Gigante: Overview

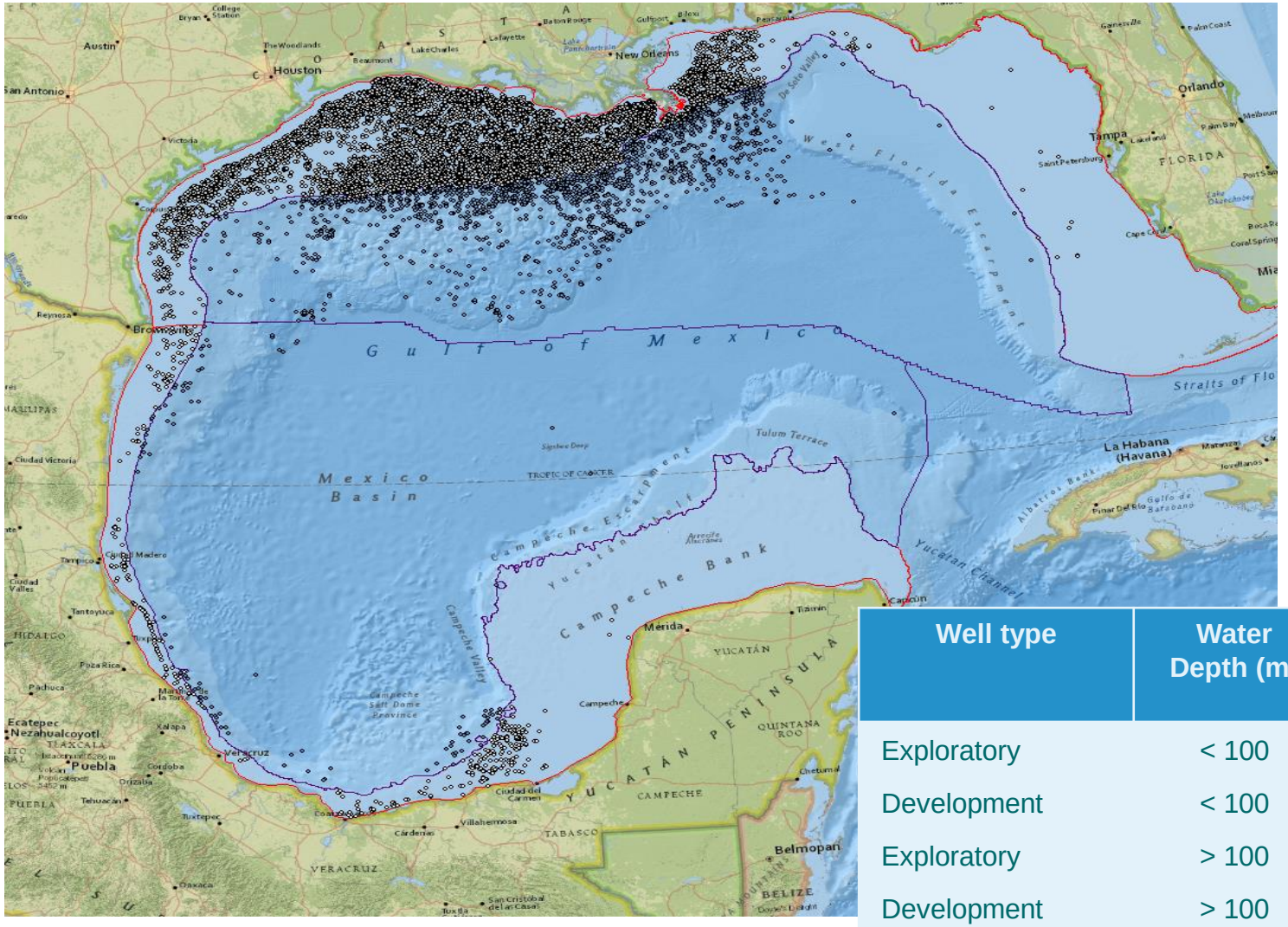
Chris Corona and Cian O' Reilly

October 21, 2016

Agenda

- Background
- Marine Data – seismic, multibeam and coring
- Other Latin America Projects (Belize)
- Seismic examples
- Concluding remarks

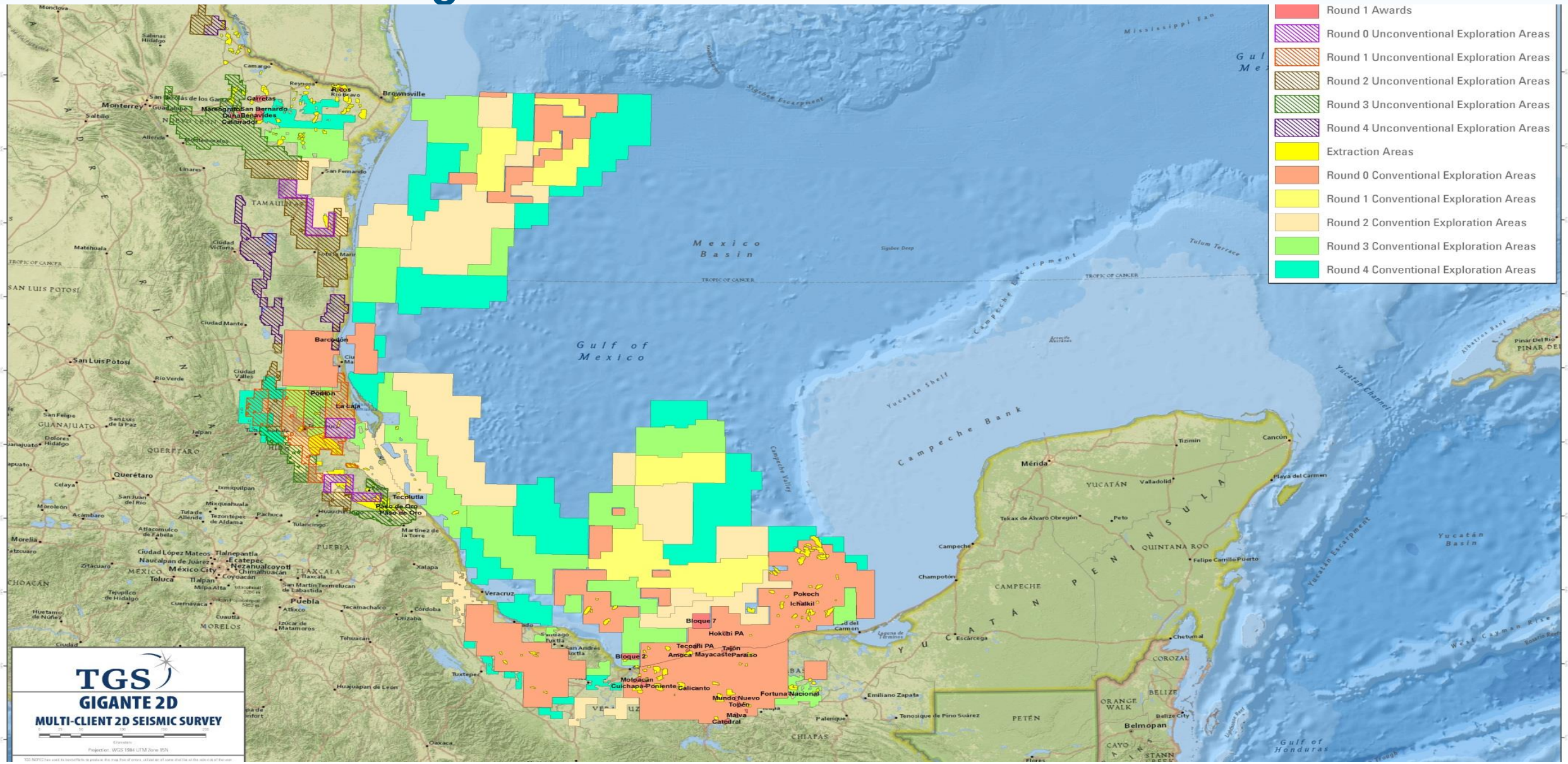
Mexico – deepwater virtually unexplored



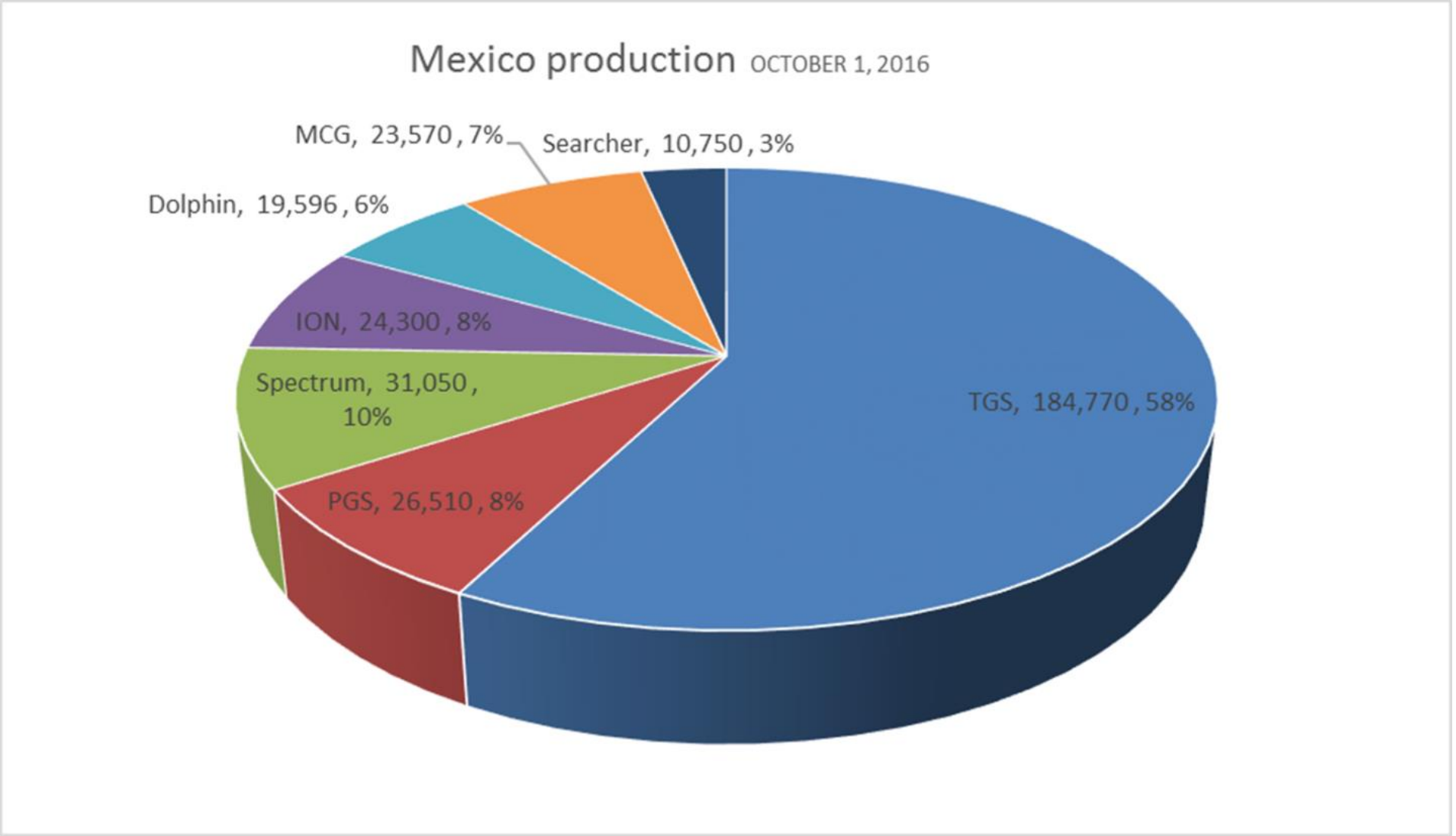
Well type	Water Depth (m)	US	México
Exploratory	< 100	14,778	474
Development	< 100	29,840	n/a
Exploratory	> 100	4,204	117
Development	> 100	4,361	n/a

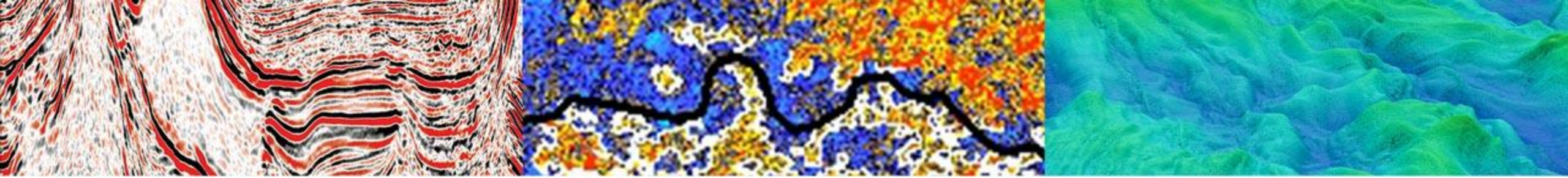
License Rounds

Planned Licensing Rounds



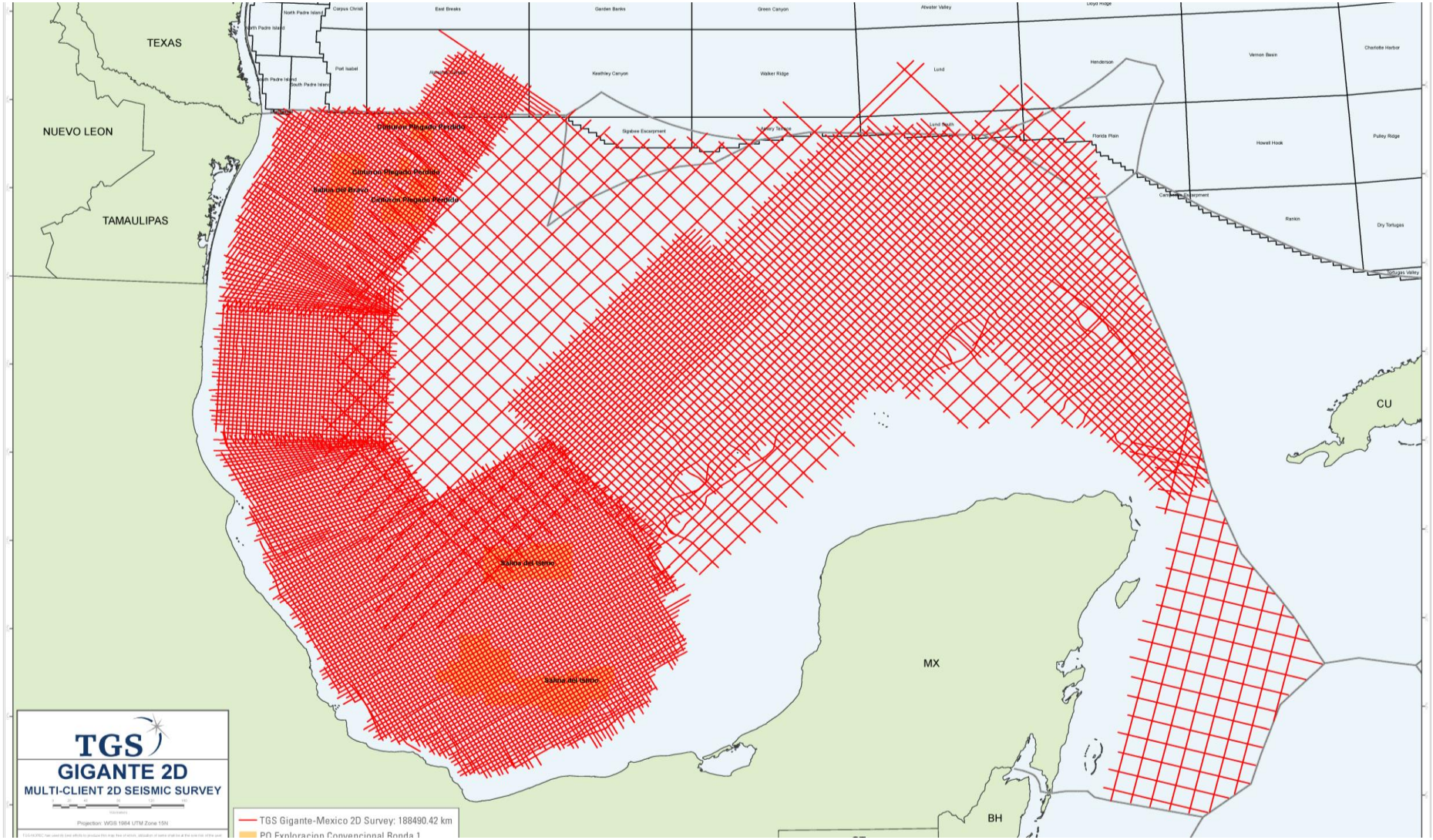
2D Seismic acquired in Mexico as of October 1st





Purpose of GIGANTE

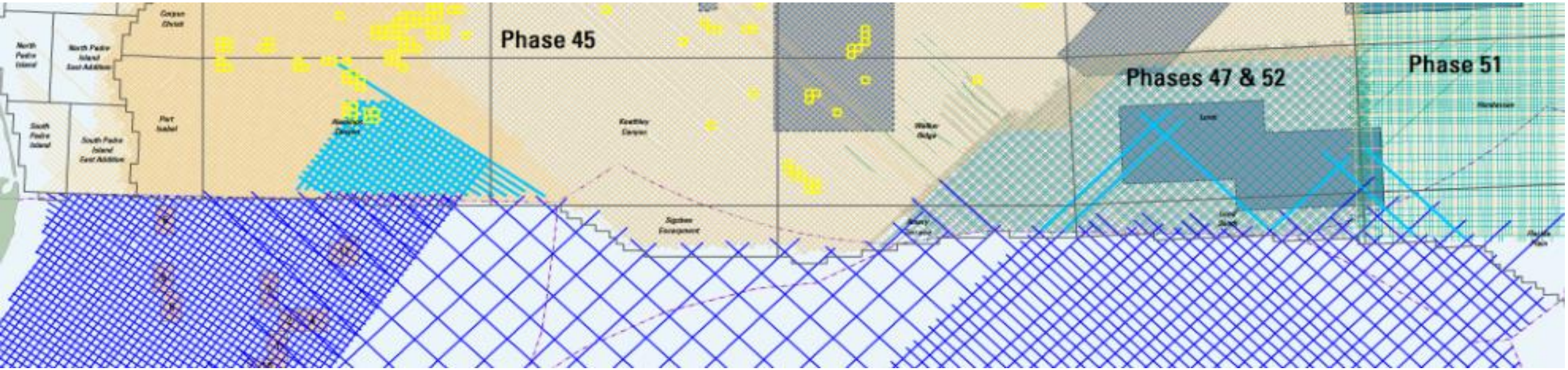
Gigante Regional 2D Survey – 188,490 km



The Purpose of Gigante

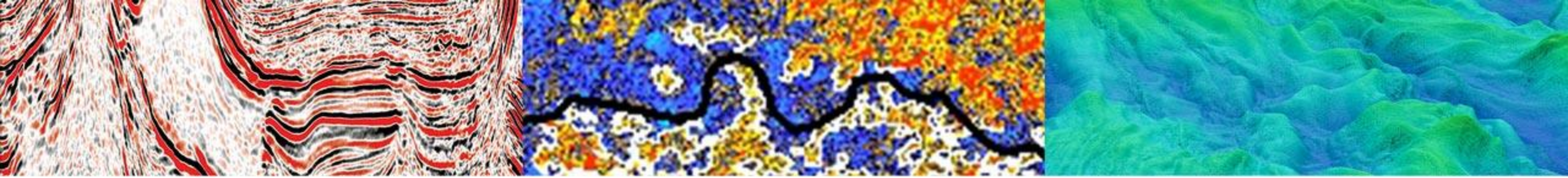
- Create a regional grid with consistent Acquisition and Processing parameters covering the entire MGOM (Mexican Gulf of Mexico)

- Tie lines of the Gigante grid into the TGS US GOM regional grids to provide a comprehensive understanding of the entire GOM basin



The Purpose of Gigante

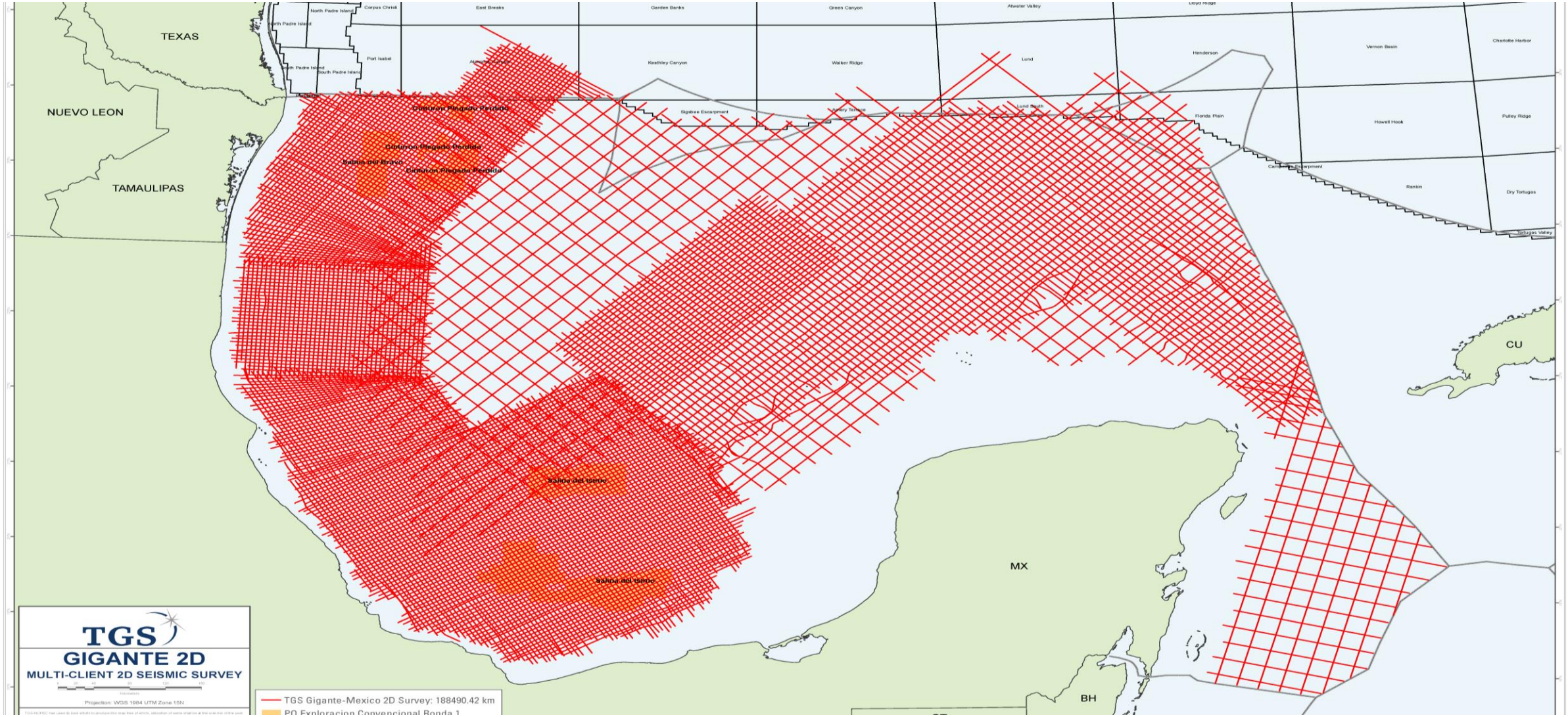
- Create additional products such as structural interpretations, gravity and magnetic data
- Assess prospectivity through Bathymetry data, Cores and Geochemical Analysis
- Generally, to create a comprehensive suite of products to facilitate the understanding of the entire GOM Basin



Gigante Regional 2D Seismic Program

Gigante Regional 2D Survey – 188,490 km

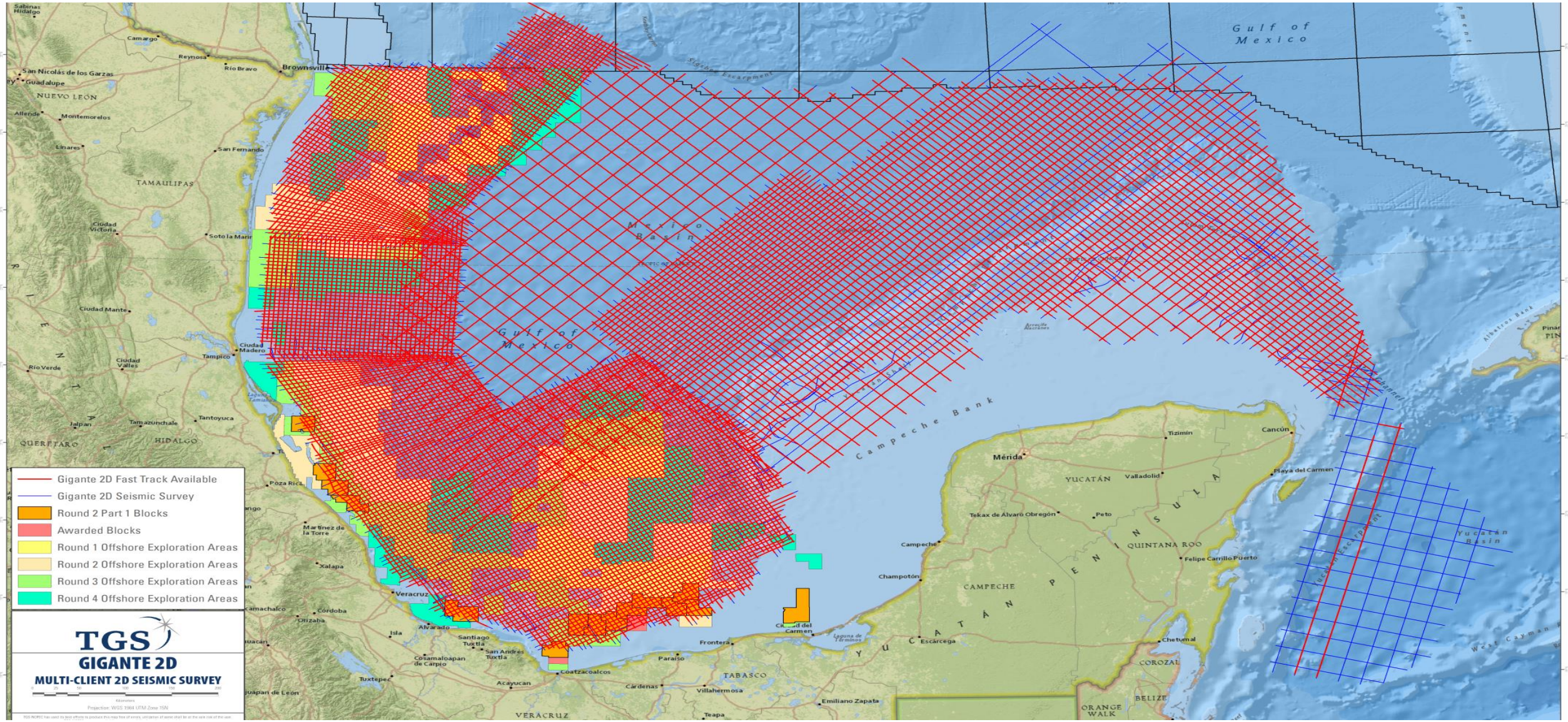
100% acquired



General Info on Gigante 2D Seismic Survey

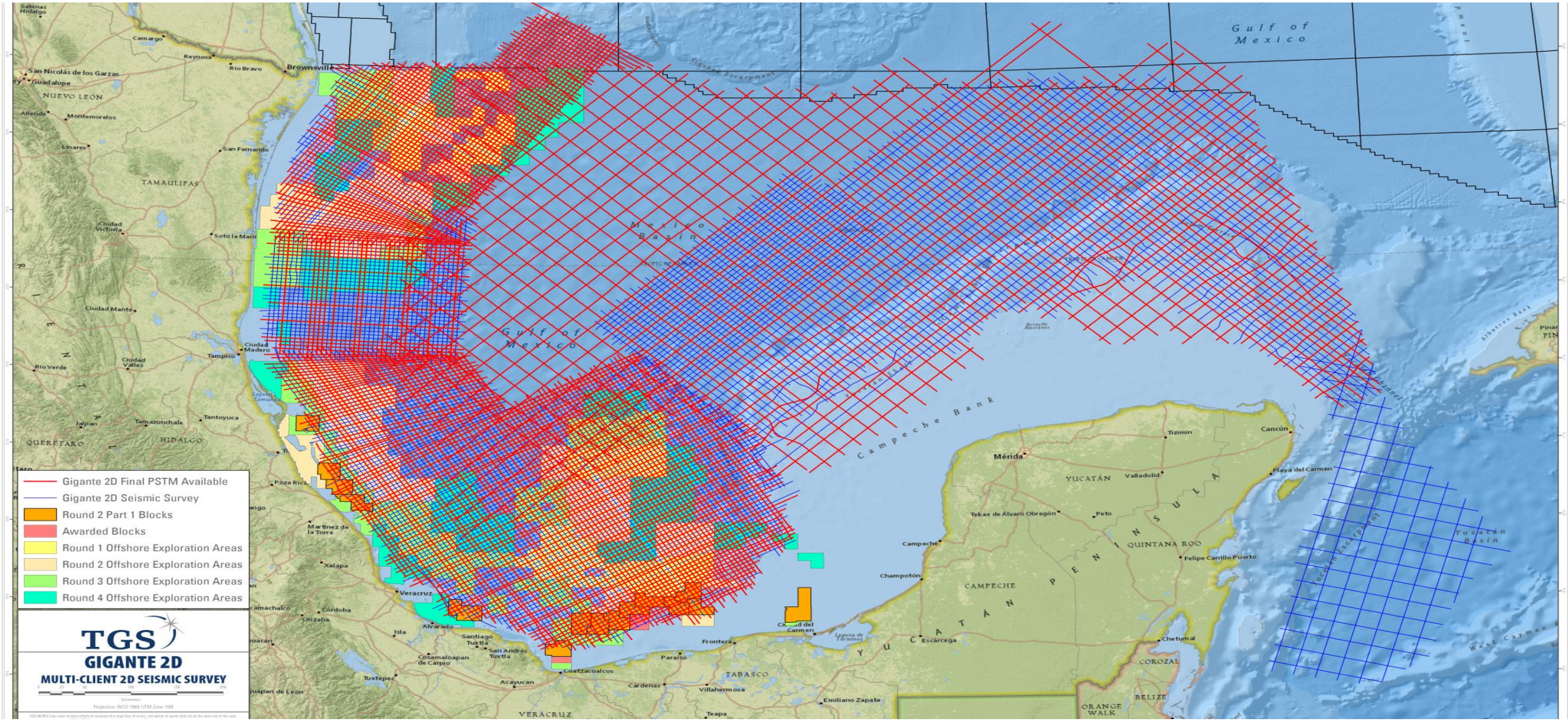
- Survey Size: ~ 188,490 km
- Ties into TGS US GOM Regional Grids
- 12 km offsets
- Acquisition Completion: Oct of 2016
- Processing Deliverables: Fast Track PSTM, PSTM, KPSDM and RTM
  - Fast Track PSTM lines available mid September 2015
  - Processing accelerated over priority grid and announced future rounds
- Processing Completion: Q2 2017 with intermediate products available sooner in areas of high interest

Fast Track PSTM Available ~ 180,000 km



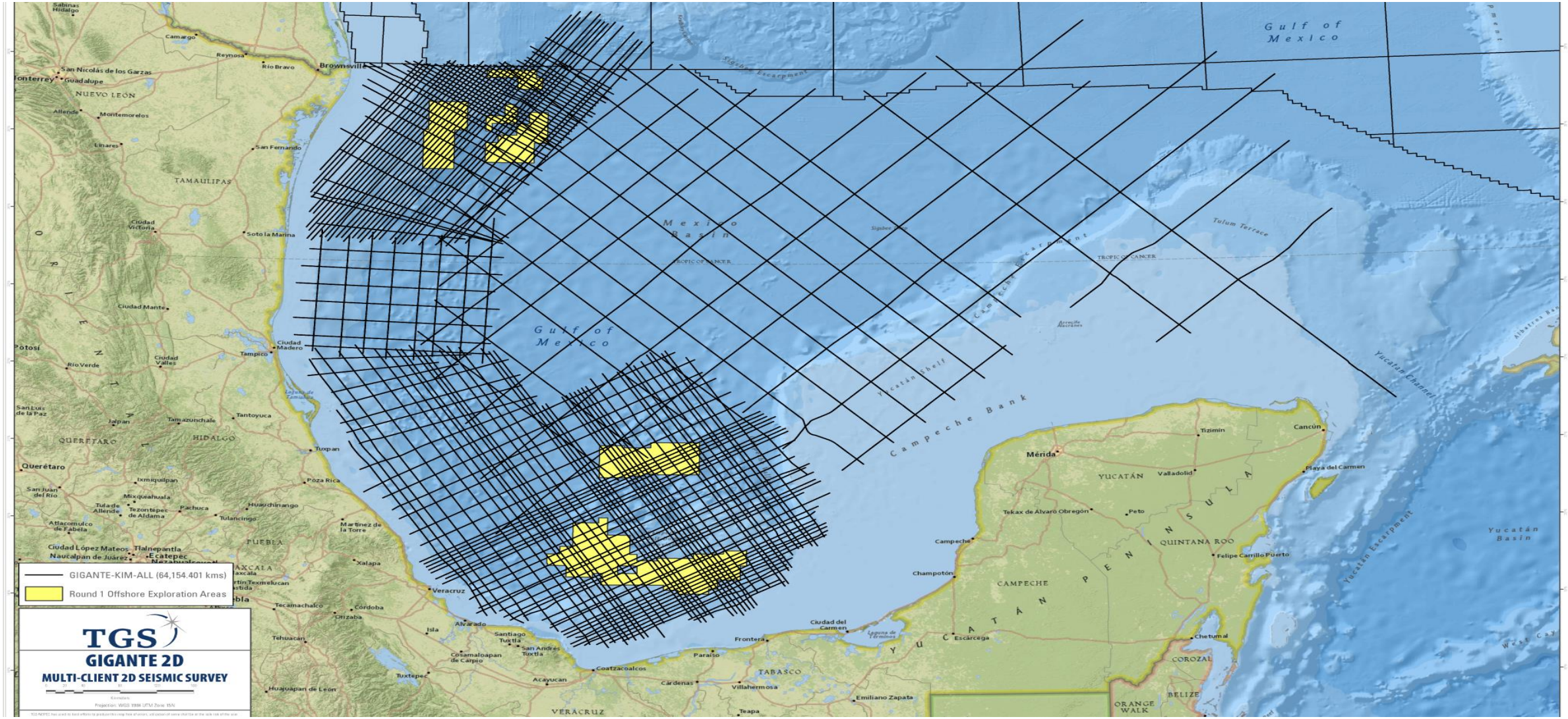
TGS

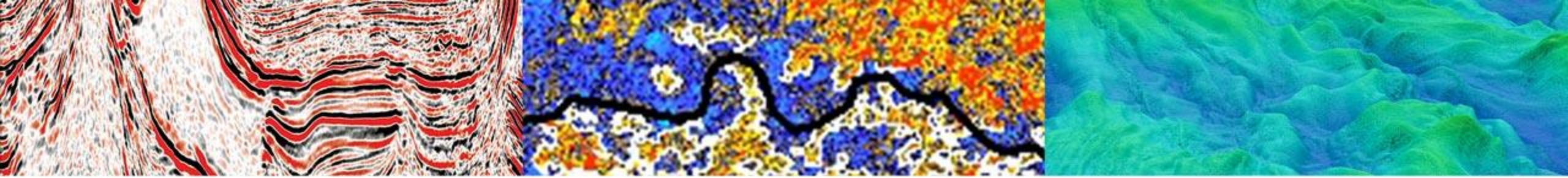
Final PSTM Available ~112,000 km



TGS

Preliminary Kirchhoff PSDM Available ~ 65,000 km



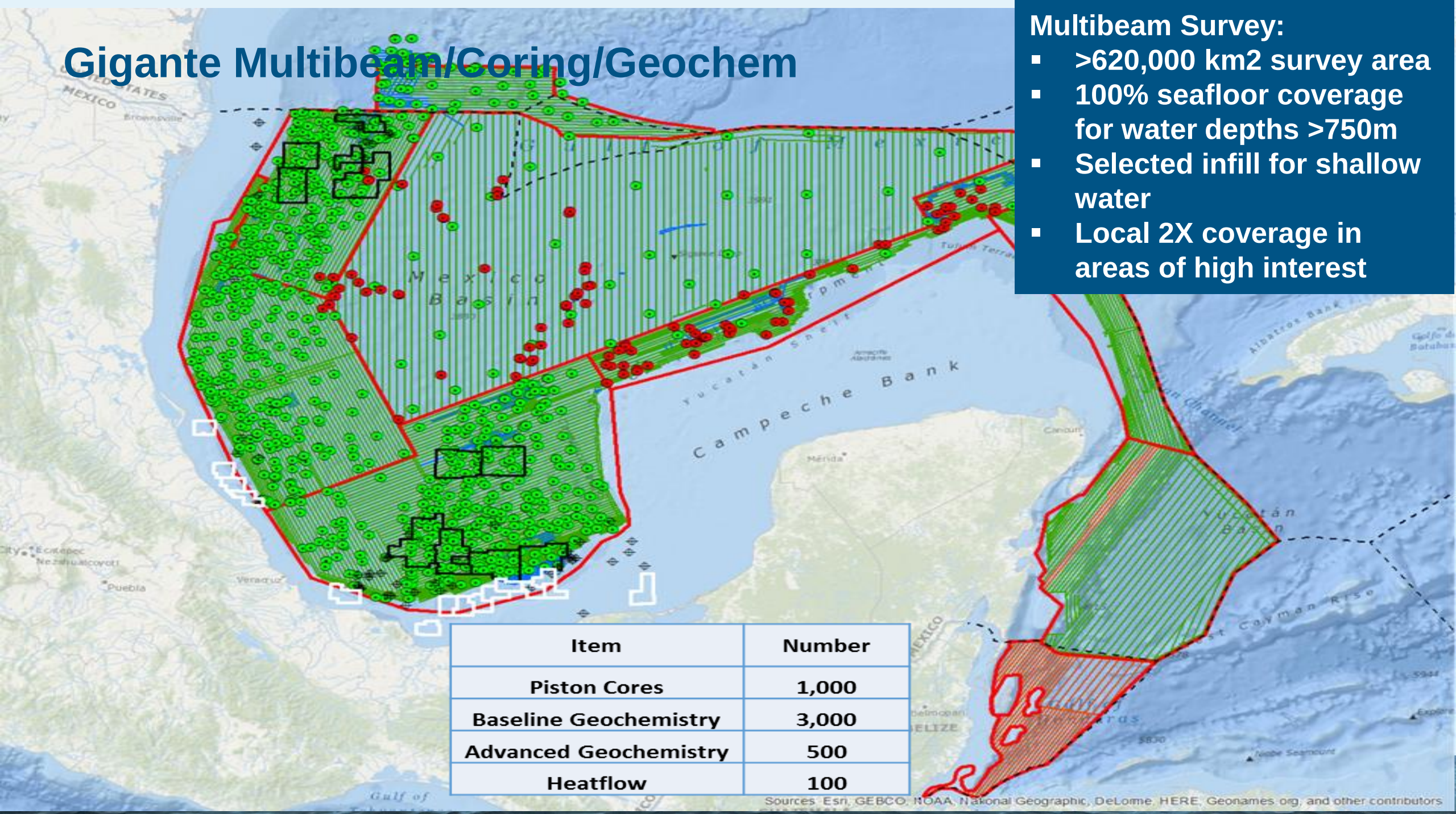


Gigante Multibeam/Core/GeoChem Program

Gigante Multibeam/Coring/Geochem

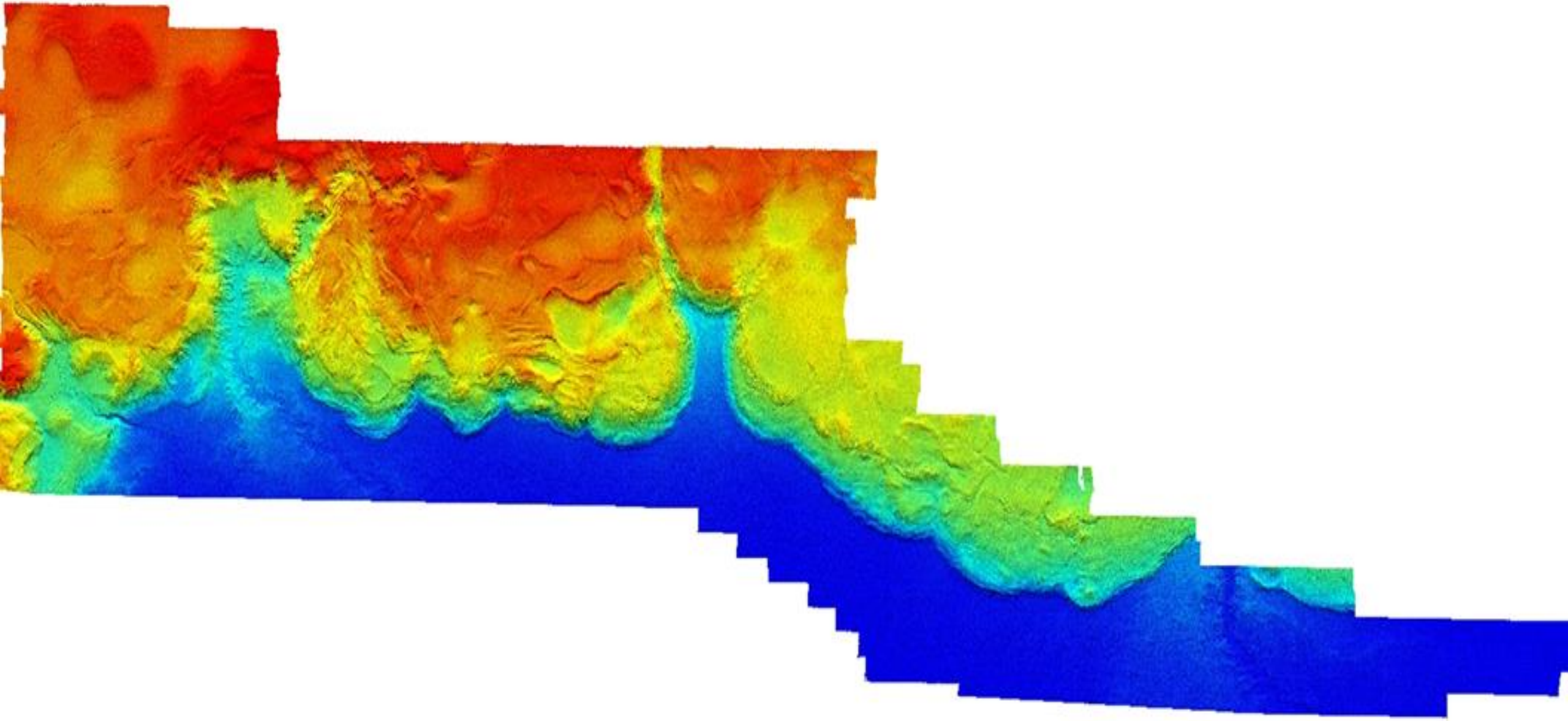
Multibeam Survey:

- **>620,000 km2 survey area**
- **100% seafloor coverage for water depths >750m**
- **Selected infill for shallow water**
- **Local 2X coverage in areas of high interest**

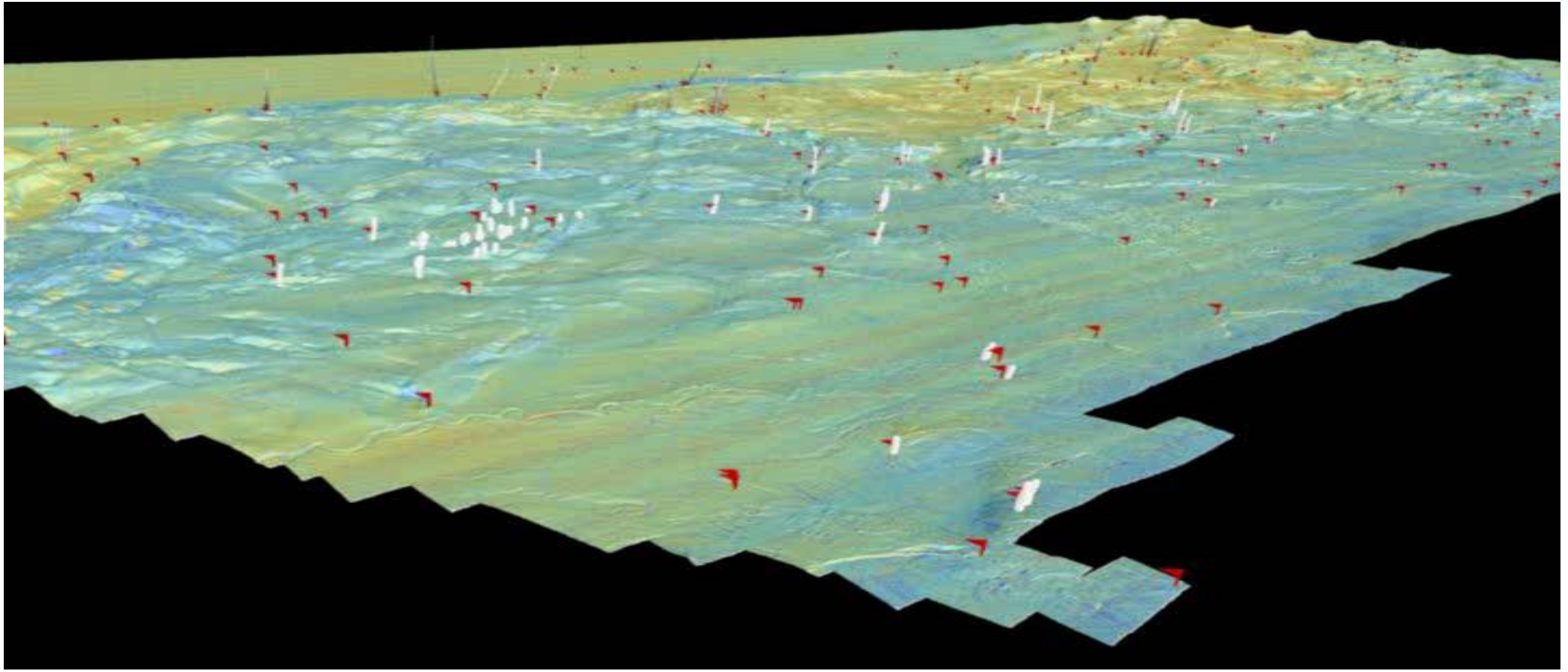


Item	Number
Piston Cores	1,000
Baseline Geochemistry	3,000
Advanced Geochemistry	500
Heatflow	100

Gigante Multibeam Map in Alaminos Canyon



Gigante Seep Movie

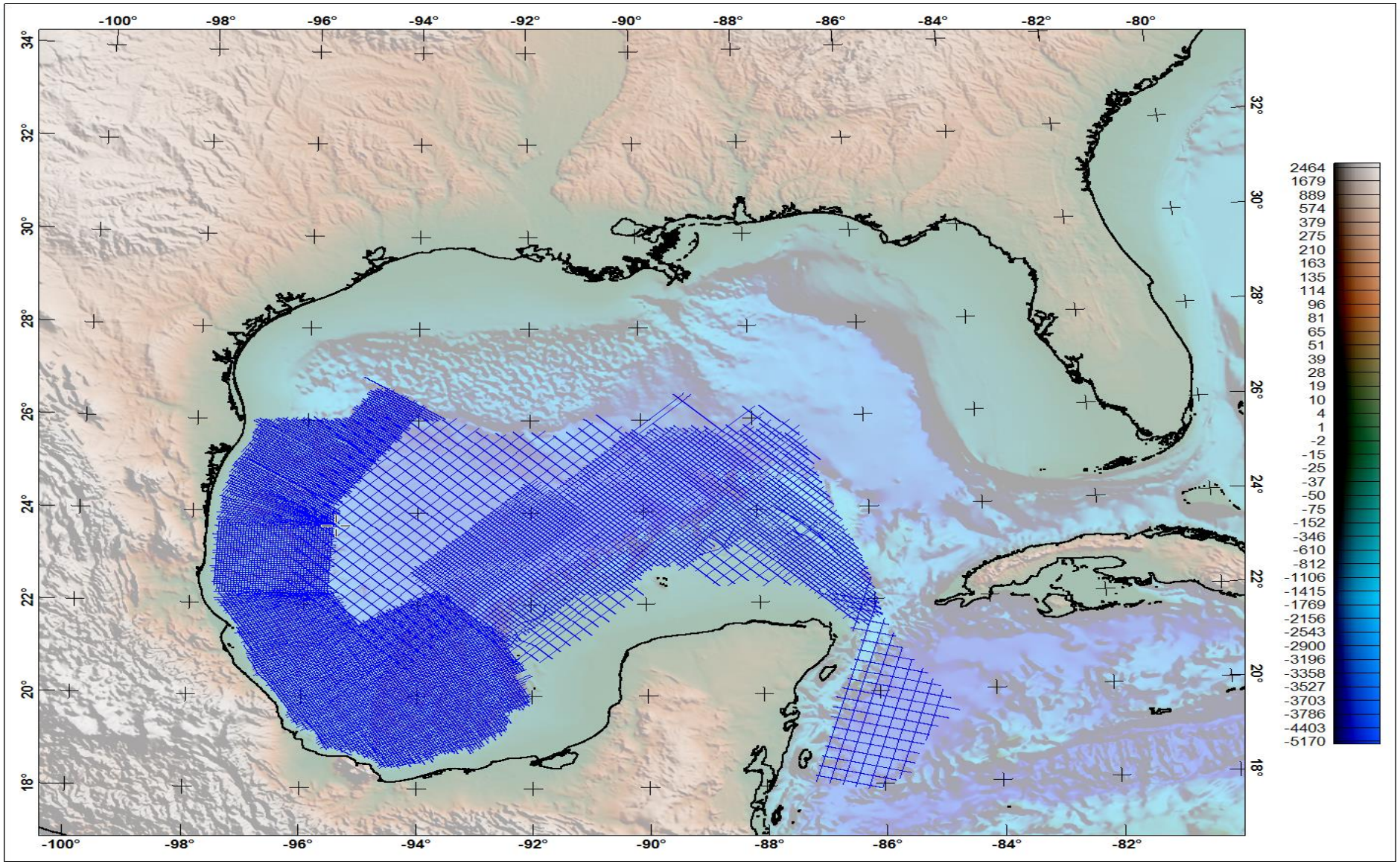


Info on Gigante Multibeam/Core/Geochem

- Survey Size: ~ 620,000 sq km,
- Project Management: Oro Negro Exploration (ONE)
- Acquisition: Fugro for the multibeam; TDI Brooks for the coring
- Bathymetry data and Geochem reports available in upcoming round areas

Gravity and Magnetic Data

Gulf of Mexico Area: Gigante Survey + Regional Data



Phase 1 covers the entire offshore U.S. and Mexico Gulf of Mexico region. Phases 2 and 3 cover the Gigante Mexico lines.

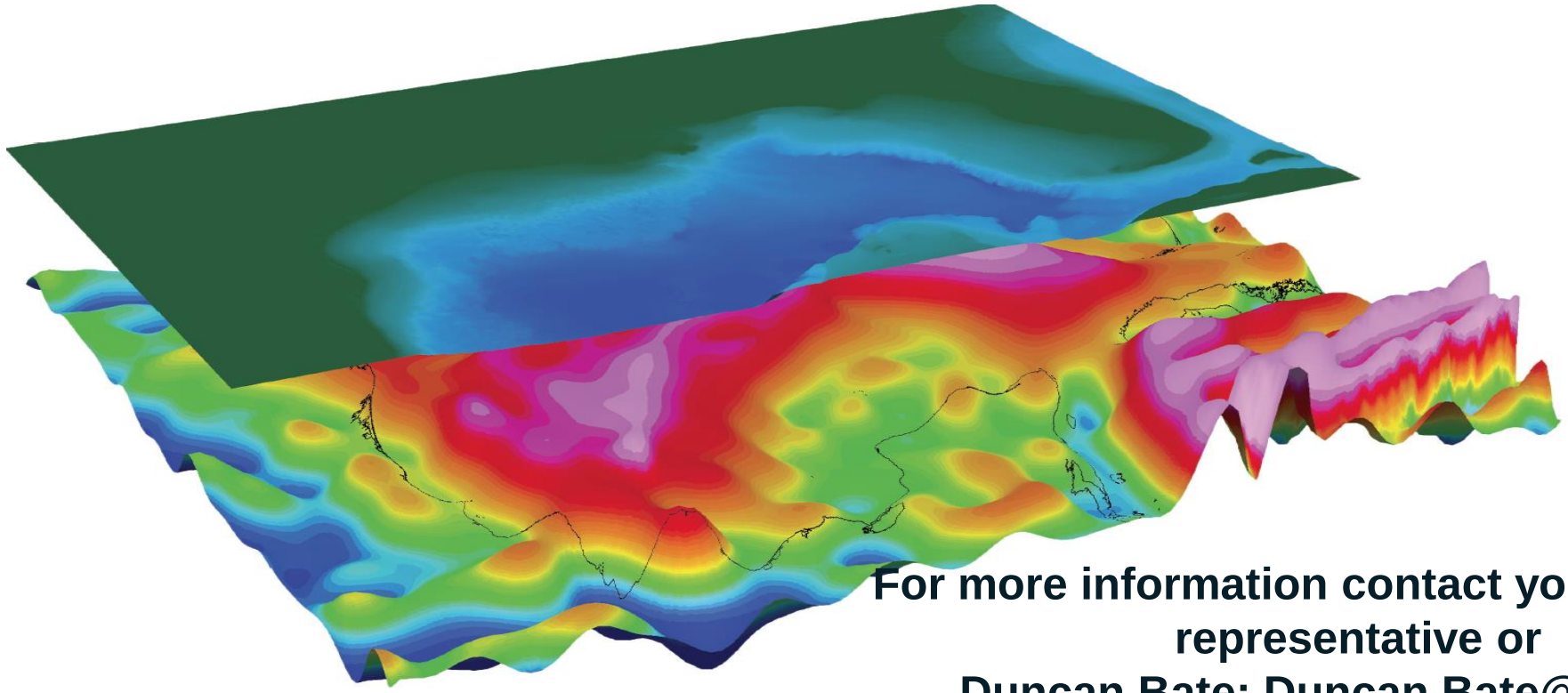
Gulf of Mexico Crustal Study - Project Deliverables

Phase 1: Moho, Crustal Thickness and LOC/COB (greater Gulf of Mexico):

- Depth to Moho
- Crustal thickness
- Limit of oceanic crust boundary (LOC/COB)

Phase 2: Depth to Magnetic (Crystalline) Basement (over Gigante survey)

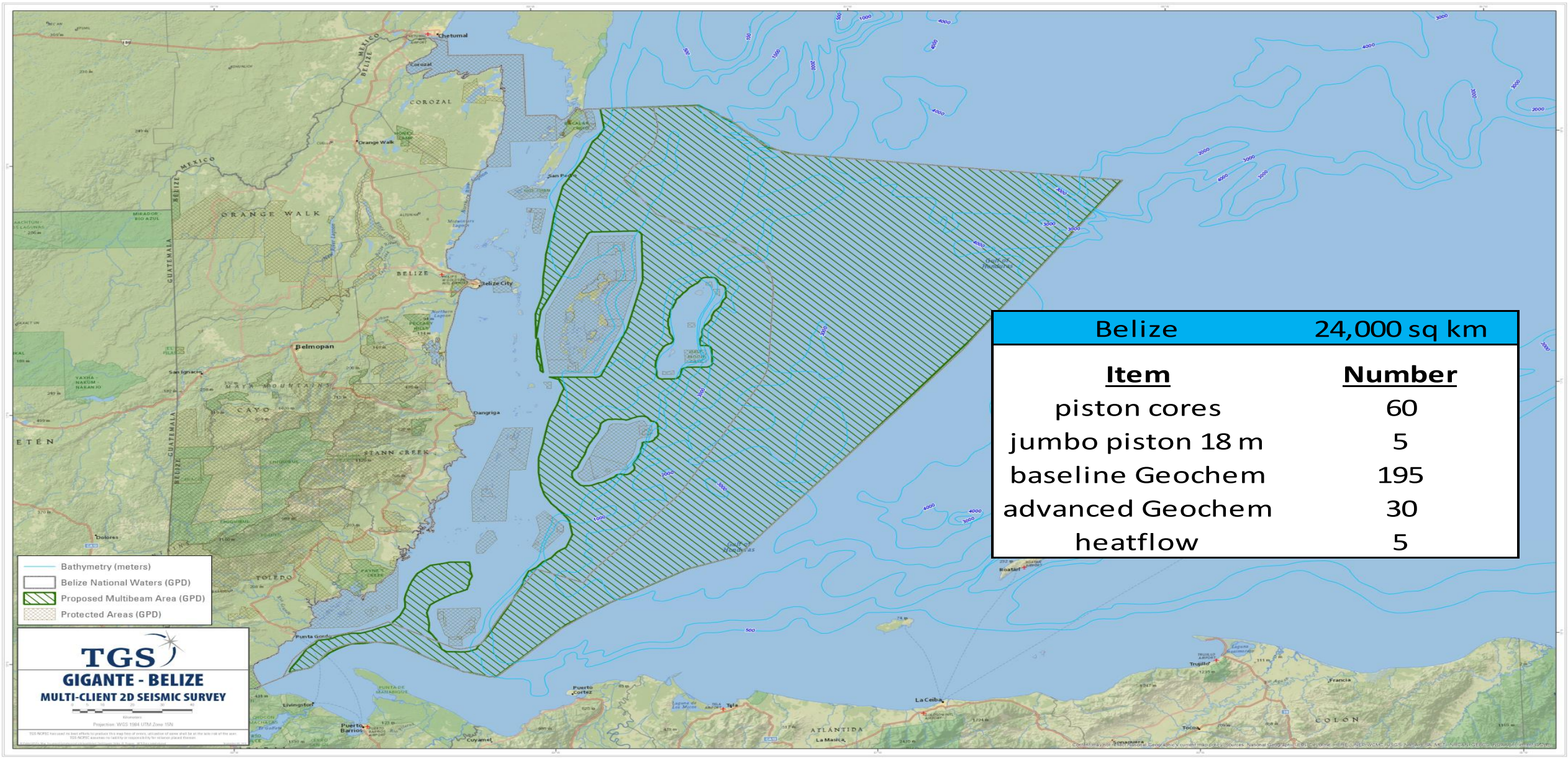
Phase 3: Magnetic Inversion to Derive Apparent Basement Susceptibility



For more information contact your TGS sales representative or
Duncan Bate: Duncan.Bate@tgs.com

Gigante in Belize

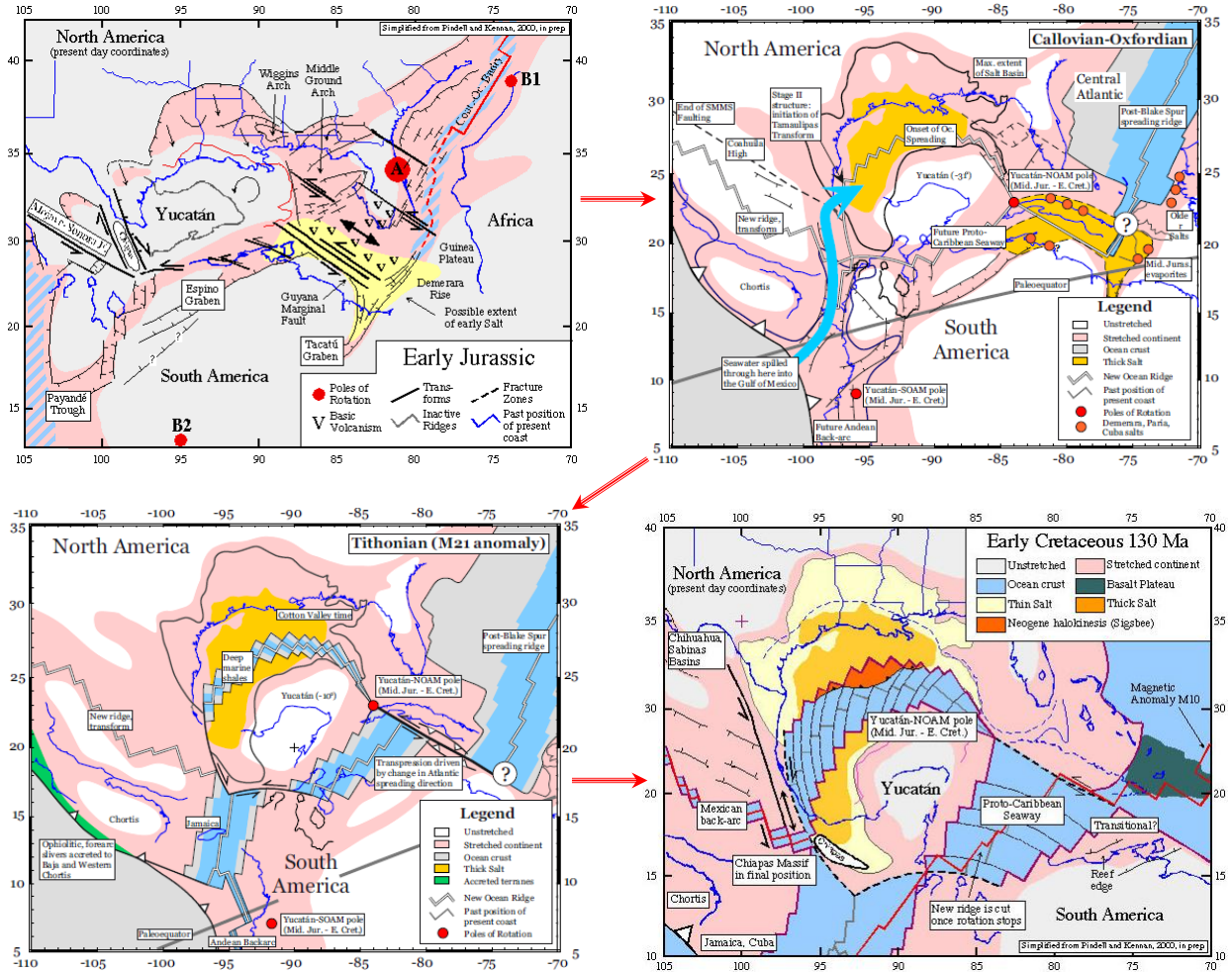
Belize Multibeam ~ 24,000 square km



Belize	24,000 sq km
Item	**Number**
piston cores	60
jumbo piston 18 m	5
baseline Geochem	195
advanced Geochem	30
heatflow	5

Seismic examples

Palaeogeographic reconstructions (Pindell & Kennan 2000, 2001)



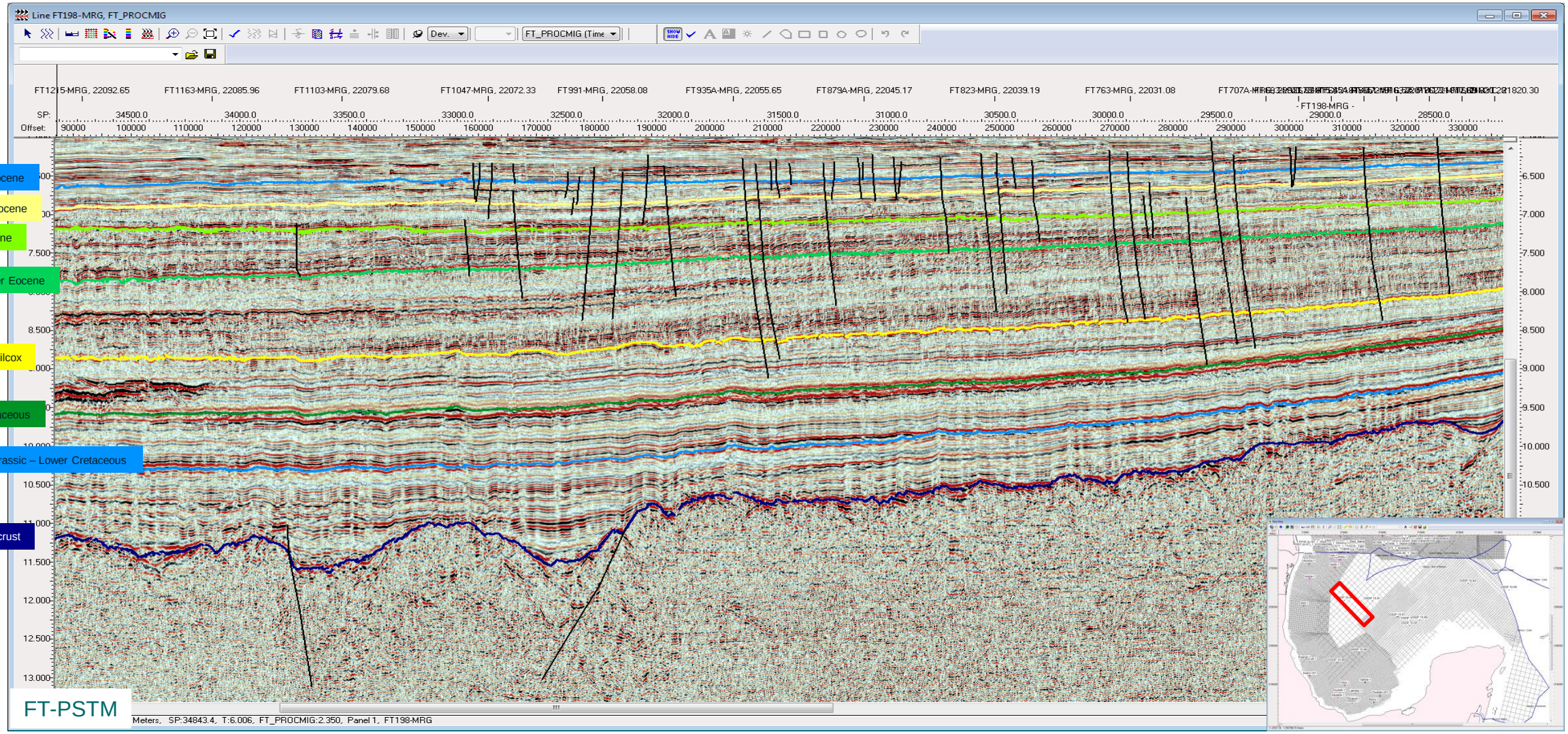
Rifting begins in the Middle - Late Triassic, with separation of Yucatan from North America, and continues through the Early Jurassic, with deposition of terrestrial clastics in rift basins from Arkansas to Yucatan. Thick Middle Jurassic (Callovian) salt was deposited in rift basins near the end of rifting.

Rifting progressed to seafloor spreading in the Late Jurassic (Tithonian). A stable tectonic setting developed from the Late Jurassic, characterized by carbonate deposition on shallow water structural highs fringing the subsiding oceanic basin.

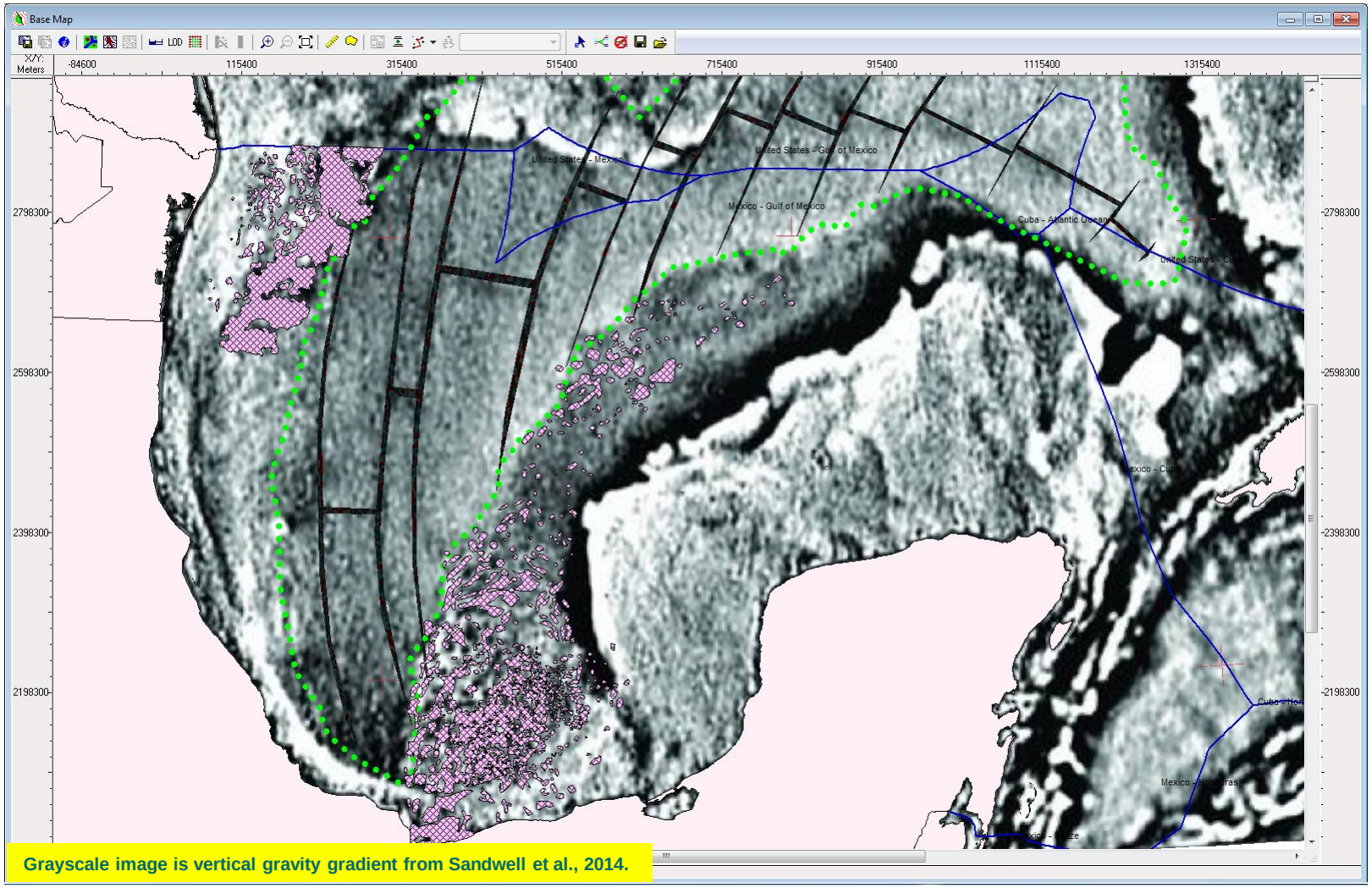
Seafloor spreading ceased by the Early Cretaceous (Valanginian).

Large Late Cretaceous to Miocene clastic sediment inputs related to events like the Laramide and Chiapas orogenies resulted in gravity sliding and high amplitude fold belts along the western flanks of the basin. Complex compressional terrains in the southern GOM (Campeche) are overprinted by halokinesis, which also sets up deep water play possibilities in the Salina del Istmo Basin.

Deep structure - Oceanic crust and transform faults



Deep structure- Fossil spreading ridge & transform faults



Grayscale image is vertical gravity gradient from Sandwell et al., 2014.

Onshore

International maritime boundaries

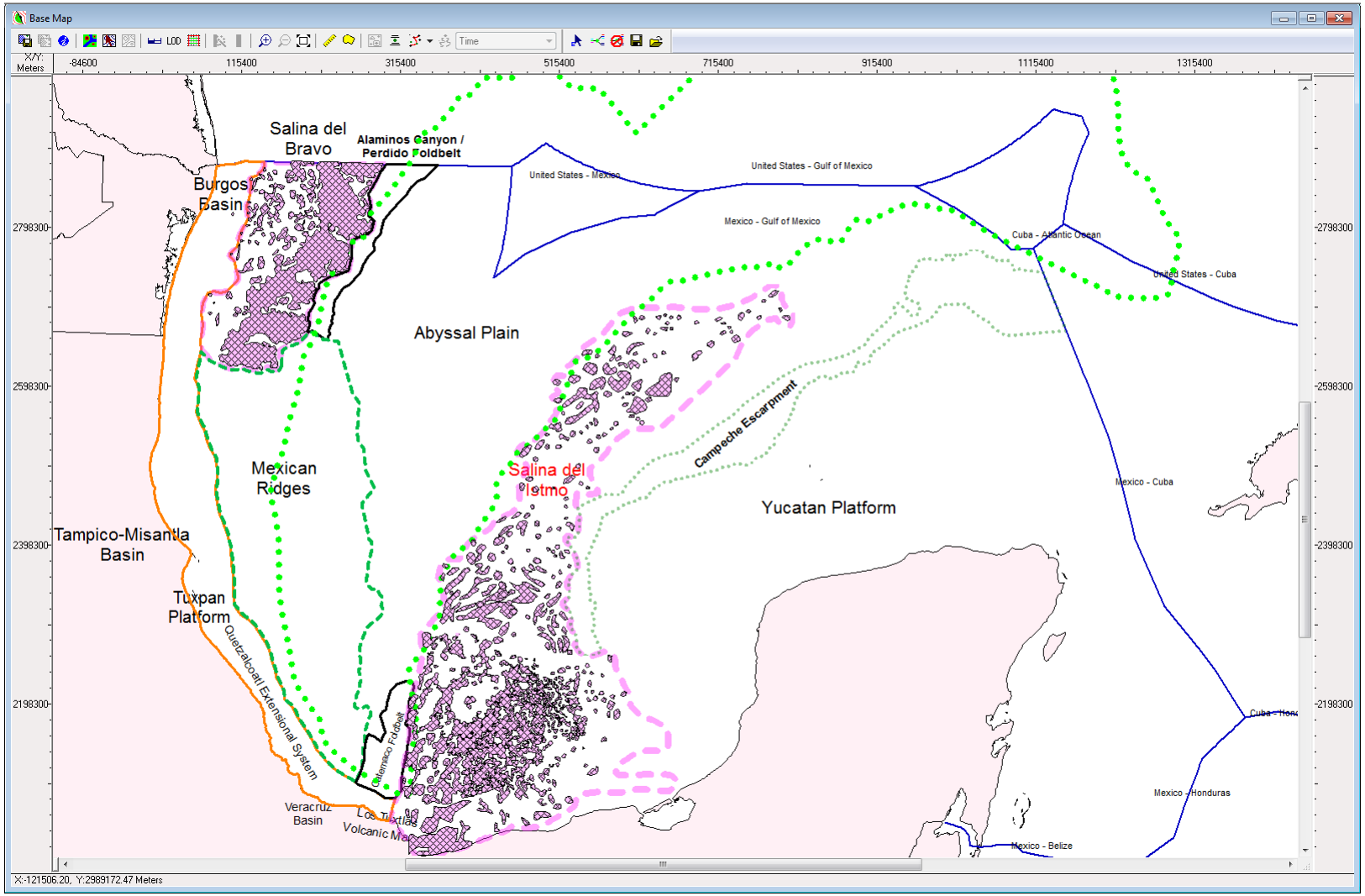
D. Sandwell - FA Gravity

Transform Faults and Spreading Centres

Continental-Oceanic Boundary (COB)

Allochthonous salt bodies

Structural elements map

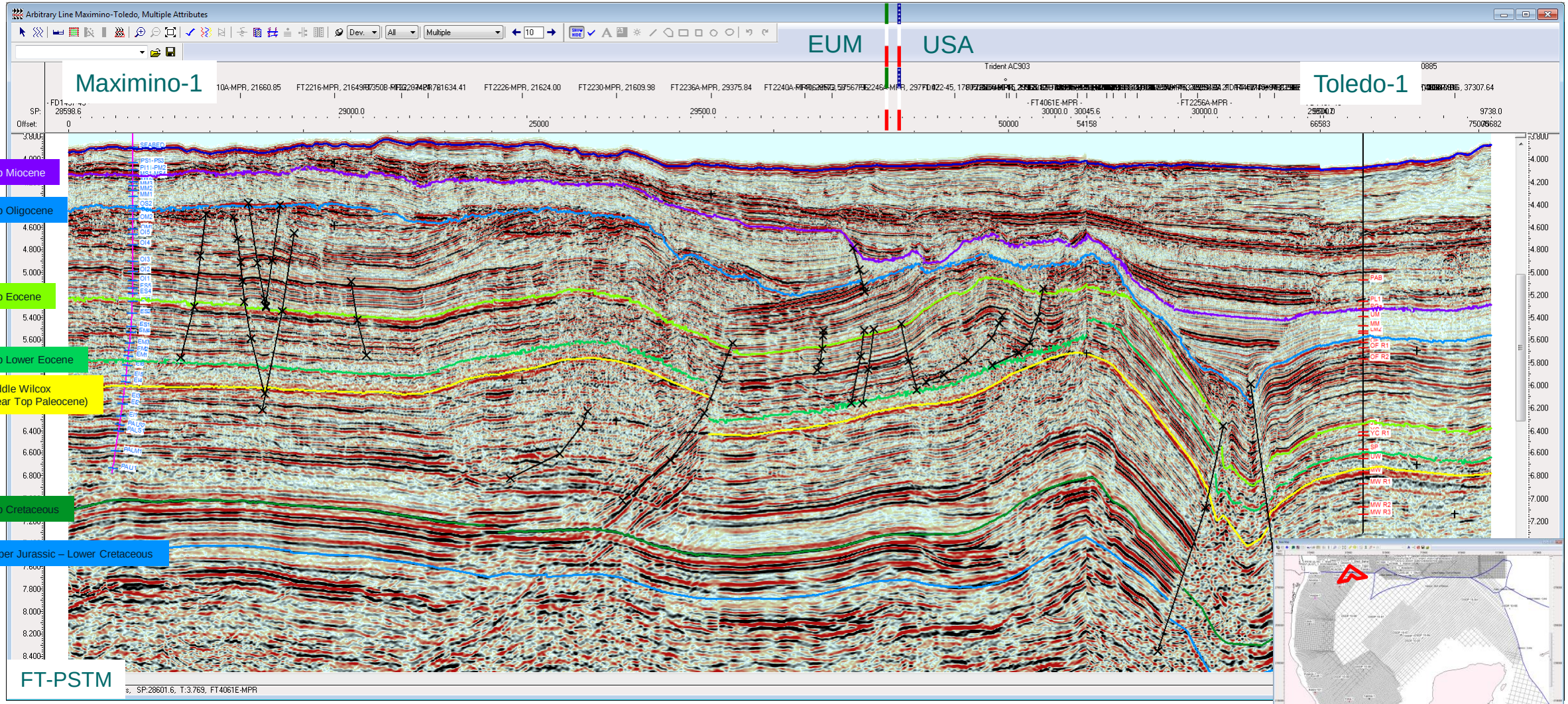


- Passive continental shelf dominated by extensional faults.
- Downdip contractional systems are associated with reverse faults and kinks.
- Salt diapirs, canopies, etc make for further structural complexity (and more trap types) in the two salt provinces.
- The Abyssal Plain shows mainly low-throw normal faults in Tertiary fine-grained clastic sediments.

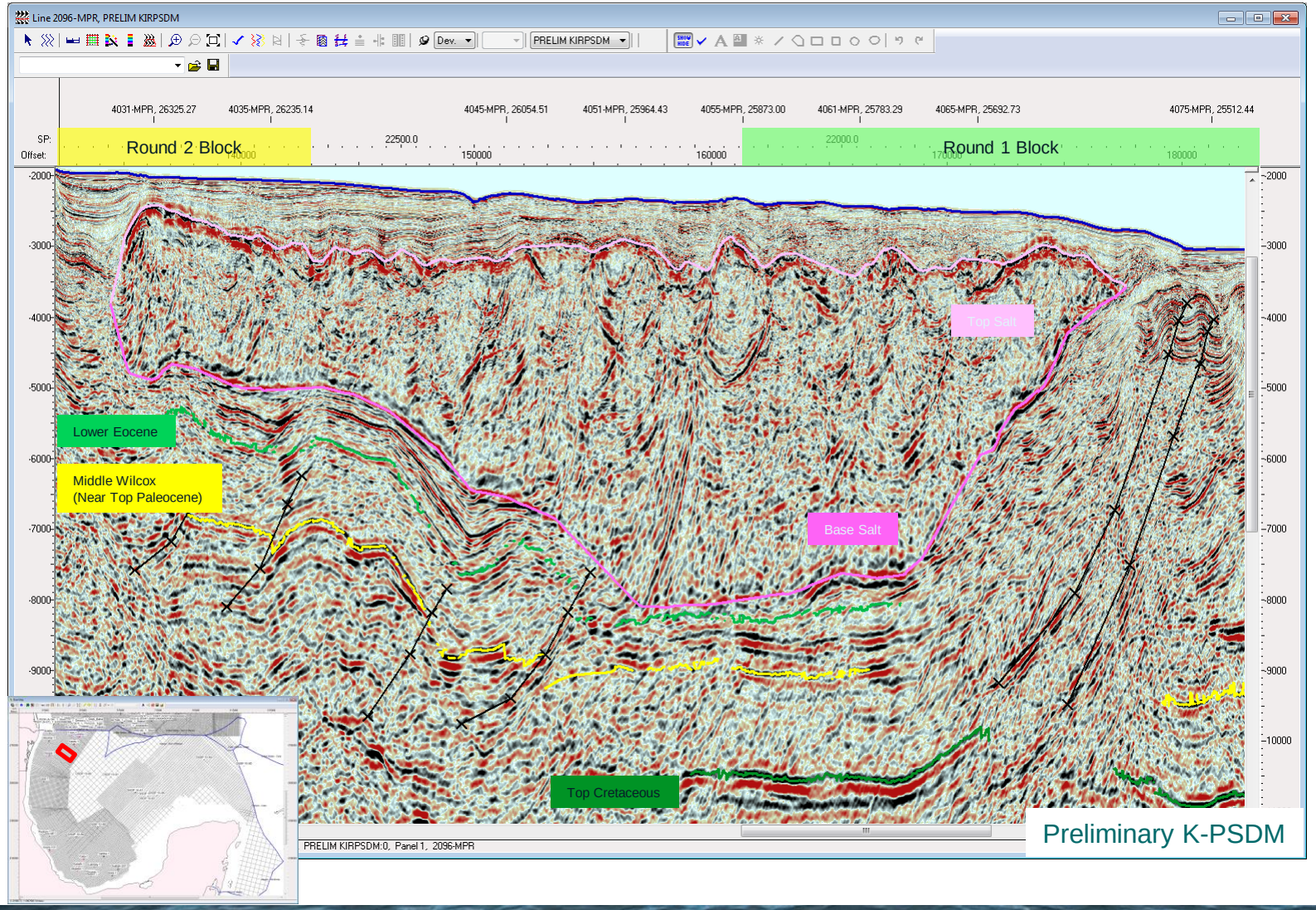
The main structurally defined areas are:

- Offshore Burgos Delta:
- Salina del Bravo:
- Perdido Fold Belt:
- Quetzalcoatl extensional system
- Mexican Ridges
- Catemaco Foldbelt
- Salina del Istmo
- Campeche Escarpment
- Yucatan Platform
- Abyssal Plain

Structural styles in the Perdido Foldbelt to Alaminos Canyon



Lead possibility in the Salina del Bravo (sub-salt zone)



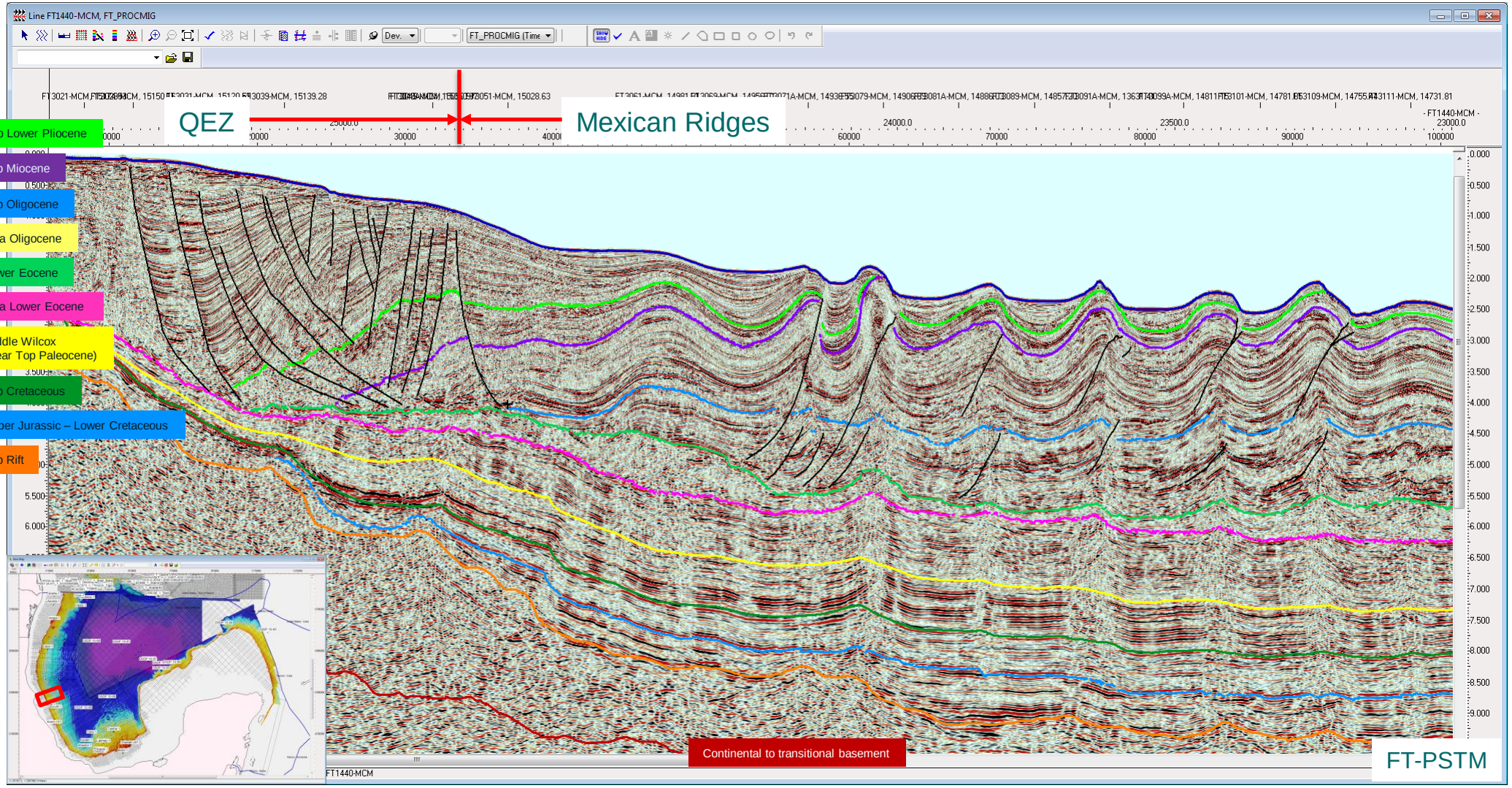
Preliminary K-PSDM

The sub-salt zone is notable for relatively shallow salt canopies and diapirs evacuated from the west. Canopy emplacement is at levels ranging from Middle Eocene to Pliocene. Gravity driven contraction results in thrusts and associated folding.

Large thrust-related fold anticlines developed in probable Wilcox sands under thick salt canopy provide good lead possibilities.

This line shows un-drilled sub-salt structural closures in Round 2 and Round 1 blocks, with targets in the Lower Eocene and Upper Paleocene Wilcox sands.

Structural styles in the Quetzalcoatl Extensional Zone (QEZ) and the Mexican Ridges

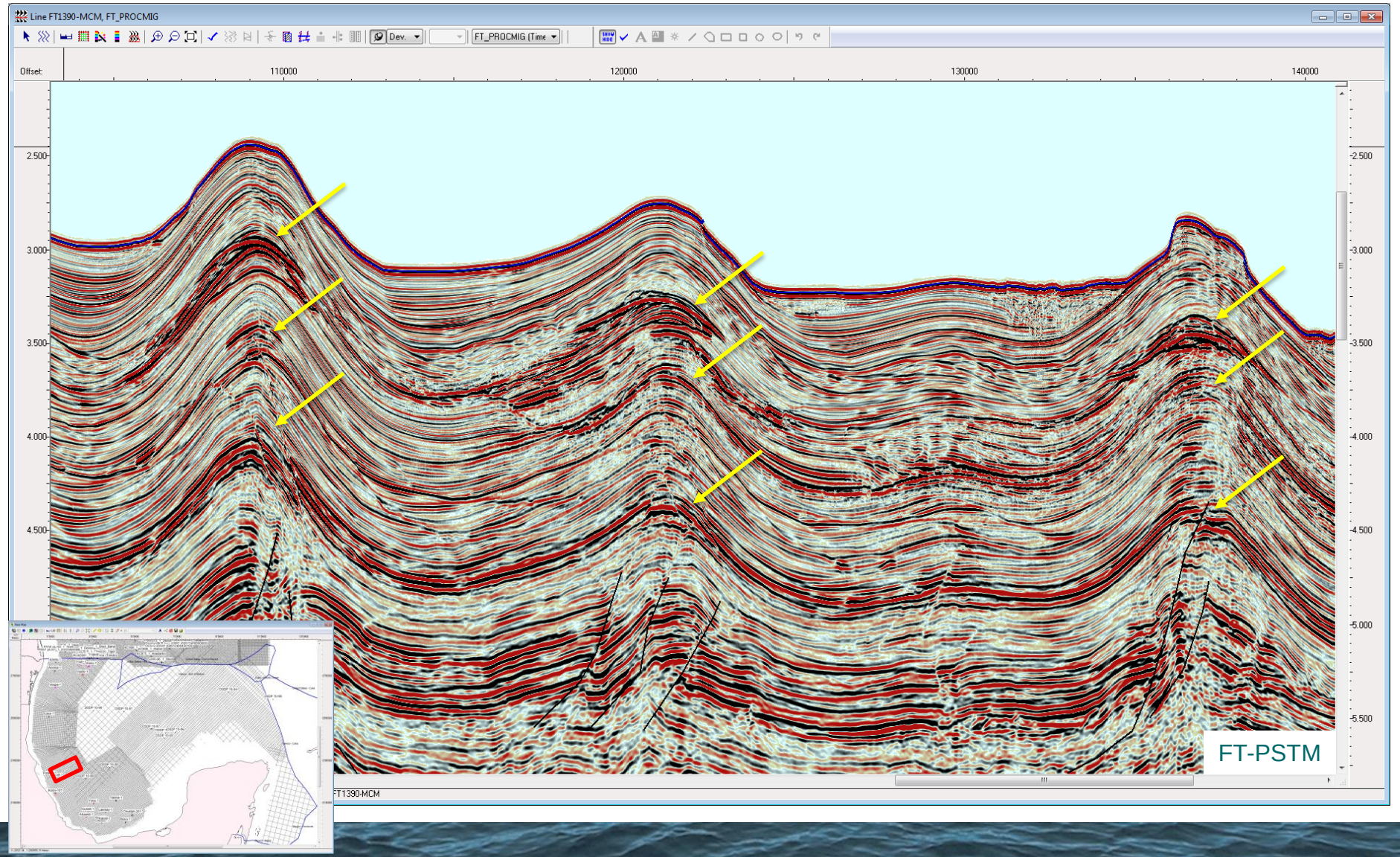


The QEZ and the Mexican Ridges comprise a linked extensional – contractional system that began to develop in the late Miocene.

Structural features in the QEZ include listric normal growth faults, rotated fault blocks and rollover anticlines.

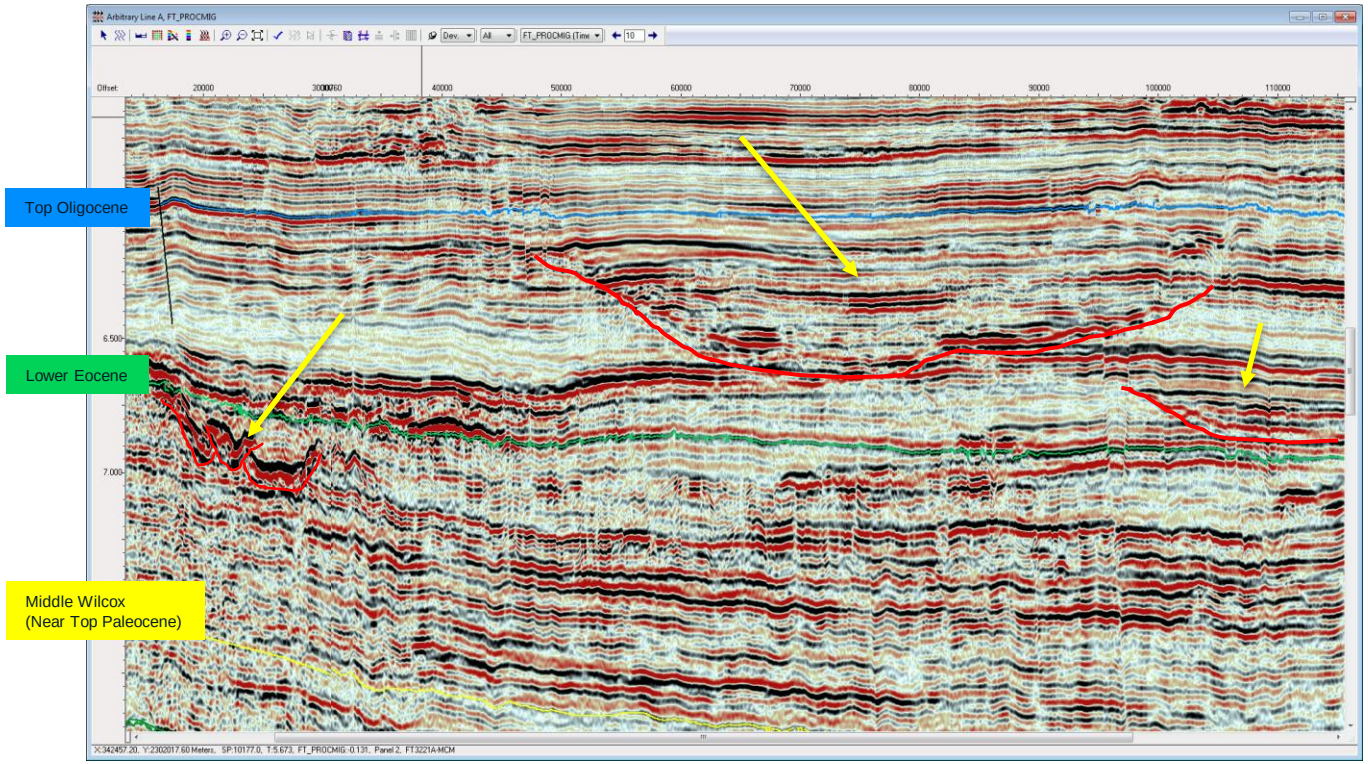
Structural features in the Mexican Ridges include thrust faults and their associated high amplitude folds that often reach seafloor) that rise from detachment surfaces developed in Oligocene and Eocene shales.

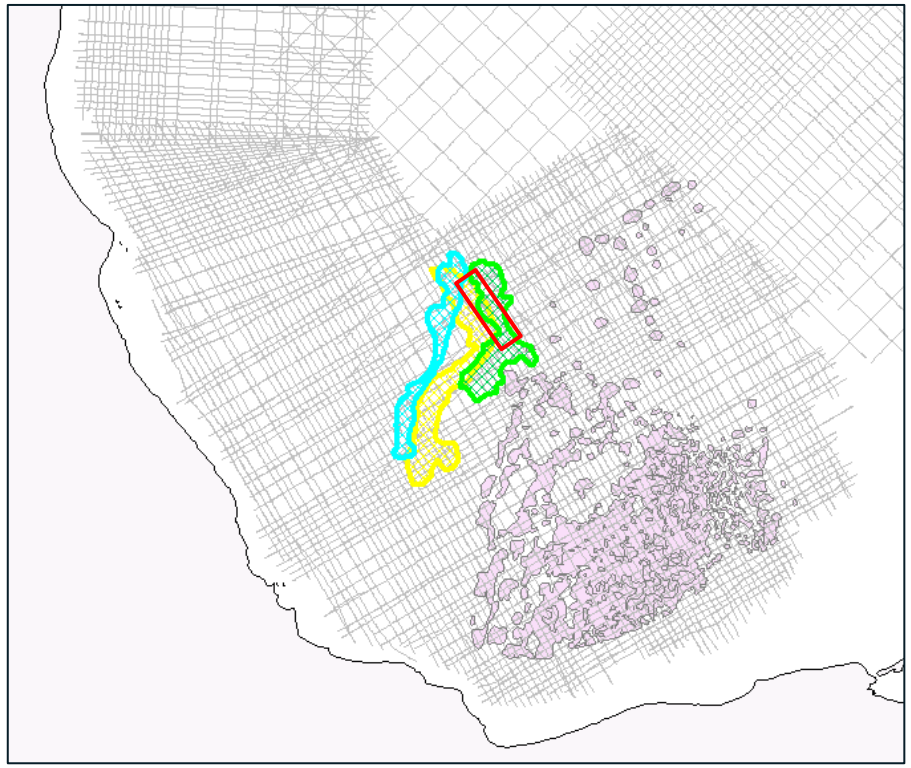
Lead concept - Mexican Ridges



- Tight folds create excellent structural closures
- Many indications of a working hydrocarbon system
- Lots of amplitude anomalies in Oligocene, Miocene and Lower Pliocene intervals
- DHIs such as flat spots

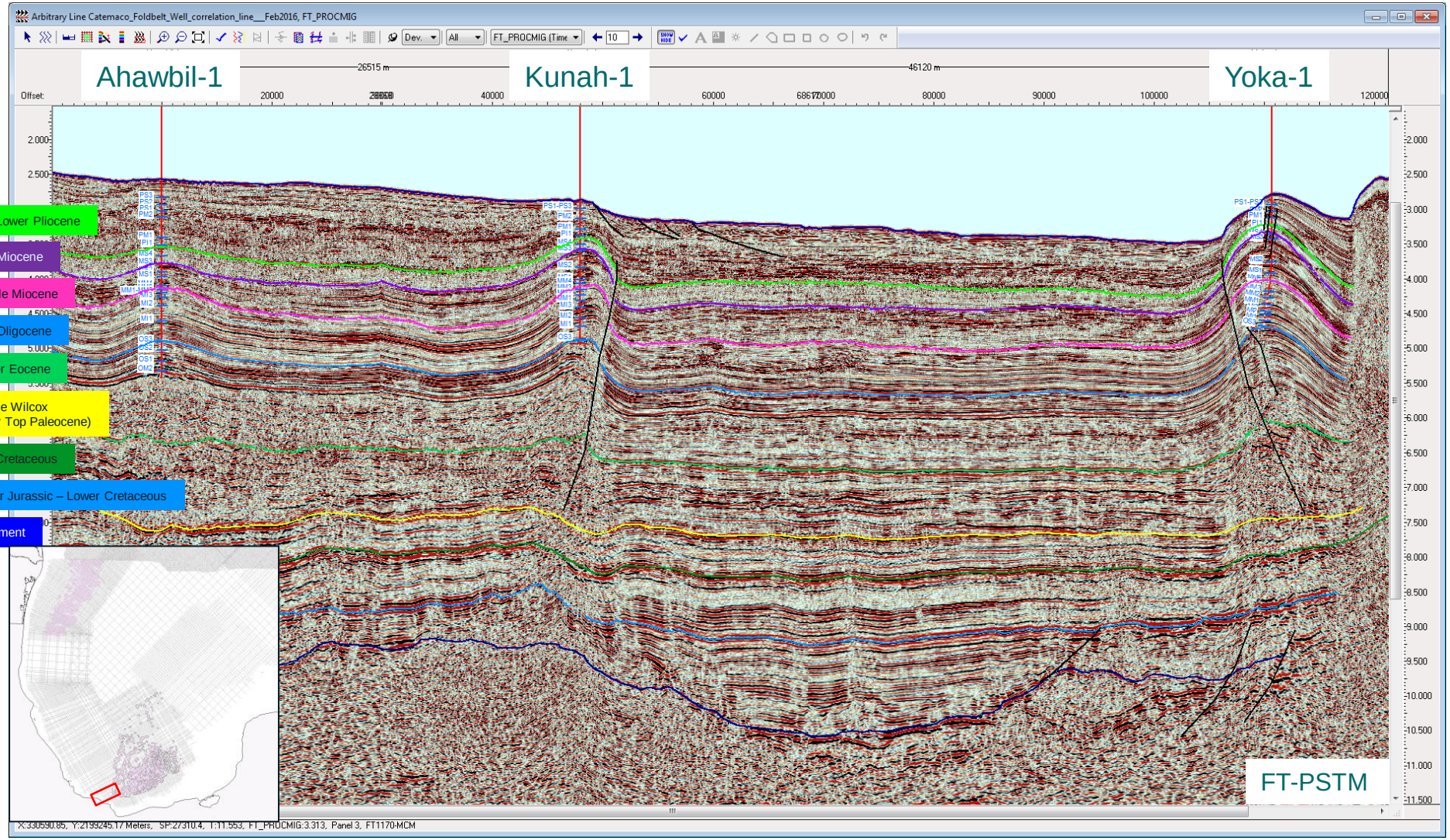
Veracruz deepwater canyon system





In the Mexican Ridges and Catemaco Fold Belt provinces massive channels have been identified. Some of these channels are 50-60 km in width and three of these channels can be traced over lengths of >150 km. These channels are within Eocene, Oligocene and Miocene sequences and were responsible for the delivery of large amount of sands to the distal parts of the basin. These channels could also be interesting stratigraphic targets to explore.

Structural styles in the Catemaco Fold Belt

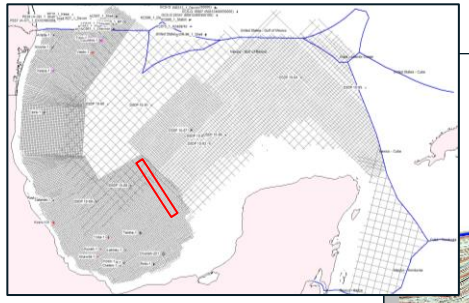


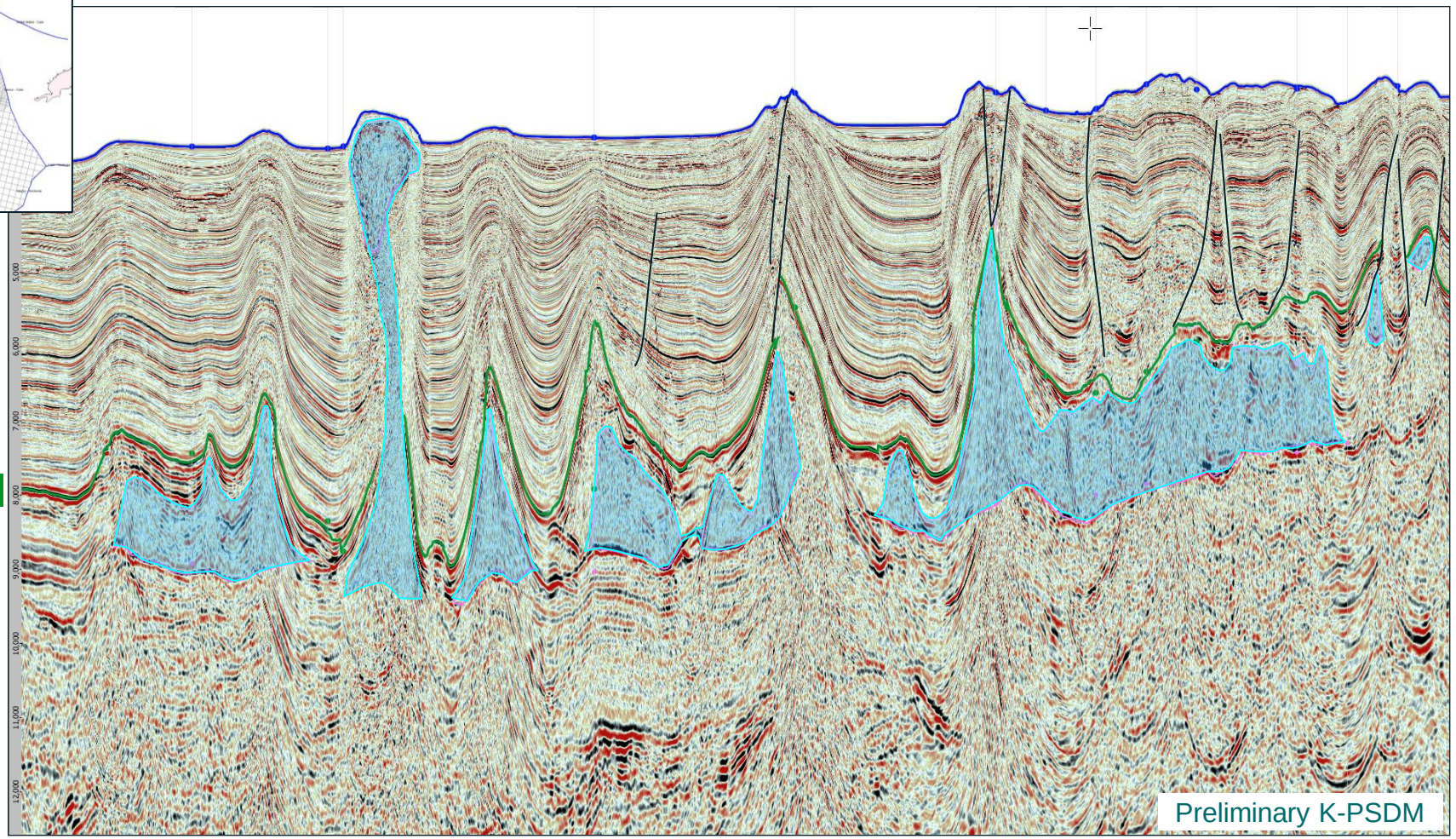
The Catemaco Fold Belt (CFB) is located between the Mexican Ridges and Salina del Istmo provinces. The structural styles of the CFB are of a contractional type.

The area is characterized by northeast-southwest aligned anticlines, thrust faults and fault-bend folds which were created during the Late Miocene-Pleistocene as a result of contraction due to the interplay of the Chiapaneco orogenic event and gravitational contraction of the Mexican Ridges.

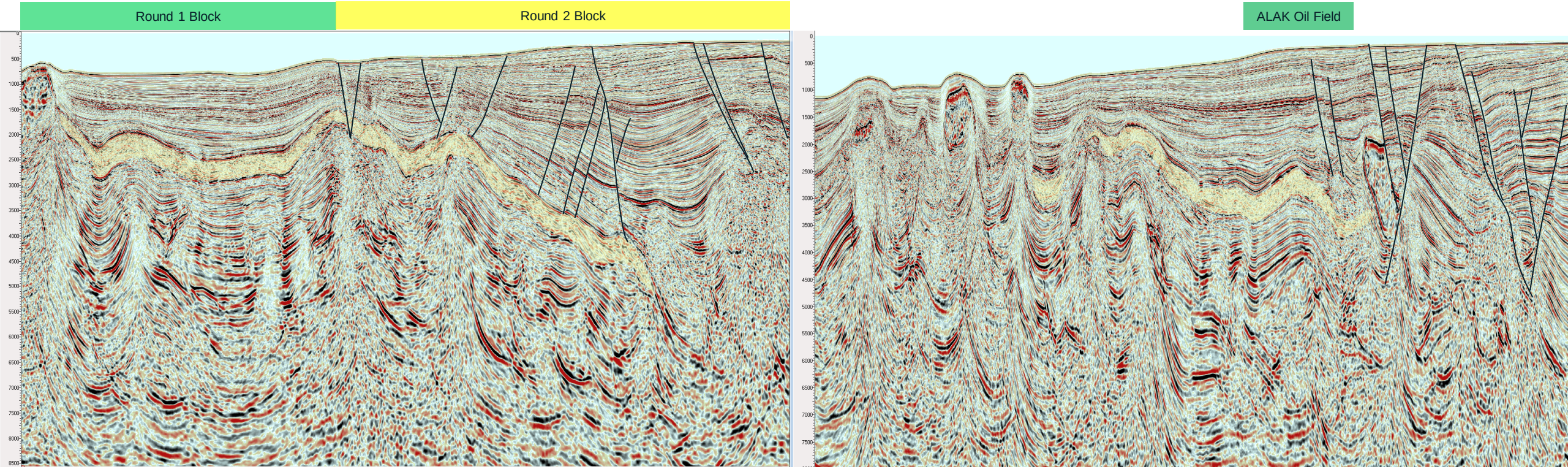
This arb-line shows a correlation between three wells which were all discoveries.

Structural styles in the Salina del Istmo (south) - Prel-PSDM





Lead concept – Salina del Istmo (south) - Prel-PSDM



- Salt cored anticlines create excellent structural closures
- Lots of amplitude anomalies from Oligocene, to Cretaceous intervals
- Known working hydrocarbon system
- DHIs such as flat spots

Concluding remarks

- A complex tectonic history has resulted in structural provinces throughout the Gulf of Mexico (GOM), each with characteristic structural styles and sedimentary sequences.
- The 186,250 km Gigante 2D seismic survey covers the entire Mexican GOM (MGOM) and ties regional 2D US GOM data.
- The Gigante regional survey is ideally suited to creating a catalogue of structural styles, depositional characteristics, and trap and play types for each of the MGOM structural provinces; as seen in this presentation. Examples of transitions between the provinces are also afforded via the continuous regional grid. Seismic integration with potential field data helps constrain the tectono-stratigraphic framework and provides insights to deep structure and delimitation of the COB.
- Most large onshore structural traps have been drilled. Many large offshore structural closures as yet un-drilled. Many of these structures have supporting hydrocarbon seep and piston coring data.
- Potential large sand-filled stratigraphic prospects (e.g. the Veracruz canyon system).

Largest	Consistent	Most Comprehensive	Industry supported
• 188,000 km in total • Acquisition Complete • Covering all sub-basins • 5 seismic vessels • 2 multi-beam vessels	• One vessel provider • Identical specs • The survey was designed and submitted to CNH with one objective • All data is being processed in Houston • Data ties to US GOM	• Includes interpretation package • Well ties • Multi-beam data • Coring data • Geo-chemical analysis • Gravity/Magnetic data	• Designed with support and input from customers • Well funded by the industry