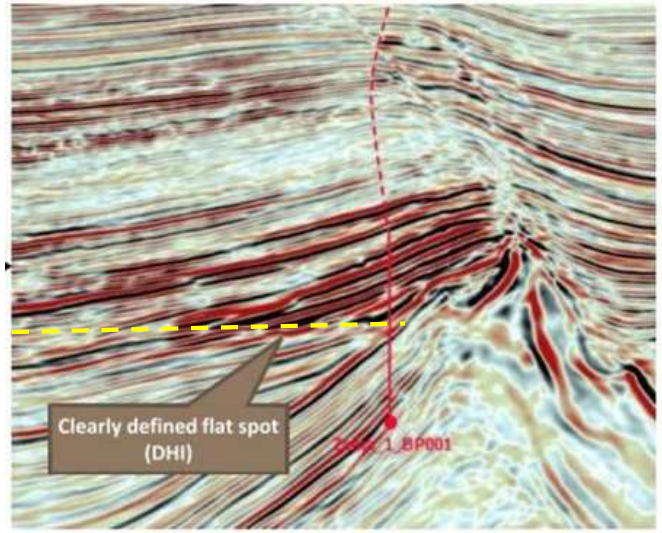
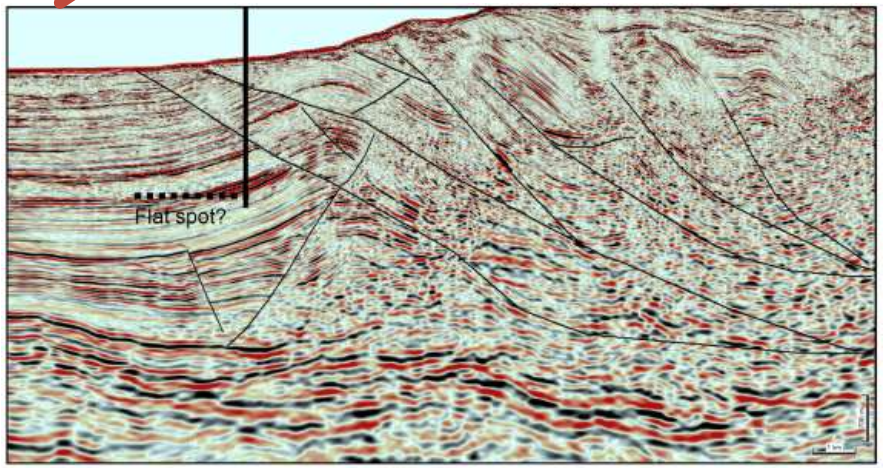
Zama-1 (850 MMbo)



Gorgon-1 (6 TCF)



Source: ION, 2022

Recent Discoveries in the Colombian Caribbean & Gulf of Mexico: Analogies & Prospectivity

By Geol. M.Sc. Ivan D. Olaya-Lopez

June 10th, 2022

Ivan Dario Olaya Lopez
International Oil & Gas Advisor

Formal Training

- Geologist (UIS)
- Master of Science in Geology (Colorado School of Mines)
- Master in Business Administration (Universidad de Los Andes)
- Specialist in Exploration Geophysics (Colorado School of Mines)
- Specialist in High Management (Universidad de Los Andes)
- Specialist in International Management of Hydrocarbons (U. de Los Andes)

Working Experience

- Ecopetrol (17 years)
- Hocol (2 years)
- Pacific Rubiales (8 years)
- Mansarovar Energy (5 years)

Volunteering

- President of the Asociación Colombiana de Geólogos y Geofísicos del Petróleo (ACGGP) 2010-2011
- Director of the Scout Group
- Professor & Lecturer on topics such as Seismic Interpretation, Advanced Petroleum Geology and Sequence Stratigraphy in various geology faculties in Latin America.
- Author of the cycle of conferences "Seismic Tour" through several sedimentary basins in Latin America
- Visiting Geologist for AAPG Latin-American & ACGGP.

Disclaimer

1. Only public information was used for academic purposes

2. Interpretations are regional and responsibility of the author

3. There may be additional confidential information that changes these interpretations.

4. The intention is to give general guidelines and not exact locations of prospects

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  2. Play Concepts Identified in the Caribbean Offshore Colombia
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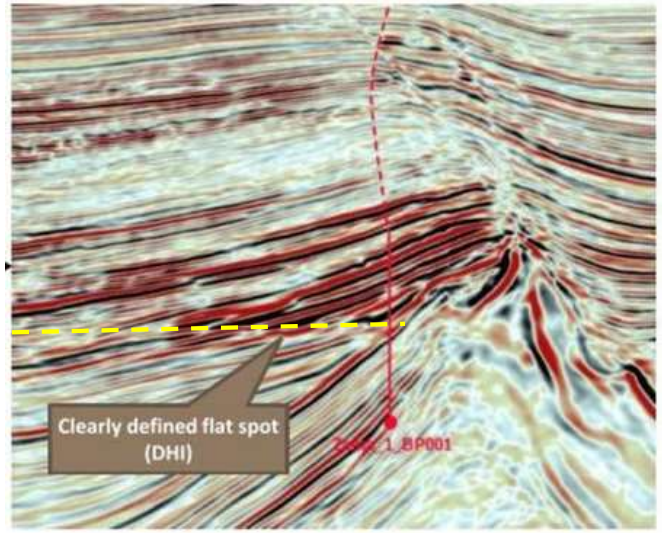
  6. Mud Diapirs entrapment features: Mizton-1
  7. Mesozoic source rocks Remnants: Veracruz Basin
  8. Listric Faulting related closures: Cibix-1
  9. Mio-Pliocene Prograding Sequences: Veracruz Basin

- **Conclusions & Recommendations**

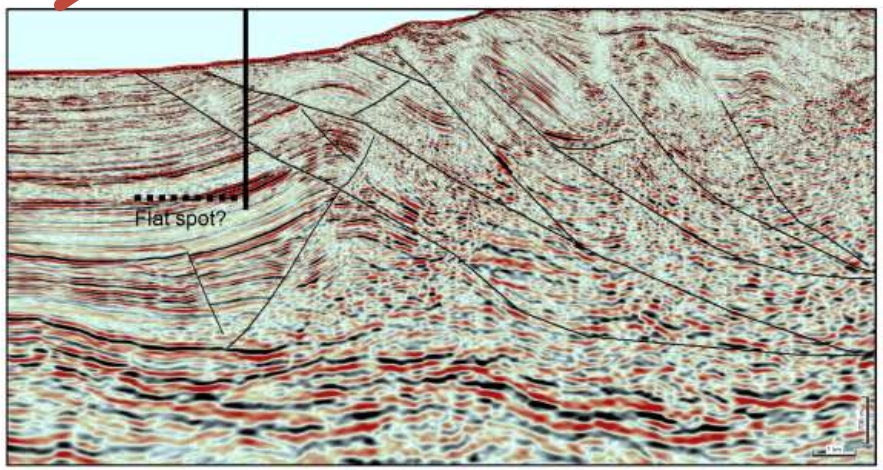
Objective

Search for analogs for the plays identified in the Colombian Caribbean

Zama-1 (850 MMbo)



Gorgon-1 (6 TCF)



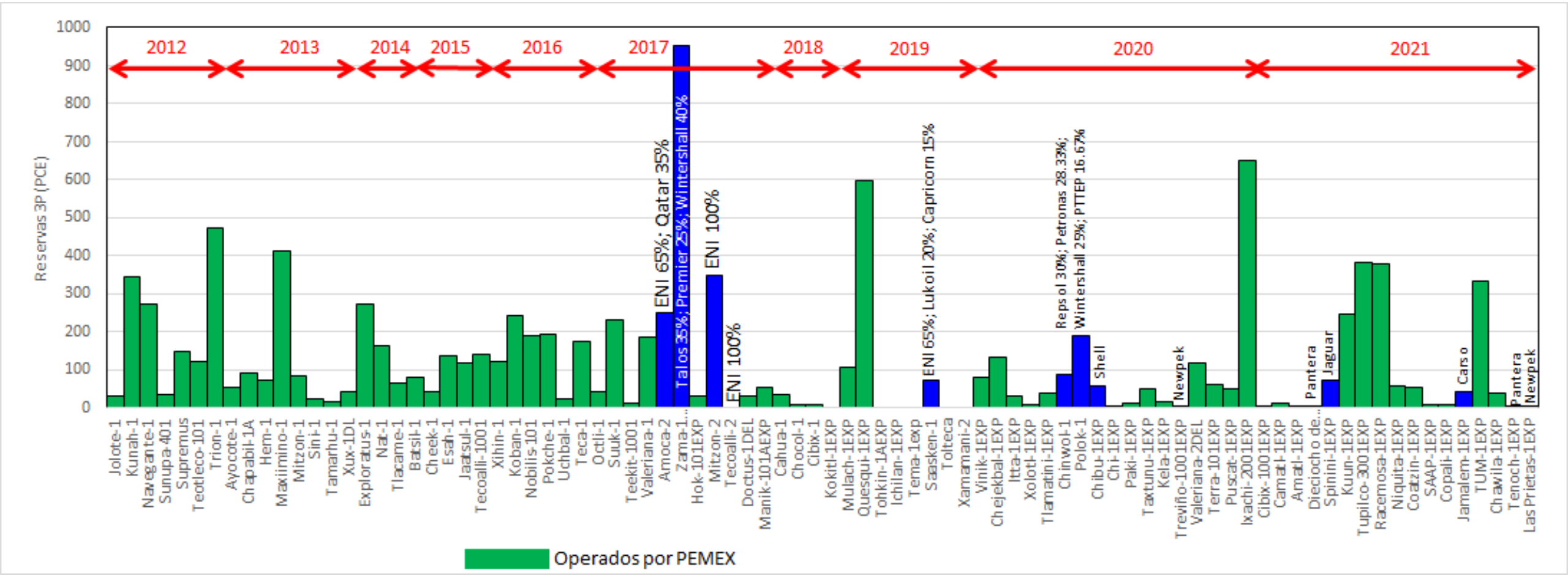
Source: ION, 2022

Play Concepts Identified in the Caribbean Offshore Colombia

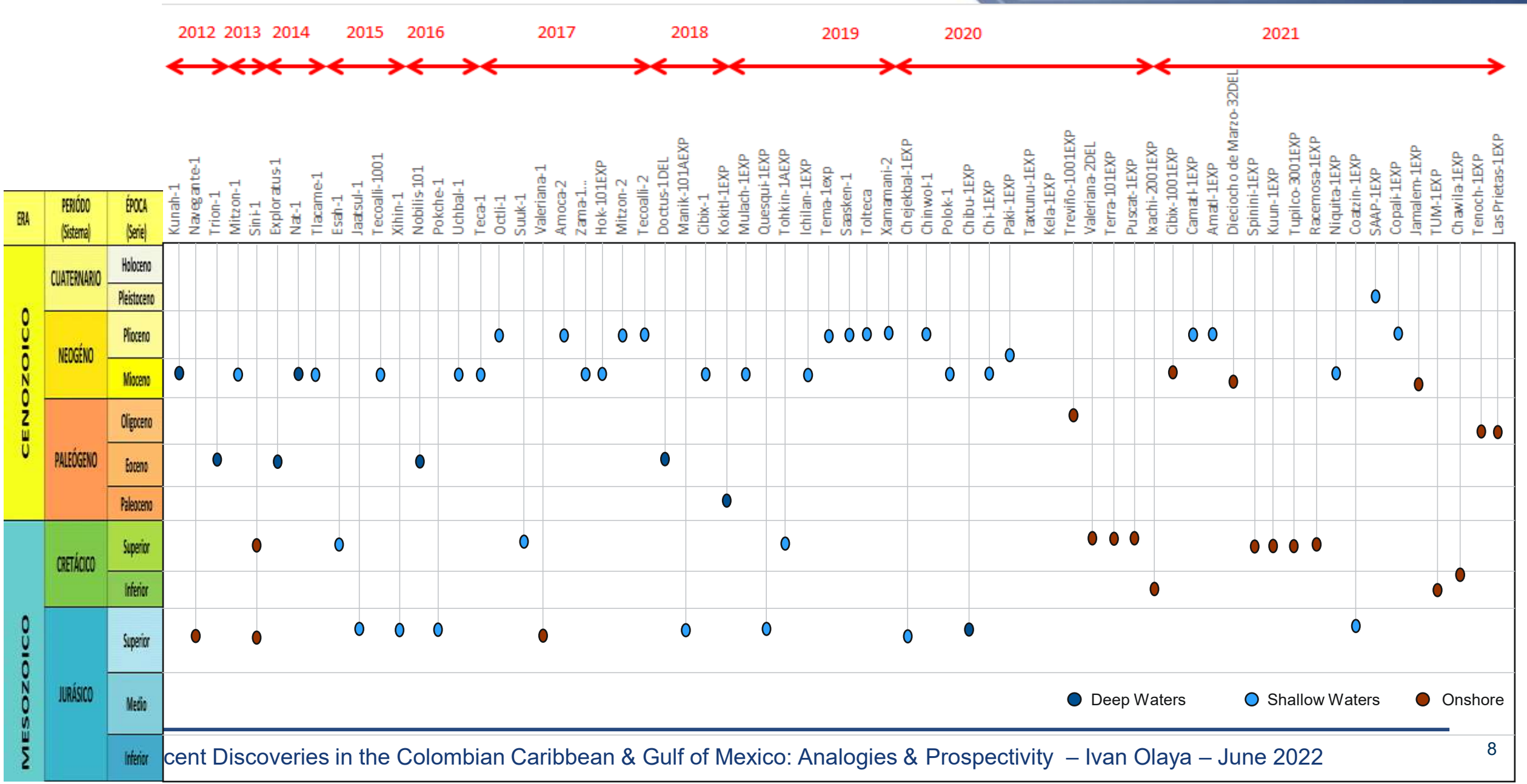
Play	Reservoir Age	Example	Mexico´s Analogous
Fold Belt Structures	Late Oligocene-Pleistocene	Kronos Gorgon Purple Angel	Zama-1
Fold Belt Structures & Strike Slip		Calasu-1	Trion-1
Carbonates in basement highs	Late Oligocene-Early Miocene	Ballena Field Perla Field	Ixachi-1
Onlaps against basement highs	K & T	Santa Ana-1 Chimare-2-1	Cauchy-1
Mio-Pliocene Channel complexes	Oligocene-Early Miocene	Mapale-1 Cartagena-2	Obertura-1
Mud Diapirs entrapment features	T		Mizton-1
Mesozoic source rocks Remnants	K		Veracruz Basin
Listric faulting related closures	Upper Tertiary		Cibix-1
Mio-Pliocene Prograding Sequences	Mid Miocene-Pliocene		Veracruz Basin

Source: Ramirez et al., 2022

Historical overview of discoveries in Mexico since 2012



Historical overview of discoveries in Mexico



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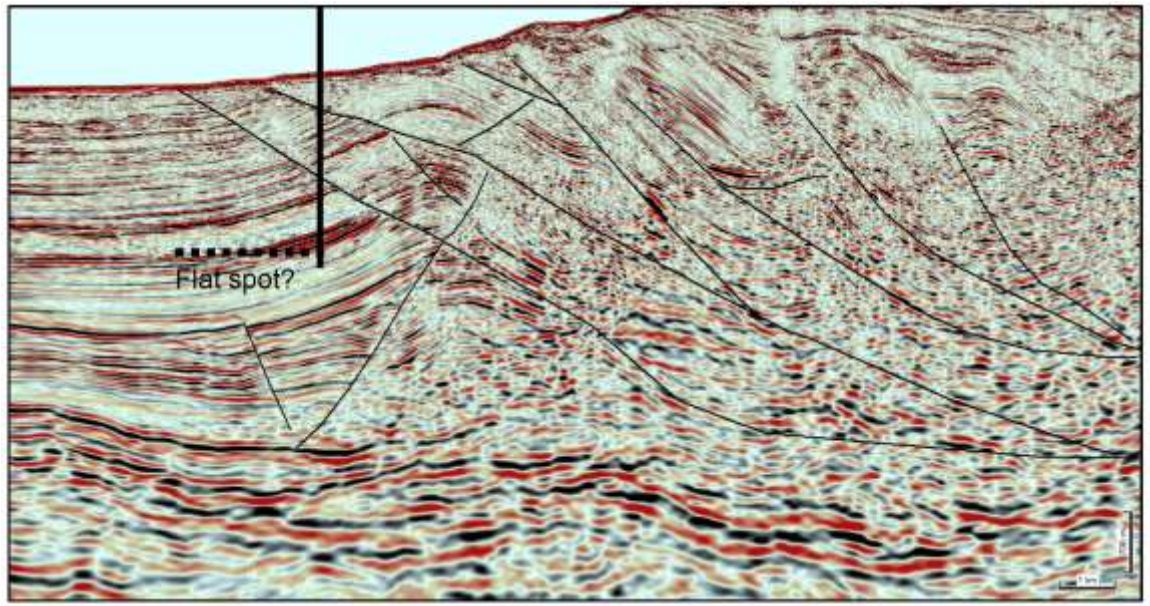
Fold Belt Structures: Gorgon vs Zama

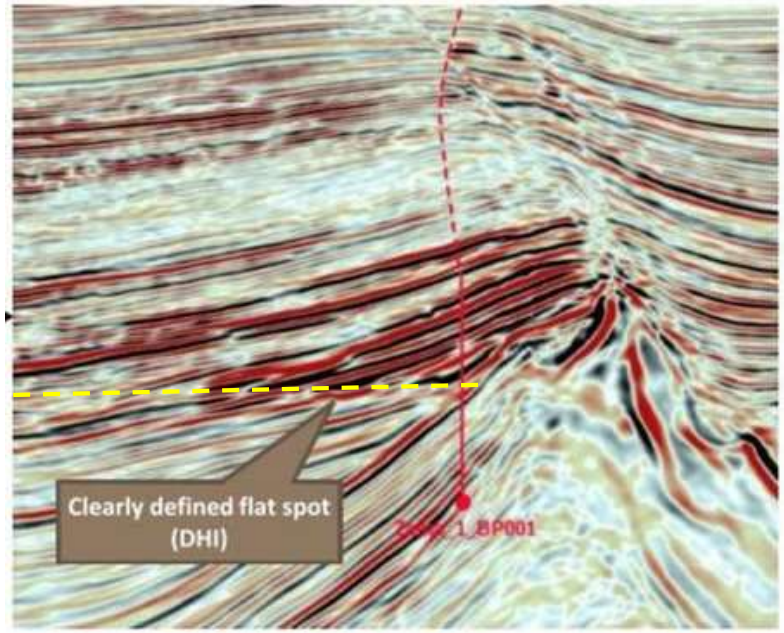
Gorgon-1 (6 TCF)



Source: ION, 2022

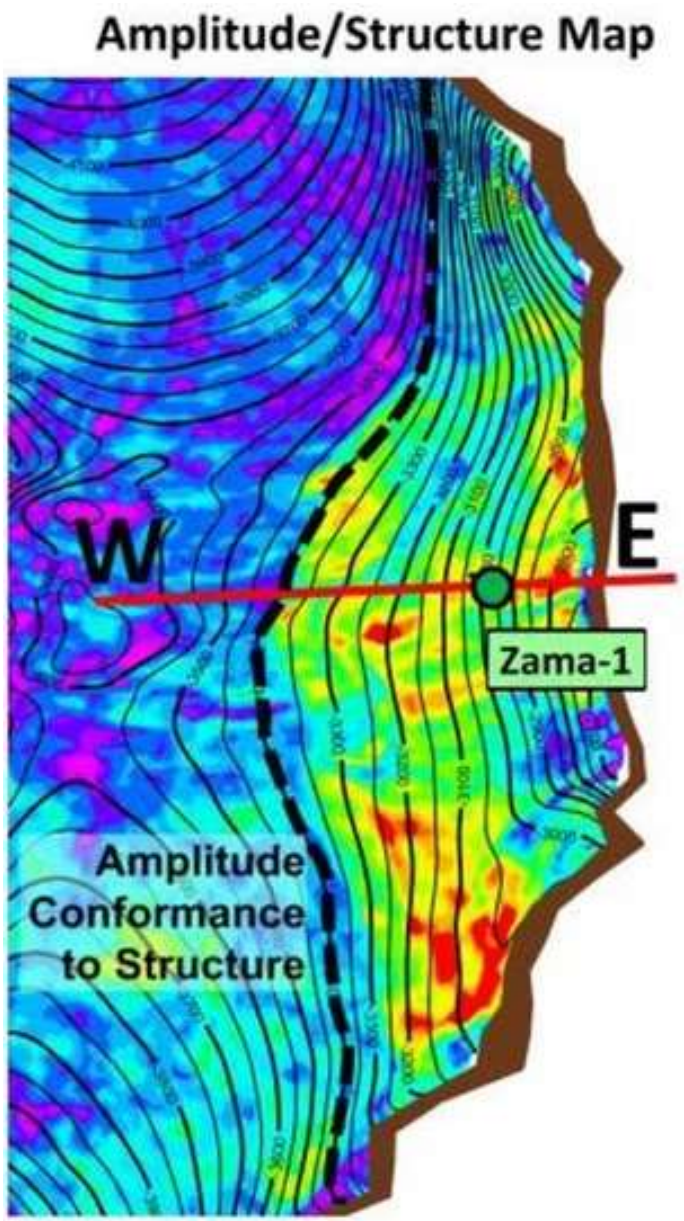
Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Late Oligocene up to Pleistocene
Trap Type: Faulted Monocline
Water Column: 2000 m
TD: 15.019´
Hydrocarbon Type: Gas & Condensate?
No Net Pay or Reserves information

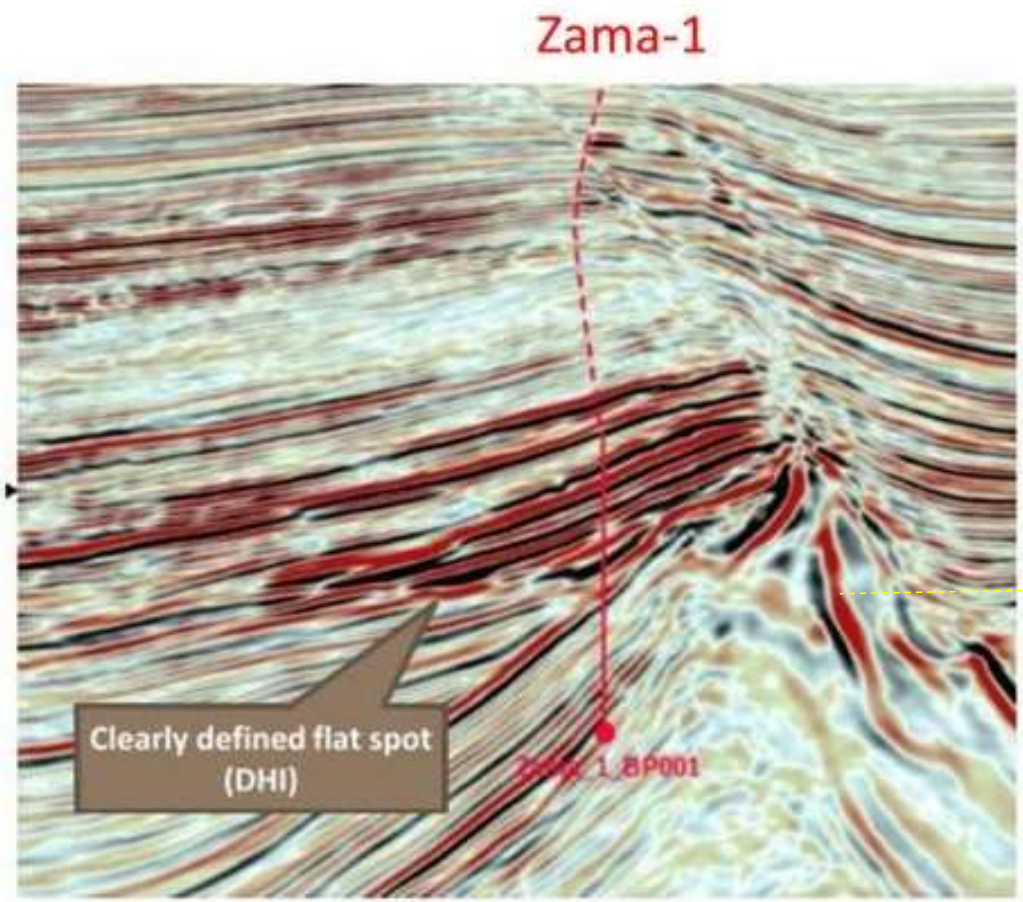
Zama-1 (850 MMbo)

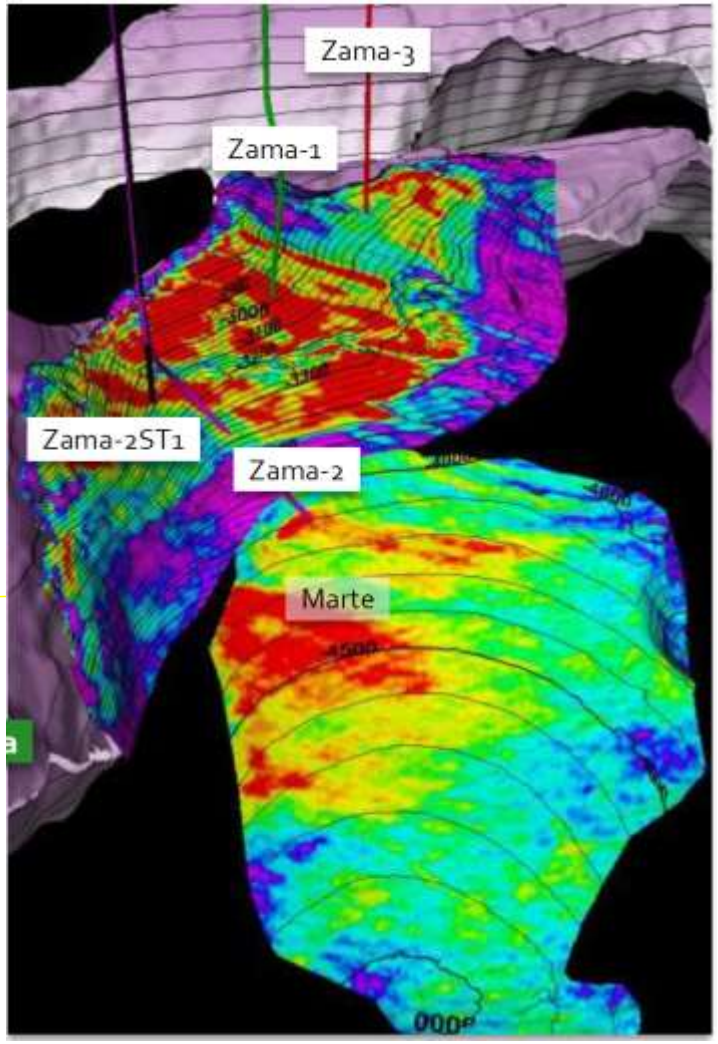


Reservoir Lithology: Deep Water Sandstone
Reservoir Age: Upper Miocene
Trap Type: Faulted Monocline
Water Column: 166 m
TD: 3383 m (11.100´)
Hydrocarbon Type: light oil 28ºAPI
Petroliferous Net Pay: 200 m
Reserves: 800 mmbo

Zama-1 Discovery Description



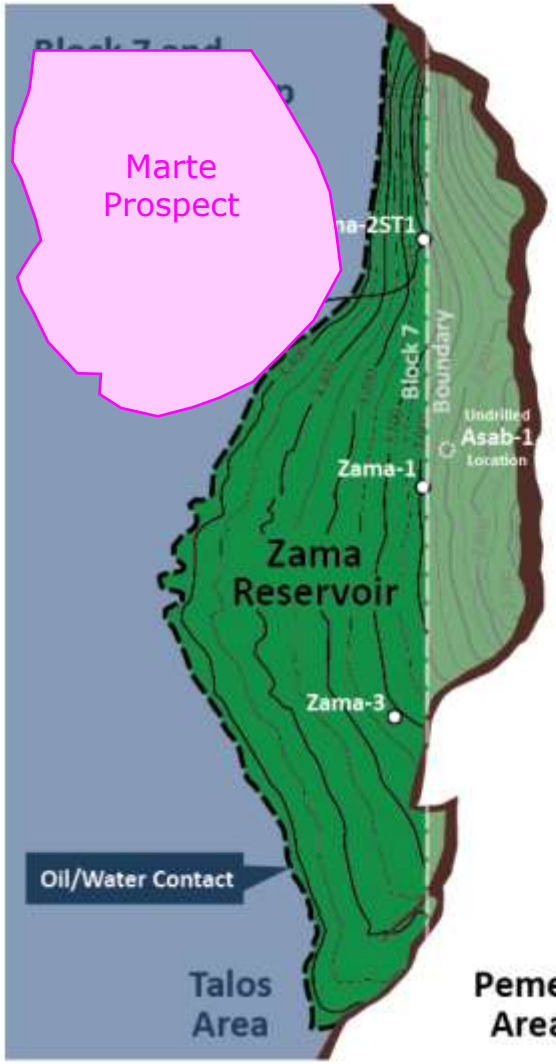




Source: Talus web page

Learned Lessons from Zama´s Development Strategy

OBJETIVE



Test OWC y existence of prospect Marte

Zama #2

- 1,676 ft gross TVD sand
- 581 ft gross TVD pay
- 68-73% net to gross
- OWC ~100 ft deeper than plan

Test reservoir continuity & flow test

Zama #2 ST1

- 873 ft gross TVD pay
- 68-73% net to gross
- 714 ft whole core, 98% recovery
- DST: 7,900 boe/d unstimulated, 94% oil

Test lateral reservoir continuity

Zama #3

- 1,000 ft gross TVD sand
- 748 ft gross TVD pay
- Similar section net to gross, 85-90% Zone 3
- 717 ft whole core, 99% recovery

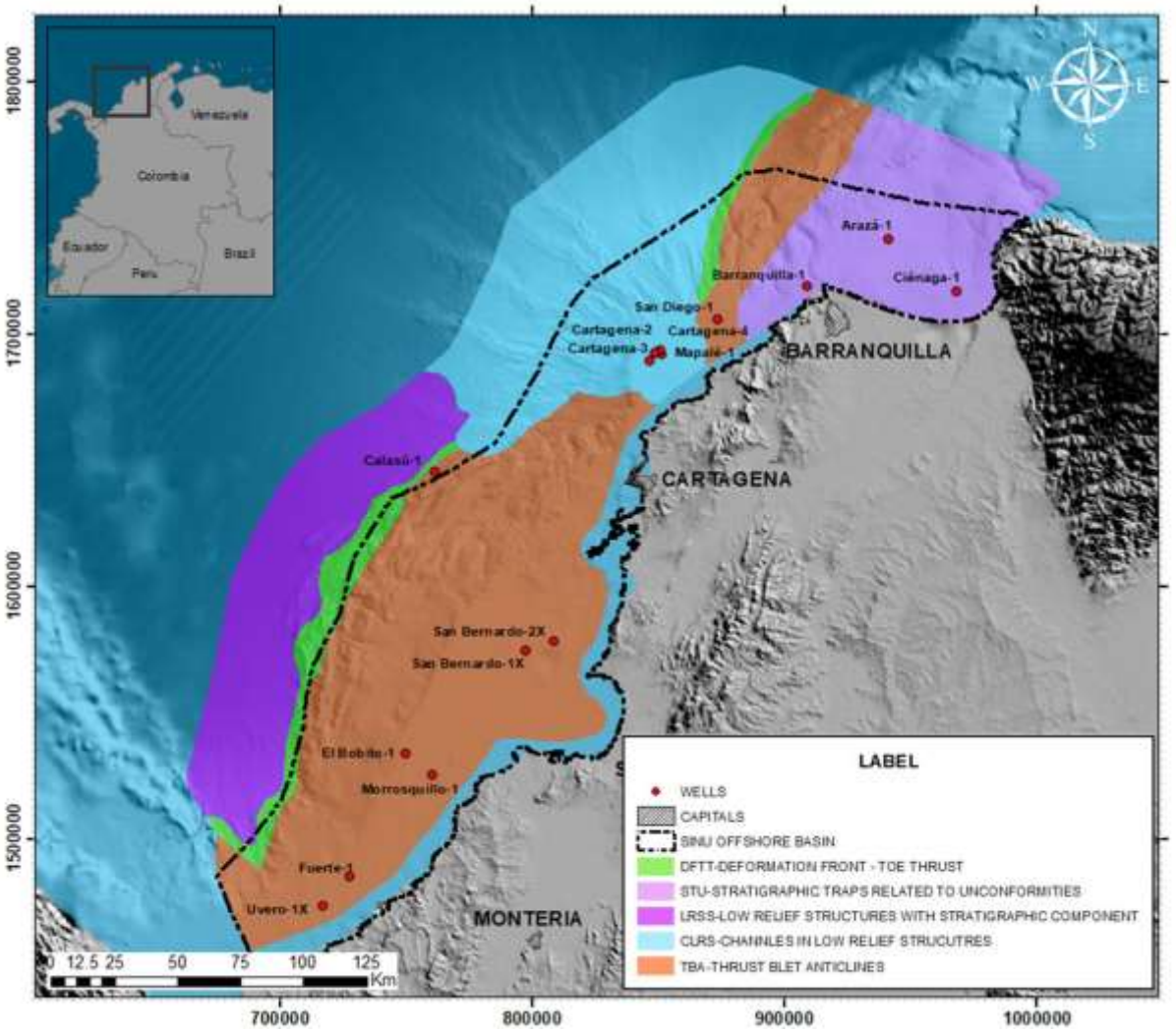
Netherland, Sewell & Associates estimates:

- **670 – 1,010 MMBOE gross recoverable resource**
- **60% of asset located on Block 7**
- **~94% high quality oil; 28 degree average API gravity**

Zama Independent Evaluation Results

Source: Talus JPM Presentation, feb2020

Sinú Offshore Prospectivity



Seismic amplitude analysis needed

DFTT – Deformation Front – Toe Thrust

LRSS – Low Relief Structures with Stratigraphic component

TBA – Thrust Belt Anticlines

ISB – Intraslope Basins

SMT – Shale Mobile related Traps

CLRS – Channels in Low Relief Structures

STU – Stratigraphic Traps related to Unconformities

Modified from ANH, 2021

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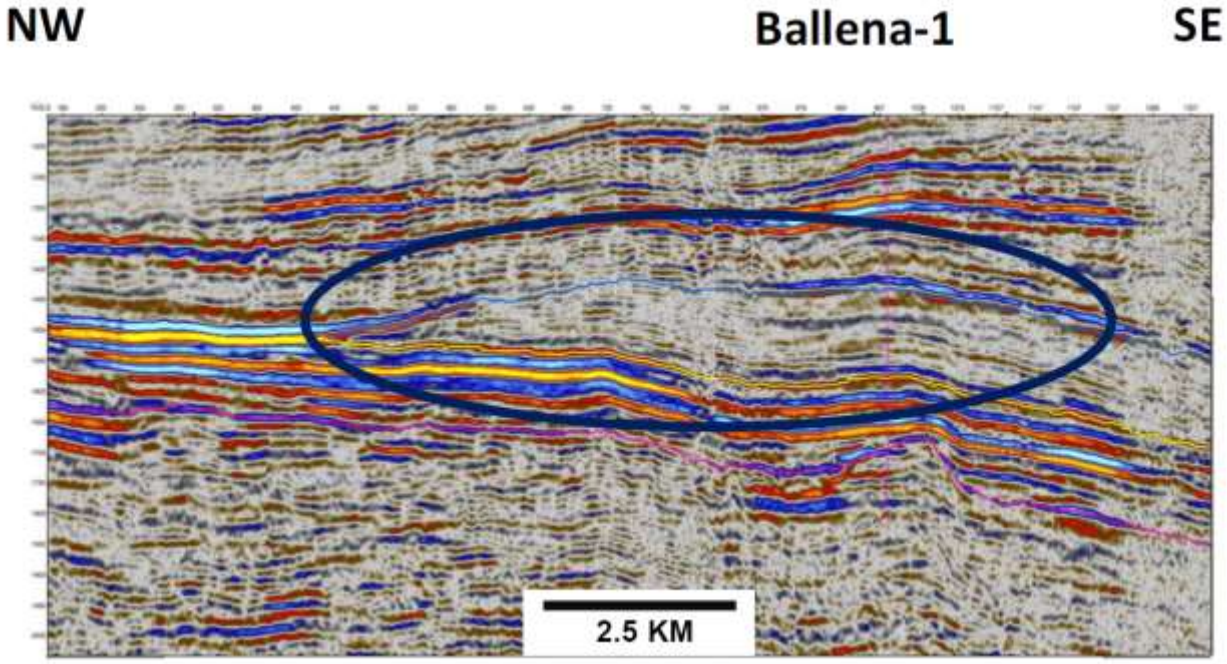
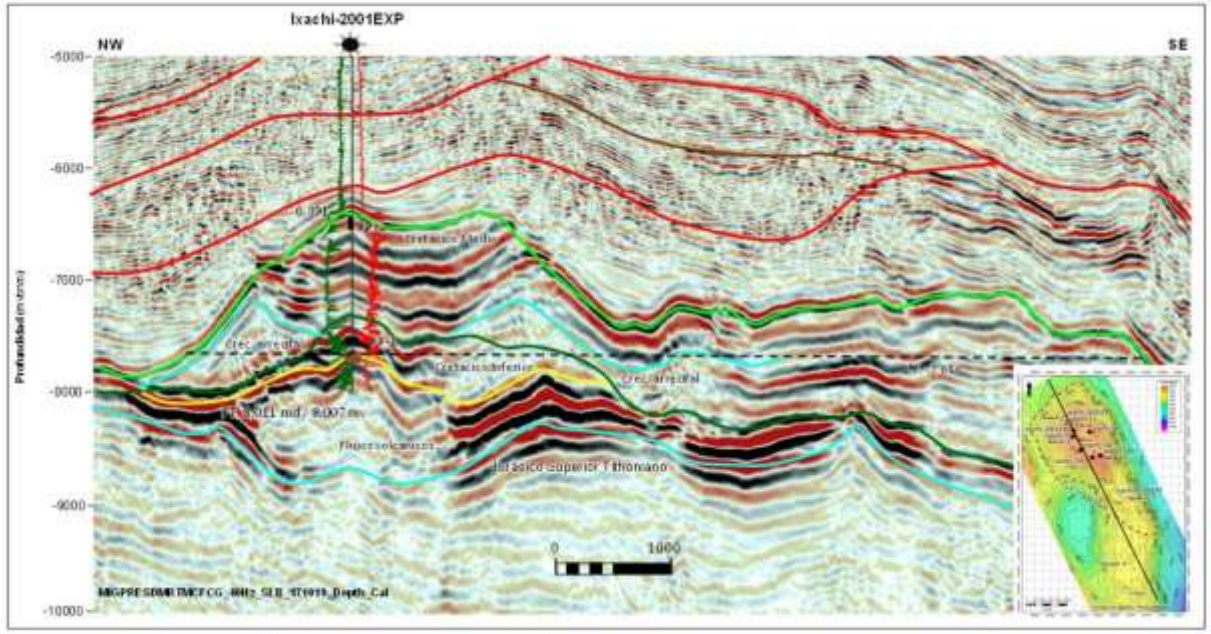
Carbonate in basement highs: Ballena vs Ixachi

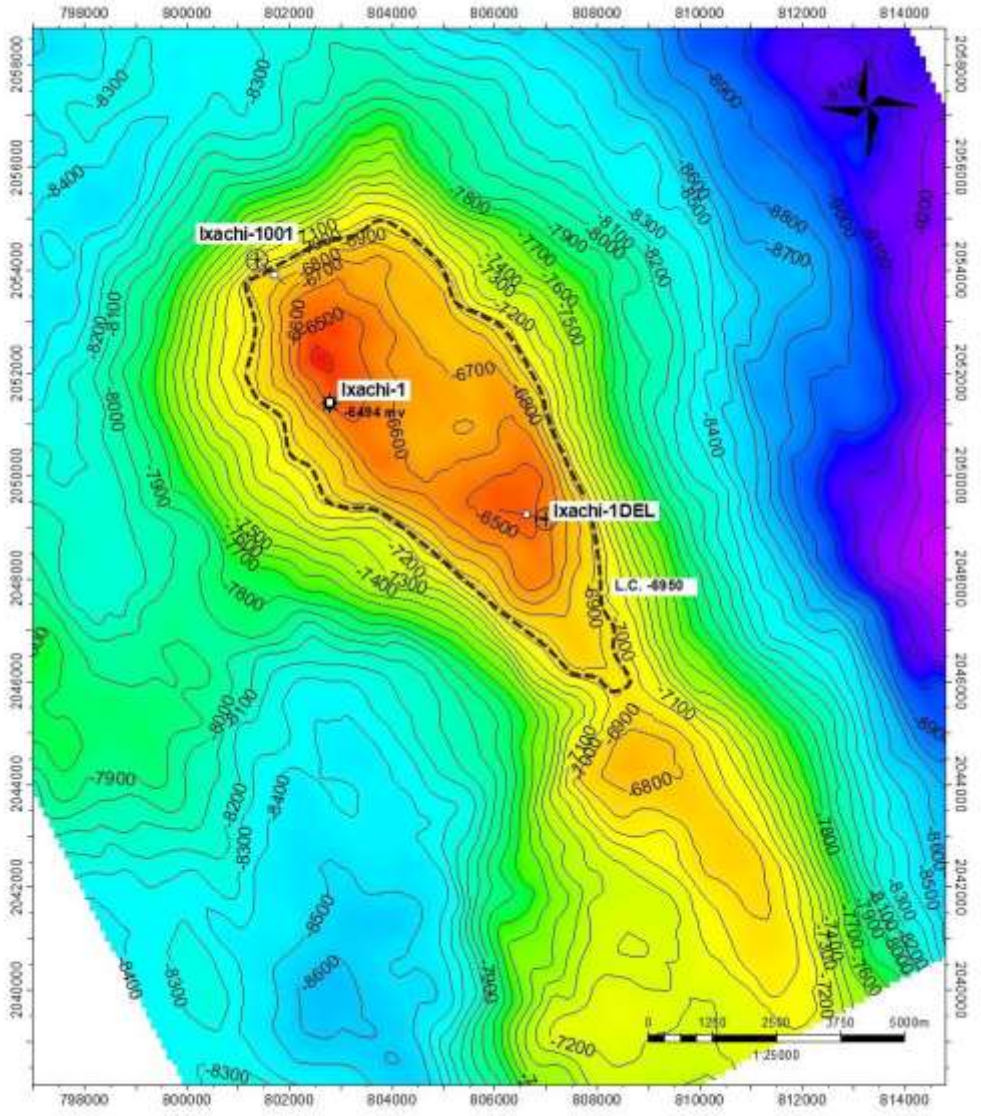


Reservoir Lithology: Carbonates
Reservoir Age: Late Oligocene to Early –Mid Miocene
Trap Type: 4-way closure
TD: 6.942´
Hydrocarbon Type: Gas

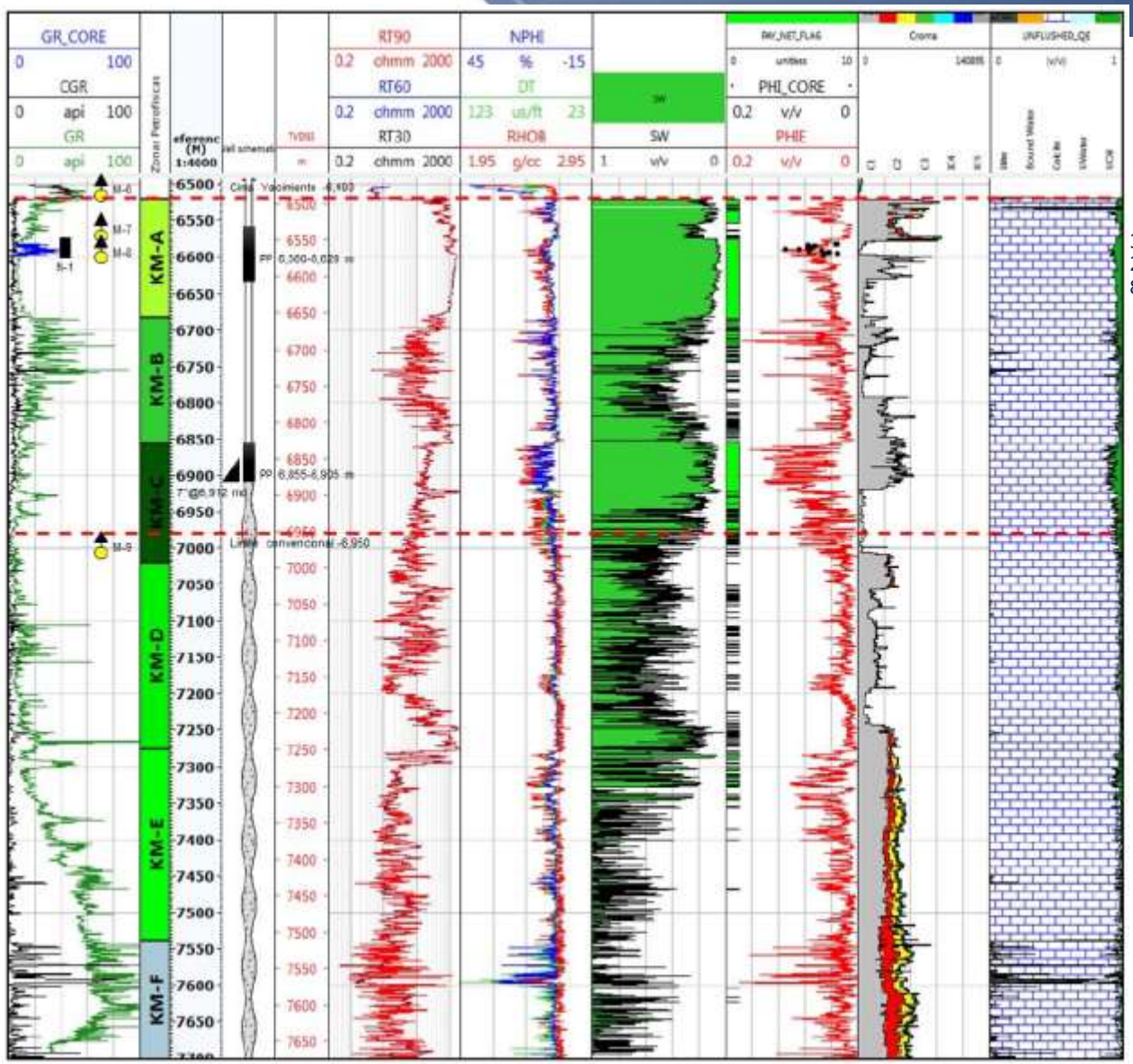


Reservoir Lithology: Carbonates (post-reef)
Reservoir Age: Cretaceous
Trap Type: 4-way closure
TD: 8,011 m (26.283´)
Hydrocarbon Type: Light oil (42ºAPI)
Reserves: 247 mmbo & 2 Tcf
Seal: Paleogene Shales (>2000 m thickness)

Ixachi Discovery (Pemex, 2017)



Depth Cretaceous Structural Map (46 km^2)



3,065 bod 42ºAPI
28 mmcfd
8,314 psi (1/2")

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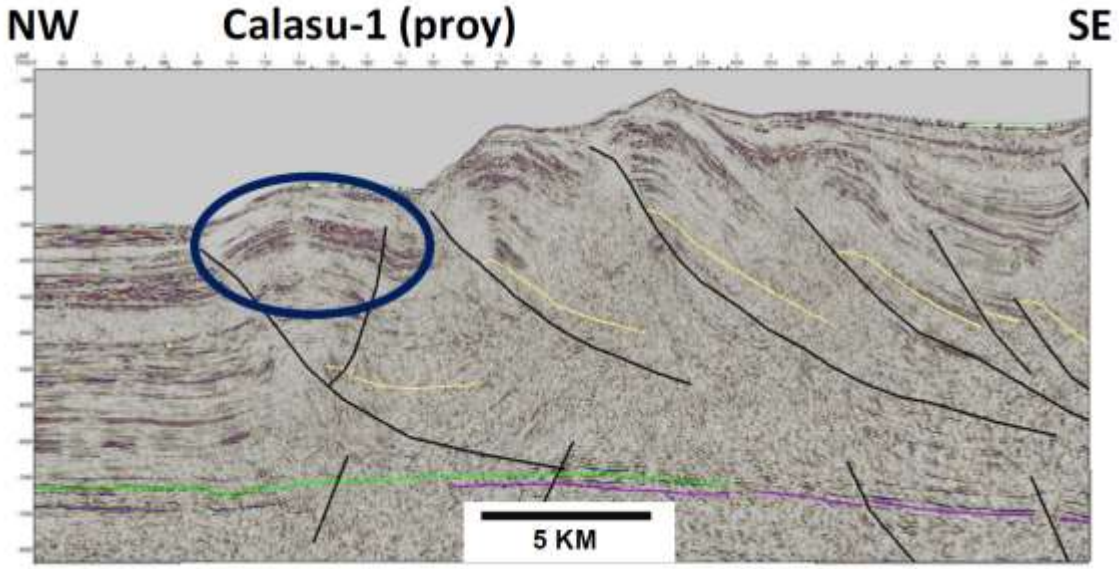
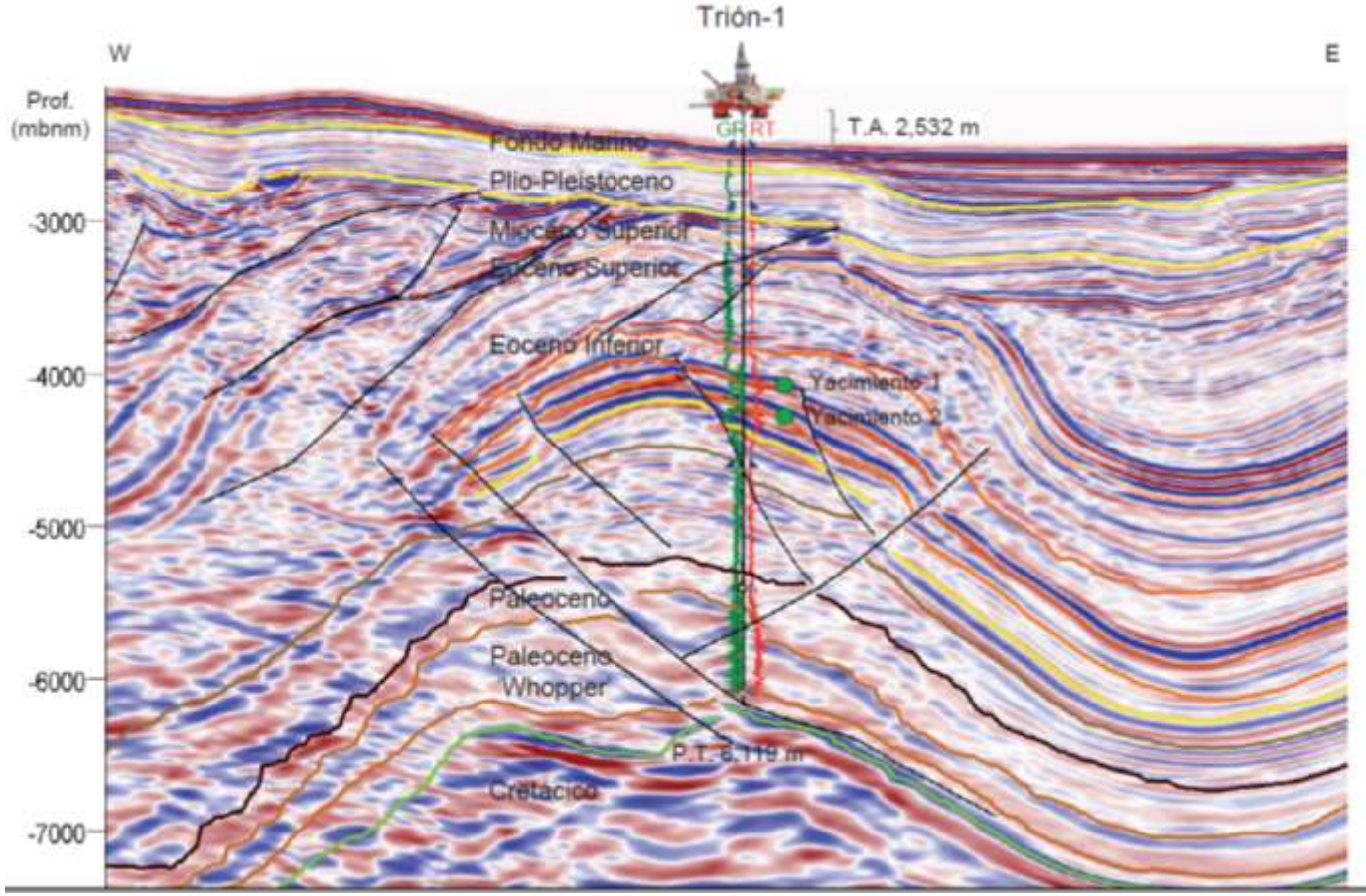
Strike Slip Structures: Calasu vs Trion



Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Miocene to Pliocene
Trap Type: Positive strike slip structure
TD: 22.556´ Water Column 2.253 m
Hydrocarbon Type: Gas?



Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Lower Eocene (Wilcox Group)
Trap Type: Positive strike slip structure
TD: 6,119 m (20,338´); Water Column: 2.540 m
Hydrocarbon Column: 320m; Porosity: 18-25%;
Permeability: 250 md

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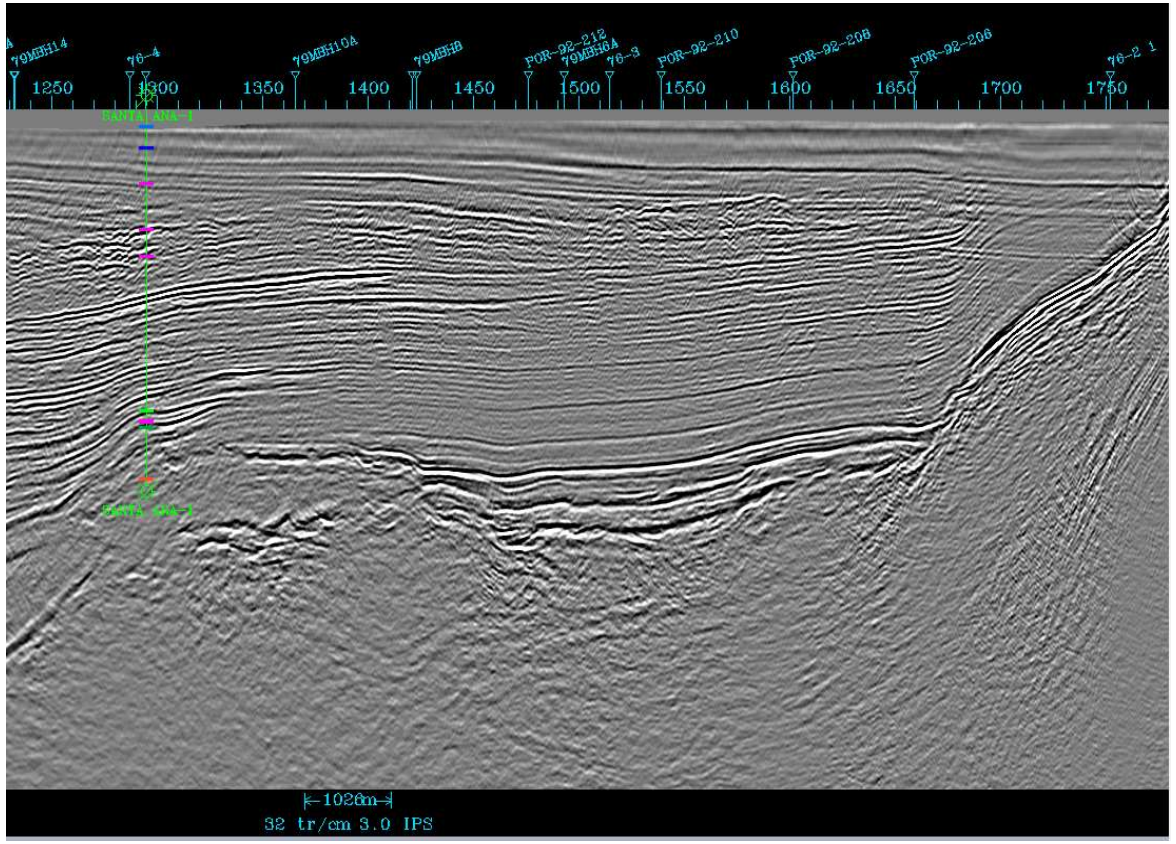
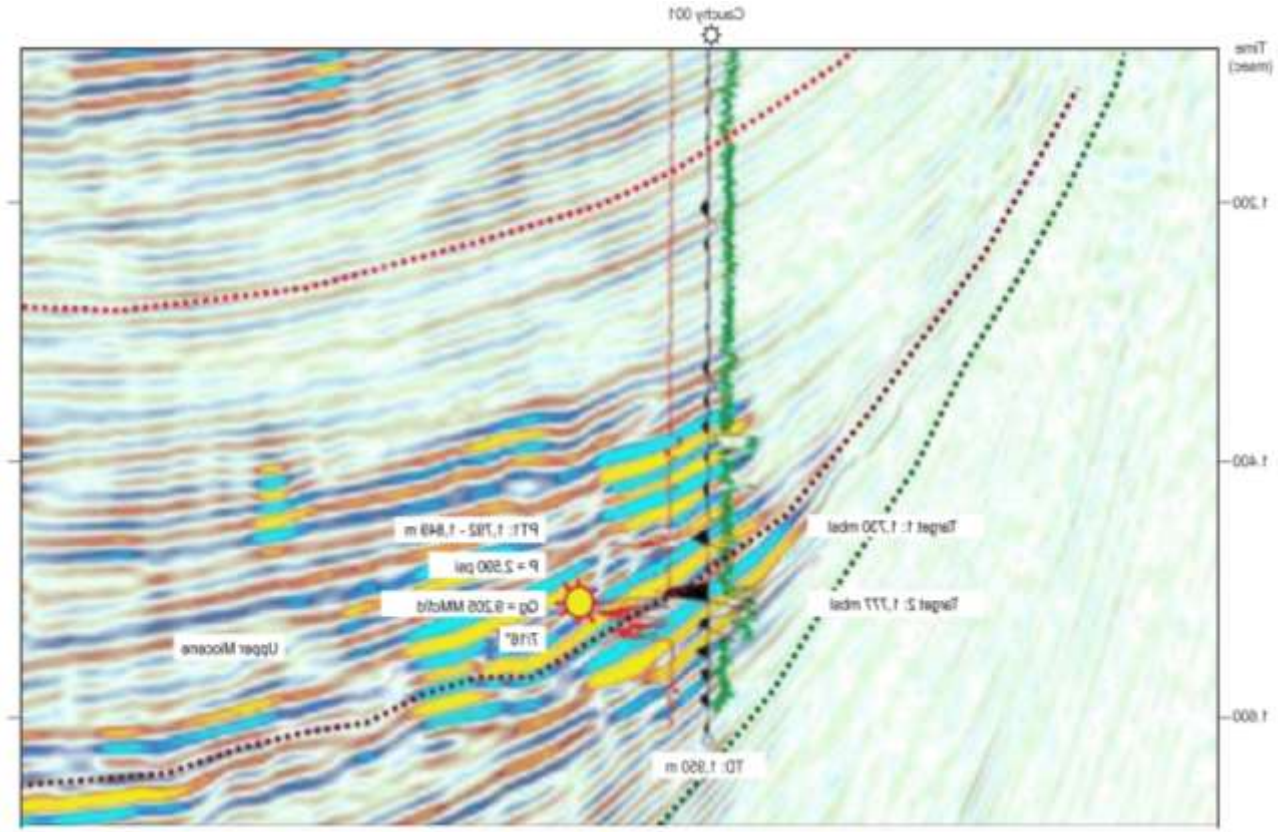
Onlaps against Basement Highs
Santa Ana-1 vs Cauchy-1

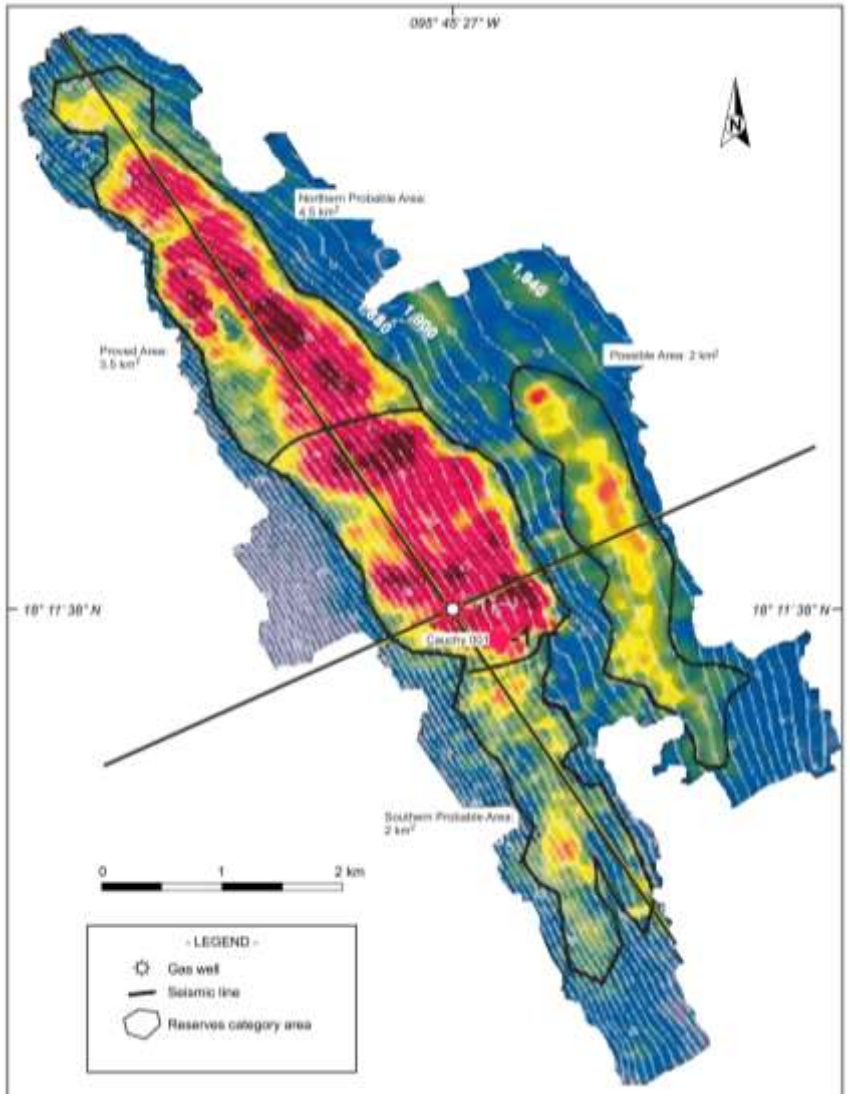


Reservoir Lithology: Sandstones
Reservoir Age: Oligocene
Trap Type: onlap against basement
TD: 4.513´ Water Column 137 m
Hydrocarbon Type: Gas



Reservoir Lithology: Sandstones
Reservoir Age: Upper Miocene
Trap Type: onlap against basement
TD: 6.398´ Water Column N.A
Hydrocarbon Type: Gas

Cauchy-1 Upper Miocene seismic amplitude anomaly map



Gas Composition:

98.340% Methane
0.760% Ethane
0.250% Propane
0.060% Butane
0.080% Pentane, 0.070% isobutane,
0.130% CO2, 0.000% H2S, and 0.310% Nitrogen

Fuente PEMEX, 2009, en IHS 2021

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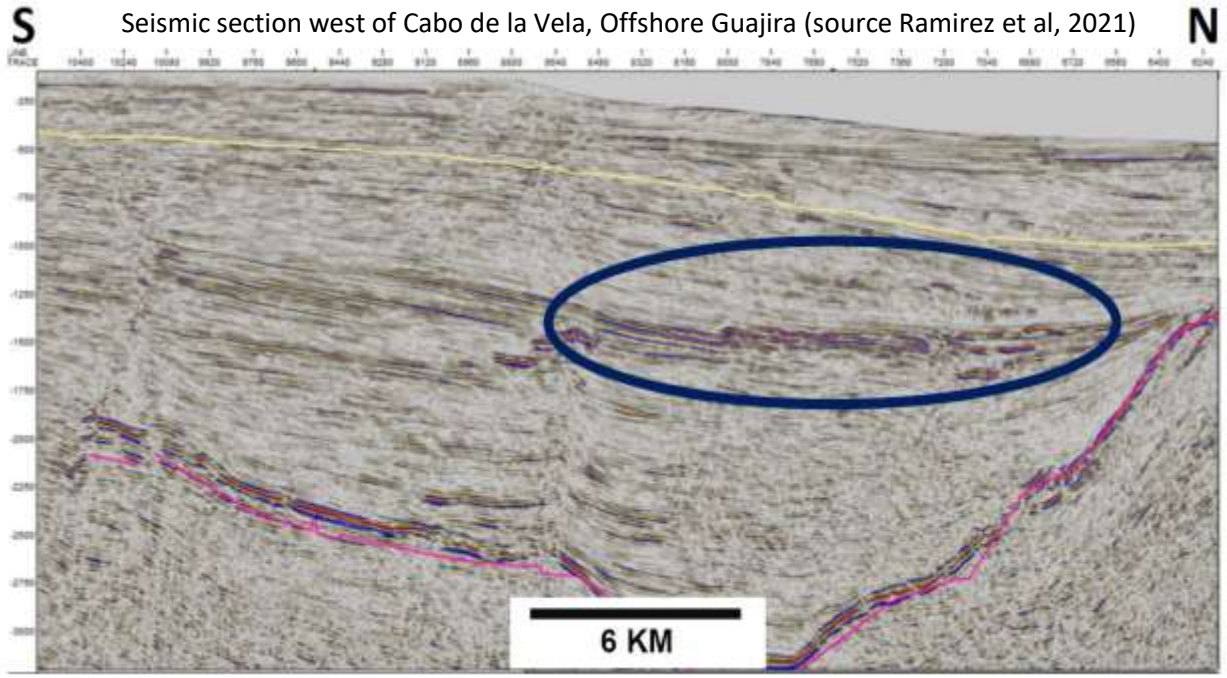
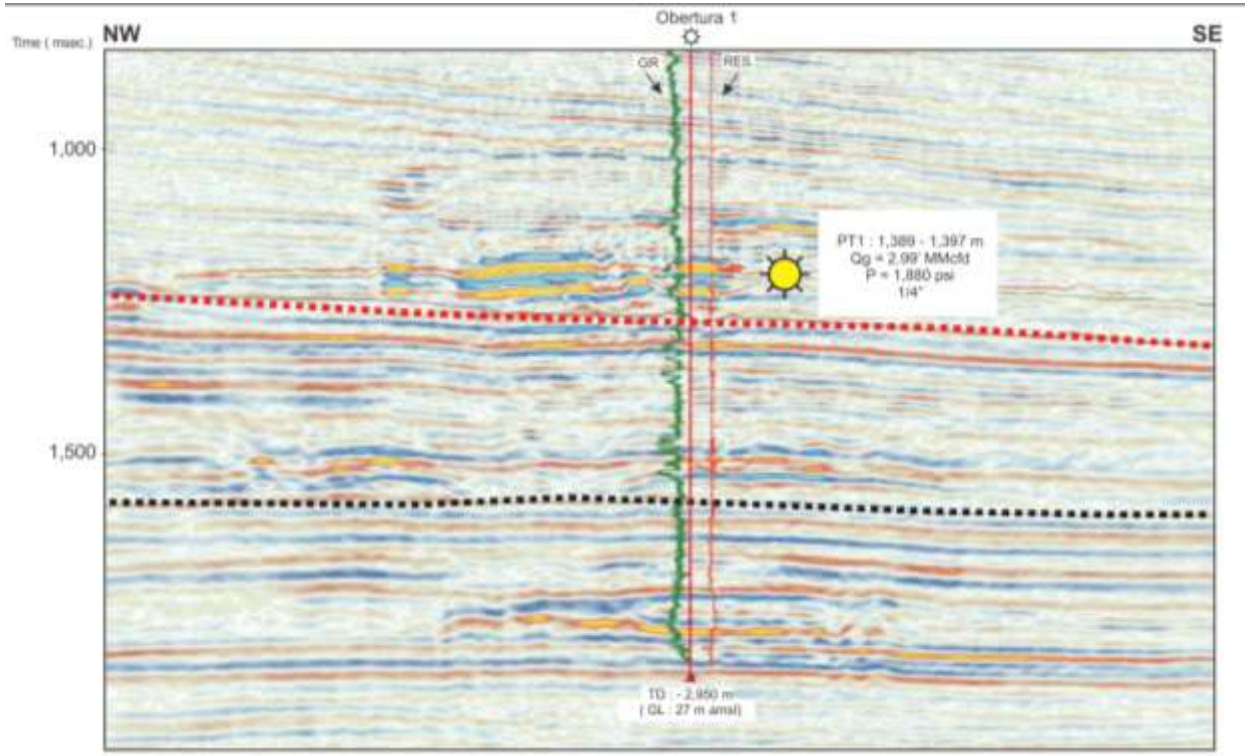
Mio-Pliocene Channel Complexes: Mapale-1 vs Obertura-1



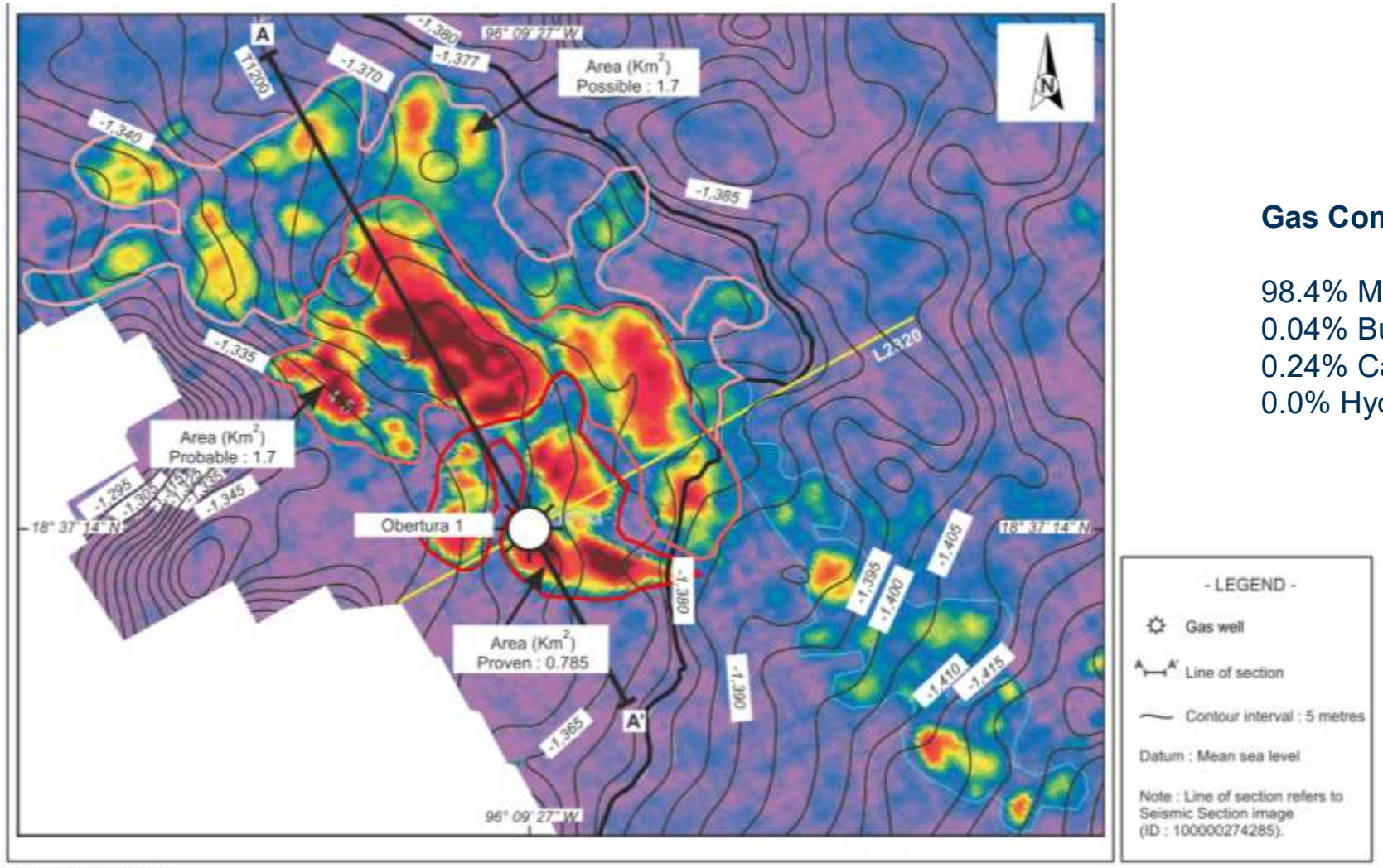
Seismic section west of Cabo de la Vela, Offshore Guajira (source Ramirez et al, 2021)

Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Mio-Pliocene
Trap Type: Channel Complexes
TD: 4.513´ Water Column 137 m
Hydrocarbon Type: Gas



Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Lower Pliocene
Trap Type: Channel Complexes
TD: 9.678´ Water Column N.A.
Hydrocarbon Type: Gas

Obertura Field Lower Pliocene amplitude anomaly map (Veracruz Basin)



Gas Composition:

98.4% Methane, 0.65% Ethane, 0.14% Propane
0.04% Butane, 0.08% i-Butane, 0.18% Pentane plus
0.24% Carbon Diox (CO2), 0.0% water,
0.0% Hydr Sulp (H2S), and 0.27% Nitrogen

Fuente PEMEX, 2008, en IHS 2021

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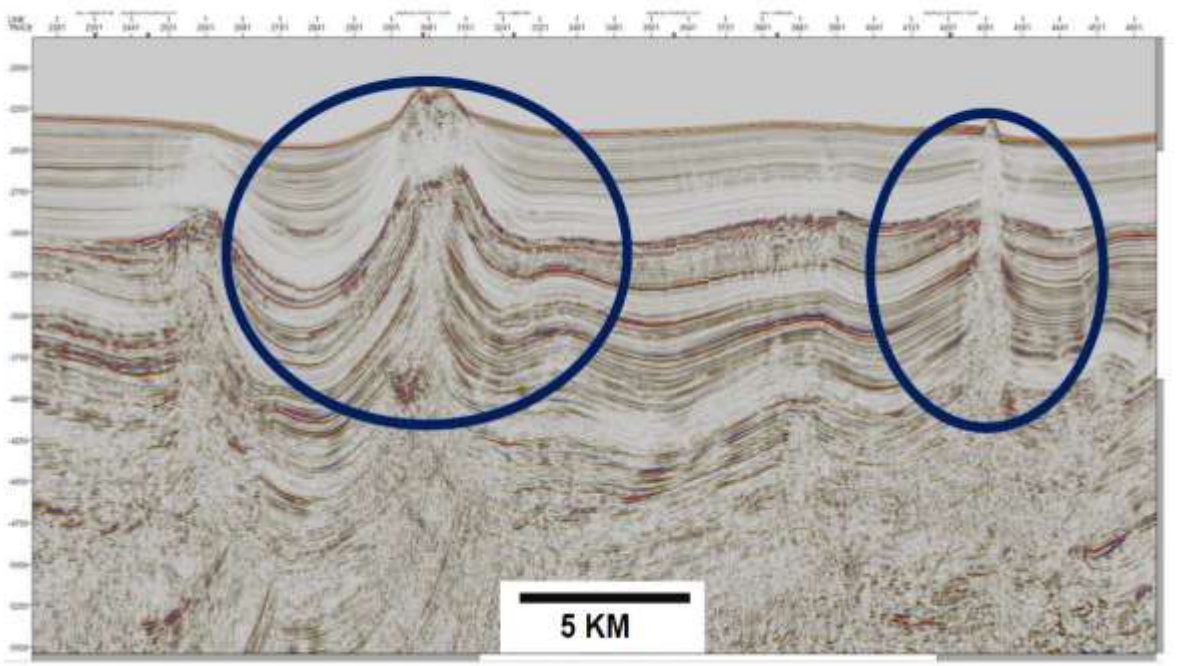
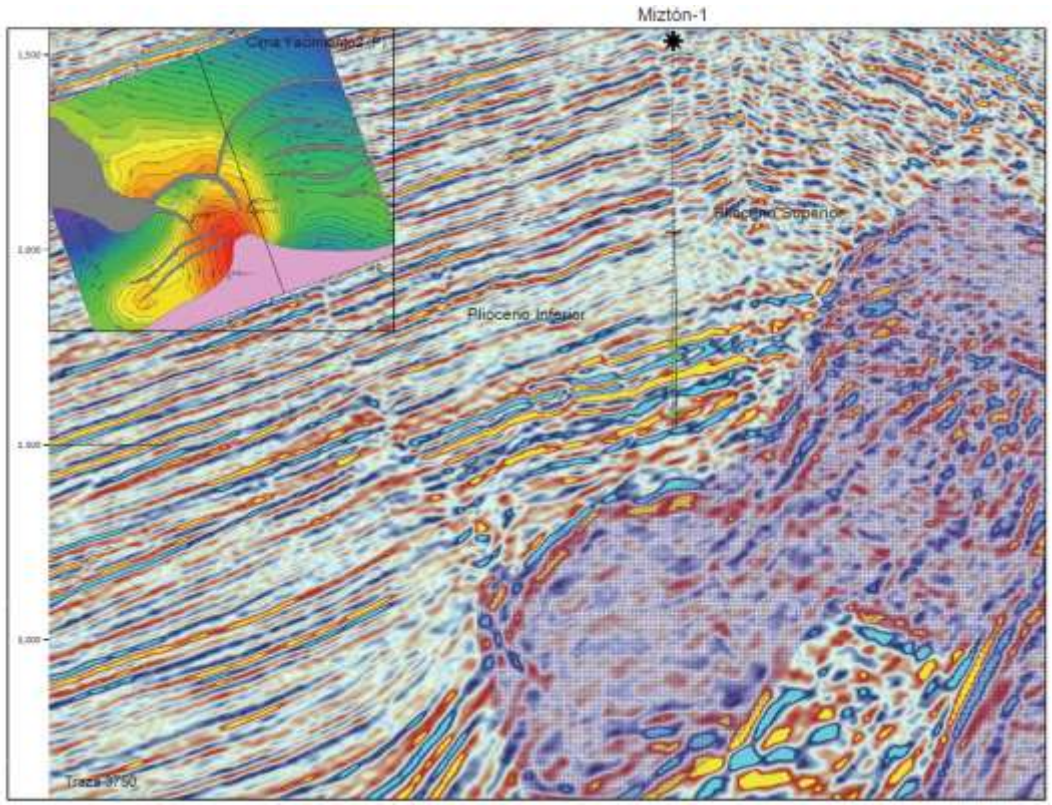
Mud Diapirs entrapment features

GUA-2014-14BP-018 (source Ramirez et al, 2021)



Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Mio-Pliocene
Trap Type: Mud Diapirs
Hydrocarbon Type: Gas



Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Pliocene
Trap Type: Mud Diapirs
TD: 3,260 m Water Depth: 33m
Hydrocarbon Type: Oil & Gas
Reserves 180 MMbo & 133 Gcf (IHS)

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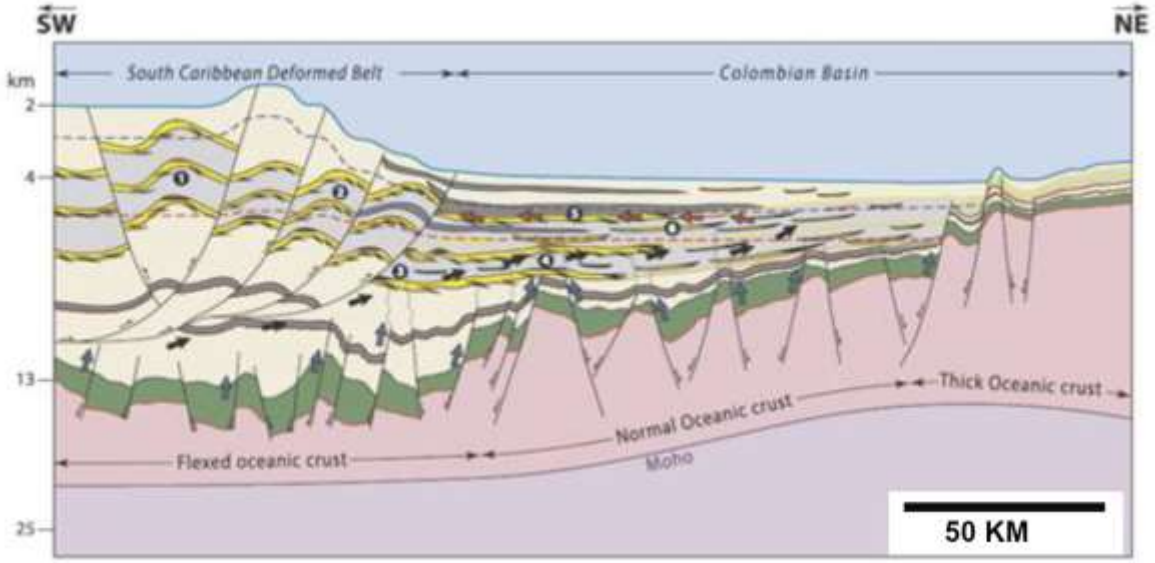
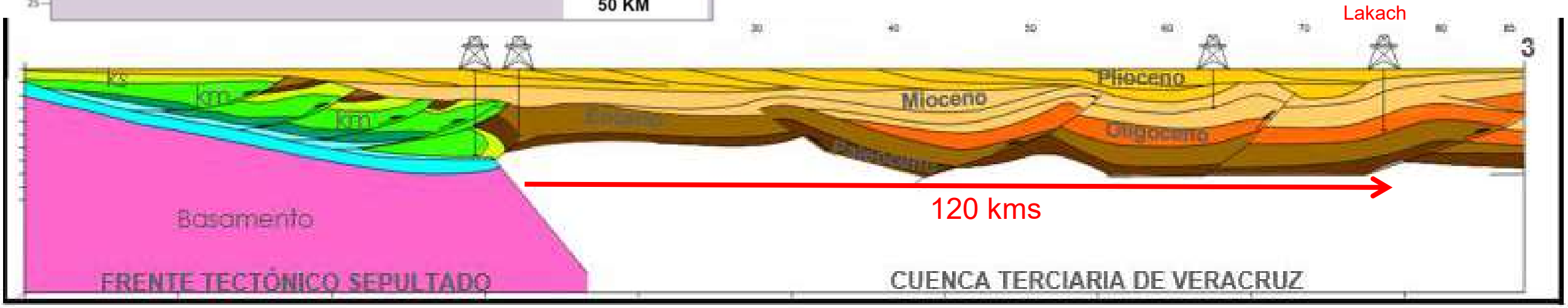
Mesozoic Source Rocks Remanents Depocenters



Maturity model by Carvajal et al (2020)



Fuente CNH, Atlas Geológico Cuenca Veracruz, 2018

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  2. Play Concepts Identified in the Caribbean Offshore Colombia
  3. Historical overview of discoveries in Mexico since 2012

- **Recent Discoveries: Analogies & Prospectivity**
  1. Fold Belt Structures: Gorgon-1 vs Zama-1
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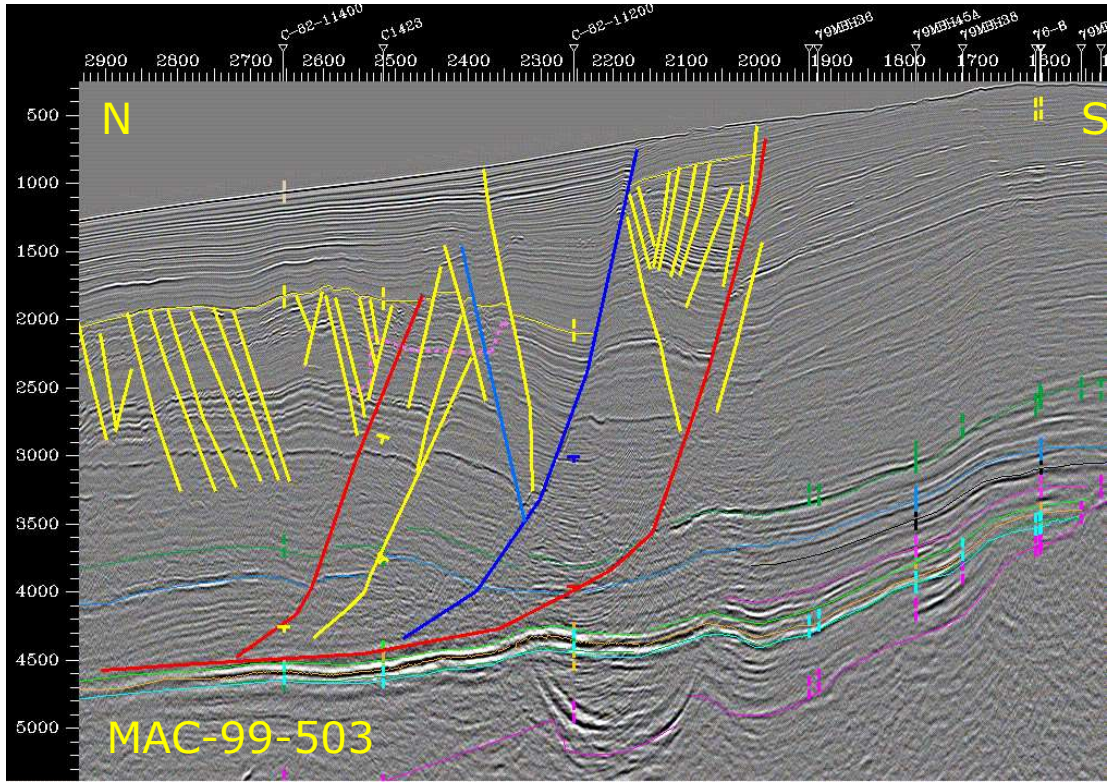
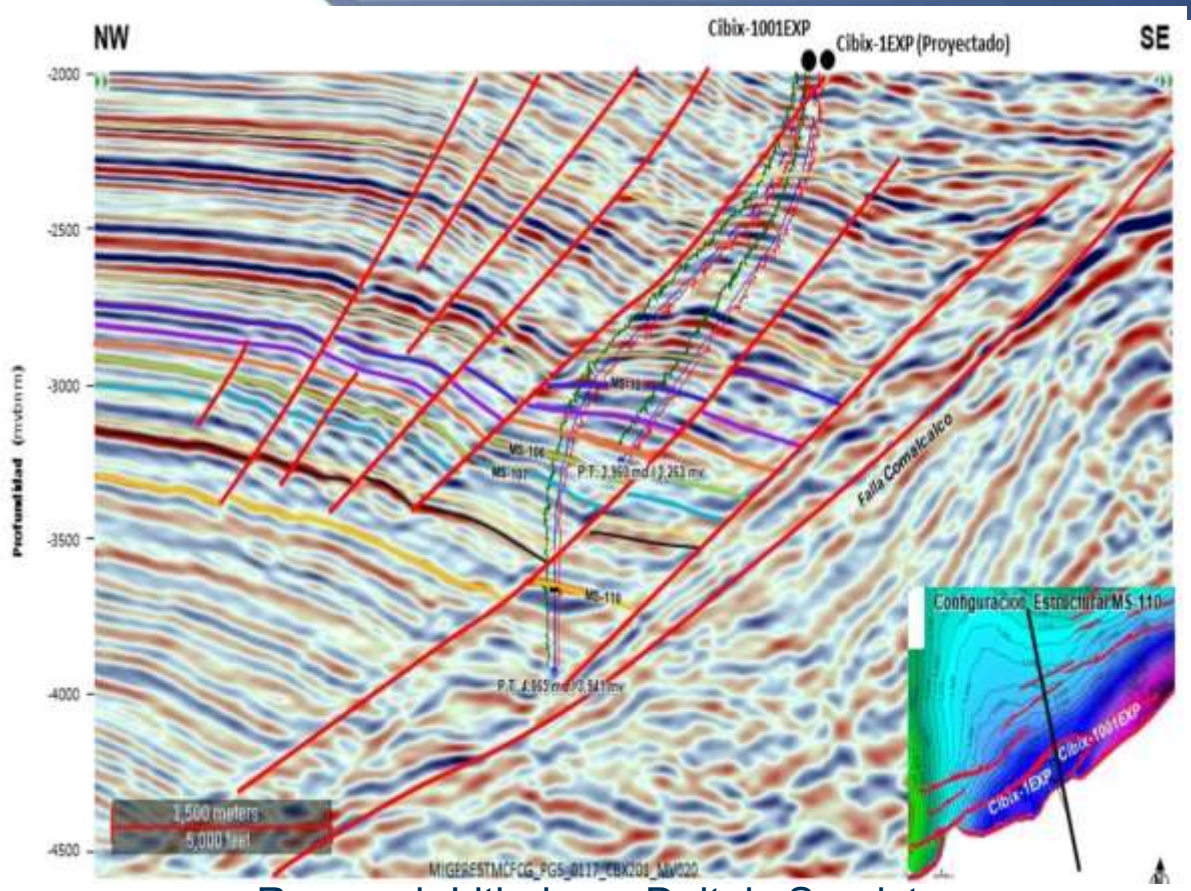
  4. Onlaps against basement highs: Santa Ana-1 vs Cauchy-1
  5. Mio-Pliocene Channel Complexes: Mapale-1 vs Obertura-1
  6. Mud Diapirs entrapment features: Mizton-1
  7. Mesozoic source rocks Remnants: Veracruz Basin
  8. Listric Faulting related closures: Cibix-1
  9. Mio-Pliocene Prograding Sequences: Veracruz Basin

- **Conclusions & Recommendations**

Listric Faulting related closures



Reservoir Lithology: Deltaic? Sandstones
Reservoir Age: Pliocene
Trap Type: Listric Faulting
Hydrocarbon Type: Gas



Reservoir Lithology: Deltaic Sandstones
Reservoir Age: Upper Mocene-Pliocene
Trap Type: Listric Faulting
TD: 12´.992
Hydrocarbon Type: Gas

Source: Pemex, Reserves Evaluation @01/01/2021

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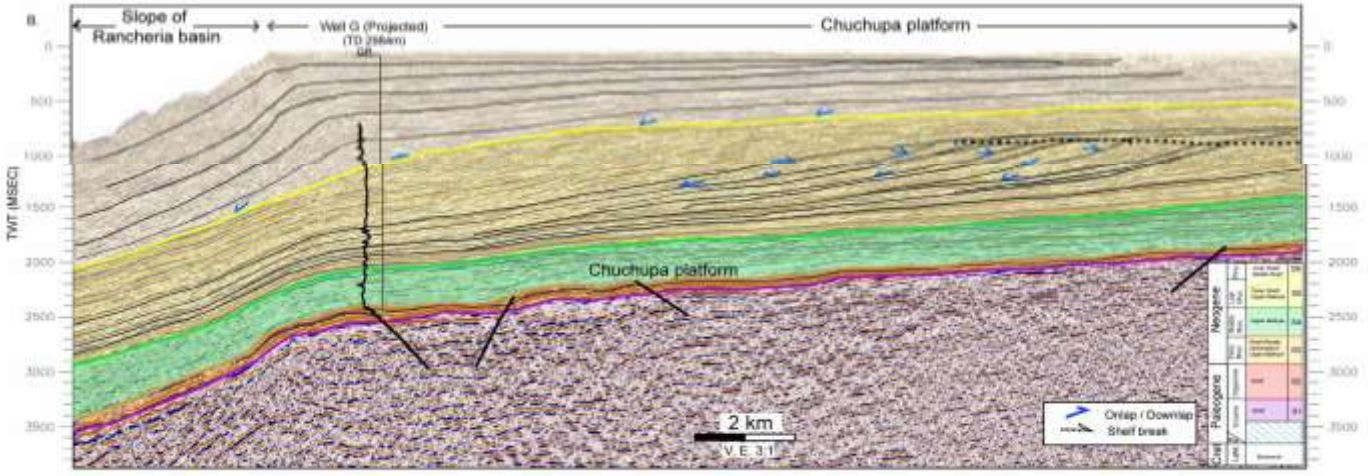
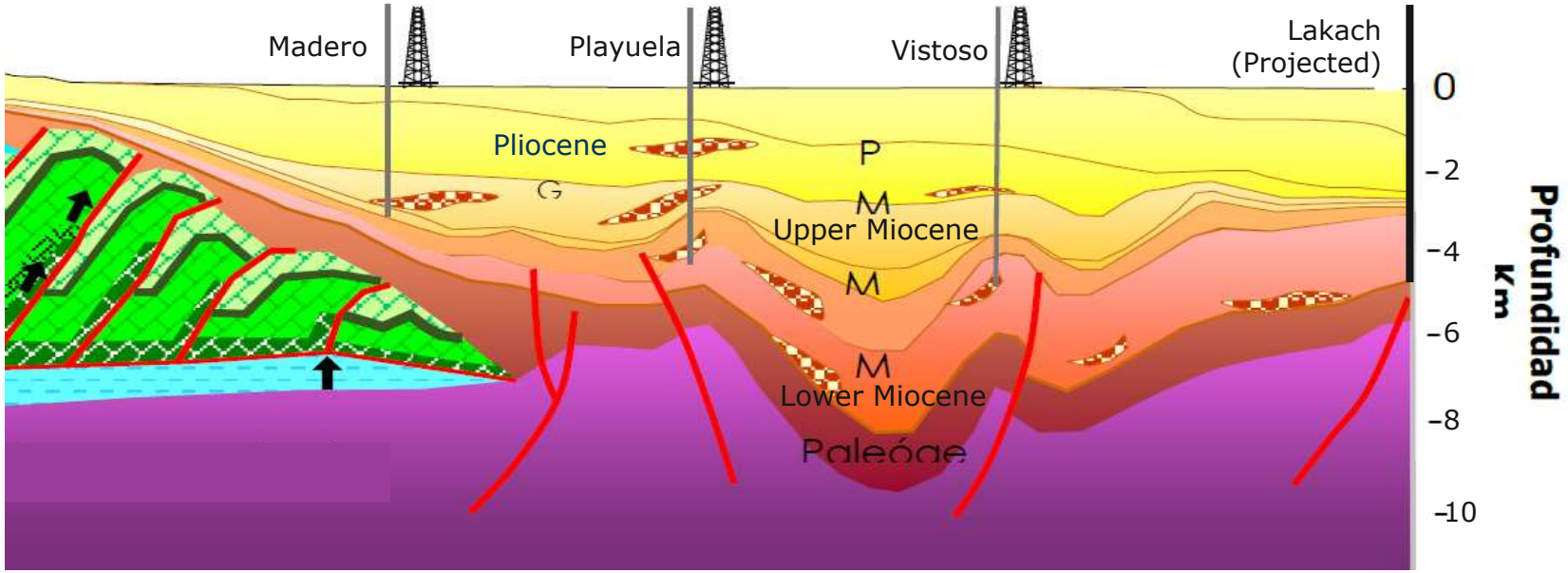
Mio-Pliocene Prograding Sequences
Chuchupa Area vs Eastern Veracruz Basin



Vence E., 2008

Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Mio-Pliocene
Trap Type: Prograding Lowstand & Highstand systems
Hydrocarbon Type: Gas

Reservoir Lithology: Deep Water Sandstones
Reservoir Age: Mio-Pliocene
Trap Type: Prograding systems
Hydrocarbon Type: Dry Gas
Lakach 2P Reserves: 650 GCF & 8 mmb condensate



Source: CNH Atlas Cuenca Veracruz, 2018

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Conclusions:

- The Caribbean Basin is a frontier basin with little information
- There is not enough well data
- Mexico has assorted structural styles that could serve as analogs for some of the Caribbean plays
- New technologies (specialized seismic reprocessing, deviated and/or horizontal drilling, etc.) have played a fundamental role in the new discoveries
- Recent discoveries are mainly based on seismic attributes

Recommendations: What do we need to do?

- Systematic acquisition of new information from new discoveries (rocks and fluids)
- Regional tectono-stratigraphic studies with the support of 3D:
  - Qualitative Interpretation: Structural maps, post-stack attribute analysis, etc.
  - Quantitative Interpretation: massive seismic inversion (estimation of porosity and other petrophysical parameters, lambda-ro, etc.), pre-stack seismic attribute (AVO, etc.) among others
  - Petroleum systems elements mapping
- Application of new technologies (deep water drilling and robotics, water bottom stability analysis, etc.)
- An ANH-CNH-PEMEX data interchange agreement is recommended

THANK YOU

QUESTIONS?

ivan-olaya@hotmail.com