Outcrop to Subsurface Linkages, Canyon and Cisco Groups, Eastern Shelf of the Permian Basin*

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Abstract

Coastal-plain, incised-valley, shelf, and shelf-edge depositional facies in the Missourian Canyon Group and Virgilian-Wolfcampian Cisco Group are well documented in outcrops in north Texas. This study links outcrops in this stratigraphic succession to subsurface slope and basin-floor systems in a ~12,000 mi^2 (~31,000 km^2) area in the southern part of the Eastern Shelf of the Permian Basin.

The Canyon Group (base Palo Pinto Limestone to top Home Creek Limestone) is mostly an aggradational, carbonate-bank succession with locally prominent reef facies. The bank/reef interval, age-equivalent to the Horseshoe reef complex, is as much as 1,540 feet (~470 m) thick in northeastern Coke County and forms an irregular shelf margin. Reef buildups also occur in local pinnacles on the platform. Canyon basin-floor facies are equivalent to the lower part of the Cline Shale ("Wolfcamp D") and are dark, organic-rich (>2% TOC) mudrocks. The Cisco section consists of a cyclic series of thirteen mudrock, limestone, and sandstone facies (top of the Home Creek to top Coleman Junction Limestone). It forms a progradational succession from the eastern edge (Bunger Limestone) to the central part of the study area (Coleman Junction Limestone). The top of the Home Creek Limestone coincides with a regional downlap surface for progradational lower Cisco shelf strata. Progressive upward decrease in height of shelf-margin clinoforms indicates that accommodation decreased in the upper Cisco Group.

The Pennsylvanian-Permian (Virgilian-Wolfcampian) boundary is at the top of the Cline Shale in the basin and slope, occurring onshelf above the Crystal Falls Limestone. The Wolfcampian section is ~700 to 850 feet (~210 to 260 m) thick on the shelf and expands basinward to 3,500 feet (~1,070 m) thick into a "foredeep" area. However, it is thinner in the deeper part of the basin (<500 feet [<152 m]). Slope facies closest to Virgilian and lower Wolfcampian shelf margins are mostly siliciclastic mudrocks and sandy turbidites. The Wolfcampian (upper Cisco) Basin system to the west comprises (1) siliciclastic, thin turbidites and hemipelagic mudrocks in the lower Wolfcampian, and (2) carbonate debris-flow deposits and turbidites in the upper part. In contrast, the Virgilian (lower Cisco) Basin succession constitutes organic-rich mudrocks of the upper Cline Shale.

References Cited

Brown, L.F., Jr., R.F. Solis Iriarte, and D.A. Johns, 1990, Regional depositional systems tracts, paleogeography, and sequence stratigraphy, Upper Pennsylvanian and Lower Permian strata, north- and west-central Texas: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 197, 116 p. + oversized plates.

Brown, L.F., Jr., W.A. Ambrose, and D.L. Carr, 2009, Supplement to Guidebook 14: The University of Texas at Austin, Bureau of Economic Geology, 34 p.

Dutton, S.P., W.A. Flanders, and M.D. Barton, 2003, Reservoir characterization of a Permian deep-water sandstone, East Ford field, Delaware basin, Texas: AAPG Bulletin, v. 87, p. 609-627.

Palacios, F.C.A., 2018, Stratigraphic framework and incised-valley systems (Lower Hope Sandstone) of the Upper Pennsylvanian Lower Cisco Group, southern Eastern Shelf of the Permian Basin, West Texas: M.S. Thesis, The University of Texas at Austin, 97 p.

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Southwest Section AAPG

April 9, 2019

THE UNIVERSITY OF TEXAS AT AUSTIN
JACKSON SCHOOL OF GEOSCIENCES

BUREAU OF ECONOMIC GEOLOGY

PROJECT STARR
STATE OF TEXAS ADVANCED OIL AND GAS RESOURCE RECOVERY

Eastern Shelf Permian Basin

Highlights

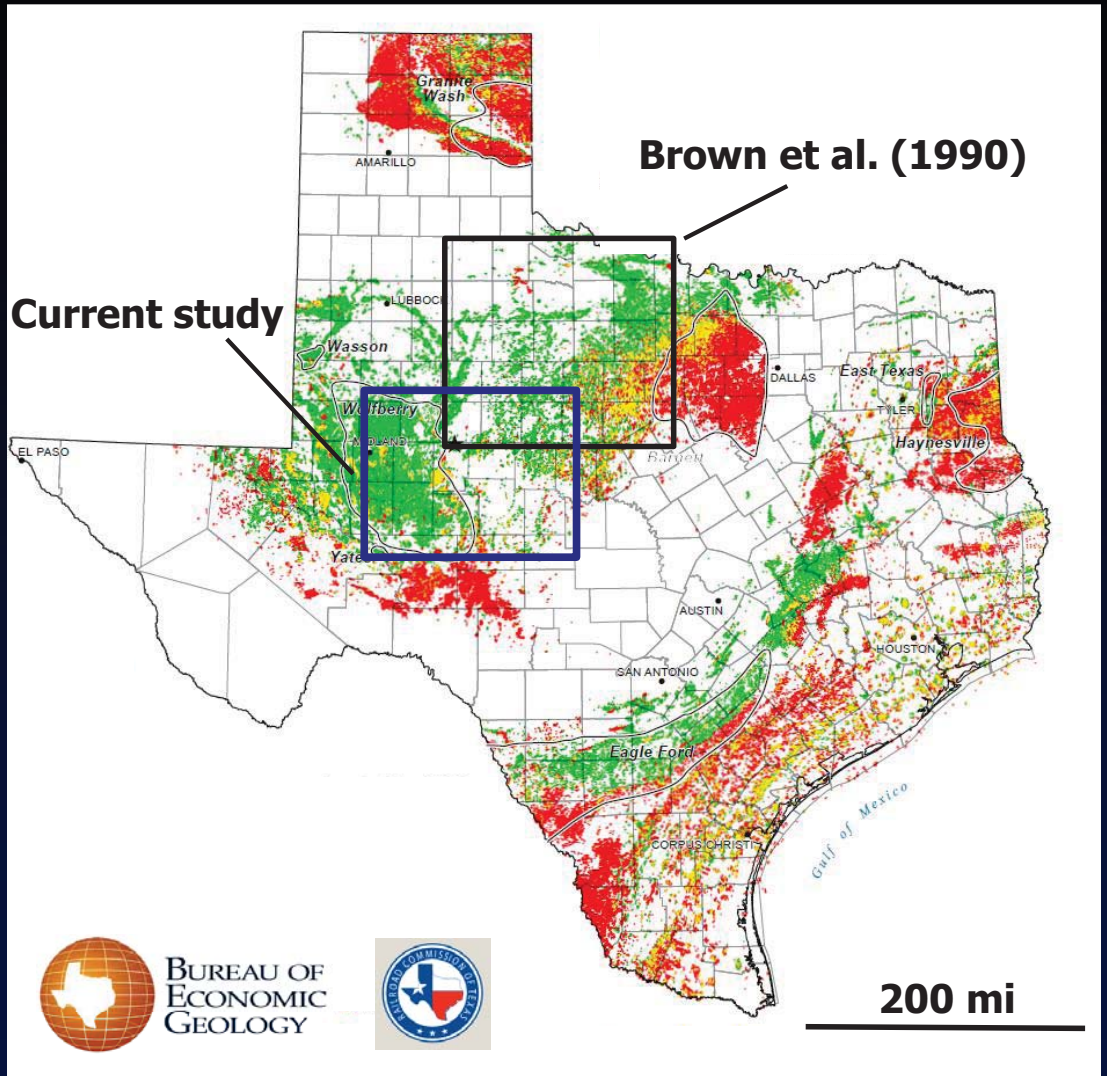
Southern extension of Brown et al. (1990)

15,500 mi² study area

Wolfcamp Fm., Canyon and Cisco Groups

Stratigraphy and Sedimentation

~2,250 wells
8 whole cores (490 ft.)
Selected 2-D lines



Stratigraphic Column

Carbonate Sandstone

500 MMbbl >2 Tcf

Wolfcamp[3]

Coleman Junction

Sedwick

Dothan

Moutray

Stockwether

Tannehill

Flippen

Cook

Cisco[2]

Crystal Falls

Breckenridge

B. Ranch

L. Hope

Ivan

Swastika

Gunsight

McMillan

Bunger

Home Creek

Winchell

Palo Pinto

Crosscut

Canyon[1]

Strawn

500 ft

>50 MMbbl 0.2 Tcf

>400 MMbbl <2 Tcf

Permian

Pennsylvanian

Virgilian

Missourian

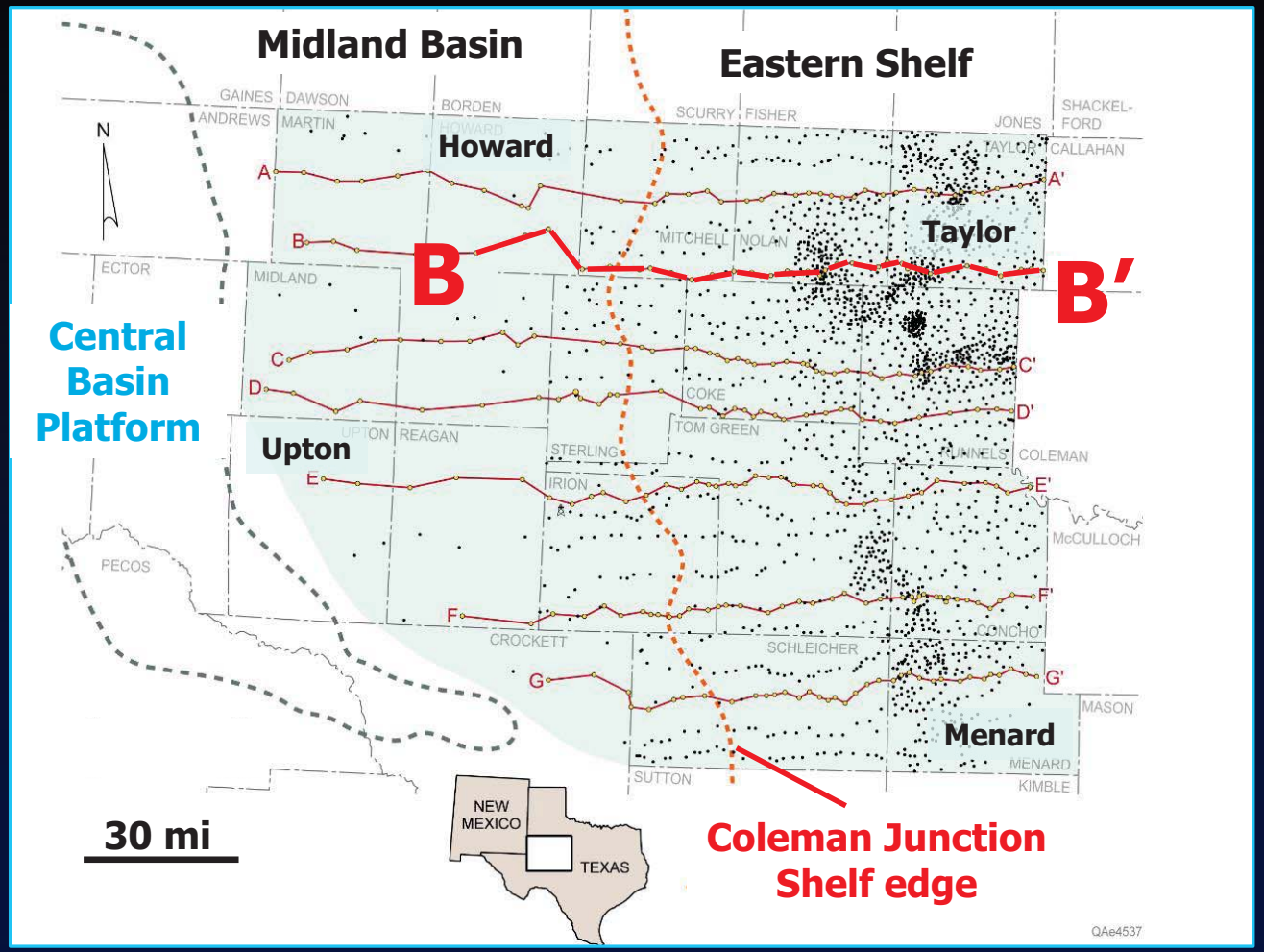
Top Pennsylvanian

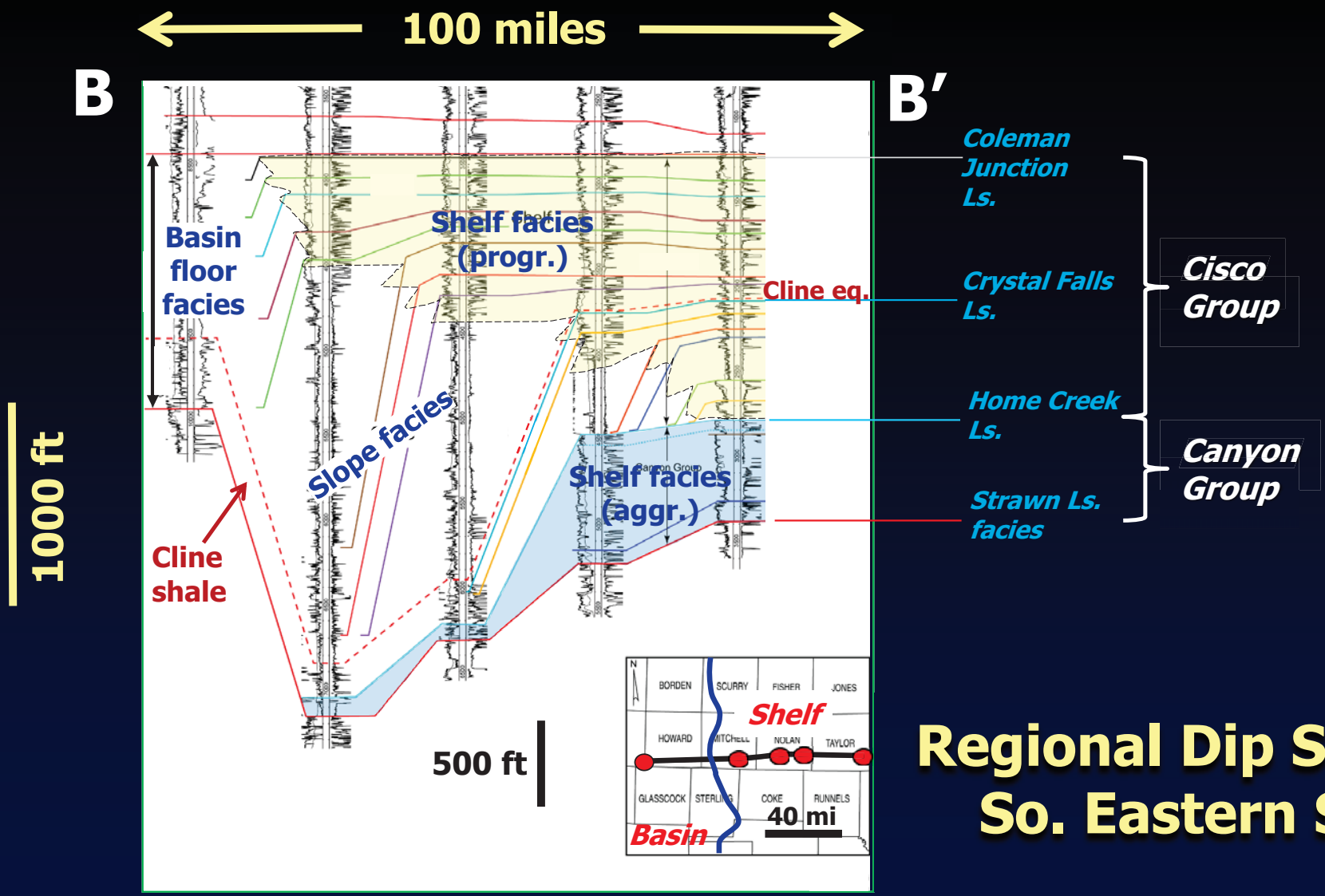
3. Incised-valley, slope, and basin

2. Incised-valley, deltaic, and slope

1. Carbonate shelf, reef

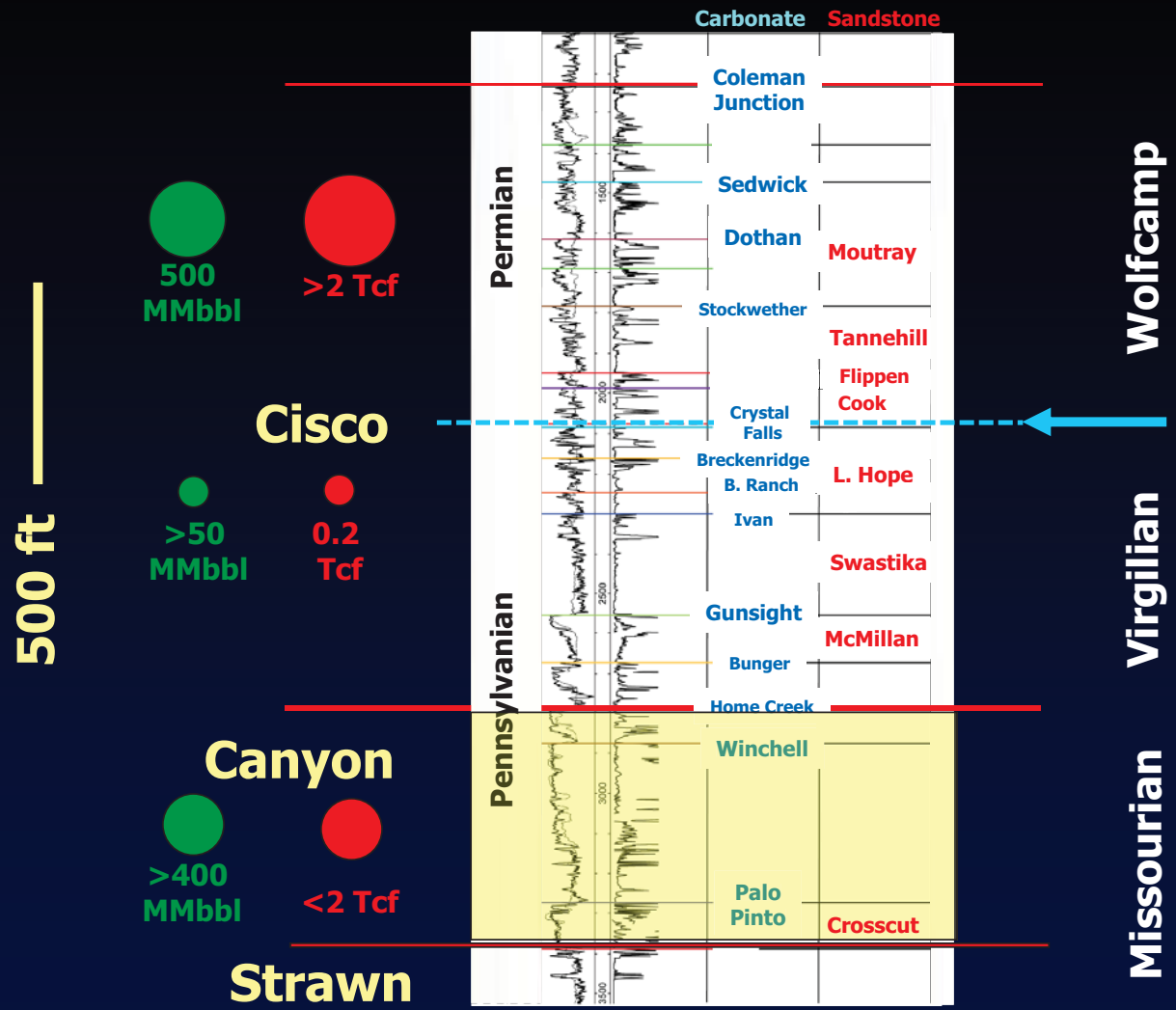
Well Control and Cross Section Grid





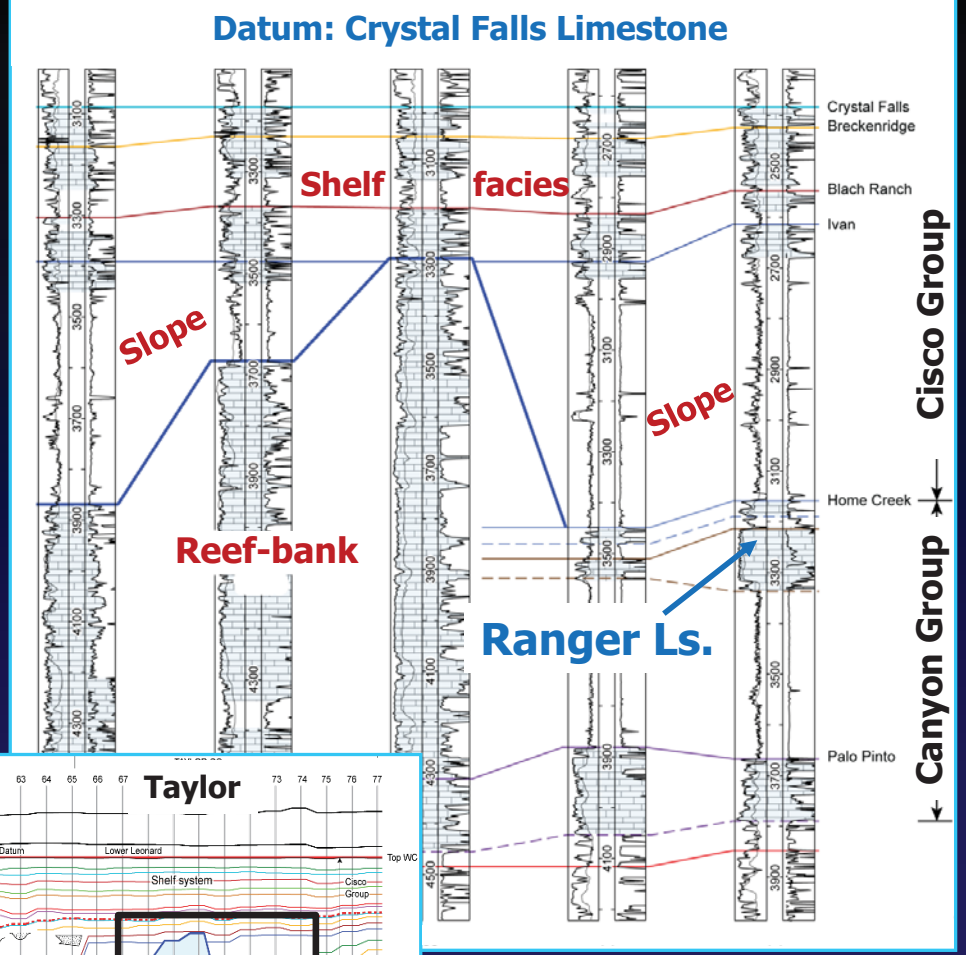
Regional Dip Section: So. Eastern Shelf

Canyon Group



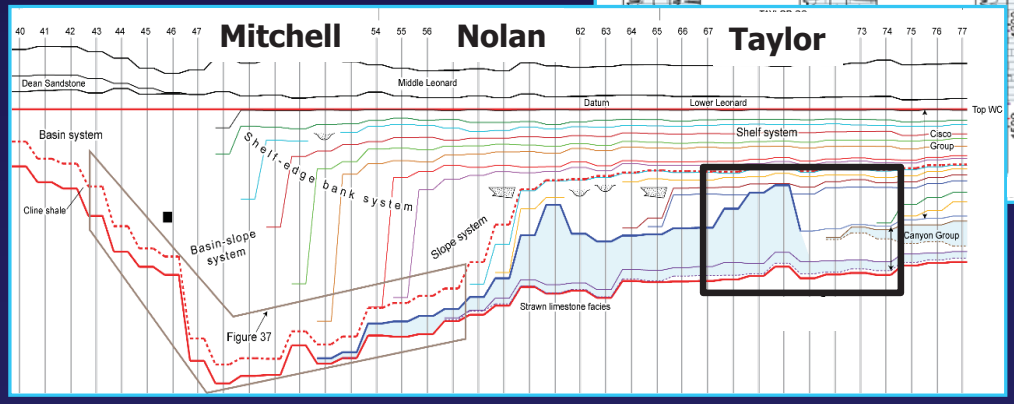
Carbonate Reef-bank system

Canyon-Cisco



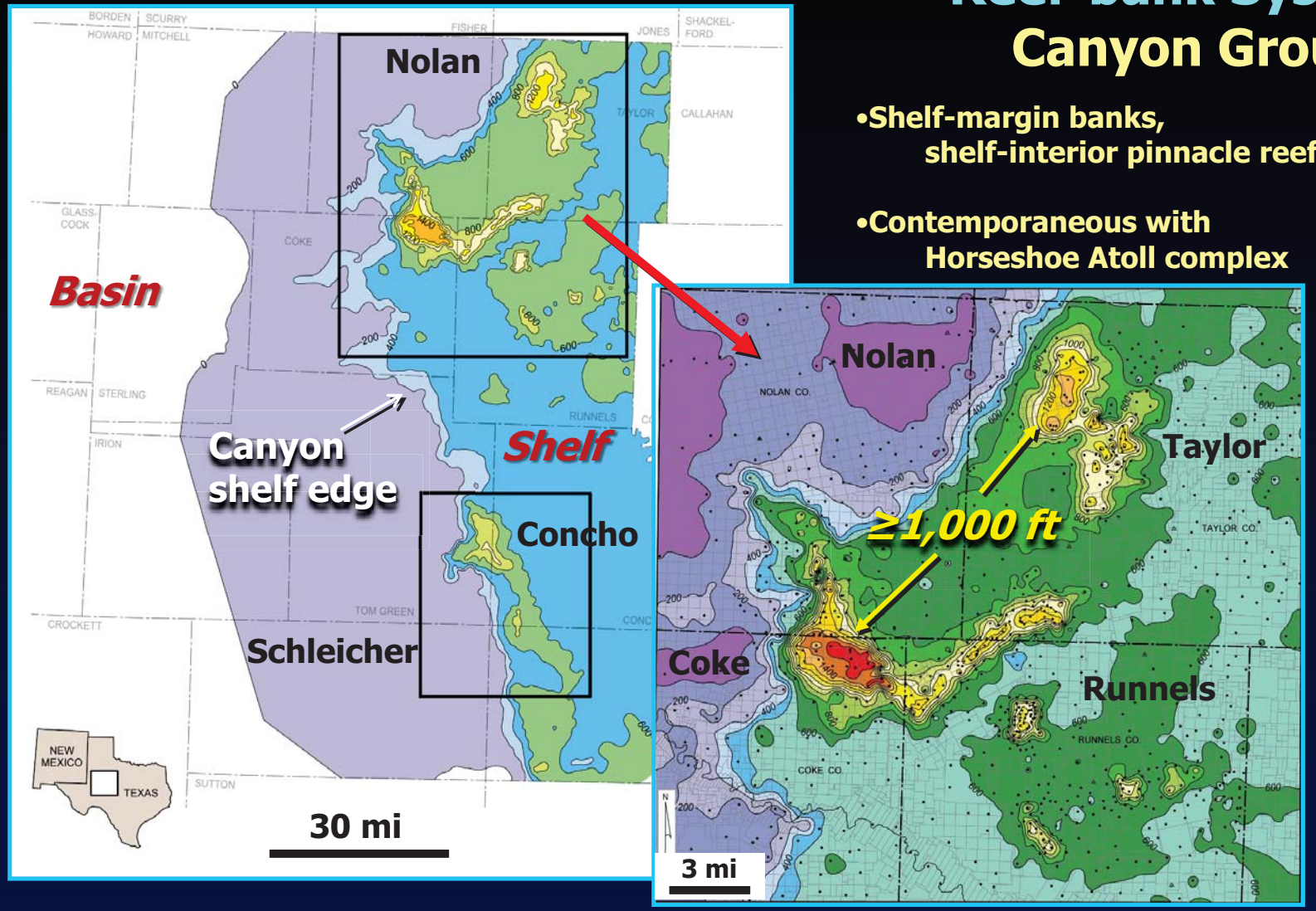
20-mile section

140-mile section



Reef-bank System: Canyon Group

- Shelf-margin banks, shelf-interior pinnacle reefs
- Contemporaneous with Horseshoe Atoll complex



Ranger Limestone
Canyon Group: Young County

Brown et al. (2009)

Ranger Limestone
Outcrop Detail

Brown et al. (2009)

Ranger Limestone

Algal plates

Brown et al. (2009)

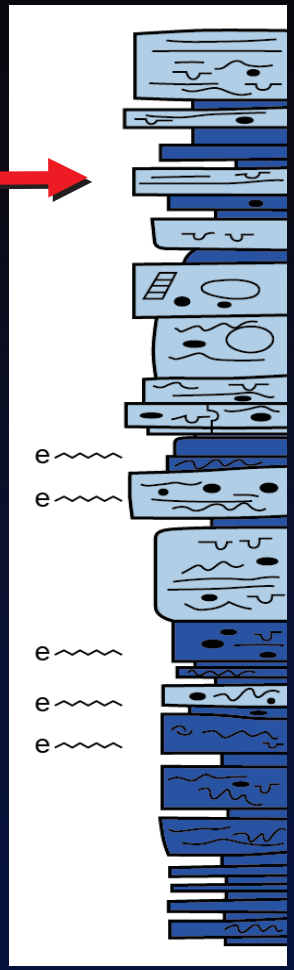
Ranger Limestone: Eastland County

Muddy Carbonate Ramp

Traction current deposits

2 inches

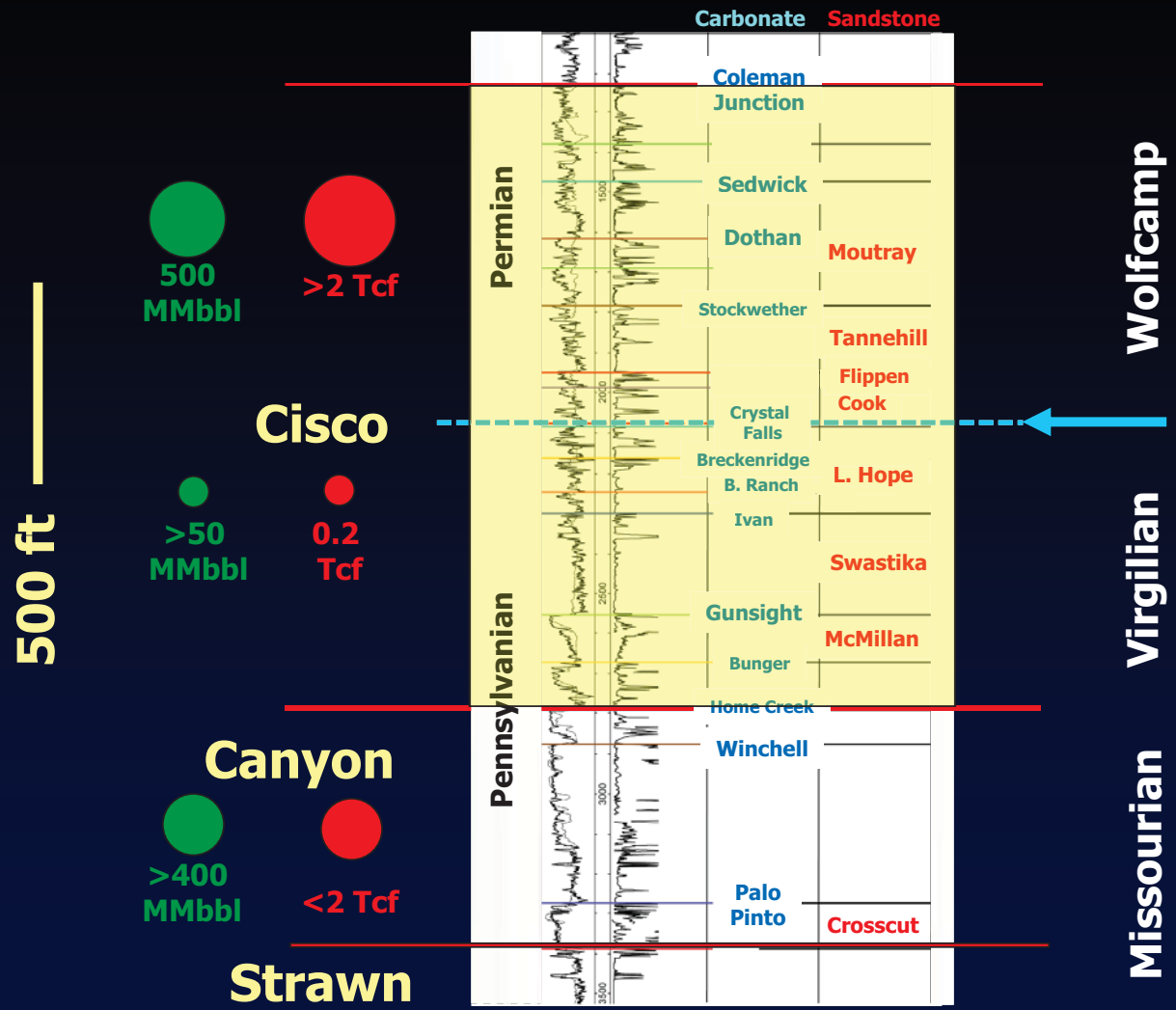
Burrowed wackestone



3320 ft

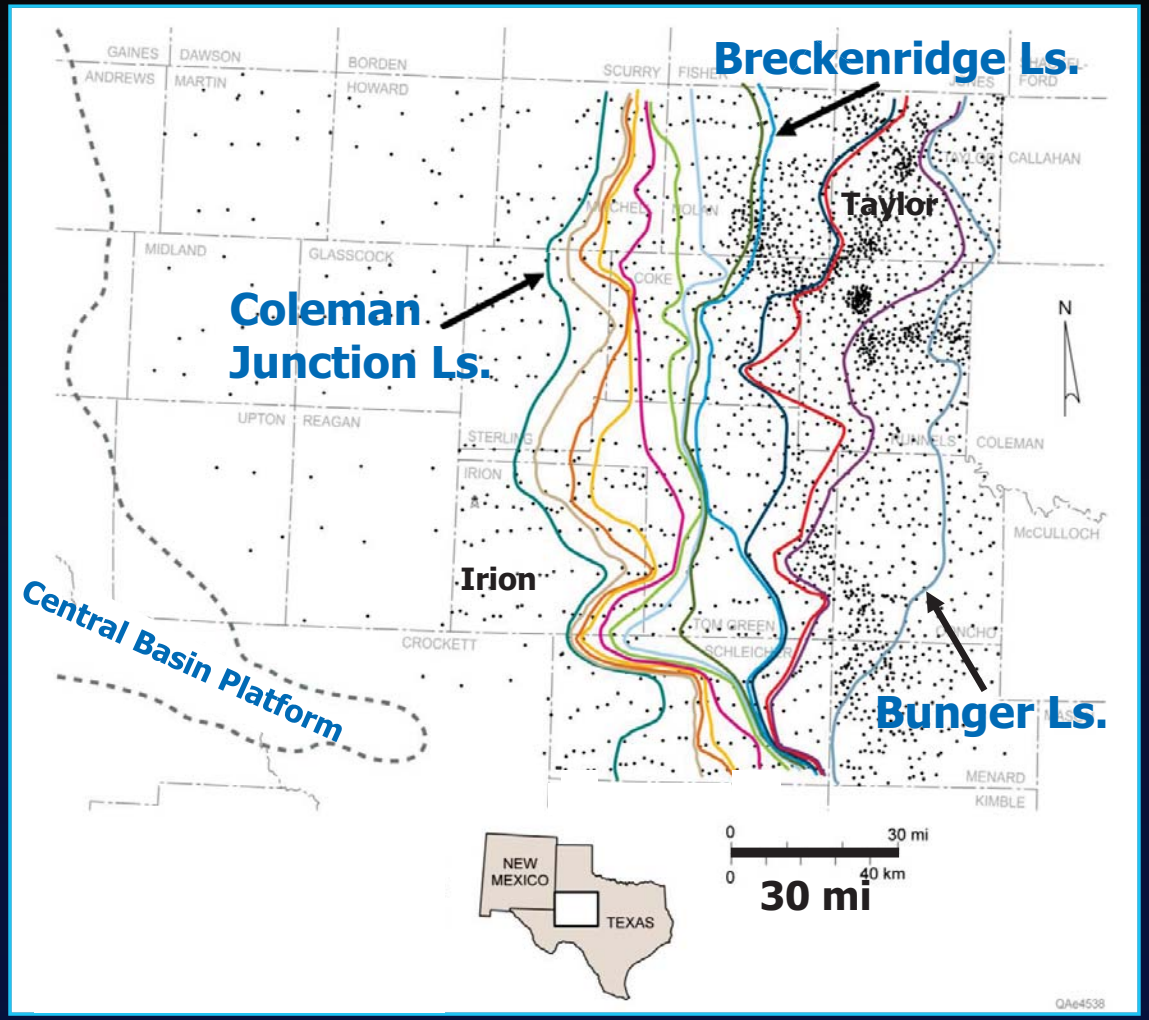
3340 ft

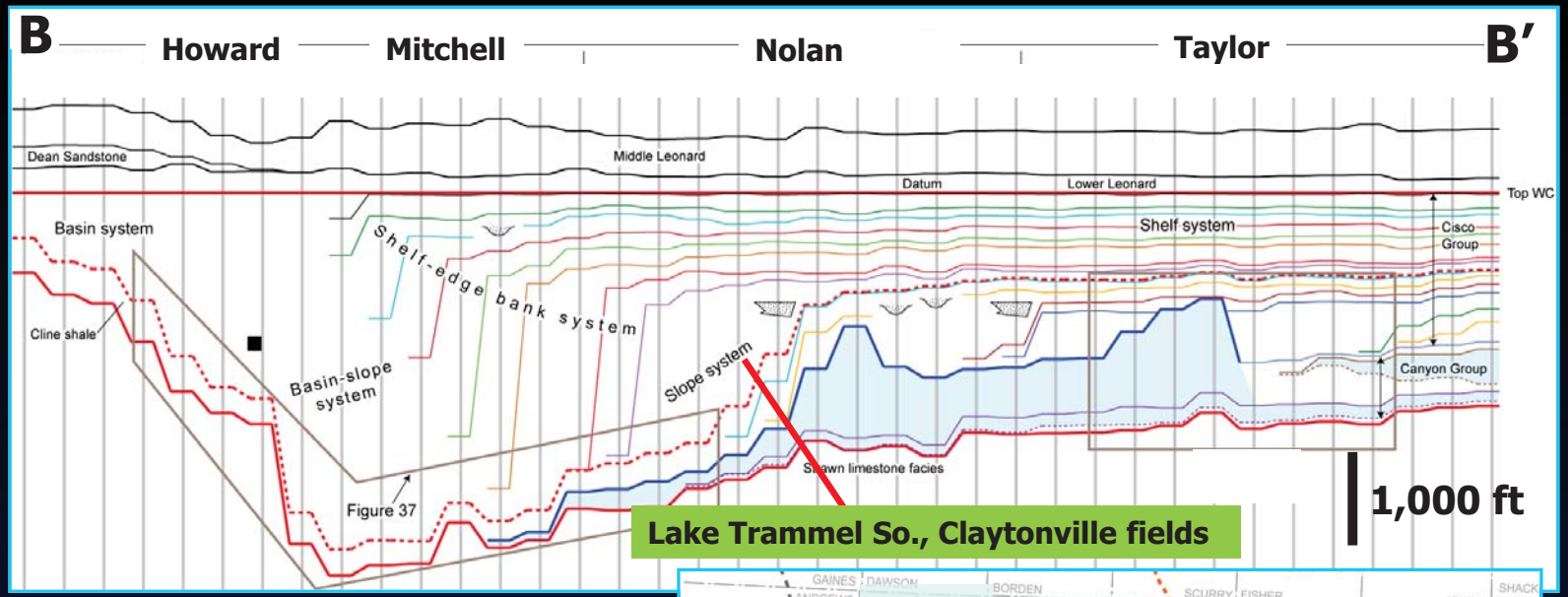
Cisco Group



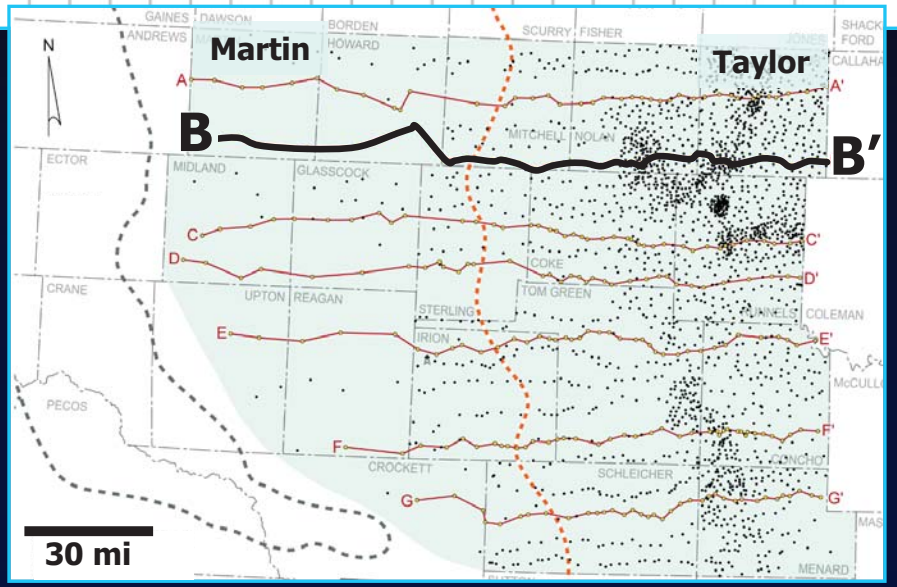
Top Pennsylvanian

Shelf Edge Distribution: Cisco Group





Cisco Slope Systems
Lake Trammel Field



Cisco Channel/Levee Systems
Lake Trammel, So. Field

Sun No. 9 Stone, Nolan County

Channel

A

2 inches

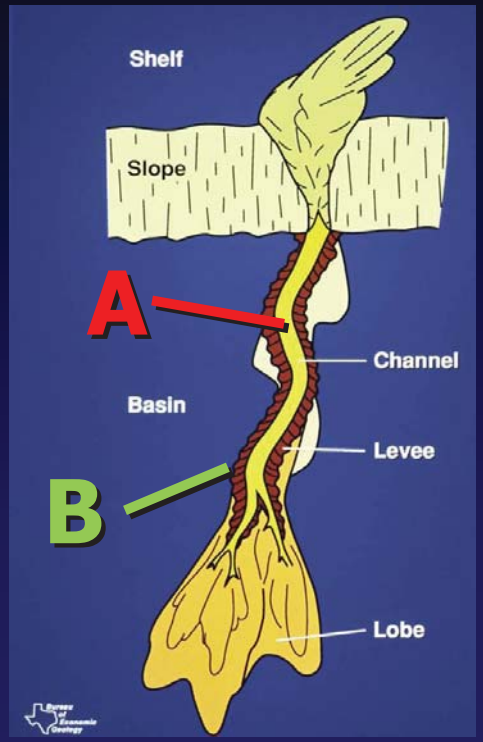
5,238 ft

Levee

B

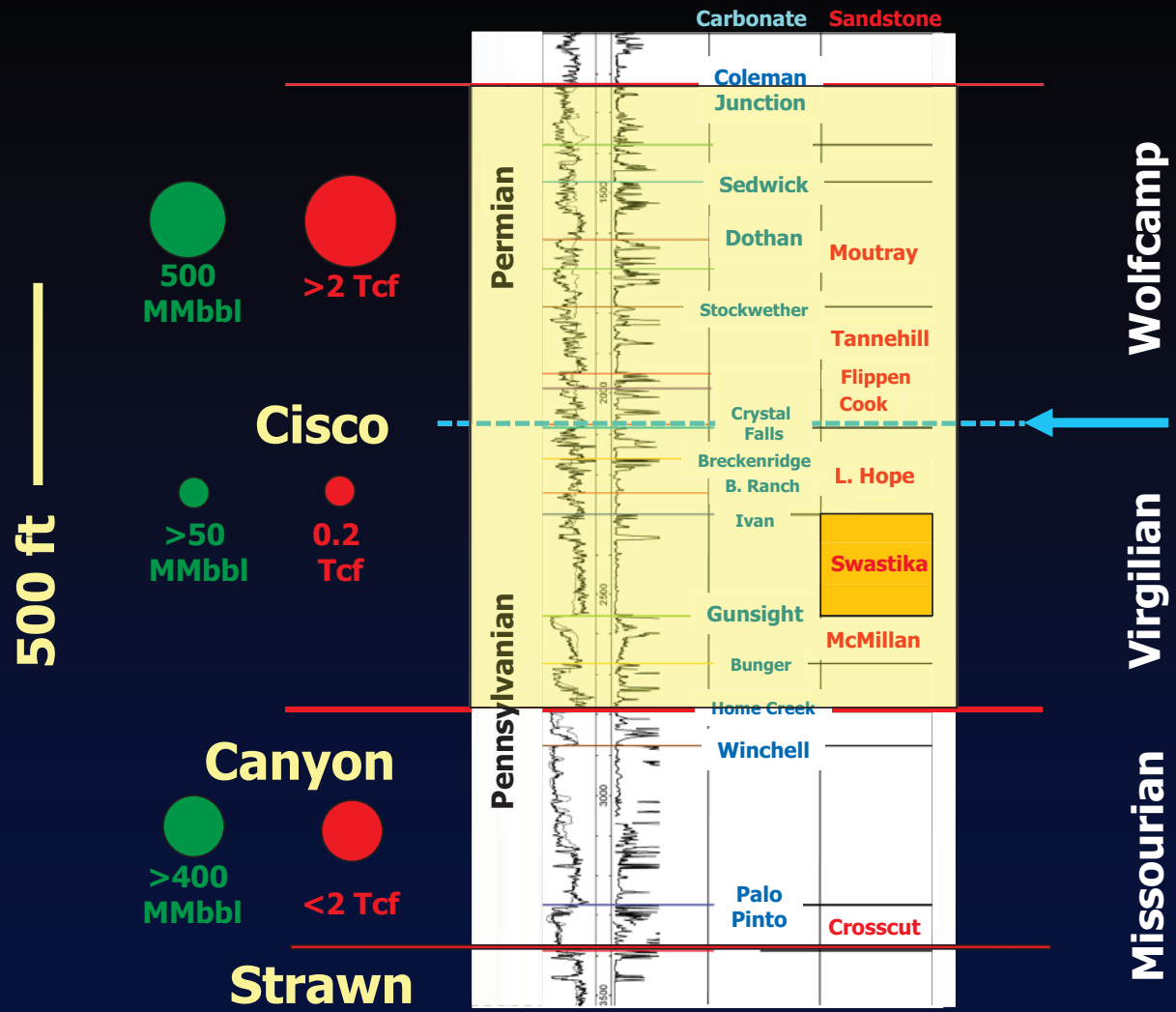
2 inches

5,115.2 ft



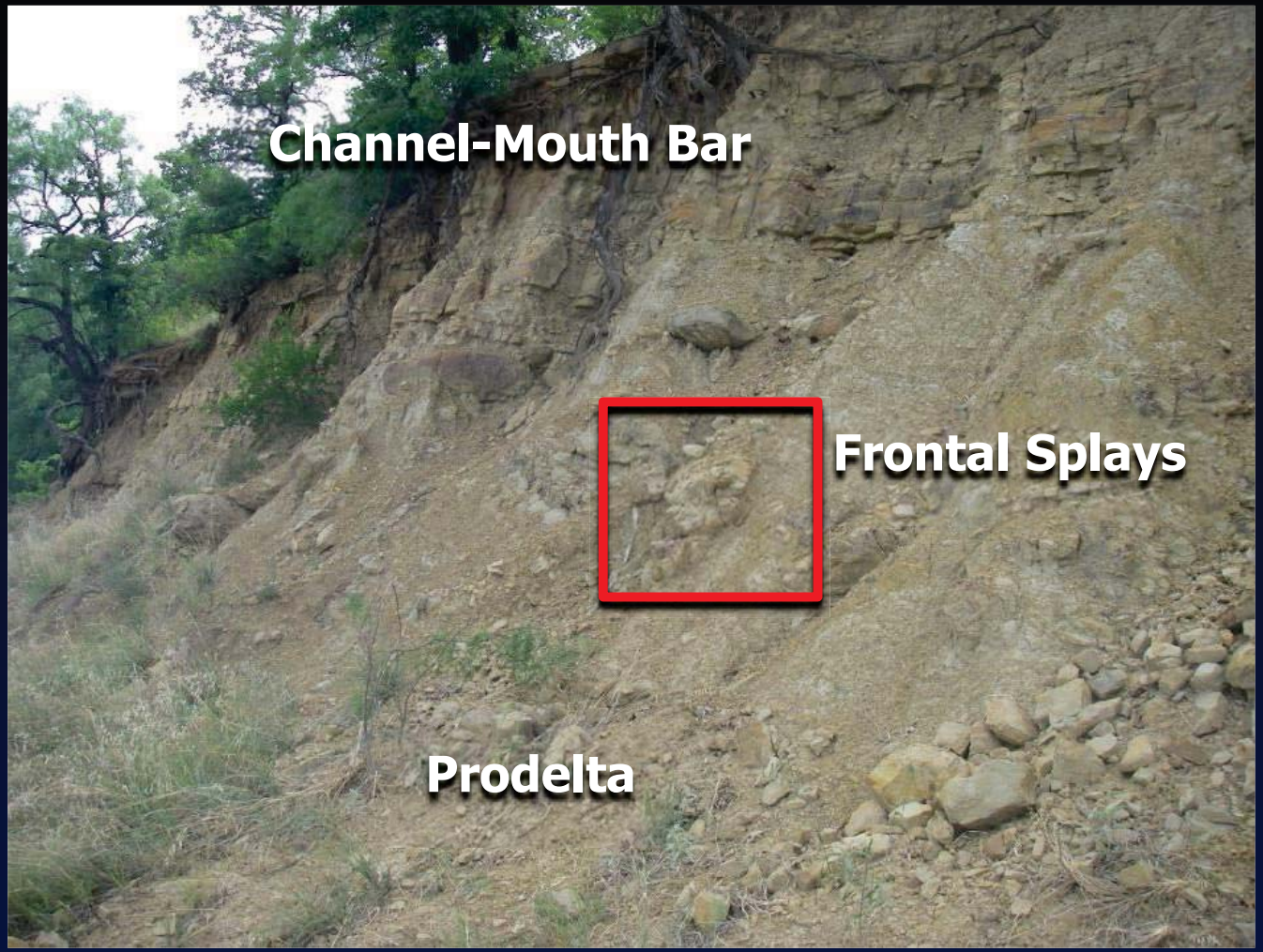
Dutton et al. (2003)

Avis- Swastika HST Delta



Top Pennsylvanian

Avis/Swastika HST Delta
Eliasville

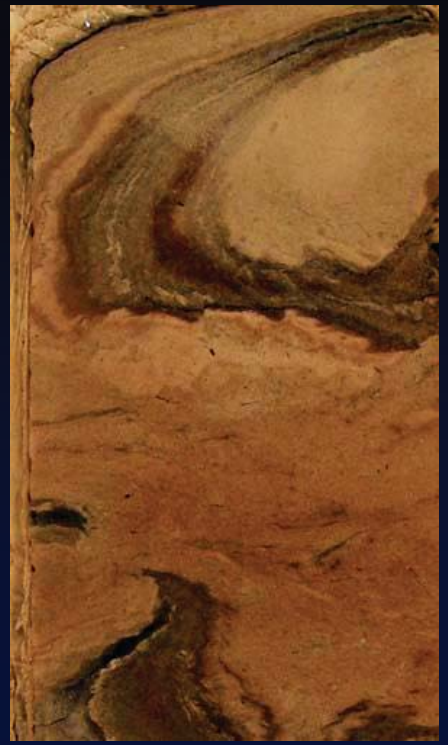


Brown et al. (2009)

Avis/Swastika Flow-Roll Structure

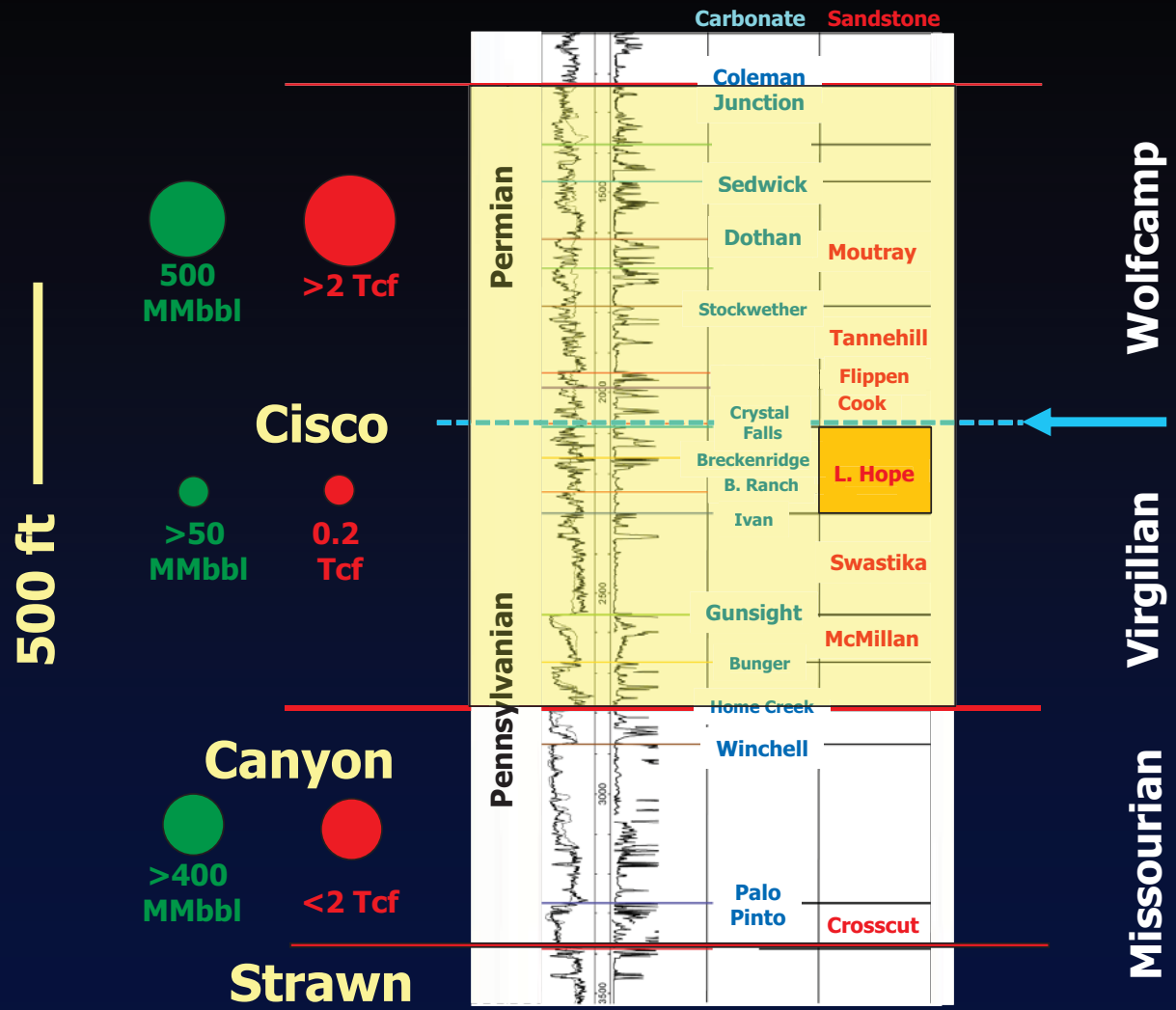
Brown et al. (2009)

2 inches



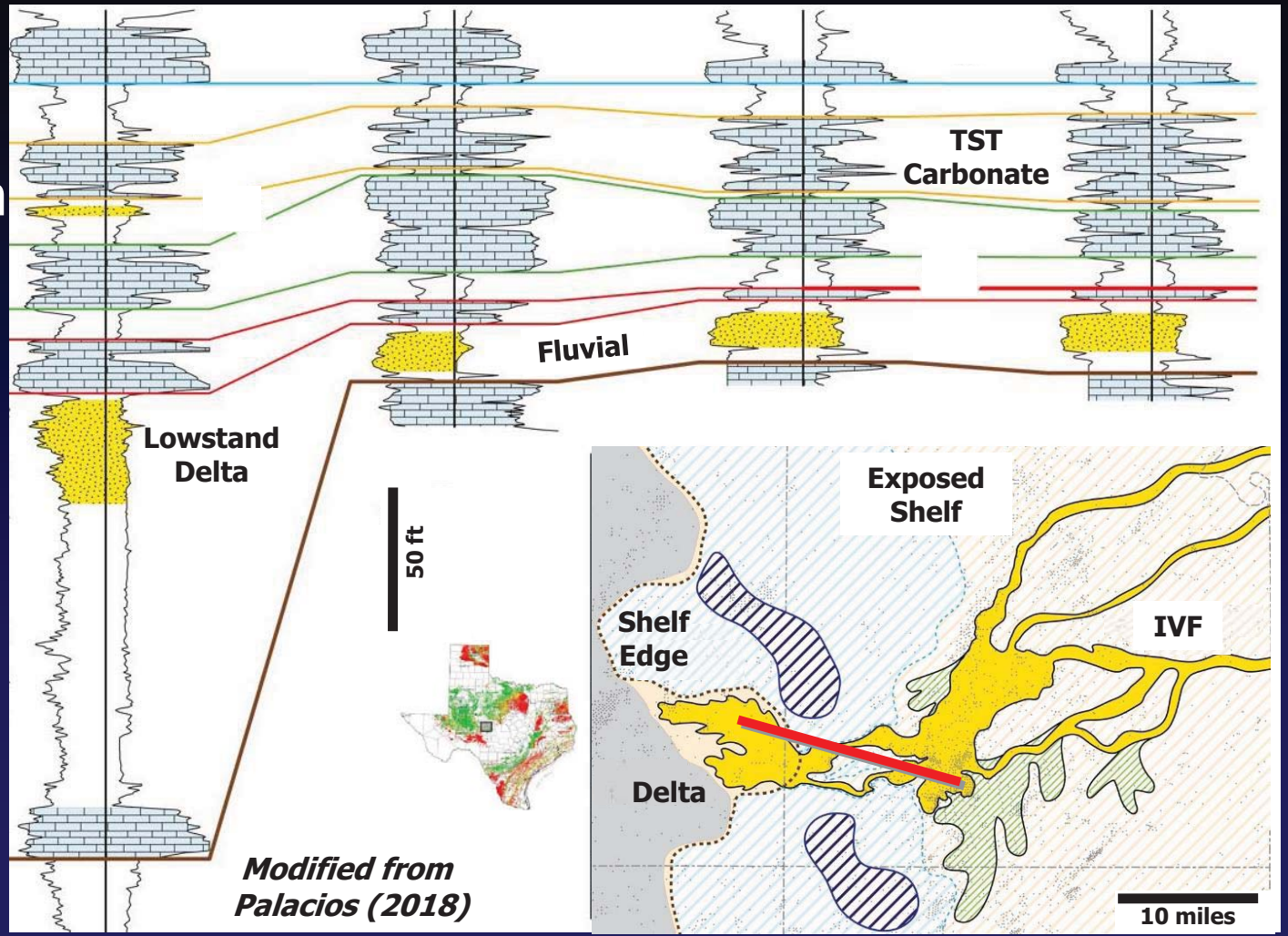
Shell No. 55 Watson
East Texas field

Lower Hope IVF



Top Pennsylvanian

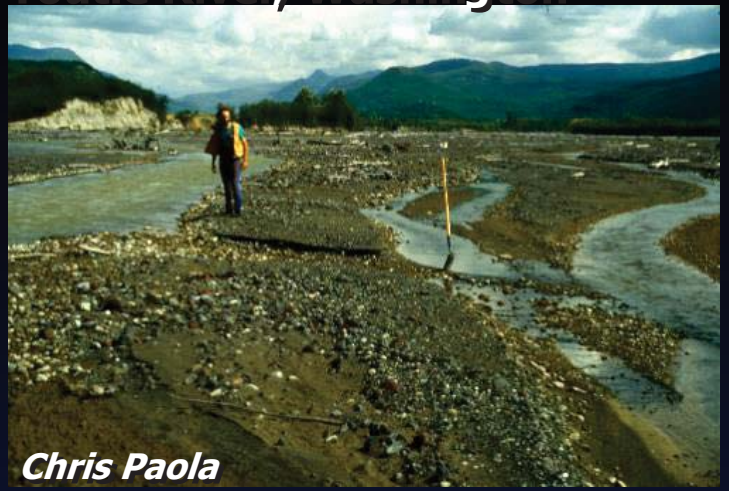
Cisco Group: Incised Valley Systems



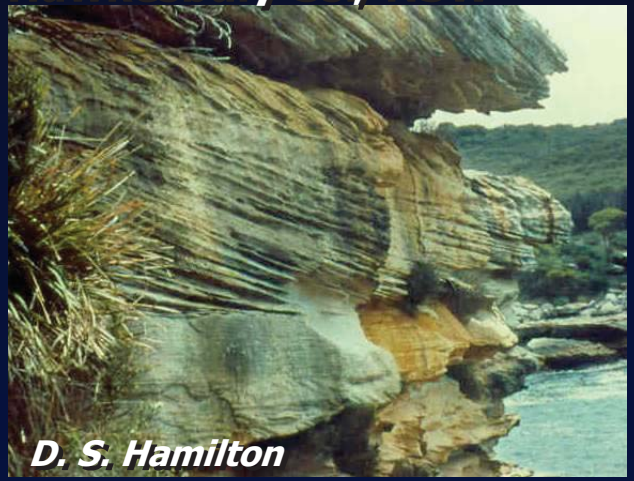
Incised-valley system:
Post-Bunger Ls.
Lower Cisco Group
Young County

Braided Stream Systems

Toutle River, Washington

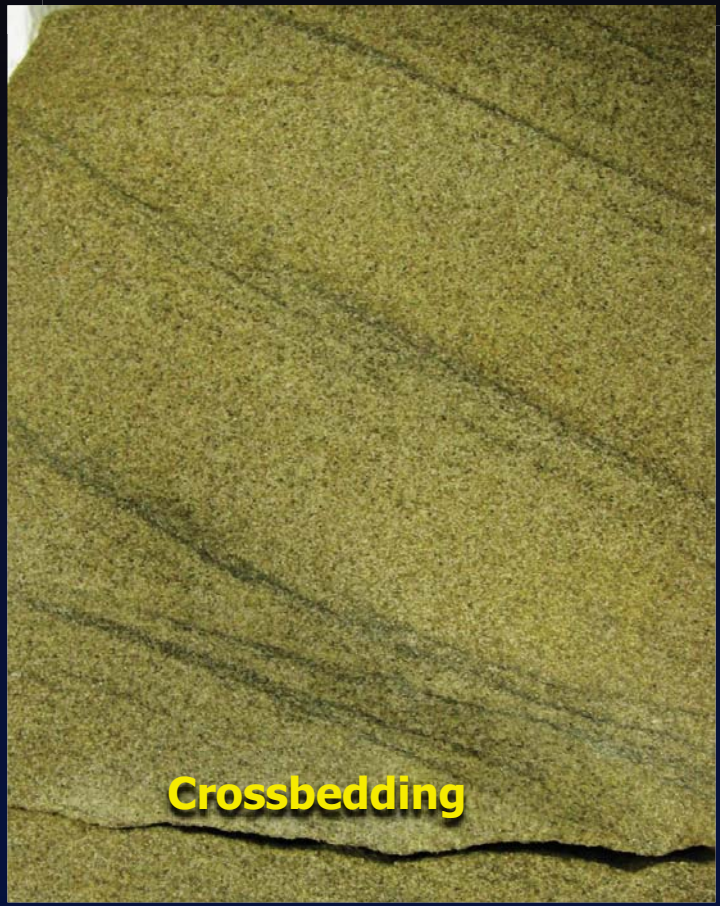


Hawkesbury Ss., NSW

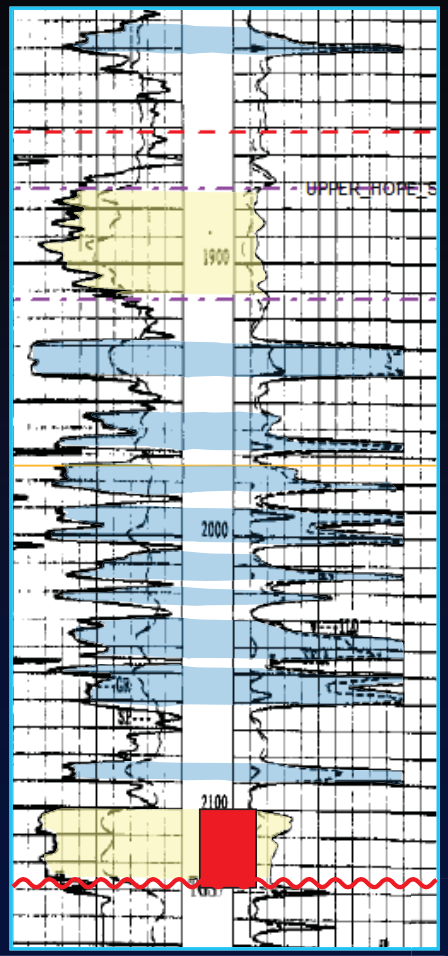


Sun No. 2 Armor-Caffey (2254.3 ft)
Concho County

Lower Hope Sand



Lower Hope Sandstone, Concho County



100 ft

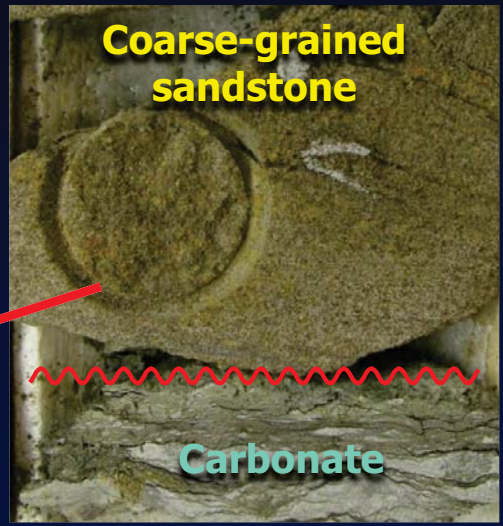
Wiser No. C-14 Jacoby

Blach Ranch Ls.

Wiser No. 3-B Jacoby

2 in

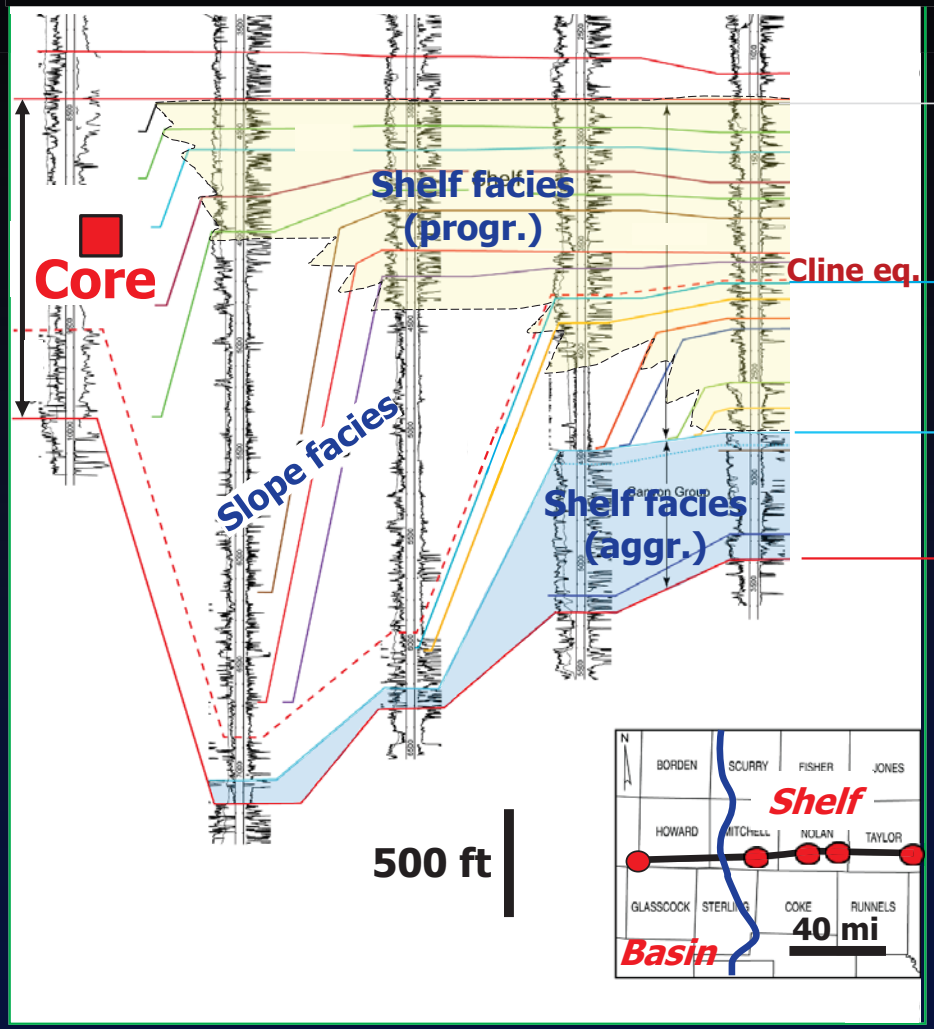
Incised-valley-fill facies



2 in

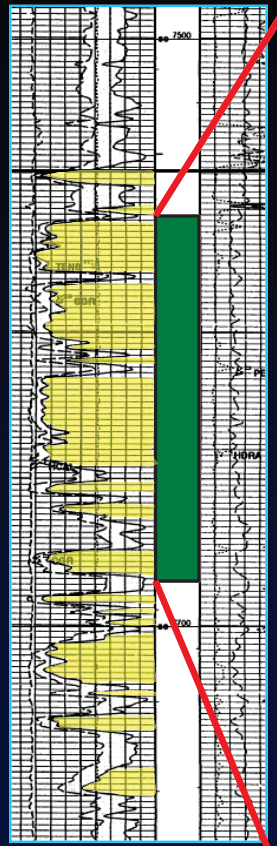
Sun No. 2 Armor-Caffey

Wolfcamp Basin-Floor Sandstones

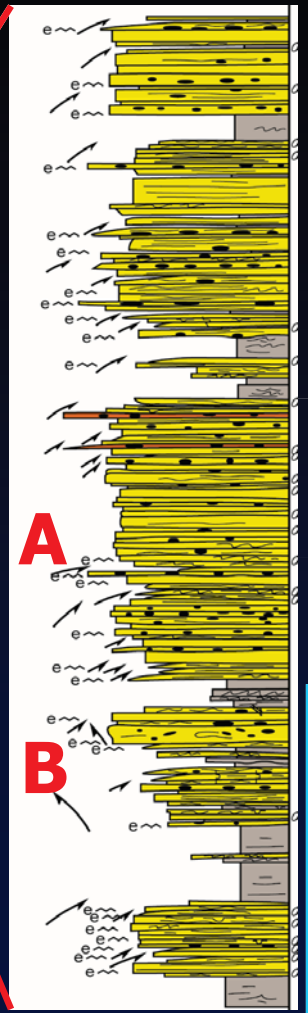


Wolfcamp Basinal Sandstones

Howard County



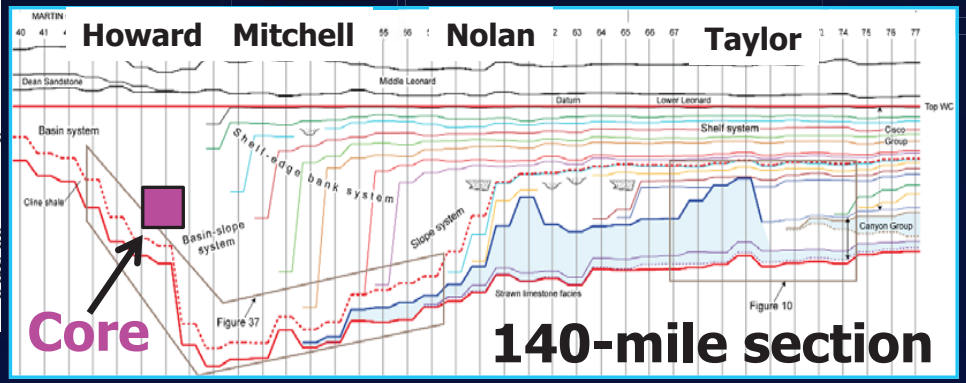
Santa Fe No. 3 Powell Ranch



A

B

2 in



Summary

- **Southern extension of Brown et al. (1990)**

- **Shelf plays:**

  Cisco Group: Incised Valley Fill: Concho-Tom Green Counties

- **Shelf-edge and slope plays:**

  Upper-Middle Cisco Group: Nolan-Fisher Counties

- **Deeper-basin plays:**

  Wolfcamp Formation clastics: Howard and Sterling Counties