Chemo III:
Site Selection Criteria and Procedures

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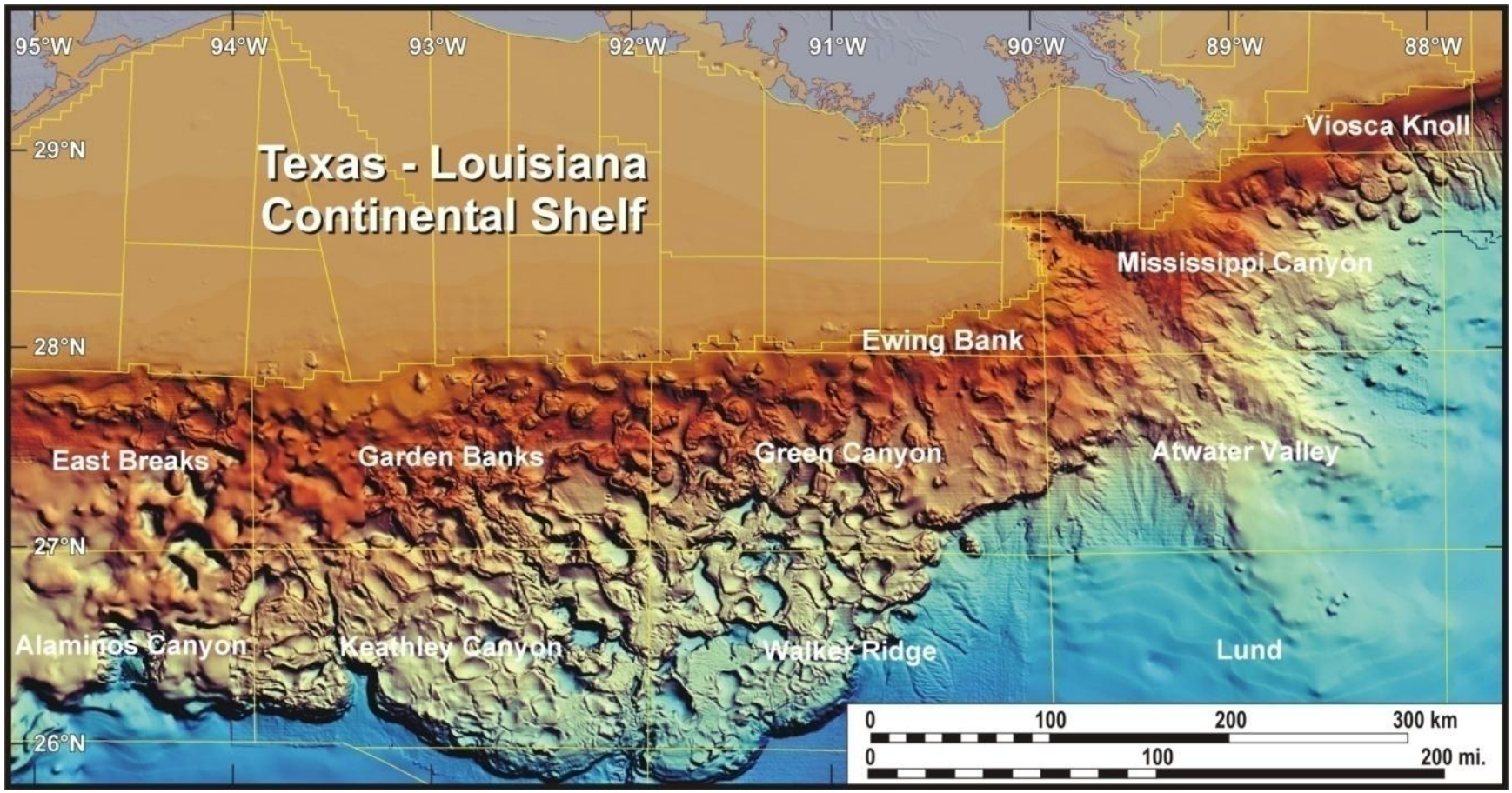
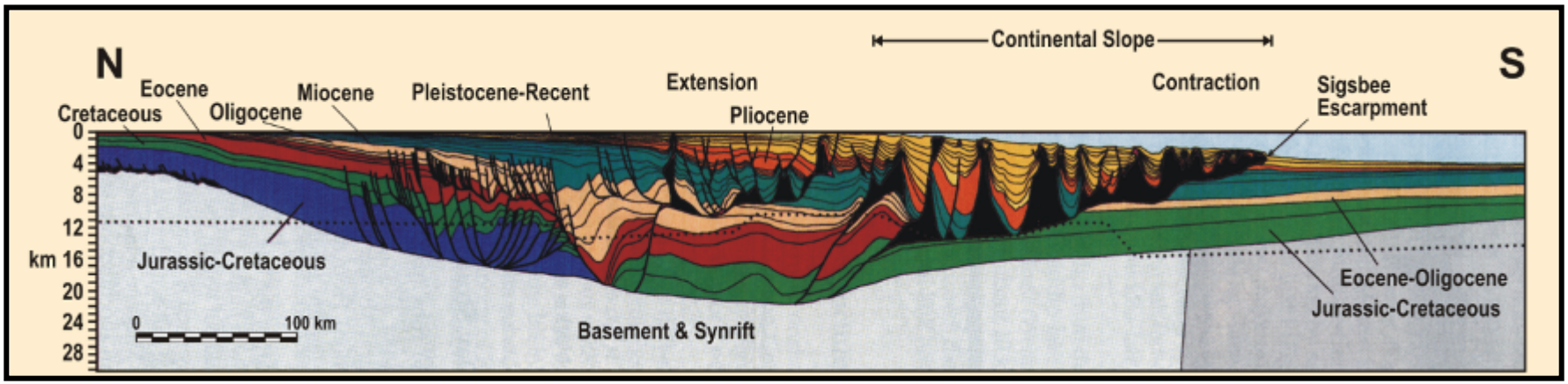
Presentation Points

- **Complex Geologic Framework**
- **Unique Database for Continental Slope**
- **Prioritization of Sites to be Sampled**
- **Site Characteristics**

Louisiana Continental Slope

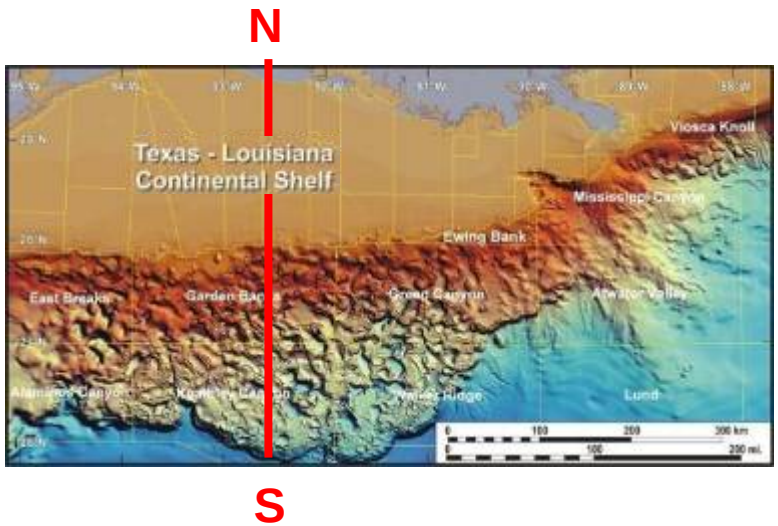


Geologic Configuration of the Northern Gulf of Mexico

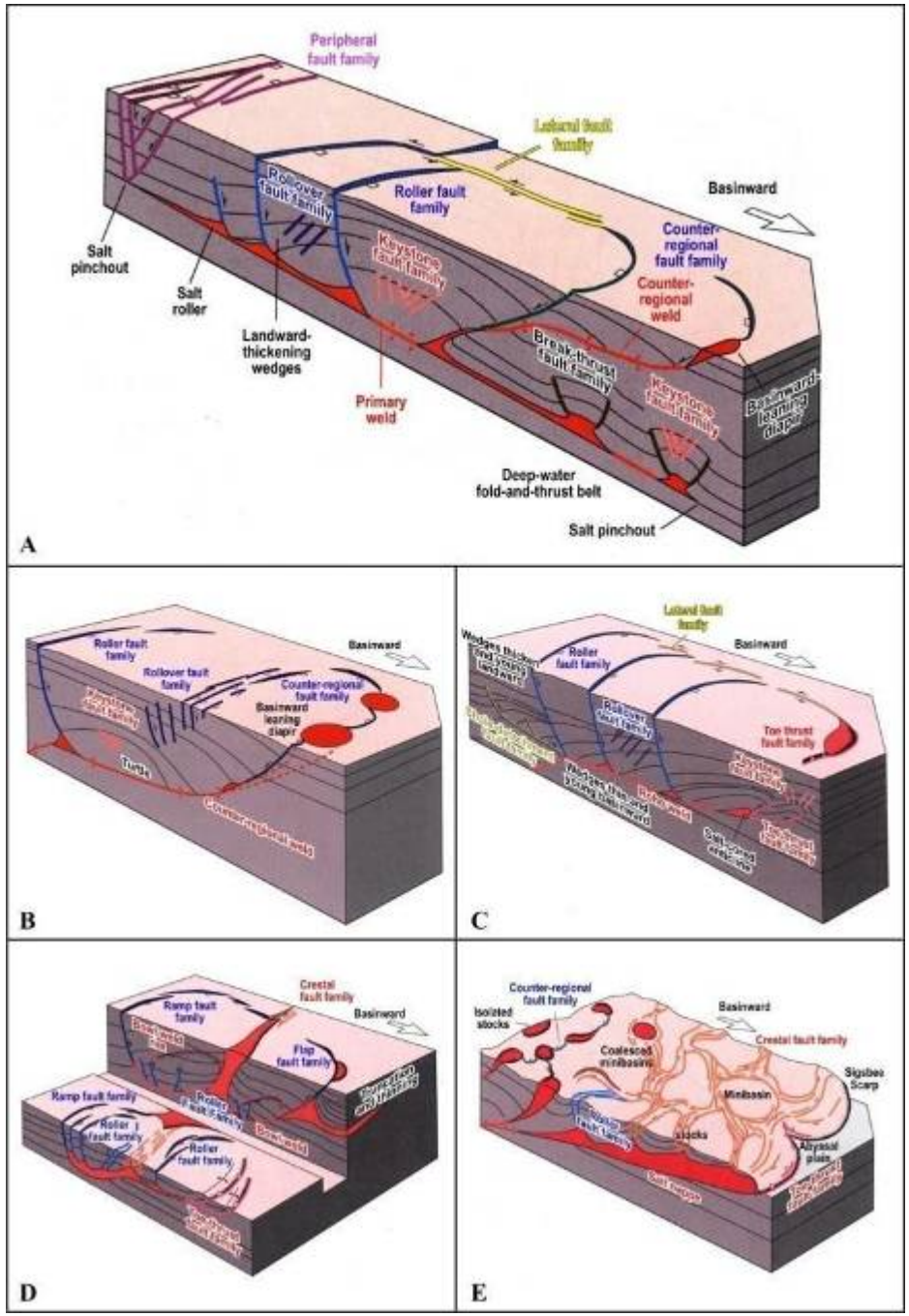


(From Peel et al. 1995)

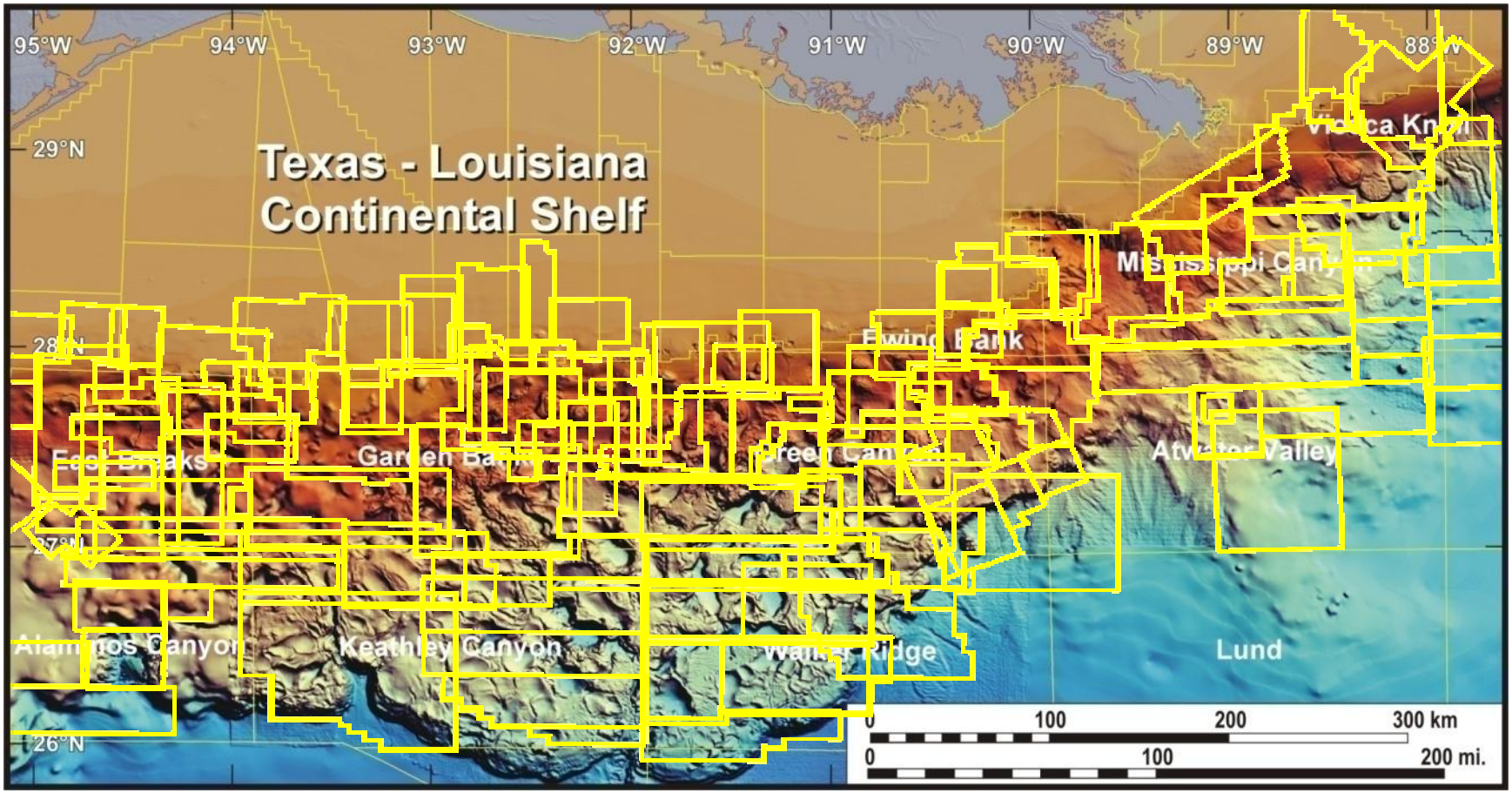
Cross-Continental Margin Structural Styles



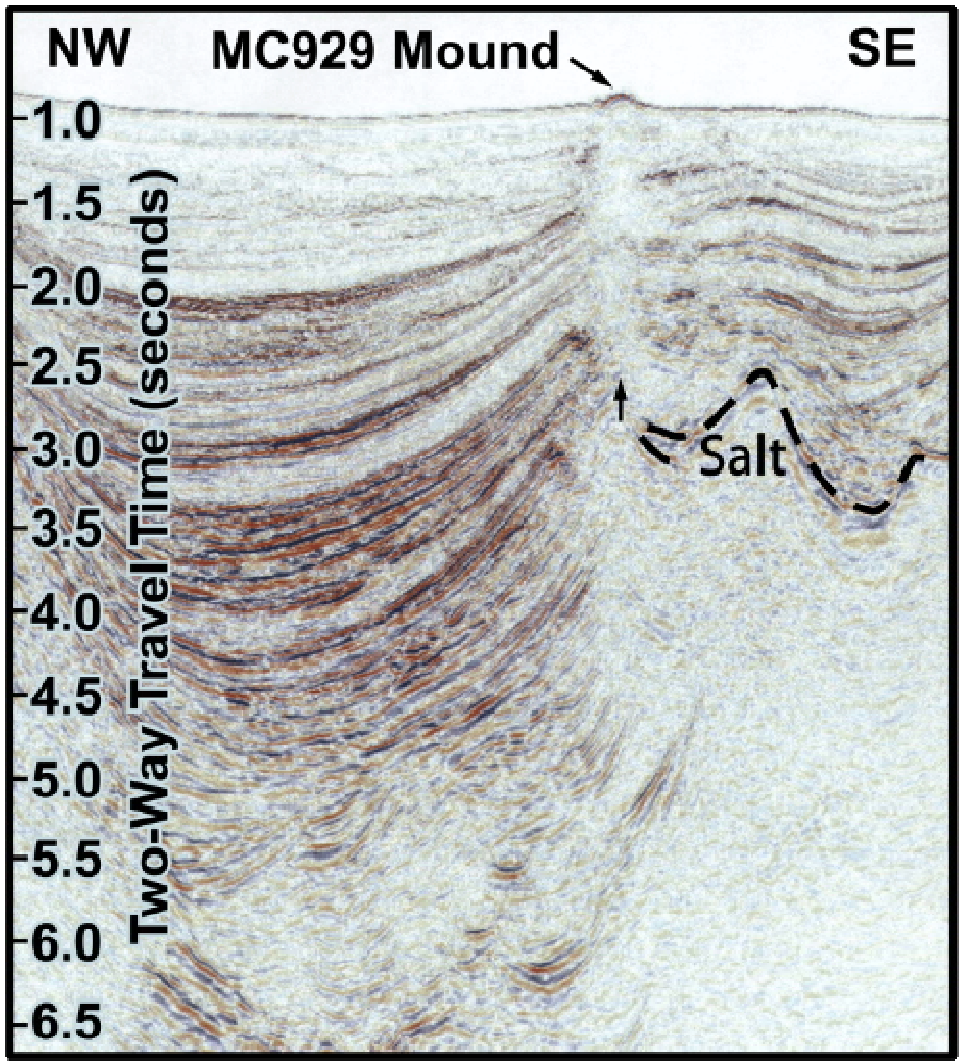
(From Rowan 1995)

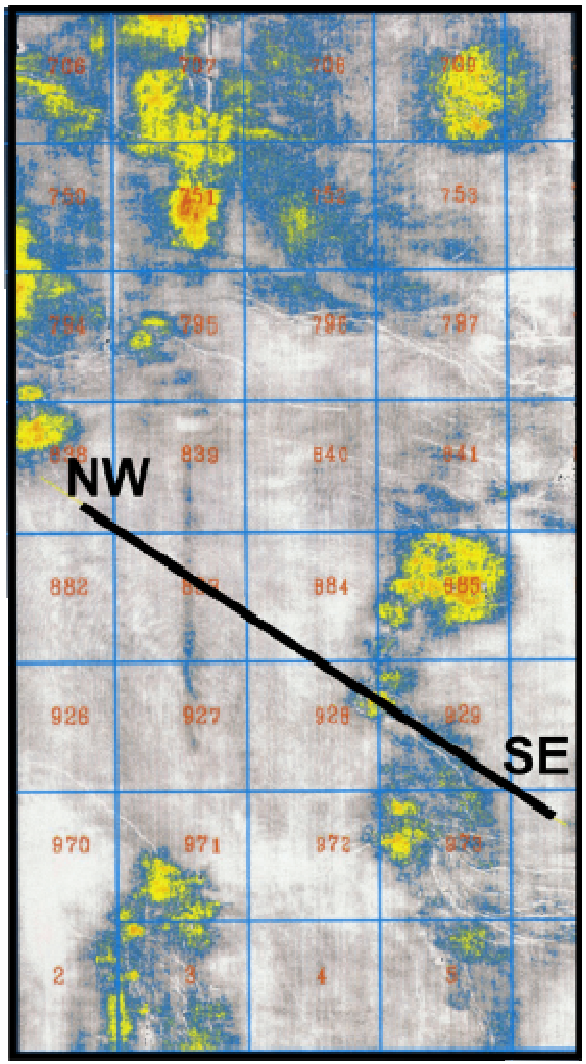


Louisiana Continental Slope



Seafloor Reflectivity and Gas Migration Relationship





Data Characteristics and Procedures

1. Used GeoQuest's IESX Interpretation Software
2. Seafloor Identified (Auto- and Hand-Picked) – Generally a Strong Reflector
3. Posted Seafloor Amplitude Extraction for Survey and Selected Sites of Interest
4. High Positives – Hard-Bottom Areas
5. Low Positives or Negatives – Gas-Rich Sediments
6. Plan-View Amplitude Patterns – Flows, Cones, etc.
7. Seismic Profiles – Identify Migration Pathways
8. Care Taken to Identify Non-Expulsion Anomalies

A Key Rationale for Chemo III

Most work on hydrocarbon seeps and their communities/geology was concentrated on the upper slope (<1,000 m WD). Middle and lower slope largely unknown territory.

Time-Table for Major Project Milestones

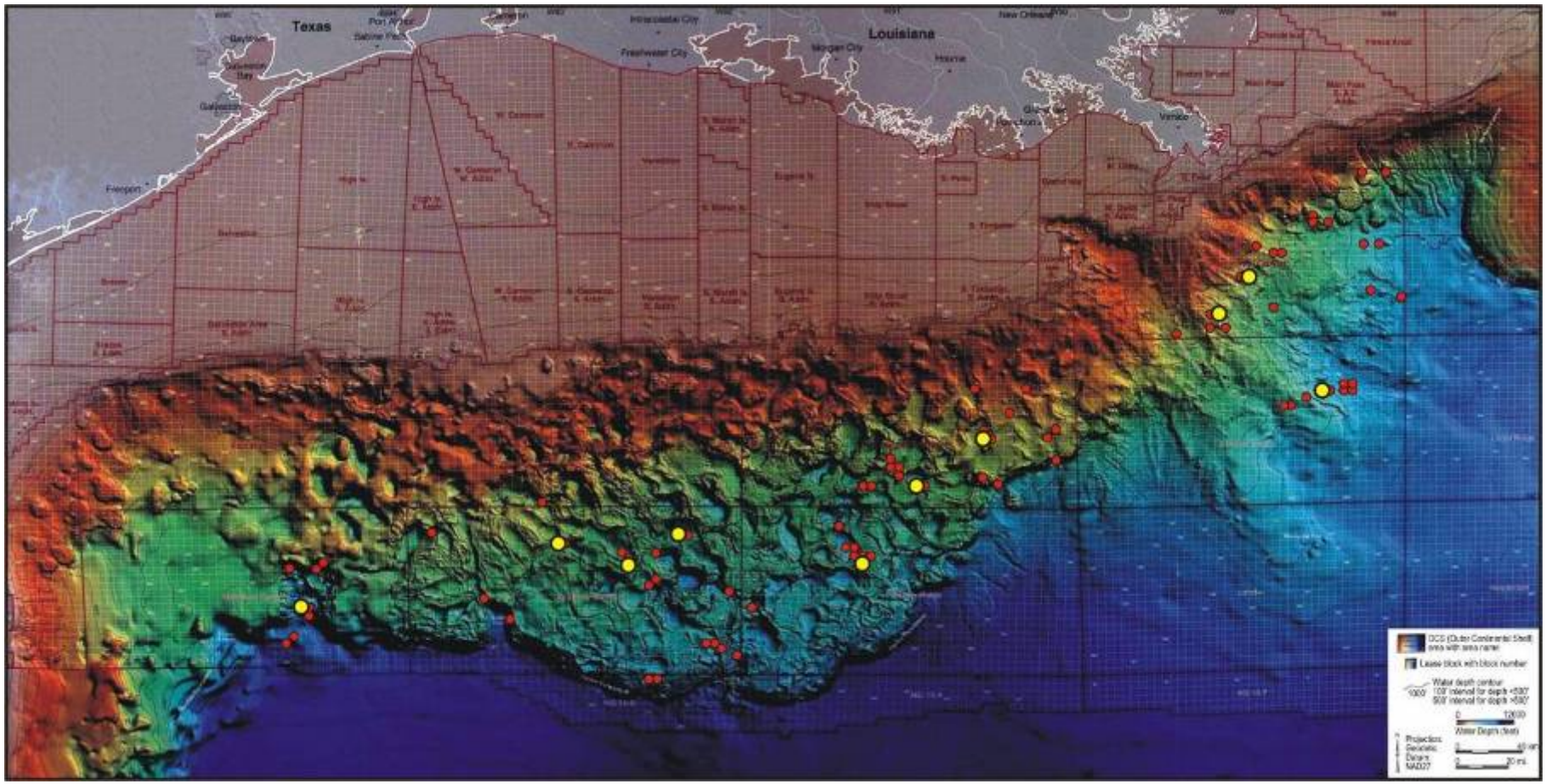
DSV Alvin (2006)

- Oct. 2005–March 2006
  (Choose Dive Site Pool)
- March 2006
  (Photo Recon Cruise)
- May–June 2006
  (Alvin Cruise)

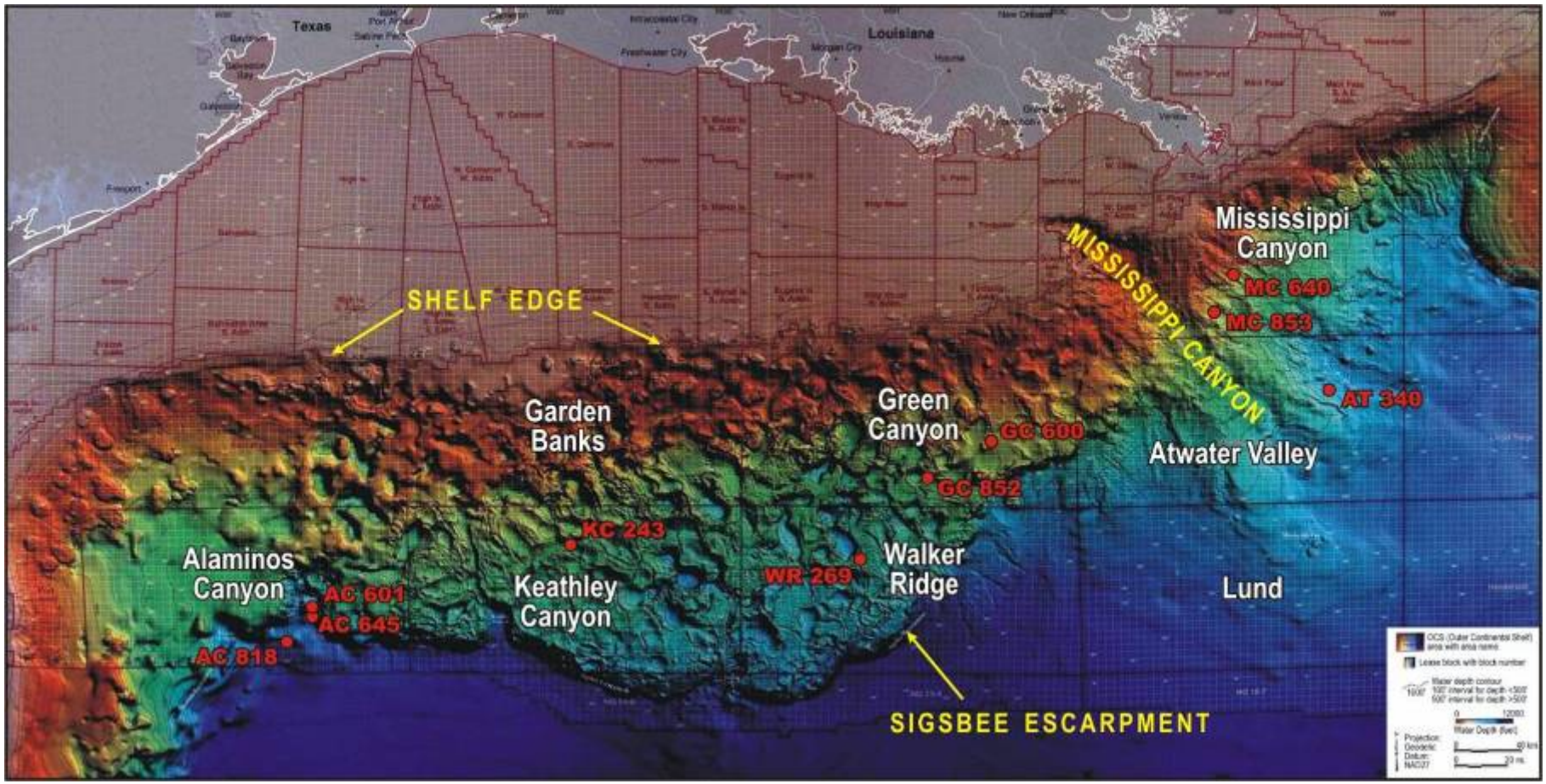
ROV Jason (2007)

- March 2007
  (AUV Data Collection)
- February–April 2007
  (New Site Selection)
- June–July 2007
  (Jason II Cruise)

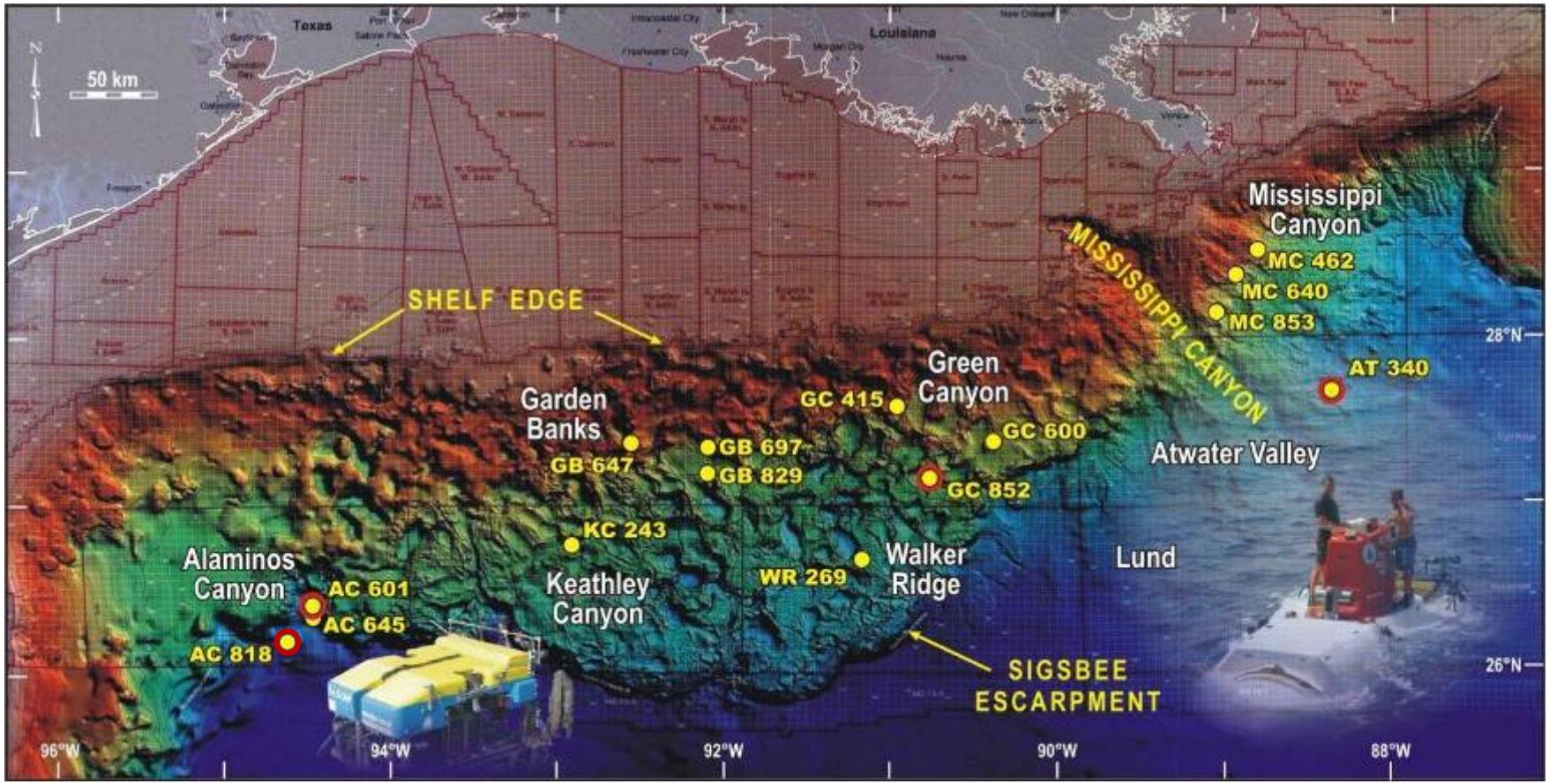
Potential ALVIN Dive Sites



Final ALVIN Dive Sites



Final ALVIN and JASON II Dive Sites



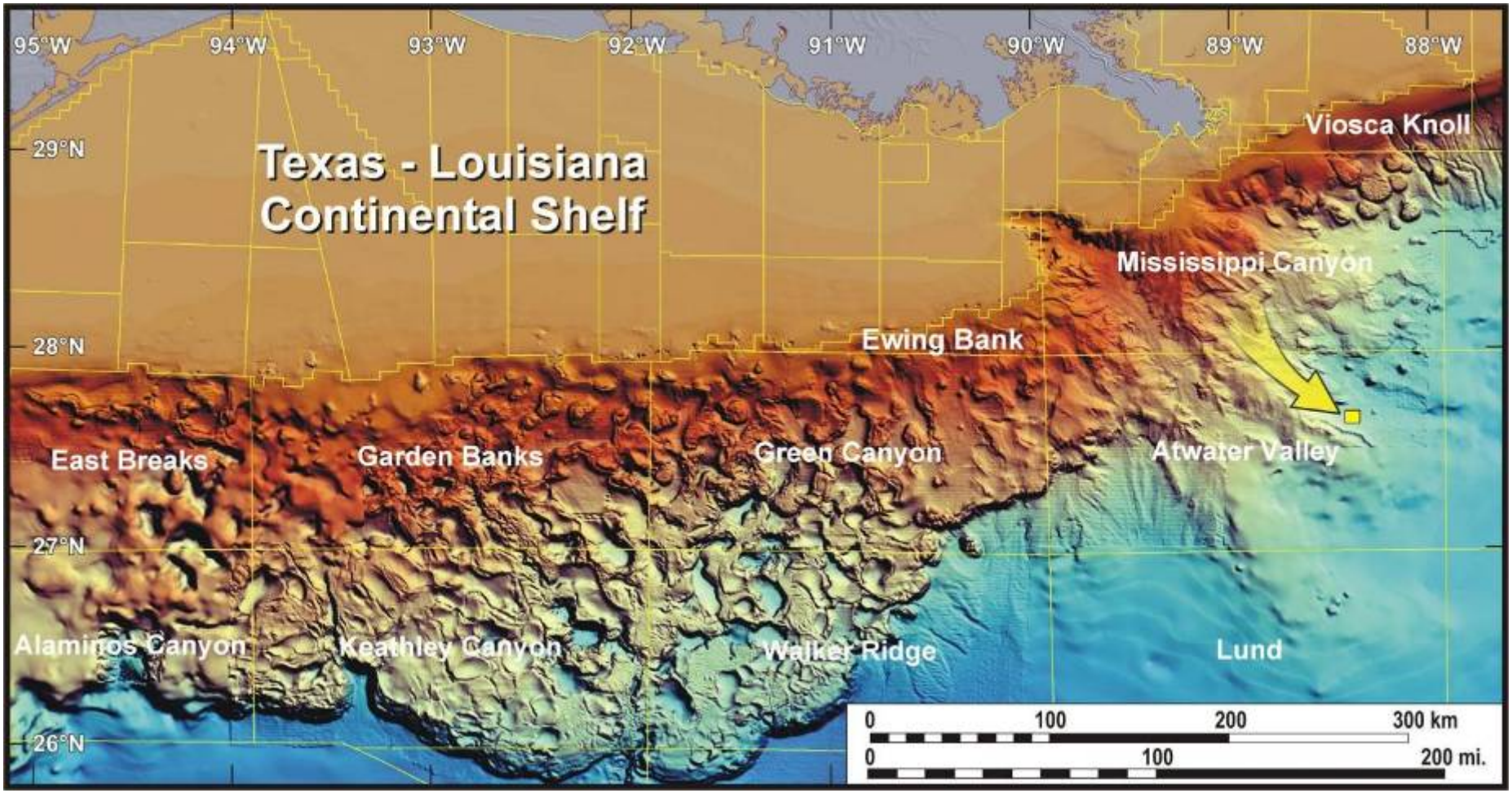
Deployment of HUGIN AUV

Advantages of the AUV

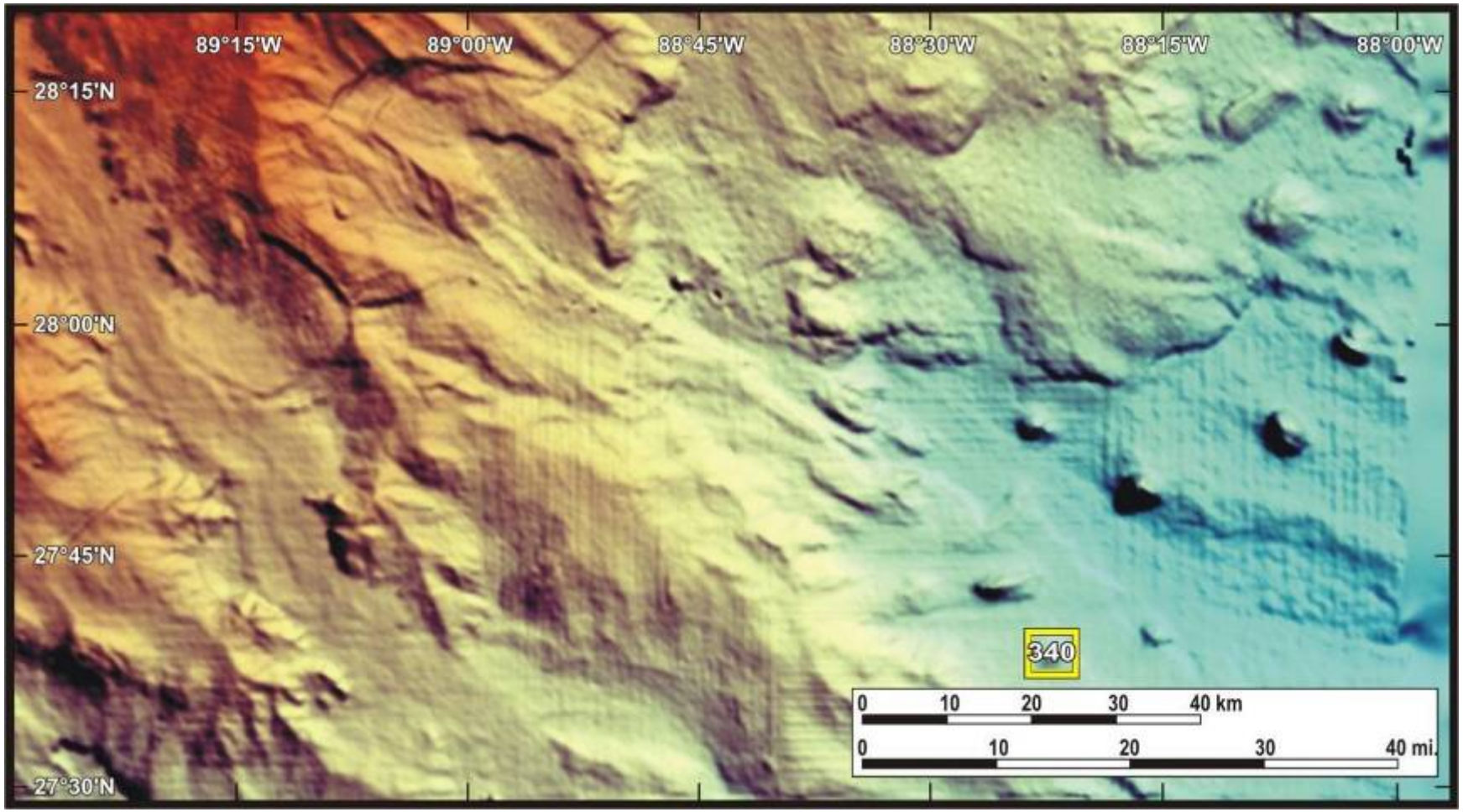
- **Survey Speed 4 kts – Deep Tow 2.5 kts.**
- **Line Turns Made in Minutes – Deep Tow = Hours**
- **AUV Better Navigation – Corrects for Currents**
- **AUV Maintains Constant Height Above Bottom**

Seafloor Verification and Site Characteristics

AT 340
Location Map



AT 340
Site Map

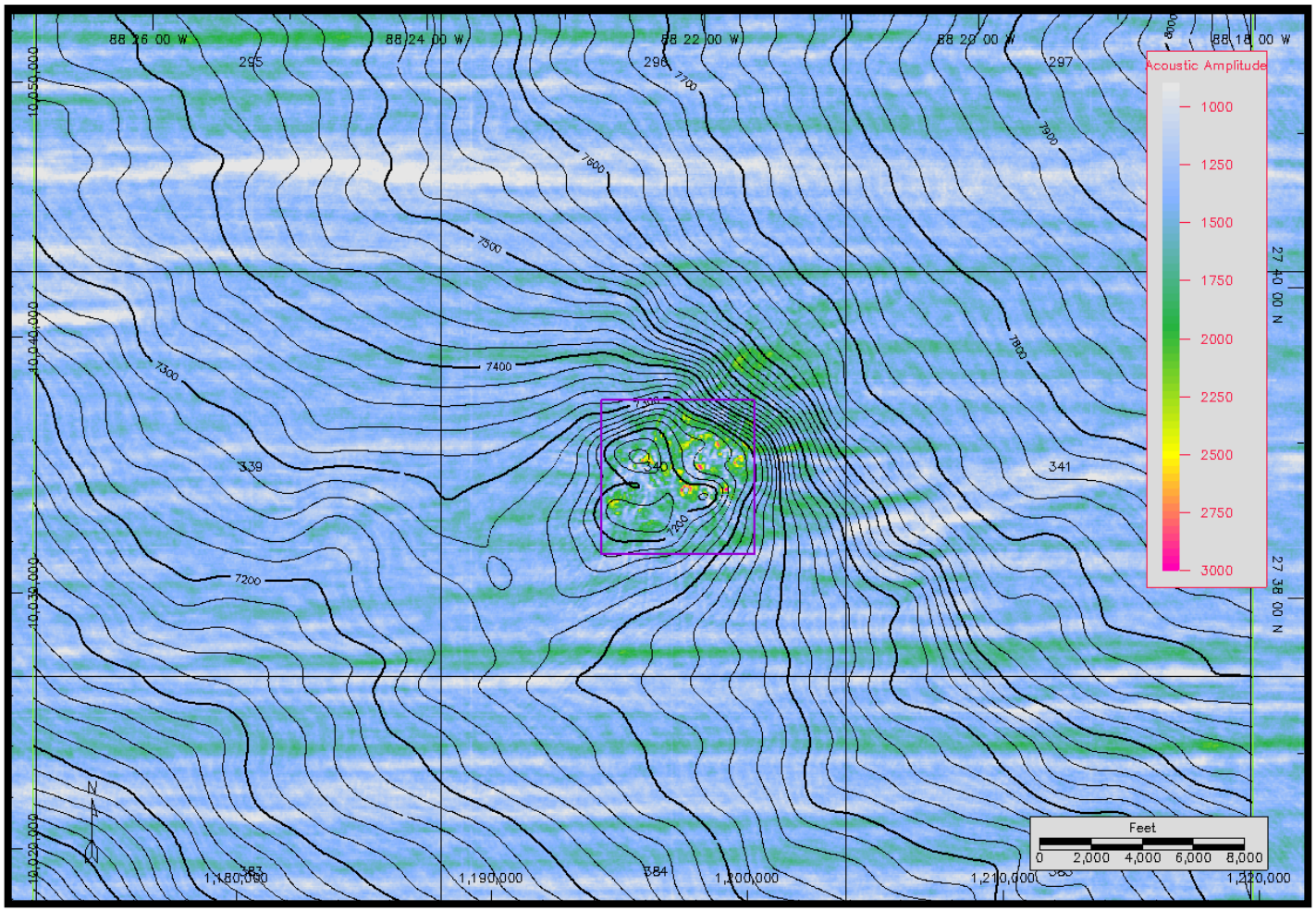


AT 340
Geologic Framework

- **Site: Salt-Supported Bathymetric High**
- **Fluid-Gas Expulsion: Fault-Controlled Migration Pathways**
- **Bathymetry: Complex Mound**
- **High Seafloor Amplitudes: Scattered at Mound Crests**
- **Moderate Seafloor Amplitudes: Off Mound Flows**

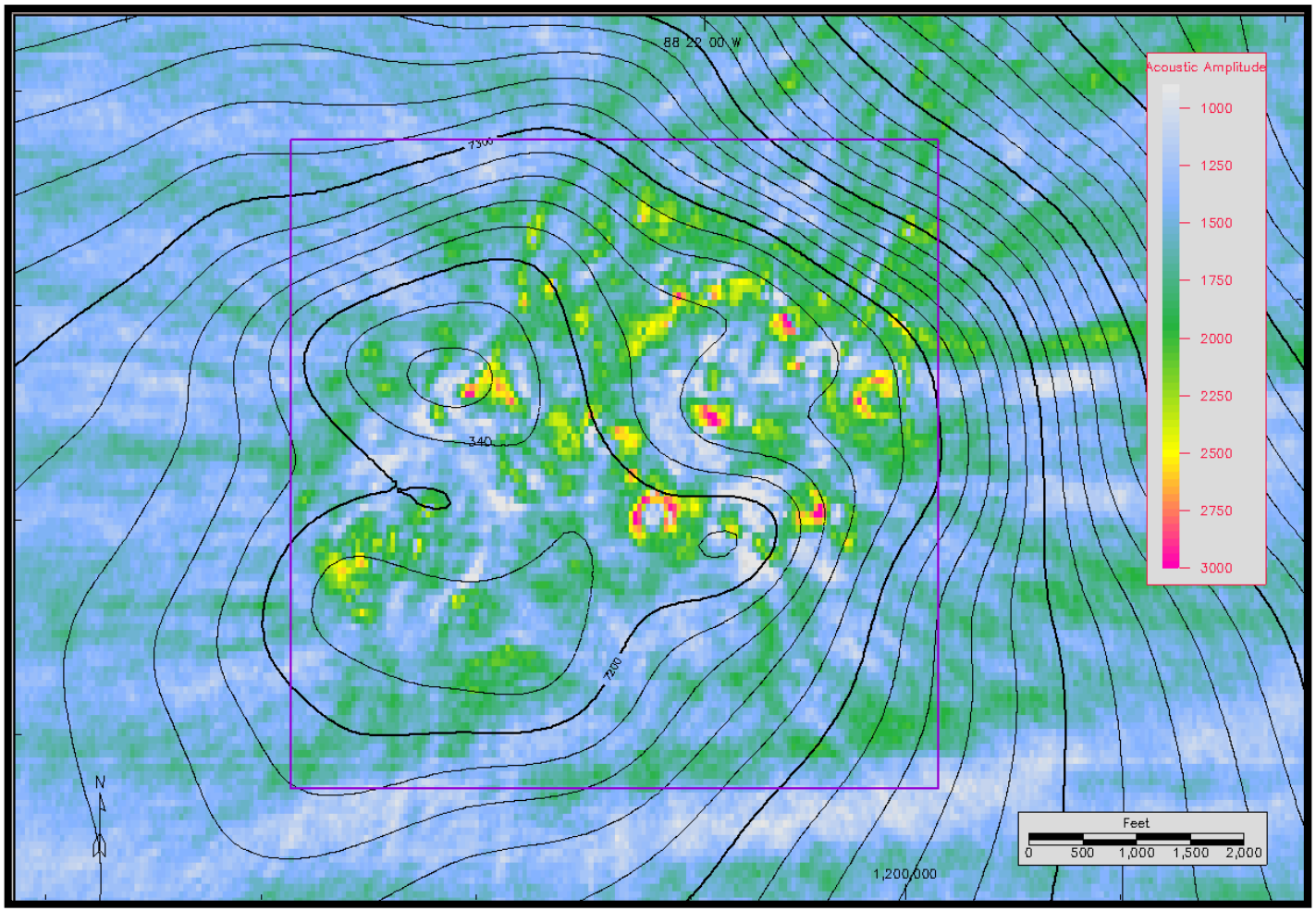
AT 340

Bathymetry



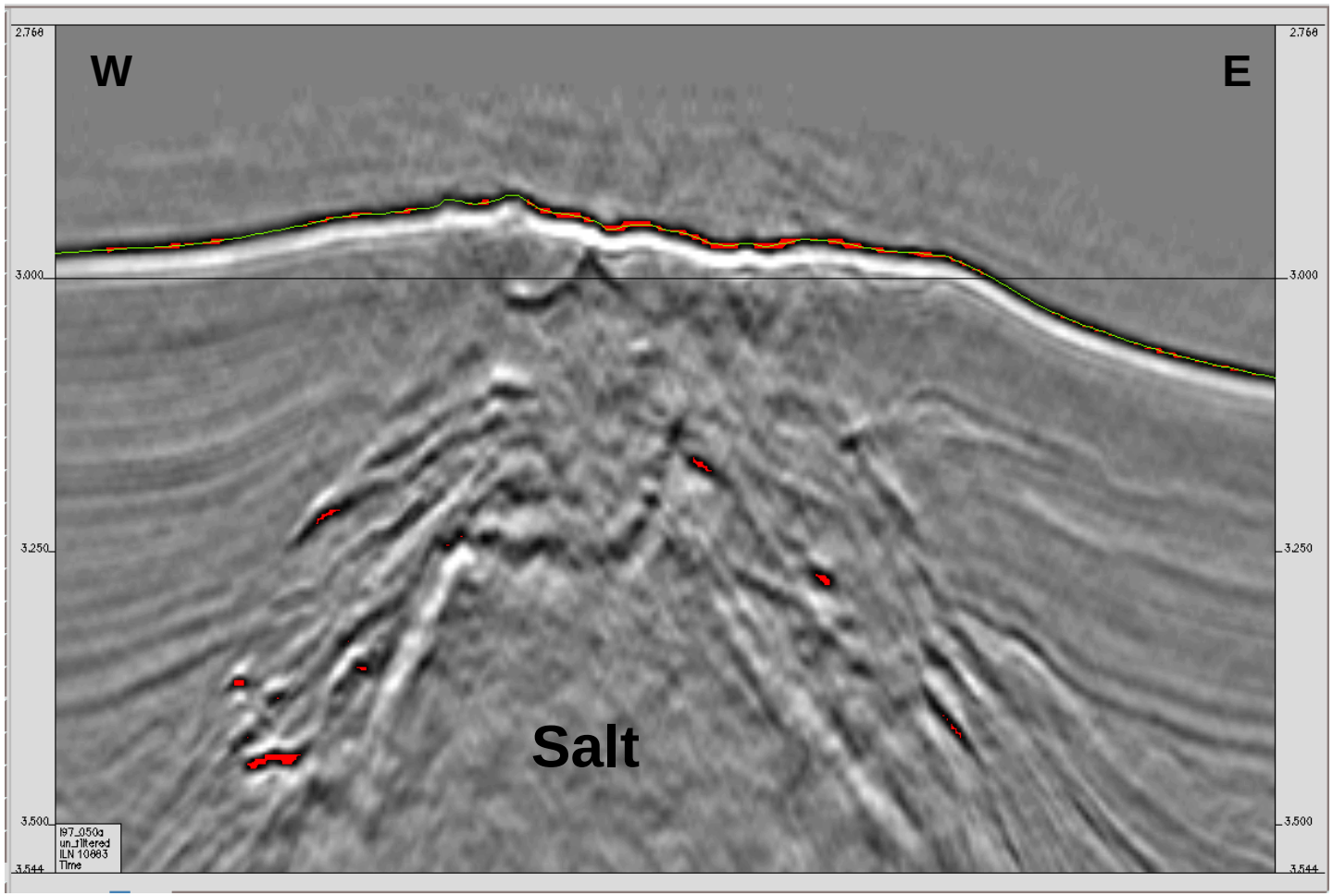
AT 340

3-D Seismic Surface Amplitude Map

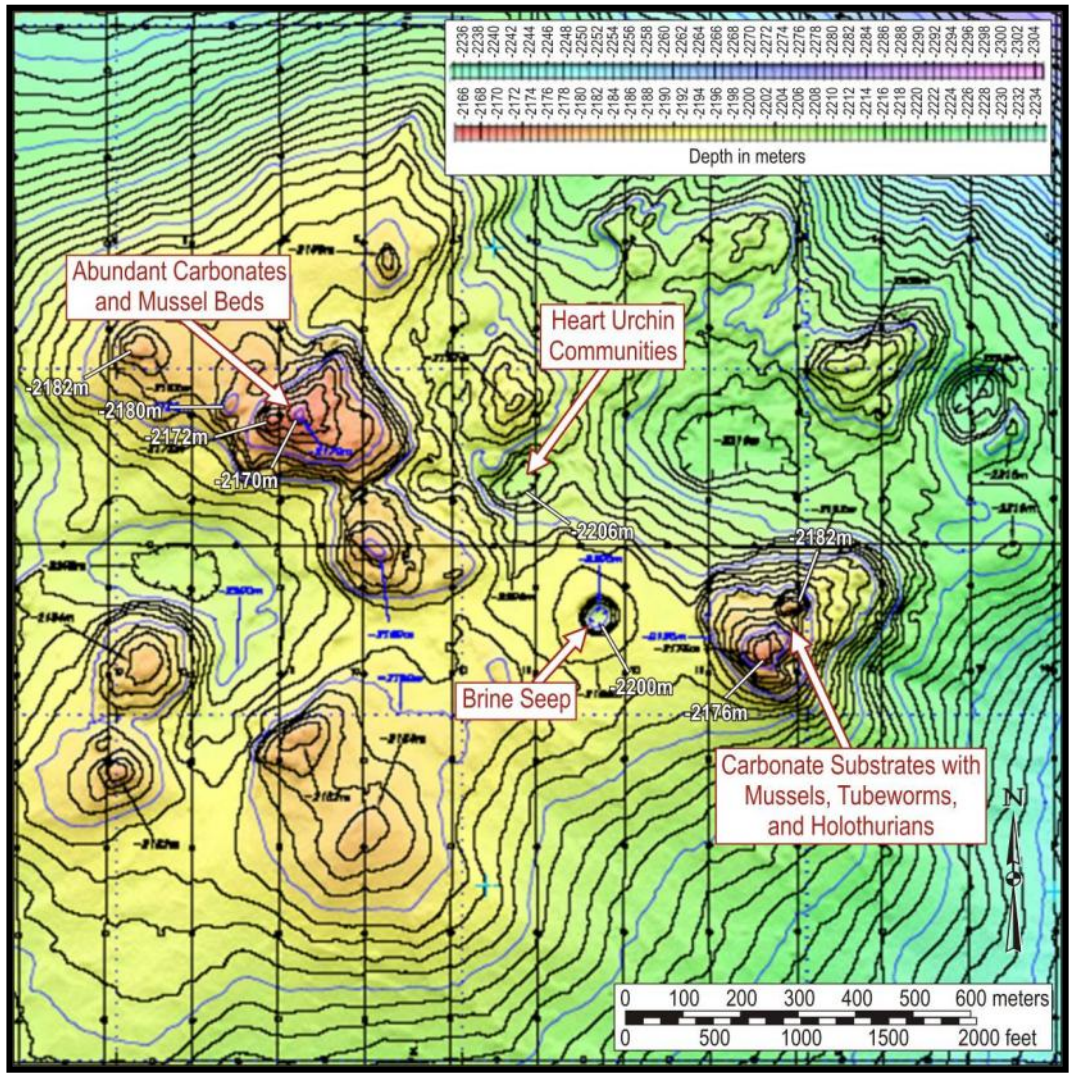


AT 340

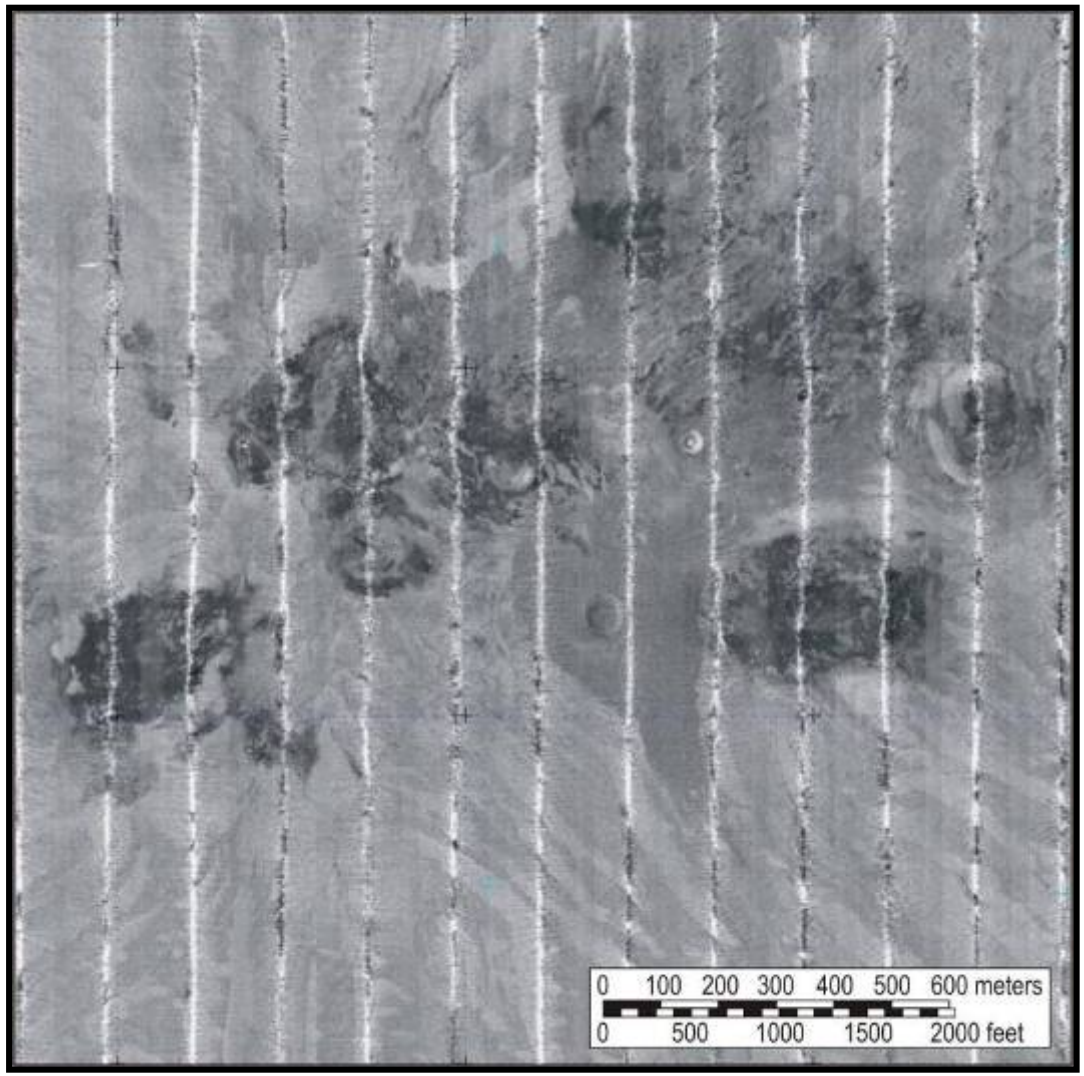
3-D Seismic Profile



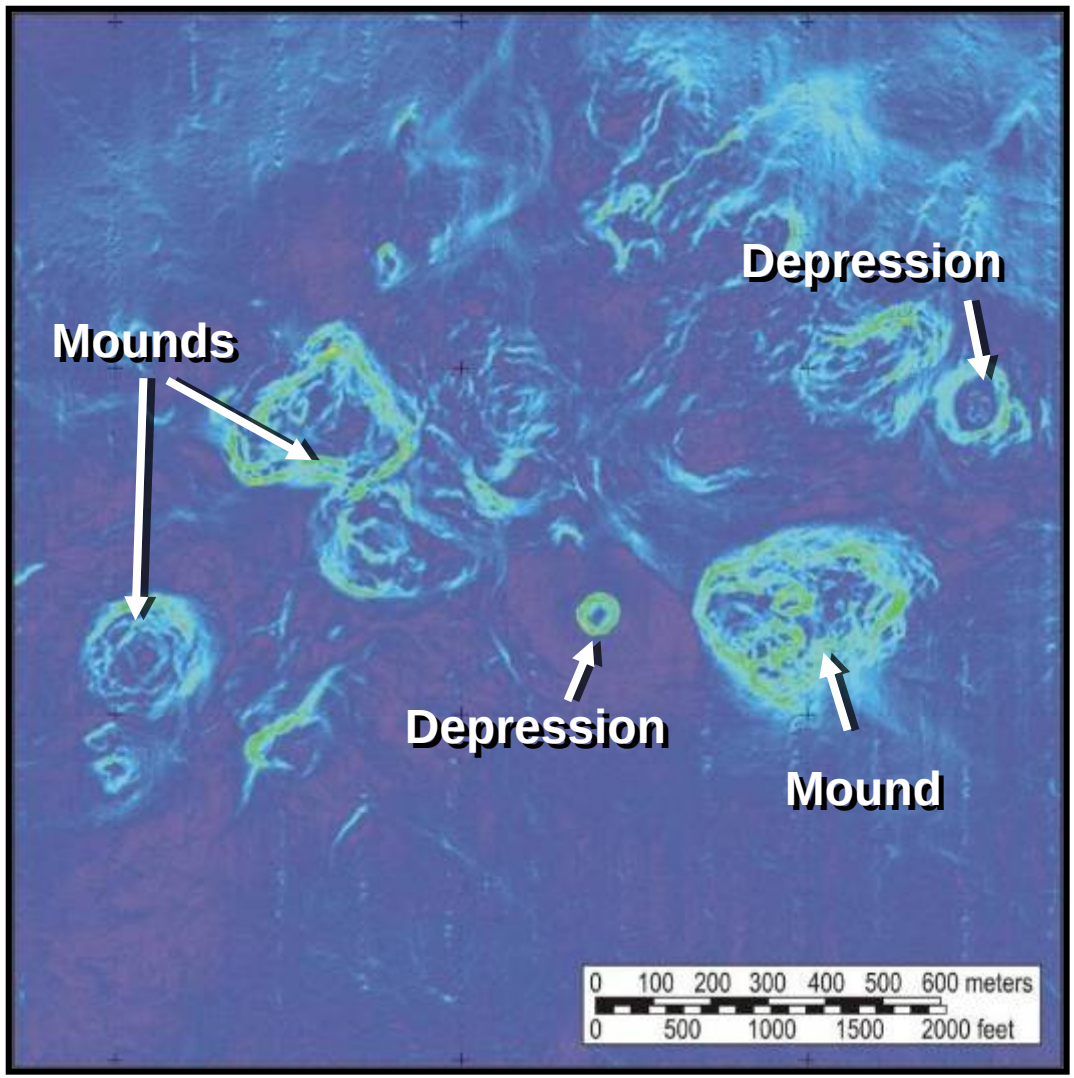
AT340 Multibeam Bathymetry



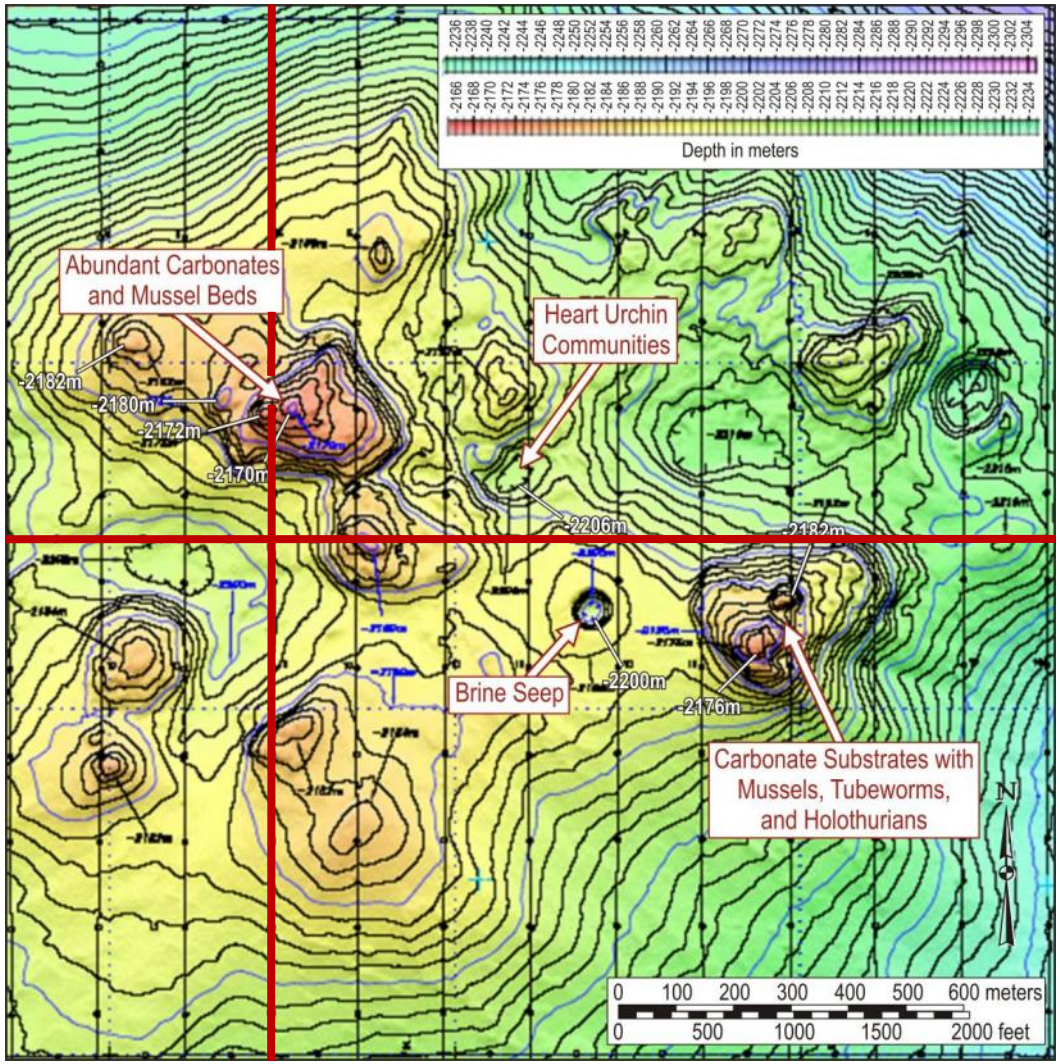
AT340 Backscatter



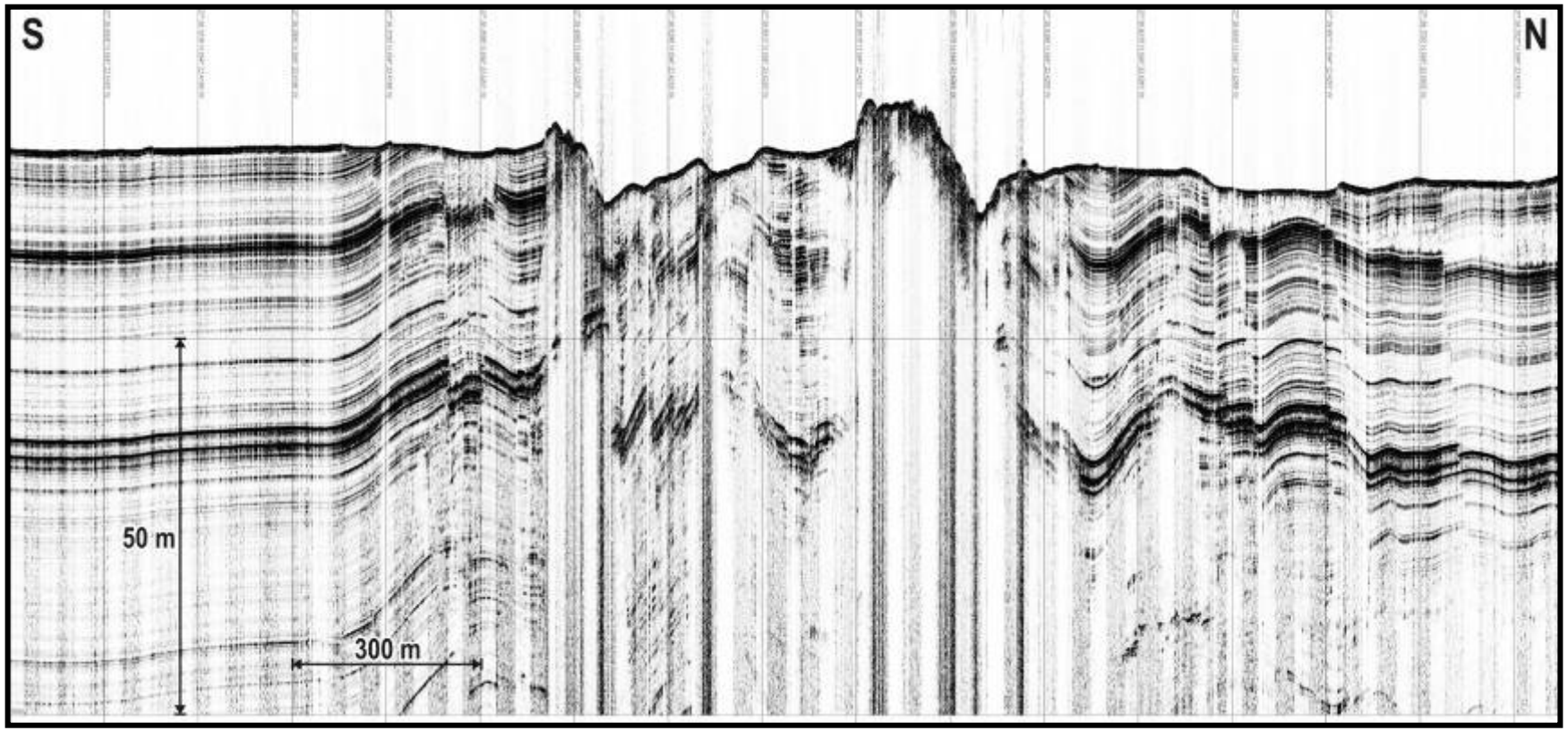
AT340 Gradient



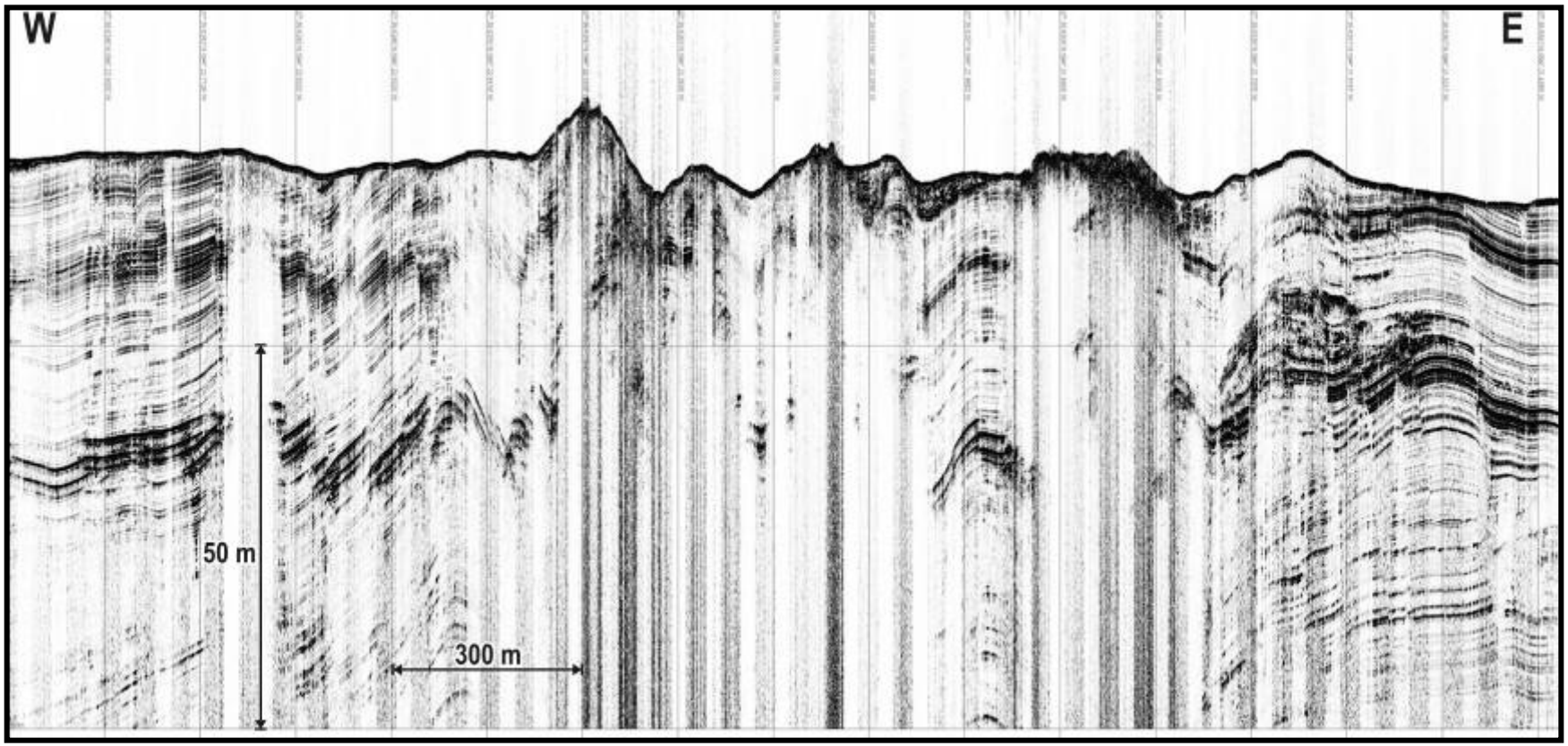
AT340 Multibeam Bathymetry



AT340—Line 304

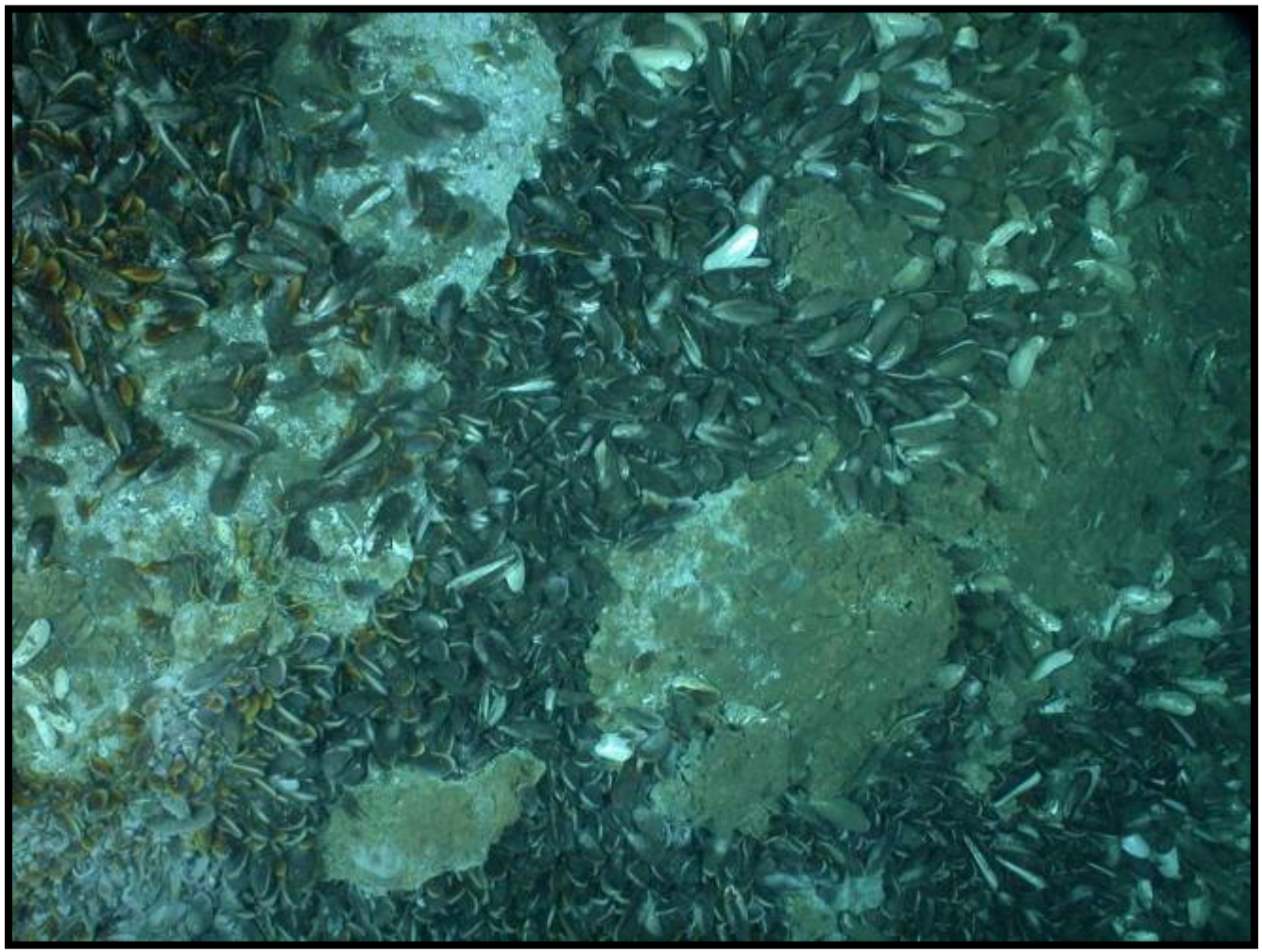


AT340 – Line 402



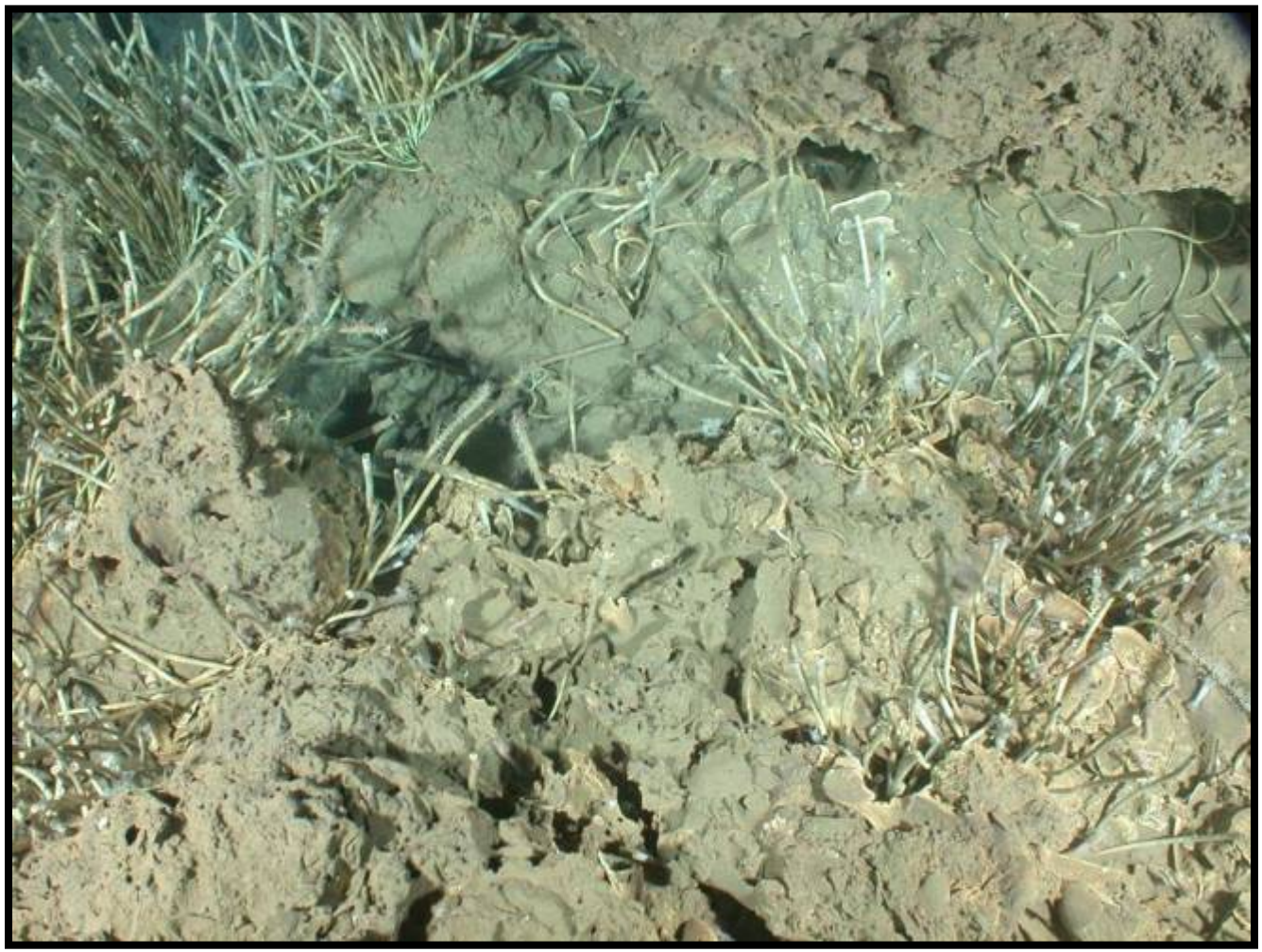
AT 340

Extensive Mussel Communities and Associated Carbonates



AT 340

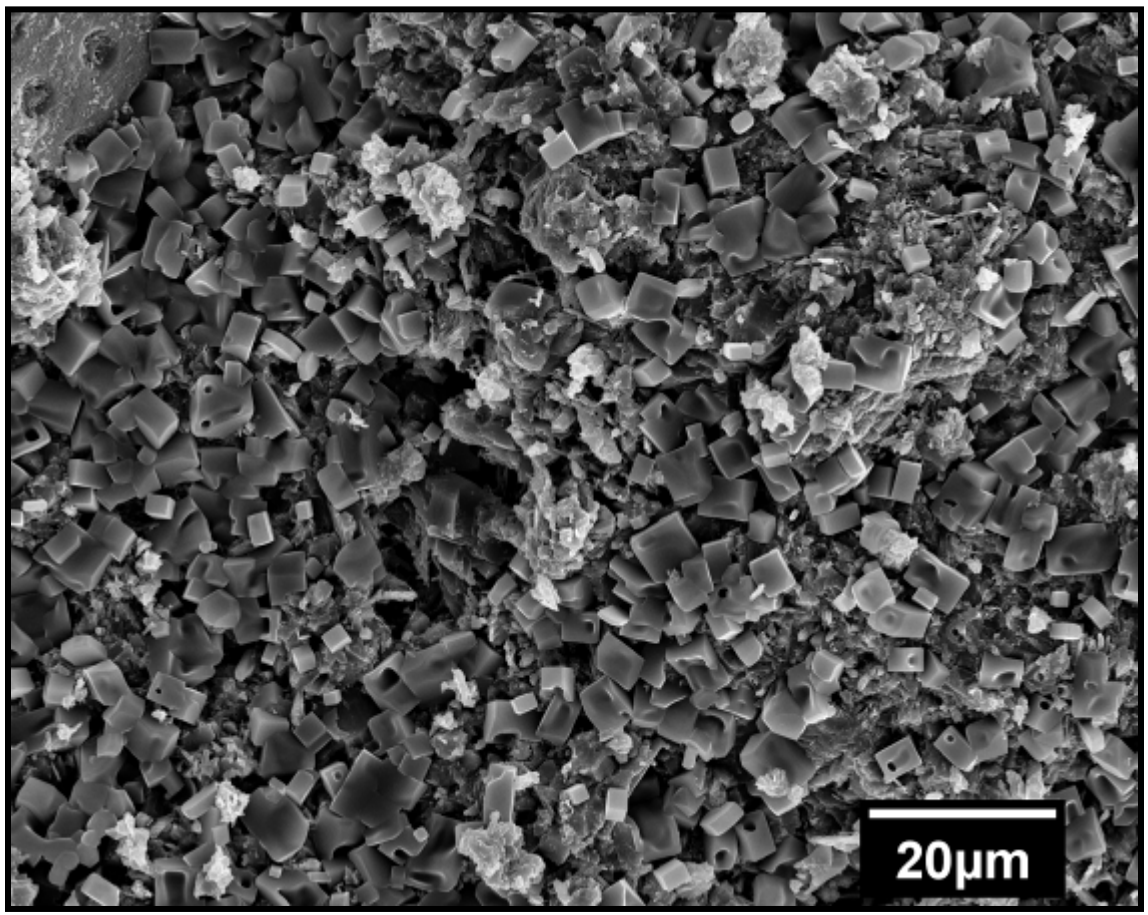
Tube Worm “Bushes” at Edges of Carbonate Slabs



AT 340

AT 340

Dolomite

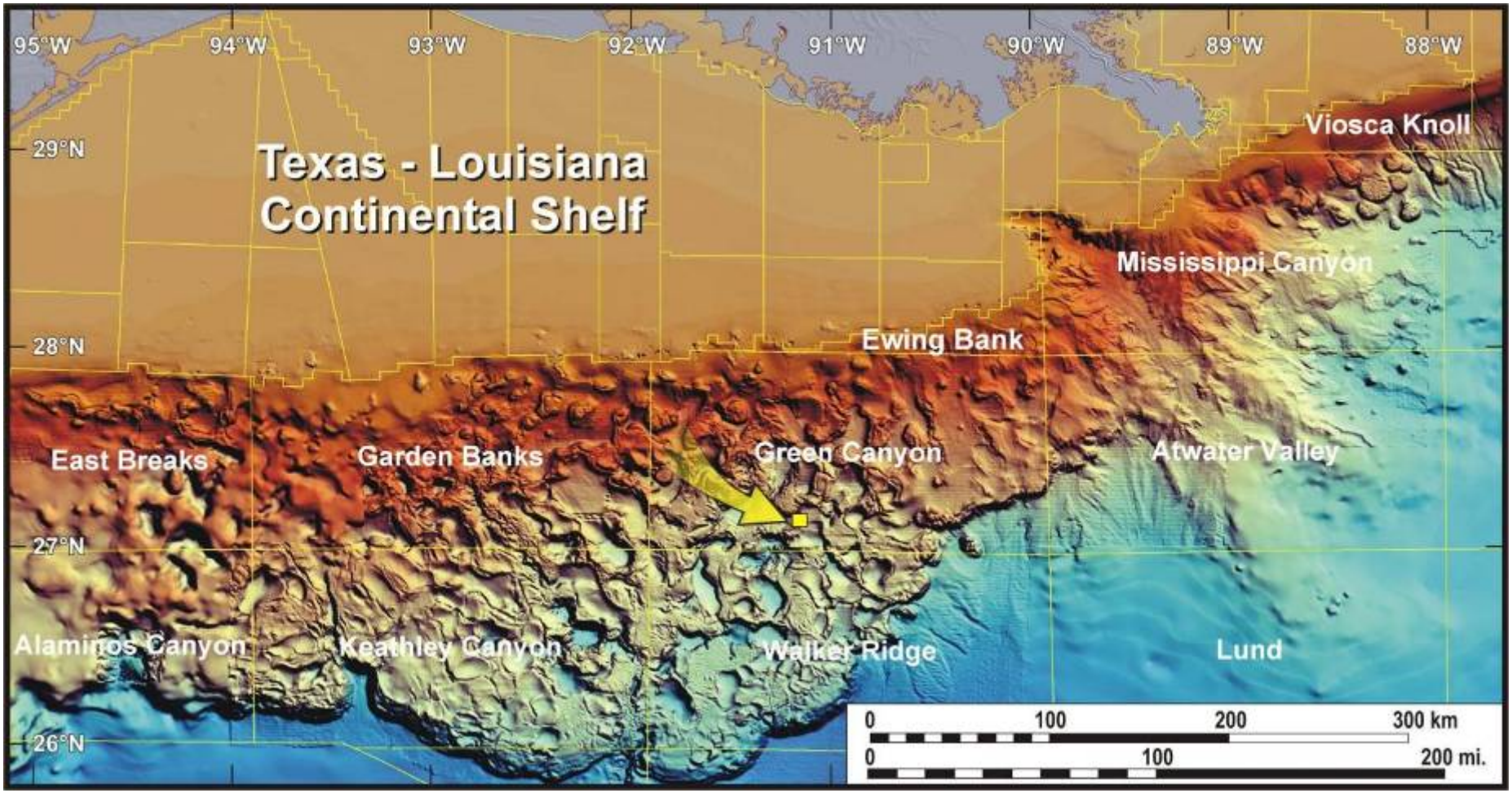


1000x

AT 340
Seafloor Characteristics

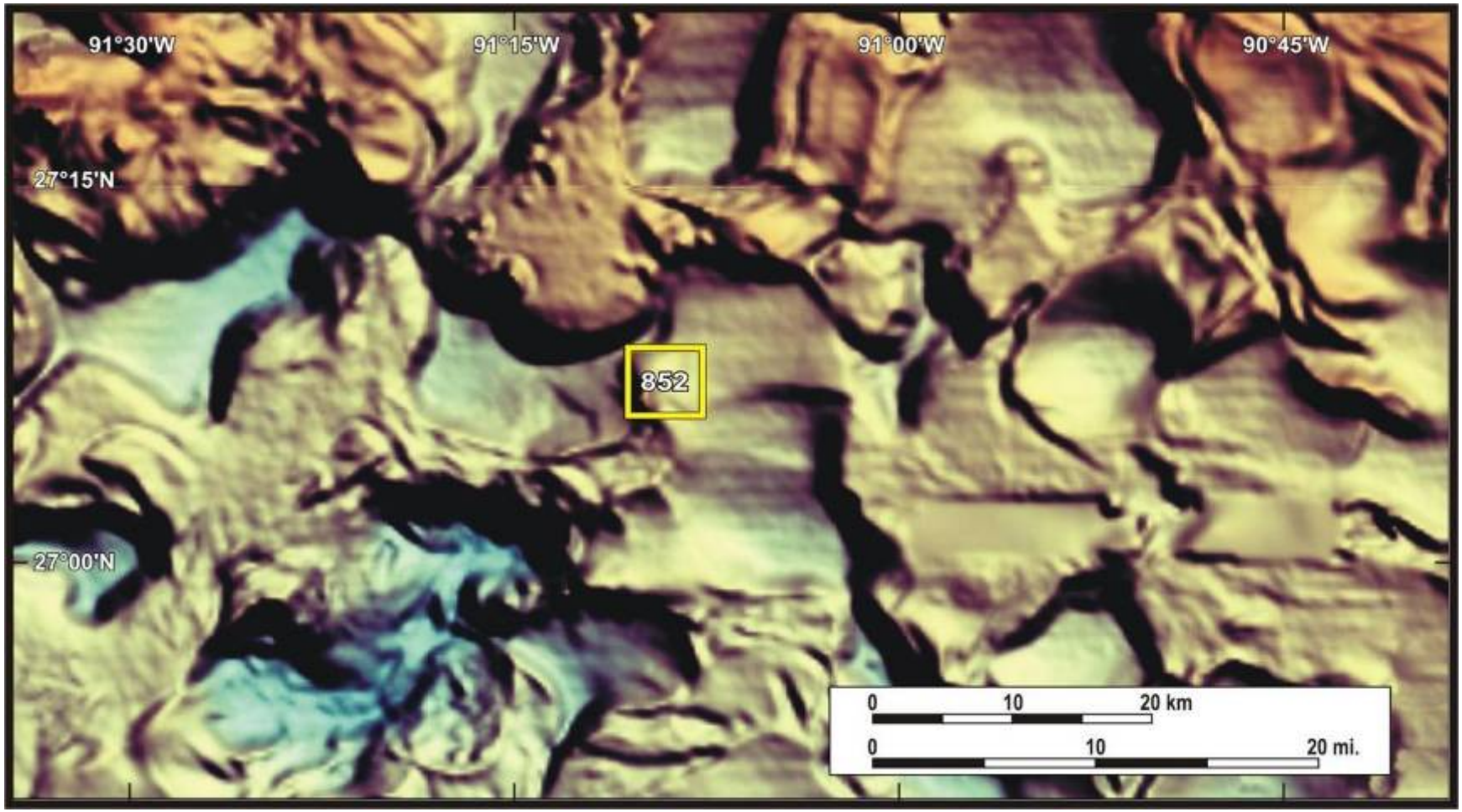
- **ALVIN Dives: 5**
- **High Amplitudes: Extensive Lithifiction (Blocks and Pavement)**
- **Low Amplitudes: Expulsion Centers**
- **Abundant Mussel Beds, Tube Worms, Urchins (Some Soft Corals)**
- **NW Mound: Brine, Hydrocarbons, Fluidized Sediment (Mussel Shell Pavements-Blocks**

GC 852
Location Map



GC 852

Site Map

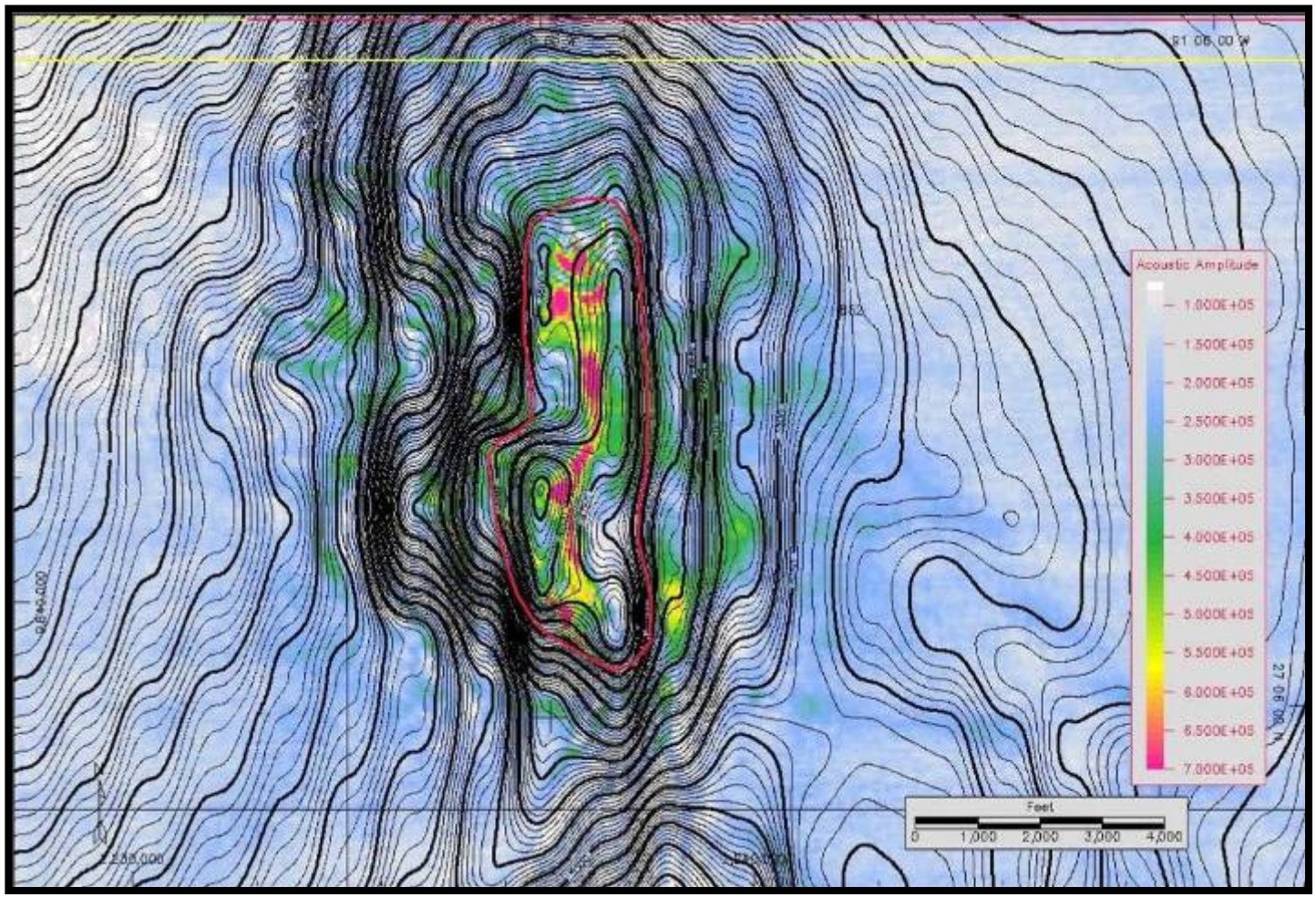


GC 852
Geologic Framework

- **Site: Salt-Supported Ridge (WD ~1450 m)**
- **Bathymetry: N-S Ridge > 200 m Relief**
- **High Seafloor Amplitudes: Along Ridge Crest and West Flank**
- **Oil Slicks Over Site**

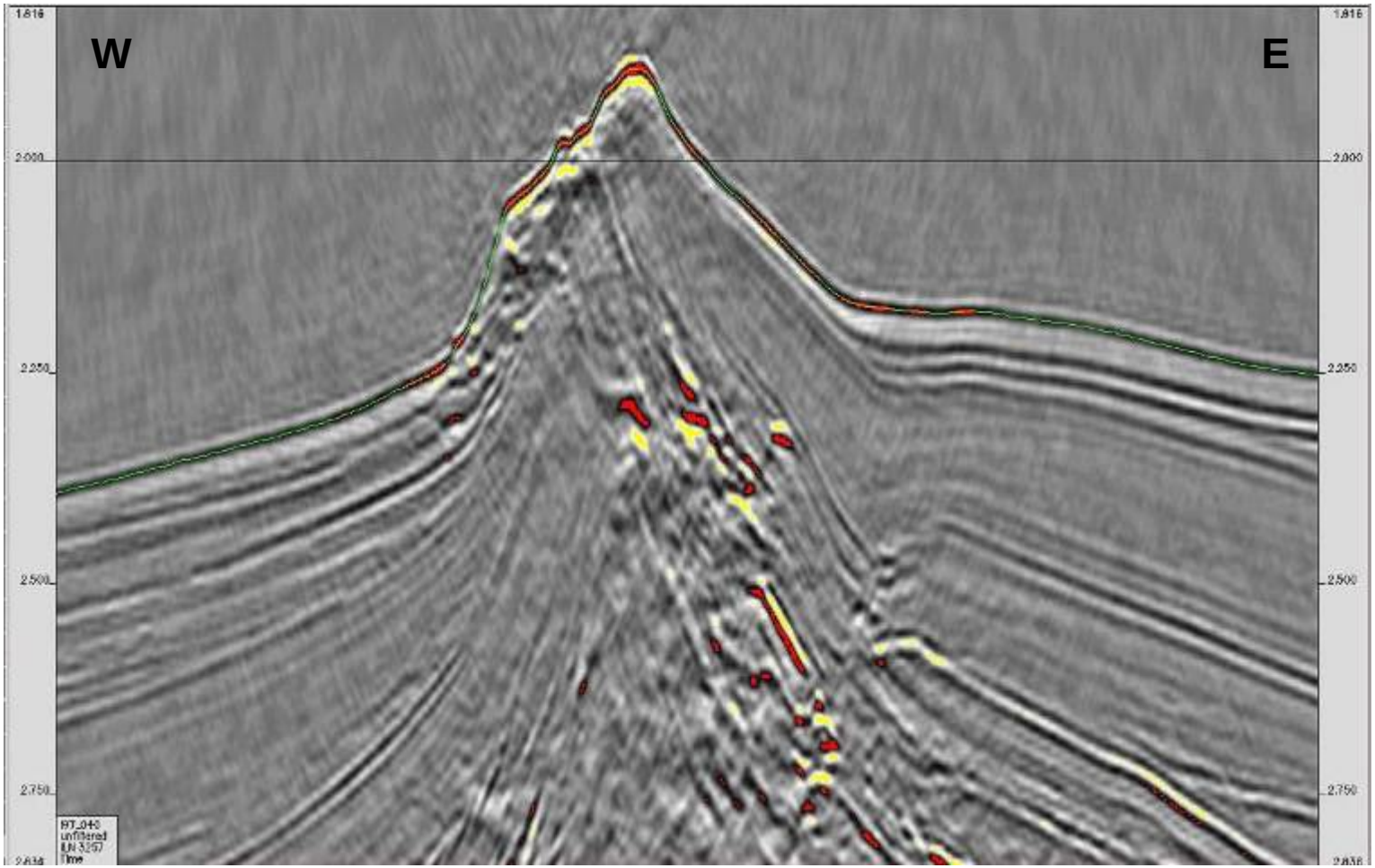
GC 852

3-D Seismic Surface Amplitude Map

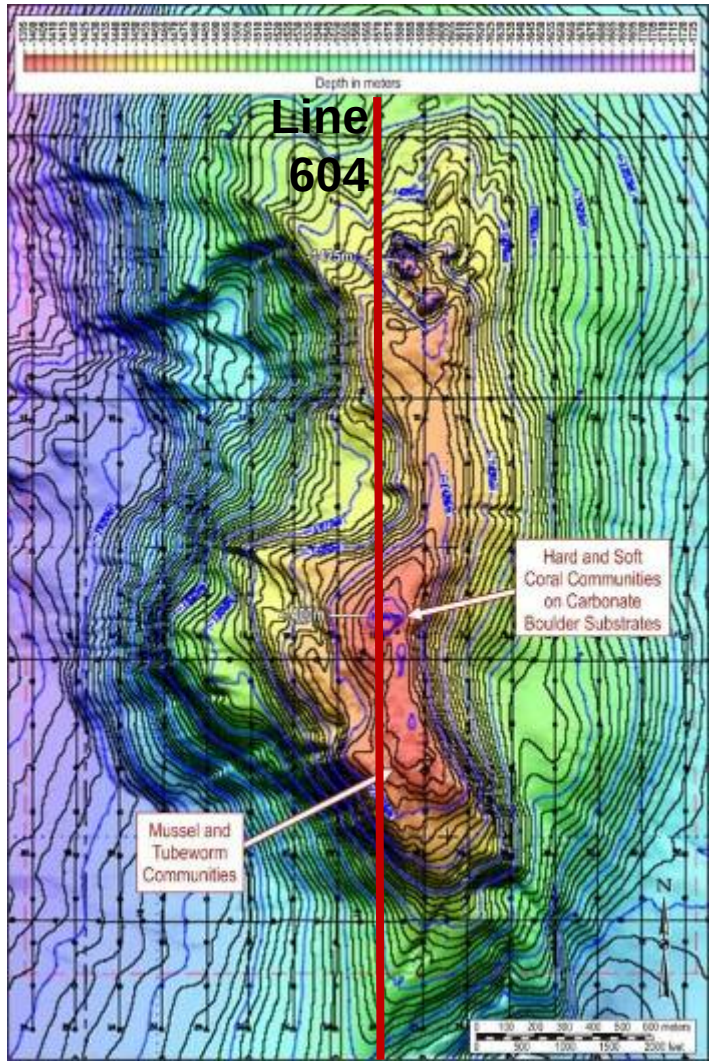


GC 852

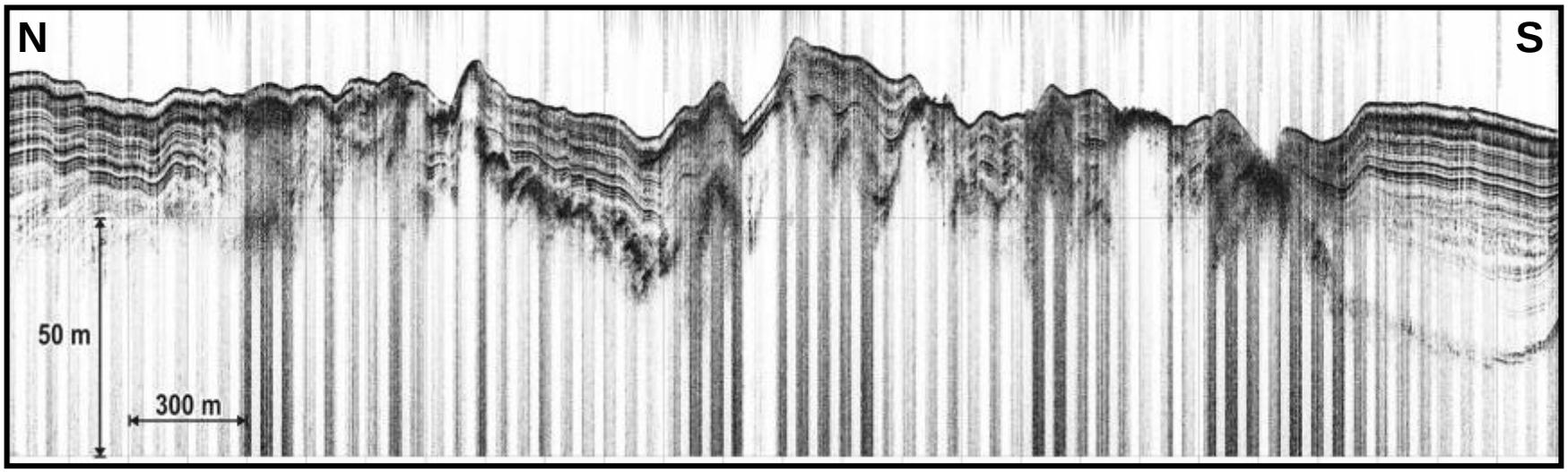
E-W Oriented Profile



GC852 Multibeam Bathymetry

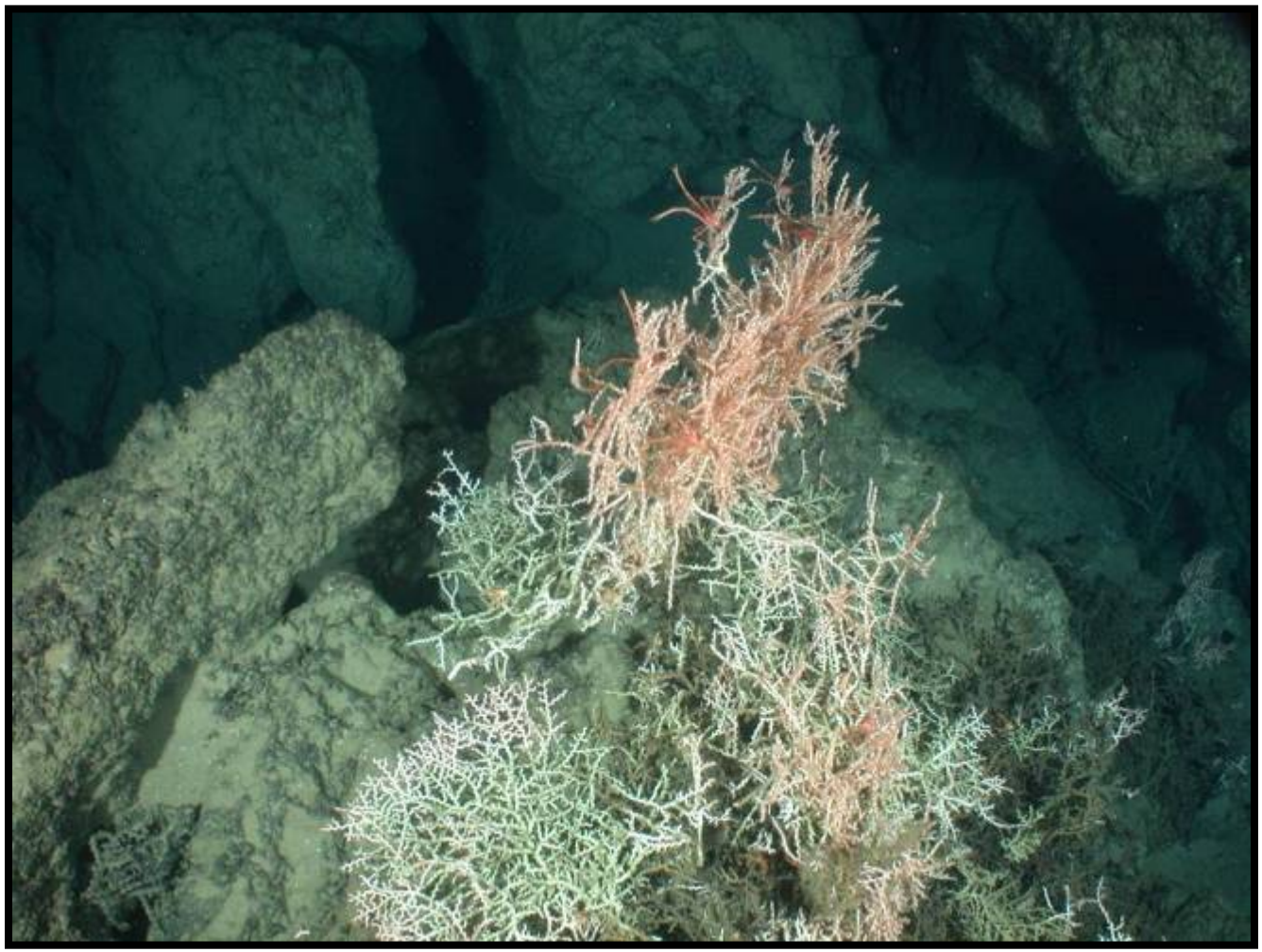


GC852 – Line 609



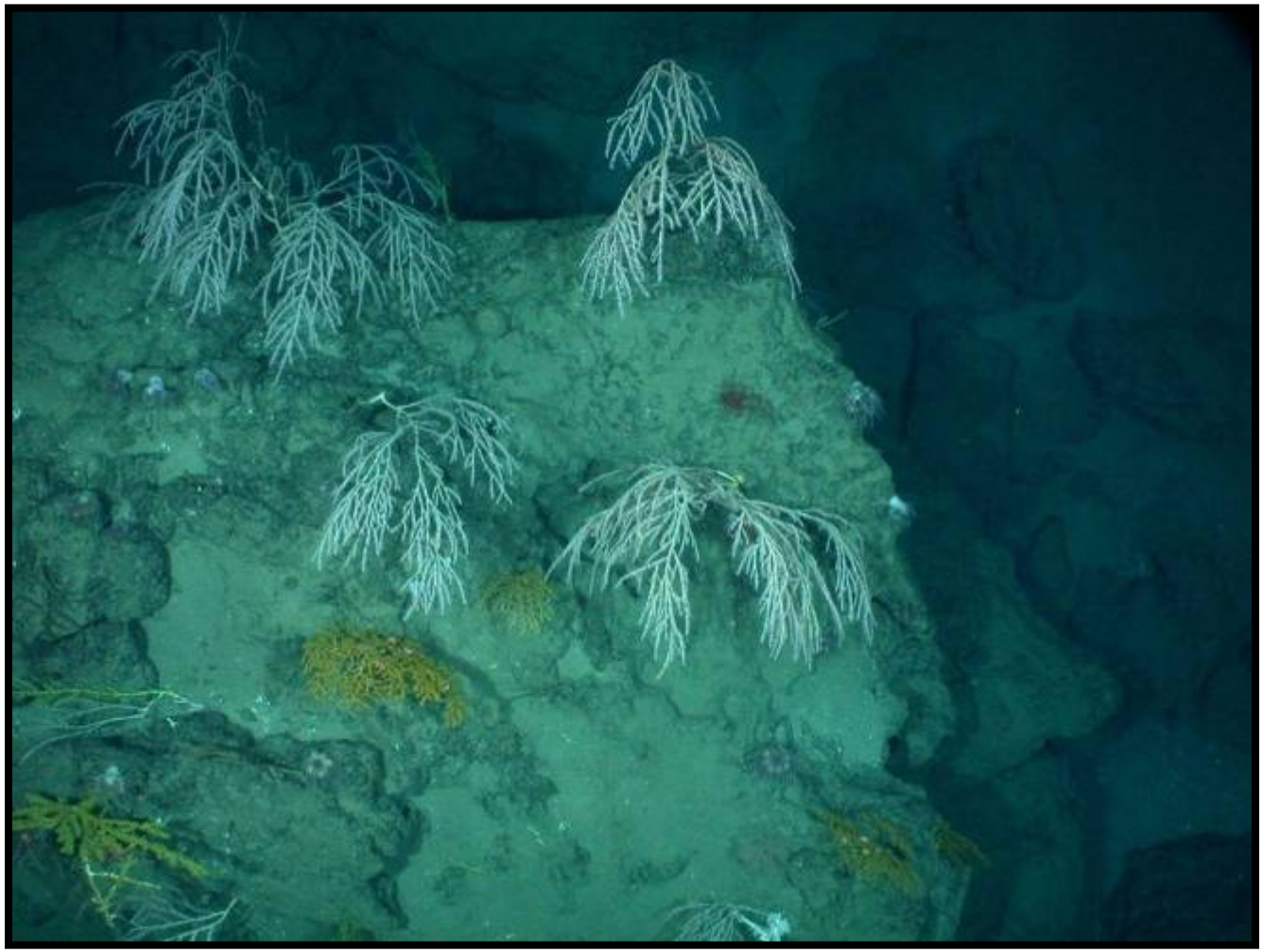
GC 852

Hard Corals on Authigenic Carbonate Substrates



GC 852

Gorgonians (soft corals) in a Strong Current

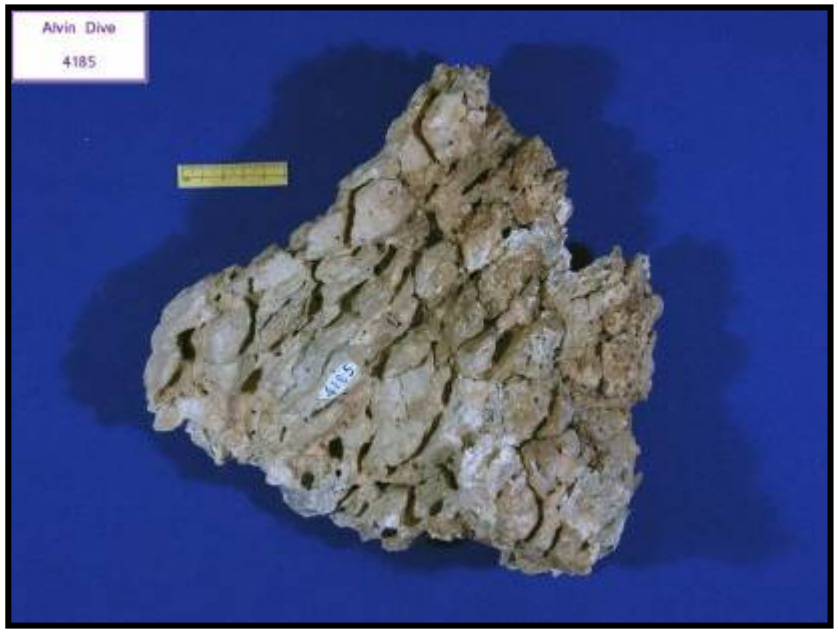


GC 852

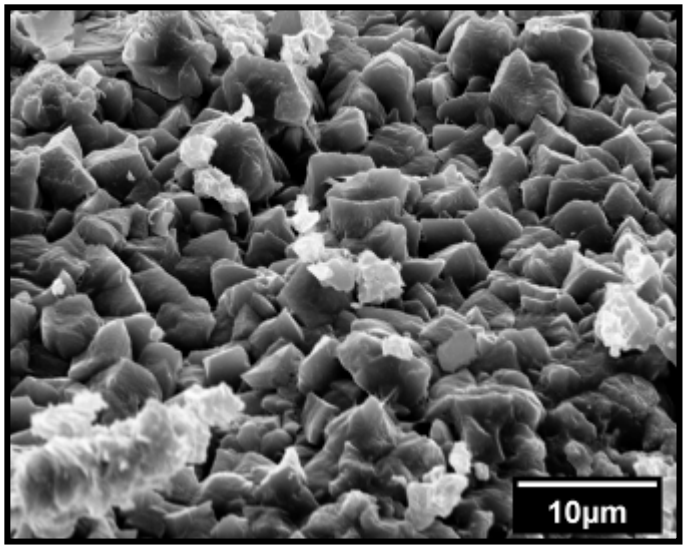
Tube Worms, Mussels, Shells, and Carbonates

GC 852

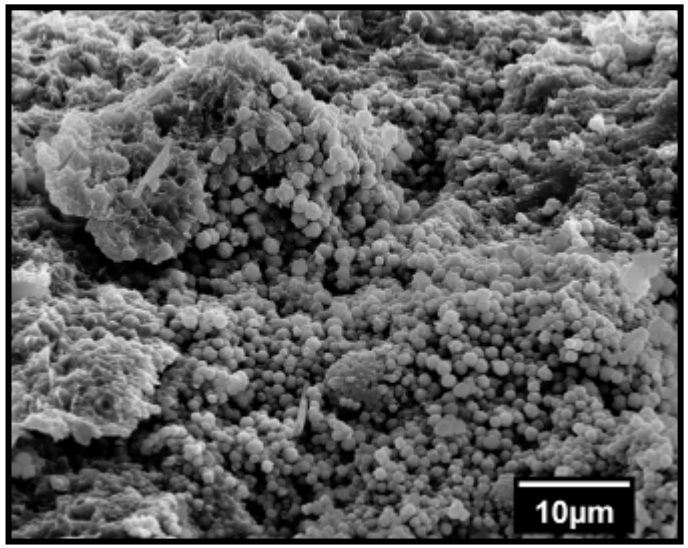
GC 852



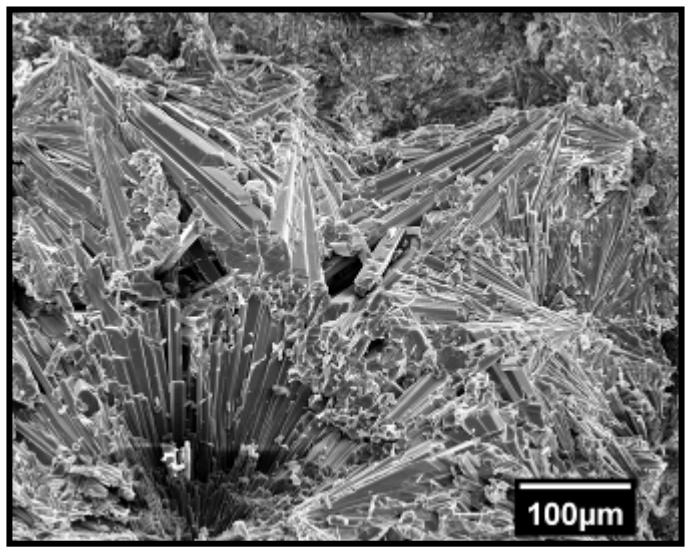
GC 852



High Mg-Cal.
2500x



Pyrite
2000x

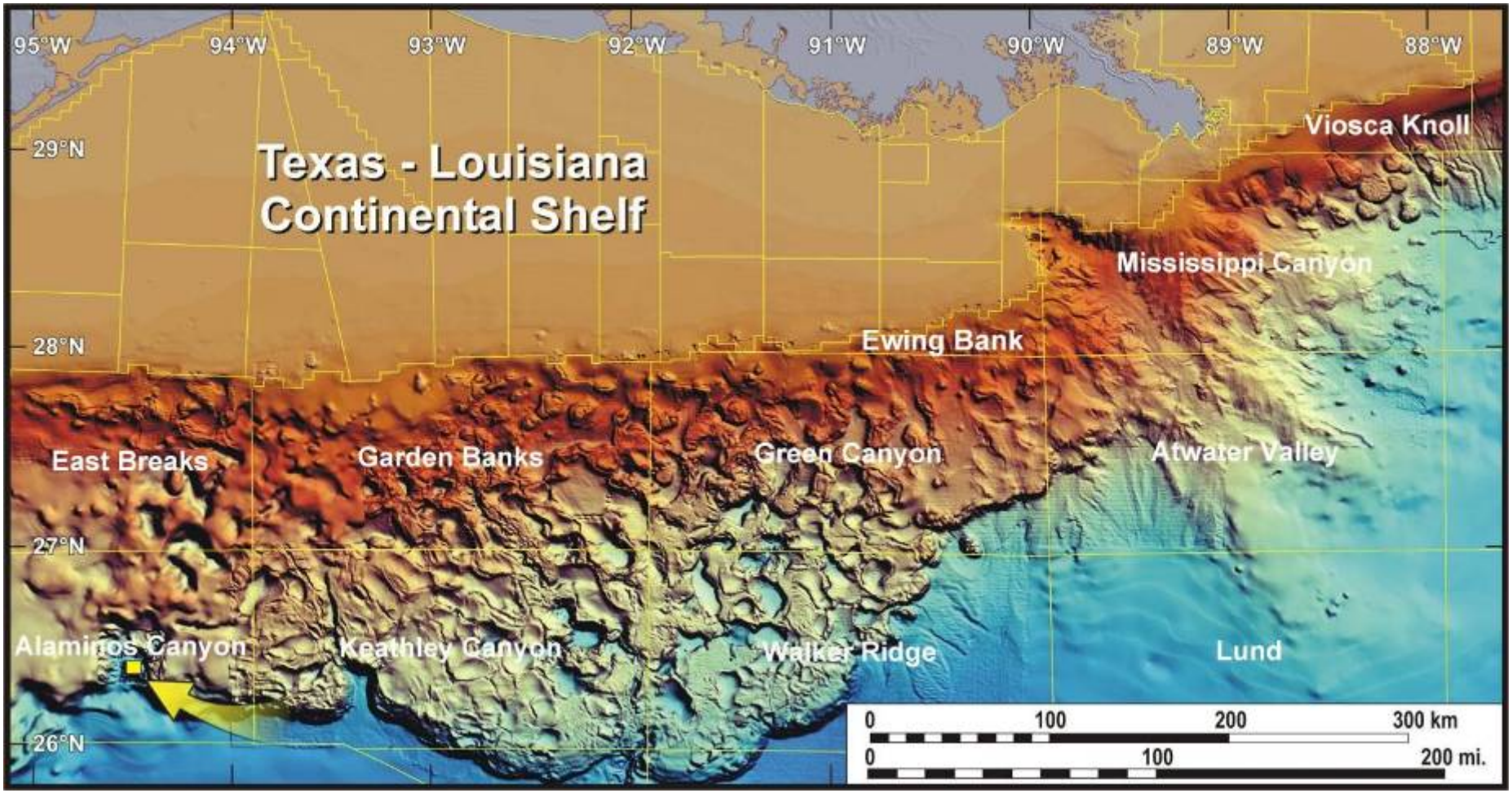


Aragonite
200x

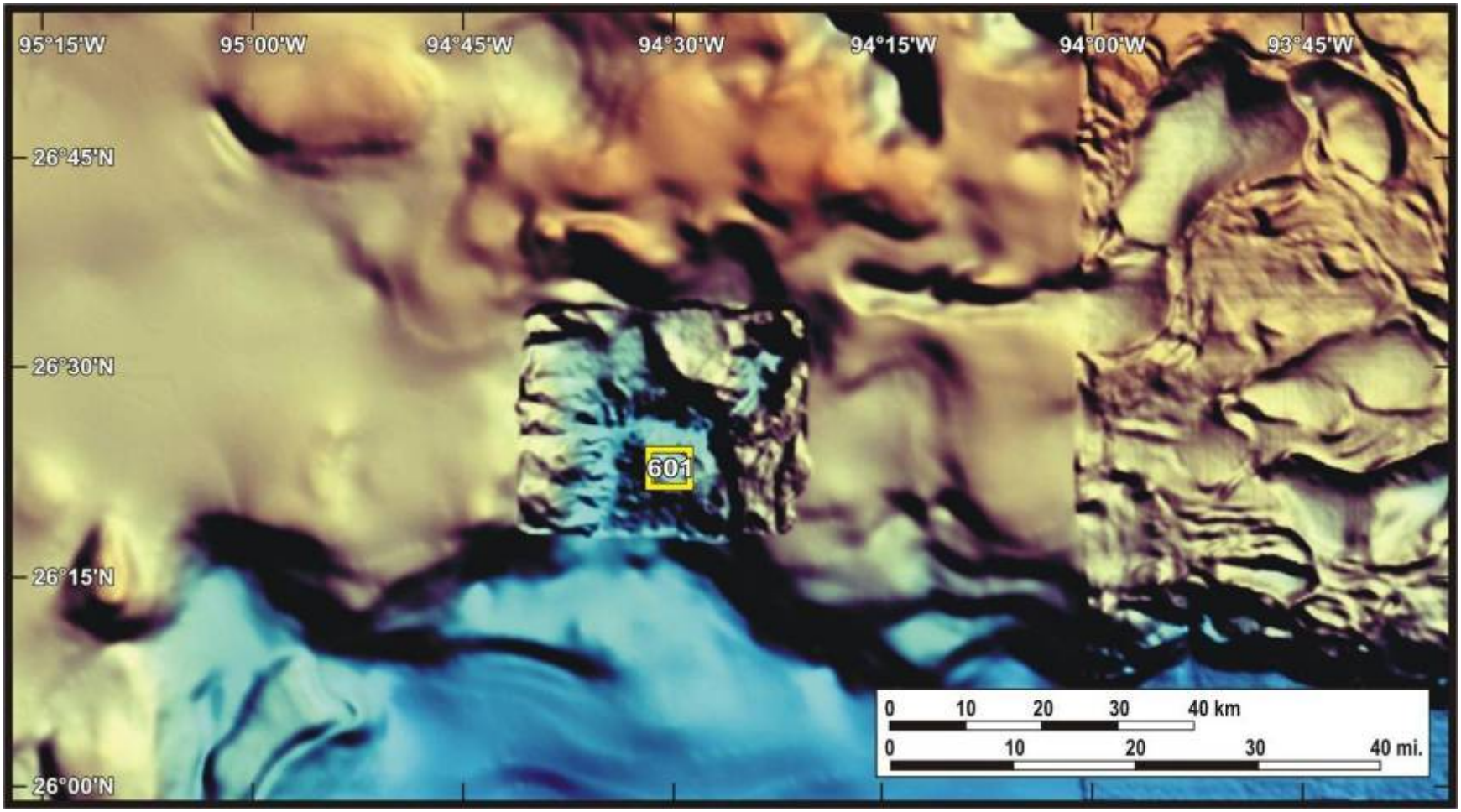
GC 852
Seafloor Characteristics

- **ALVIN Dives: 5**
- **High Amplitudes: Extensive Lithification (Blocks and Pavement)**
- **Mussel Beds, Tube Worms, Clams Along Crest**
- **Hard and Soft Corals on Authigenic Carbonates (Strong Current)**

AC 601
Location Map



AC 601
Site Map

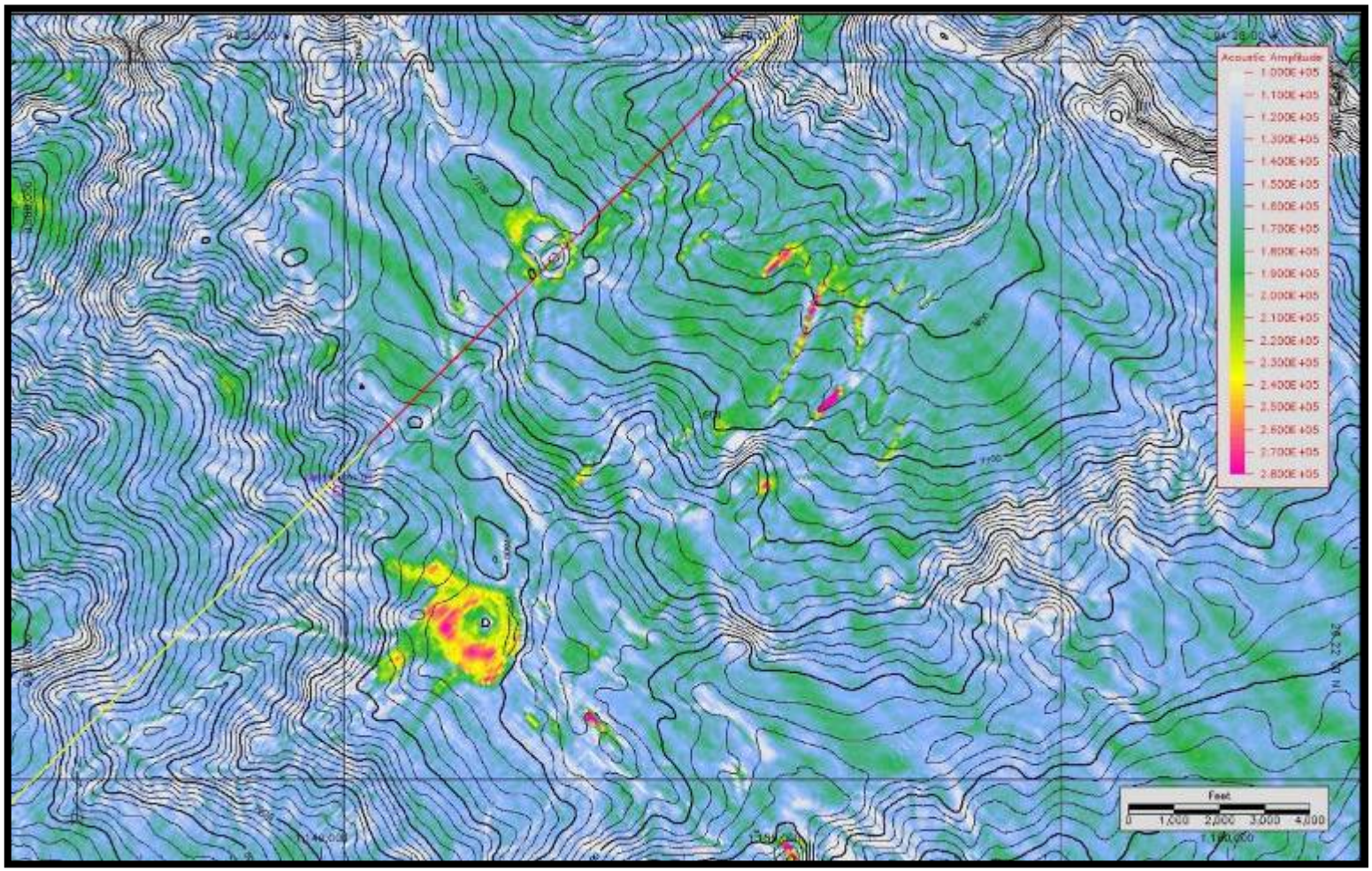


AC 601
Geologic Framework

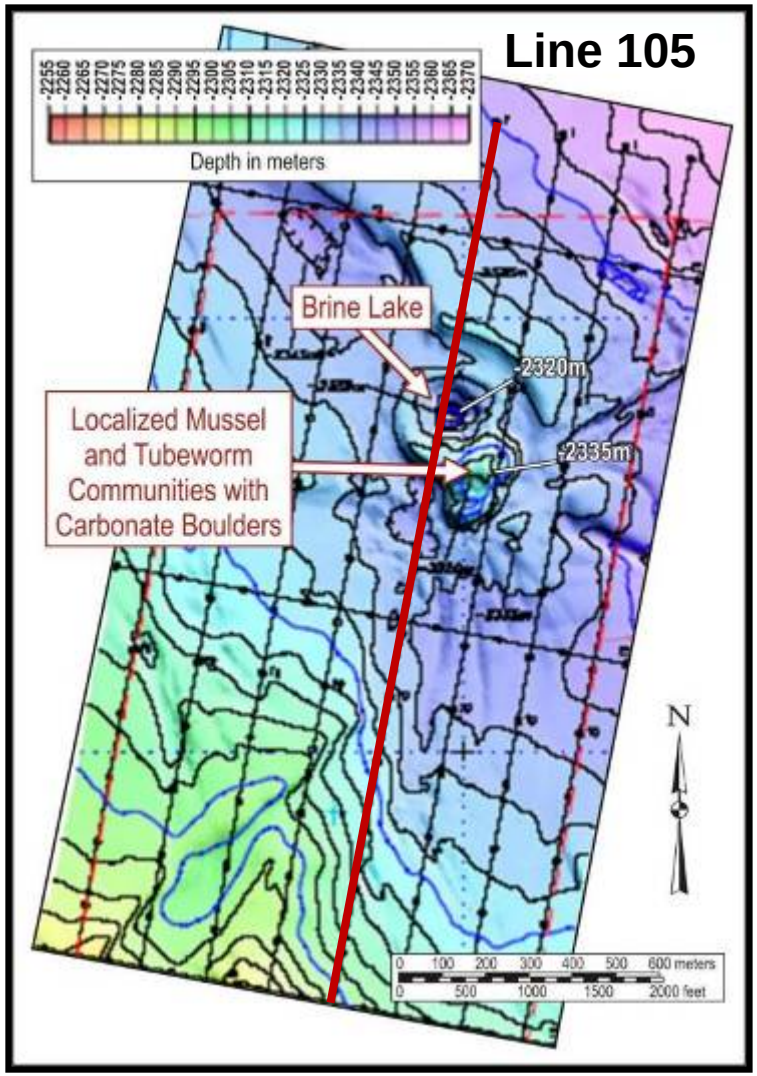
- **Site: Sigsbee Escarpment Reentrant (WD ~2340 m)**
- **Fluid-Gas Expulsion: Breached Anticline**
- **Bathymetry: Complex**
- **High Seafloor Amplitudes: Around Localized Expulsion Sites (4 in AC 601)**
- **Brine Seepage**

AC 601

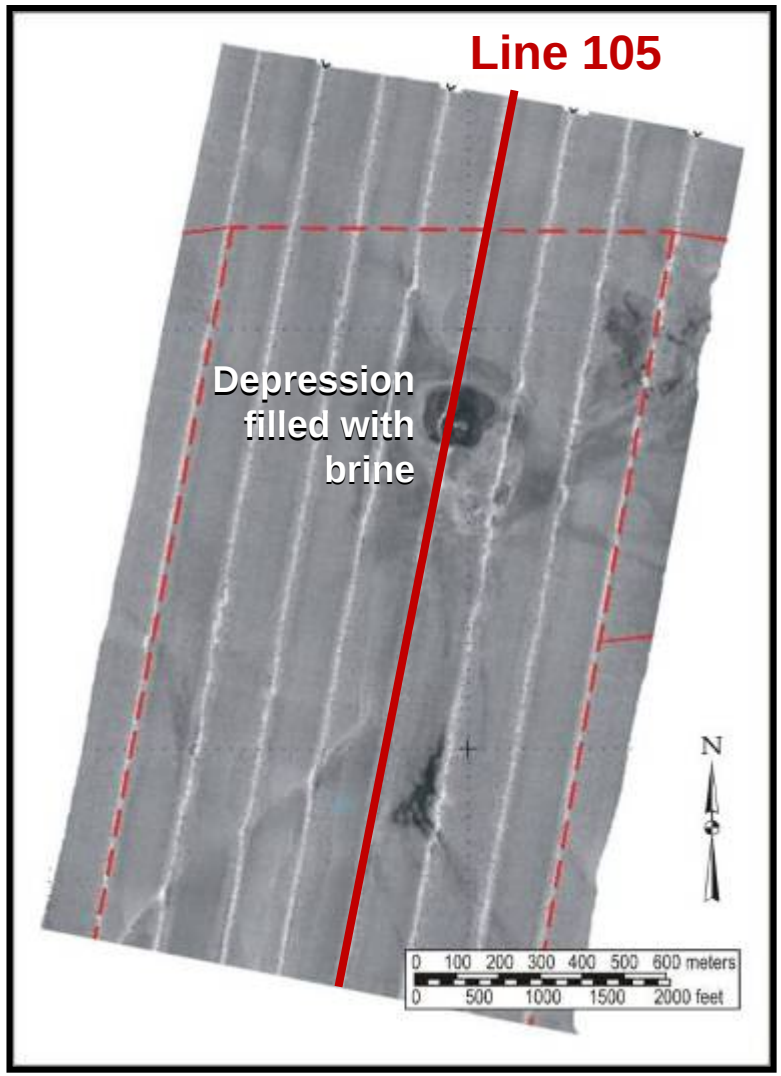
3-D Seismic Surface Amplitude Map



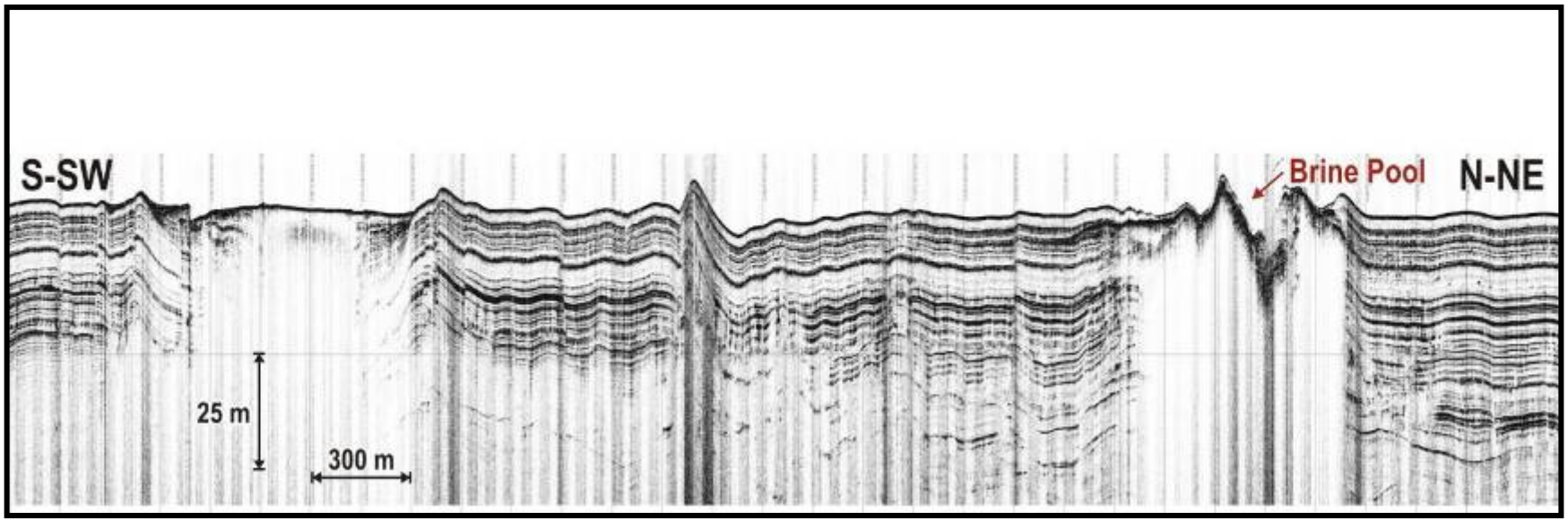
AC601 Multibeam Bathymetry



AC601 Backscatter



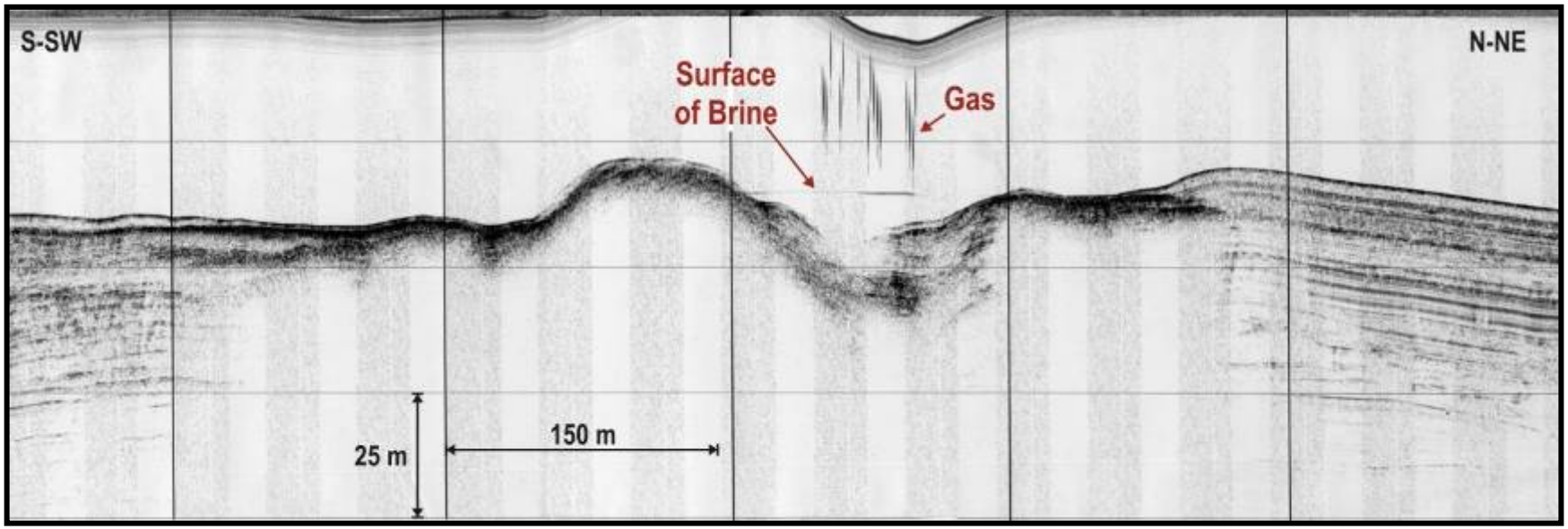
AC601 – Line 105



Acoustically opaque area

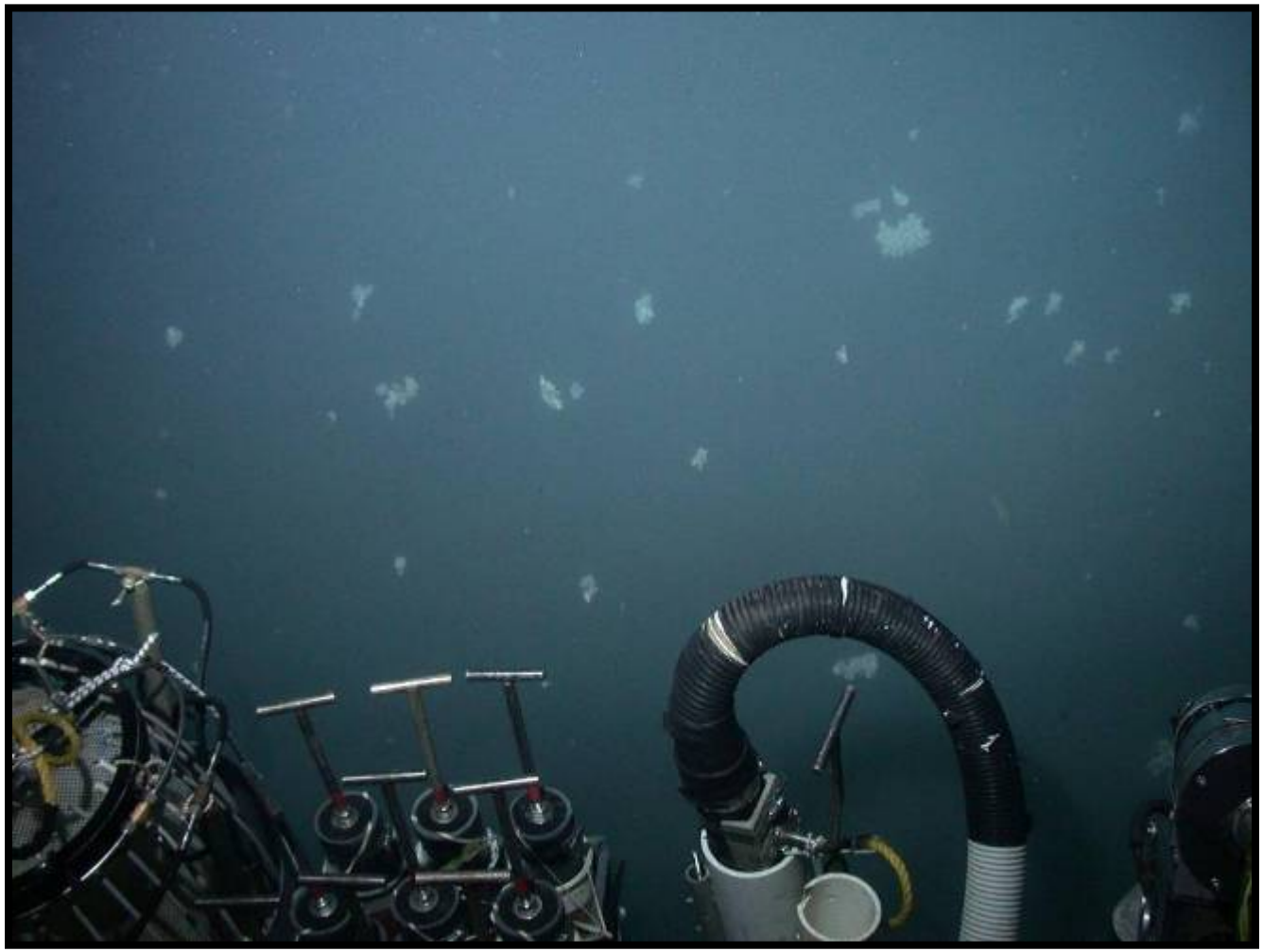
Acoustically opaque area

AC601 – Line 105



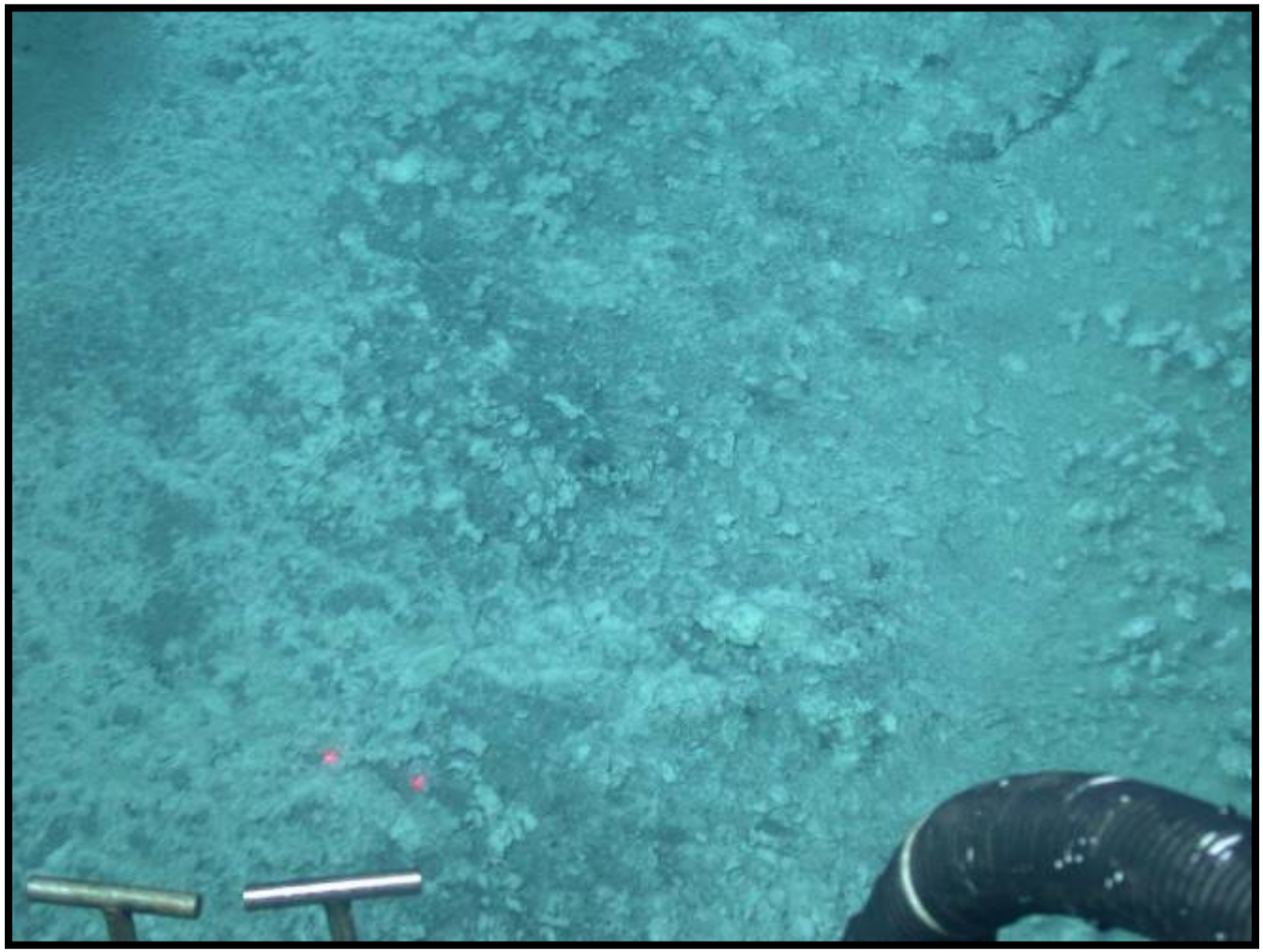
AC 601

Barite Crystal “Rafts” in Brine Lake



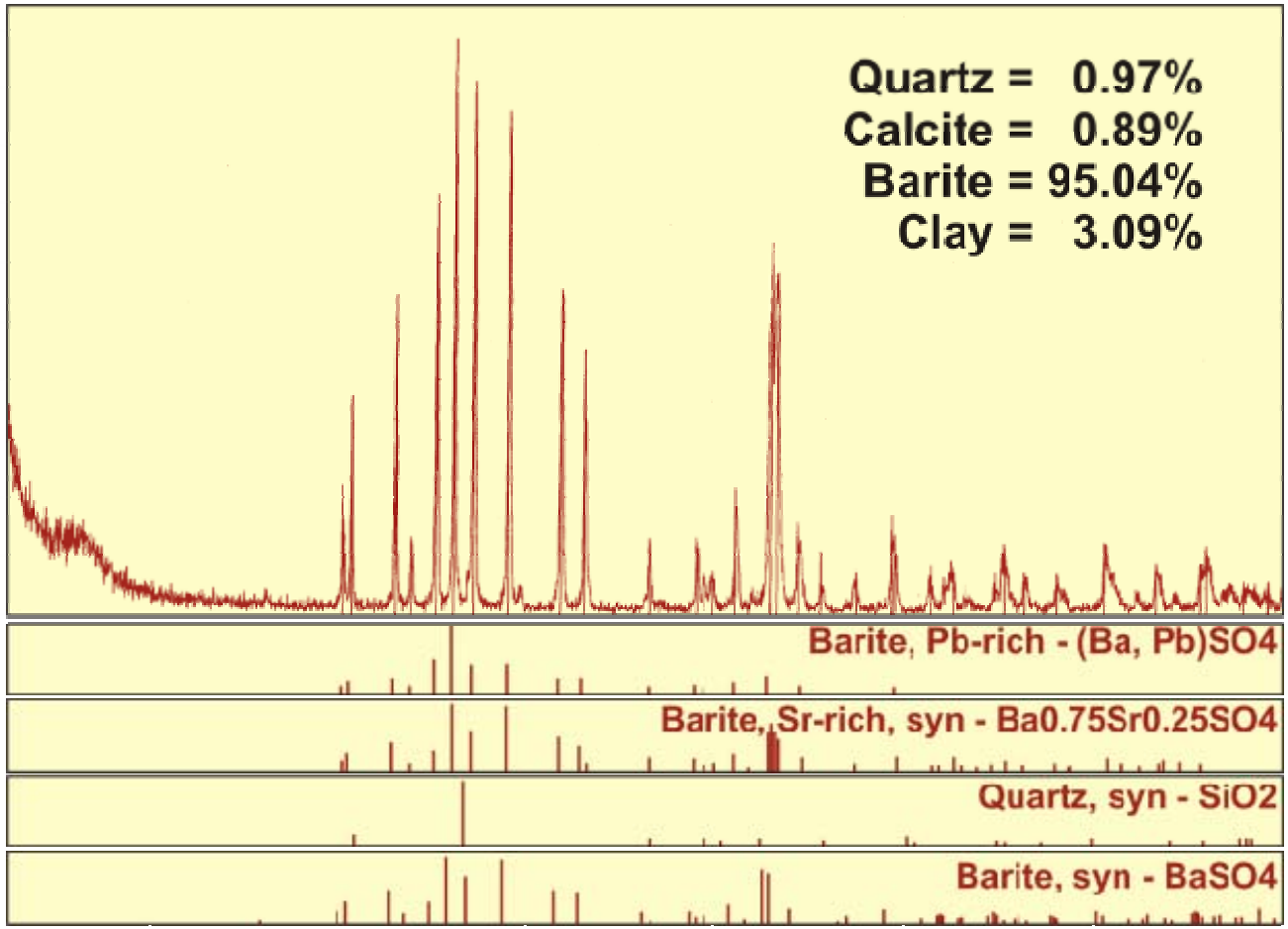
AC 601

Barite “Clots” Along Brine Lake Shoreline



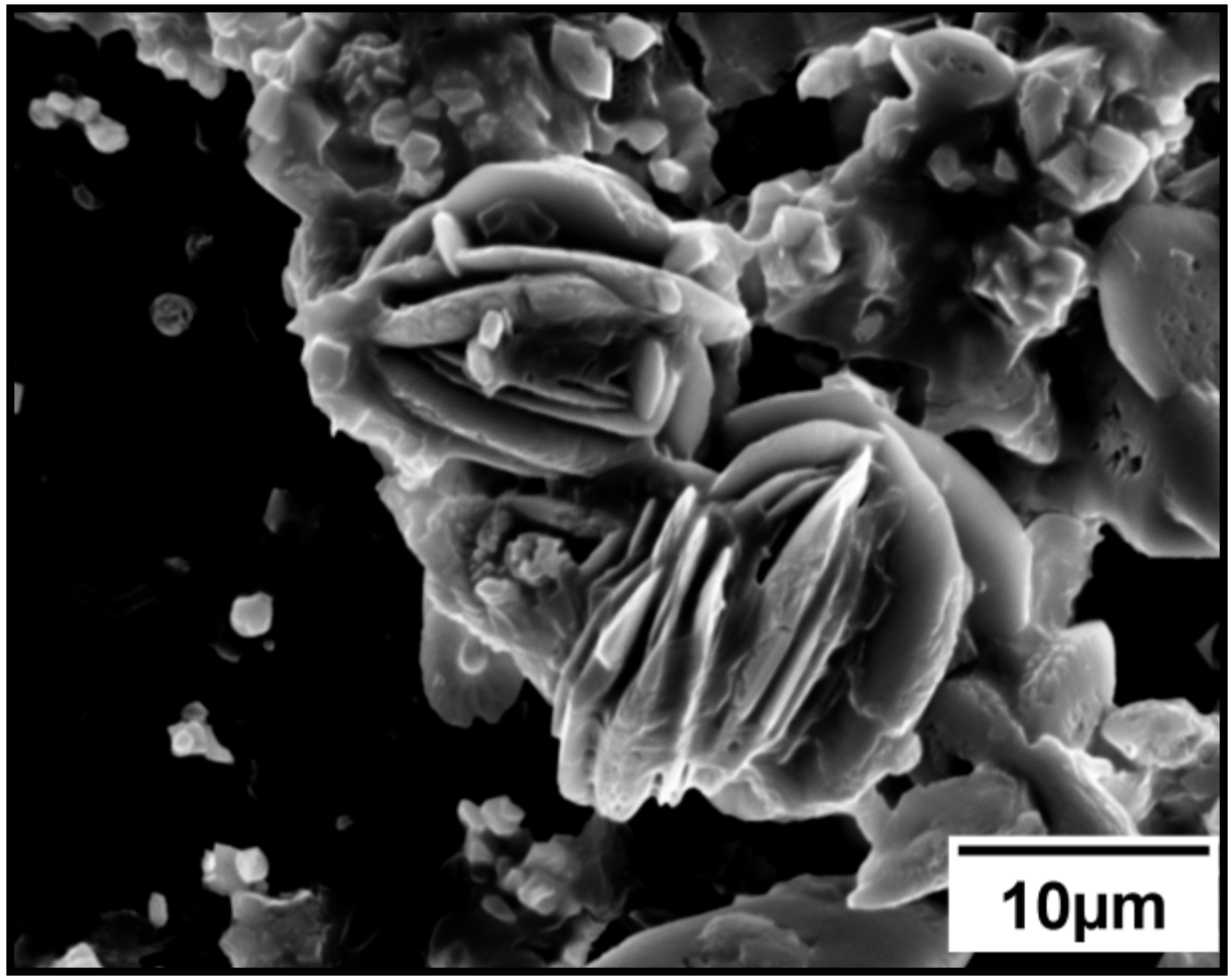
X-Ray Diffraction (Long Scan)

Filtered Sample, Crystal Rafts – Brine Lake (AC601)



AC 601

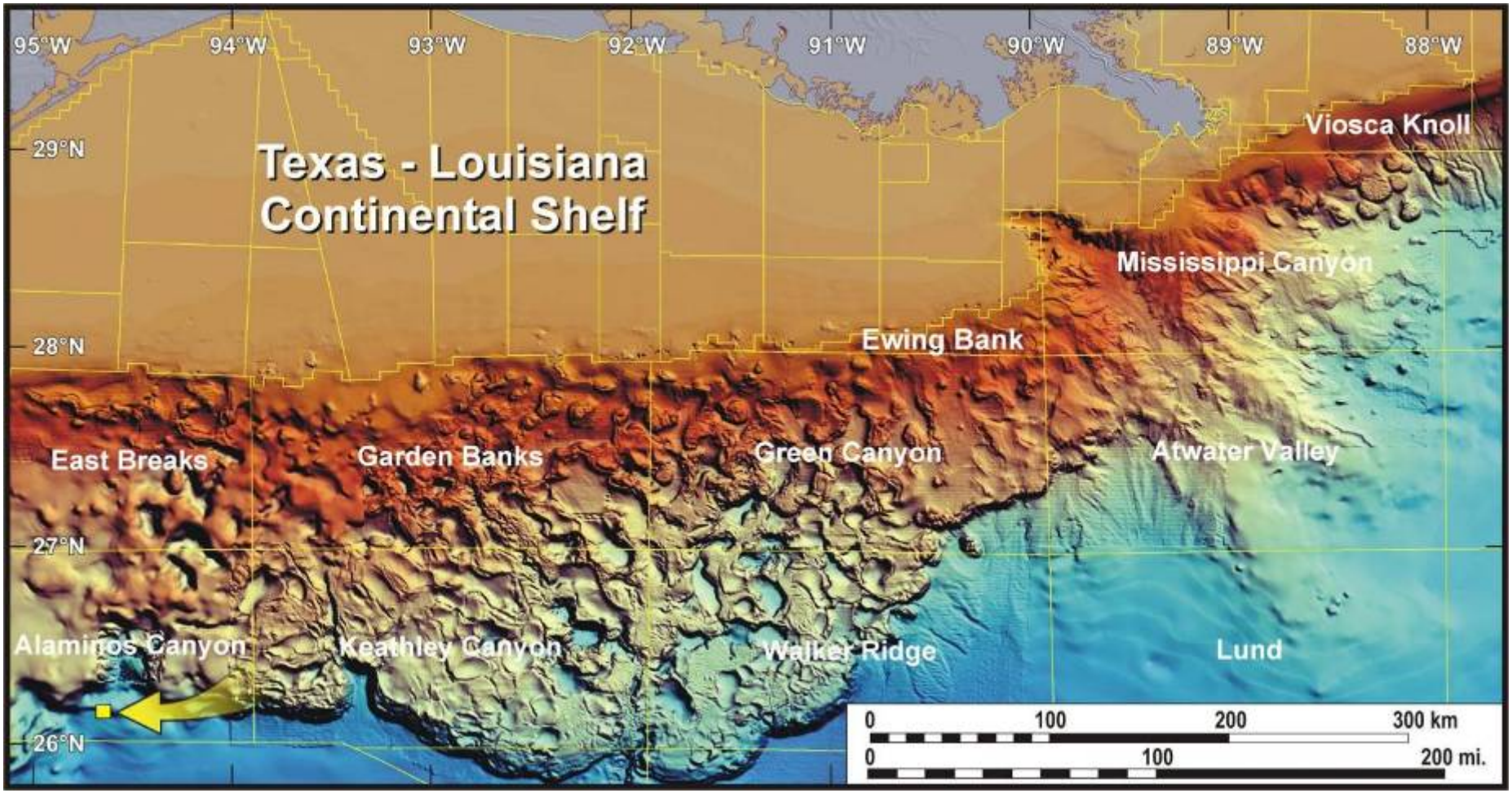
Brine Lake Sample



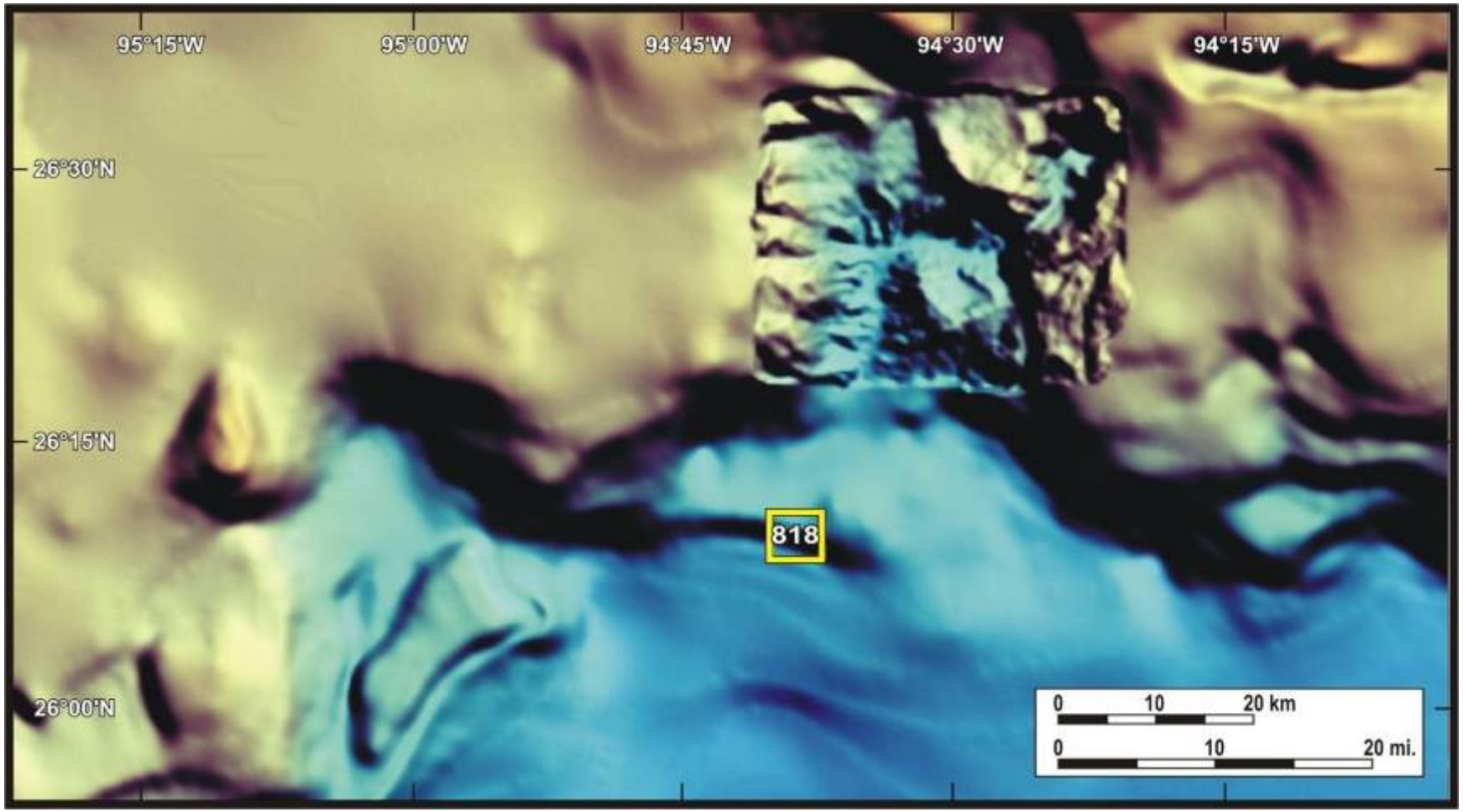
AC 601
Seafloor Characteristics

- **ALVIN Dives: 2**
- **Low Amplitude: Depression with Brine**
- **Brine Lake: ~4 m Deep, ~180 m Diameter**
- **White Crystalline “Flocs” in Brine, Lake Bottom**
- **Scattered Mussels, Clams, Tube Worms, Urchins Around Lake**
- **High Amplitudes: Local Lithification Around Lake**

AC 818
Location Map

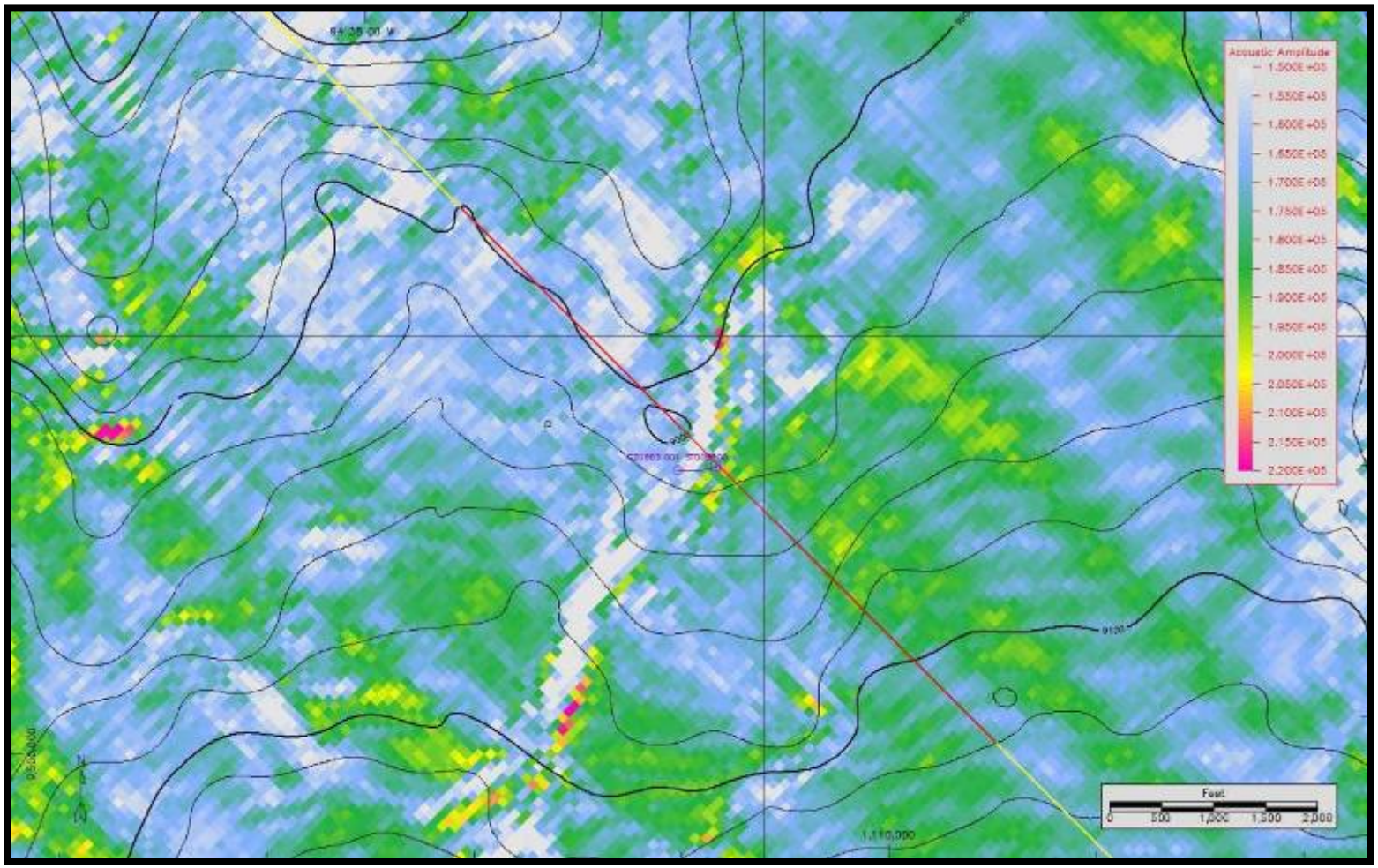


AC 818
Site Map



AC 818

3-D Seismic Surface Amplitude Map

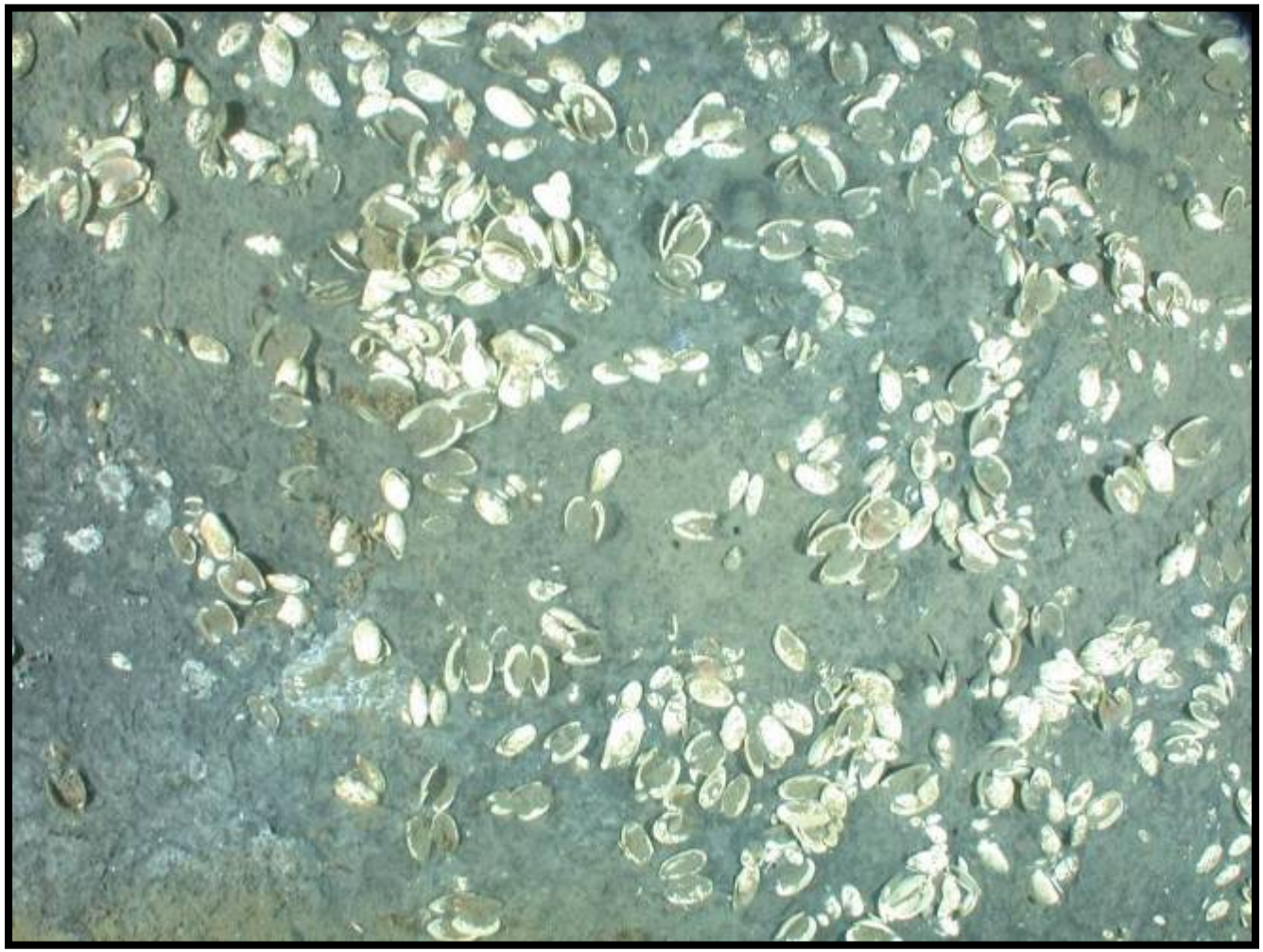


AC 818
Geologic Framework

- **Site: Seaward of Sigsbee Escarpment (WD ~2775 m)**
- **Seepage: Along N-NE to S-SW Trending Fault**
- **Bathymetry: Simple**
- **High Seafloor Amplitude: Localized Along Fault**

AC 818

Clam Beds Distributed Along Fault



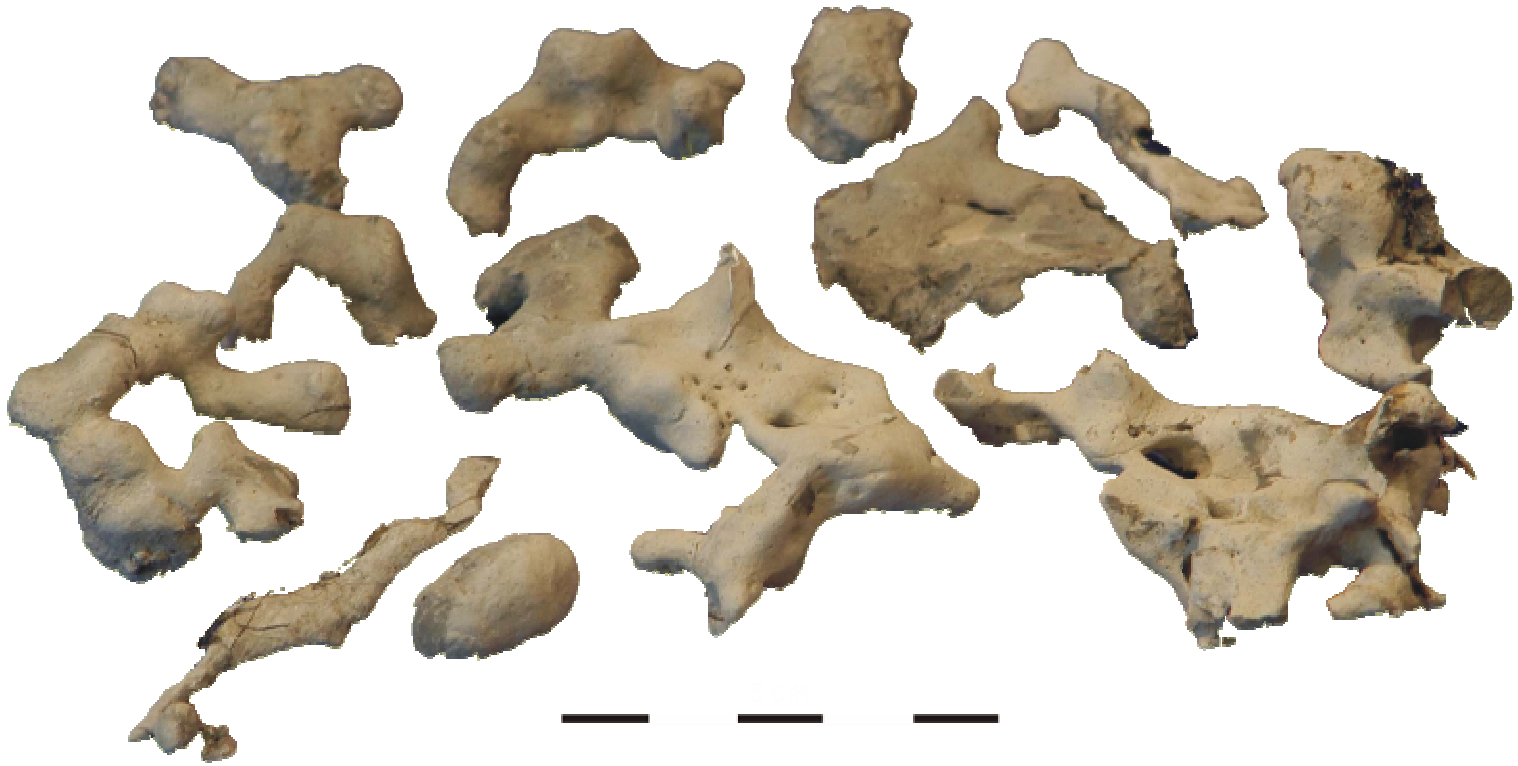
AC 818

Urchins Exploiting Reducing Sediment

AC 818

Tube Worm “Bush” and Mussels Along Fault

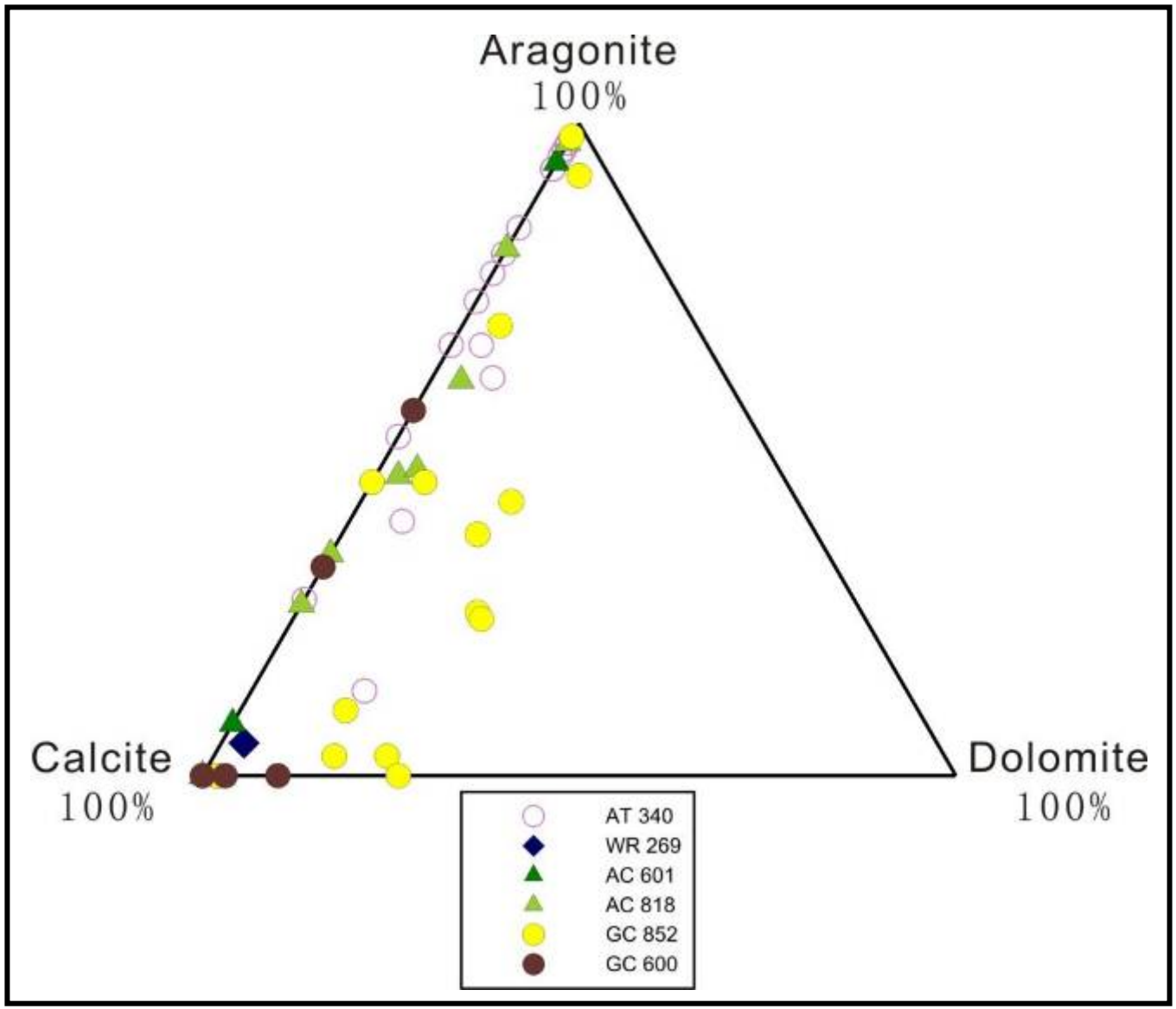
AC 818



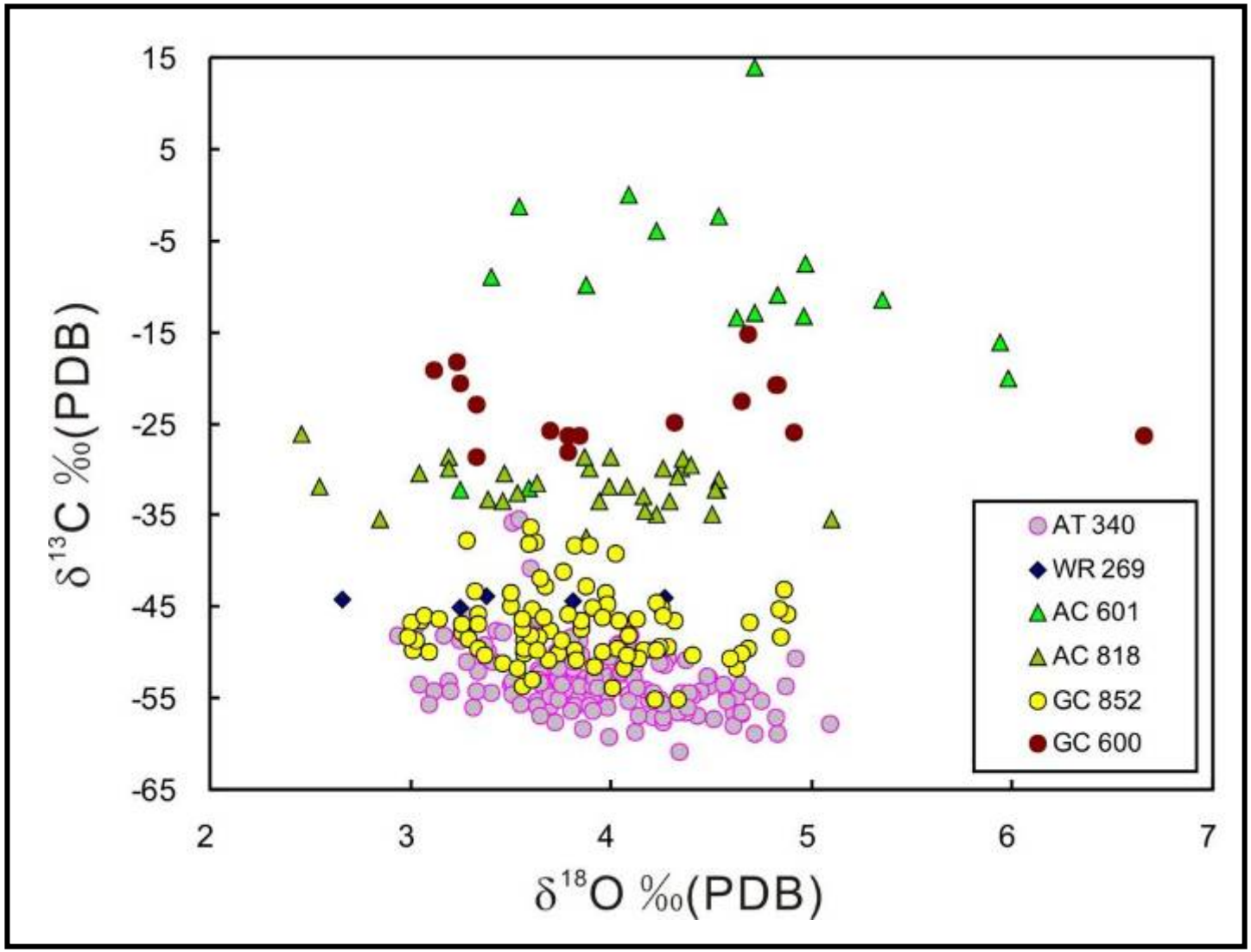
AC 818
Seafloor Characteristics

- **ALVIN Dives: 2**
- **Narrow Belt of Chemosynthetic Communities**
- **Lucinid-Vesycomyid Clam Beds Common**
- **Localized Mussels, Tube Worms, Urchins, Carbonates**
- **Community Scale: Generally Below Seismic Resolution**

Carbonate Mineralogy



C and O Isotope Values



Summary

- **3D-Seismic Surface Amplitude Mapping Identifies 1,000s of Slope-Wide Anomalies**
- **Manned Submersible and ROV Dives Confirm Amplitudes Products of Fluid and Gas Expulsion**
- **Chemosynthetic Community Sites for DSV ALVIN and ROV Jason Dive Identified by This Method (’06 and ‘07 Cruises)**

References

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