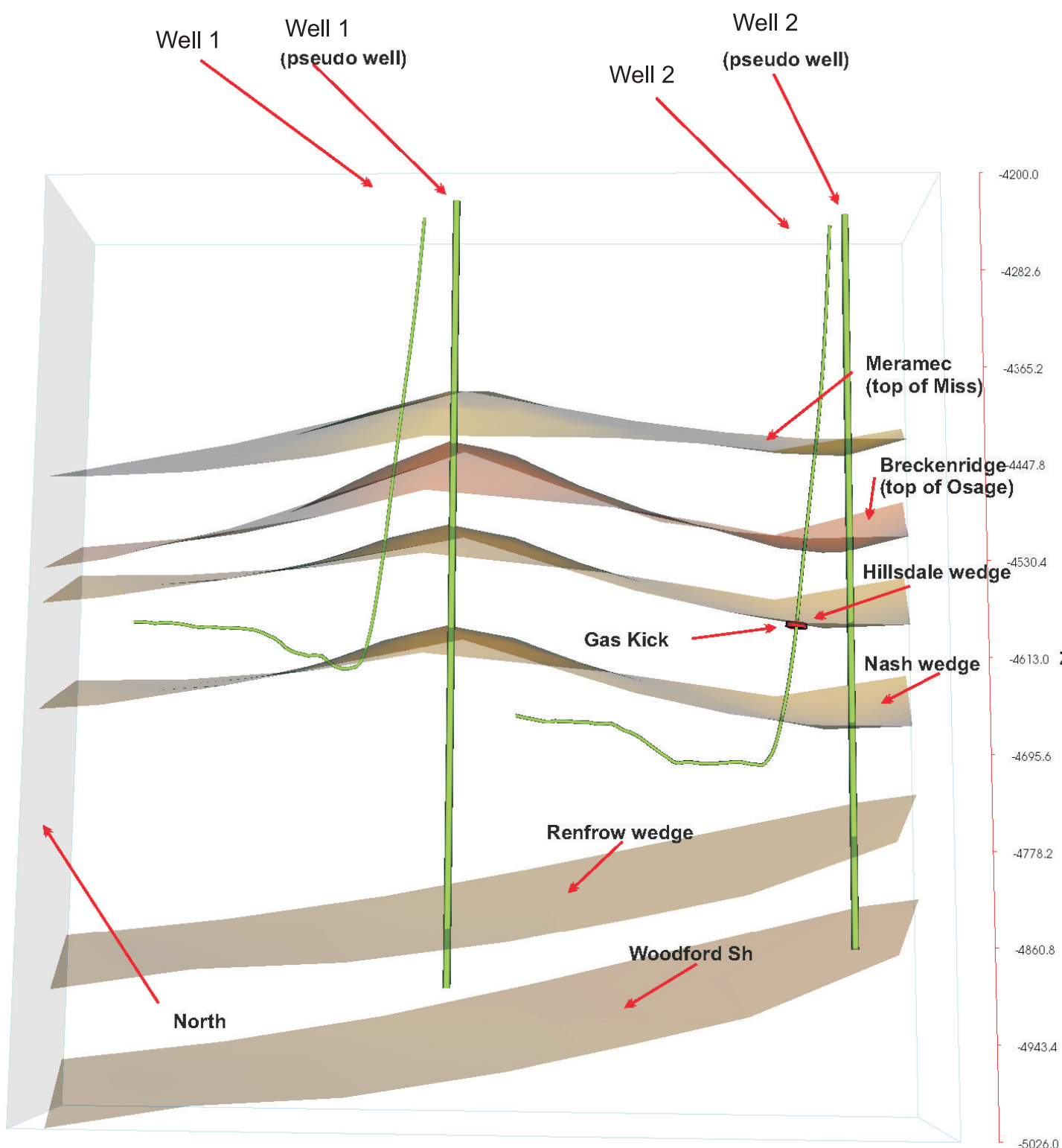


Fig 78 3d illustration of intraformational boundaries for exploration & Development

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