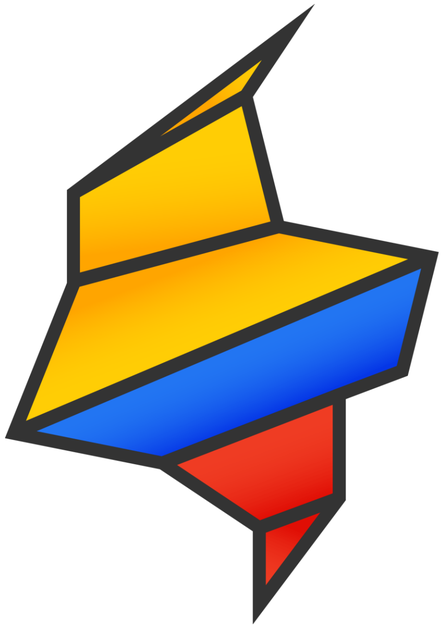
ANH
AGENCIA NACIONAL DE HIDROCARBUROS

El futuro es de todos

Minenergía



COLOMBIA ROUND 2021

UNIVERSIDAD NACIONAL DE COLOMBIA

UNIVERSIDAD DE CALDAS

Uptc Universidad Pedagógica y Tecnológica de Colombia

UNIVERSIDAD DE PAMPLONA

ACGGP ASOCIACIÓN COLOMBIANA DE GEÓLOGOS Y GEOFÍSICOS DEL PETRÓLEO

AAPG

SEG

Acipet Asociación Colombiana de Ingenieros de Petróleos

acp

EAGE

COLOMBIA ROUND 2021

SINU – SAN JACINTO

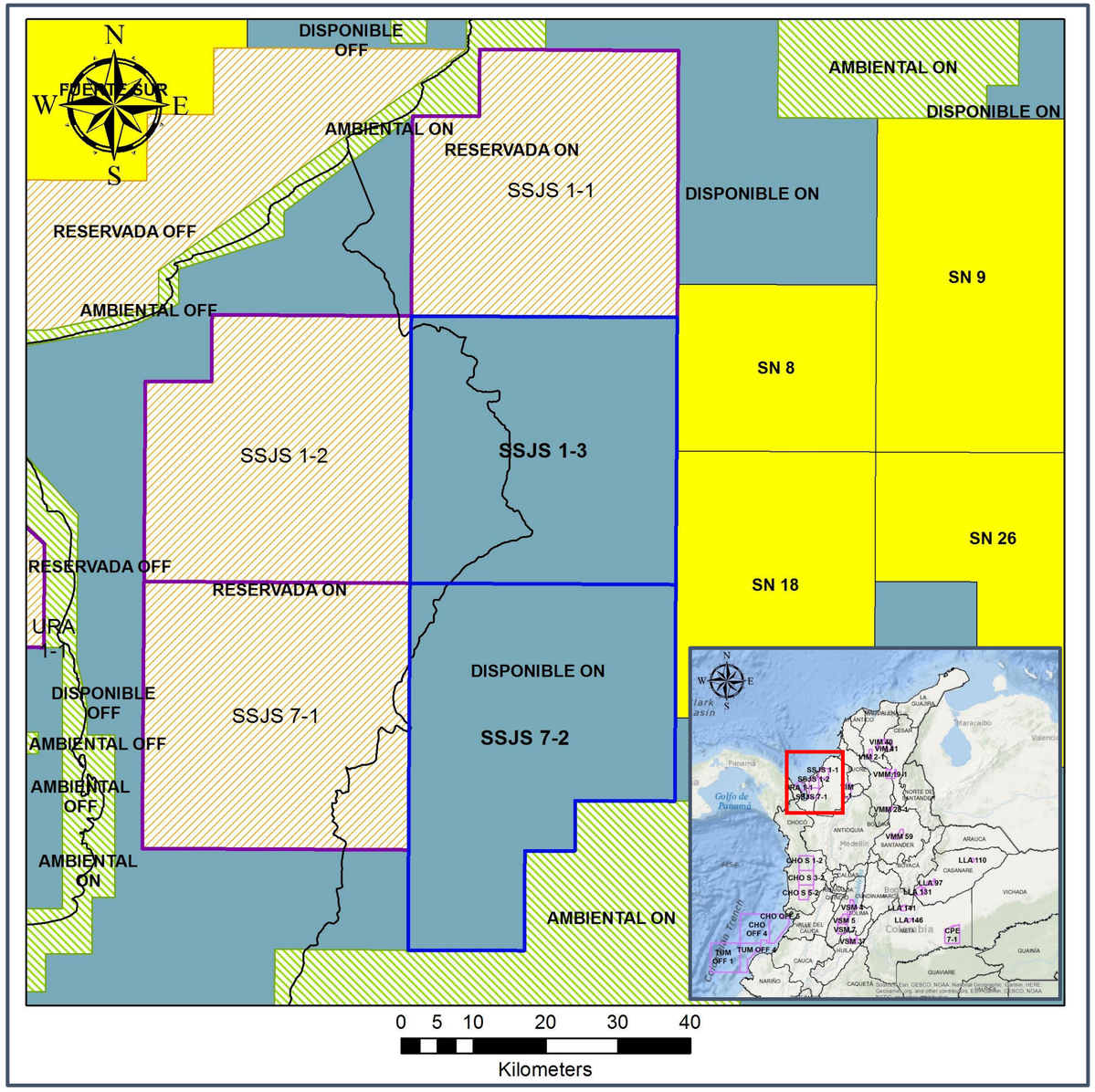
UNDEVELOPED ALREADY DISCOVERED RESERVOIRS (UADR) & INCORPORATED AREAS

27/08/2021

COLOMBIA ROUND 2021

CONTENT

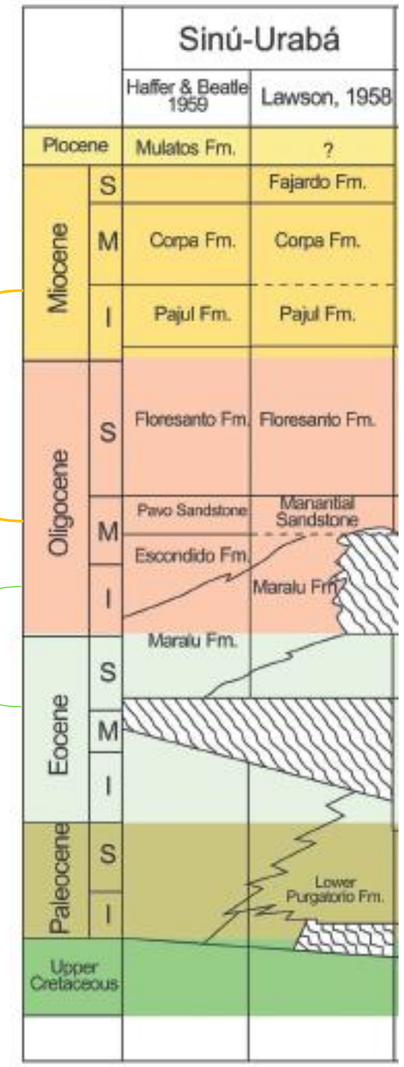
LOCATION

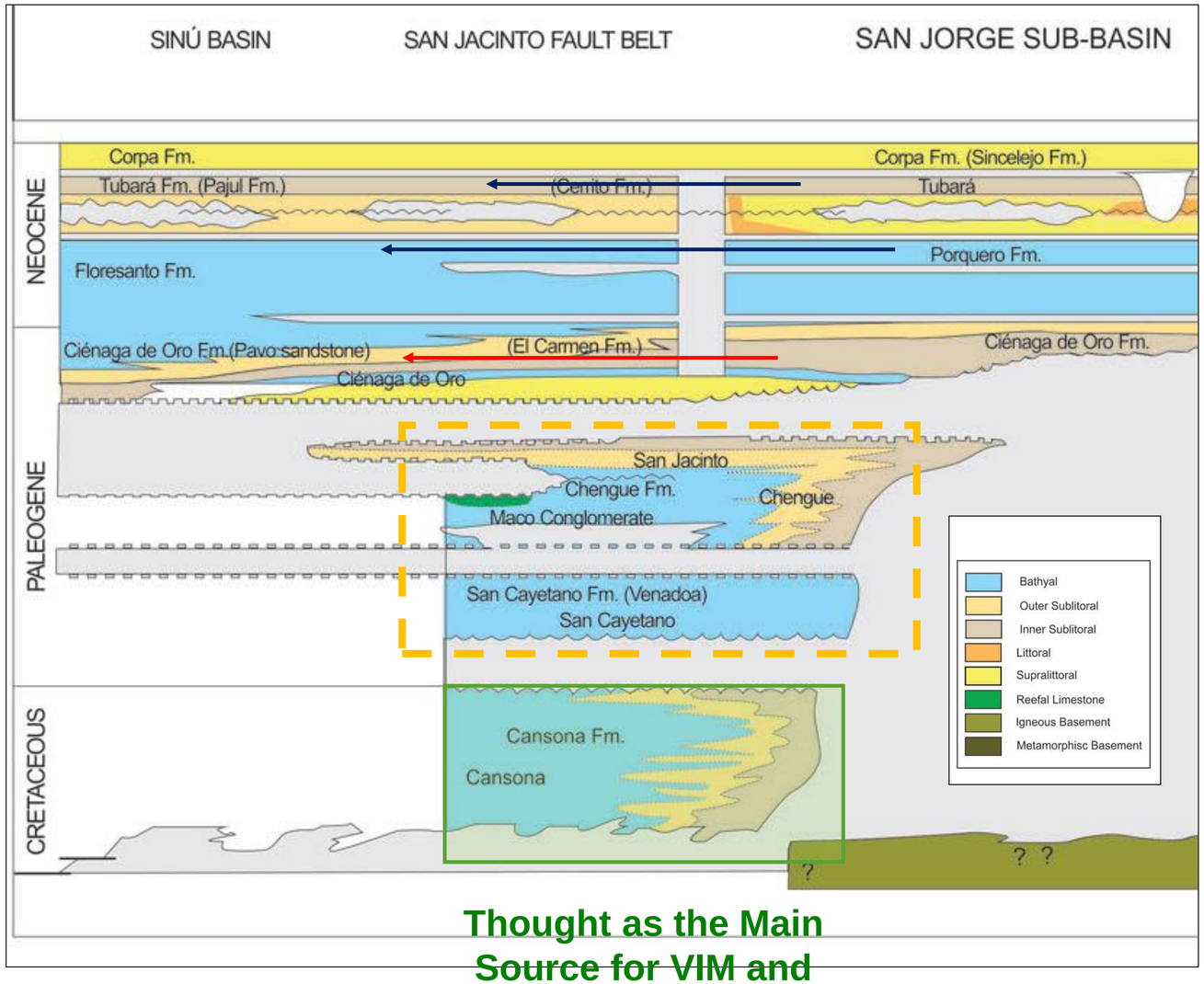


- **Block Areas**
- SSJS 1-3 (135,481 Ha)
- SSJS 7-2 (148,324 Ha)
- **Departments**
- Córdoba & Antioquia

GEOLOGICAL FRAMEWORK

STRATIGRAPHIC SETTING



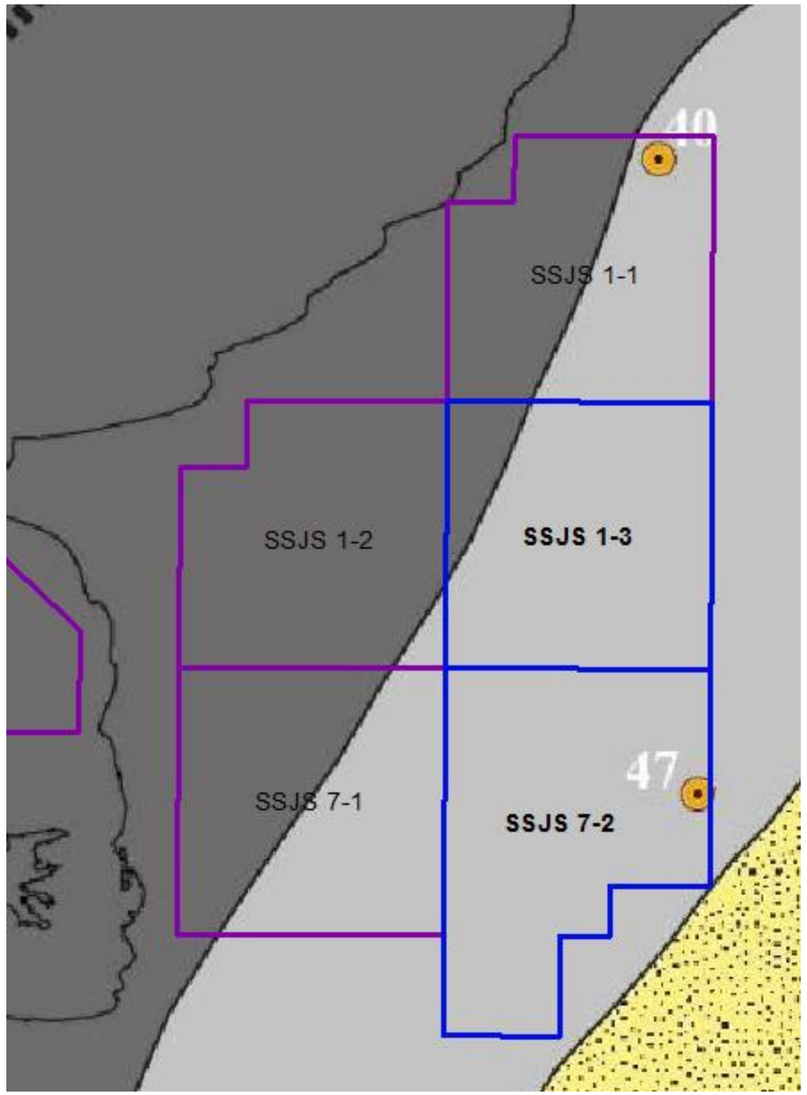


Thought as the Main Source for VIM and SSJ

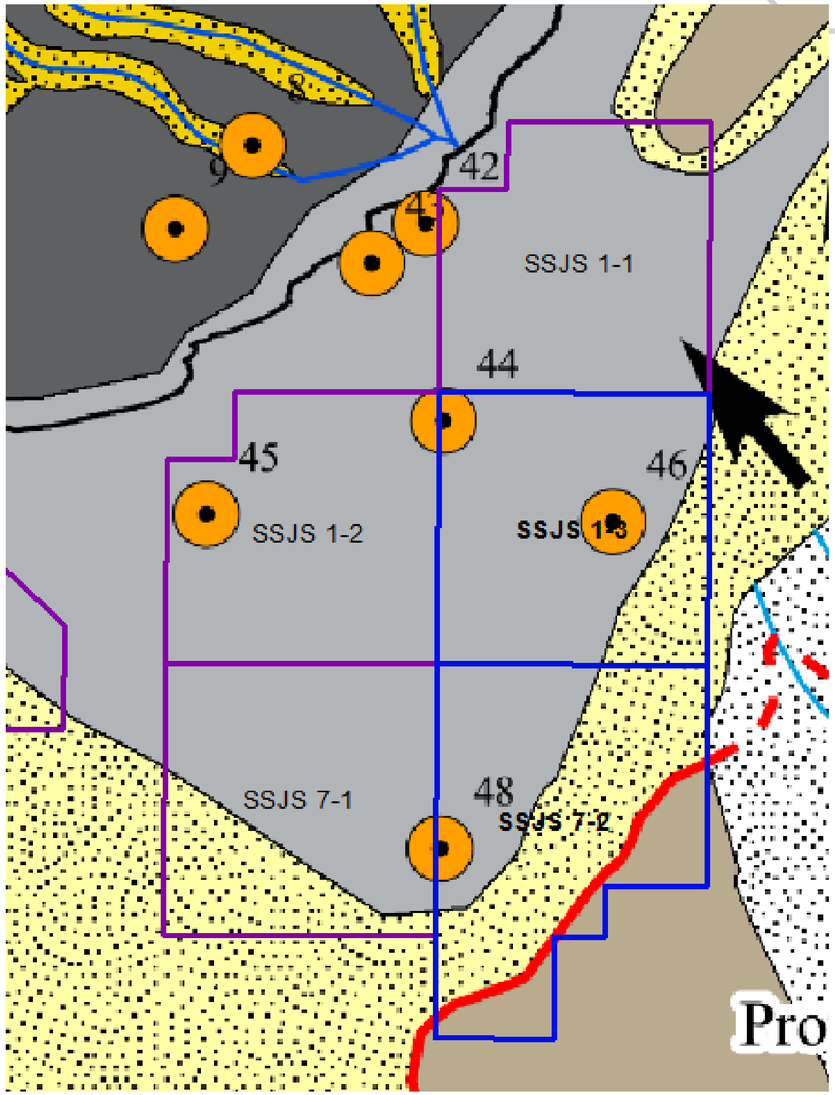
From Lower Magdalena to SSJ

- 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

FACIES MAPS



- **Oligocene**

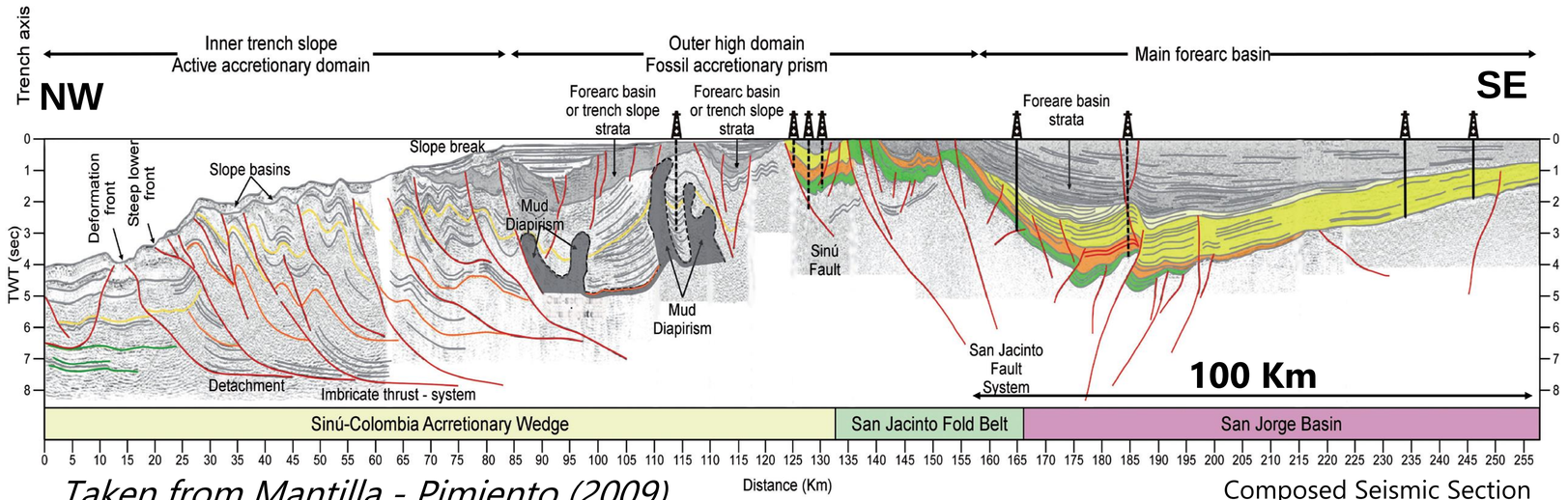


- **Late Miocene – Early Pliocene**

LEYENDA

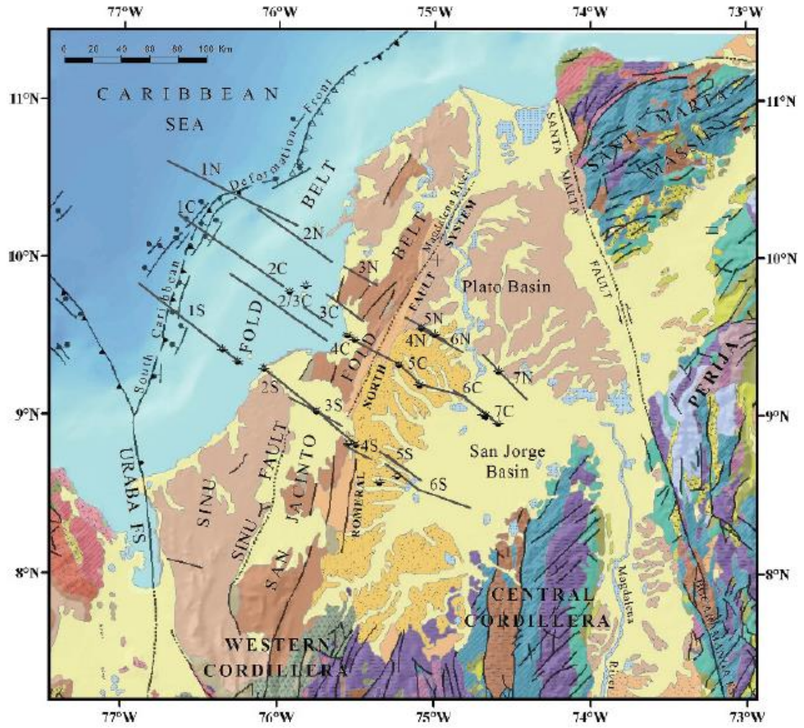
- Área emergida
- Carbonatos
- Ambiente transicional (delta, llanuras mareales, *foreshore* y *shoreface*)
- Ambiente marino somero (*offshore*-plataforma)
- Ambiente marino profundo (talud-llanura abisal)
- Abanicos deltaicos y submarinos
- Abanicos aluviales, depósitos fluviales
- Límite área de estudio
- Dirección de aporte de sedimentos
- Drenajes
- Falla normal
- Falla inversa
- Falla inferida
- Patrones en *Onlap* a partir de sísmica

STRUCTURAL FRAMEWORK



Taken from Mantilla - Pimiento (2009)

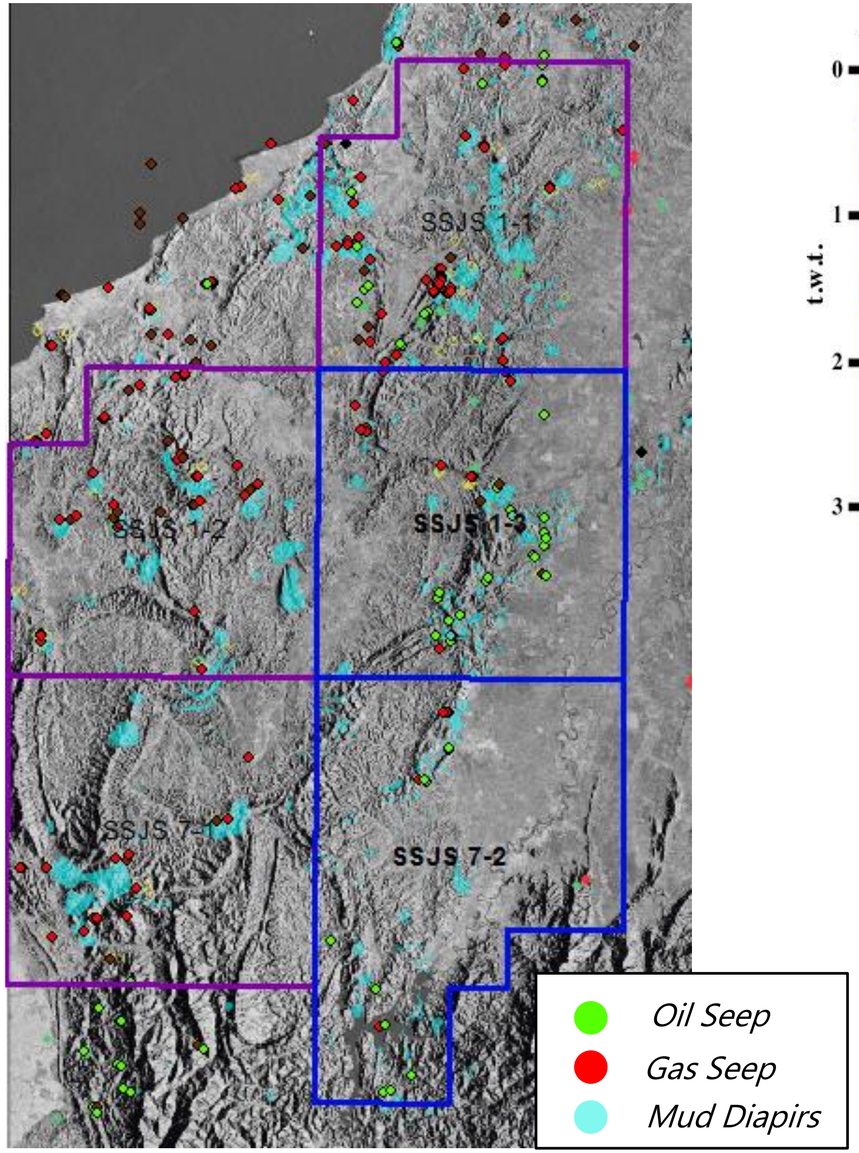
Composed Seismic Section

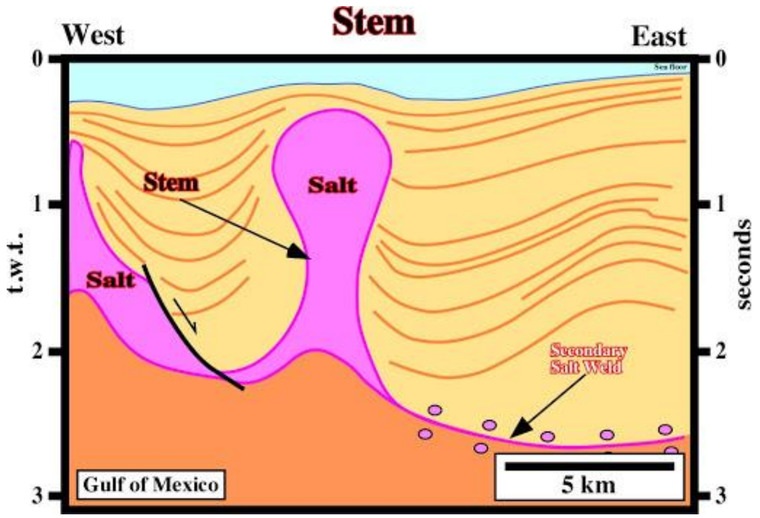


Taken from Mantilla - Pimiento (2009)

- 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 Beld characterized by growth folding, mud diapirism and normal faulting due to gravitational collapse
- 3) **The San Jorge – Plato Forearc Basin**

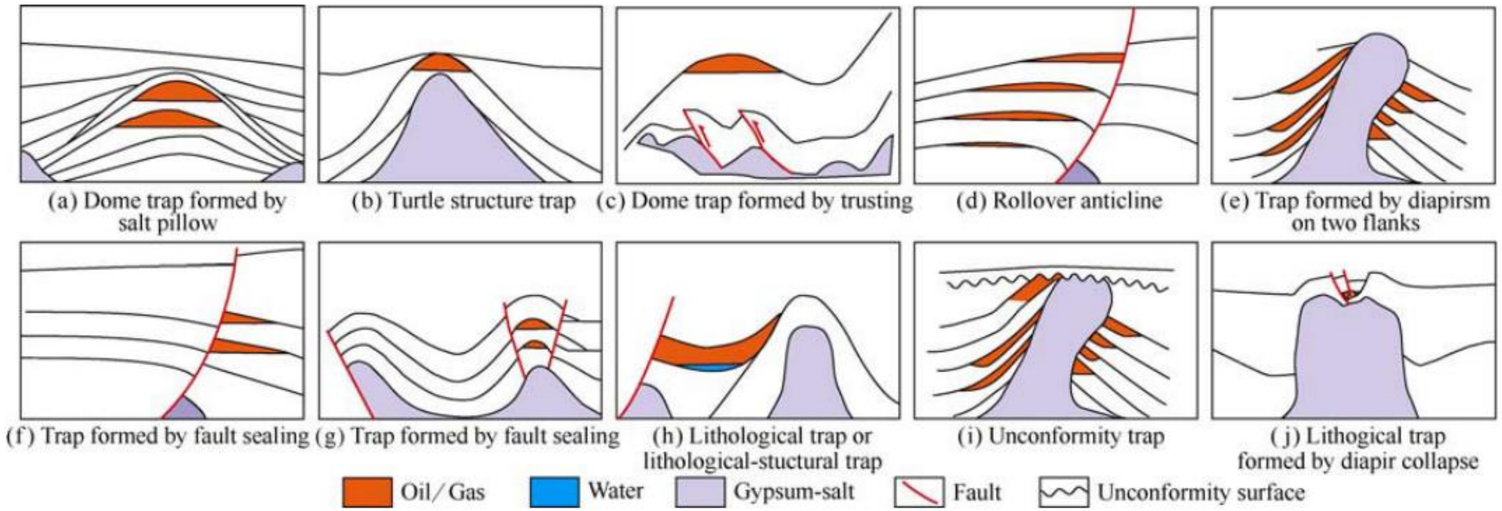
MUD DIAPIRISM





- **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**

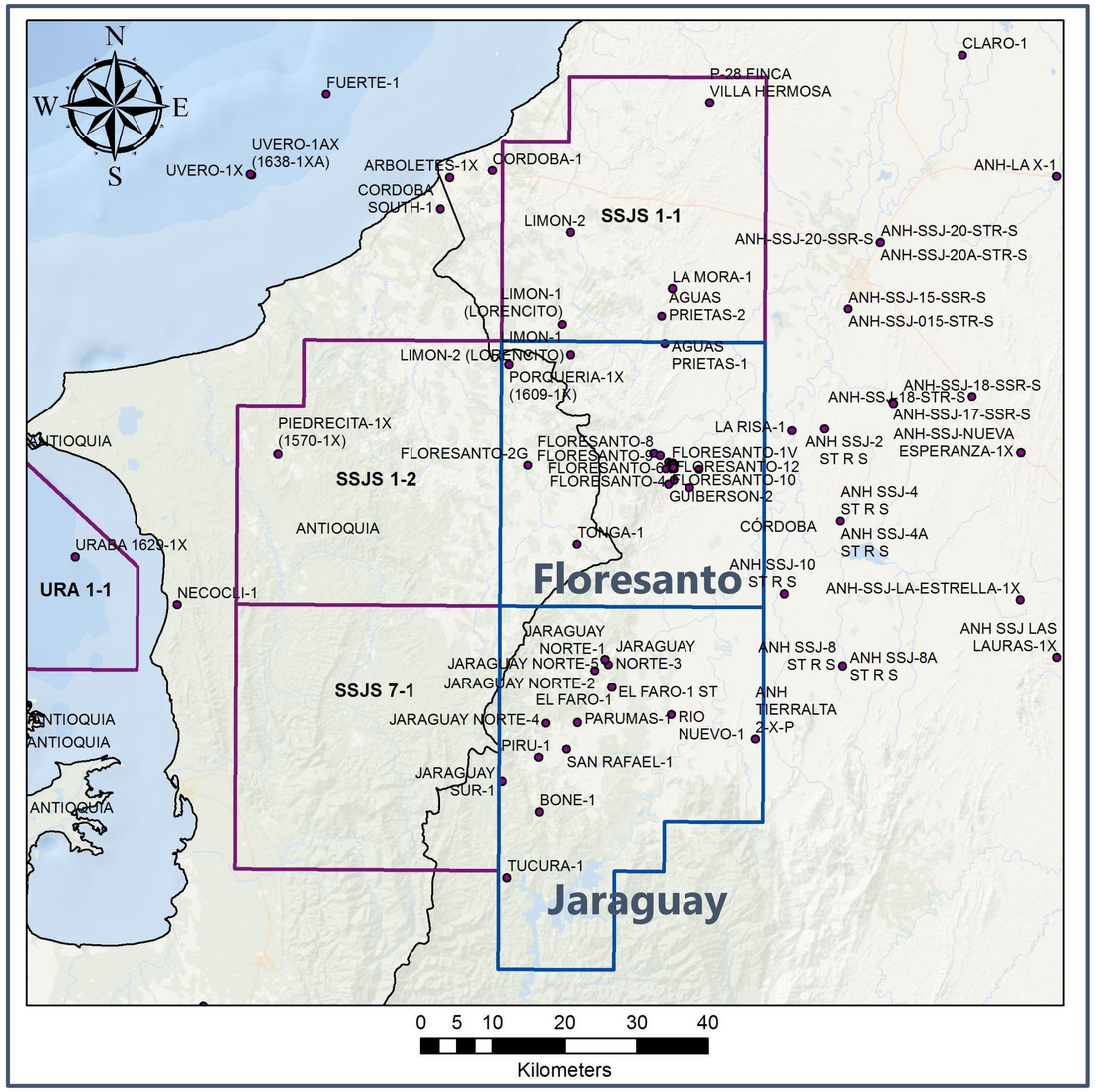
Traps associated to diapirism



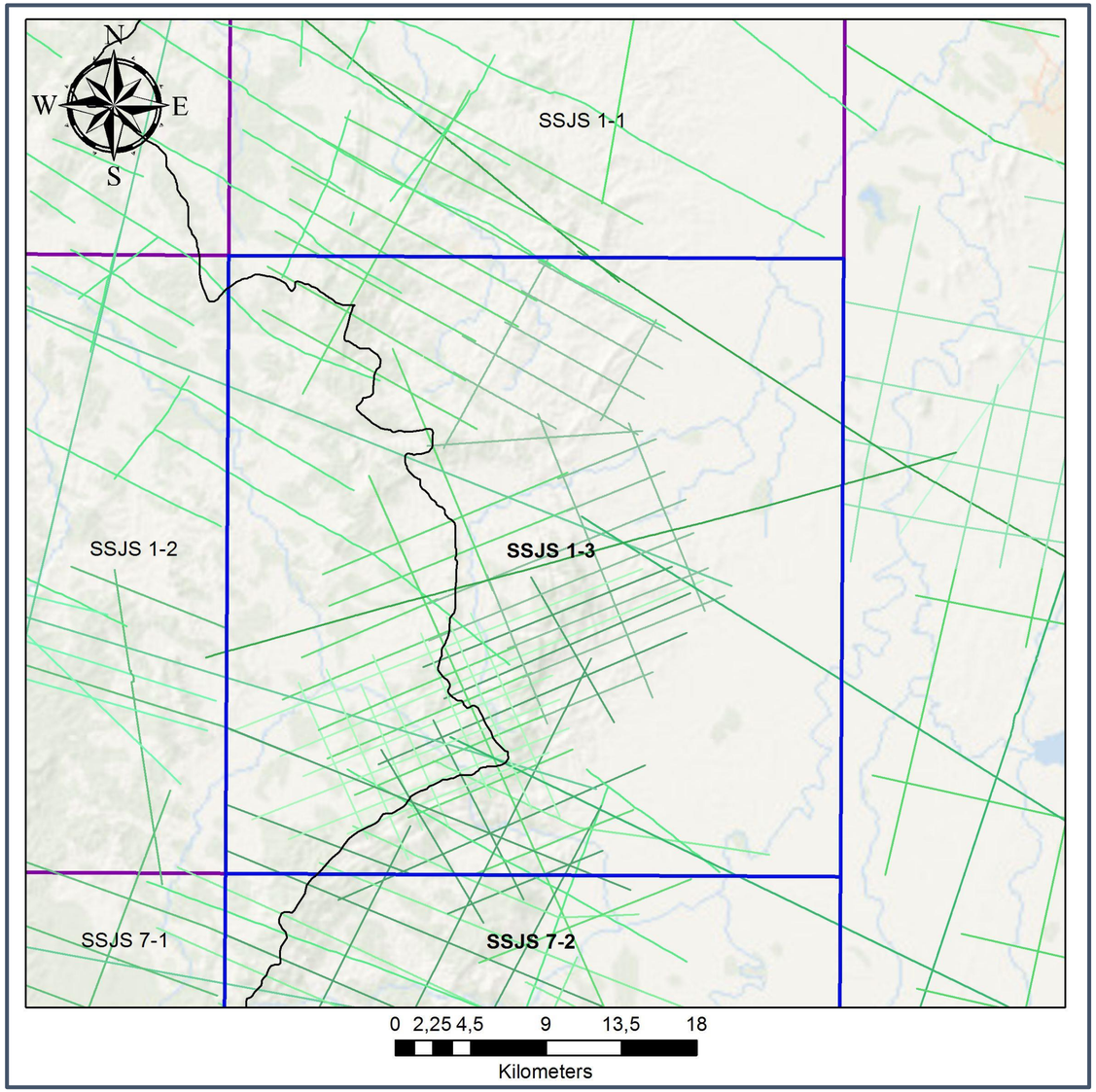
SSJS 1-3: FLORESANTO (UADR)

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)
- Succesful production tests in another thirteen wells (Considered **as non-commercial at the time**)
- 191 wells have been drilled in the whole basin



DATABASE SEISMIC: SSJS 1-3 FLORESANTO



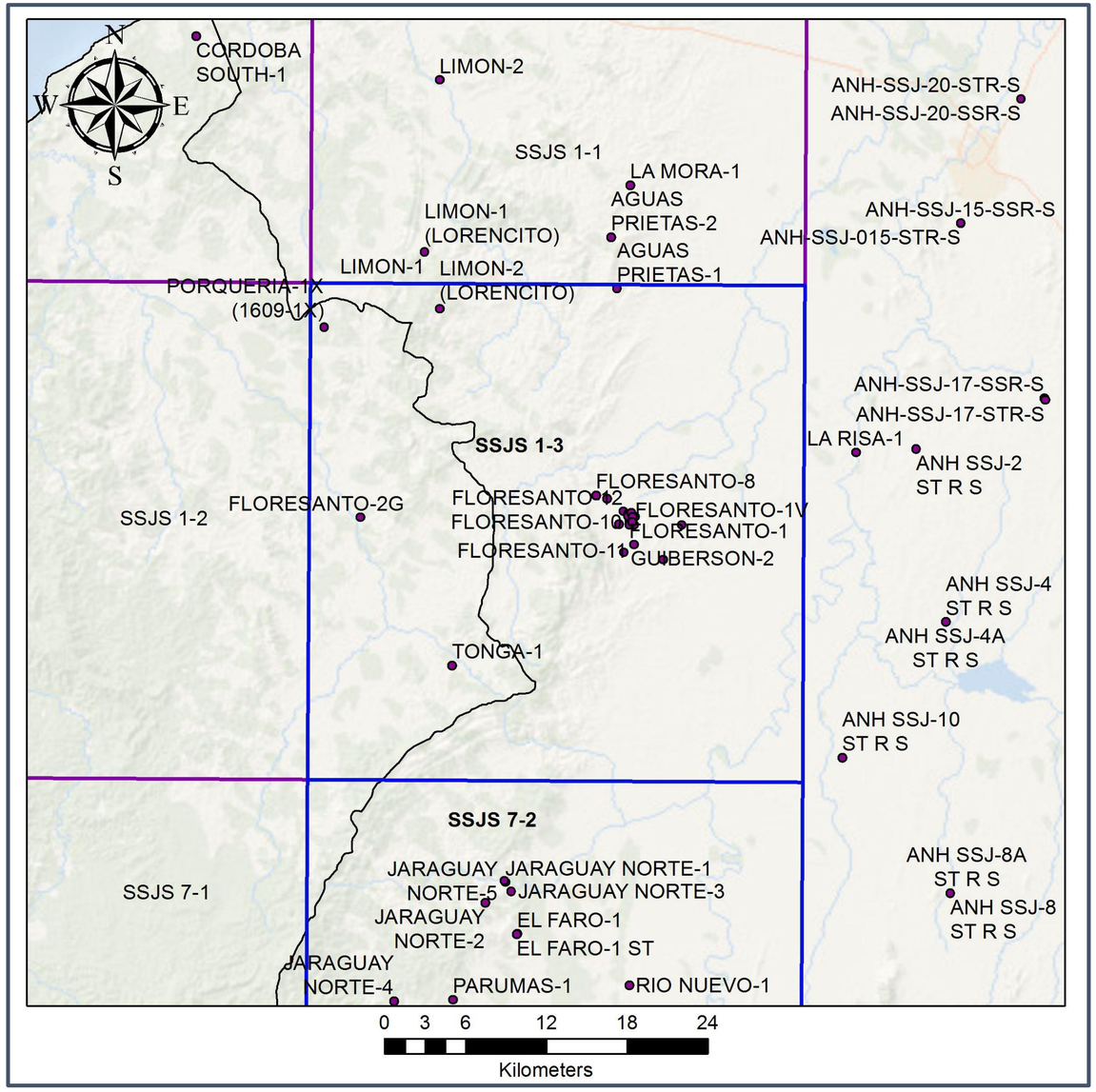
- **SEISMIC**

- **2D Seismic Surveys:**

- Sinú Sur 2D – 2008
- Sinú San Jacinto Sur 2D - 2008
- Cordoba Floresanto – 89
- Floresanto 79
- Urabá – 67
- NW Colombia – 84
- Sinú1 2D – 2014
- Sinú3 2D - 2014
- Sinú1 2D – 2015
- Urabá Sinú – 80

- **Total Length** (1,047 Km)

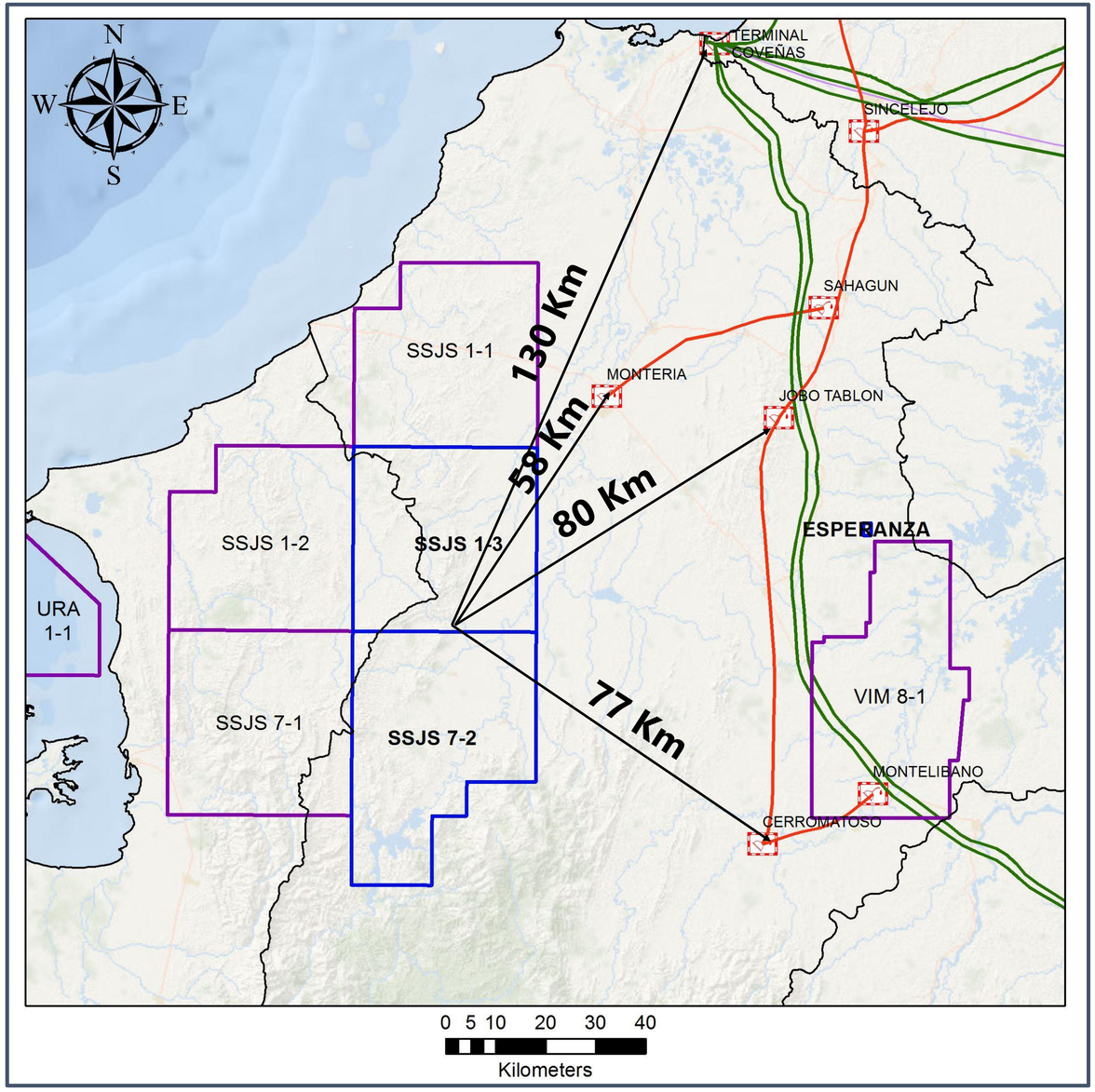
DATABASE WELLS: FLORESANTO



20 Wells

Well	Data Available	Year	TD (ft)
Tonga - 1	**Yes**	**2018**	**7,910**
Porquería 1X	Yes	1969	14,512
Limon – 1 (Lorencito)	No	Unknown	Unknown
Limon – 2 (Lorencito)	No	Unknown	Unknown
Delta - 2	No	1957	Unknown
Floresanto – 1	**Yes**	**1944**	**6,938**
Floresanto – 2	Yes	1945	1,985
Floresanto – 3	Yes	1945	2,065
Floresanto – 4	Yes	1945	1,504
Floresanto – 5	Yes	1945	1,330
Floresanto – 6	Yes	1946	1,505
Floresanto – 7	Yes	1946	2,217
Floresanto - 8	Yes	1946	2,175
Floresanto - 9	Yes	1946	1,203
Floresanto – 10	Yes	1947	10,876
Floresanto - 11	Yes	1946	1,813
Floresanto – 12	Yes	1946	1,675
Floresanto – 1G	No	1951	Unknown
Floresanto – 2G	No	1951	Unknown
Guiberson - 1	No	1951	Unknown

INFRASTRUCTURE FLORESANTO AND JARAGUAY



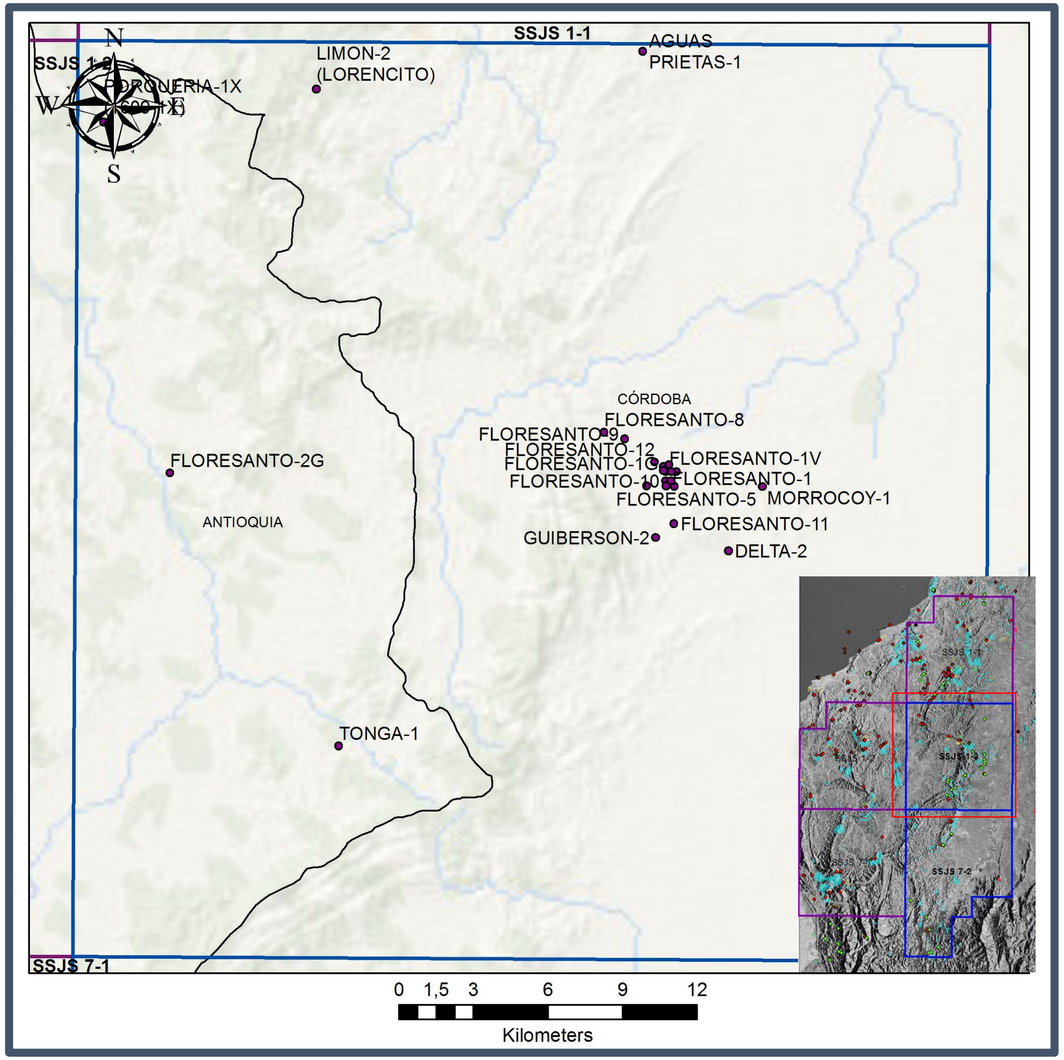
Main Infrastructure nearby

- **Oil Pipeline**
- Terminal Coveñas (130 Km)
- **Gas Pipeline**
- Monteria (58 Km)
- Jobo Tablón (80 Km)
- Cerromatoso (77 Km)

FLORESANTO: GENERALITIES

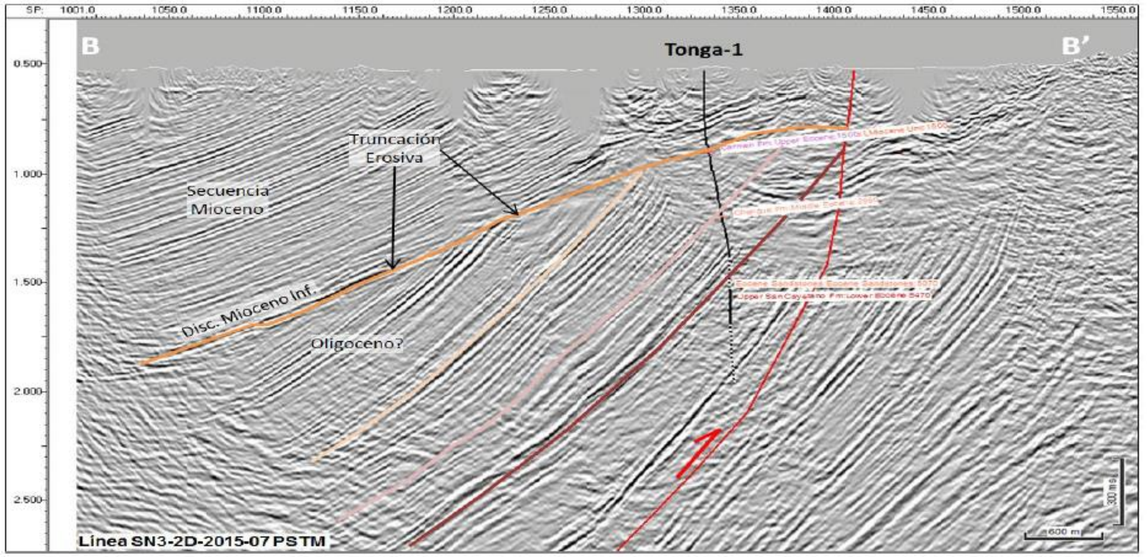
- Twelve (12) wells were drilled from May of 1945 to August of 1947.
- Most of them were drilled by Socony-Mobil and classified as producer wells. However, **formal production** was only declared in the wells **Floresanto 1** and **Floresanto 6**
- Ten (10) of the twelve (12) wells were shallow (an average 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 (**50° API**)

Taken from Ecopetrol (2000)



Tonga – 1

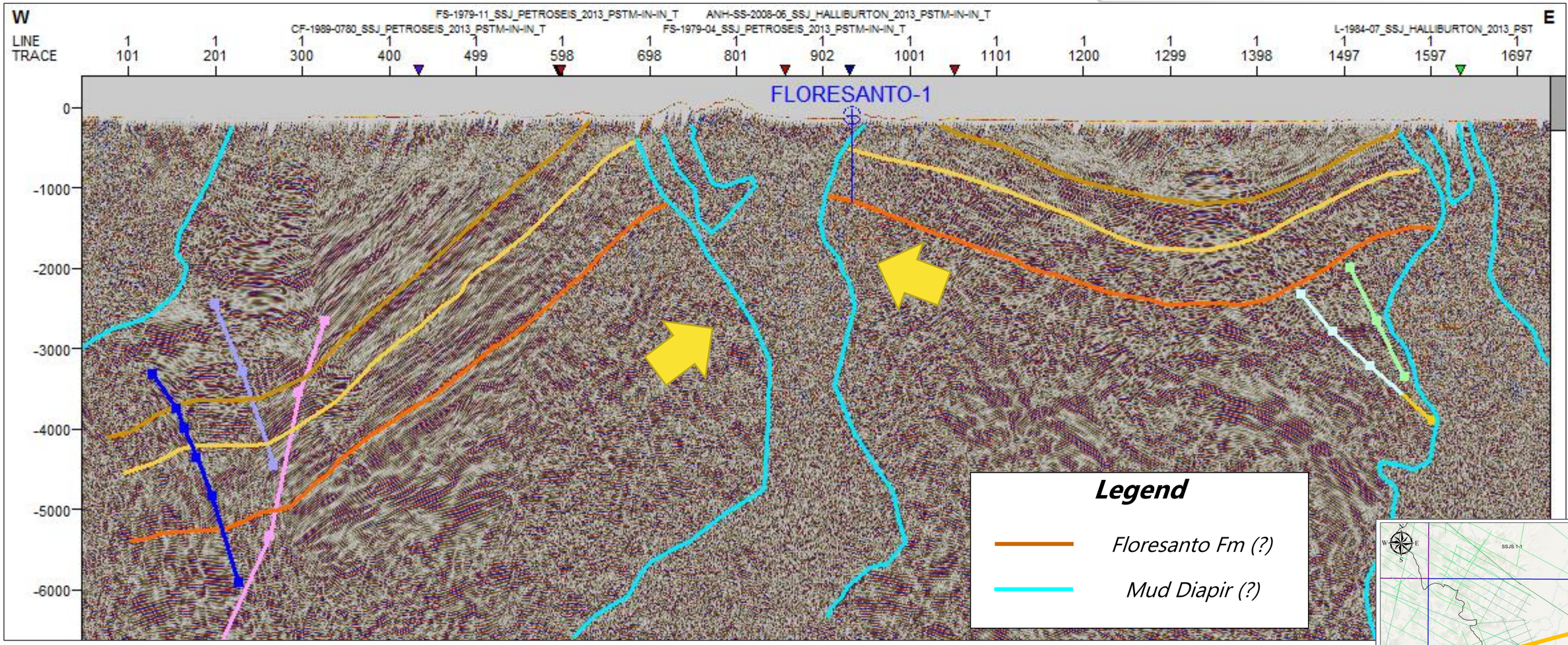
- The well Tonga – 1 was drilled by Gran Tierra Energy in **2018** with a TD of 8000′.
- The well tried to find presence of hydrocarbons in **Eocene sandstones** (Chengue Fm) and characterize units below Miocene discordance
- Despite of finding the reservoir, the shows were not economically viable.
- The well was plugged up and abandoned



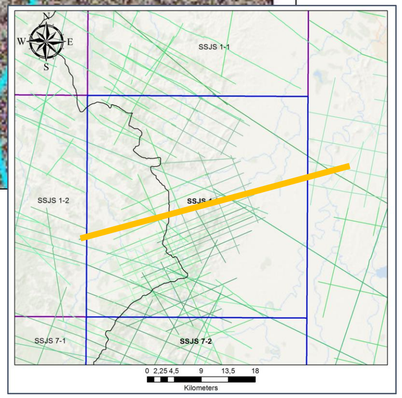
FORMACIÓN	TOPES PROGNOSIS			TOPES TENTATIVOS POR MUESTRAS			DIFERENCIA ESTRUCT. (pies)	
	MD (pies)	(TVD) (pies)	TVDss (pies)	MD (pies)	(TVD) (pies)	TVDss (pies)	Mayor (H) TVD'ss	Menor (L) TVD'ss
MIOCENE (PAJUIL/FLORESANTO)	Surface	Surf	345	Surface	Surface	345	--	--
MIOCENO BASAL	941	941	-596	--	--	--	--	--
DISCORDANCIA MIOCENO INFERIOR	1521	1511	-1166	1500	1490	-1145	-21	--
EOCENO TARDÍO (CARMEN)	1521	1511	-1166	1500	1490	-1145	-21	--
EOCENO MEDIO(CHENGUE)	2213	2178	-1833	2980	2920	-2575	--	742
EOCENO INFERIOR (SAN CAYETANO SUPERIOR	5070	4983	-4638	5470	5385	-5040	--	402
TD	6587	6500	-6155	8000	7910	-7565	--	--

GAS SHOWS					ppm							RATIO'S CALCULATIONS			
Interval (ft)	Lithology	Tot. %	B.G.G	Net %	C_1	C_2	C_3	iC_4	nC4	iC5	nC5	Wh	Bh	Ch	Type
FORMACIÓN PAJUIL/ FLORESANTO (MIOCENO)															
335 – 344	SST	0.21	0.04	0.17	2131	-	-	-	-	-	-	-	-	-	-
482 – 485	COAL	0.17	0.05	0.12	1709	-	-	-	-	-	-	-	-	-	-
665 – 670	SST	0.17	0.05	0.12	1685	-	-	-	-	-	-	-	-	-	-
707-712	COAL	0.36	0.04	0.32	3613	1	-	-	-	-	-	-	-	-	-
841' – 844'	COAL	0.19	0.15	0.04	1919	-	-	-	-	-	-	-	-	-	-
895' – 900'	SD	0.83	0.68	0.04	8385	-	-	-	-	-	-	-	-	-	-
900' – 1130'		-	0.08	-	4451	1	-	1	-	-	-	-	-	-	-
1392' – 1397'	SLTST	1.47	0.08	1.39	14789	45	6	1	1	-	-	-	-	-	-
FORMACIÓN CARMEN (EOCENO TARDÍO) - DISCORDANCIA (MIOCENO INFERIOR)															
1500 - 2980	-	-	0.04	-	4100	-	-	-	-	-	-	-	-	-	-
FORMACION CHENGUE (EOCENO MEDIO)															
2980 - 3350	--	-	0.08	-	5621	20	9	9	2	7	1	-	-	-	-
3370 - 3510	---	-	0.92	-	9194	24	8	1	1	4	1	-	-	-	-
3520 – 3770	SLTST /SD	-	1.66	---	16588	38	8	5	1	2	1	-	-	-	-
3770 – 3940	SLTST/SD	-	0.5	---	5290	14	2	3	-	-	-	-	-	-	-
4001' – 4010	SST	2.0	0.5	1.5	20130	59	18	13	3	6	1	-	-	-	-
4067 – 4073	SST	2.4	0.5	1.9	24139	77	26	22	4	9	2	-	-	-	-
4210 – 4520	SLTST	-	0.96	-	9572	25	6	6	1	3	1	-	-	-	-
4530 – 4760	SST/SLTST	-	0.86	-	8599	25	7	6	1	3	1	-	-	-	-
4760 – 5160	SLTST	-	0.97	-	9692	29	9	9	1	4	1	-	-	-	-
5293 -5320	SST	2.43	0.44	1.99	24116	69	27	20	4	10	2	-	-	-	-
FORMACIÓN SAN CAYETANO SUPERIOR (EOCENO INFERIOR)															
5704 -5709	SST	1.6	0.6	1.0	16024	48	16	12	2	7	2	-	-	-	-
5776 - 5820	SST-SD	1.99	0.68	1.31	19816	55	19	15	3	7	4	-	-	-	-
5842 - 6020	SLTST	-	1.43	-	14195	42	14	11	2	6	1	-	-	-	-
6130 - 6220	SLTST	-	0.82	-	8110	25	9	8	2	5	1	-	-	-	-

SEISMIC INTERPRETATION: FLORESANTO (Dip Line)



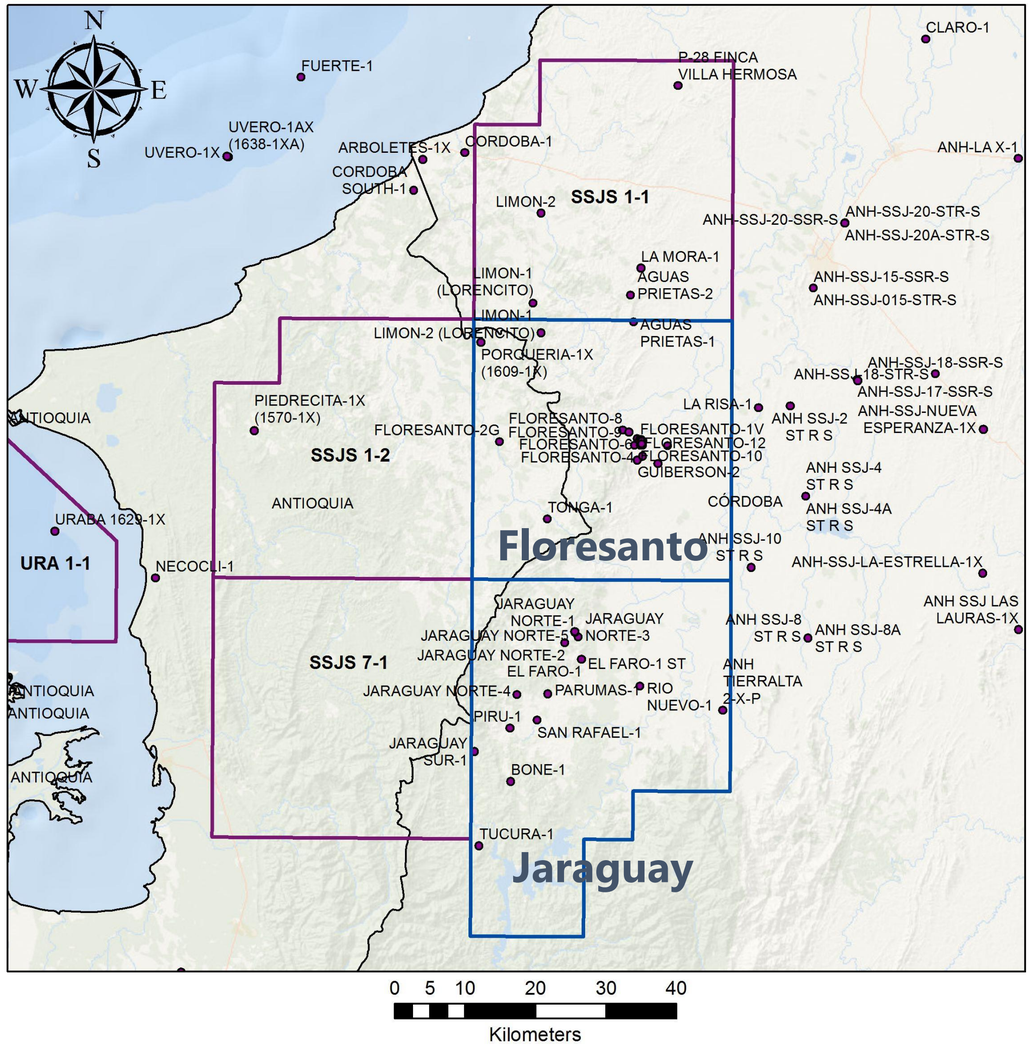
Seismic Dip Line L-1984-09-SSJ



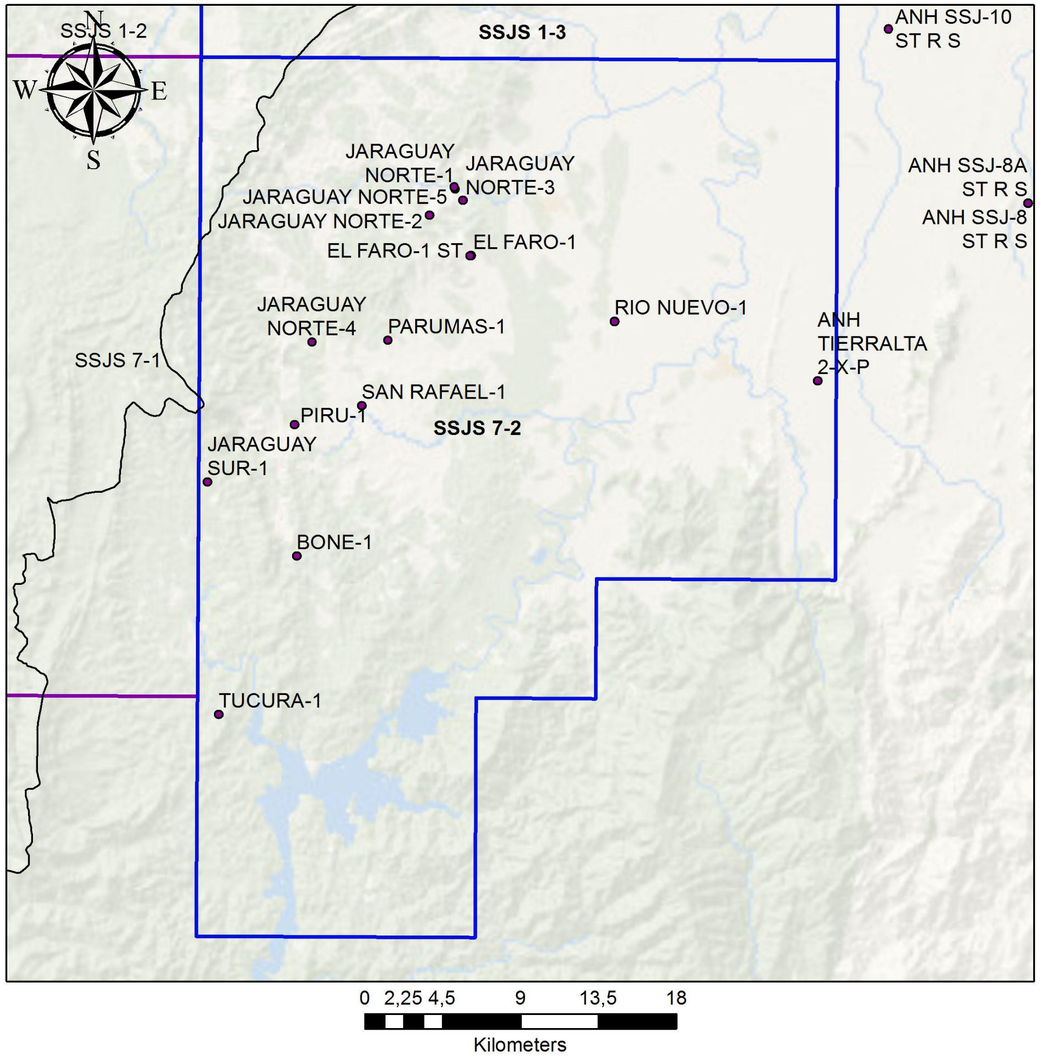
JARAGUAY NORTE (SSJS 7-2)

JARAGUAY: GENERALITIES

- 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'** and 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



DATABASE: WELLS

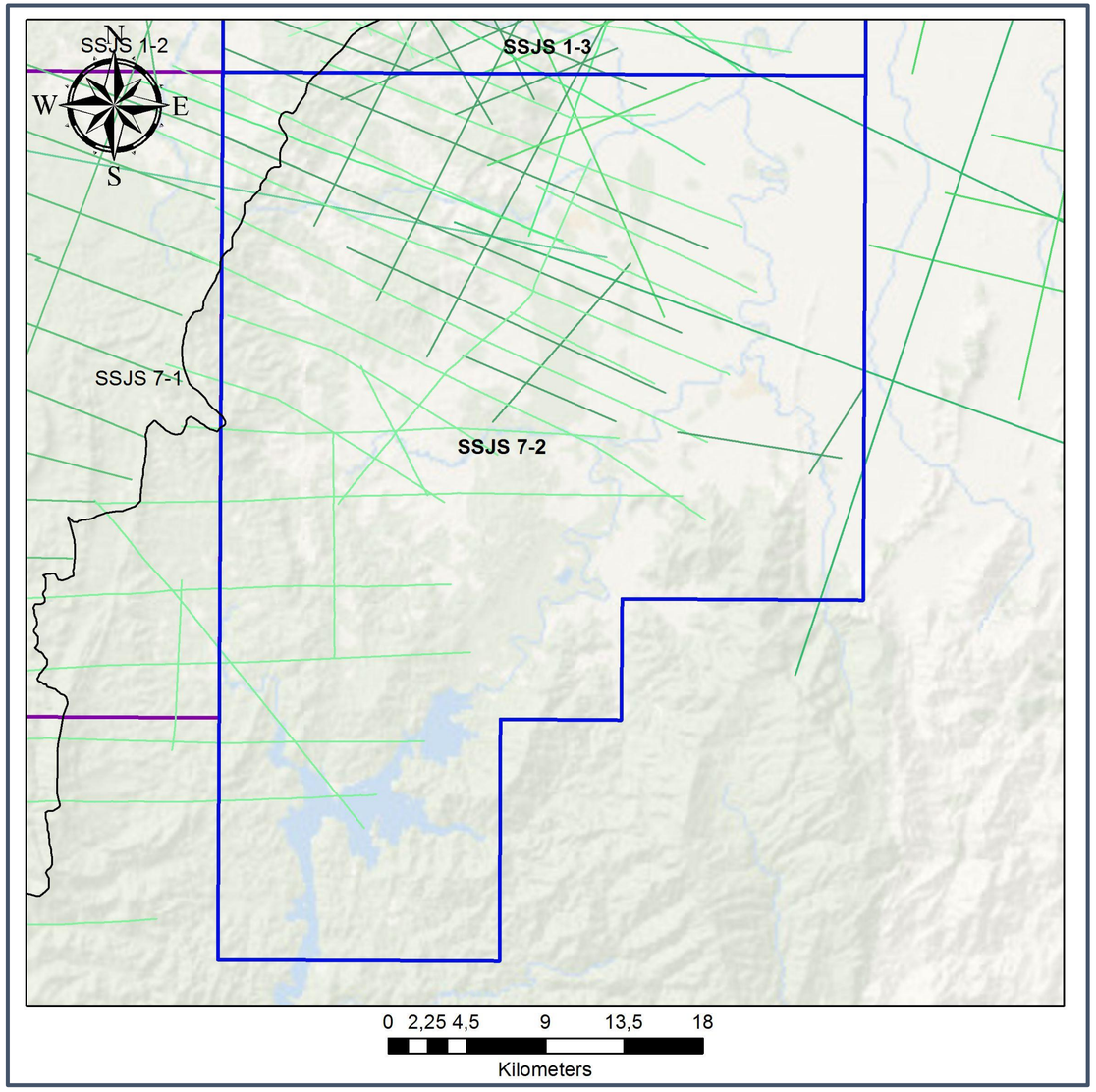


WELLS & FIELDS NEARBY

14 Wells

WellS	Data Available	Year	TD (ft)
ANH - Tierralta 2X	Yes	2014	8711
Bone – 1	Yes	1980	234
El Faro – 1 ST	Yes	1982	5770
Jaraguay Norte – 1	Yes	1981	4737
Jaraguay Norte – 2	Yes	1981	8517
Jaraguay Norte – 3	Yes	1982	4822
Jaraguay Norte – 4	Yes	1982	5007
Jaraguay Norte – 5	Yes	1983	2515
Jarguay Sur -1	Yes	1982	8002
Parumas – 1	Yes	1984	5148
Piru – 1	Yes	1980	247
Rio Nuevo – 1	Yes	1982	6800
San Rafael – 1	Yes	1981	8980
Tucura - 1	Yes	1980	247

DATABASE: SEISMIC



- **SEISMIC**

- **2D Seismic Surveys:**

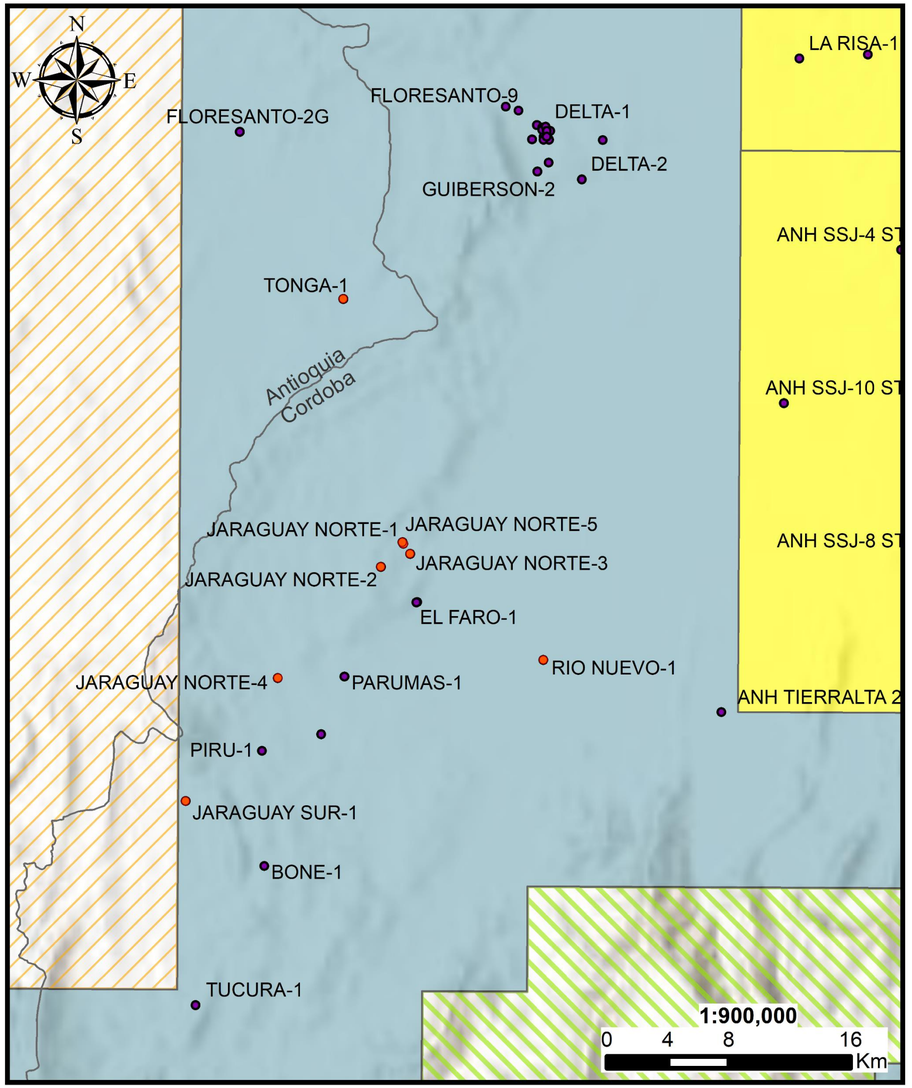
- Sinú Sur 2D – 2008
- Sinú San Jacinto Sur 2D - 2008
- Cordoba Floresanto - 89
- Urabá – 67
- Sinú3 2D - 2014
- Urabá - Sinú – 80

- **Total Length** (681 Km)

JARAGUAY - PRODUCER

- **Petrocol LTD** drilled 10 wells from 1981 to 1984

- **Jaraguay Norte-1** (1981) TD:4737′:
  - Reservoir: **Upper sands from Floresanto Fm** (1020′ San Rafael and 437′ El Pavo sands)
  - Structure: **Jaraguay "anticline"**
  - Q_o: **32,8 BPD** , Cumulative production: **700 Bbl**
  - Status: **plugged up and abandoned** due to the termination of the Association contract and production declined to 17 BPD
  - **API: 48°**

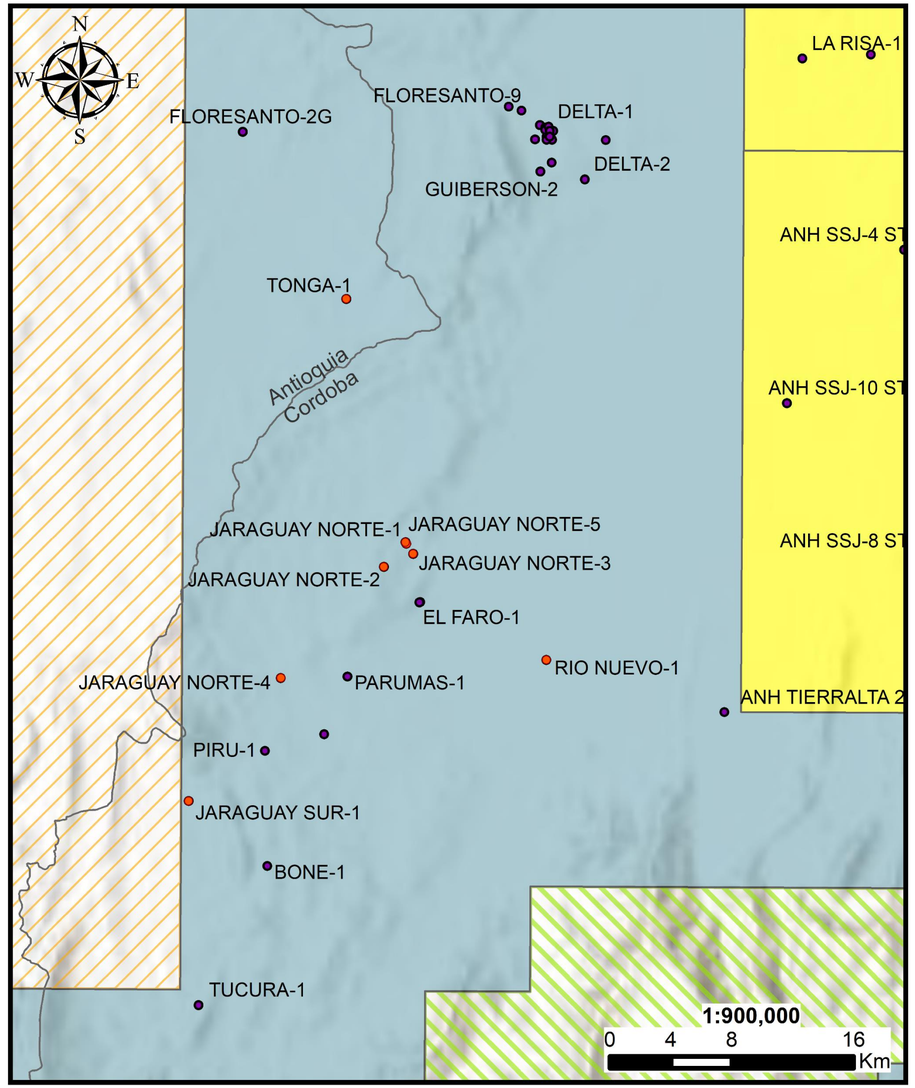


JARAGUAY – DRY WELLS

- **Jaraguay Norte-2** (1981, TD: 8517'):
  - The target was **Chengue Fm** however it founded **Maralú Fm** (biostratigraphy and logs interpretations)
  - **El Pavo Fm**: progressive sandstones (**deltaic**)
  - Shows in: San Rafael Sandstones and El Pavo Fm (**not probe**)

- **Jaraguay Norte-3** (1982, TD: 4822'):
  - If founded below 3160' **Chengue Fm** (Eoceno): Pelagic shales, chert, conglomerate. Conglomerates then were interpretated as **Corpa Fm**
  - **San Rafael Sandstones** had 6 DST (half barrel of **23°** and a gallon of **38°API**)

- **Jaraguay Norte-4** (1982, TD: 5007'):
  - It is considered to have drilled a "**different structure"**
  - Shows: In San Rafael Sandstones (**not probe**)

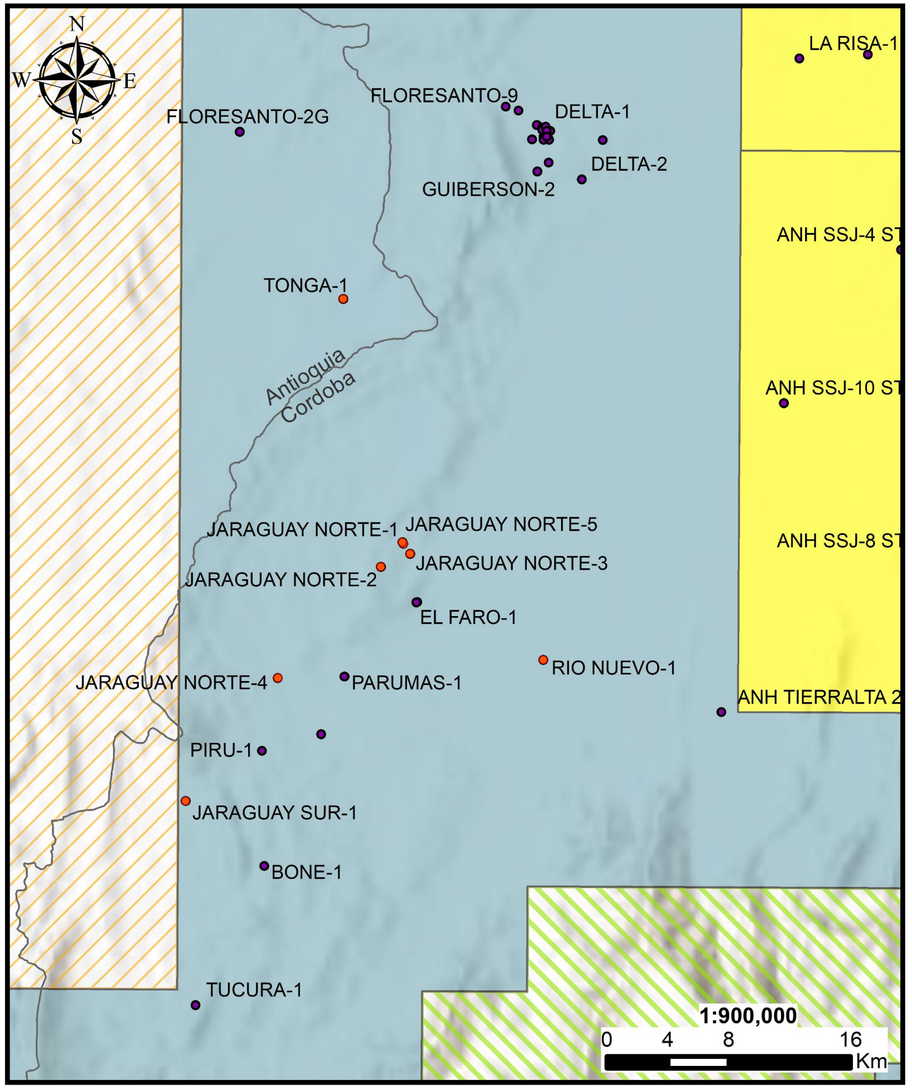


JARAGUAY – DRY WELLS

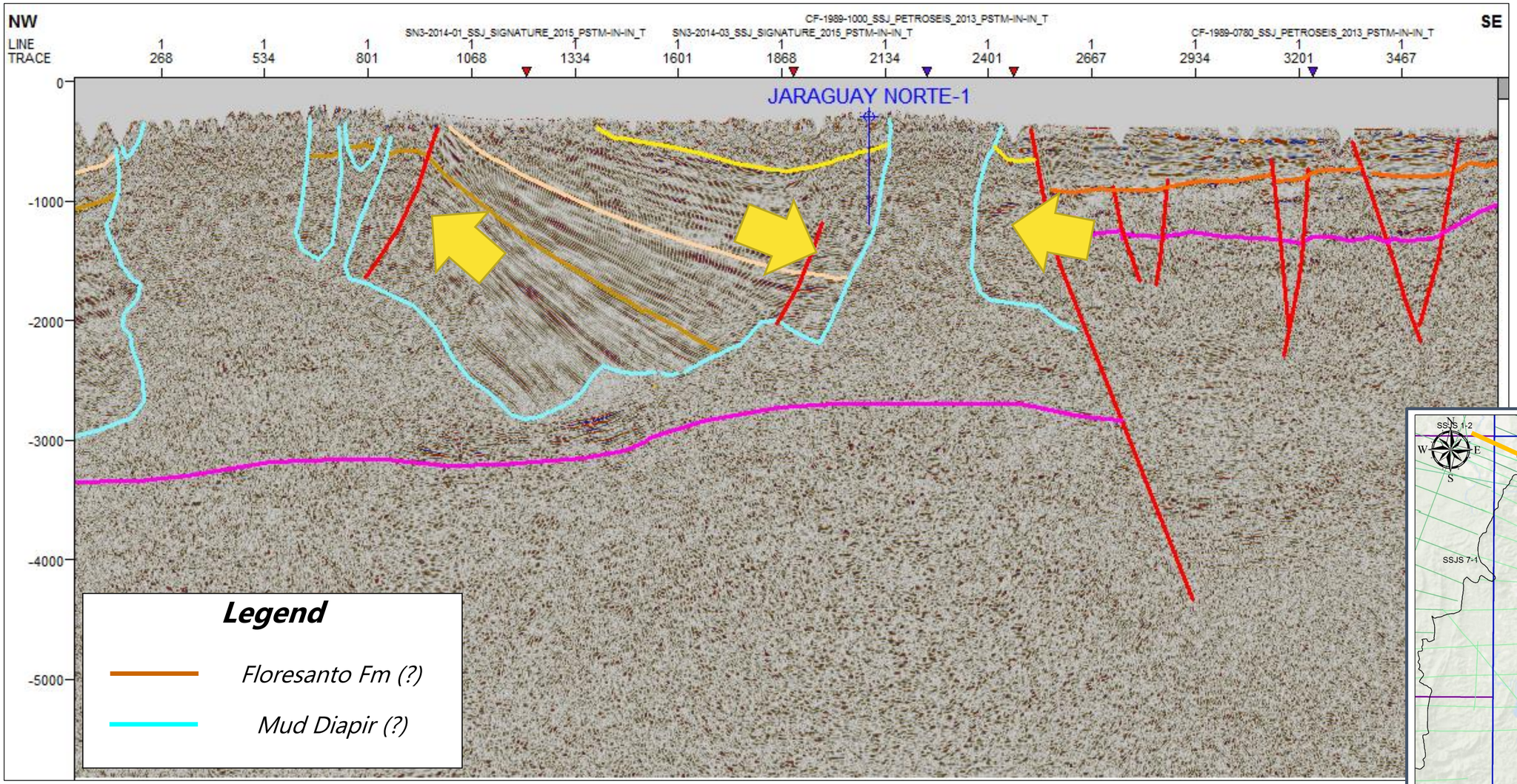
- **Jaraguay Norte-5** (1983, TD:2515'):
  - Drilled as **development well** near well 1
  - **No shows, no tests**

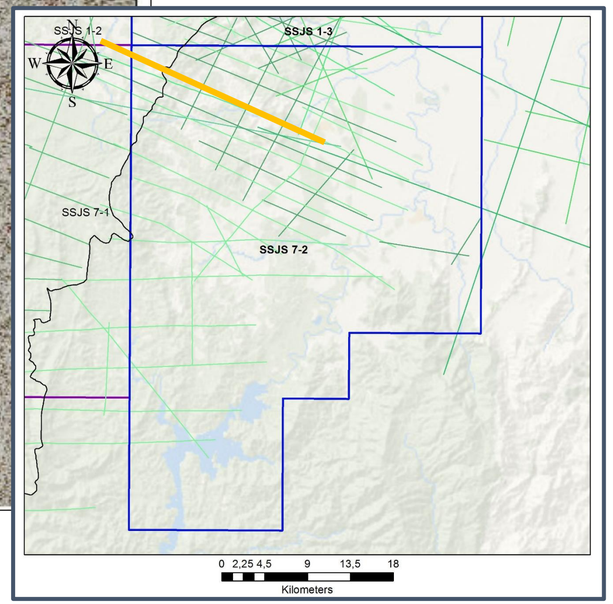
- **Jaraguay Sur-1** (1982, TD: 8002'):
  - **Corpa Fm** was found directly over El Pavo Sandstone
  - **Not found:** San Rafael Sandstones or lower part of Upper Porquero

- **Río Nuevo-1** (1982, TD: 6800'):
  - **Shows** during drilling in San Rafael Sandstones and El Pavo Sandstone (they were tested but no information is available)



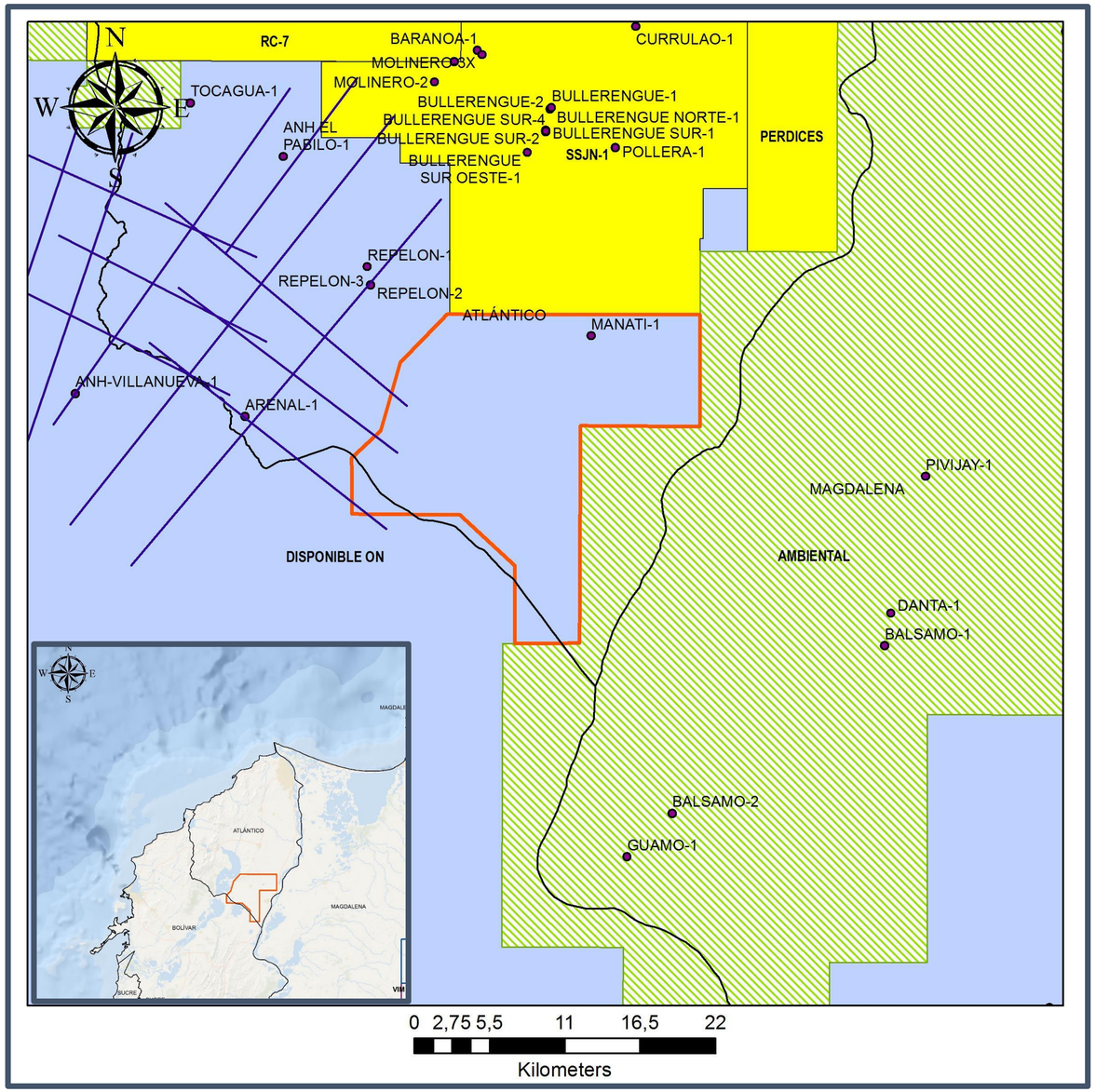
SEISMIC INTERPRETATION: JARAGUAY NORTE DIP LINE





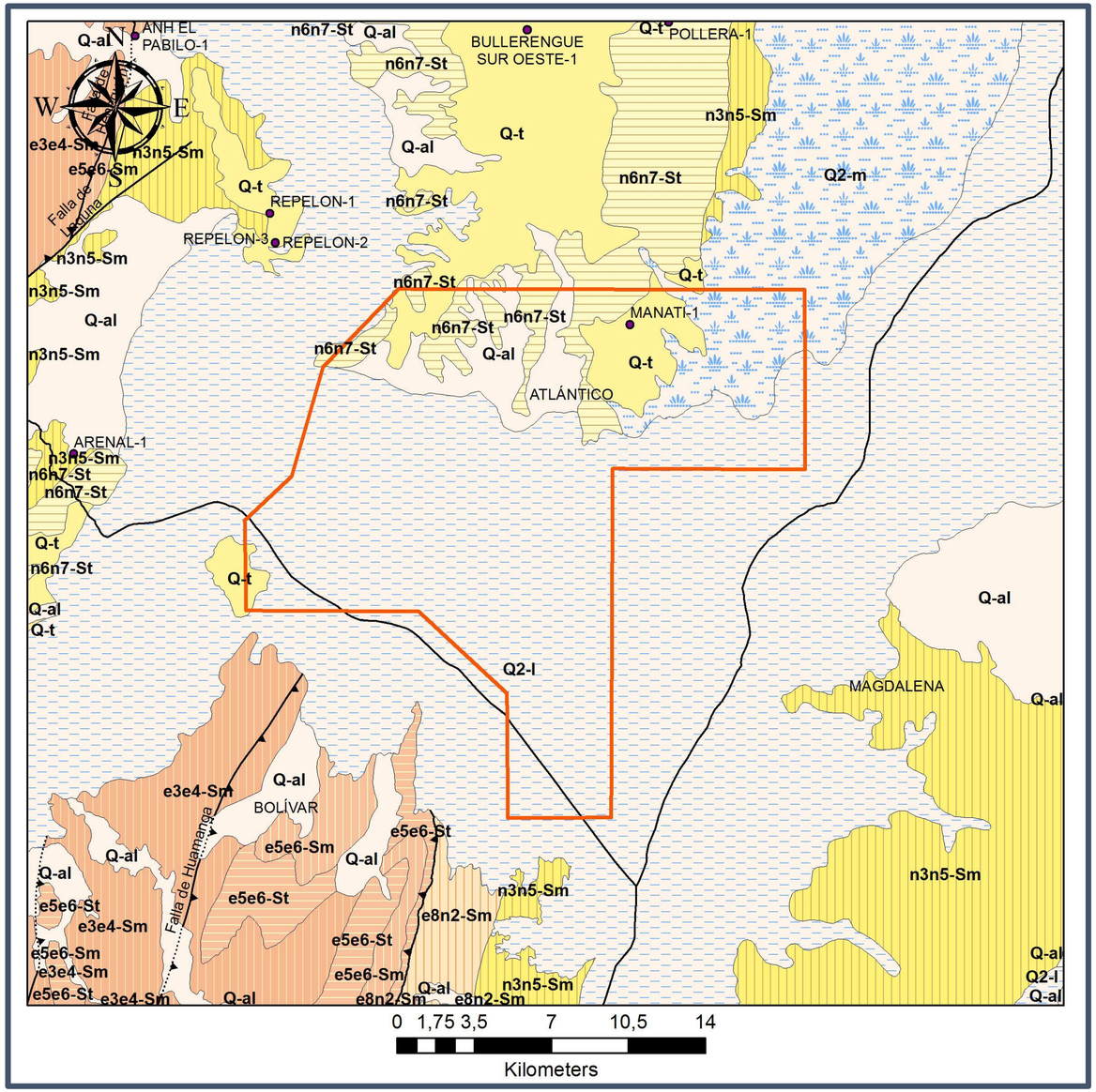
SSJN 3-1 MANATÍ (INCORPORATED AREA)

LOCATION



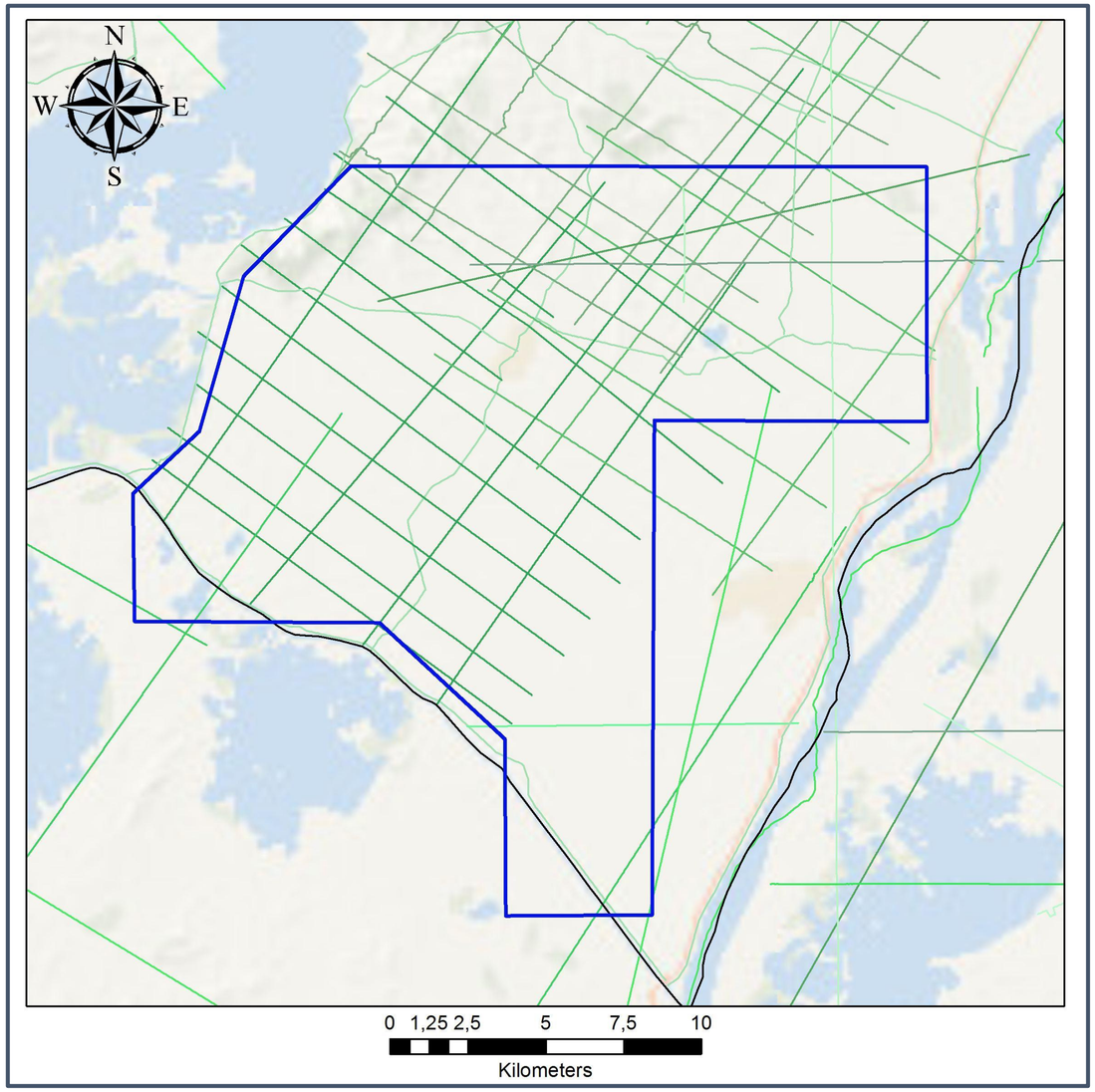
- **Block Areas**
- SSJN 3-1 (33,402 Ha)
- **Departments**
- Atlántico & Bolivar

GEOLOGICAL MAP



- Due to transpressive dynamic because of strike-slip faults at the north outcrop units from the Miocene & Pliocene:
- **Tubará Fm & Hibácharo Fm**
- At the south units from the Paleocene to Oligocene outrop:
- Carmen Fm
- Chengue Fm
- Maco Fm
- San Cayetano Fm

DATABASE: SEISMIC



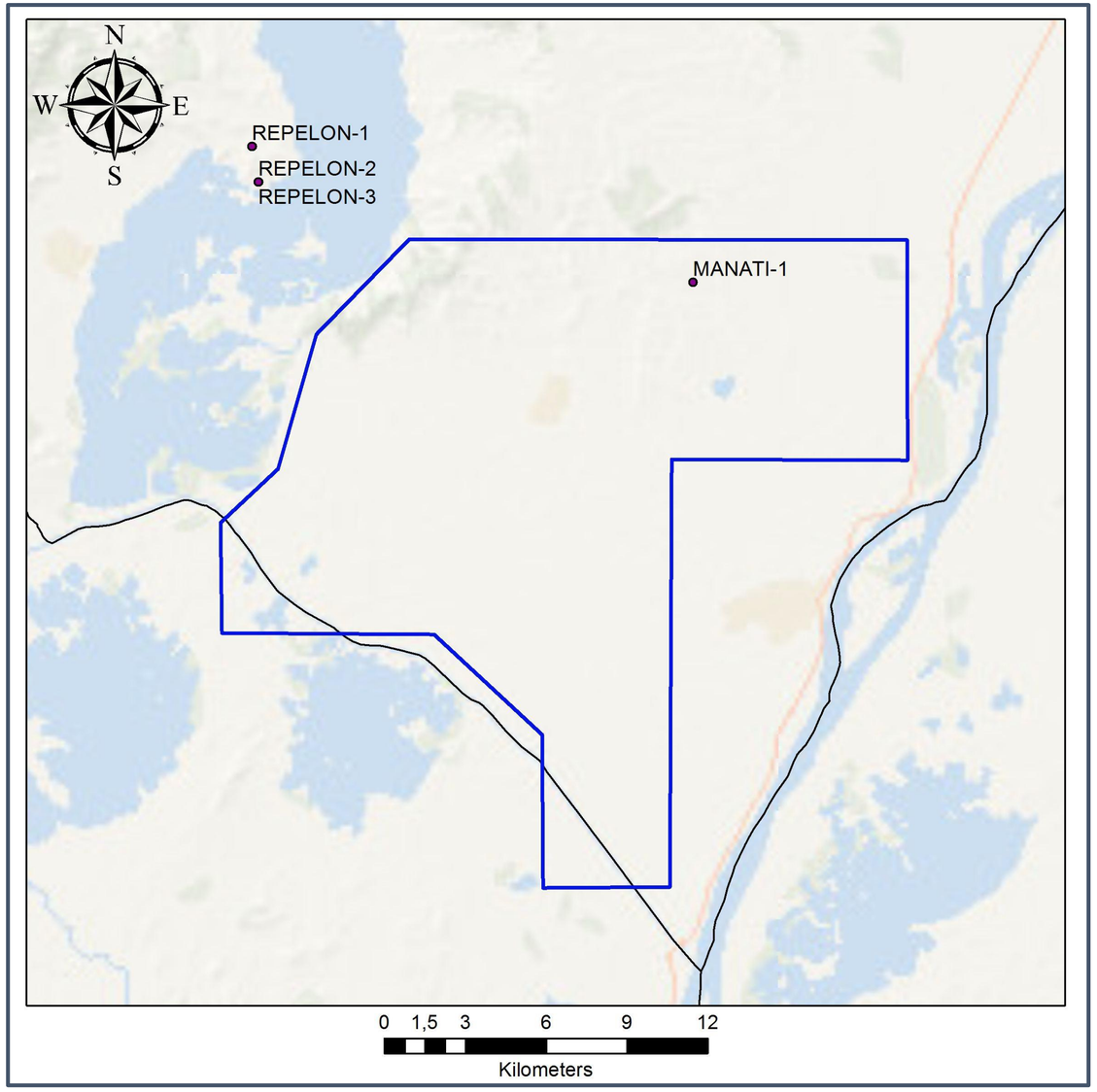
- **SEISMIC**

- **2D Seismic Surveys:**

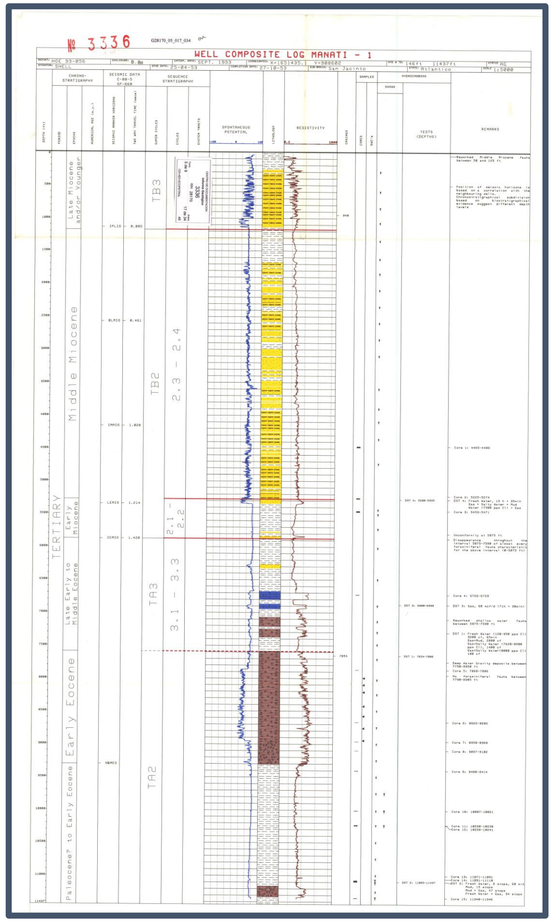
- Atlantico – 89
- Sinu San Jacinto 2D – 2005
- San Jorge – 74
- San Jorge - 75
- Atlantico – 76
- Molinero – 79
- Molinero – 82
- Montes de Maria 2D – 2012
- Pivijay – 91
- Pivijay - 89

- **Total Length** (425 Km)

DATABASE: WELLS



Well	Data Available	Year	TD (ft)
Manati - 1	Yes	1953	11,443

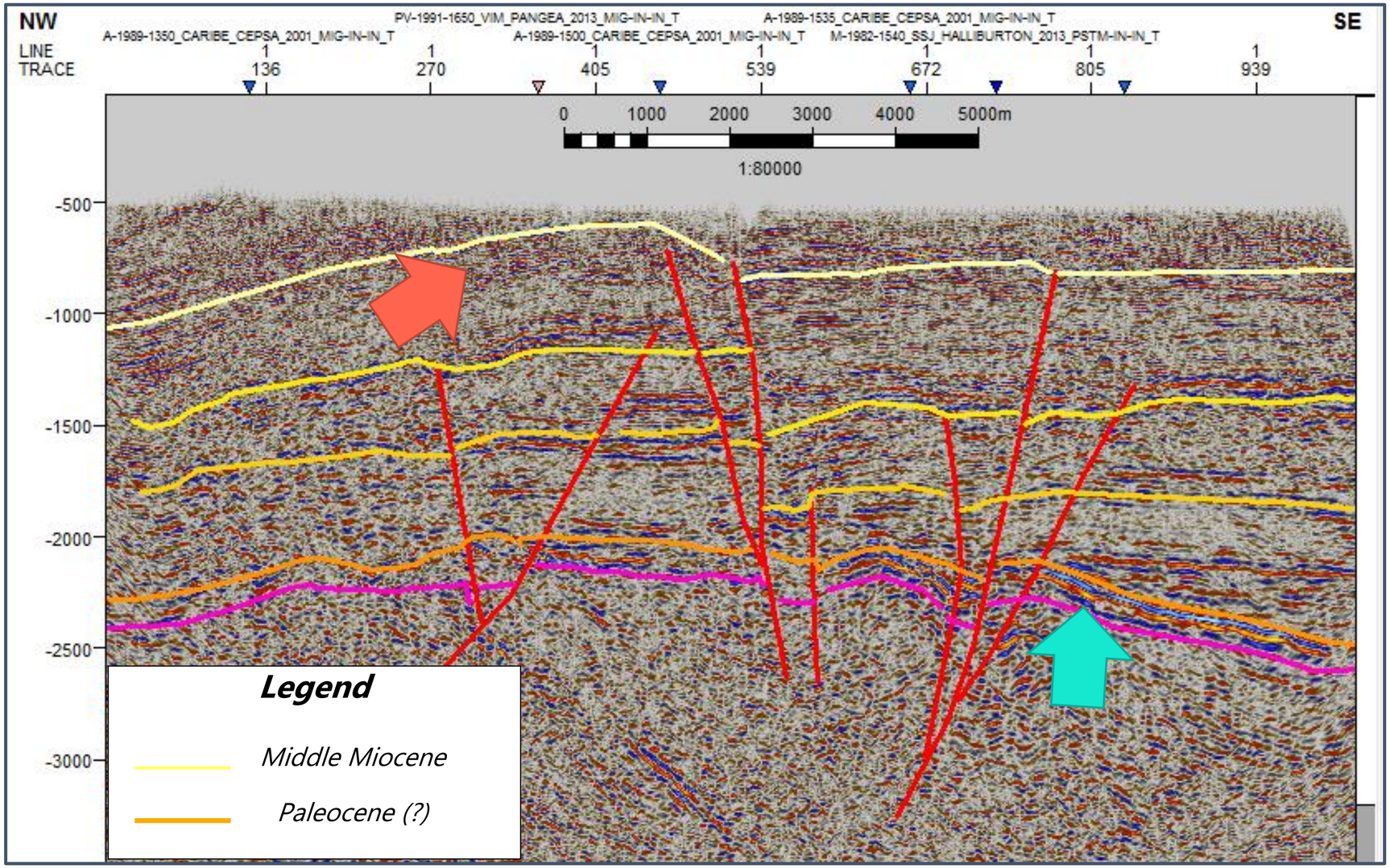


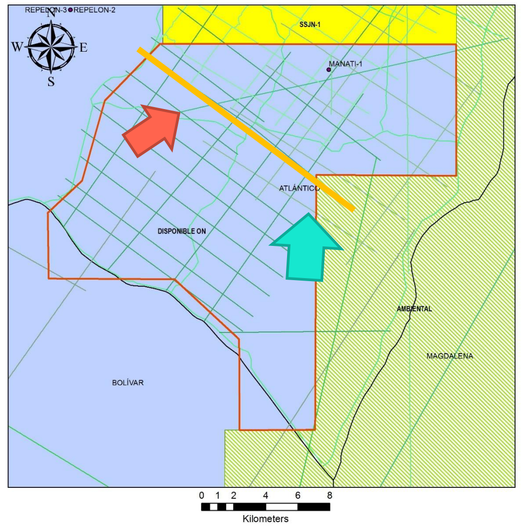
MANATÍ

- Well drilled in 1953 by Shell – Condor SA
- The well had a TD of 11,443 passing trough the units Carmen Fm, Maco Conglomerates and Luruaco Flysch
- 11 cores were taken and 4 DSTs
- Despite the fact that the well had gas & oil shows and had gas production during the tests, the well was abandoned and plugged up

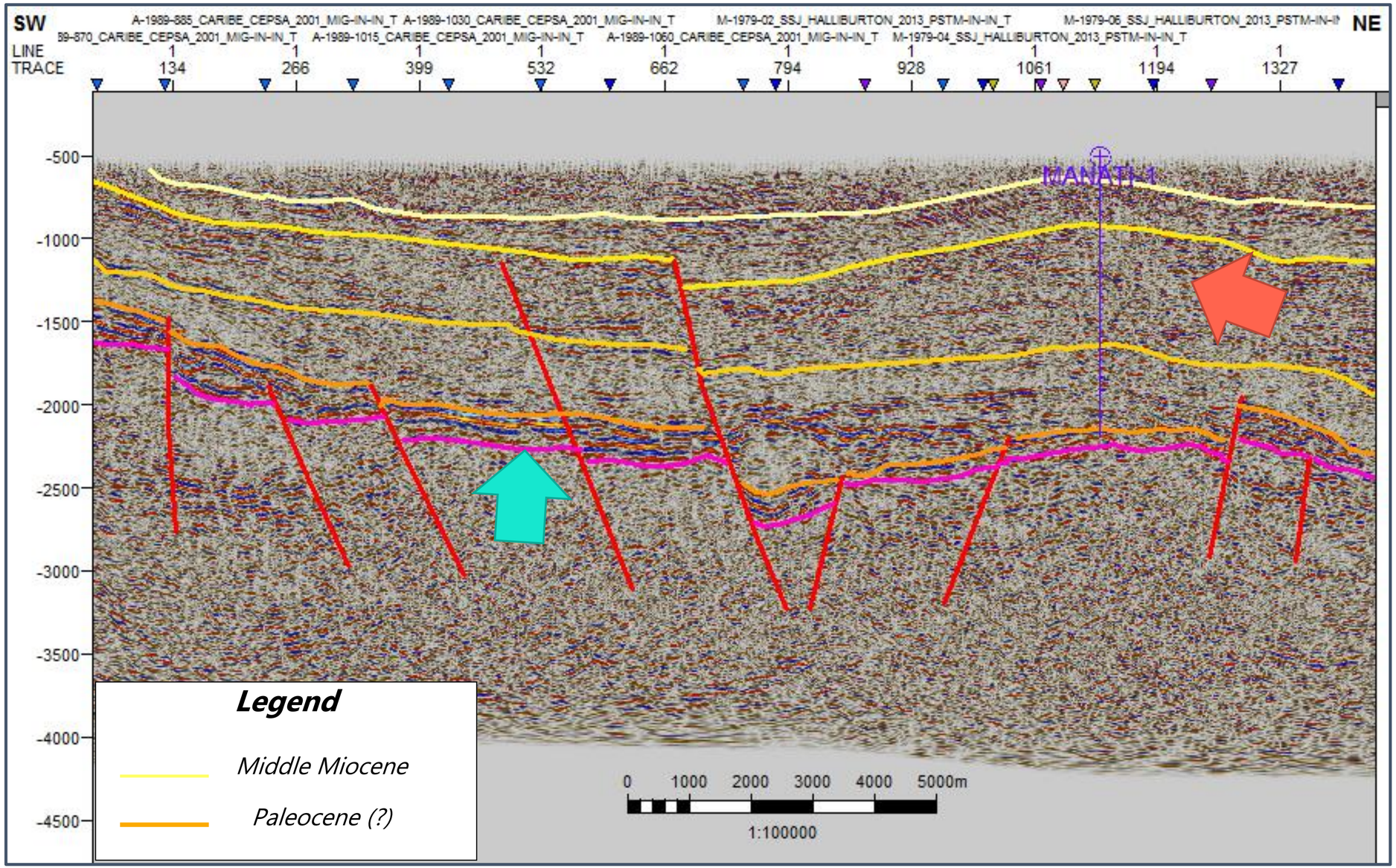
DSTs Manatí 1		
DST	**Depth**	**Result**
1	7,654' - 7,886'	Fresh Water (120-350 ppm Cl) 3200cf, 65 min **Gas + Mud, 2800cf** **Gas + Salty Water (7620 - 8500 ppm Cl) 180 cf**
2	11,095' - 11,437'	Fresh Water, 6 Stops, 60 min Mud, 15 stops **Mud + Gas**, 47 stops **Fresh Water + Gas**, 34 Stops
3	6,880' - 6,938'	**Gas, 60 kcf/d** (71h + 38min)
4	5,280' - 5,335'	Fresh Water, 15 h + 35min Gas + Salty Water + Mud Water (7300 ppm Cl) + Gas

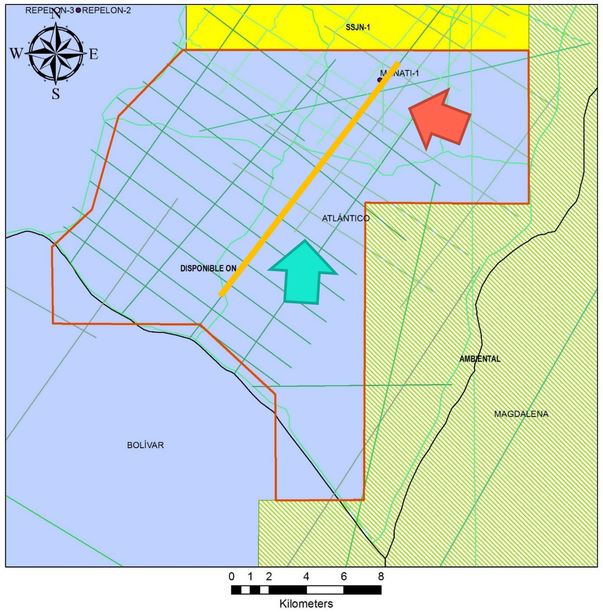
SEISMIC INTERPRETATION



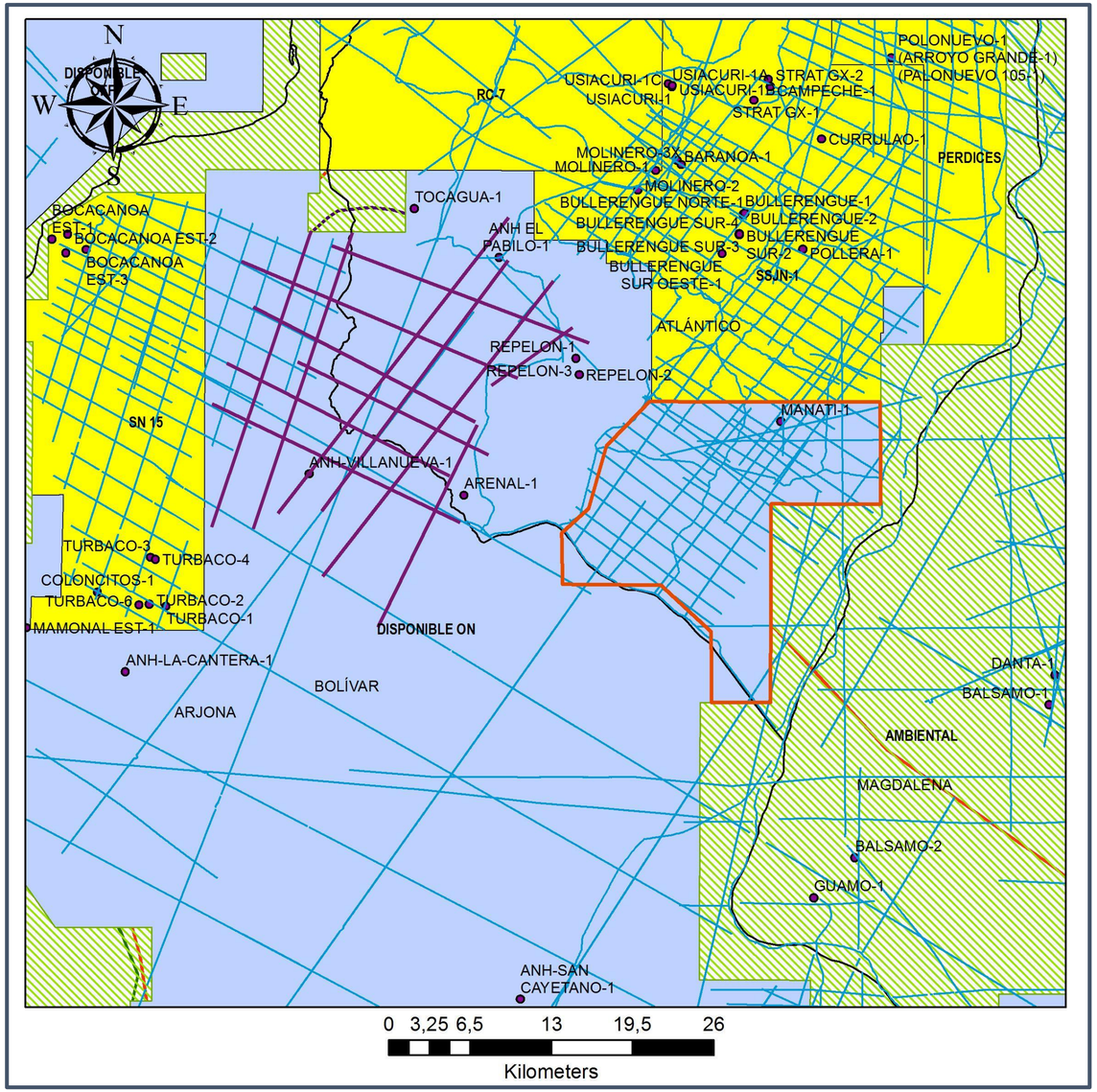


SEISMIC INTERPRETATION





REPELON 2D SEISMIC 2021 ANH - ENTERRITORIO



- The ANH & Enterritorio will acquire in 2021 286 Km of 2D seismic in the San Jacinto sub – basin
- The program consists of 7 strike lines (NE-SW) and 6 dip lines (NE – SW)
- The program will connect regional seismic lines with local programs from SN – 15 and Manati Area, improving the understatement of reservoir disposition

CONCLUSIONS

- Floresanto and Jaraguay areas have an structural dominance by mud diapirism that could by trapping hydrocarbons at the Floresanto Fm and El Pavo Sandstone. At the moment of drilling, this concept was not taken into account

- Floresanto has a proven petroleum system with **two producer wells**: **Floresanto –1** that produced a total of **28,730 bbls** with **51º API** and **Floresanto 6** that produced **42 bbls** during tests with **50º API** in 12 hours

- In the Jaraguay Norte area 5 wells were drilled with **1 producer well**. The well Jaraguay Norte –1 had a cumulative production of **700 bbl** of **48º API** with a peak production of **126 bbl** per day. Despite of not having production, the rest of the wells found good quality reservoirs with shows and even DSTs with production of **gallon and a half** in **Jaraguay Norte-3.**

- Most of the wells despite of not declaring commerciality in the Floresanto and Jaraguay area, have shown **significant amount of oil and gas shows**. It is worth to bear in mind that gas was not a matter of interest at spud dates of most of the wells.

- **Manatí (SSJN 3-1)** is a recent **incorporated area** by the industry to the round. Into the area the ANH identified to types of traps: 1) structural traps with anticlines that involves Miocene sediments and 2) stratigraphic traps with development of carbonates from Paleocene and Eocene age similar to the Bullerengue discoveries at the north

- The ANH with Enterritorio will be acquiring a 2D seismic program of 286 Km with the purpose of connecting regional seismic lines and local programs nearby the SSJN 3-1 area.

Thanks

www.anh.gov.co

COLOMBIA ROUND 2021

DATE