Stratigraphy and Sedimentary Facies of the Eagle Ford Shale (Cretaceous) between the Maverick Basin and the San Marcos Arch, Texas, USA*

John A. Breyer[1], Richard Denne[2], Jonathan Funk[2], Tobi Kosanke[2], and Joan Spaw[2]

Search and Discovery Article #50899 (2013)**
Posted December 9, 2013

*Adapted from oral presentation presented at AAPG Annual Convention and Exhibition, Pittsburgh, Pennsylvania, May 19-22, 2013

[1]Marathon Oil Company, 5555 San Felipe, Houston, TX 77056 (jabreyer@marathonoil.com)
[2]Marathon Oil Company, 5555 San Felipe, Houston, TX 77056

Abstract

The main part of the Eagle Ford play extends along strike from the San Marcos arch in the northeast into the Maverick basin along the international border with Mexico. The highest initial production is in a strike-parallel belt basinward of the Karnes trough and landward of the Cretaceous shelf margin. Three lithologies comprise the bulk of the Eagle Ford Shale in this area: argillaceous mudrock (shale), calcareous mudrock (marl), and limestone. The marls consist mainly of coccoliths and contain more total organic carbon (TOC) than the other lithologies. The sand- and silt-sized grains in the marls and limestones consist predominantly of planktonic foraminifera with lesser amounts of inoceramid fragments and other carbonate grains. The limestones may be partially to entirely recrystallized. The strength and rigidity of the rocks increase with calcite content—the limestones are stronger and more rigid than the marls. Argillaceous mudrocks (shale) comprise only a small portion of the Eagle Ford between the San Marcos arch and the Maverick basin, but are more common in the lower part of the formation and along strike to the northeast.

Seven stratigraphic intervals can be recognized and mapped within the Eagle Ford Shale between the San Marcos arch and the Maverick basin. Significant changes in major and trace element concentration mark the boundaries of these intervals. The boundary between the Upper and Lower Eagle Ford as commonly picked on well logs is below the Cenomanian-Turonian boundary. Typically, the Upper Eagle Ford contains less vanadium, molybdenum, uranium, and TOC than the Lower Eagle Ford, indicating bottom water oxygen levels were higher during its deposition. Isopach maps show that the Eagle Ford as a whole and each of its major subdivisions thin across an area in southwestern Karnes County. The percentage of limestone within the Eagle Ford and each of its major subdivisions increases over this area. Southwestern Karnes County sits above a high on a time-structure map on the top of the Buda. Changes in thickness and facies within the Eagle Ford suggest the area above this high on the time-structure map was a topographic high on the sea floor and furthermore that changes in bathymetry influenced facies distribution and ultimately production from the Eagle Ford Shale.

References Cited

Harbor, R.L., 2011, Facies characterization and stratigraphic architecture of organic-rich mudrocks, Upper Cretaceous Eagle Ford Formation, South Texas: M.S. Thesis, University of Texas at Austin, 184 p.

Reed, R.M., and S.C. Ruppel, 2012, Pore Morphology and Distribution in the Cretaceous Eagle Ford Shale, South Texas, USA: GCAGS Transactions, p. 599-603.

Stratigraphy and Sedimentary Facies, Eagle Ford Shale (Cretaceous), South Texas, USA

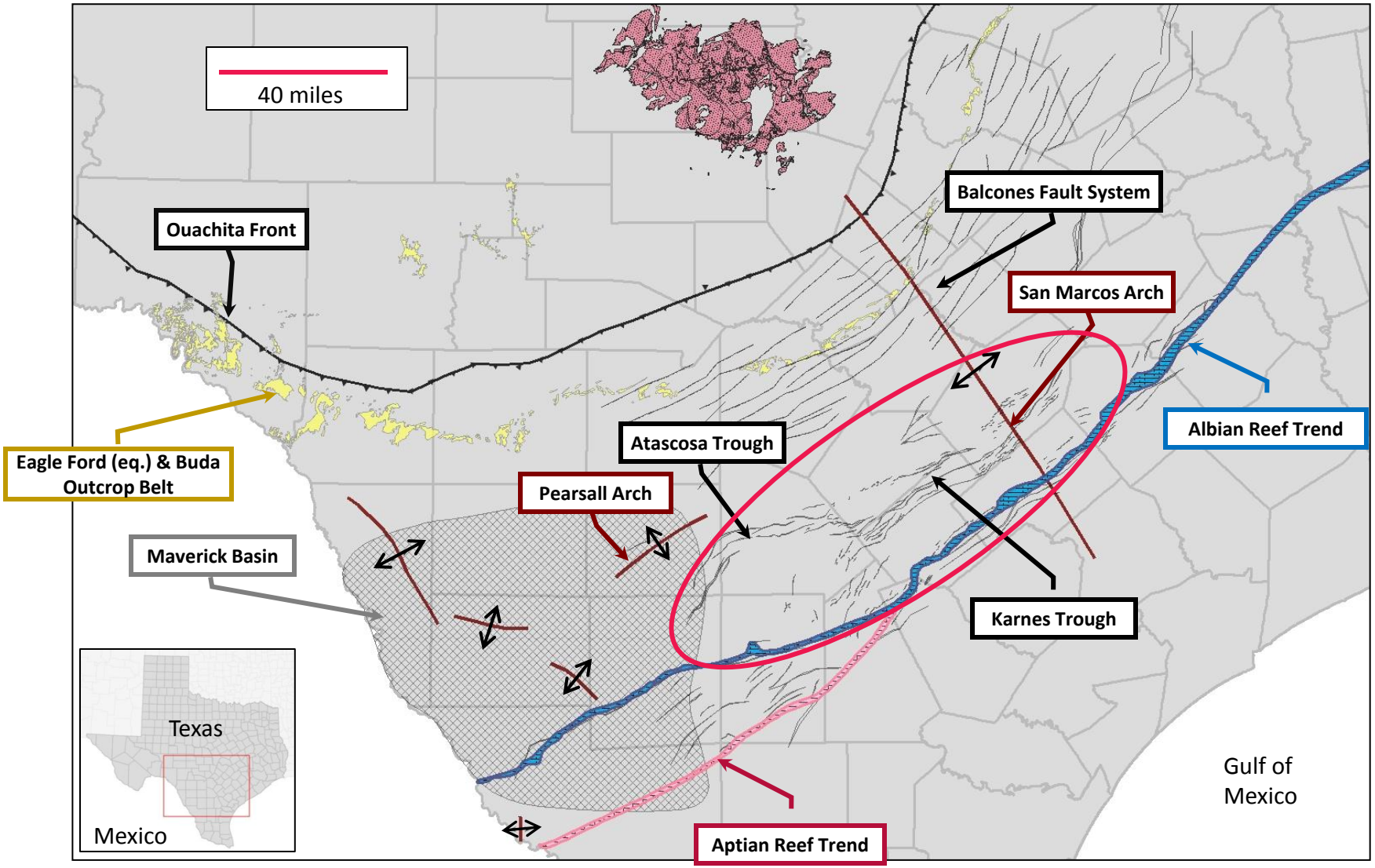
[1] John Breyer, Richard Denne, Jonathan Funk, Tobi Kosanke and Joan Spaw

[1] Marathon Oil Company, 5555 San Felipe, Houston, TX 77056

Marathon Oil®

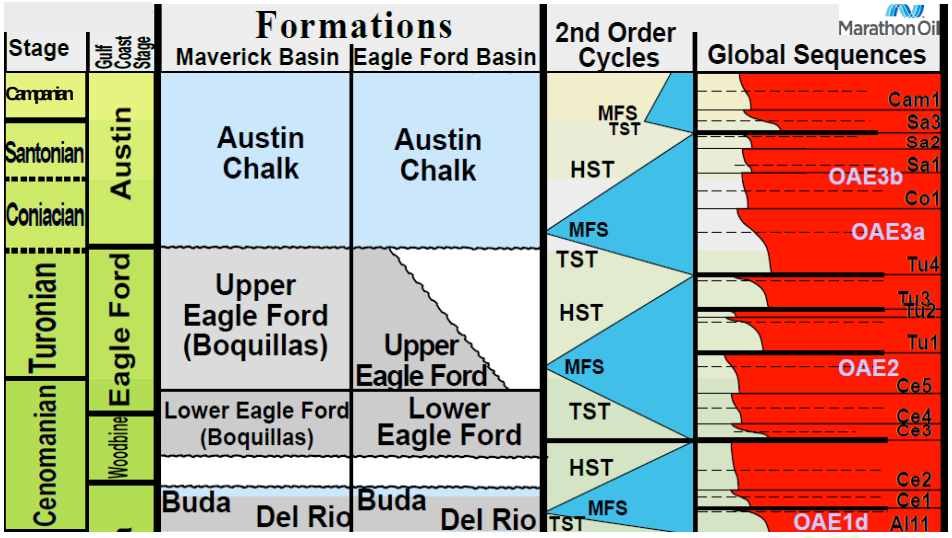
The Eagle Ford Play

Geographic and Geologic Setting

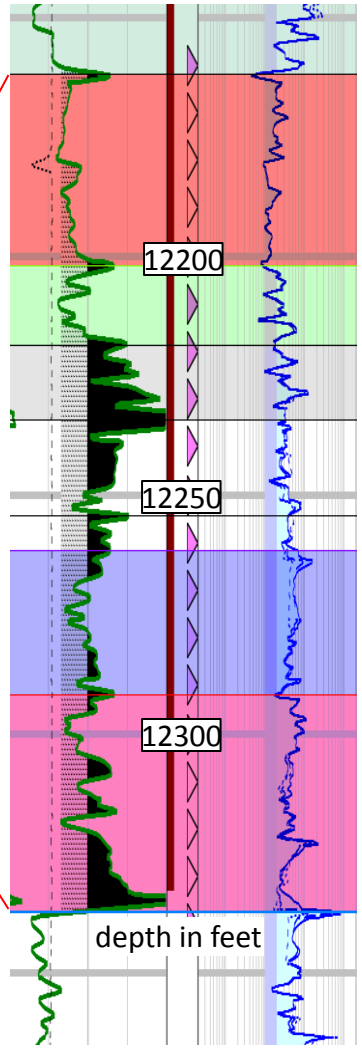


Marathon Stratigraphy

Chronostratigraphic Chart (Upper Cretaceous)



Type Log



Austin

EGFD 500

EGFD 400

EGFD 300A

EGFD 300B

EGFD 300C

EGFD 200

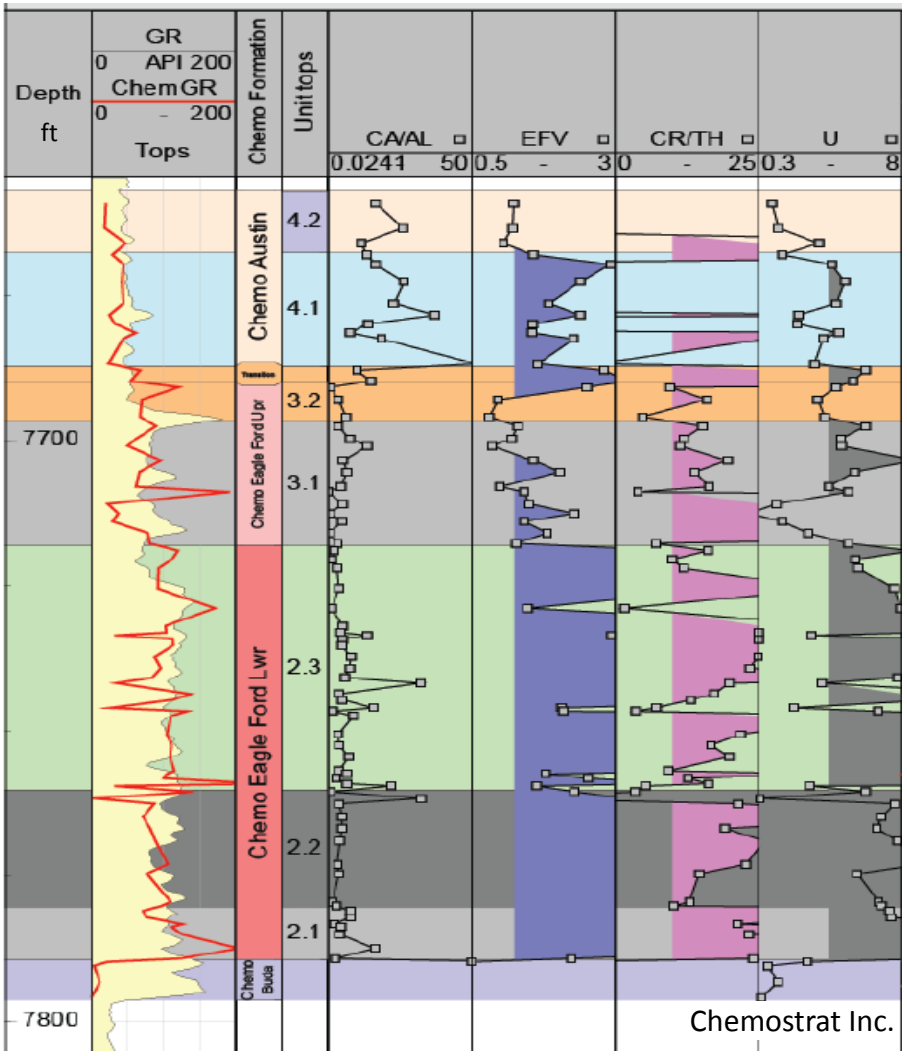
EGFD 100

Buda

Upper EGFD

Lower EGFD

Chemostratigraphy



High EFV implies anoxic/dysoxic conditions

Consistent with higher TOC

AUSTIN

EGFD500

EGFD400

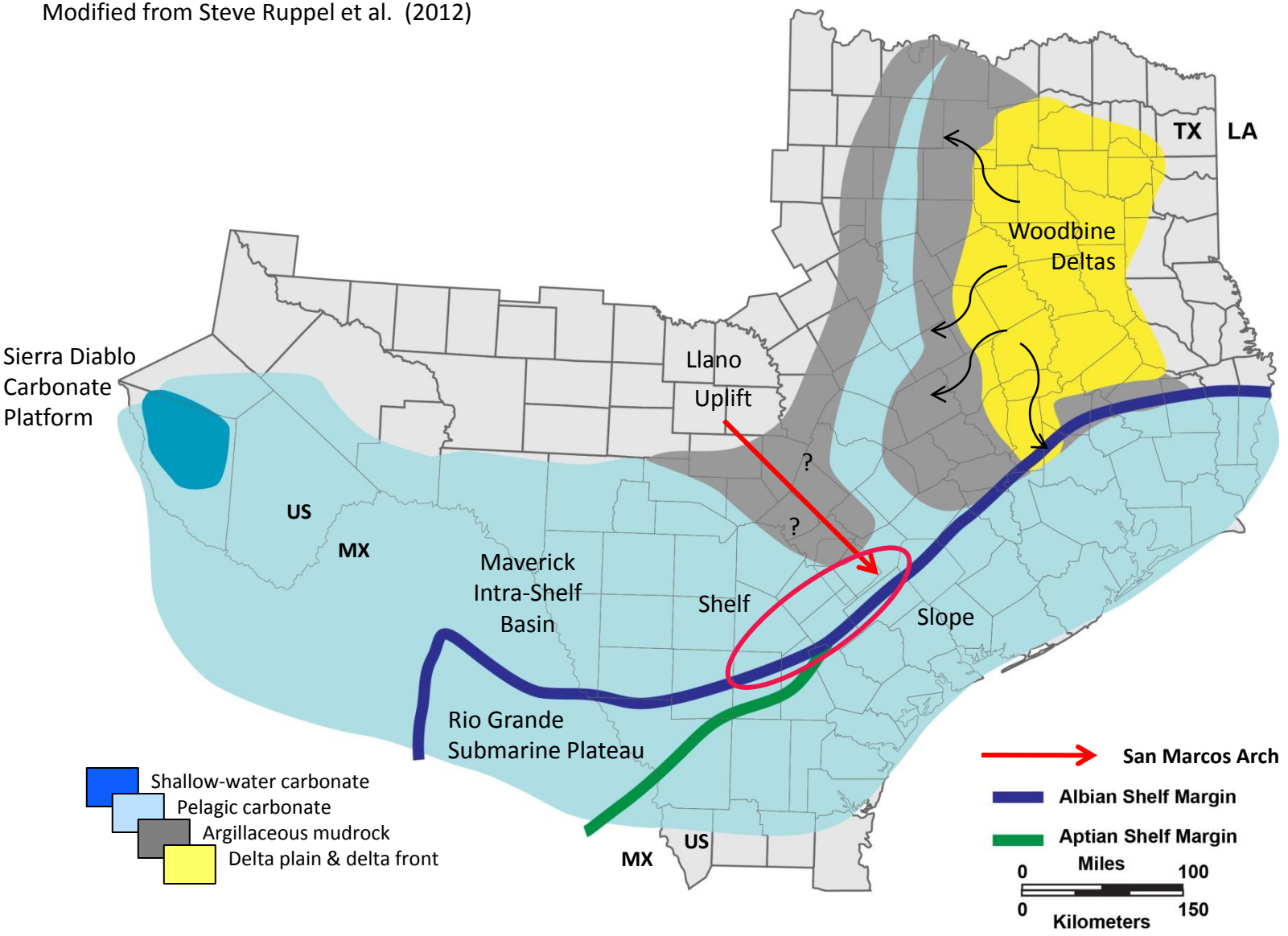
EGFD 300
&
EGFD200

EGFD100

BUDA

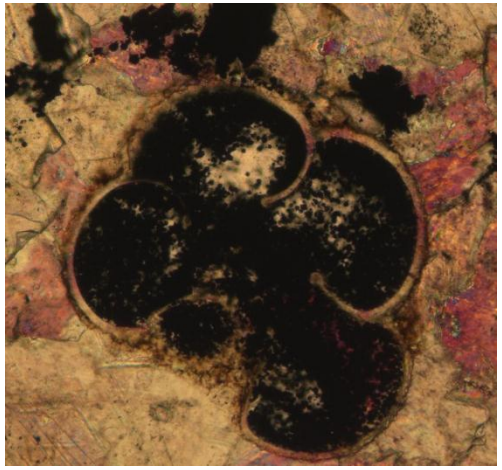
Regional Depositional System

Modified from Steve Ruppel et al. (2012)

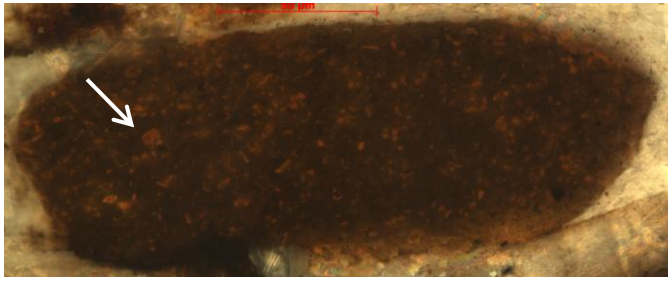


Lower Eagle Ford Distal and Mid-Shelf Fauna

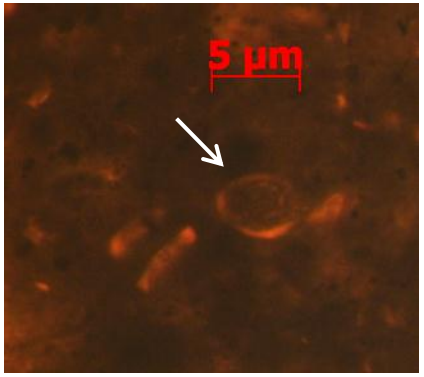
Planktonic



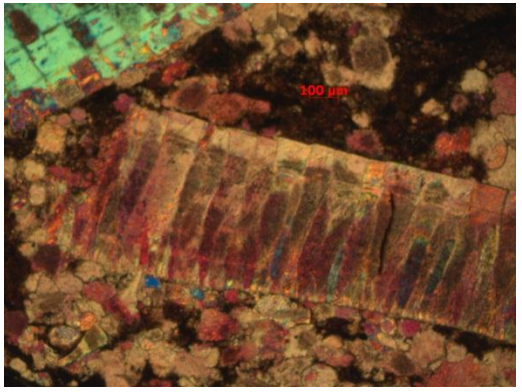
forams



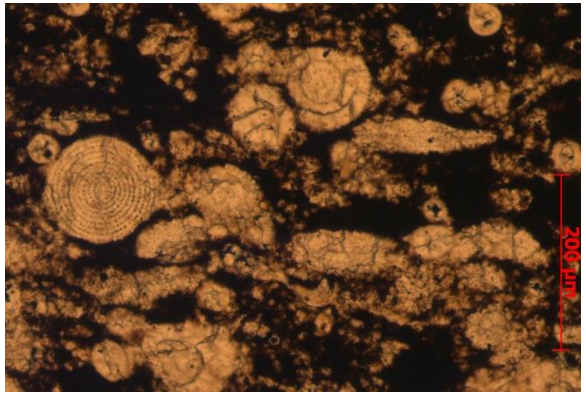
coccoliths in fecal pellet



Benthonic



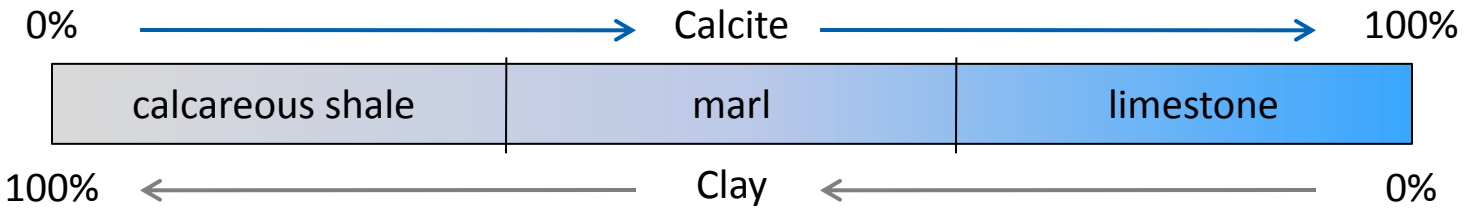
inoceramids

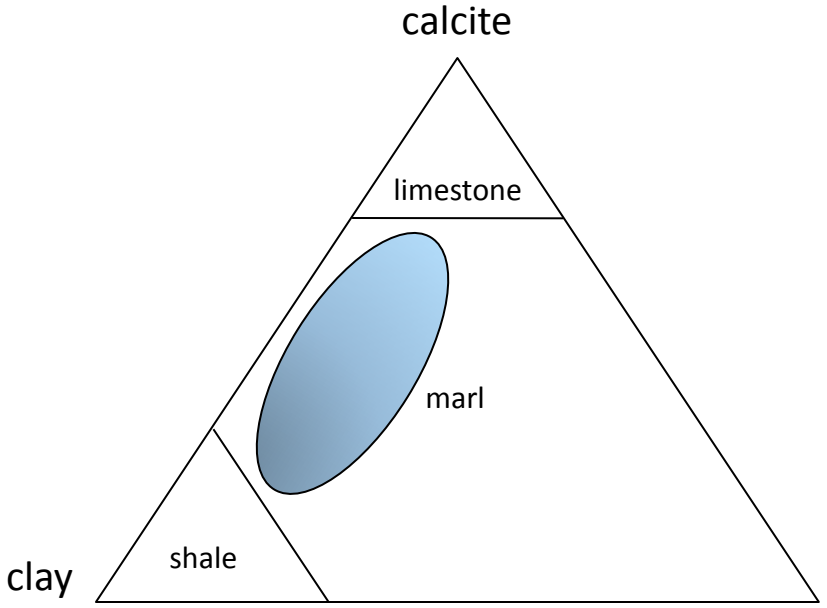


radiolarians and calcispheres

Lithology

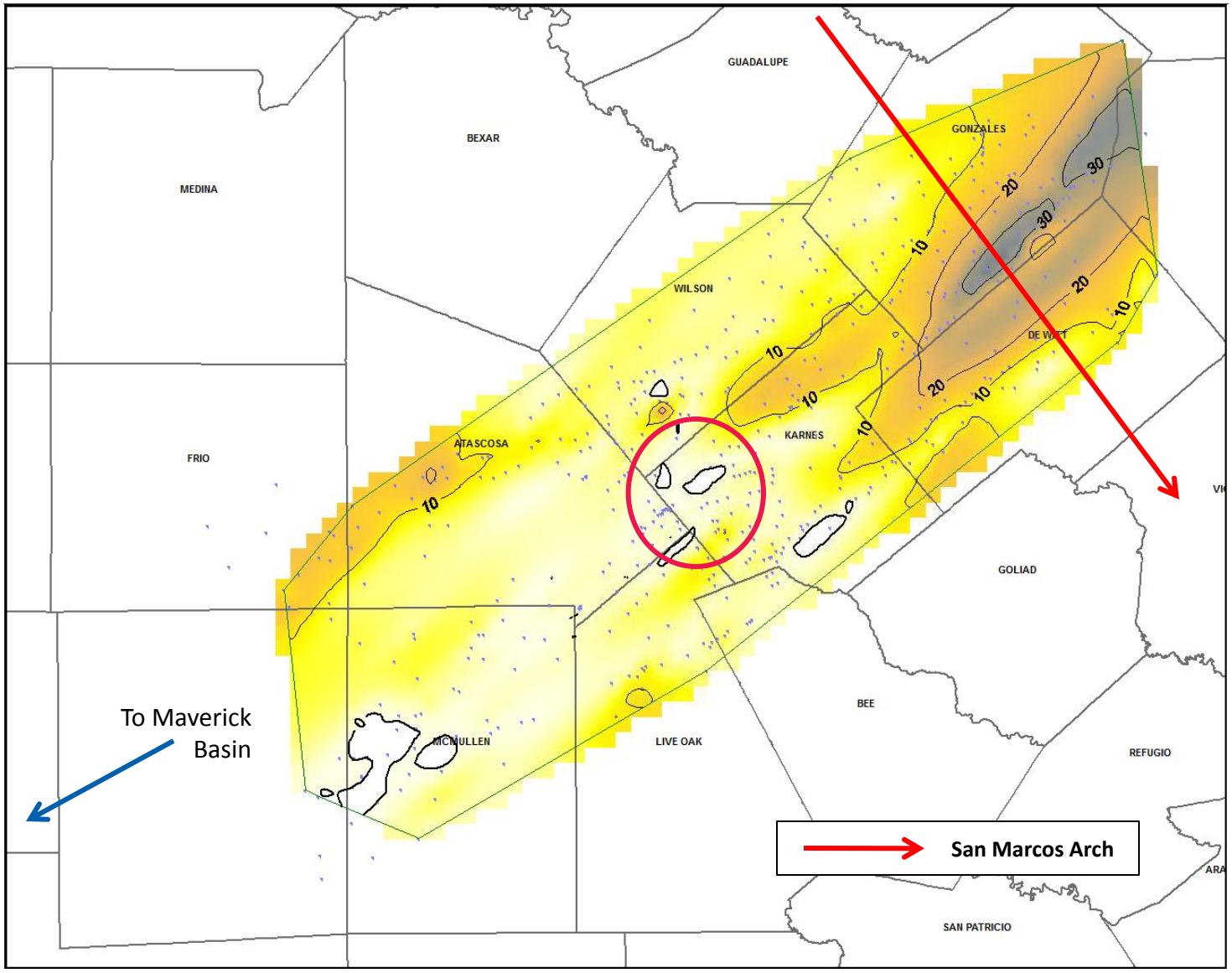
Two Component System





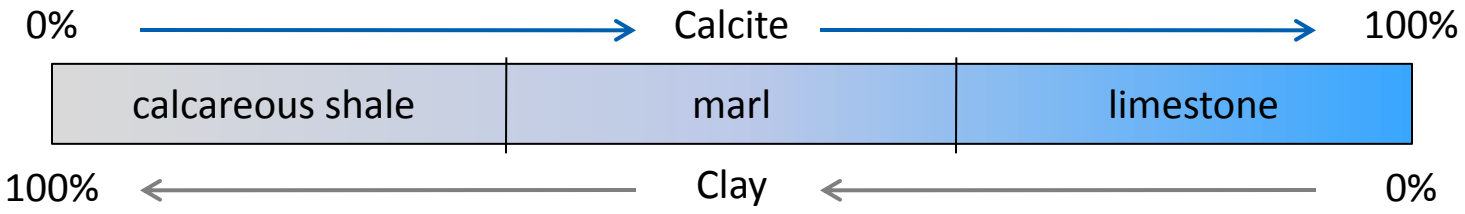
Other:
quartz
feldspar
organic matter
pyrite
etc.

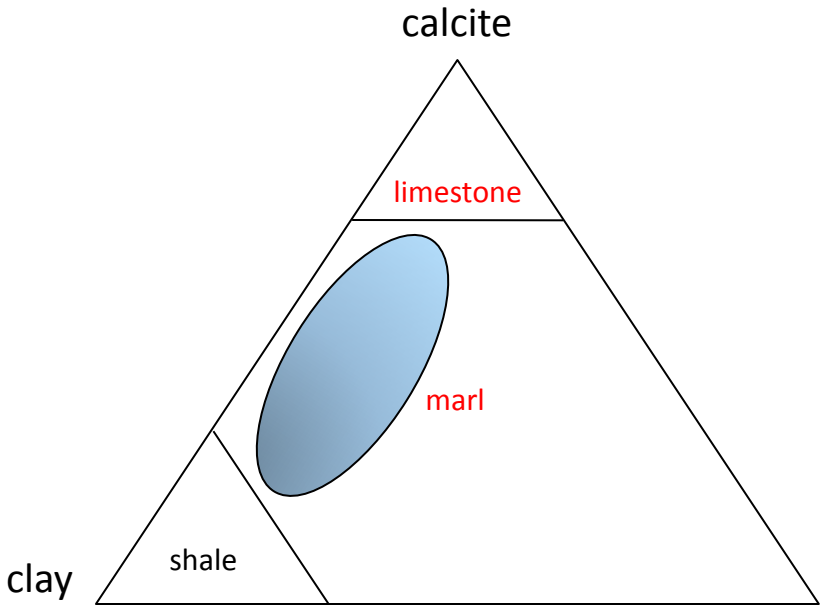
Argillaceous Mudrocks/Calcareous Shale



Lithology

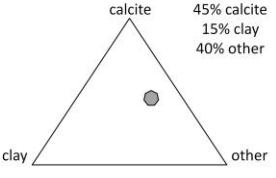
Two Component System

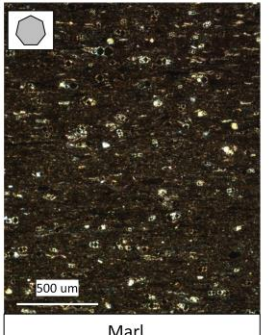




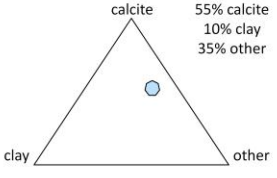
Other:
quartz
feldspar
organic matter
pyrite
etc.

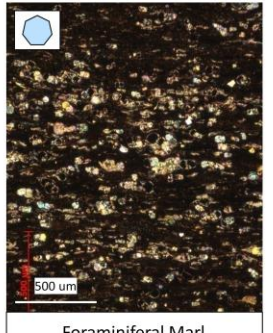
Marls



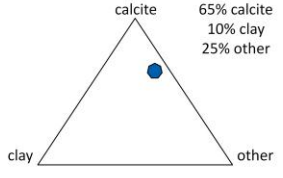


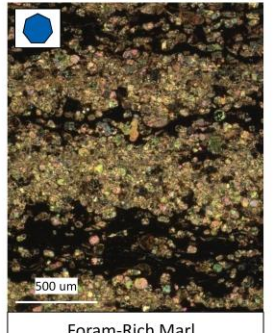
Marl





Foraminiferal Marl

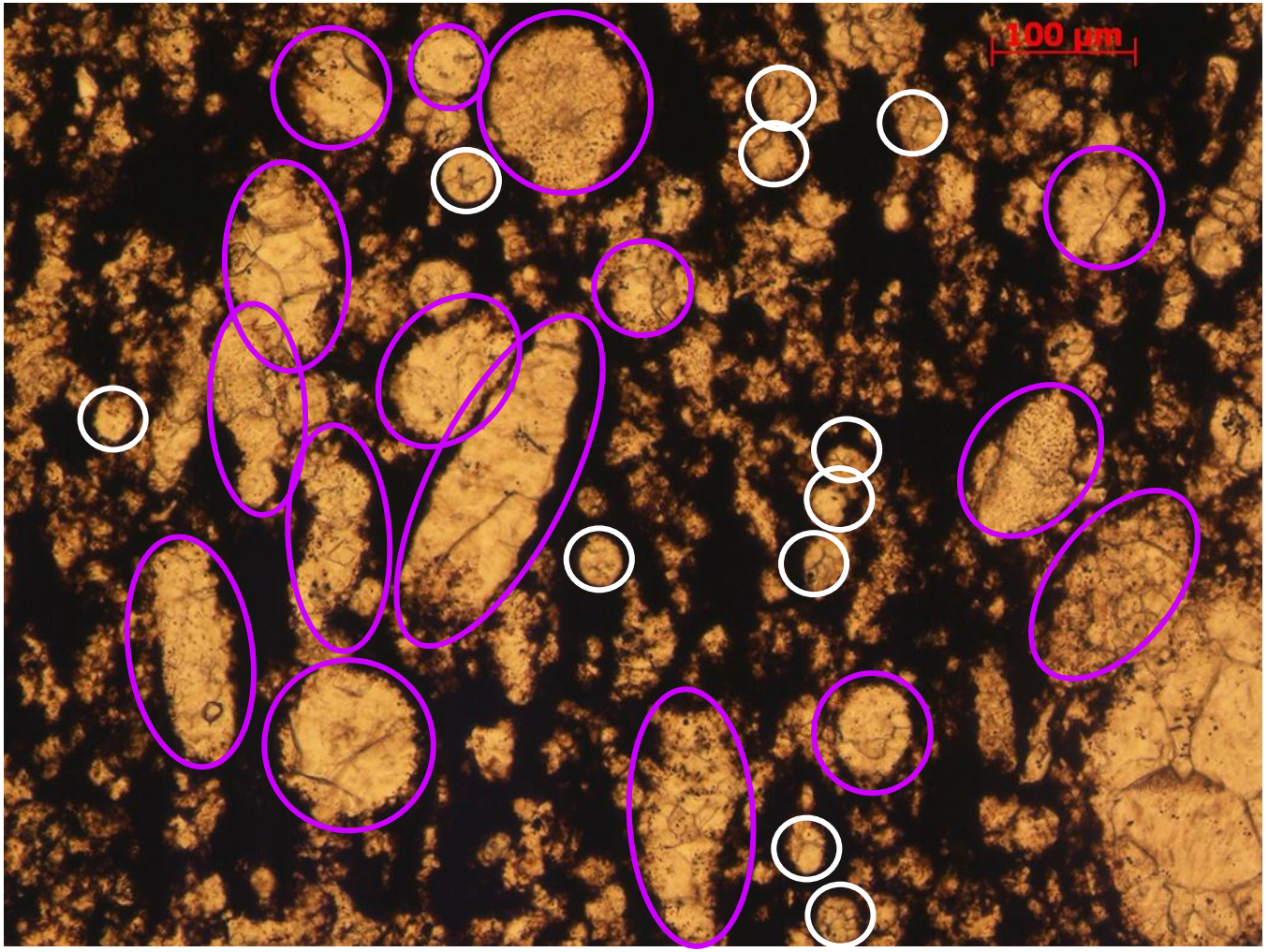




Foram-Rich Marl

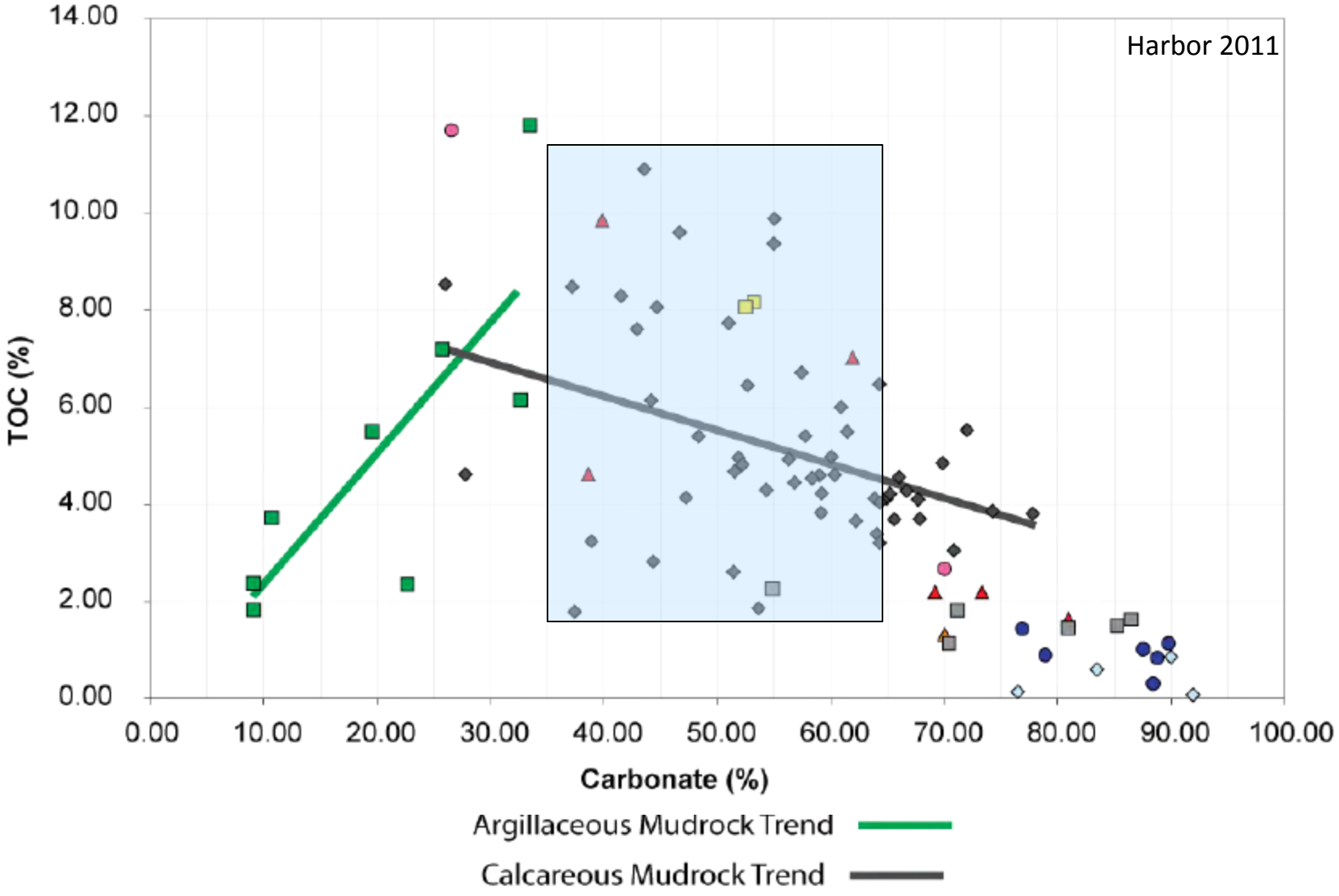
Presenter's notes: Limestones have calcified radiolarians and calcispheres in addition to forams. Marls generally lack both of these types of fossils.

Limestones



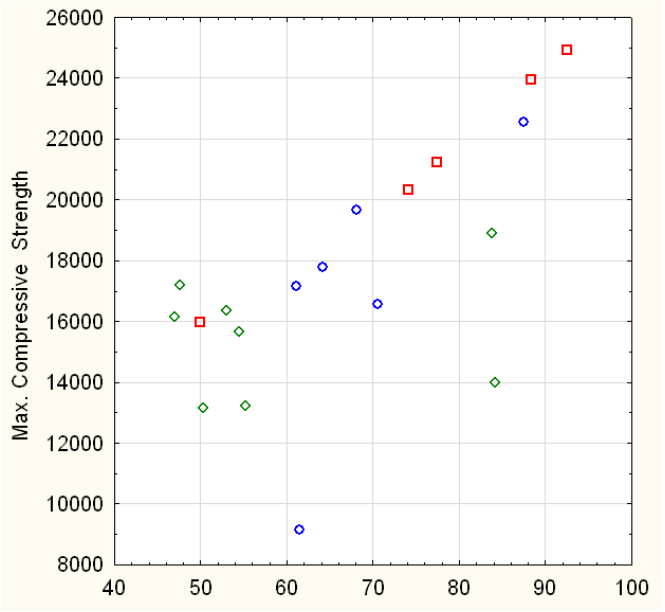
XRF Analysis: Calcite 82% Quartz 9% Clay 4% Other 5%

Lithology and TOC

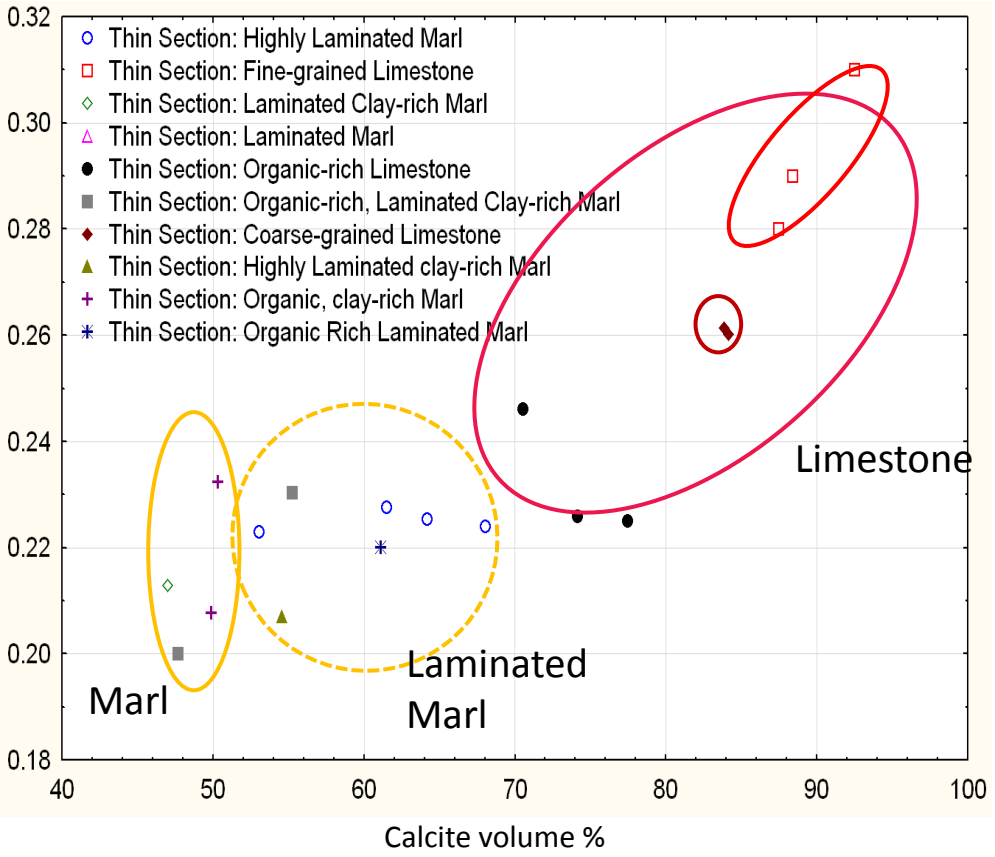


Lithology and Geomechanical Behavior

Maximum Compressive Strength



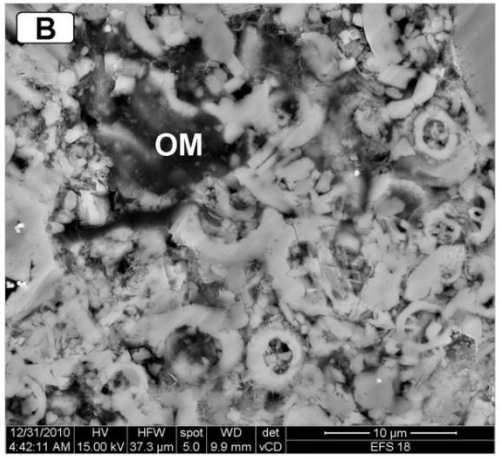
Poisson's Ratio (Vertical)



Measurements from Marathon Tech Lab

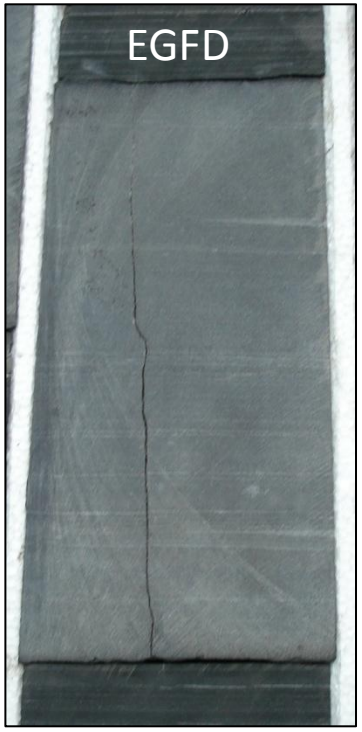
Rationale for Facies Scheme

Reservoir Quality



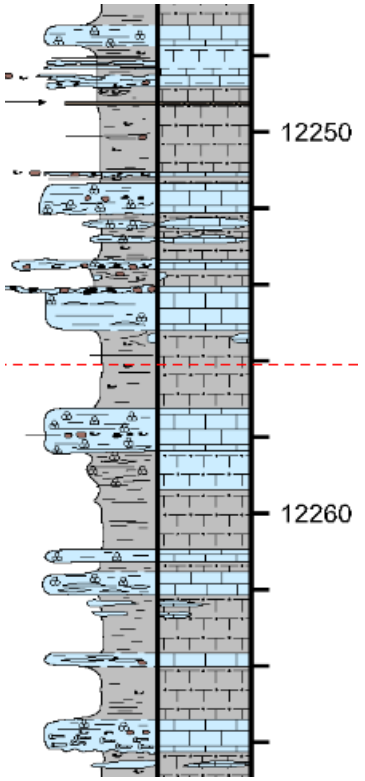
SEM photomicrograph CoreLab

Completions Quality

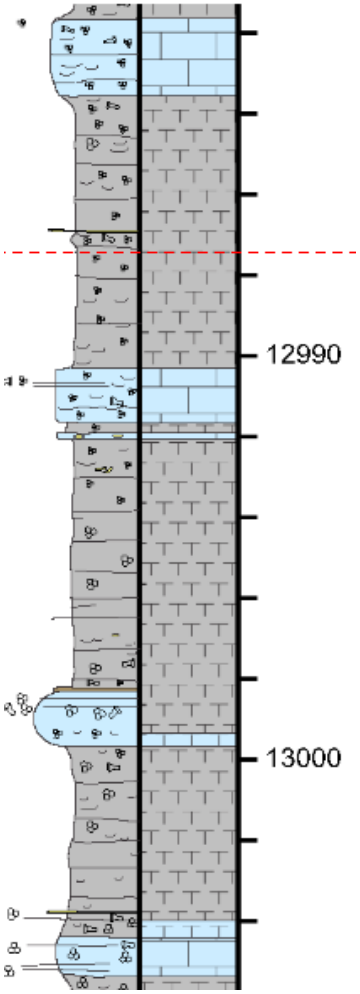


core photograph

Interbedding of Limestone and Marl



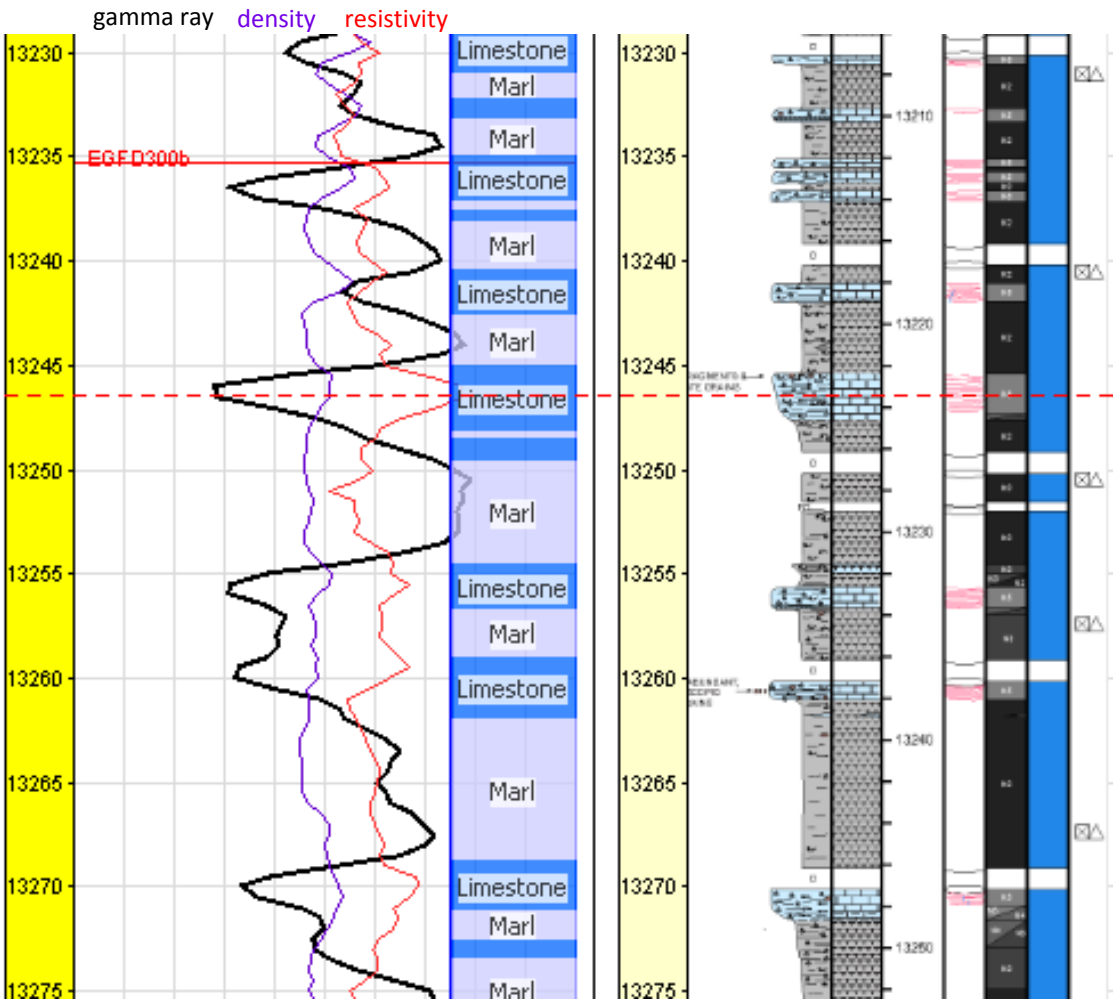
CoreLab



Depth in feet

EGFD300b top

Defining and Mapping Facies

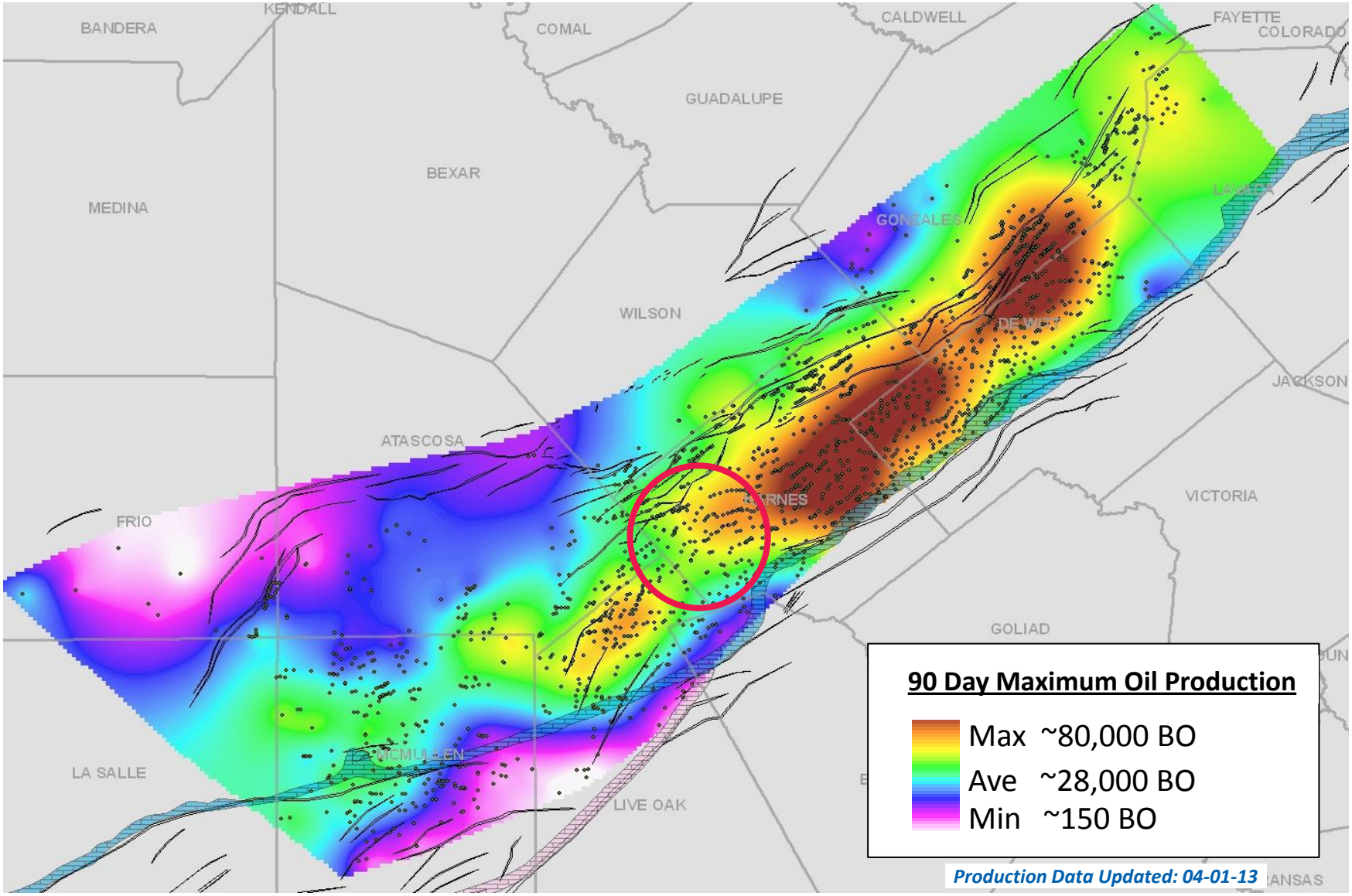


iPoint Thin-Bed-Analysis

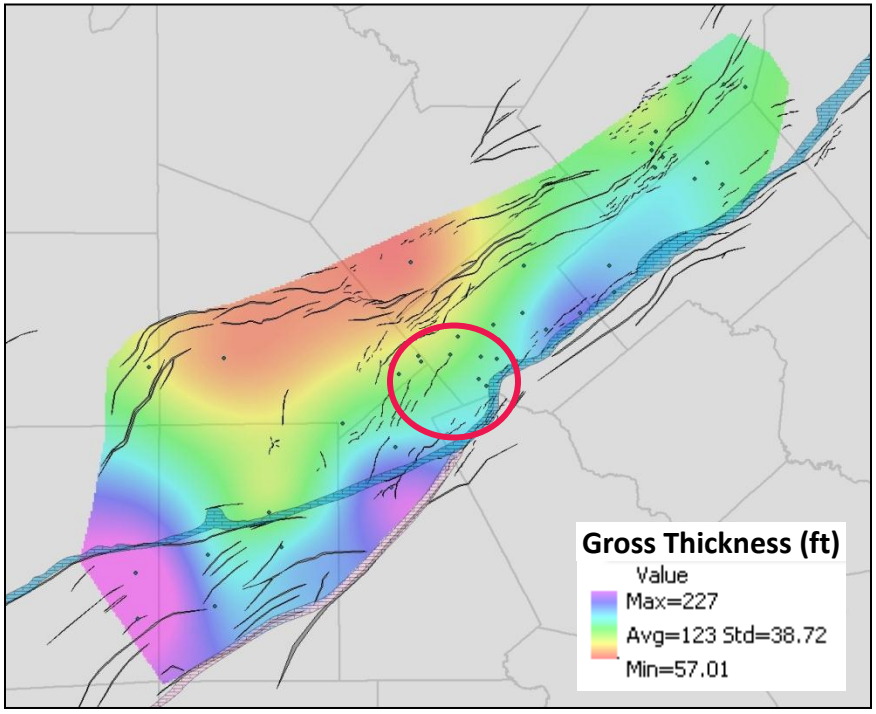
For each lithology in each stratigraphic interval:

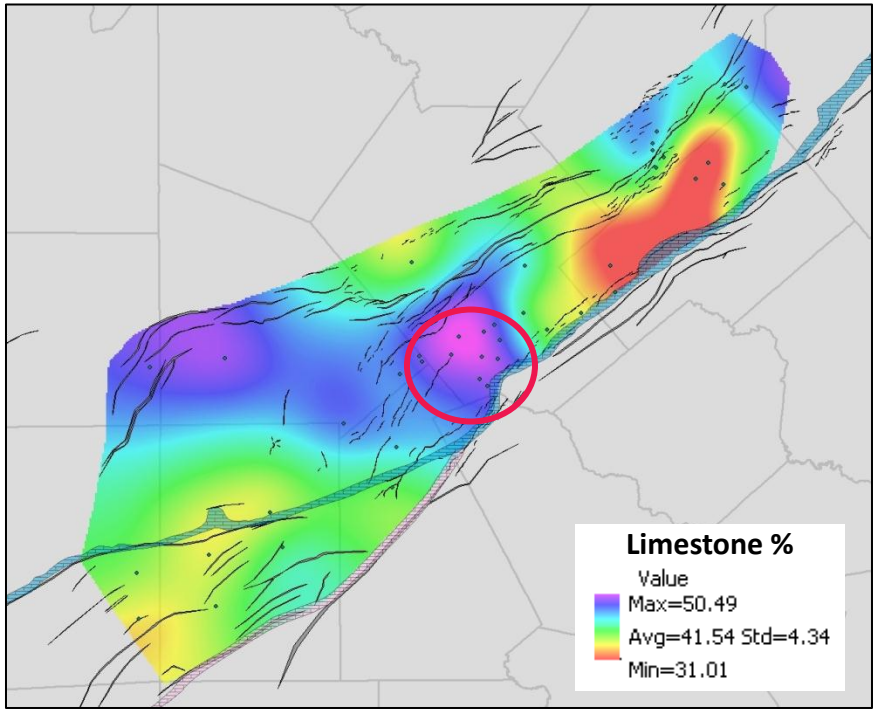
- Thickness
- Percentage ★
- Number of beds
- Spacing of beds ★
- Average bed thickness
- Maximum bed thickness
- Minimum bed thickness

Maximum 90 Days Oil Production

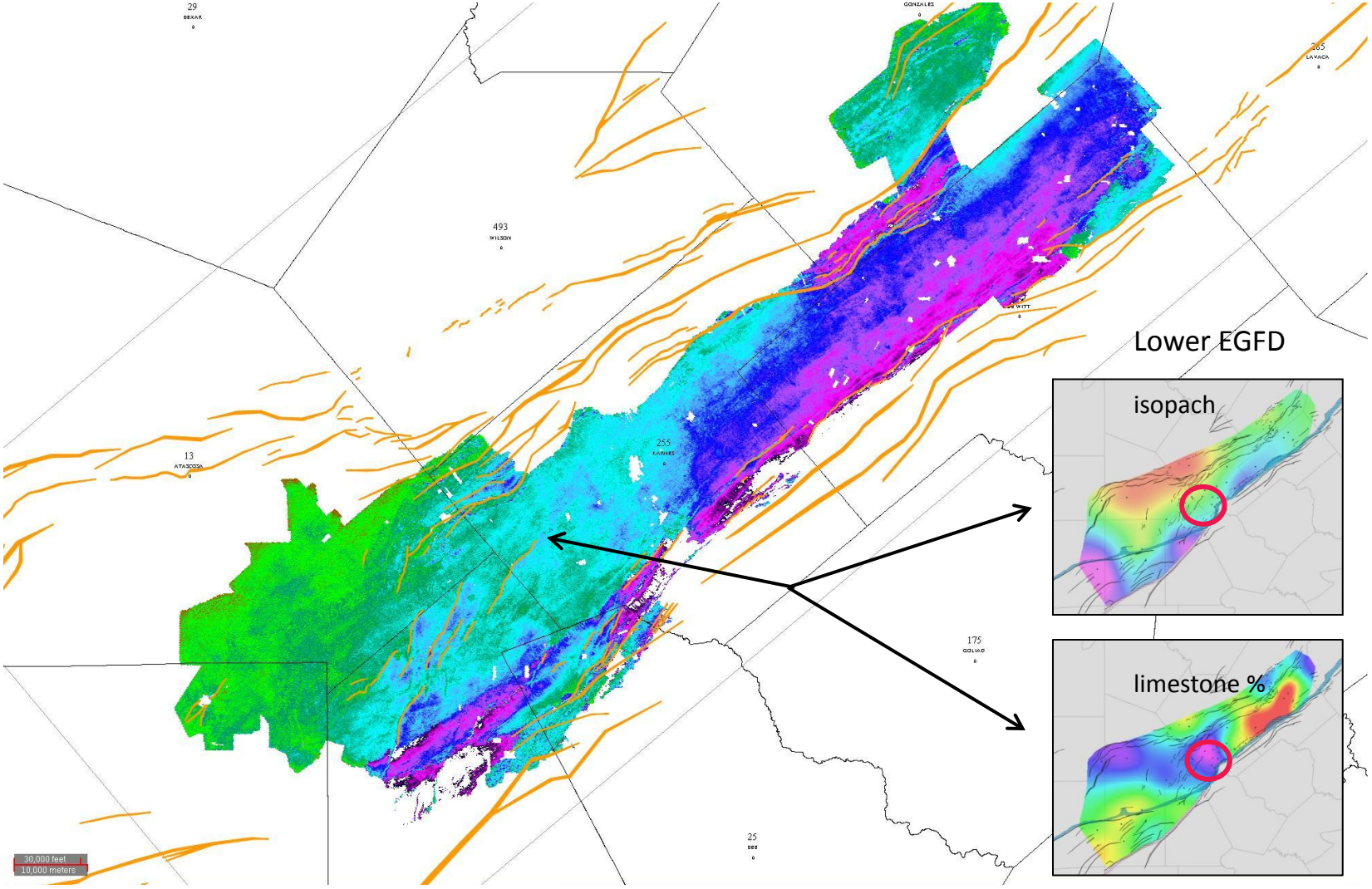


Lower EGFD: Isopach and Limestone Percentage





Paleobathymetry

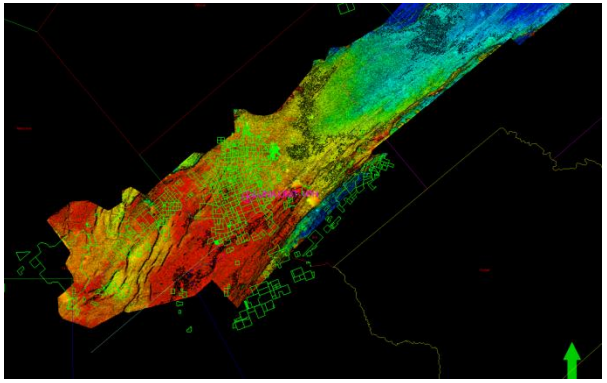


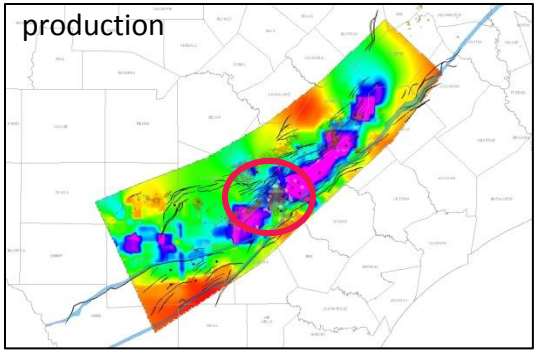
Conclusions and a …

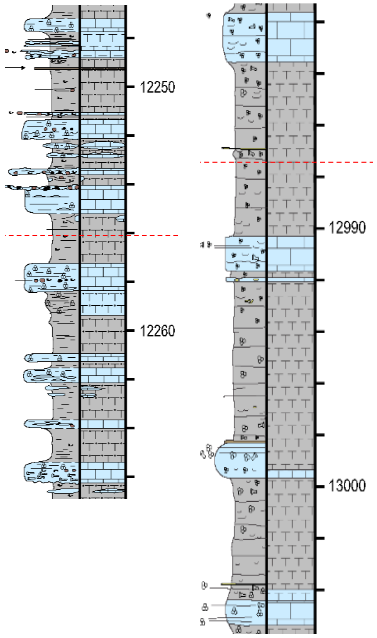
Structural control on bathymetry (in part)

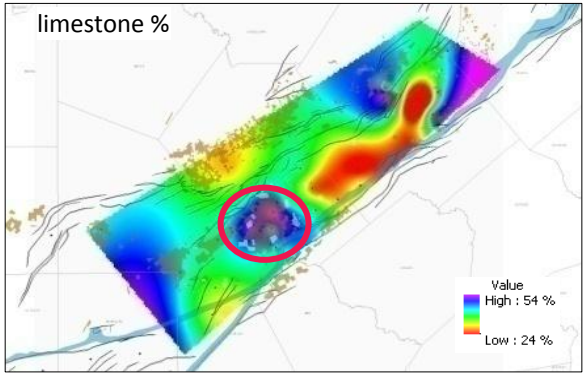
Bathymetric control on facies (in part)

Facies control on production (in part)



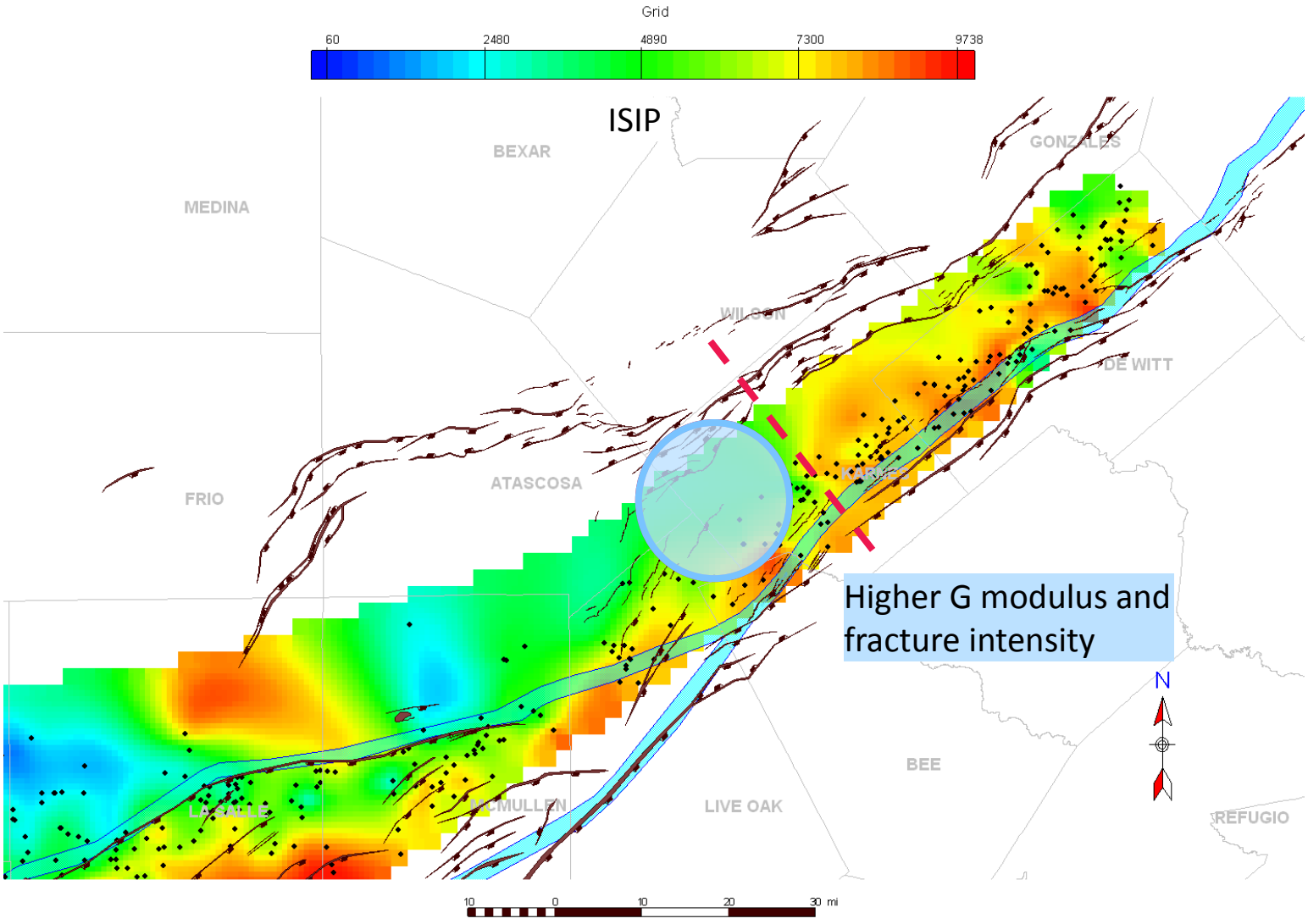






Marathon Oil

Caveat


Grid
60
2480
4890
7300
9738
ISIP
BEXAR
MEDINA
WILSON
DE WITT
FRIO
ATASCOSA
LA SALLE
MCMULLEN
LIVE OAK
BEE
REFUGIO
Higher G modulus and fracture intensity
N
10
0
10
20
30 mi