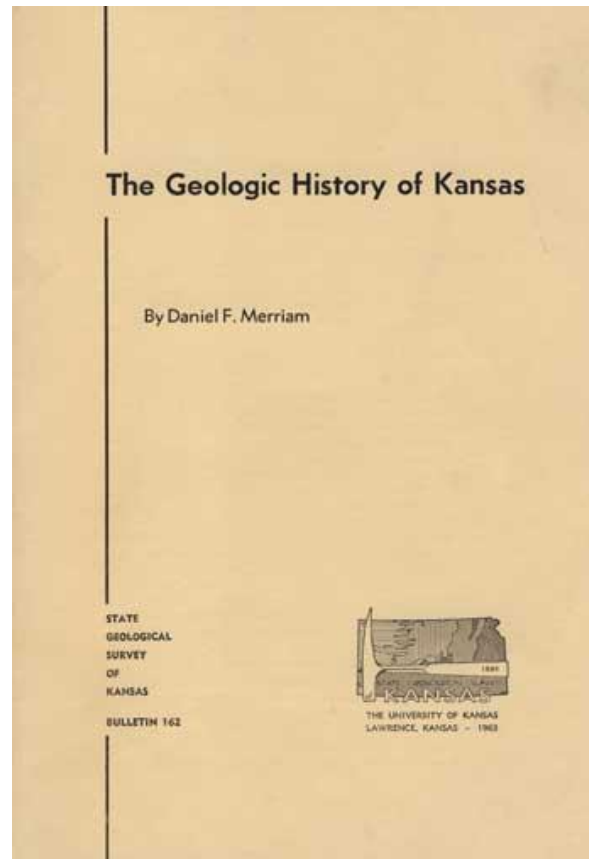


Geologic History of Kansas, 2013
Or
Updating the Work of a Legend

by
Paul Gerlach

Unpubl. Ph.D. dissertation
Department of Geology
University of Kansas
Lawrence, KS
475 pages (2 vols.)
1961



Education

BS in Geology, University of Kansas, 1949

MS in Geology, University of Kansas, 1953

PhD, University of Kansas, 1961

MSc in Geology, Leicester University (England), 1969

DSc, Leicester University (England), 1975

Professional Experience

Union Oil Company of California

geologist, 1949-51, summer 1952

Kansas Geological Survey, University of Kansas

geologist, 1953-58

Head of Basic Geology, 1958-63

Chief of Geologic Research, 1963-71

Syracuse University

Jessie Page Heroy Professor of Geology, 1971-81

head, Department of Geology, 1971-80

Wichita State University

Endowment Association Distinguished Professor of the Natural Sciences, 1981-91;
emeritus 1997

chairman, Department of Geology, 1981-87

Kansas Geological Survey, University of Kansas

Senior Research Scientist, 1991-1997; emeritus 1997



Current Kansas Geological Publication List: 368; 1st in 1956; Last in 2011

Perspective – 93 publications before I got out of High School

Comparison of Geologic data types in 1962 and 2013

Data Types

Total Well Count: 168,379

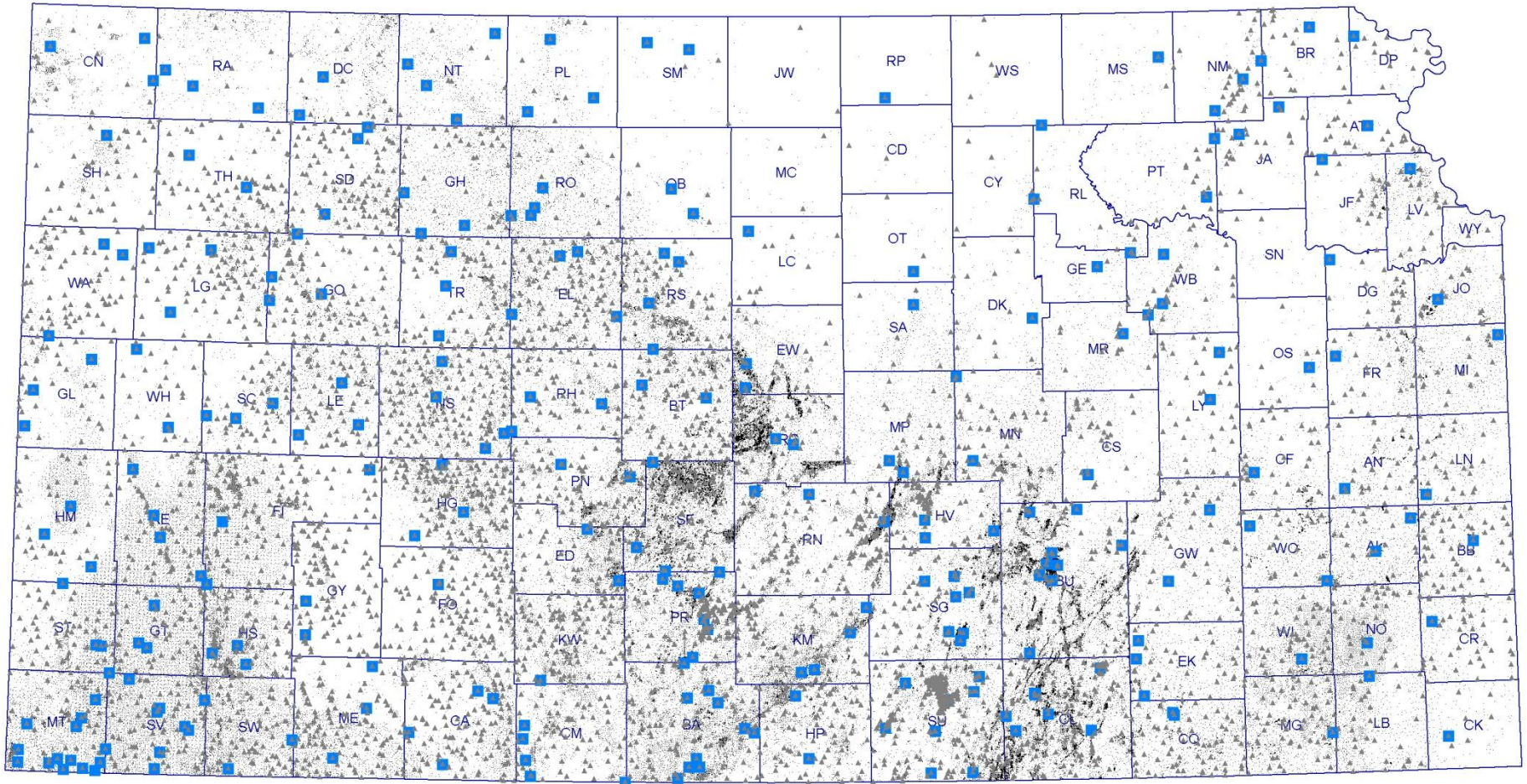
Wells with E-log: 5423

Supertype Wells: 268

Dr. Merriam made extensive use of surface outcrop data from his previous work and others. I've used only the "Measured Type Sections" as a starting point for subsurface correlations.

Subsurface Data Points:

Formation	Merriam, 1962	Gerlach, 2013
Stone Corral	4,950	21,734
Mississippian	4,800	46,133
Pre-Cambrian	2,100	3,171
Total Well Count	Unknown	168,379

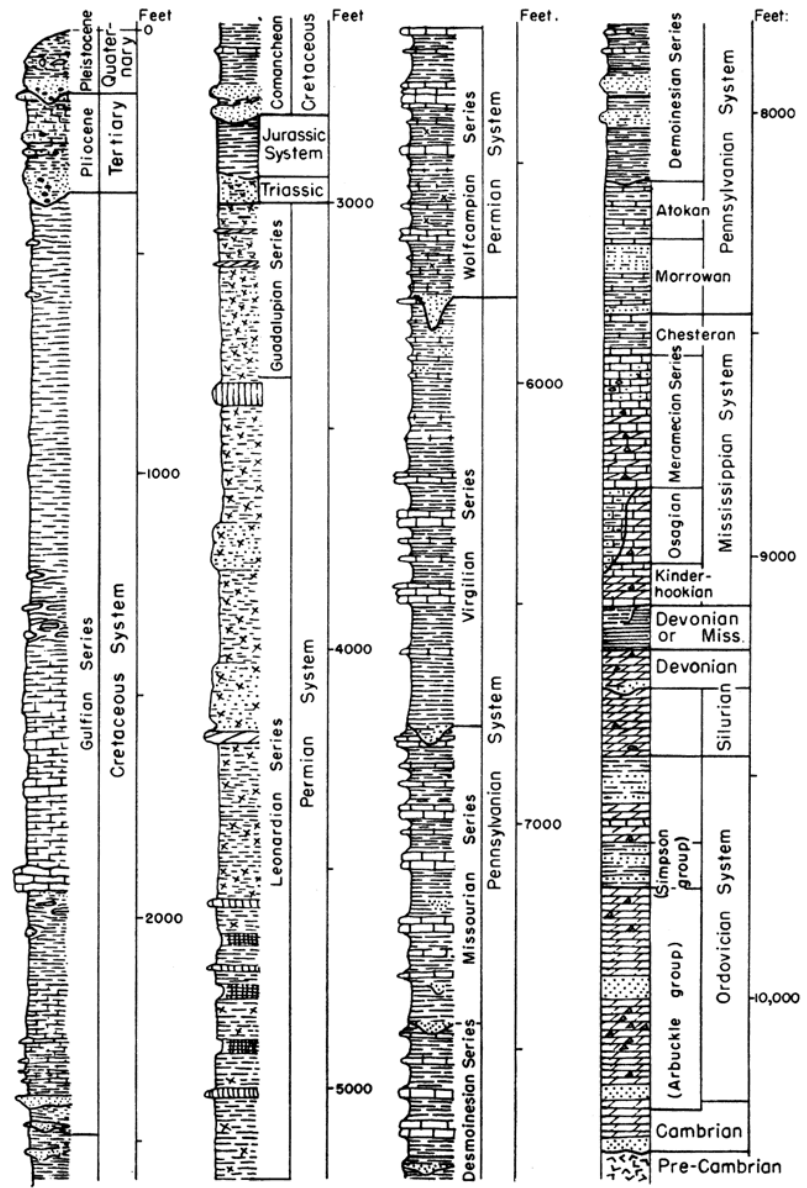


Stratigraphy

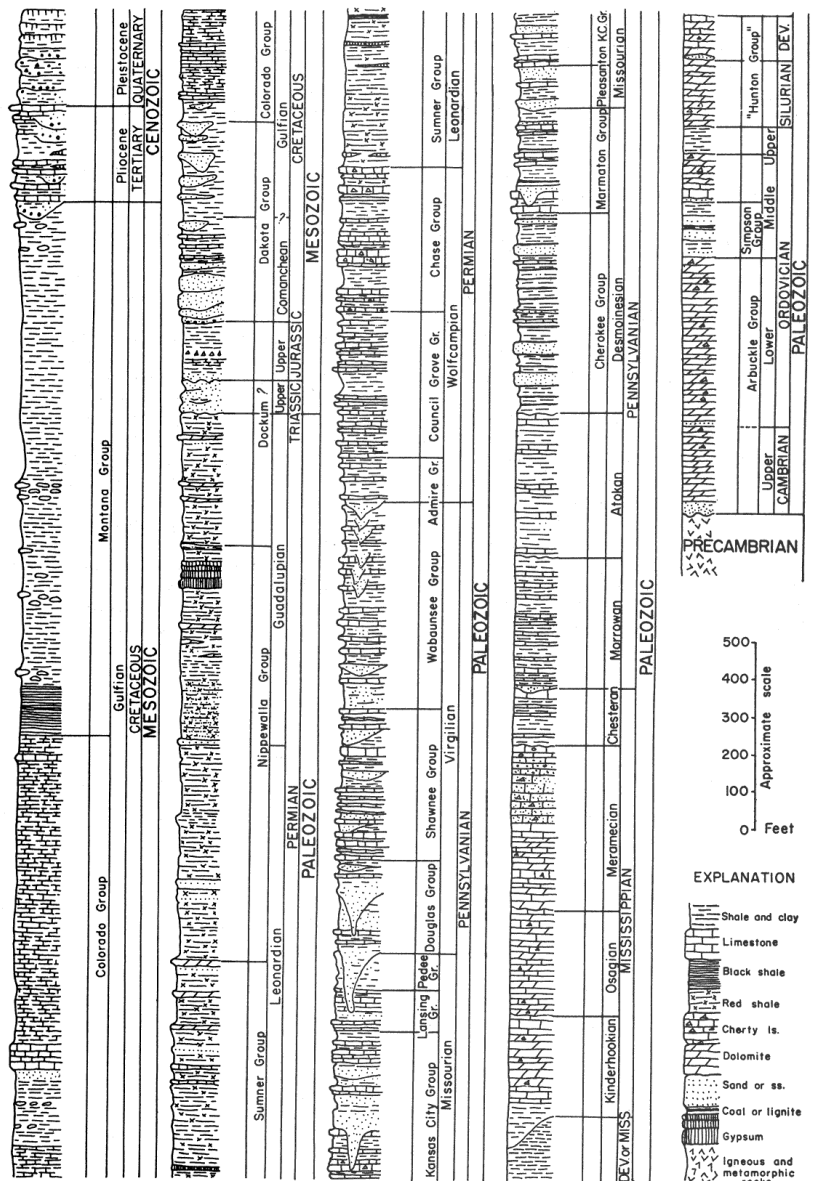
Structure

The Geologic History of Kansas, 1963 KGS Bulletin 162

The Kansas Rock Column, 1951
KGS Bulletin 89

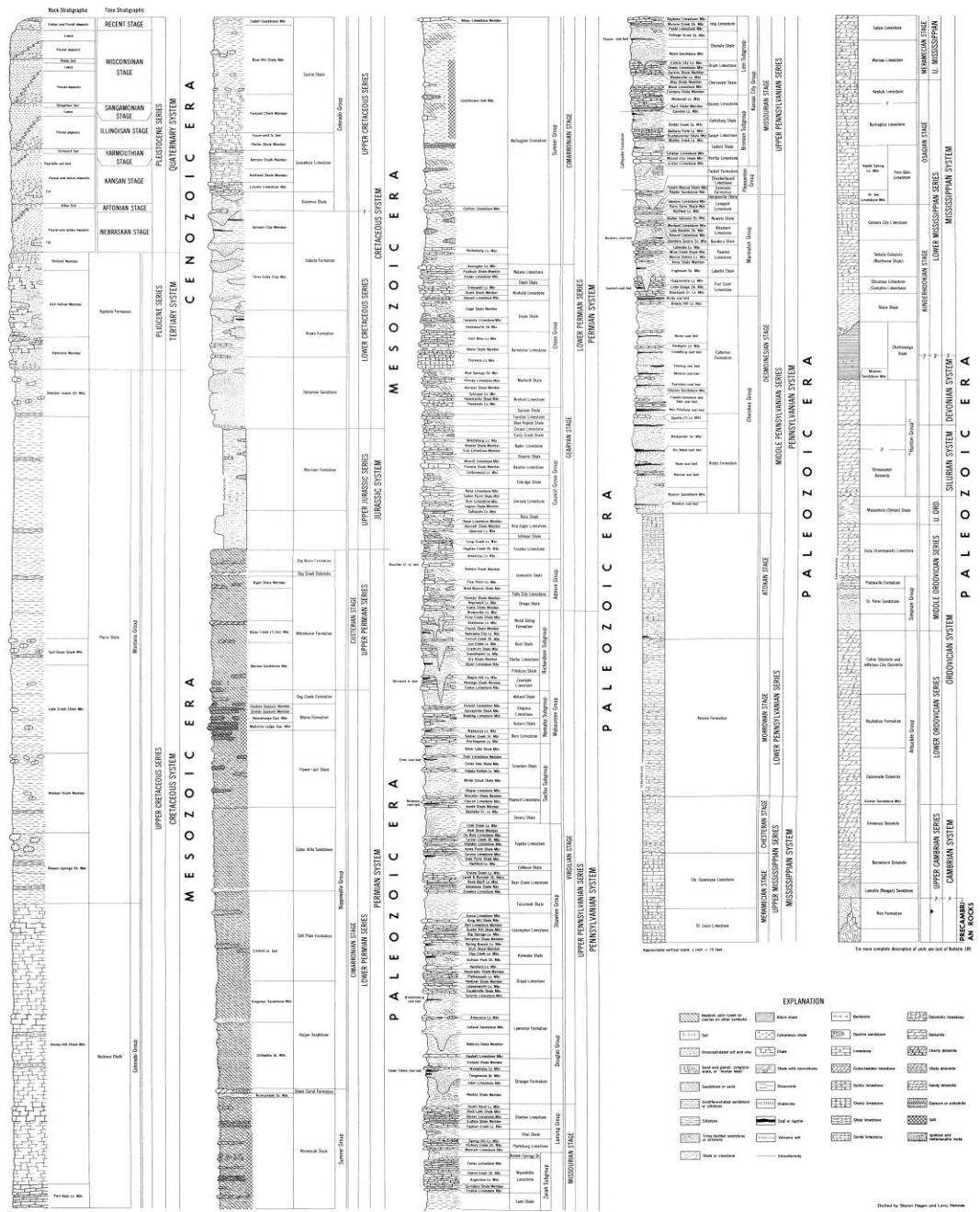


Primary Update:
Refined Groups by Formation, & Member



Stratigraphy

The Stratigraphic Succession in Kansas, 1968 KGS Bulletin 189



Primary Update:
Inclusion of a graphic presentation on one chart of the classification of rocks in Kansas

Resolved major areas of disagreement with surrounding States

KGS Stratigraphic Nomenclature Committee of the KGS, 2005, 2006 & 2010

Publications since 1968 have proposed changes to the classification of Kansas stratigraphic units, their positioning and nomenclature.

<http://www.kgs.ku.edu/General/Strat/Chart/index.html>

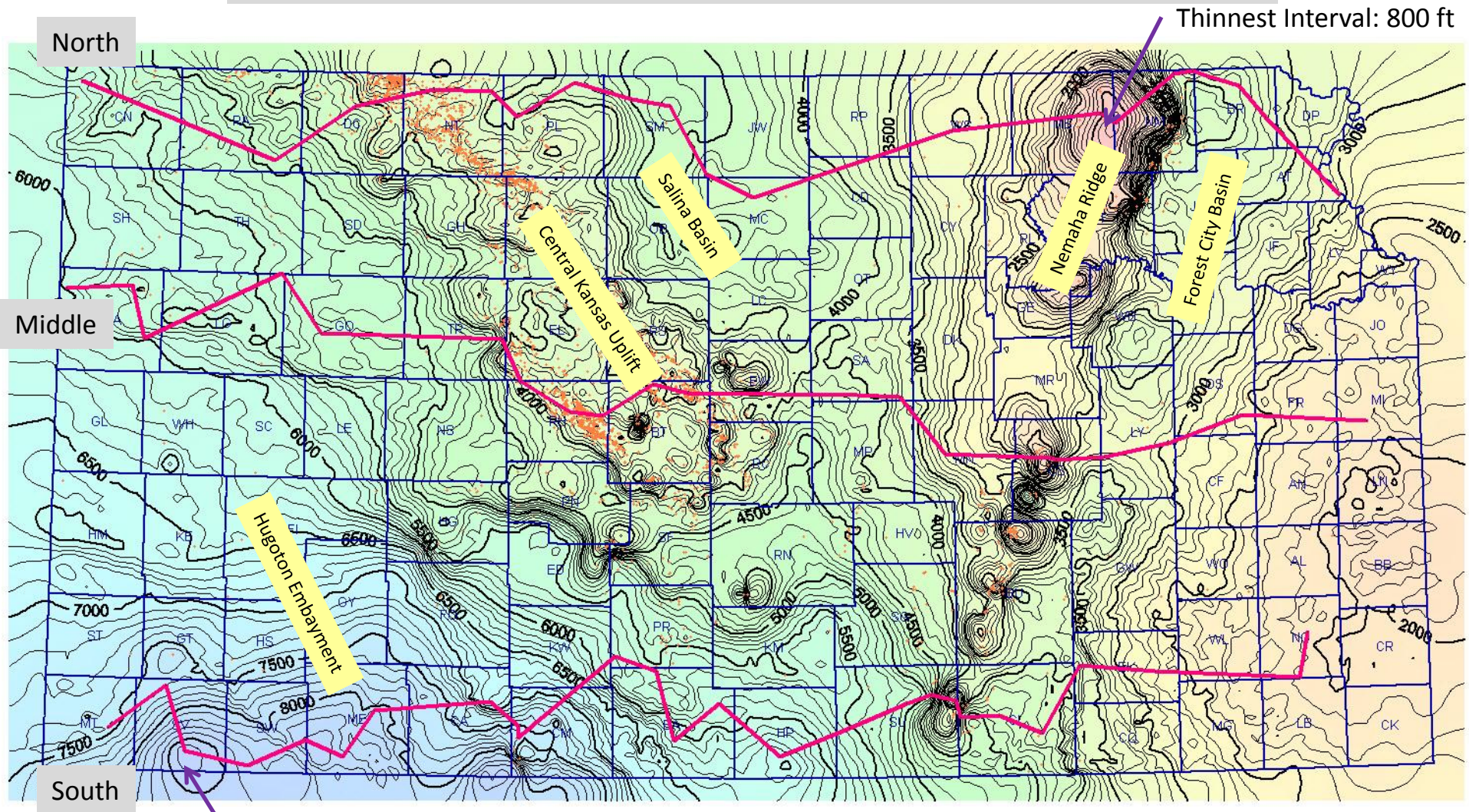
Primary Update:

Sought formal guidance concerning Kansas stratigraphy by state, national, and international organizations

Carboniferous System
Pennsylvanian Subsystem
Mississippian Subsystem

Edited by Sharon Hagen and Larry Nissen

**Isopach of Post-Pre-Cambrian sediments (Surface to Basement) (ci: 100 ft.)
With
West to East Regional Cross-Sections**



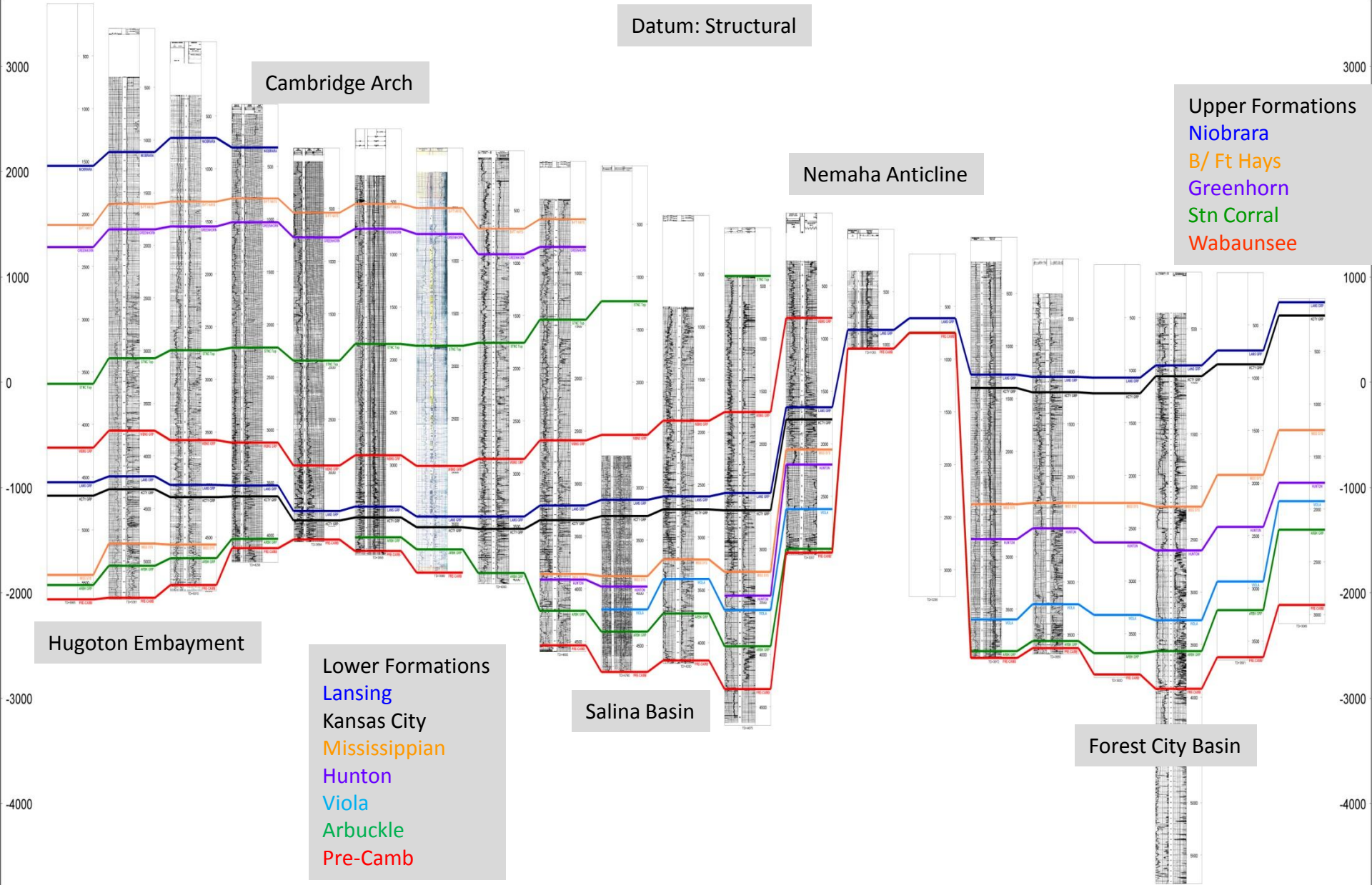
Thickest Interval: 8600 ft

Comment:
First indication of the role the Pre-Cambrian basement played in sedimentation and Pre-Pennsylvanian structural features

Post-Pre-Cambrian Sediments West to East Regional Cross-Section North



Datum: Structural



Cambridge Arch

Nemaha Anticline

Hugoton Embayment

Salina Basin

Forest City Basin

Upper Formations
 Niobrara
 B/ Ft Hays
 Greenhorn
 Stn Corral
 Wabaunsee

Lower Formations
 Lansing
 Kansas City
 Mississippian
 Hunton
 Viola
 Arbuckle
 Pre-Camb

Upper Formations

Niobrara

B/ Ft Hays

Greenhorn

Stn Corral

Hutch Salt

Wabaunsee

Post Pre-Cambrian Sediments West to East Regional Cross-Section Middle

Datum: Structural

Lower Formations

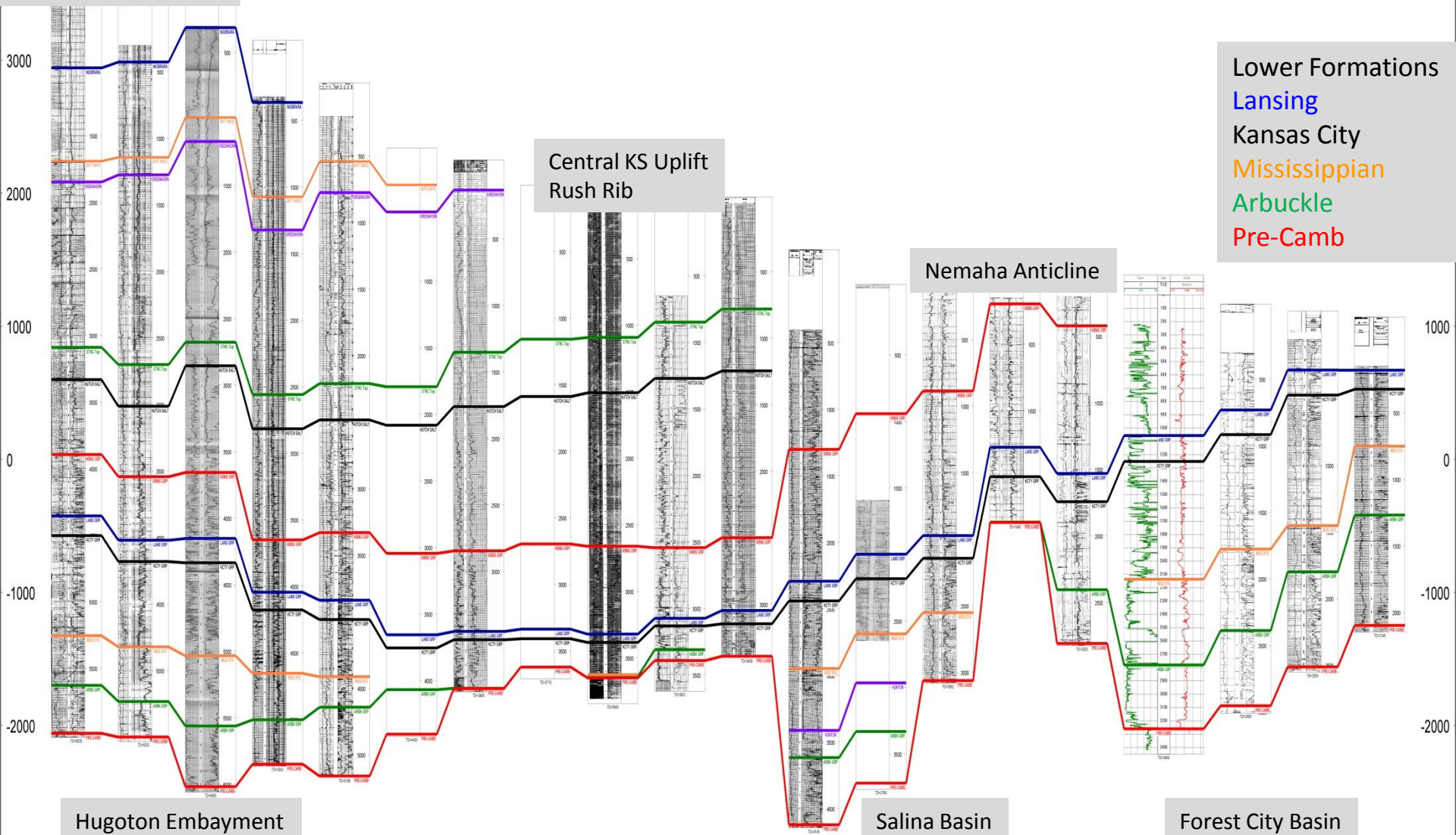
Lansing

Kansas City

Mississippian

Arbuckle

Pre-Camb



Central KS Uplift
Rush Rib

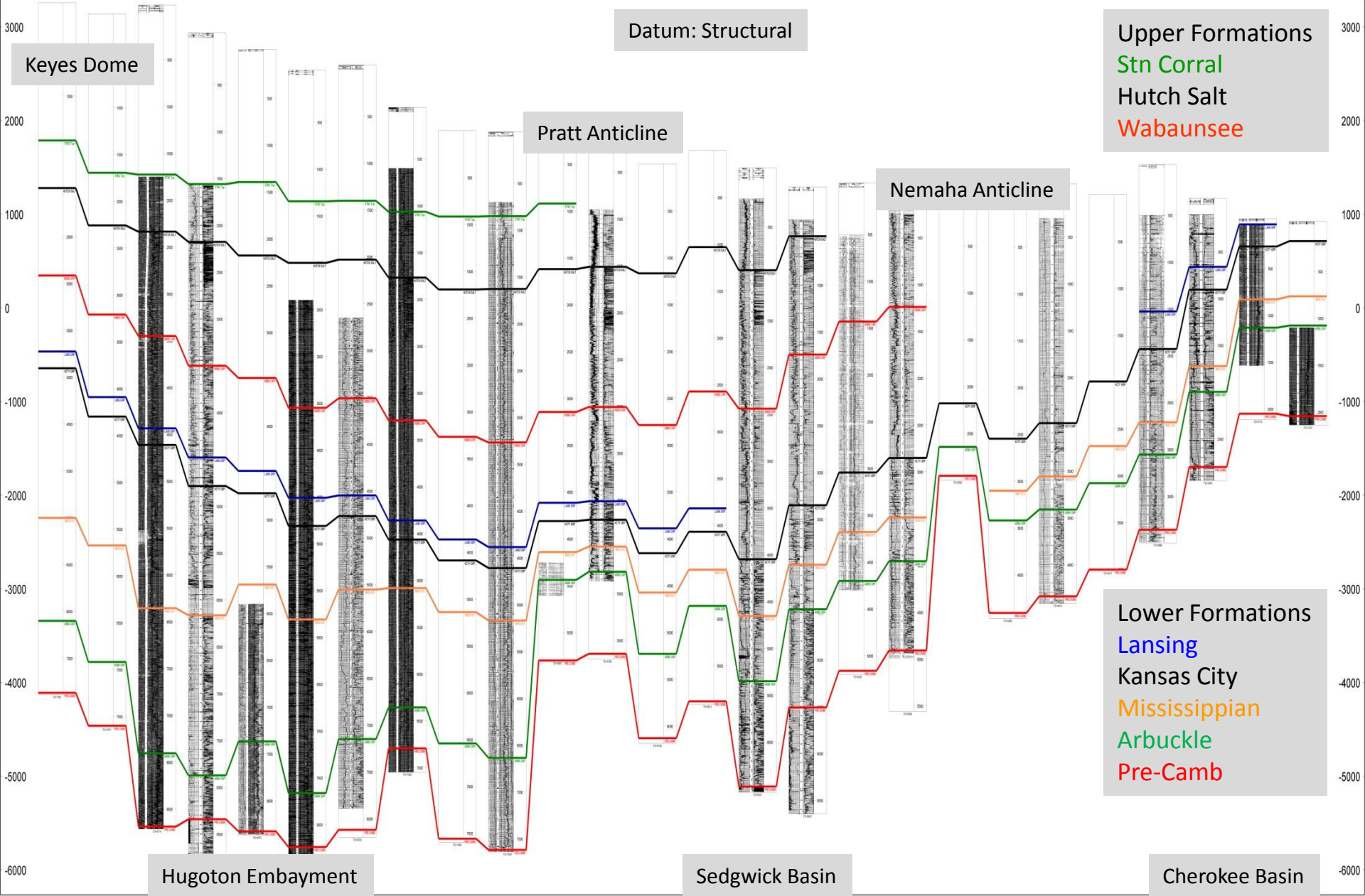
Nemaha Anticline

Hugoton Embayment

Salina Basin

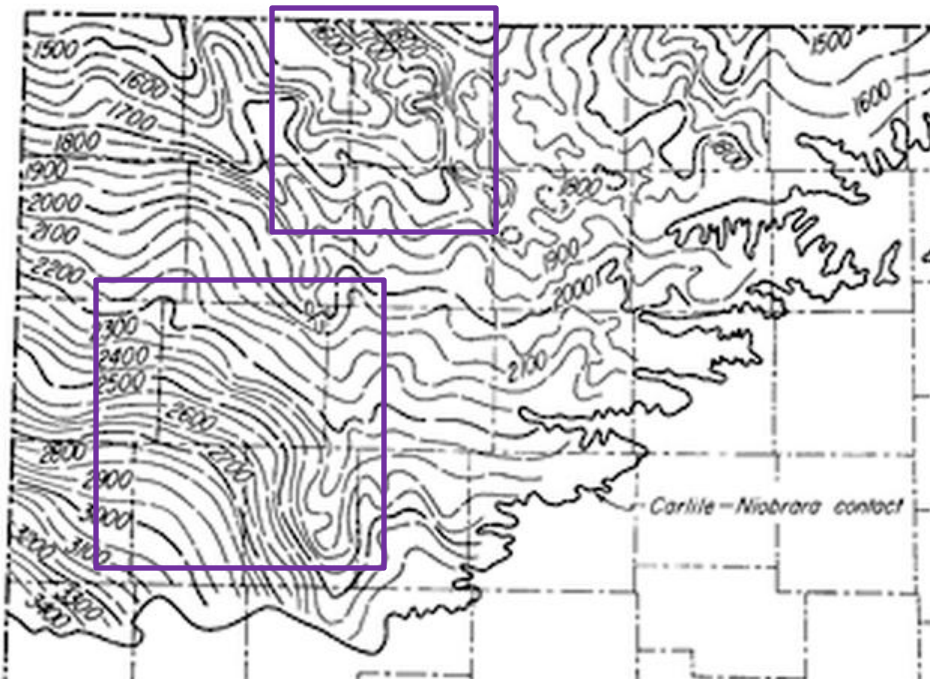
Forest City Basin

Post-Pre-Cambrian Sediments West to East Regional Cross-Section South

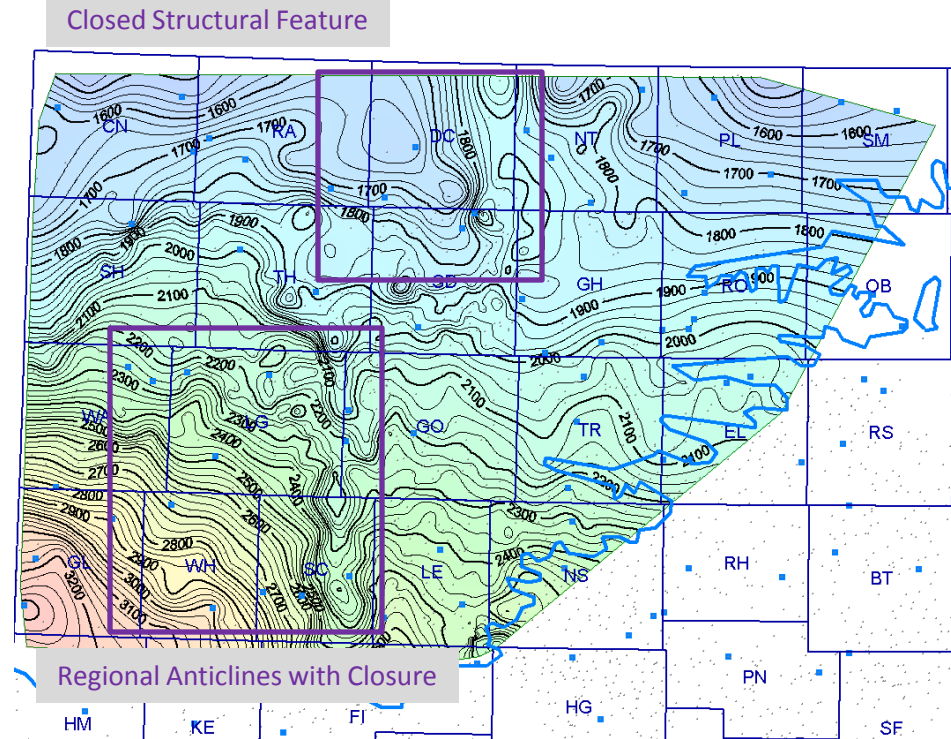


Base of the Niobrara Structure (B-Ft Hays) (ci: 25 ft.) Updates

Merriam, 1962 (ci: 50 ft)



Gerlach, 2013



Comment:

Contours indicate a northward sloping surface having sizeable relief.

Suggests incised valleys (Dakota, Cheyenne, Morrison) cut into Permian, Triassic, and Jurassic sediments.

Eastern Limit of Base of the Ft Hays (Merriam, 1962)

Isopach of Lower Permian sediments* (ci: 100 ft)

with

NW to SE Salt-Anhydrite Basins Cross-Section

Limit of Permian Sediments (Merriam, 1962)

NW to SE X-Sec

Hutchinson Salt

Thinnest Interval: 200 ft

Salt in Blaine

Salt in Blaine

LOWER PERMIAN	Dog Creek Fm.	
	Blaine Formation	Orange
	Flower-pot Shale	
	Cedar Hills Sandstone	
	Salt Plain Formation	
	Harper Sandstone	
	Stone Corral Fm.	
	Ninnescah Shale	Green
	Wellington Formation	Blue

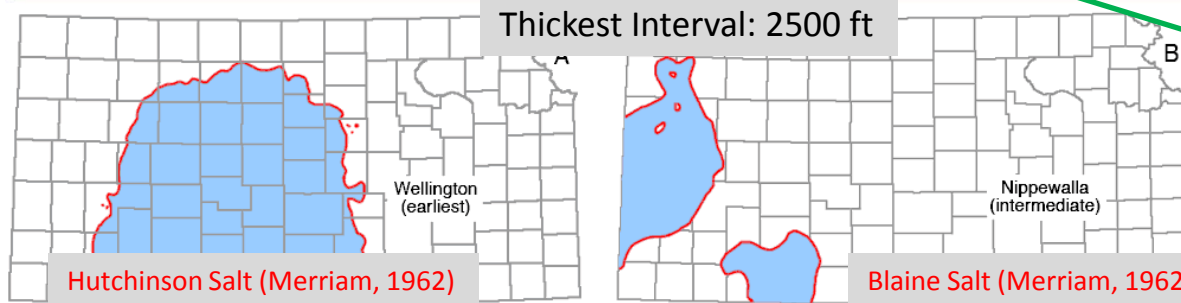
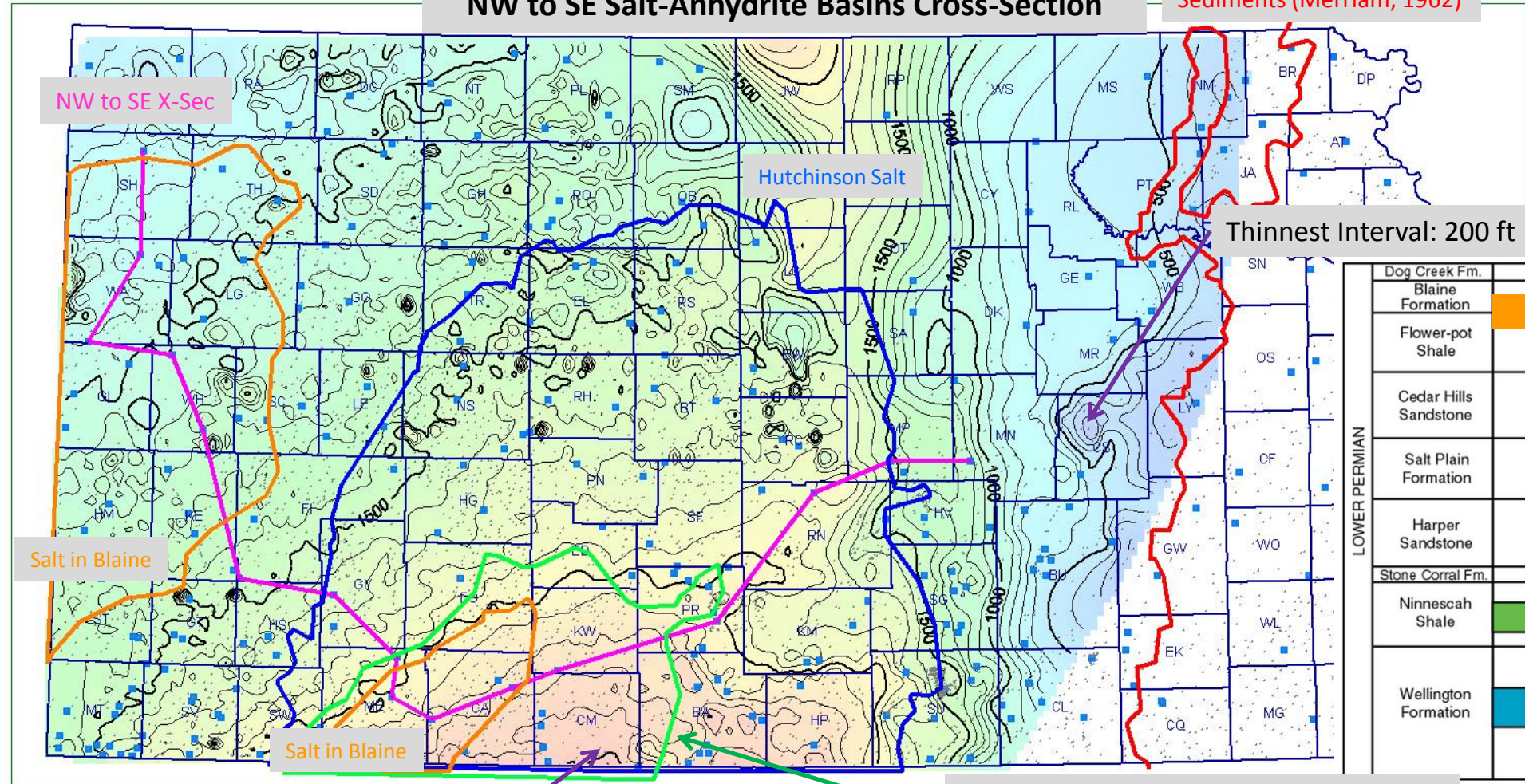
Thickest Interval: 2500 ft

Subsequent Addition Salt in Ninnescah, beneath Stone Corral

Hutchinson Salt (Merriam, 1962)

Blaine Salt (Merriam, 1962)

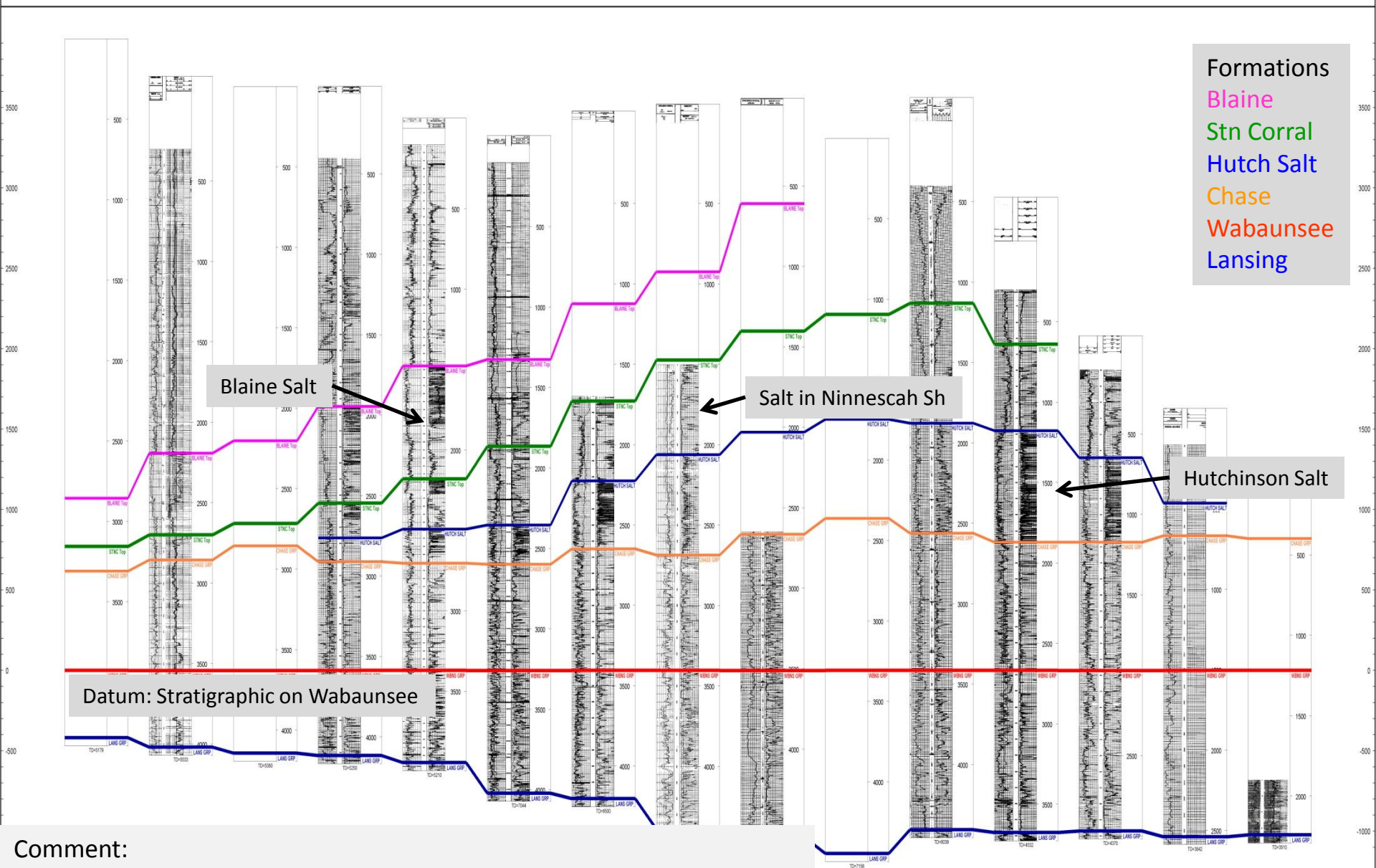
*Isopach from Stn Corral to Wabaunsee



Permian sediments NW to SE Salt Basins Cross-Section

NW

SE



Formations

- Blaine
- Stn Corral
- Hutch Salt
- Chase
- Wabaunsee
- Lansing

Blaine Salt

Salt in Ninnescah Sh

Hutchinson Salt

Datum: Stratigraphic on Wabaunsee

Comment:
Large portions of Western Kansas are within a "sub-salt-anhydrite" play.

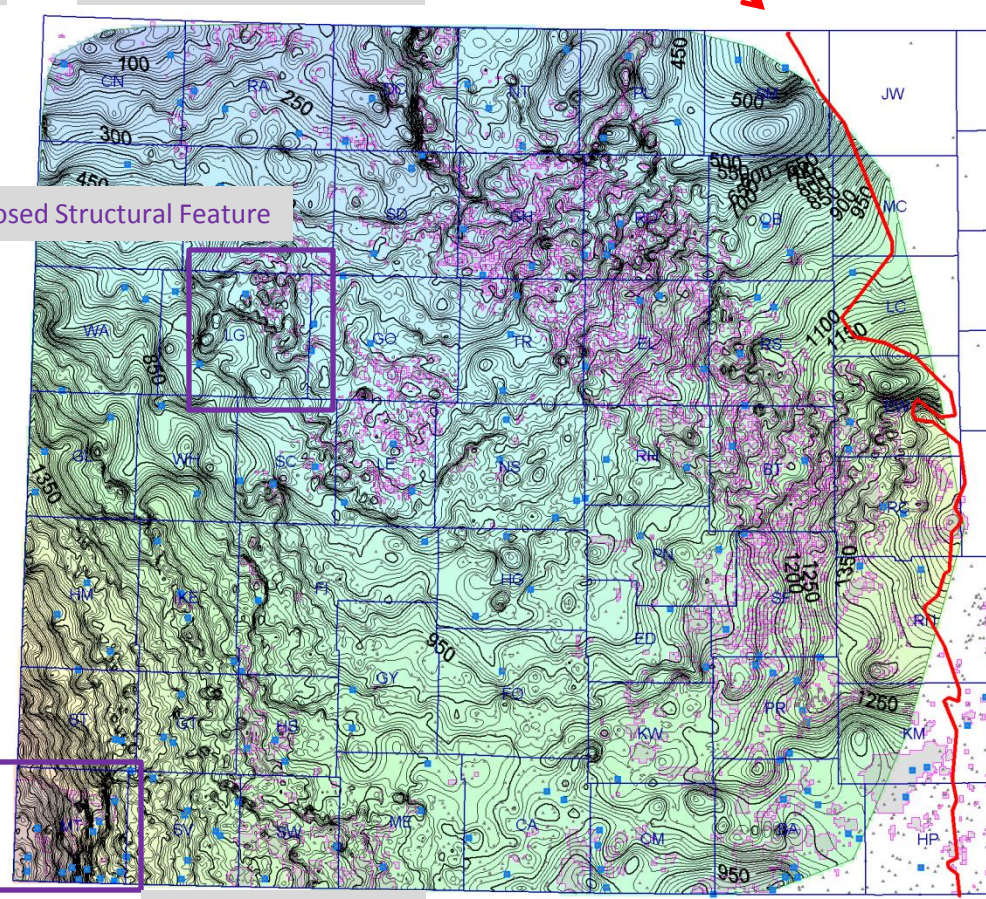
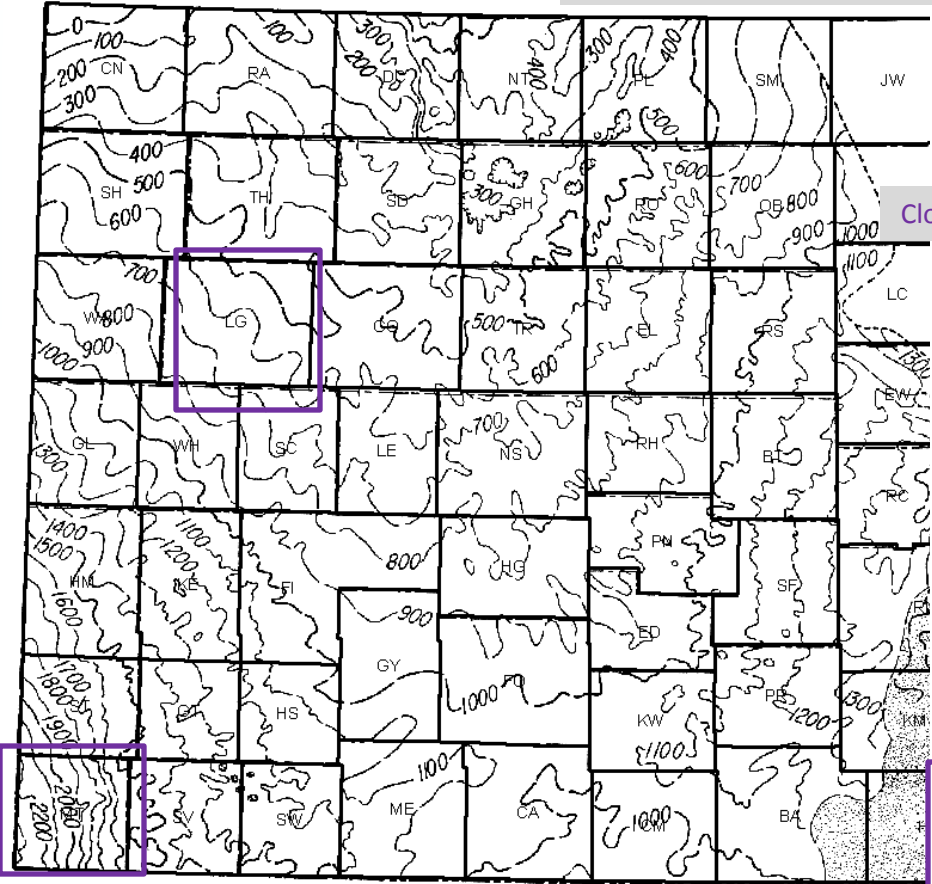
Structure

Structural Map on top of Stone Corral Formation

Eastern Limit of Stone Corral (Merriam, 1962)

Merriam, 1962 (ci:100 ft.)

Gerlach, 2013 (ci:10 ft.)



Closed Structural Feature

Fault Traces on flank of Keyes Dome

Comment:

Structure – “primary changes”

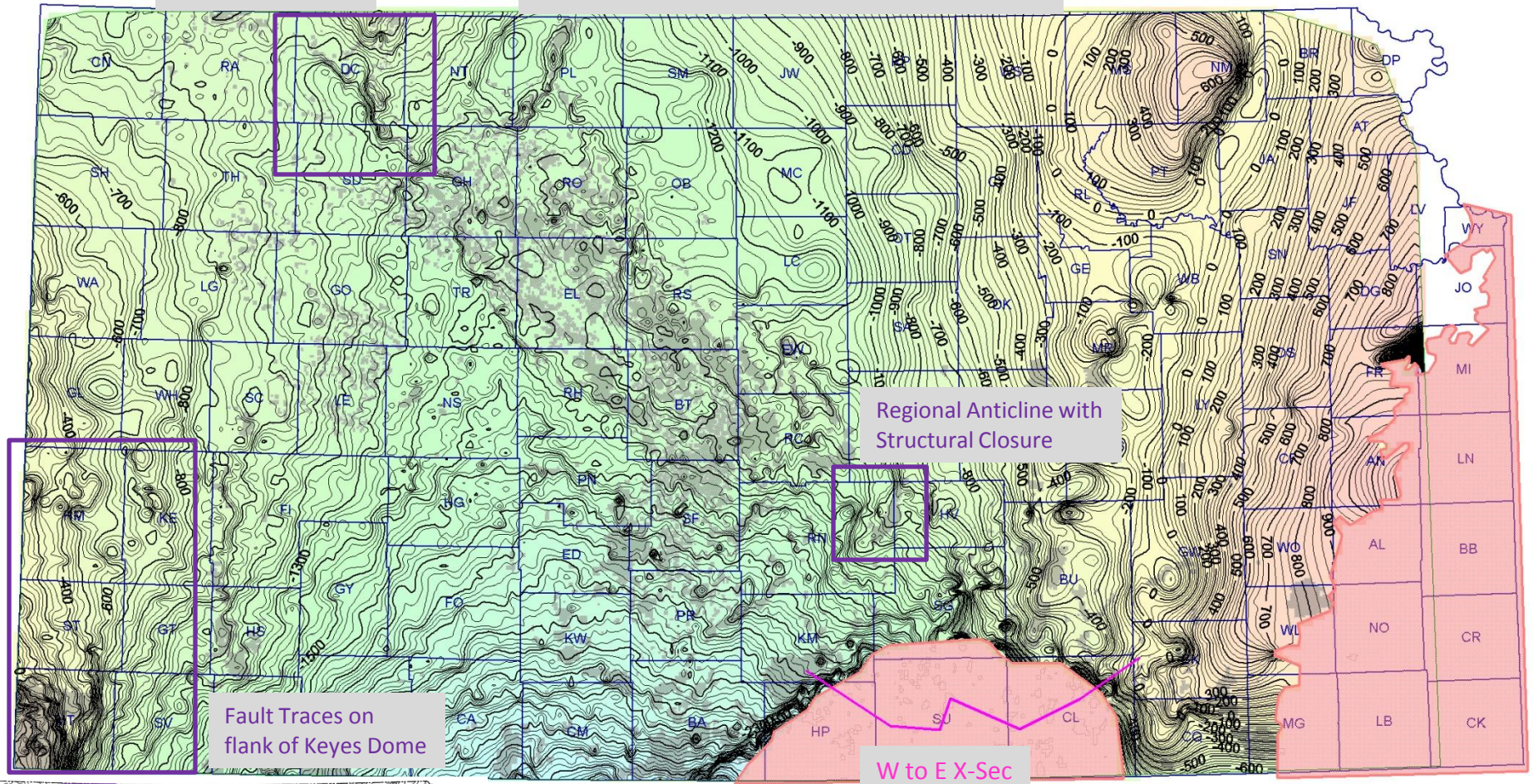
Additional data points and finer contour interval reveals areas of anticlinal closure and steep dip. Past experience relates shallow structure to deeper production.

Structure

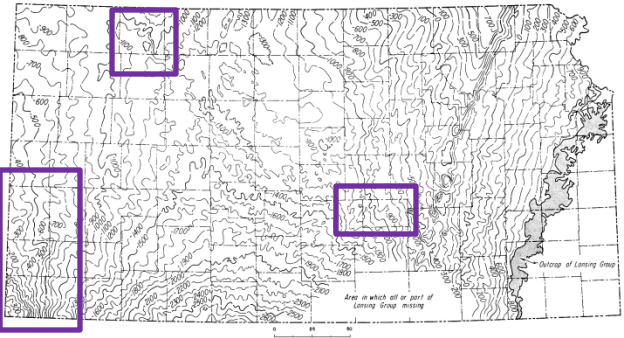
Structural Closures in Decatur Cnty

Structure on the Lansing (ci: 25 ft.) with W to E Cross-Section

Lansing-Kansas City producing fields



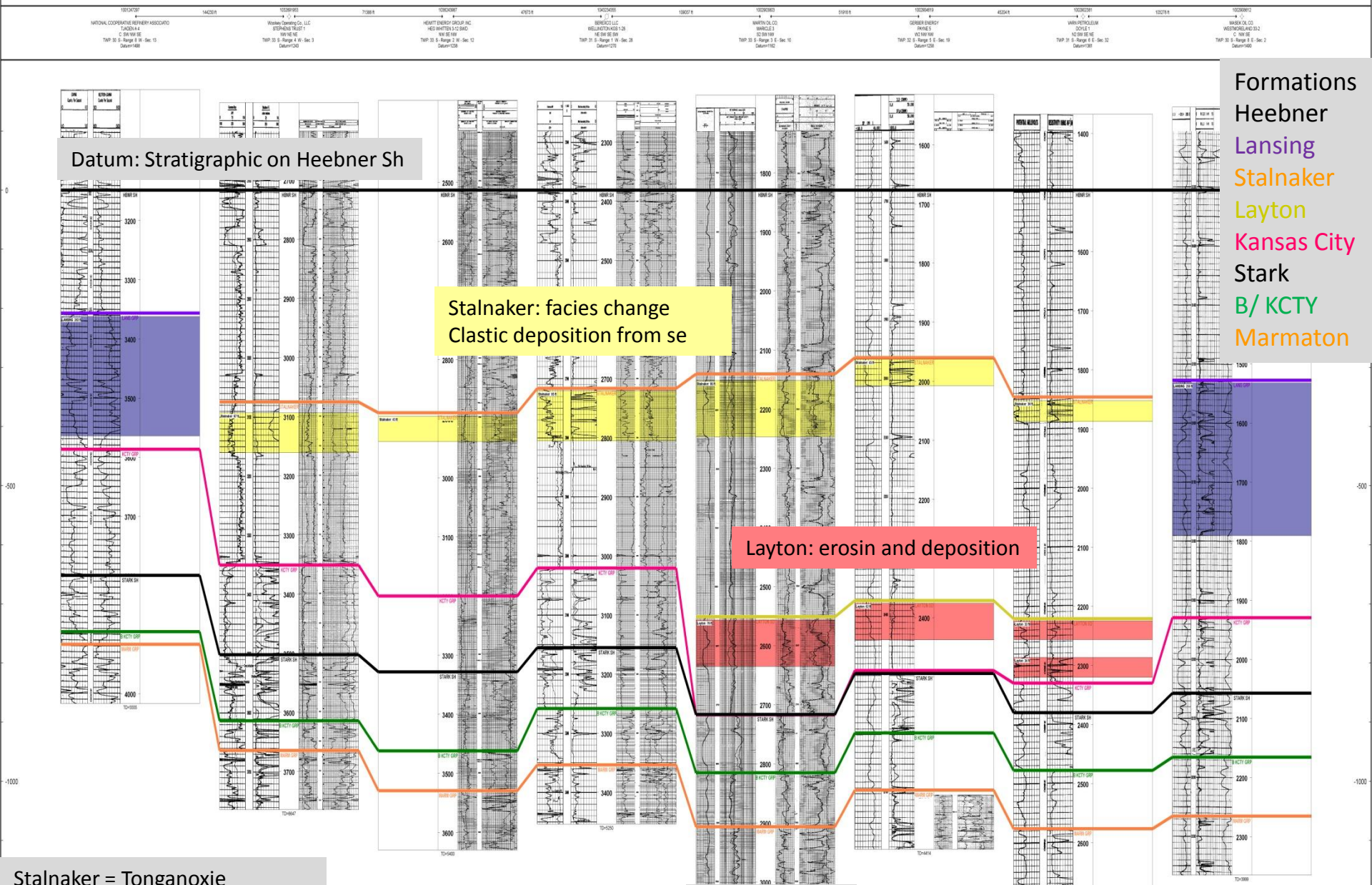
Lansing not present



Merriam, 1962 (ci:100 ft.)

Comment:
 Early research questioned the deposition of Stalnaker and Layton,
 Is it erosion and deposition or facies change ?

West to East Regional Cross-Section Lansing in Sedgwick Basin

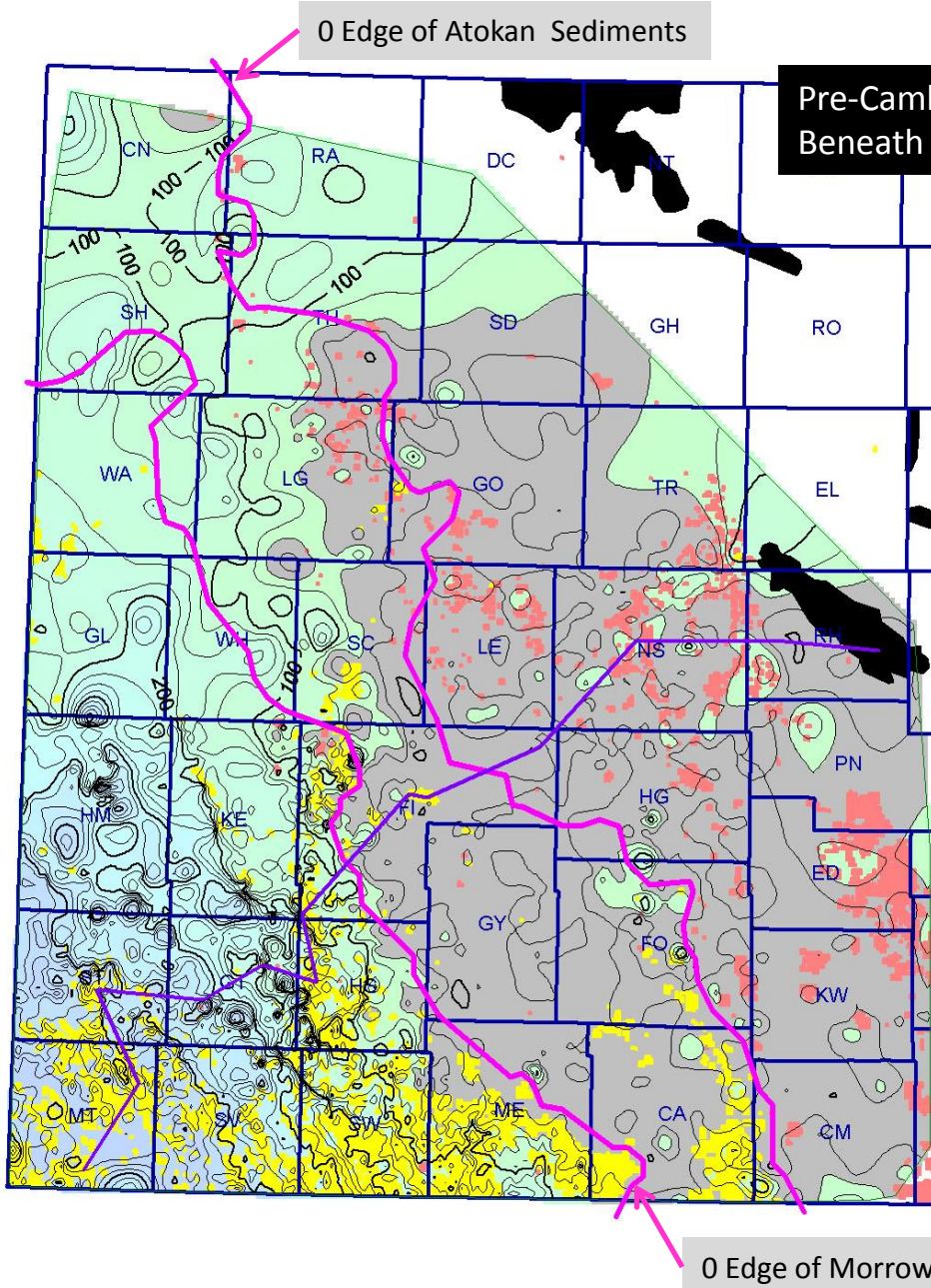


Stalnaker = Tonganoxie
 Layton = Cottage Grove & Noxie

Sedgwick Basin

Stratigraphy

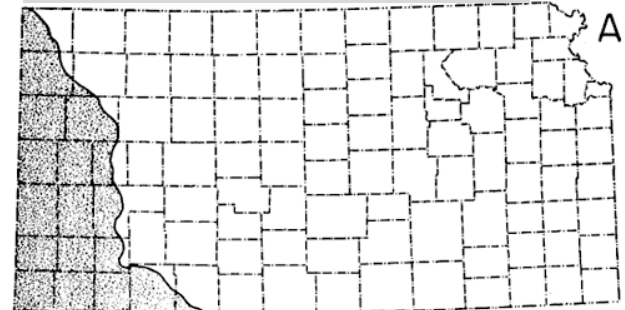
Isopach B-P/Lm to Mississippian (ci: 25 ft) SW to NE Cross-Section



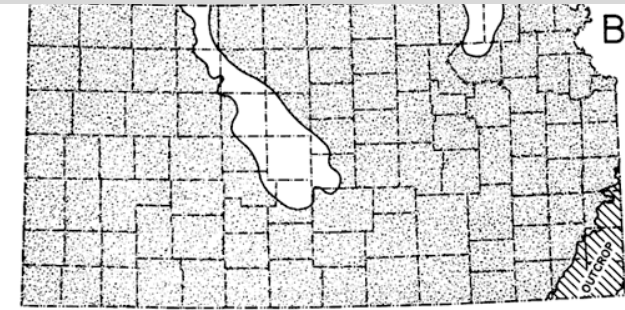
0 Edge of Atokan Sediments

Pre-Camb Outcrop
Beneath Pennsylvanian

Morrowan distribution, Merriam, 1962



Desmoinesian and Atokan distribution, Merriam, 1962

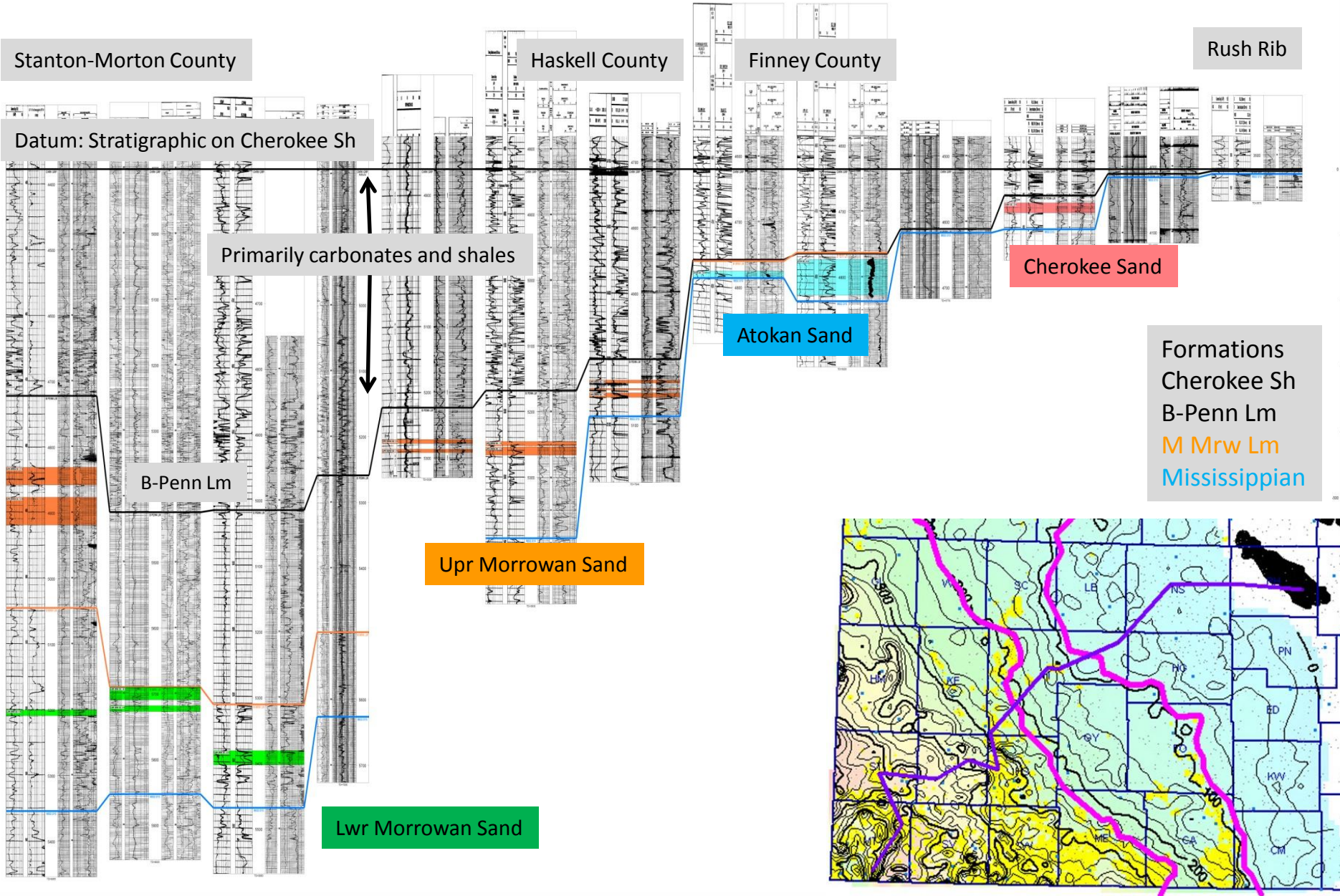


Comment:
Gray color is < 50 ft

Morrowan and Atokan
Producing Formations

Cherokee
Producing Formations

SW to NE Regional Cross-Section Morrowan Atokan Cherokee



Structure

Structure on top of Mississippian rocks

ci: 100 ft

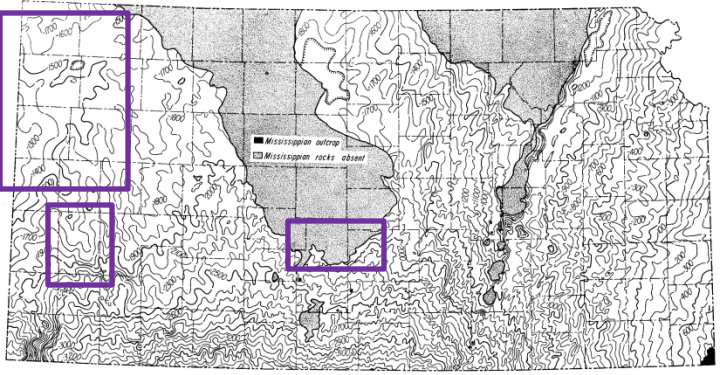
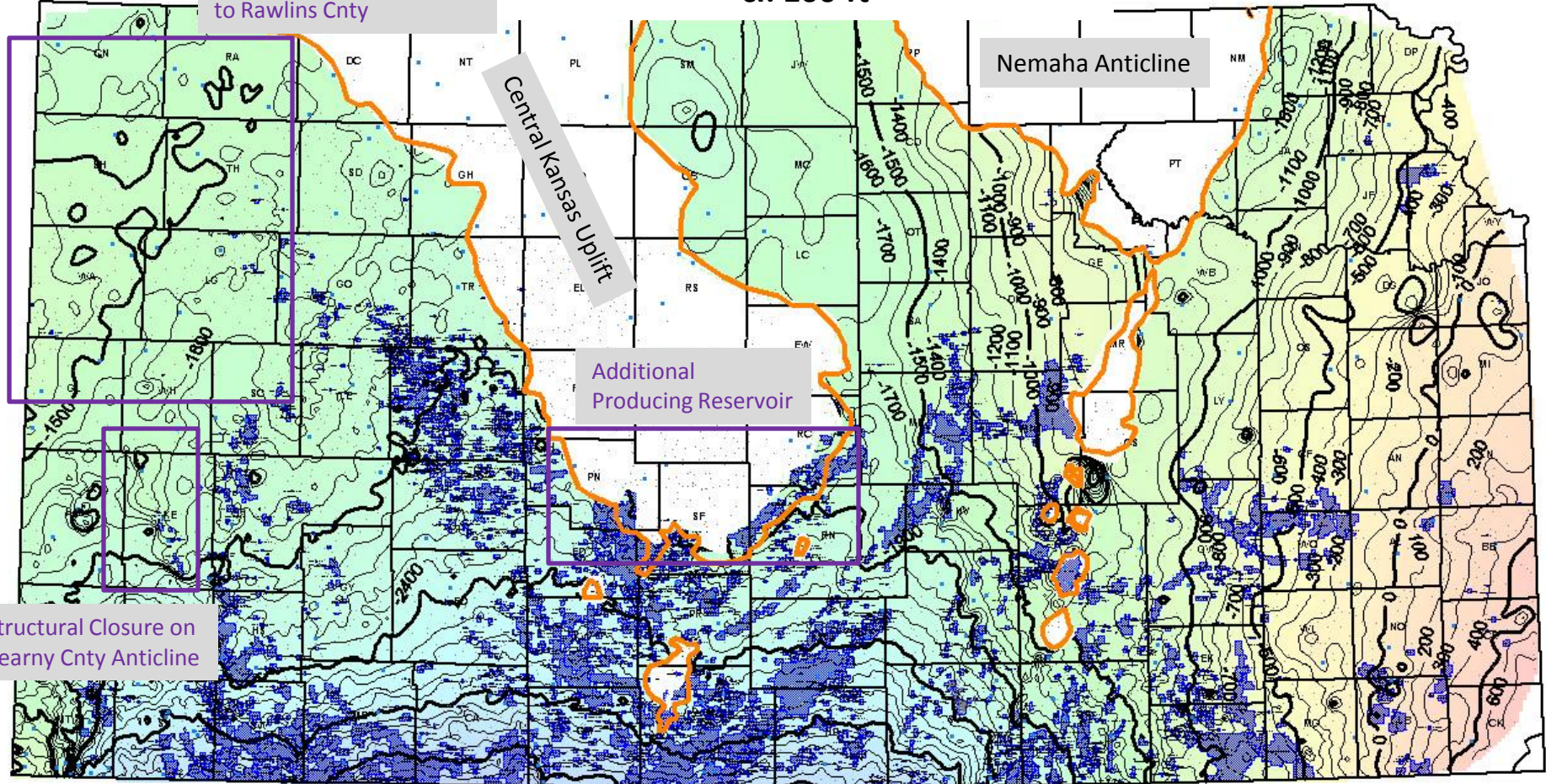
Las Animas Arch extended to Rawlins Cnty

Nemaha Anticline

Central Kansas Uplift

Additional Producing Reservoir

Structural Closure on Kearny Cnty Anticline



Mississippian rocks absent, Merriam, 1962
Mississippian outcrop, Merriam, 1962

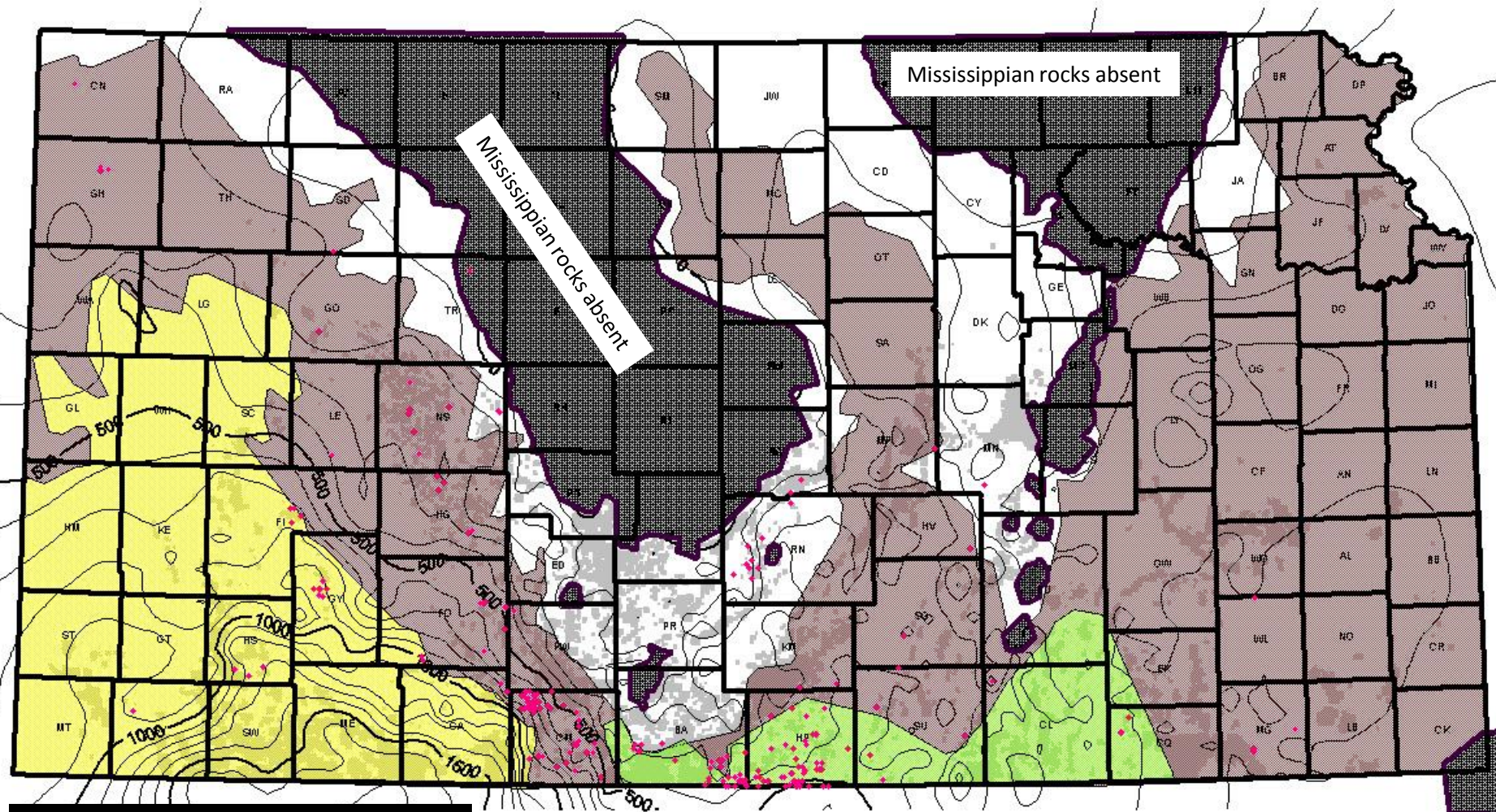
Structure on Mississippian, Ci:100ft, Merriam, 1962

Isopach of Mississippian sediments

ci: 100 ft

Pre-Pennsylvanian Mississippian Subcrop

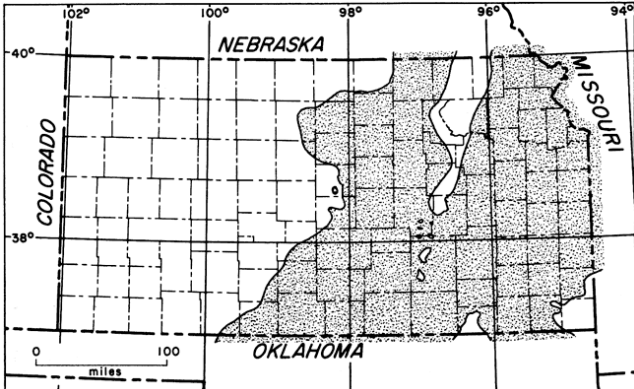
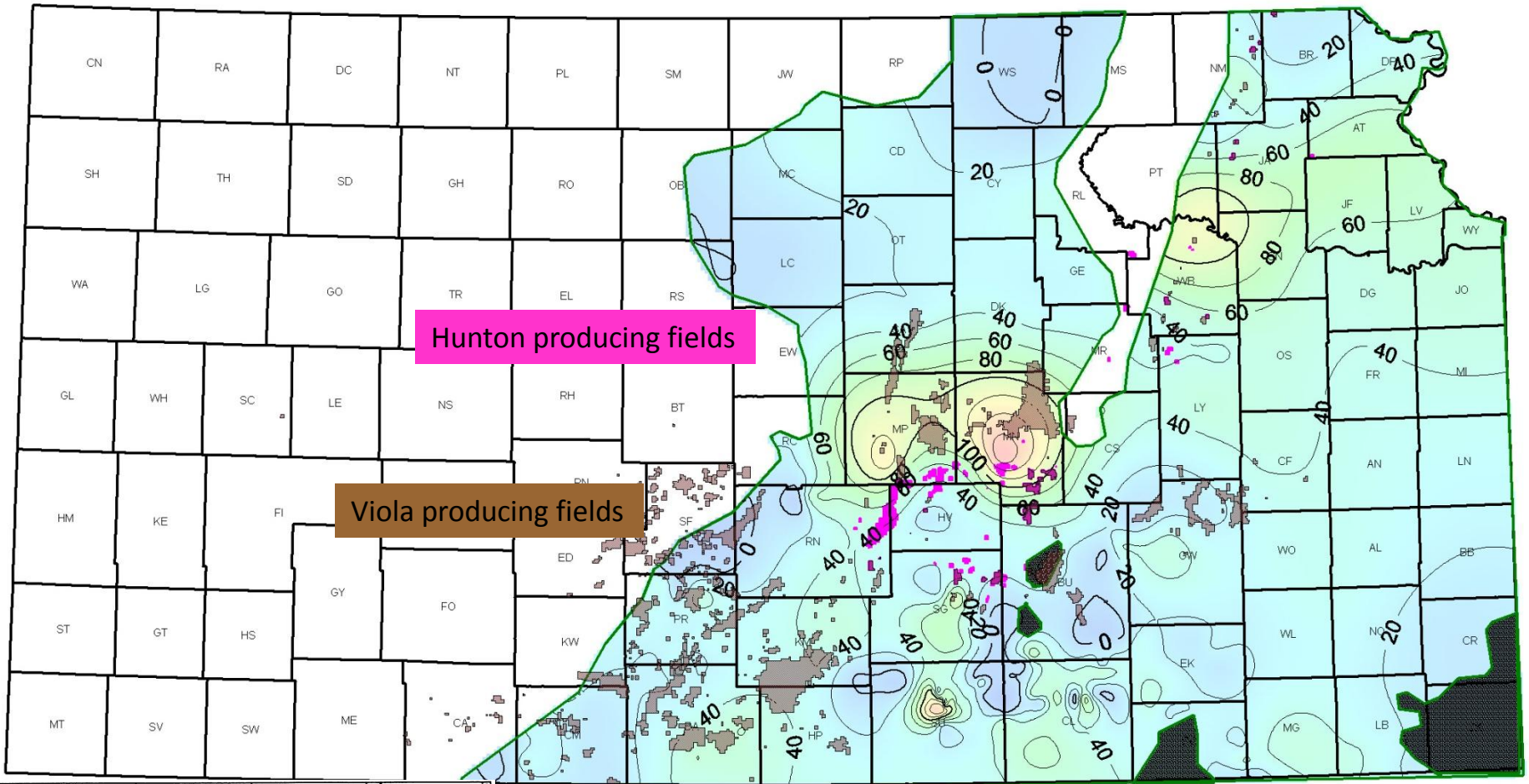
Location of recent horizontal wells



Mississippian Units below Pennsylvanian
St Gen and St Louis
 Spergen and Warsaw
Cowley
 Osage

Horizontal Wells spudded from 1-1-2010

Mississippian producing fields



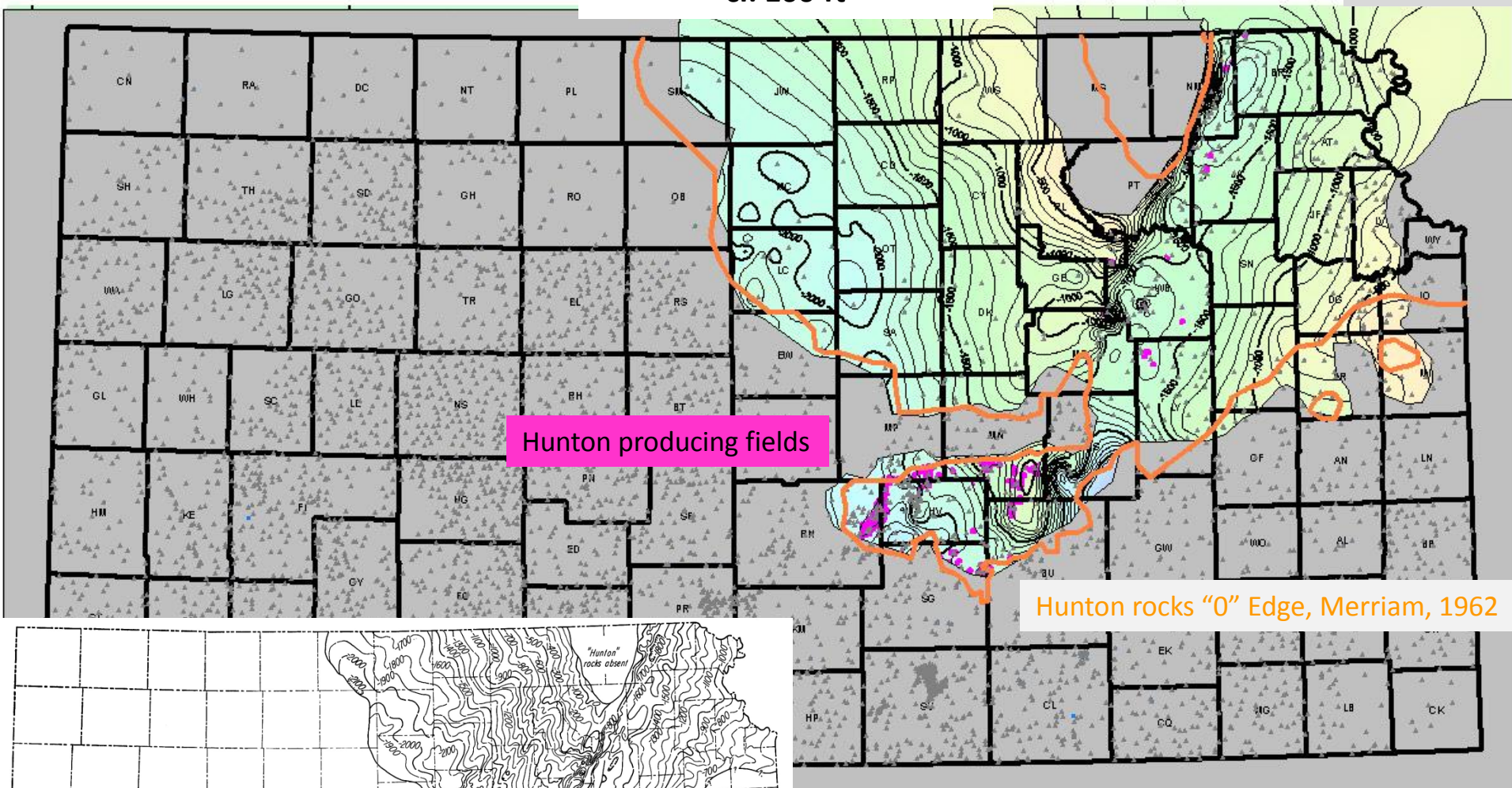
Chattanooga Sh "0" Edge, Merriam, 1962

Distribution of Chattanooga Shale, Merriam, 1962

Structure

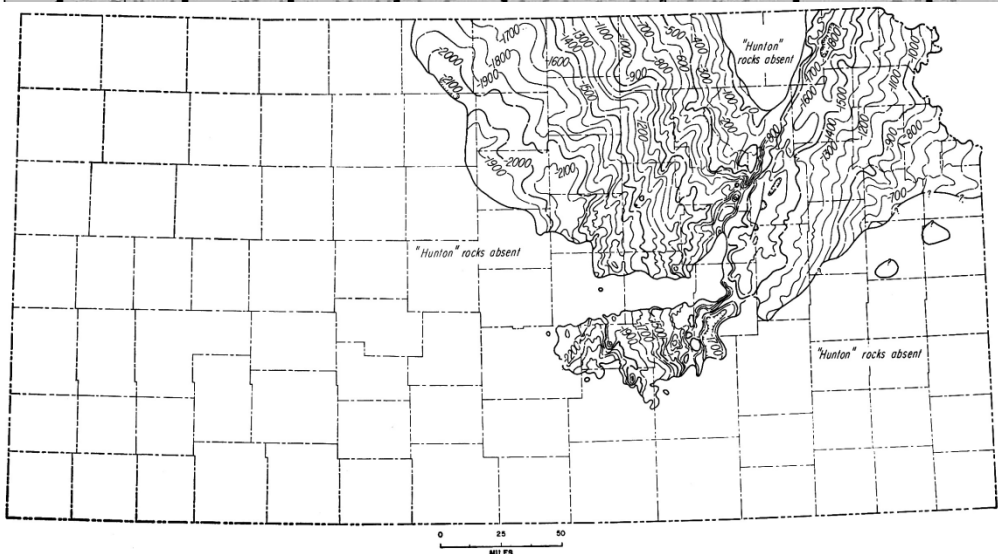
Structure on top of Hunton ci: 100 ft

Gerlach, 2013



Hunton producing fields

Hunton rocks "0" Edge, Merriam, 1962

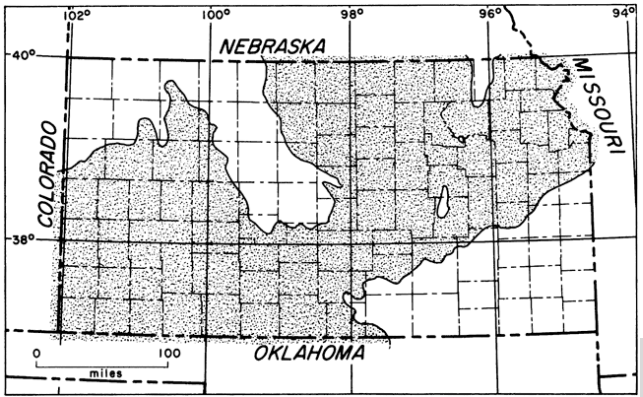
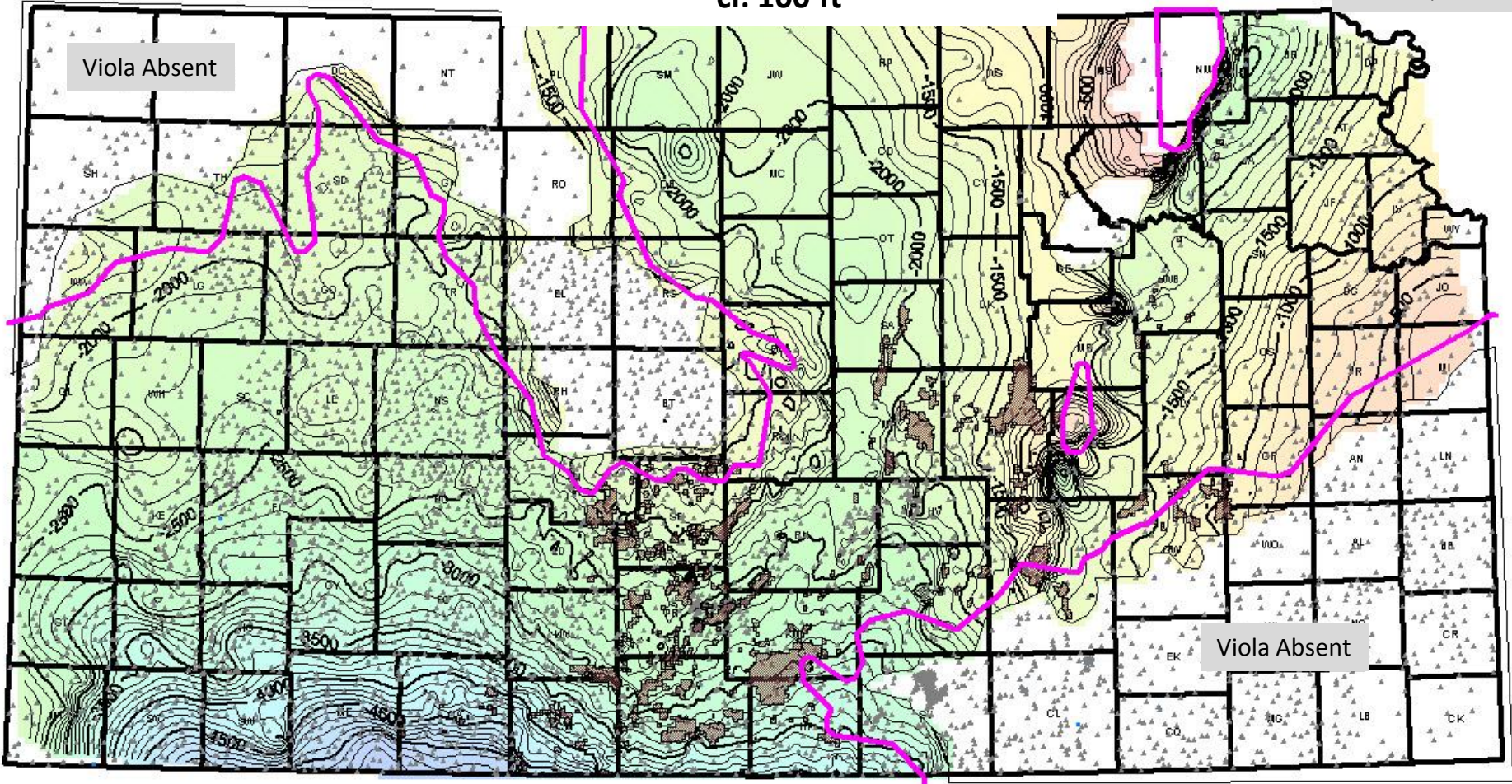


Structure on the Hunton, Merriam, 1962

Structure

Structure on top of Viola sediments ci: 100 ft

Gerlach, 2013



Viola rocks "0" Edge, Merriam, 1962

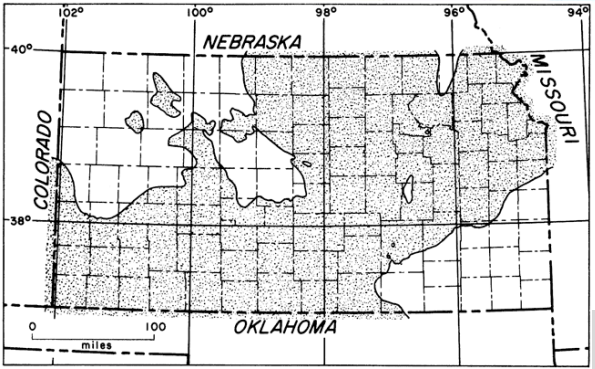
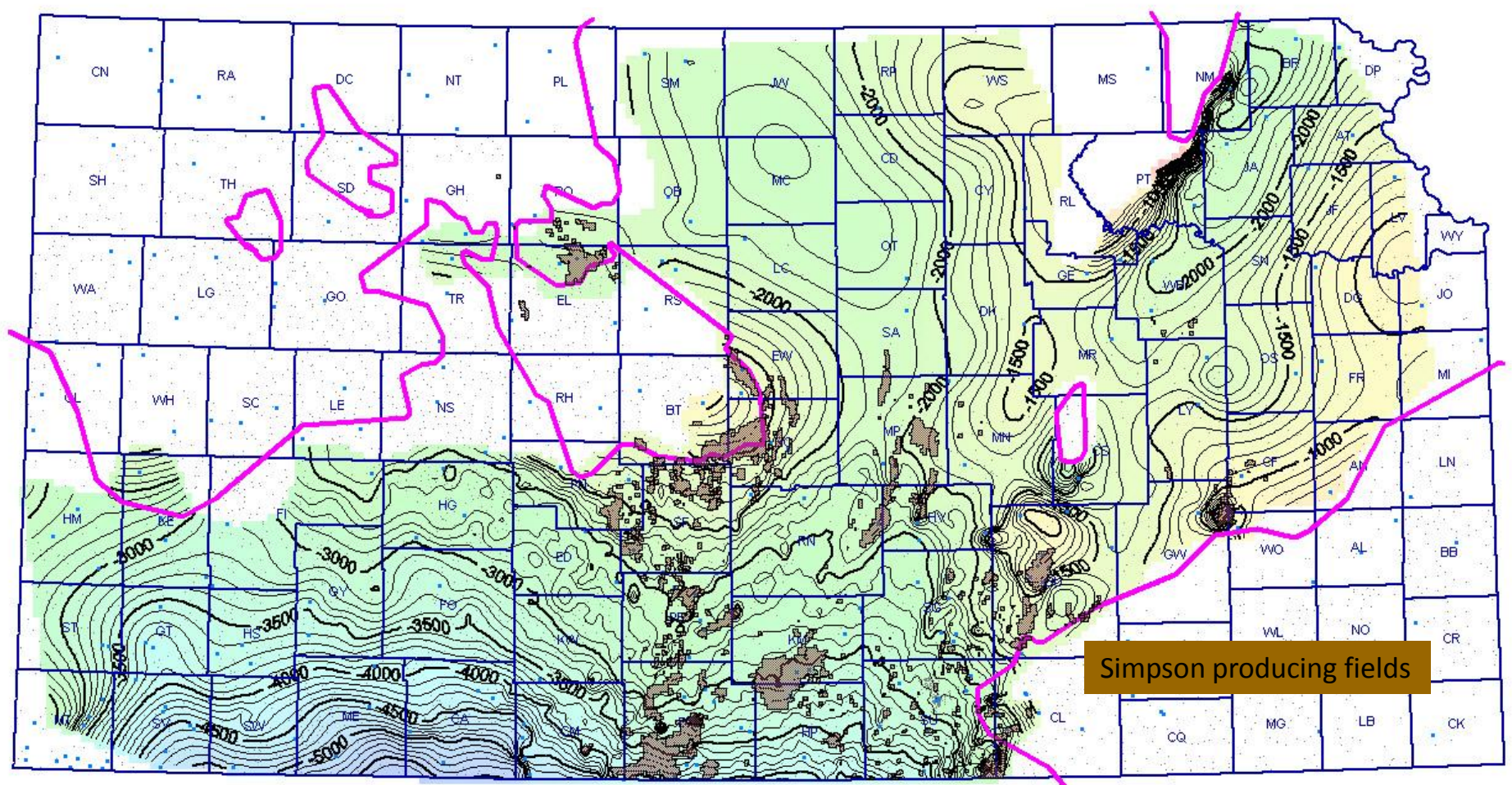
Viola producing fields

Distribution of Viola, Merriam, 1962

Structure

Structure on top of Simpson sediments ci: 100 ft

Gerlach, 1953



Simpson "0" Edge, Merriam, 1962

Distribution of Simpson, Merriam, 1962

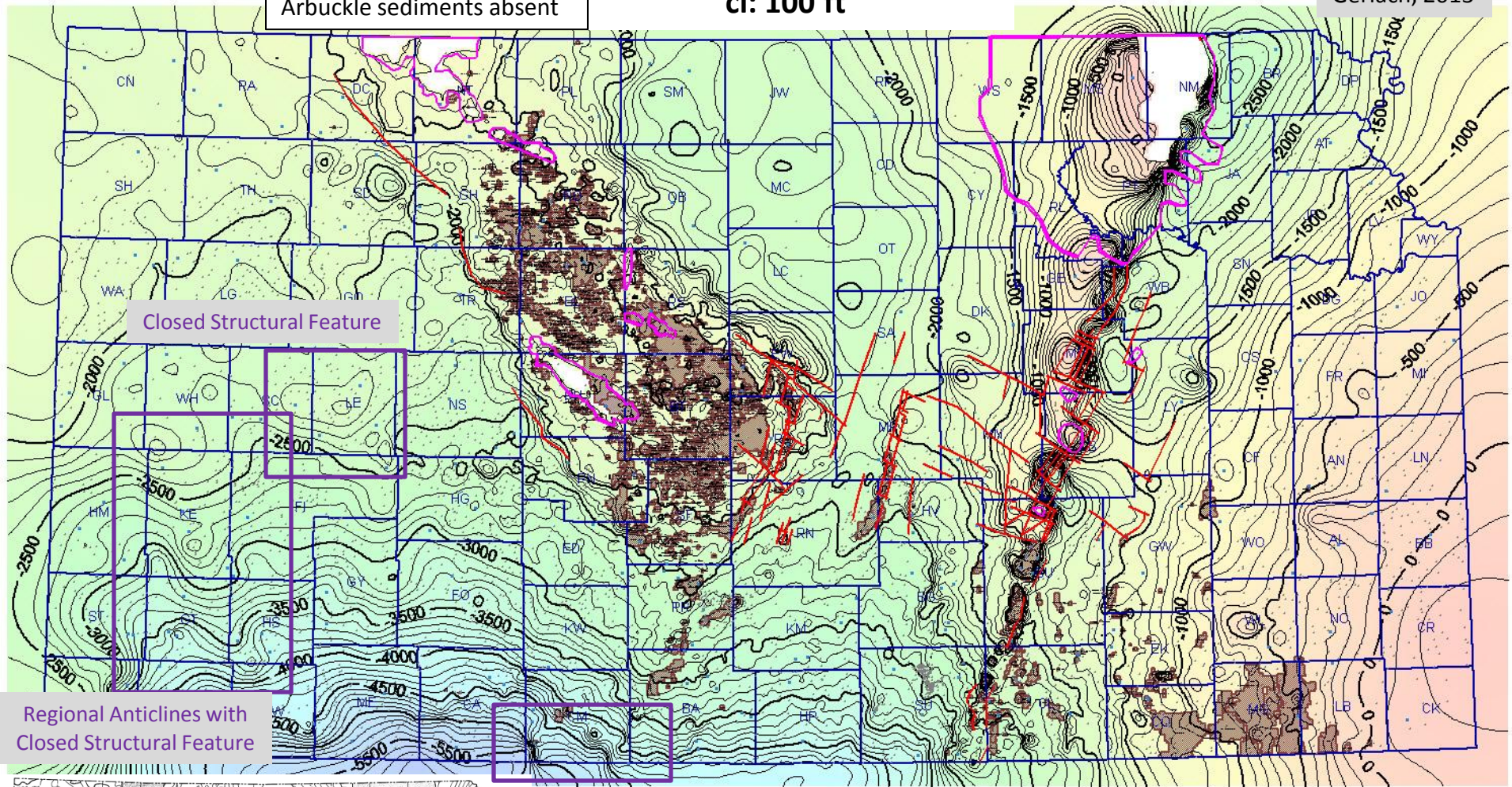
Structure

Structure on top of ARBUCKLE

ci: 100 ft

Gerlach, 2013

Arbuckle sediments absent

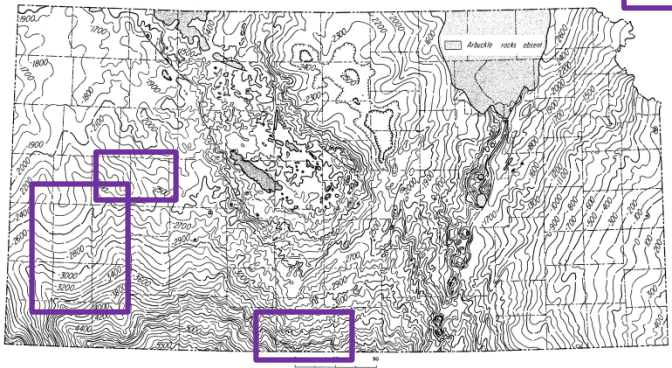


Regional Anticlines with Closed Structural Feature

Fault Traces

Arbuckle Faults, Merriam 1962, Barrs 1990

Arbuckle rocks "0" Edge, Merriam, 1962



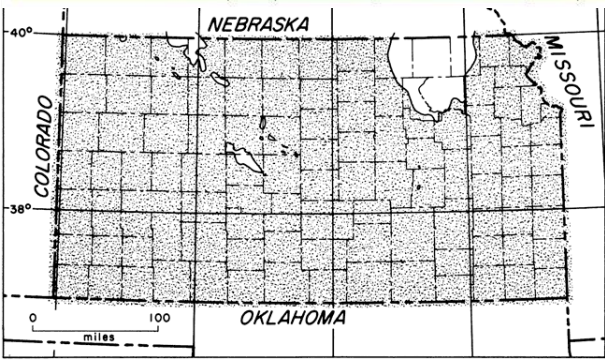
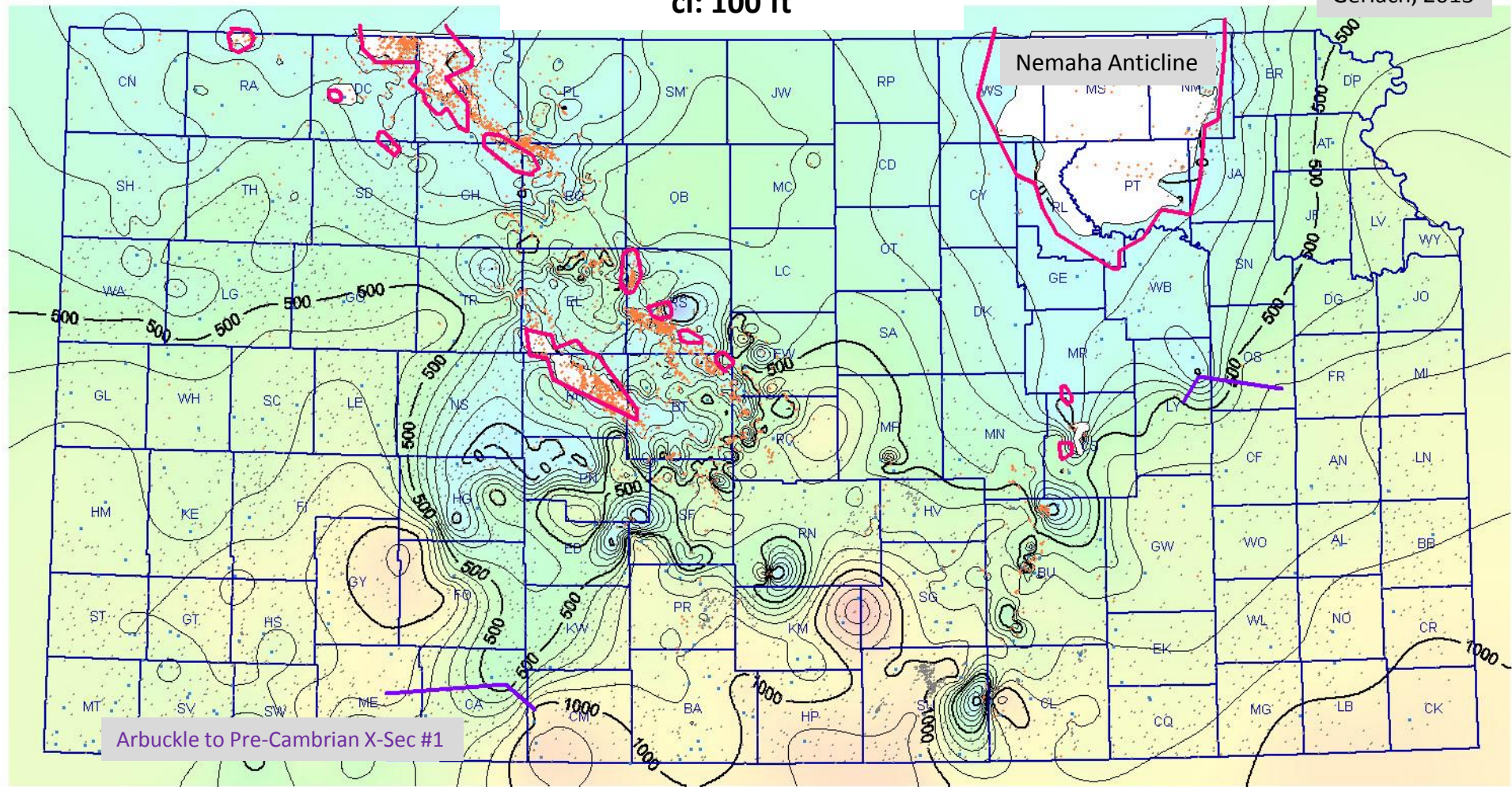
Structure on Arbuckle, Merriam, 1962

Arbuckle producing fields

Stratigraphy

Isopach of Arbuckle sediments ci: 100 ft

Gerlach, 2013



Well penetrating Pre-Camb

Arbuckle rocks "0" Edge, Merriam, 1962

Arbuckle sediments absent

Distribution of Arbuckle, Merriam, 1962

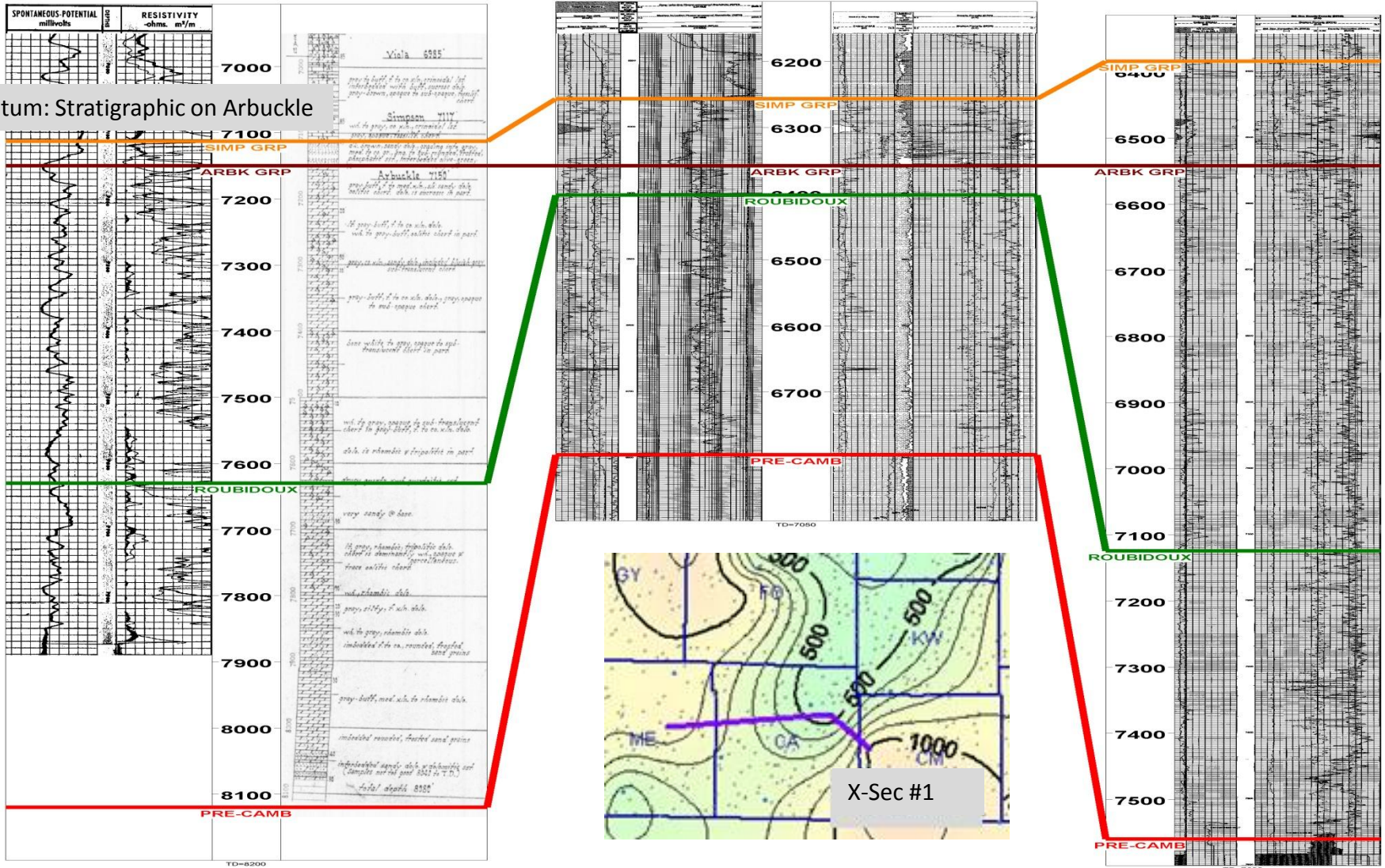
Update:
Pre-Simpson Post-Arbuckle unconformity
more extensive than previously documented

X-Sec #1: Arbuckle to Pre-Cambrian

Simpson
Arbuckle
Roubidoux
Pre-Camb

1002880829 NORTHERN NAT GAS PROD COLLINGSWOOD 1 SW SW NE TWP: 32 S - Range: 27 W - Sec. 8 Datum: 2090
 181282 R
 1006032935 DLB O&G GILES 15-24 NW SW SW SE TWP: 31 S - Range: 22 W - Sec. 24 Datum: 2091
 59066 R
 1029517863 Palmer Petroleum, Inc. Herd SE NW NW TWP: 32 S - Range: 20 W - Sec. 33 Datum: 1891

Datum: Stratigraphic on Arbuckle

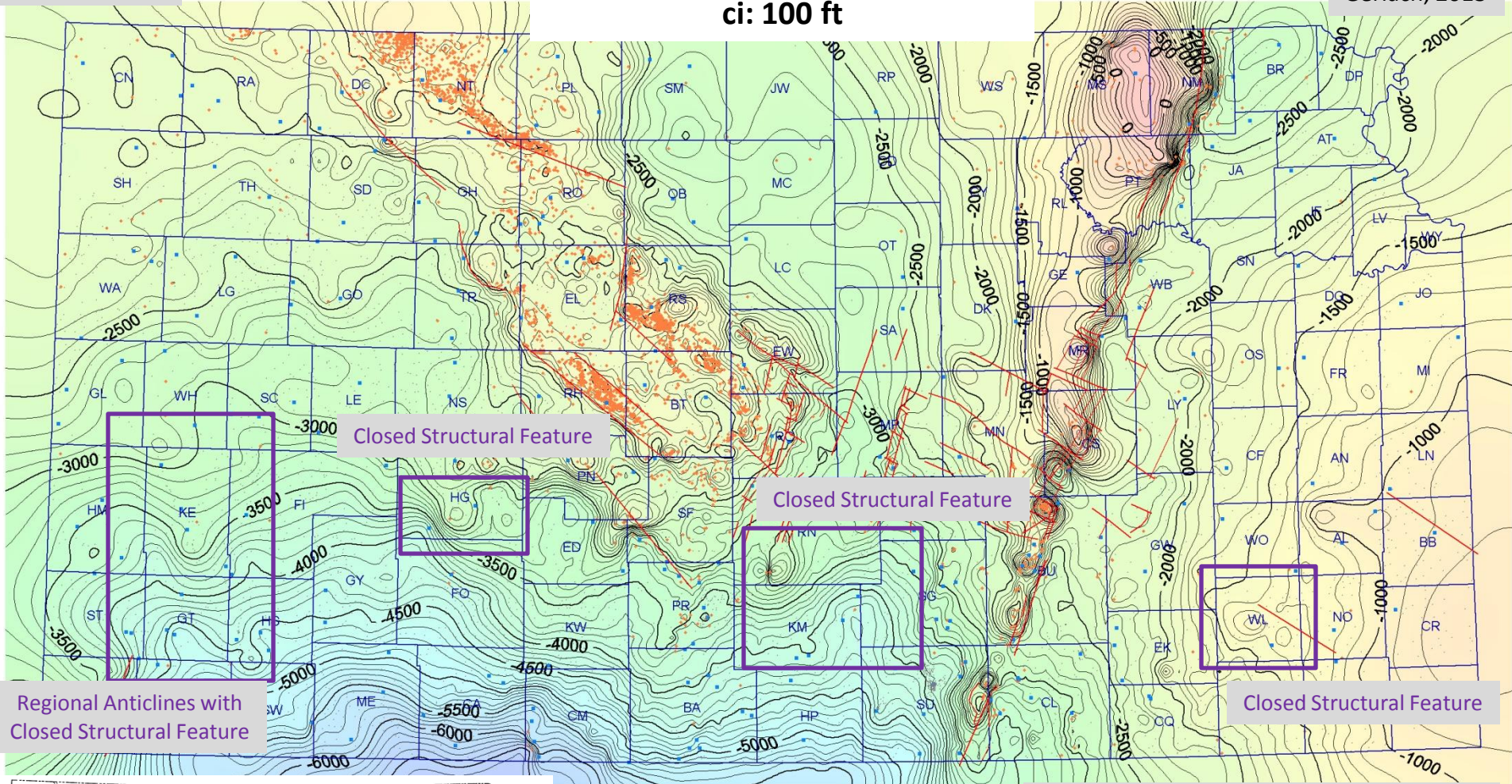


Structure

Structure on top of Pre-Cambrian

Gerlach, 2013

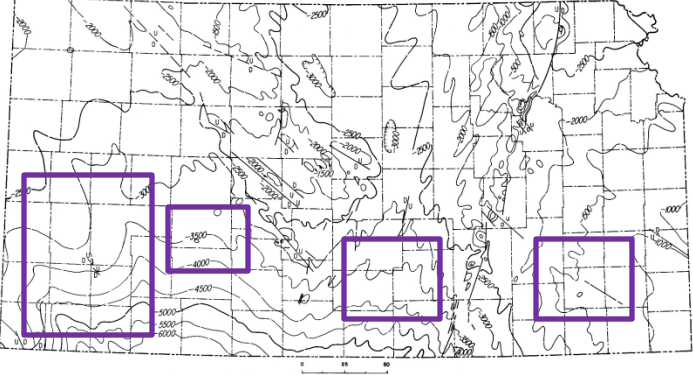
ci: 100 ft



Arbuckle Faults, Merriam 1962, Barrs 1990

Well penetrating Pre-Camb

Update:
Nemaha & Central Kansas Uplift better defined
P-C uplift south of CKU discovered



Structure on Pre-Camb (ci: 500 ft), Merriam, 1962

Summary of Update to Merriam, 1962

At a State (regional) scale, Merriam, 1962 is little changed

At a sub-regional scale, Merriam, 1962, has many changes.
Which is to be expected with the additional control and computer aided exploration software.

Additional control points and finer contours (ie: <100 ft ci)
Reveal subtle structural and stratigraphic features across multiple geologic horizons.

Regional Synclines and Anticlines have been identified

Closed structural features have been identified

Additional drilling has identified new salt basins and expanded existing salt basins

The overlay producing horizons on Structure and Isopach Horizons reveals new producing areas

Separate Morrowan from Atokan productive sediments

Identify expanded distribution for producing horizons

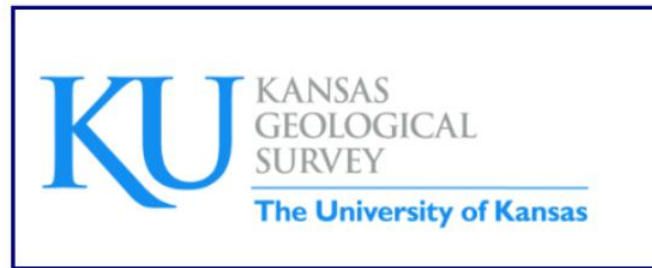
Subcrops on Pre-Pennsylvanian formations have significantly changed (principally due to additional control)

Pre-Simpson Post Arbuckle unconformities more extensive than previously documented

Pre-Cambrian surface and fault displacement better defined

Acknowledgements

Tom Hansen, Bittersweet Energy,



Lynn Watney, Kansas Geological Survey



Department of Energy, CO2 Project
DOE Award DE-FE002056

Acknowledgements -- The work supported by the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) under Grant DE-FE0002056 and DE-FE0006821, W.L. Watney and Jason Rush, Joint PIs. Project is managed and administered by the Kansas Geological Survey/KUCR at the University of Kansas and funded by DOE/NETL and cost-sharing partners.