

COLOMBIA ROUND 2021

COLOMBIA ROUND 2021: SINU – SAN JACINTO EXPLORATORY OPPORTUNITIES

Location

History of Exploration

Database

Infrastructure

Geological Framework

Well Summary

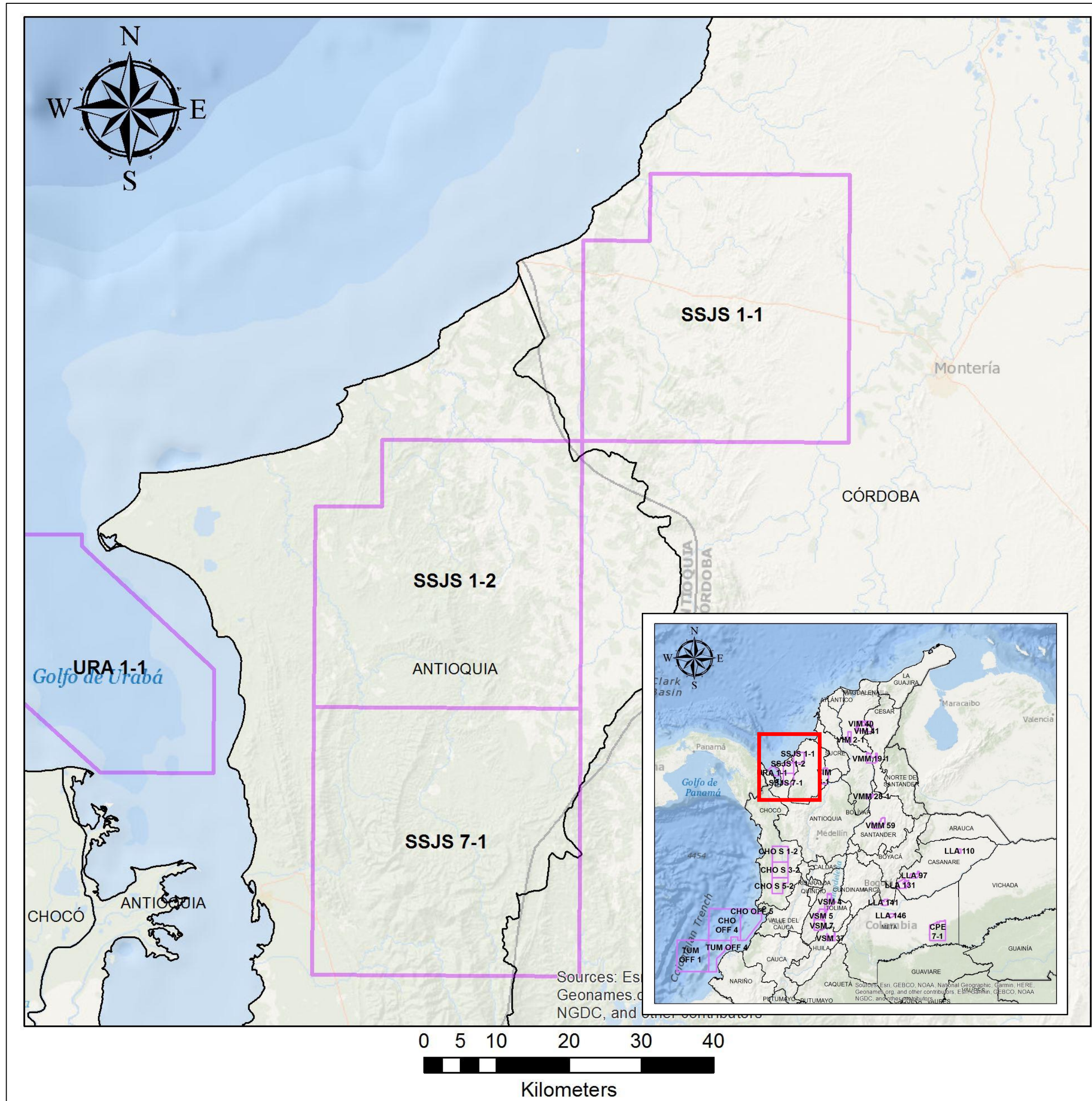
Seismic Interpretation

Prospectivity

Conclusions

INTRODUCTION

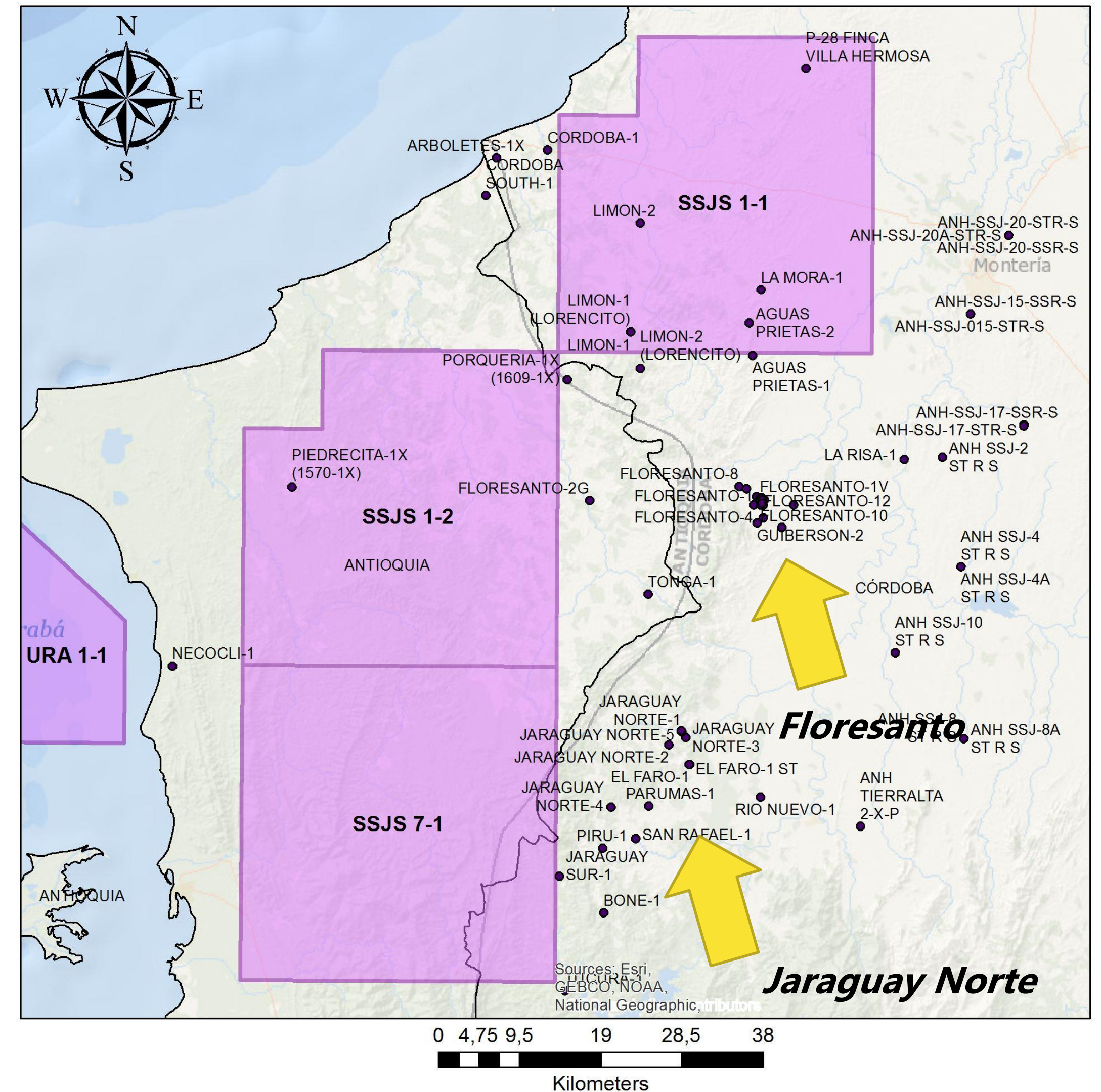
LOCATION

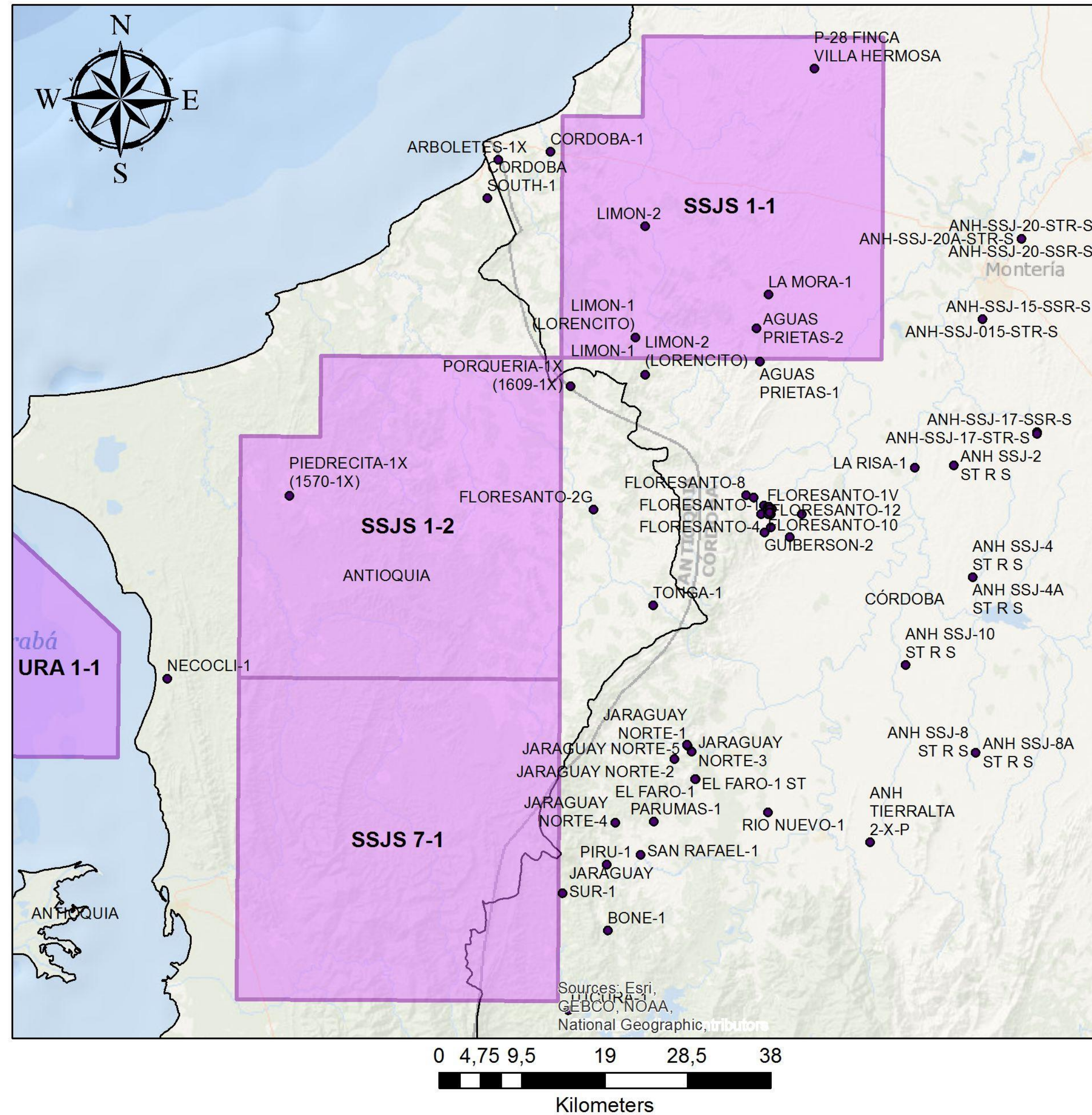


- **Block Areas**
- SSJS 1-1 (135,700 Ha)
- SSJS 1-2 (126,900 Ha)
- SSJS 7-1 (127,100 Ha)
- **Departments**
- Antioquia & Córdoba

HISTORY OF EXPLORATION

- Despite of being under-explored, **this basin has a long exploration history** (since 1945)
- One well with commercial production **Floresanto – 1**: Depleted after two years with a total production of **28,730 BLS** of 51°API oil (nearby to the area)
- **Jaraguay N-1: 126 BOPD** of 48° API (close to the area)
- Successful production tests in another thirteen wells (Considered **as non-commercial at the time**)
- 191 wells have been drilled in the whole basin

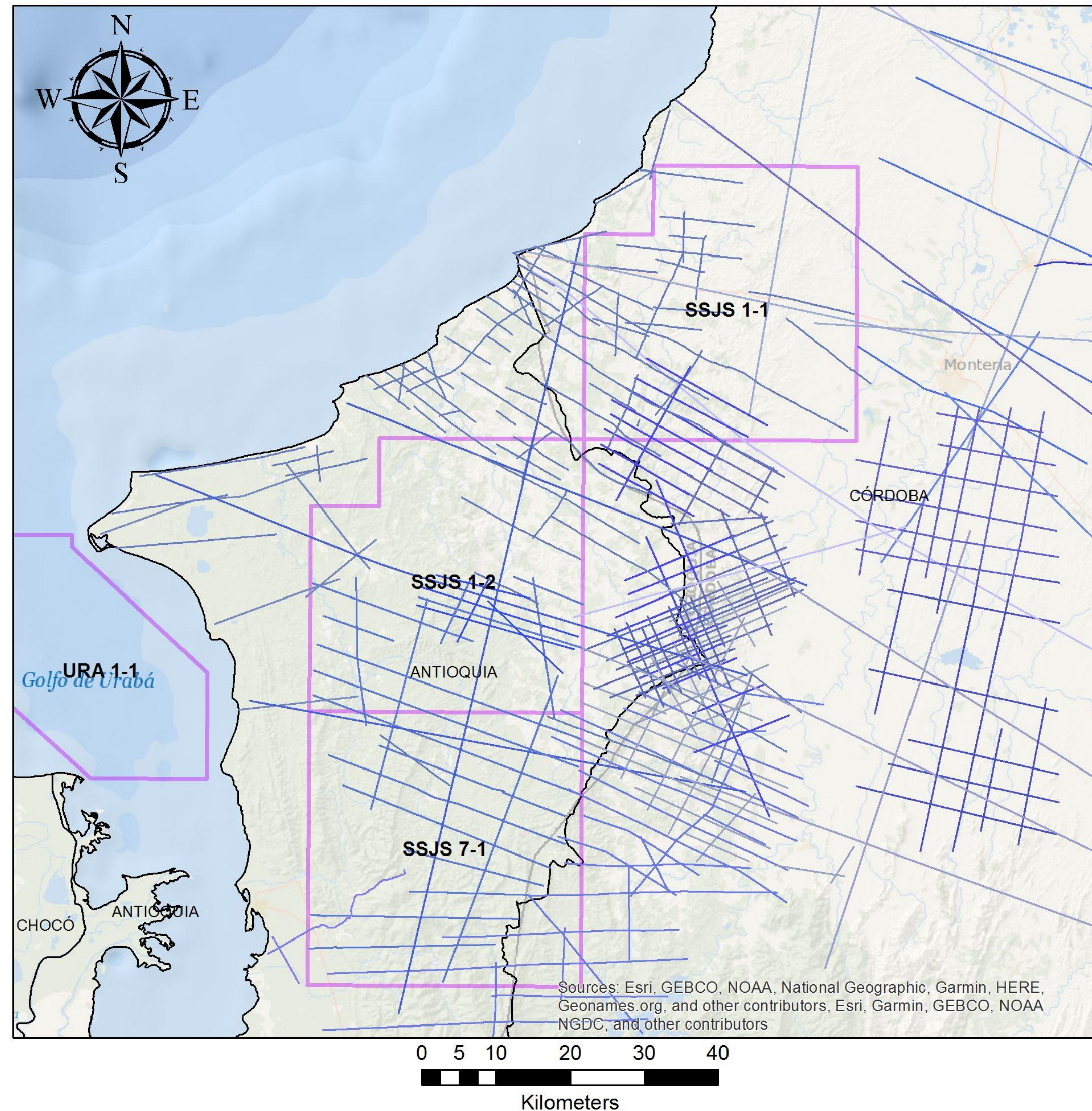




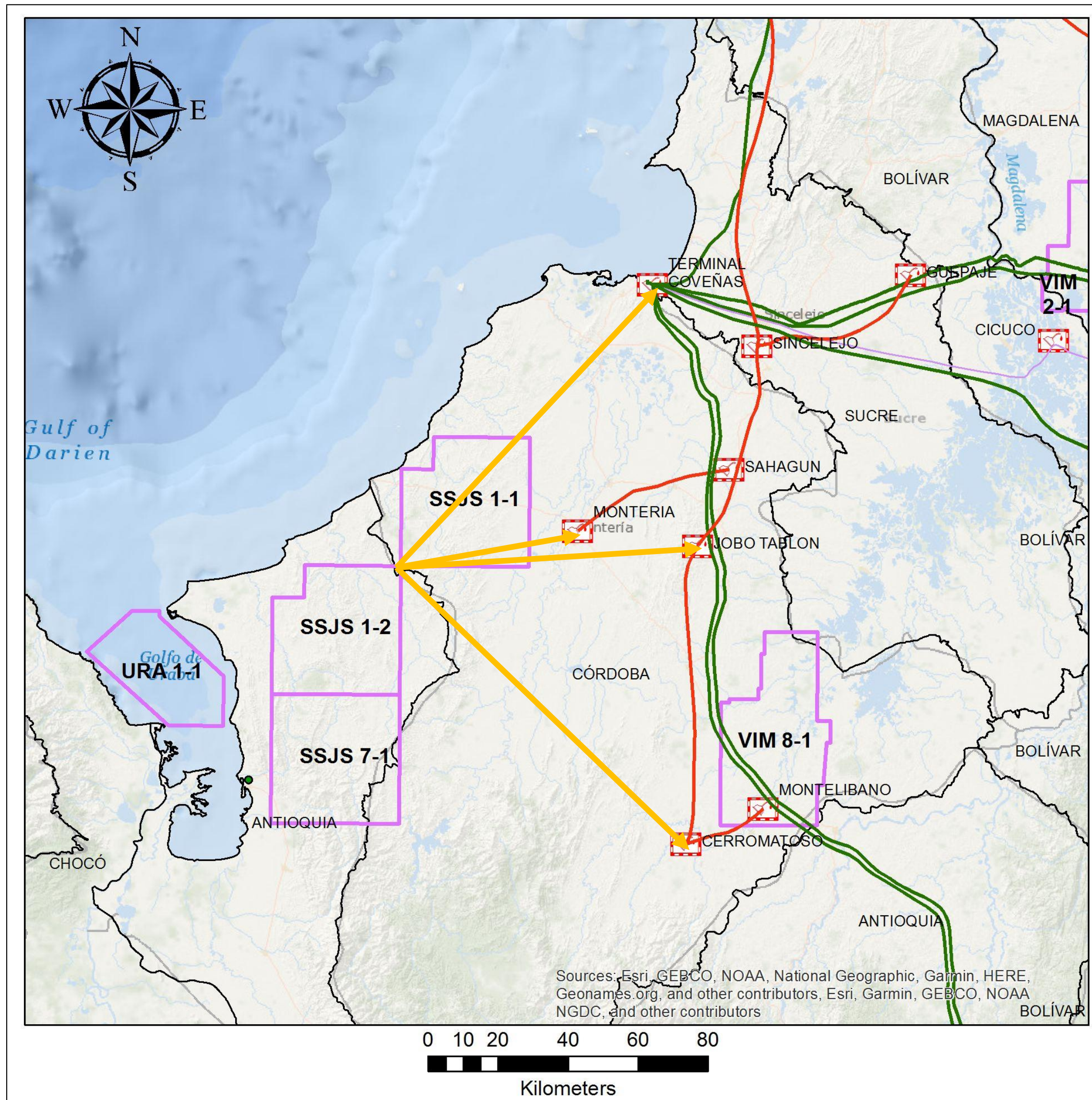
WELLS & FIELDS NEARBY

Well	Data Available	Year	TD (ft)
Piedrecita 1X	Yes	1968	12,262
Porquería 1X	Yes	1969	14,512
Limon – 1 (Lorencito)	No	N/A	N/A
Limon – 2 (Lorencito)	No	N/A	N/A
La Mora - 1	Yes	1958	8,800
Aguas Prietas - 1	No	1926	N/A
Aguas Prietas - 2	No	1926	N/A
Floresanto – 2G	No	1951	N/A

Field	Year of first well drilled	Year of last well drilled	# Of Wells
Floresanto	1945	1946	12
Jaraguay Norte	1981	1983	5



- **SEISMIC**
- **2D Seismic Surveys:**
- Sinú Sur 2D – 2008
- Necoclí – 85
- Urabá – 67
- Bajo Atrato – 79
- Sinú1 2D – 2014
- Sinú3 2D - 2014
- Sinú1 2D – 2015
- Urabá Sinú – 80
- **Total Length (3,101 Km)**

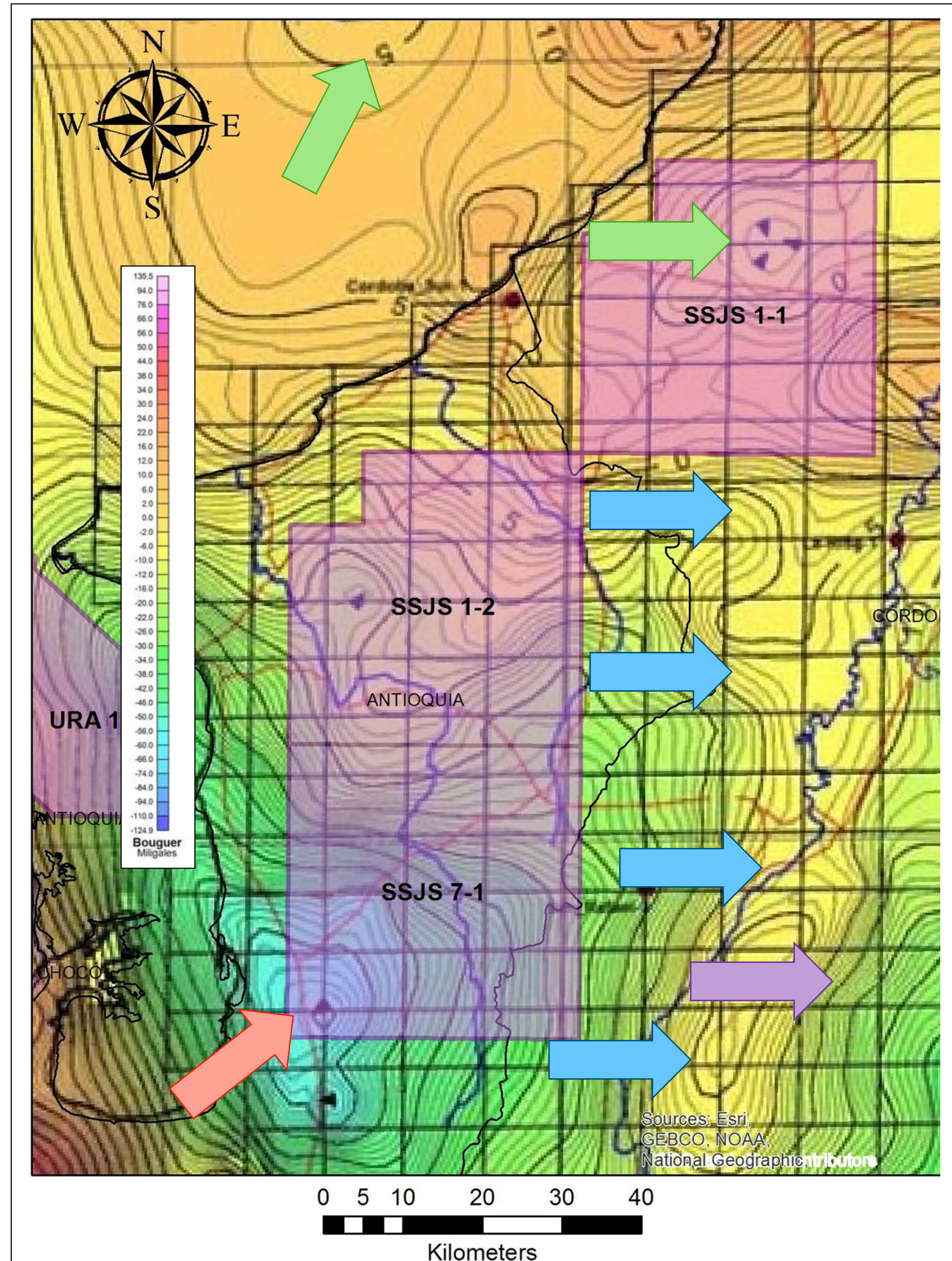


Main Infrastructure nearby

- **Oil Pipeline**
- Terminal Coveñas (107 Km)
- **Gas Pipeline**
- Montería (51 Km)
- Jobo Tablón (85 Km)
- Cerromatoso (114 Km)

GEOLOGICAL FRAMEWORK

Bouguer Anomaly & General Structural Elements



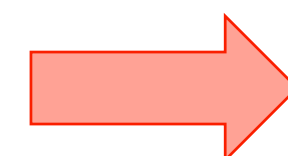
■ Main gravimetric features of the area



- Local depocenters



- Positive anomaly representing the San Jacinto Fold Belt



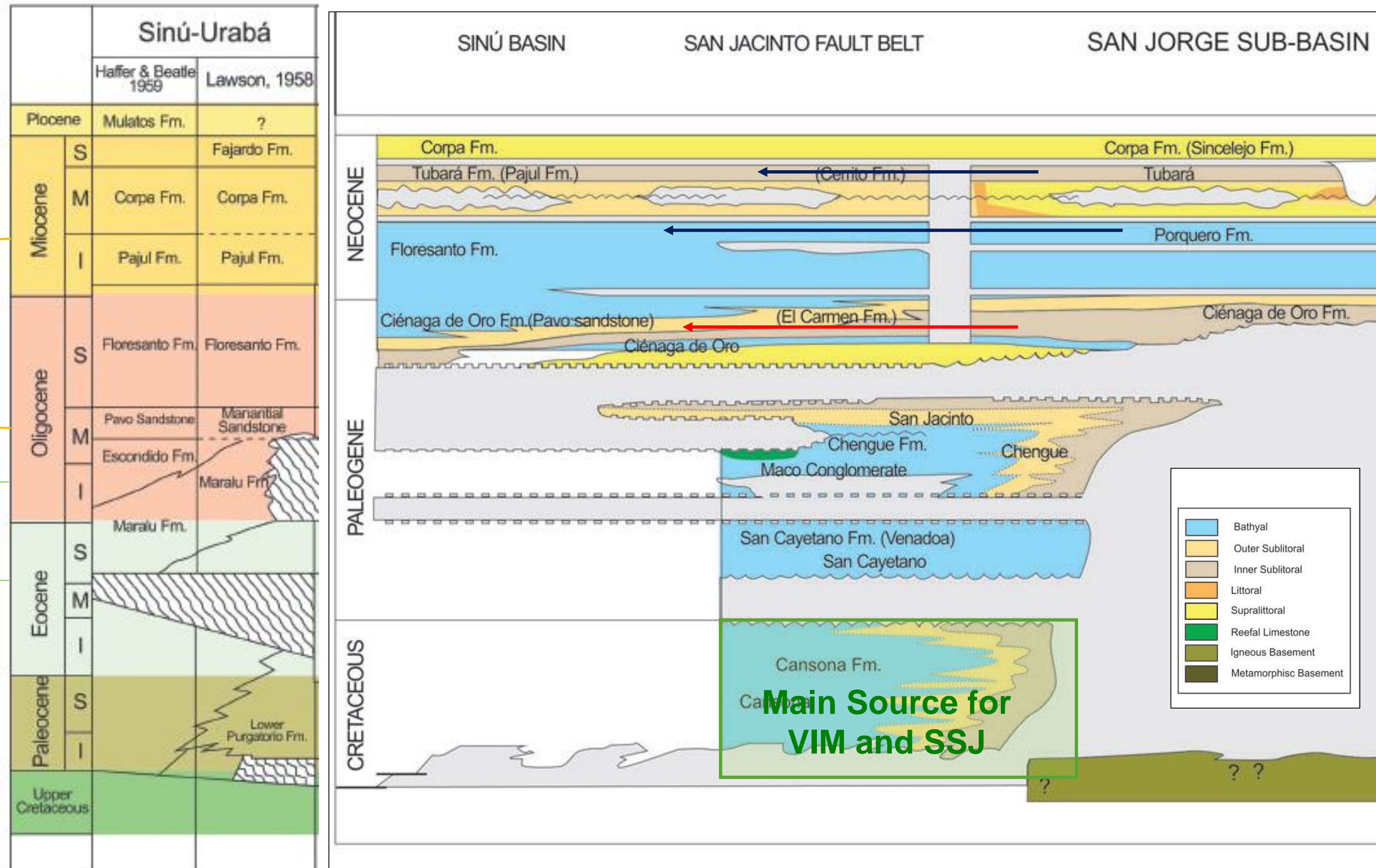
- Regional depocenter



- Abrupt difference in anomalies due to the presence of the Romeral Fault System

STRATIGRAPHIC SETTING

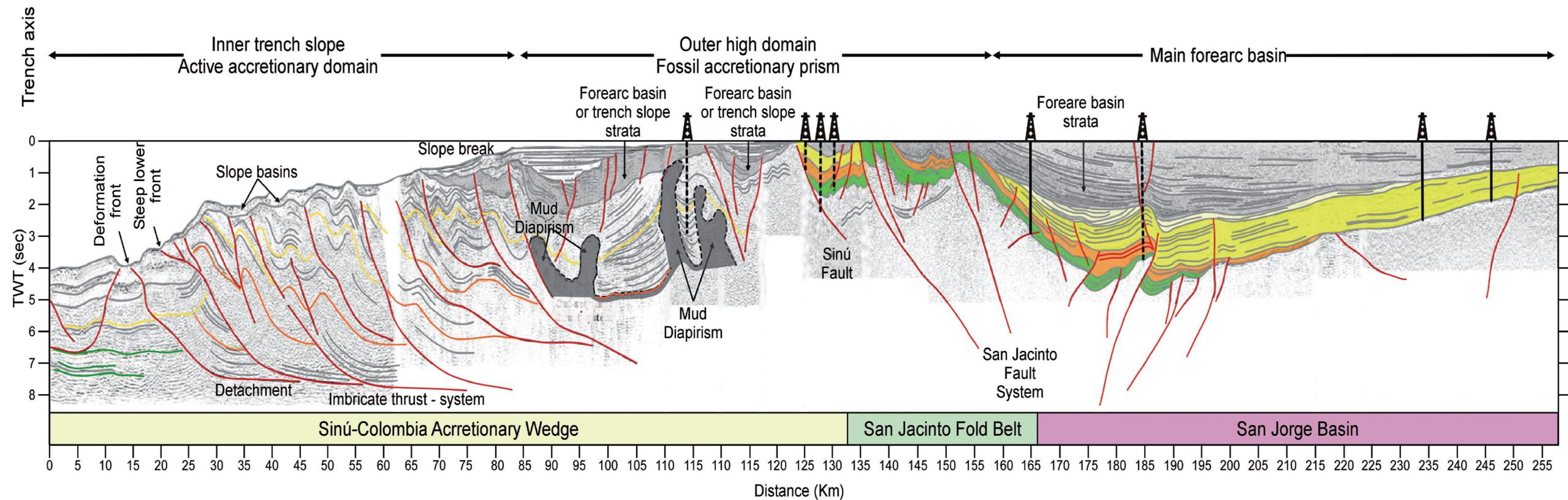
Reservoir
Considered as Source
in Jaraguay



From Lower Magdalena to SSJ

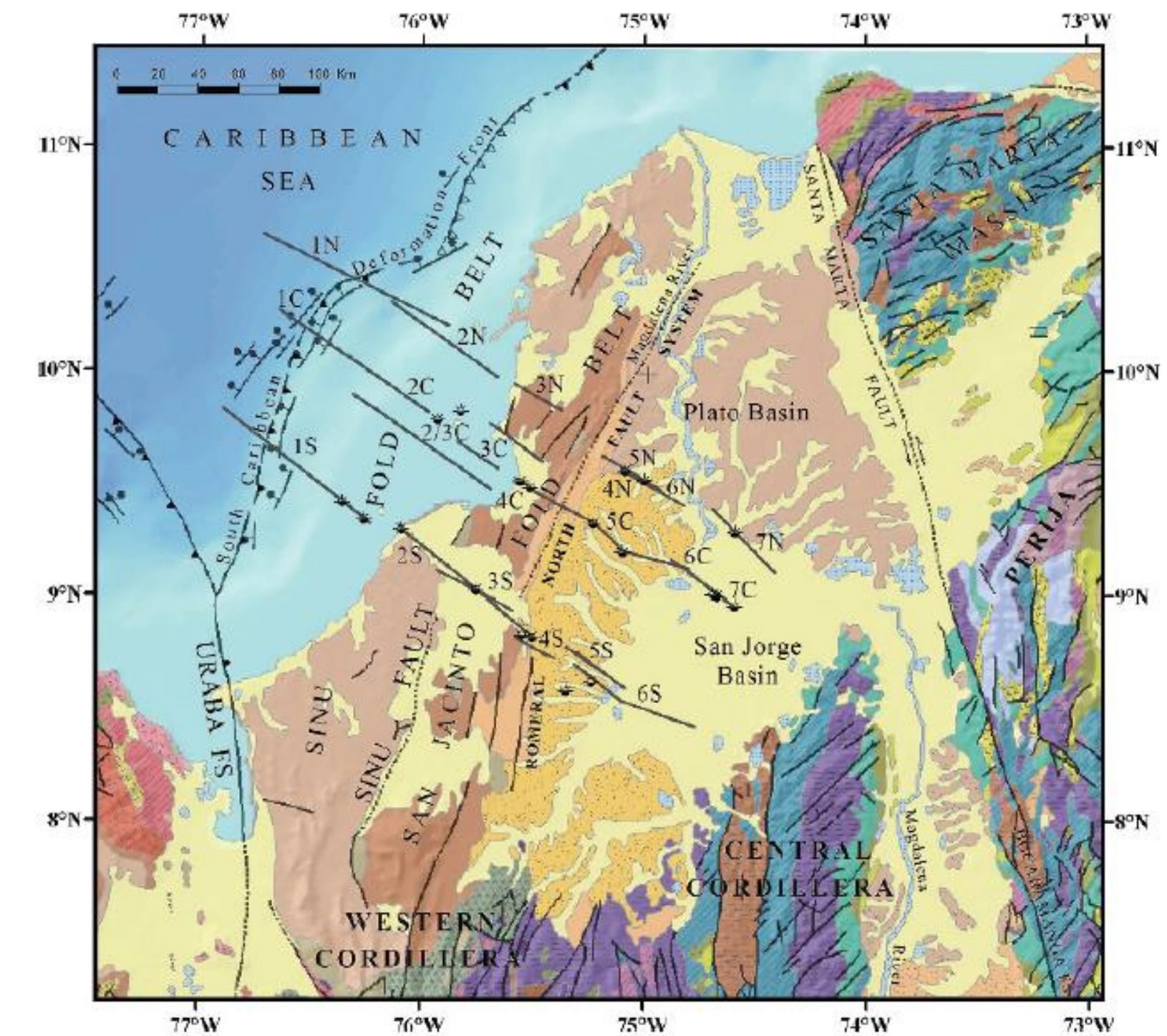
- Fluvial facies of **Tubará Fm.** remains relatively the same (Jaraguay tested production at sandstones of this level)
- Deepest facies to the ones related to the **Porquero Fm.** will be found in the **Floresanto Fm** in the Sinu Basin
- Sandstones of deeper facies to the ones related to the Cienaga De Oro Fm. are known as **Pavo sandstones** in the Sinu basin

STRUCTURAL FRAMEWORK



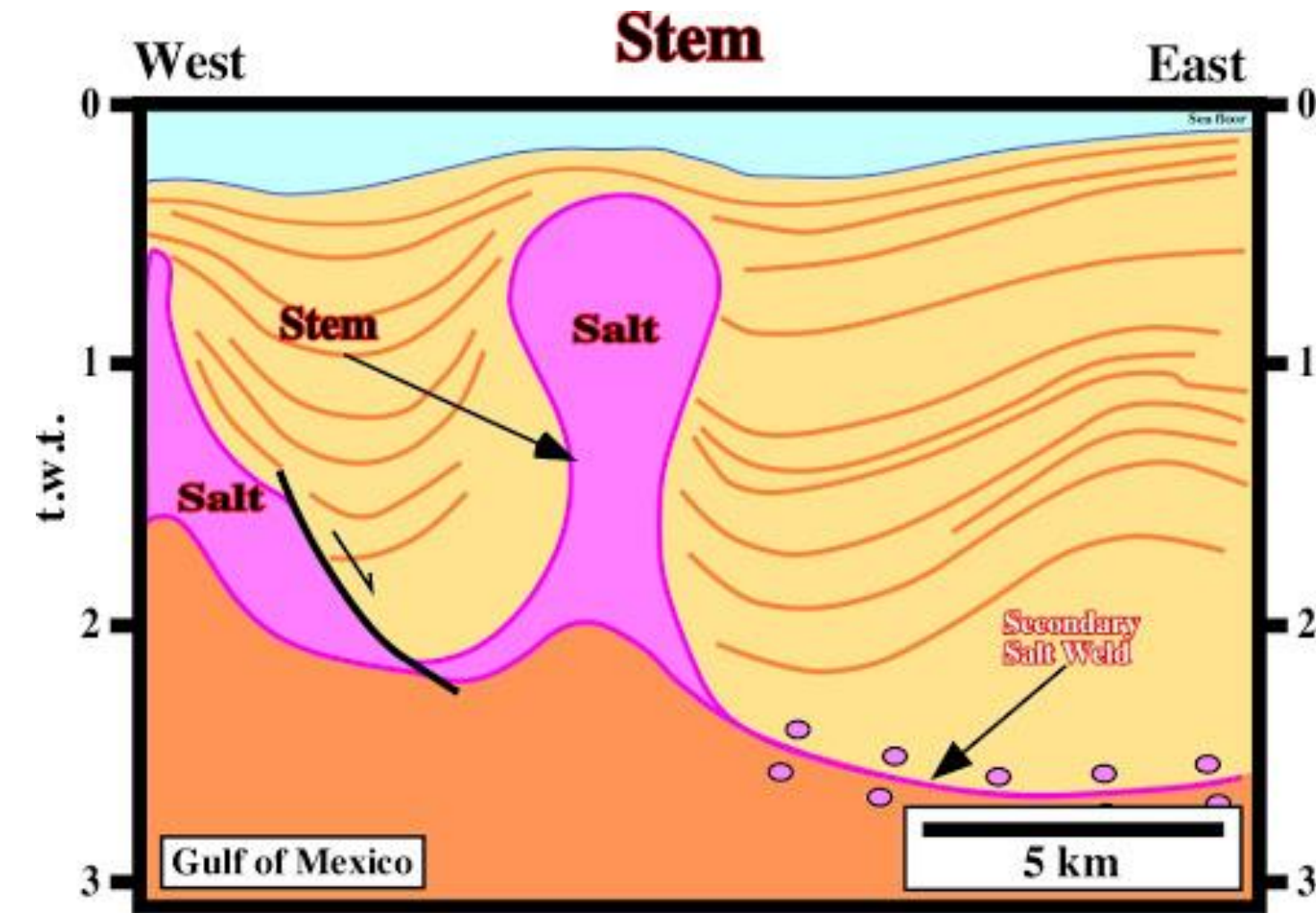
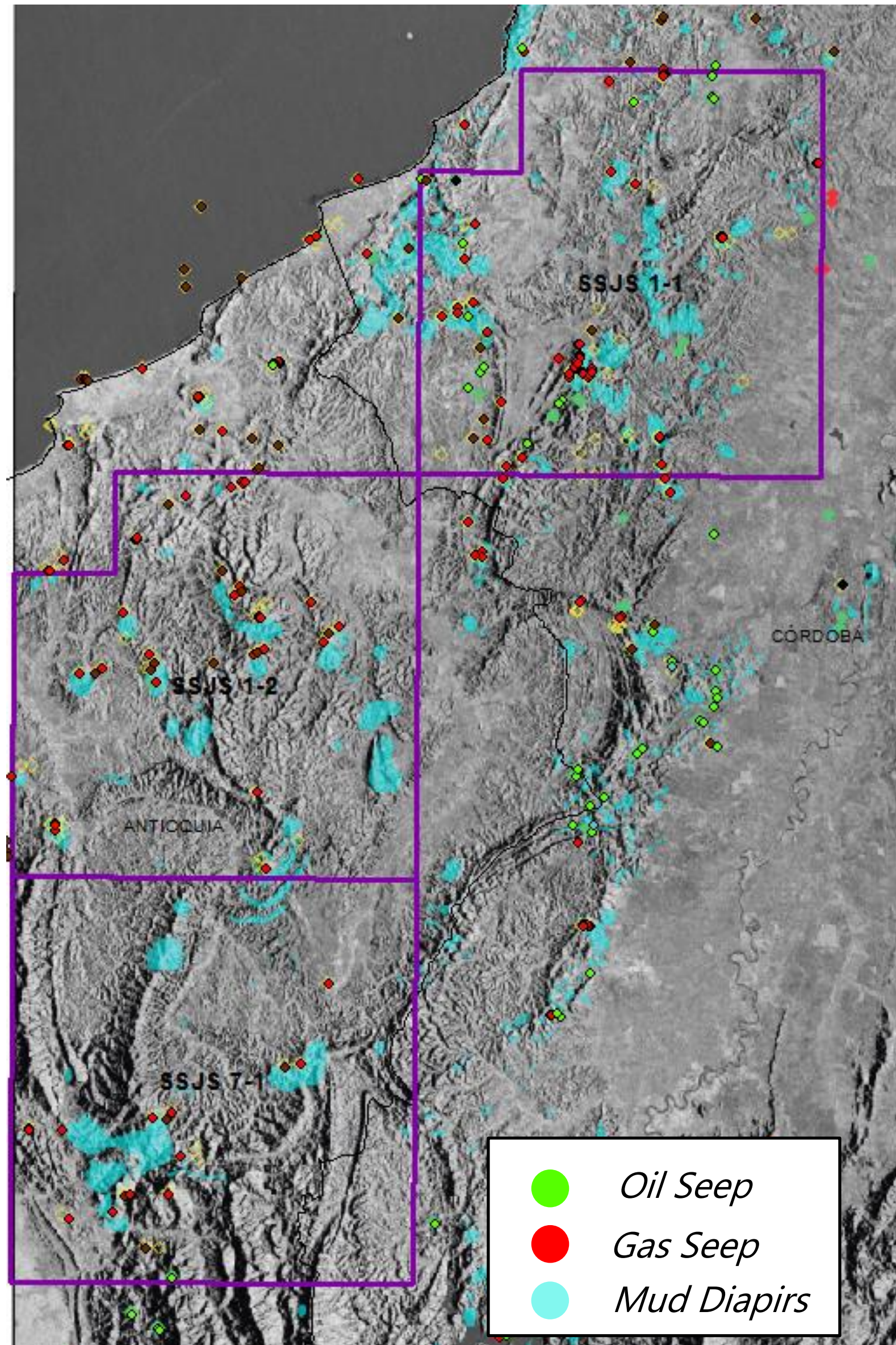
Taken from Mantilla - Pimiento (2009)

- Three major tectonic areas were identified by Mantilla-Pimiento *et al* (2009):
- 1) **An active accretionary prism** with a seaward vergent imbricate thrust system
- 2) **A fossil accretionary prism** including the Sinú Accretionary Wedge and the San Jacinto Fold Belt characterized by growth folding, mud diapirism and normal faulting due to gravitational collapse
- 3) **The San Jorge – Plato Forearc Basin**



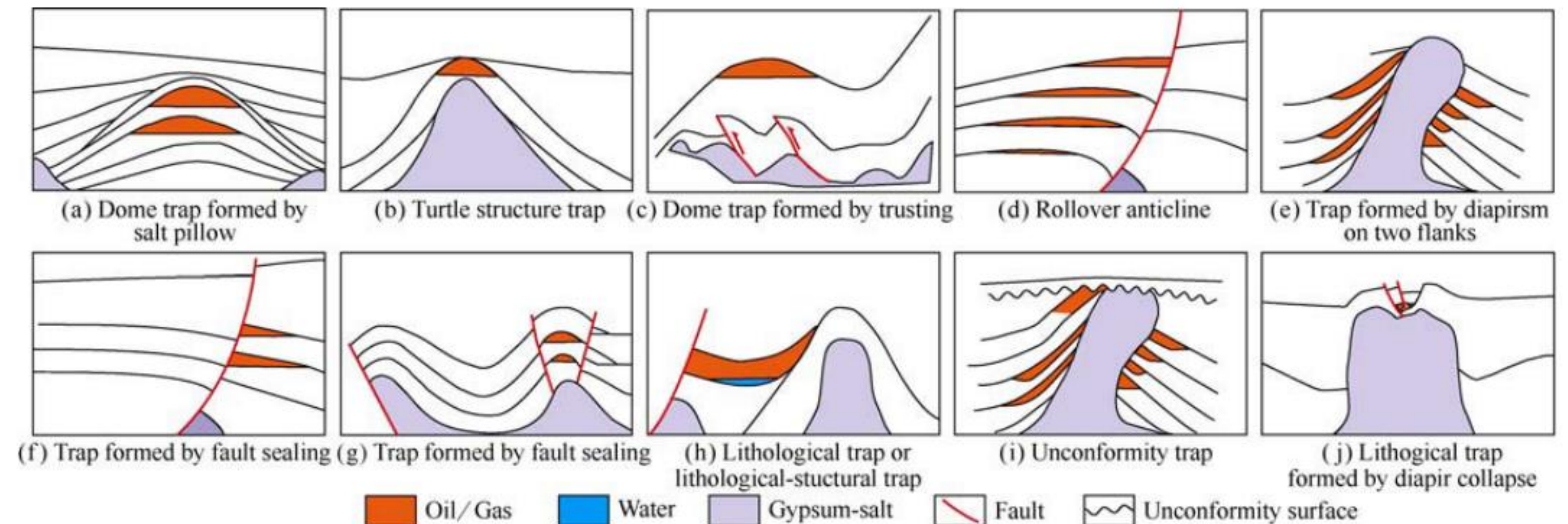
Taken from Mantilla - Pimiento (2009)

MUD DIAPIRISM



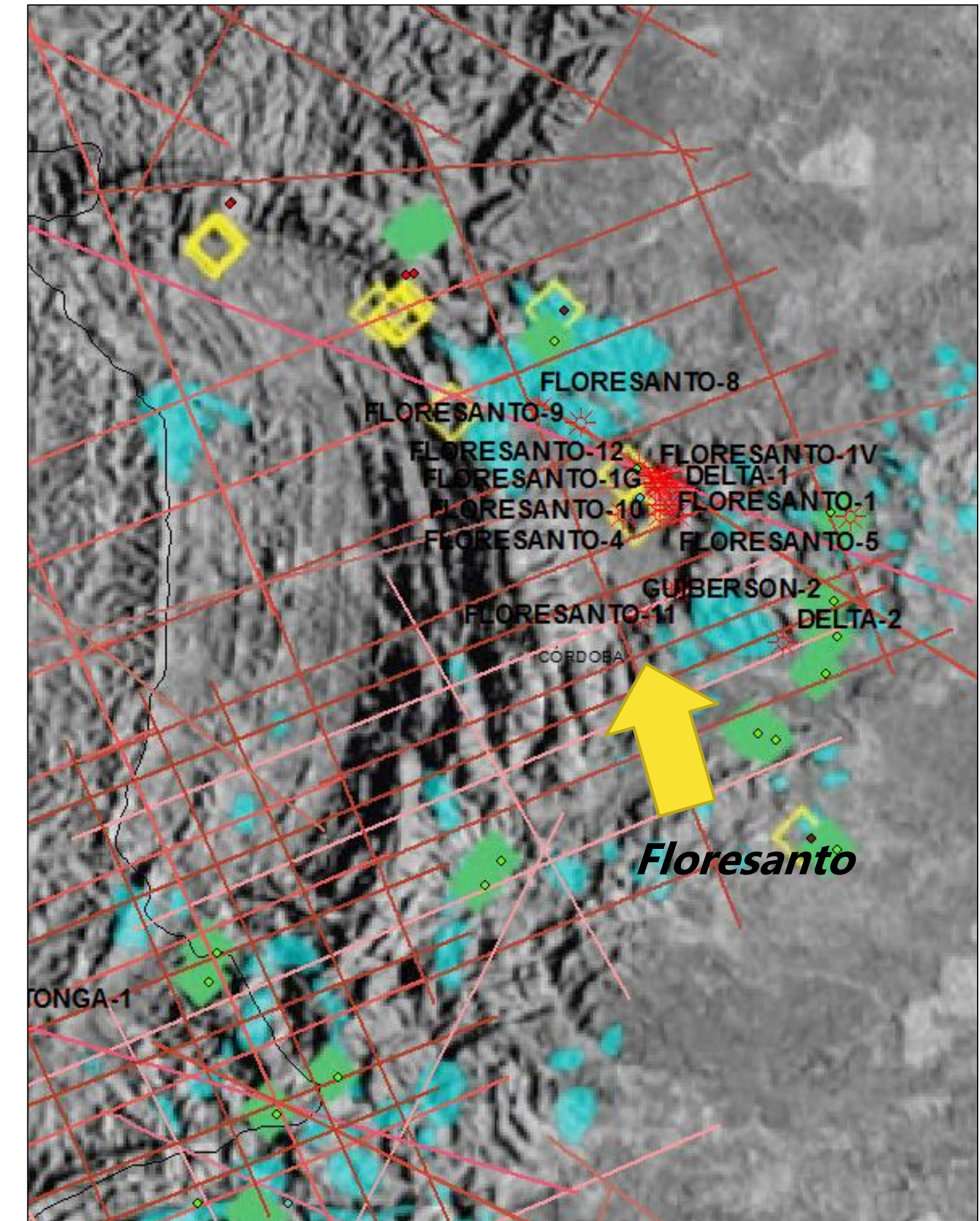
- **Mud diapirism** could be explained based on **salt diapirs schemes** due to its **similarity**
- **Ellipsoid structures** in surface are related to mud diapirs and syntectonic synclines
- **Syntectonic sediments** could be identified because of its difference in thickness
- **Weld faults** could have an importance into traps
- In SSJ mud diapirs have an strong relation with **oil and gas seeps distribution**

Traps associated to diapirism

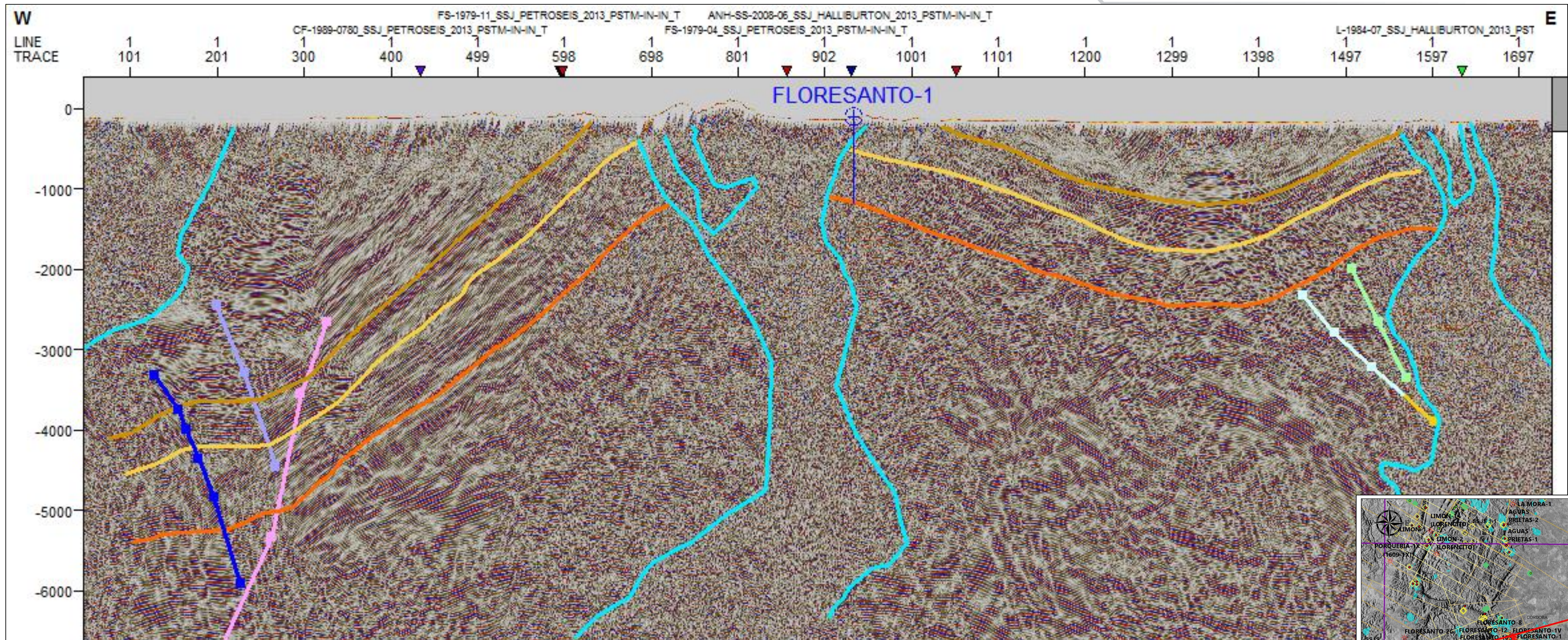


WELL SUMMARY & ANALOGUE FIELDS

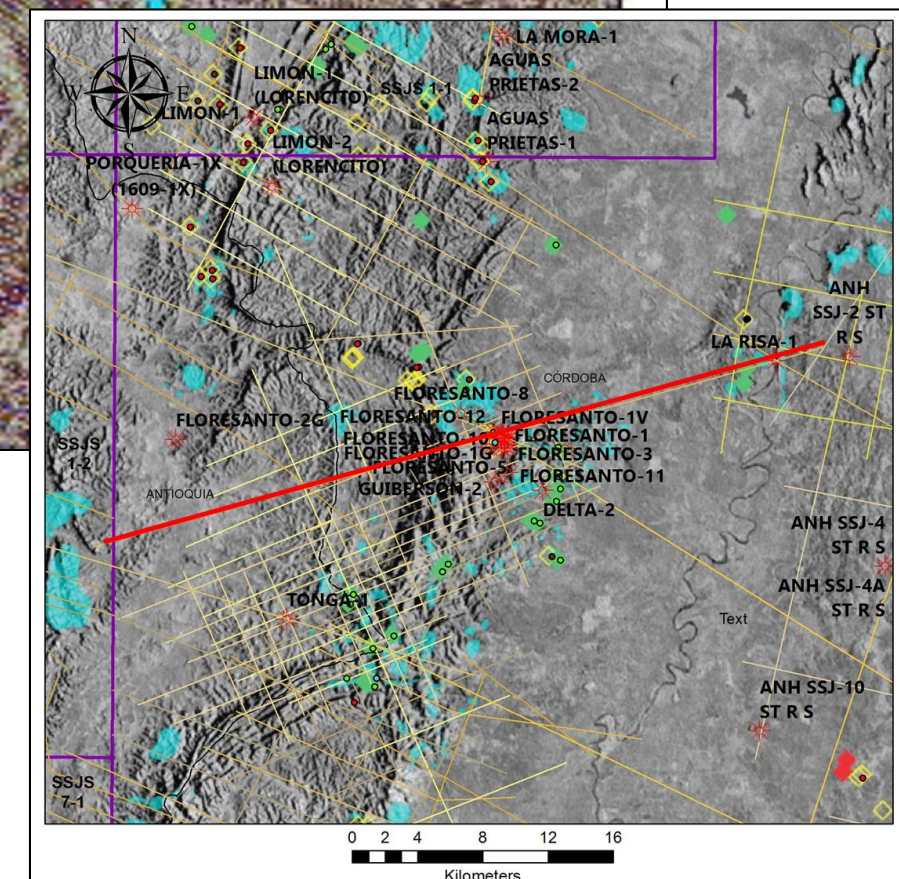
- Twelve (12) wells were drilled from May of **1945** to August of **1947**.
- Most of them were drilled by **Socony-Mobil** and classified as producer wells. However, formal production was only declared in the wells **Floresanto 1** and **Floresanto 6**
- Ten (10) of the twelve (12) wells were shallow (an average of 1,541') and the other two (2): **Floresanto 1** and **Floresanto 10**, reached total depths of 6,936' and 10,876', respectively.
- **Floresanto 1**: Oil production from of the **Floresanto - Pajuil Fm.** (694-614') started in december of 1944. At August of 1945, **28,730 bbls** were produced. (51° API)
- **Floresanto 6**: During tests the well produced 42 bbls in 12 hours (API 50°)



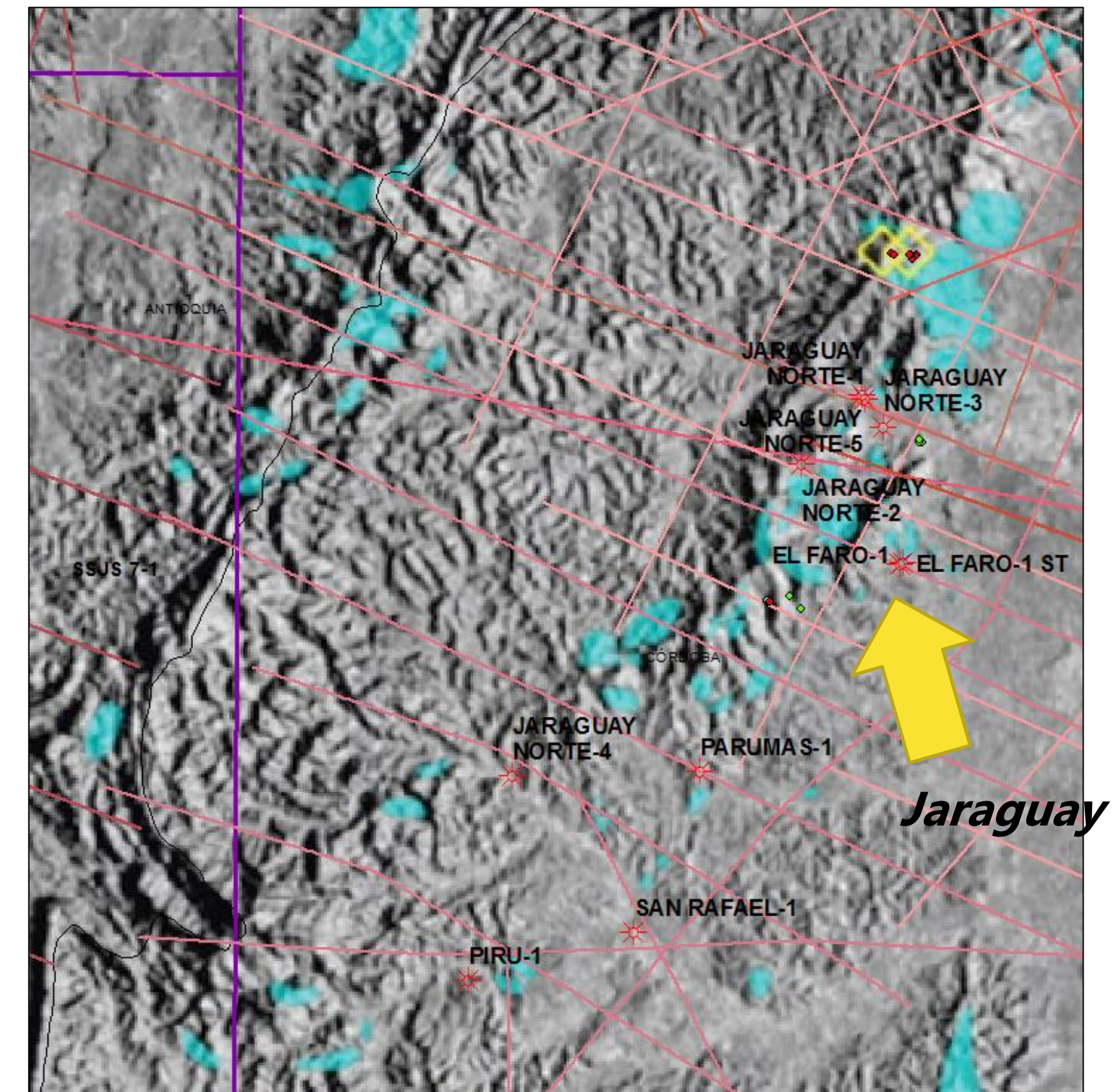
Floresanto: Dip Seismic Line



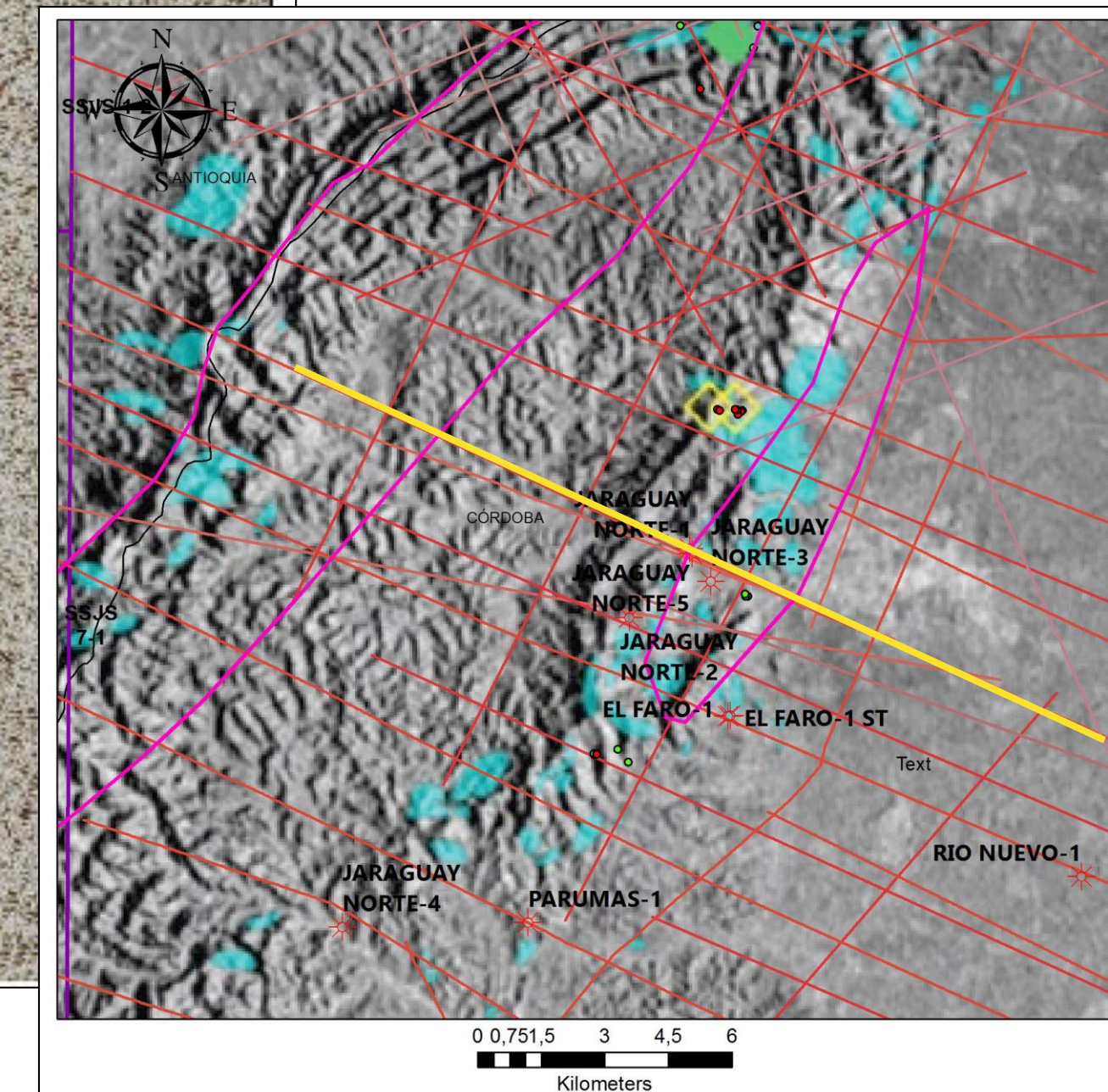
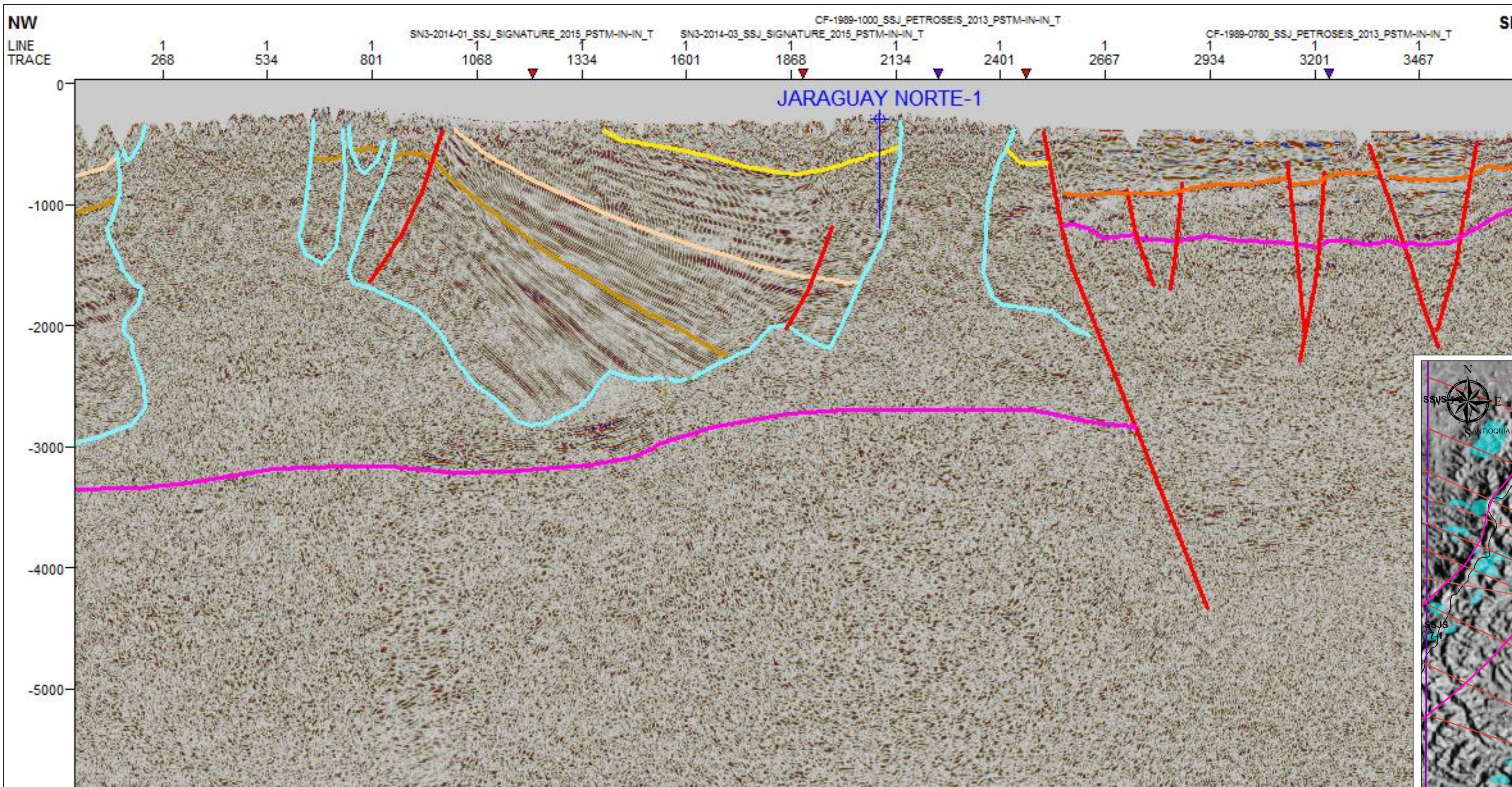
Seismic Dip Line L-1984-09-SSJ



- Jaraguay area is located at the south of the Sinú basin
- At the Jaraguay area, rocks from the Oligocene (Maralú Fm = Lower CDO) to the Pliocene (Corpa Fm.) have been drilled
- Well targets were the equivalents of the Lower Porquero Fm (Floresanto Fm) and Cienaga de Oro Fm (Pavo Fm).
- Total depths of the Jaraguay Norte wells were reached between 2,500 and 5,000'. The well Jaraguay Sur-1 reached 8,002'
- Oil found in production tests and seeps in the area are considered as light oil (>40° API)
- Pavo sandstones are considered as the best reservoir in the area
- **Jaraguay Norte – 1:** During production tests in the Floresanto Fm. **3,5 bls** of 48°API oil were obtained at the interval 1,834' – 2,338', **6,3 bls** of 47°API at the interval 1,148' – 1,364'. The well produced at its peak **126 BOPD**
- **Jaraguay Norte – 3:** During tests only one gallon of oil were recovered

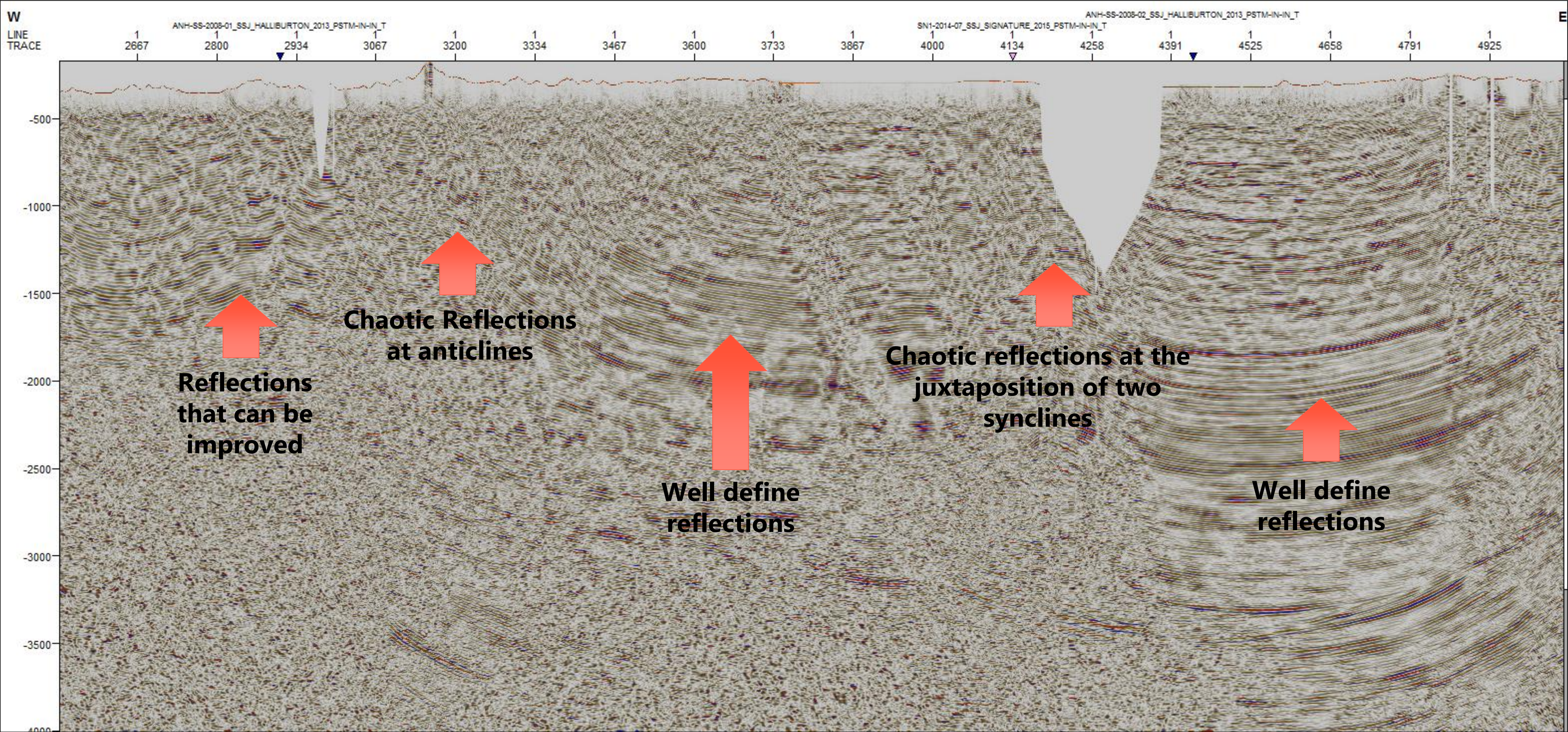


Jaraguay Norte: Dip Seismic Line



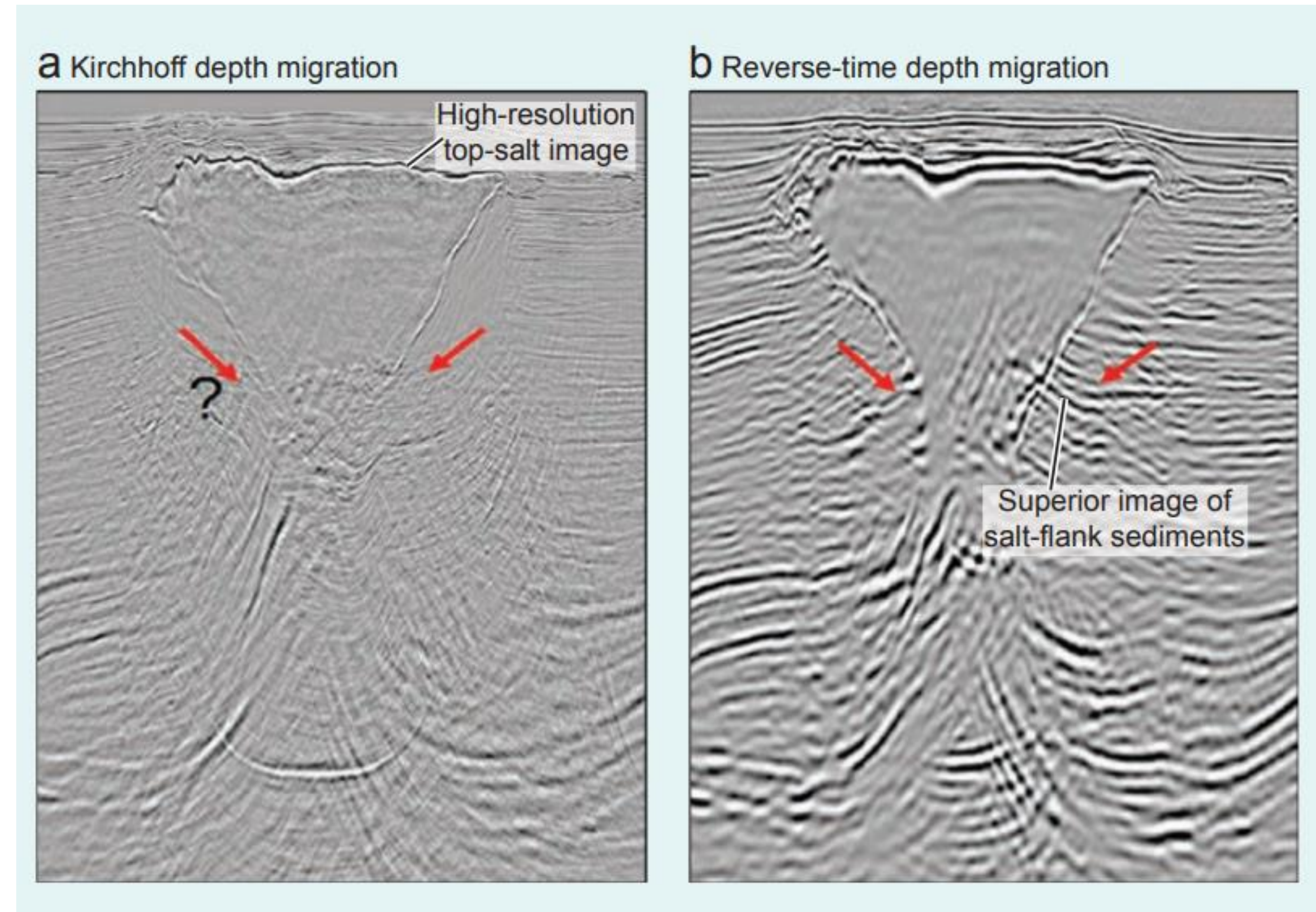
SEISMIC QUALITY

SEISMIC QUALITY



SEISMIC QUALITY: How to improve?

- Historically, getting well seismic imaging at the Sinu - San Jacinto basin has always been considered a challenge
- Geophysically speaking it is probably that the image is correct and anticlines does not exist properly
- Mud diapirism is controlling strongly the basin and its seismic signature is dominantly chaotic reflectors
- Chaotic reflections have well defined geometries that matches with surface geology
- RTM (Reverse Time Migration) could be a tool to improve imaging

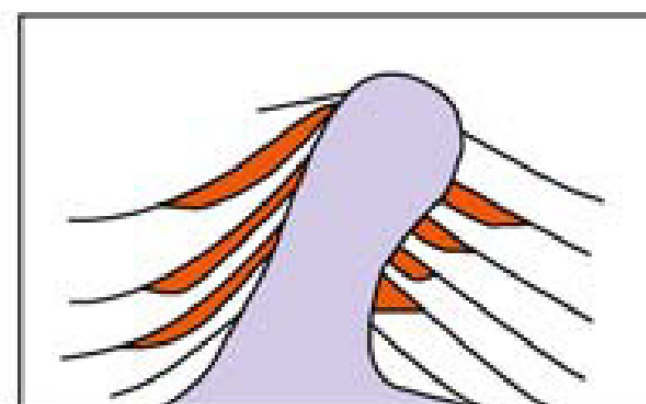
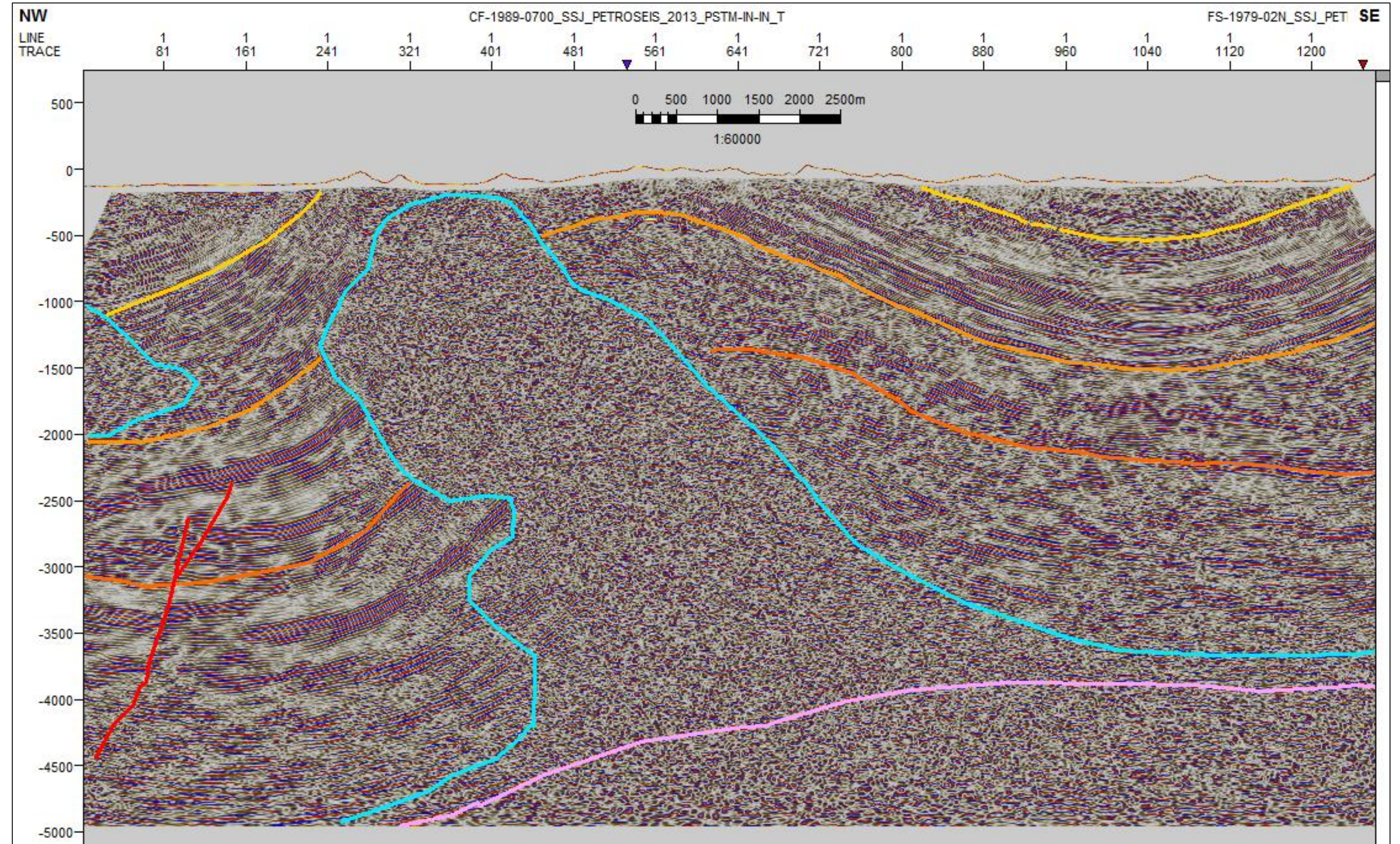
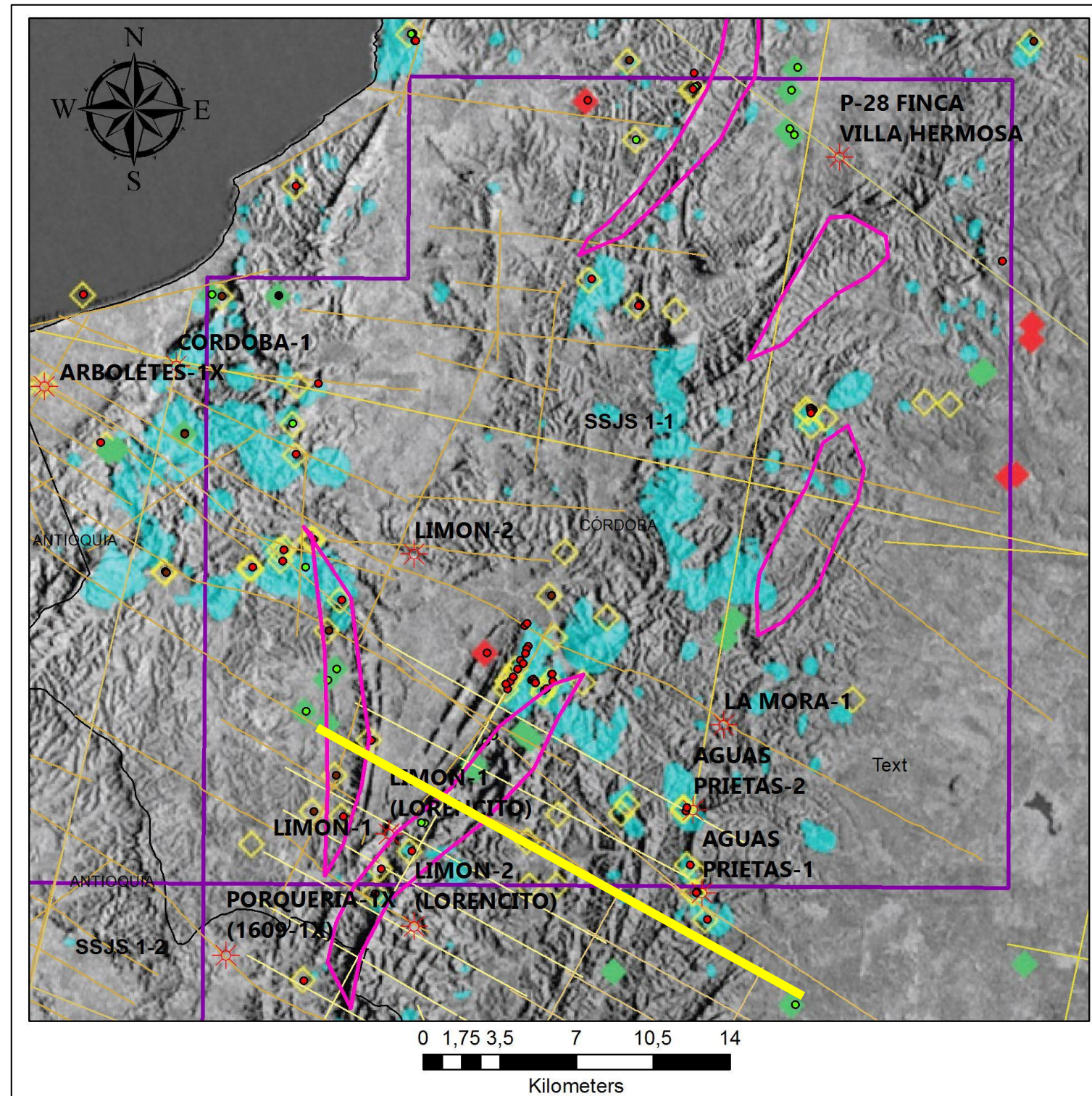


SEISMIC INTERPRETATION

Three Different Types of Traps

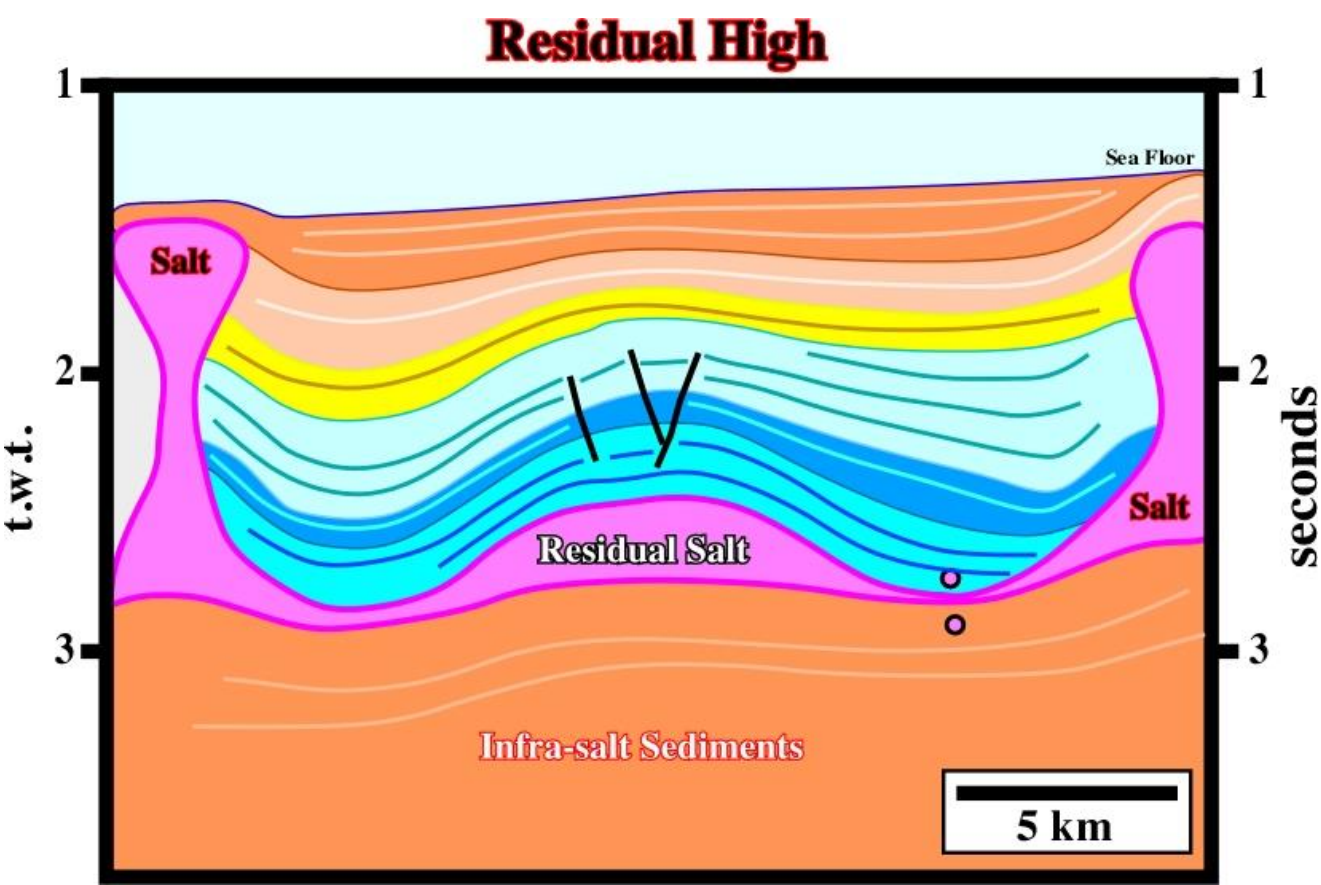
- 1) Traps on Flanks
- 2) Anticlines with Normal Faults by Collapse
- 3) Unconformities

SEISMIC INTERPRETATION SSJ 1-1: Traps on flanks

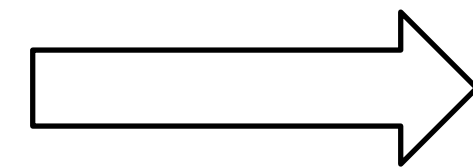
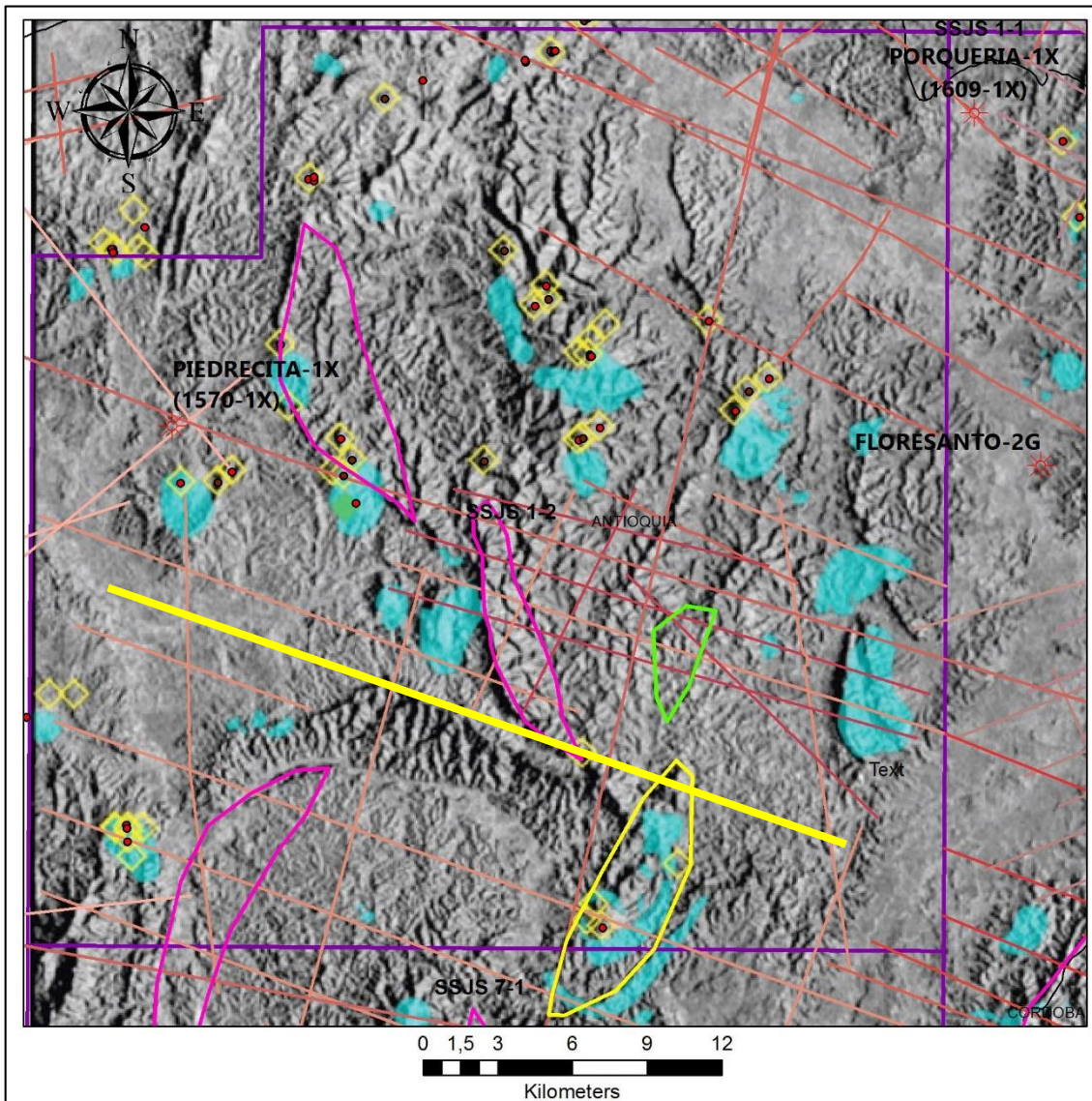


(e) Trap formed by diapirism
on two flanks

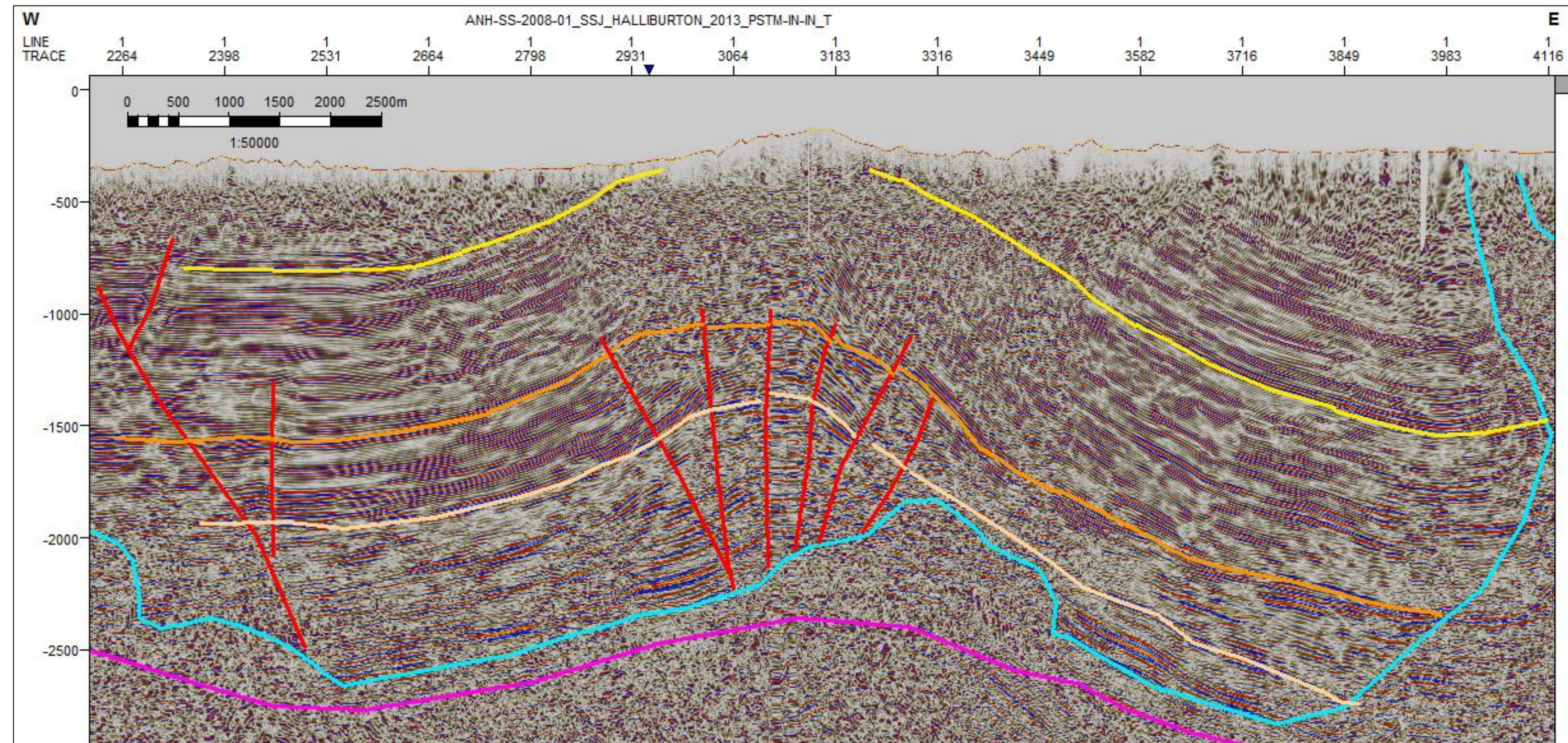
SEISMIC INTERPRETATION SSJ 1-2: Anticline with normal faults by collapse



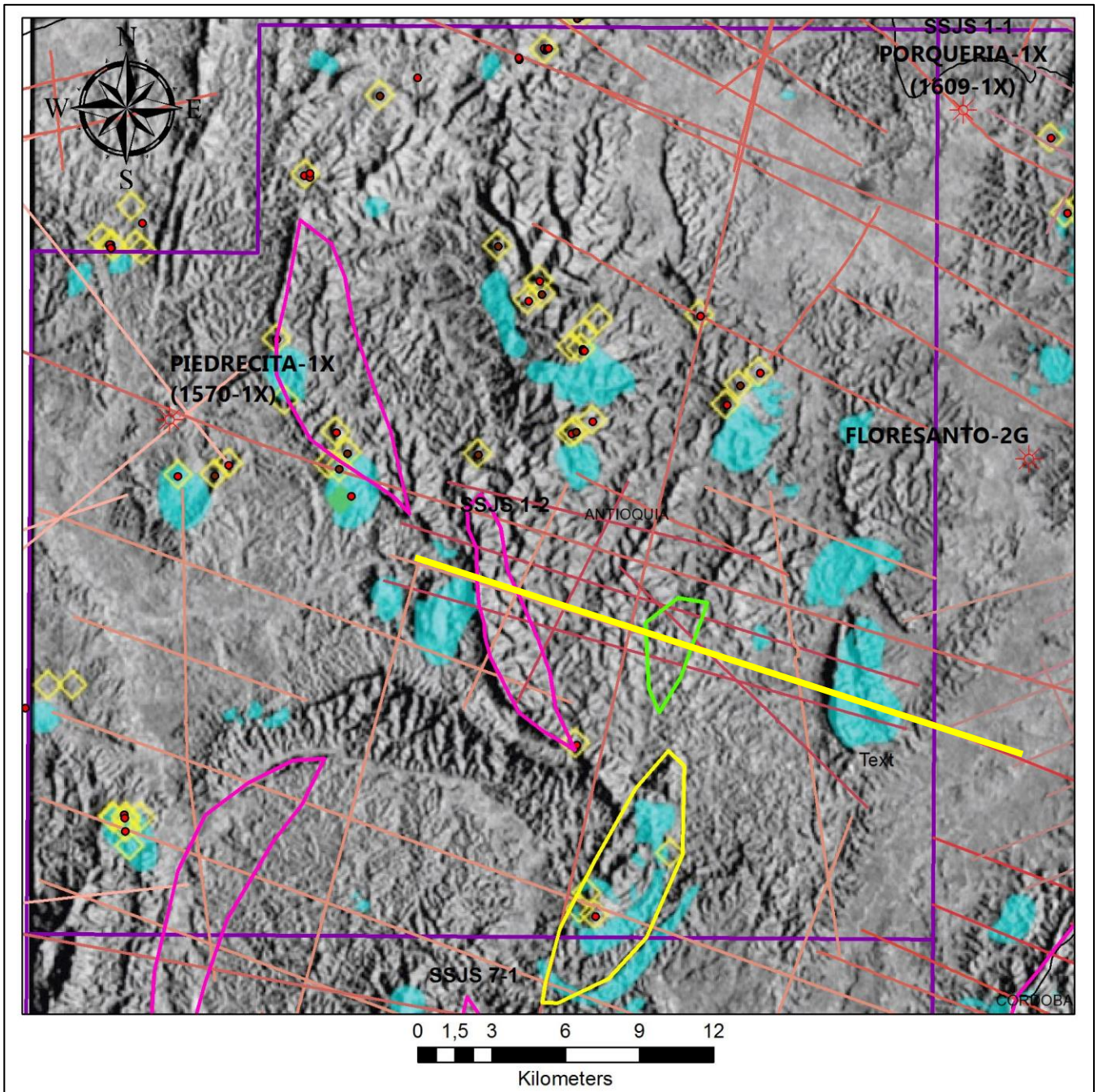
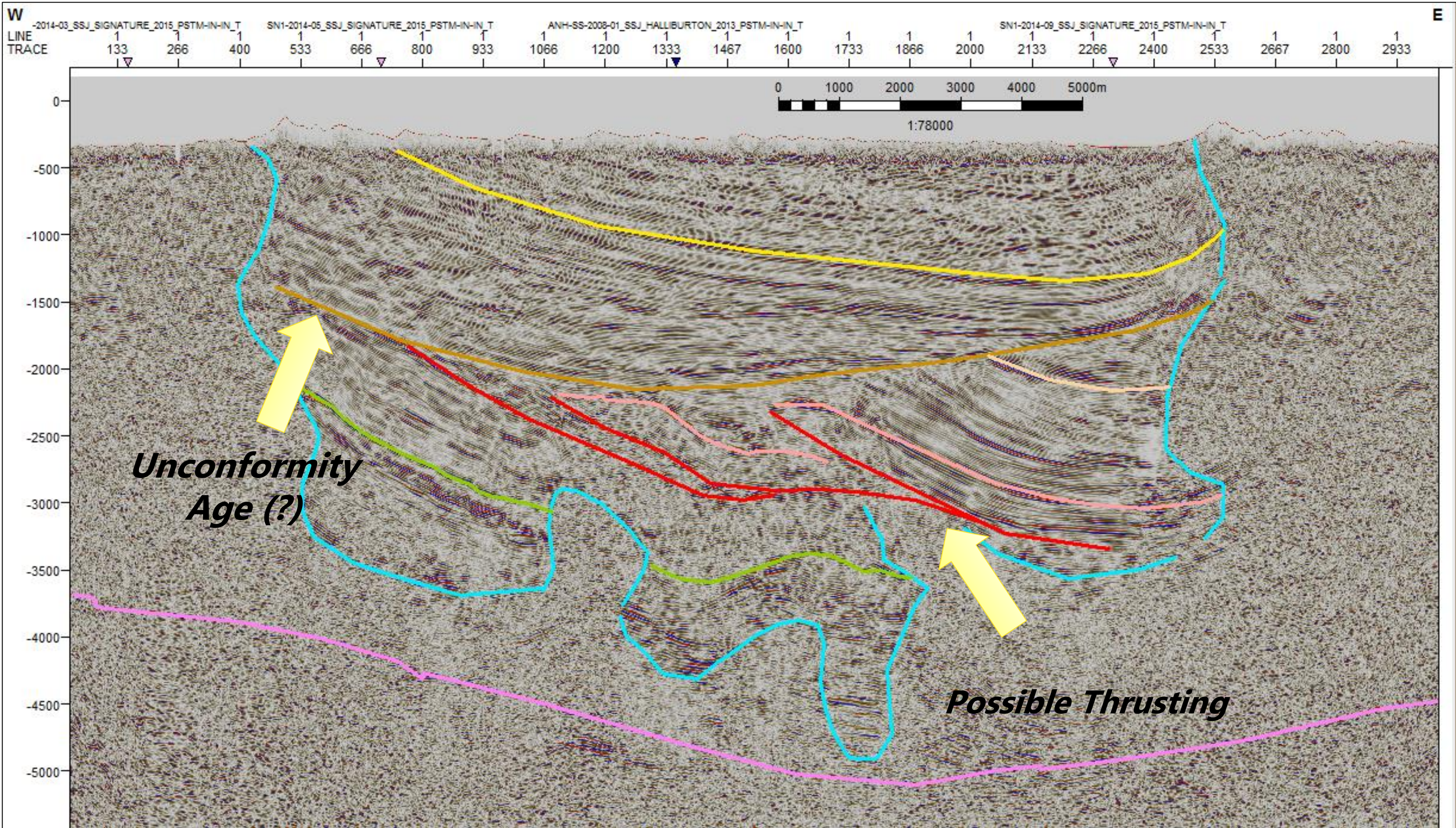
Taken from (Seffel, 1968)



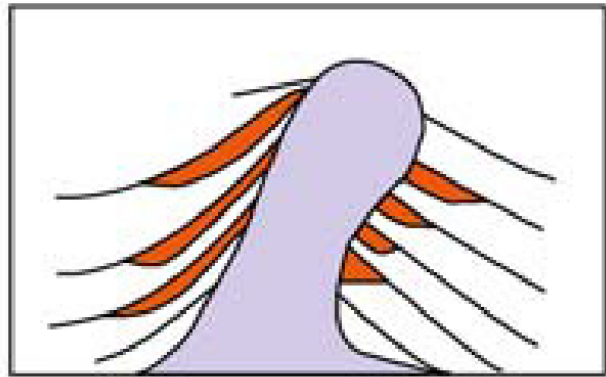
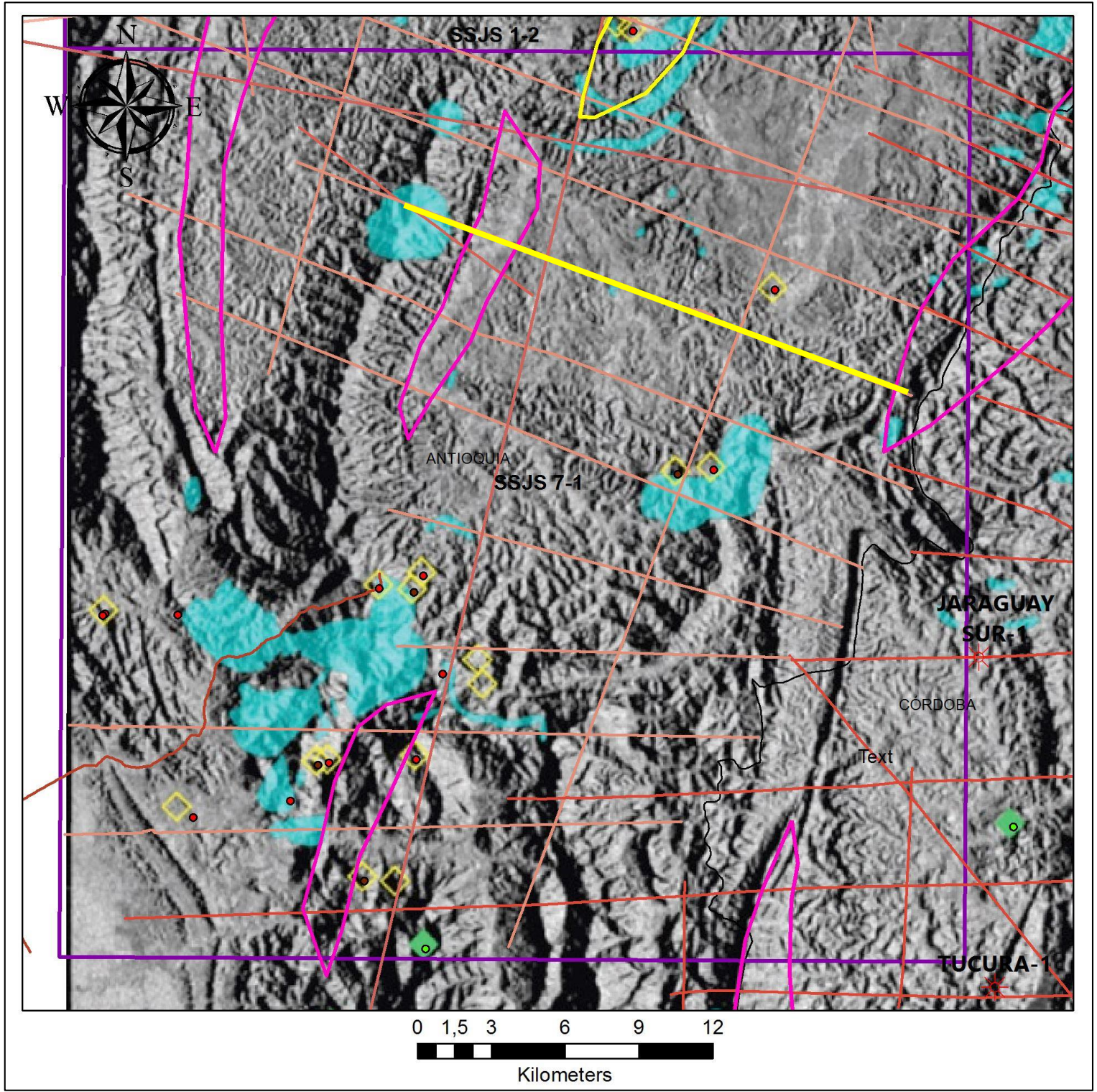
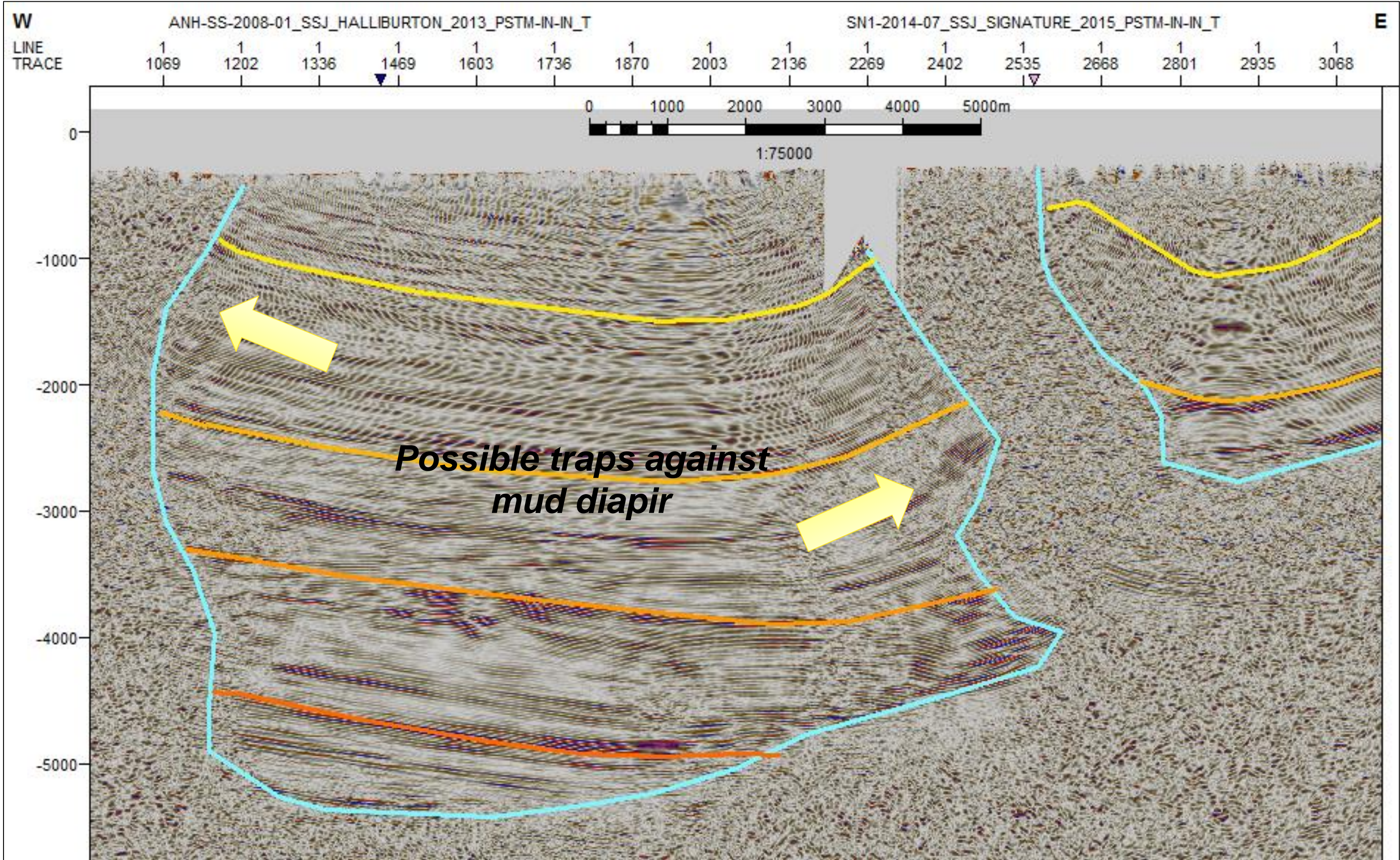
Residual High: Antiforms formed as an early stage of "Turtle Back" structures



SEISMIC INTERPRETATION SSJ 1-2: Unconformities



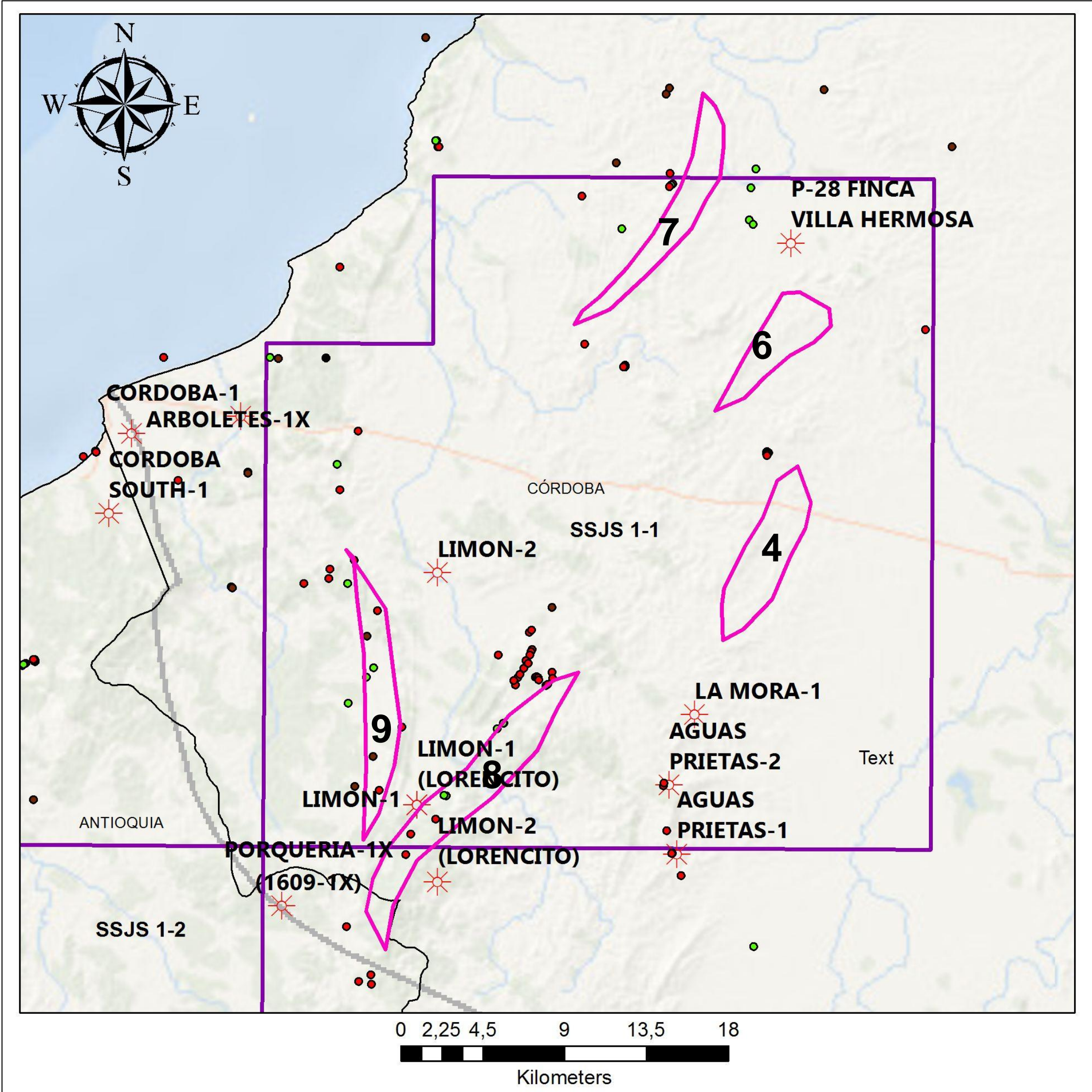
SEISMIC INTERPRETATION SSJ 7-1: Traps on flanks



(e) Trap formed by diapirism on two flanks

RECOVERABLE PROSPECTIVE RESOURCES

VOLUMETRICS SSJ 1-1:



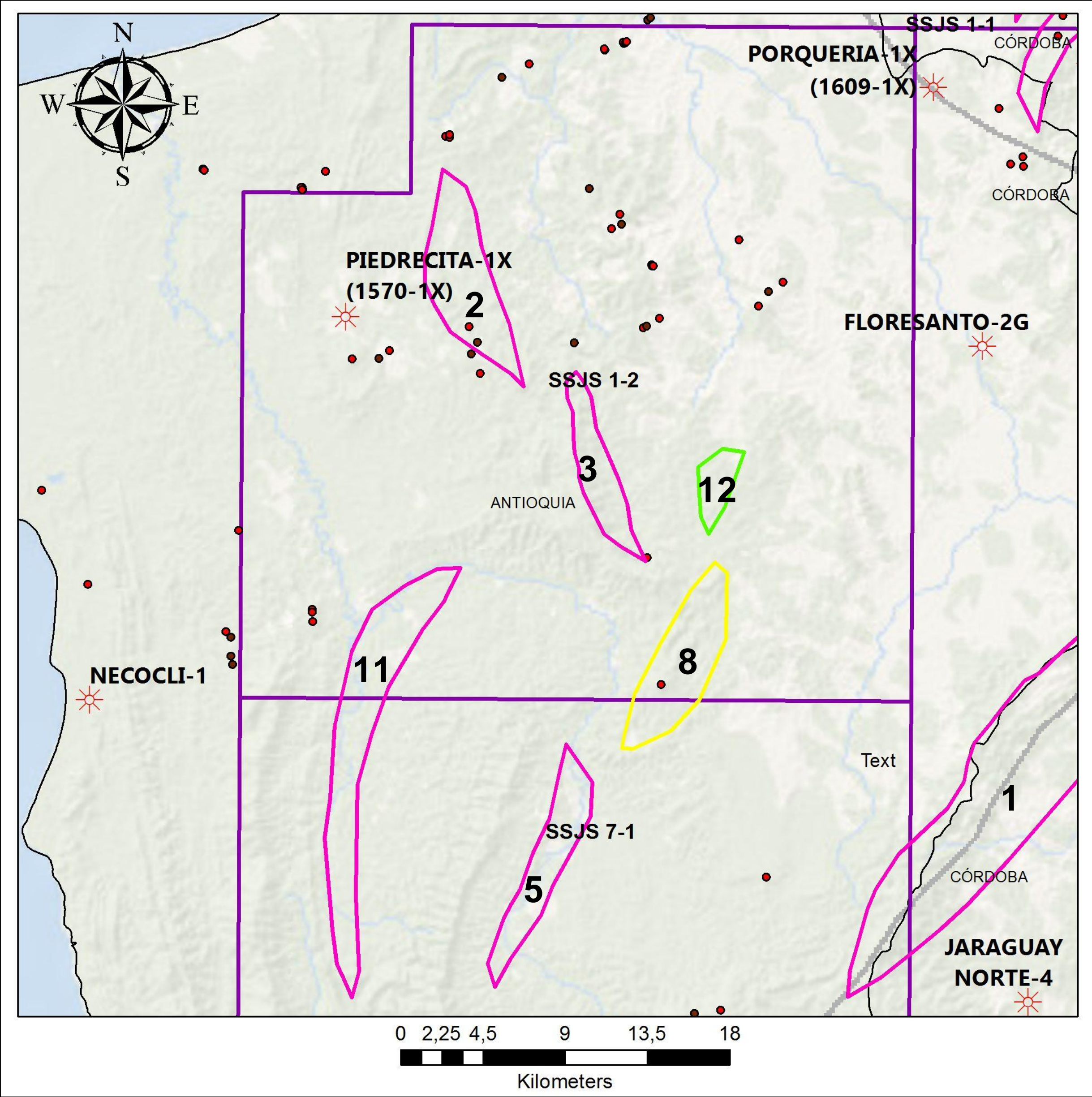
5 LEADS

Recoverable Prospective Resources

Lead No	OOIP MMBO	R. Prospective Resources MMBO
4	90,64	13,59
6	64,78	9,72
7	82,38	12,36
8	143,43	21,51
9	86,55	12,98

Lead	Area
4	20,86 km ²
6	14,91 km ²
7	18,96 km ²
8	33,01 km ²
9	19,92 km ²

VOLUMETRICS SSJ 1-2



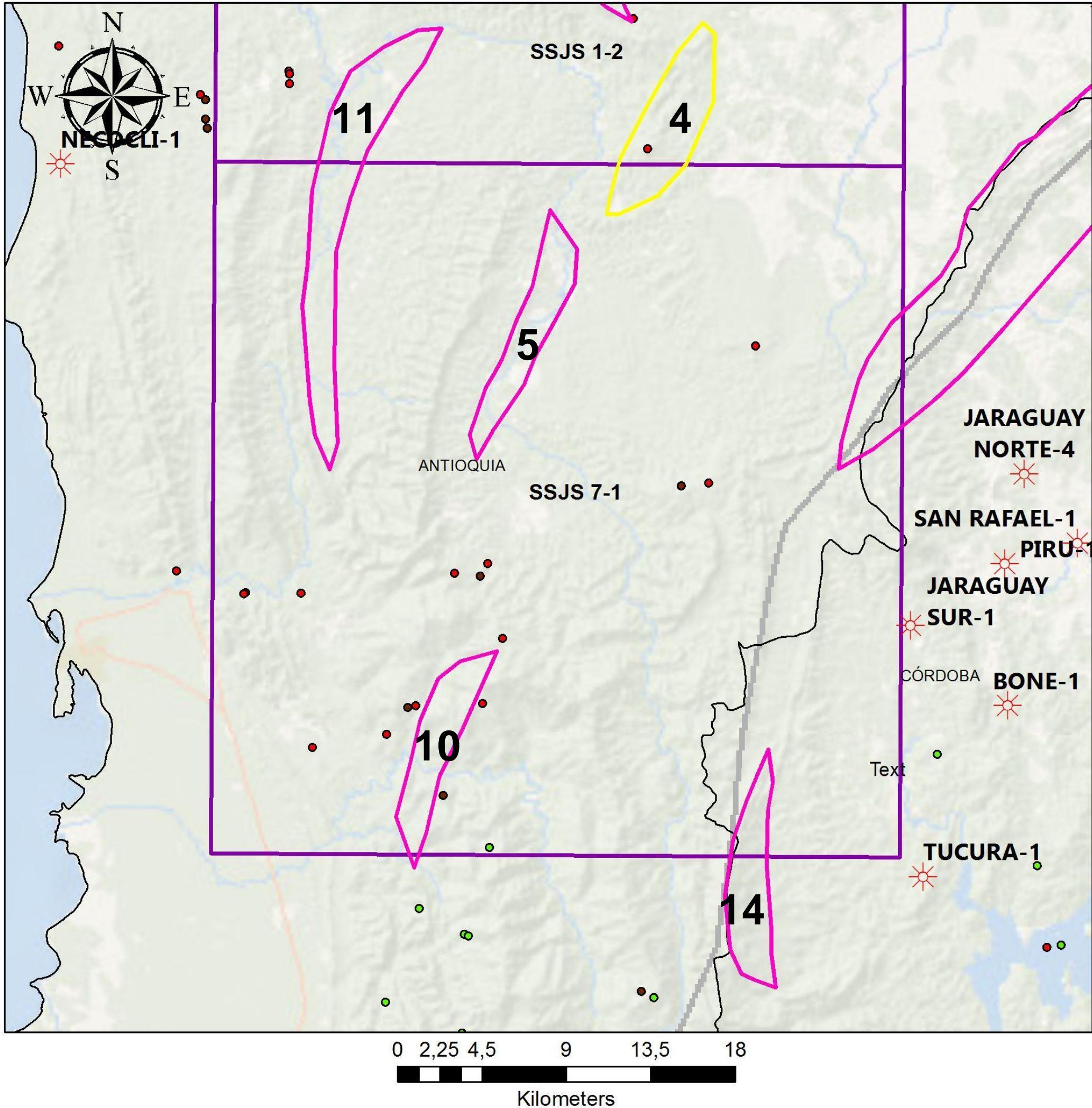
5 LEADS

Recoverable Prospective Resources

Lead No	OOIP MMBO	R. Prospective Resources MMBO
2	127,62	19,14
3	66,09	9,91
8	143,44	21,51
11	198,88	29,93
12	28,72	4,31

Lead	Area
2	29,37 km ²
3	15,21 km ²
8	33,01 km ²
11	45,77 km ²
12	6,61 km ²

VOLUMETRICS SSJ 7-1

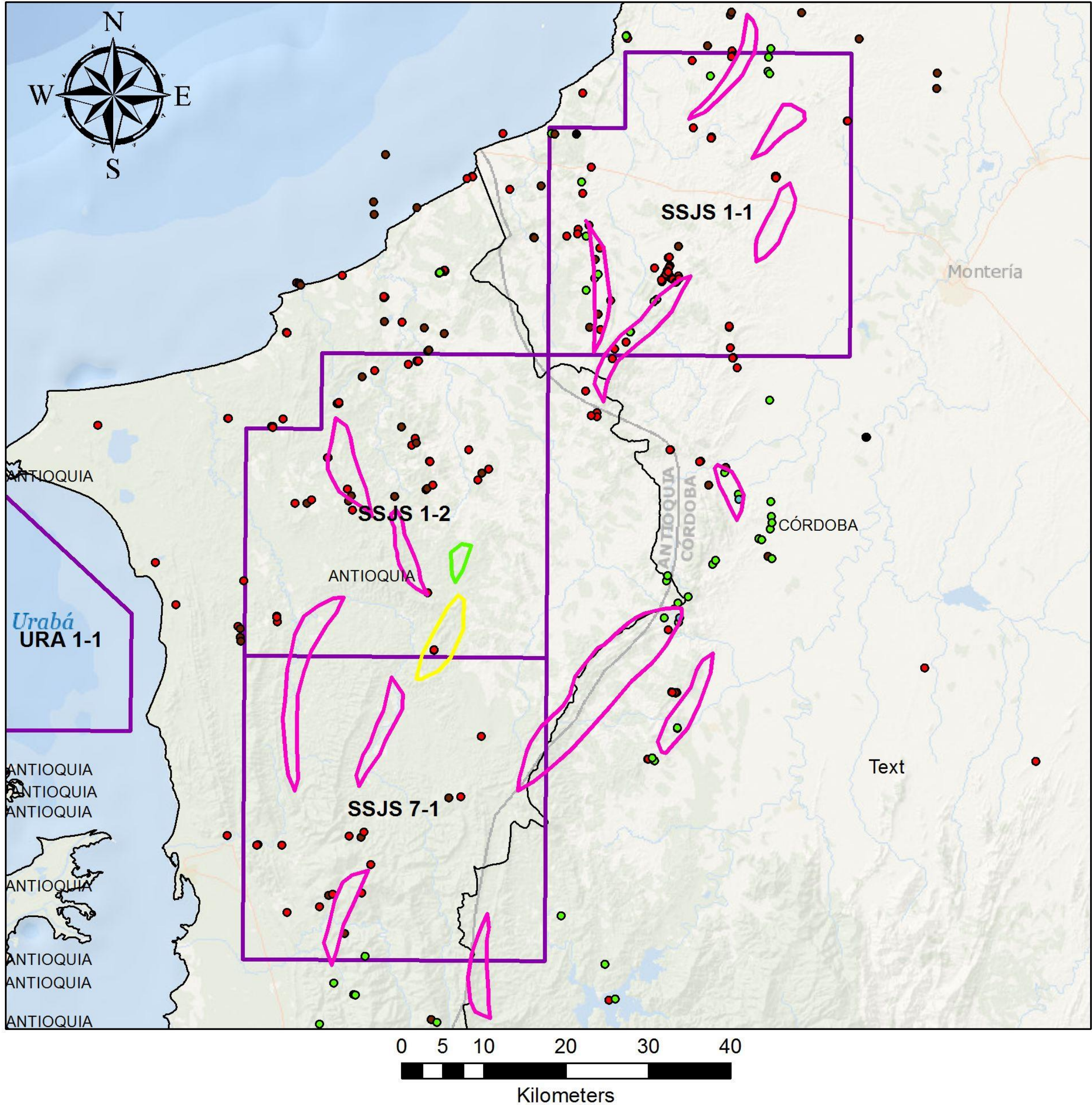


5 LEADS Recoverable Prospective Resources

Lead No	OOIP MMBO	Prospective Resources MMBO
4	90,64	13,60
5	92,42	13,86
10	89,55	13,431
11	198,88	29,83
14	91,21	13,68

Lead	Area
4	20,86 km ²
5	21,27 km ²
10	20,61 km ²
11	45,77 km ²
14	20,99 km ²

VOLUMETRICS: TOTAL



Oil (Deterministic)

- **13 leads in total**
- **OOIP: 1,282.51 MMBls**

Recovery factor 50%
Chance of success 30%

- **Prospective Resources**

High Estimate	1,282.51 MMBls
Best Estimate	641.25 MMBls
Low Estimate	128.2 MMBls

CONCLUSIONS

- The area **despite of being unexplored** has a **very long history of exploration**, including wells of the **Floresanto field** drilled from 1945 to 1947 by Socony Mobil and wells of the **Jaraguay Norte field** drilled in 1981 by Petrocol.
- **7 wells** and **3,101 Km** of 2D seismic have been acquired in the mega area including SSJ 1-1, SSJ-2, SSJ 7-1 areas.
- Maralu (Eocene) and **Cansona (Upper K) Formations** are considered as the source rock in the area and the **Pavo sandstones, Floresanto** and **Pajuil Formations** are considered as the reservoirs
- The synclines and main structures in the area are dominated by the dynamic of mud diapirs with a source possibly at Oligocene Sediments
- Two fields have shown production in the area: Floresanto (**28,730 bls/51°API**) and Jaraguay Norte (**126 BOPD bls/48°API in Jaraguay Norte -1**) with **12** and **5** wells drilled respectively
- The seismic imaging could be improved using **wave-based migration** techniques such as RTM (**Reverse Time Migration**)
- **Three different sort of traps** have been identified: 1) traps at **mud diapir flanks**, 2) **anticlines with normal faults by collapse** and 3) traps **related to unconformities**, being the first one the most common
- Inside the areas offered by the ANH, **13 leads have been mapped** using surface geology and seismic interpretation with a **best estimate of recoverable prospective resources of 641,25 MMBls**.

Thanks

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