Evaluation of the Trinity – Tiger Shoals Complex: A Potential Sand Resource for Coastal Restoration

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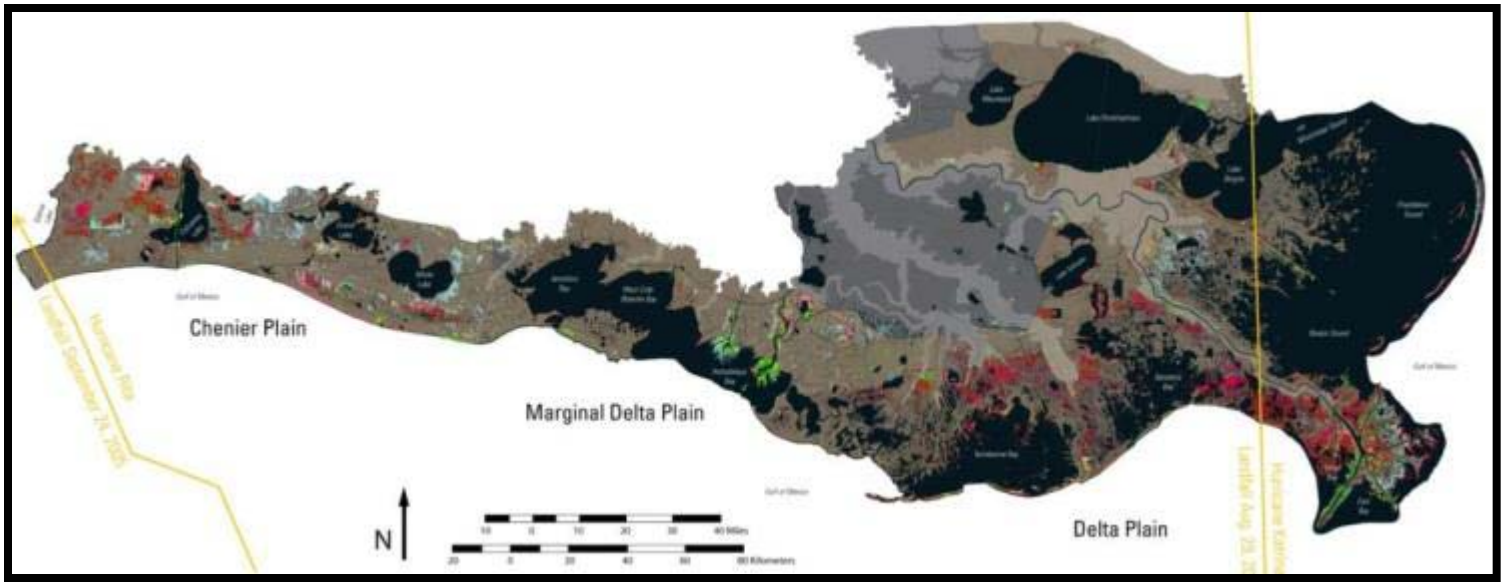
- Roger Amato (Project Officer)

The State We Are In



From Barras et al. (2008)

Land loss since the 1930s: ~ 4,800 km^2 (Britsch and Dunbar 1993)

Projections: ~ 1,300 km^2 within 50 years (Barras et al. 2003)
~ 10,000 – 13,500 km^2 by 2100 (Blum and Roberts 2009)

Factors that contribute to coastal land loss:

- eustatic sea-level rise
- subsidence
- tropical storm impacts
- “normal” wave energy
- anthropogenic

Barrier Islands: The First Line of Defense

www.science.nationalgeographic.com/wallpaper

http://ngom.usgs.gov/phototours/

Act as a physical buffer against open marine processes

Tropical storms + subsidence = net degradation

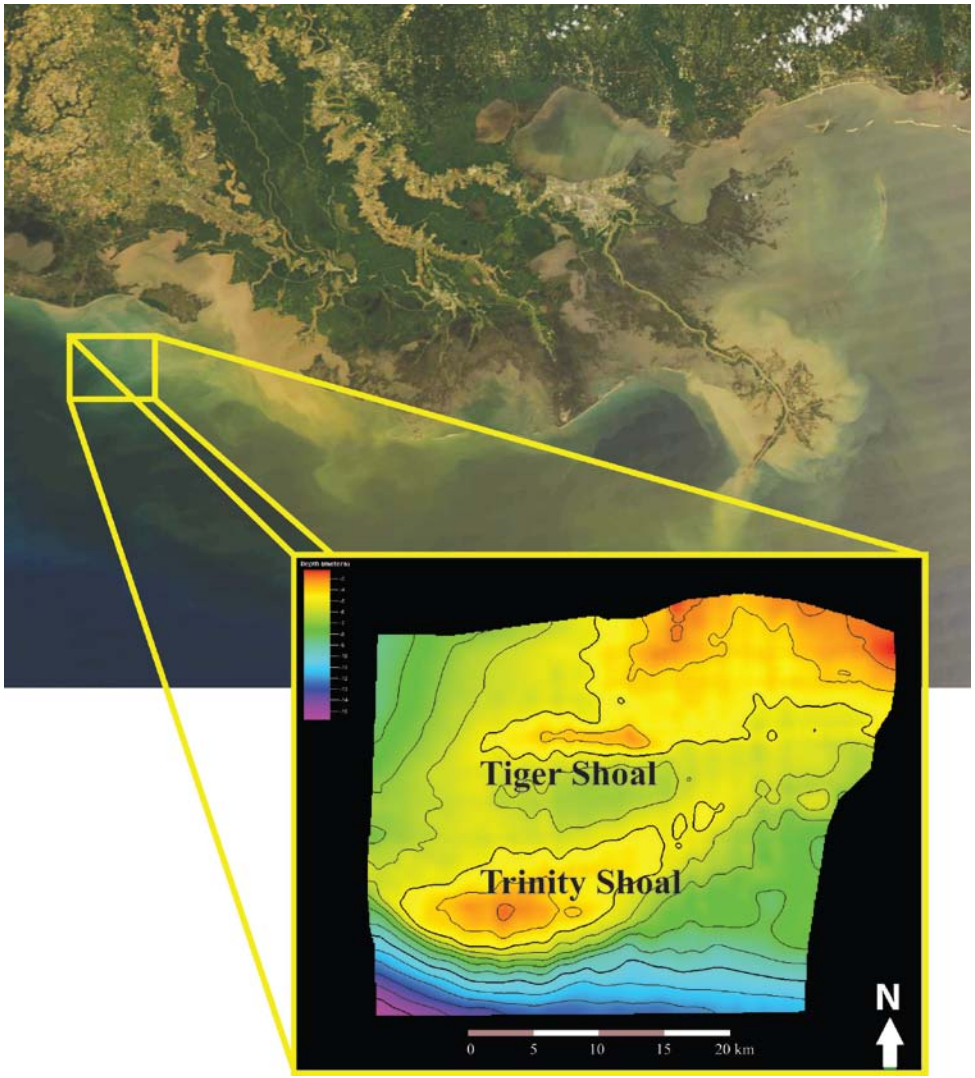
www.atchafalayarevisited.com

Sand Resources

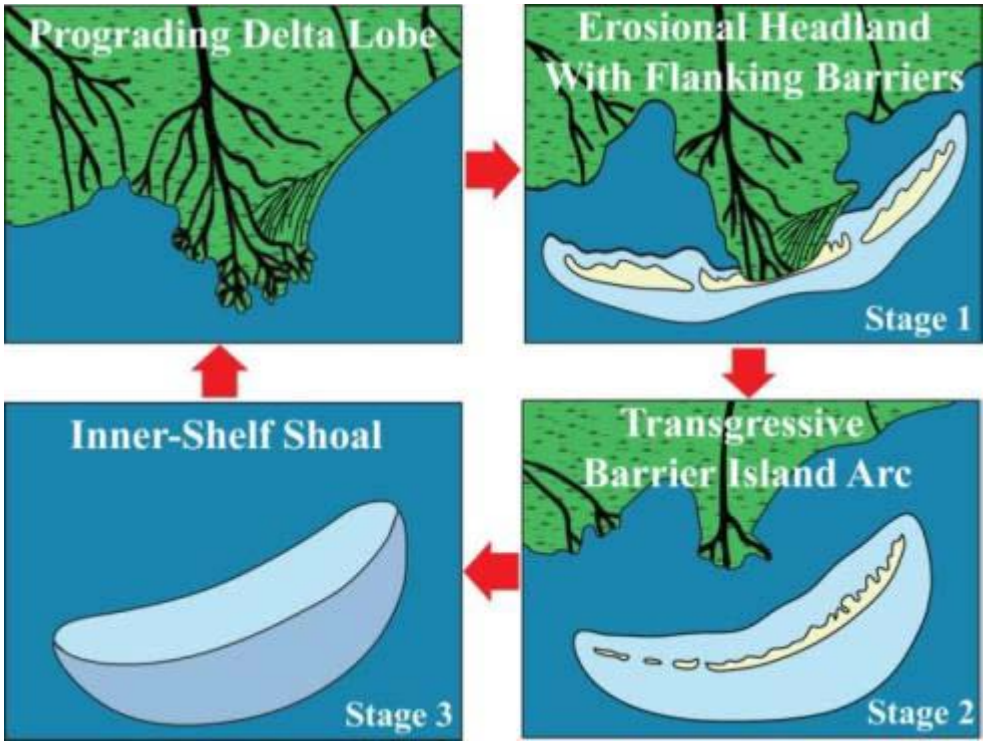
Sand resources: paleo-channels, prograded mouth bars, and crevasse splays

Mud overburden ≠ economical

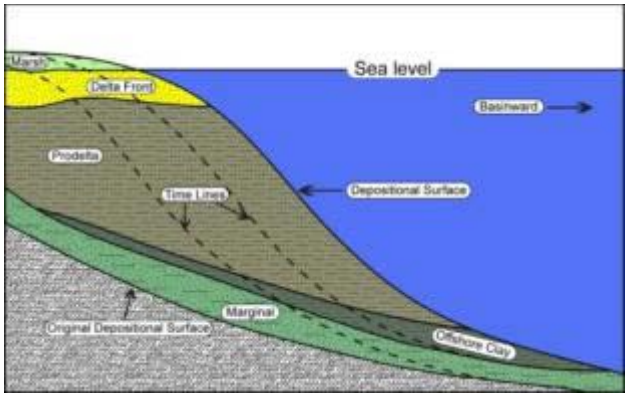
Offshore sand shoals offer a concentrated resource = economical



Offshore Sand Shoals: Geological Evolution



Modified from Penland et al. (1988)



Modified from Scruton (1960)

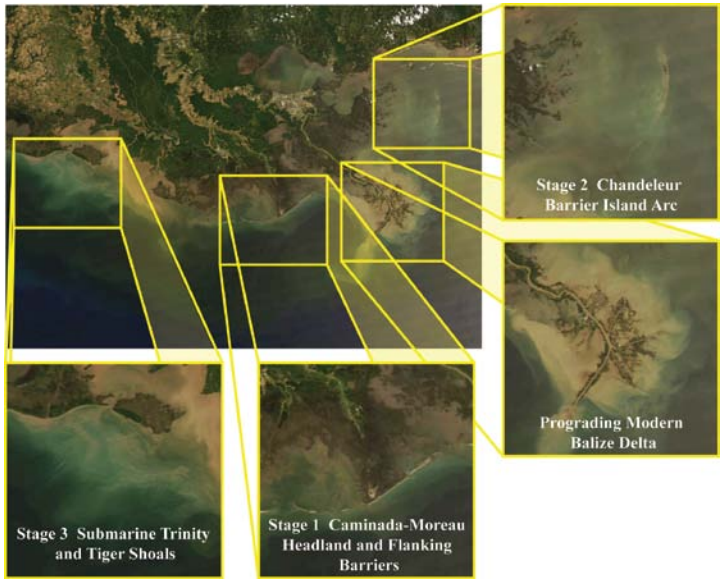
Modified from Roberts (1997) & www.lgs.lsu.edu

Delta building is inherently cyclical → regressive and transgressive phases

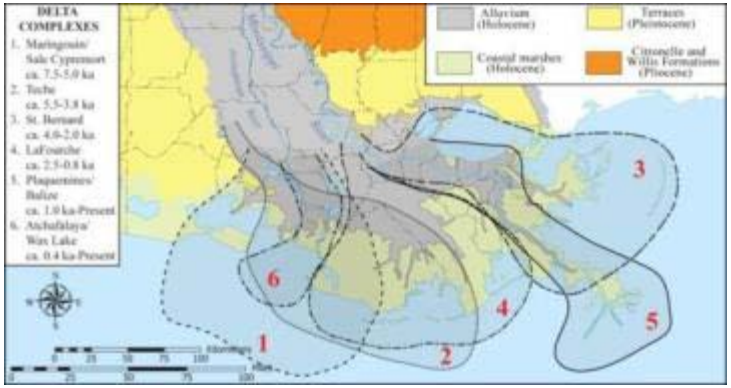
Trinity-Tiger Shoals: End Members of the Delta Cycle

MS River Delta Plain displays all components of the delta cycle

Trinity and Tiger Shoals: end products of the delta cycle

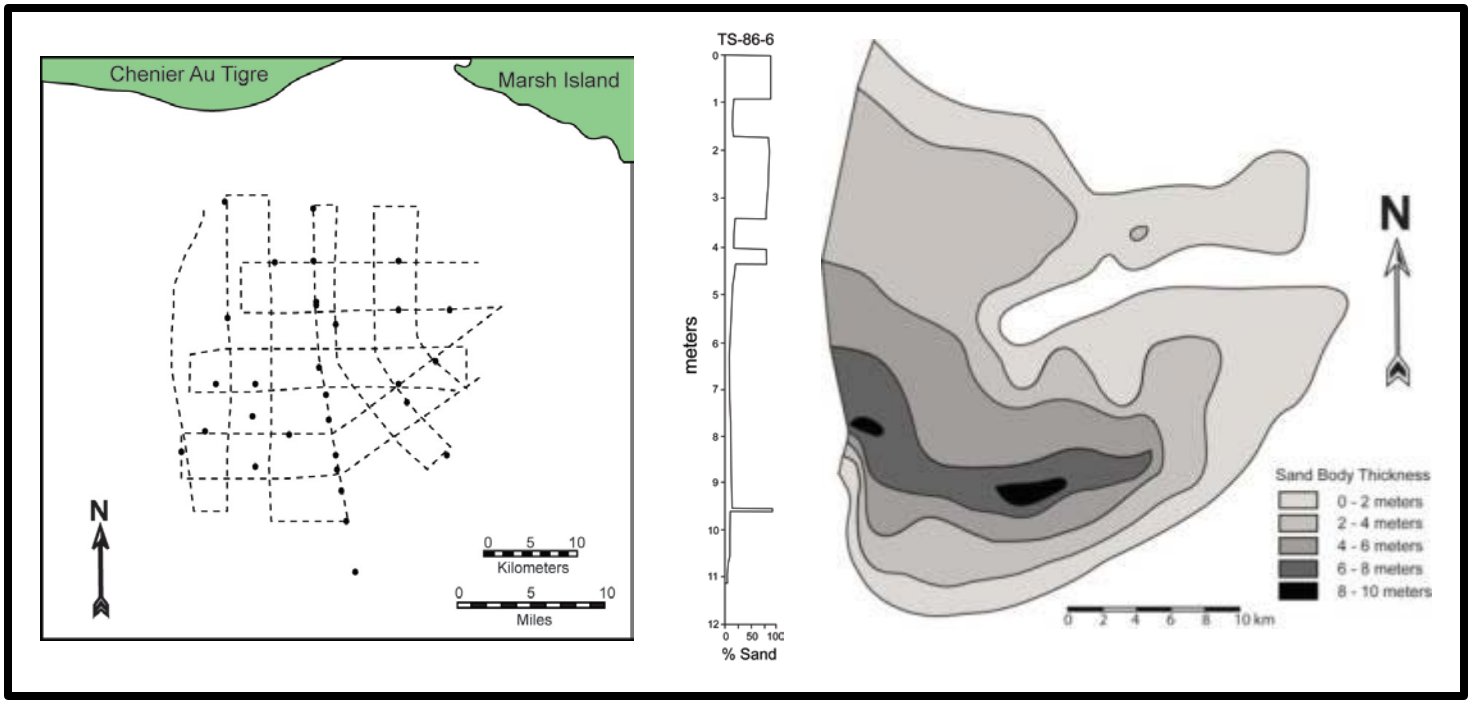


MODIS Satellite image from the Louisiana State University Earth Scan Laboratory



Modified from Roberts (1997) & www.lgs.lsu.edu

Previous Study



Modified from Penland et al. (1990)

800 km of acoustic data

30 vibracores

Results: percent-sand logs; entirely vf sand; geological x-sections; isopach map (2.0 billion m^3)

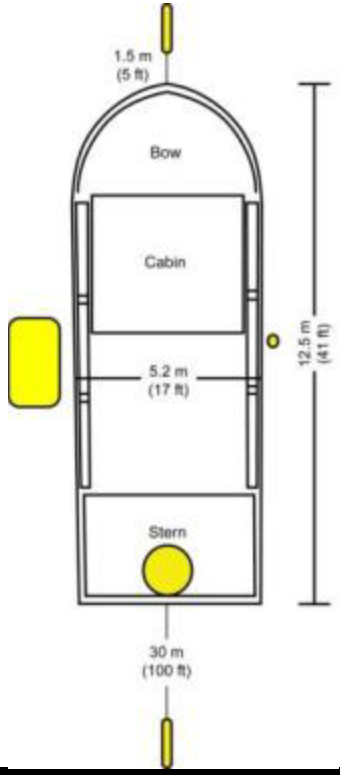
Purpose

Develop a detailed model of the Trinity-Tiger Shoals Complex

Objectives:

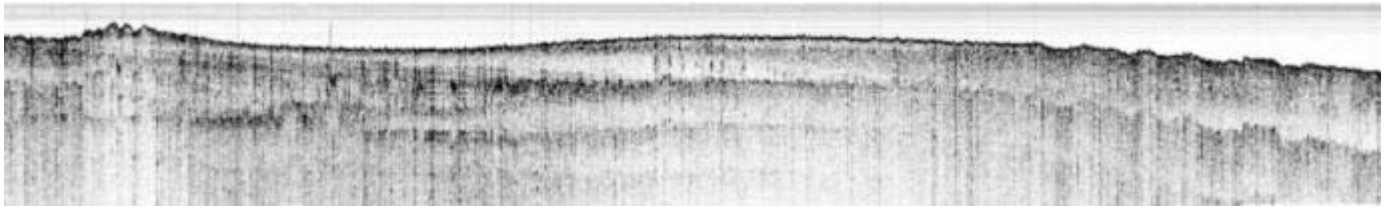
1) Evaluate quantity and quality of sand
2) Locate pipelines and other metallic hazards
3) Integrate objectives 1 and 2 to calculate total sand volume available for extraction

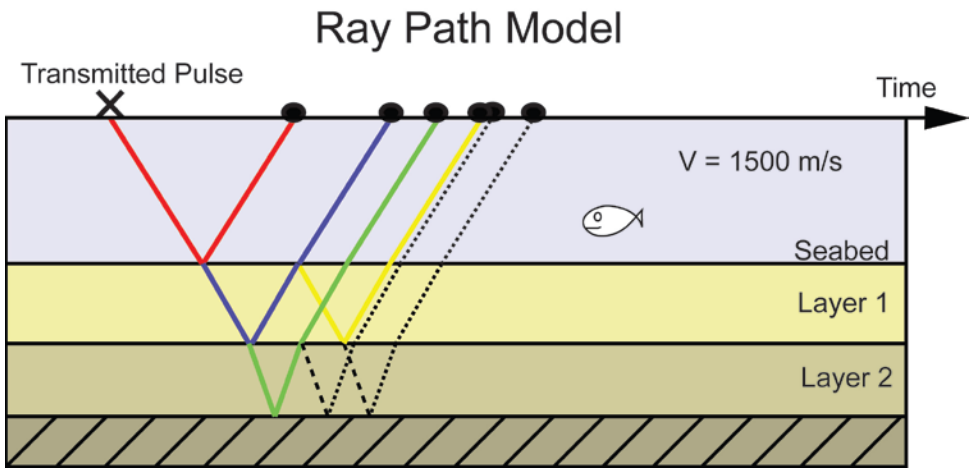
Methodologies: Rationale and Approach



R/V *Coastal Profiler*

Sub-Bottom Profiler



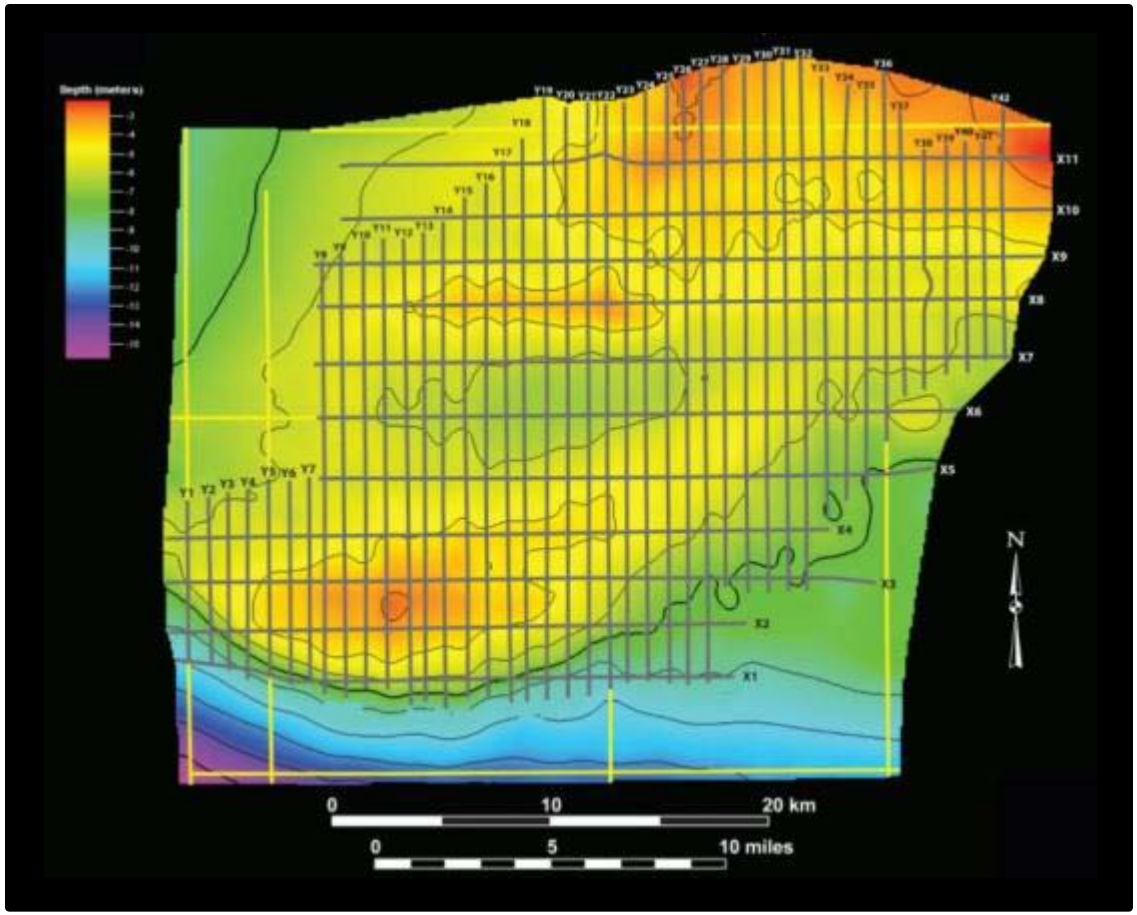


EdgeTech SB 512i towfish

High-frequency sonar data

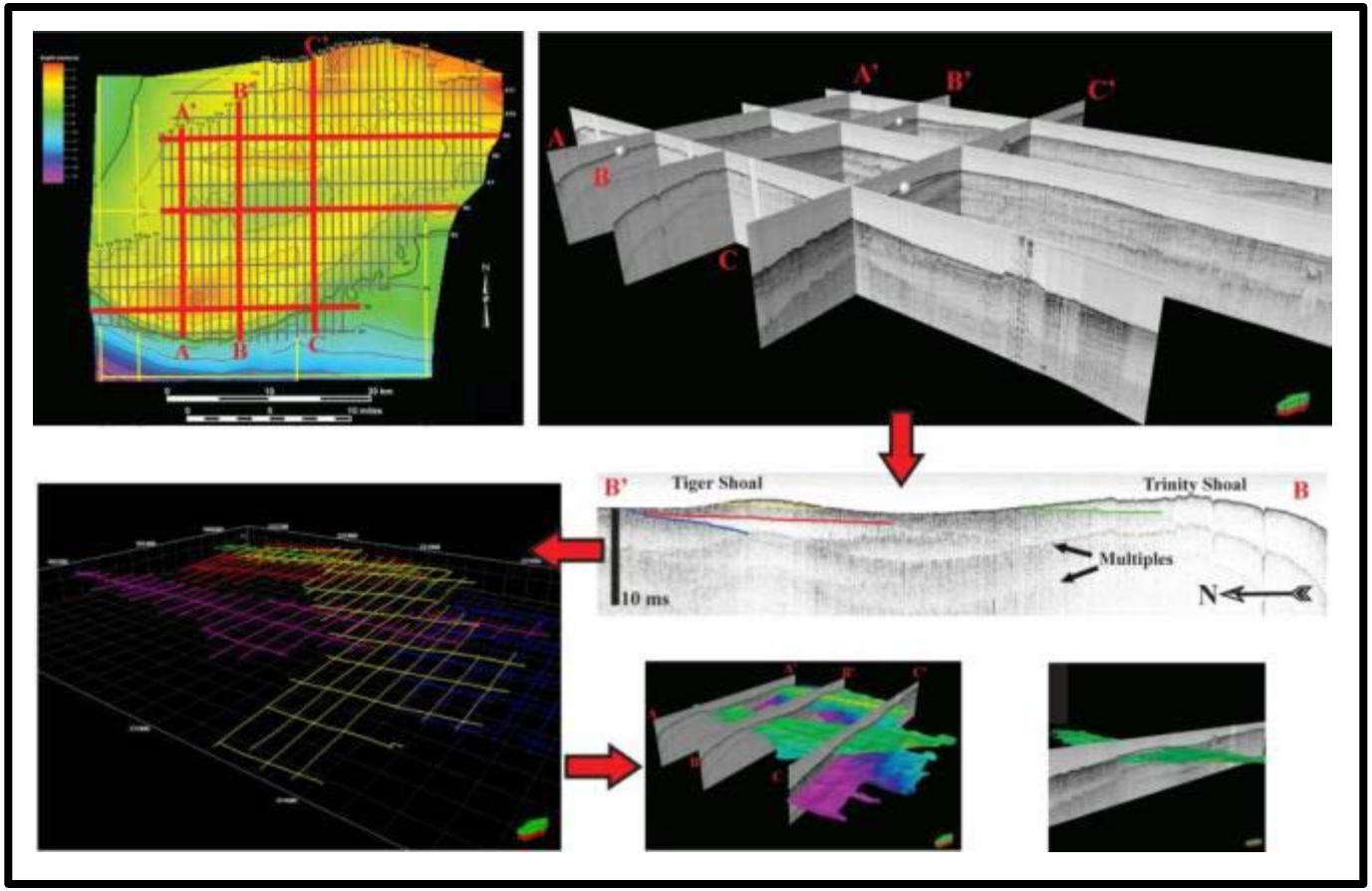
Reflection seismology: I = v * ρ → a change in I causes a reflection

Survey Grid



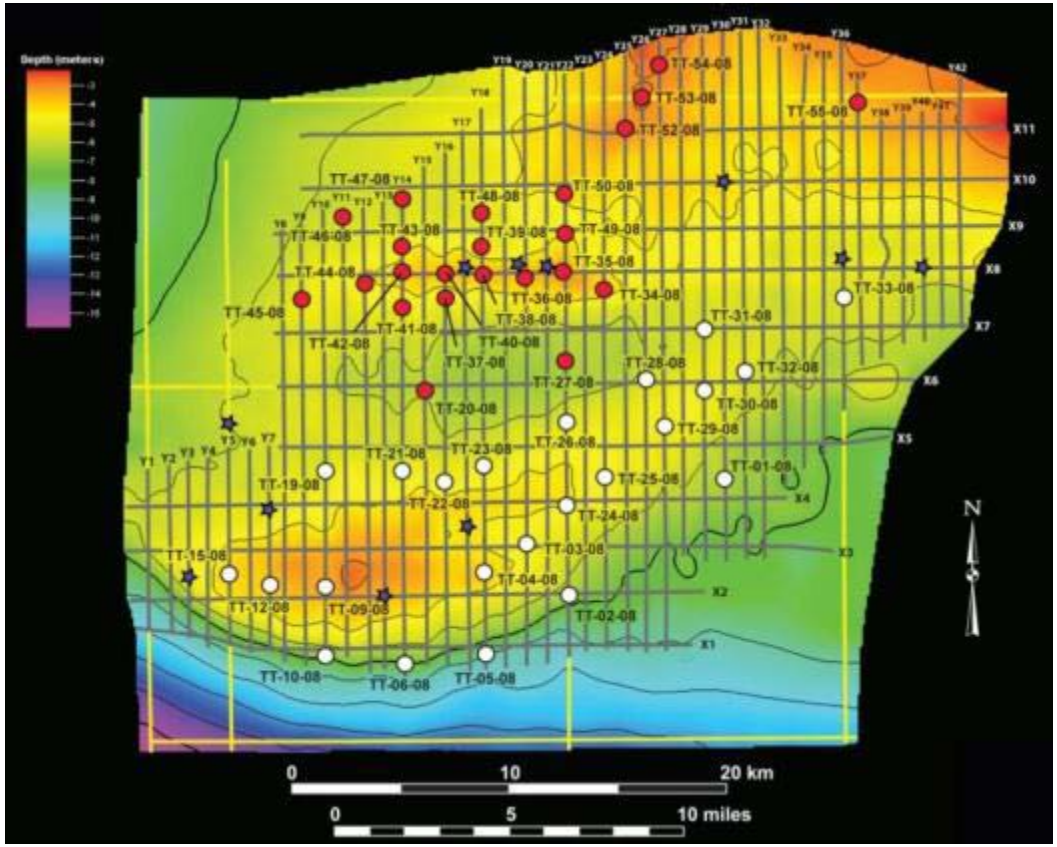
2 separate surveys → 1,350 line km
Initial grid's spacing interval is 0.9 km vs. 2.3 km

Picking Coring Sites



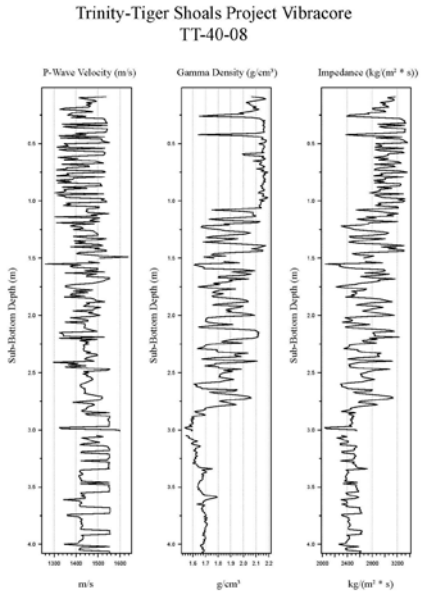
Motivation: (1) satisfy our BOEMRE objective, and (2) penetrate surfaces in as many locations as possible so as to extrapolate geological interpretations throughout the study area

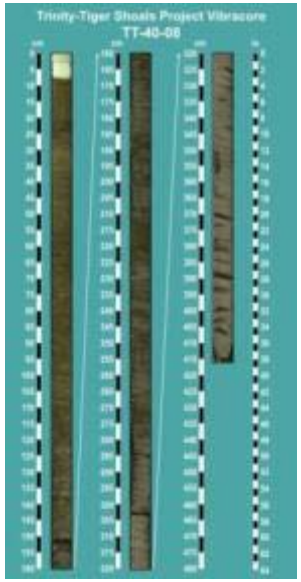
Ground-Truthing Data

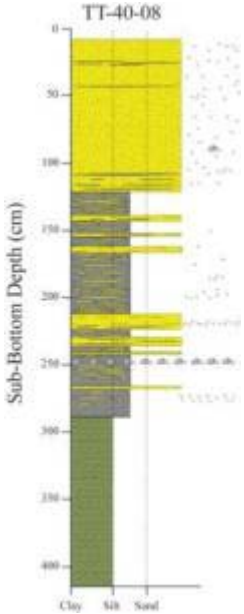


60 total vibracores

Core Logging







GeoTek Multisensor Core Logger: Gamma Ray Attenuation (bulk density) and P-Wave Velocity (lithology)
High-resolution digital imaging for archiving

Sampled for sand/mud ratios, grain-size analysis, and radiocarbon dating

Cores were visually described, and lithologs were constructed

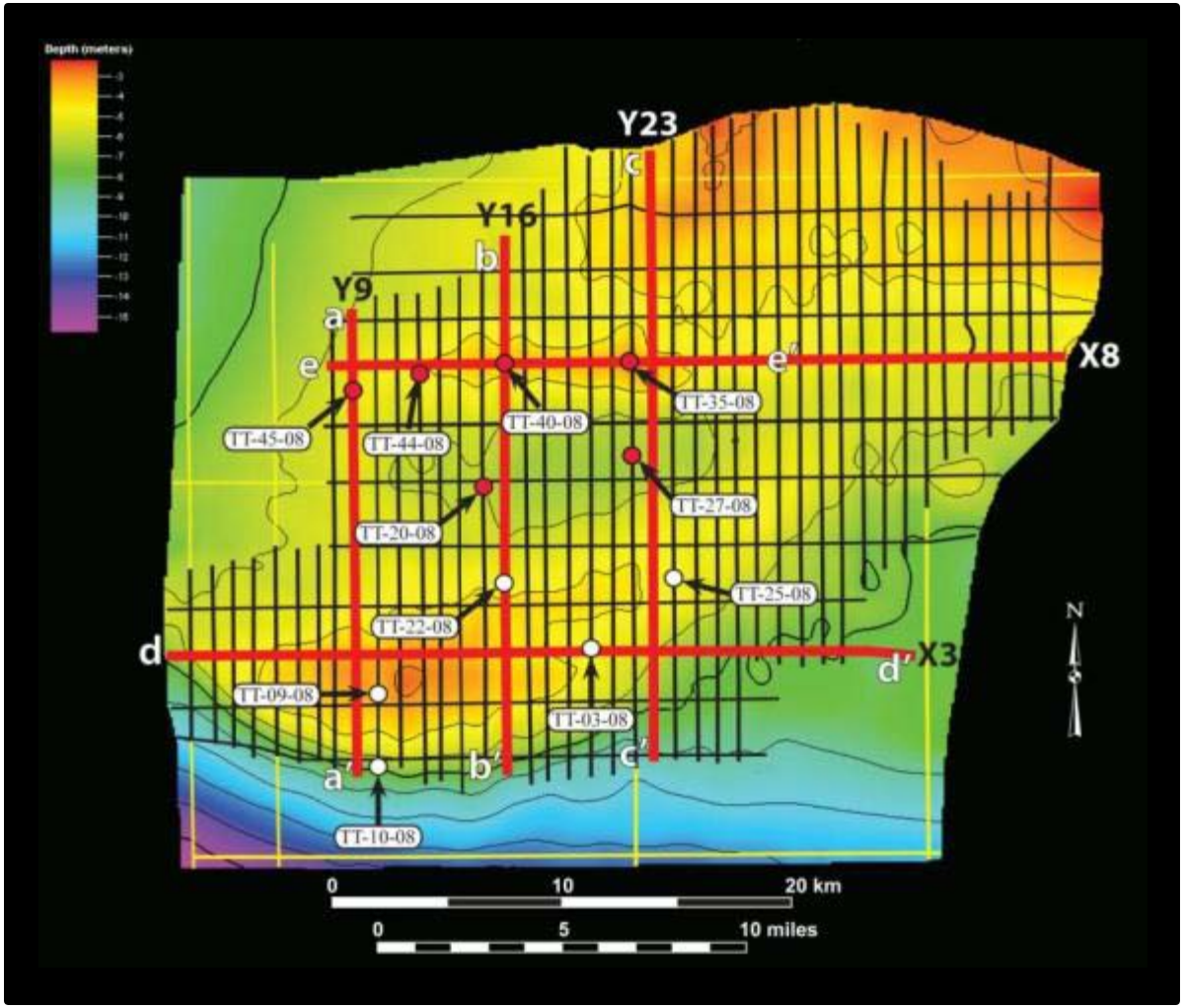
Grain Size Analysis

Sand-mud ratios: 293 samples

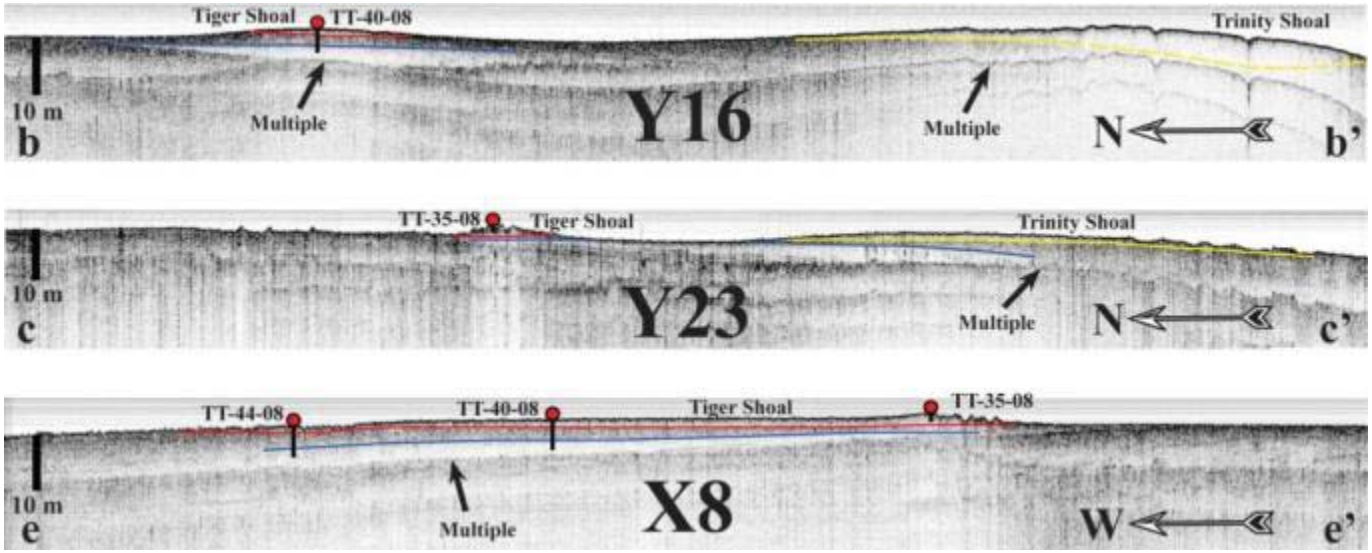
Grain-size analysis of sand fraction
241 samples

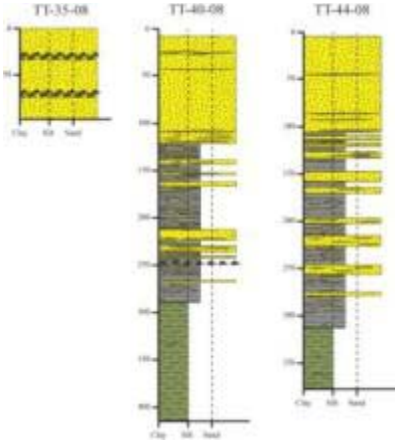
Gilson SS-3 Sieve Shaker
- 0.25 Φ sieve intervals

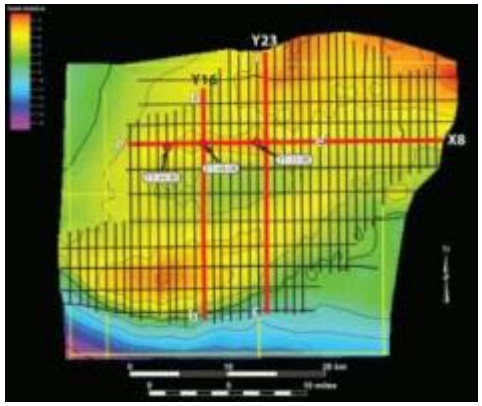
Stratigraphic Framework



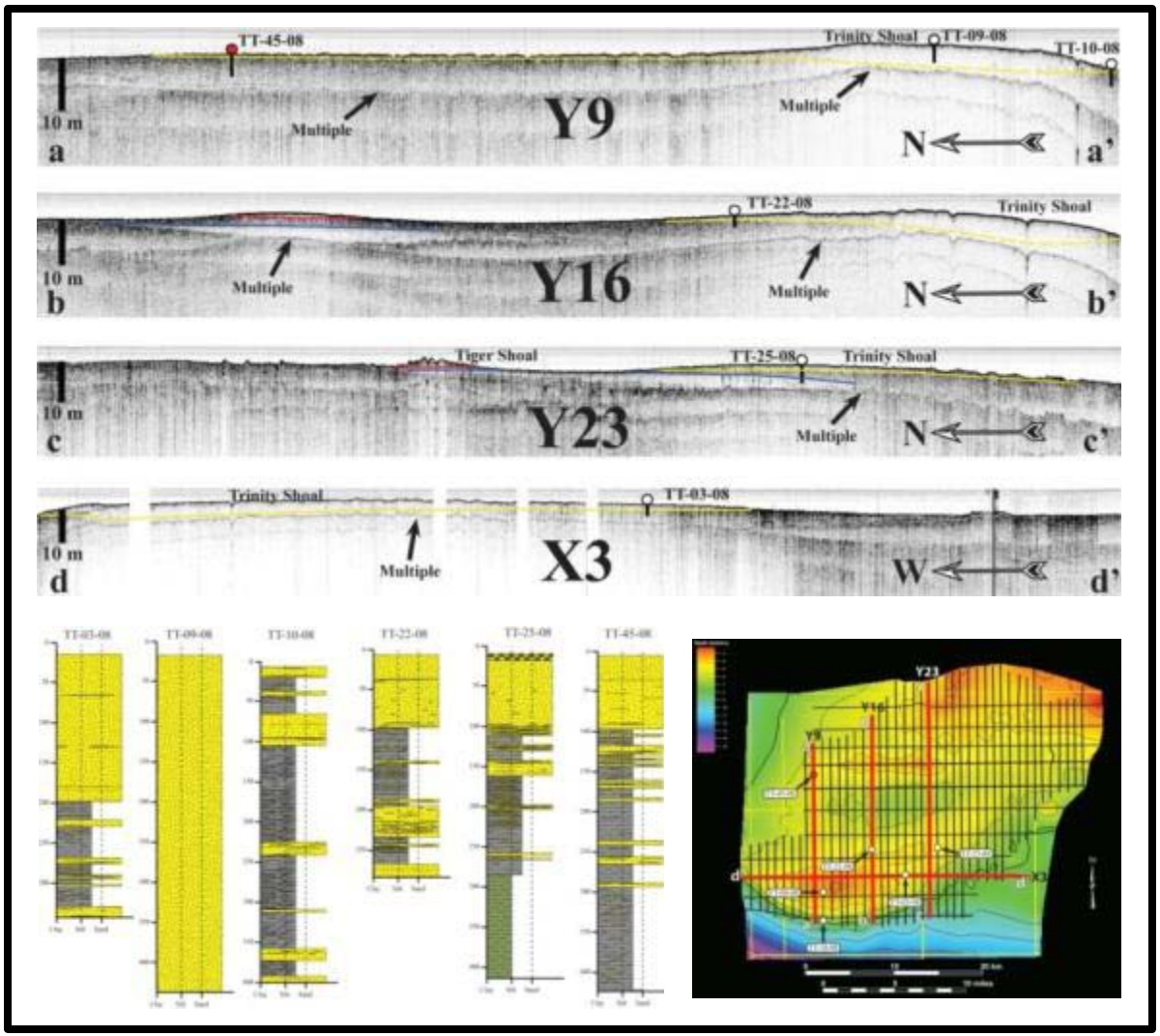
Tiger Shoal


Tiger Shoal
TT-40-08
Trinity Shoal
10 m
b
Multiple
Y16
Multiple
N
b'
TT-35-08
Tiger Shoal
Trinity Shoal
10 m
c
Y23
Multiple
N
c'
TT-44-08
TT-40-08
Tiger Shoal
TT-35-08
10 m
e
Multiple
X8
W
e'

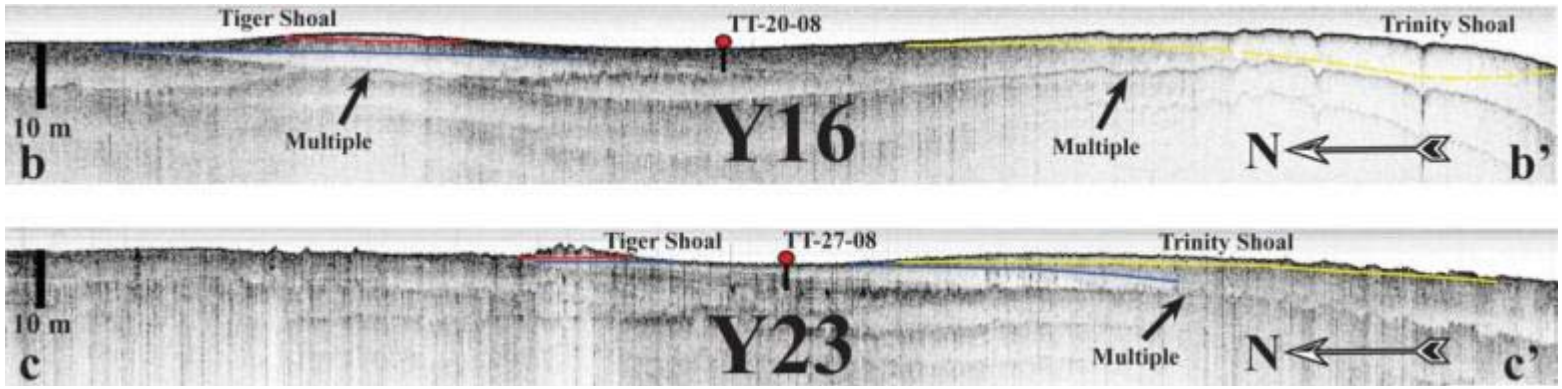

TT-35-08
TT-40-08
TT-44-08

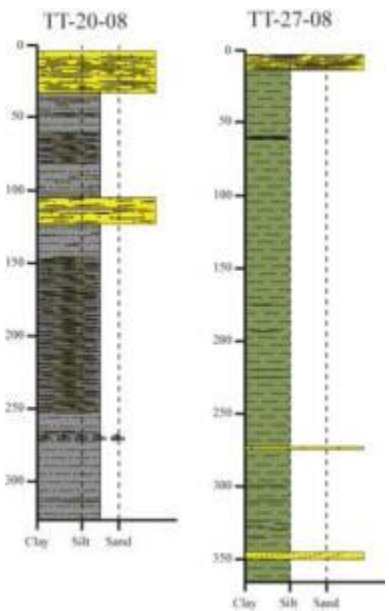

Y23
Y16
X8

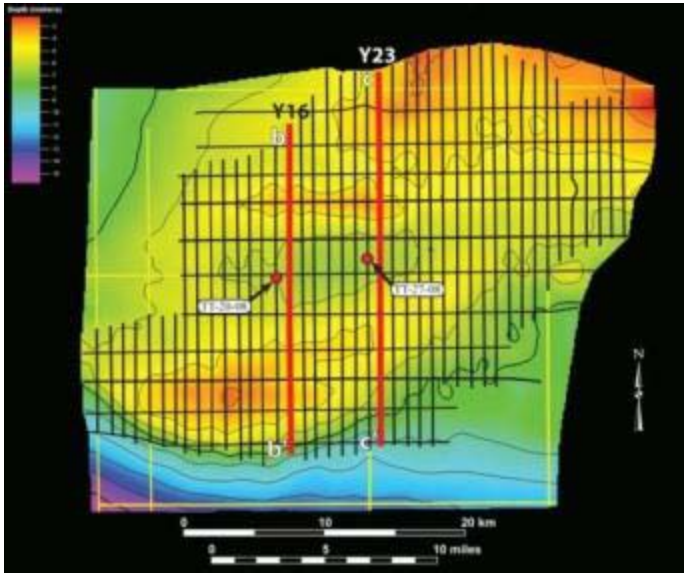
Trinity Shoal



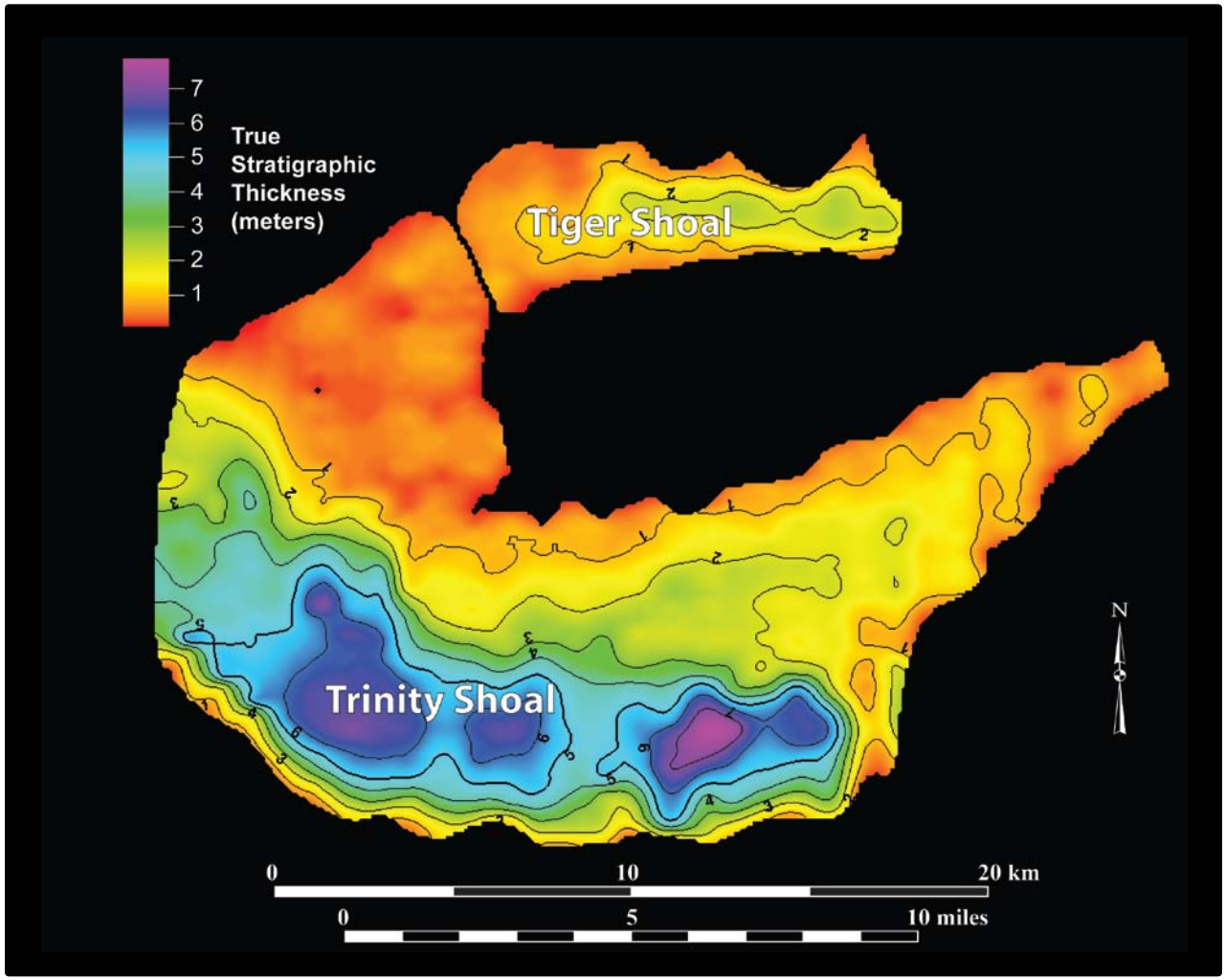
Two Separate Depositional Bodies



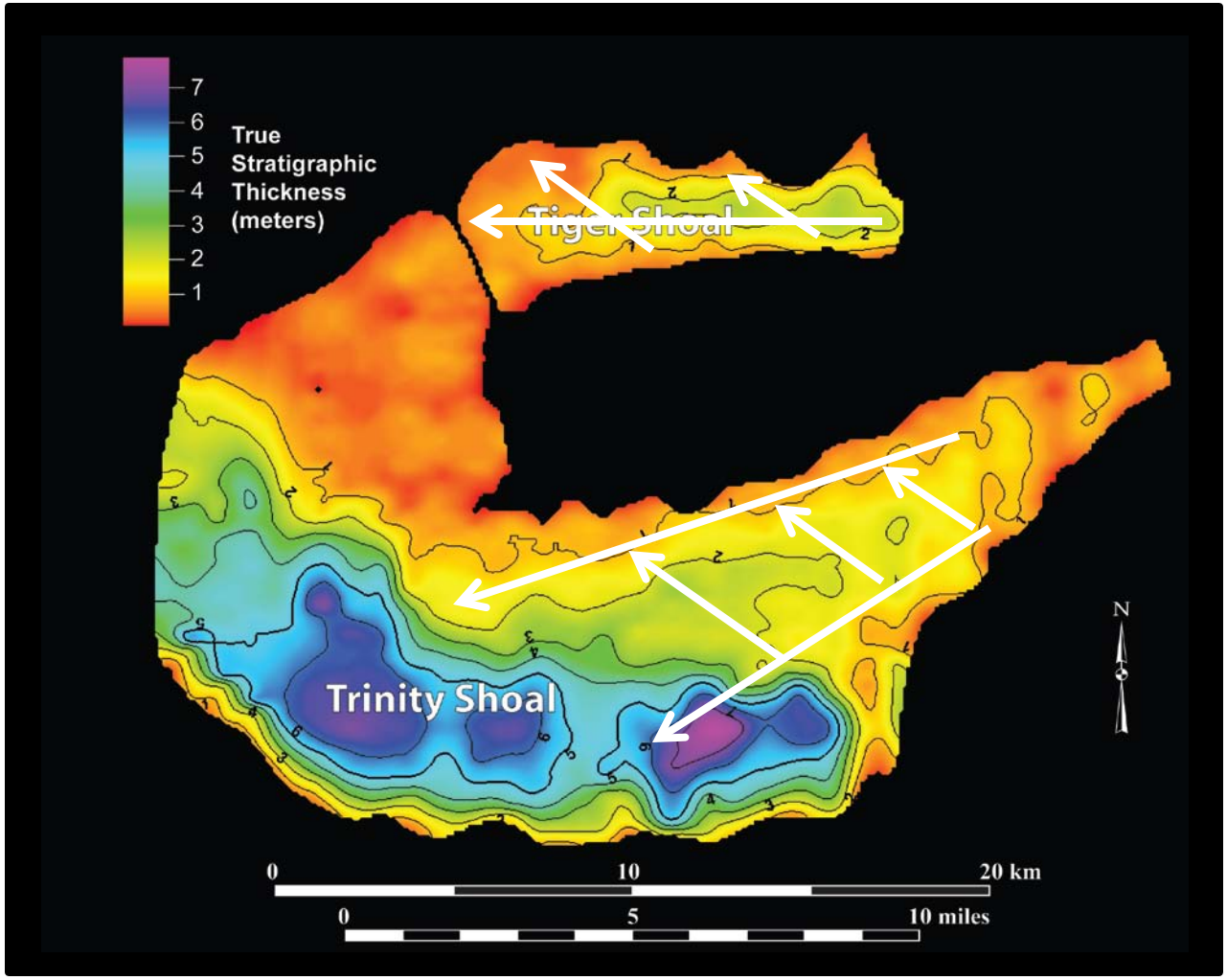




Sand Thickness Map

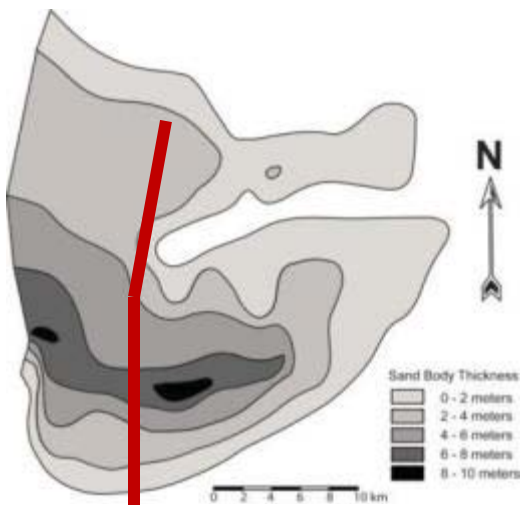


Grain-Size Distribution

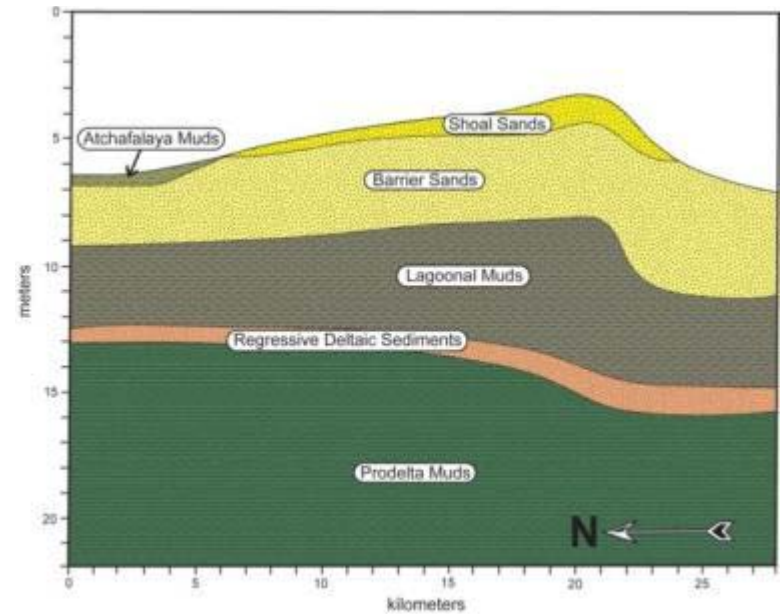


Grain size fines in the direction of the arrows

Sand Volumes



Modified from Penland et al. (1990)



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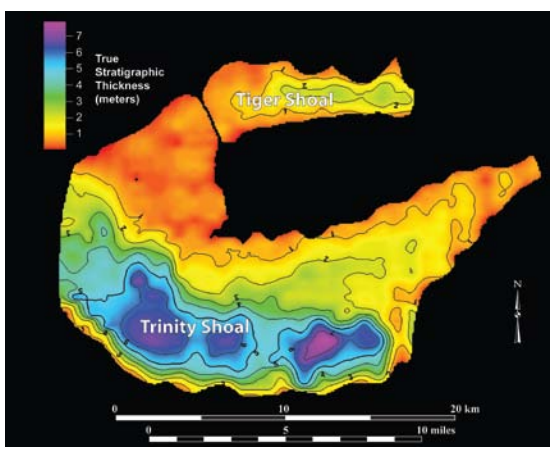
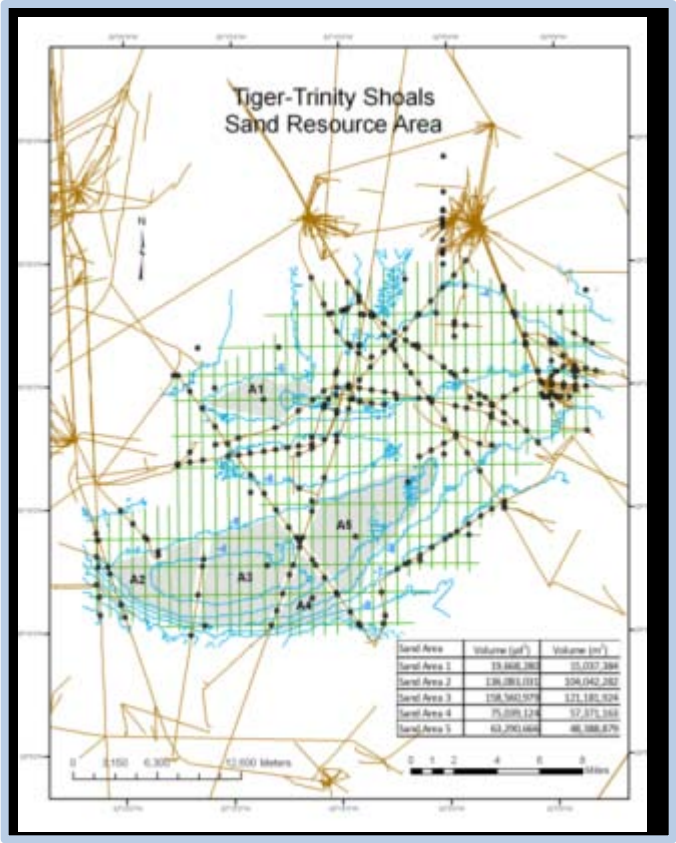


Sand Volume	
Penland et al. (1990)	Roberts et al. (2010)
2 billion m^3 (2.6 billion yd^3)	731,615,645 m^3 (933.379.955 yd^3)
	Trinity → 686,778,133 m^3 (898,277,592 yd^3)
	Tiger → 44,837,512 m^3 (58,645,624 yd^3)

Actual Sand Available

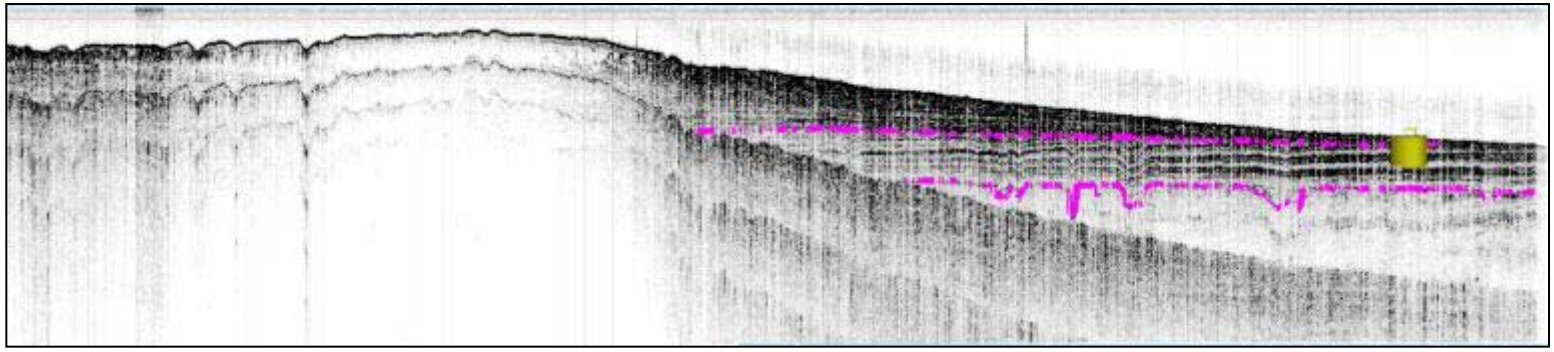


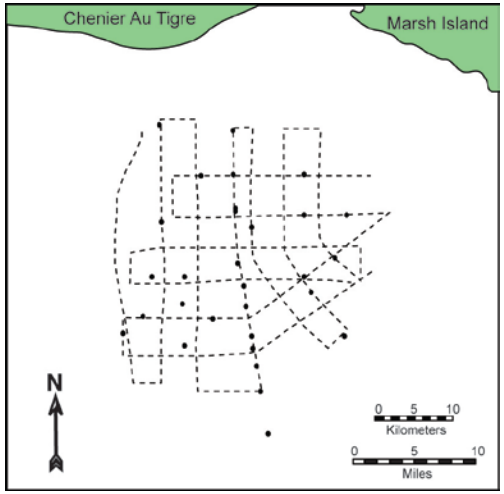
Sand Area	Volume (yd³)	Volume (m³)
Sand Area 1	19,668,280	15,037,384
Sand Area 2	136,083,031	104,042,282
Sand Area 3	158,560,979	121,181,924
Sand Area 4	75,039,124	57,371,163
Sand Area 5	63,290,666	48,388,879
Total	452,642,080	346,021,632

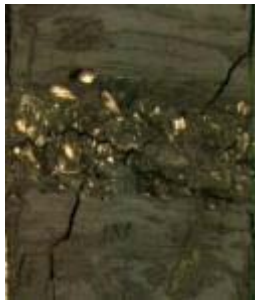
Conclusions

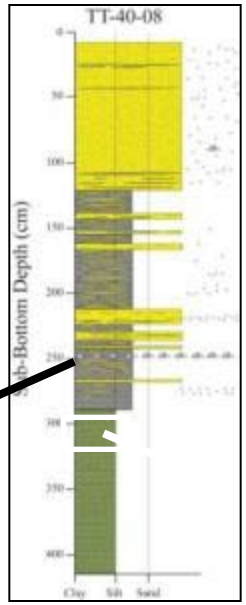
- Trinity and Tiger Shoals are two separate depositional units
- Trinity Shoal >> Tiger Shoal
- Geological interpretations from this study differ from the previous study
- Thus, volumetric calculations are substantially different
  - 731,615,645 m^3 vs 2,000,000,000 m^3
- Actual available sand volume: 346,021,632 m^3
- Trinity and Tiger Shoals are an enormous sand resource
- Grain size of sand fraction available is entirely very-fine sand

On-Going and Future Work









Acknowledgments

- Bureau of Ocean Energy Management, Regulation & Enforcement
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