Syndepositional Tectonism and its Effects on Mississippian (Kinderhookian to Osagean) Lithostratigraphic Architecture: Part 2 – Subsurface Occurrences in the Midcontinent USA*

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Abstract

As in exposures of Kinderhookian to Osagean carbonates in Missouri and adjoining Arkansas and Oklahoma, deposition of these rocks in the subsurface of Kansas and northern Oklahoma also records aggradational and progradational sedimentation that was overprinted by syndepositional tectonism related to regional Ouachita tectonism. Such deposition and tectonic overprint are reflected in the character, occurrence, and type of petroleum reservoir rocks in the subsurface, hence they are significant attributes of any exploration model. There are, for example, relatively narrow but regionally extensive linear E-W oriented belts wherein the Kinderhookian-Osagean section is thin, and includes many marine and subaerial unconformities and folded strata that reflect the repeated passage of foreland bulges (arches) during deposition.

Potential subunconformity-truncation and structural traps abound in such situations, although periodic eustatic lowstands also contributed to reservoir porosity formation in some units. On a more regional scale, the absence of Mississippian rocks over much of central Oklahoma to central Texas likewise is related to broad Ouachita-related uplift. In contrast, significant thickening of these units in central Kansas reflects anomalous subsidence, and potential facies-trap reservoirs are likely in such areas. Reefs in the section are both allochthonous (related to syndepositional tectonism) and autochthonous. They locally are porous and oil-stained in outcrops, hence they may be viable reservoir objectives in the subsurface.

Reference

Lane, H.R., and R.L. DeKeyser, 1980, Paleogeography of late Early Mississippian (Tournaisian 3) in the central and southwestern United States, *in* T.D. Foutch, and E.G. Magathan, (eds.) Paleozoic Paleostratigraphy of the West-Central United States: West-Central U.S. Paleogeography Symposium 1, Rocky Mountain Section, SEPM, p. 149-162.

SYNDEPOSITIONAL TECTONISM AND ITS EFFECTS ON MISSISSIPPIAN (KINDERHOOKIAN TO OSAGEAN) LITHOSTRATIGRAPHIC ARCHITECTURE

PART 2

SUBSURFACE OCCURRENCES IN THE MID-CONTINENT USA

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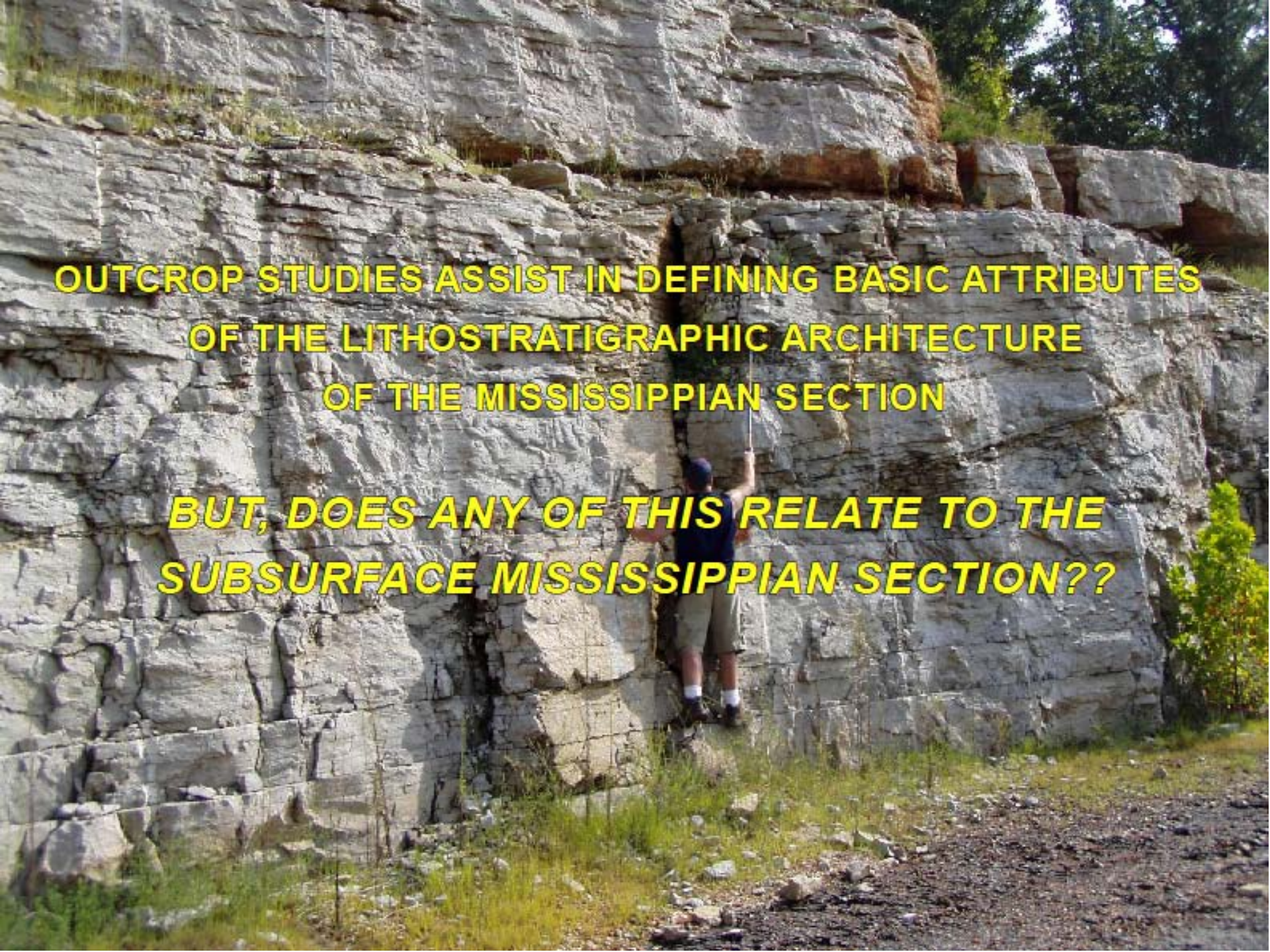
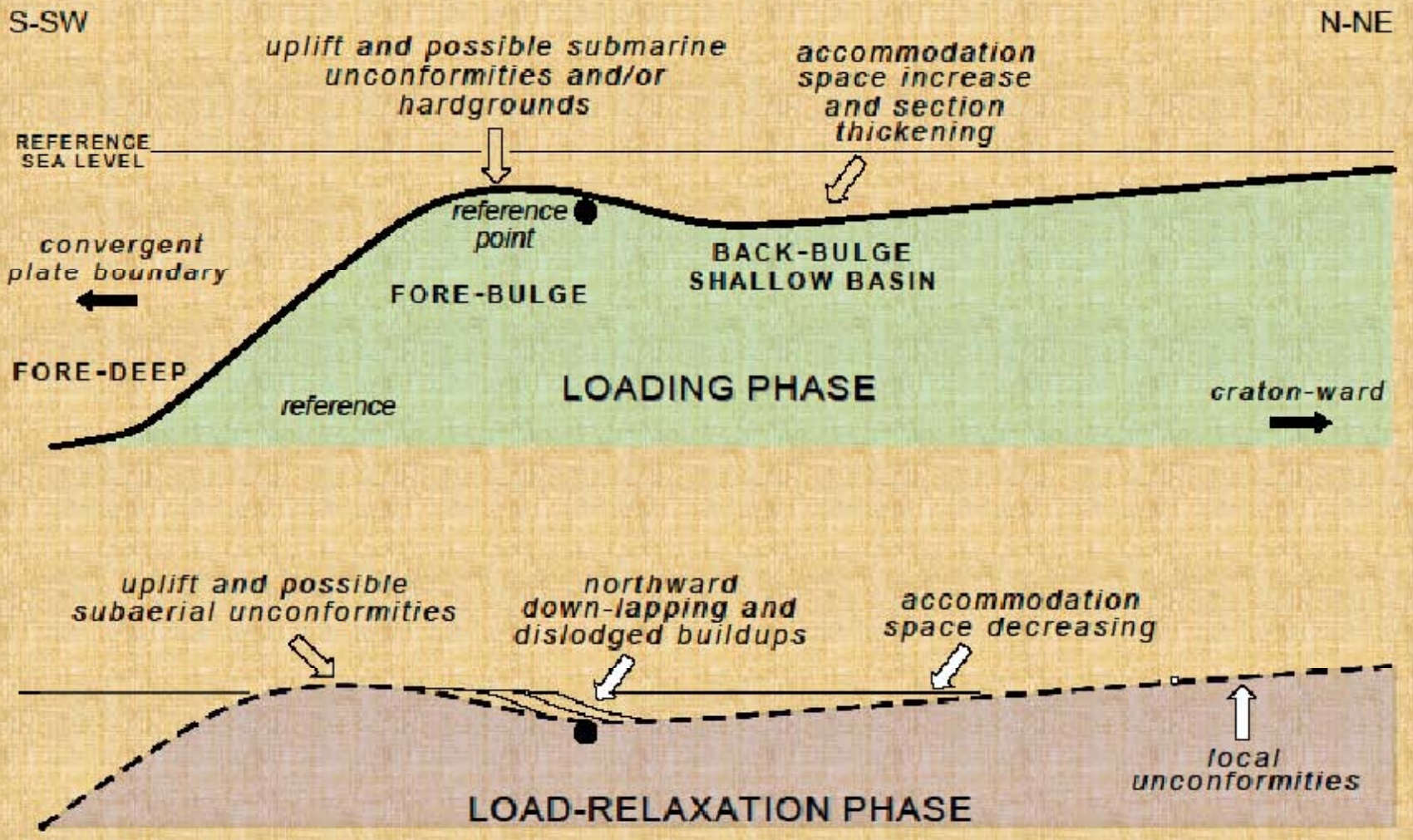
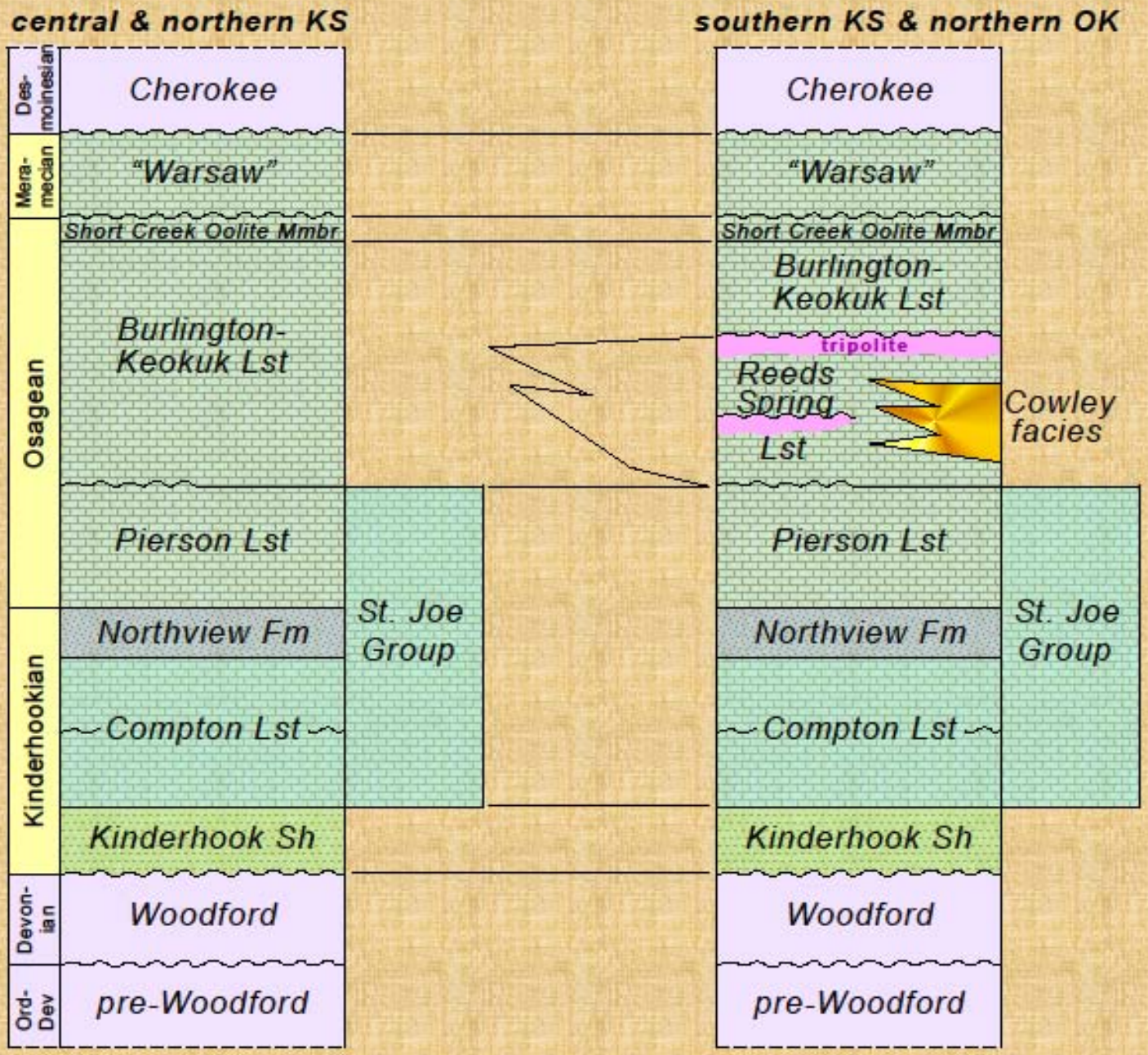

OUTCROP STUDIES ASSIST IN DEFINING BASIC ATTRIBUTES
OF THE LITHOSTRATIGRAPHIC ARCHITECTURE
OF THE MISSISSIPPIAN SECTION
BUT, DOES ANY OF THIS RELATE TO THE
SUBSURFACE MISSISSIPPIAN SECTION??

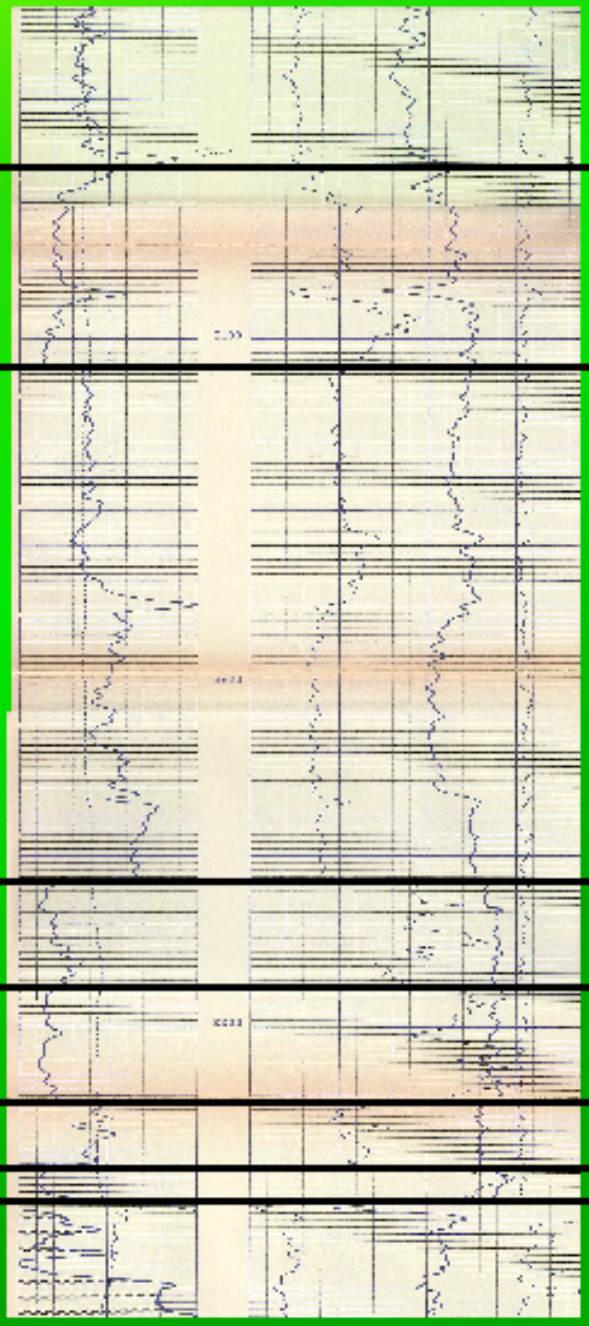

LAURUSSIA
Transcontinental Arch
equator
CO
KS
MO
OK
ARK
NM
TX
Anadarko Basin
GONDWANA
area of volcanic activity during the Mississippian
Caballos-Arkansas chert island chain


S-SW
N-NE
uplift and possible submarine unconformities and/or hardgrounds
accommodation space increase and section thickening
REFERENCE SEA LEVEL
reference point
convergent plate boundary
FORE-BULGE
BACK-BULGE SHALLOW BASIN
FORE-DEEP
reference
LOADING PHASE
craton-ward
uplift and possible subaerial unconformities
northward down-lapping and dislodged buildups
accommodation space decreasing
local unconformities
LOAD-RELAXATION PHASE

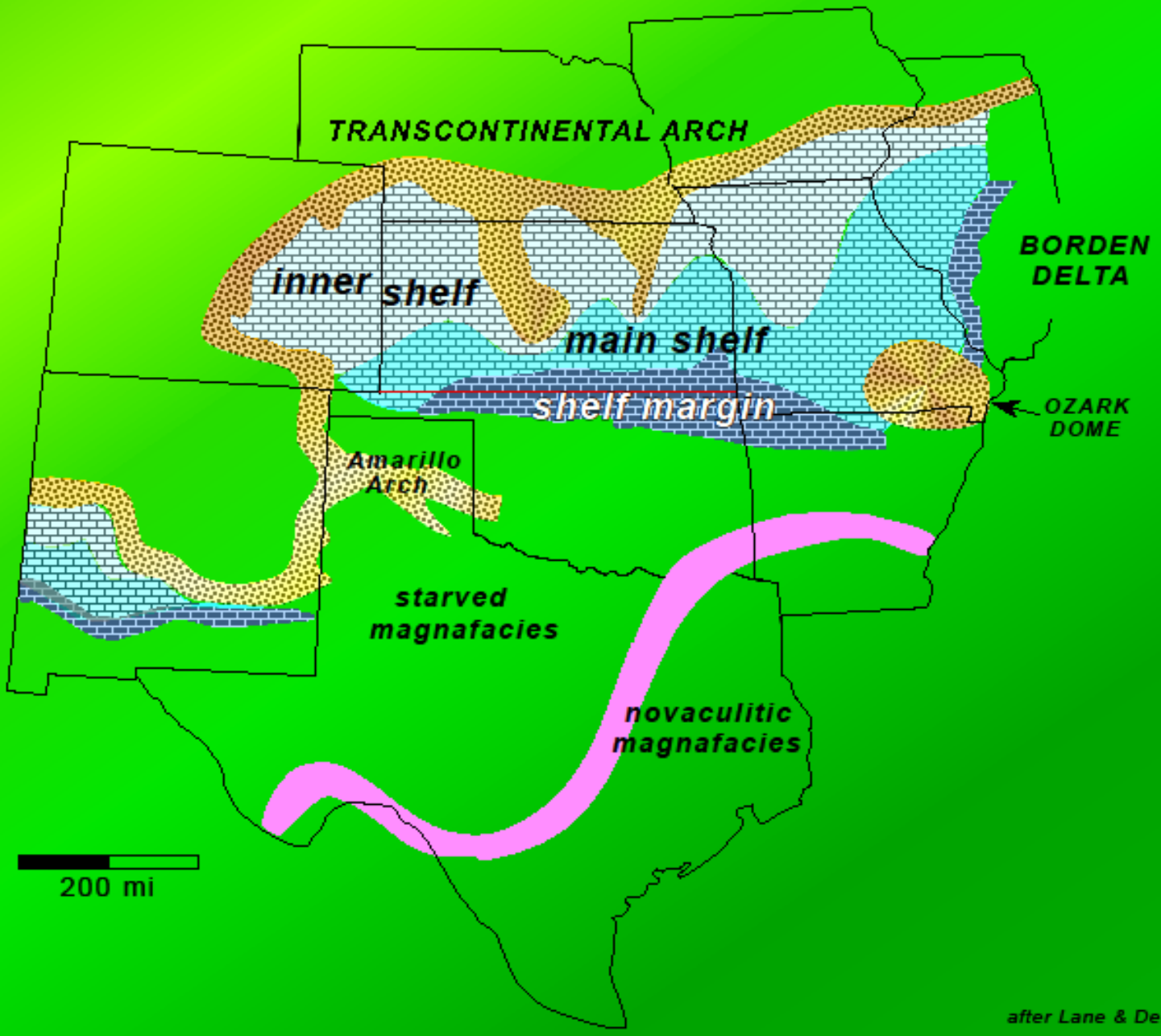
SUBSURFACE STRATIGRAPHY



TYPE LOG, SOUTH-CENTRAL KANSAS

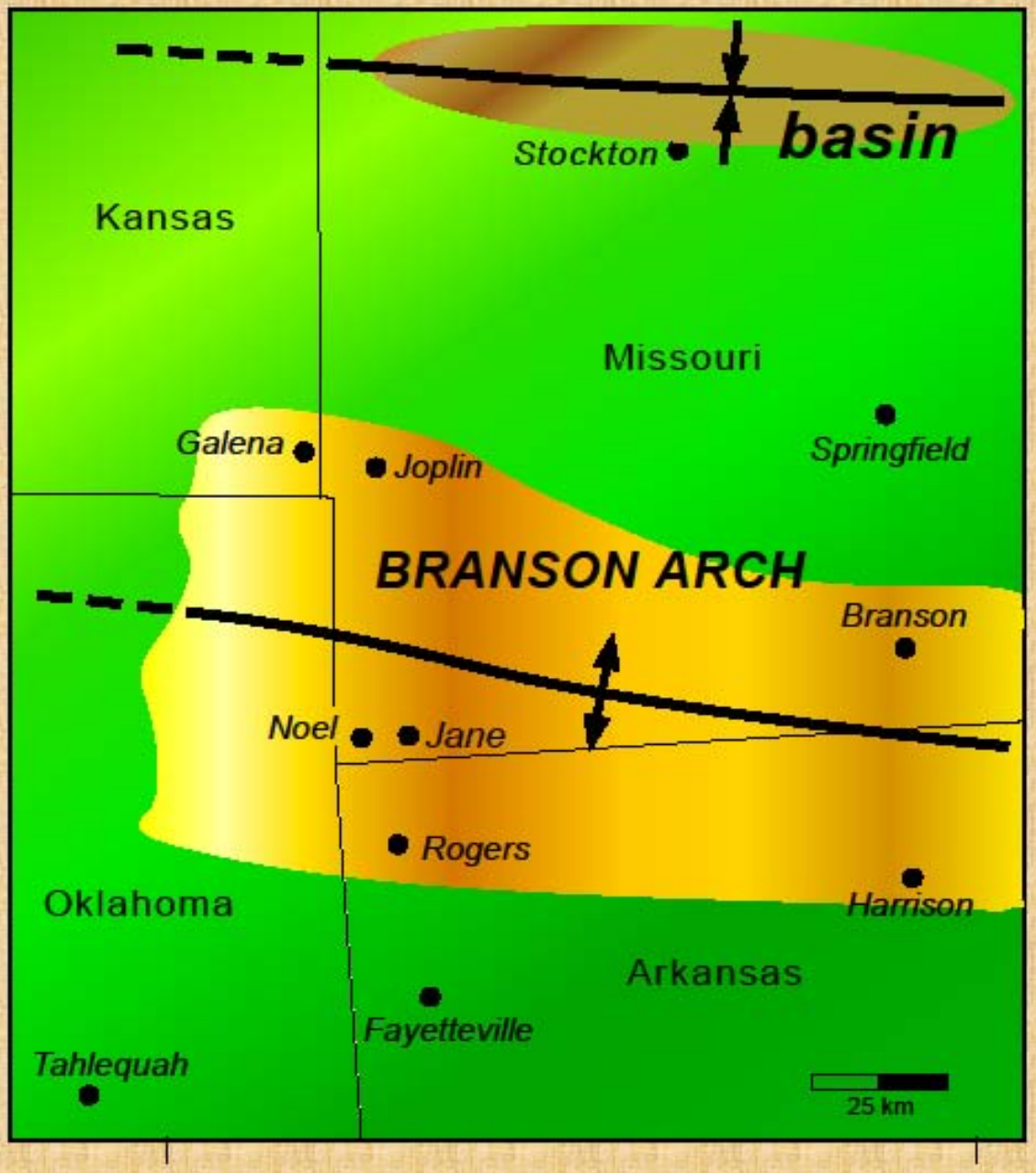


EXTANT REGIONAL PALEOFACIES MODEL

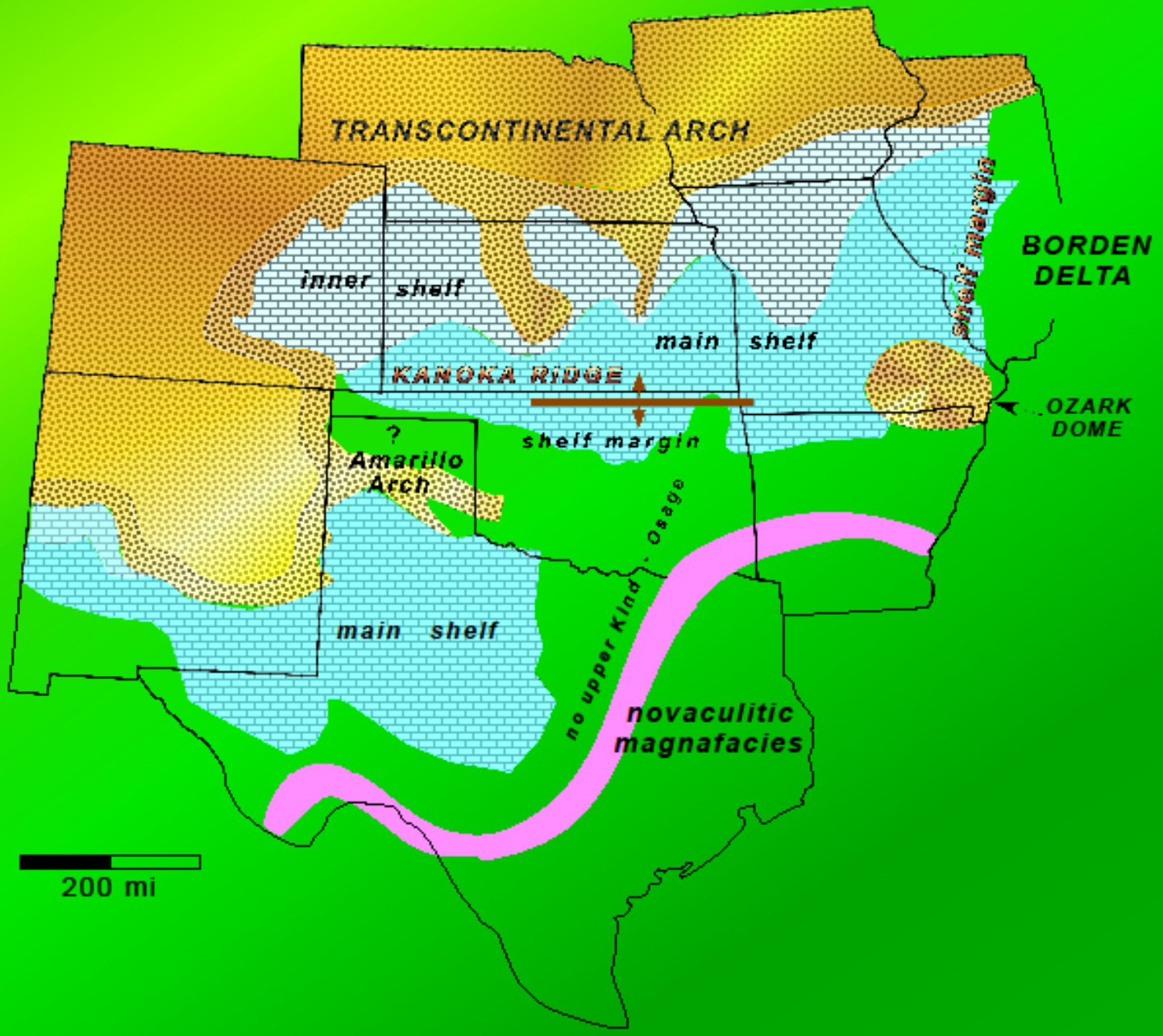


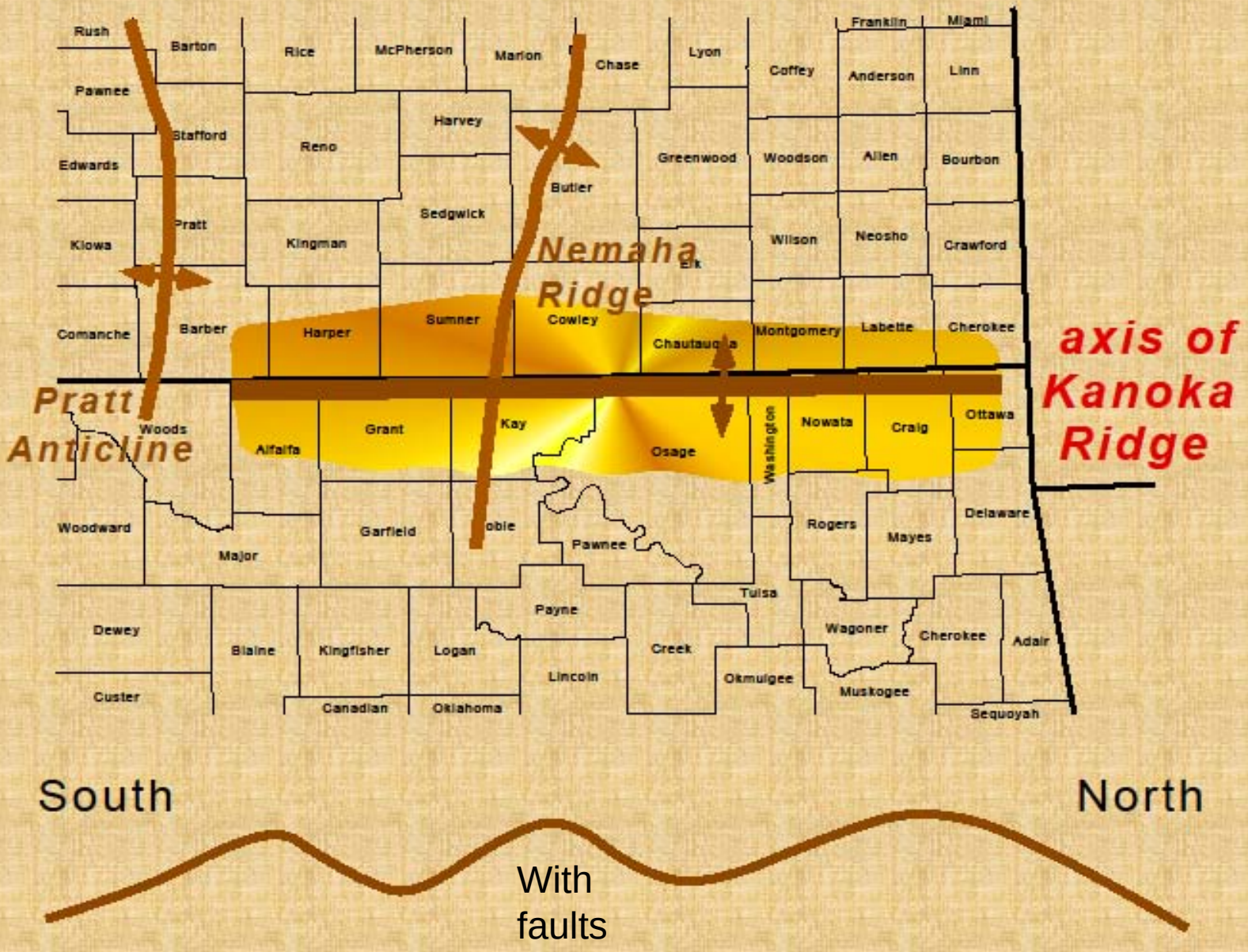
after Lane & DeKeyser (1980

OUTCROP TECTONIC FRAMEWORK



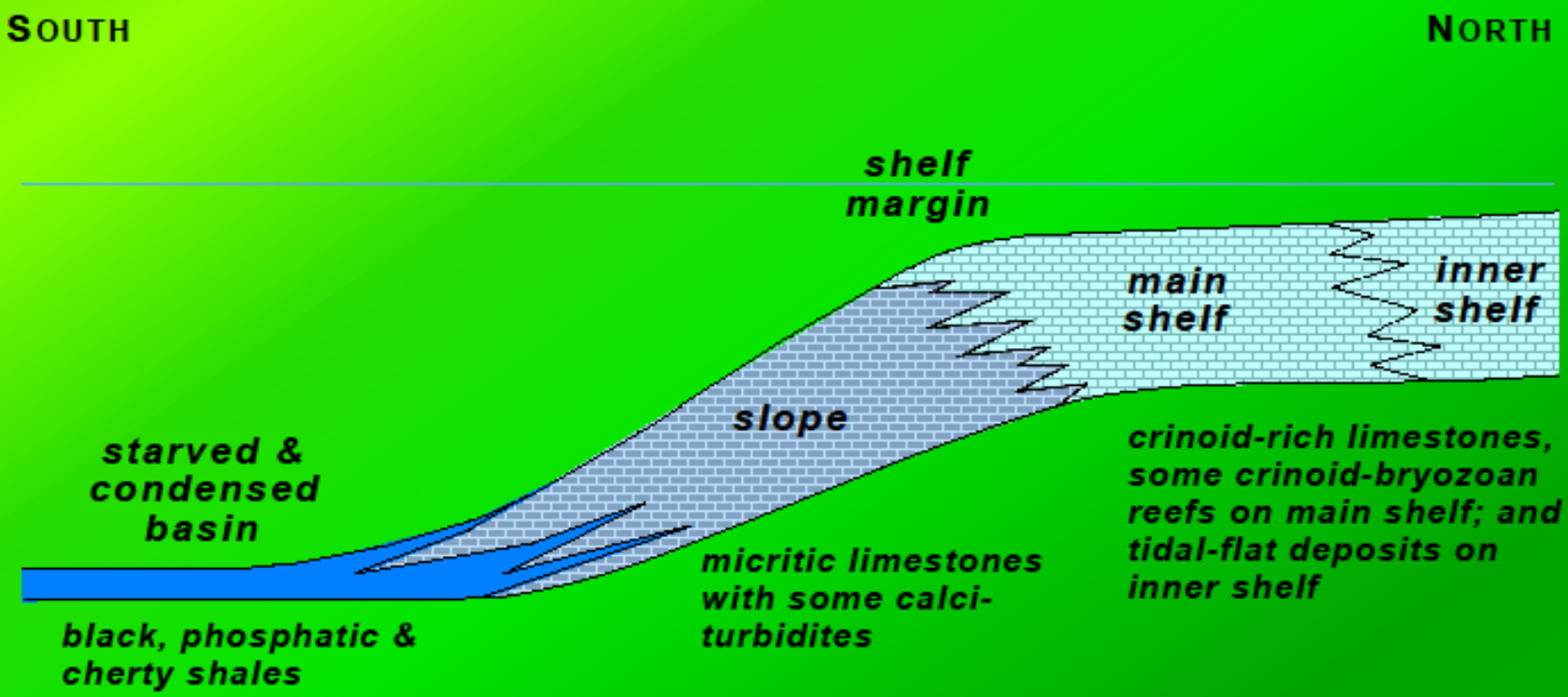
REVISED REGIONAL PALEOFACIES MODEL




Rush
Barton
Rice
McPherson
Marion
Chase
Lyon
Coffey
Franklin
Anderson
Miami
Linn
Pawnee
Stafford
Harvey
Reno
Greenwood
Woodson
Allen
Bourbon
Edwards
Butler
Sedgwick
Pratt
Kiowa
Kingman
Nemaha Ridge
Wilson
Neosho
Crawford
Barber
Harper
Sumner
Cowley
Montgomery
Labette
Cherokee
Comanche
Chautauqua
axis of Kanoka Ridge
Pratt Anticline
Woods
Alfalfa
Grant
Kay
Osage
Washington
Nowata
Craig
Ottawa
Woodward
Major
Garfield
Pawnee
Rogers
Mayes
Delaware
Tulsa
Payne
Dewey
Blaine
Kingfisher
Logan
Creek
Wagoner
Cherokee
Adair
Lincoln
Okmulgee
Muskogee
Custer
Canadian
Oklahoma
Sequoyah
South
North

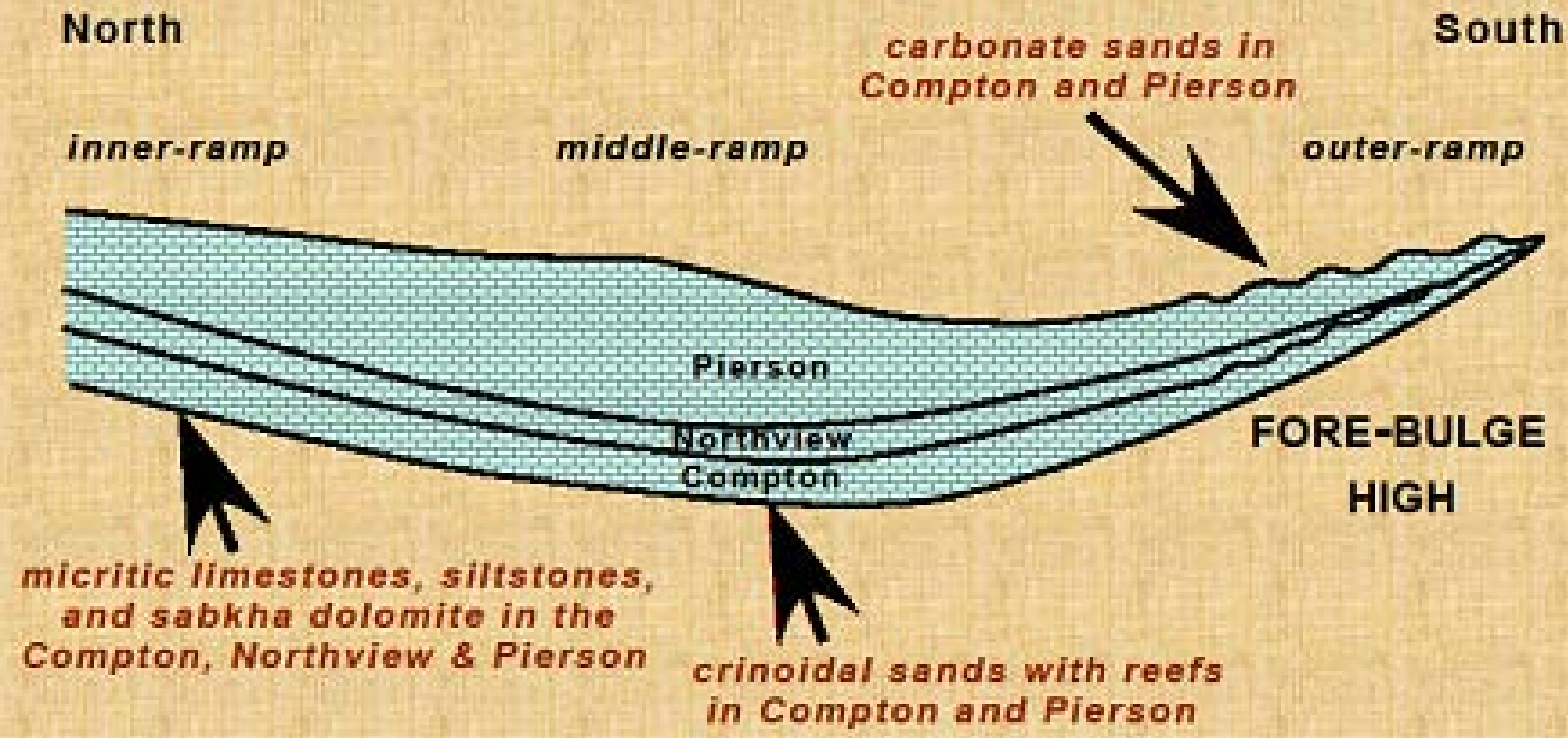
With faults

EXTANT DEPOSITIONAL MODEL

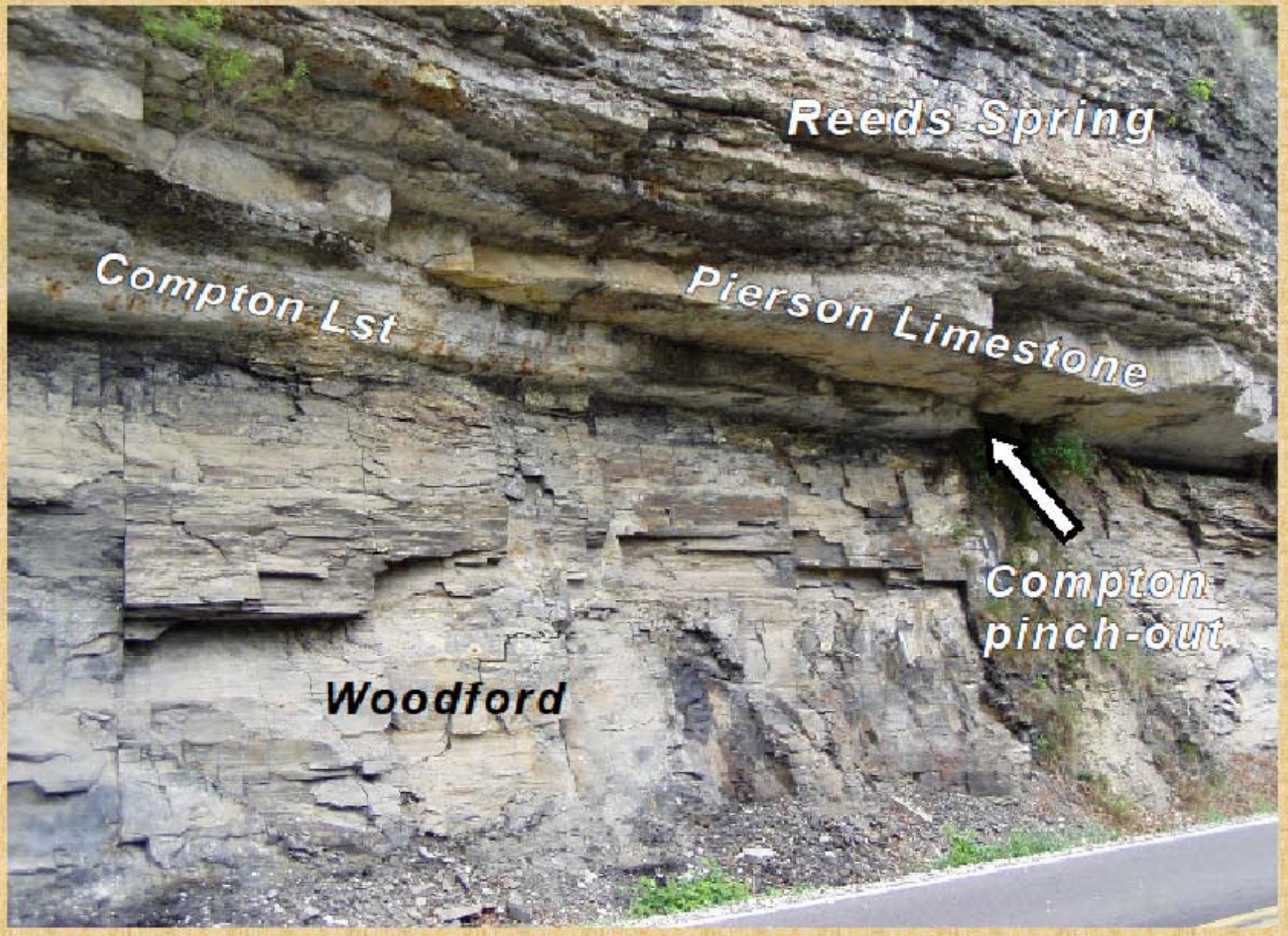


modified from Lane & DeKeyser (1980)

DOWN-DIP FACIES CHANGES

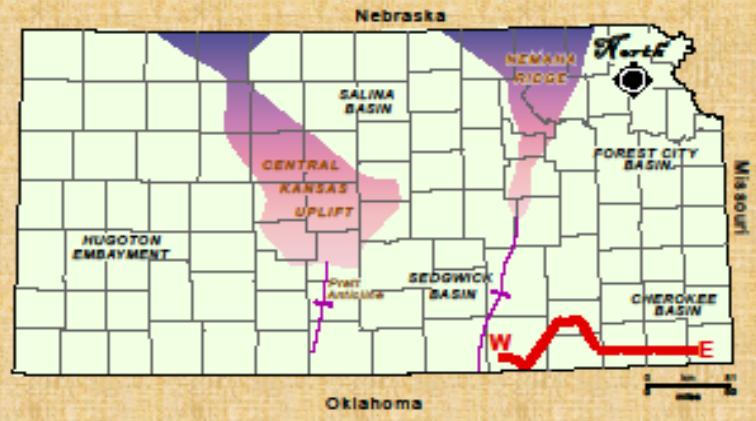


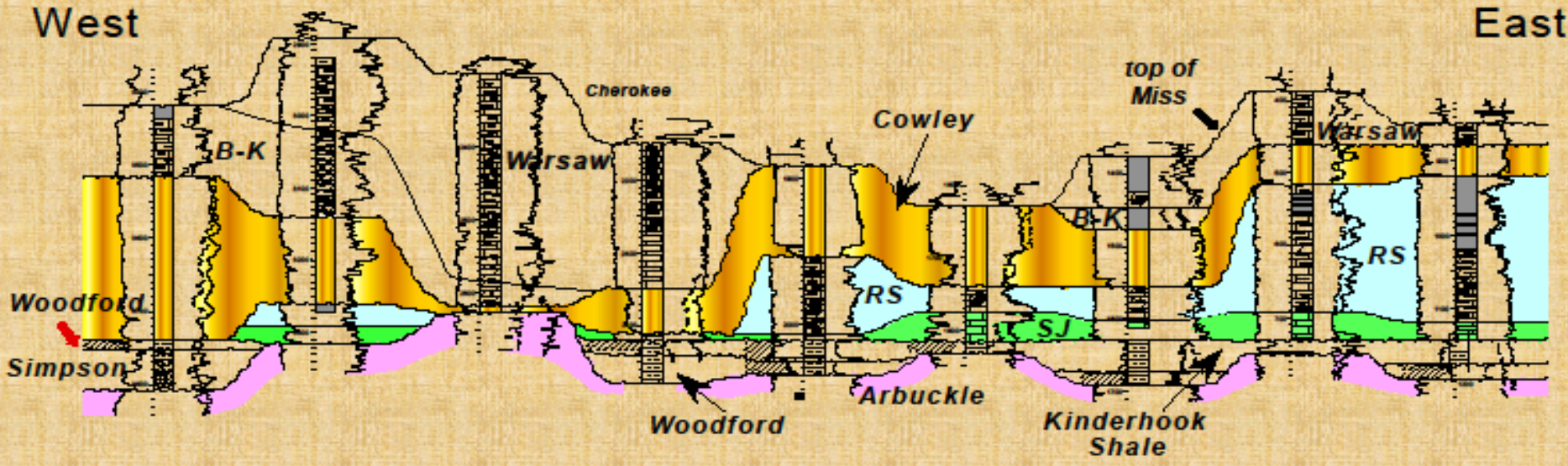
The Compton, Northview, and Pierson DO NOT thin southward into starved and condensed basinal facies. Rather, they maintain their shallow-water identity while thinning southward, eventually pinching out depositionally and erosionally against a fore-bulge high that existed during Kinderhookian to early Osagean time



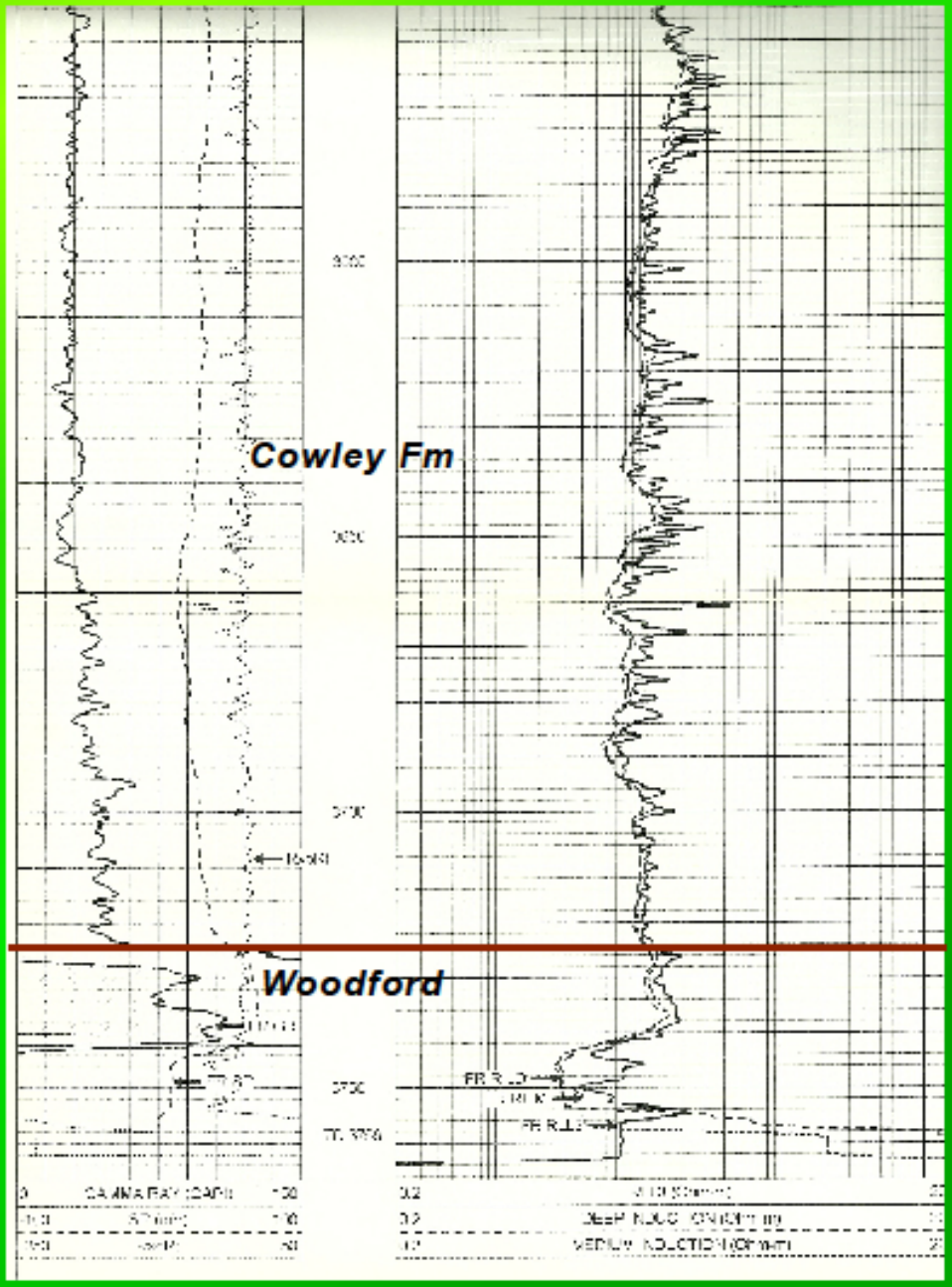
Thin St. Joe at No-Head Hollow

THIN COMPTON-NORTHVIEW-PIERSON SECTION





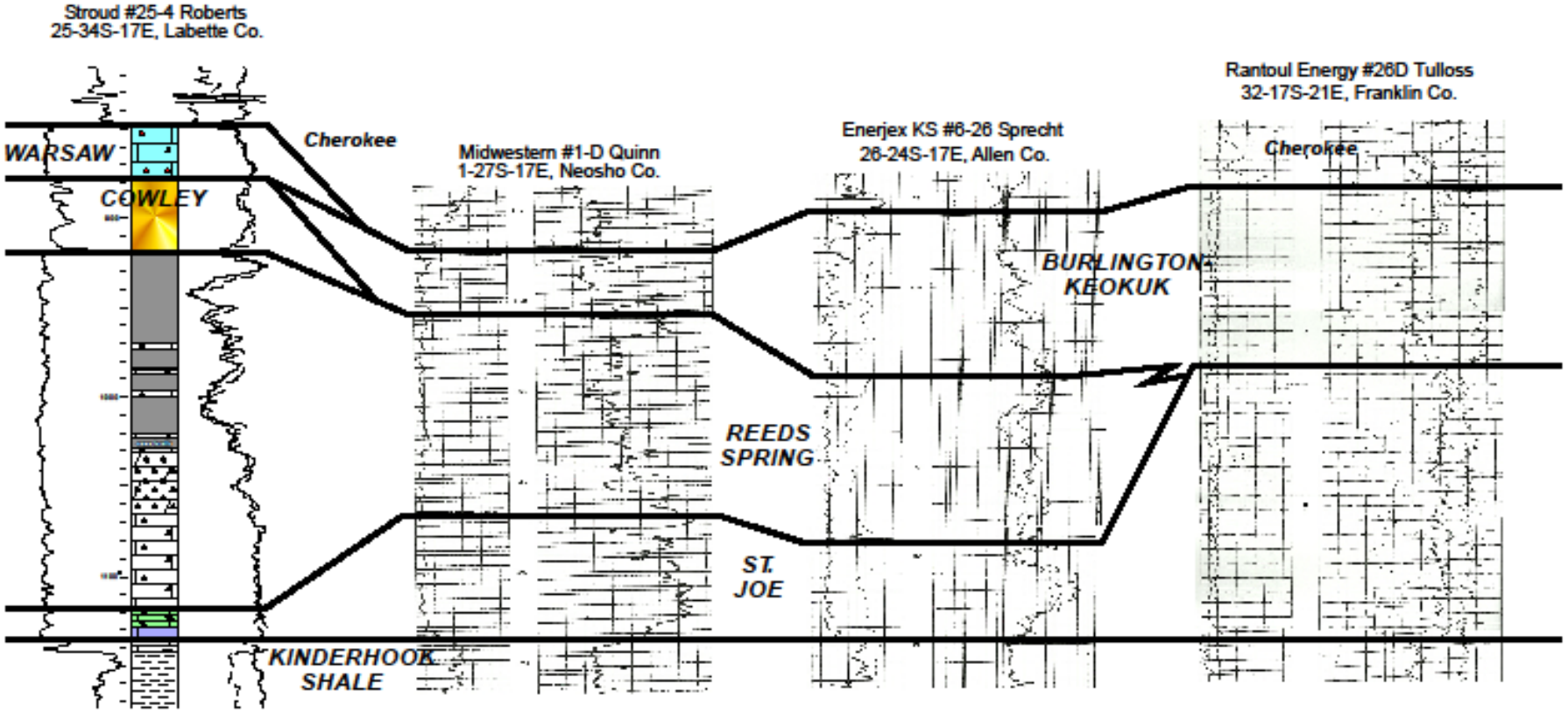
DIRECTLY ATOP THE KANOKA RIDGE (SO. COWLEY COUNTY)

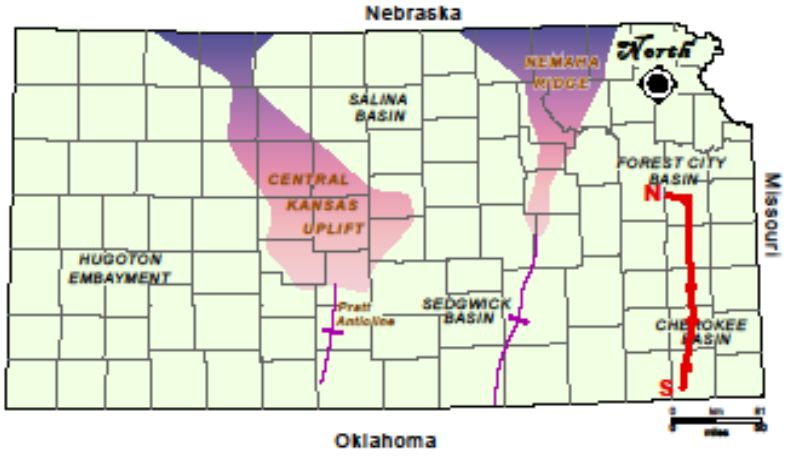


REGIONAL N-S STRATIGRAPHIC CHANGES

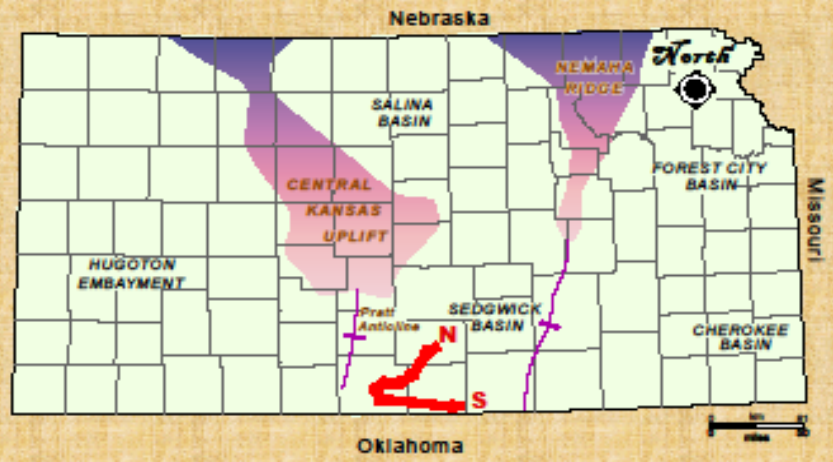
South

North



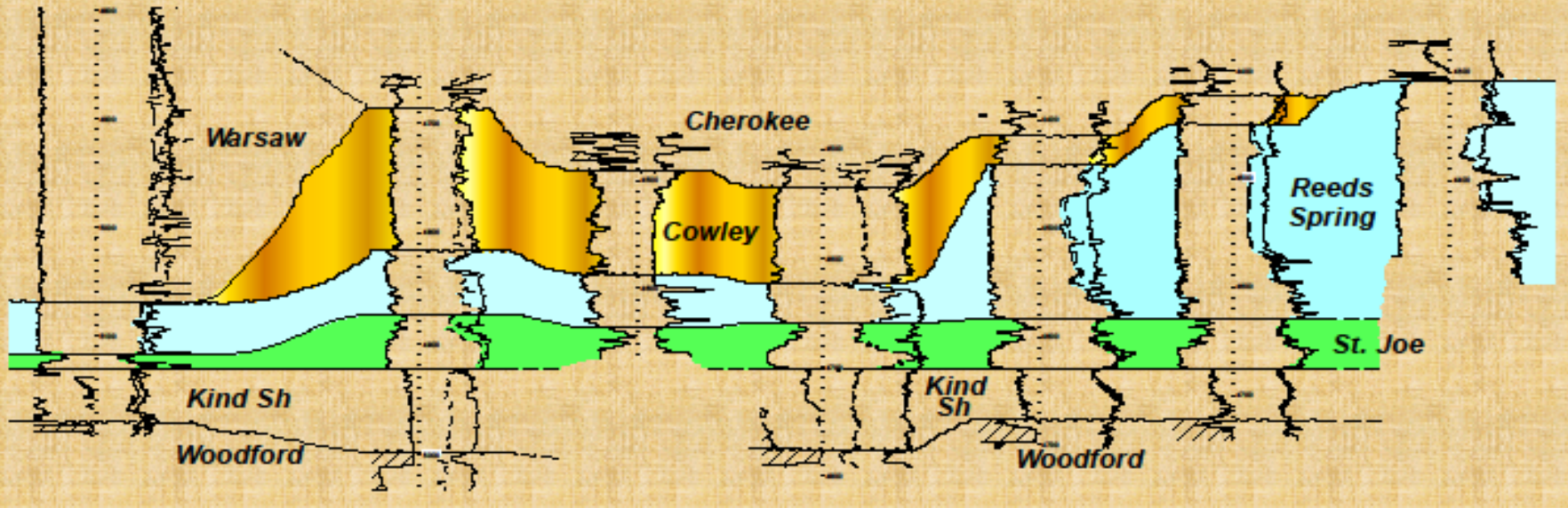


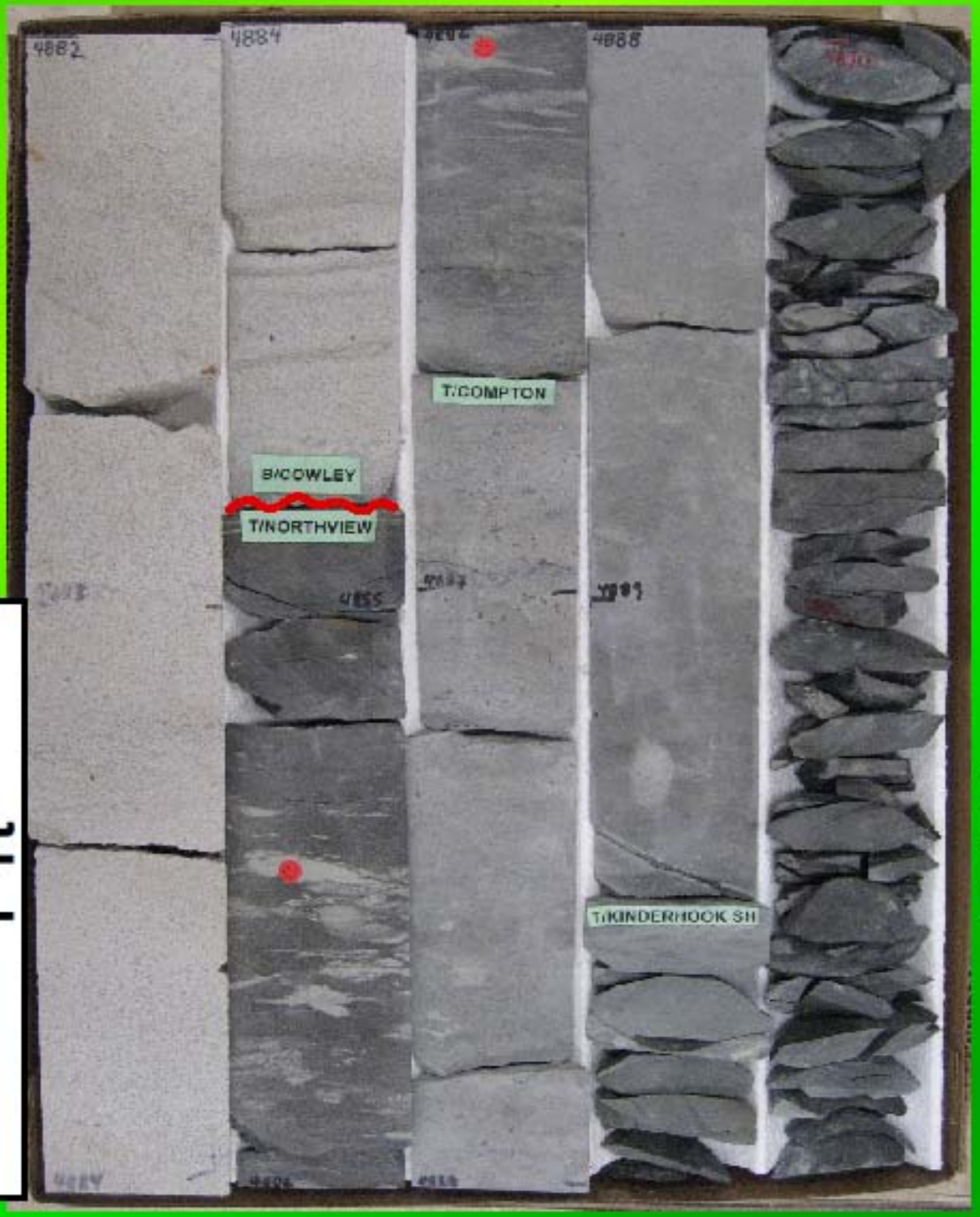
THIN COMPTON-NORTHVIEW-PIERSON SECTION



South

North





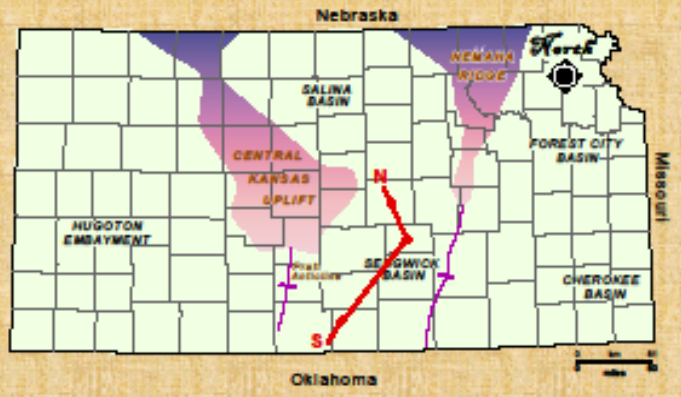
THIN ST. JOE GROUP (COMPTON AND NORTHVIEW FORMATIONS, TOTAL THICKNESS <5 FT), WITH PIERSON LIMESTONE ERODED.

HARPER COUNTY, KS

REGIONAL N-S STRATIGRAPHIC CHANGES

South

North



Harper Co.

Harvey Co.

McPherson Co.

Meramecian

Burlington-Keokuk Lst

Reeds Spring Fm

Cowley Fm

Pierson Lst

Northview Fm

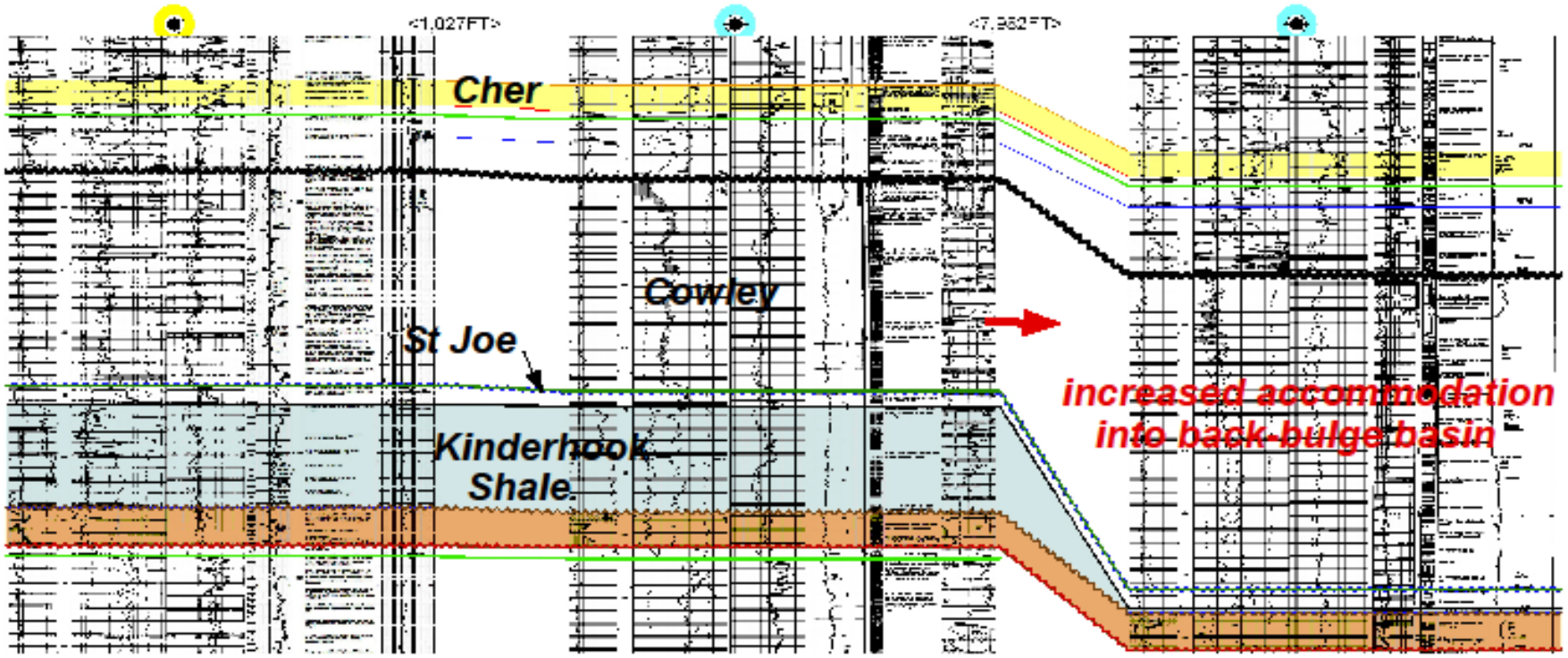
Compton Lst

thin Compton & Northview, Pierson Lst eroded

Kinderhook Shale

KANOKA RIDGE

INCREASED ACCOMMODATION TO NORTH



SOUTH

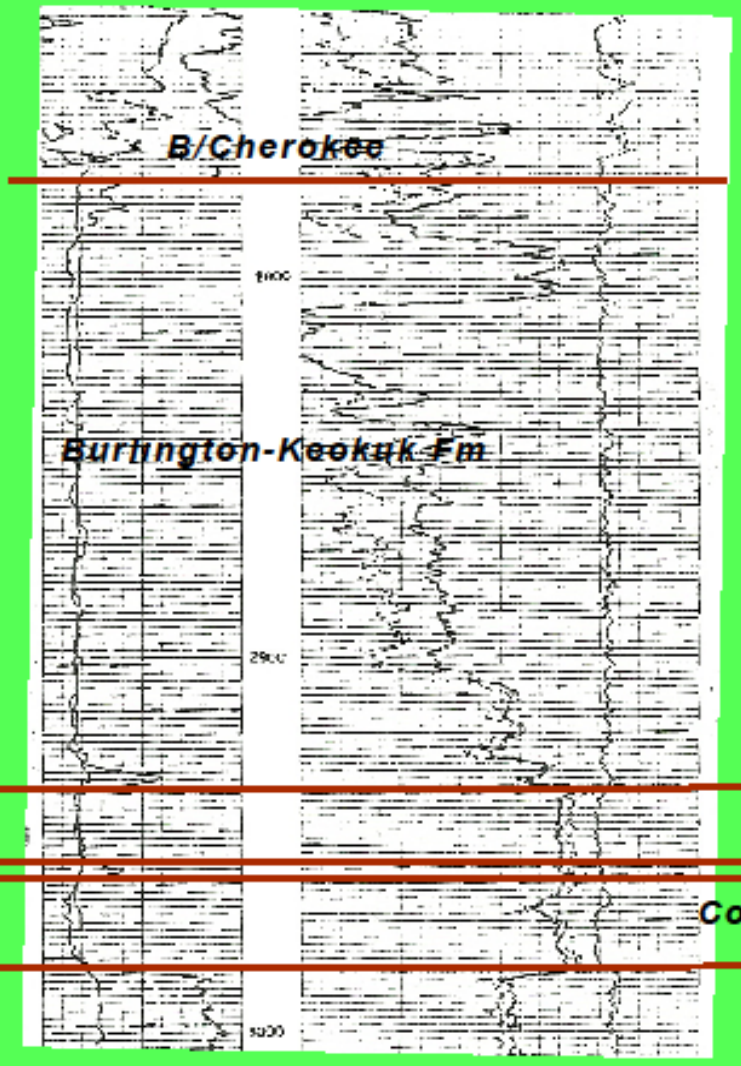
NORTH

WEST

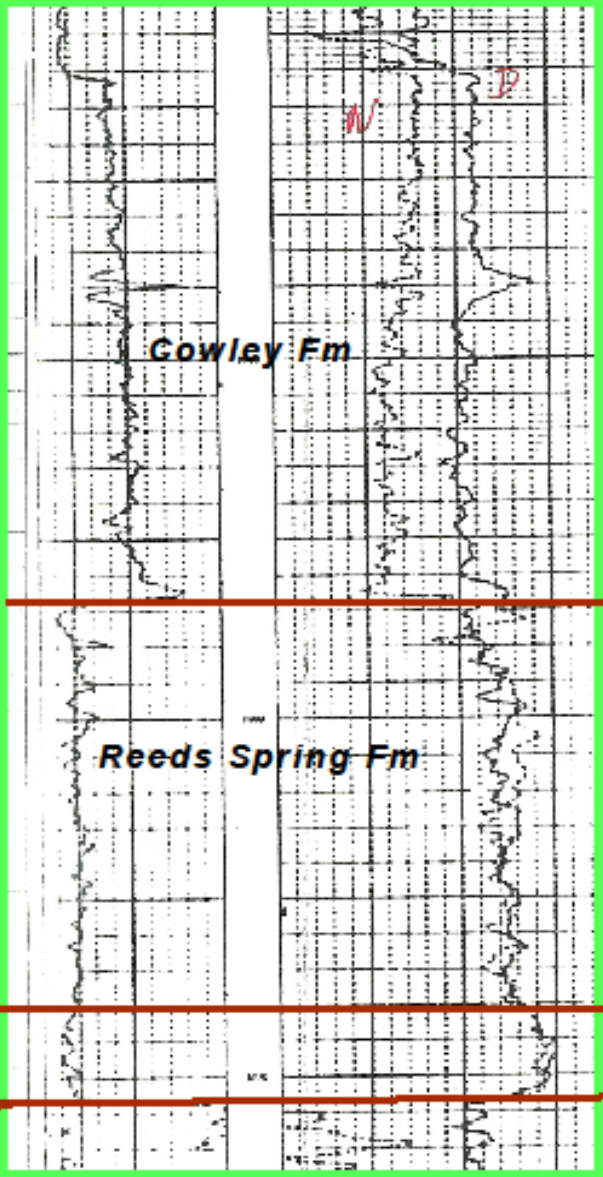
EAST

NEMAHA RIDGE (AND CKU) WERE POSITIVE FEATURES DURING THE KINDERHOOKIAN TO EARLY OSAGEAN

Marion County



Butler County



onlap

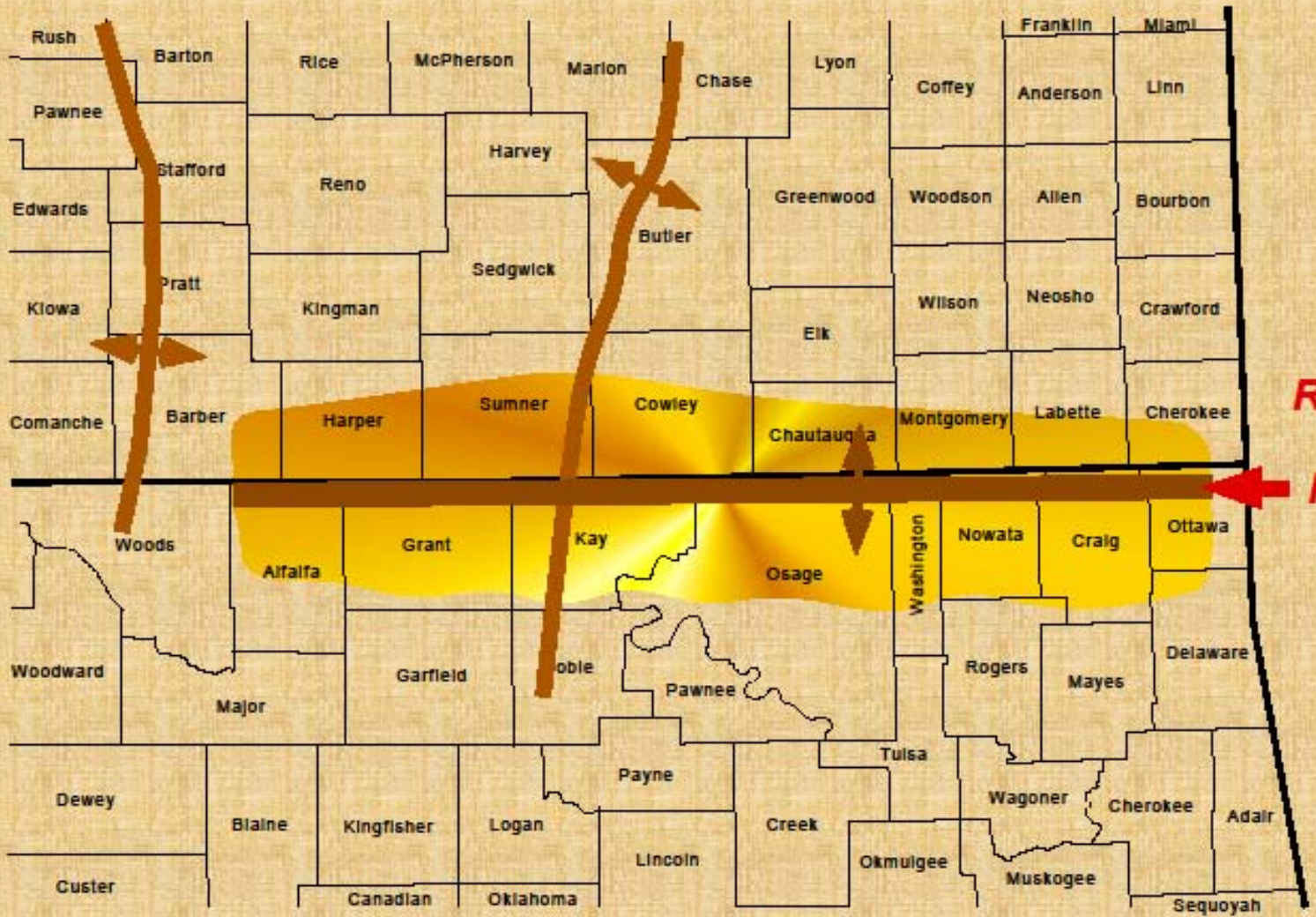
Pierson Lst

Northview Fm

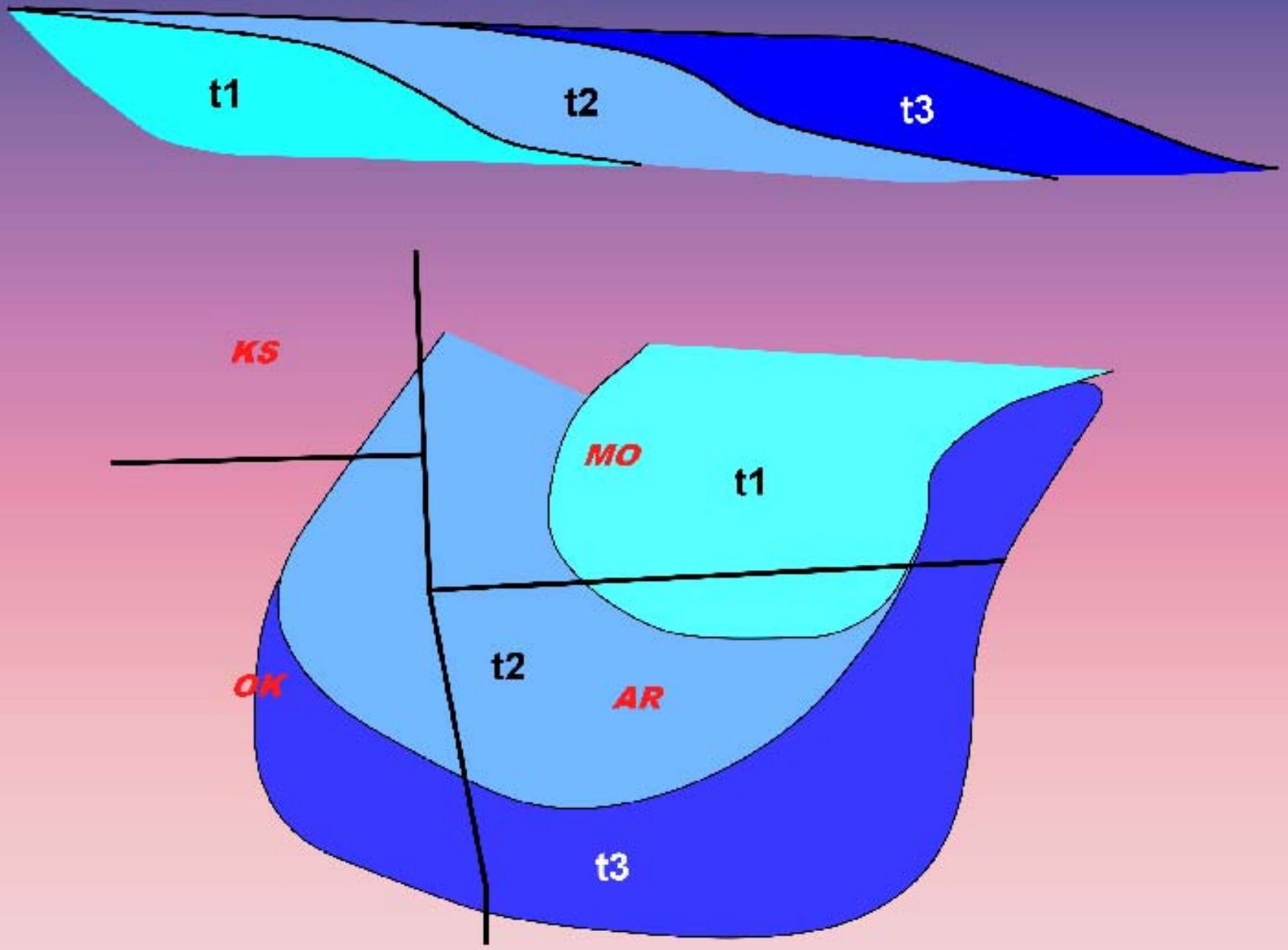
Compton Lst

Kinderhook Shale

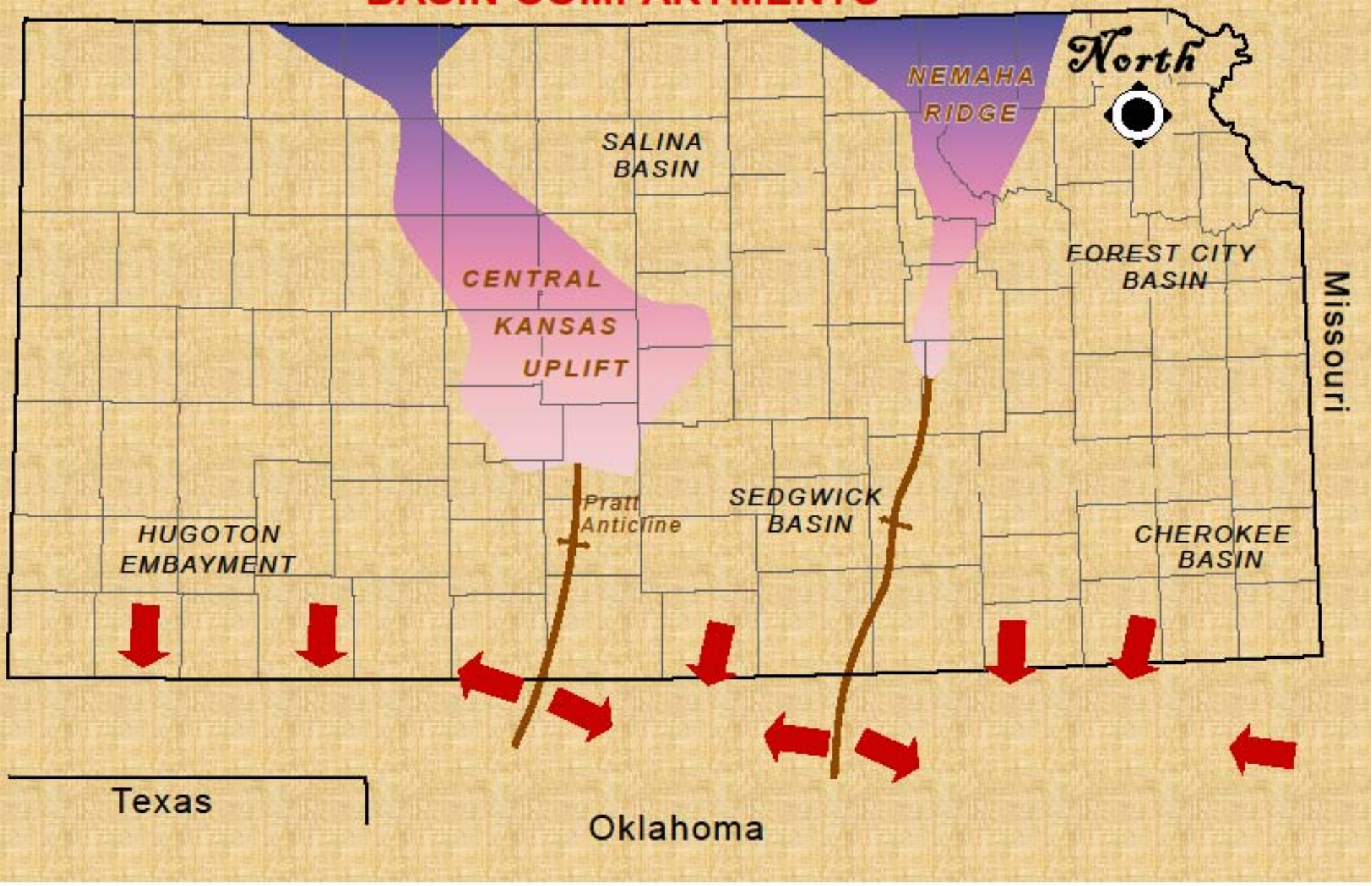
PLAYS ASSOCIATED WITH THE KANOKA RIDGE



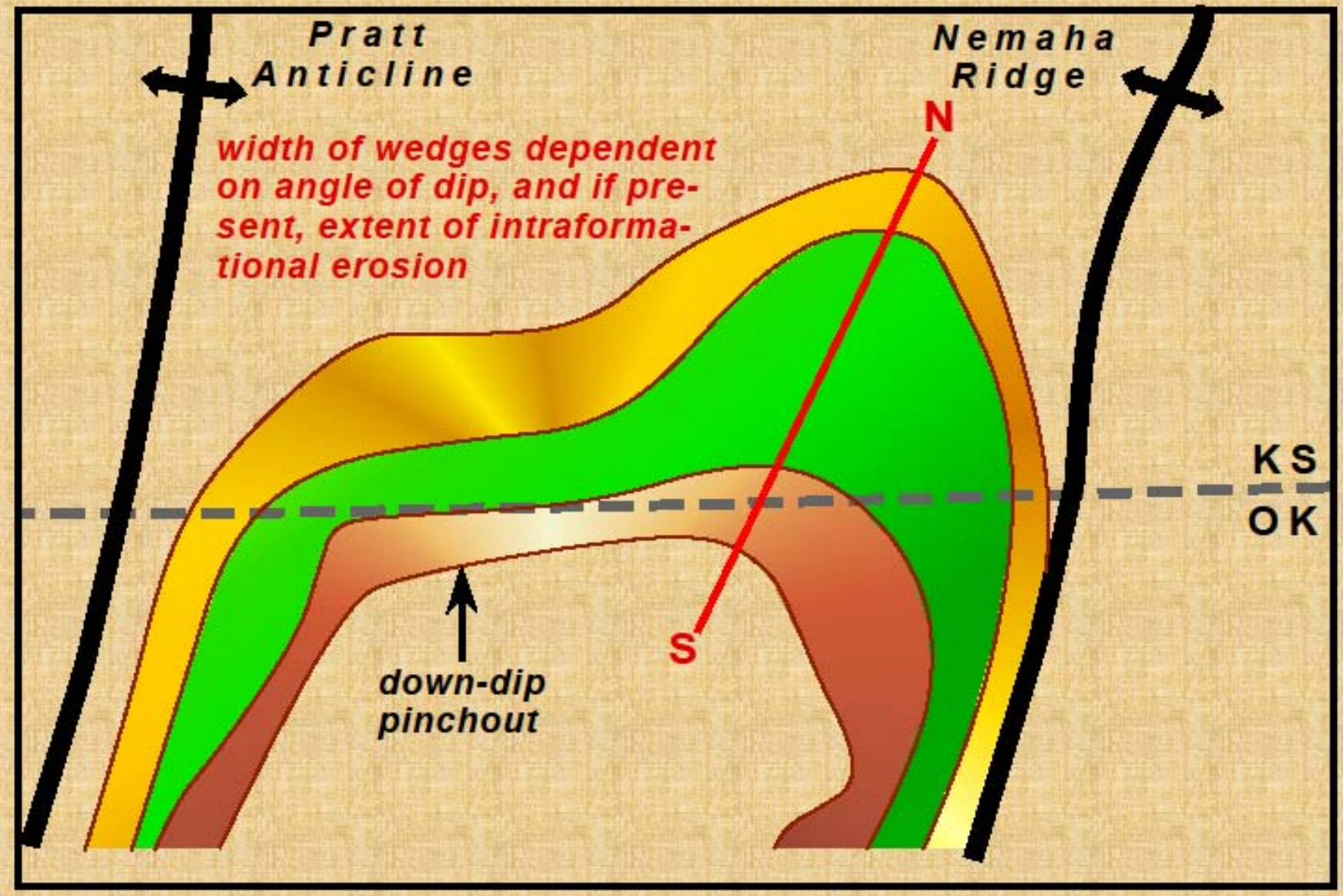
Reeds Spring tripolite, RS resource play, and the Cowley


t1
t2
t3
KS
MO
t1
t2
OK
AR
t3

DIRECTIONS OF REEDS SPRING AND COWLEY PROGRADATIONAL WEDGES -- THAT DEFINE "BASIN COMPARTMENTS"

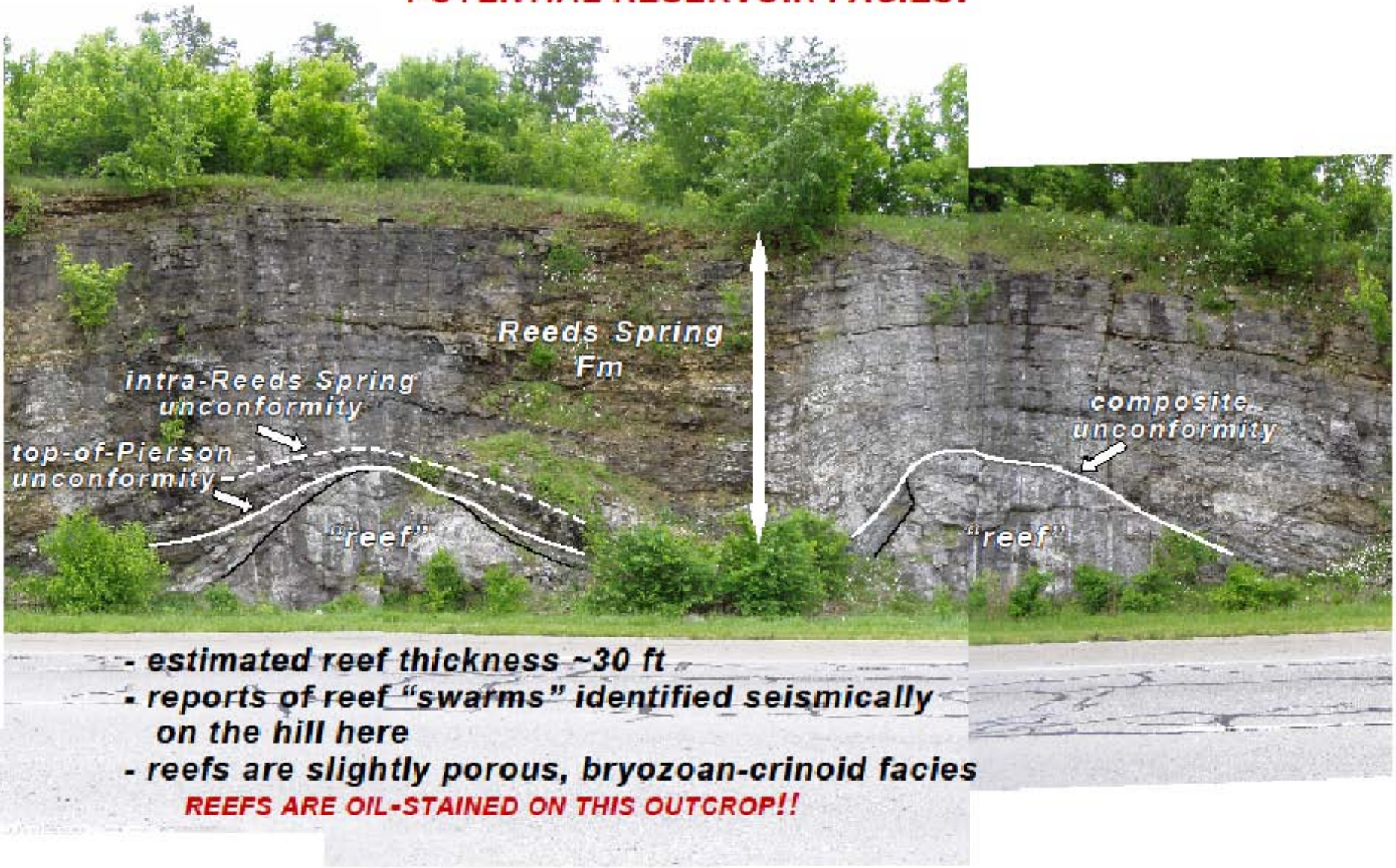


MAP VIEW OF INDIVIDUAL WEDGES (RESERVOIRS) IN THE REEDS SPRING OR COWLEY



PIERSON MID-RAMP REEFS

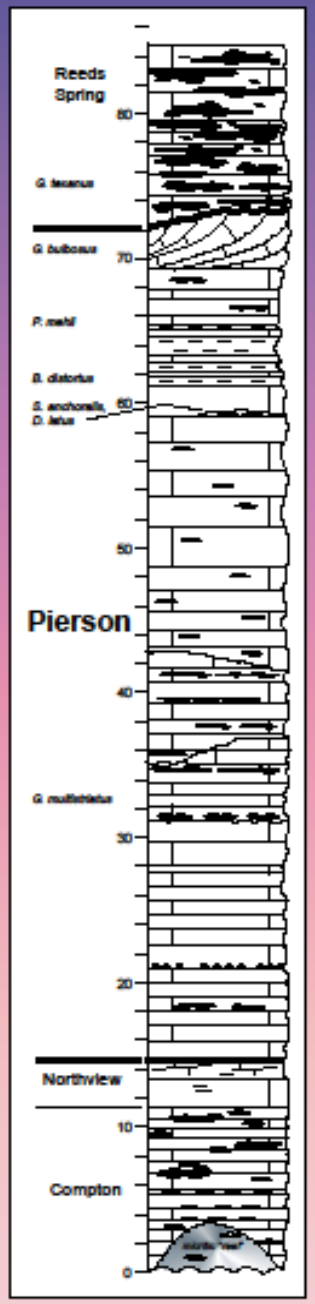
POTENTIAL RESERVOIR FACIES!



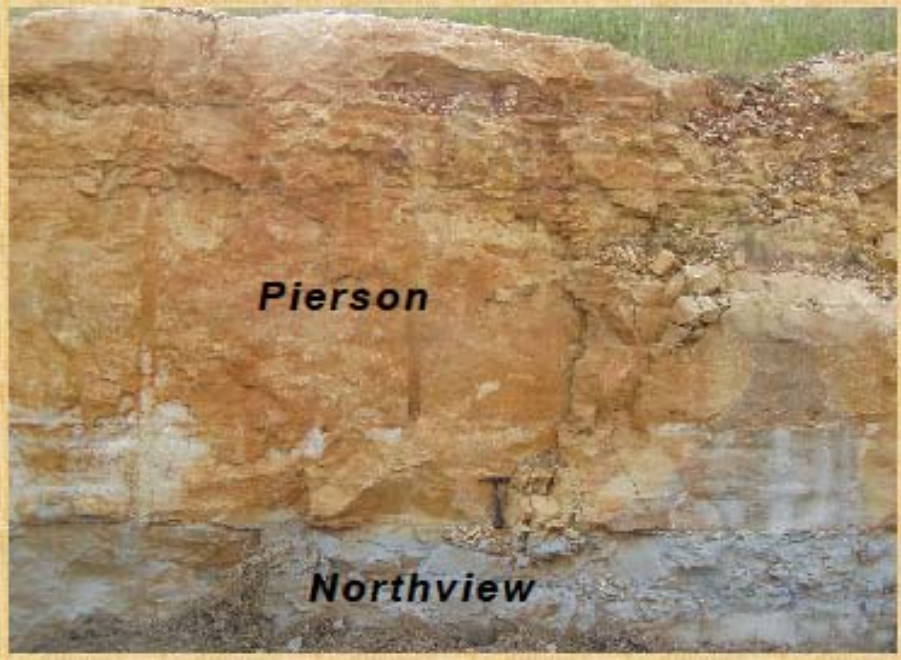
- estimated reef thickness ~30 ft
- reports of reef "swarms" identified seismically on the hill here
- reefs are slightly porous, bryozoan-crinoid facies

REEFS ARE OIL-STAINED ON THIS OUTCROP!!

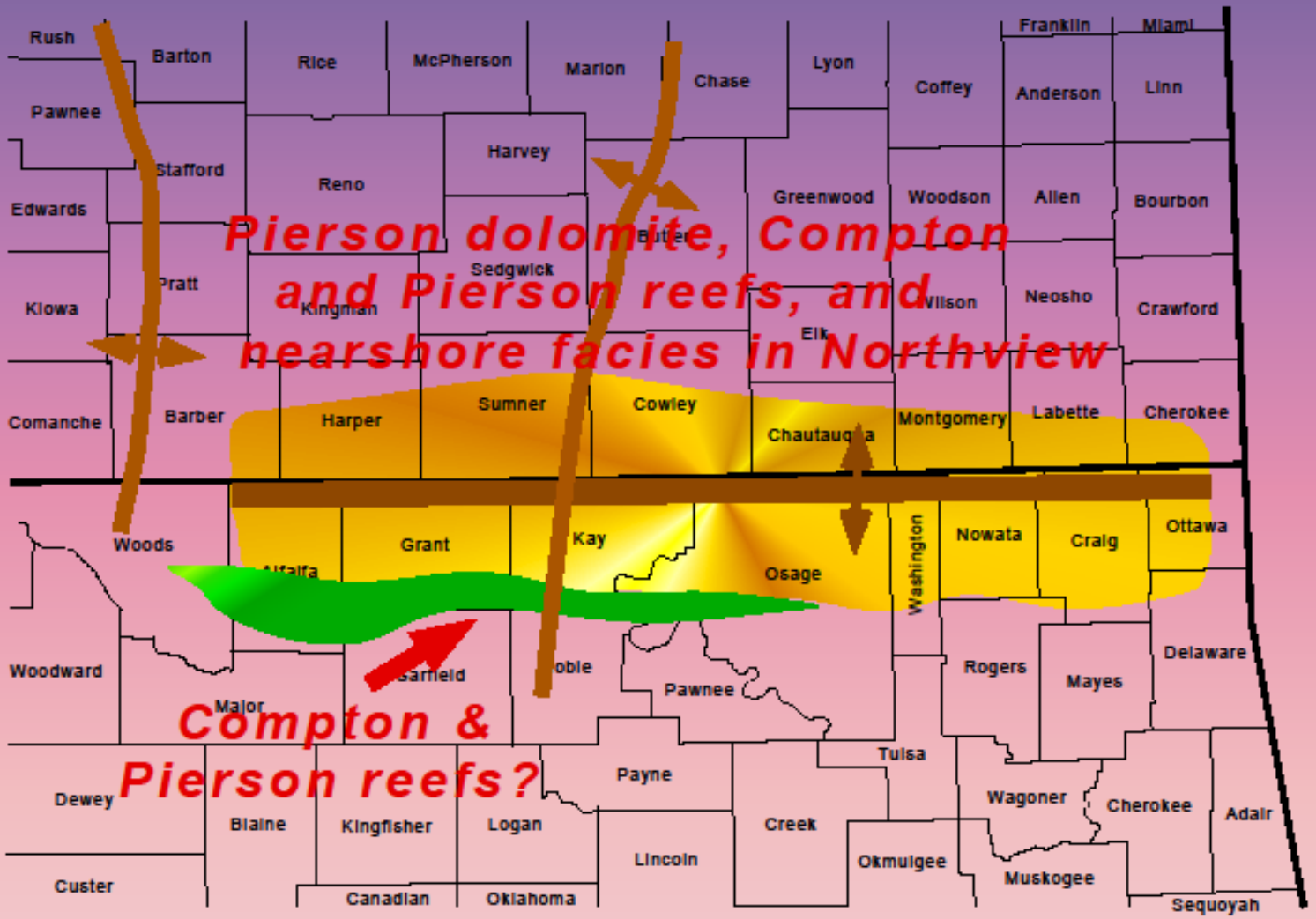
EROSION OF UPPER PIERSON ON LOCAL SYNDEPOSITIONAL HIGHS, HIGHWAY 71, SW MISSOURI



PIERSON FORMATION TO THE NORTH



- *in north part of study area, Pierson Fm is sandwiched between the Northview and Burlington-Keokuk formations*
- *thickness is ~13 ft*
- *the formation is very porous (RESERVOIR GRADE), medium crystalline dolomite with evidence of evaporites (sabkha facies overprinted on shallow-marine)*


Pierson dolomite, Compton and Pierson reefs, and nearshore facies in Northview
Compton & Pierson reefs?
Rush
Barton
Rice
McPherson
Marion
Chase
Lyon
Coffey
Franklin
Miami
Anderson
Linn
Pawnee
Stafford
Harvey
Reno
Greenwood
Woodson
Allen
Bourbon
Edwards
Butler
Sedgwick
Pratt
Kiowa
Kingman
Wilson
Neosho
Crawford
Elk
Comanche
Barber
Harper
Sumner
Cowley
Chautauqua
Montgomery
Labette
Cherokee
Woods
Grant
Kay
Osage
Washington
Nowata
Craig
Ottawa
Alfalfa
Woodward
Garfield
Pawnee
Rogers
Mayes
Delaware
Major
Tulsa
Payne
Dewey
Blaine
Kingfisher
Logan
Creek
Wagoner
Cherokee
Adair
Lincoln
Okmulgee
Muskogee
Custer
Canadian
Oklahoma
Sequoyah

CONCLUSIONS

- THERE IS CLEAR STRATIGRAPHIC EVIDENCE OF THE EXISTENCE OF THE KANOKA RIDGE DURING THE LATE KINDERHOOKIAN TO EARLY OSAGEAN
- THIS RIDGE, AND THE NEMAHA UPLIFT AND PRATT ANTICLINE-CENTRAL KANSAS UPLIFT, WERE POSITIVE FEATURES DURING THE LATE KINDER-HOOKIAN TO EARLY OSAGEAN
- THESE POSITIVE FEATURES CONTROL THE EXTENT OF SEVERAL MISSISSIPPIAN PLAYS IN KANSAS AND NORTHERN OKLAHOMA