Tidal Depositional Systems in Pennsylvanian Strata in the Anadarko Basin, Northeast Texas Panhandle*

William A. Ambrose[1], Tucker F. Hentz[1], and Logan Tussey[2]

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[1]Bureau of Economic Geology, University of Texas at Austin, Austin, TX, USA (William.ambrose@beg.utexas.edu, tucker.hentz@beg.utexas.edu)
[2]University of Texas at Austin, Austin, TX, USA (lbt0004@gmail.com)

Abstract

A thick (>6,000-ft [>1,830-m]) succession of Desmoinesian to Virgilian (Pennsylvanian) strata in the northwest part of the Anadarko Basin contains a variety of tidally modified deposits. This succession, which encompasses the Marmaton Group (Upper Desmoinesian), Cleveland Formation (Missourian) and Douglas Group (Virgilian), records progradation of highstand tidally modified delta and shorezone systems punctuated by lowstand incised-valley deposits. Tidal stratification in this succession includes asymmetric, double-draped ripples, reactivation surfaces, flaser bedding, rhythmic, laminar stratification, UFR (upper flow regime) planar stratification, and minor herringbone stratification.

Tidal amplification and reworking of deltaic and shorezone sediments was controlled by (1) basin configuration, consisting of a broad, shallow shelf merging northward with an extensive epicontinental seaway in the U.S. Midcontinent, and (2) the formation of embayments during periods of relative sea-level fall, notably in the Cleveland Formation, in which an east-west-trending lowstand paleovalley contains a vertical succession of coarse-grained fluvial-channel, tidal-channel, sandy tidal flat, muddy tidal flat, and transgressive facies associated with late-stage estuarine deposits. Local paleogeography was an important factor in the preservation of tidal signatures in the Marmaton to Douglas succession, where the relative weakness of wave and fluvial processes in areas between depocenters resulted in preservation of rhythmic bedding and bi-directional, double-draped ripples. A macrotidal setting is inferred for parallel, narrow and dip-elongate, upward-coarsening sandstone bodies in highstand-shelf systems in the Marmaton Group. In contrast, absence of large-scale bedforms such as estuarine-floor tidal sand bars in lowstand incised-valley fill systems in the Cleveland Formation instead suggests upper-microtidal to lower-mesotidal regimes.

Gross-sandstone-thickness maps of highstand versus lowstand systems tracts within the Cleveland Formation and Marmaton Group document systematic changes in sandstone-body thickness, continuity, and regional extent through time. These variations in sandstone-body geometry are a function of a unique paleogeomorphologic setting within each systems tract. Abrupt changes in sandstone-body geometry between each systems tract control variations in reservoir continuity and permeability pathways that should be considered in future resource development

References Cited

Allen, G.P. and H.W. Posamentier, 1993, Sequence stratigraphy and facies model of an incised valley fill: the Gironde Estuary, France: Journal of Sedimentary Petrology v. 63, p. 378-391.

Blakey, Ron, 2005, Library of Paleogeography: Web Accessed May 21, 2015, http://cpgeosystems.com/paleomaps.html.

Houbolt, J.J.H.C., 1968, Recent sediments in the Southern Bight of the North Sea: Geol. Mijn., v. 47, p. 245-273.

Kvale, E.P. and A.W. Archer, 1990, Tidal deposits associated with low-sulfur coals, Brazil Fm. (Lower Pennsylvanian), Indiana: Journal of Sedimentary Petrology, v. 60, p. 563-574.

Swift, D.J.P., 1975, Tidal sand ridges and shoal-retreat massifs: Marine Geology, v. 18, p. 105-134.

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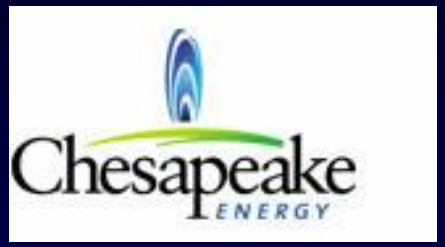
Bureau of Economic Geology

Acknowledgments

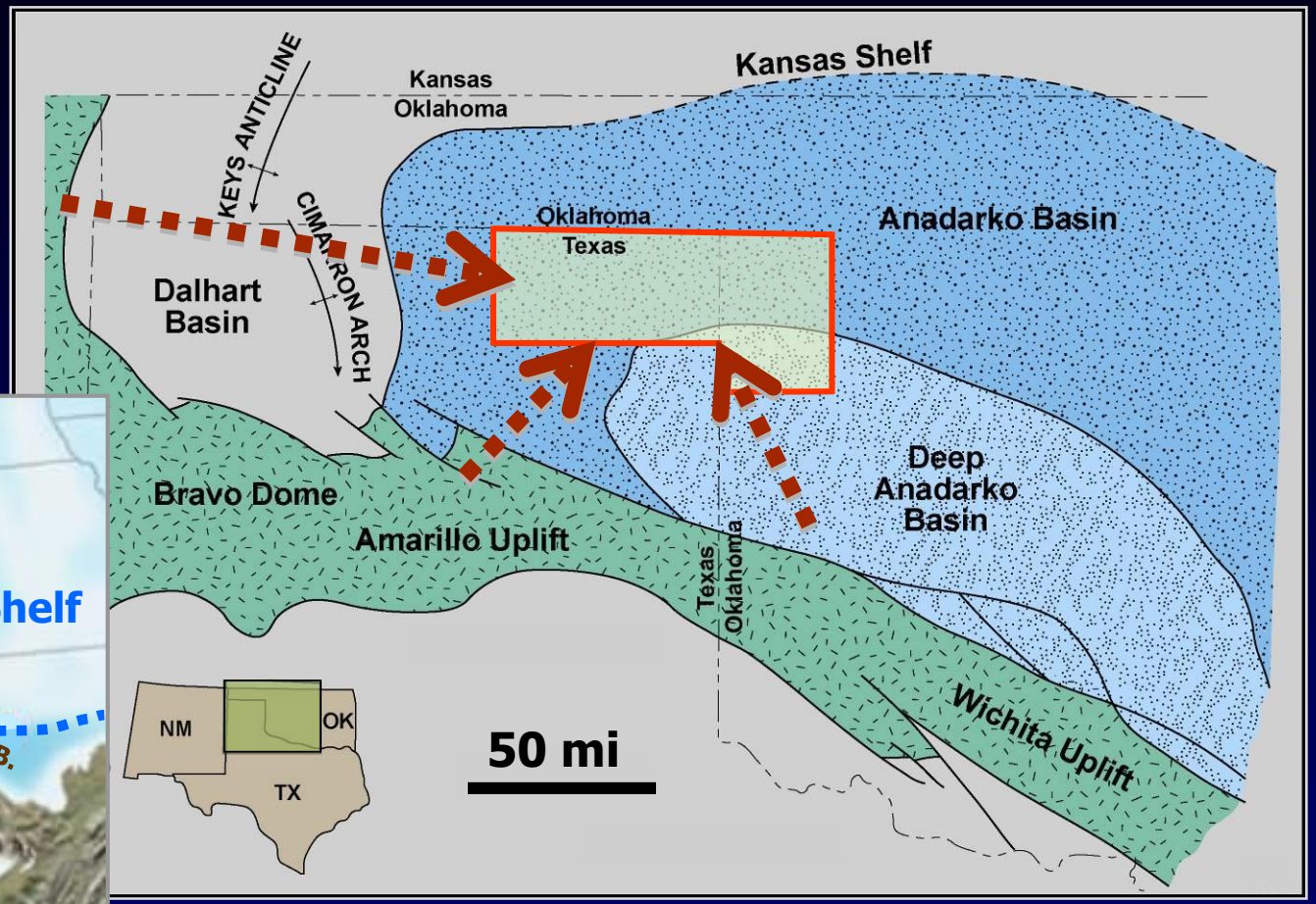


State of Texas Advanced Oil and Gas Resource Recovery

Anadarko Basin and Source Areas

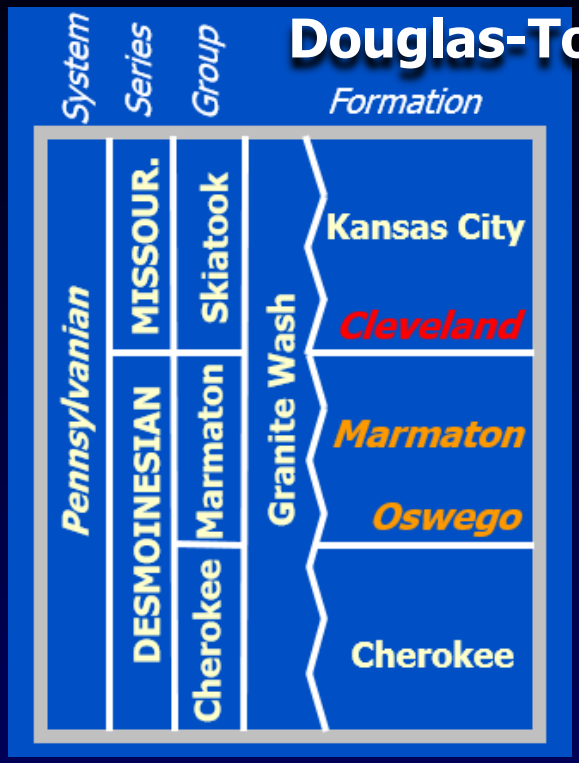
Pennsylvanian (Missourian) paleogeography

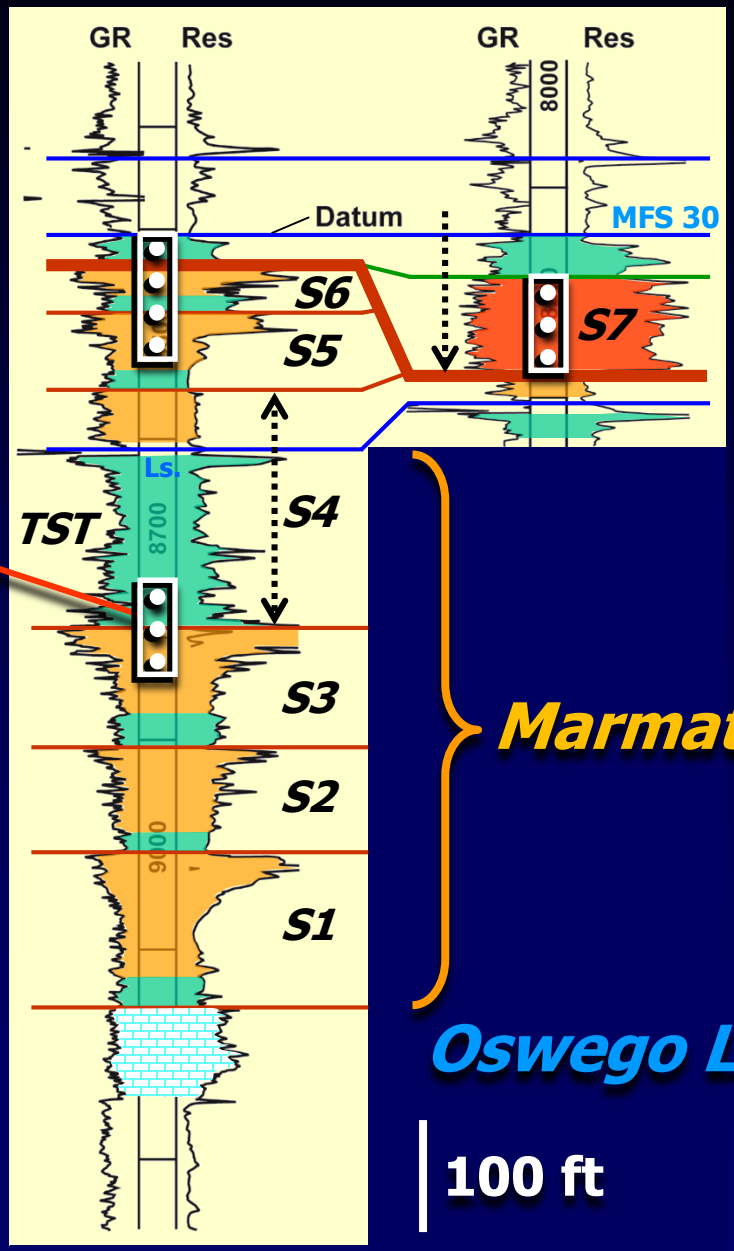
Blakey (2005)



Study area

Type Logs

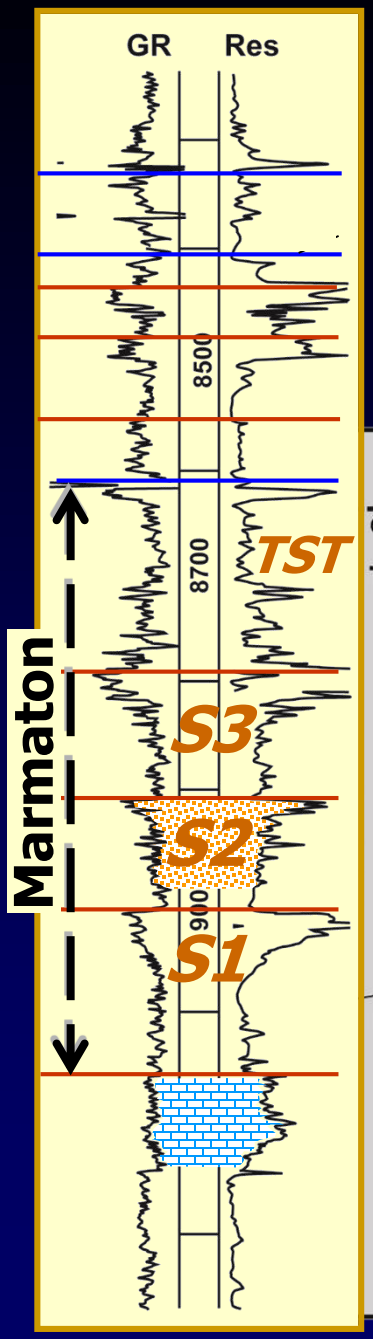


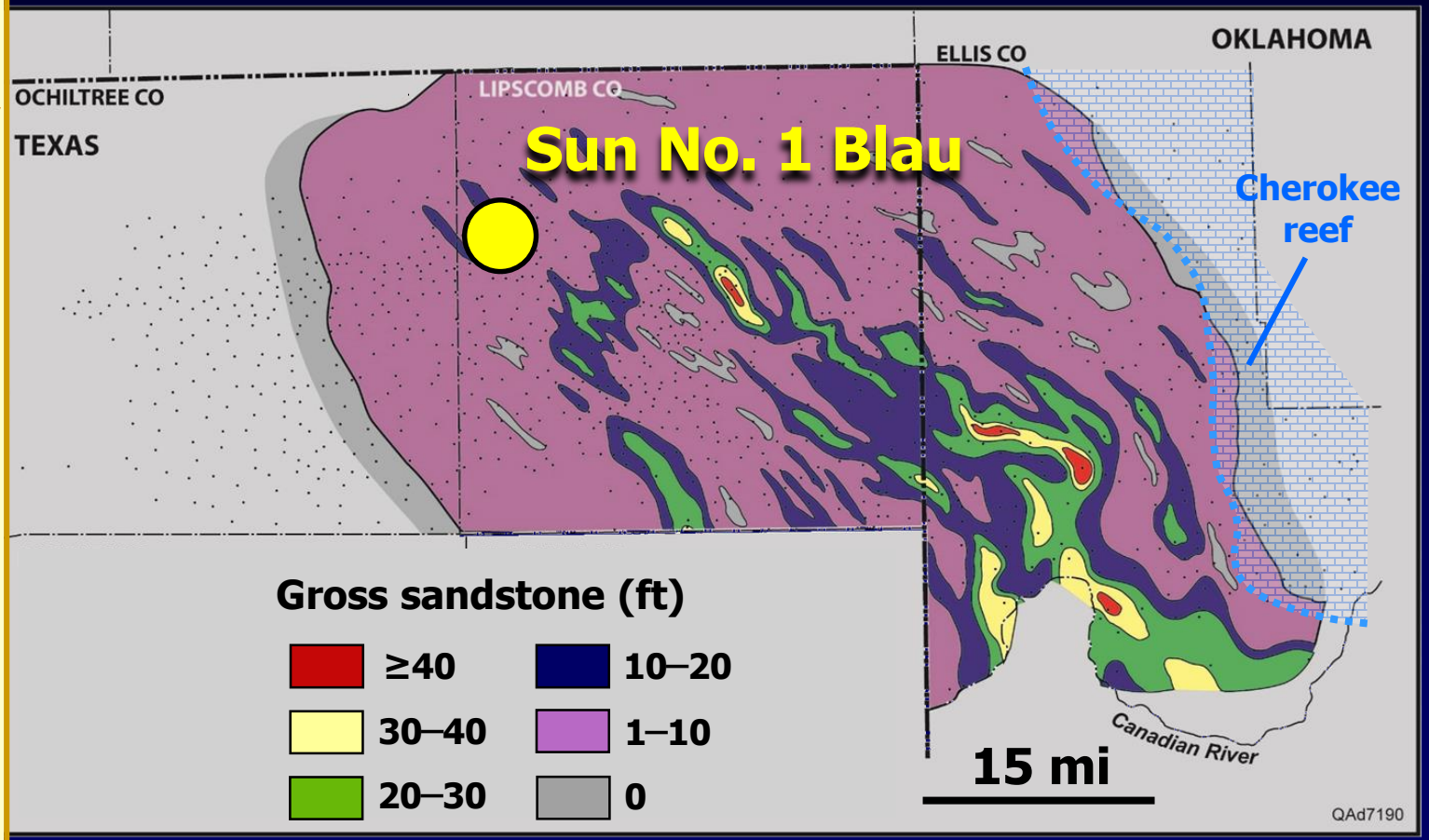


Systems tracts

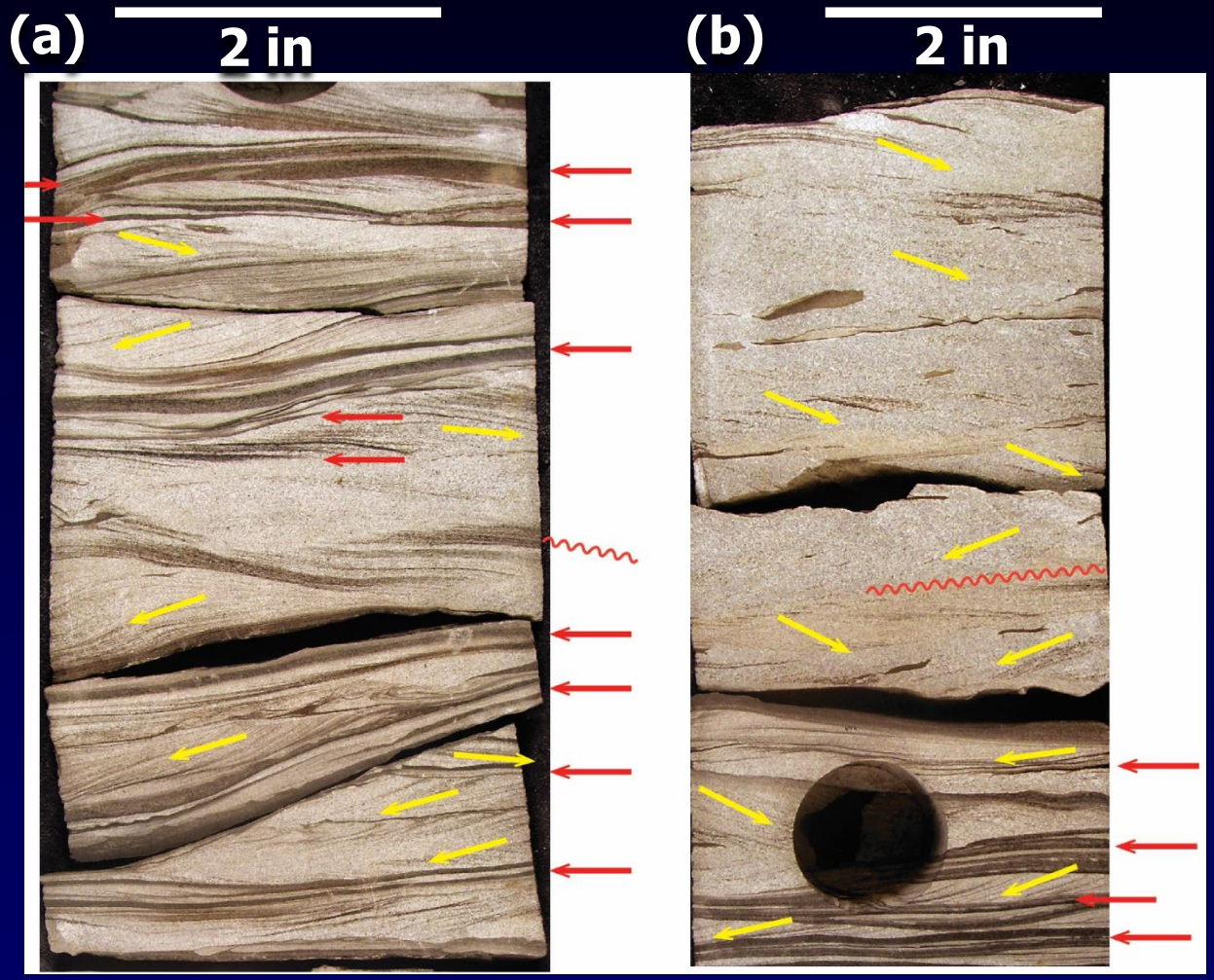
- Lowstand: incised-valley fill
- Highstand
- Transgressive

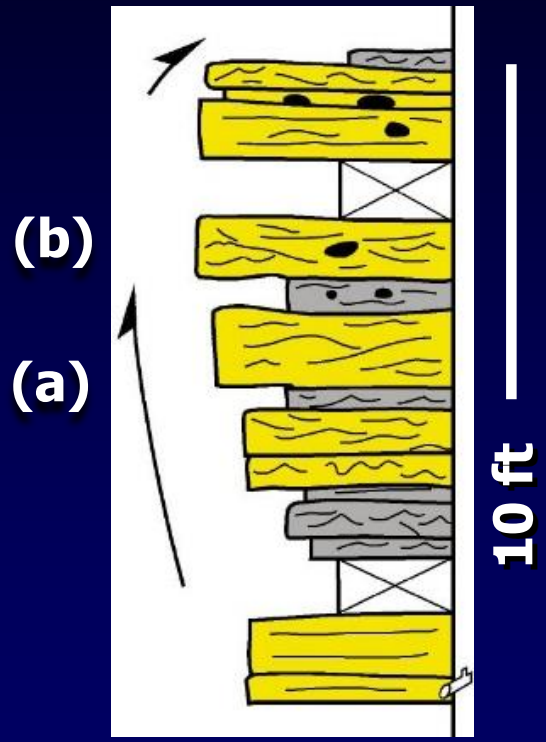
Marmaton Group
Sequence 2 Tidal Bars





Sun No. 1 Blau: Tidal Bar Facies



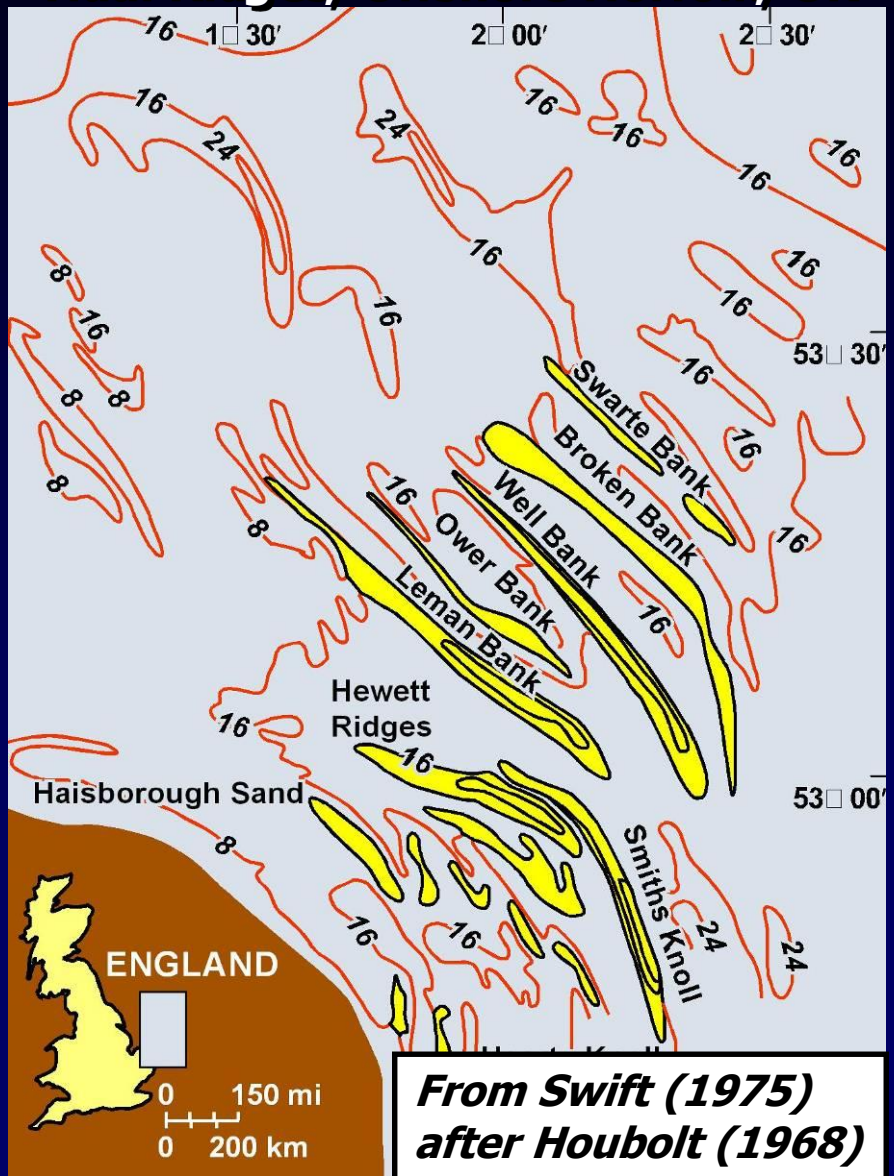


Double mud drape

Orientation of ripple foresets

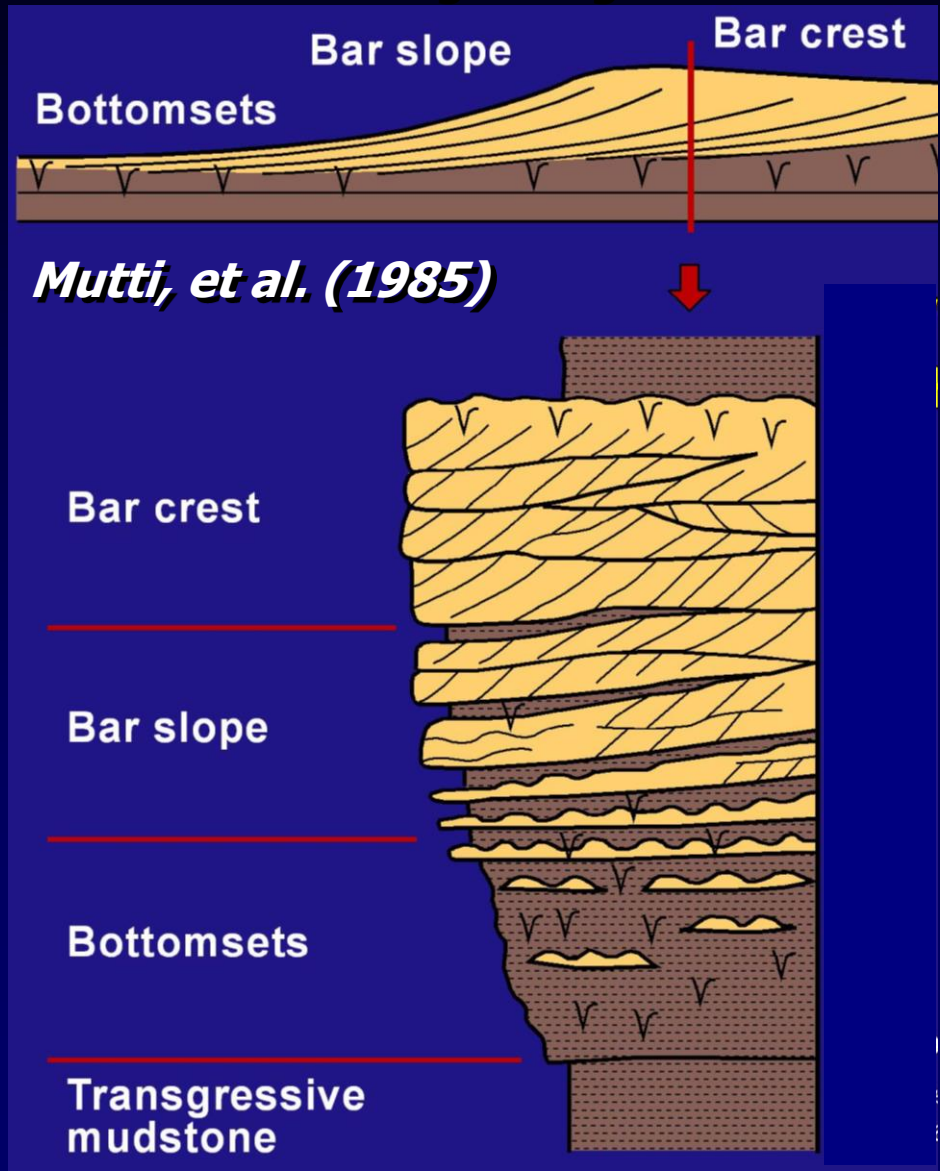
Shallow Shelf Tidal Systems

Tidal Ridges, Offshore Norfolk, UK



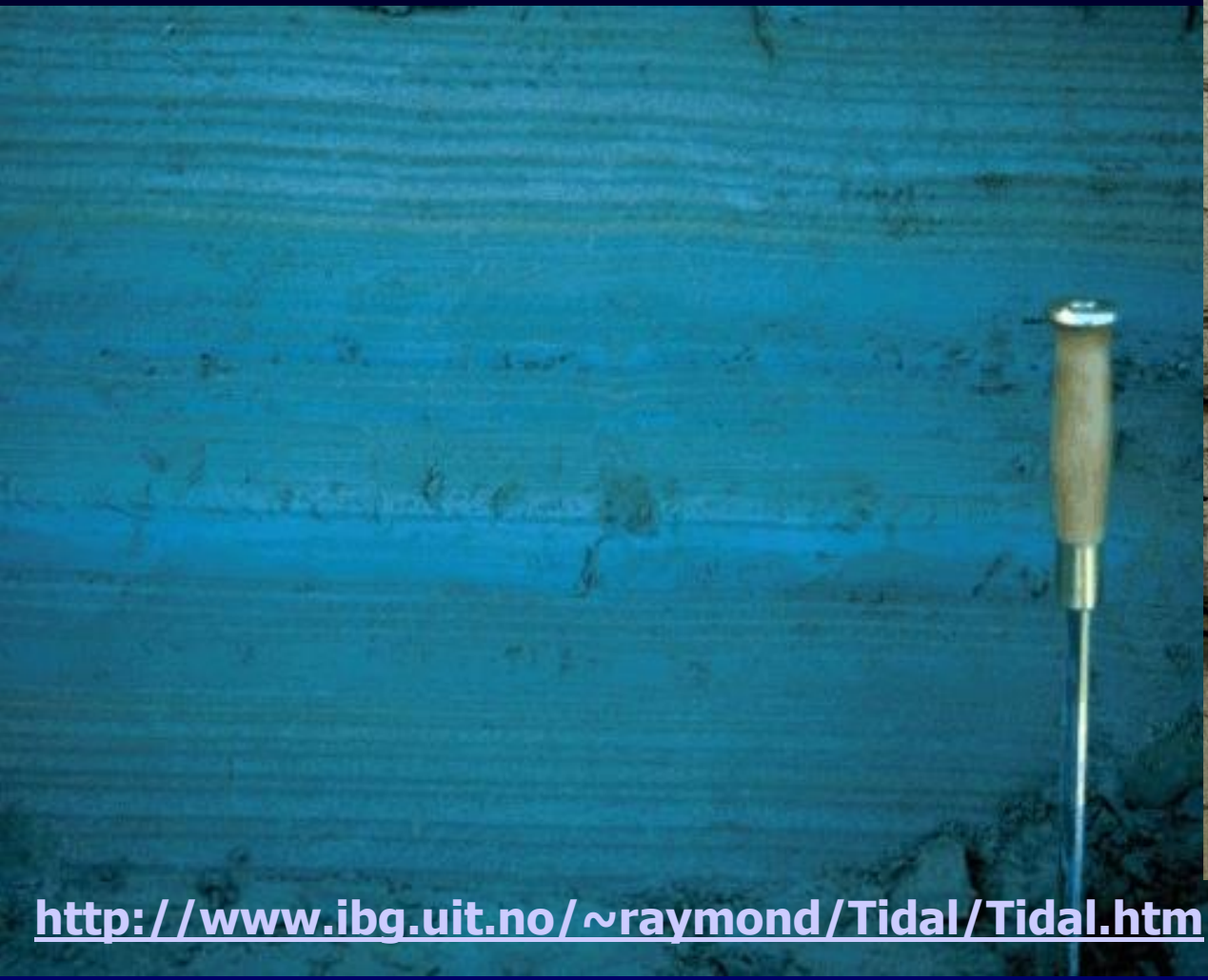
From Swift (1975) after Houbolt (1968)

Profile of Prograding Tidal Bar



Tidal Rhythmites

Norway: Neap-spring cyclicity and diurnal inequality



Cleveland Fm.

2 inches

http://www.ibg.uit.no/~raymond/Tidal/Tidal.htm

Tidal Rhythmites

Norway: Neap-spring cyclicity and diurnal inequality

http://www.ibg.uit.no/~raymond/Tidal/Tidal.htm

Douglas Group

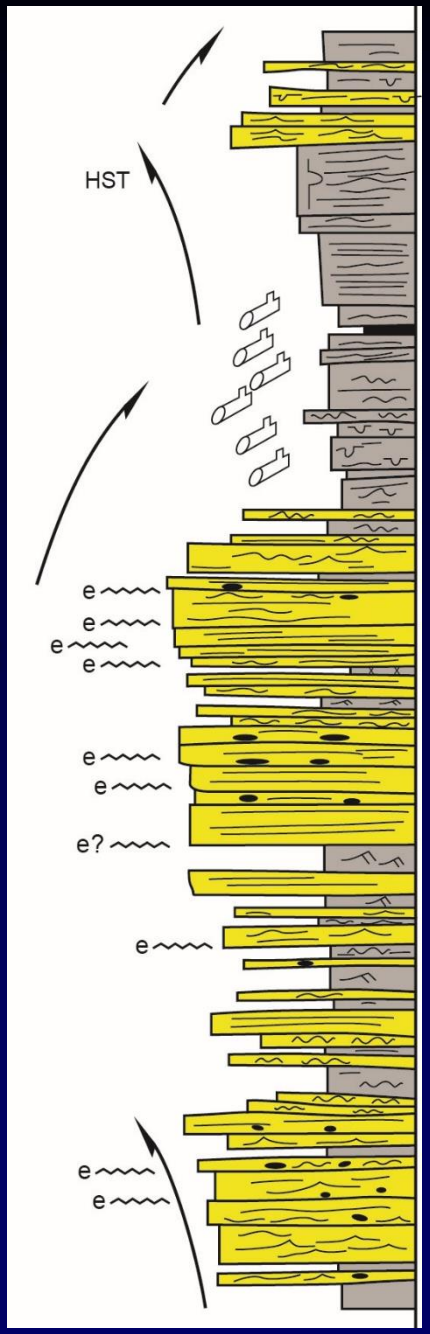
Internorth No. 46-1 Humphries

2 inches

Tidal Rhythmites

Douglas Group

Internorth No. 46-1 Humphries



Coal seam

Delta Front

Tidal Bar

Photo

20 ft

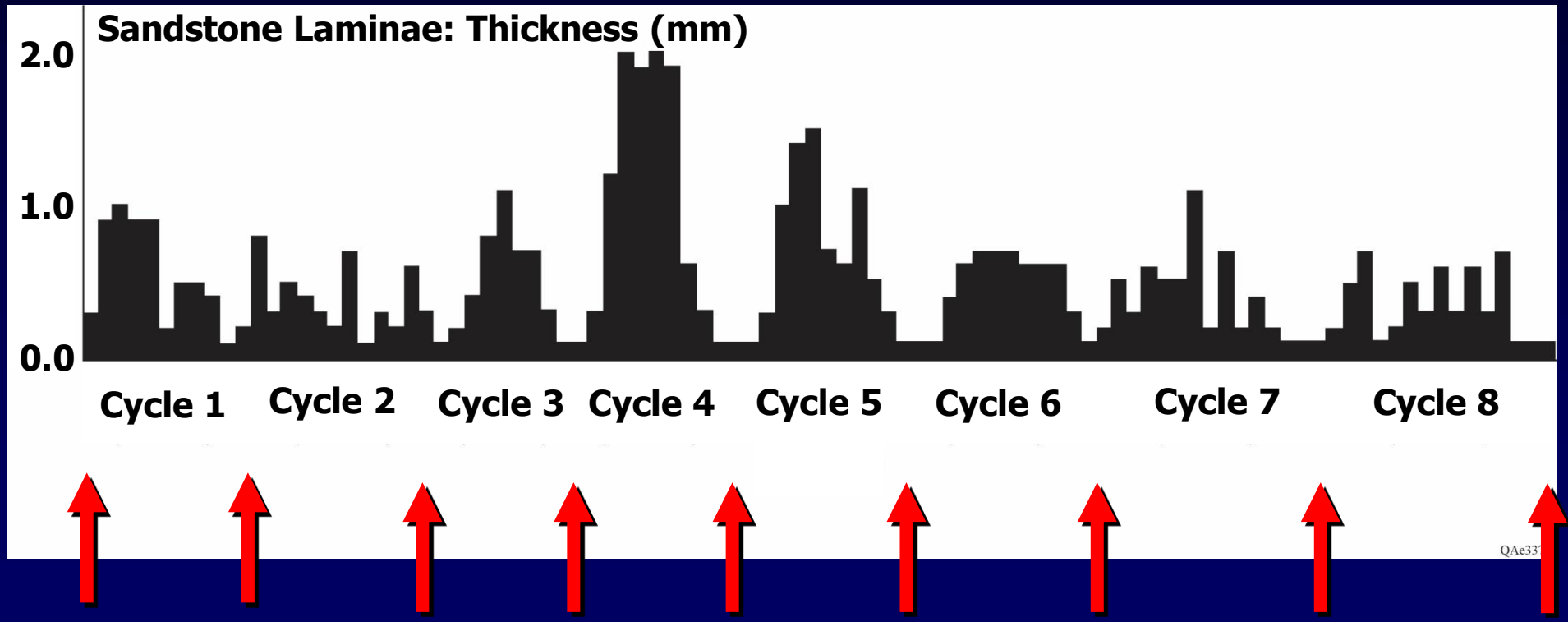
Neap Tides

2 inches

Tidal Rhythmites: Cycles

Douglas Group

Internorth No. 46-1 Humphries

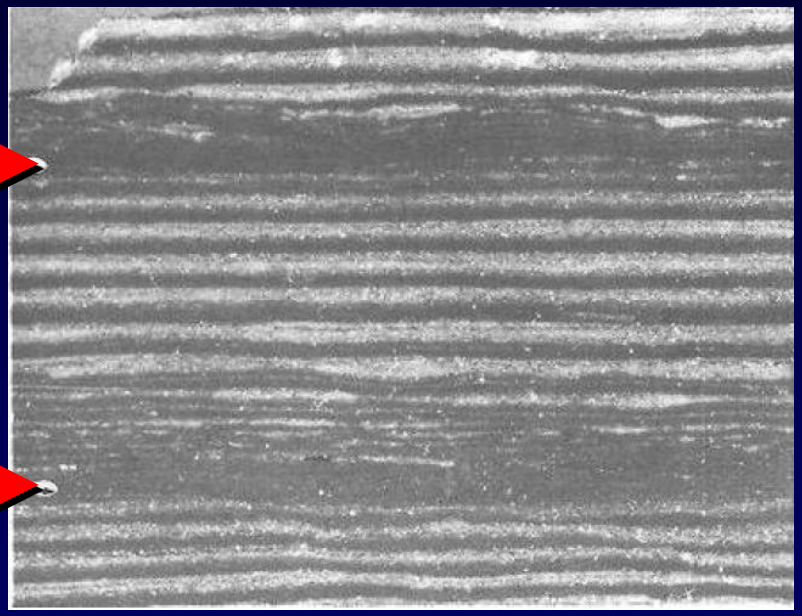


Neap Tides

Tidal Rhythmites

Brazil Formation

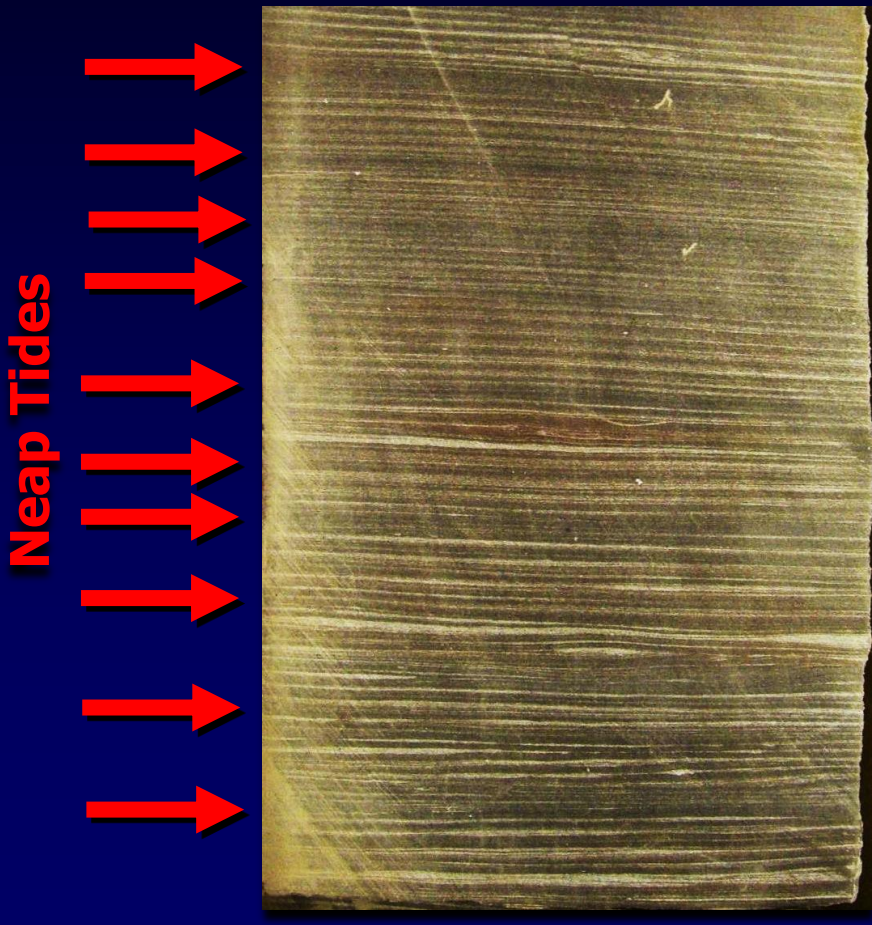
Illinois Basin



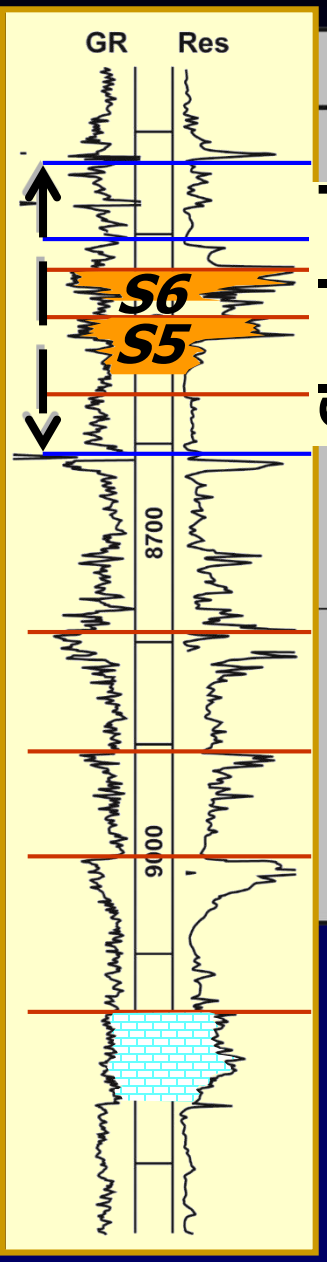
Kvale and Archer (1990)

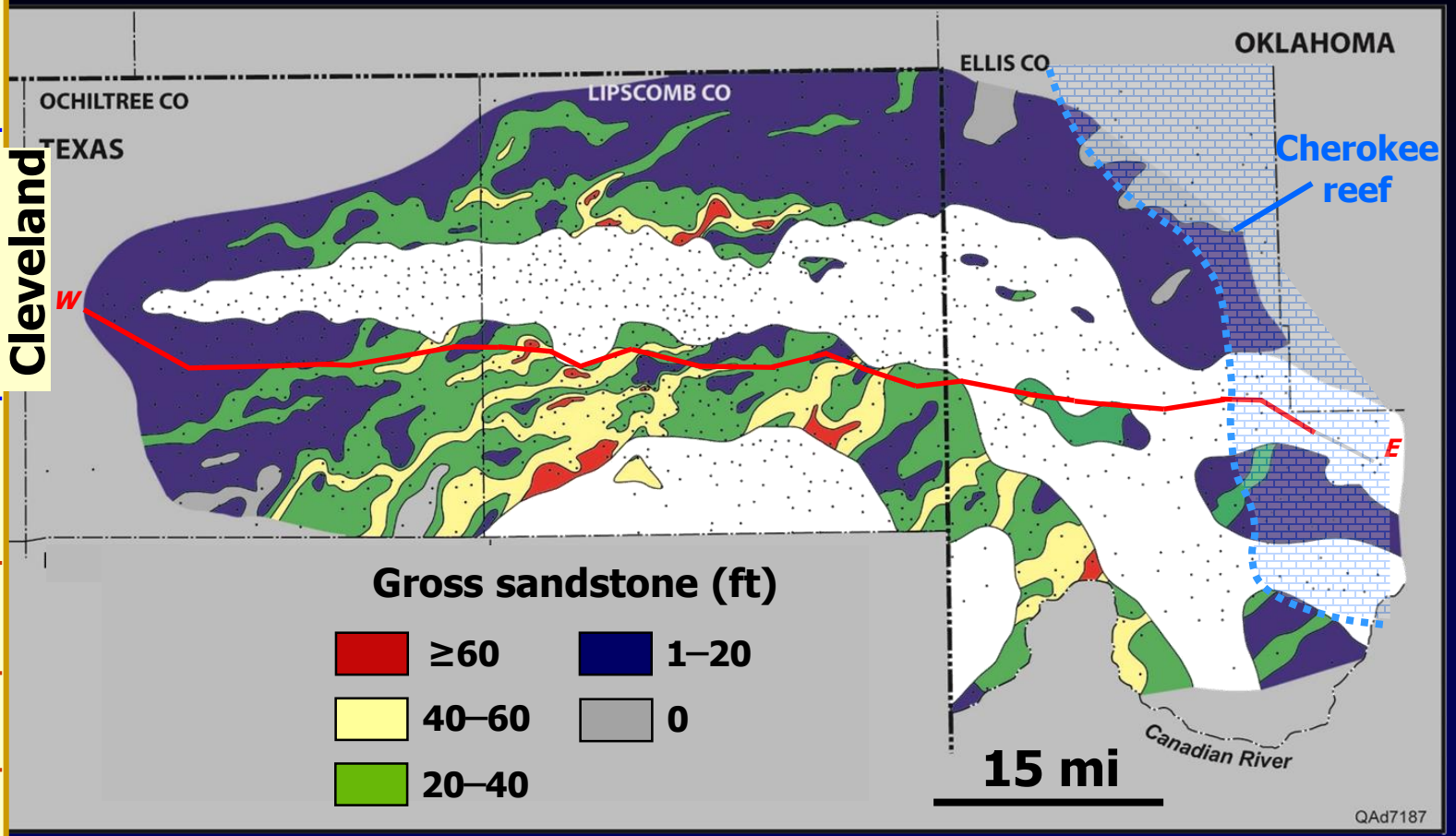
Douglas Group

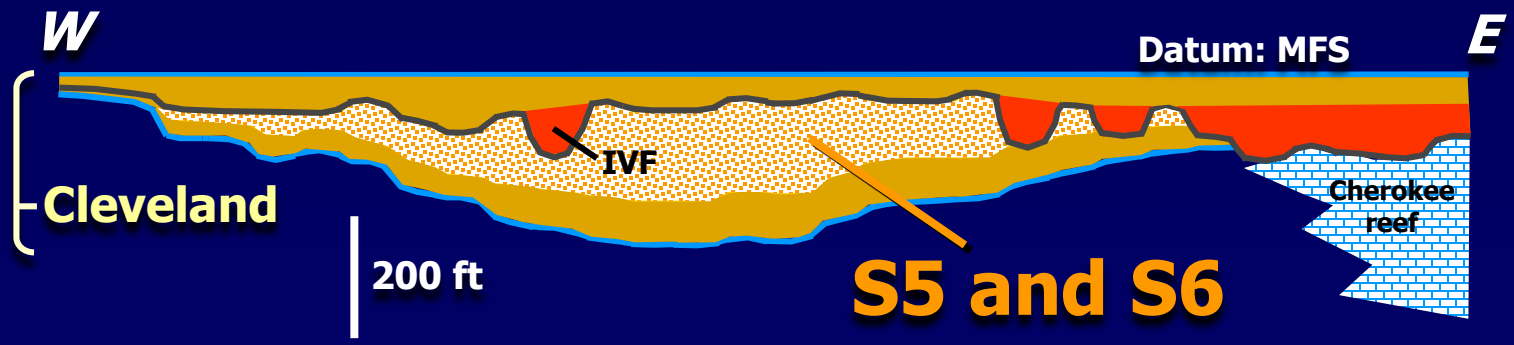
Internorth No. 46-1 Humphries



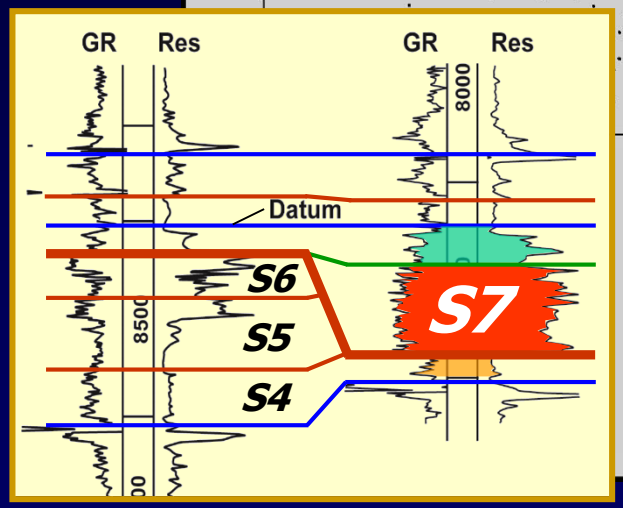
Cleveland: Sequences 5 and 6 HST

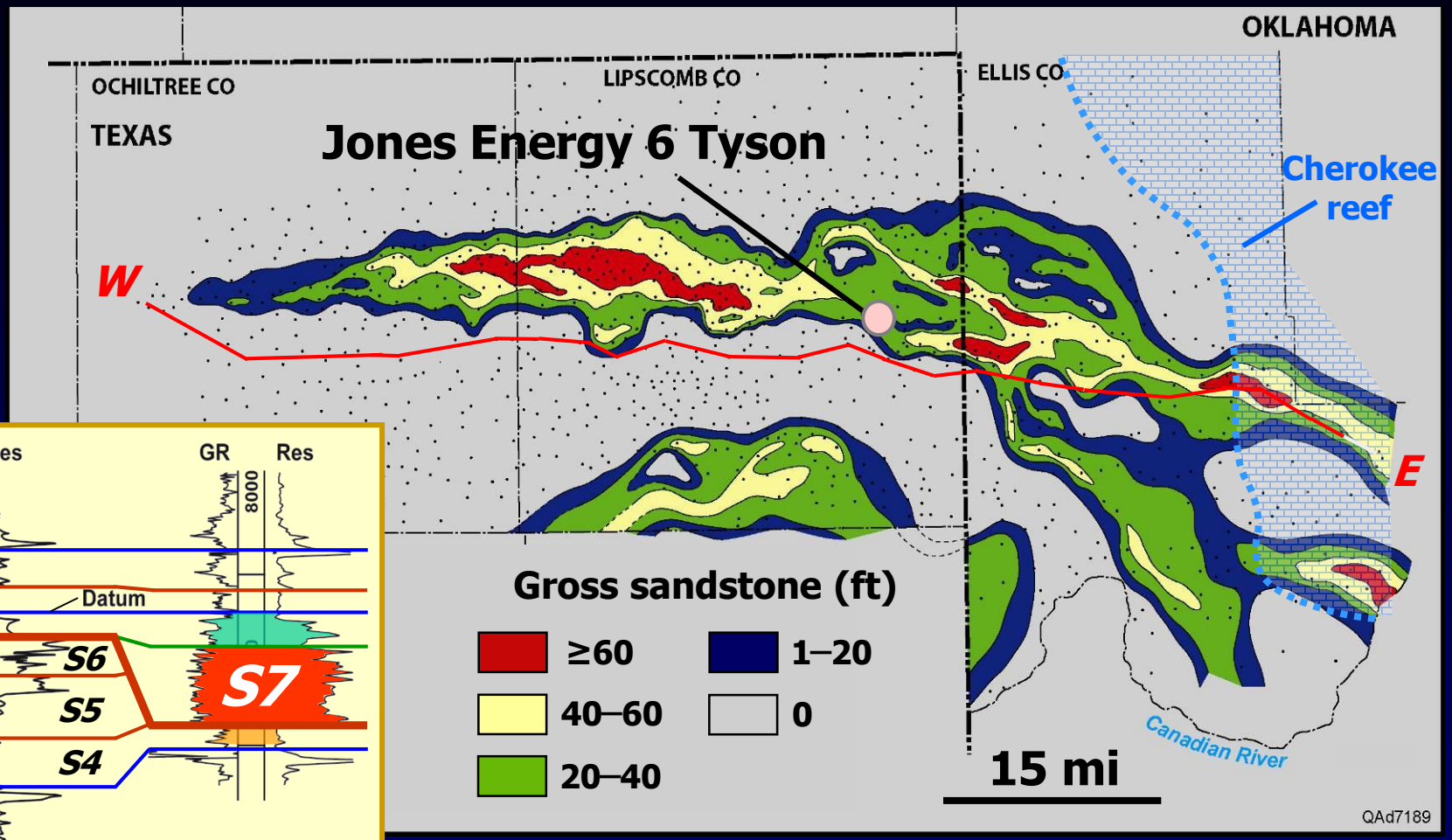


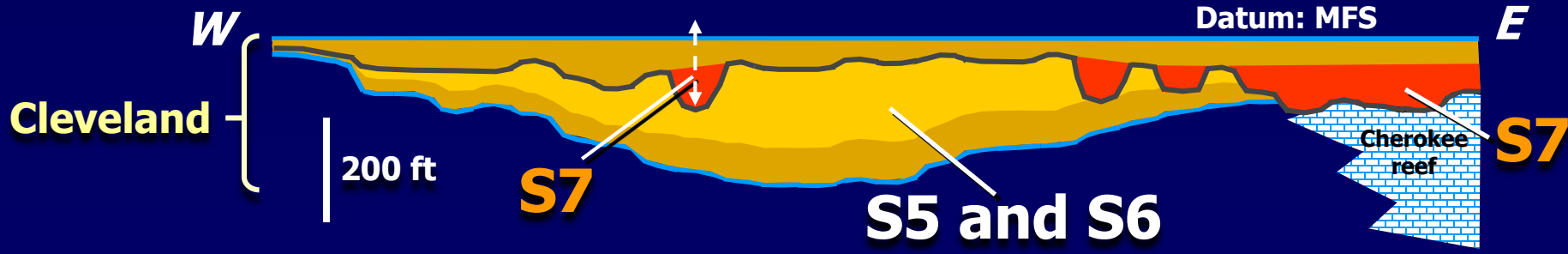




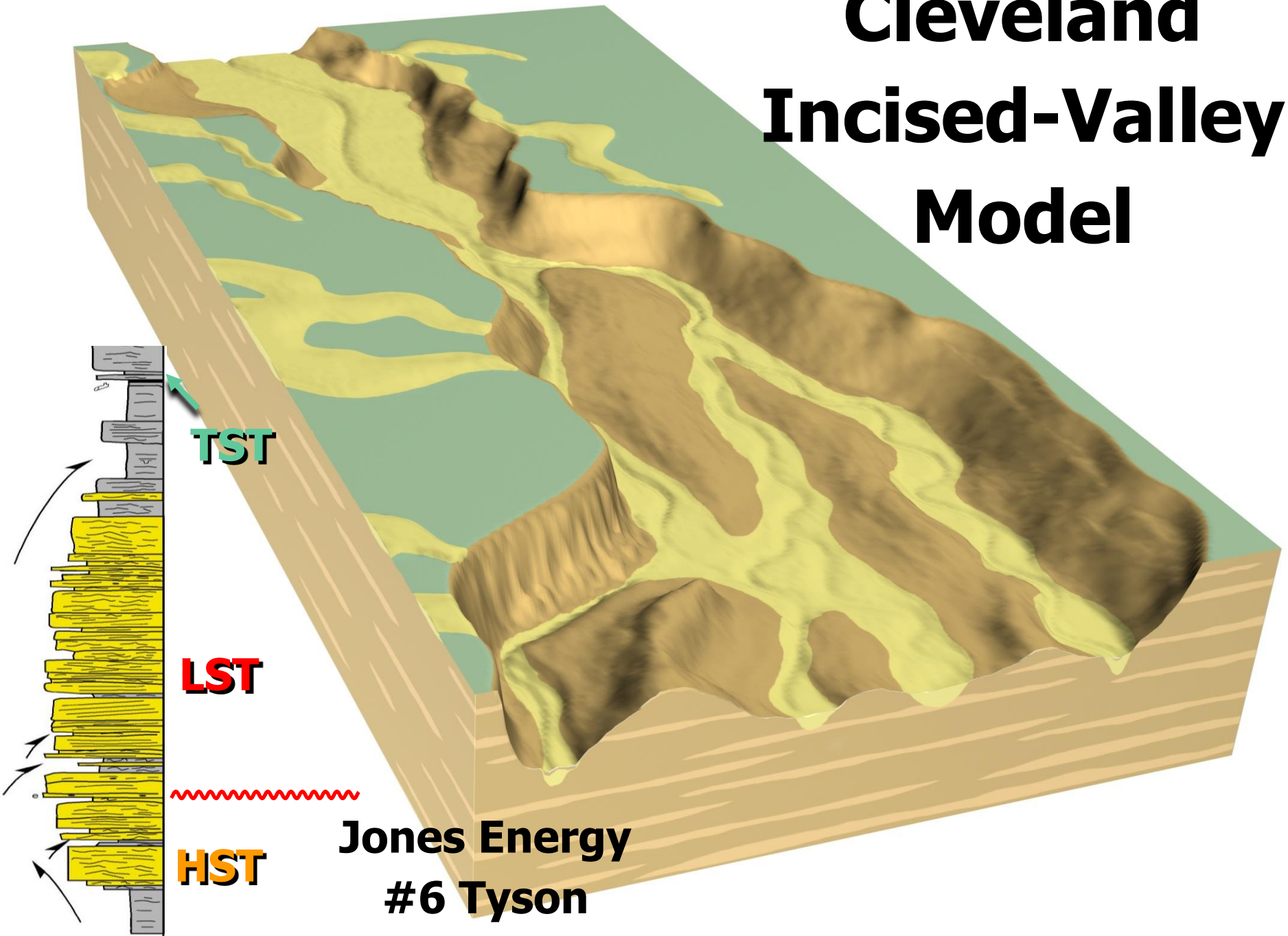
Middle Cleveland: LST Incised-Valley Fill



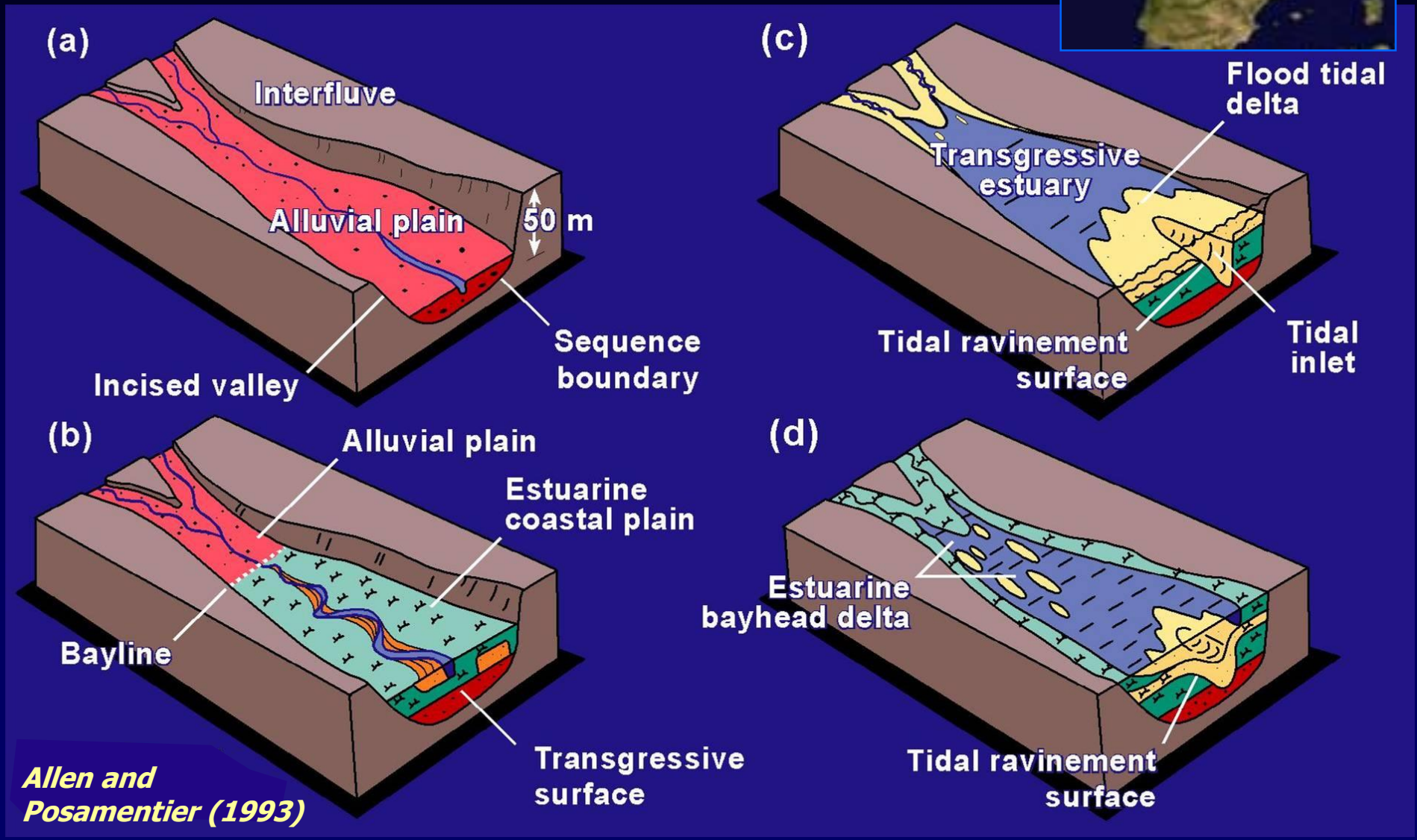




Cleveland Incised-Valley Model



Gironde Estuary



Allen and Posamentier (1993)

Shoreline Curvature and Tidal Regime

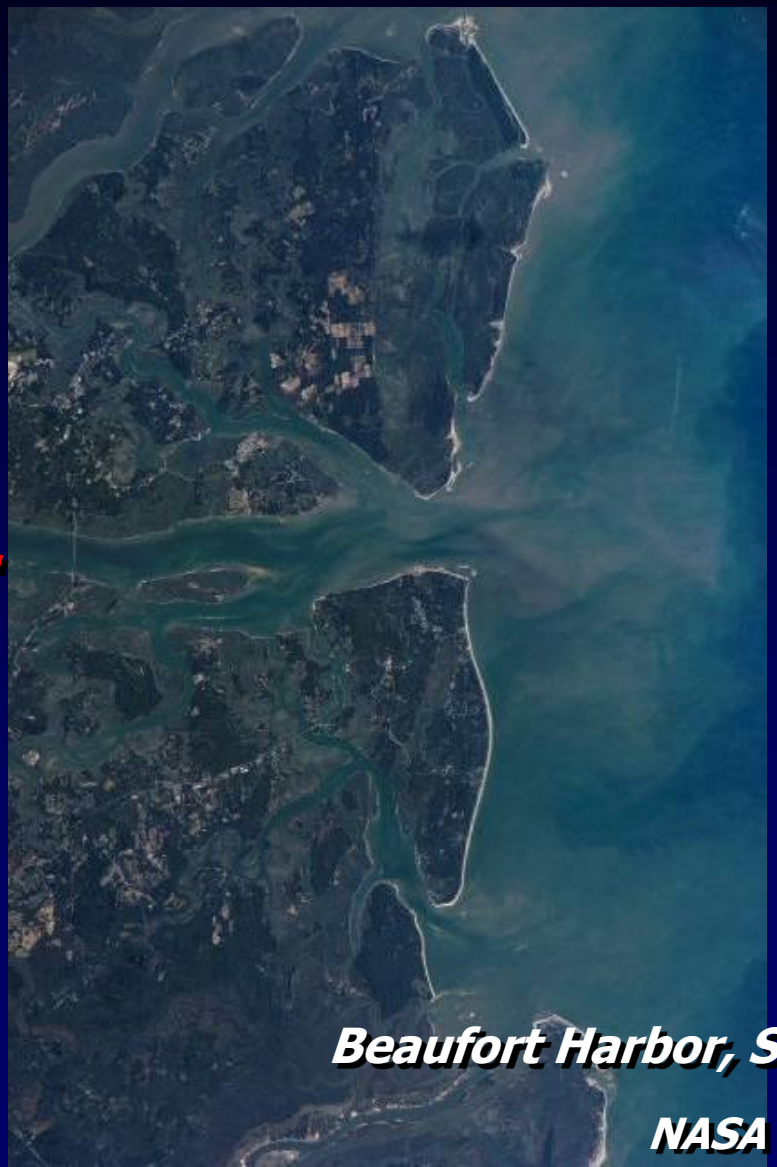
SE US Atlantic Coast

Tidal Regime

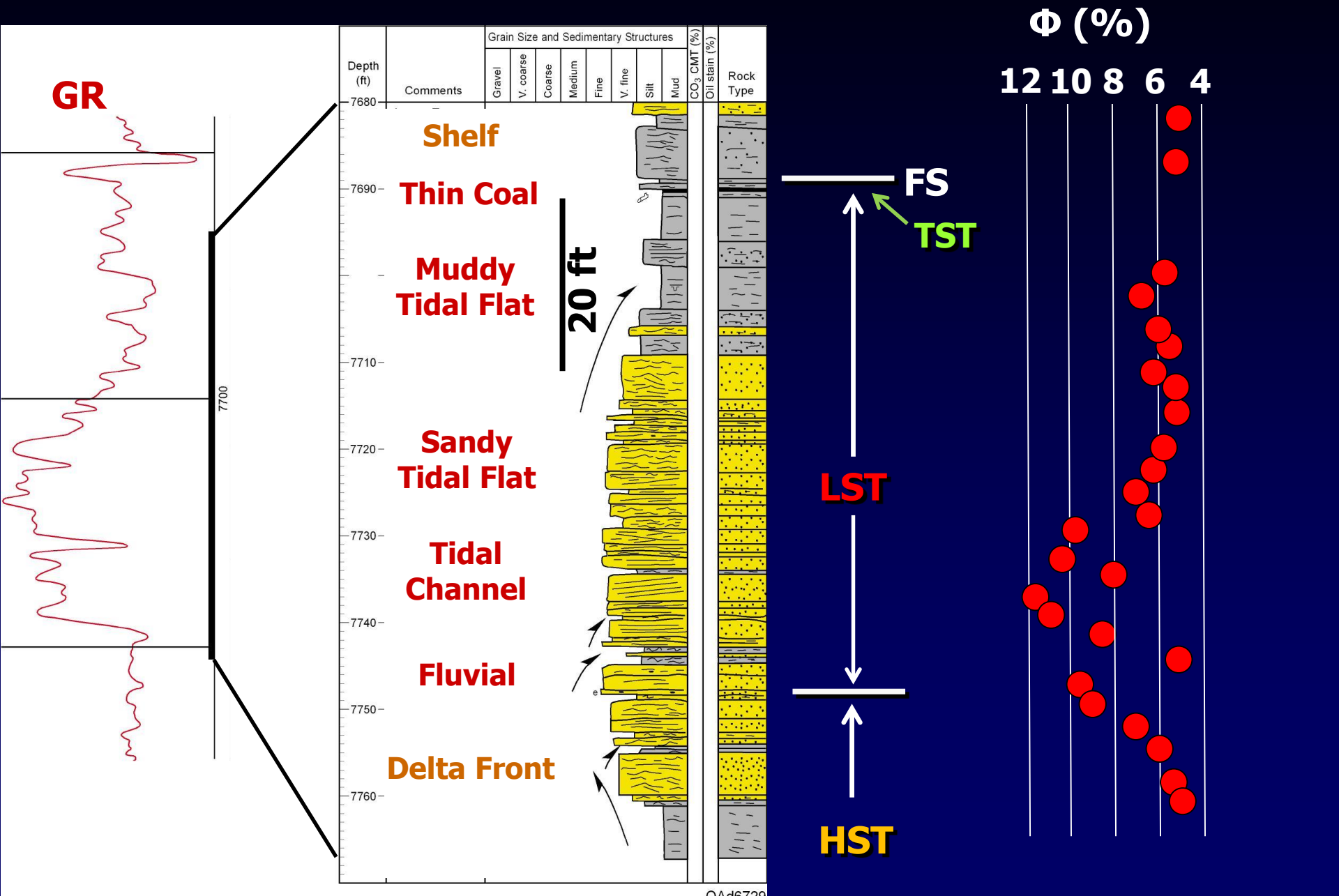
Diurnal Range (m)

Microtidal (0-2 m)
Mesotidal (2-4 m)
Macrotidal (>4 m)

Macrotidal

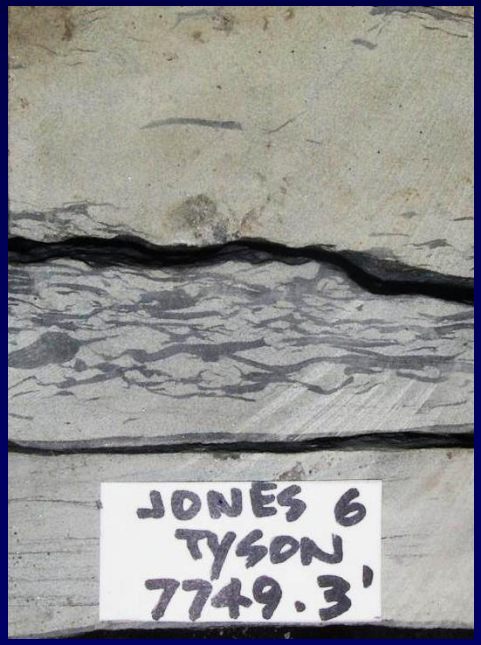


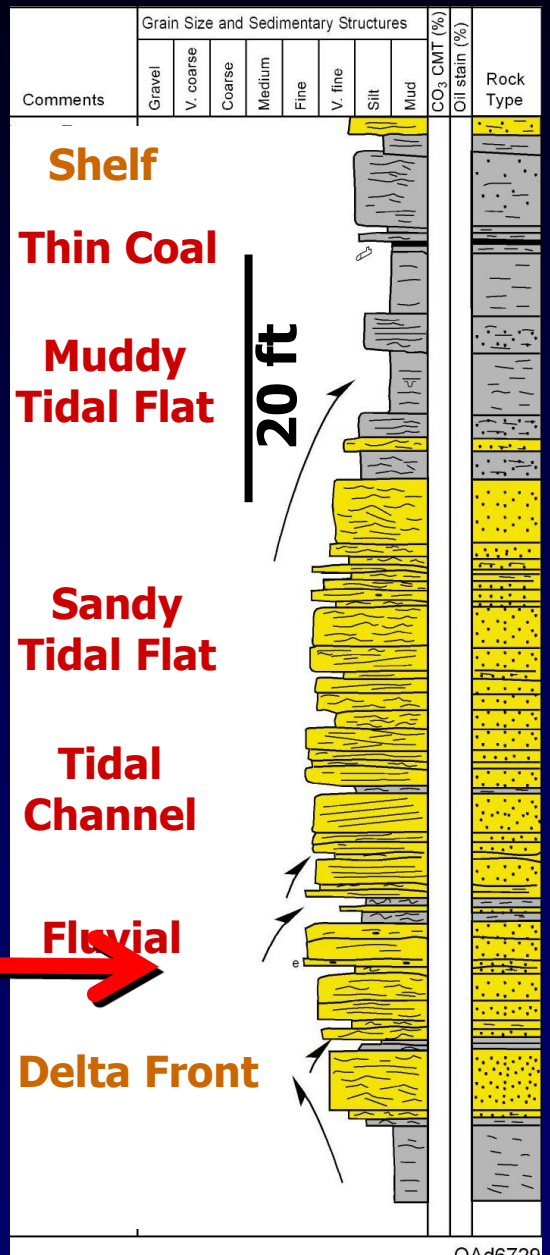
Jones Energy #6 Tyson

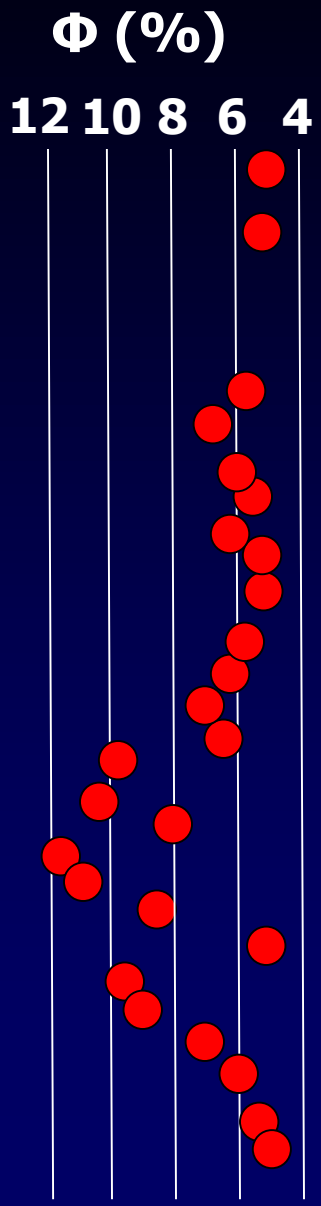


Jones Energy #6 Tyson

2 in







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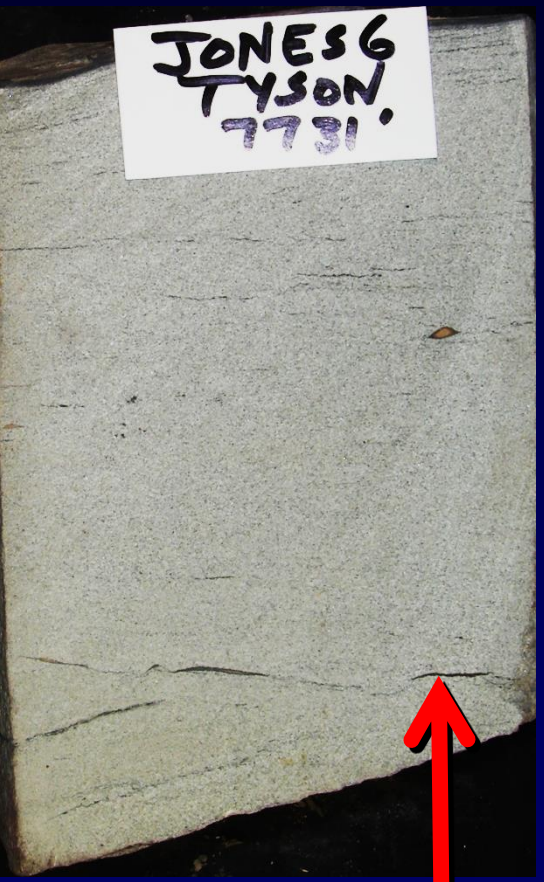
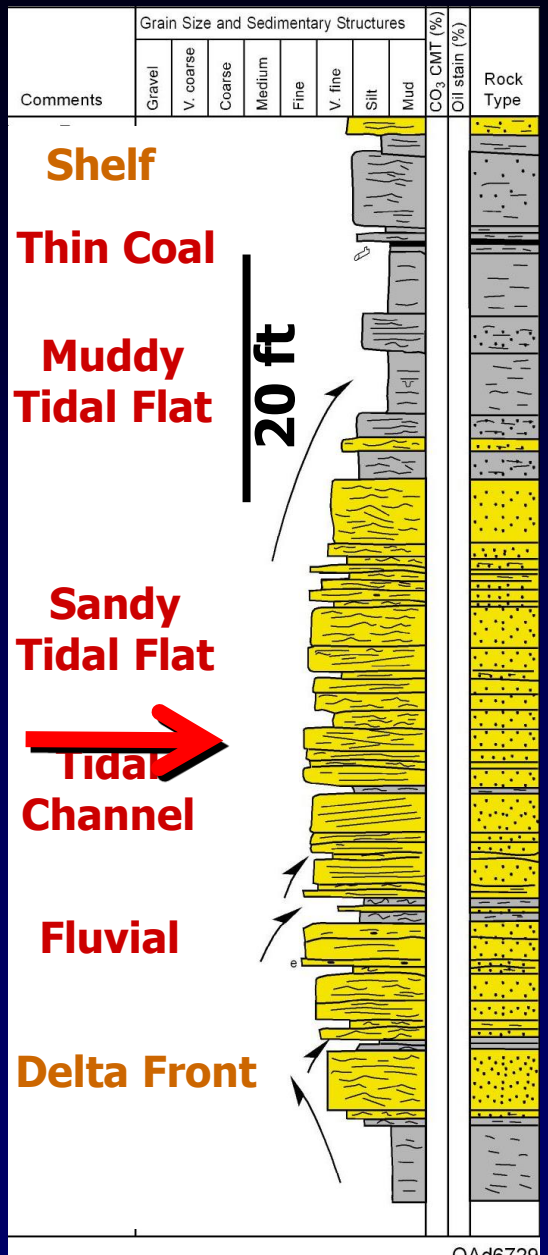


Erosional contact

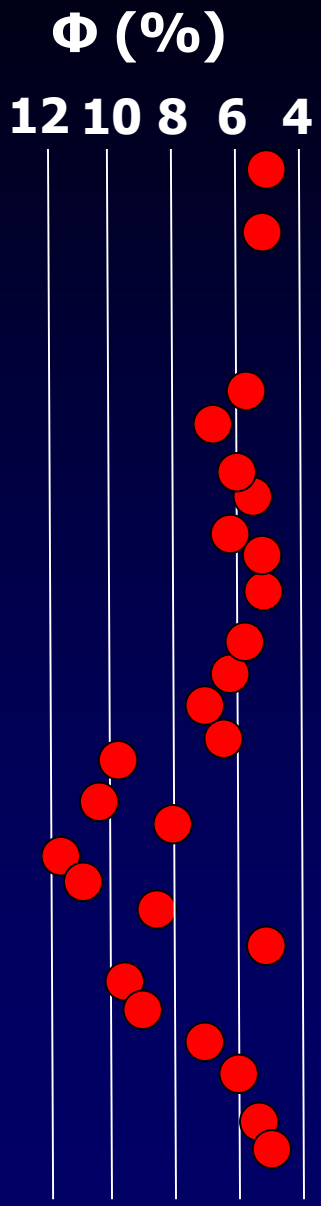


FS

TST

LST

HST



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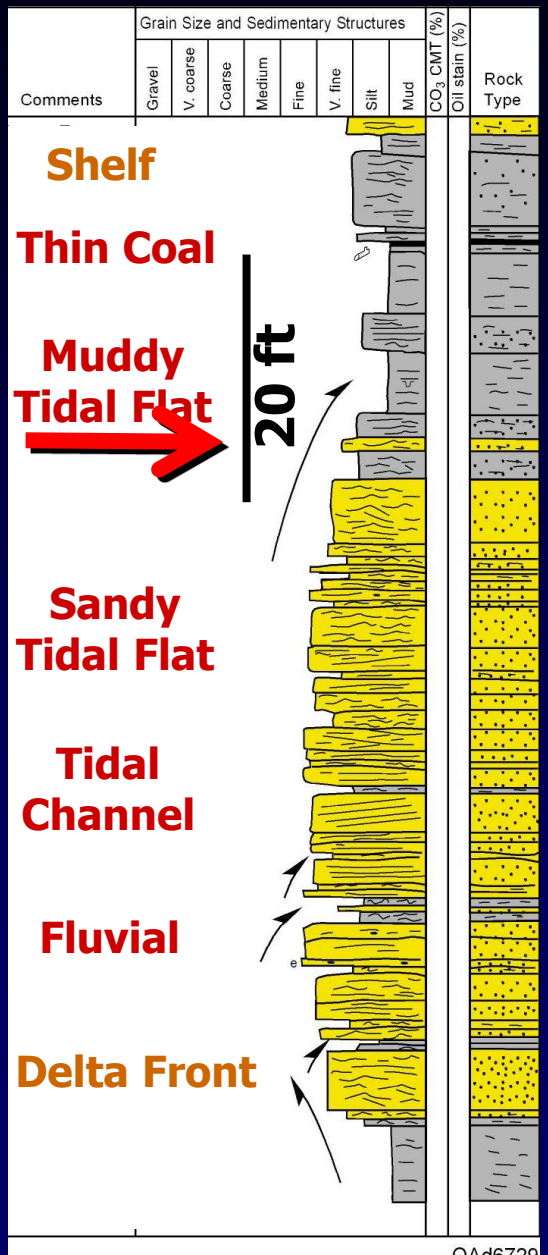

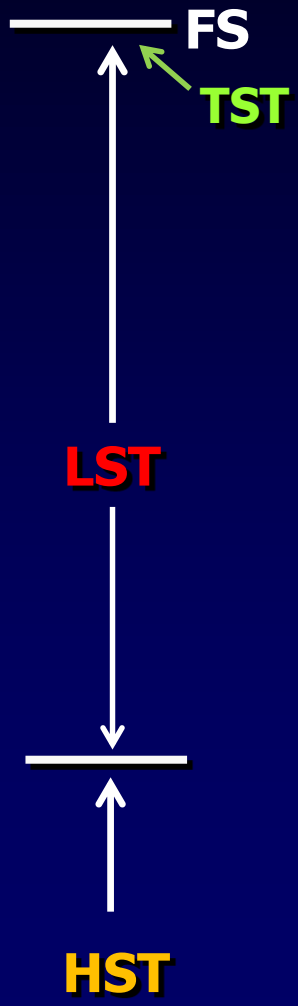

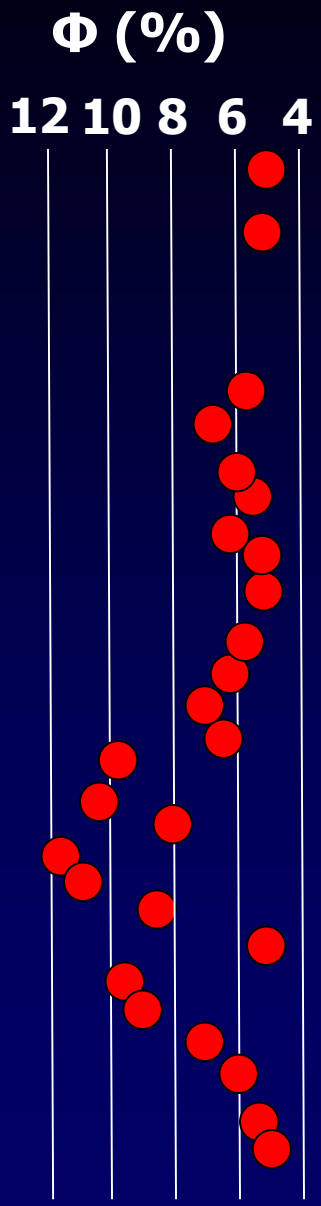

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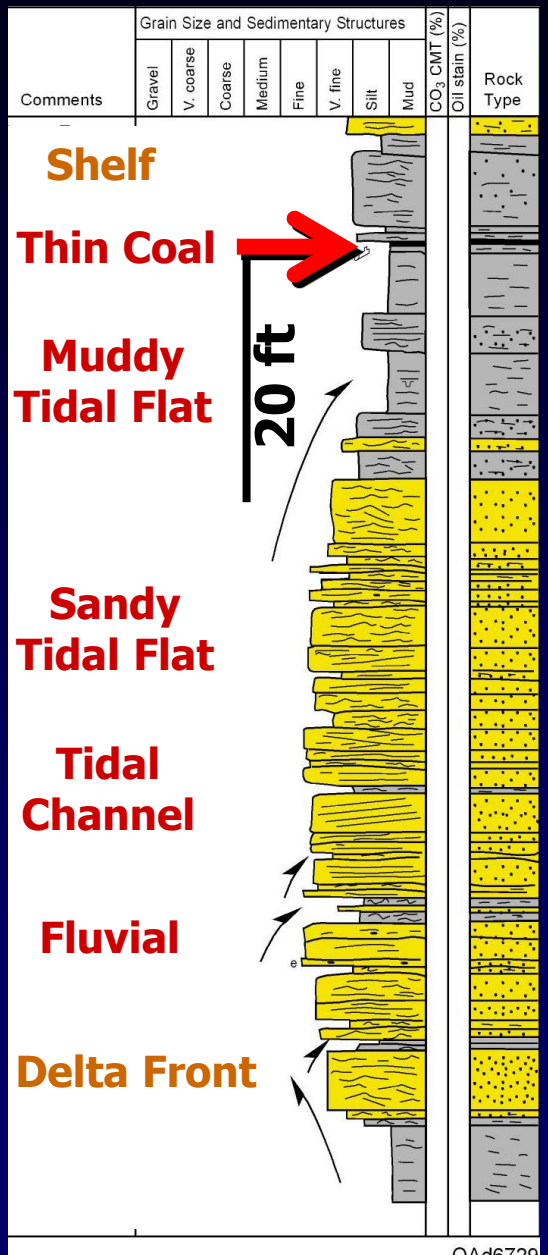
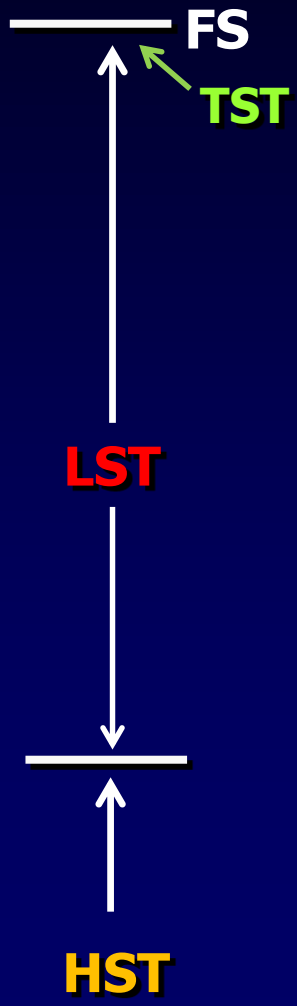
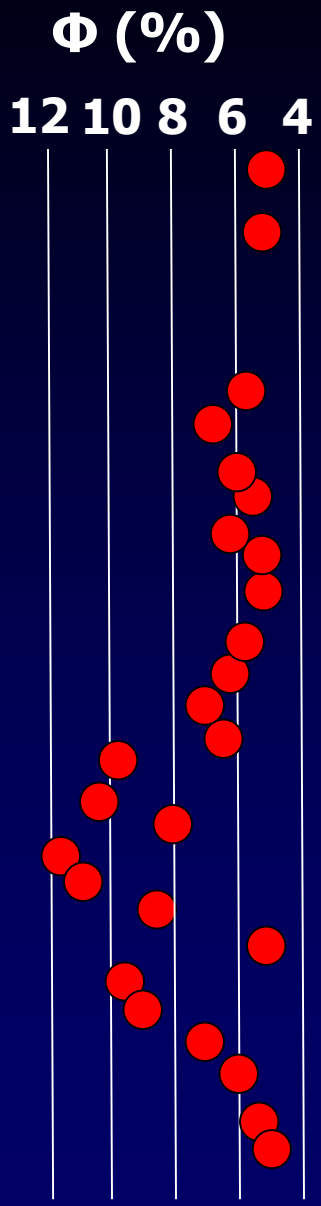
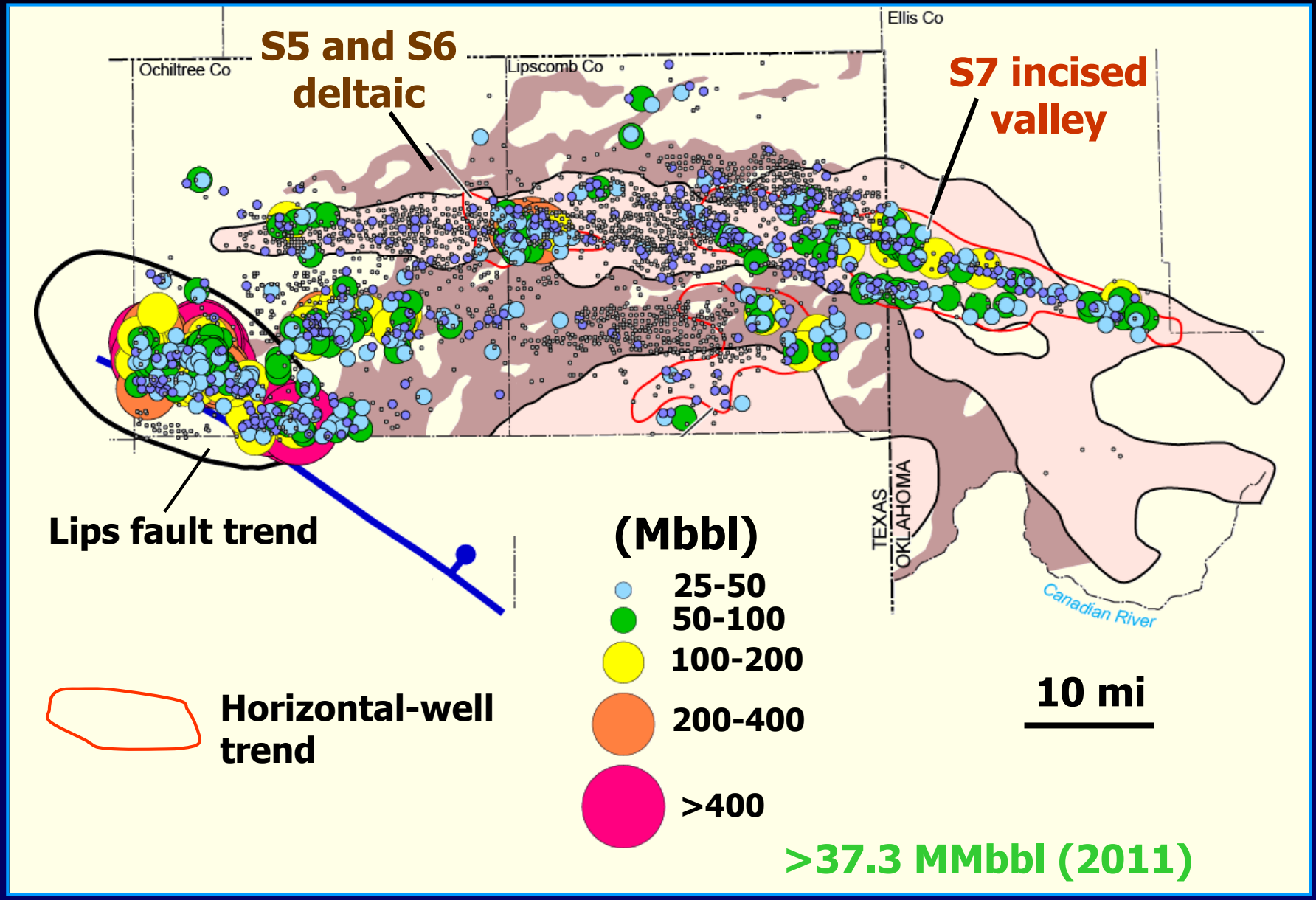


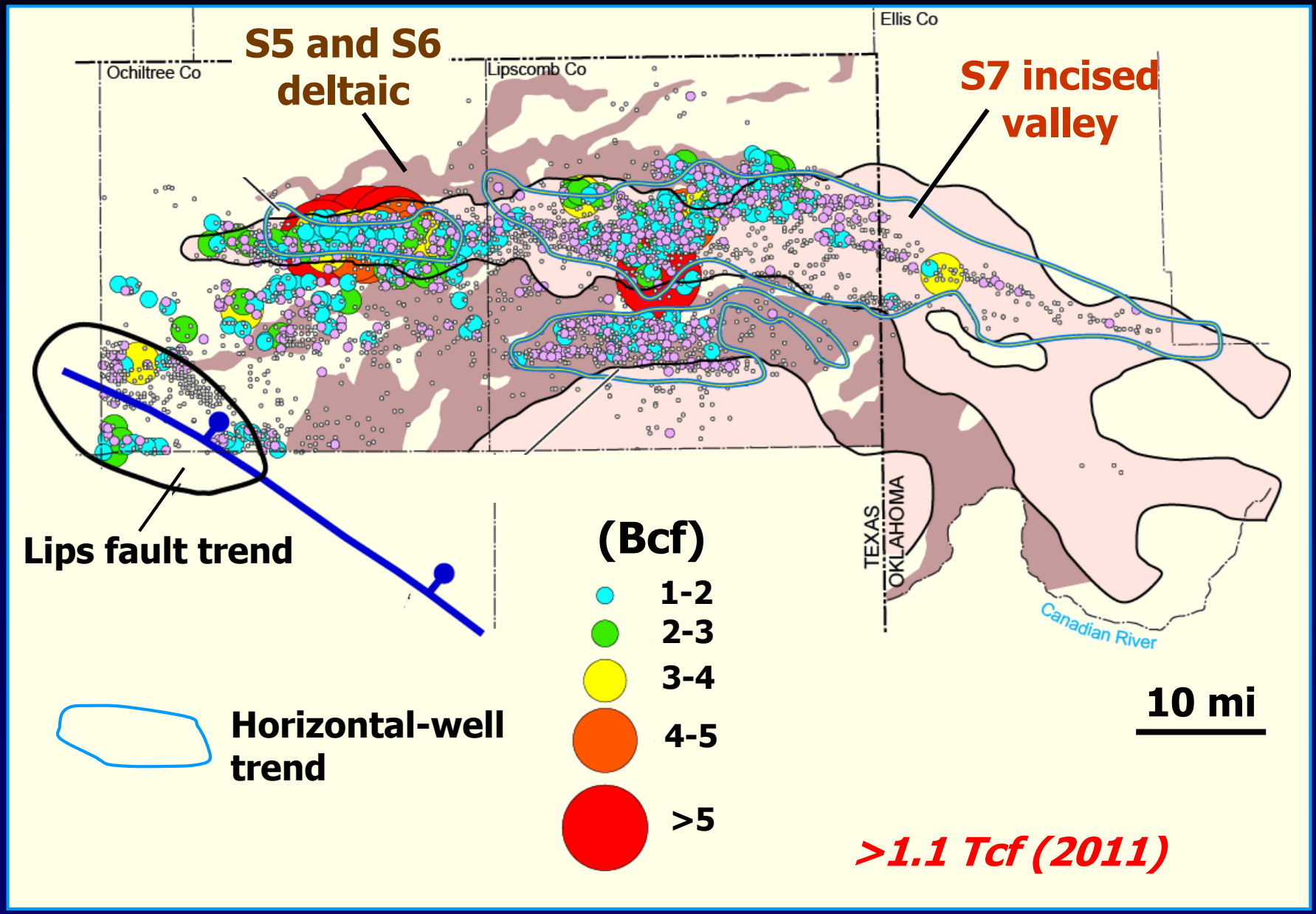




Cumulative Cleveland Oil Production



Cumulative Cleveland Gas Production



Summary

- Irregular shelf (or ramp) topography
- Tidally influenced shelf and IVF systems
- Controls on hydrocarbon accumulation:

  (1) incised-valley-fill deposits

  (2) up-structure pinch outs and faults