

# **Integrating Core, Well Logs and Seismic Interpretation to Improve Understanding of Albian Patch Reefs, Maverick Basin, SW Texas \***

By  
**Enzo S. Aconcha<sup>1</sup>**

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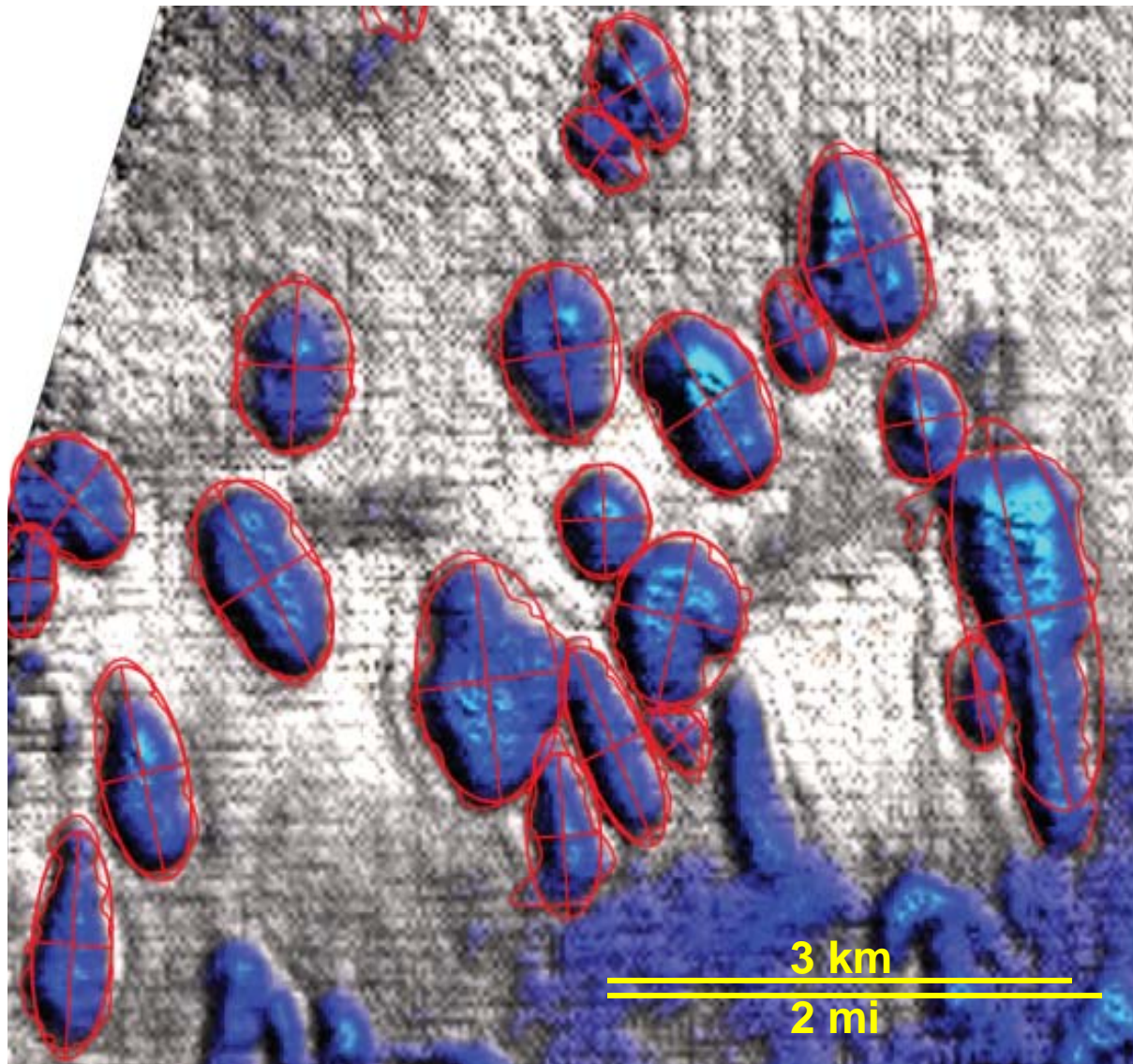
\*Adapted from oral presentation at AAPG Annual Convention, San Antonio, TX, April 20-23, 2008

<sup>1</sup>Jackson School of Geosciences, University of Texas at Austin, Austin, TX. ([ezsener@hotmail.com](mailto:ezsener@hotmail.com))

## **Abstract**

Using the stratal slicing technique, a seismic sedimentologic analysis was performed on the mid-Albian carbonates of the Glen Rose Formation, Maverick Basin, SW Texas. The 3D seismic subset covers an area of 186 km<sup>2</sup> and is integrated with 68 wells, 2 cored intervals and 40 thin sections. A retrogradational stacking pattern is documented from the sequential development of shallow platform buildups with an early phase in the south (basinward) followed by a younger phase in the north (landward). This suggests the mound growth occurred during the TST of the lower Glen Rose composite sequence. The external shape of the buildups on each stratal slice was reconstructed through the geometrical parameters computed from the best-fit ellipses. Buildup area decreases over time, with buildup cores migrating westward, and average external shape becoming NNW-SSE elongated. The repose angles of the patch reefs show very steep west margins, with values that in the SW direction frequently exceeds 50 degrees. East-facing flanks display more gradual 12-20 degree dips. The implications of these morphological patterns may be related to prevailing currents and winds during buildups growth. Patch reefs usually display a clean box-shape gamma-ray pattern (5-20 GAPI and low variance) and are associated with the highest negative seismic amplitudes. Positive seismic amplitudes pair with a jagged (mud-rich) GR (20-60 GAPI and high variance). Negative seismic amplitudes close to the zero crossing may show either a clean box or muddy jagged GR response. The stratal slices reveal that positive amplitudes define positive relief features (mud mounds) preceding the buildup facies proper. Before this result, buildups were thought to develop on top of the relatively flat, shallow platform.

# Integrating core, well logs and seismic interpretation to improve our understanding of Albian patch reefs, Maverick Basin, SW Texas



By Enzo Aconcha

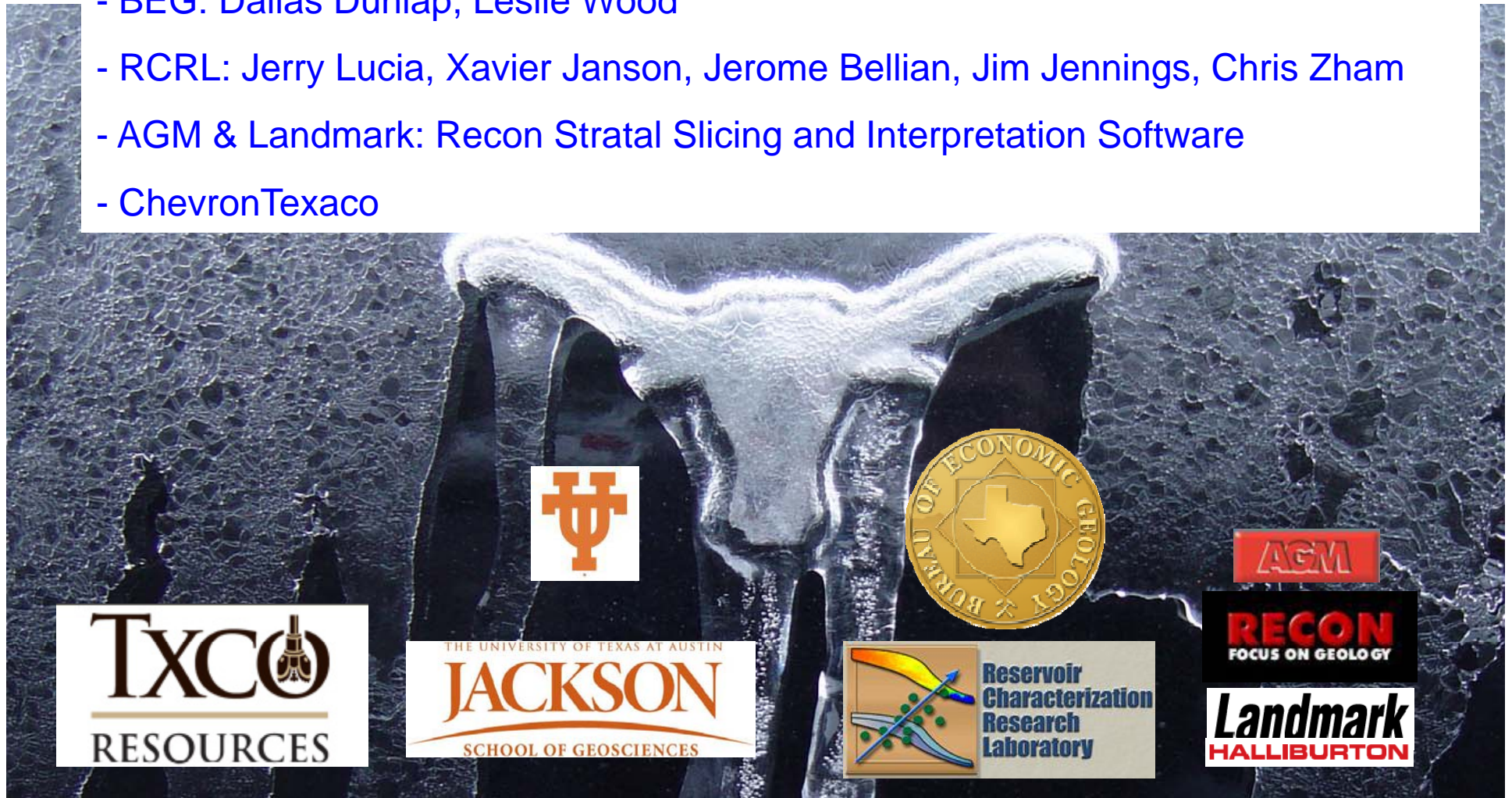
University of Texas at Austin  
Jackson School of Geosciences

April 2008



# Acknowledgements

- Jackson School of Geosciences and GCAGS
- Charlie Kerans, Hongliu Zeng, William Fisher, Bob Loucks, Carlos Torres-Verdin
- TxCO: Bob Scott, Craig Cobb, Barbara Romans
- BEG: Dallas Dunlap, Leslie Wood
- RCRL: Jerry Lucia, Xavier Janson, Jerome Bellian, Jim Jennings, Chris Zham
- AGM & Landmark: Recon Stratal Slicing and Interpretation Software
- ChevronTexaco



# Outline

## Introduction

- Area of Study
- Geological framework
- Dataset

## Stratigraphic development of Patch Reefs

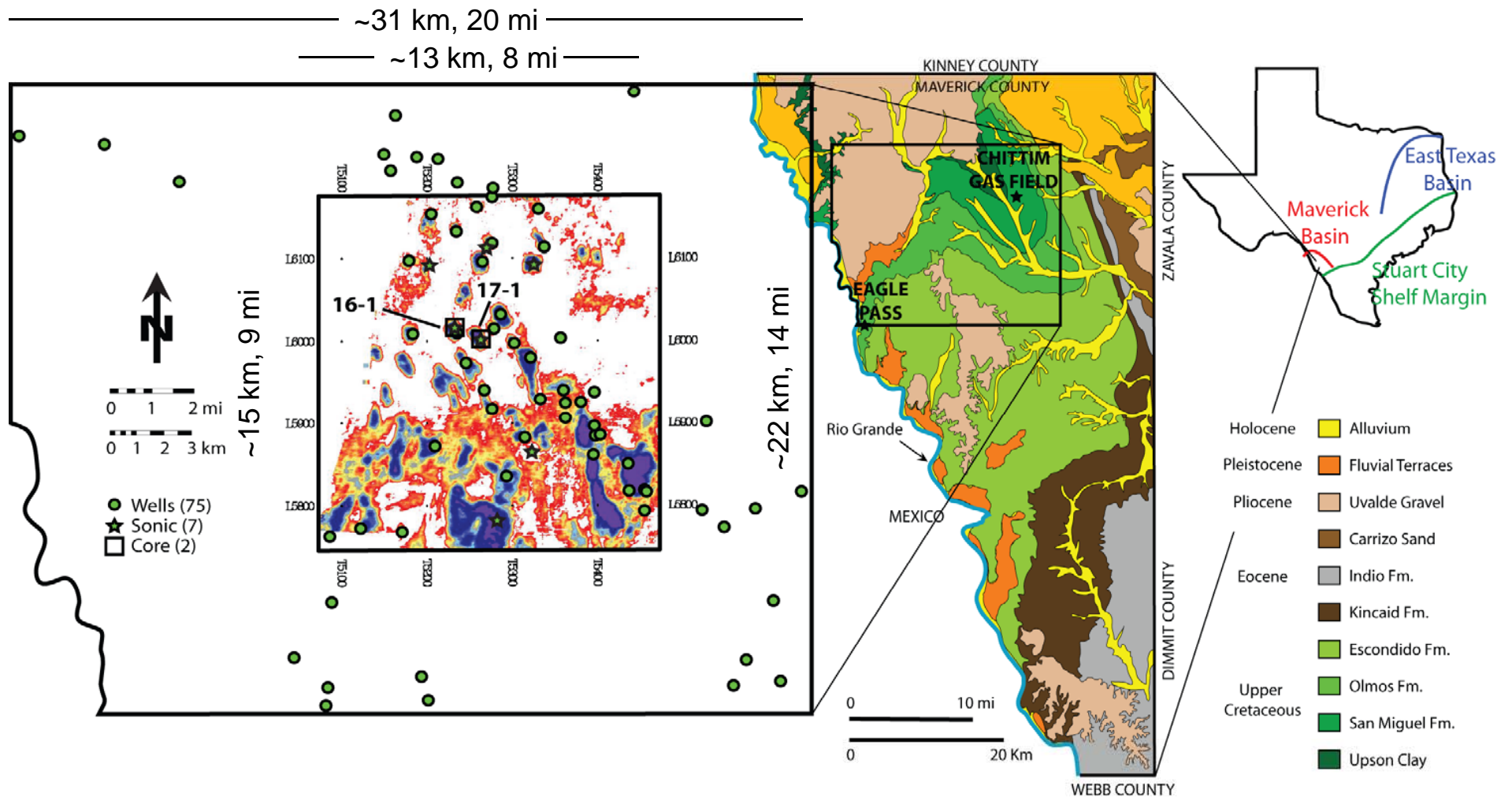
- Core description & plug measurements & well logs
- Seismic analysis (Stratal Slicing)

## Geomorphologic analysis of Buildups

## Conclusions

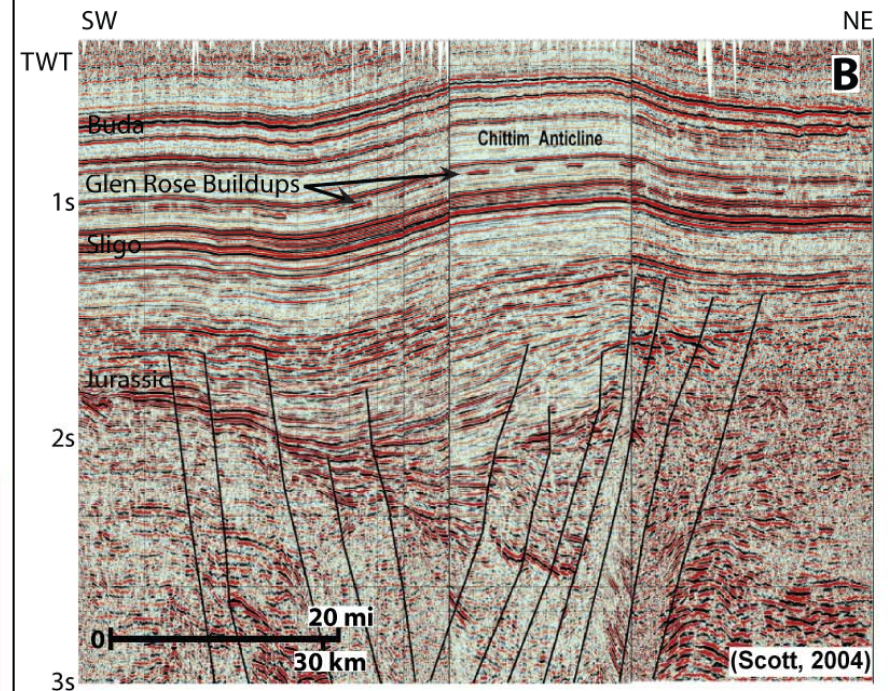
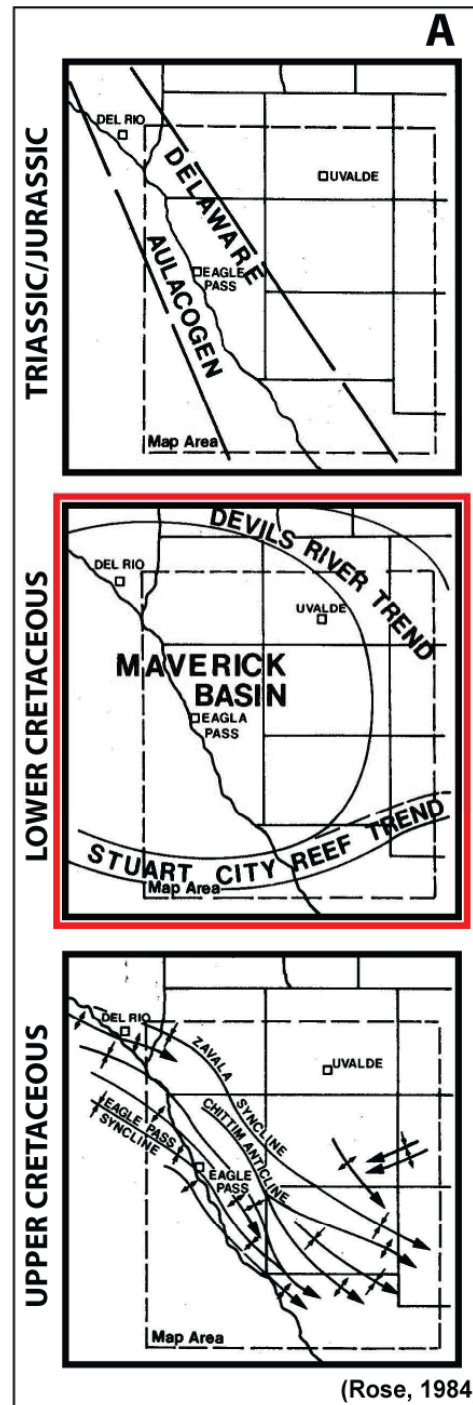


# Area of Study: The Maverick Basin

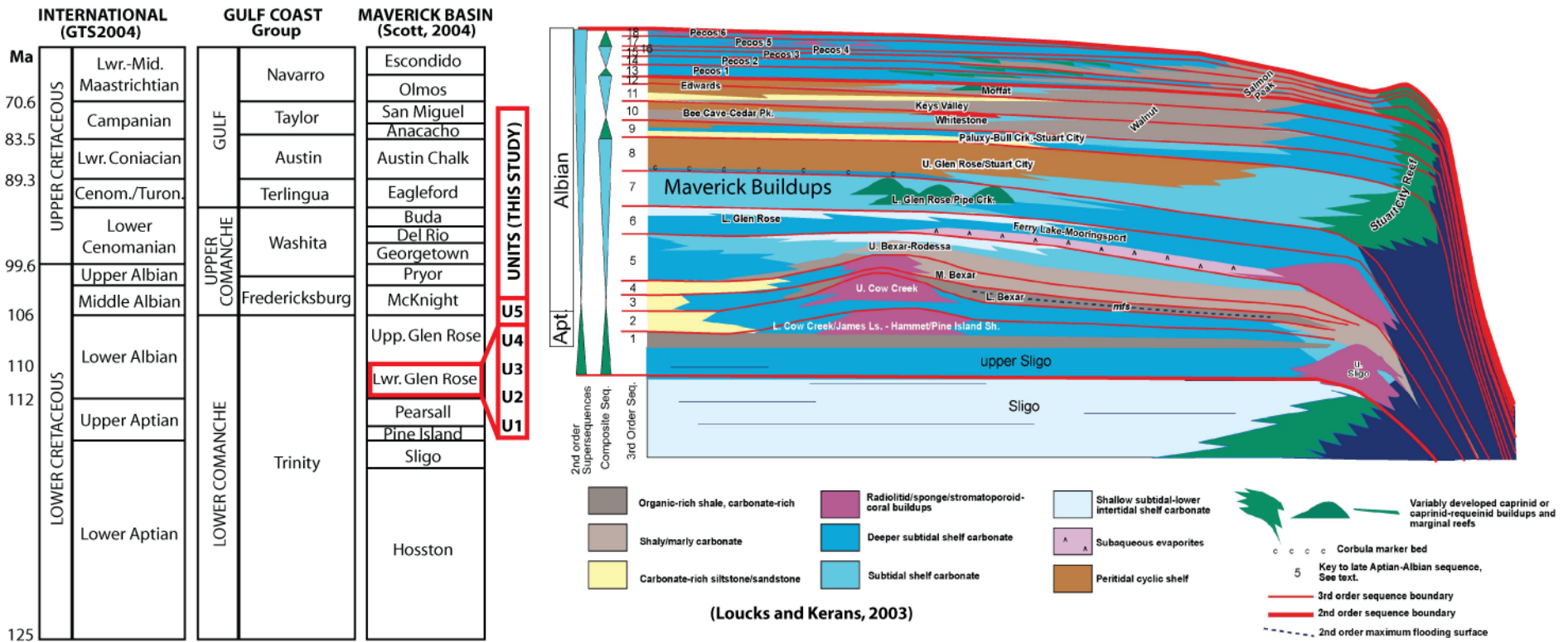


Modified from BEG, 1976

# Structural & Paleogeographic Setting



# Sequence Stratigraphic Setting



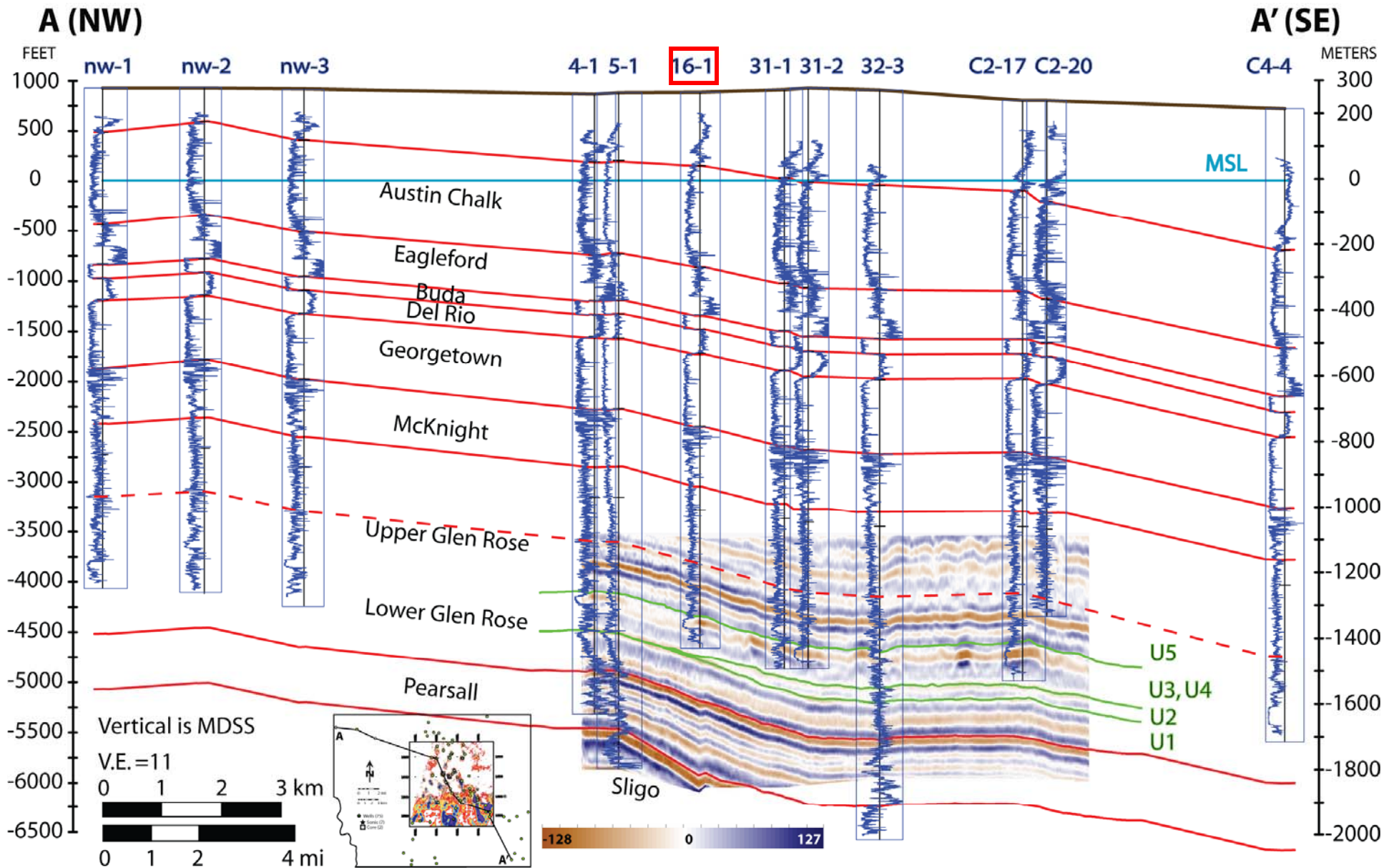
Upper Glen Rose: ~ 3.5 my, Sequence 8, unit 5 (this study).

----- *Corbula* Marker -----

Lower Glen Rose: ~ 2-2.5 my, Sequences 6 and 7, units 1-4 (this study).



# Dataset



# Outline

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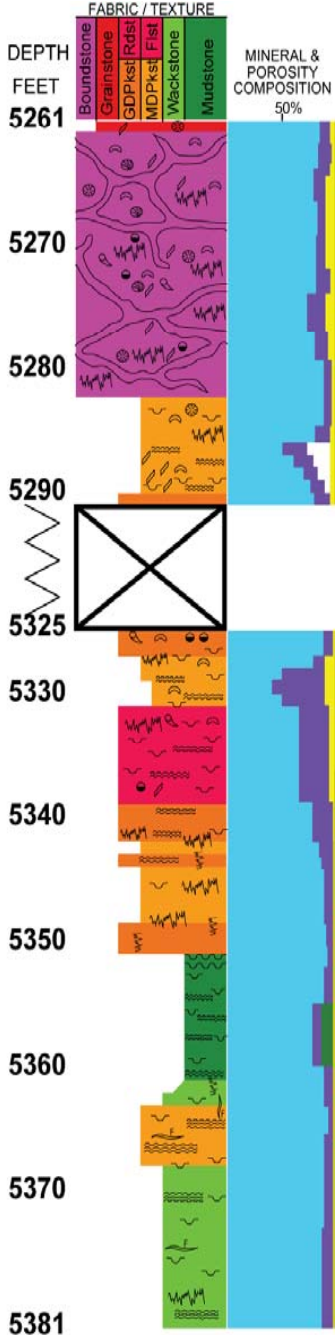
## Stratigraphic development of Patch Reefs

- Core description & plug measurements & well logs
- Seismic analysis (Stratal Slicing)

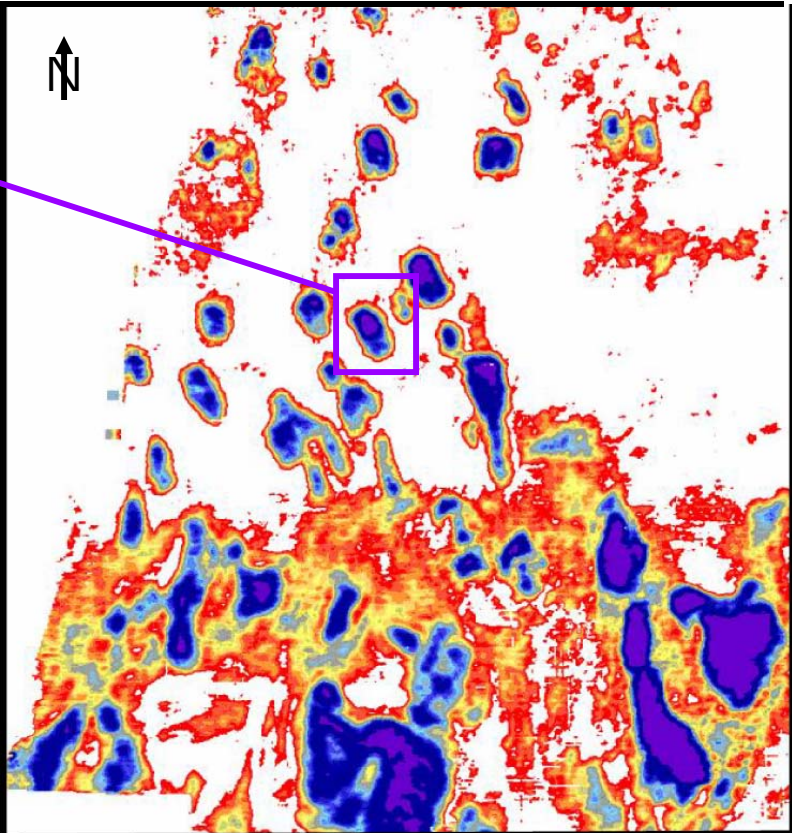
## Geomorphologic analysis of Buildups

## Conclusions

# WELL 17-1



0.7 mi  
1.13 km



### Fabric/Texture

- ● Geopetal
- W W Stylolites (Hrz., Vert.)
- E F Fractures (Hrz., Vert.)
- ~ ~ Burrows
- ~ ~ ~ ~ Wispy Laminations

### Allochems/Minerals

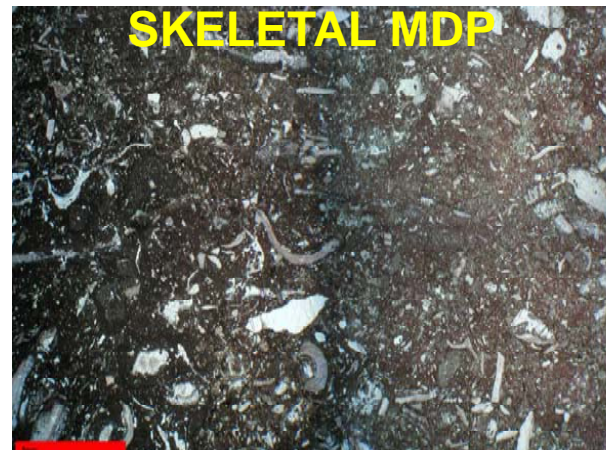
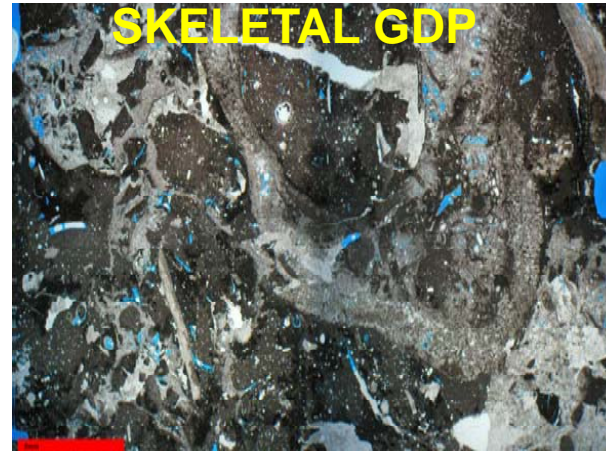
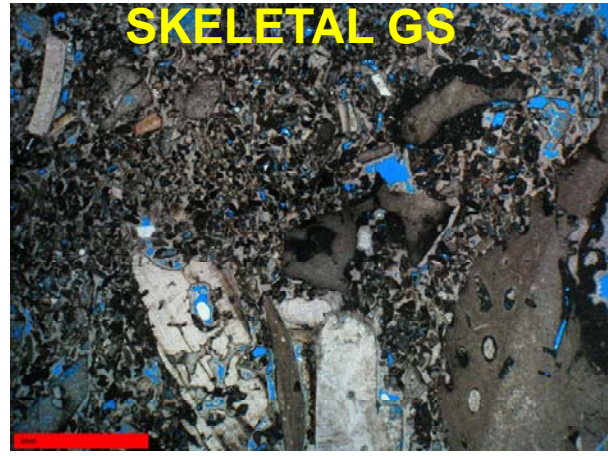
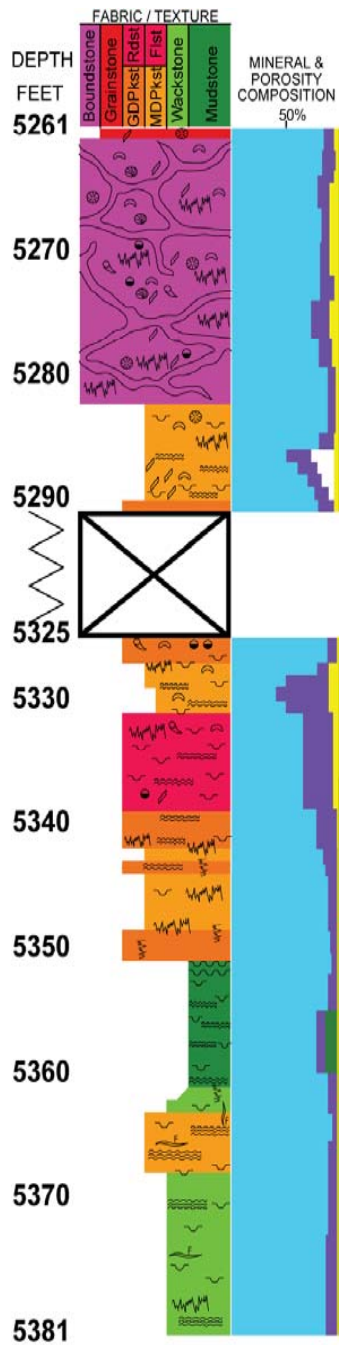
- ⊗ Corals
- ⊙ Stromatoporoid
- ⊖ Caprinids
- ⊖ Requierids
- ⊖ Anhydrite

### Mineralogy/Porosity

- Calcite
- Dolomite
- Anhydrite
- Clays
- Porosity



# Well 17-1 Rock Facies

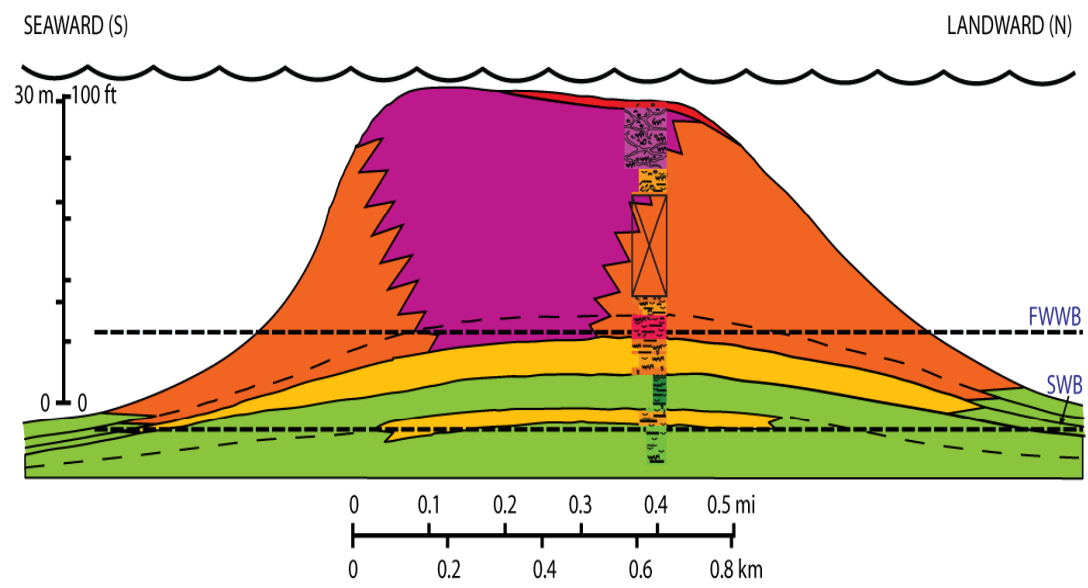
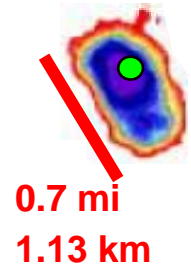
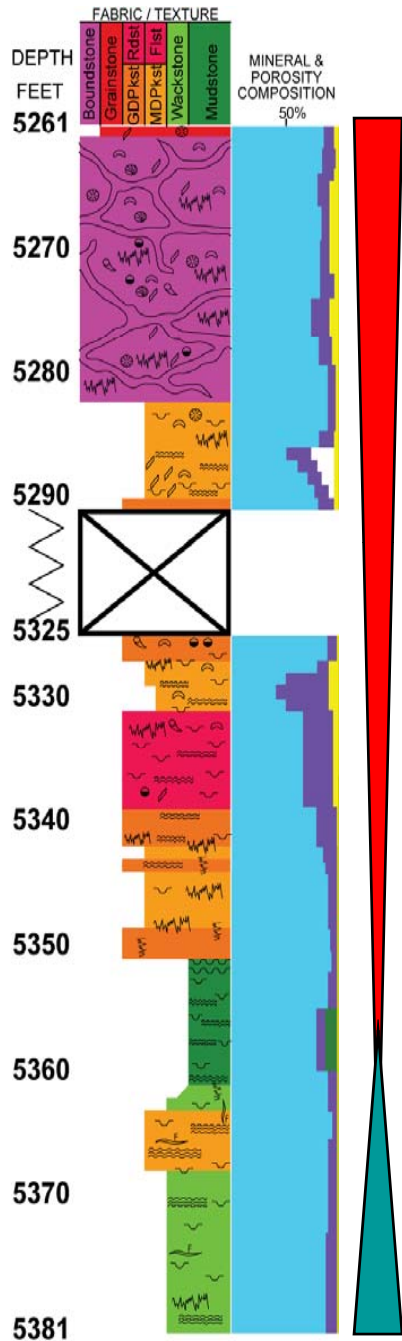


**5 mm**

- Calcite
- Dolomite
- Anhydrite
- Clays
- Porosity



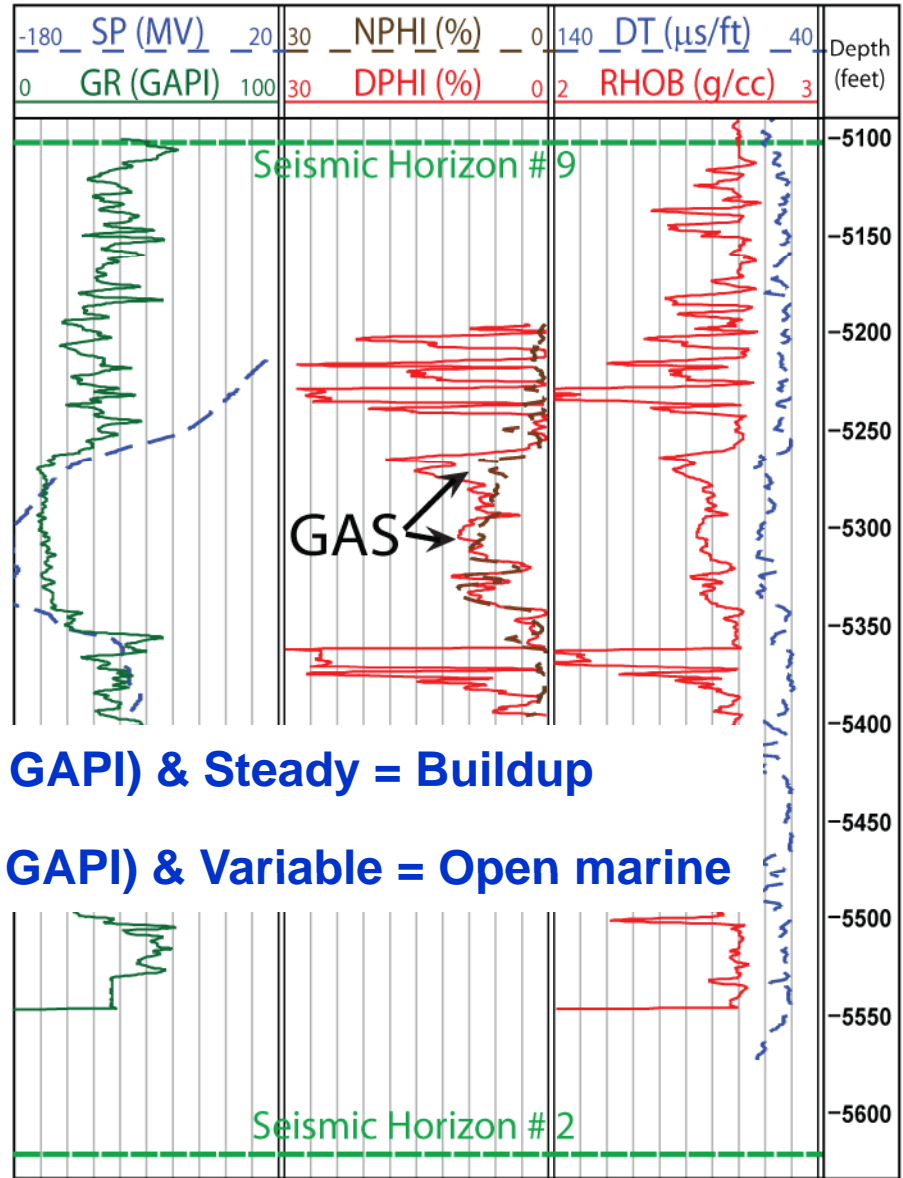
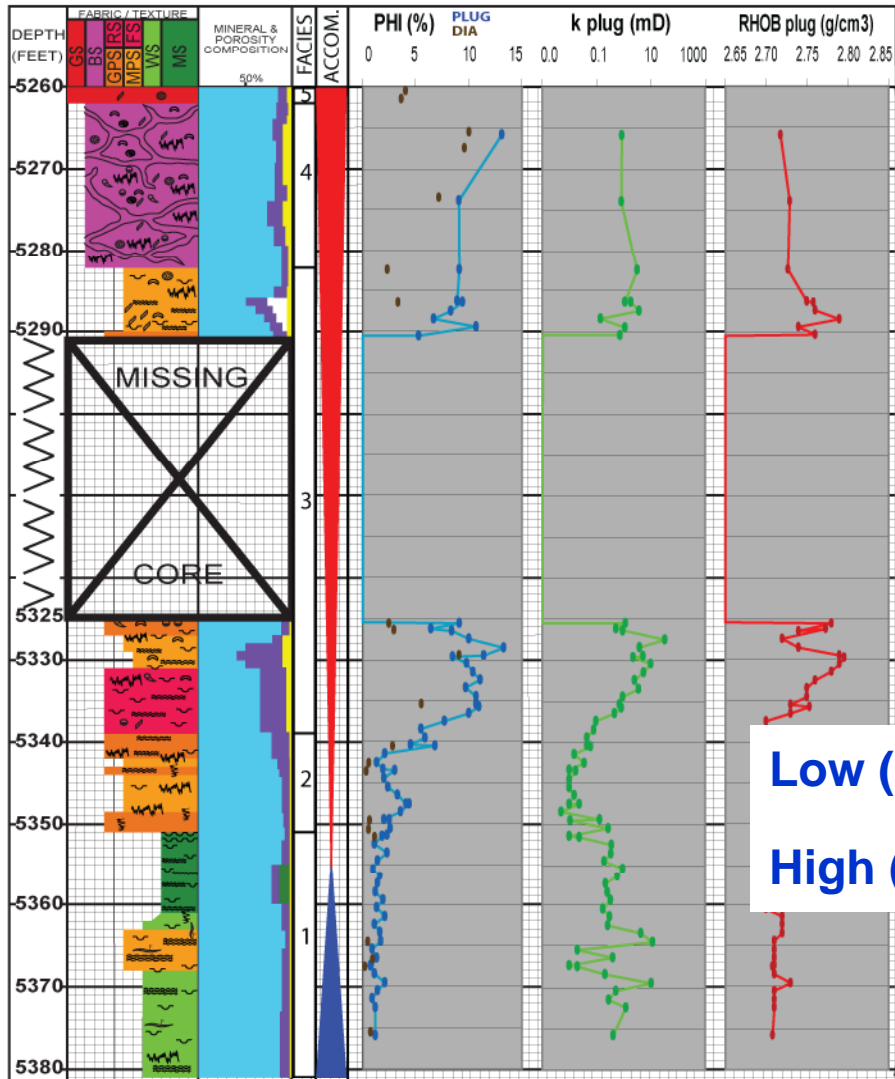
# WELL 17-1



- 1 Burrowed, skeletal WS/MS interrupted by skeletal MDP/GDP
- 2 Burrowed, oncoidal-skeletal MDP/GDP
- 3 Rudist-coral-stromatopoid, skeletal MDP/GDP to RS
- 4 Rudist-coral-stromatopoid, skeletal-peloidal BS
- 5 Skeletal-peloidal GS to RS

- | Fabric/Texture |                          | Allochems/Minerals |              | Mineralogy/Porosity |           |
|----------------|--------------------------|--------------------|--------------|---------------------|-----------|
| ● ●            | Geopetal                 | ⊗                  | Corals       | ■                   | Calcite   |
| W W W W        | Stylolites (Hrz., Vert.) | ⊙                  | Stromatopoid | ■                   | Dolomite  |
| — — — —        | Fractures (Hrz., Vert.)  | ⊂                  | Caprinids    | □                   | Anhydrite |
| ~ ~ ~ ~        | Burrows                  | ⌒                  | Requienids   | ■                   | Clays     |
| ~~~~~          | Wispy Laminations        | ⌄                  | Anhydrite    | ■                   | Porosity  |

# WELL 17-1

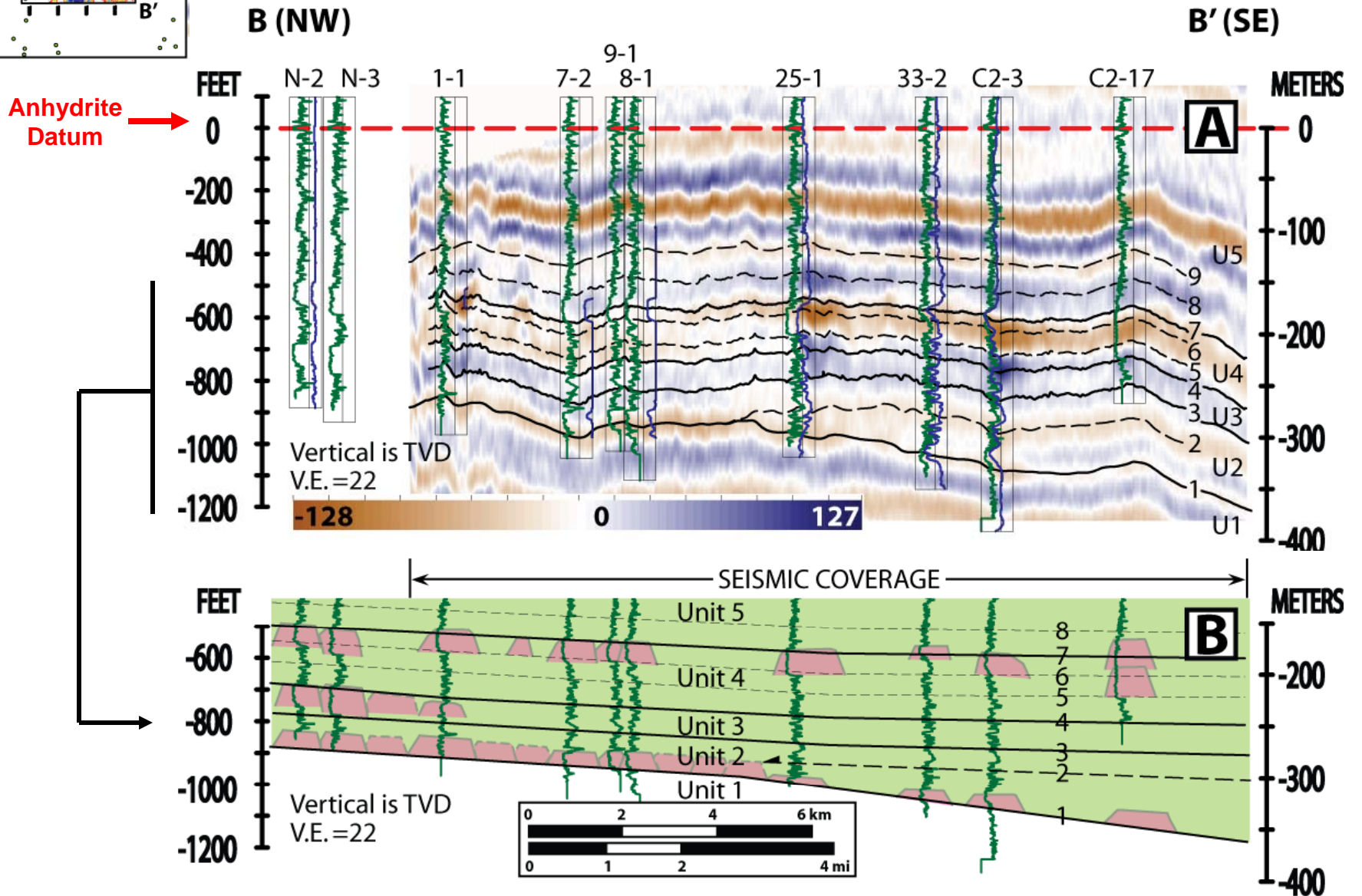
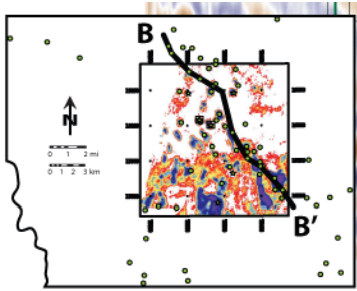


**Low (5-20 GAPI) & Steady = Buildup**

**High (>20 GAPI) & Variable = Open marine**

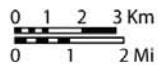
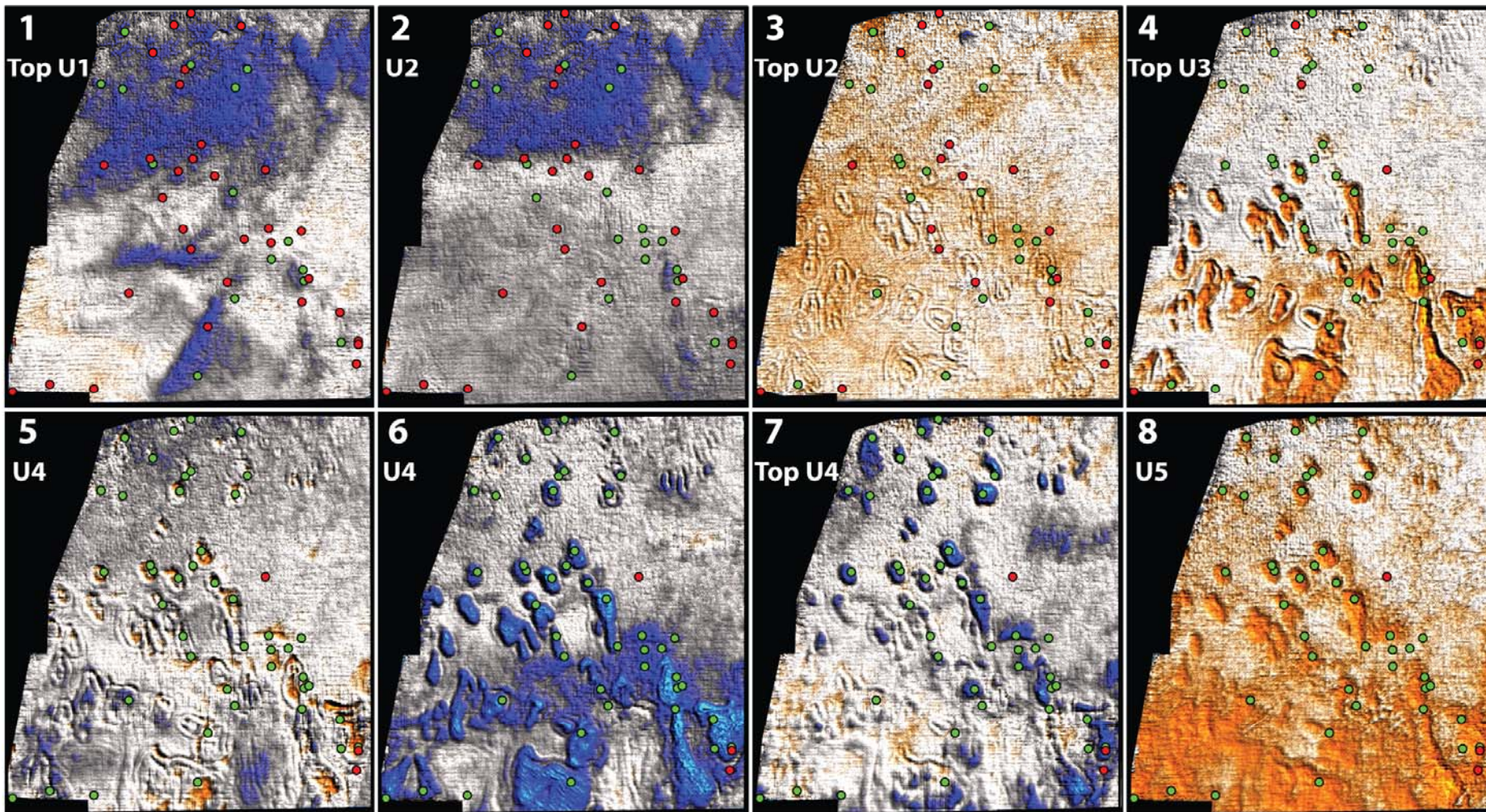
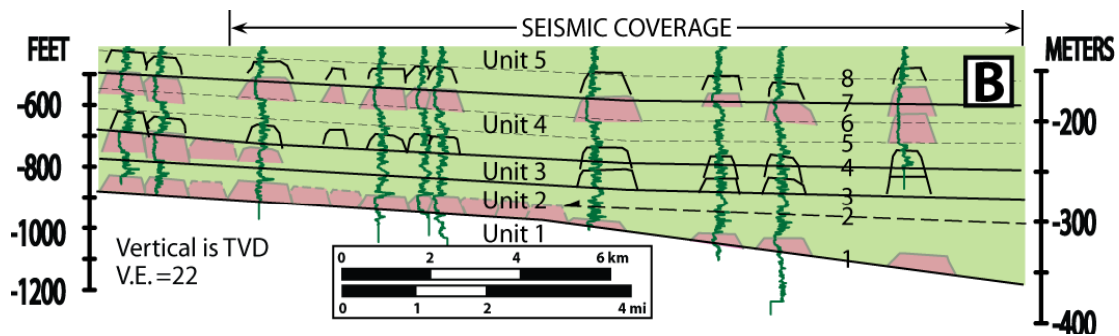
- | Fabric/Texture             | Allochems/Minerals | Mineralogy/Porosity | Accommodation |
|----------------------------|--------------------|---------------------|---------------|
| ●● Geopetal                | ● Corals           | ■ Calcite           | ▼ Decreasing  |
| ⋈ Stylolites (Hrz., Vert.) | ● Stromatoporoid   | ■ Dolomite          | ▲ Increasing  |
| ⋈ Fractures (Hrz., Vert.)  | ● Caprinids        | ■ Anhydrite         |               |
| ⋈ Burrows                  | ● Requinids        | ■ Clays             |               |
| ⋈ Wispy Laminations        | ● Anhydrite        | ■ Porosity          |               |





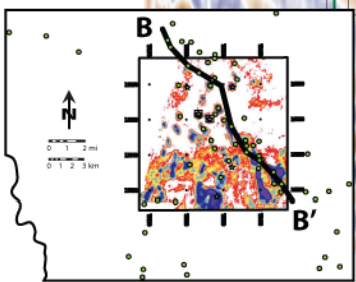


# Stratal Slices



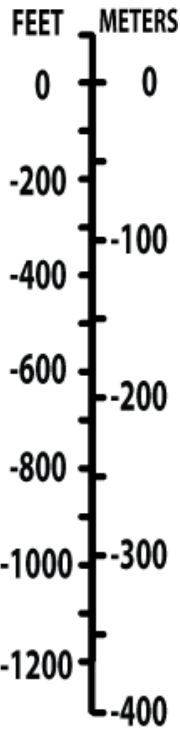
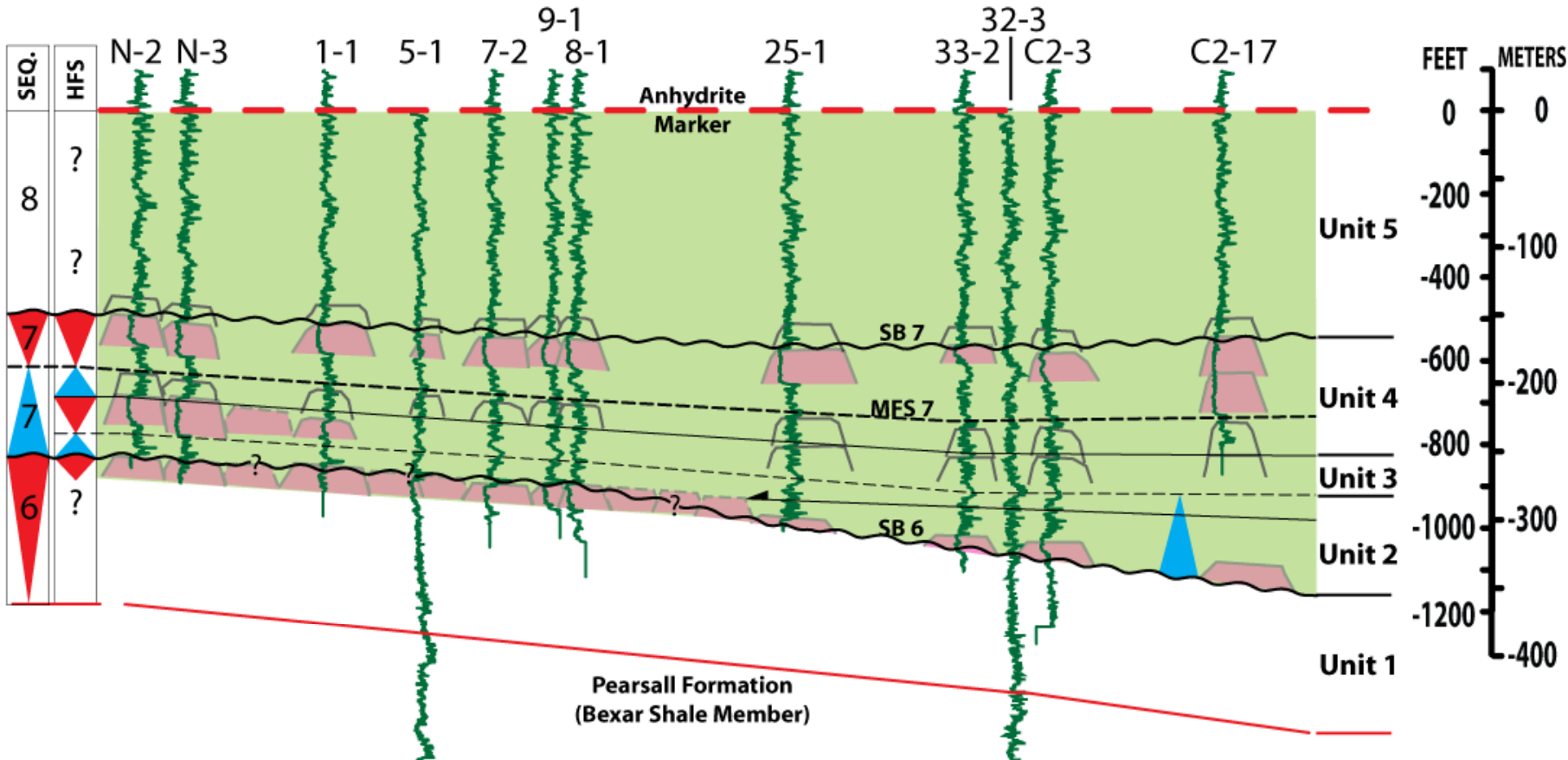
\* If the stratal-slice is perforated by a well then (o) otherwise (●)



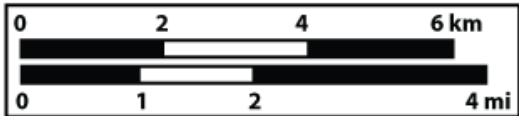


**B (NW)**

**B' (SE)**



◆ Increasing Accommodation  
 ▼ Decreasing Accommodation  
 HFS: High Frequency Sequences (4th Order)  
 SEQ.: Sequences (3rd Order)  
 SB: Sequence Boundary  
 MFS: Maximum Flooding Surface



Vertical is TVD  
V.E. = 22



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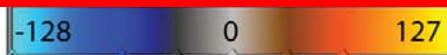
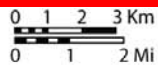
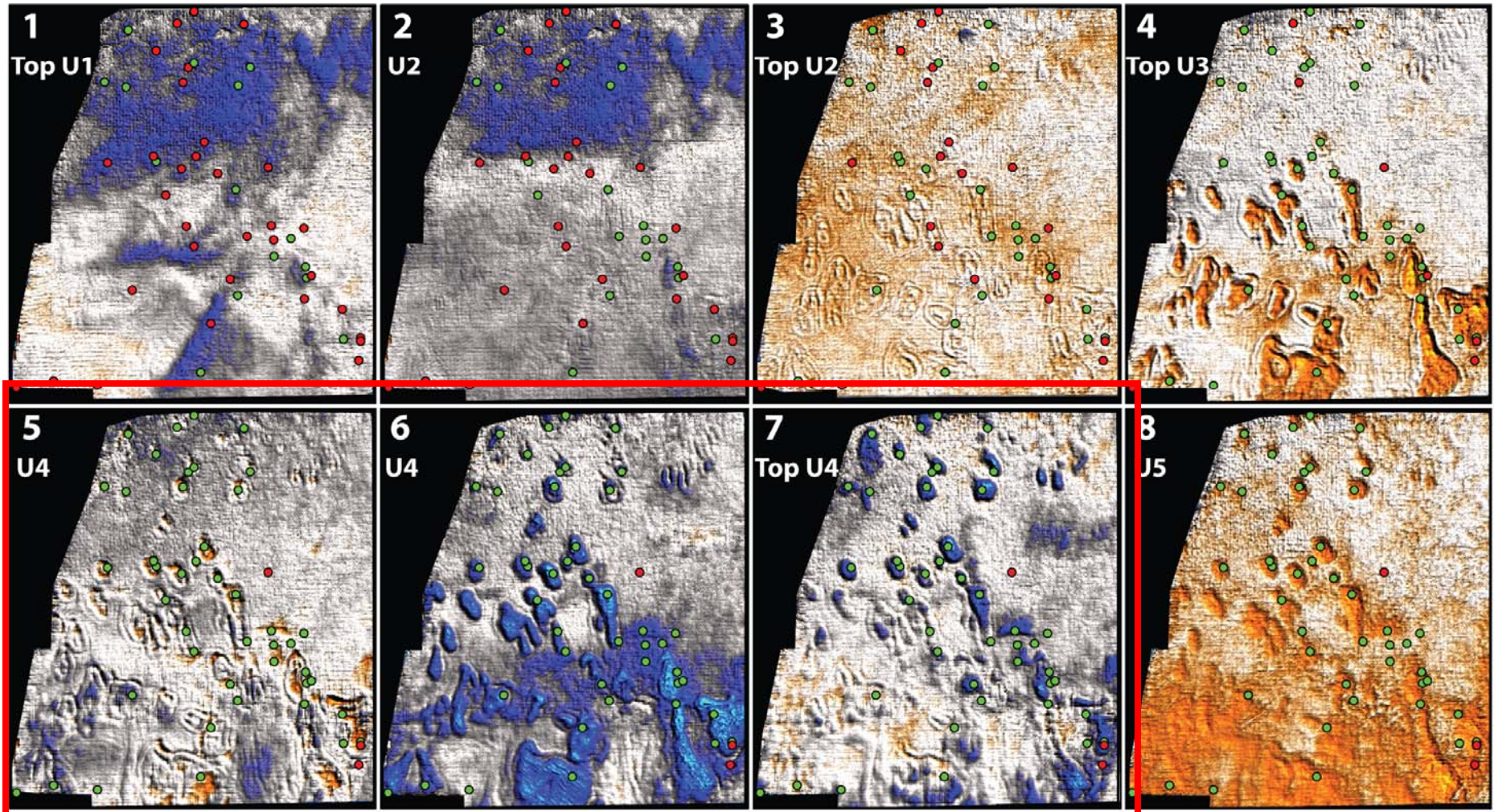
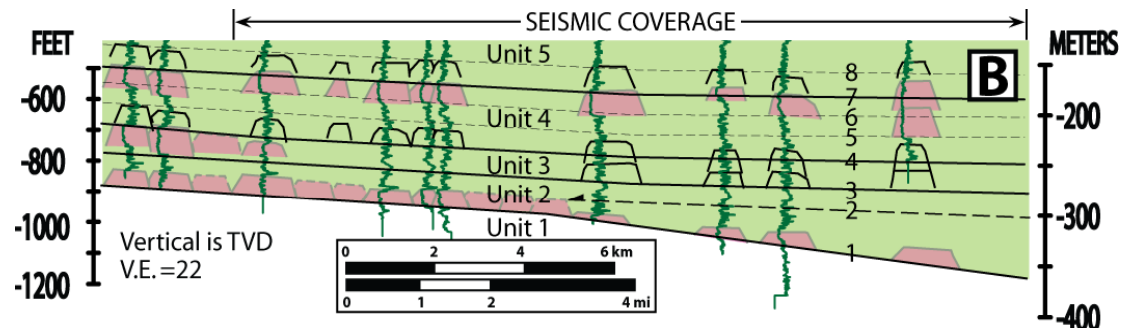
## Stratigraphic development of Patch Reefs

- Core description & plug measurements & well logs
- Seismic analysis (Stratal Slicing)

## Geomorphologic analysis of Buildups

## Conclusions

# Geomorphologic analysis



\* If the stratal-slice is perforated by a well then (o) otherwise (●)



# Reef morphology:

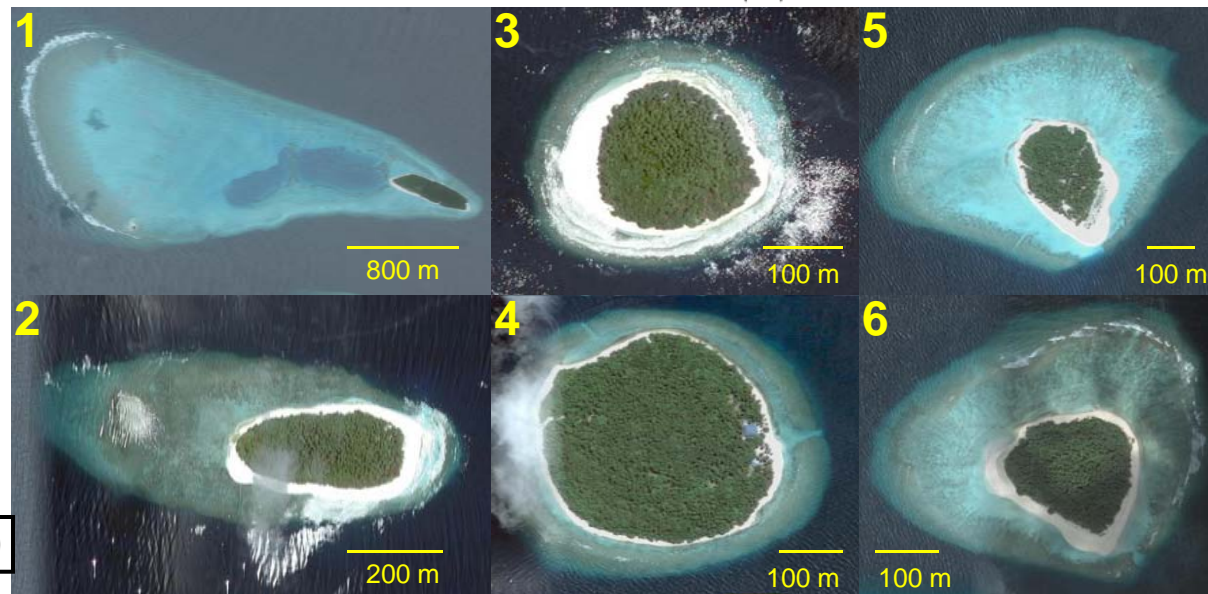
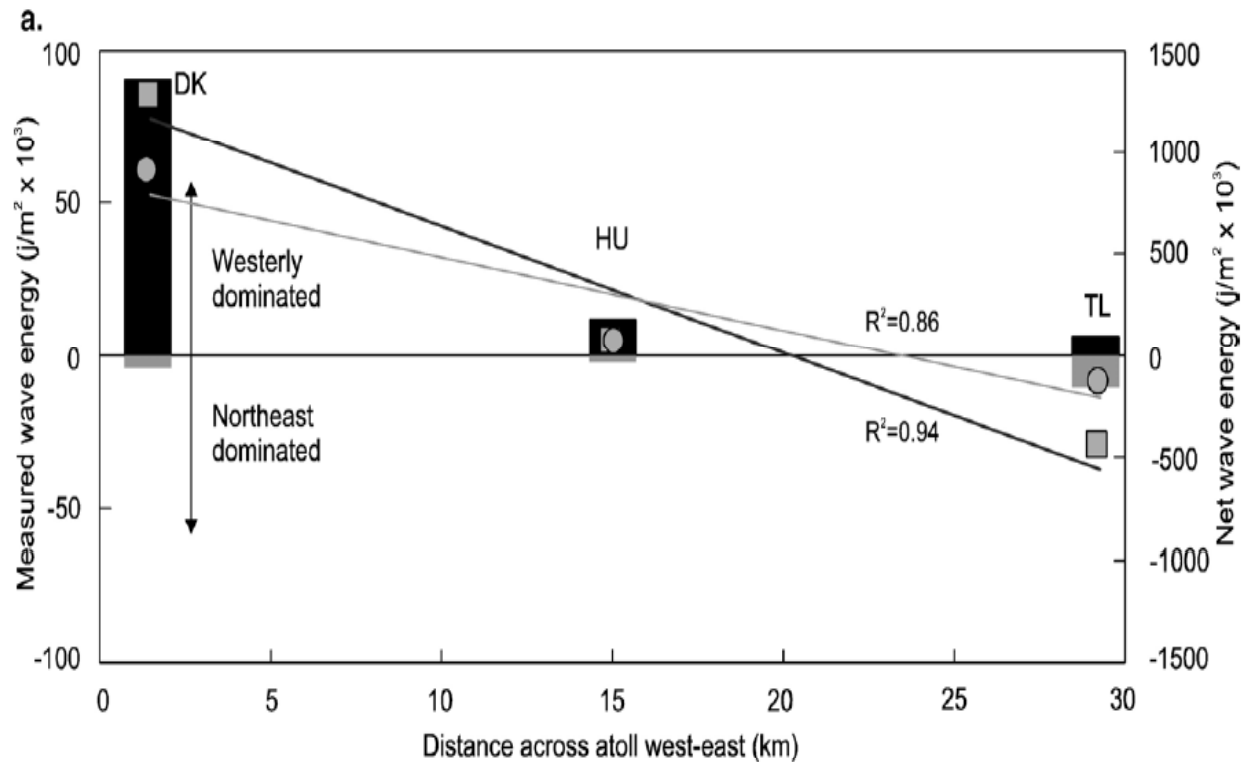
Patch reef shape changes across the platform

Wave energy changes too:

Ocean swells (N-S)

Wind-driven waves (W & NE Monsoons)

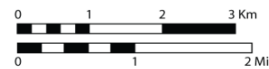
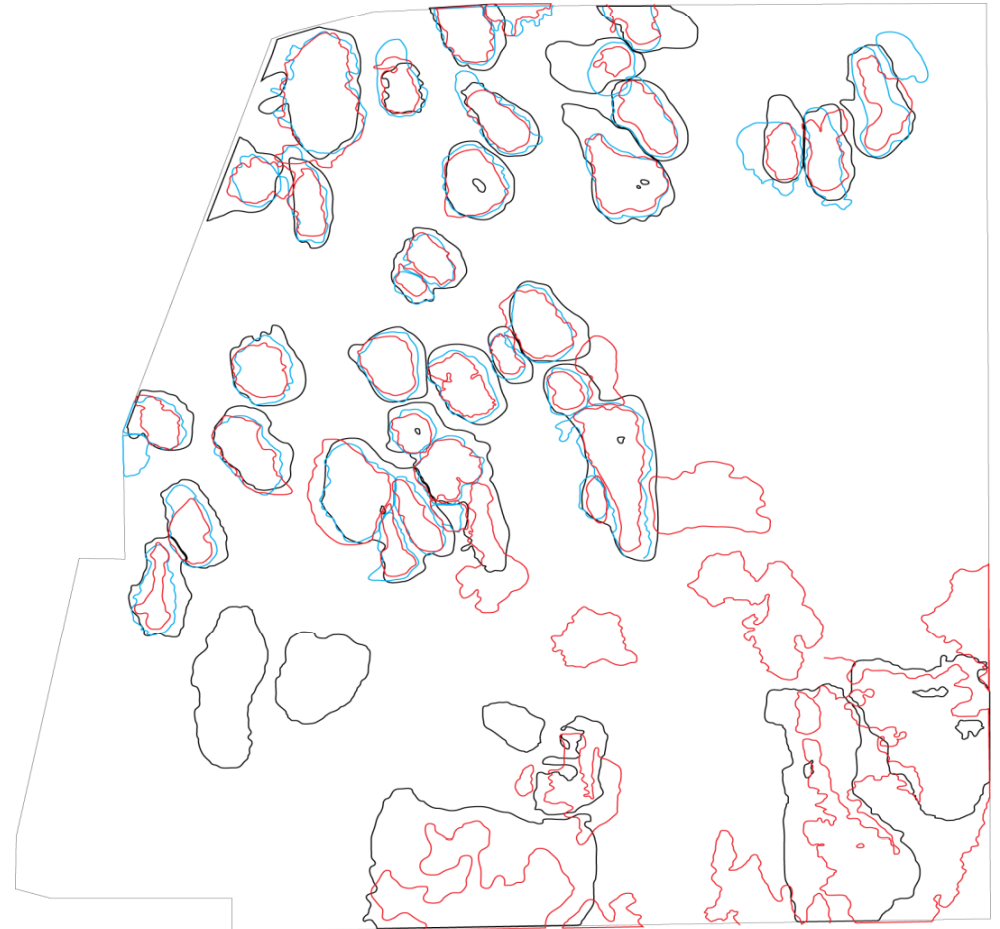
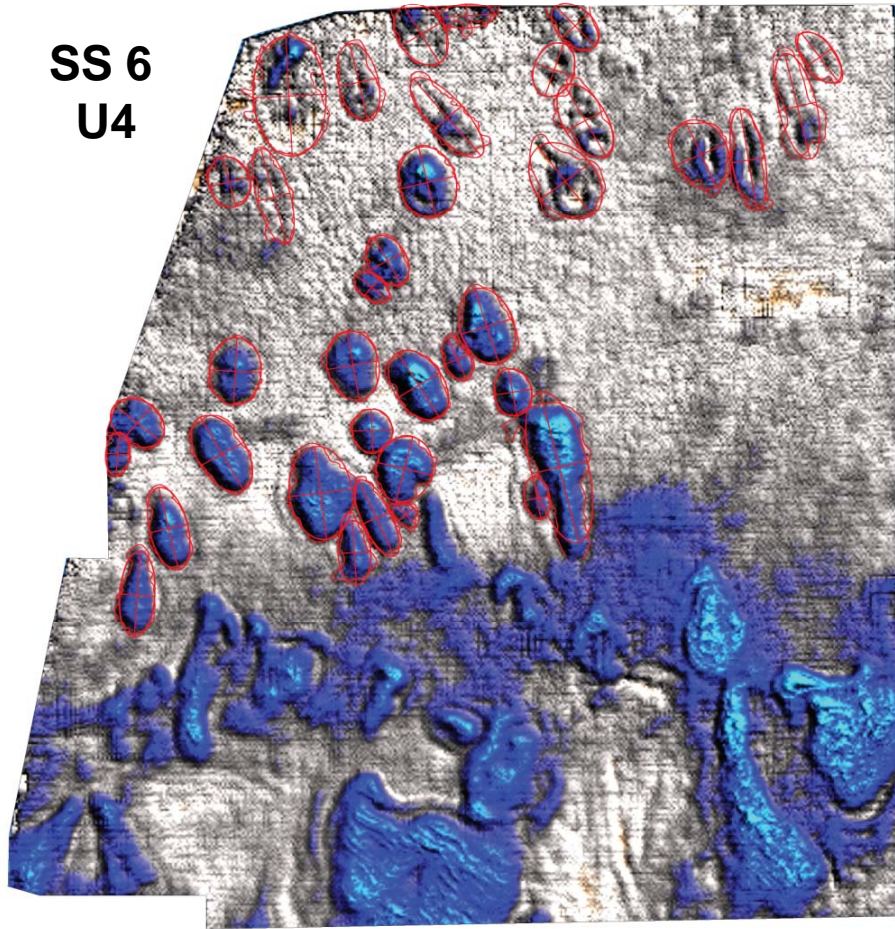
Facies distribution within patch reefs is controlled by net wave energy plus tidal range





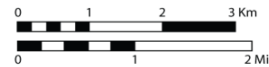
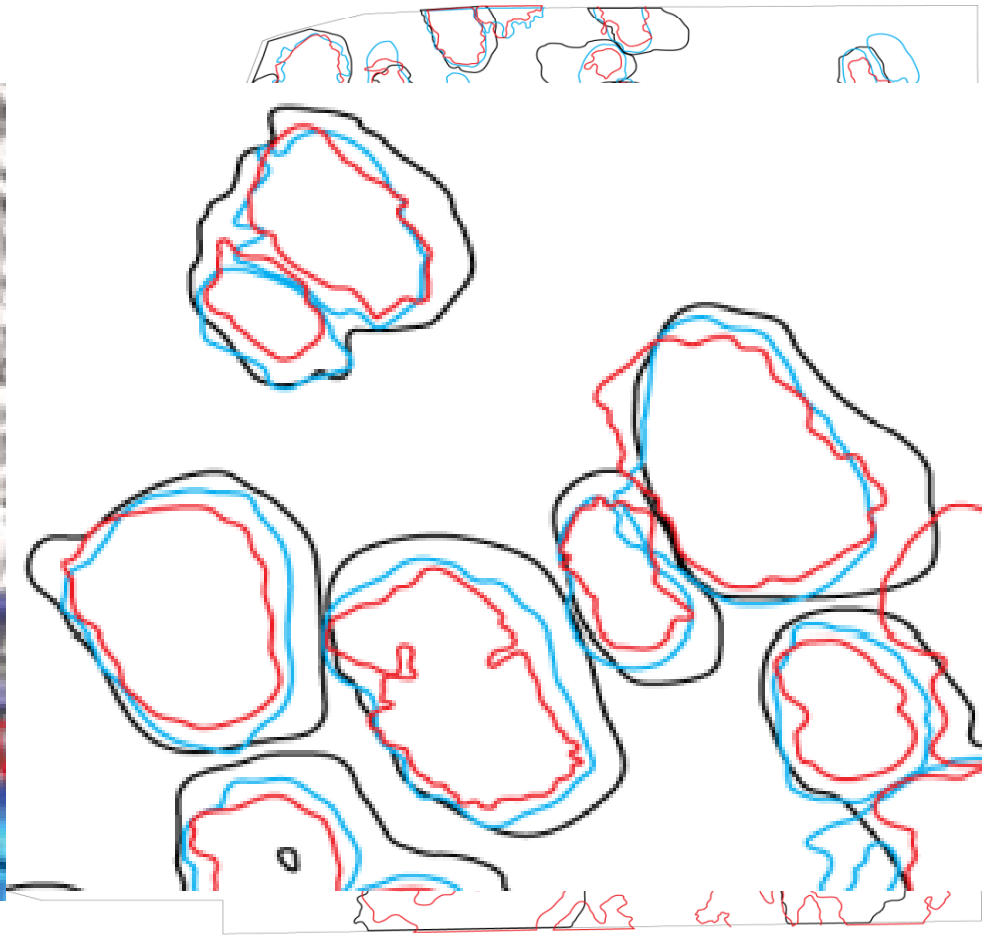
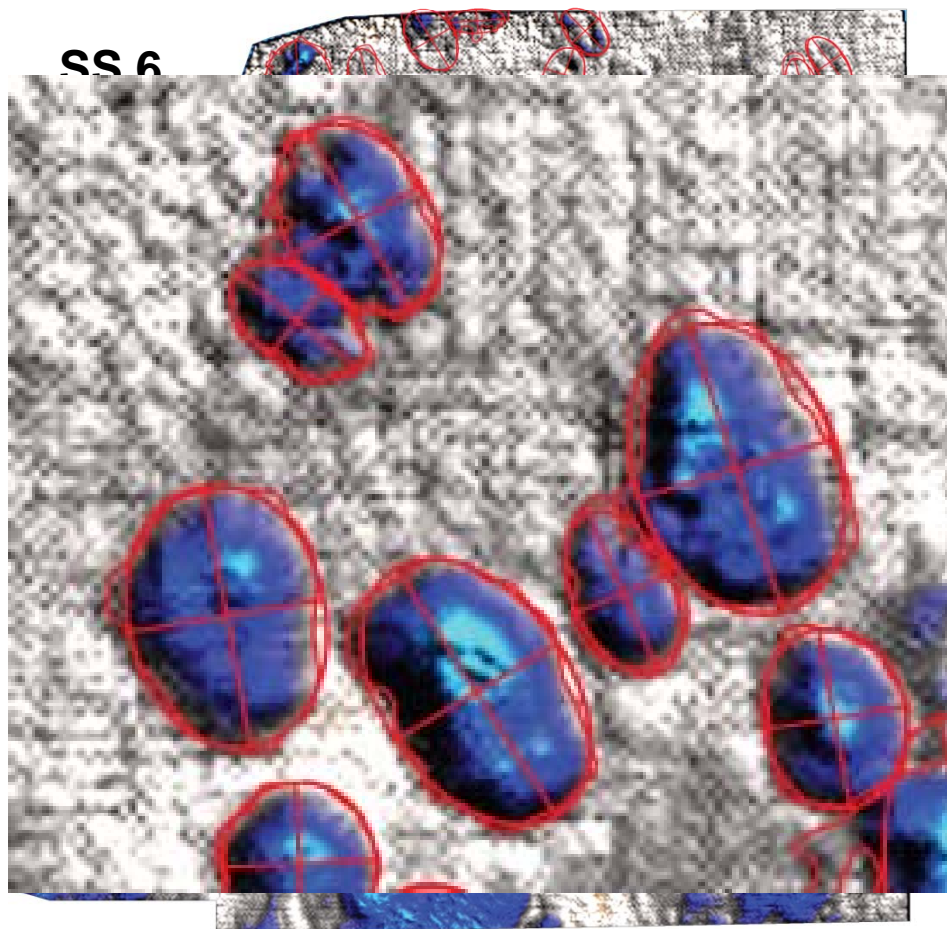
# Steeper buildup walls to W and SW

SS 6  
U4



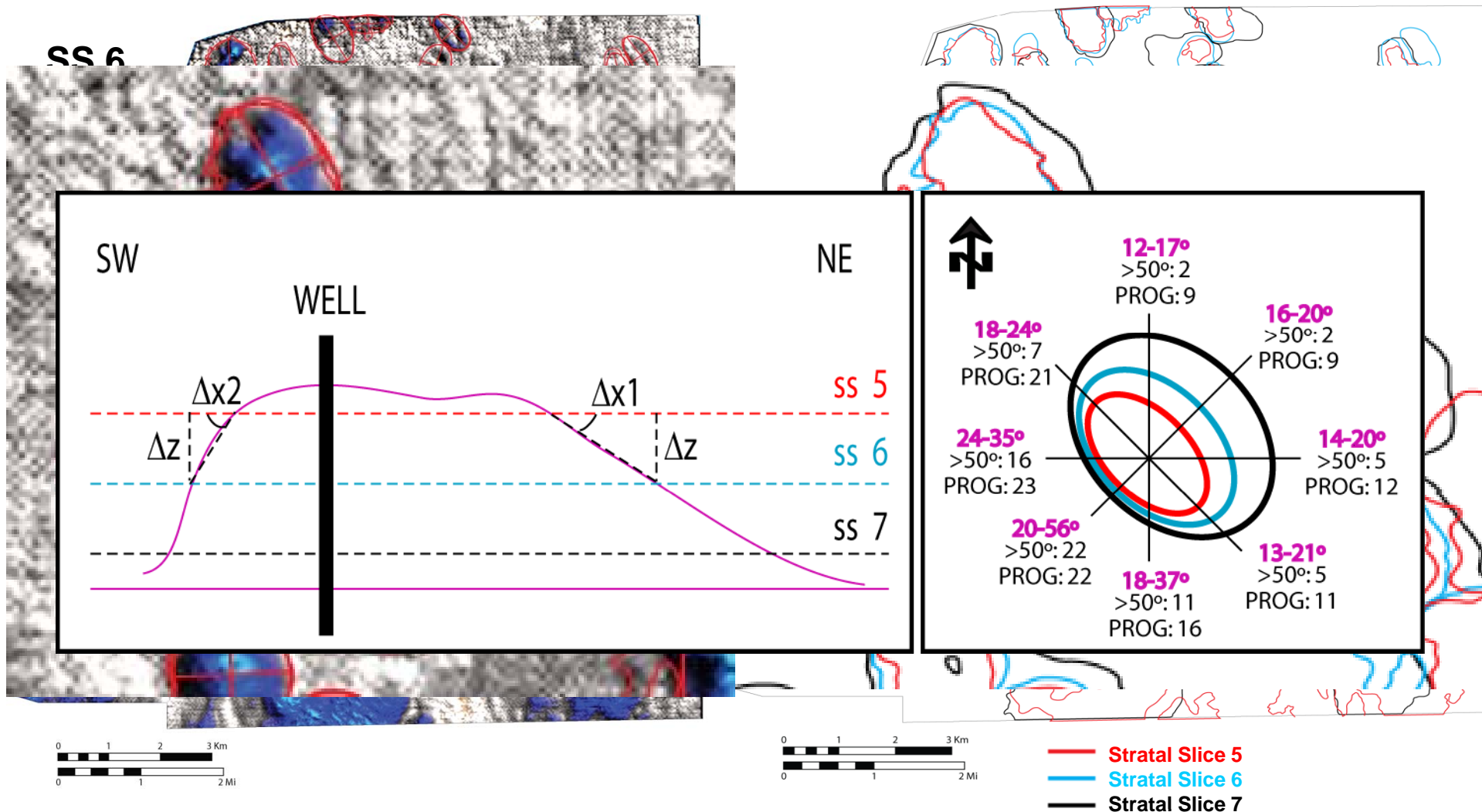
— Stratal Slice 5  
— Stratal Slice 6  
— Stratal Slice 7

# Steeper buildup walls to W and SW



- Stratal Slice 5
- Stratal Slice 6
- Stratal Slice 7

# Steeper buildup walls to W and SW





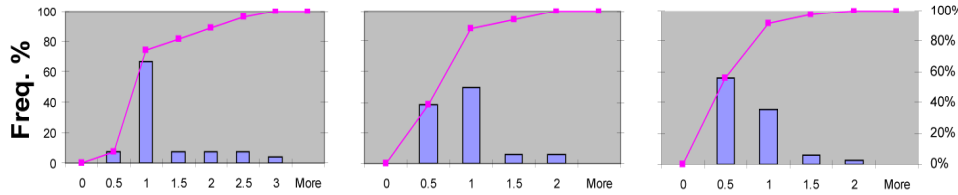
# Geomorphometric parameters

SS 5

SS 6

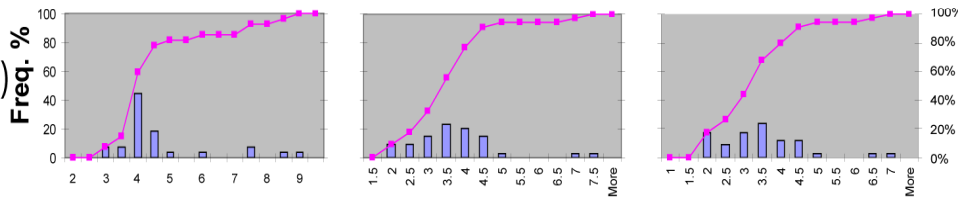
SS 7

Area (km<sup>2</sup>)



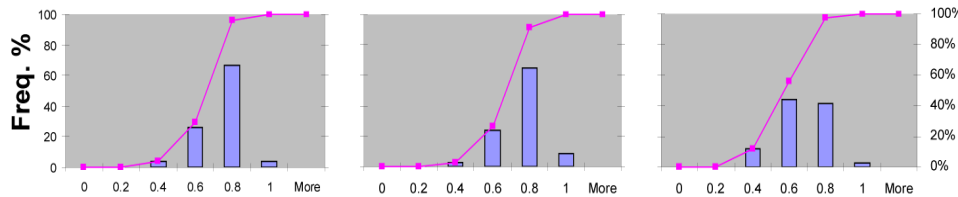
Area decreases with time

Perimeter (km)



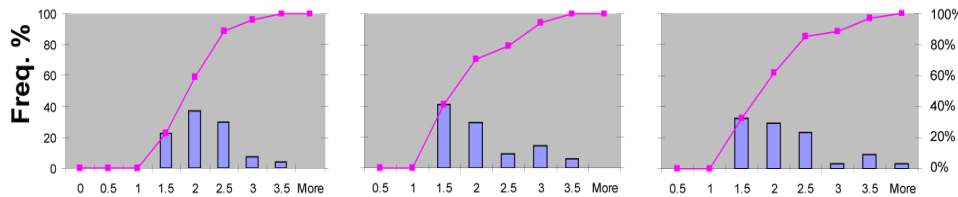
Perimeter decreases with time

Circularity



More Elliptical with time

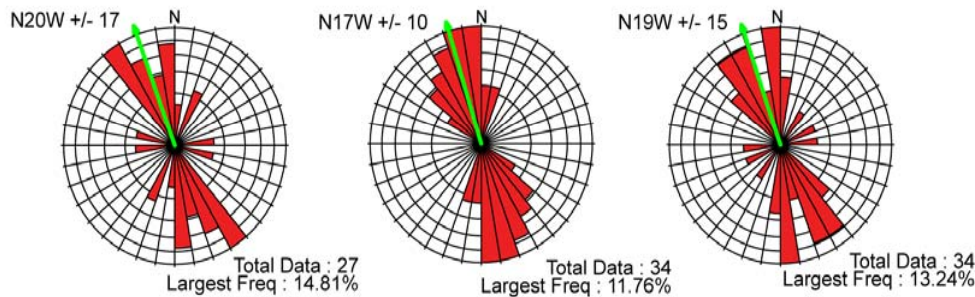
M/m ratio



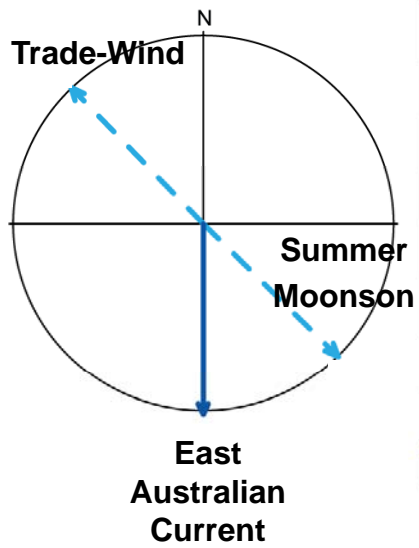
Long Axes=(1.5-2.5)\*short axes

— PDF — CDF

Elongation Direction

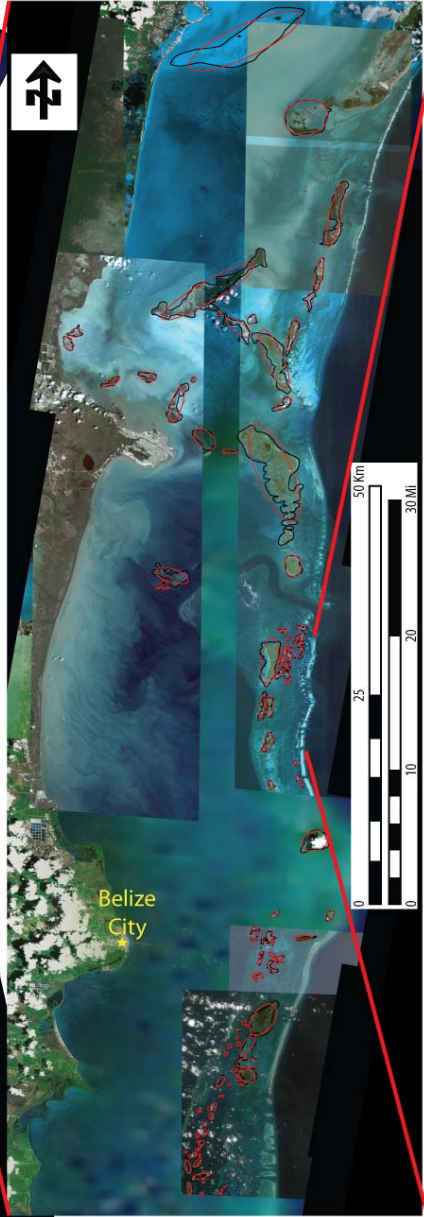


NNW-SSE Long Axes



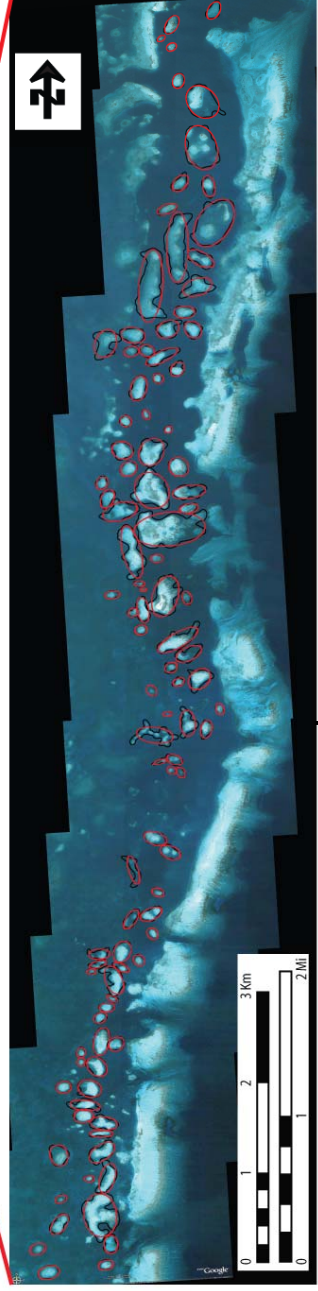
425 patch reefs

**BELIZE INTERMEDIATE**



104 patch reefs

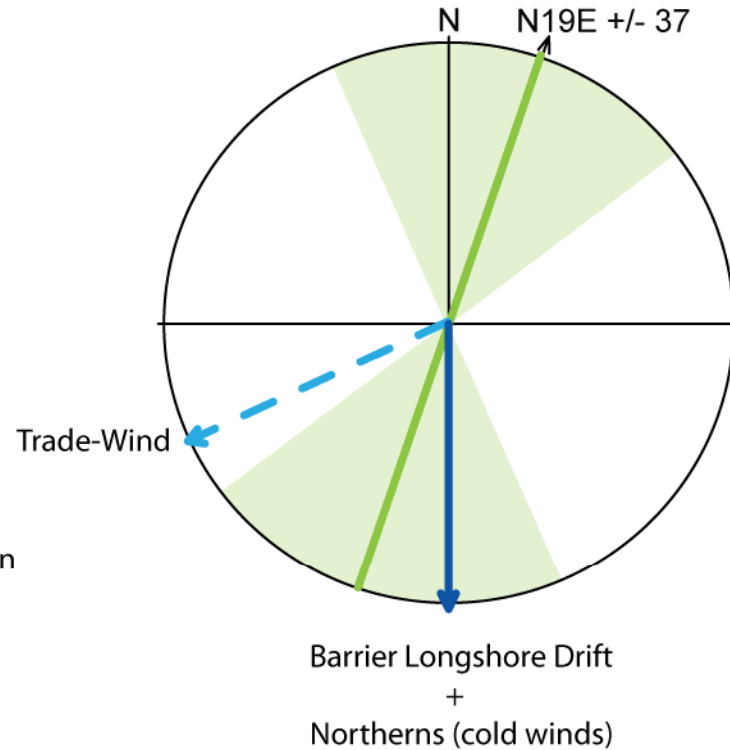
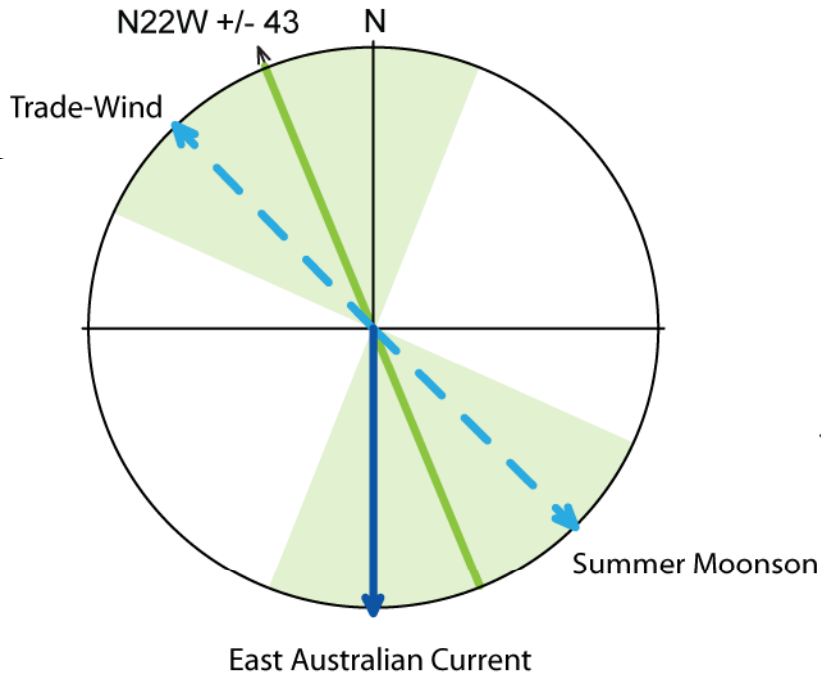
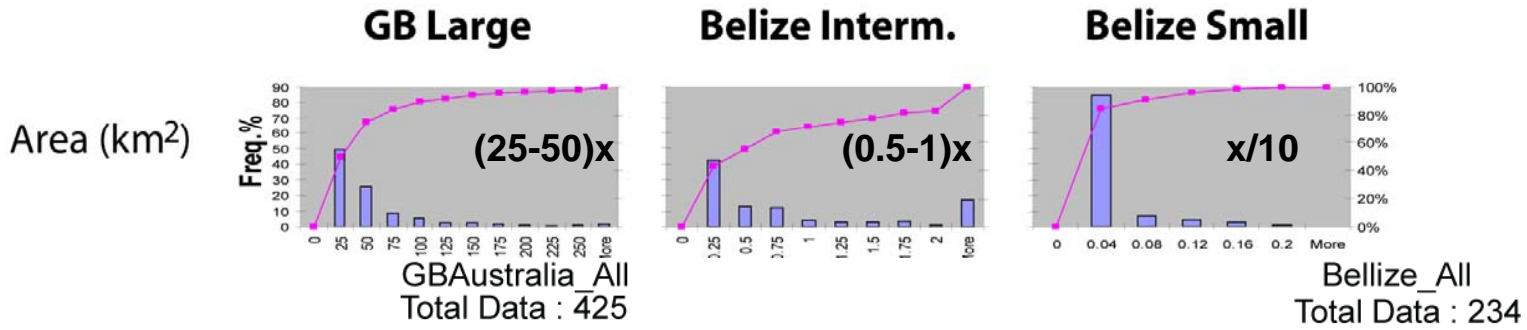
**BELIZE SMALL**



134 patch reefs



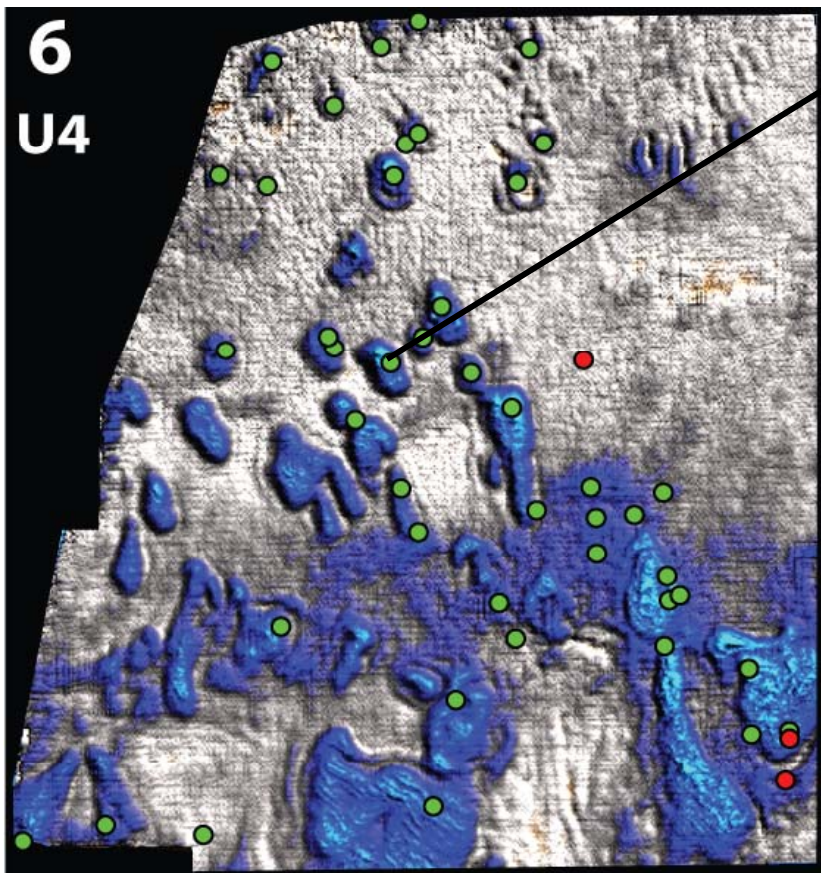
# Modern Buildup Geomorphometrics



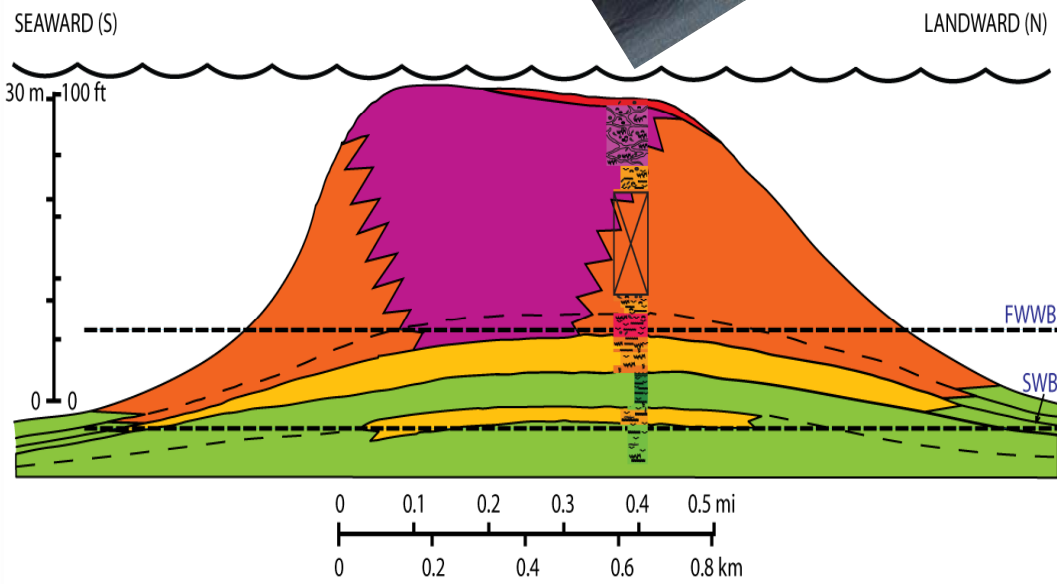
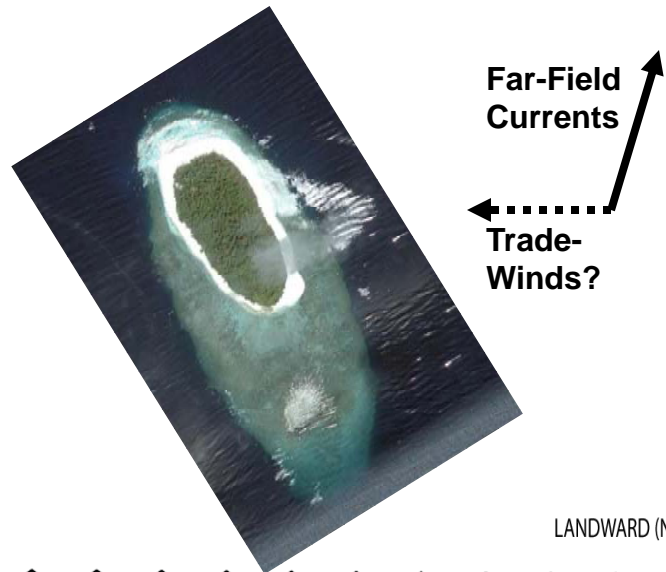
**Elongation direction = Trade-Wind (Coral Spawning) + Far-Field Current**



# How to apply hydrodynamics understanding?



0.7 mi  
1.13 km



- 1 Burrowed, skeletal WS/MS interrupted by skeletal MDP/GDP
- 2 Burrowed, oncoidal-skeletal MDP/GDP
- 3 Rudist-coral-stromatoporoid, skeletal MDP/GDP to RS
- 4 Rudist-coral-stromatoporoid, skeletal-peloidal BS
- 5 Skeletal-peloidal GS to RS



# Conclusions

## The Lower Glen Rose (Albian) buildups in the Maverick Basin:

- 1. Developed in three levels within the sequence 7. Two of the levels occurred within the TST. Buildups occurred as biostrome and bioherms with an arrangement of shoaling-reefal rock facies deposited mostly during 4<sup>th</sup> order decreasing accommodation cycles.**
- 2. Are mounded features elongated NNW-SSE with steeper sides to the SW. This asymmetry may have resulted from paleo-currents directed NNE and E paleo-trade-winds. The implication is that better reservoir rock facies locate to the SW side of the buildups.**
- 3. Maybe preceded by shallow mud mounds.**

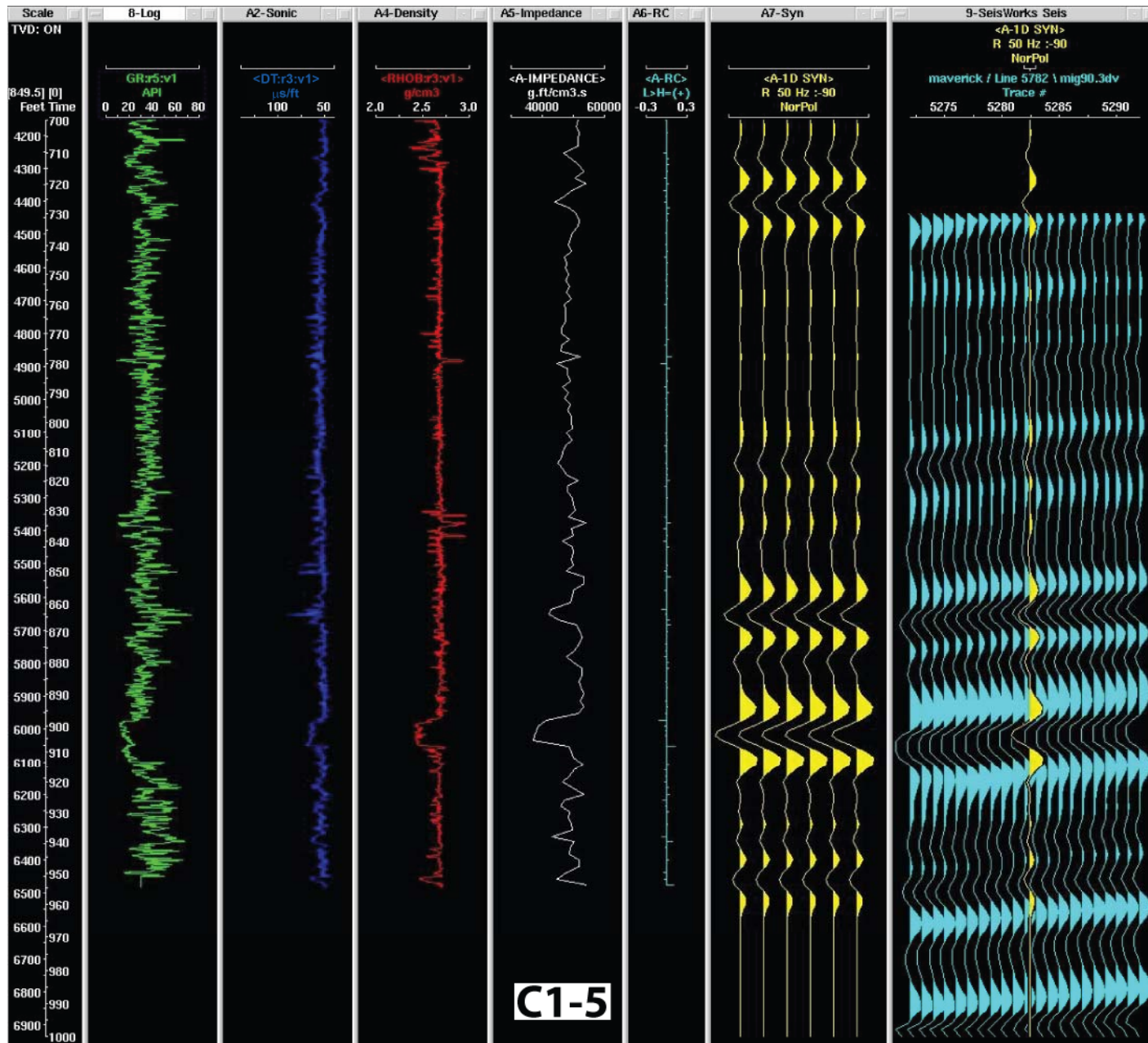
**THANKS**



# Shallow water Mud Mounds Candidates

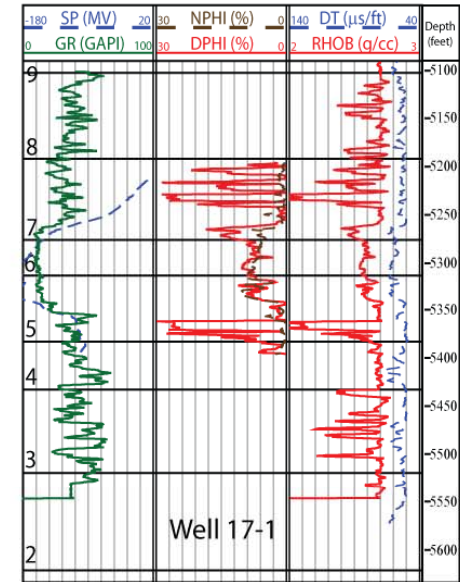
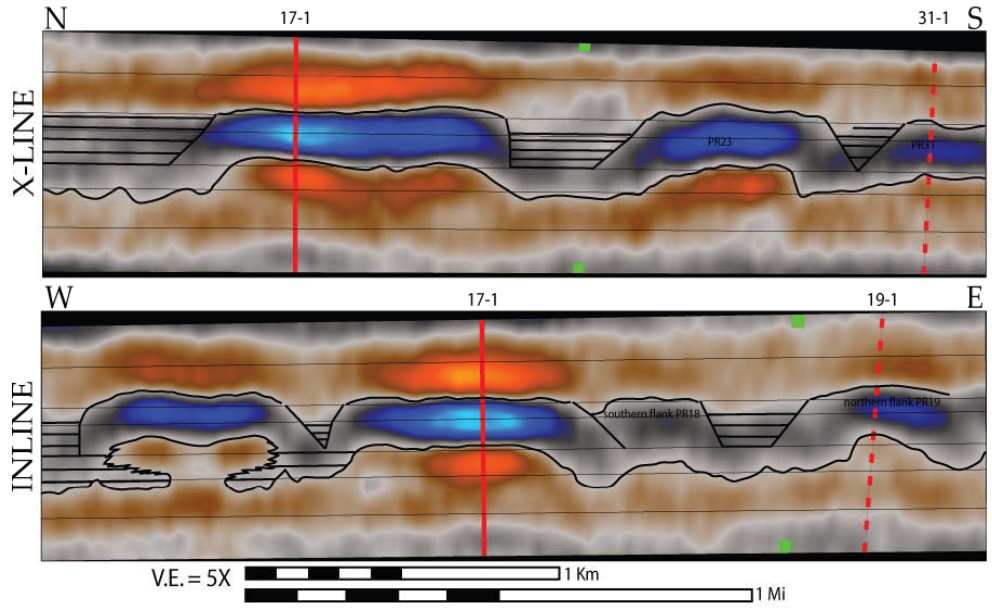
- Oyster Reefs: Texas coast, Murray Basin - S Australia (Pufahl & James 2006).
- Halimeda (green algae) bioherms: GB Australia (Marshall & Davies, 1988).
- Thalassia (sea grass) stabilized mud mounds: Florida, Rodriguez bank (Turmel & Swanson 1976), Tavernier bank (Bosence et al. 1985).
- Biodetrital mud-shoals: Cangrejo and Bulkhead shoals in northern Belize (Mazzulo et al. 2003).
- Microbial mounds: Lower Carboniferous SW Spain (Cózar et al. 2003).
- Phylloid algae: El Hueco Mountains in Texas / New Mexico (Forsythe 2003) and Viséan Irish Platform (Somerville 2003).

# Dataset

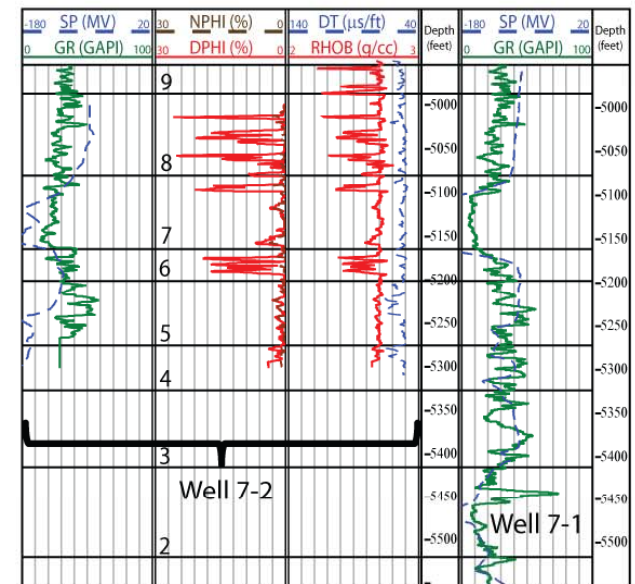
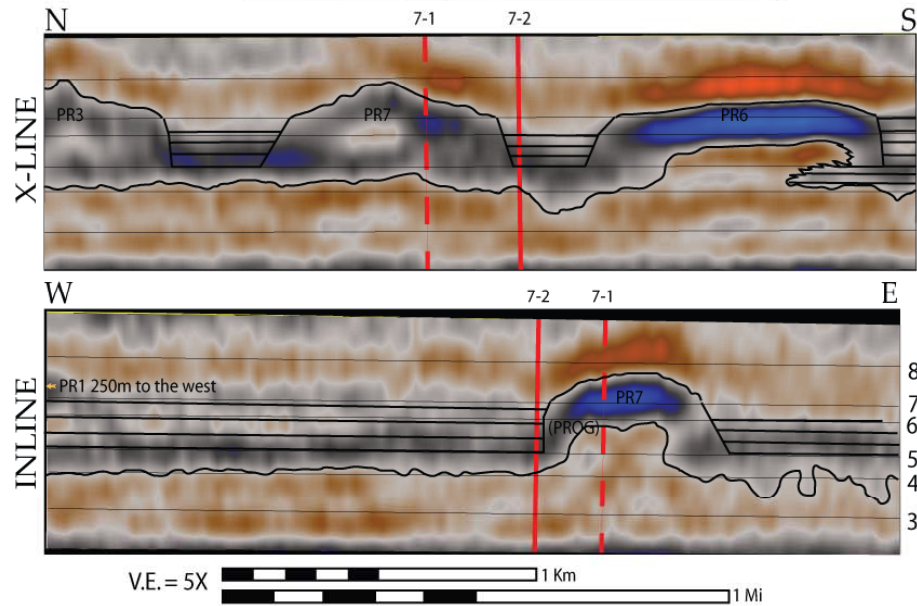


# Buildups profile and Lithologic characterization

Buildup of well 17-1

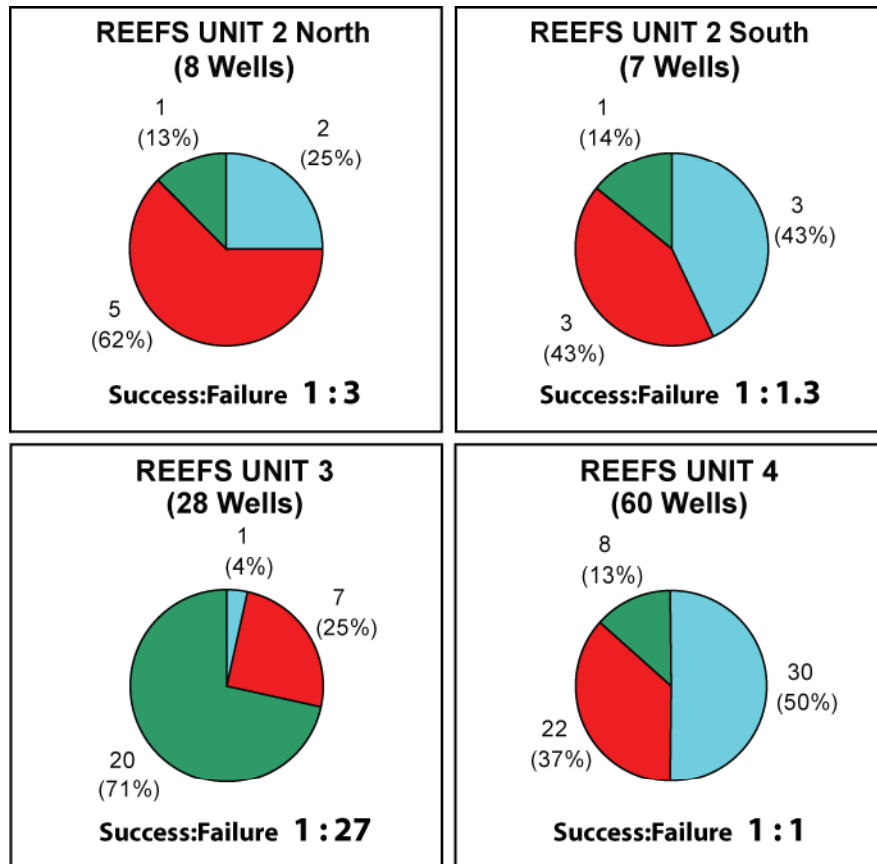


Buildup of well 7-1





# Production in Lower Glen Rose Buildups



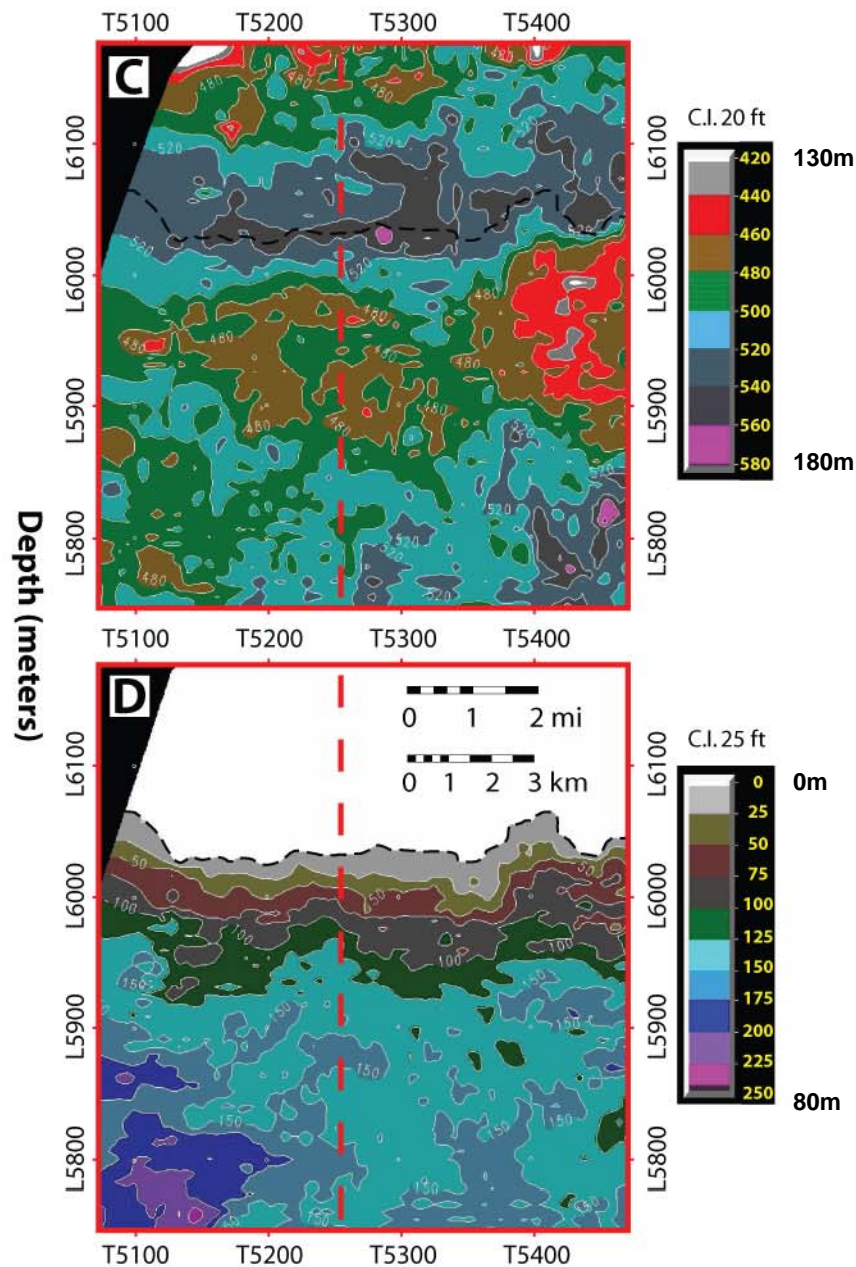
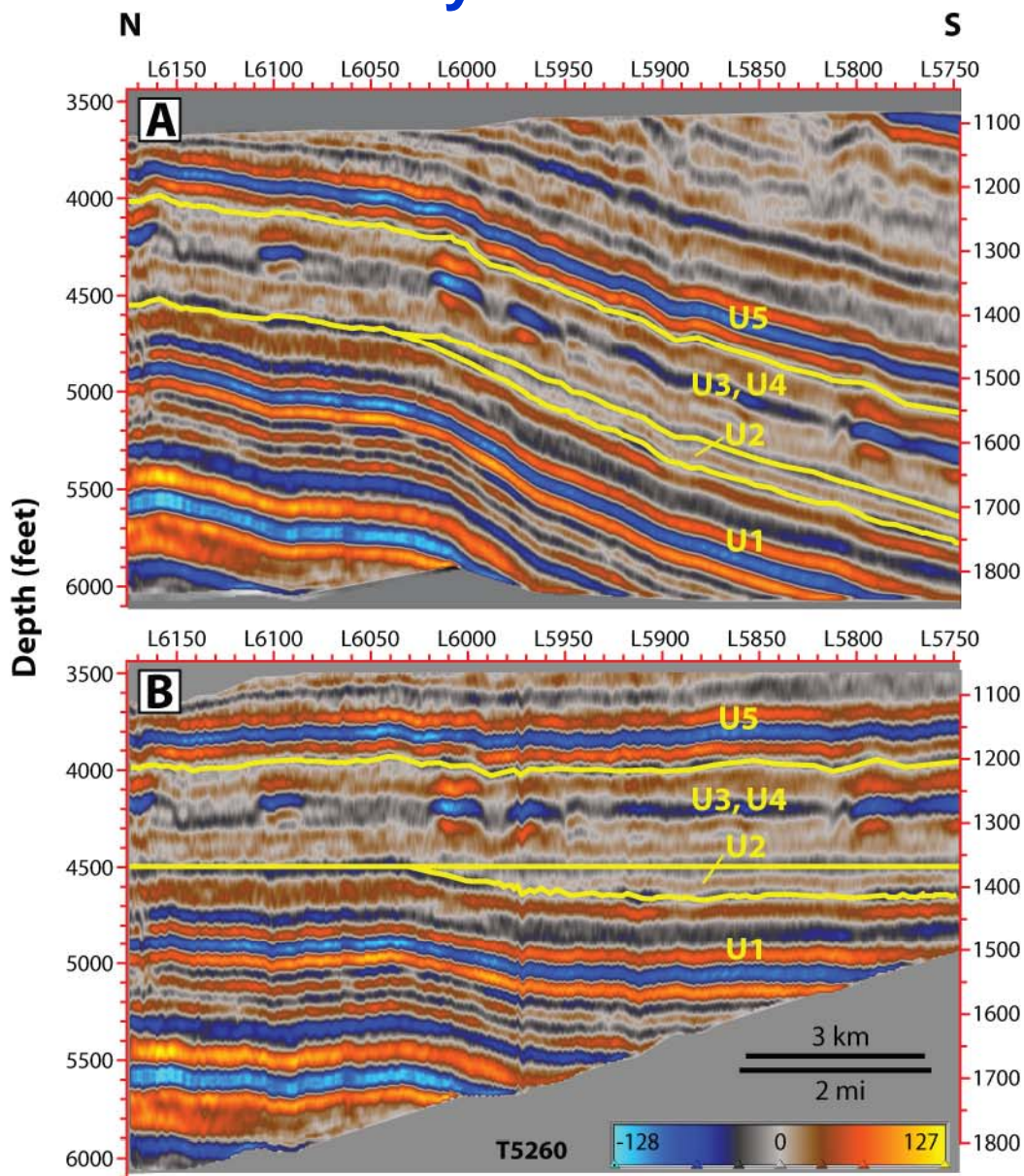
## Chittim Gas Field:

- Discovered 1929
- First well prod.: >30 BCF (1981)

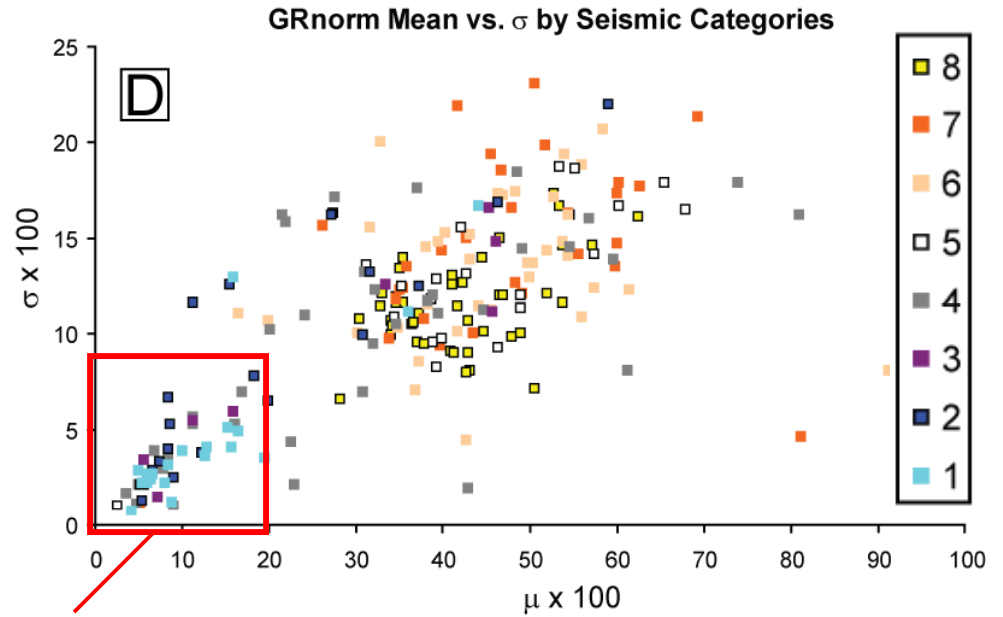
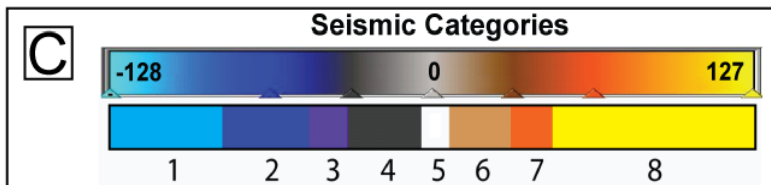
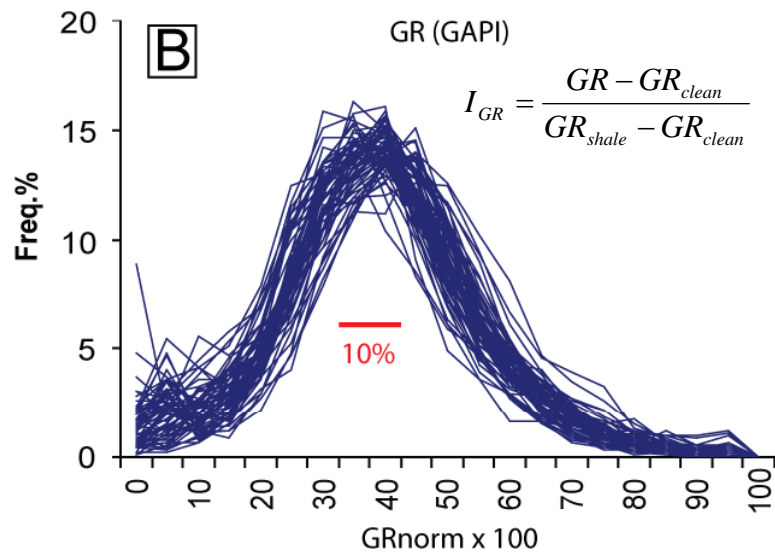
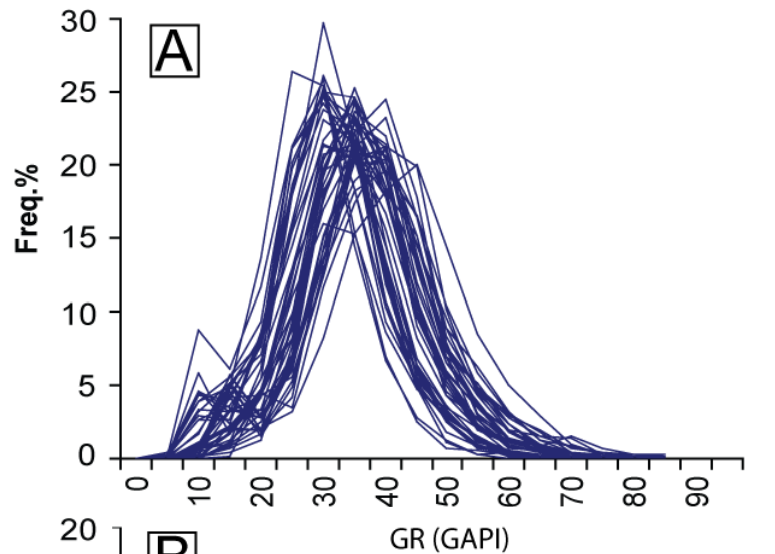
## This dataset (75 wells):

- 17 wells drilled before 3D seismic (1993)
- Unit 4's prod. (26 wells): 38.5 BCF  
 Prod. Range (>1970): 0.2-5.7 BCF  
 12 wells : >1 BCF (>1970)

# Seismic Analysis



# Seismic Amplitude Facies & Gamma-Ray description



**Buildups**

