

PROSPECTIVITY OF THE CENOZOIC UNITS FROM THE UPPER MAGDALENA VALLEY.

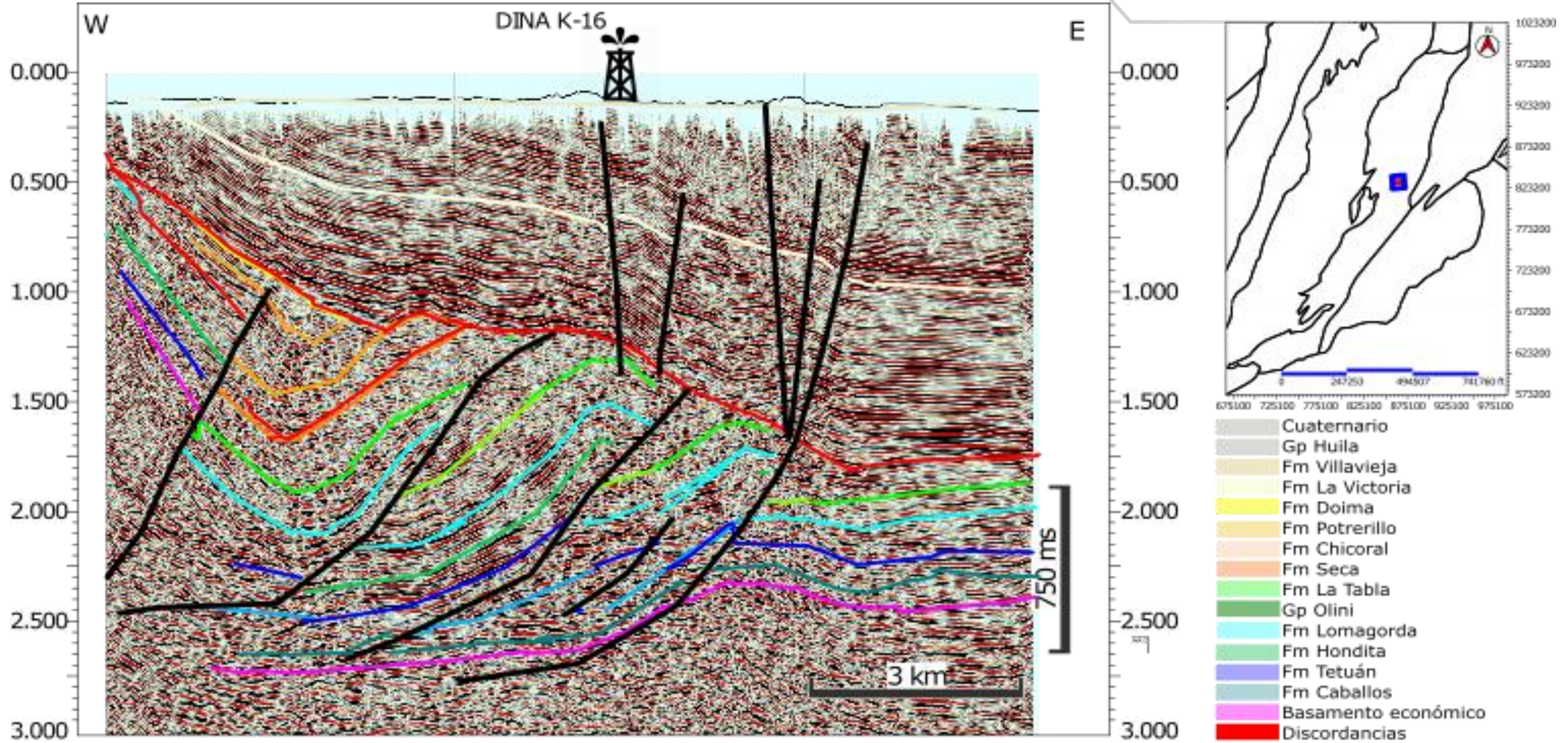


Javier Guerrero, Álvaro Vargas, Chajid Kairuz, Maria Daroca, César Mora.

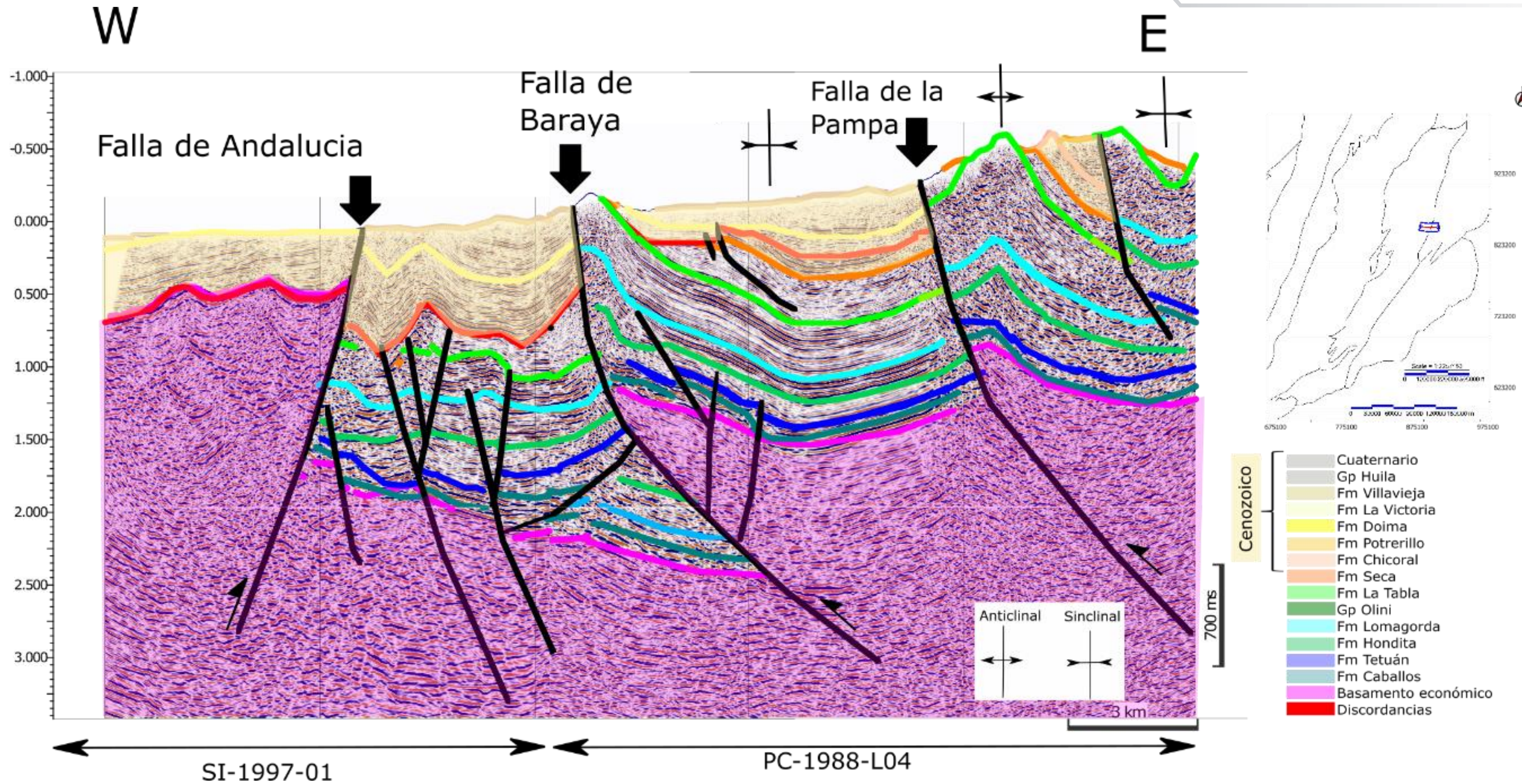
June 17, 2022

Regional Geology, Stratigraphy, Sedimentology.

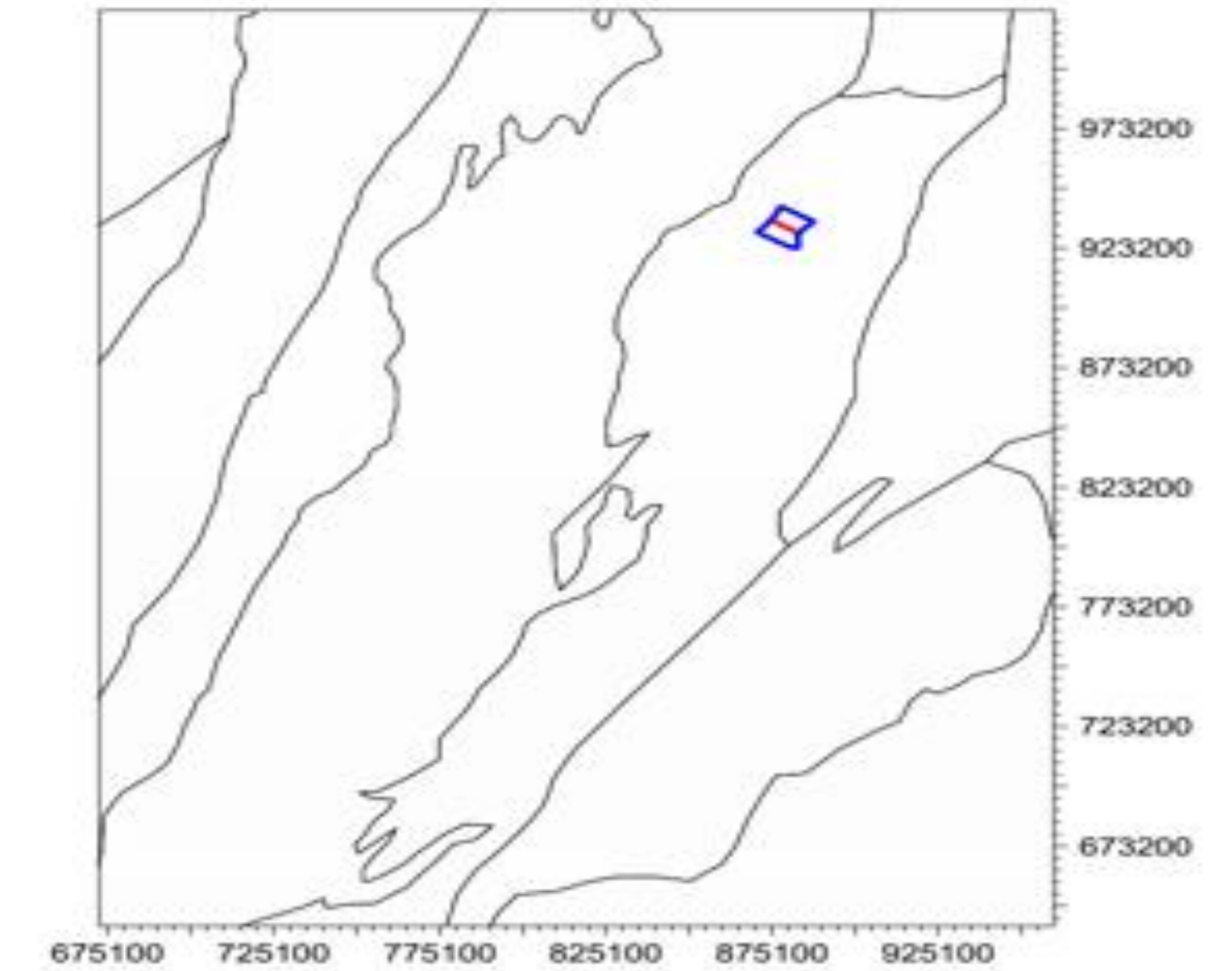
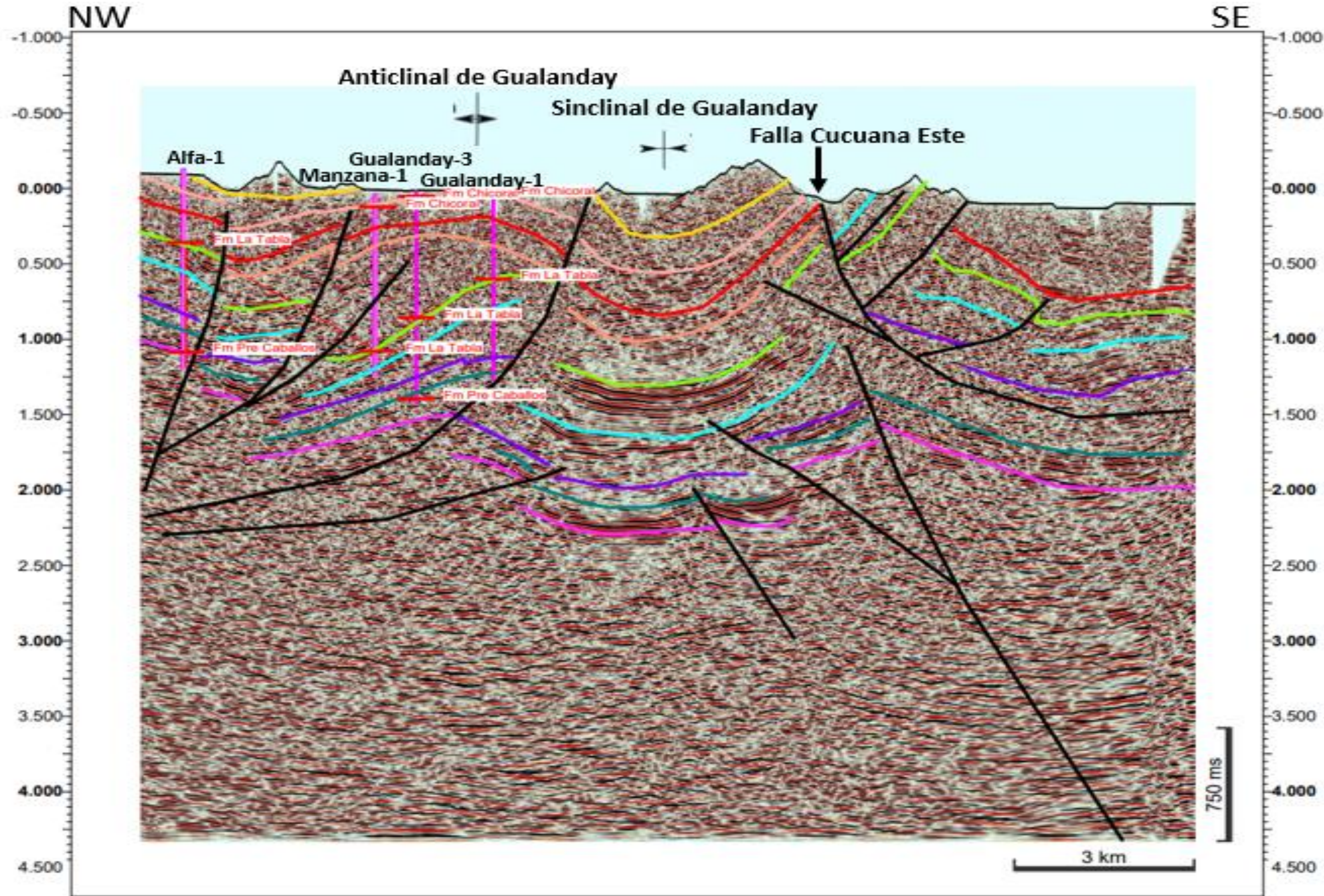
EDAD	UNIDAD (GRUPO)	UNIDAD (FORMACIÓN / MIEMBRO)	Ma		LITOLOGÍA	ESPESOR
PLIOCENO / CUATERNARIO		FORTALECILLAS / CEIBAS / GARZÓN / LAS VUELTAS/ MESA	Holoceno 5,3 Ma	RST	Arenitas conglomeráticas y conglomerados de guijos y cantos de dacitas y andesitas. Presencia menor de fragmentos metamórficos e ígneos. En la Fm Garzón conglomerados de rocas metamórficas derivadas del ya expuesto Macizo de Garzón, con clastos de 50 cm de diámetro hasta 2.5 m, en capas de 15 a 40 m de espesor.	500 a 900 m
MIOCENO TARDÍO	H U I L A	GIGANTE	8,4 - 6,2 Ma	TST	Lodolitas y arenitas de color blanco y gris claro, con restos de hojas y troncos de árboles. Composición dacítica y andesítica. Algunas capas de ceniza volcánica. Muy baja densidad por el contenido de partículas de pómez.	500 a 700 m
		NEIVA	10,1 - 8,4 Ma	RST	Conglomerados de guijos y cantos de composición dacítica y andesítica de hasta 10 cm de diámetro. Fragmentos de rocas volcánicas Jurásicas en el área de Gigante. Intercalaciones menores de arenitas conglomeráticas y lodolitas de color blanco y gris muy claro, con restos de plantas.	100 a 200 m
MIOCENO MEDIO	H O N D A	VILLAVIEJA	13,1 - 12 Ma	TST	Lodolitas con intercalaciones menores de litoarenitas (volcánicas) granodecrecientes de hasta 6 m de espesor. Con fragmentos de andesita y dacita. En la mitad superior de la unidad predominan las lodolitas rojas con intercalaciones esporádicas de litoarenitas.	600 a 700 m
		LA VICTORIA	13,6 - 13,1 Ma	TST	Litorenitas volcánicas en sucesiones granodecrecientes de hasta 10 m de espesor (con fragmentos de andesita y dacita), intercaladas con lodolitas multicoloreadas del mismo espesor. Los conglomerados de guijos y las arenitas conglomeráticas son muy comunes en la base de cada sucesión.	600 a 700 m
DISCORDANCIA ANGULAR cerca a 13.6 Ma EN LA BASE DEL GRUPO HONDA. EN VARIAS LOCALIDADES DEL VSM LA UNIDAD SE ENCUENTRA SOBRE EL BASAMENTO CRISTALINO JURÁSICO O SOBRE ESTRATOS DEL CRETÁCICO SUPERIOR O DEL PALEÓGENO. ANTES DEL INICIO DEL DEPÓSITO DEL GRUPO HONDA (13.6 - 12 Ma), SE PRODUJO PLEGAMIENTO, FALLAMIENTO, EXHUMACIÓN Y ELIMINACIÓN POR EROSIÓN (16.0 - 13.8 Ma) DE LA SUCESIÓN CRETÁCICA, PALEÓGENA Y DEL MIOCENO TEMPRANO.						
MIOCENO TEMPRANO		TUNE / LA CIRA / SANTA TERESA	23,0 - 16,0 Ma	TST	Lodolitas grises con esporádicas intercalaciones de litoarenitas de grano fino compuestas por partículas de chert y cuarzo. Presencia de lodolitas negras, carbonosas y de carbón.	100 a 700 m
OLIGOCENO TARDÍO	G U A L A N D A Y	DOIMA / SAN JUAN SUPERIOR	27,8 - 23,0 Ma	RST	Conglomerados y arenitas conglomeráticas en capas muy gruesas. Guijos y cantos de hasta 15 cm de diámetro, compuestos principalmente por chert negro y cuarzo. Algunos fragmentos de rocas metamórficas e ígneas.	200 a 400 m
OLIGOCENO TEMPRANO Y EOCENO TARDÍO		POTRERILLO / SAN JUAN INFERIOR	37,7 - 27,8 Ma	TST	Lodolitas rojizas y multicoloreadas con intercalaciones repetitivas y alternantes de litoarenitas granodecrecientes (de 4 a 12 m de espesor), compuestas por partículas de chert negro y cuarzo.	200 a 400 m
EOCENO MEDIO		TESALIA / CHICORAL SUP / HOYÓN SUP	47,8 - 37,7 Ma	RST	Conglomerados y arenitas conglomeráticas en capas muy gruesas. Guijos y cantos de hasta 15 cm de diámetro, compuestos principalmente por chert negro y cuarzo. Algunos fragmentos de rocas metamórficas e ígneas.	200 a 400 m
EOCENO TEMPRANO		BACHE / CHICORAL MED / HOYÓN MED	56,0 - 47,8 Ma	TST	Lodolitas rojizas y multicoloreadas con intercalaciones repetitivas y alternantes de litoarenitas granodecrecientes (de 4 a 12 m de espesor), compuestas por partículas de chert negro y cuarzo.	200 a 300 m
PALEOCENO TARDÍO		PALERMO / HOYÓN INF / CHICORAL INF	59,2 - 56,0 Ma	RST	Conglomerados y arenitas conglomeráticas en capas muy gruesas. Guijos y cantos de hasta 15 cm de diámetro, compuestos principalmente por chert negro y cuarzo. Algunos fragmentos de rocas metamórficas e ígneas.	200 a 300 m
PALEOCENO TEMPRANO Y MAASTRICHTIANO TARDÍO		SECA	69,0 - 61,6 Ma	TST	Lodolitas grises fosilíferas (con foraminíferos bentónicos), lodolitas carbonosas y carbón. Intercalaciones de arenitas fosilíferas marinas y de lodolitas/arenitas multicoloreadas de ambientes fluviales.	50 a 400 m
MAASTRICHTIANO TEMPRANO		LA TABLA Y BUSCAVIDA	72,1 - 69,0 Ma	RST	Sucesión granocreciente desde lodolitas y litoarenitas fosilíferas (volcánico-metamórficas), hasta conglomerados de guijos. Internamente se aprecian parasecuencias (de 3 a 6 m de espesor) con lodolitas y arenitas granocrecientes. Roca resevorio de hidrocarburos. Denominada informalmente como "formación monserrate".	160 a 180 m
CAMPANIANO TARDÍO		OLINI SUPERIOR	77,8 - 72,1 Ma	TST	Cherts diagenéticos: Biomicritas de foraminíferos (calizas de baja energía), parcial a totalmente reemplazadas por cuarzo durante la diagénesis. Fractura ortogonal a macroescala (cubos de 5 a 15 cm). Roca fuente de hidrocarburos.	60 a 160 m
CAMPANIANO TEMPRANO		EL COBRE	83,6 - 77,8 Ma	RST	Sucesión granocreciente desde shales y arenitas de grano muy fino a fino (excepcionalmente grano medio). Se trata de una unidad terrígena entre dos unidades de caliza (Lomagorda y Olini Superior). Denominada informalmente en algunas localidades como "aico shale".	140 A 200 m
SANTONIANO CONIACIANO		LOMAGORDA	93,9 - 83,6 Ma	TST	Calizas de baja energía: biomicritas de foraminíferos. Elevados contenidos de materia orgánica. Roca fuente de hidrocarburos. Equivalente lateral de la Formación La Luna. Un delgado horizonte de 20 a 30 metros de espesor en la parte superior se encuentra parcialmente silicificado y ha sido asignado al miembro inferior de la Fm Olini.	210 - 250 m
CENOMANIANO		HONDITA	100,5 - 93,9 Ma	RST	Sucesión granocreciente desde shale hasta litoarenita de grano muy fino, con abundantes fósiles de foraminíferos. Denominada informalmente como "bambuca shale".	140 A 200 m
ALBIANO TARDÍO Y MEDIO		TETUAN	109,0 - 100,5 Ma	TST	Biomicritas de foraminíferos planctónicos, con elevados contenidos de materia orgánica y fosfatos. Roca fuente de hidrocarburos.	150 a 200 m
ALBIANO TEMPRANO		CABALLOS SUPERIOR	113,0 - 109,0 Ma	RST	Sucesión granocreciente desde arenitas de grano muy fino a grano grano medio. Las calizas de alta energía (bioesparitas y bioesparitas arenosas) predominan en algunas localidades.	100 a 200 m
APTIANO TARDÍO		CABALLOS MEDIO	117,0 - 113,0 Ma	TST	Shales fosilíferos y biomicritas de foraminíferos con elevados contenidos de materia orgánica. Roca fuente de hidrocarburos.	100 a 200 m
APTIANO MEDIO		CABALLOS INF YAVI	121,0 - 117,0 Ma	TST	Sucesión granodecreciente desde conglomerados de cantos y guijos hasta arenitas de grano medio, con intercalaciones menores de lodolitas rojas en la Fm. Yaví. Pasan transicionalmente a arenitas de grano medio a muy fino en el miembro inferior de la Fm. Caballos	100 a 300 m



Angular unconformity of the middle Miocene (Serravallian) Honda Group (13.6 to 12 Ma) deposited over previously folded, faulted and exhumed strata of Cretaceous to early Miocene age. Major uplift event followed by subsidence of the foreland of the Central Cordillera occurred during the Langhian (16 to 13.8 Ma), eroding the Early Miocene Tuné Fm, the Gualanday Gr. and the upper Cretaceous strata.

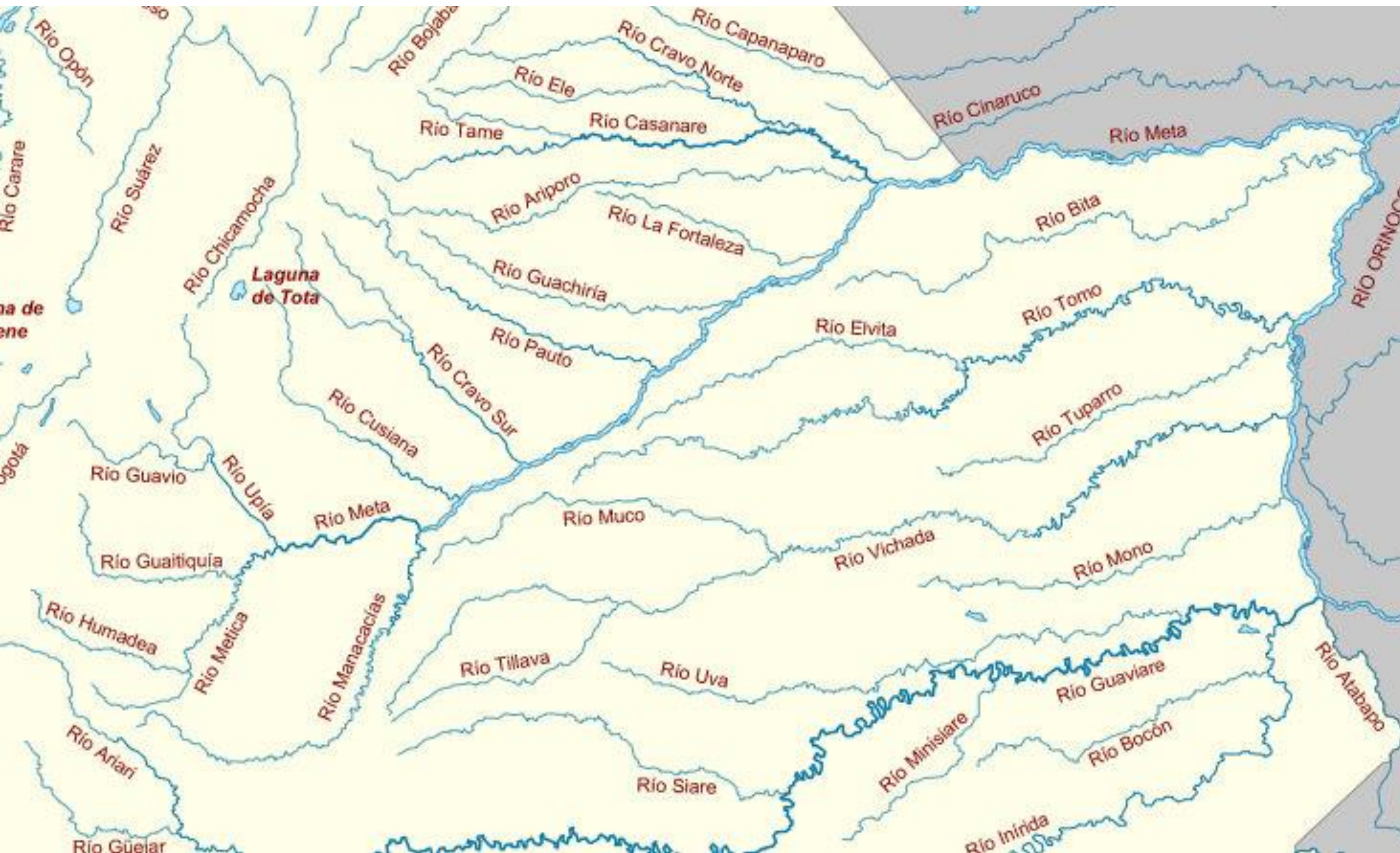


Lines SI-1997-04 and PC-1988-L04 showing the W vergence Baraya and La Pampa faults, opposite to the E vergence Andalucía fault..



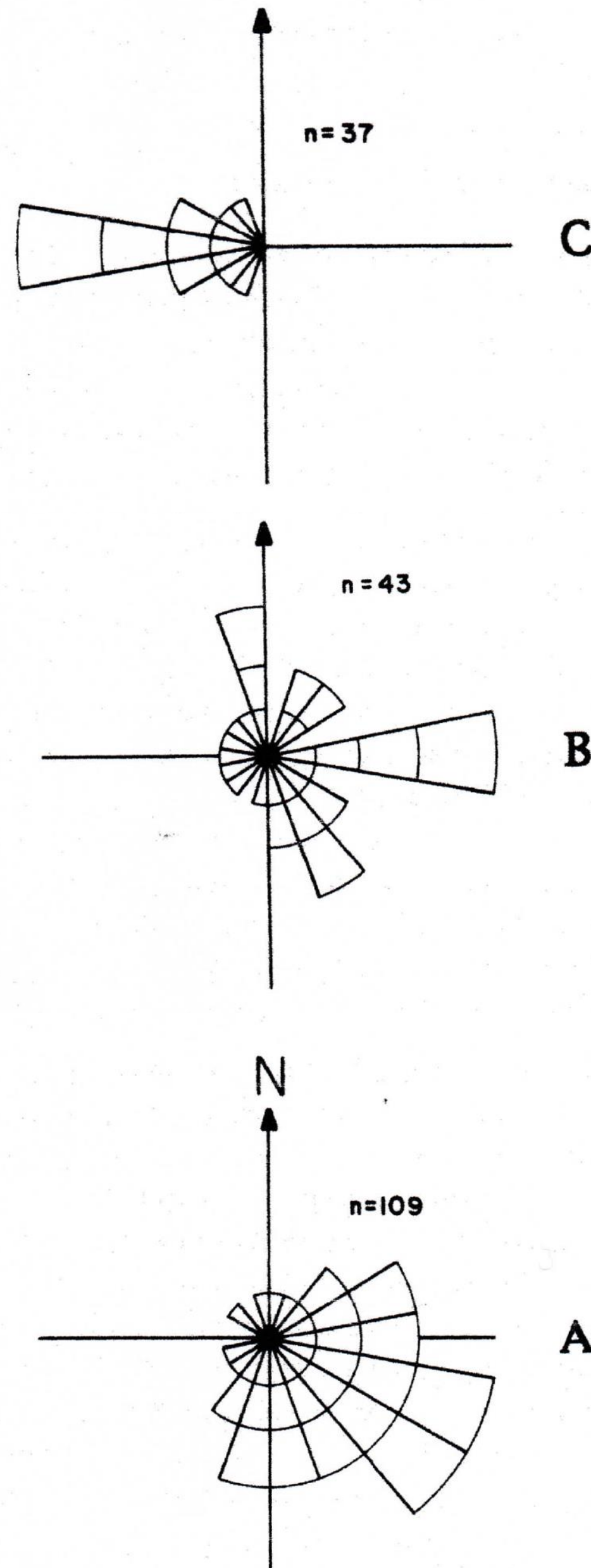
- Cuaternario
- Gp Huila
- Fm Villavieja
- Fm La Victoria
- Fm Doima
- Fm Potrerillo
- Fm Chicorot
- Fm Seca
- Fm La Tabla
- Gp Olini
- Fm Lomagorda
- Fm Hondita
- Fm Tetuán
- Fm Caballos
- Basamento económico
- Discordancias

Late Paleocene to Oligocene Gualanday Group over the Cretaceous succession. An erosional unconformity of Late Paleocene age has been documented in other localities over the Seca / Guaduas Formation, but there is no angular unconformity.



**Meandering rivers
and floodplains of the
Orinoco river basin.**

Villavieja Formation
13.1 to 12 Ma



La Victoria Formation
13.6 to 13.1 Ma

Figure 2.10. Paleocurrent directions in the Honda Group of the La Venta area. *A.* Paleocurrent directions from cross-bedding sets in the La Victoria Formation (with the exception of the Cerbatana Conglomerate Beds). *B.* Paleocurrent directions from cross-bedding sets in the Baraya Member and the lower part of the Cerro Colorado Member. *C.* Paleocurrent directions from cross-bedding sets in the upper part of the Cerro Colorado Member.

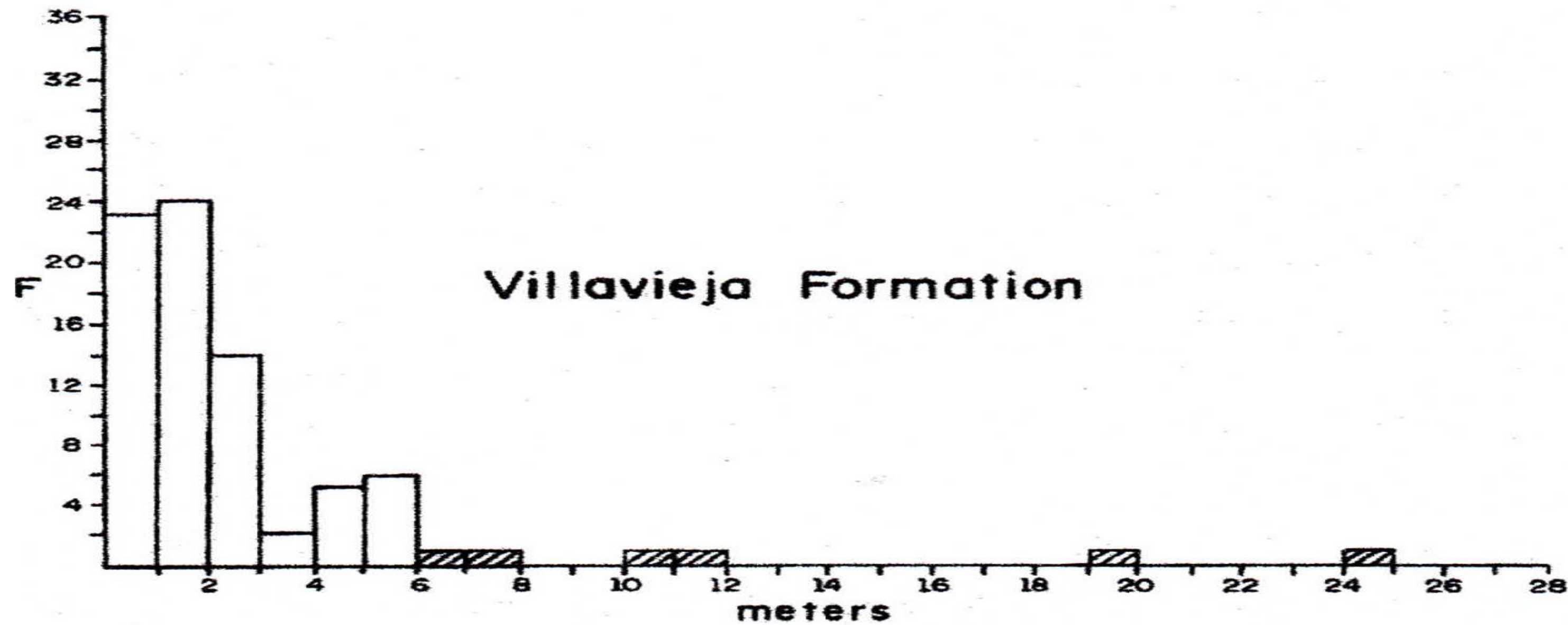
Paleocurrent directions of the Honda Group mainly towards the SE and E.

A) La Victoria Formation.

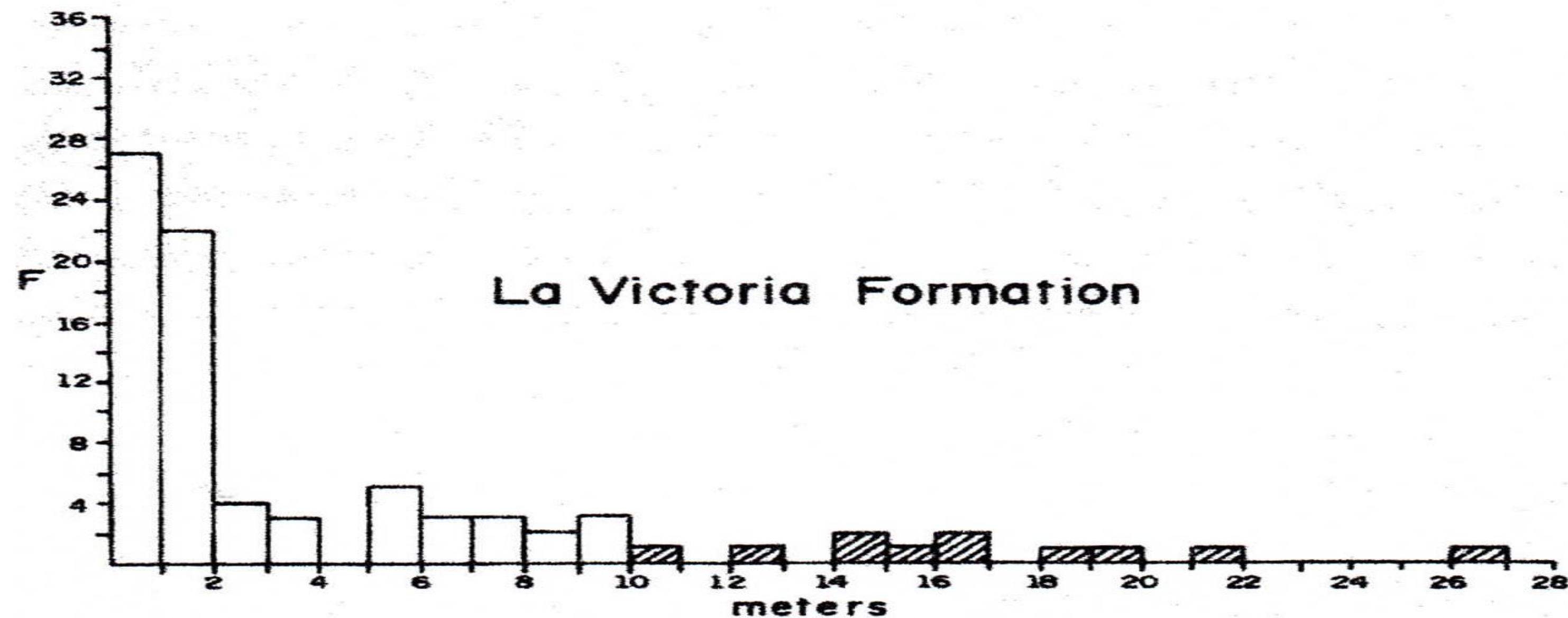
B) Lower part of the Villavieja Formation.

C) Uppermost part of the Villavieja Formation with currents towards the W showing a new source area in the E by about 12 Ma: The new-born Eastern Cordillera.

Taken from Guerrero (1997): Stratigraphy, Sedimentary Environments, and the Miocene Uplift of the Colombian Andes .



Thickness of individual sandstone beds composed each of a single meander bar. Sandstone thickness indicates channel depths of up to 10 m in the La Victoria Formation and 6 m in the Villavieja Formation.



Multistory sandstone bodies up to 27 m thick in meander belts.

Taken from Guerrero (1997): Stratigraphy, Sedimentary Environments, and the Miocene Uplift of the Colombian Andes .

Table 2.1. Measured and calculated dimensions (m) of the Honda Group meandering rivers

D	W	W_m	W_{mr}
2-3	20-37	188-351	150-350
6	107	1,020	—
8-10	167-235	1,588-2,240	2,000-4,000

Notes: D = depth, or thickness of epsilon units. W = width, $6.8D^{1.54}$. W_m = meander belt width, $64.6D^{1.54}$. W_{mr} = width of sandstone bodies in the field.

Width of the meander belts measured in the field between 2 and 4 km measured in multistory sandstone bodies made with channels 8 to 10 m depth.

From Guerrero (1997): Stratigraphy, Sedimentary Environments, and the Miocene Uplift of the Colombian Andes .

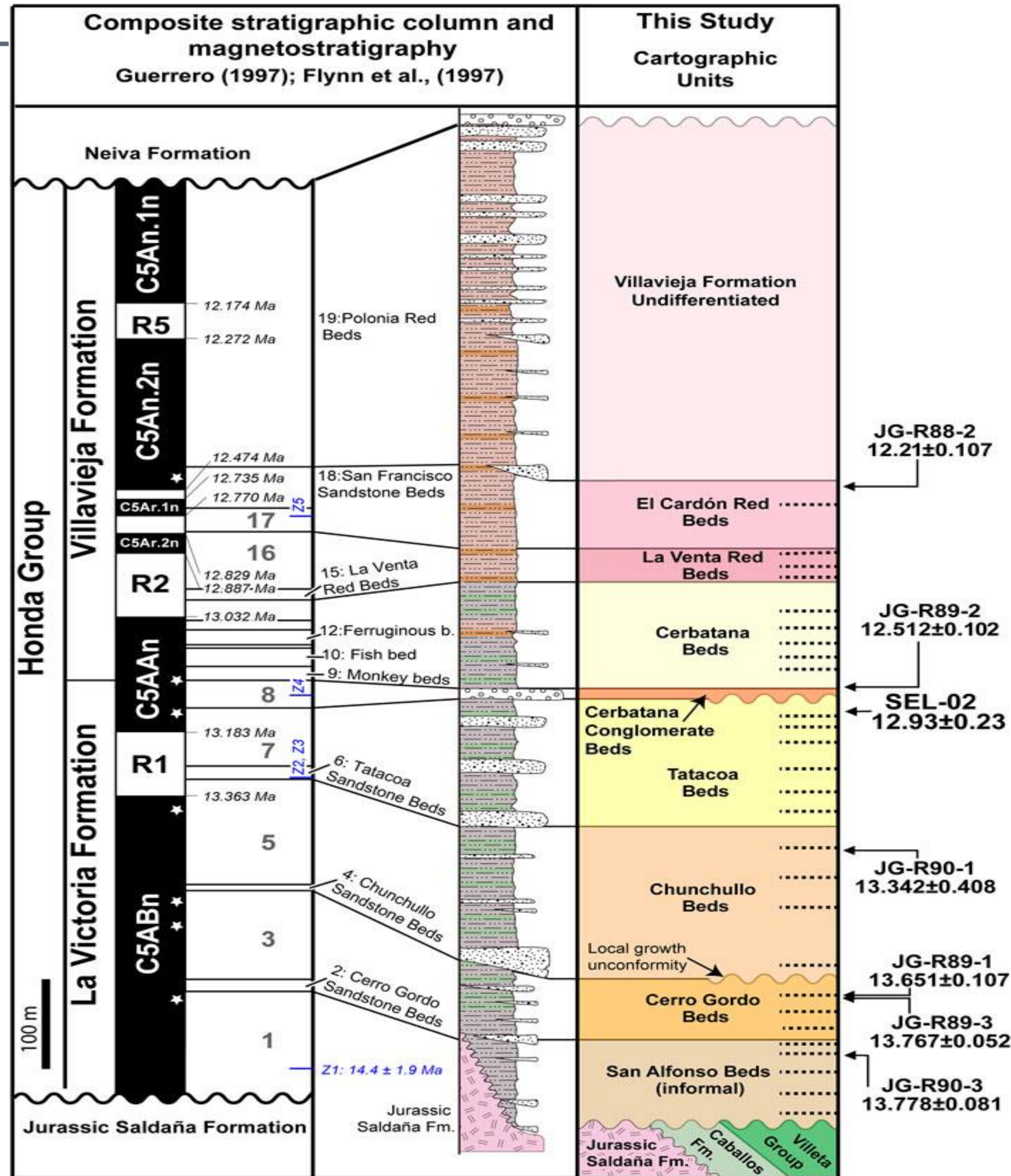


Figure 3 of Montes et al (2021): A Middle to Late Miocene Trans-Andean Portal: Geologic Record in the Tatacoa Desert.

Updated stratigraphic scheme for the Honda Group in the Tatacoa Desert. Stratigraphy and Ar-Ar ages from Guerrero (1993, 1997). Magnetostratigraphy from Flynn et al (1997).

U-Pb detrital ages from Anderson et al (2016).

Magnetostratigraphy covers the C5An.1n-C5ABn interval, showing updated ages after Hilgen et al (2012).

Black arrows represent geochronological samples from Flynn et al (1997). Blue arrows represent maximum depositional ages of Anderson et al., (2016).

Maximum time span of Honda Group deposition (Serravalian and Laventan Land Mammal Age) between 13.6 Ma and 12 Ma according to updated magnetostratigraphic ages.

La Victoria Formation of the Honda Group at the Barzalosa locality. Reddish mudstone facies with root casts, interpreted as alluvial floodplain deposits with paleosoil development. In the upper part, fining-upward sandstone body 3 meters thick, interpreted as a meandering channel.





Honda Group near the town of Tocaima. Fining-upward sandstone body 7 meters thick, interpreted as a meandering channel.

Tesalia Formation of the Gualanday Group in the syncline of the same name, in the type locality of the unit. Espinal – Gualanday highway. Conglomerates (pebbles and cobbles) and conglomeratic sandstones interpreted together as deposits of braided channels from the Middle Eocene foreland of the Central Cordillera.



**Conglomeratic sandstone
facies with asphalt seeps.
Tesalia Formation. Espinal –
Gualanday highway.**



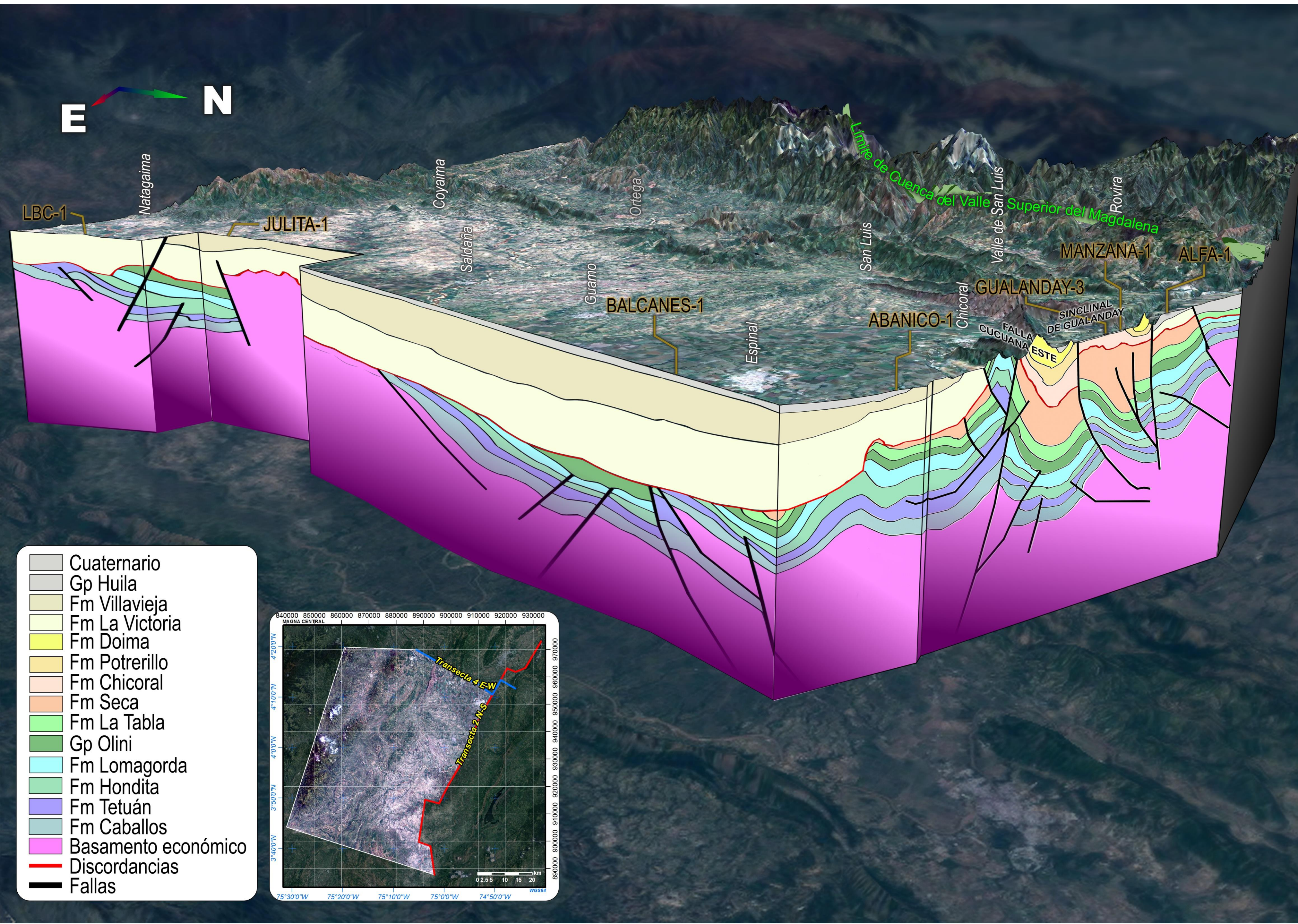
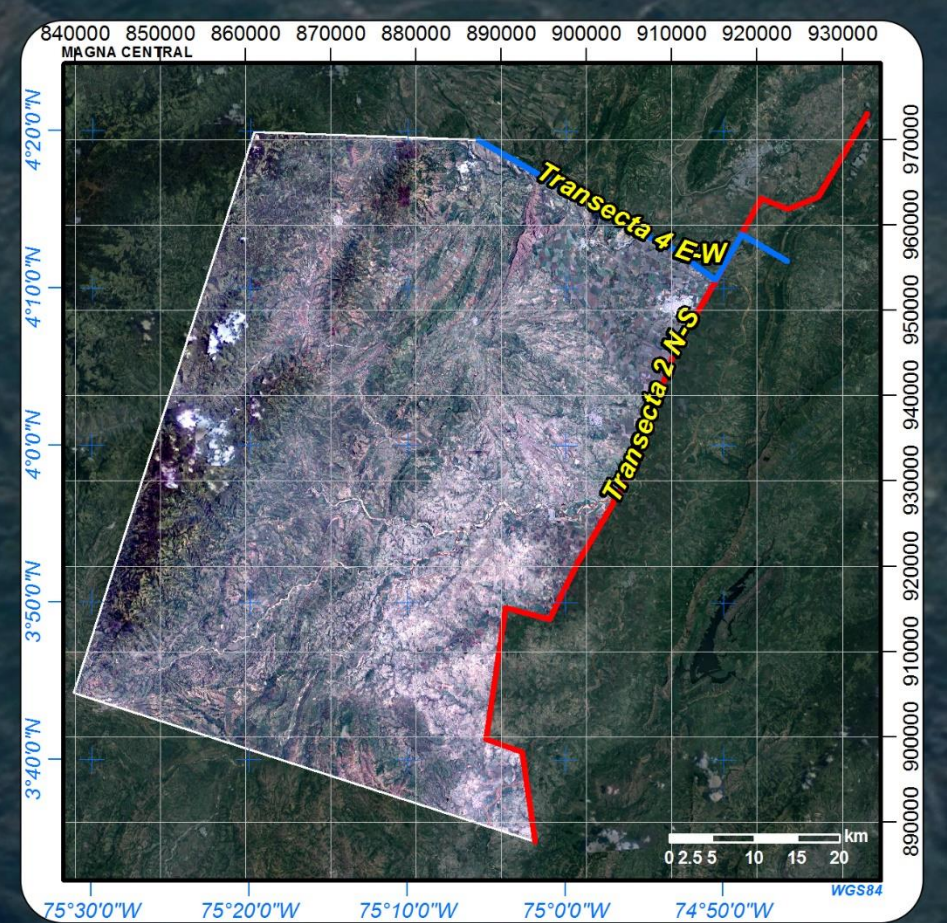


Diagram from the seismic interpretation of the Girardot area from the UMV showing the type section of the Gualanday Group and a large area with the Middle Miocene (Serravallian) Honda Group unconformable over the previously exhumed Cretaceous and Paleogene units.

The early Miocene lacustrine units including the Tuné, La Cira, and Santa Teresa Formations were the first units to be eroded during the Middle Miocene (Langhian) uplift event.

- Cuaternario
- Gp Huila
- Fm Villavieja
- Fm La Victoria
- Fm Doima
- Fm Potrerillo
- Fm Chicoral
- Fm Seca
- Fm La Tabla
- Gp Olini
- Fm Lomagorda
- Fm Hondita
- Fm Tetuán
- Fm Caballos
- Basamento económico
- Discordancias
- Fallas



Stratigraphic Field Sections with Gamma Ray

Statistics

16 sections: 5,372 linear meters

Total with Radiometry: 4,480 m

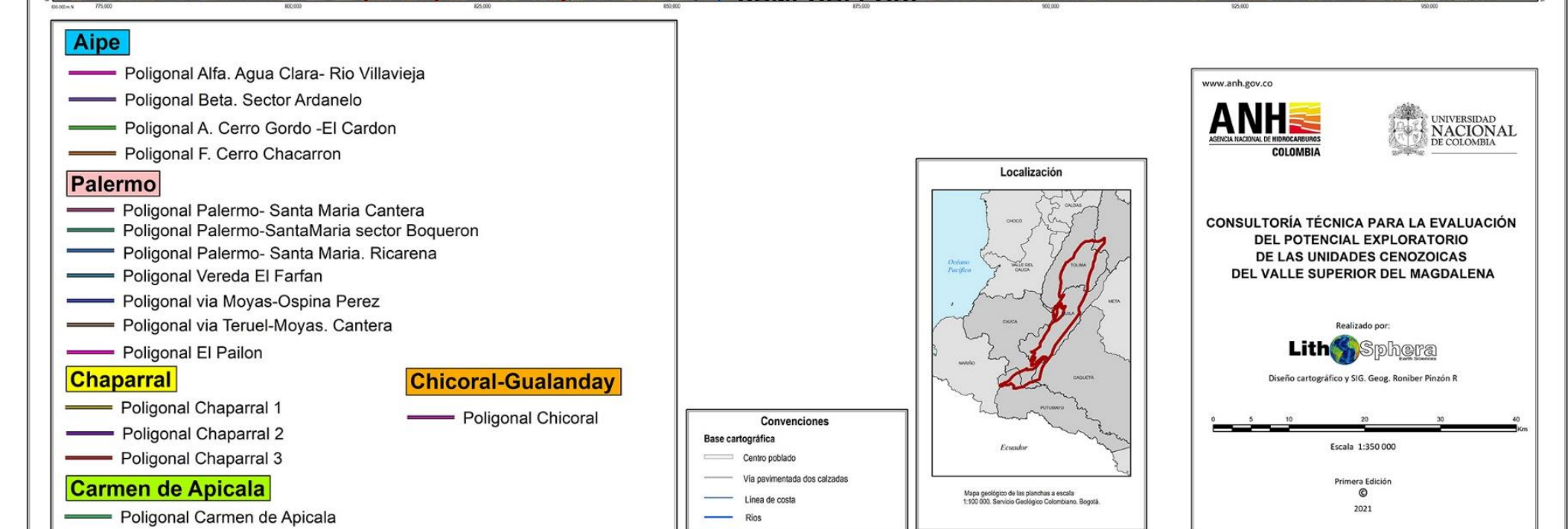
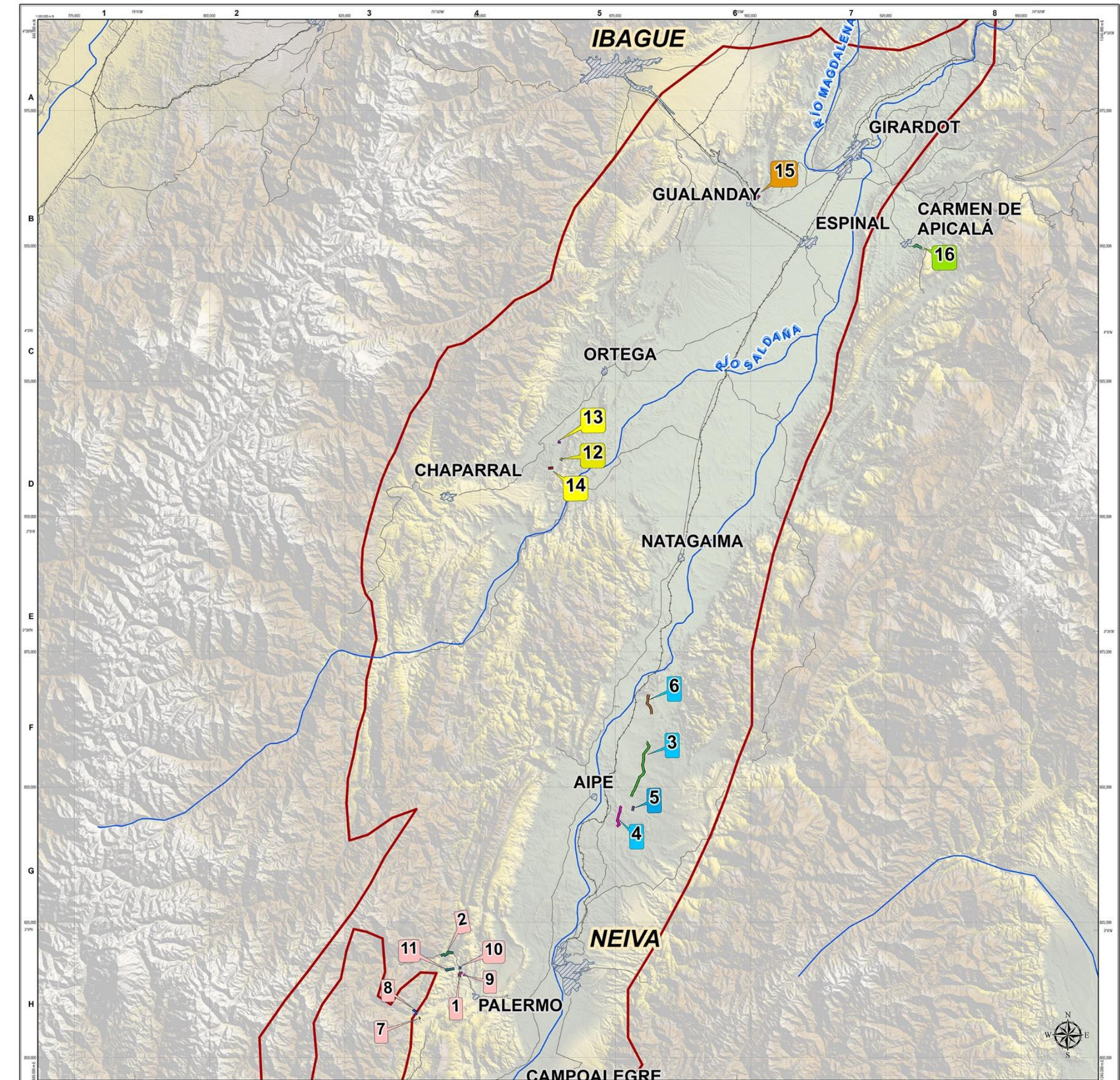
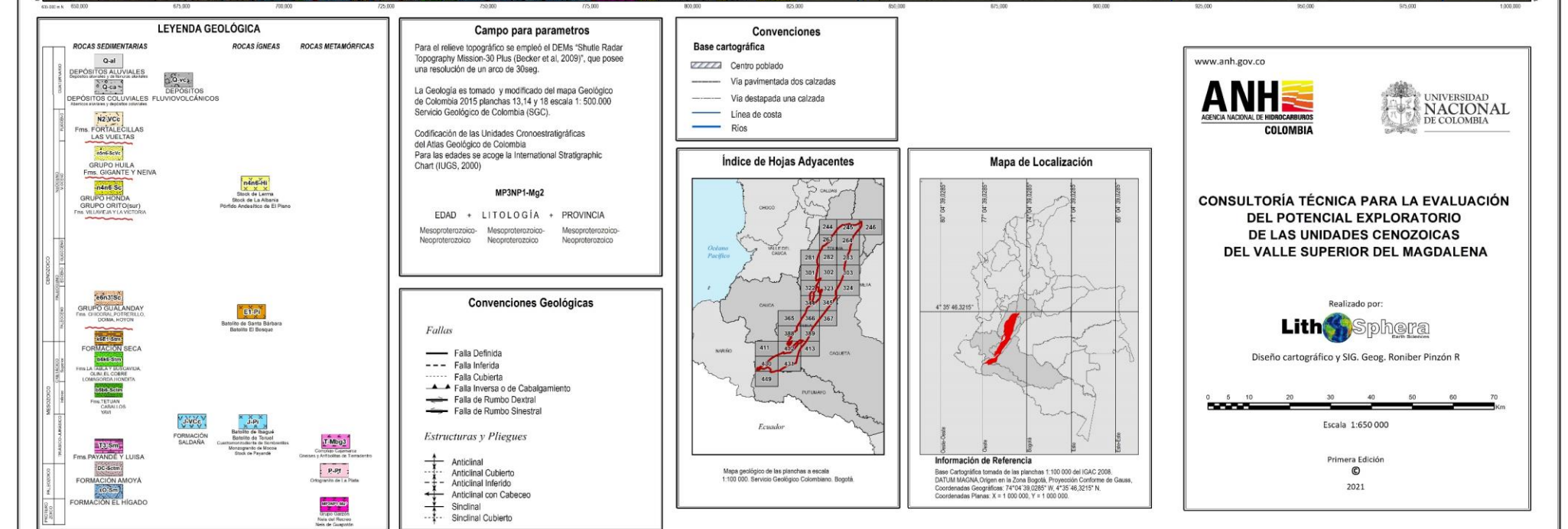
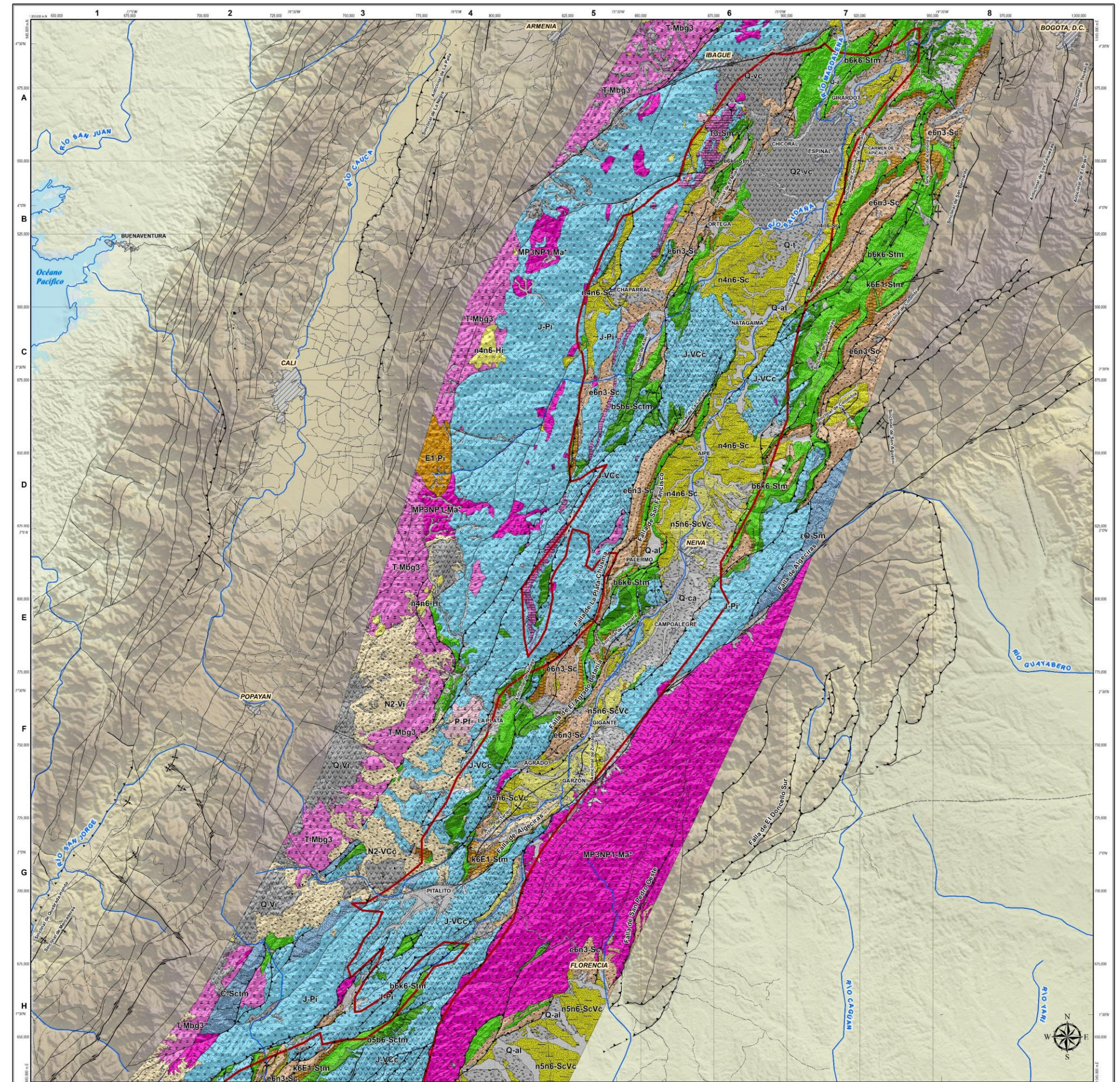
Gualanday Group: 2,959 m

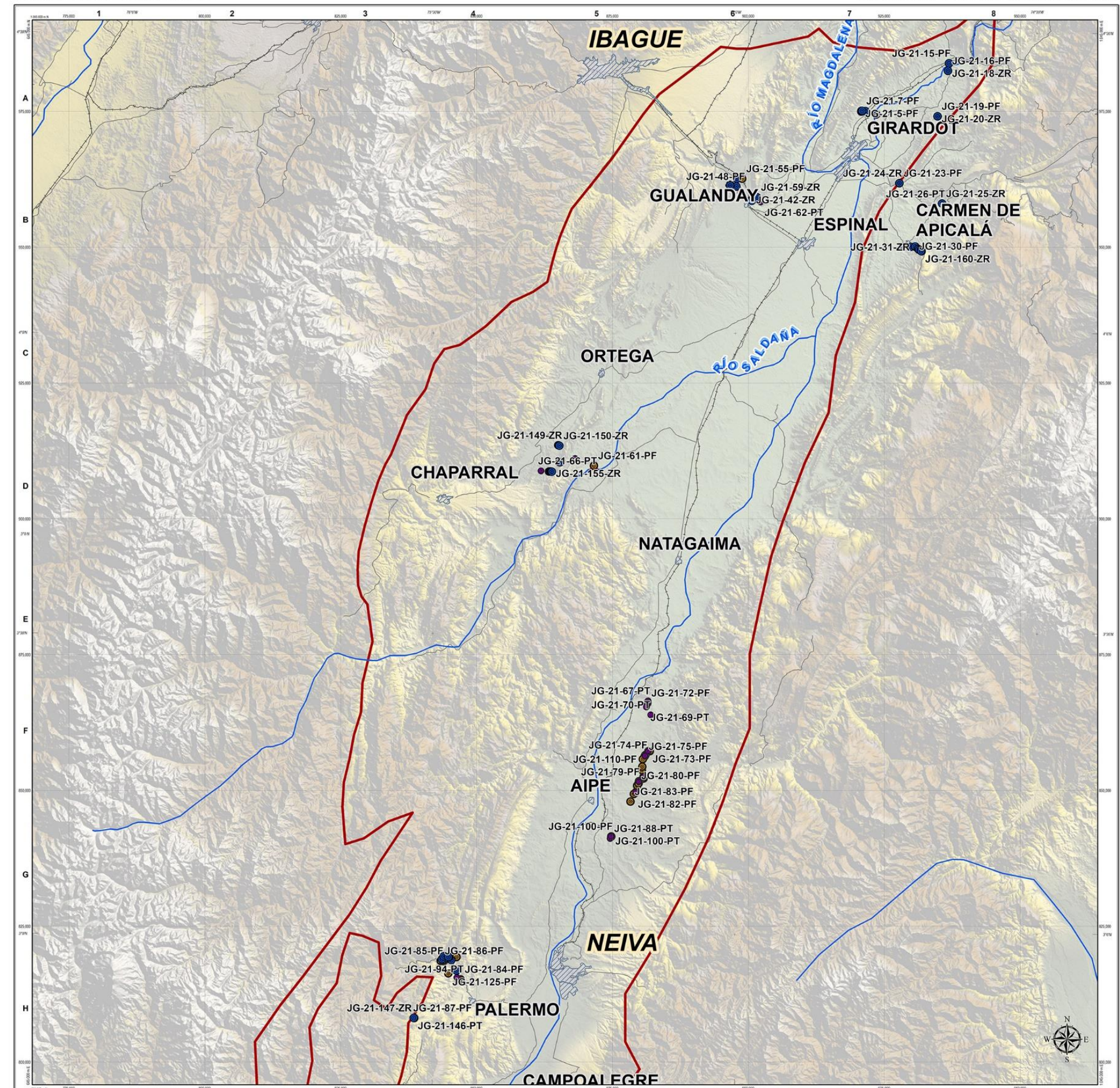
Honda Group: 1,521 m

- STAFF:





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- Juan Guillermo Vargas
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Muestras Geológicas

-  Palinología (PAL)
-  Petrografía (PT)
-  Petrofísica (PF)
-  Difracción Rayos X (DRX)

Convenciones

-  Base cartográfica
-  Centro poblado
-  Vía pavimentada dos calzadas
-  Línea de costa
-  Ríos



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AGENCIA NACIONAL DE HIDROCARBUROS
COLOMBIA

UNIVERSIDAD NACIONAL DE COLOMBIA

CONSULTORÍA TÉCNICA PARA LA EVALUACIÓN DEL POTENCIAL EXPLORATORIO DE LAS UNIDADES CENOZOICAS DEL VALLE SUPERIOR DEL MAGDALENA

Realizado por:
LithoSphera

Diseño cartográfico y SIG. Geog. Romber Pinzón R.

Escala 1:350.000

Primera Edición © 2021

Field Sampling

Total Samples: 200 collected
Delivered: 148



Radiometry Data Example in Chicoral place

Metro Colum Assay	Date	Time	Temperature Stabilized	Total[ppm]	Total[cpm]	K[%]	K[cpm]	U[ppm]	U[cpm]	Th[ppm]	Th[cpm]	Dose	Dose units	
-0,25	2683	5/09/2021	13:41:47	27,7	1	17,7	4756,7	3,6	793,3	2,4	89	13	104,4	94,8 nGy/h
0	2684	5/09/2021	13:43:56	28,2	1	16,5	4427,8	3,3	772,3	5	128,7	10,5	85,5	99 nGy/h
0,25	2685	5/09/2021	13:44:46	28,3	1	13,1	3527,2	2,2	510,7	2,1	74,3	10,2	81,3	68 nGy/h
0,5	2686	5/09/2021	13:45:38	28,5	1	11,6	3110,8	2	460,5	2,6	76,4	8,6	68,8	62,6 nGy/h
0,75	2687	5/09/2021	13:47:23	28,7	1	10	2698,6	1,9	414,4	1,4	49,2	6,7	54,1	50,1 nGy/h
1	2688	5/09/2021	13:48:13	28,7	1	11,4	3073,1	1,8	435,4	2,9	82,6	8,8	70,8	62,9 nGy/h
1,25	2689	5/09/2021	13:49:11	28,9	1	10,8	2911,9	2,1	477,1	2,3	70,1	8	64,6	61,3 nGy/h
1,5	2690	5/09/2021	13:50:50	28,9	1	11,9	3200,6	1,8	435,4	2,7	76,4	7,8	62,5	59,7 nGy/h
1,75	2691	5/09/2021	13:51:40	29,1	1	11,3	3043,6	1,8	416,6	1,9	61,7	7,8	62,5	54,9 nGy/h
2	2692	5/09/2021	13:52:30	29,1	1	11,8	3167,1	1,8	437,5	2,7	76,3	8	64,6	60,2 nGy/h
2,25	2693	5/09/2021	13:54:01	29,1	1	11,2	3018,7	1,6	408,2	4,2	105,6	8,3	66,7	65,8 nGy/h
2,5	2694	5/09/2021	13:54:46	29,1	1	10,5	2830,6	1,4	351,8	3,1	82,6	7,8	62,5	55,7 nGy/h
2,75	2695	5/09/2021	13:55:35	29,3	1	11,3	3039,6	1,9	437,5	3	76,3	6,4	52	57,7 nGy/h
3	2696	5/09/2021	13:56:49	29,4	1	13,3	3571,1	2,7	602,7	1,8	65,9	9,6	77,1	71,2 nGy/h
3,25	2697	5/09/2021	13:57:55	29,4	1	13,8	3715,7	2,6	590,2	3	80,6	7,4	60,4	70,4 nGy/h
3,5	2698	5/09/2021	13:58:43	29,4	1	15,1	4054,8	3,2	694,8	2,2	68	8	64,6	75,1 nGy/h
3,75	2699	5/09/2021	13:59:28	29,3	1	15	4025,5	3,3	726,1	1,8	72,2	11,2	89,7	83,3 nGy/h
4	2700	5/09/2021	14:00:11	29,5	1	14,9	4006,8	2,8	632,1	2,4	82,7	10,9	87,6	79,2 nGy/h
4,25	2701	5/09/2021	14:01:25	29,5	1	16	4304	3	680,2	2,6	84,8	10,4	83,4	82 nGy/h
4,5	2702	5/09/2021	14:02:12	29,5	1	16,7	4482	3,6	782,7	2,8	84,8	9,2	75,1	87 nGy/h
4,75	2703	5/09/2021	14:03:04	29,5	1	19	5100,4	3,7	845,7	4,9	120,3	8,9	73	99,3 nGy/h
5	2704	5/09/2021	14:03:46	29,5	1	19,1	5146,4	3,7	852	4,4	128,7	13,7	110,7	109,4 nGy/h
5,25	2705	5/09/2021	14:04:32	29,5	1	20,1	5408,4	4,1	906,5	3,5	107,8	12,1	98,1	105,4 nGy/h
5,5	2706	5/09/2021	14:05:16	29,5	1	18,3	4913,9	3,7	833,1	4,2	107,8	8,9	73	95,4 nGy/h
5,75	2707	5/09/2021	14:06:10	29,5	1	19,7	5300	4,2	931,6	2,7	112	17,8	142	117,1 nGy/h
6	2708	5/09/2021	14:06:57	29,5	1	20,1	5396,4	4,4	952,6	2,4	93,2	14	112,8	107,9 nGy/h
6,25	2709	5/09/2021	14:13:37	29,8	1	20,6	5542,5	3,7	837,5	3,3	109,9	14,1	112,8	104,4 nGy/h
6,5	2710	5/09/2021	14:14:26	29,8	1	21,8	5859,8	4,4	979,9	4,2	124,6	13,7	110,7	116,8 nGy/h
6,75	2711	5/09/2021	14:15:12	29,8	1	21,8	5863,7	4,8	1036,4	2,8	97,4	12,9	104,4	112,7 nGy/h
7	2712	5/09/2021	14:16:02	29,7	1	21,8	5857,5	4,2	931,8	2,8	103,6	15,1	121,2	110,8 nGy/h
7,25	2713	5/09/2021	14:16:45	29,9	1	21,3	5738	4,5	1009,2	3,9	124,6	15,3	123,2	121,3 nGy/h
7,5	2714	5/09/2021	14:17:33	29,9	1	20,7	5561,5	4,6	992,3	2,5	93,2	13,5	108,6	109,7 nGy/h
7,75	2715	5/09/2021	14:18:23	29,9	1	15,6	4180,8	3,2	715,8	3,3	88,9	8,2	66,7	81,9 nGy/h

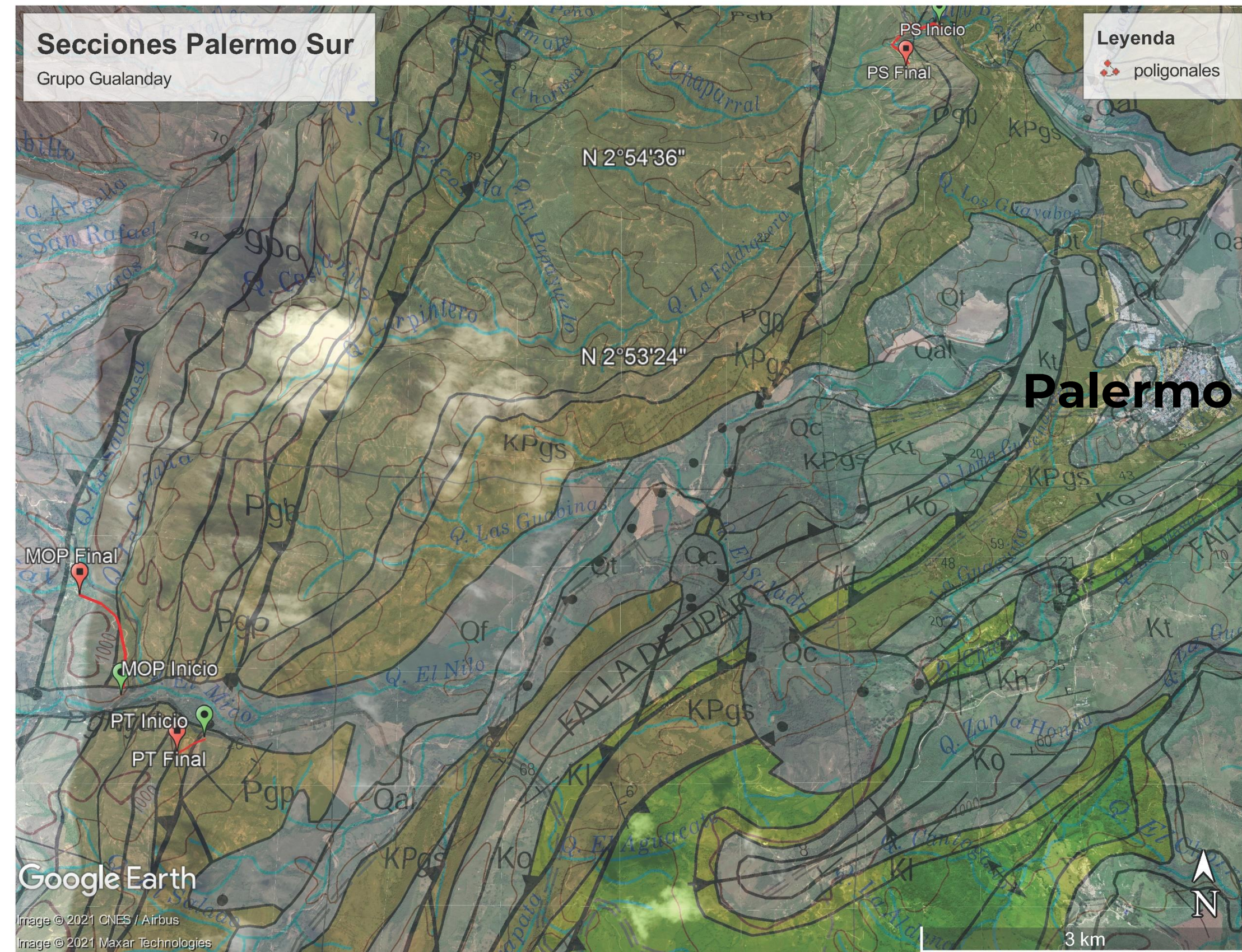
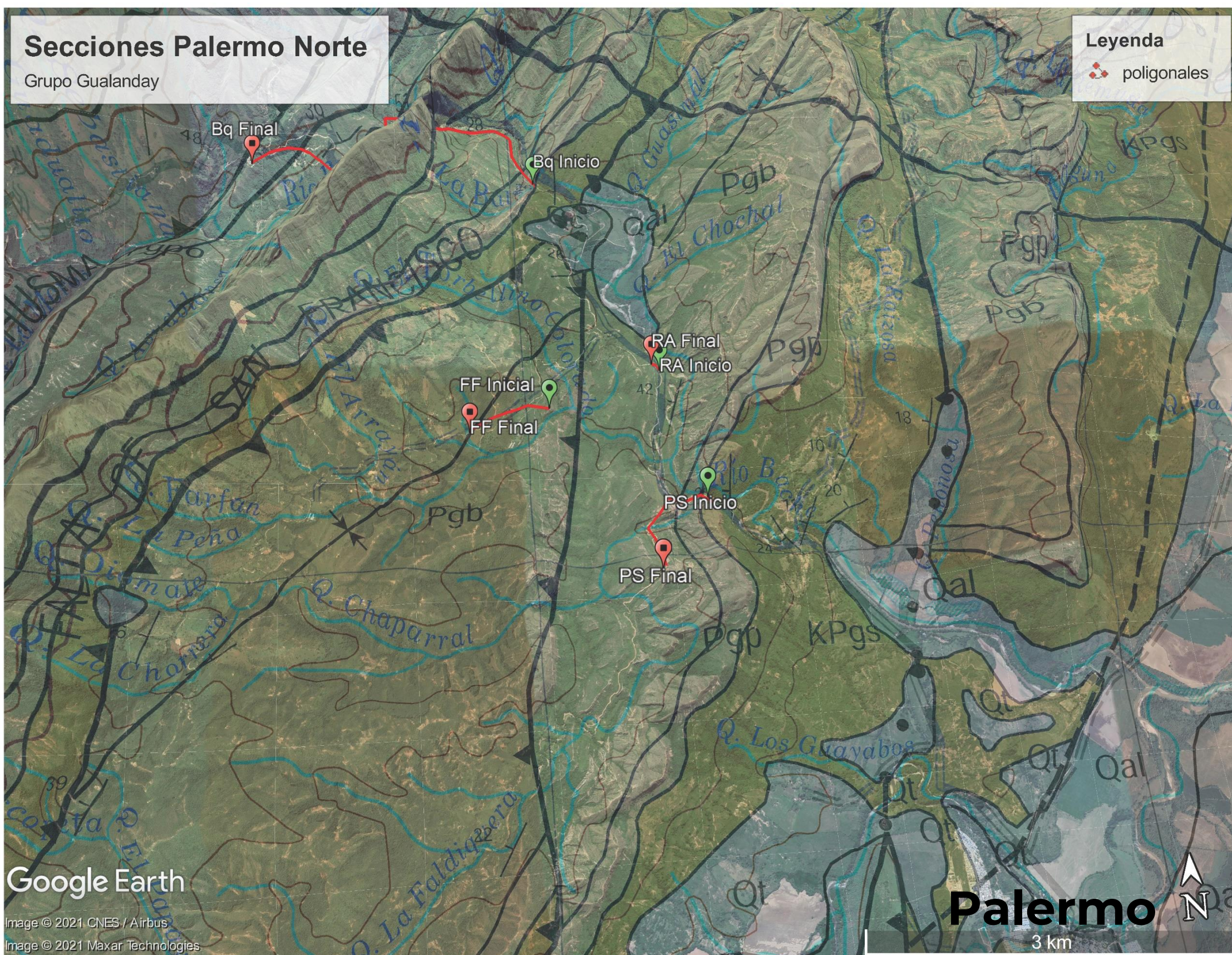
North & South Palermo Sections – Gualanday Group

Gualanday Group (Palermo, Baché, Tesalia, Potrerillo & Doima Fms.) Scale 1:500

Total: 2,078 m (7 sections)

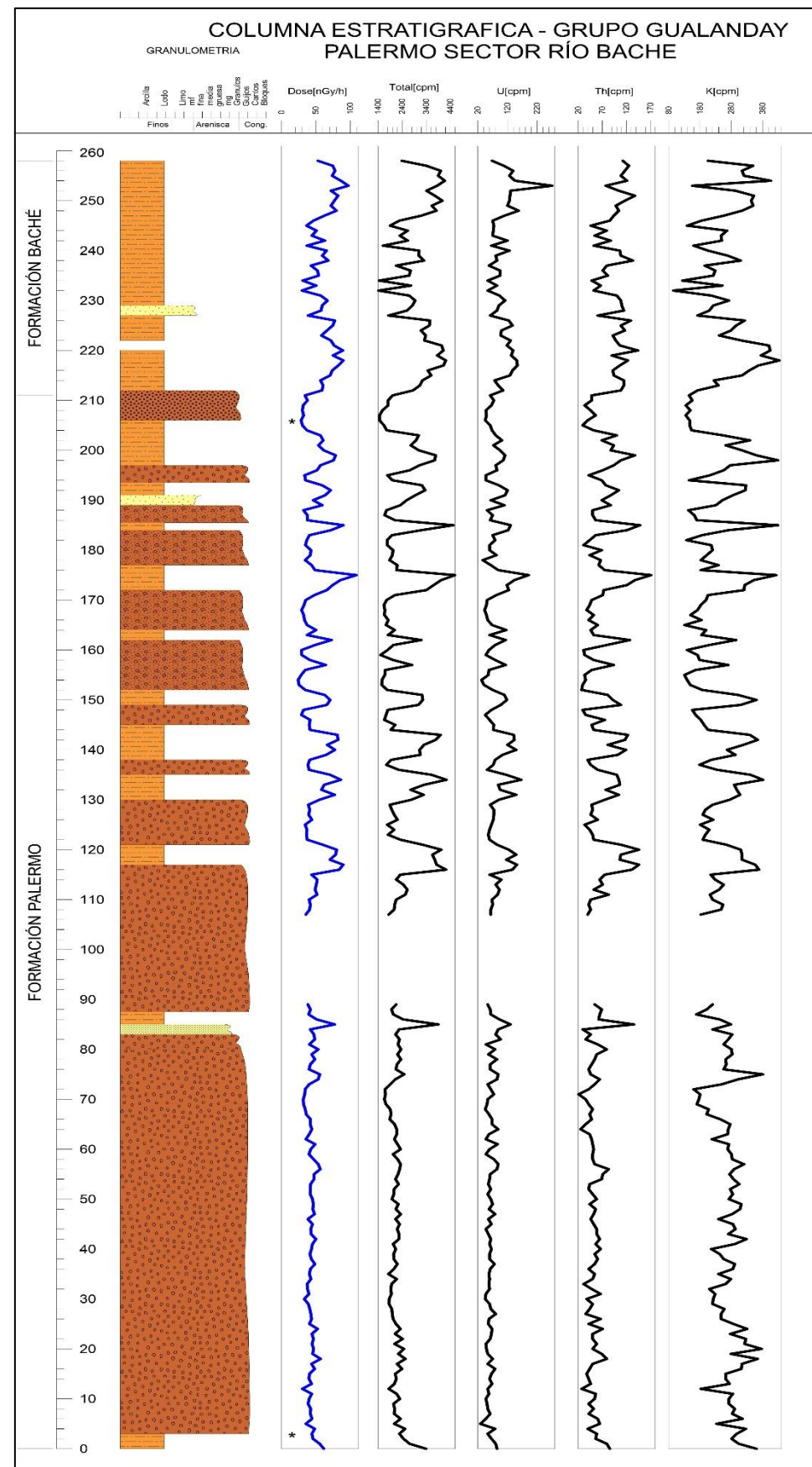
Covered: 579 m

With radiometry : 1,499 m

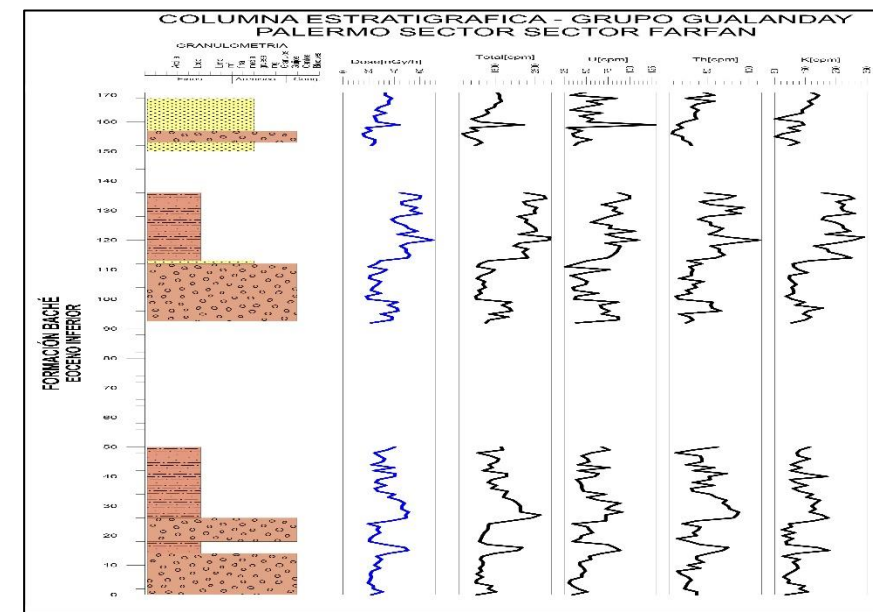


Palermo North Sections

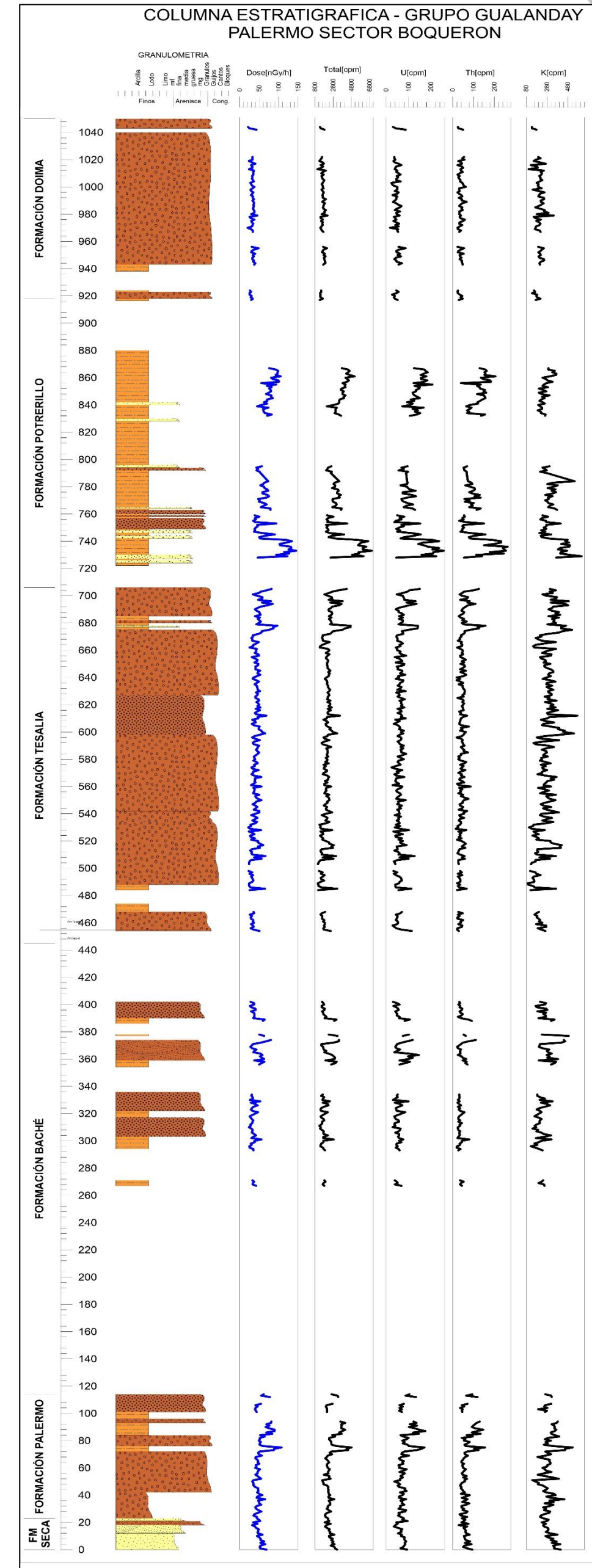




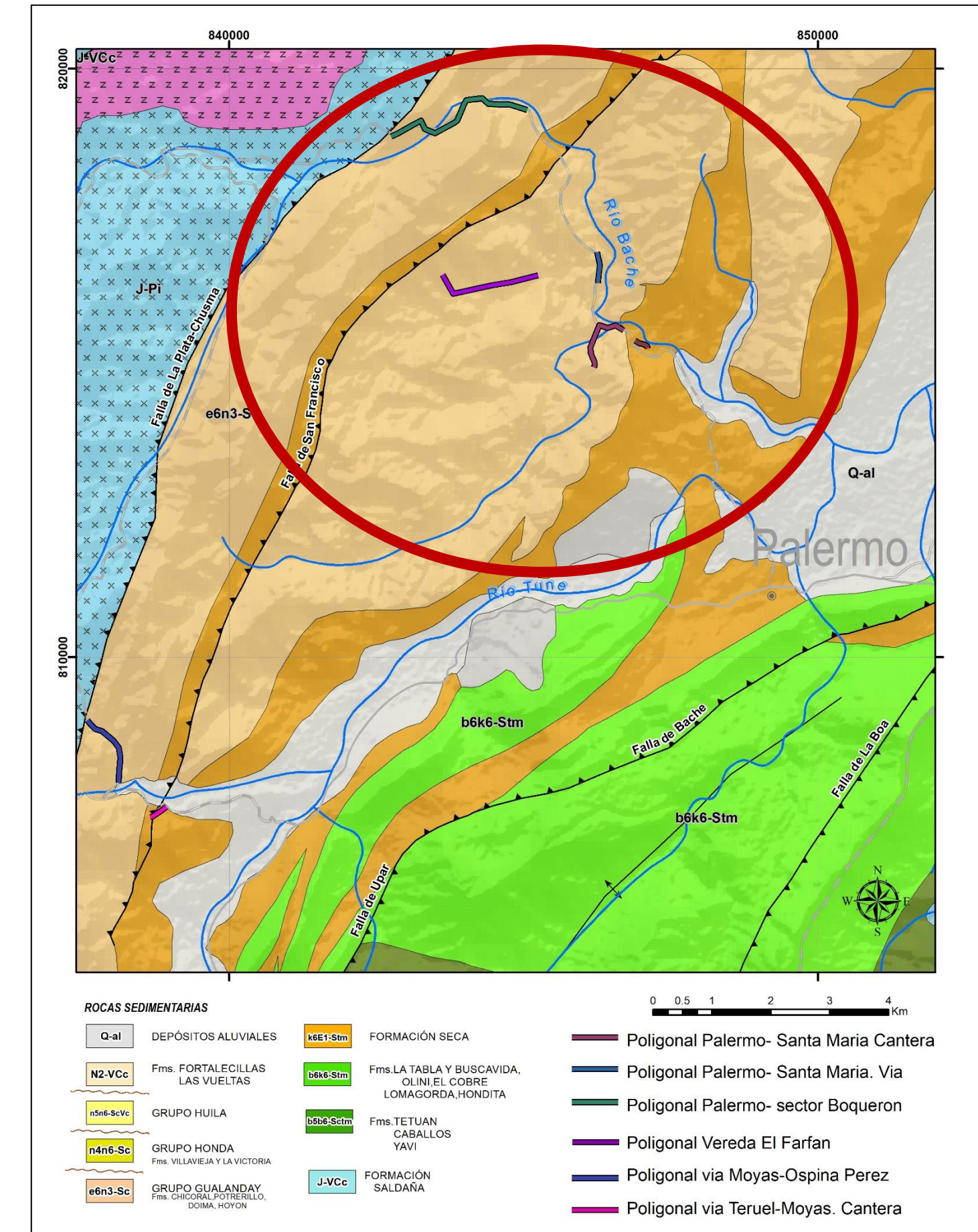
Baché 258 m



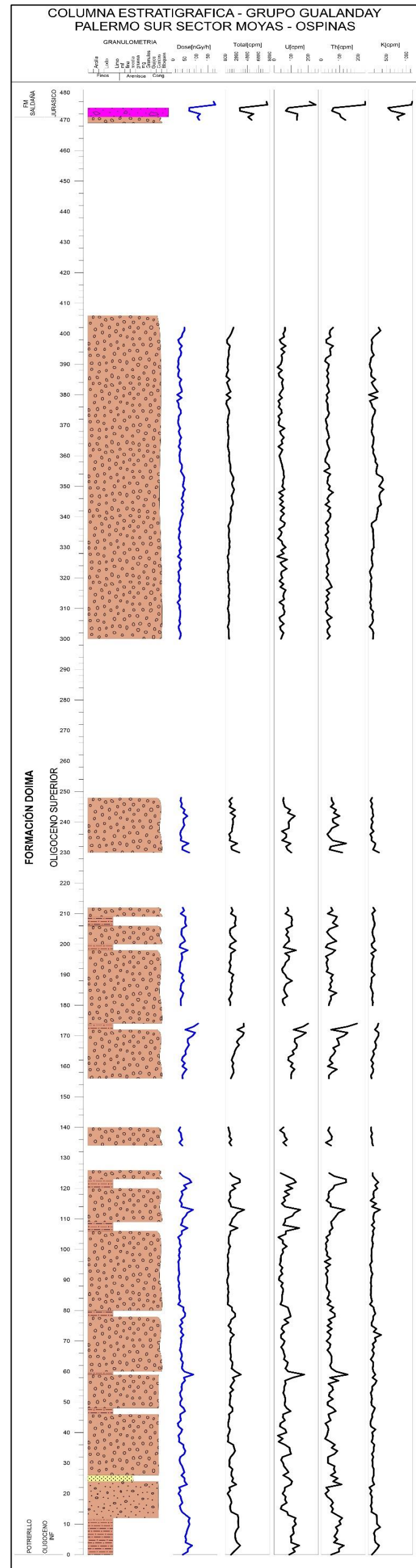
Farfán 168 m



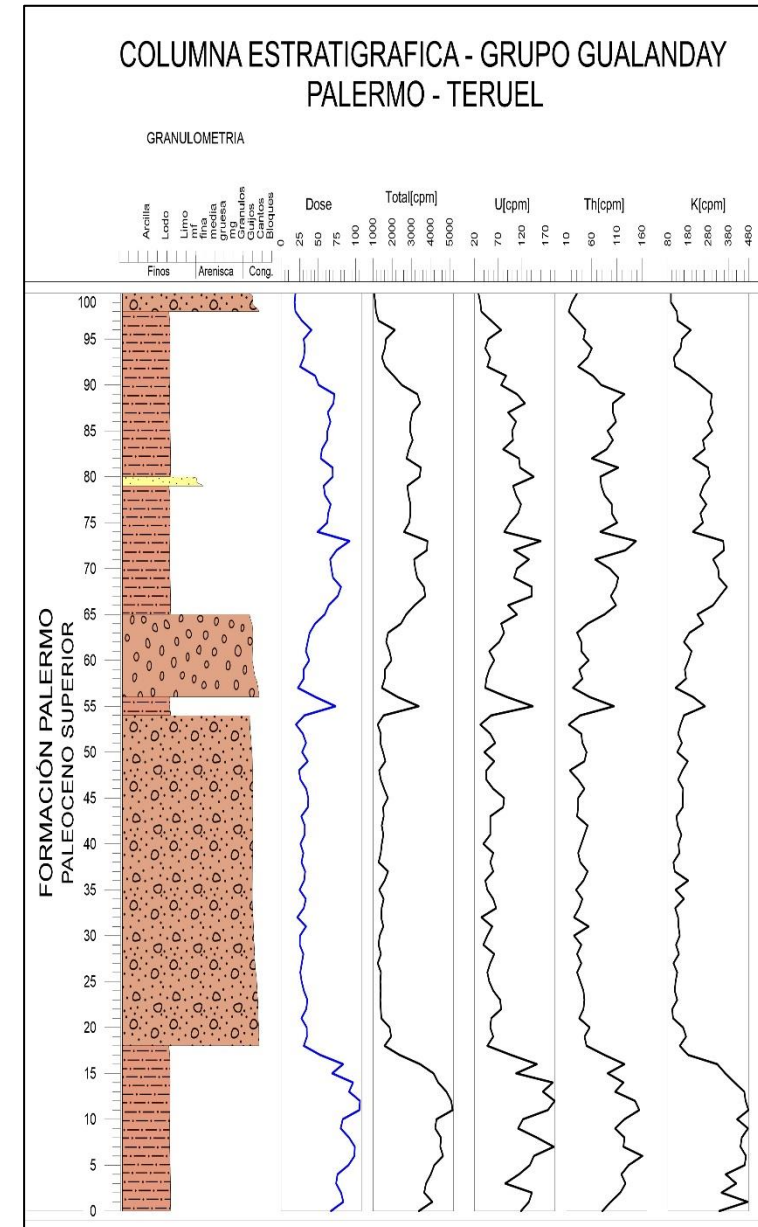
Boquerón 1042 m



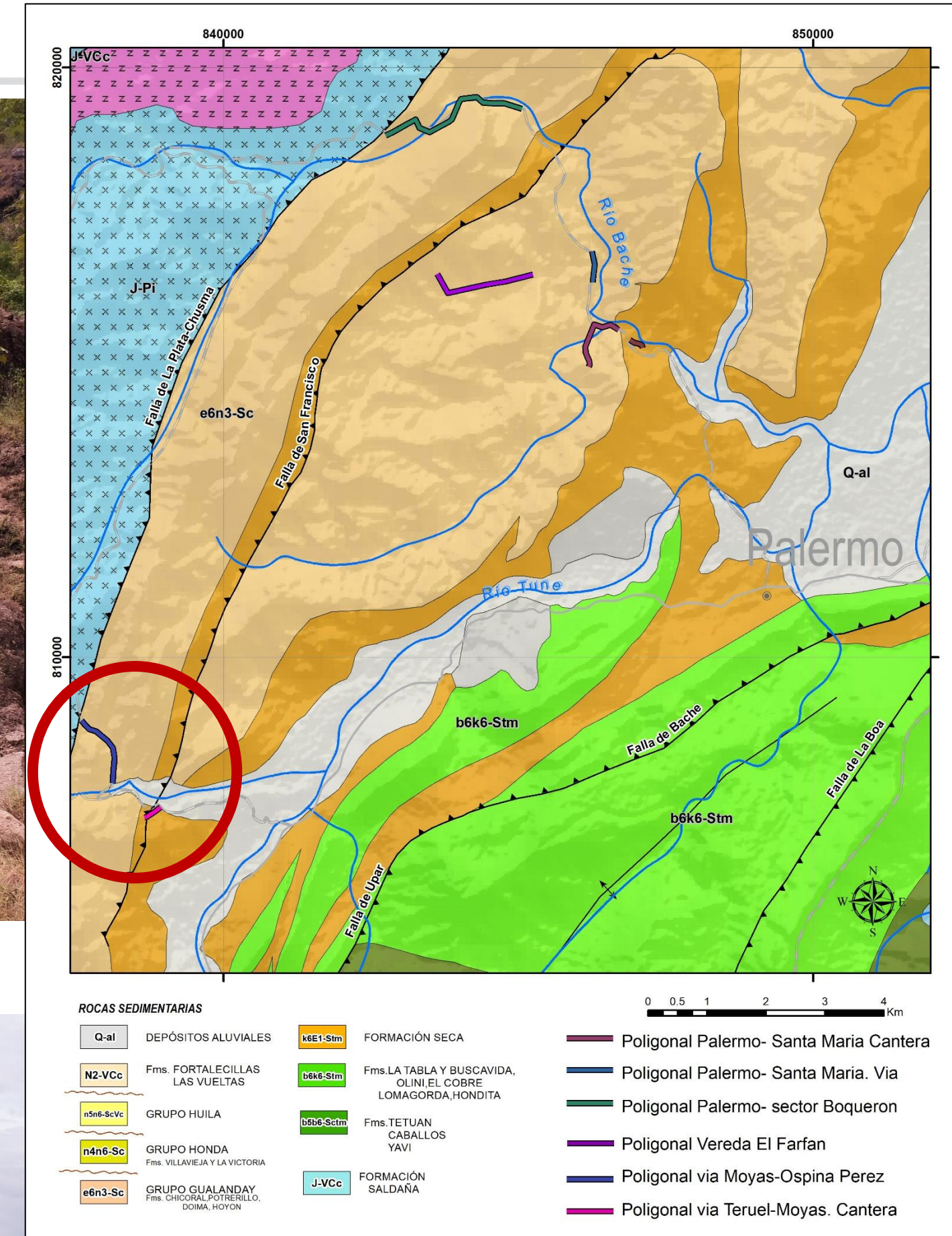
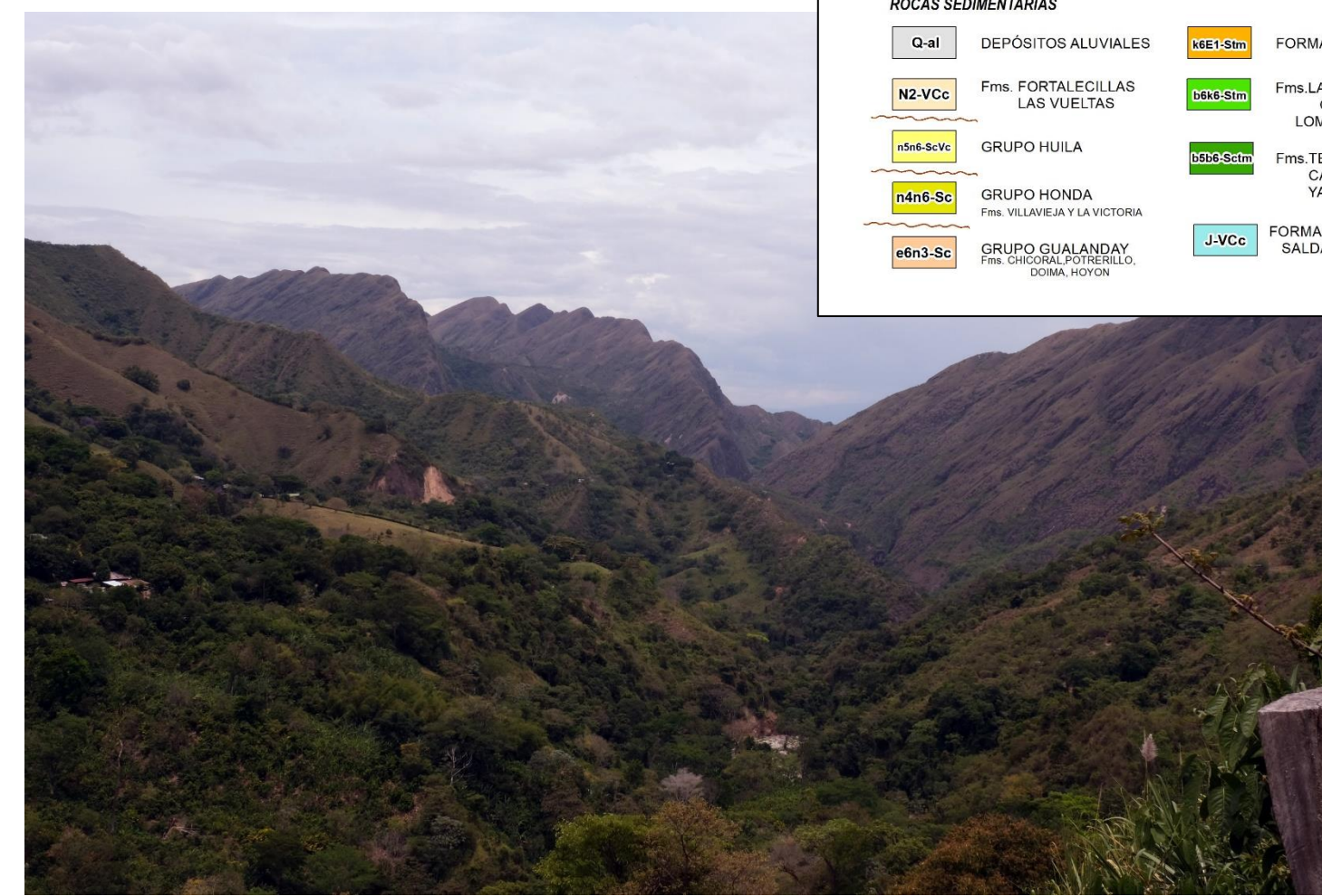
Palermo South Sections



Moyas – Ospinas 474 m



Palermo Teruel 102 m



Chicoral Section –Gualanday Gr

Gualanday Group (Baché & Tesalia Fms) Scale 1:100

Total section: 417 m

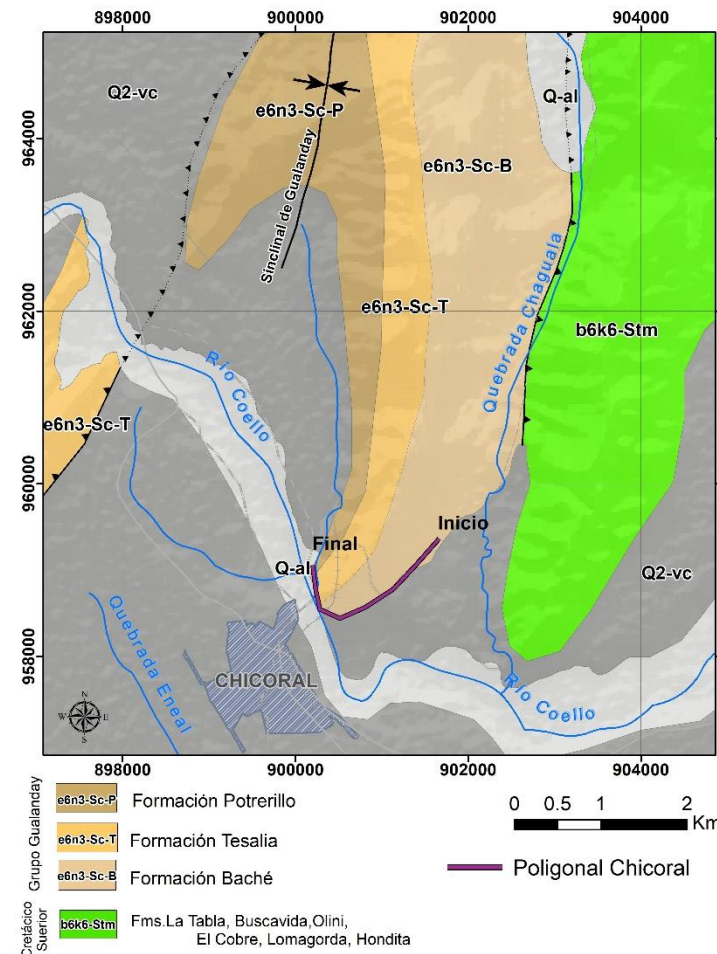
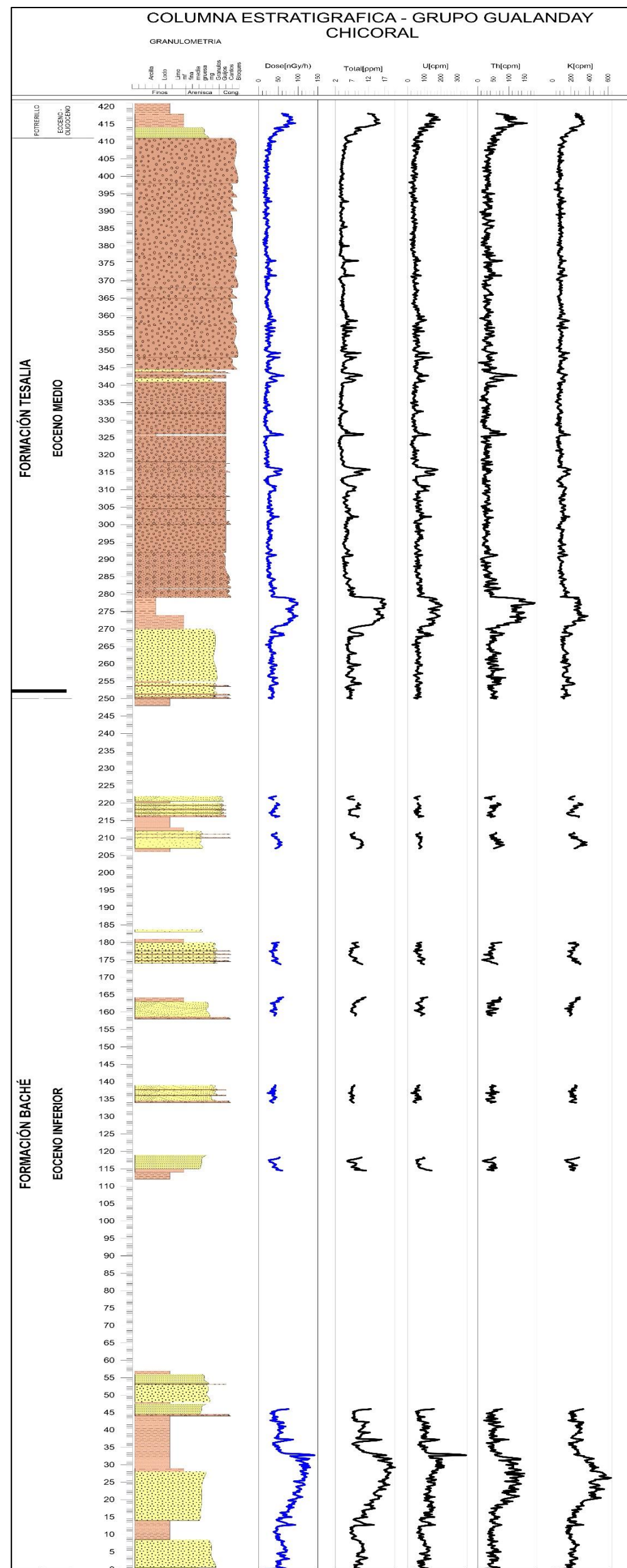
Covered: 148 m

With radiometry: 269 m



Chicoral – Gr Gualanday Section

Bache & Tesalia Fms



417 m mesaured

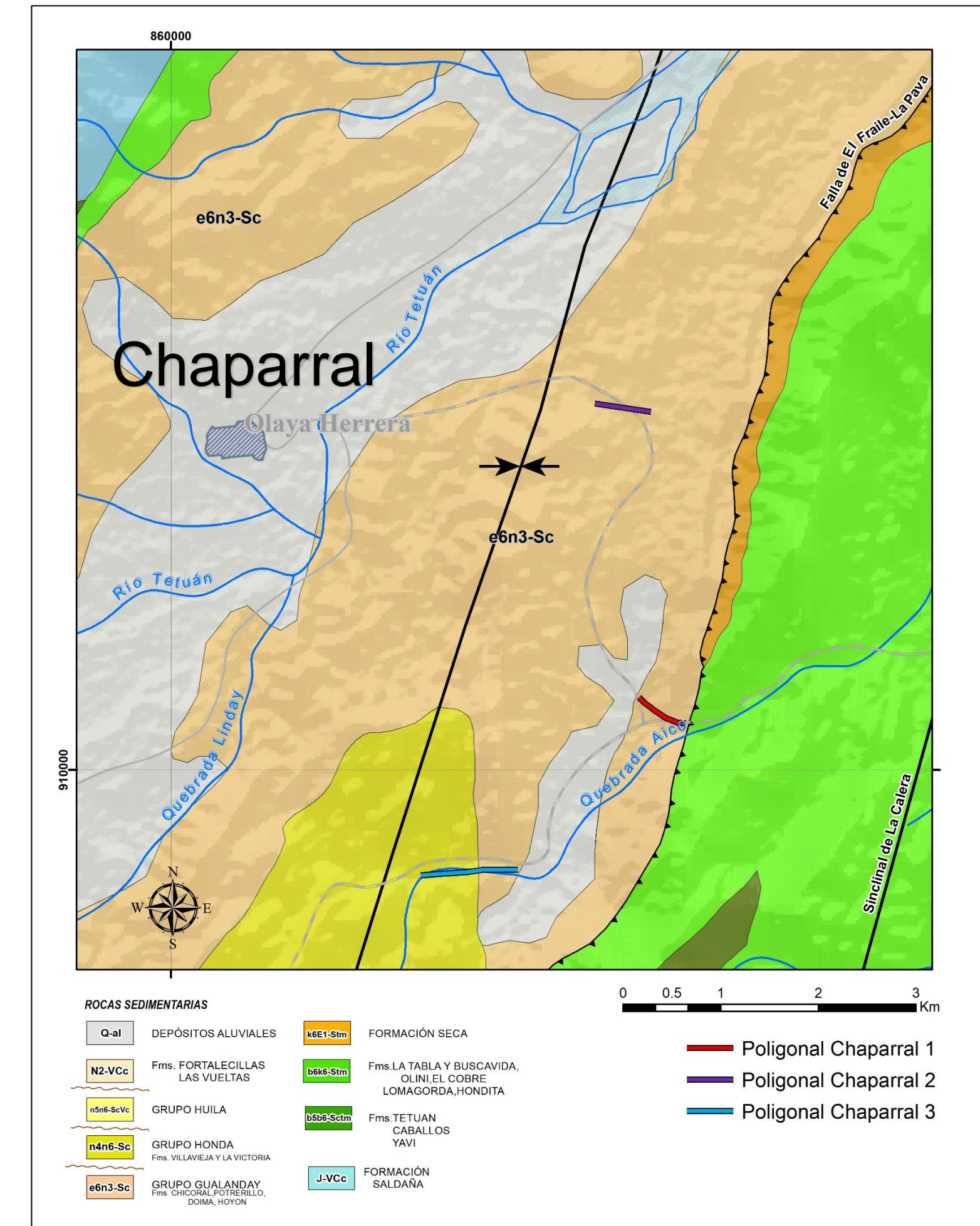
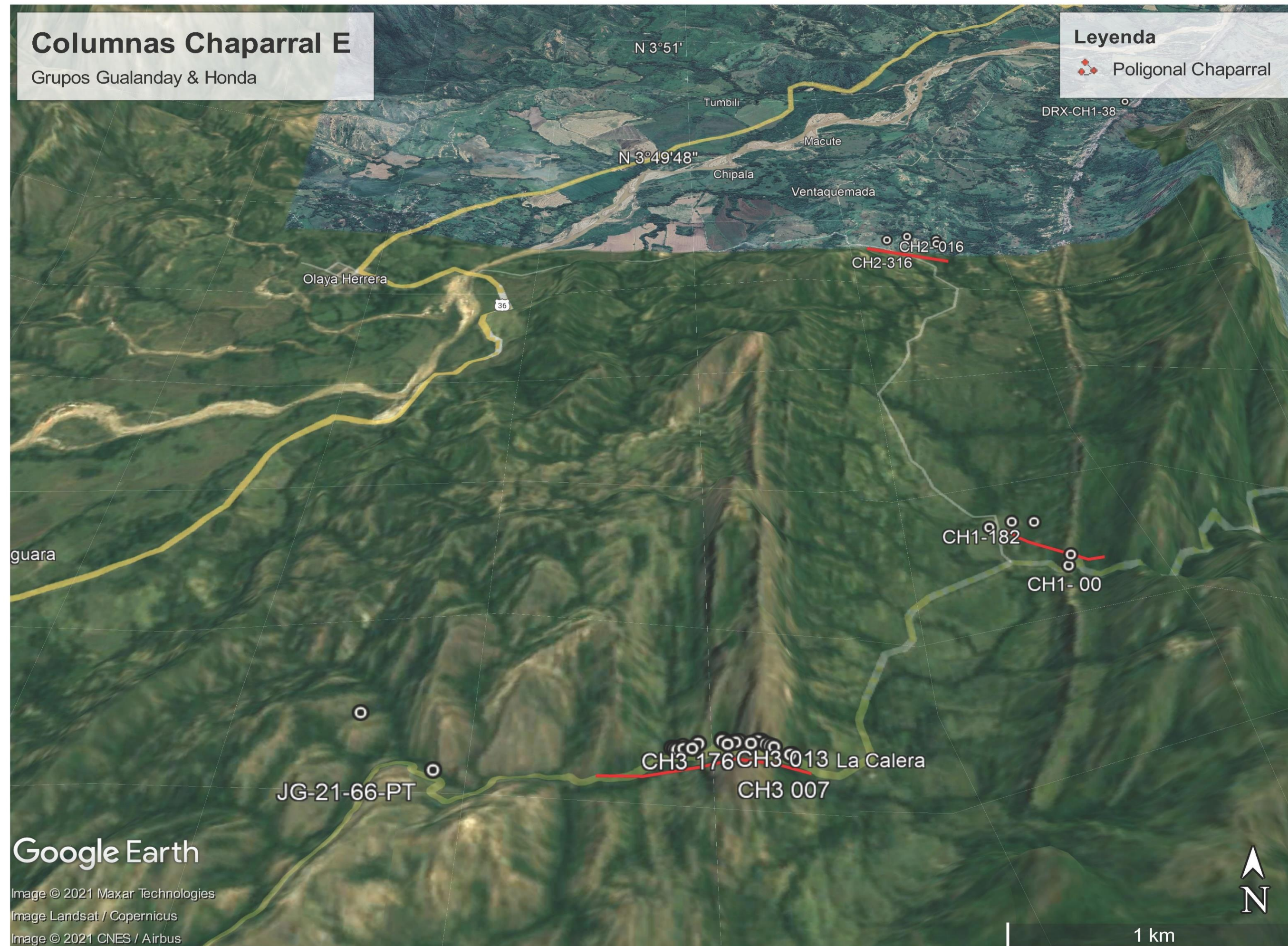
Chaparral Sections – Gualanday & Honda Groups

Gualanday Gr (Tesalia, Potrerillo & Doima Fms.) Scale 1:500

Total: 1,039 m (3 section)

Covered: 367 m

With radiometry: 672 m



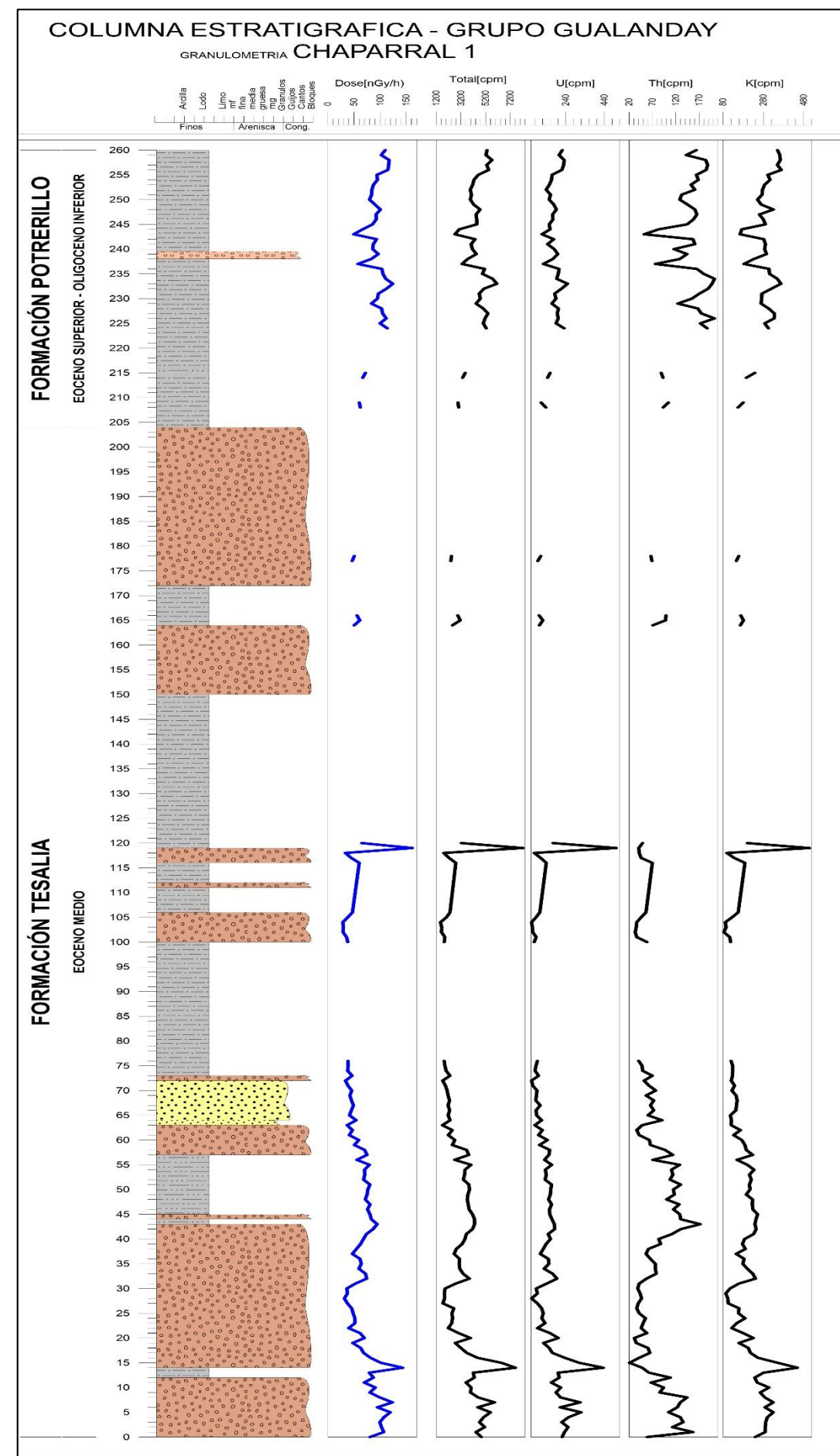
Chaparral – Gr Gualanday & Honda Sections

Gualanday Gr (Tesalia, Potrerillo & Doima Fms) Scale 1:500

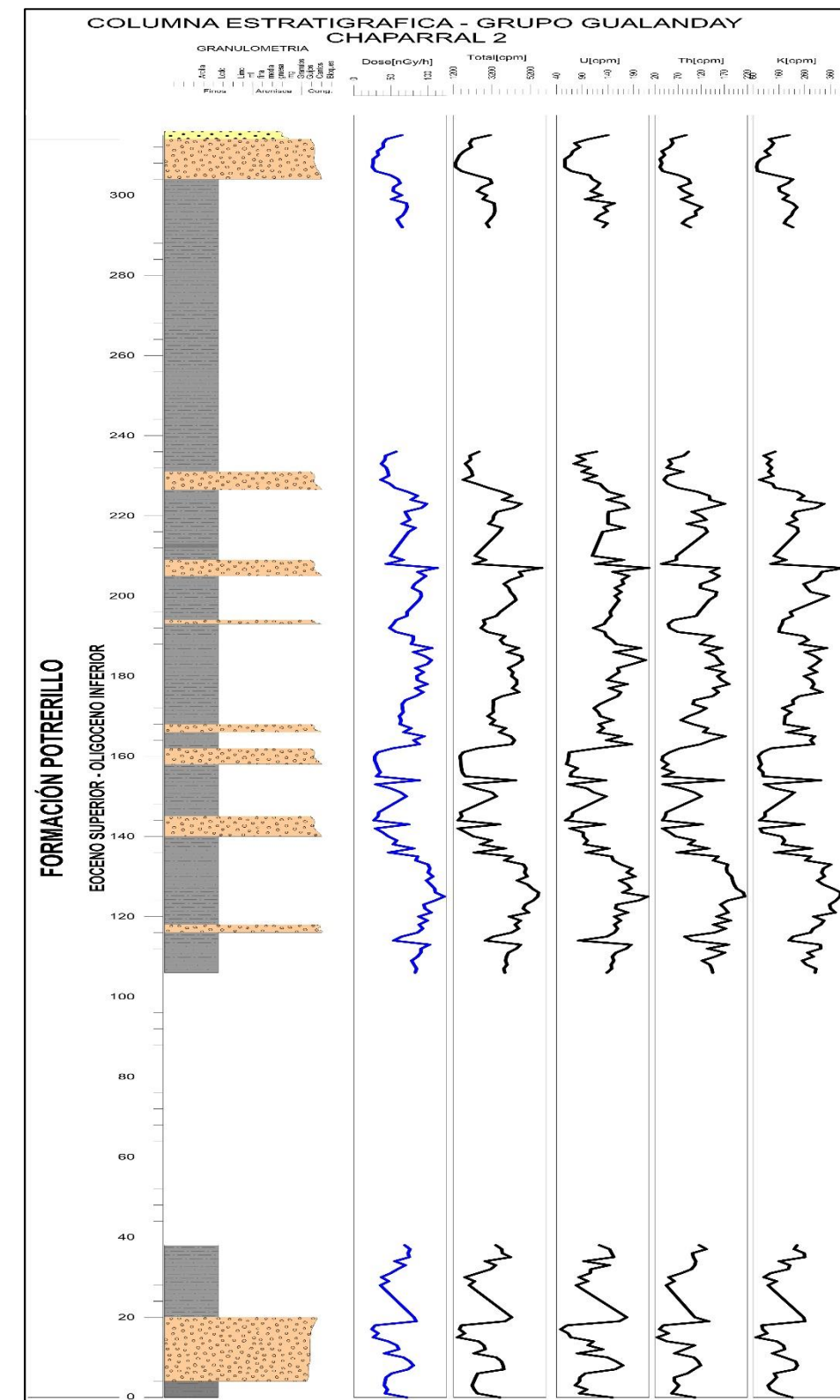
Total: 1,039 m

Covered: 367 m

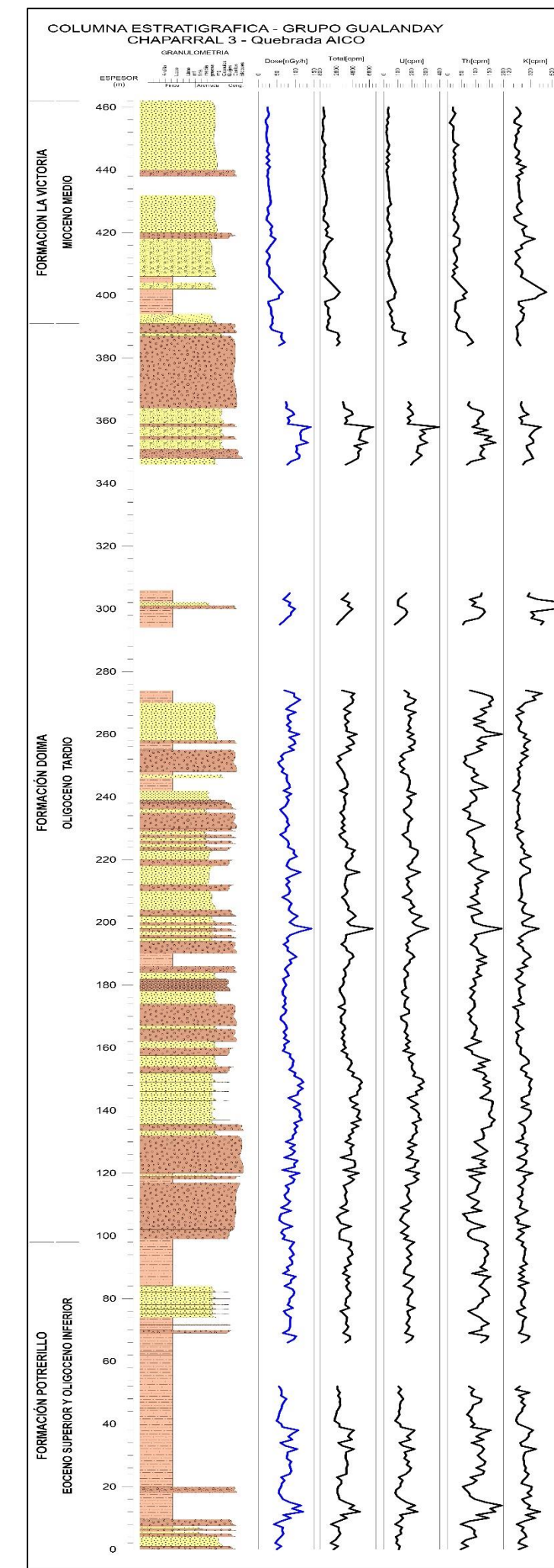
With radiometry: 672 m



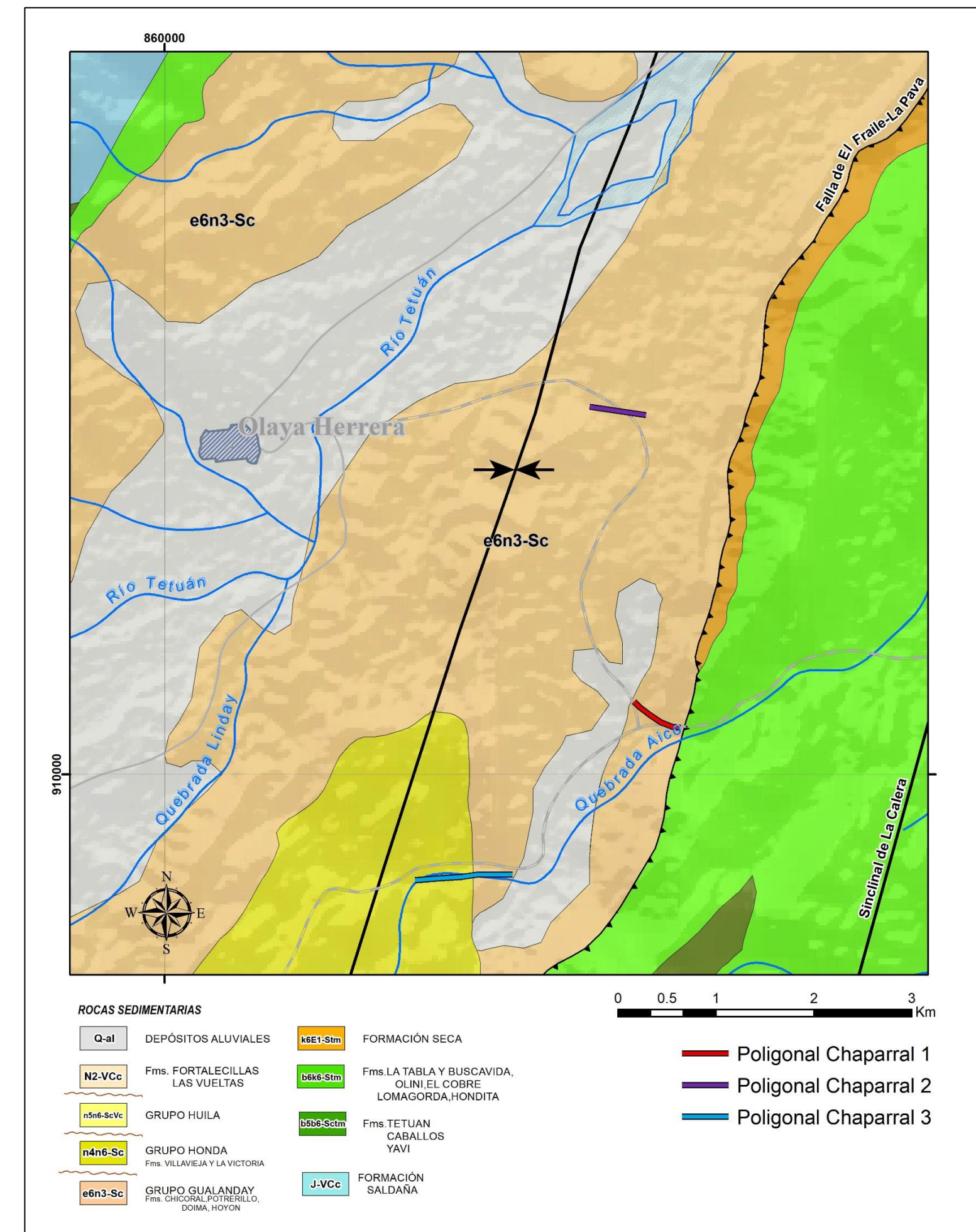
Chaparral 1: 262 m

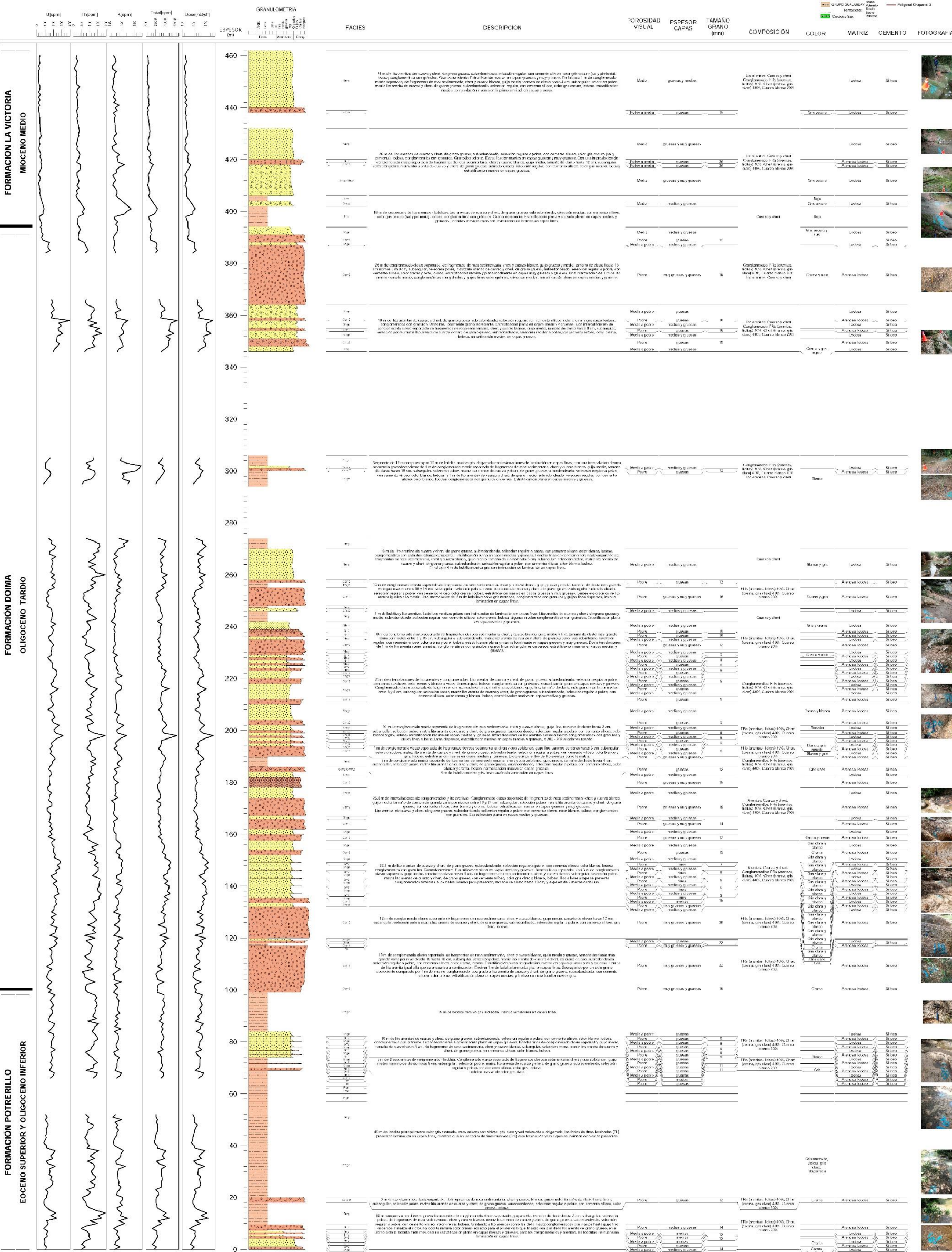
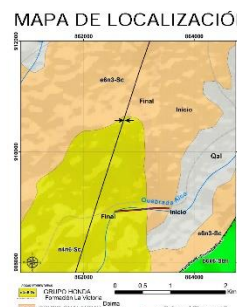


Chaparral 2: 316 m



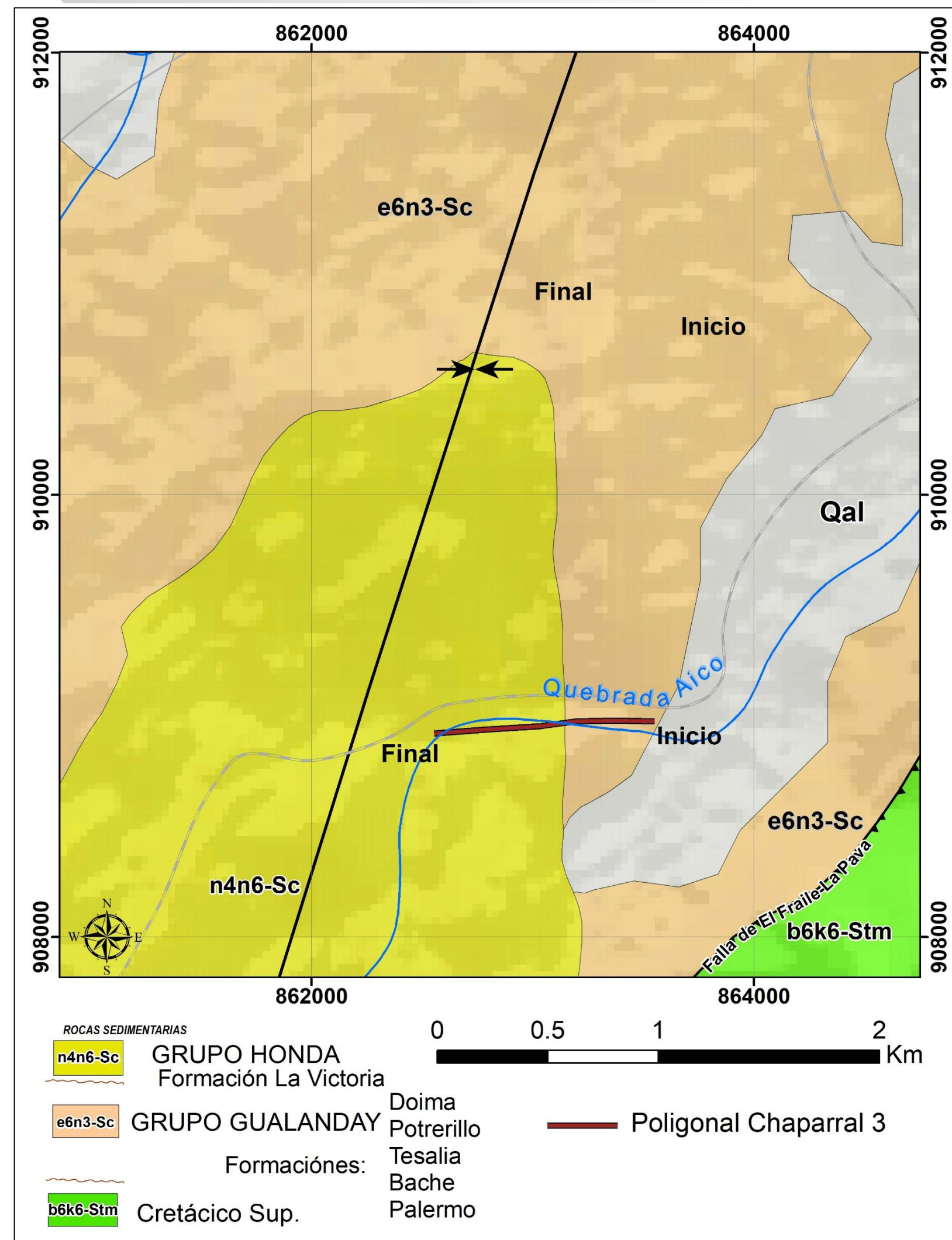
Aico 462 m





Aico Creek

462 m



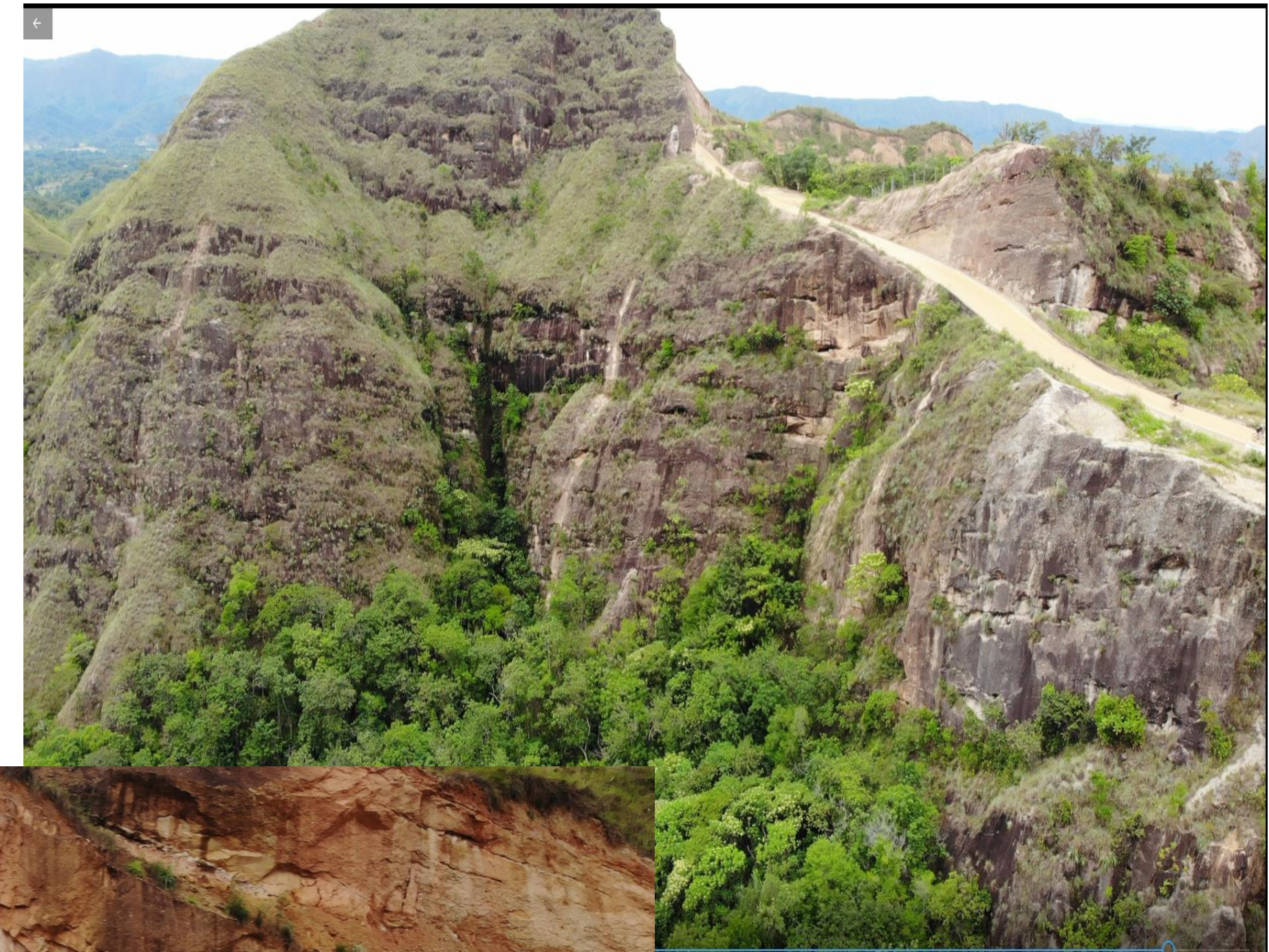
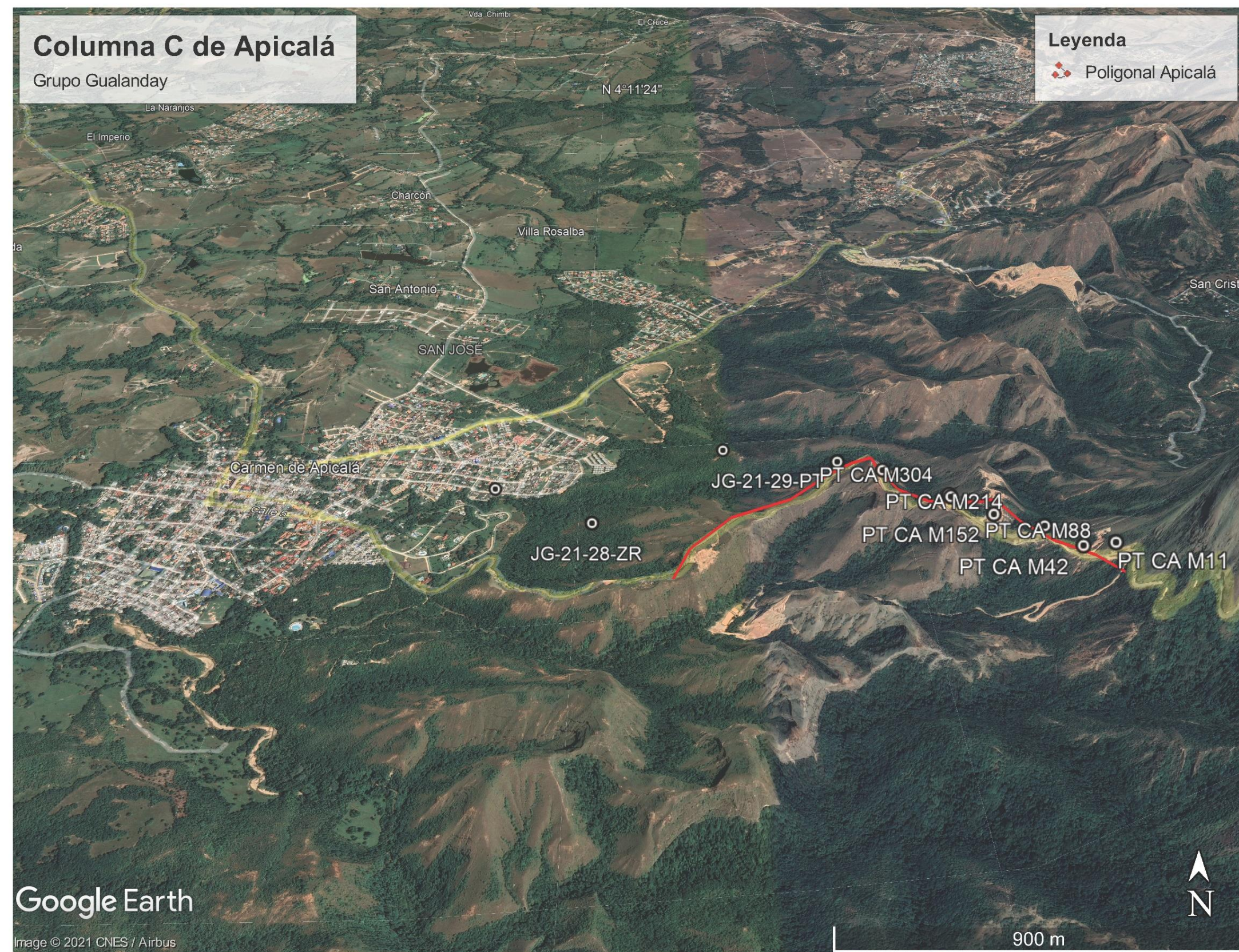
Cármén de Apicalá – Gualanday Gr

(Doima Fm) Scale 1:500

Total: 350 m

Covered: 94 m

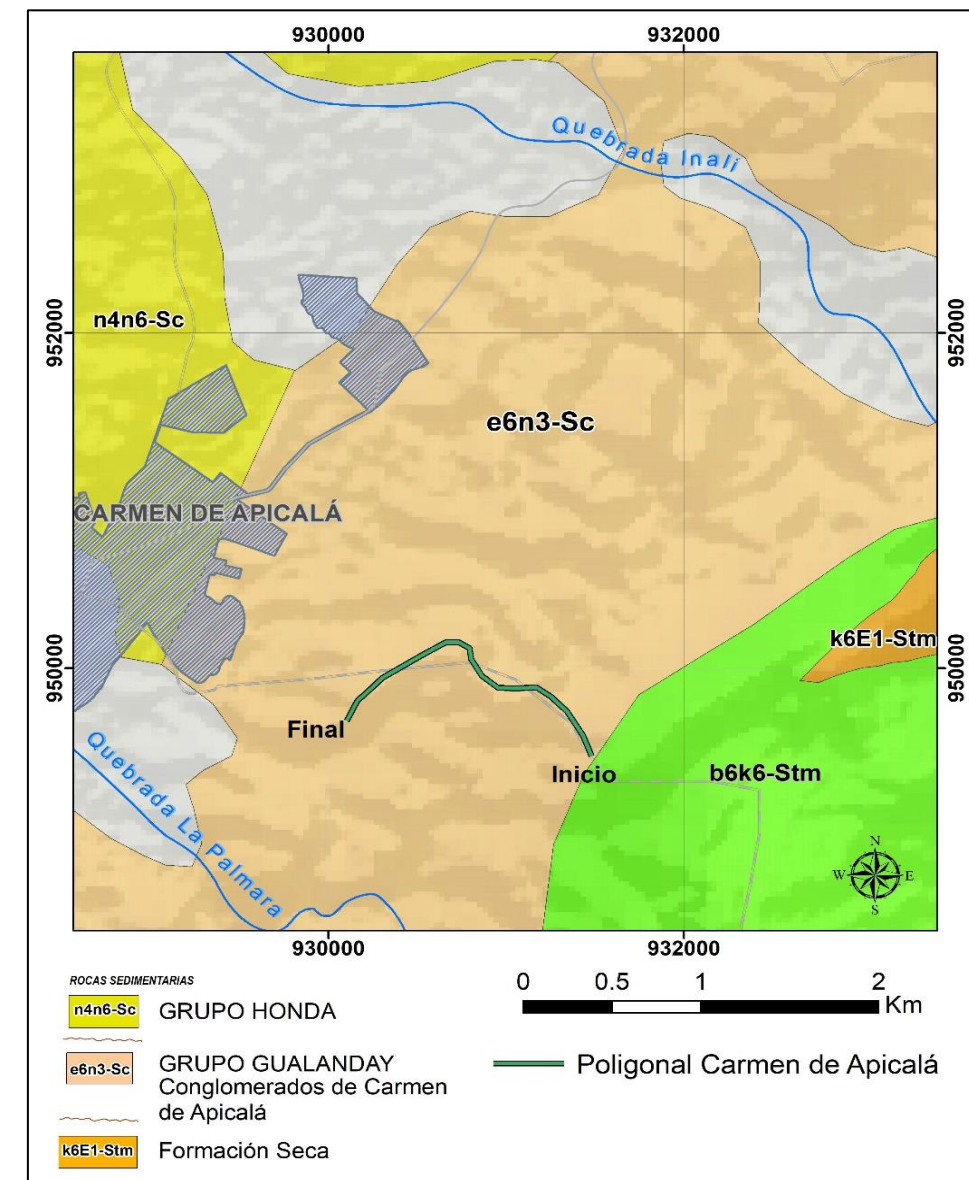
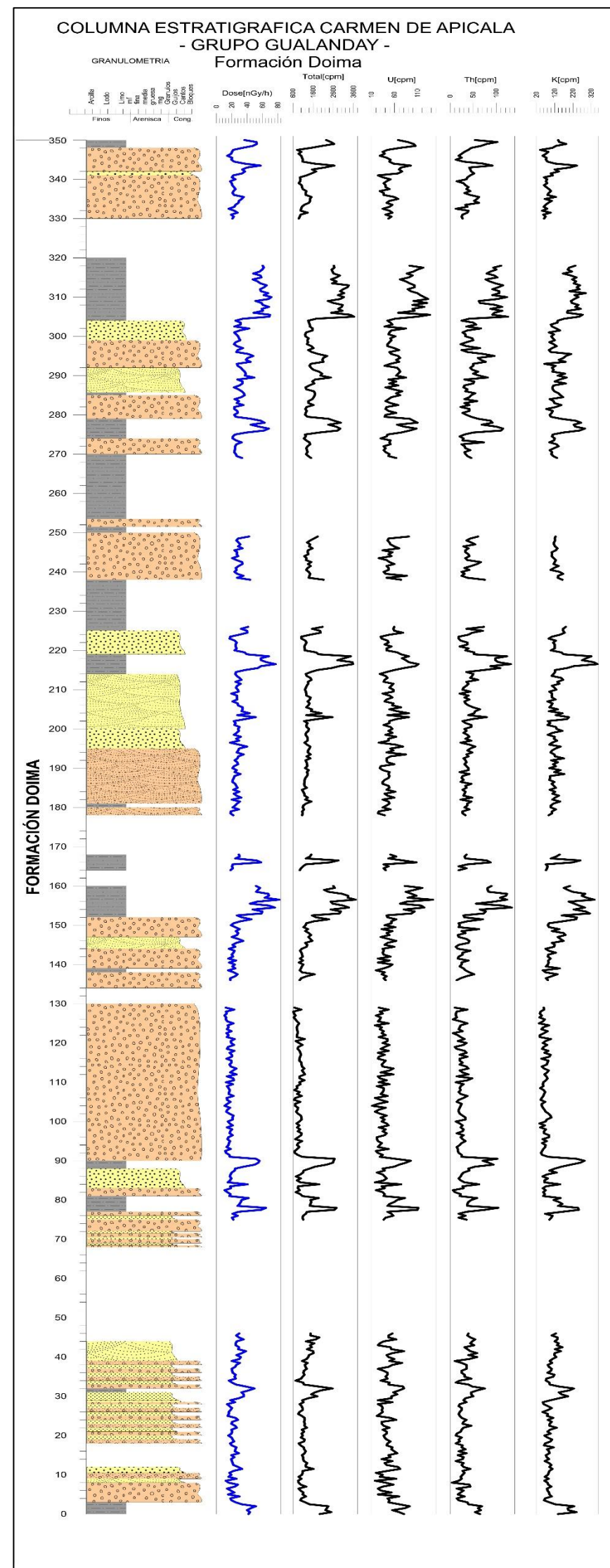
With radiometry: 256 m



C de Apicalá Section – Gualanday Gr

(Doima Fm.) Scale 1:500

Total: 350 m - Covered: 94 m - With radiometry: 256 m



Apicalá: 350 m

La Tatacoa Desert – Gr Honda Sections

(La Victoria & Villavieja Fms) Scale 1:100

Total: 1,488 m (4 sections)

Covered : 21 m

With radiometry : 1,467 m



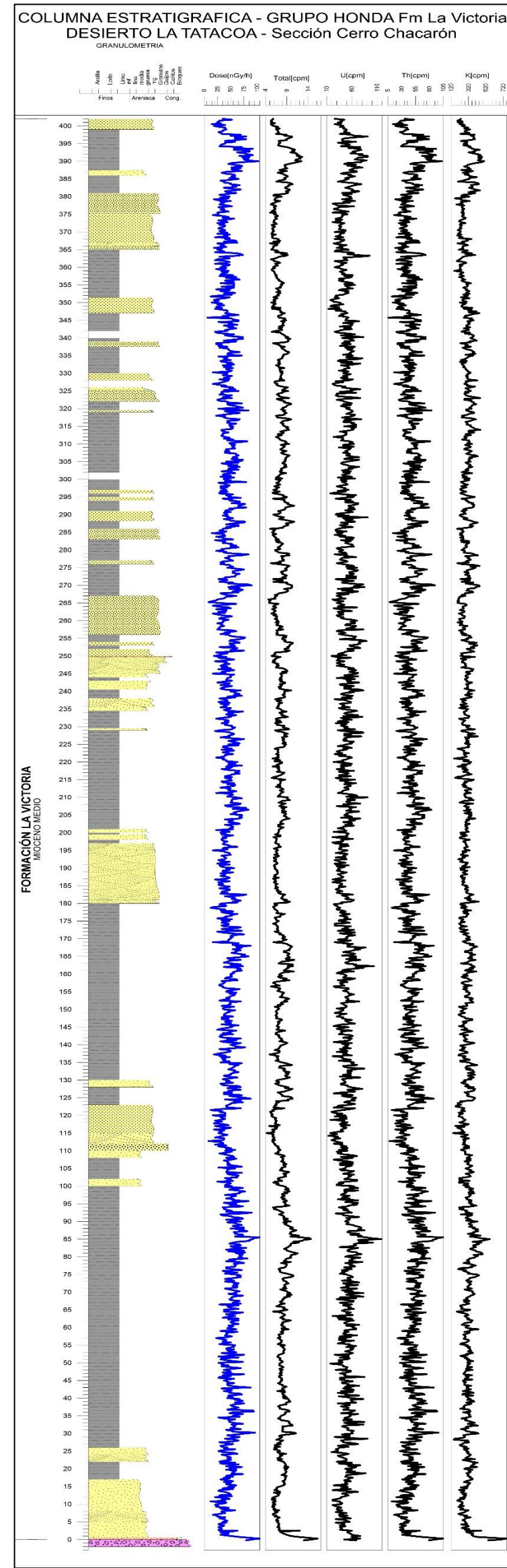


South view from Cerro
Chacarón

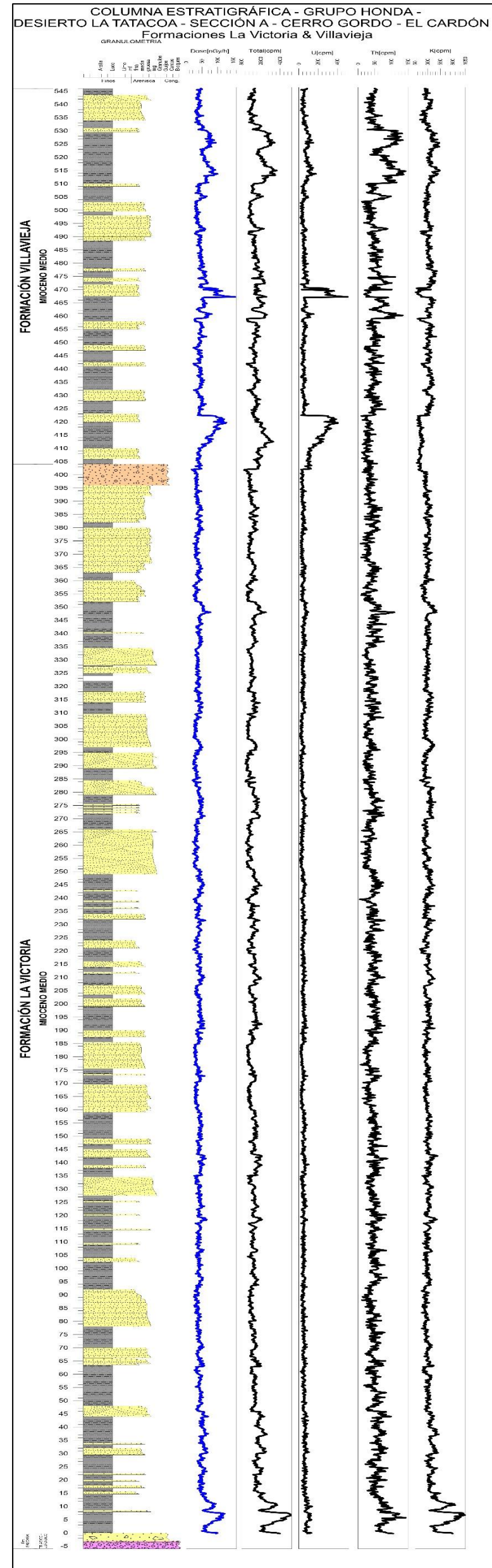


South view from Cerro
Gordo

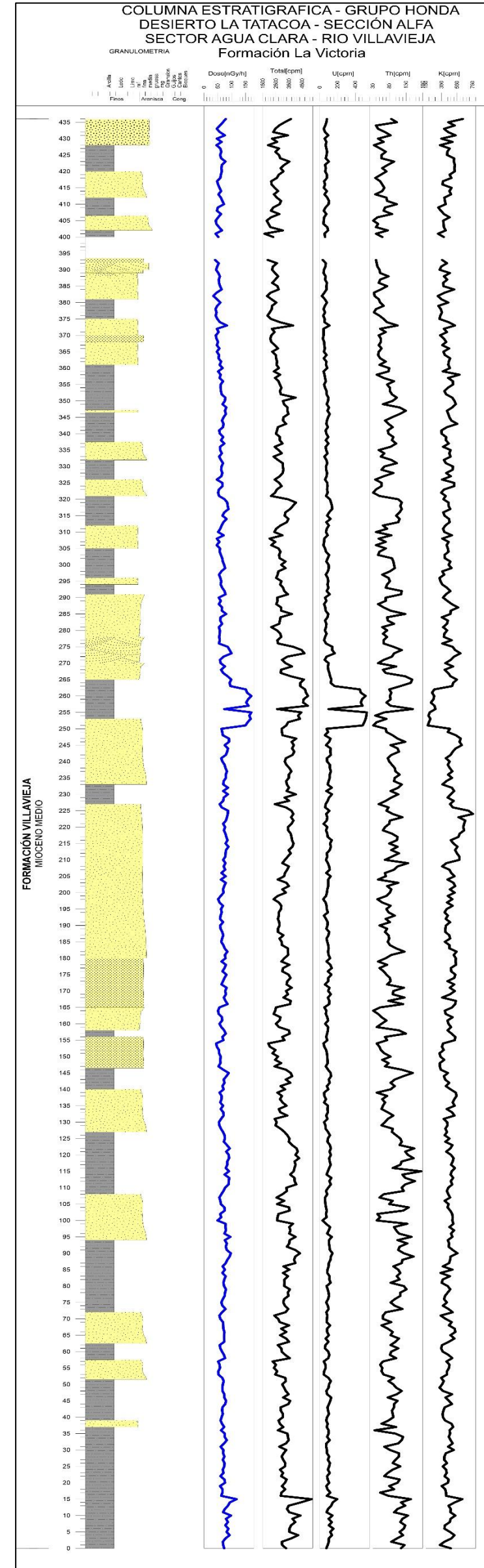
Tatacoa Desert – Gr Honda La Victoria & Villavieja Fms



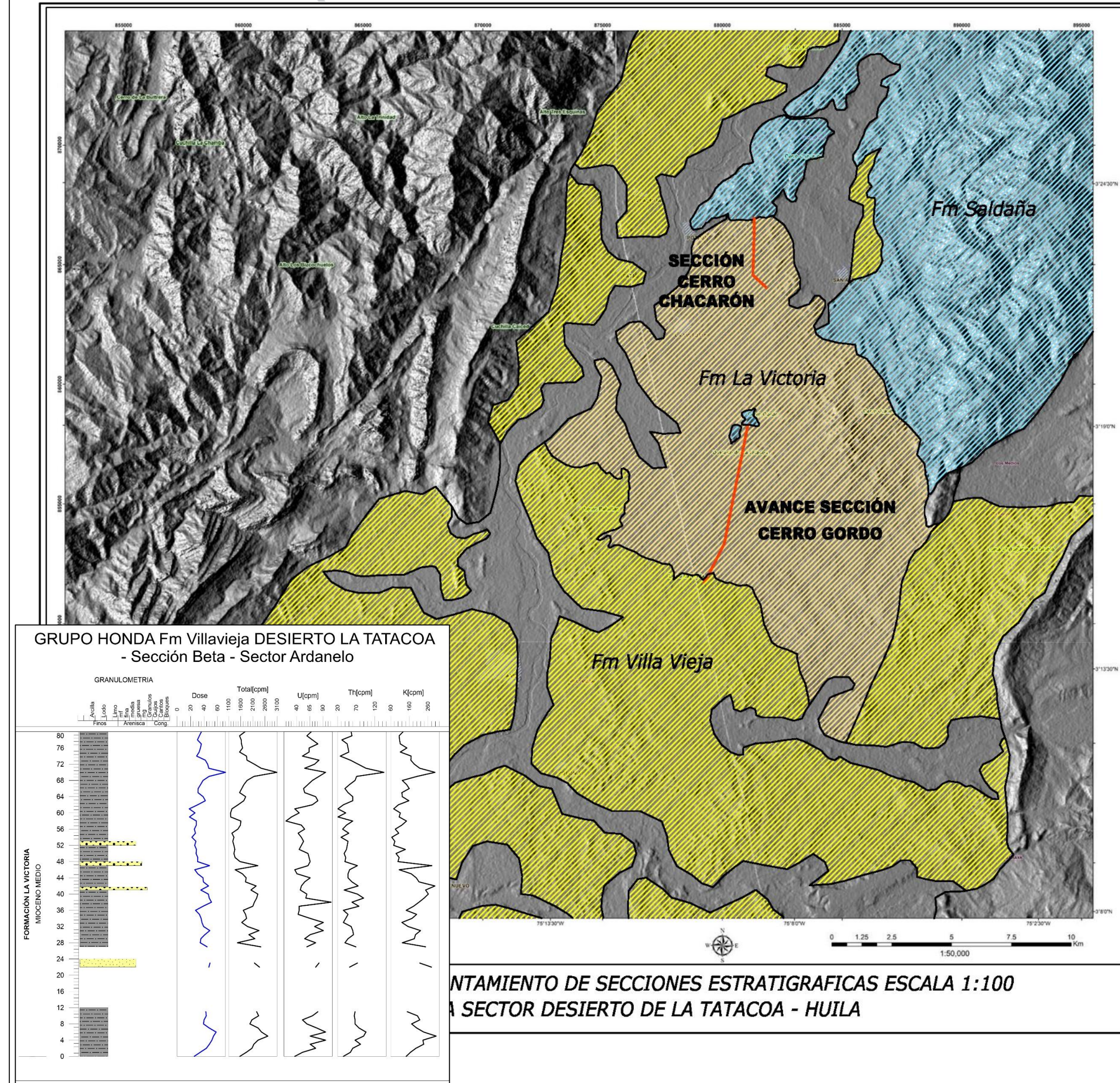
Cerro Chacarón 404 m



Cerro Gordo basal 546 m



Cerro Gordo Tope 435 m

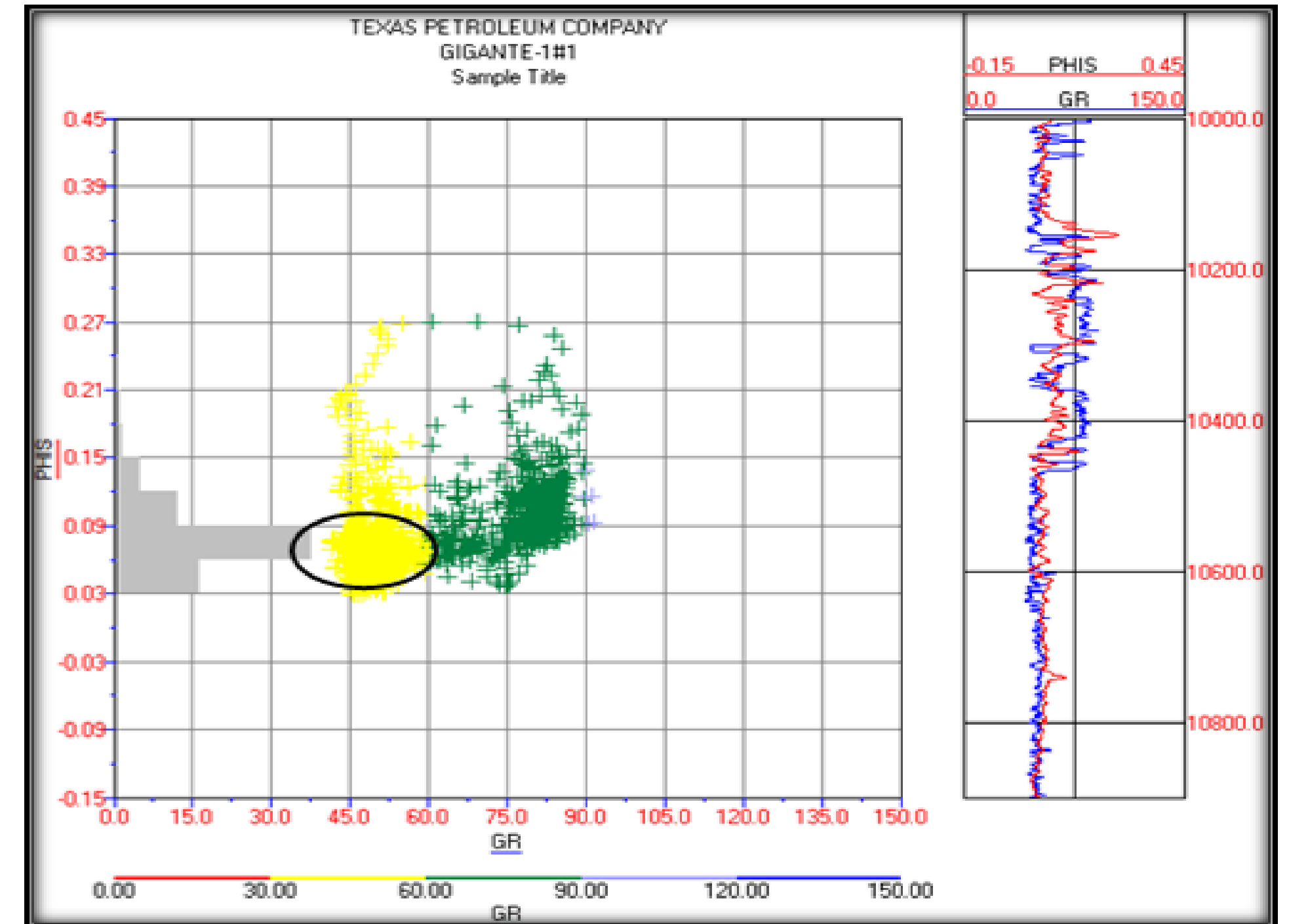
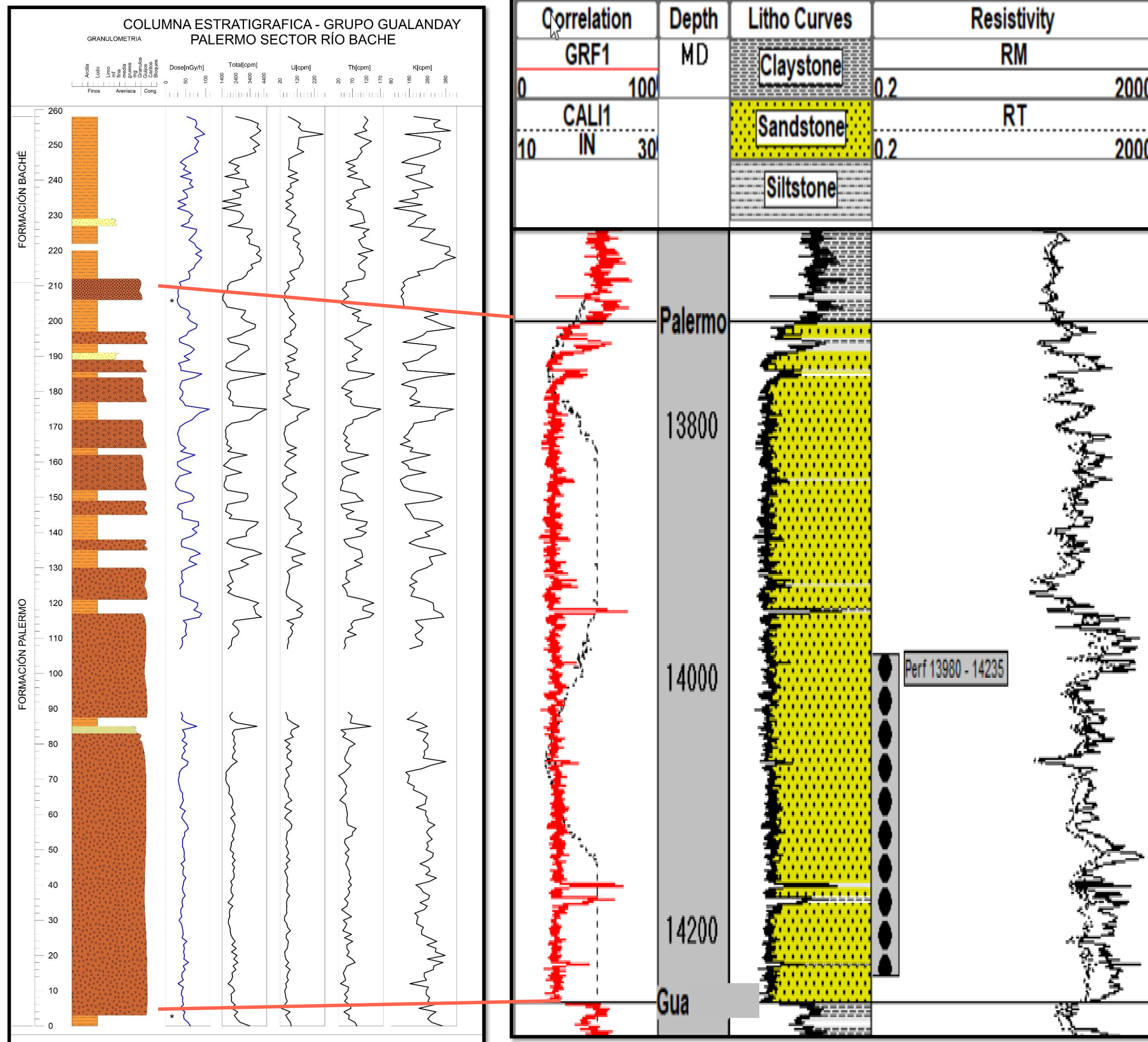


Beta 82 m

CONTAMINAMIENTO DE SECCIONES ESTRATIGRAFICAS ESCALA 1:100
A SECTOR DESIERTO DE LA TATACOA - HUILA

Petrophysics

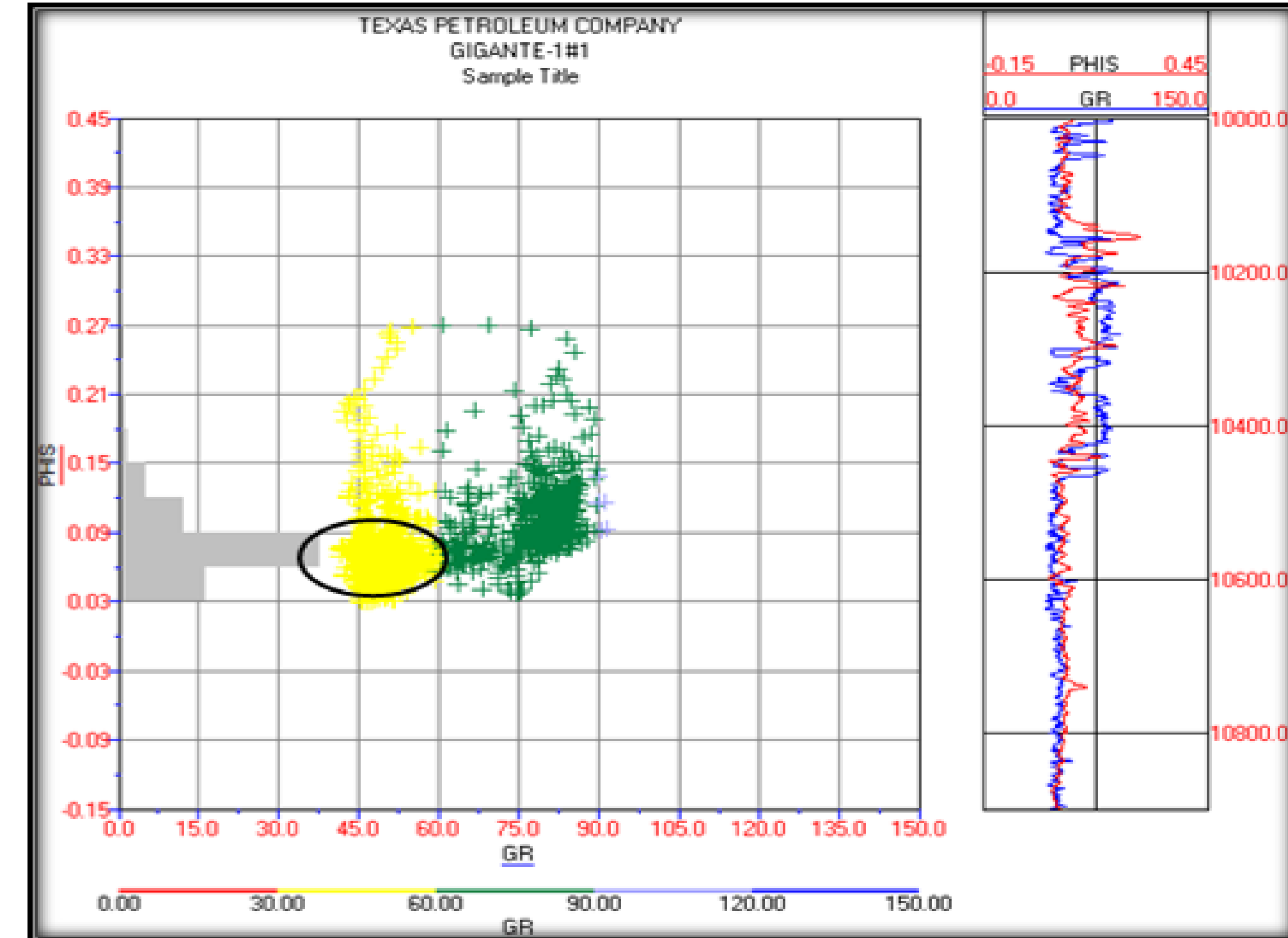
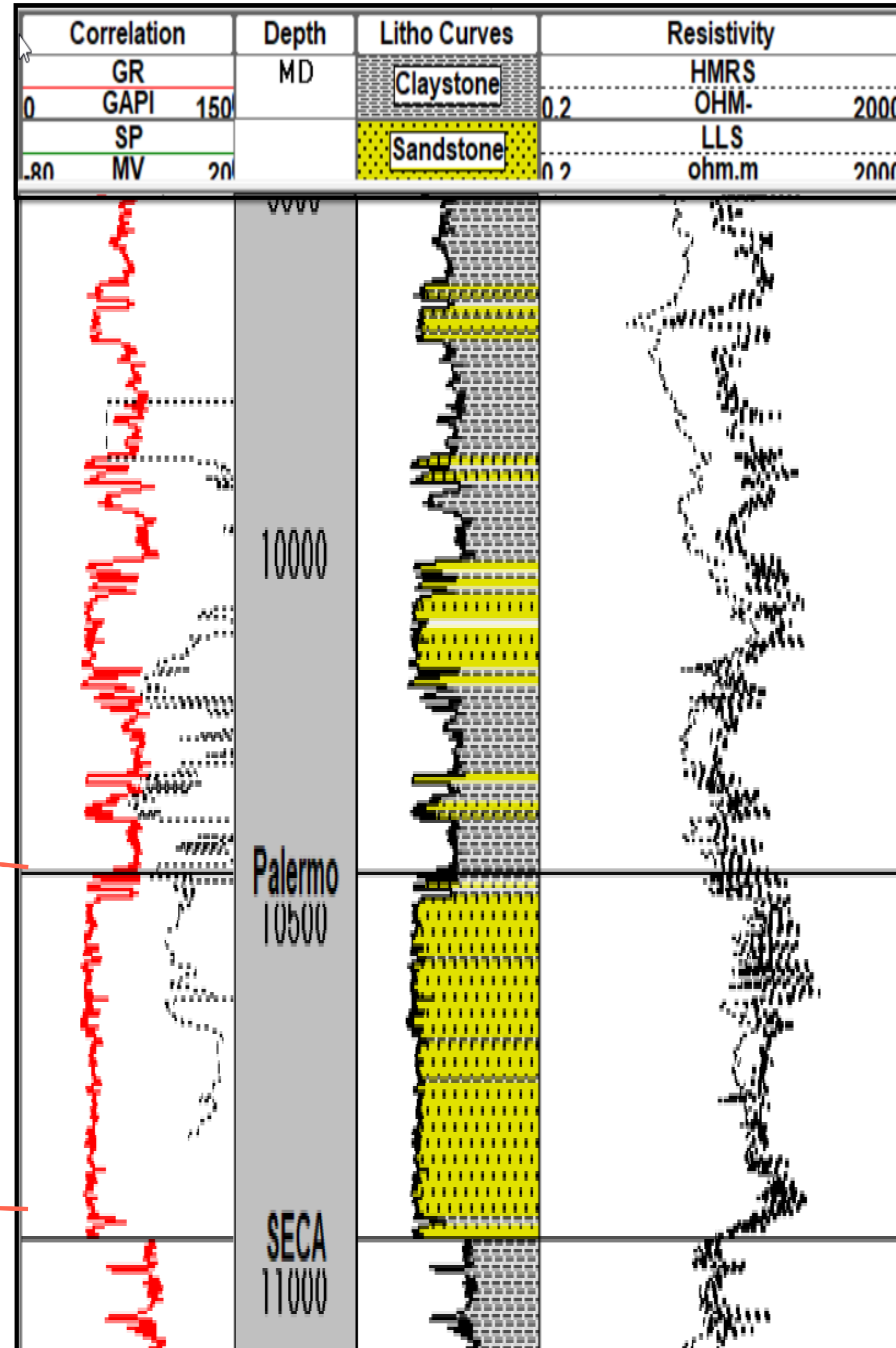
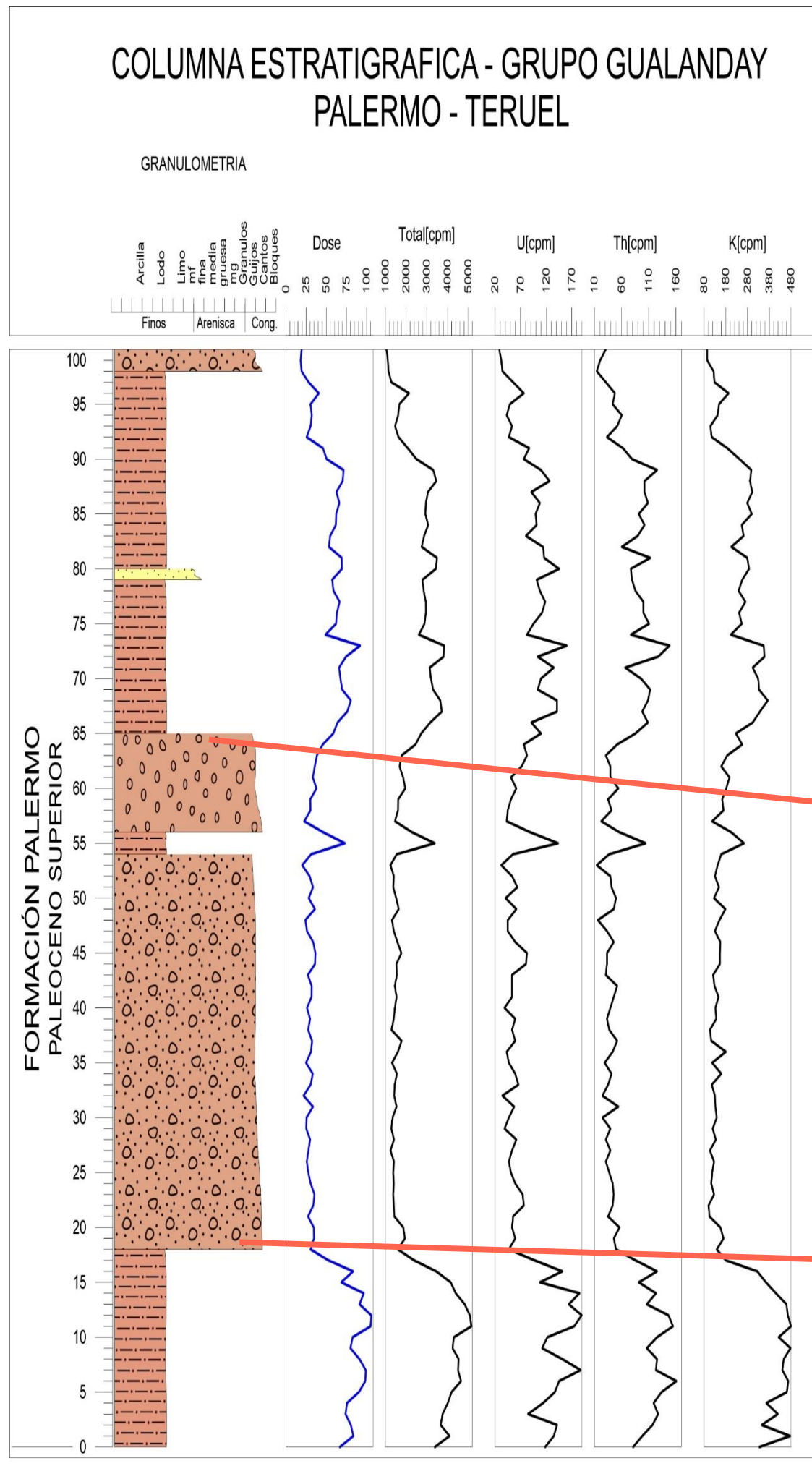
Gualanday Group, petrophysics



Palermo Formation

Gigante -1 well (Neiva area)

Gualanday Group, petrophysics



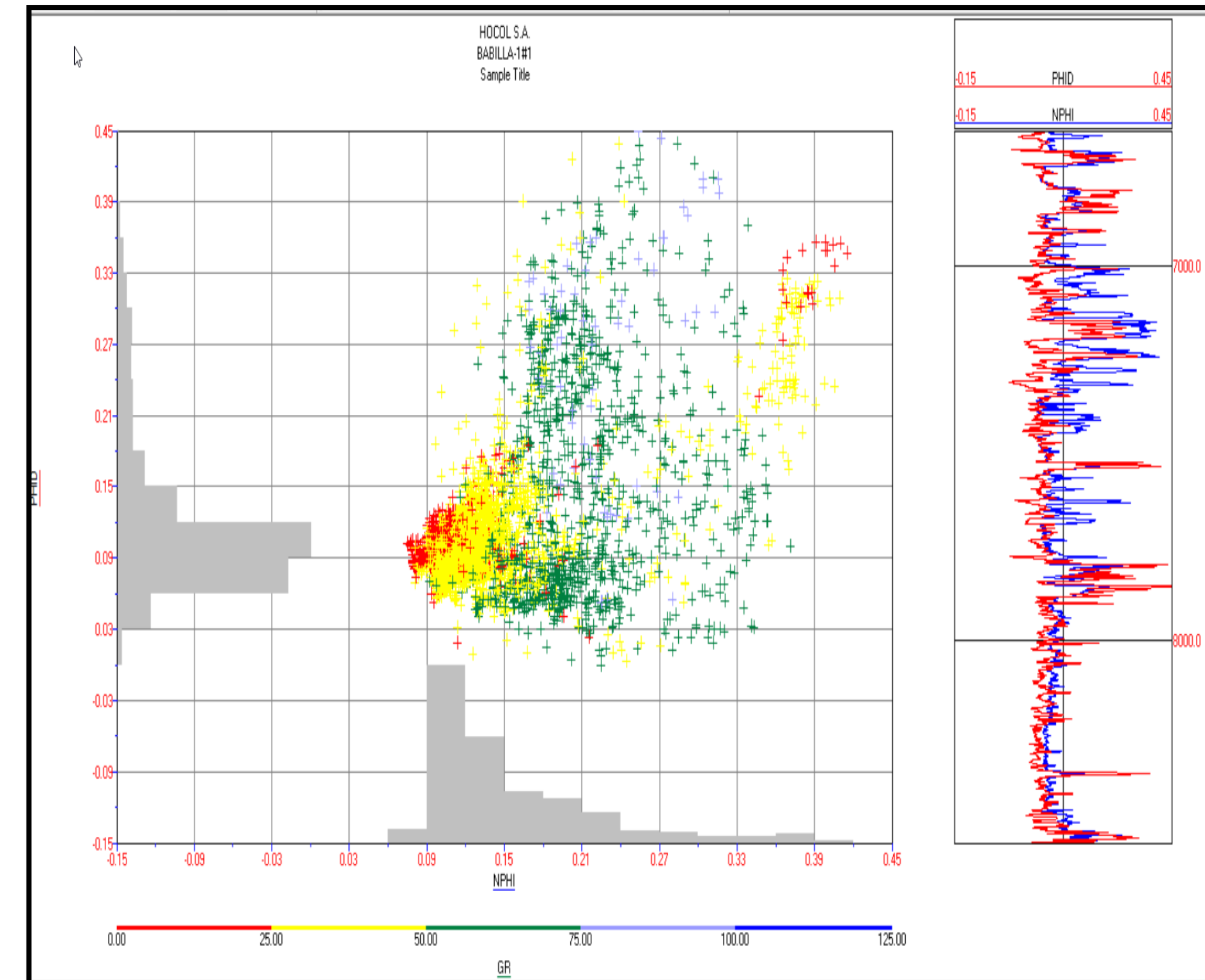
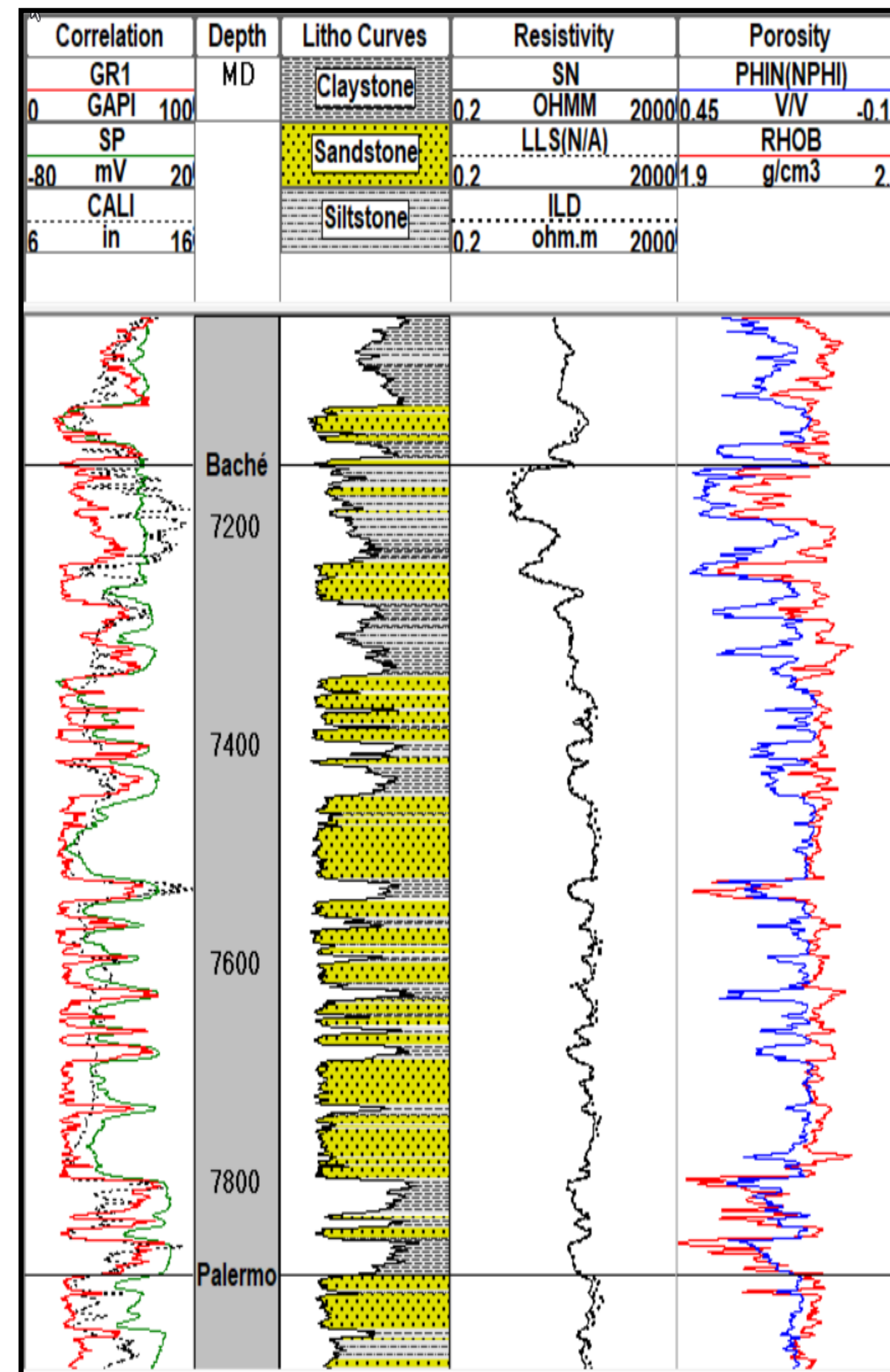
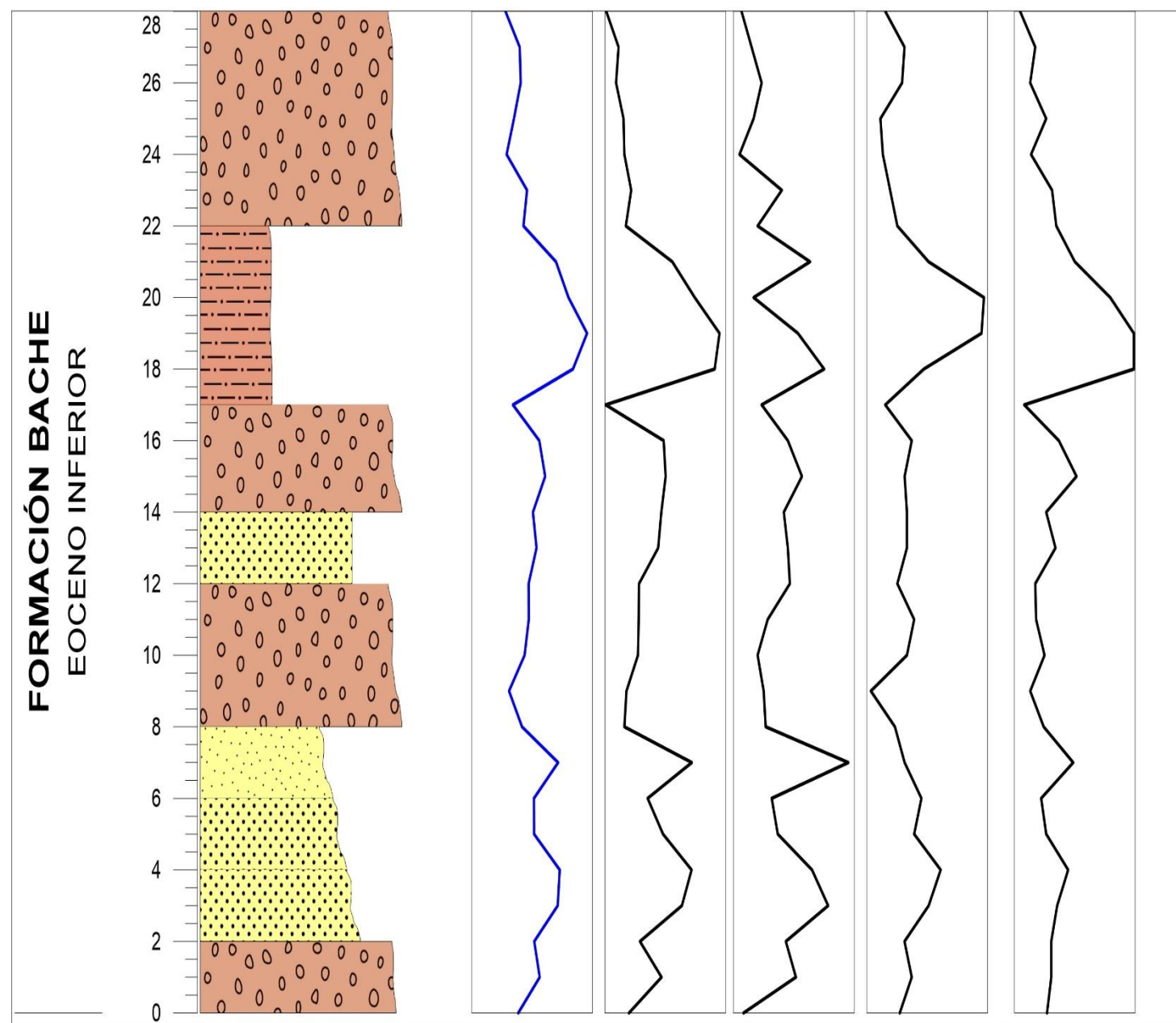
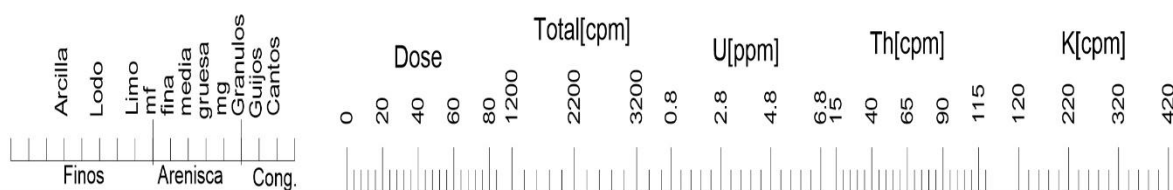
Palermo Formation

Gigante -1 well (Neiva area)

Gualanday Group, petrophysics

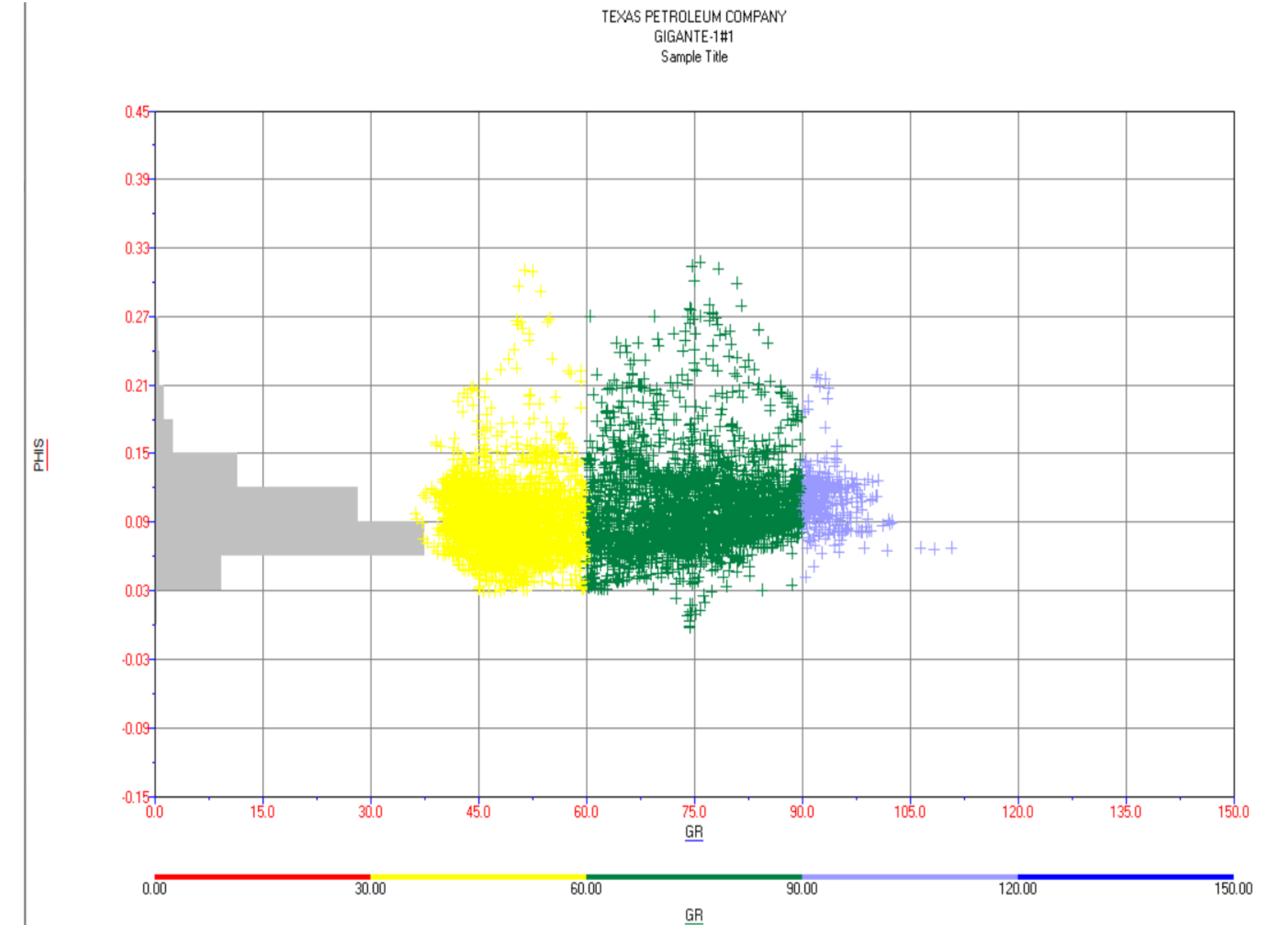
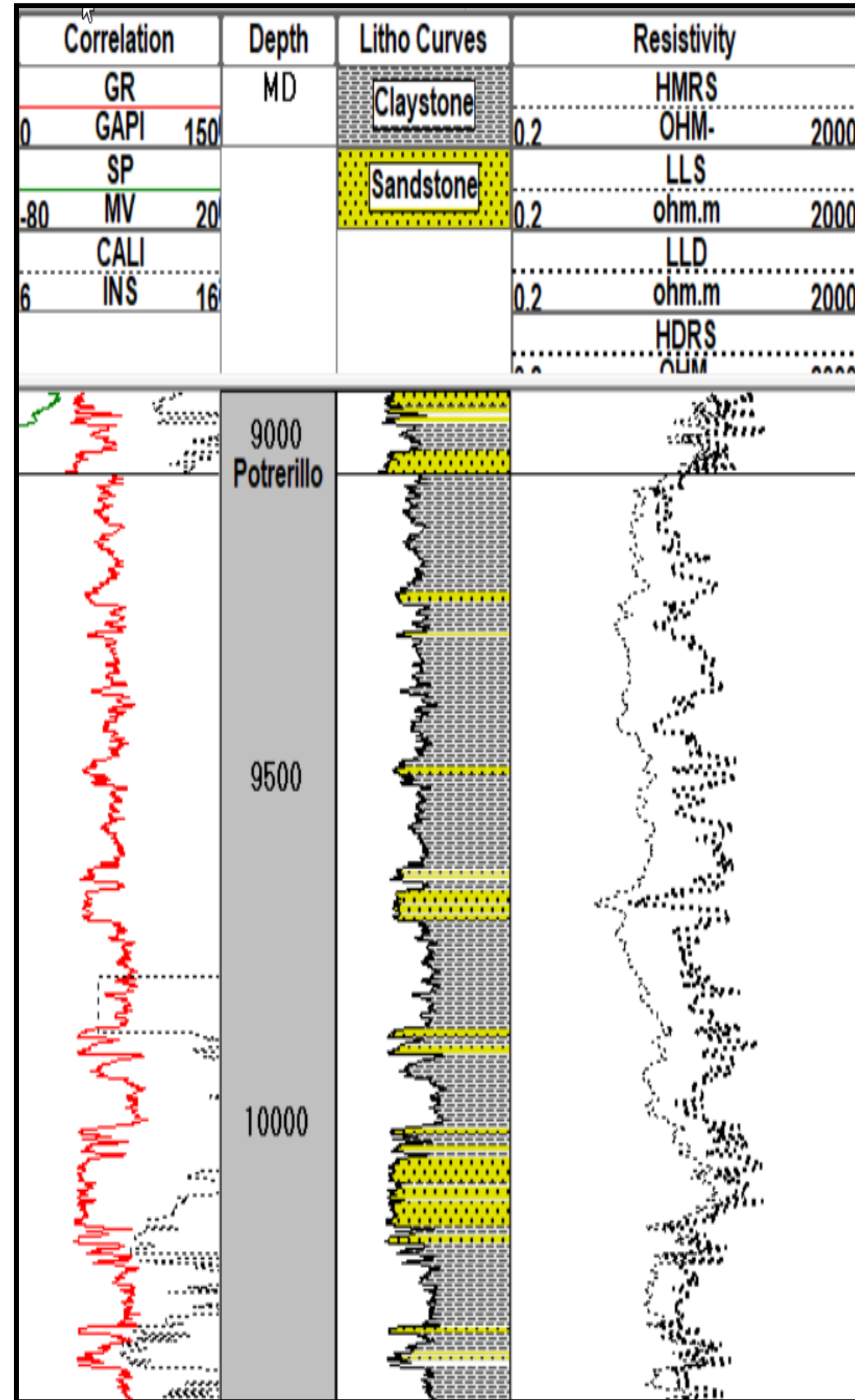
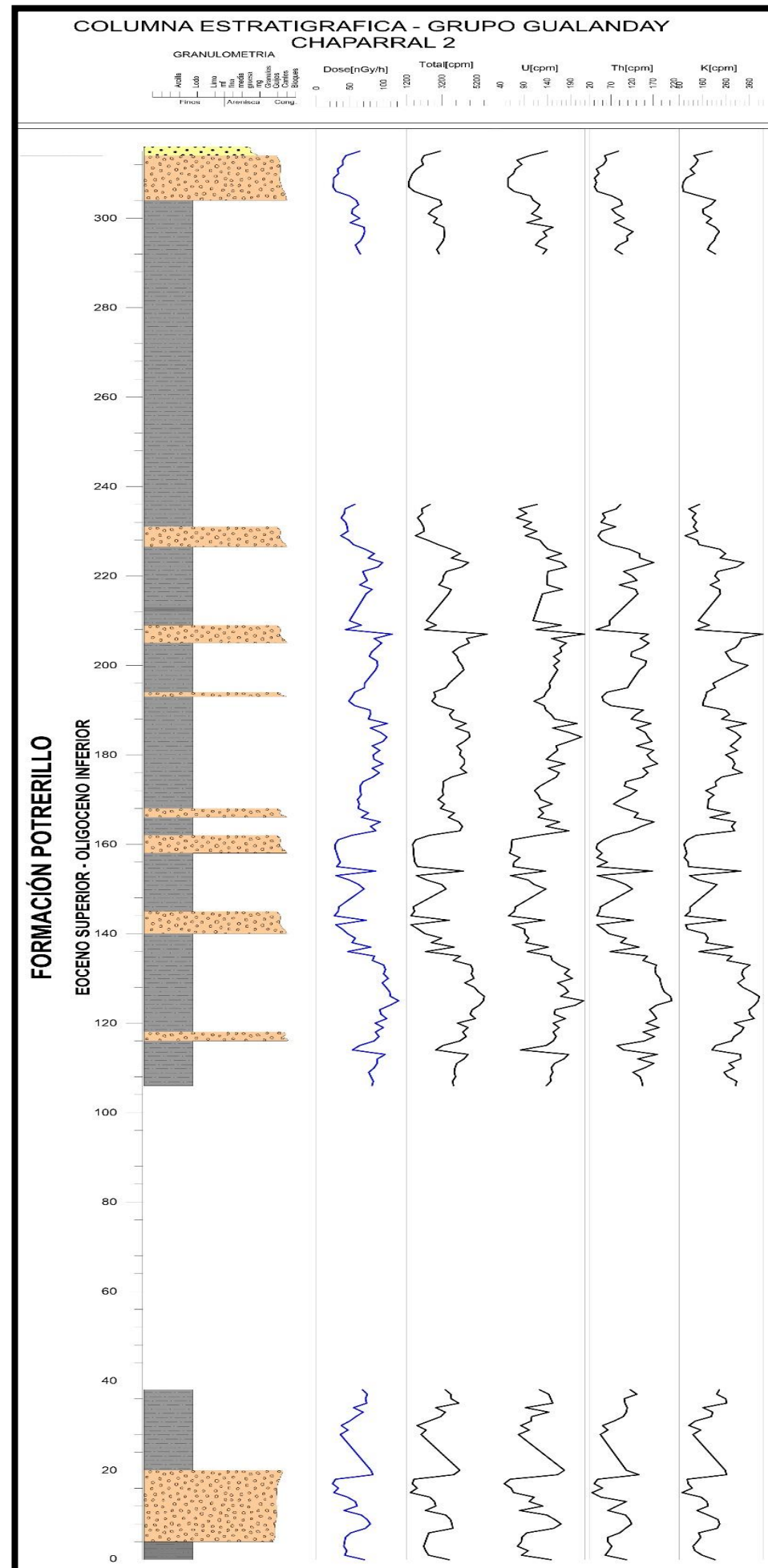
COLUMNA ESTRATIGRAFICA - GRUPO GUALANDAY PALERMO SECTOR RIKARENA

GRANULOMETRIA



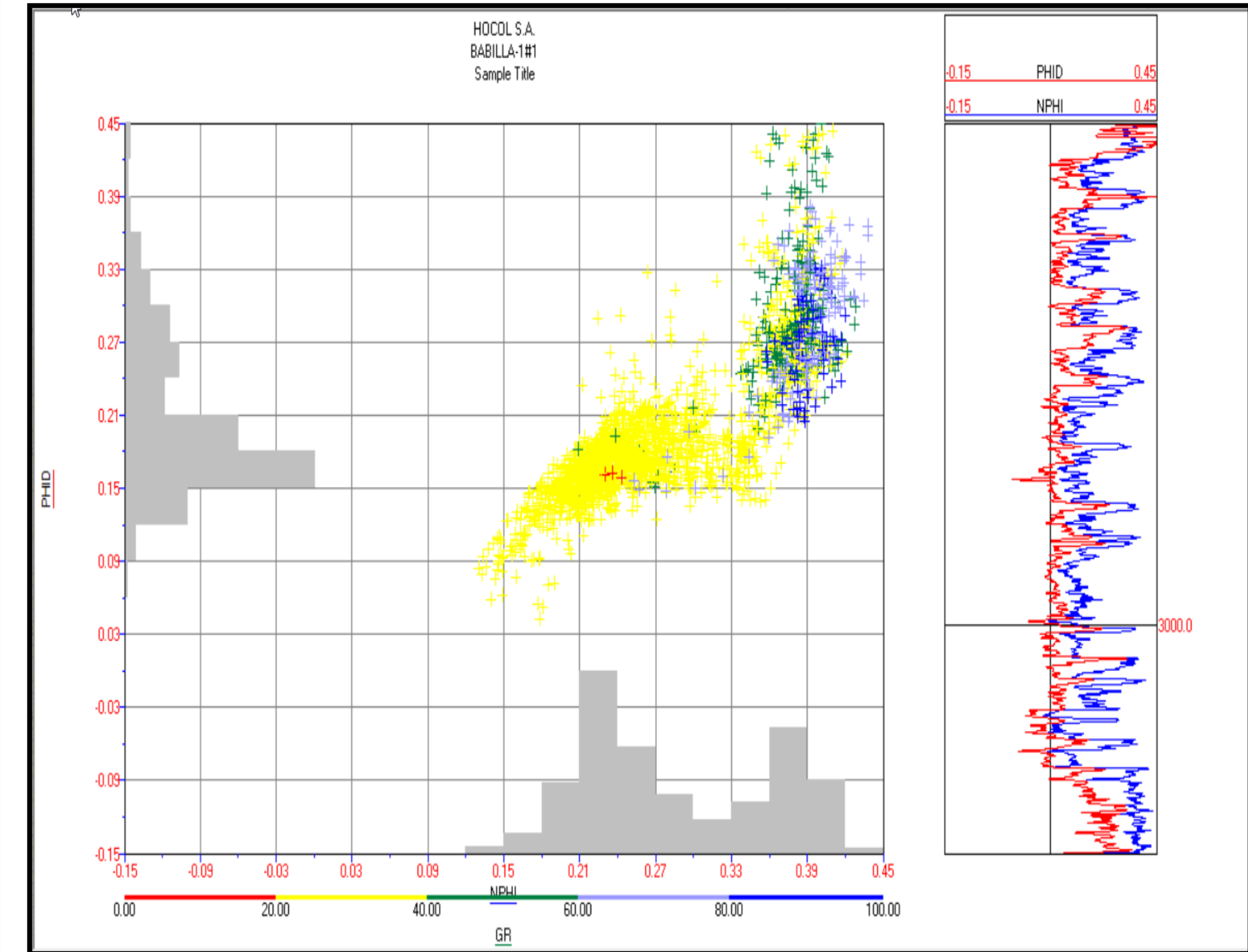
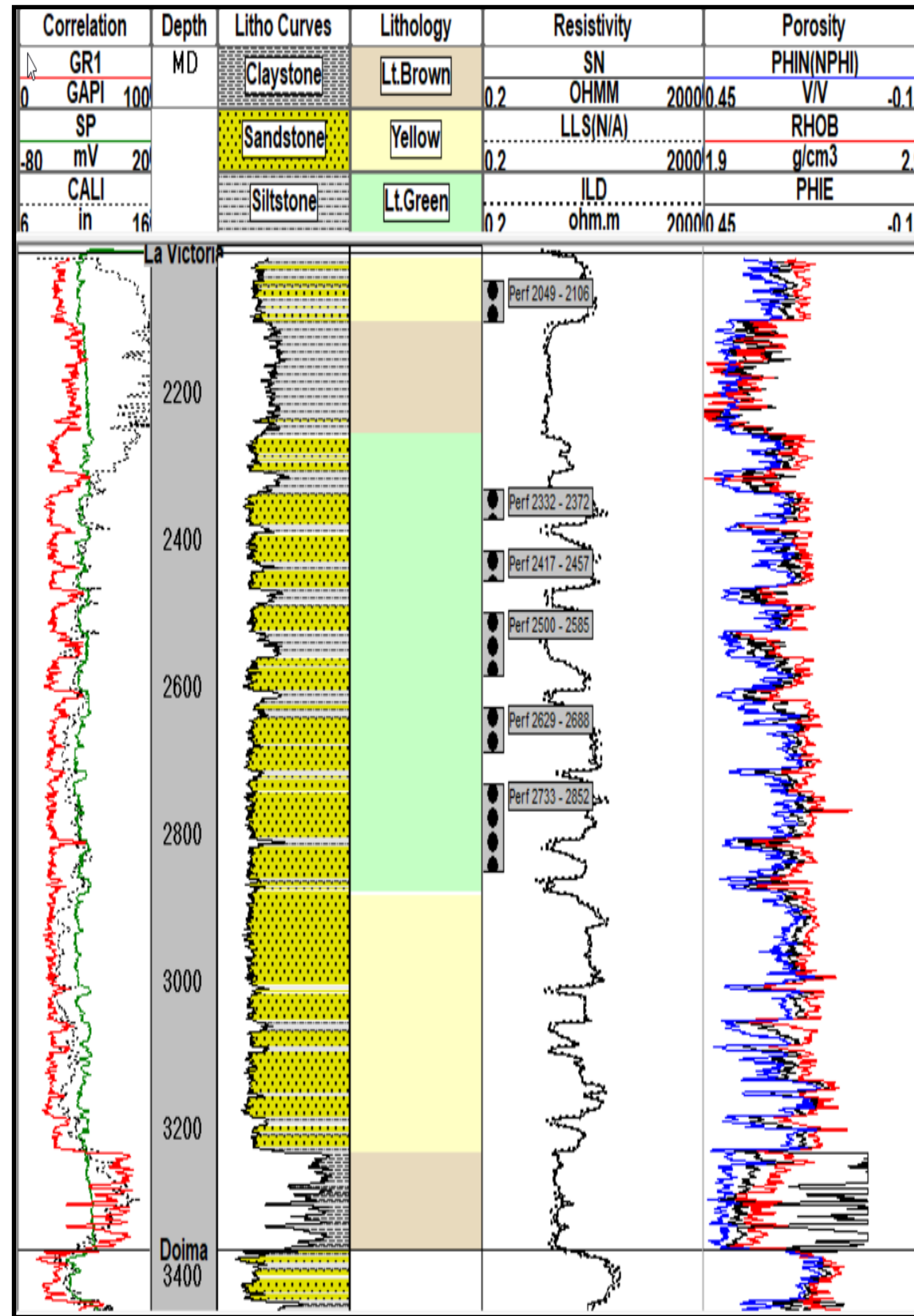
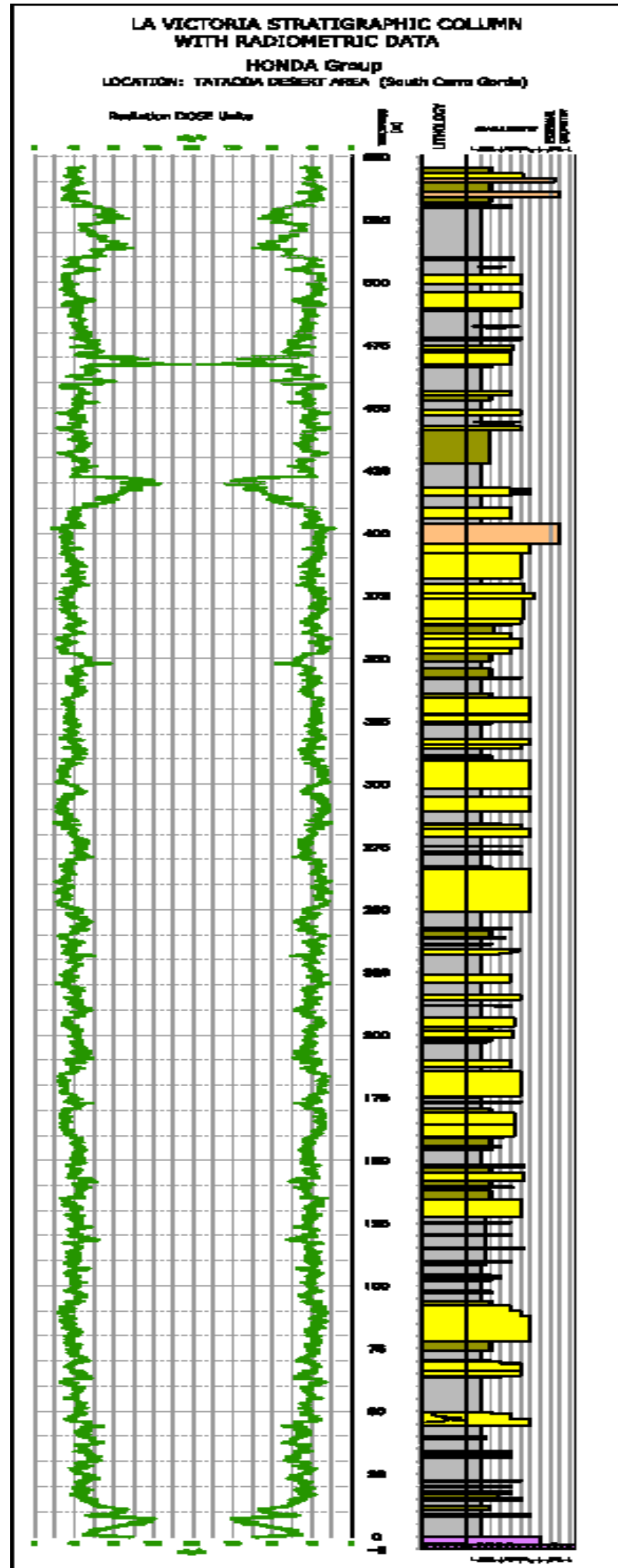
Bache Formation

Gualanday Group, petrophysics



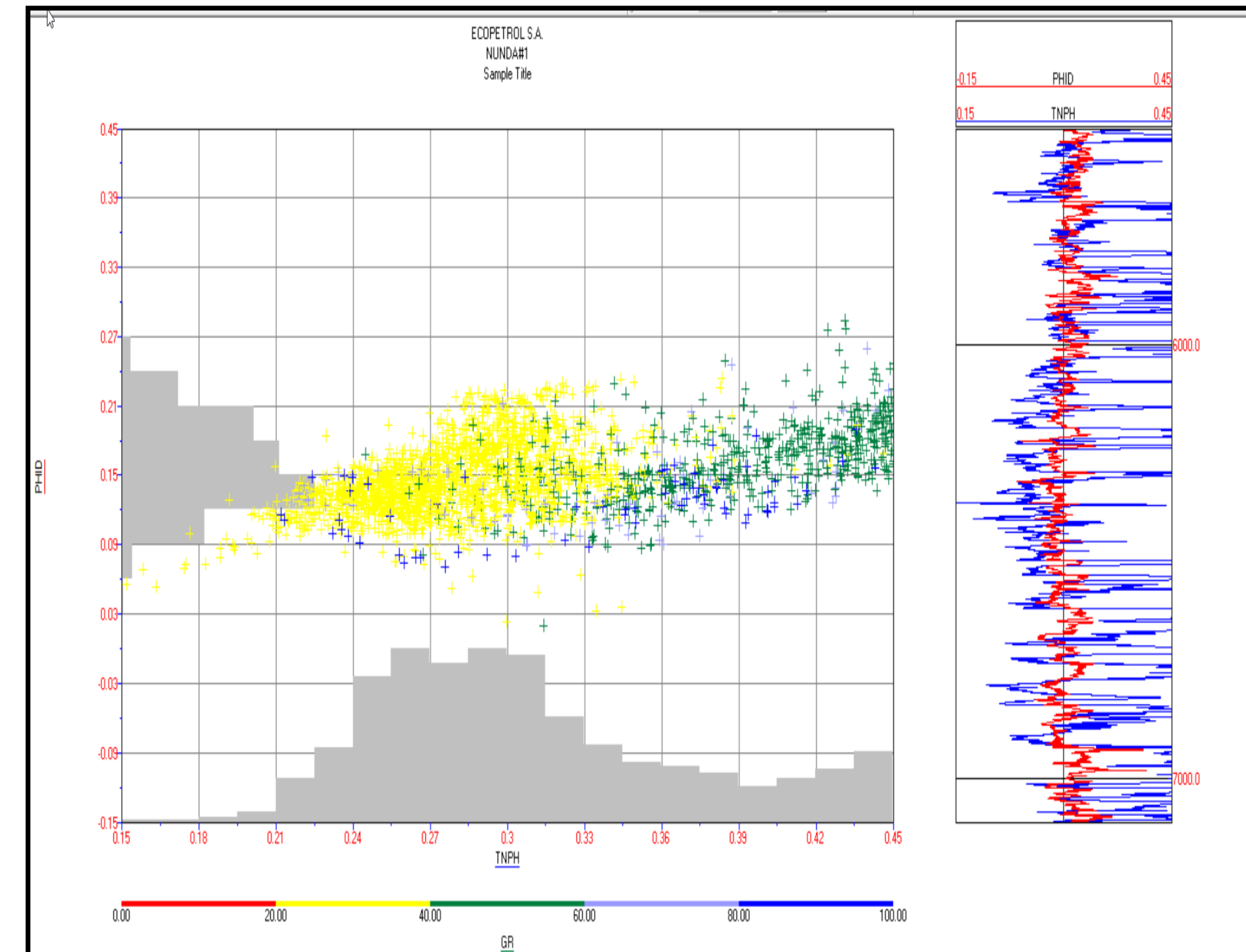
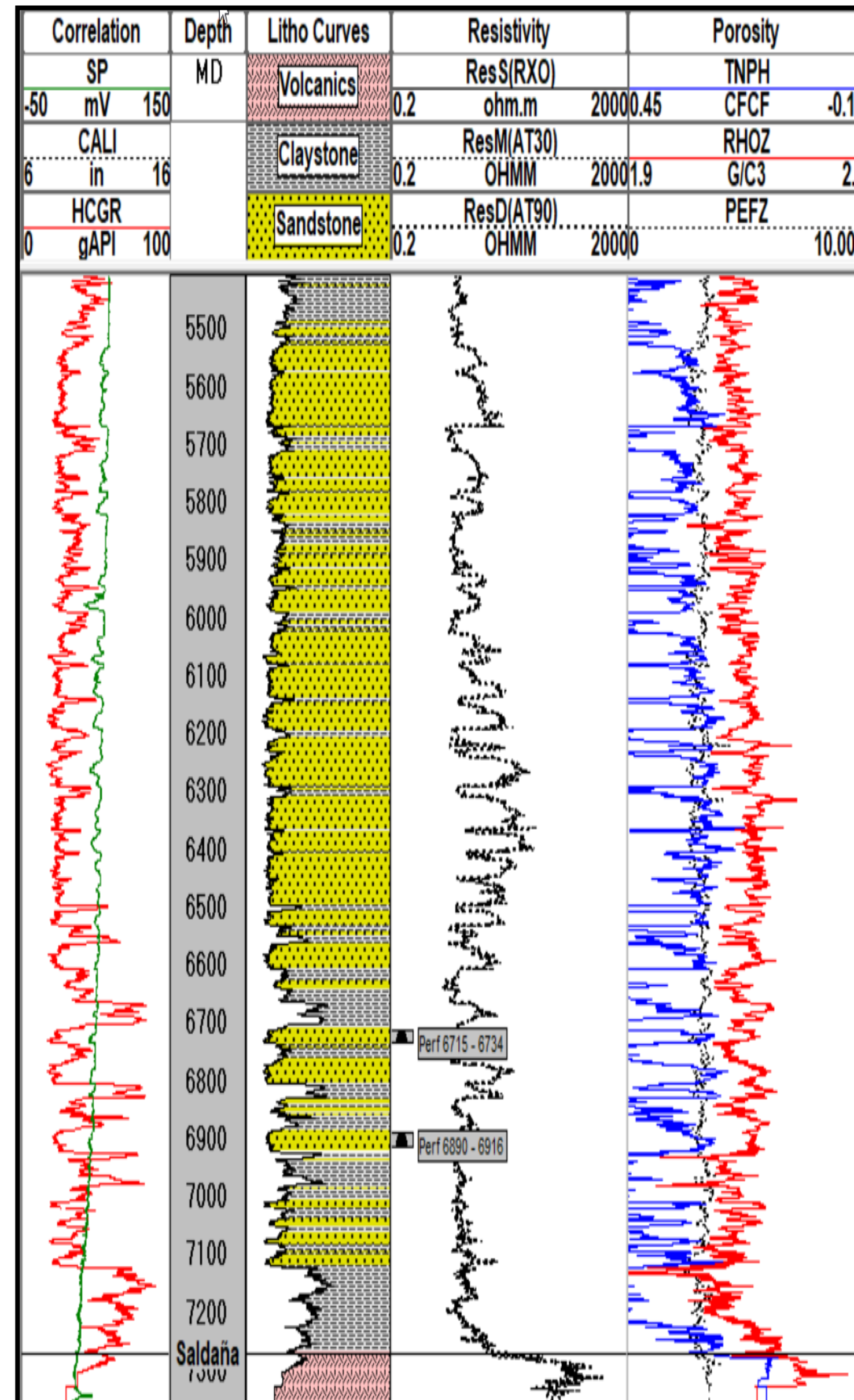
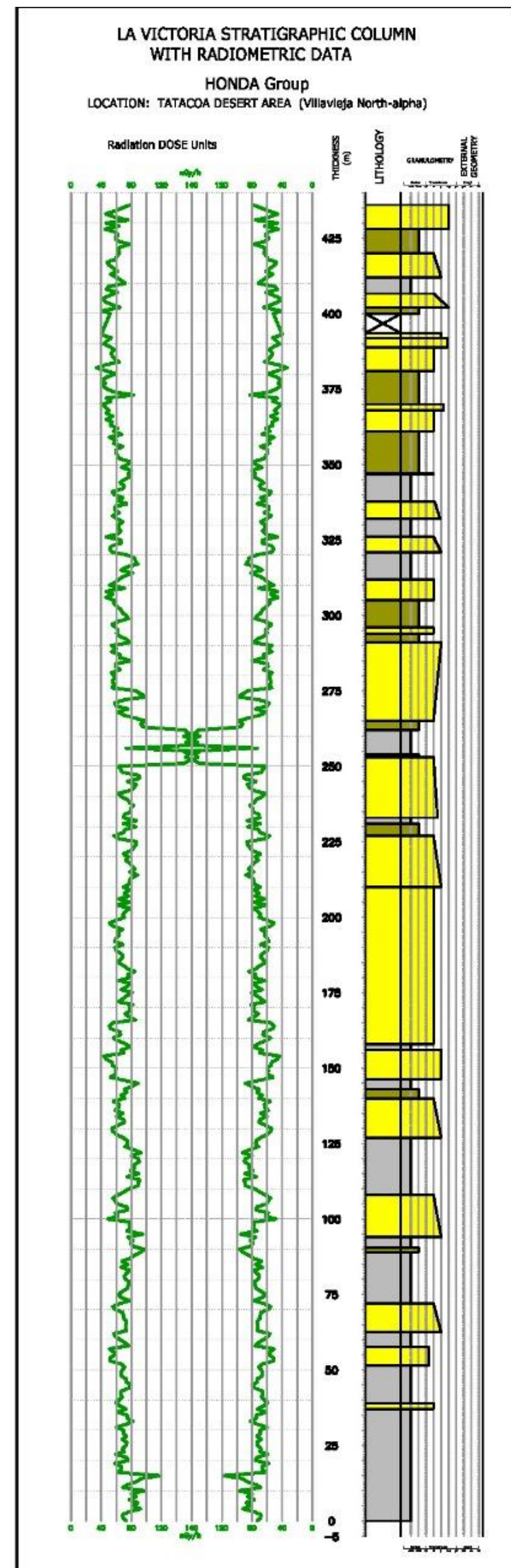
Graph of sonic porosity versus gamma rays, for the Potrerillo Formation, where average values for sandstones between 6 to 12% are observed

La Victoria Formation, petrophysics



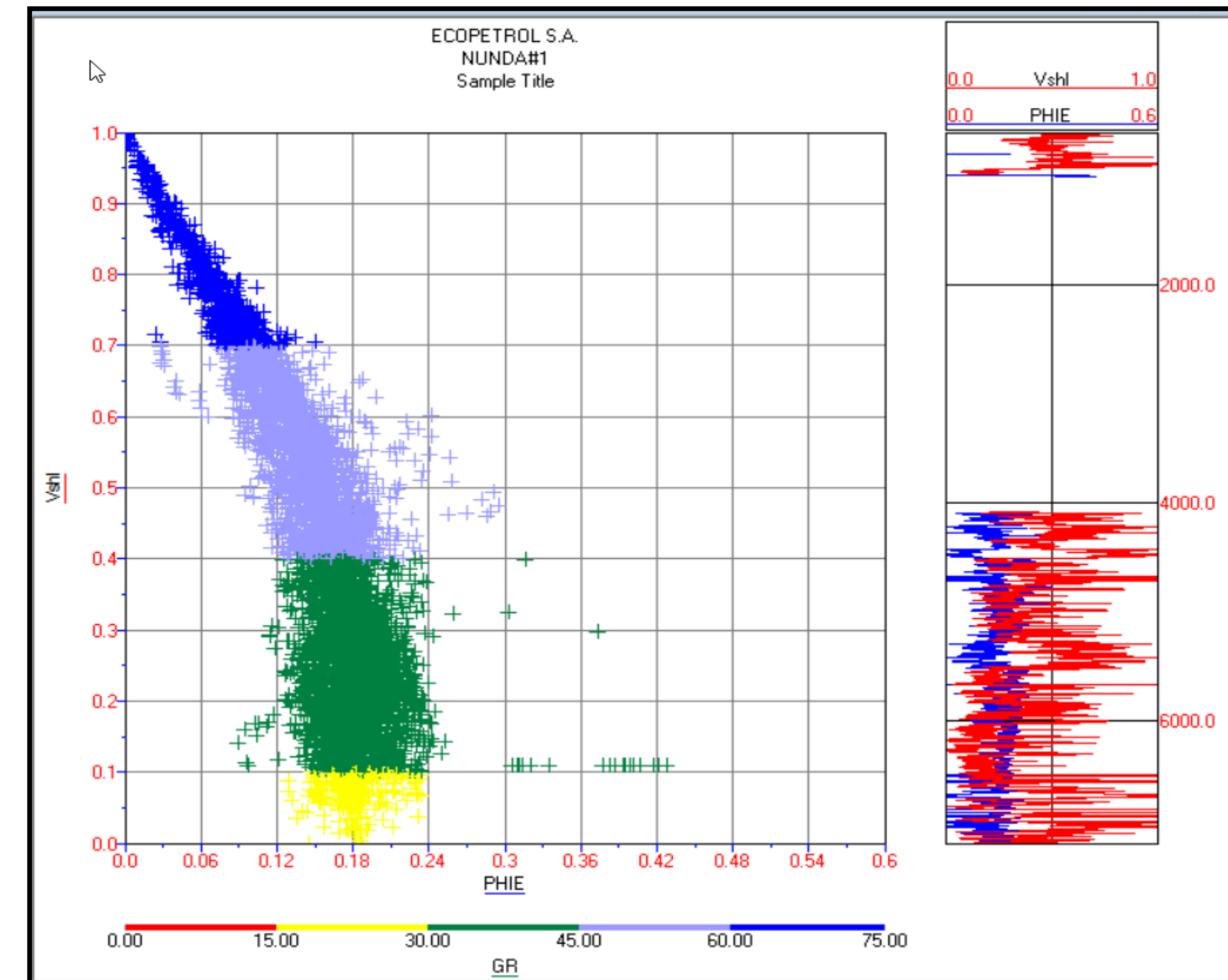
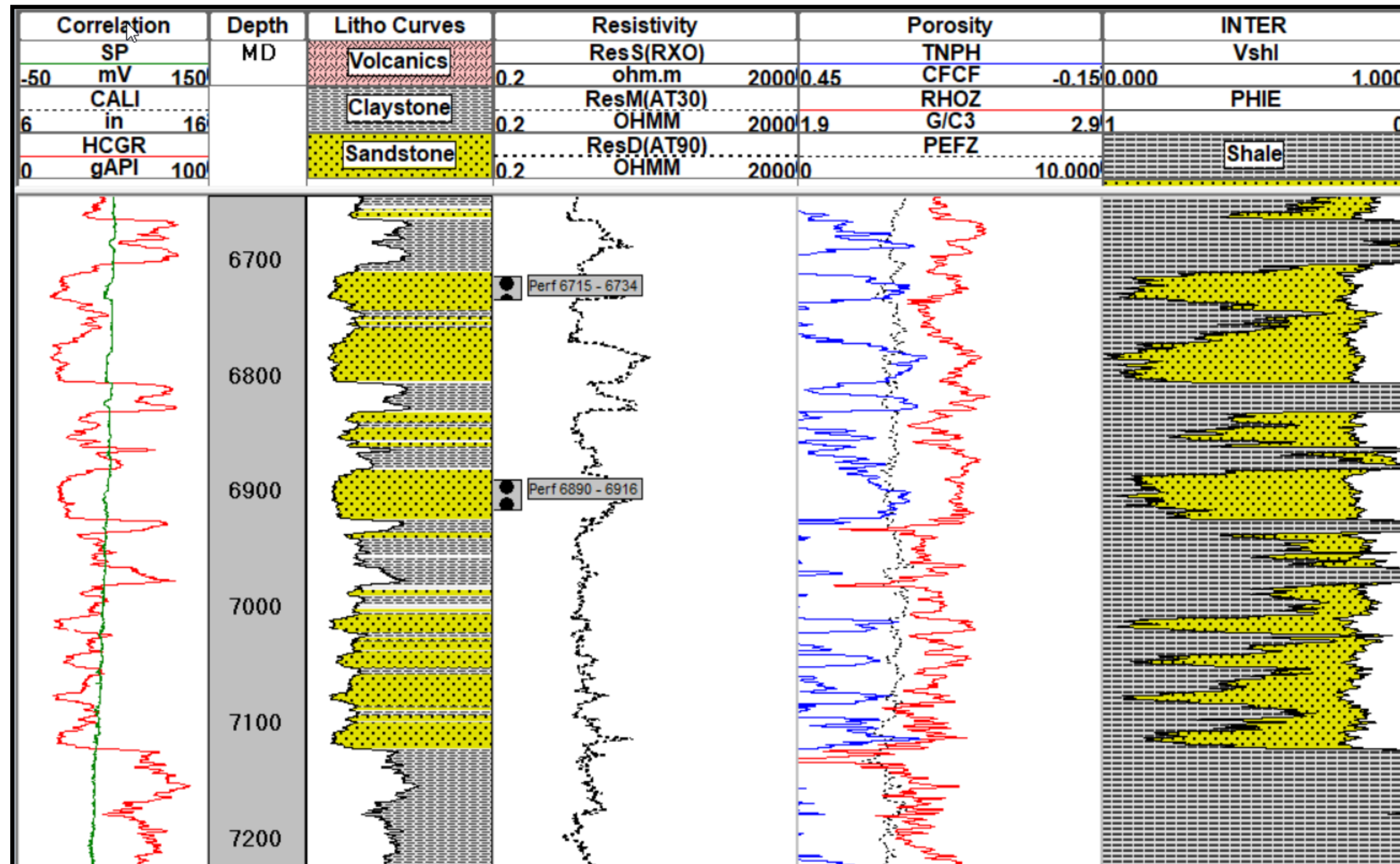
Babilla 1 Well, Neiva area

La Victoria Formation, petrophysics



Nunda 1 Well, Neiva area

La Victoria Formation, petrophysics



Nunda -1 Well. Lower segment of the La Victoria Formation, where non-commercial production was reported.
Porosity 12-24%. Vshale between 0-20%, which should affect permeability

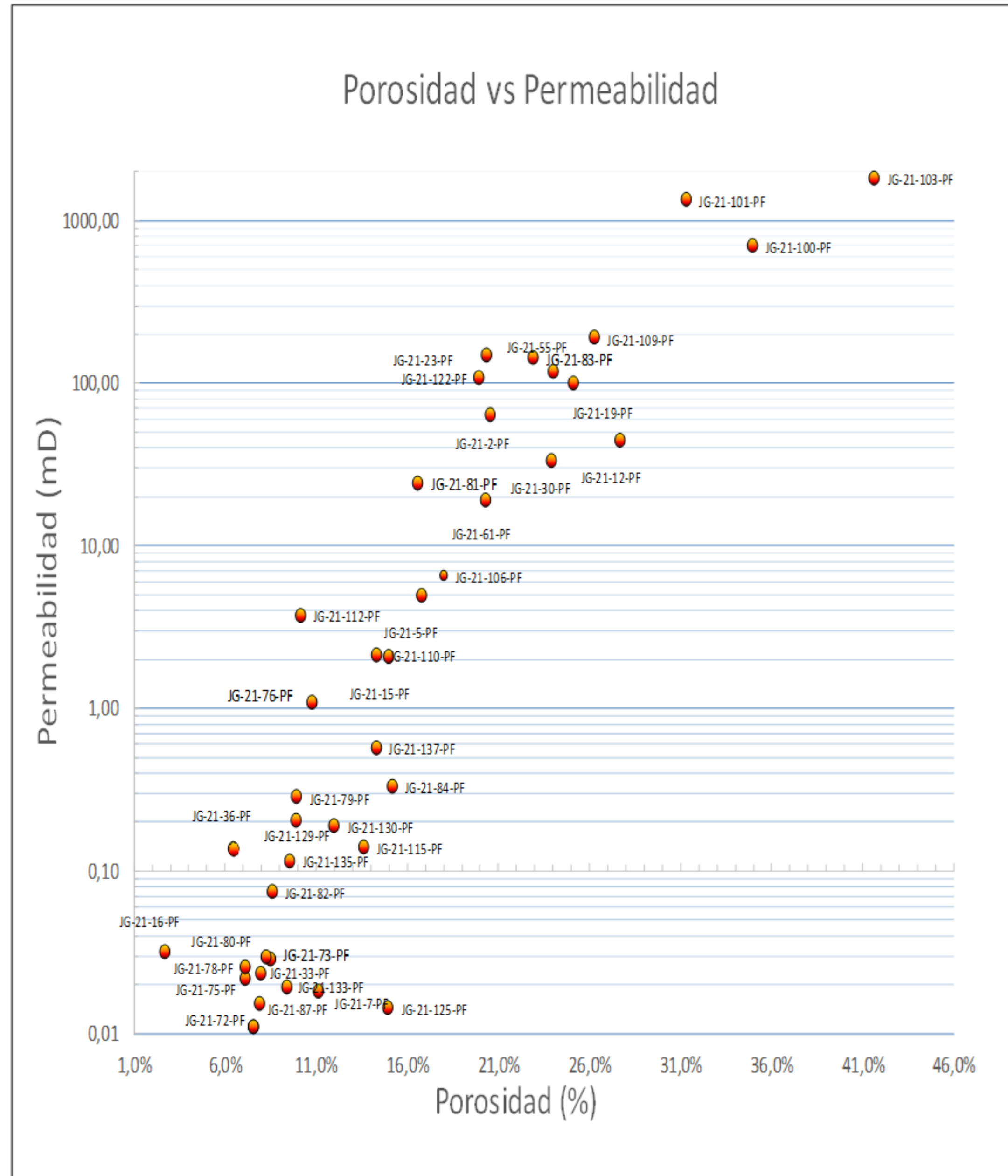
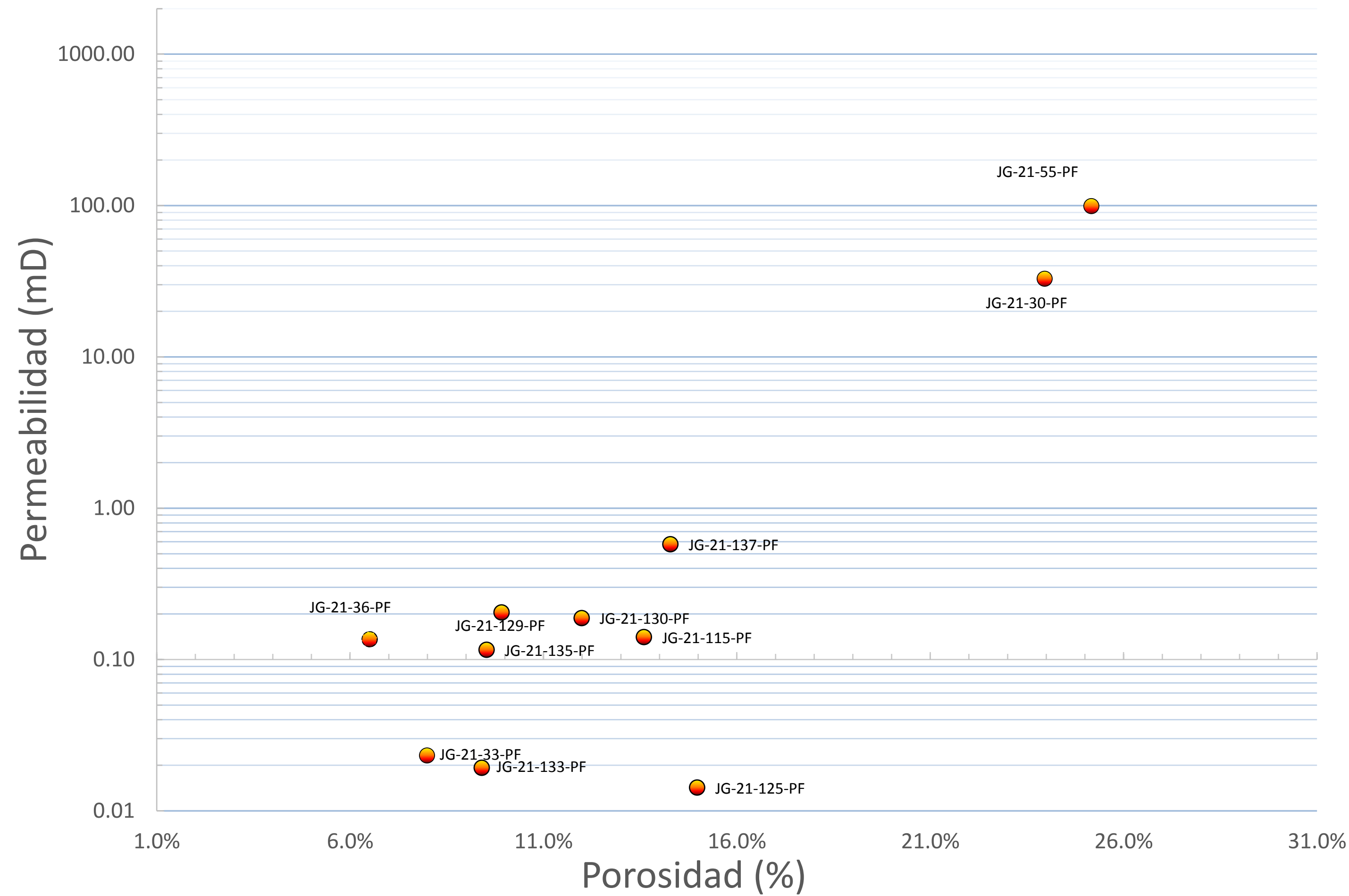


Gráfico 1: Porosidad vs. Permeabilidad. La porosidad se expresa en porcentaje (%) y la permeabilidad en Milidarcy (mD) en escala logarítmica.

POROSITY VS PERMEABILITY

- % Porosity values vs permeability mD, all samples analyzed

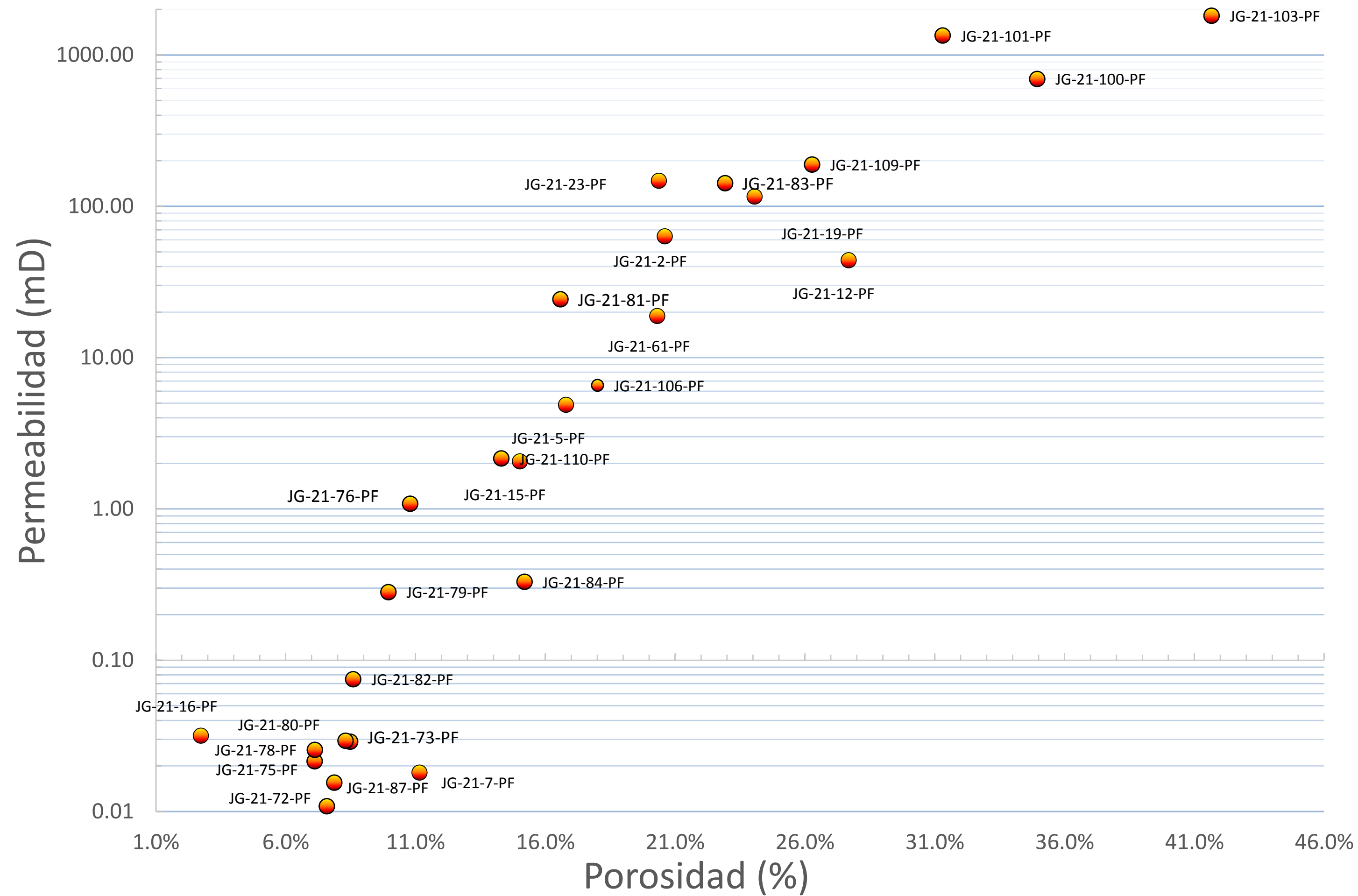
Porosidad vs Permeabilidad



POROSITY VS PERMEABILITY

Porosity % values vs permeability mD, Gualanday Group, Neiva and Girardot areas

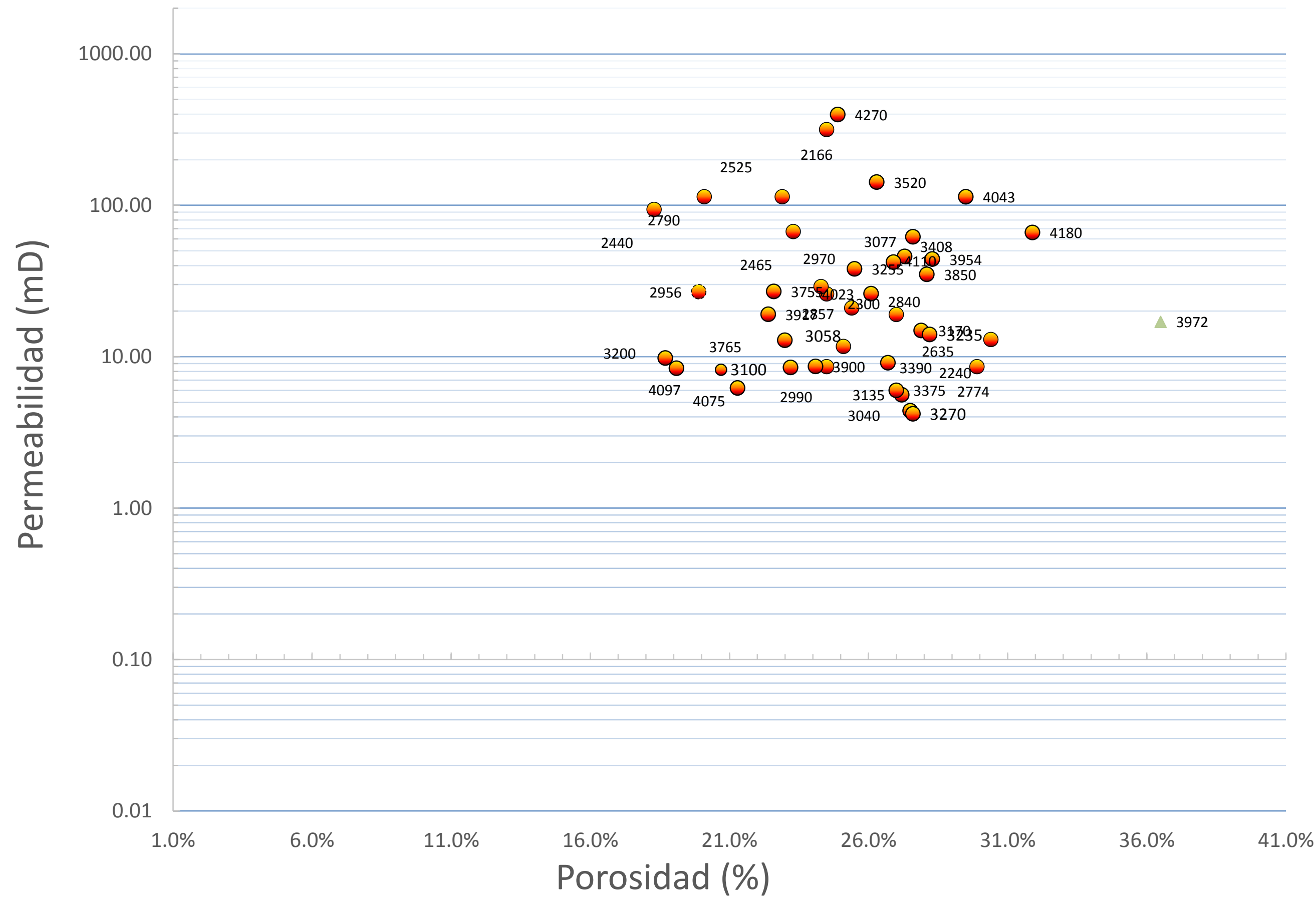
Porosidad vs Permeabilidad



POROSITY VS PERMEABILITY

% Porosity values vs permeability mD, Honda Group, Neiva and Girardot areas

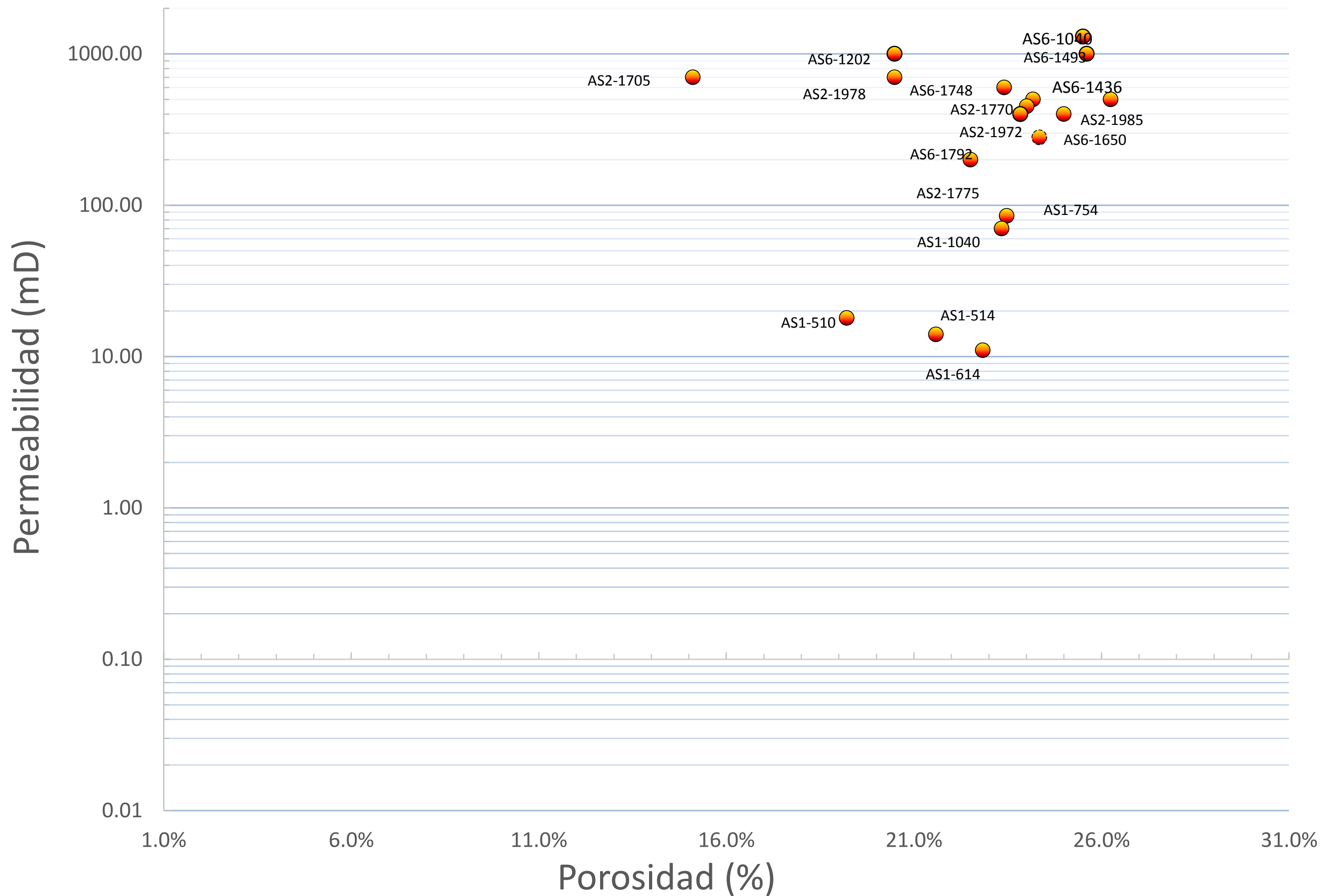
Porosidad vs Permeabilidad



POROSITY VS PERMEABILITY

%Porosity values vs permeability mD, La Victoria Formation, Palogrande Field

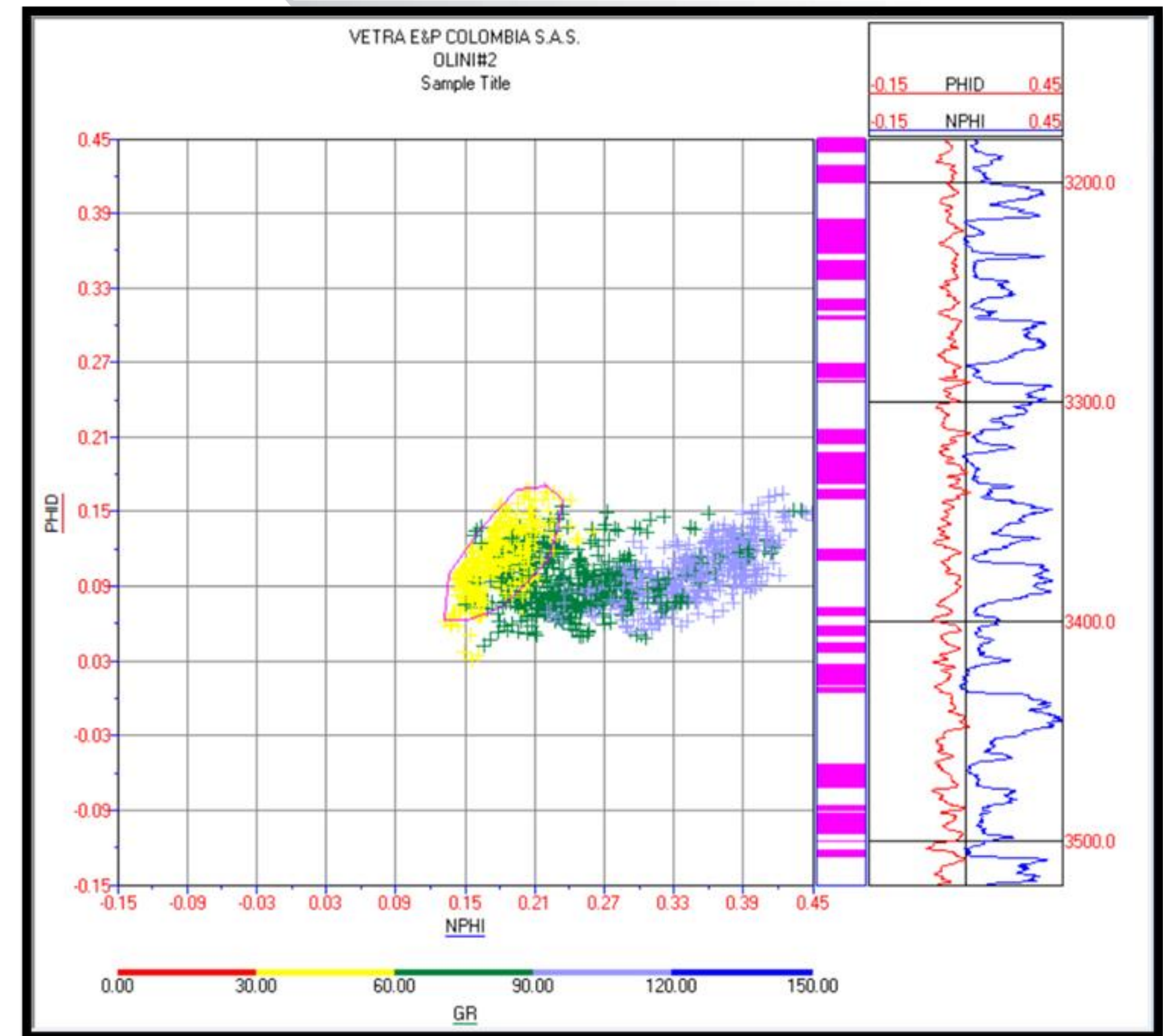
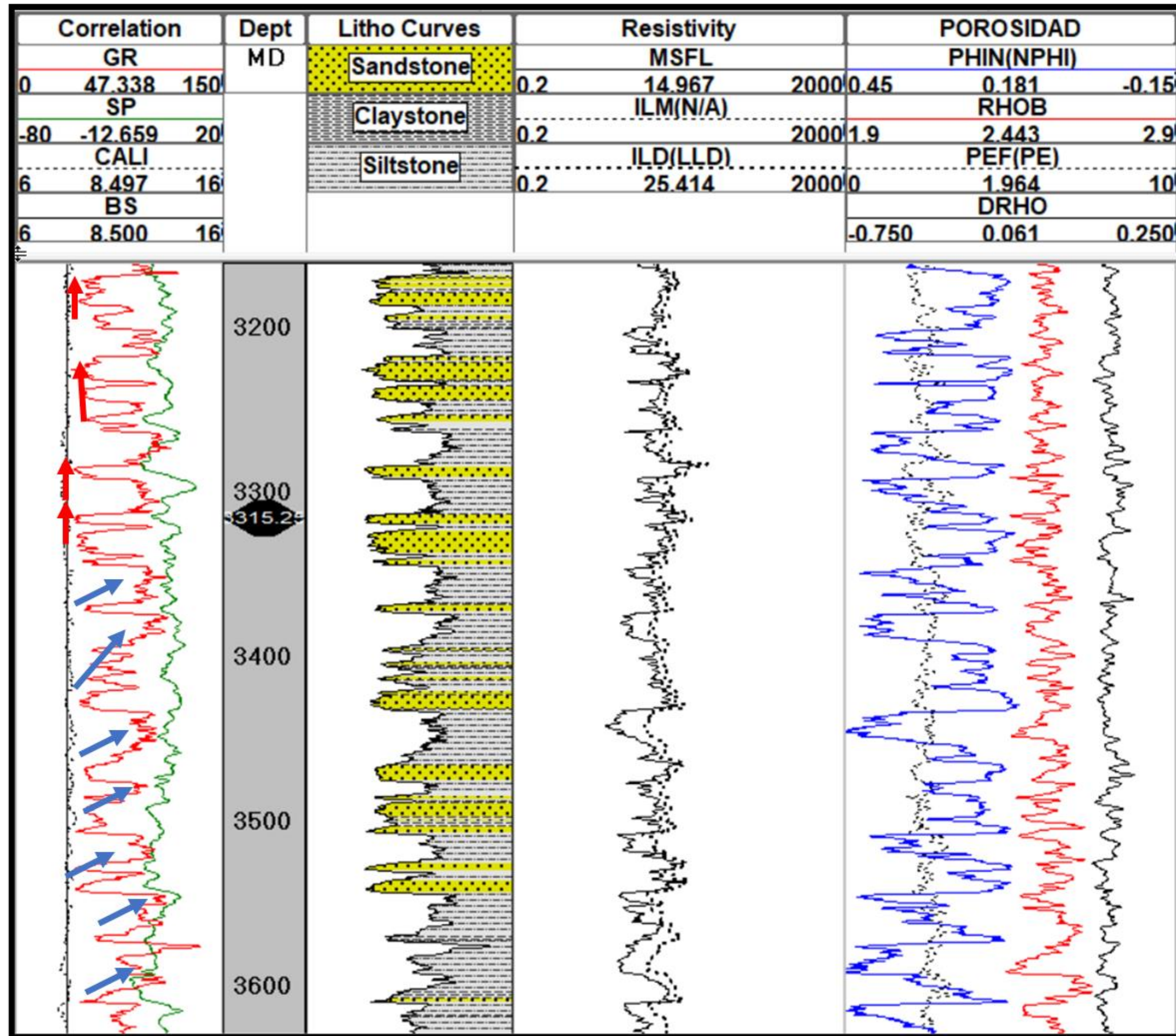
Porosidad vs Permeabilidad



POROSITY VS PERMEABILITY

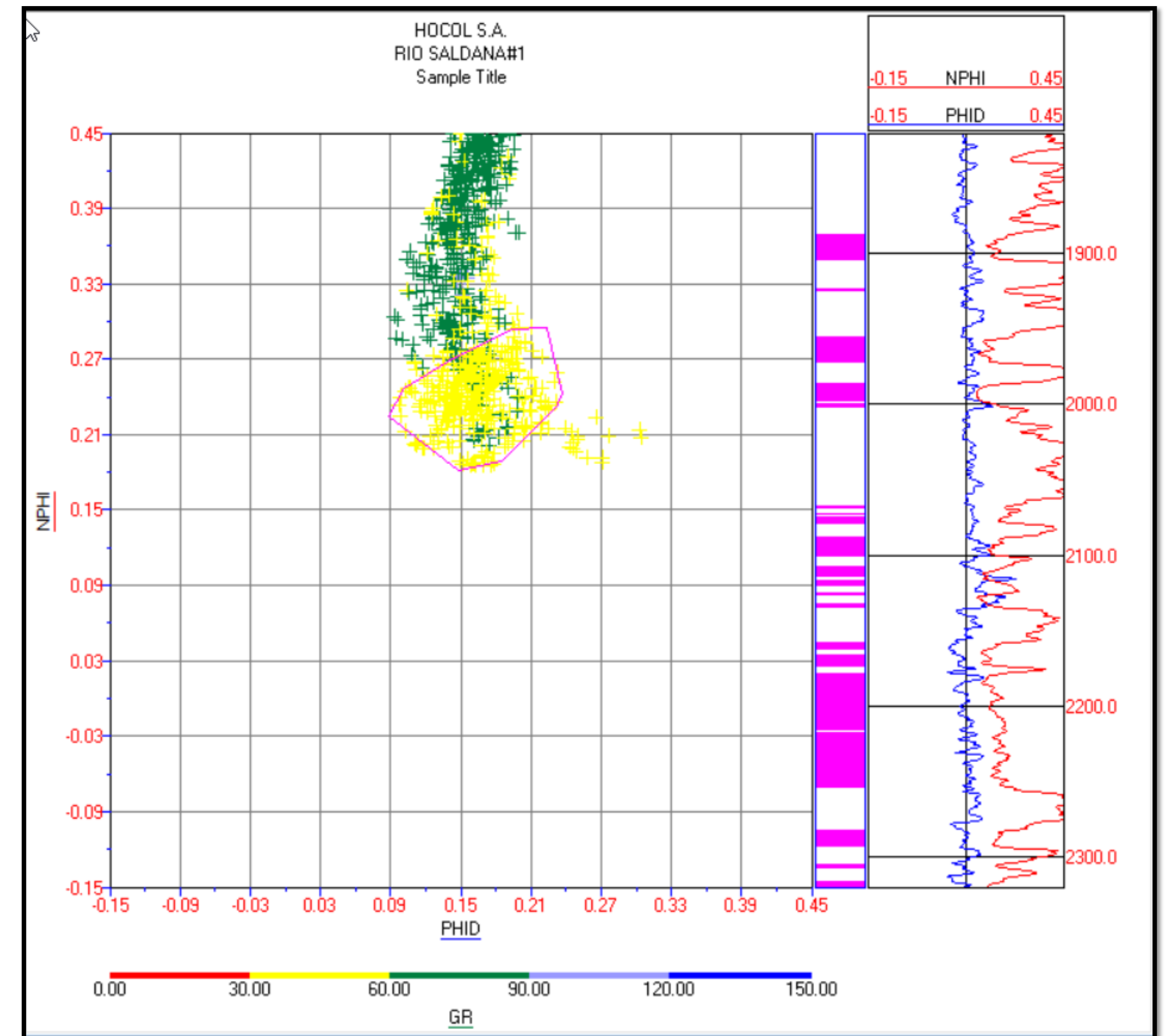
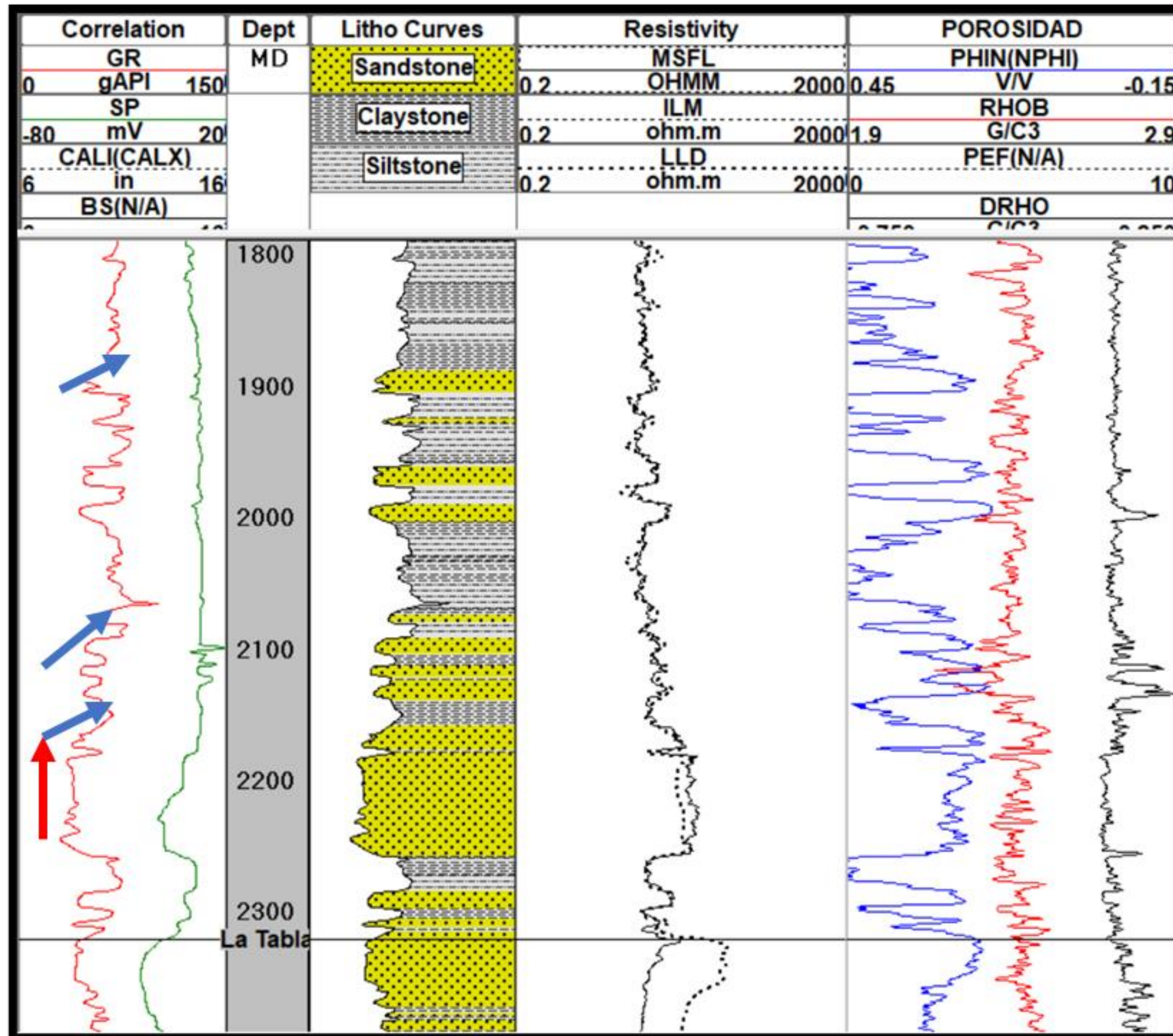
% Porosity values vs permeability mD, Andalucía Sur well, La Victoria Formation

La Victoria Formation, petrophysics



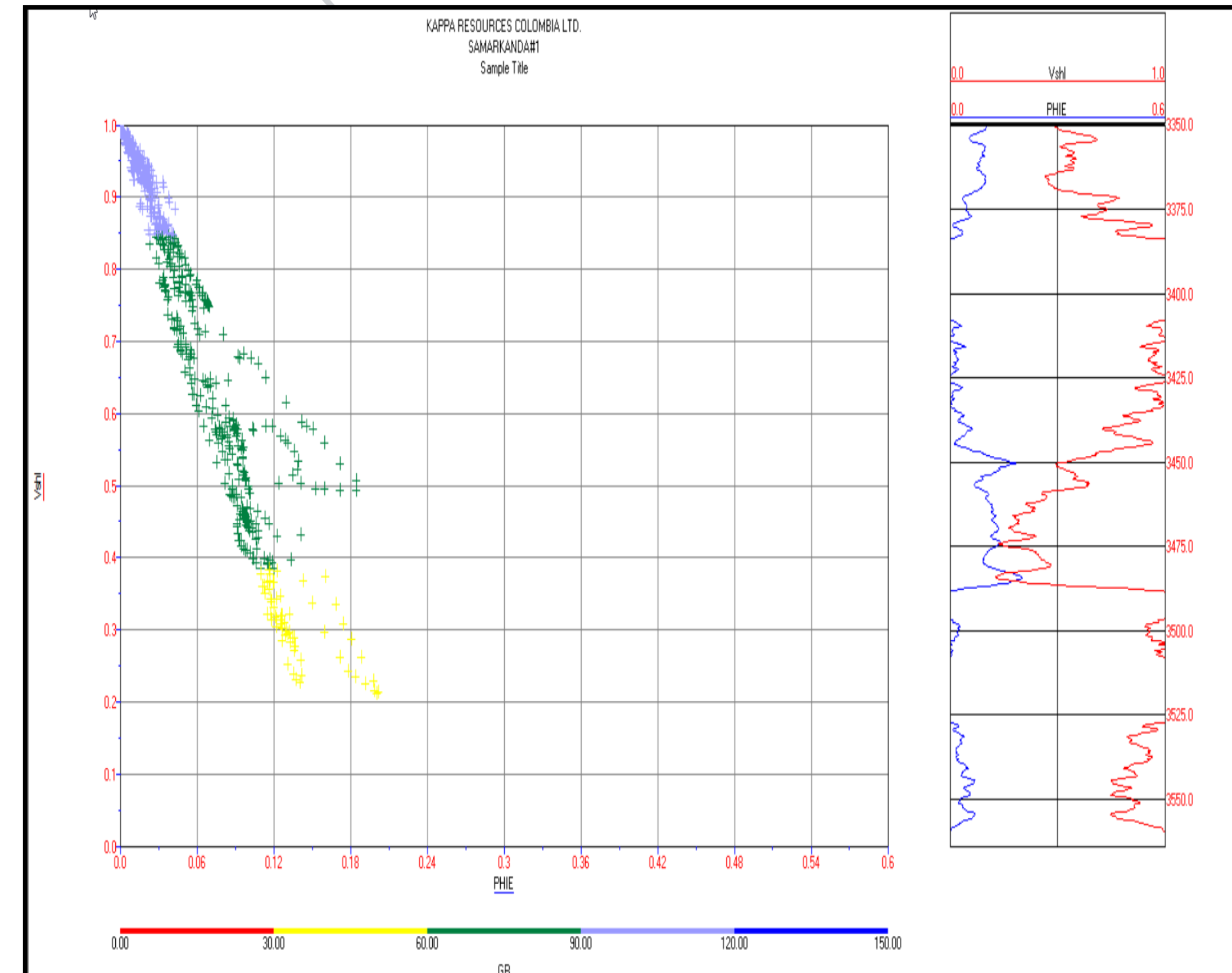
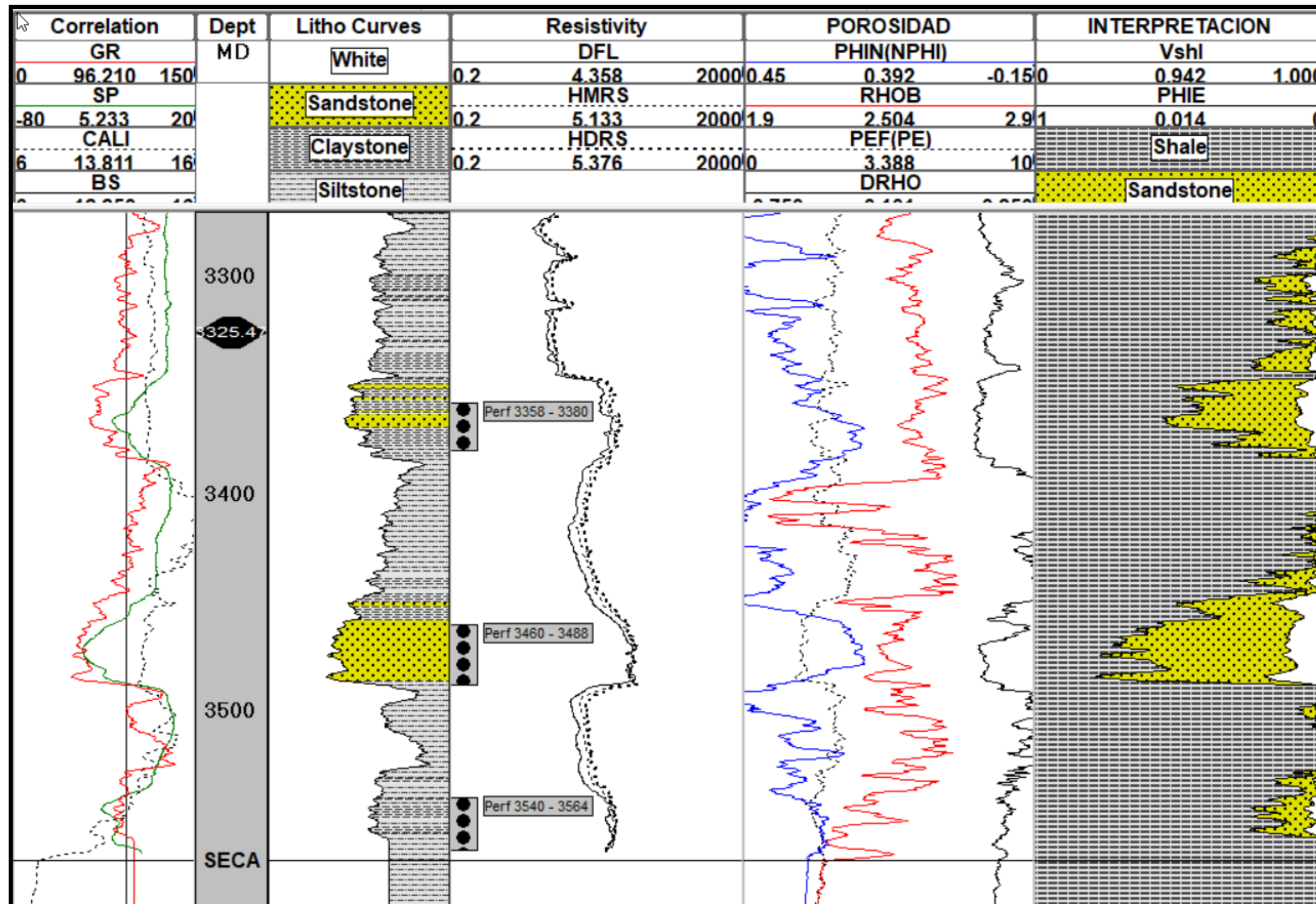
Olini – 2 well. Lithological interpretation and determination of average porosity values from density and neutron logs. Girardot area.

La Victoria Formation, petrophysics



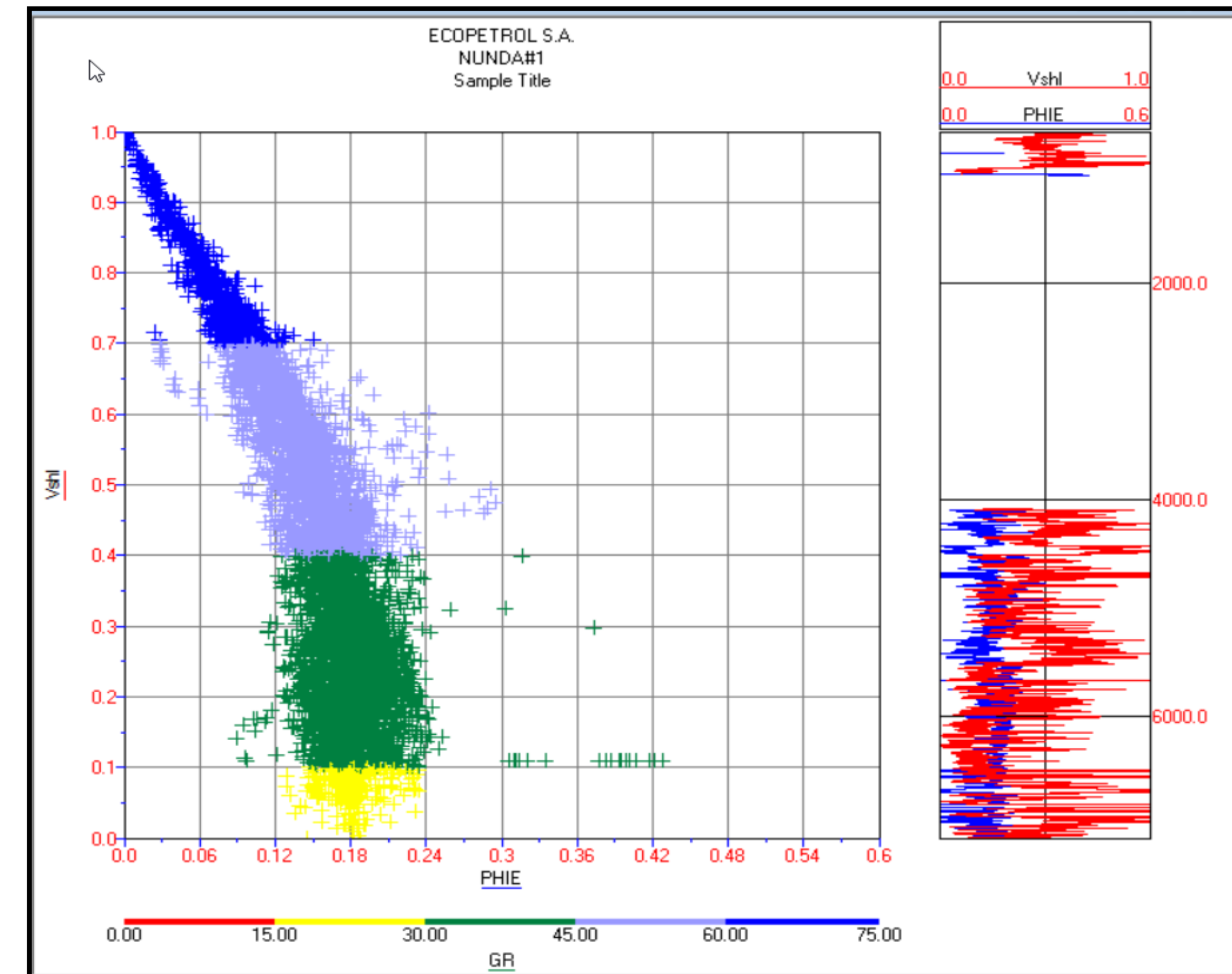
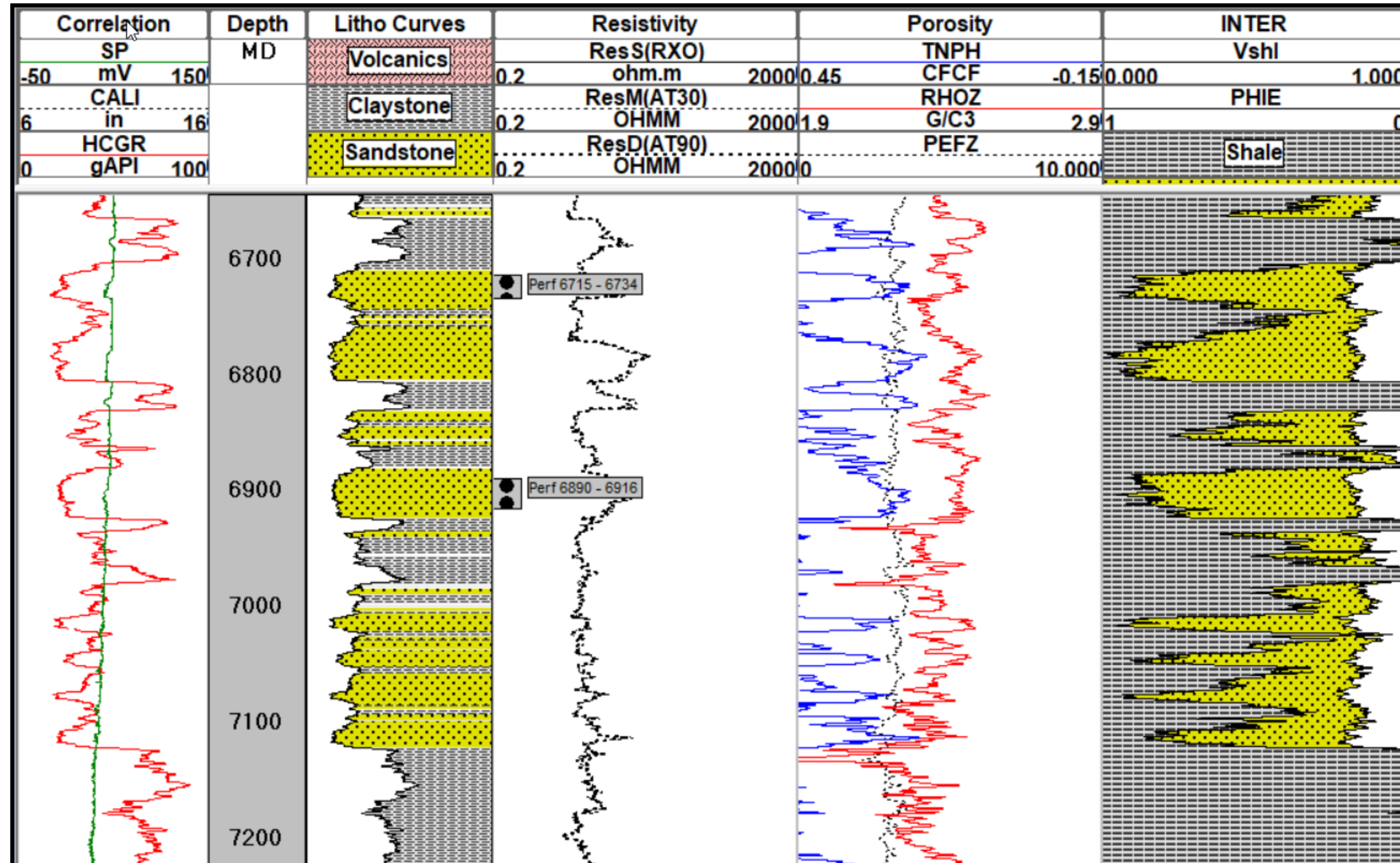
Rio Saldaña – 2 well, lithological interpretation and determination of average porosity values from density and neutron logs. Girardot area.

La Victoria Formation, petrophysics



Samarkanda -1 well. Lower segment of the La Victoria Formation, where production was reported. Porosity 12-19%. Vshale between 20-40%, which should affect permeability. Girardot area.

La Victoria Formation, petrophysics

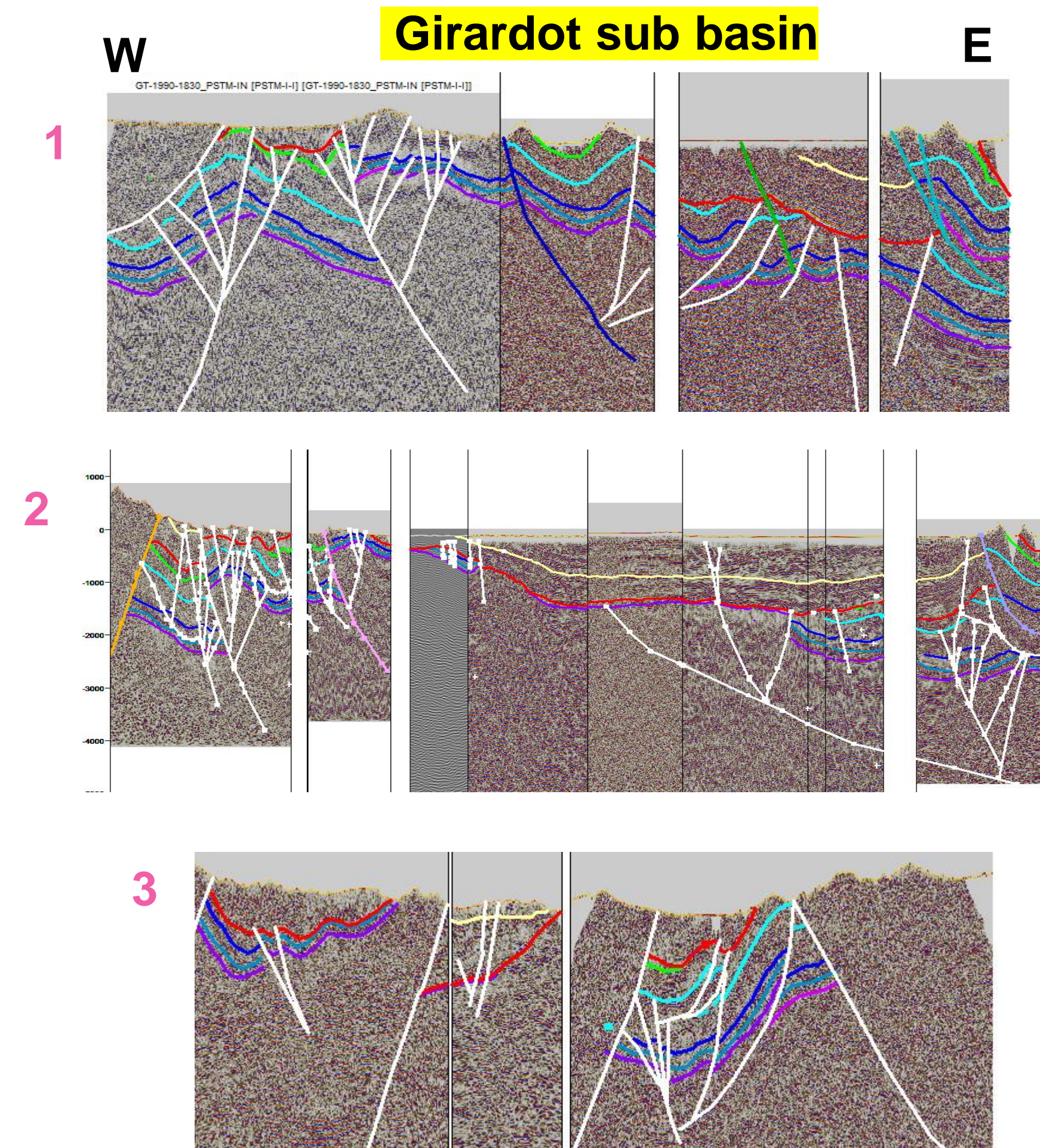
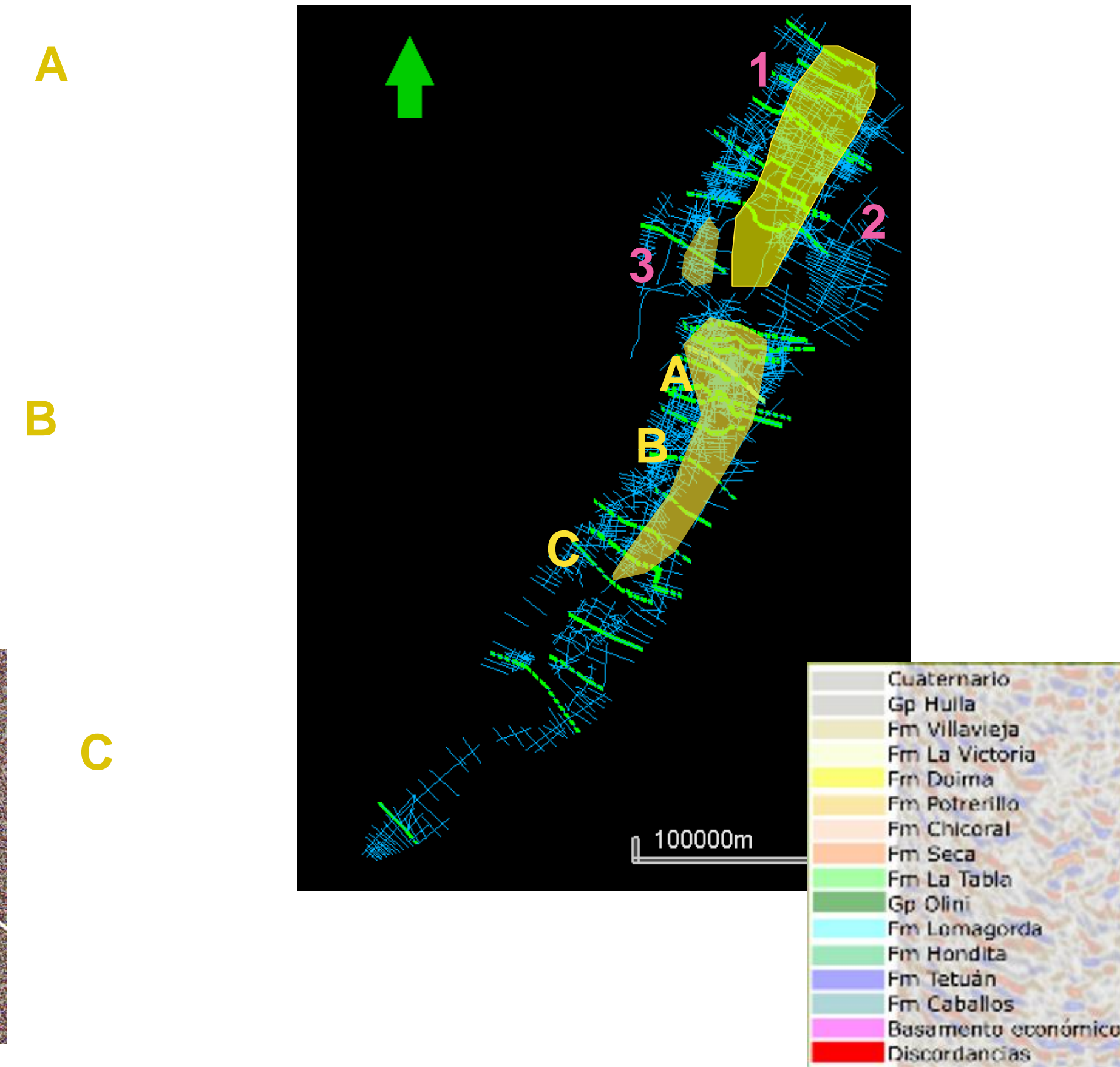
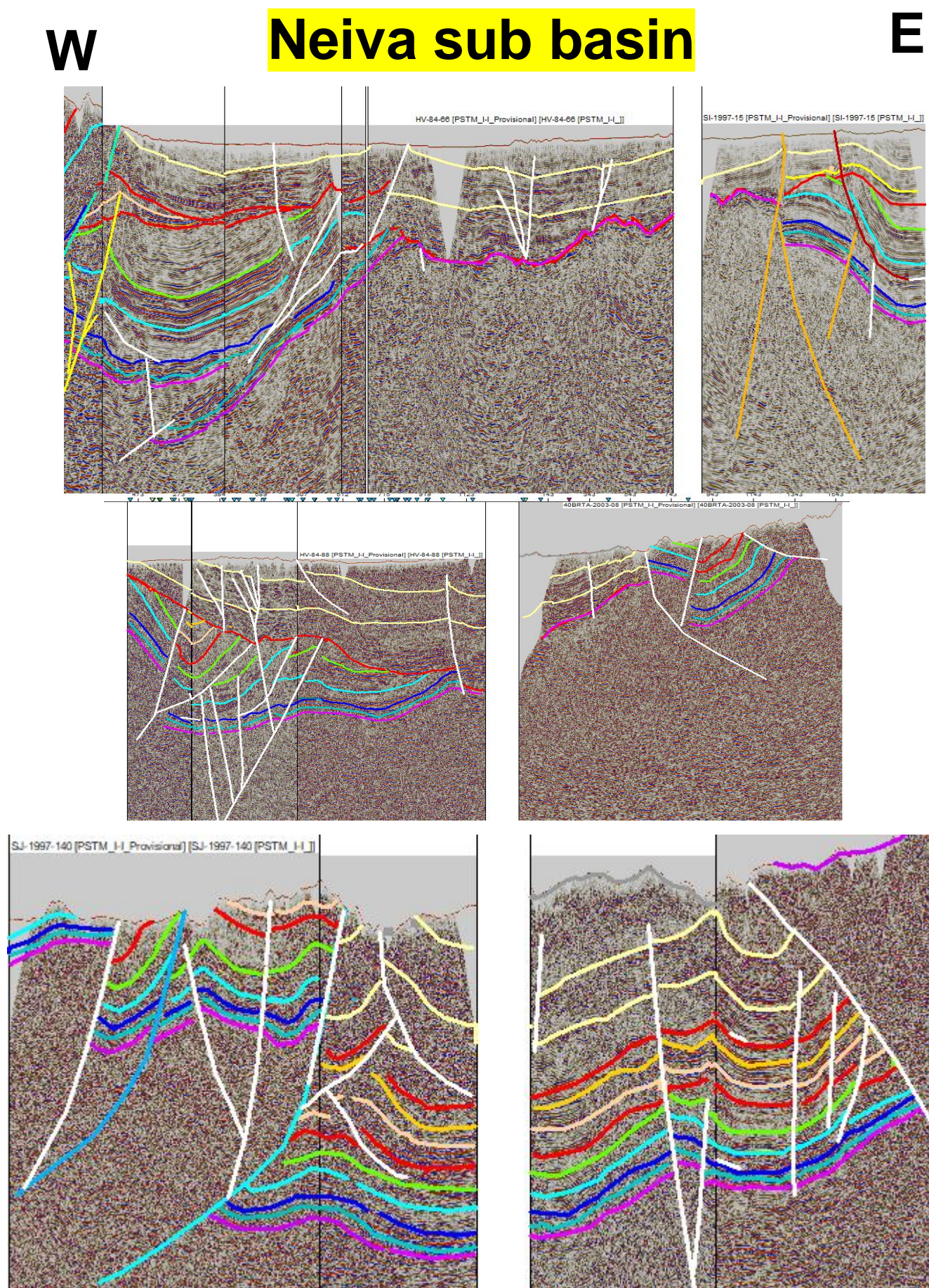


Nunda -1 Well. Lower segment of the La Victoria Formation, where non-commercial production was reported. Porosity 12-24% and Vshale between 0-20%, which should affect permeability. Neiva area.

Play definition in the Honda Group from seismic Interpretation.

1. Seismic sections elaboration

- Elaboration of 27 seismic sections in the Upper Magdalena Basin in order to improve structural component and identify areas of interest.



2. Plays identification

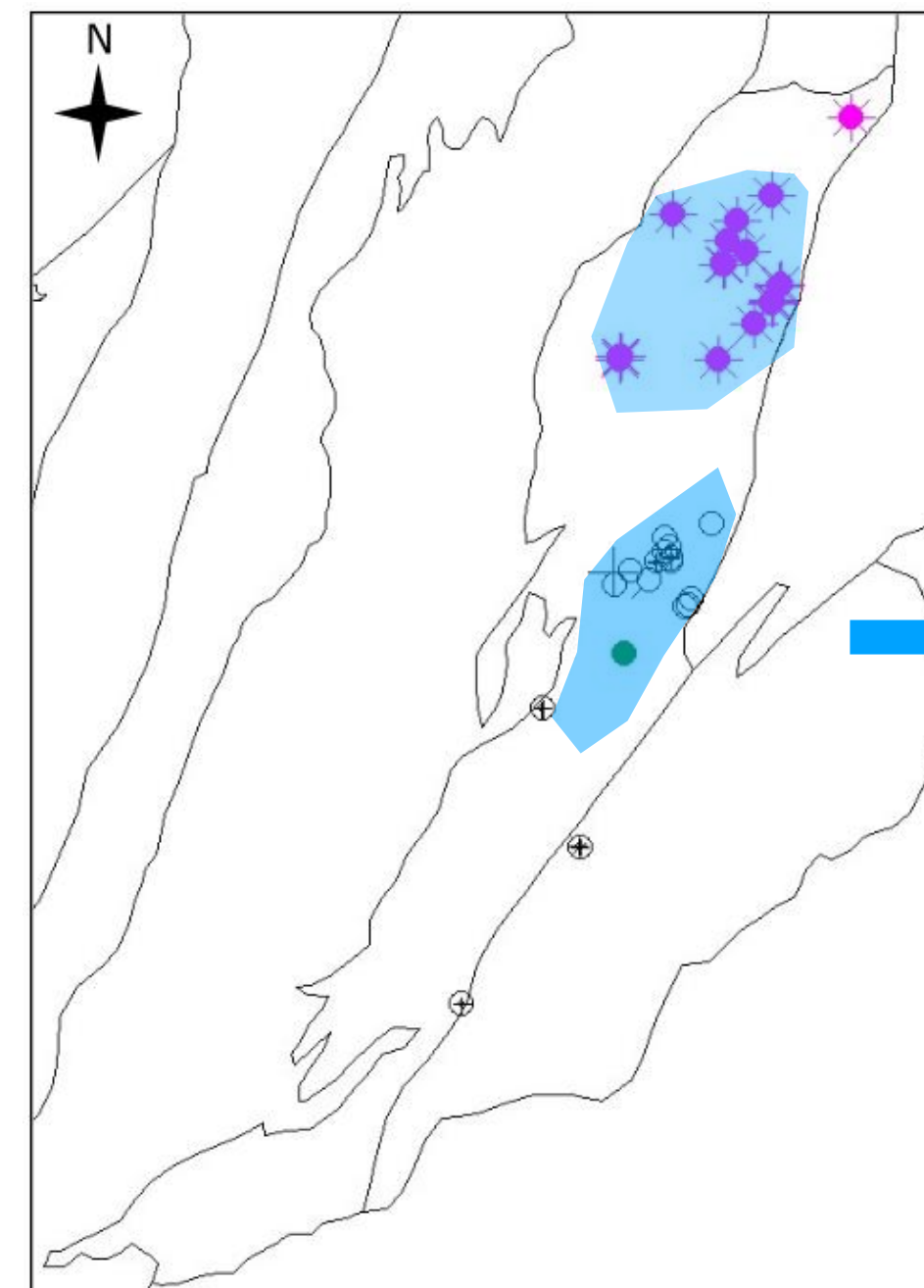
Definition of the area of interest

- From wells information and hydrocarbon shows we improved the selected area of interest.

LISTADO POZOS TRABAJADOS	SUBCUENCA A	REGISTRO DE MANIFESTACIONES DE HIDROCARBUROS					
		Villavieja		La Victoria		La Victoria Basal	
		Intervalo	Tipo	Intervalo	Tipo	Intervalo	Tipo
CACICA-1	NEIVA	--	--	(5856-5885)	(5856-6010)	Gas (máxima concent.) Aceite	(6150-6300) >C1<C2 Y C3
CORINTO-1	NEIVA	N/A	N/A	340'-360', 500'-563', 800', 960'-970'		Manifestaciones de gas (I)	N/A
GAITANA-1	NEIVA	--	--	(6180-6220)-(6320-6340) y (6145-6210)		aceite y gas	(6946-7185) gas
GUANABANA-1	NEIVA	7293		Gas (muy bajas concentraciones)	(7450-13453)	Gas (muy bajas contraciones)	(7450-13453) Gas (muy bajas contraciones)
NUNDA SO-1	NEIVA	2610-2615	G	6738-6766/6856-6864 / 6730-6766		O/G	6971-6980/ 7032-7057 / 7062-7085 G
NUNDA-1	NEIVA	-	-	(6710-6734) (5595-5797)	(6895-6918) (6240-6710)	Aceite Gas C1	<C1<C2Y C3 (7125-7270) <C1<C2Y C3
PALOGRANDE-1	NEIVA	--	--	(1) 2465-2525 (2) 3250 (3)3370-3410 (4)3750-3800 (5)3880-3990 (6)4020 (7)4070 (8)4110 (9)4170-4200 (10)4240-4300 (11)4425 (12)4620	(1, 2, 5, 6, 7, 8, 9, 10, 11, 12)manifestaciones débiles de aceite (3, 4)manifestaciones fuertes de aceite		5960-5980 manifestaciones fuertes de aceite
POLONIA-1	NEIVA	-	-	(3955-3960) (6125-6200)		GyA C1-C2-C3-C4 G C1-C2-C3-C4-C5	(4310-4315) (4450-4455) (4495-4510) G C1-C2-C3-C4-tr C5 GYA C1-C2-C3-C4 G C1-C2-C3-C4
YARUMO-1	NEIVA	--	--	(1)4891-4903 (2)4943-5160 (3)5005-5106 (4)5160-5242 (5)5268	(1)28ppm_gas (2)10ppm_gas (3)485ppm_gas(4)12ppm_gas (5)213ppm_gas		(1)5306-5329 (1)413ppm_gas
DINA T-165	NEIVA			gas c1-c5	gas c1-c5	muy pobre manifestacion HC/ gas c1-c5	muy pobre manifestacion HC/ gas c1-c5 gas c1-c3 gas c1-c3

Examples of the wells with hydrocarbon shows in the Honda group.

Girardot	Neiva
CABALONGA-1	CACICA-1
CALARMA-1	CORINTO-1
CHENCHE-1	GAITANA-1
CHICORAL-1ST	GUANABANA-1
CANELO-1	NUNDA SO-1
GEOPOZOS-1A	NUNDA-1
POSEIDON-1	PALOGRANDE-1
VENTARRON-1	POLONIA-1
ALELI-1	YARUMO-1
OLINI-2	DINA T-165



Primary focus : to identify the main existing plays associated to the Cenozoic Honda Group.

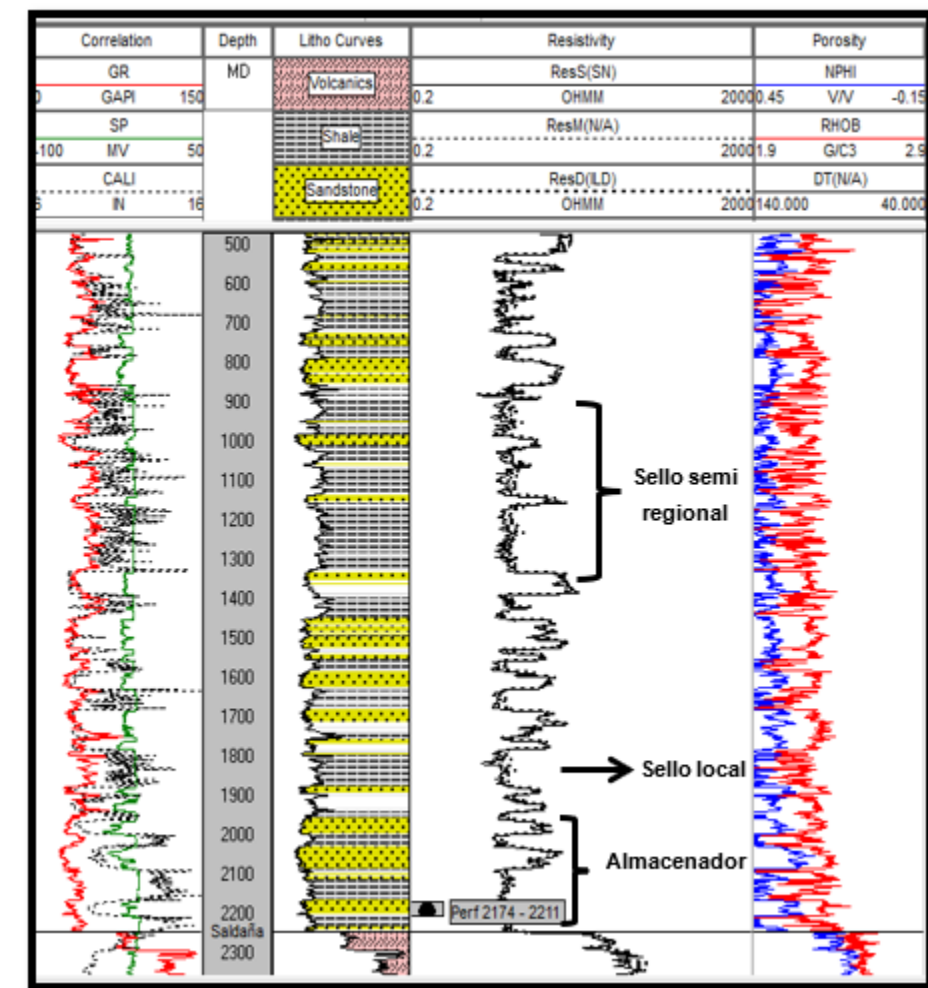
We identified 5 Plays:
- 3 structural
-2 stratigraphic

2. Plays indentification

Play# 1: Associated to valley fill deposit on basement.

Tipo	Estratigrafía	Paleocanales		
Características		Estratigráfico-Asociados a planicie de Inundaciones y paleocanales		
Esquema en planta				
Corte esquemático				
Sistema Petrolífero		Edad de la trampa, Reservorio, Roca madre, Sello, Migración T*		
Periodo/Epoca				
Cenozoico	Cuaternario	Holoceno	Fm Fortalecidas / Mesa / Garzón	
		Pleistoceno		
	Neógeno	Plioceno	Tardío	
		Temprano		
	Mioceno	Tardío	Gr Huila	
		Medio	Gr Honda	
	Oligoceno	Temprano	Fm Tune / Cira	
		Tardío	Fm Doima	
	Paleógeno	Eoceno	Temprano	Fm Potrerillo
			Tardío	
Paleoceno		Medio	Fm Chicoral (Mb Tesalia)	
		Temprano	Fm Chicoral (Mb Bache)	
Cretácico		Tardío	Fm Chicoral (Mb Palermo)	
		Temprano	Fm Seca	
Mesozoico	Tardío	Mastrichtiano	Fm La Tabla	
		Campaniano	Gr Olini	
		Santoniano	Fm Lamagrada	
	Inferior	Turoniano	Fm Hondita	
		Albiano	Fm Tetuan	
		Aptiano	Fm Caballos	
Jurásico		Fm Saldaña		
Ejemplo en el sector				
		Campo Andaluía Sur (OOP 55.94 MBPS)		
Tipo de play y riesgo asociado				
		Estratigráfico-riesgos asociado a la delimitaciones de los canales.		

- Stratigraphic play: Channels or valley fill deposit. Associated to the sandstone at the base of the Victoria Fm which have filled paleotopography of the basement (Formation Saldaña).
- Proven stratigraphic play (Andaluía Sur, Rio Ceibas fields and the non comercial discoveries in the Nunda-1, Nunda SO y Cacica-1 wells).



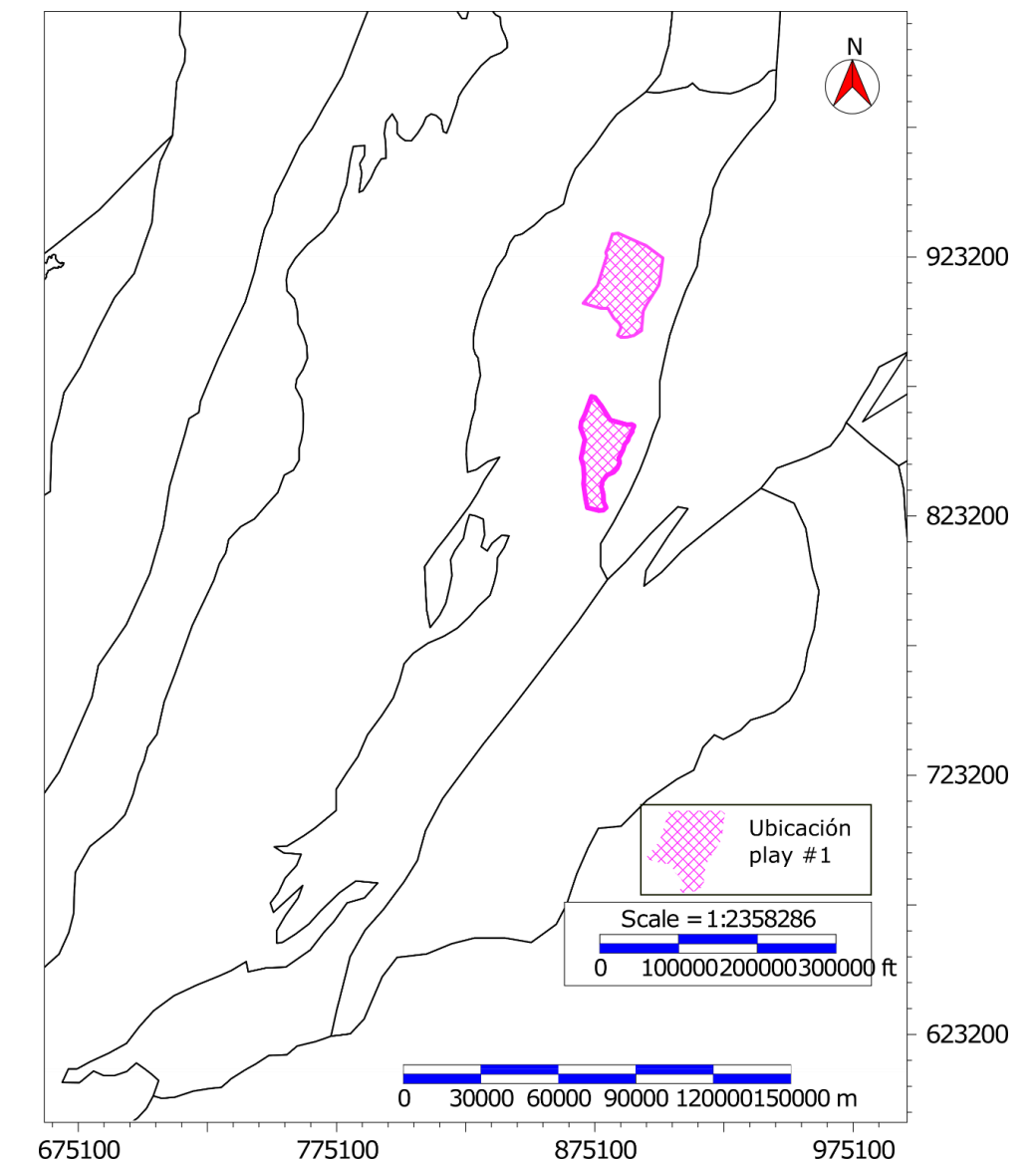
Stratigraphic interpretation of the Andaluía Sur -1 Well (La Victoria Fm)

Location in the Neiva Sub basin

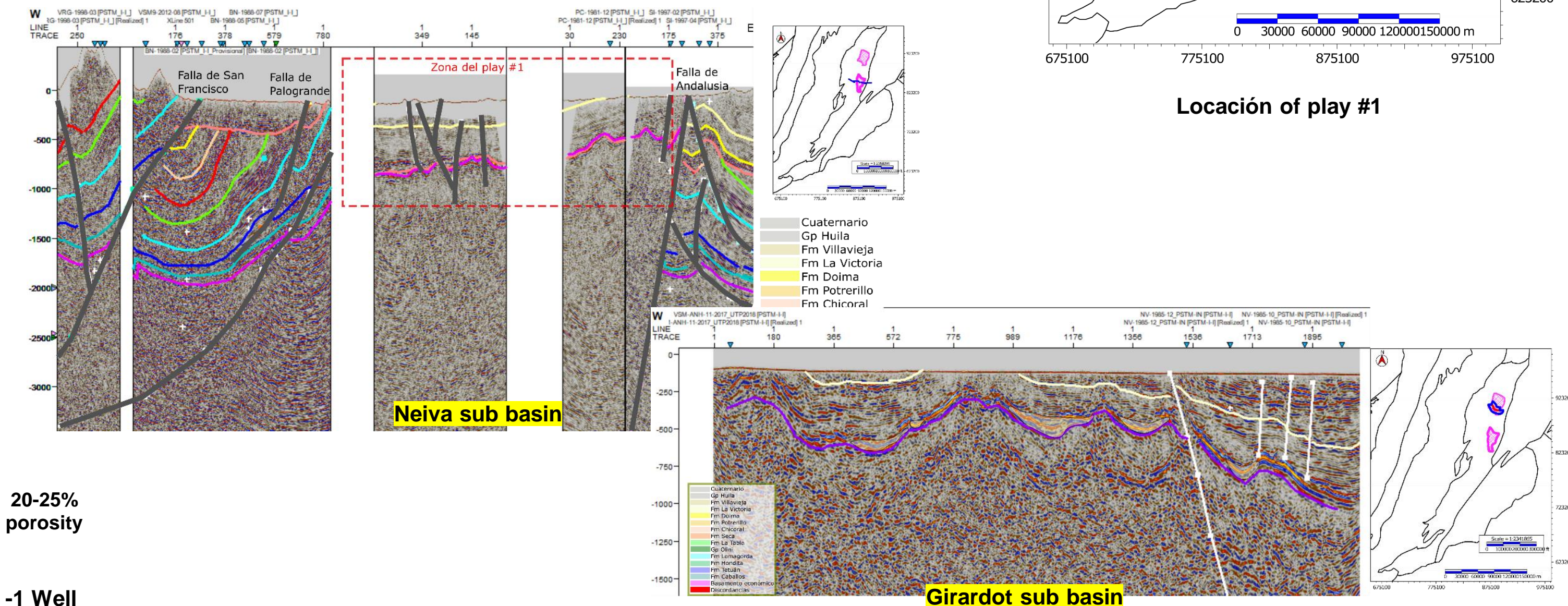
- Between the Andaluía fault (East) and the Palogrande fault (West)
 - Up North, limited by paleo-highs of Natagaima abs Patá.
 - Down south, near the Rio Ceibas -1 well.

Location in the Girardot sub basin :

- At the west of the Prado fault and East of the San Antonio fault.
 - To the south by Natagaima and patá paleo highs.



Locación of play #1



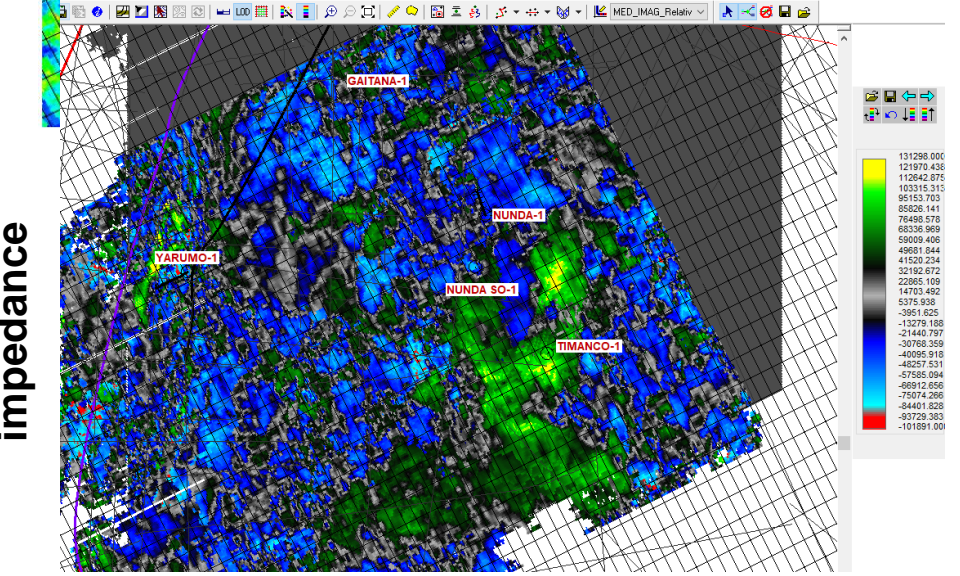
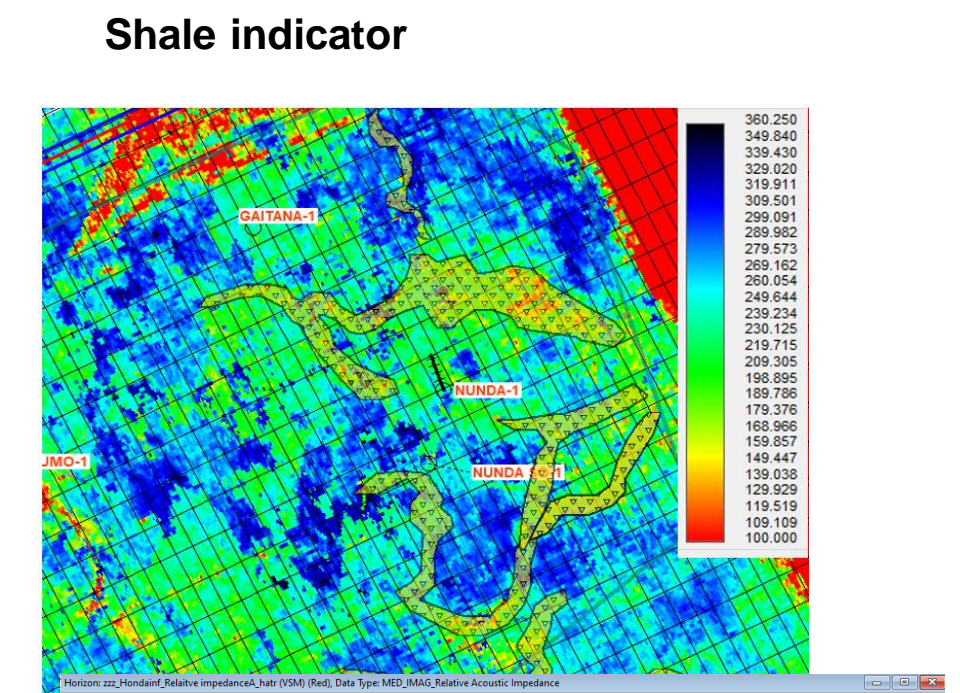
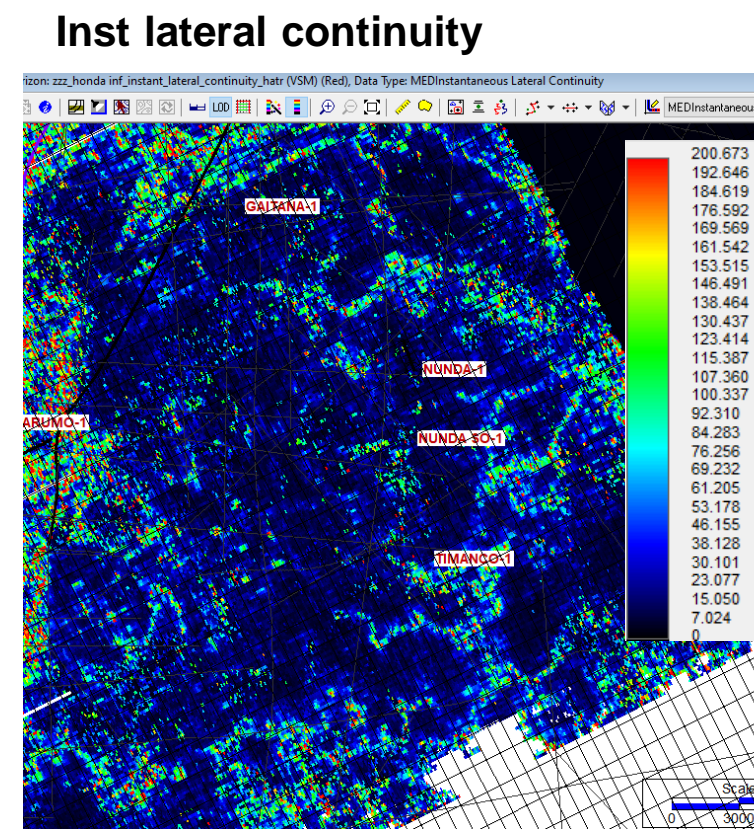
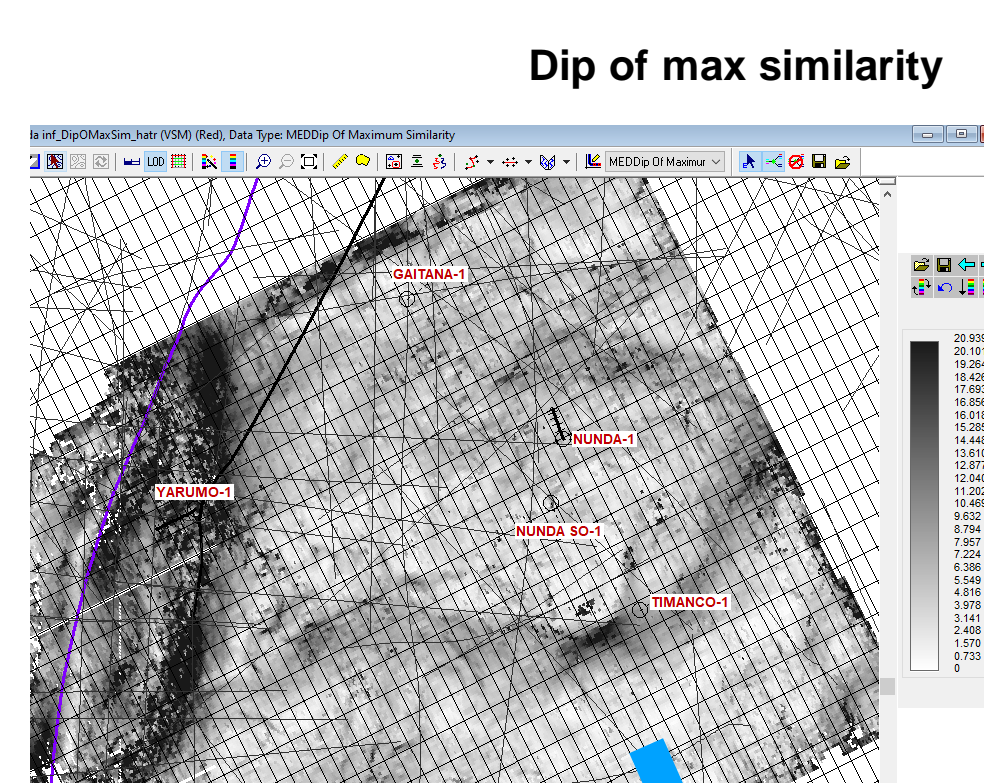
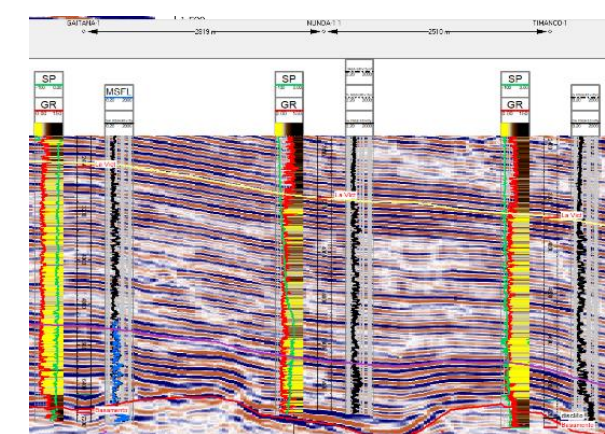
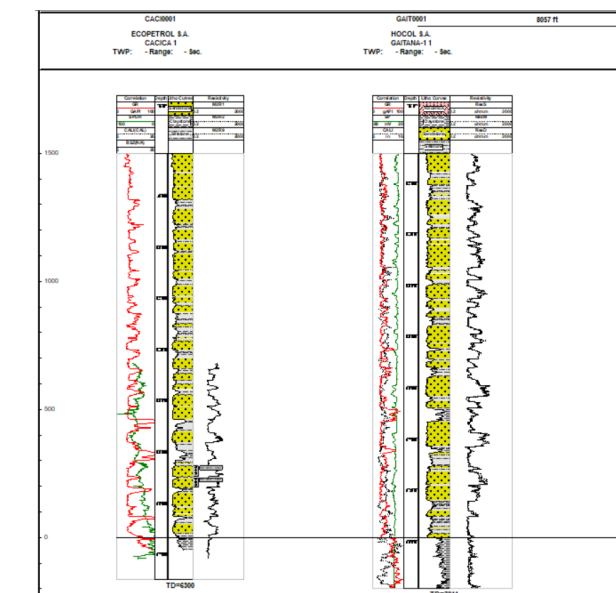
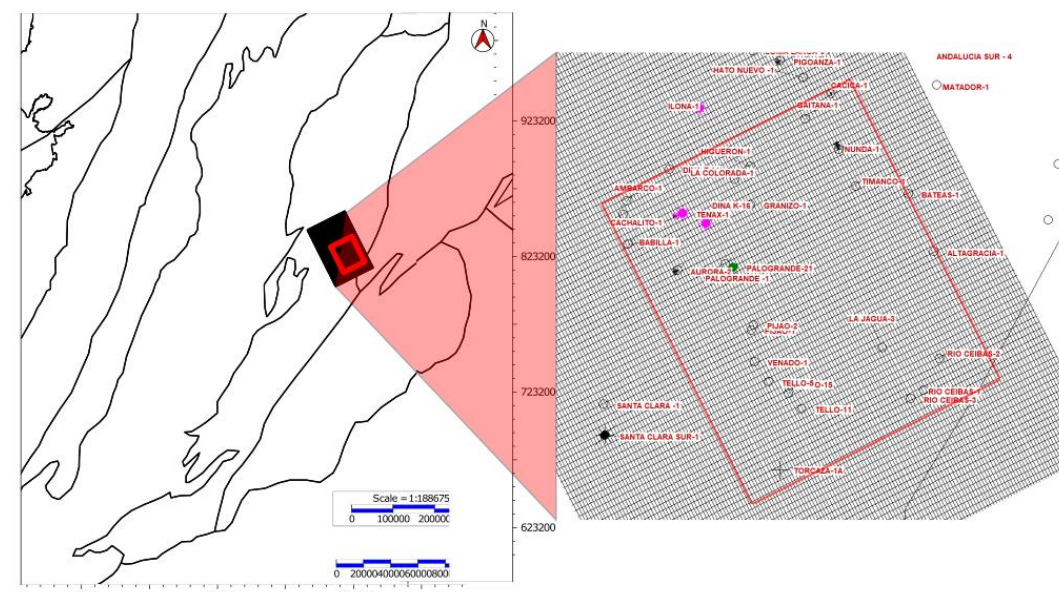
Girardot sub basin

20-25% porosity

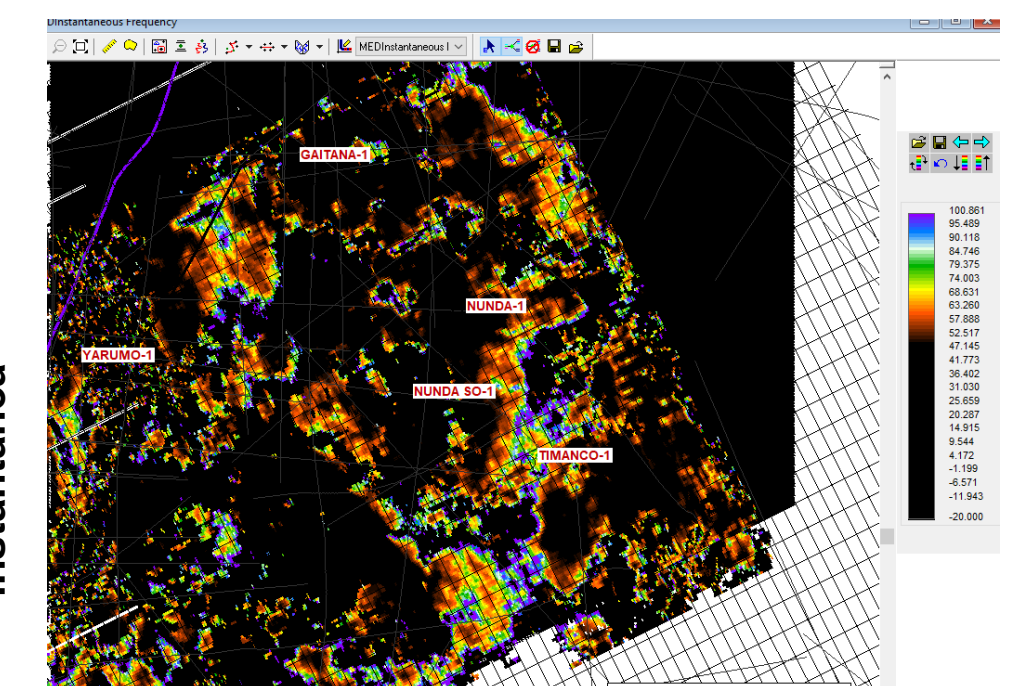
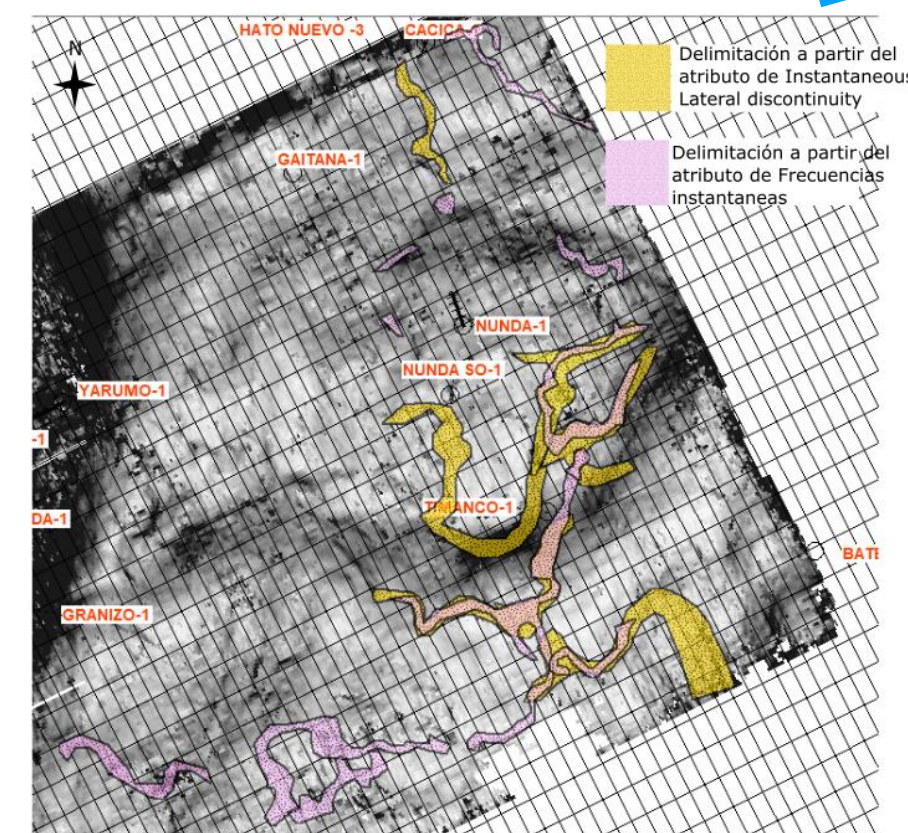
2. Plays indentification

Play# 1: Associated to valley fill deposits over basement.

- From 3D seismic volume Neiva 3D, we generated some seismic attribute in order to try identify channels accumulation.
- We proposed several polygon from the analysis of 5 seismic attributes.



Relative acoustic impedance



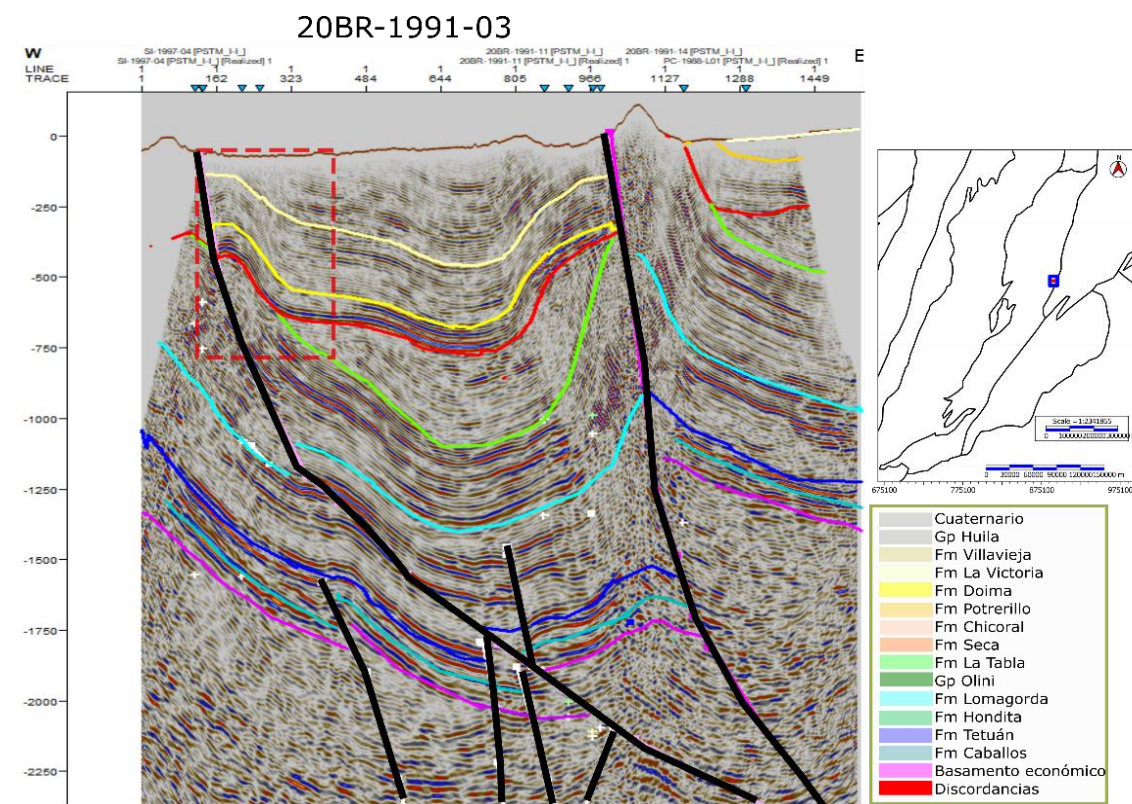
Frecuencia instantanea

Attribute	Depositional Environment	Continuity Discontinuity	Lithology	Fault	Fracture	HC indicador	Porosity
Instantaneous Frequency	X		X		X	X	
Relative Acoustic (Impedance)		X	X				X
Dip of Maximum Similarity	X			X			
Instantaneous Lateral Continuity	X	X		X	X		
Shale Indicator	X		X				

2. Plays indentification

Play# 2: Reverse drag fold in the La Victoria Formation.

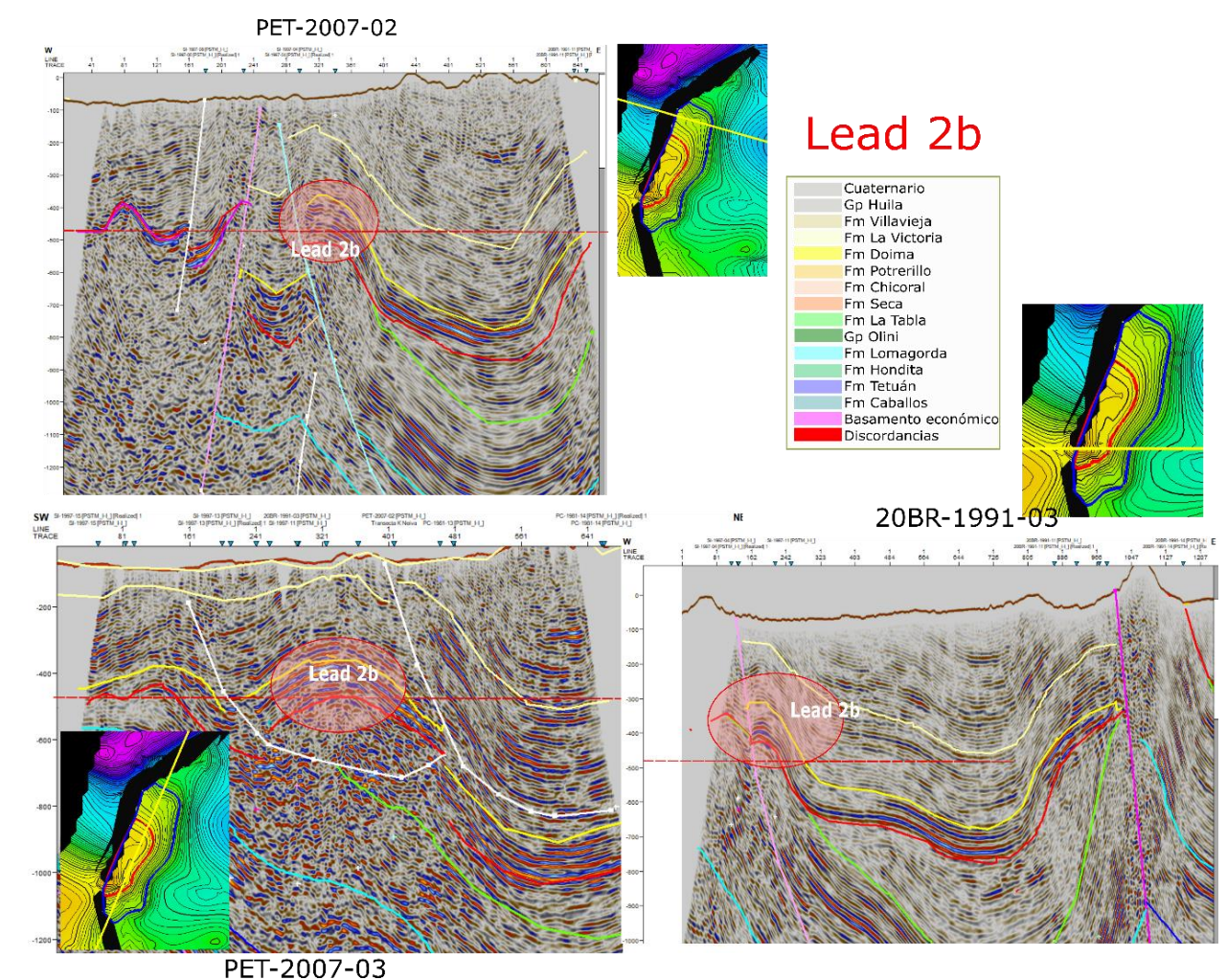
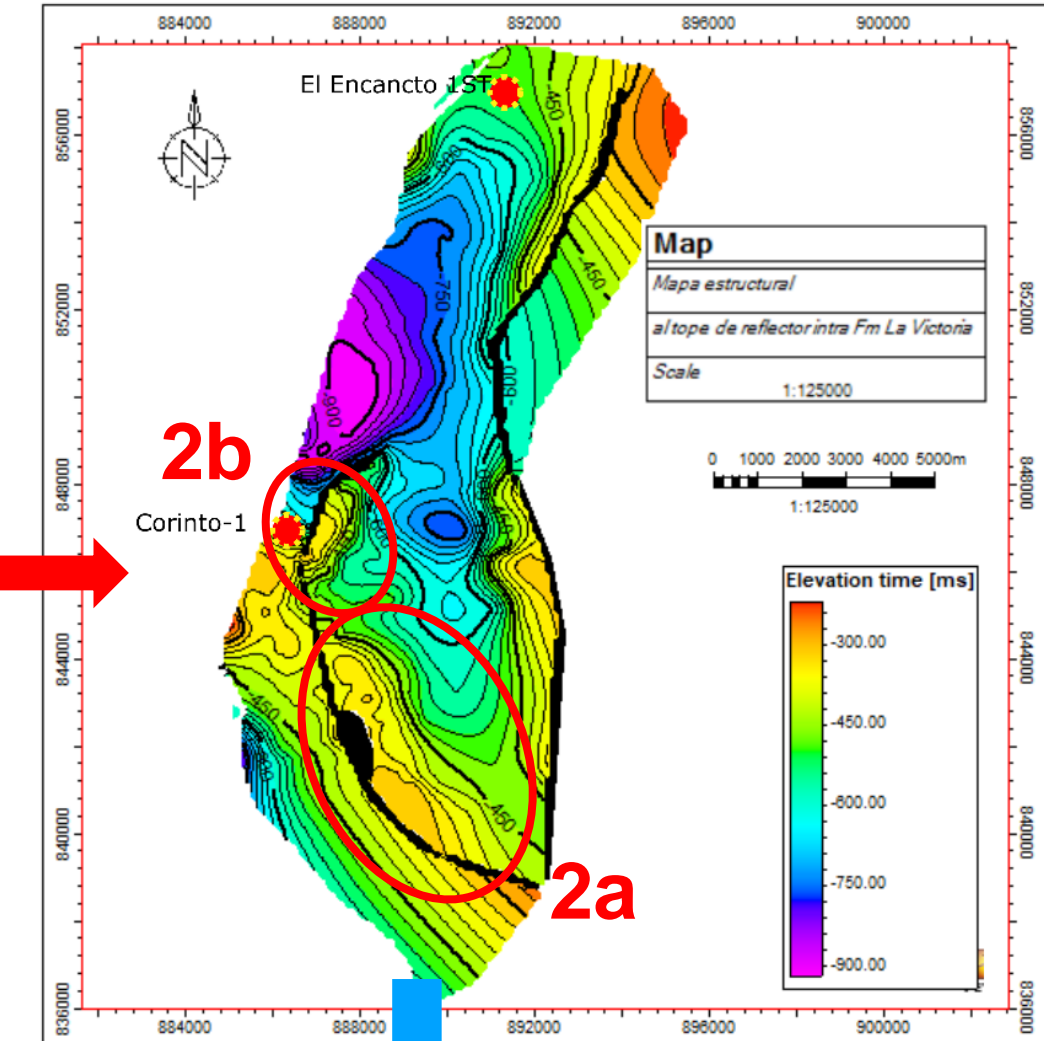
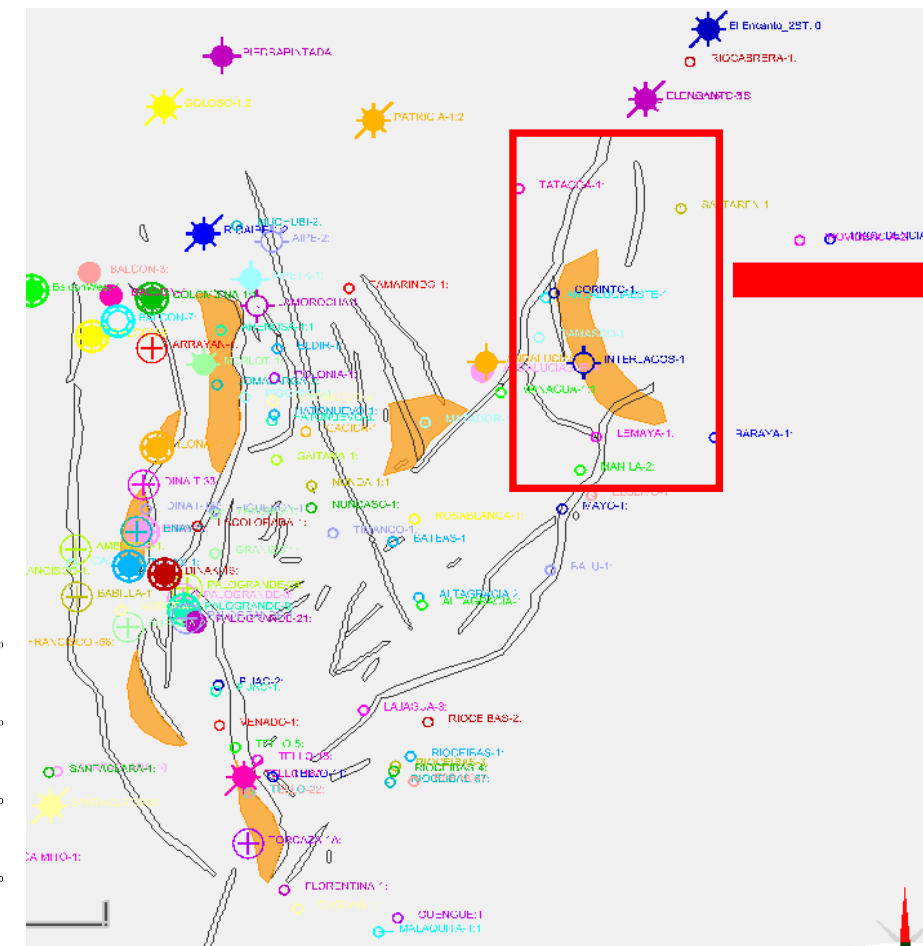
Structural play related to an anticline drag fold in the hanging wall of a reverse fault in the La Victoria fm.
La Jagua field is the most representative field of this kind.



Location in Neiva sub-basin:

- Associated to west vergence system thrust as the Baraya fault. (shortcut fault)
- Associated to the thrust propagation fold of the imbricated system thrust near the Dina, Brisas y Tello fields.

IDENTIFICATION of 2 Leads : 2a y 2b



The estimate of the potential of prospective resources in lead 2a, is a P50 of 44.6 mbpe (million barrels of oil equivalent) and 2b is a P50 of 8.1 mbpe.

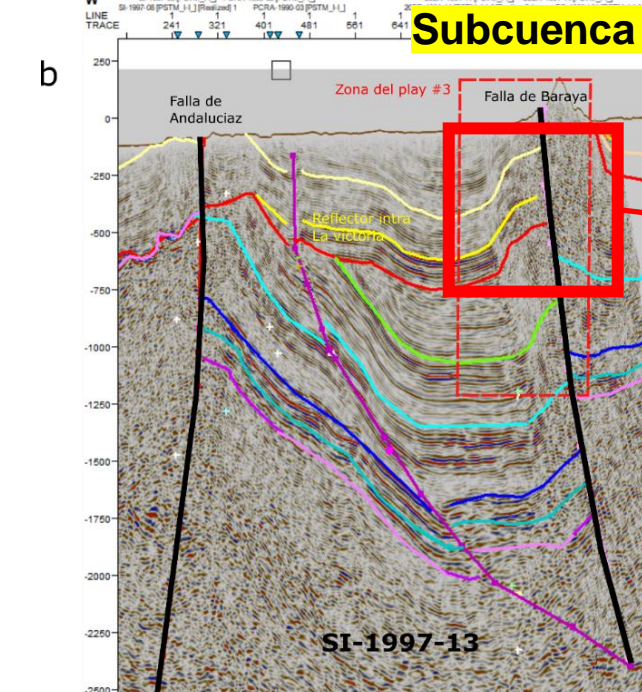
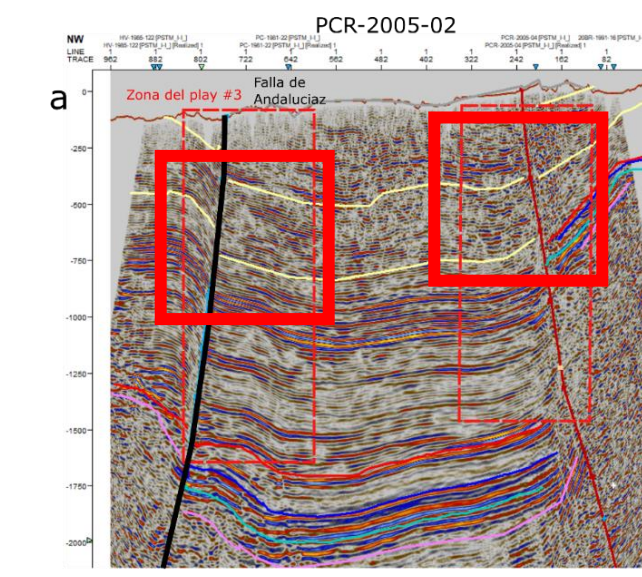
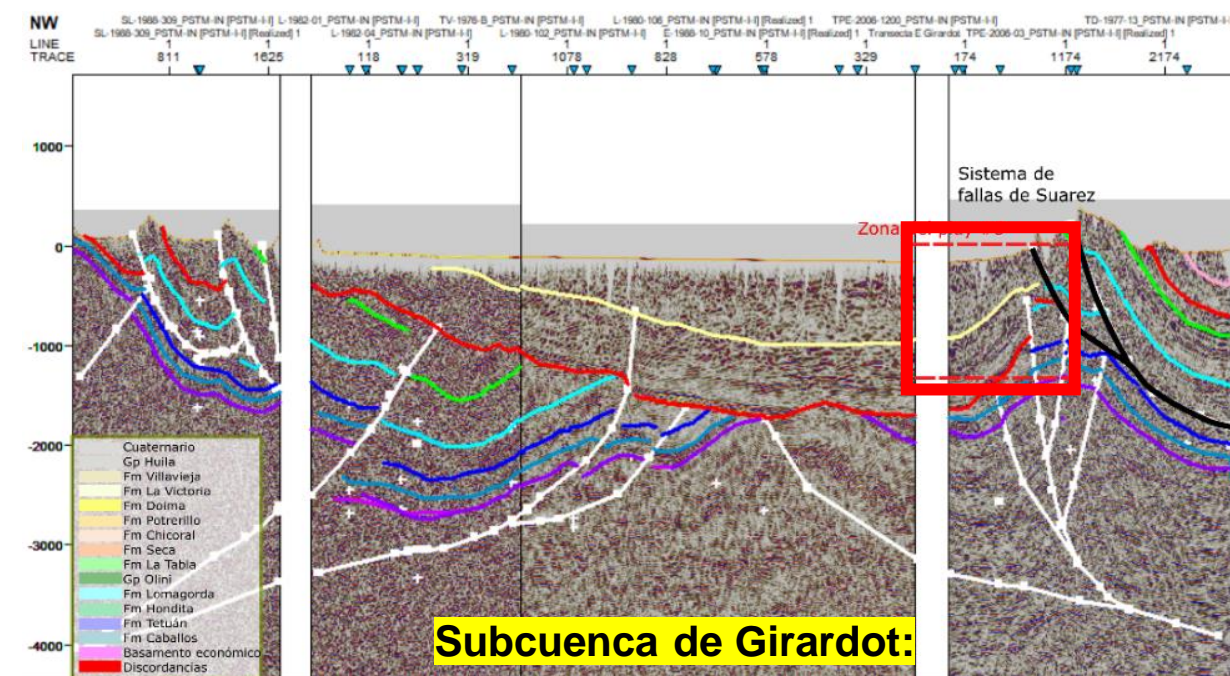
Tipo	Estratigrafía	Anticlina de arrastre		
Características		Estructural - compresional - cierre contra falla.		
Esquema en planta				
Corte esquemático				
Sistema Petrolífero		Edad de la trampa Reservorio Roca madre Sello Migración T		
Periodo/Epoca				
Cenozoico	Cuaternario	Holoceno	Fm Fortalecillas / Mesa / Garzón	
		Pleistoceno		
	Neogeno	Plioceno	Tardío	Gr Huila
			Temprano	
		Medio	Gr Honda	
	Paleogeno	Mioceno	Tardío	Fm Tune / Cira
			Temprano	Fm Doima
		Oligoceno	Tardío	Fm Potrerillo
	Paleoceno	Eoceno	Medio	Fm Chicorla (Mb Tesalia)
			Temprano	Fm Chicorla (Mb Bache)
Paleoceno		Tardío	Fm Chicorla (Mb Palermo)	
		Temprano	Fm Seca	
Mesozoico	Cretácico	Mastrichtiano	Fm La Tabla	
		Campaniano	Gr Olini	
		Santoniano	Fm Lomasgorda	
	Inferior	Turoniano	Fm Hondita	
		Cenomaniano	Fm Tetuán	
		Albiano	Fm Caballos	
Jurásico	Aptiano	Fm Yavi		
Jurásico		Fm Saldaña		
Ejemplo en el sector		La Jagua		
Tipo de play y riesgo		Estructural riesgos asociado al caracter sellante de la falla		

2. Plays indentification

Play # 3: Monocline /Anticline in the footwall of reverse fault.

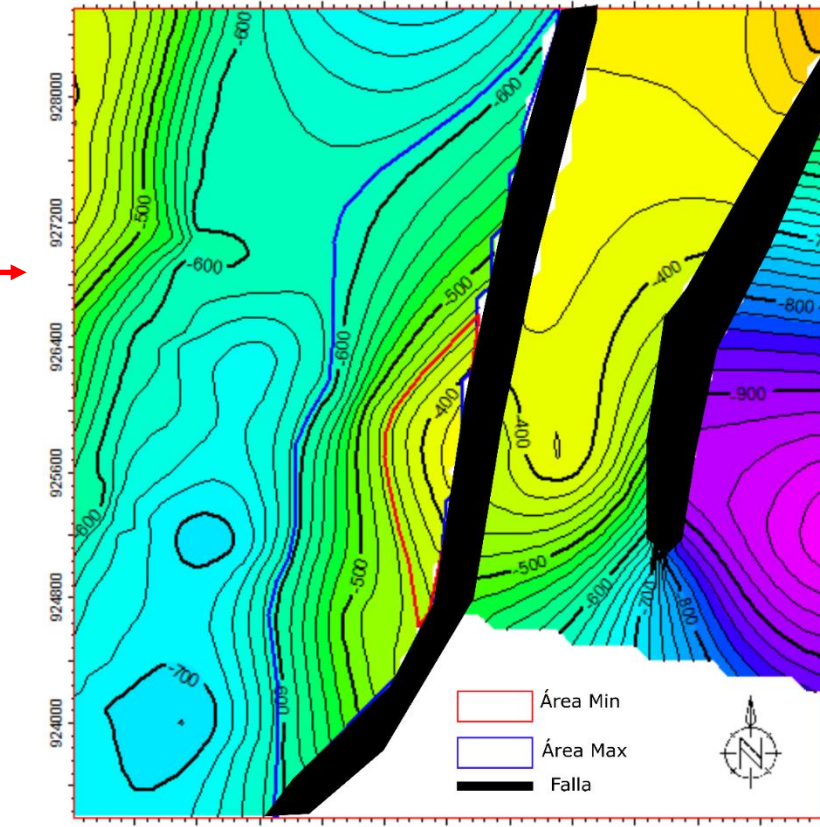
Tipo	Estratigrafía	Monoclinal-anticlina en bloque yacente de falla inversa		
Características		Estructural		
Esquema en planta				
Corte esquemático				
Sistema Petrolífero		Edad de la trampa, Reservorio, Roca madre, Sello, Migración T*		
Periodo/Epoca				
Cenozoico	Cuaternario	Holoceno		
		Pleistoceno	Fm Fortalecillas / Mesa / Garzón	
		Tardío		
	Plioceno	Tardío		
		Medio	Gr Huila	
		Temprano	Gr Honda	
	Mioceno	Temprano	Fm Tune / Cira	
		Tardío	Fm Doima	
		Medio		
	Oligoceno	Temprano	Fm Potrerillo	
		Tardío		
		Medio	Fm Chicoral (Mb Tesalia)	
	Eoceno	Temprano	Fm Chicorla (Mb Bache)	
		Tardío	Fm Chicoral (Mb Palermo)	
Medio				
Paleoceno	Temprano	Fm Seca		
	Tardío			
	Medio			
Mesozoico	Mastriaciano		Fm La Tabla	
			Gr Olini	
	Tardío	Campaniano		Fm Lomagorda
		Santoniano		Fm Hondita
		Coniaciano		Fm Tetuan
		Turoniano		Fm Caballos
	Inferior	Albiano		Fm Yavi
		Aptiano		Fm Saldaña
	Jurásico			
	Ejemplo en el sector			
Tipo de play y riesgo		Estructural- riesgos asociado al sello efectivo de la falla y calidad de reservorio.		

- Structural Play related to monocline / anticline in footwall of reverse fault.
- This structure is located most of all in the footwall of regional fault that limits the basin in its Eastern Edge
- **Neiva sub basin** : associated to the de Baraya/ Garzón Algeciras reverse fault and also the Andalucía fault.
- **Girardot sub basin**: the play is present all along the strike of Prado / Suarez system faults.

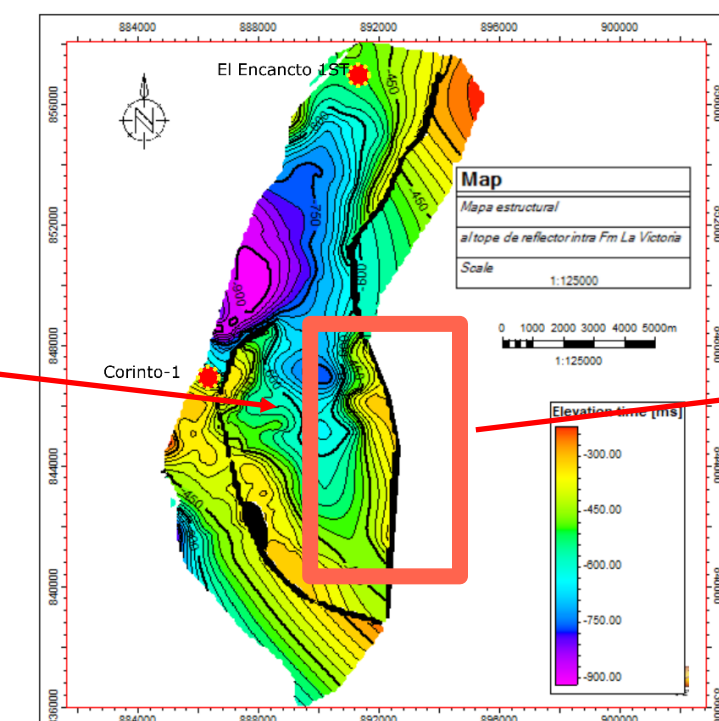
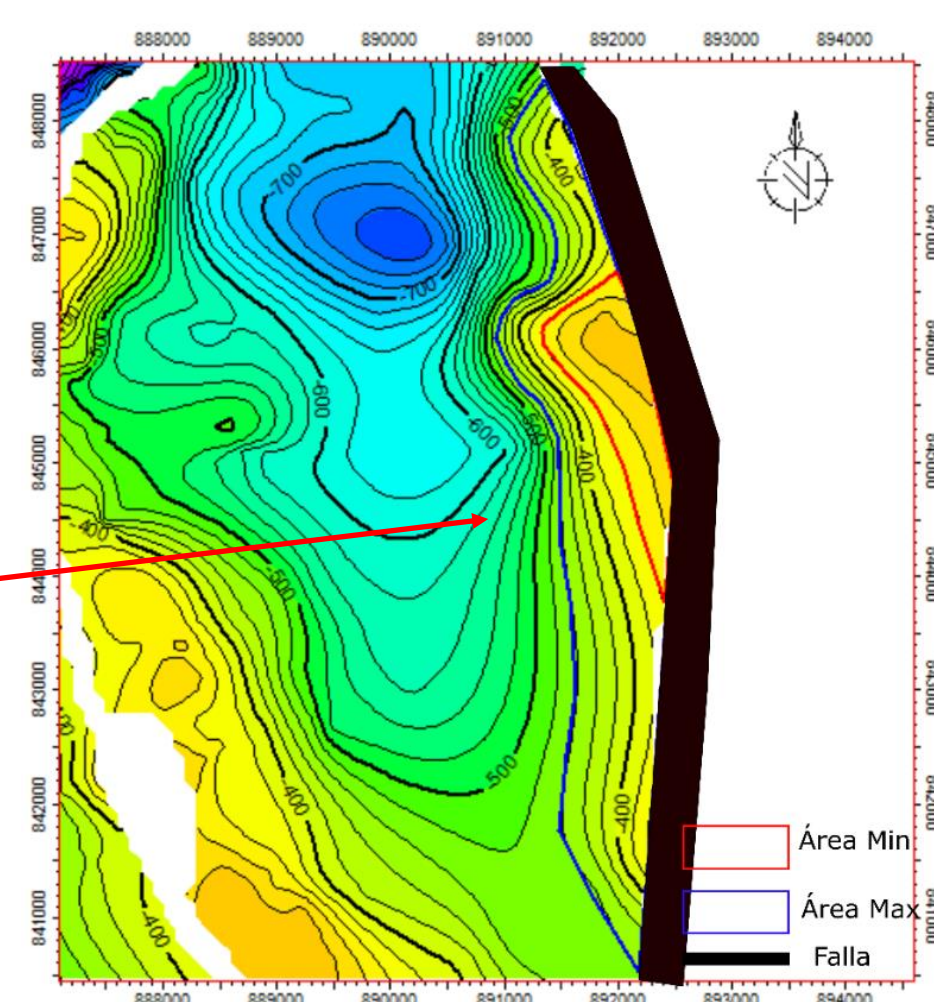


IDENTIFICATION OF 2 Leads : 3a y 3b

Lead 3b



Lead 3a



2. Plays identification

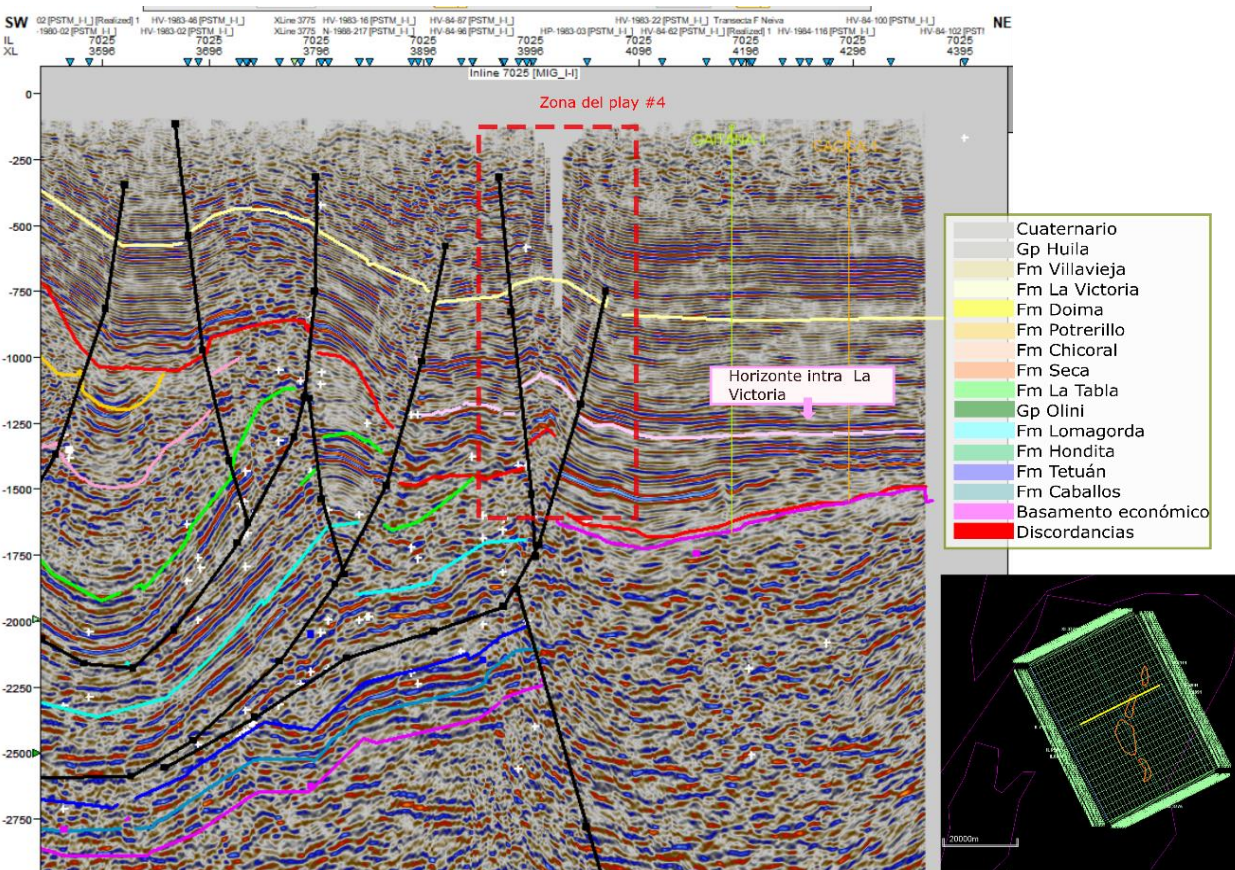
Play # 4: Anticlines with 2 ways closures due to reverse fault and backthrust.

Tipo	Estratigrafía	Anticline and back thrust		
Características		Estructural		
Esquema en planta				
Corte esquemático				
Sistema Petrolífero		Edad de la trampa, Reservorio, Roca madre, Sello, Migración T*		
Periodo/Epoca				
Cenozoico	Cuaternario	Holoceno		
		Pleistoceno	Fm Fortalecillas / Mesa / Garzón	
	Neógeno	Plioceno	Tardío	Gr Huila
			Temprano	Gr Honda
		Mioceno	Temprano	Fm Tune / Cira
	Paleógeno	Oligoceno	Tardío	Fm Doima
			Temprano	Fm Potrerillo
		Eoceno	Medio	Fm Chicoral (Mb Tesalia)
			Temprano	Fm Chicoral (Mb Bache)
			Tardío	Fm Chicoral (Mb Palermo)
Mesozoico	Paleoceno	Temprano	Fm Seca	
		Tardío	Mastriaciano	Fm La Tabla
			Campaniano	Gr Olini
	Cretácico	Tardío	Coniaciano	Fm Lomagorda
			Turoniano	Fm Hondita
		Inferior	Albiano	Fm Tetuan
			Aptiano	Fm Caballos
Jurásico			Fm Saldaña	
Ejemplo en el sector				
Tipo de play y riesgo		Riesgos asociados al sello efectivo de las fallas.		

- Anticline structural play closed in two directions by reverse faults and back thrust (opposite vergence).

- **Neiva sub basin;** In the imbricate system thrust area
- In this north-central zone of the Neiva sub basin, it was reported that the wells Higuéron-1, Yarumo-1, La Colorada-1 and Polonia-1 all present shows of hydrocarbon in the La Victoria Formation, whereby there is evidence of an effective migration in this sector for the Honda Group.

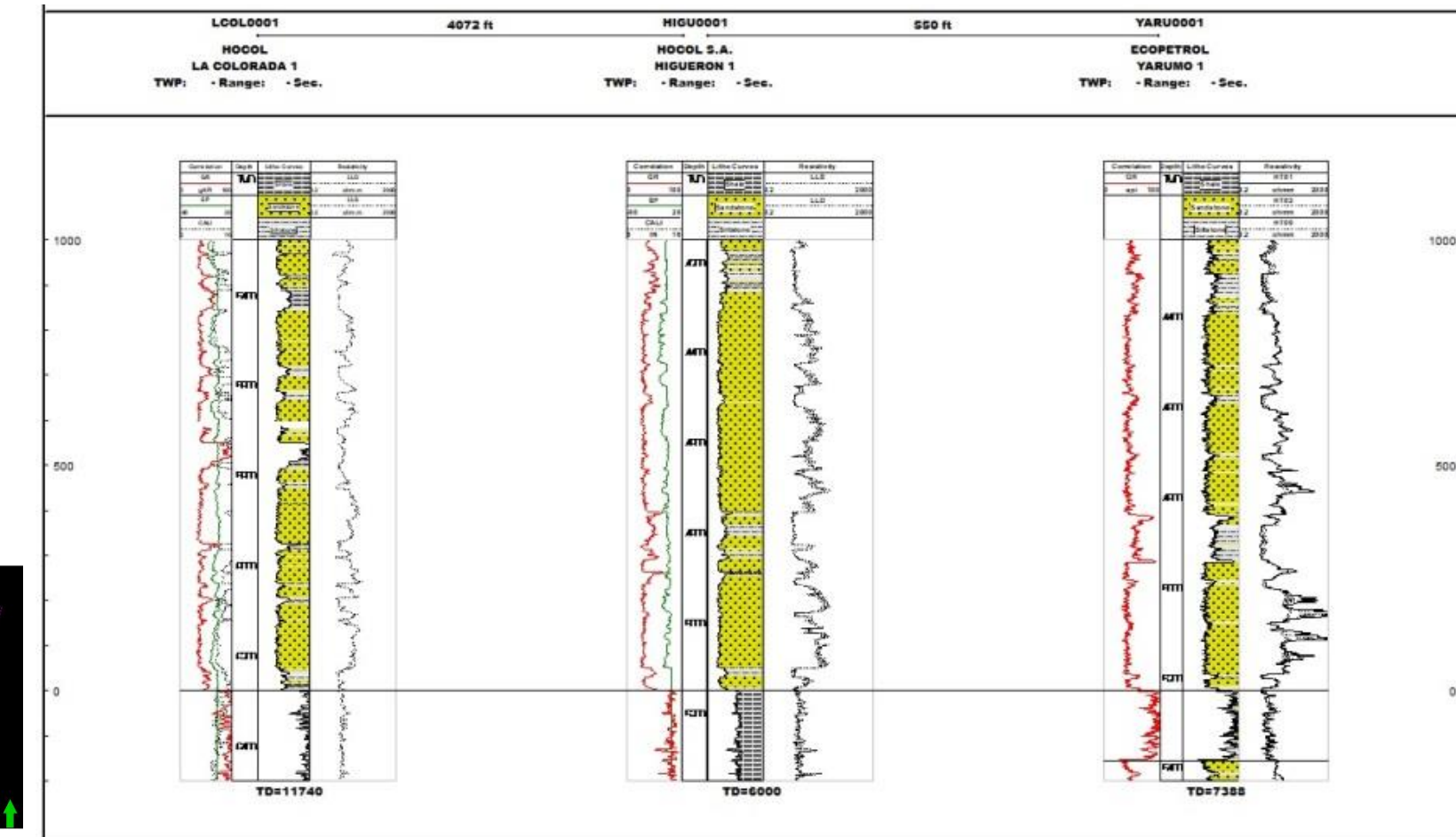
Subcuenca de Neiva:



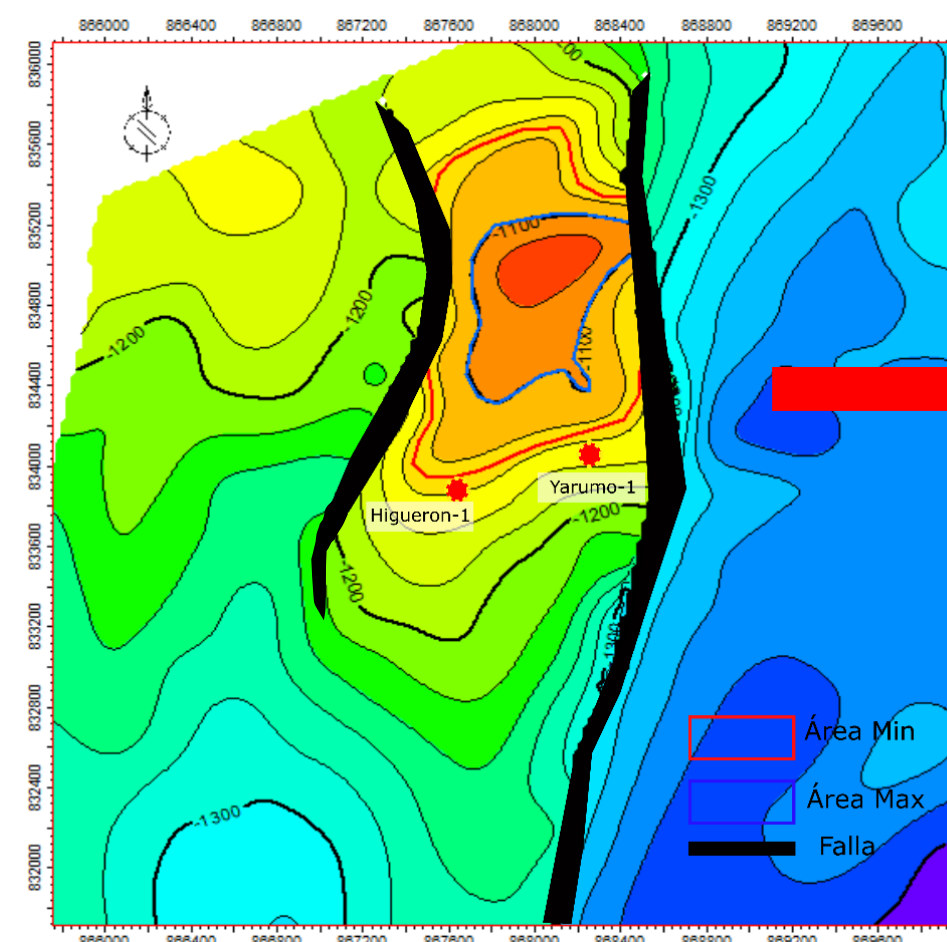
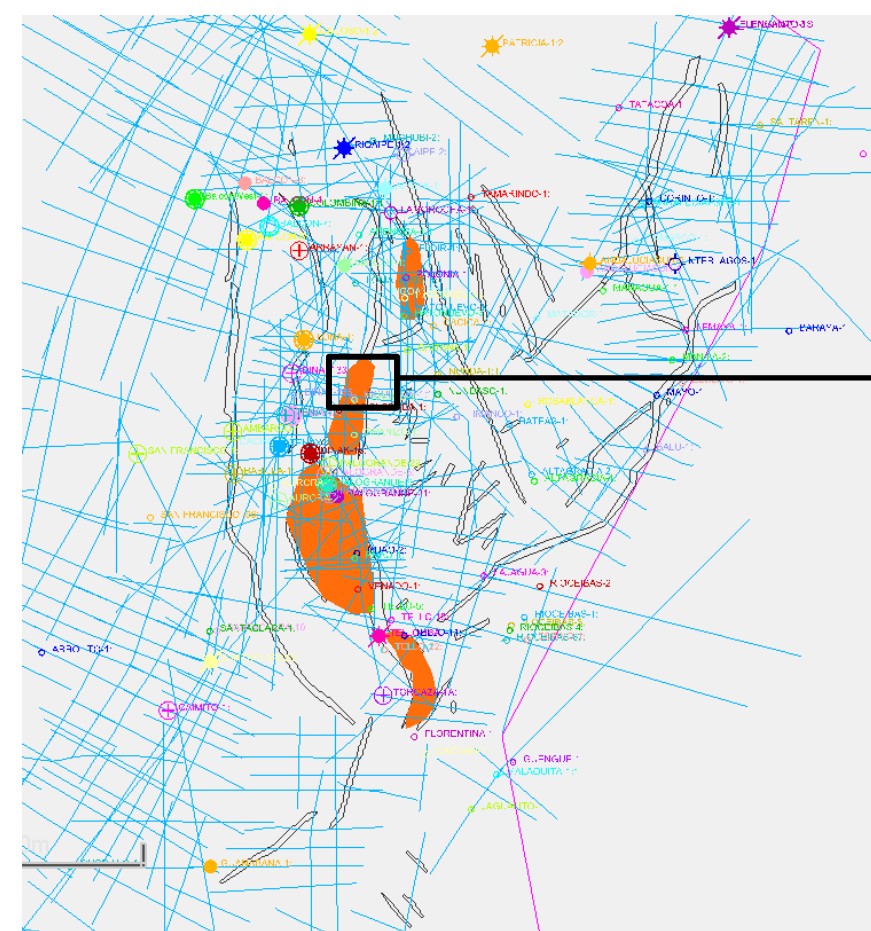
La colorada -1

Higuéron-1

Yarumo-1



Lead 4a



The estimate of the potential of prospective resources in the lead, is a P50 of 10.8 mbpe (million barrels of oil equivalent).

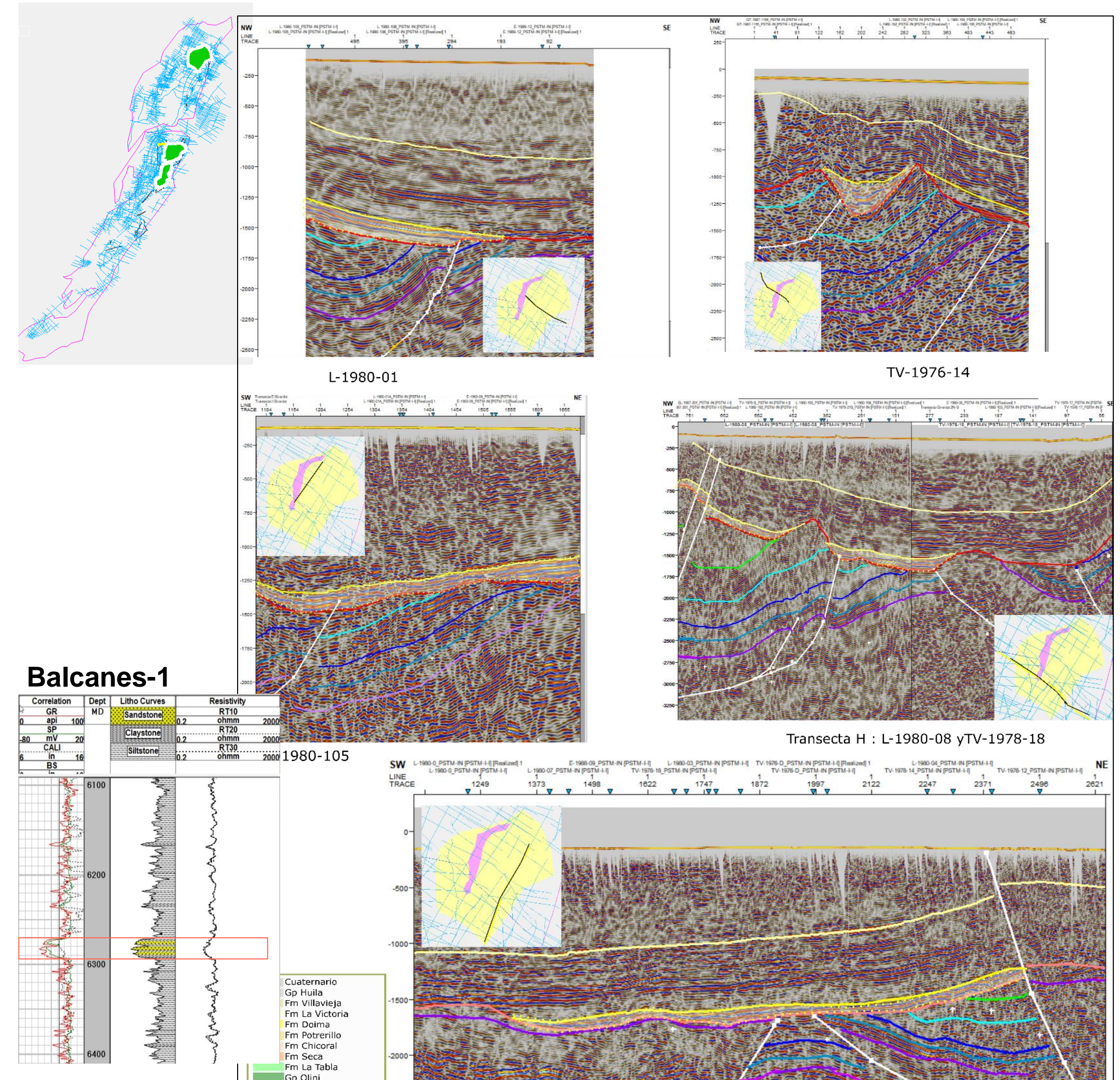
NORTE HIGUERON					
	P10	P50	P90	Media	Relación
AREA	120	200	352	200	2.9
ESPOSOR	60	80	100	80	1.7
POROSIDAD	0.15	0.18	0.15	0.18	1.0
FACTOR GEOMETRICO	0.75	0.85	0.95	0.85	1.3
So	0.6	0.65	0.7	0.65	1.2
Fv	1.1	1.14	1.18	1.14	1.1
FR	0.15	0.25	0.35	0.25	2.3

2. Plays identification

Play #5 Onlap on regional unconformity.

Subcuenca de Girardot:

- Stratigraphic play related to deposition: *onlap* of the la Victoria formation reflectors on cretaceous formations through an erosive surface (middle Miocene unconformity).
- **Girardot sub-basin**: in the central part between the Suarez fault to the East and Cucuana fault to the West
- **Neiva sub-basin** in the northeast sector in some isolated areas in the imbricated thrusts sector and the Andalusia fault.



Tipo		Estratigrafía	Acuñamiento sobre discordancia regional	
Características			Estratigráfico	
Esquema en planta				
Corte esquemático				
Sistema Petrolífero			Edad de la trampa, Reservorio, Roca madre, Sello, Migración T*	
Periodo/Epoca				
Cenozoico	Cuaternario	Holoceno	Fm Fortalecillas / Mesa / Garzón	
		Pleistoceno		
		Tardío		
	Neogene	Plioceno		
		Mioceno	Gr Huila, Gr Honda, Fm Tune / Cira	
		Temprano		
	Paleogeno	Oligoceno	Tardío	Fm Daíma
			Temprano	Fm Potrerillo
		Eoceno	Medio	Fm Chicoral (Mb Tesalia)
			Temprano	Fm Chicoral (Mb Bache)
Paleoceno		Tardío	Fm Chicoral (Mb Palermo)	
		Temprano	Fm Seca	
Mesozoico	Cretácico	Mastrichtiano	Fm La Tabla	
		Campaniano	Gr Olini	
		Santoniano		
		Coniaciano	Fm Lomagorda	
		Turoniano	Fm Hondita	
	Inferior	Albiano	Fm Tetuan	
			Fm Caballos	
		Aptiano	Fm Yavi	
	Jurásico		Fm Saldaña	
	Ejemplo en el sector			Riesgos asociado al sello efectivo de las intercalaciones y a la delimitaciones del acuñamiento.
Tipo de play y riesgo				

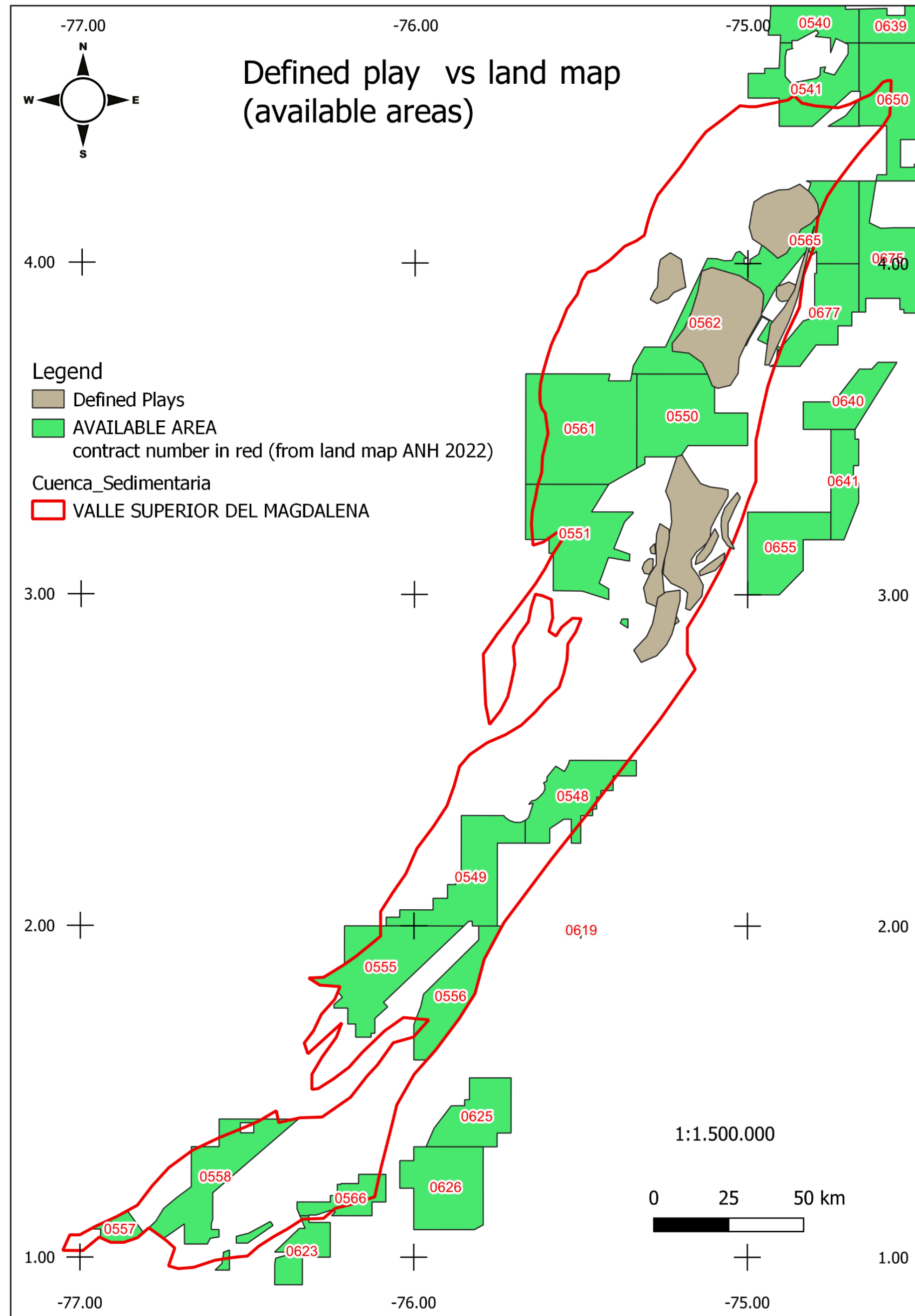
2. Conclusions

PLAYS

- 5 plays.
- 2 are stratigraphic, one associated with the filling of paleo-channels and the other with a onlap on regional discontinuity. These are the plays with the largest area in the basin, although they are the **ones with the highest associated risk related to their delimitation since a large part of these sectors are only covered by 2D seismic.**
- For the Play #1, the preliminary work with seismic attributes needs further investigation.
- In this work, the study focused on the sectors where evidence of hydrocarbons in wells was recorded. However, it is recommended in future works to extend this same exercise to other areas with good 3D or 2D seismic coverage.

LEADS

- **The synchronism of all the leads is positive** because the structures that make up the closures are reverse faults that affect the Honda and Huila Groups, whereby they have been active for the last 5 million years. Having worked in the sectors where La Victoria Formation presents manifestations of hydrocarbons would indicate that there are effective migration paths for the proposed leads.
- **The risks are associated with the quality of the 2D seismic and the sealing nature of the faults** that close the structures. But also associated with migration related to the amount that could have filled the structures.



Land map : Available areas

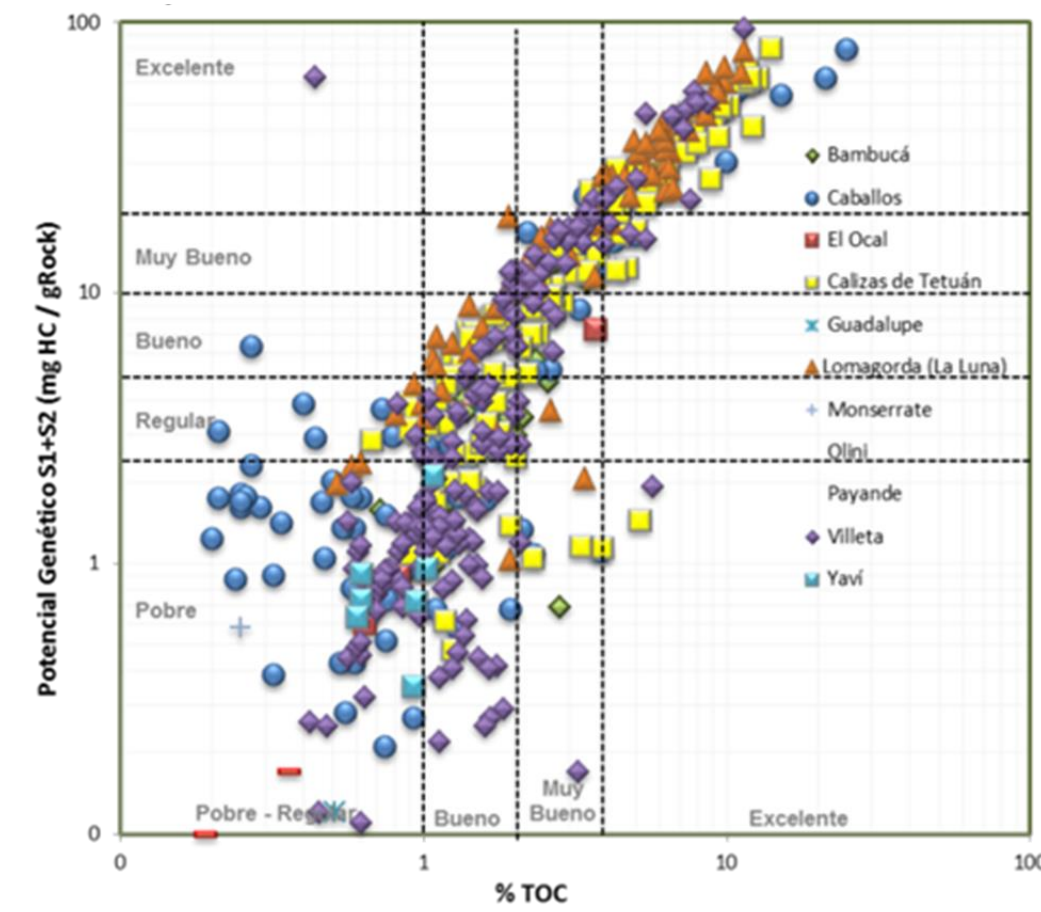
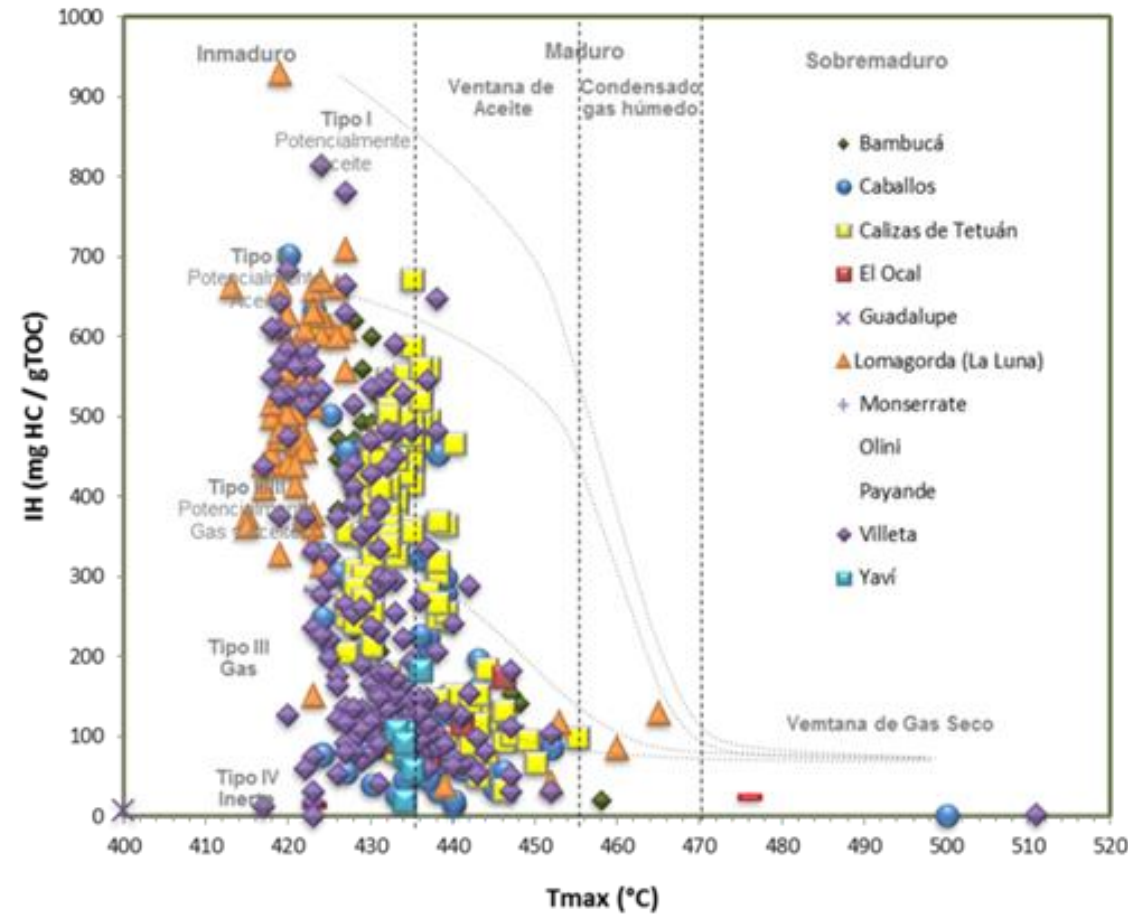
- In the exploratory and reserved areas, it is important to mention that in addition to the classic reservoirs of the Cretaceous, there is an opportunity in the Cenozoic formations associated with the Honda Group.
- In available areas, we can observe that it exists opportunities in Girardot sub basin associated to stratigraphic play (1, 5) but also in some isolated sector near the Prado - Suarez fault opportunity related to structural plays (3)

Petroleum Systems Modelling, Play Fairway Maps & YTF Assessment

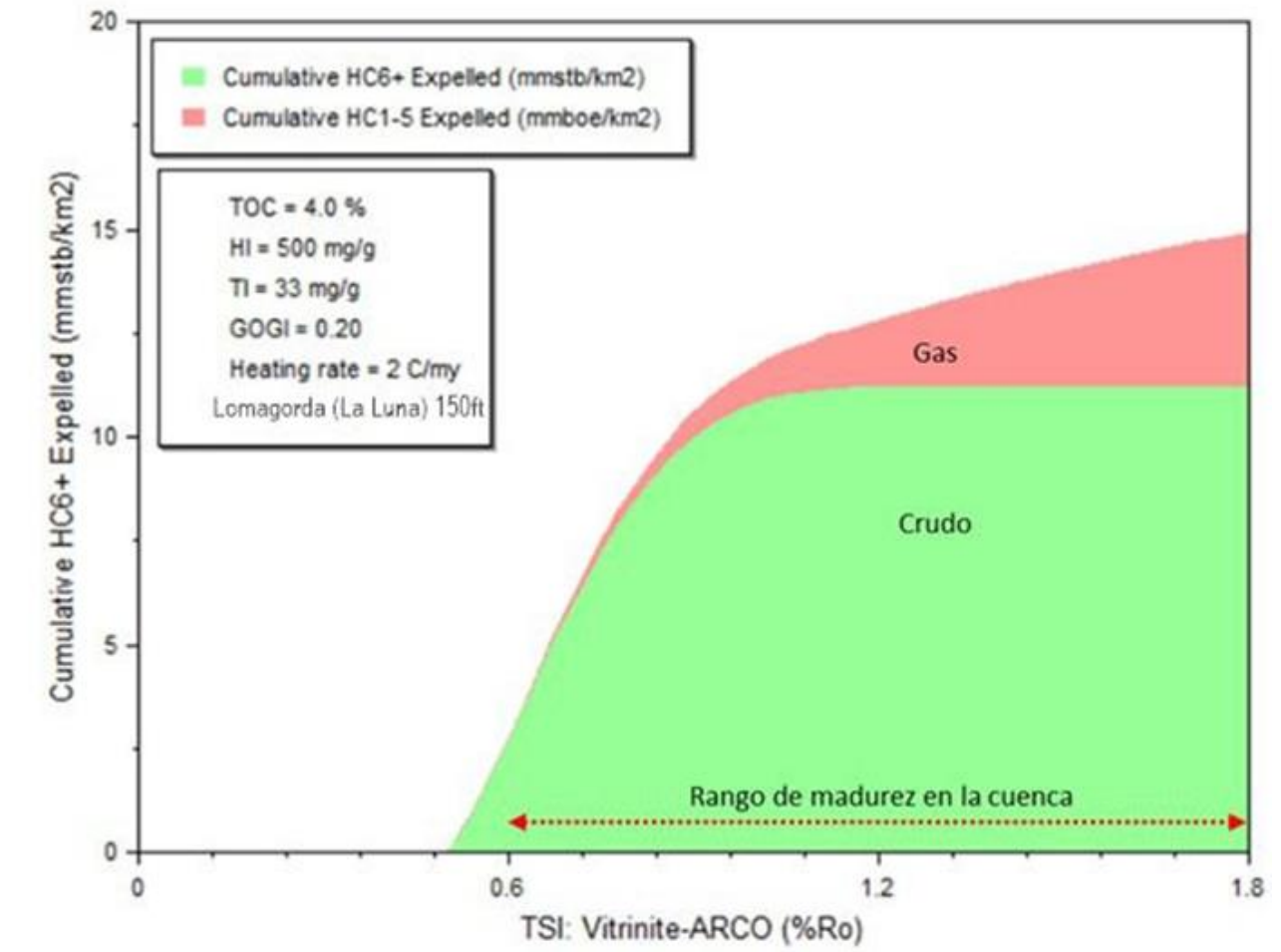
Petroleum Systems Modelling

OM Kinetics

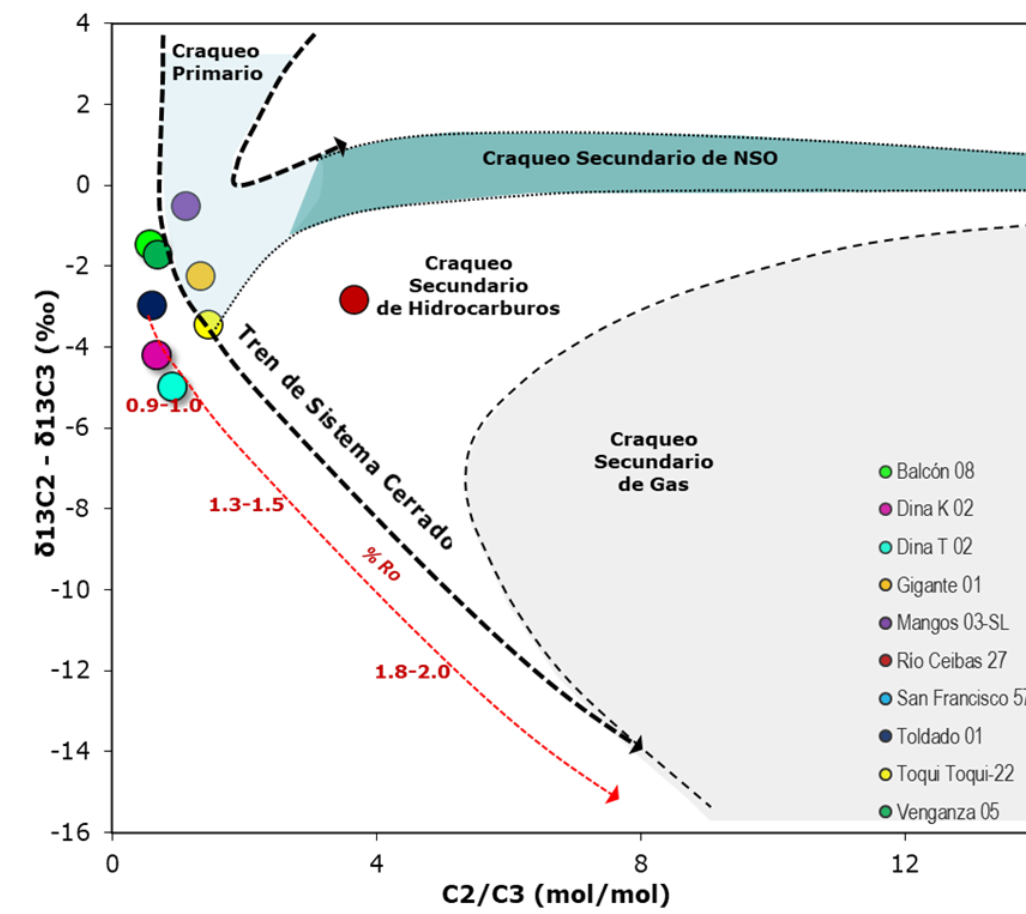
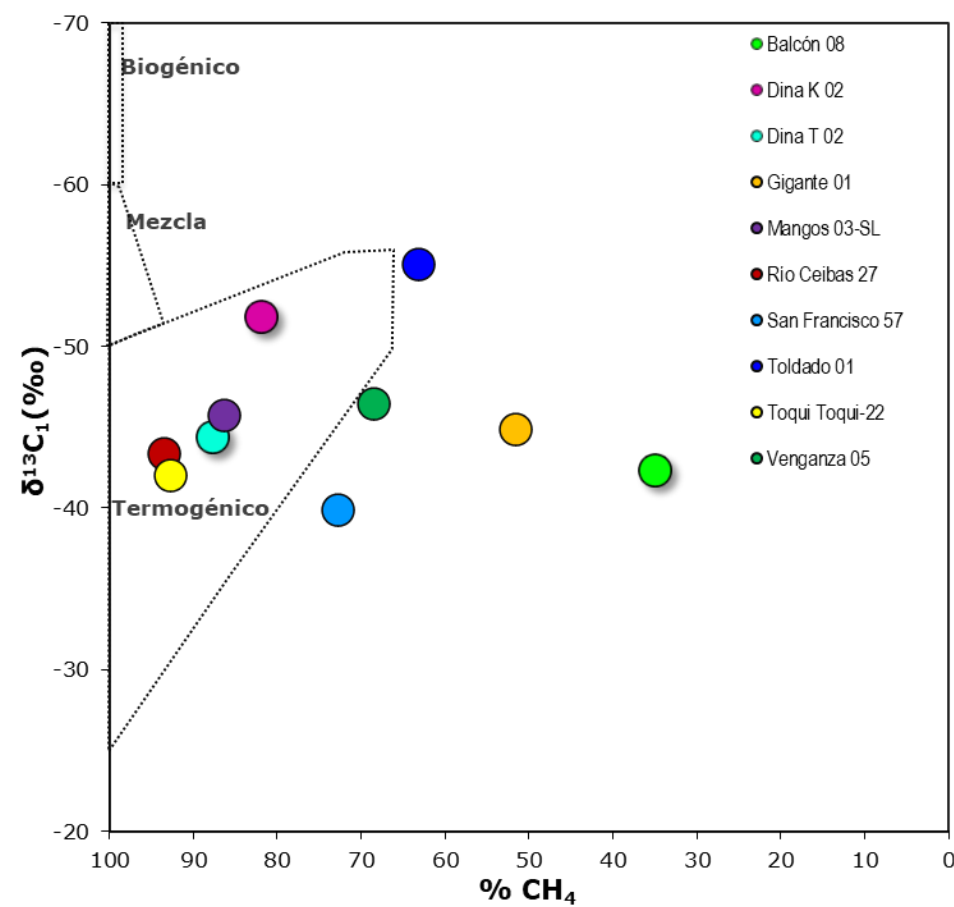
Source Rock Geochemistry



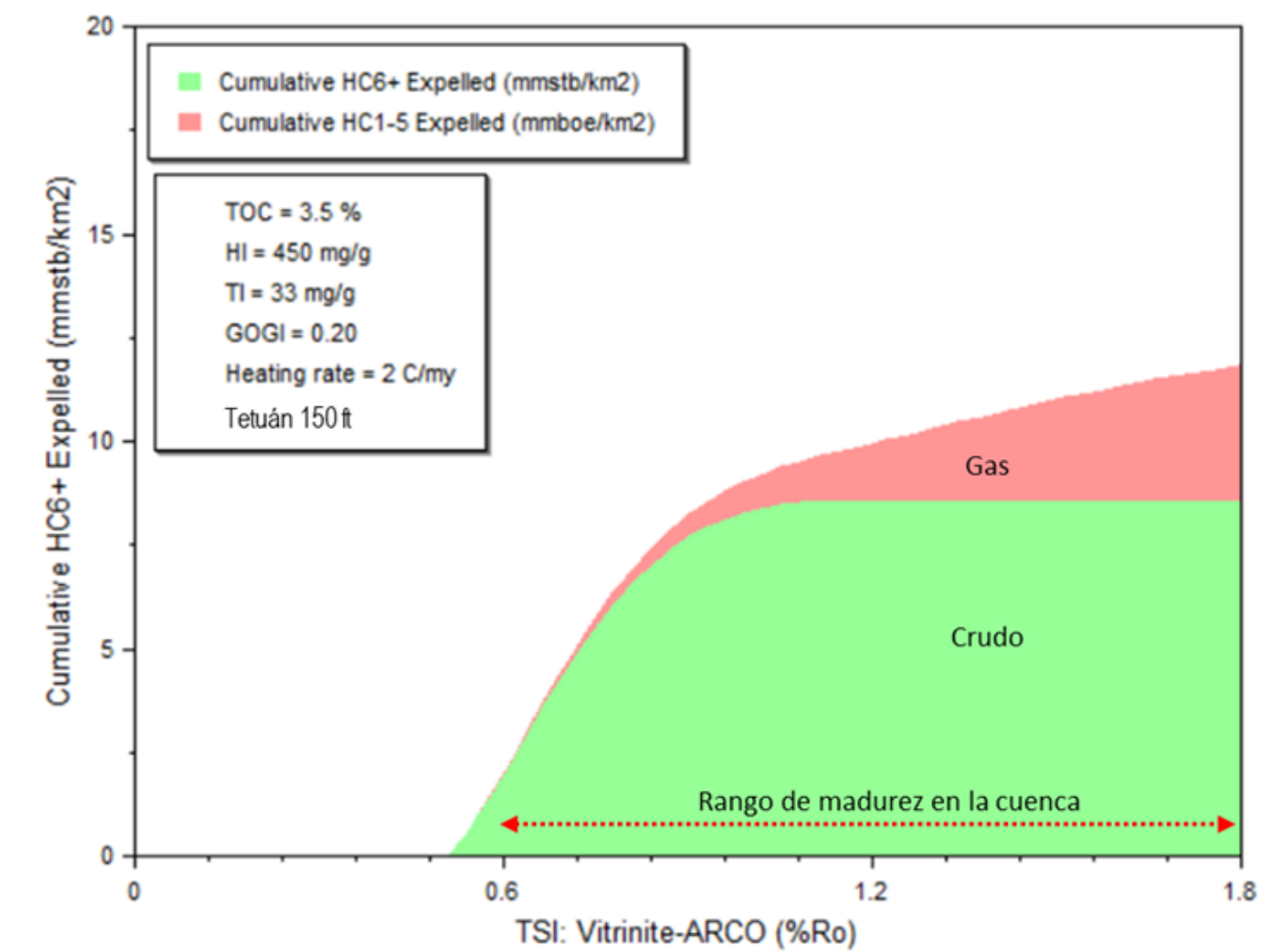
Lomagorda Formation (La Luna)



Gas Geochemistry



Tetuan Formation (La Luna)



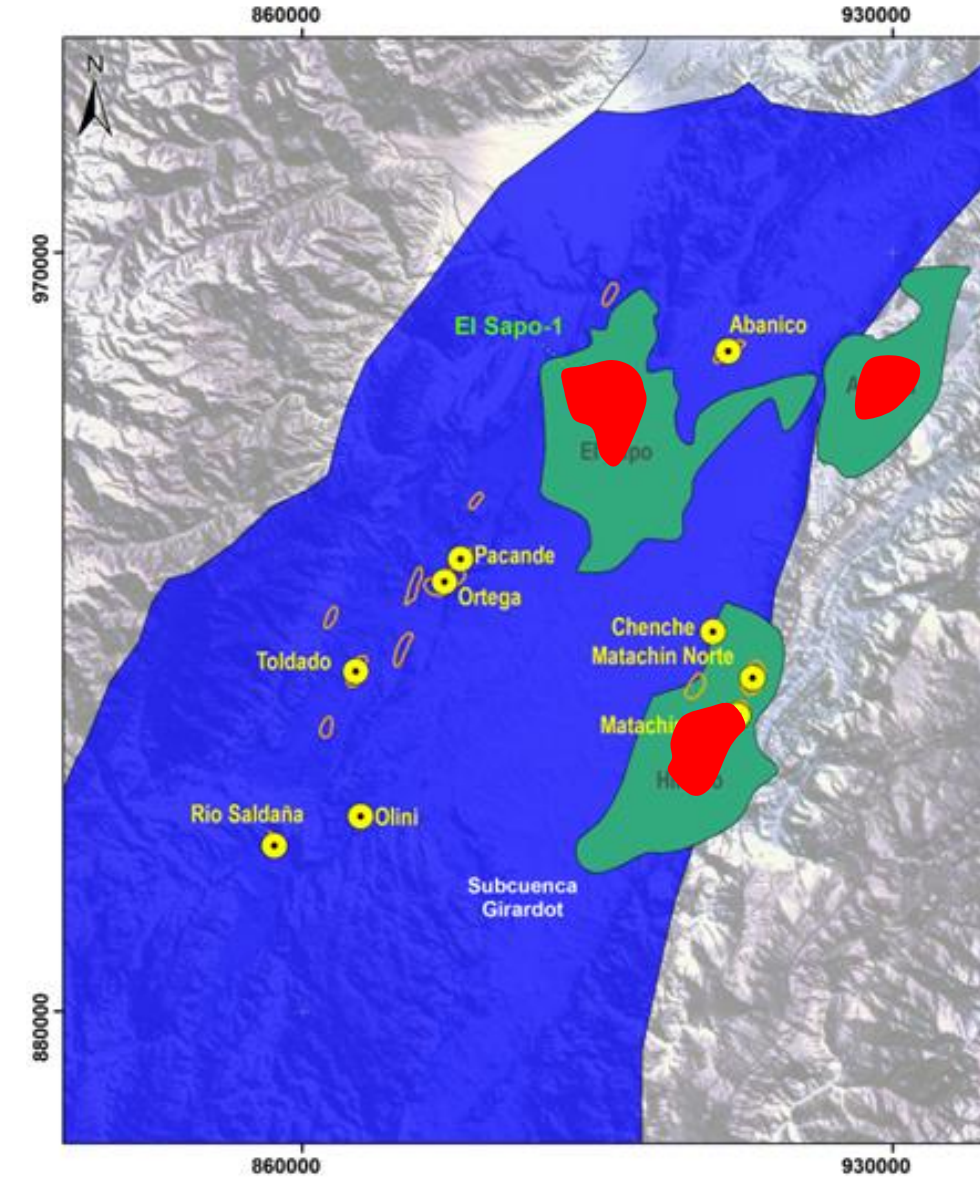
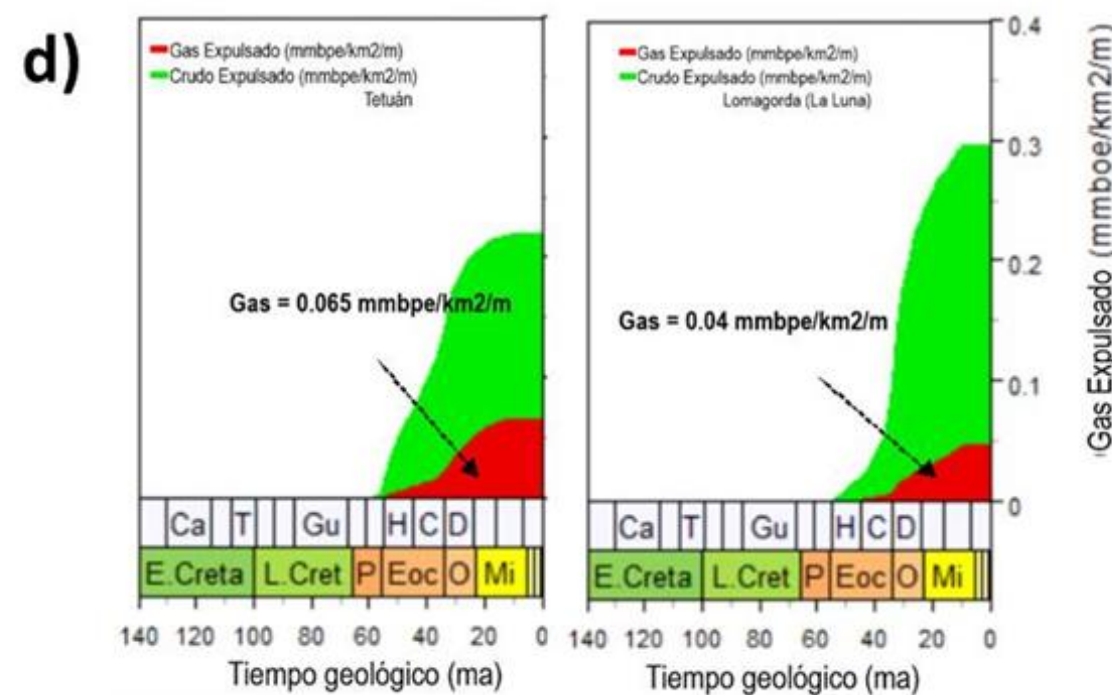
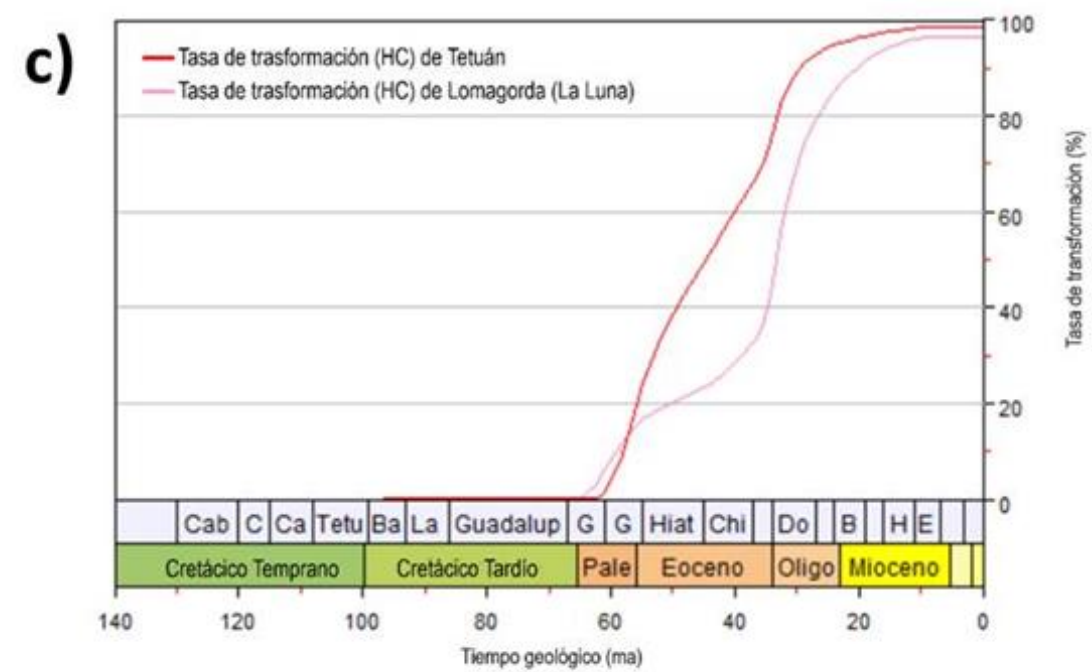
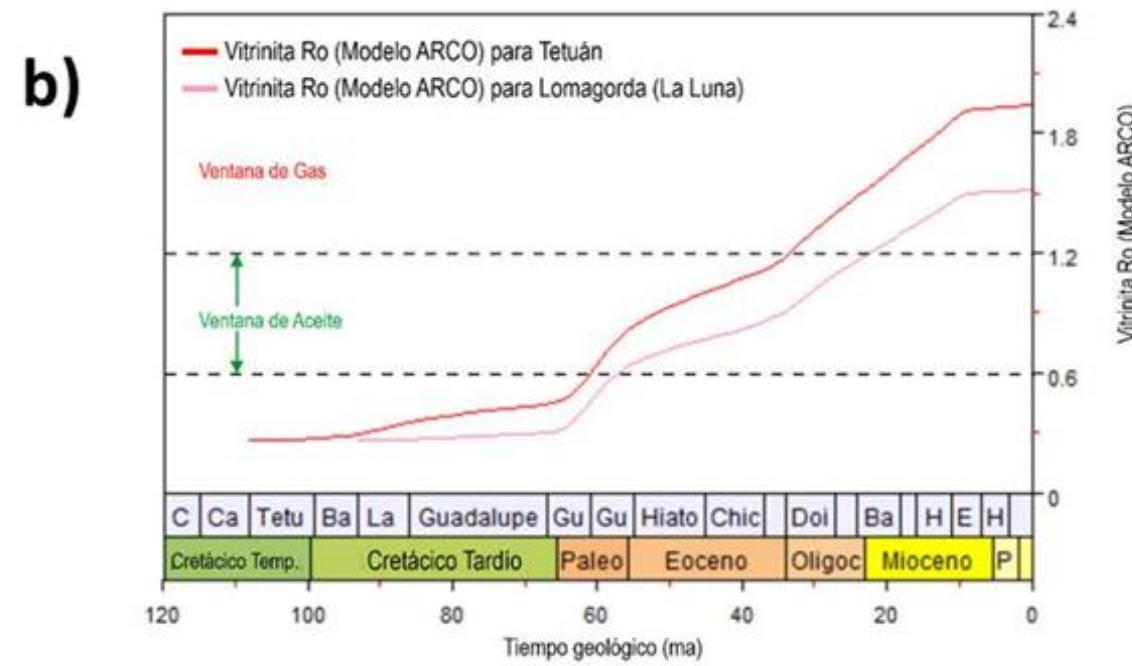
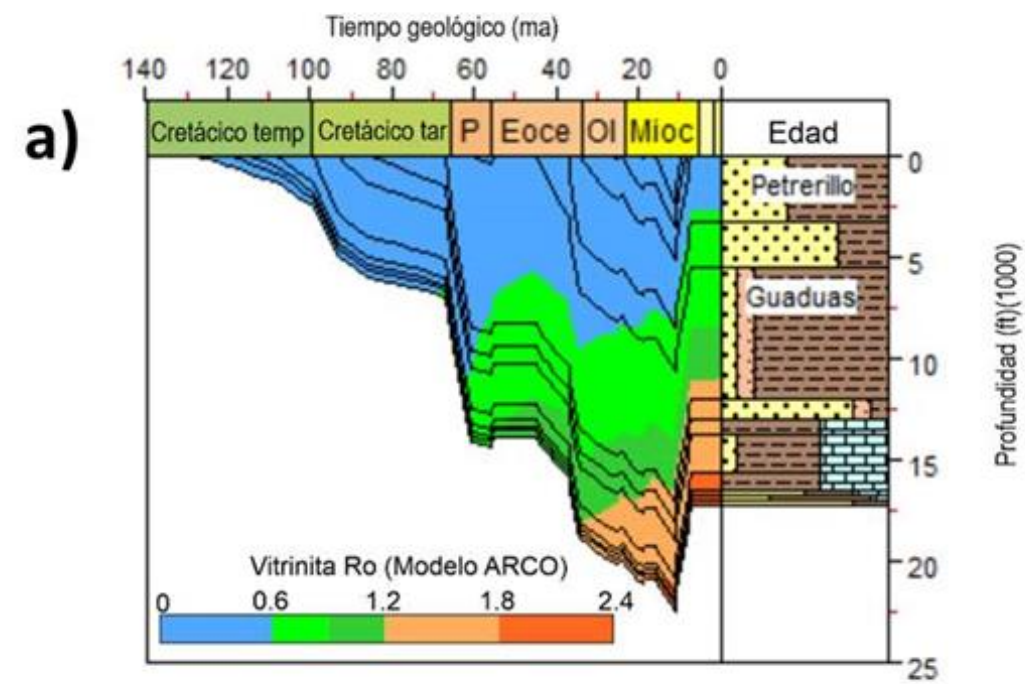
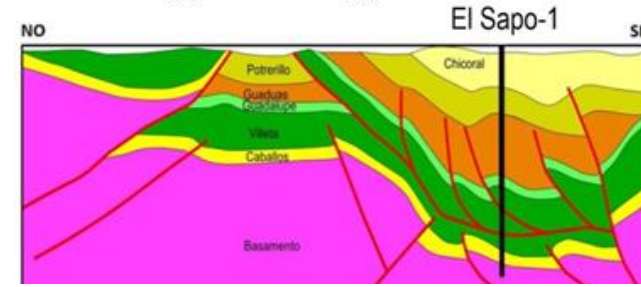
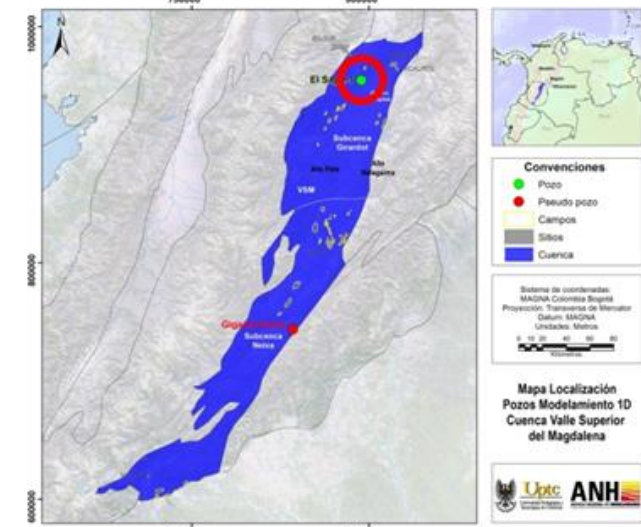
Petroleum Systems Modelling



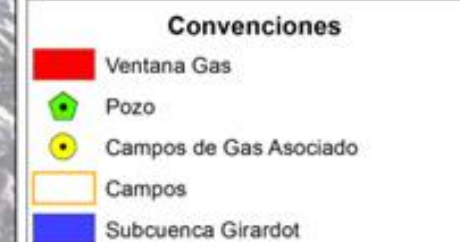
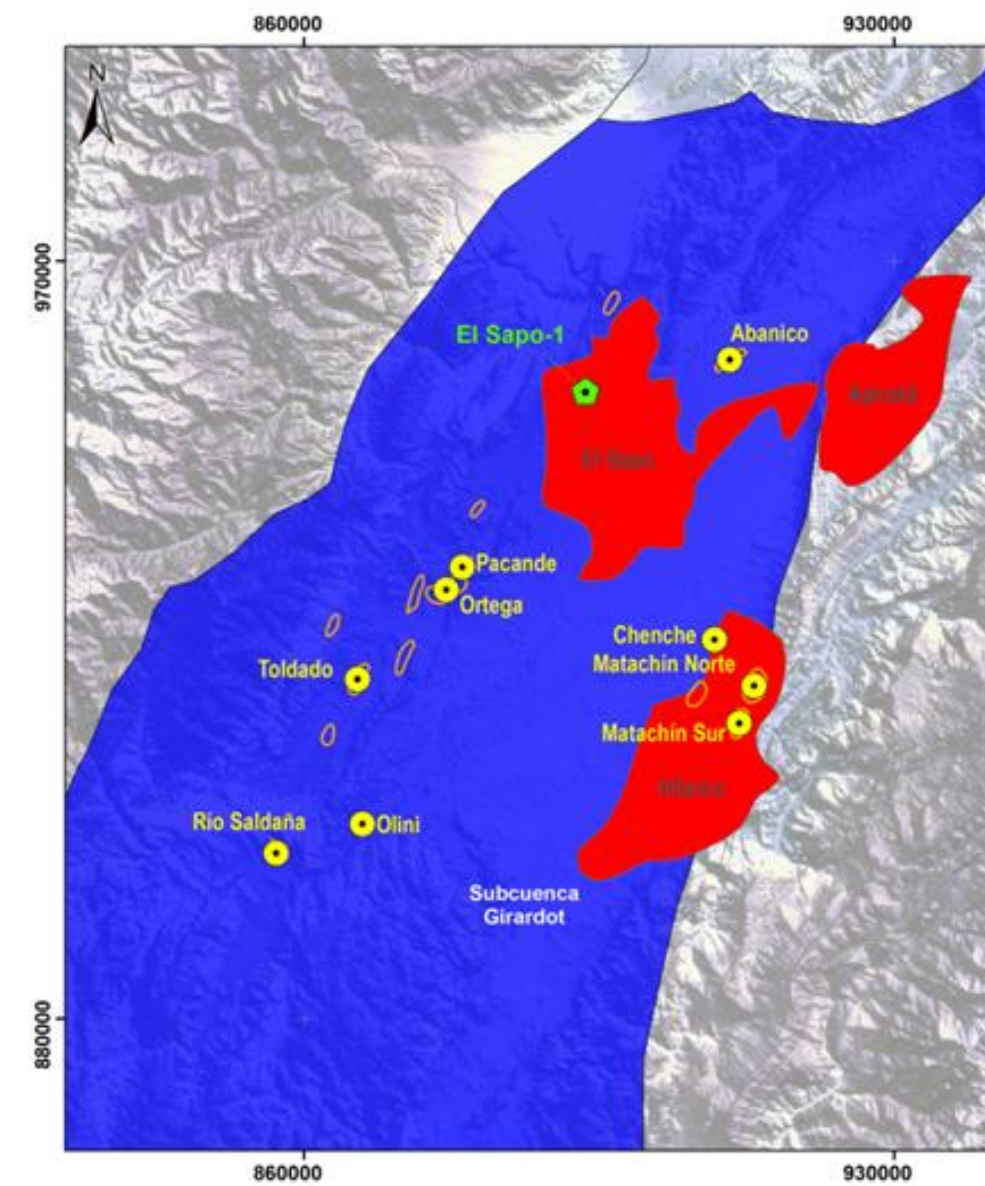
El futuro es de todos

Minenergía

El Sapo / Girardot Sub-Basin



Mapa de Madurez Térmica Intervalo Generador Formación Lomagorda (La Luna) Subcuenca Girardot (VSM)

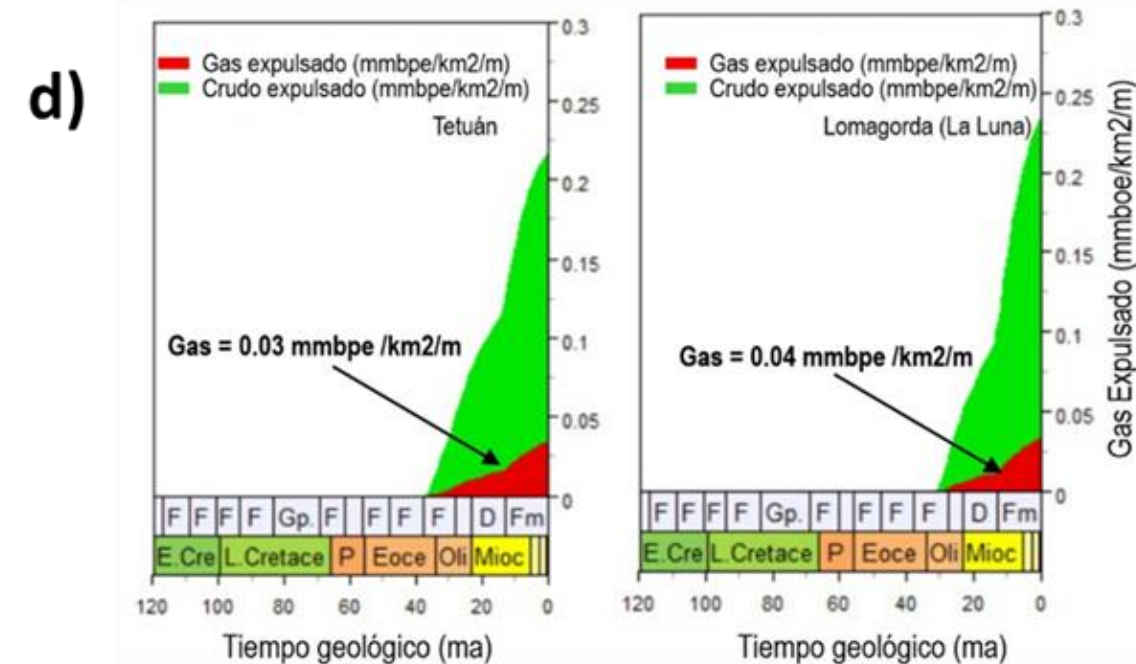
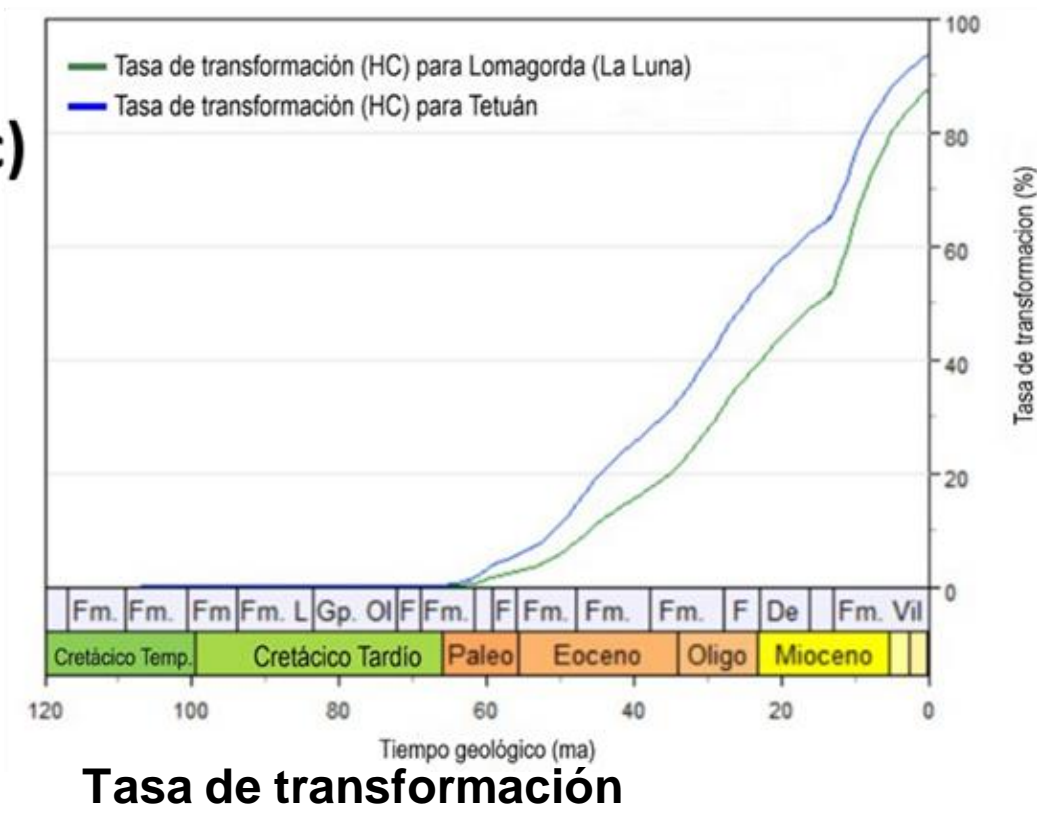
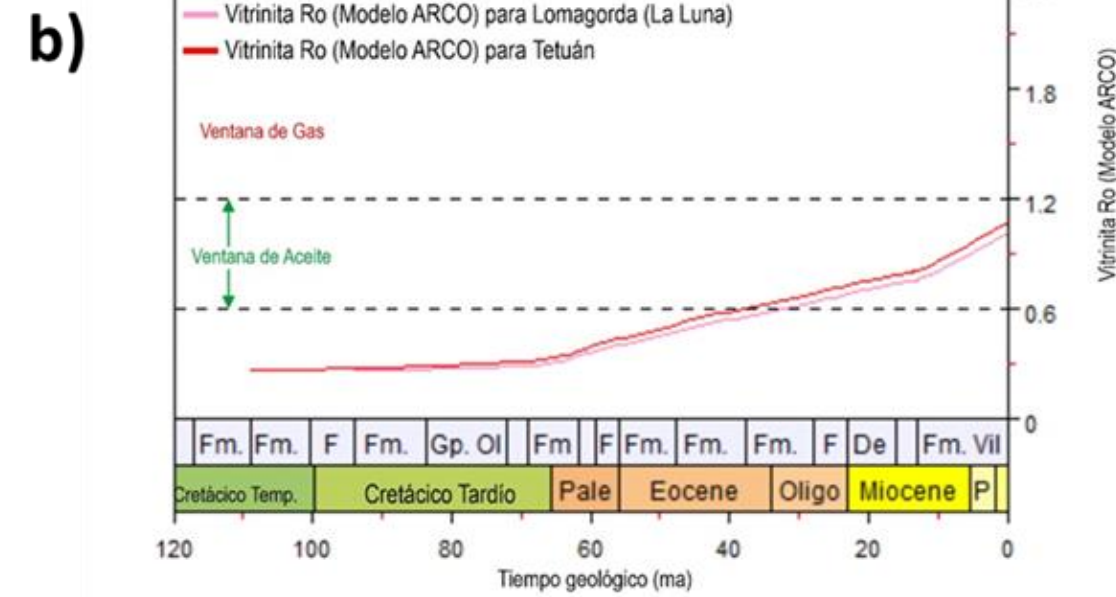
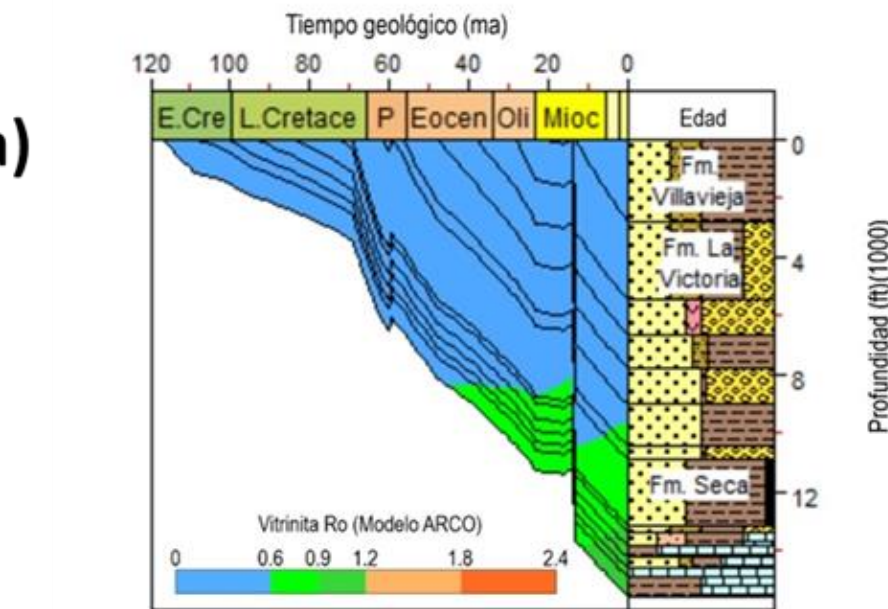
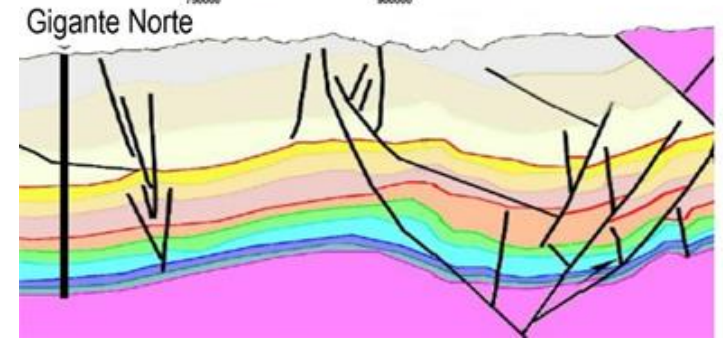
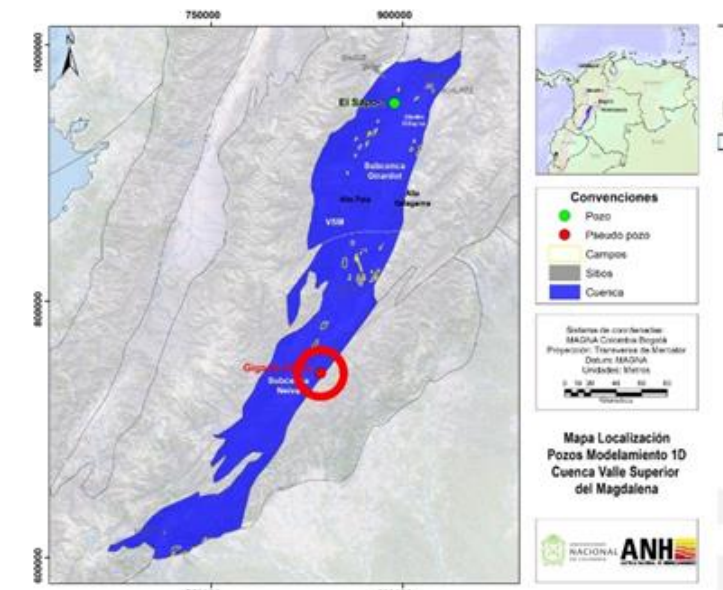


Mapa de Madurez Térmica Intervalo Generador Formación Tetuán Subcuenca Girardot (VSM)

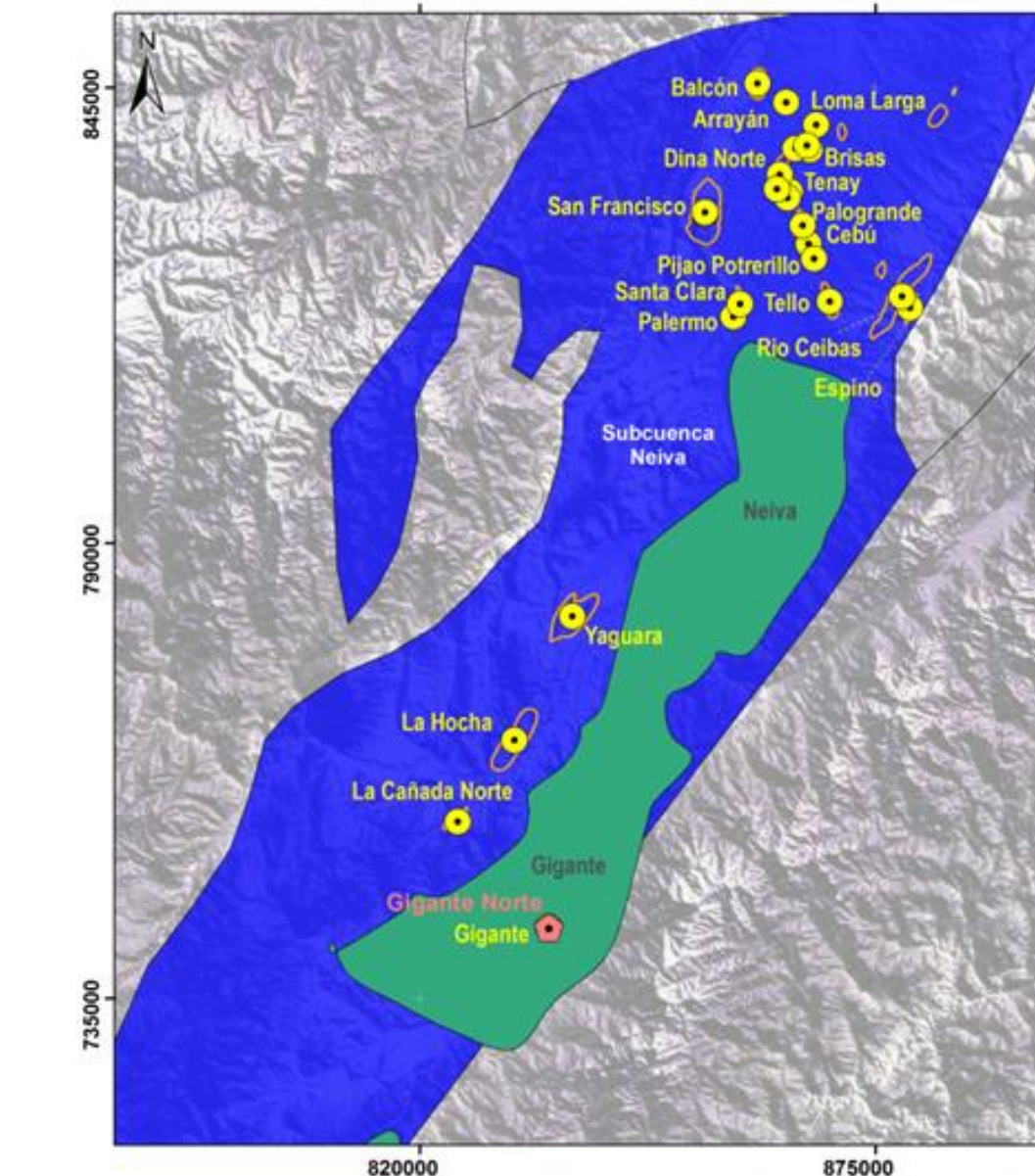
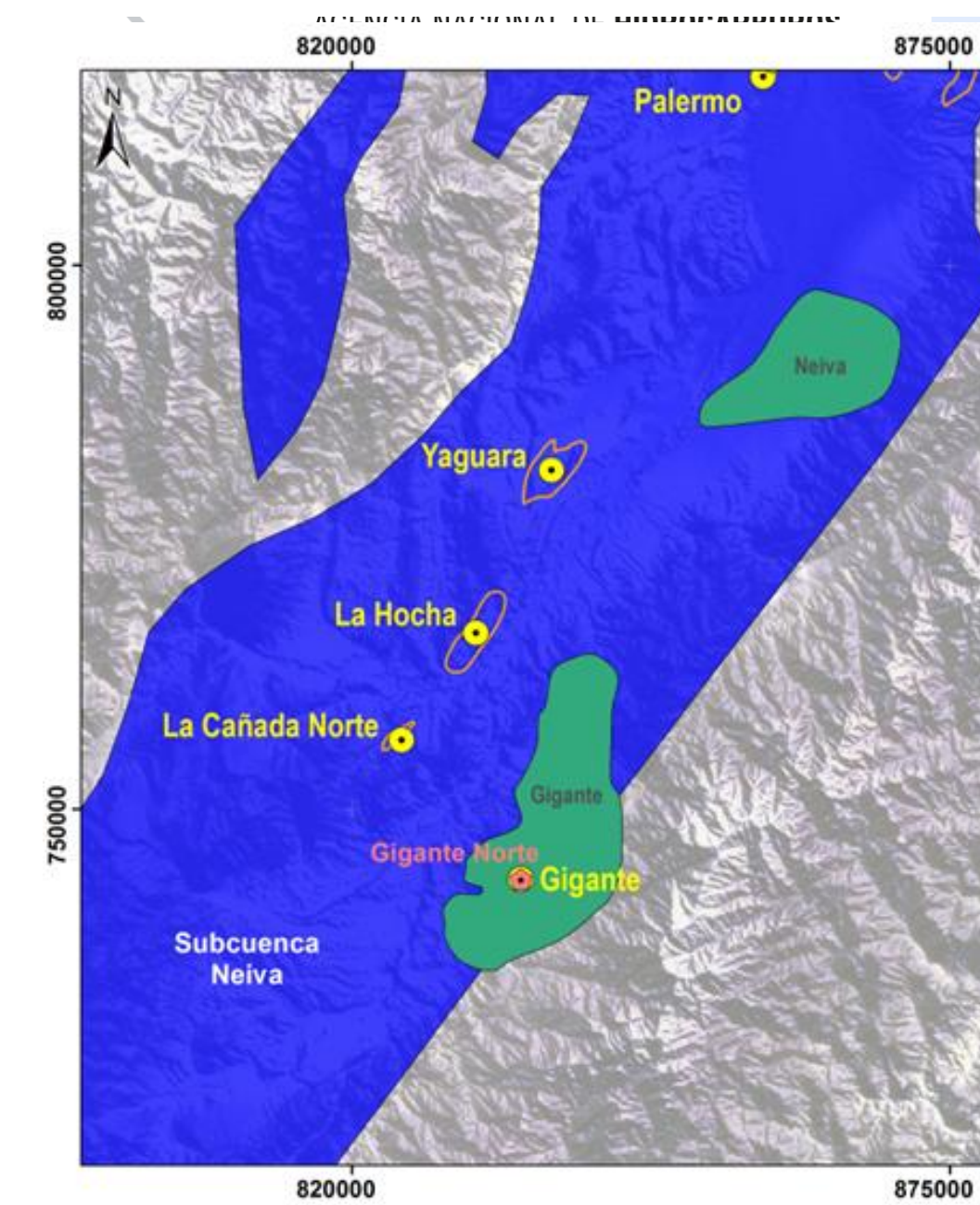


Petroleum Systems Modelling

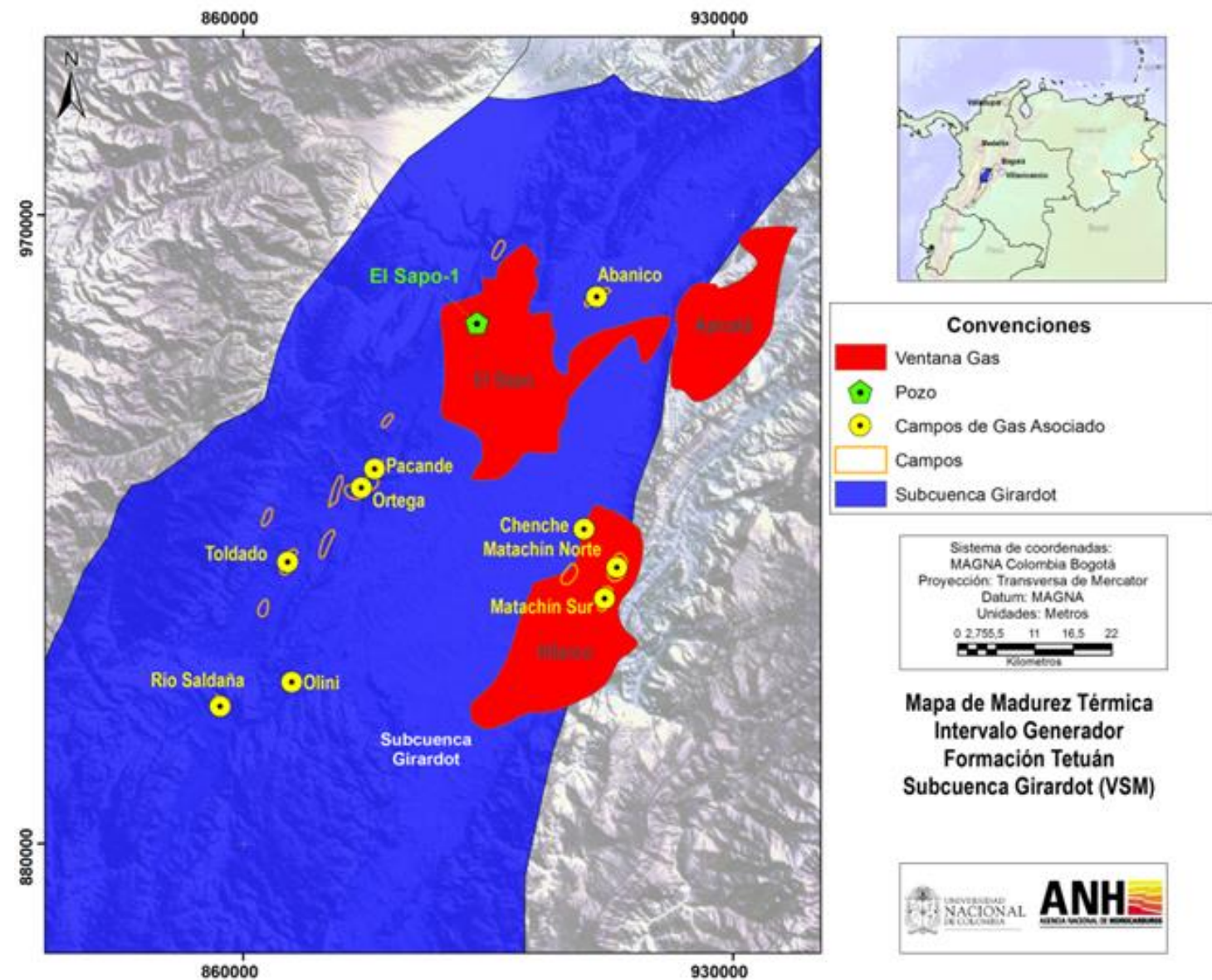
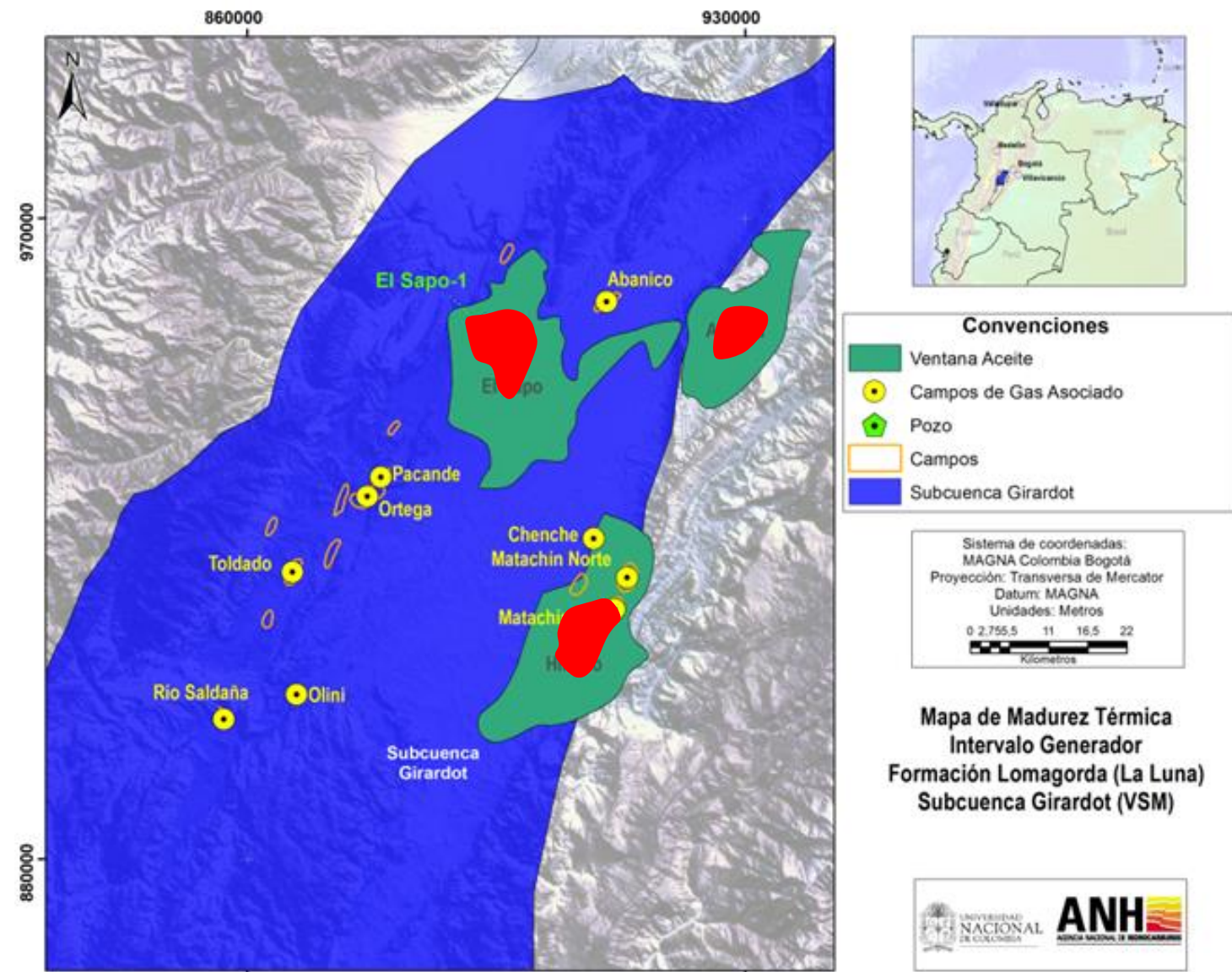
SP Gigante N / Neiva Sub Basin



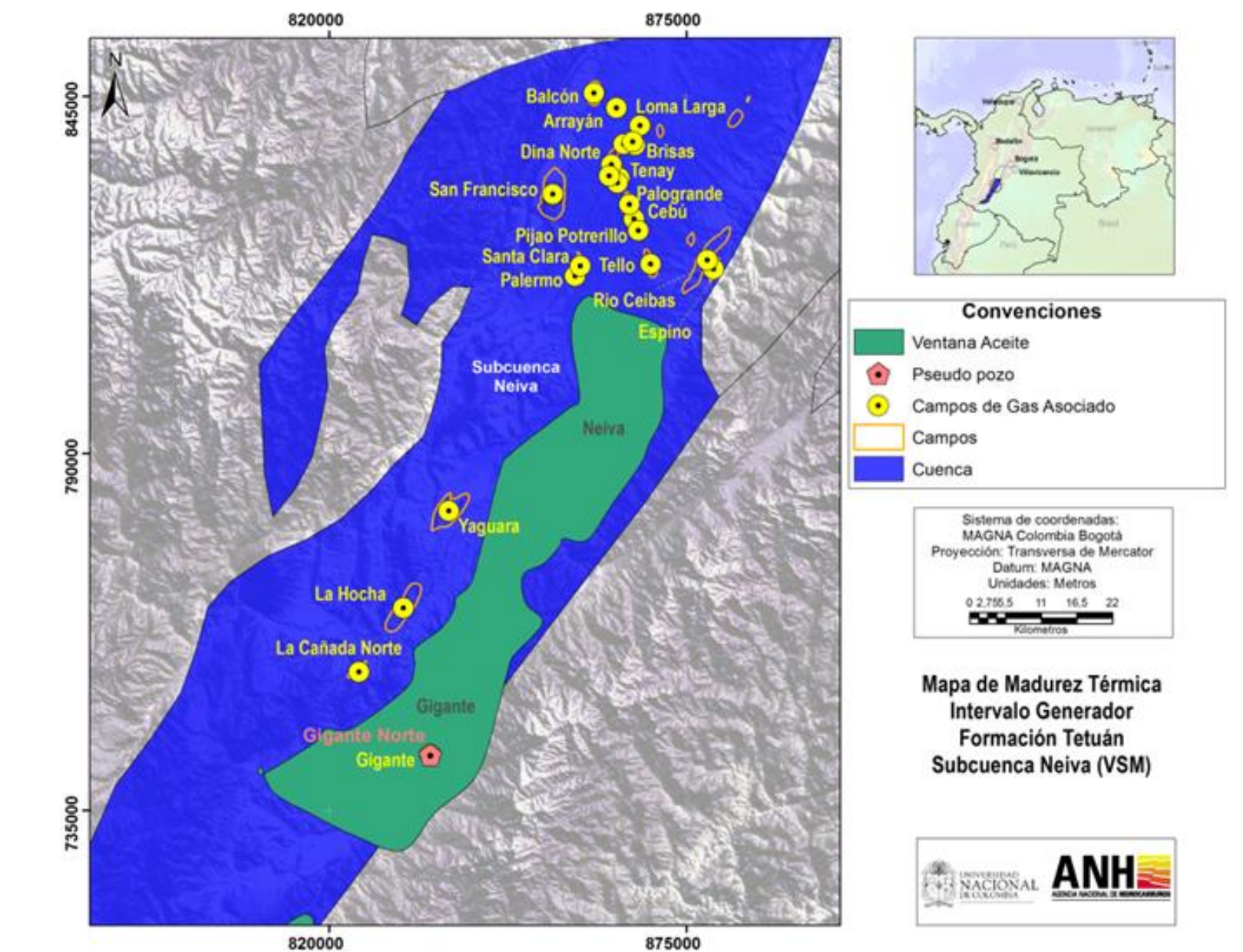
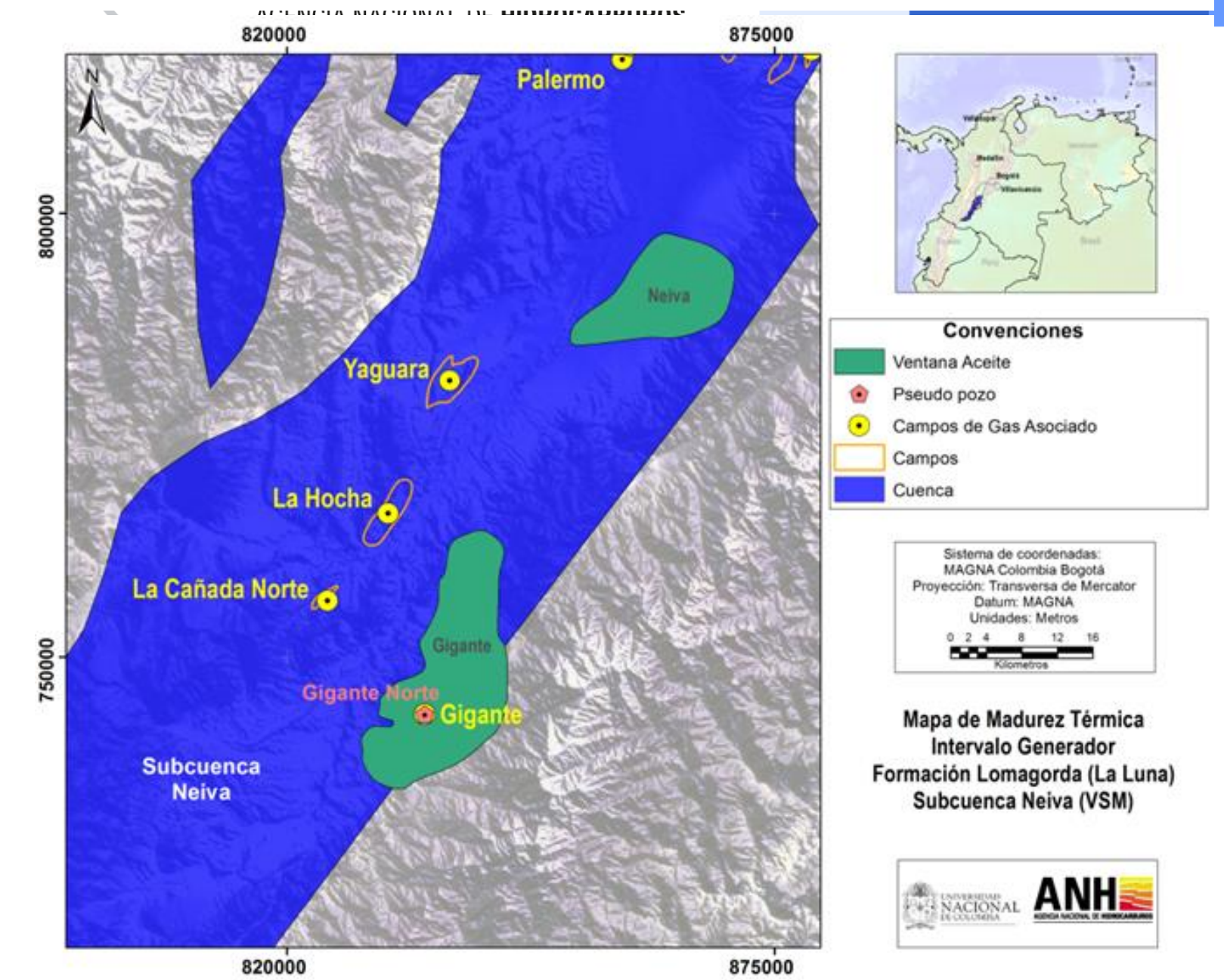
Pod Active SR / Neiva SB



Pod Active SR / Girardot SB

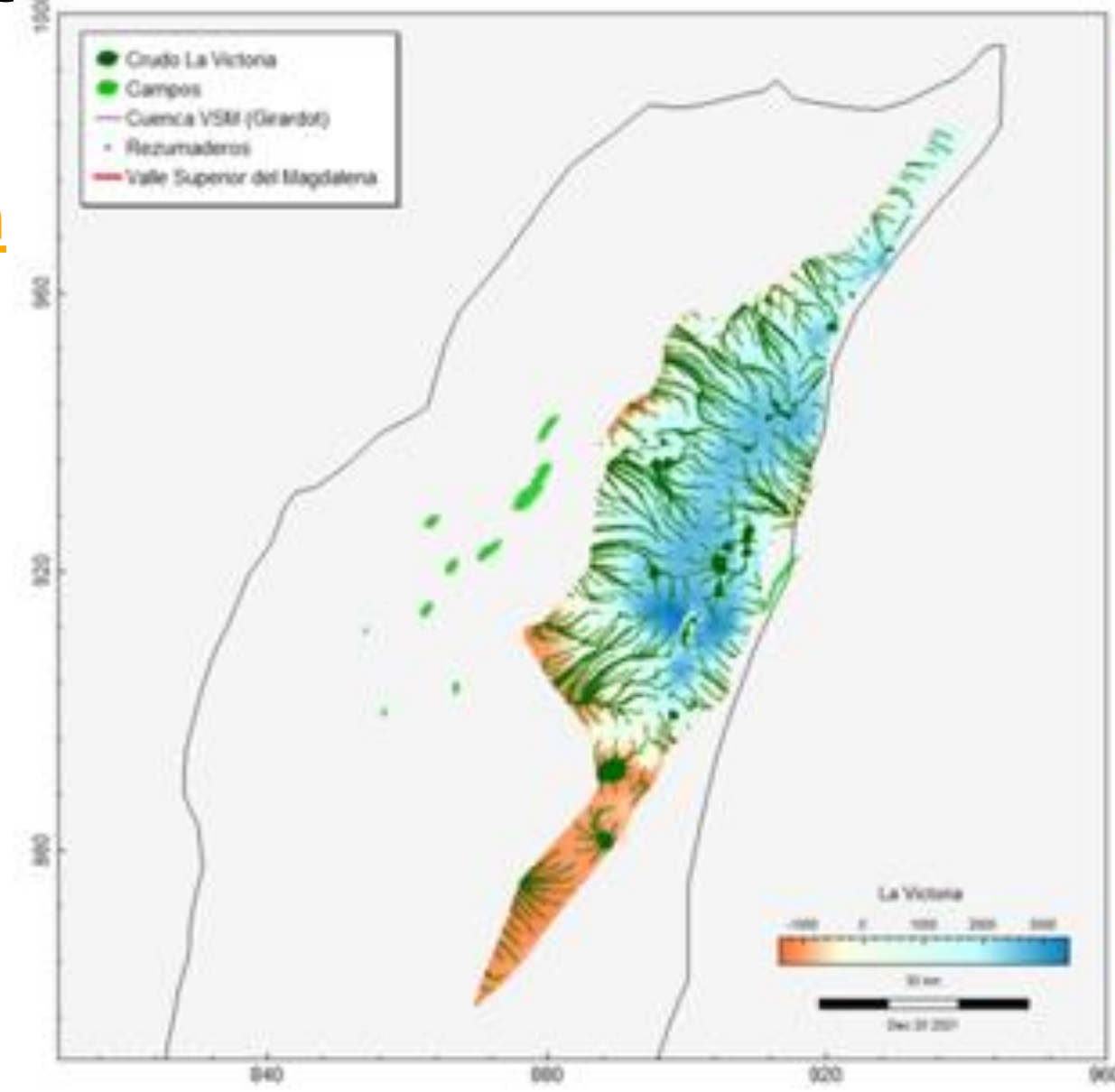


Pod Active SR / Neiva SB

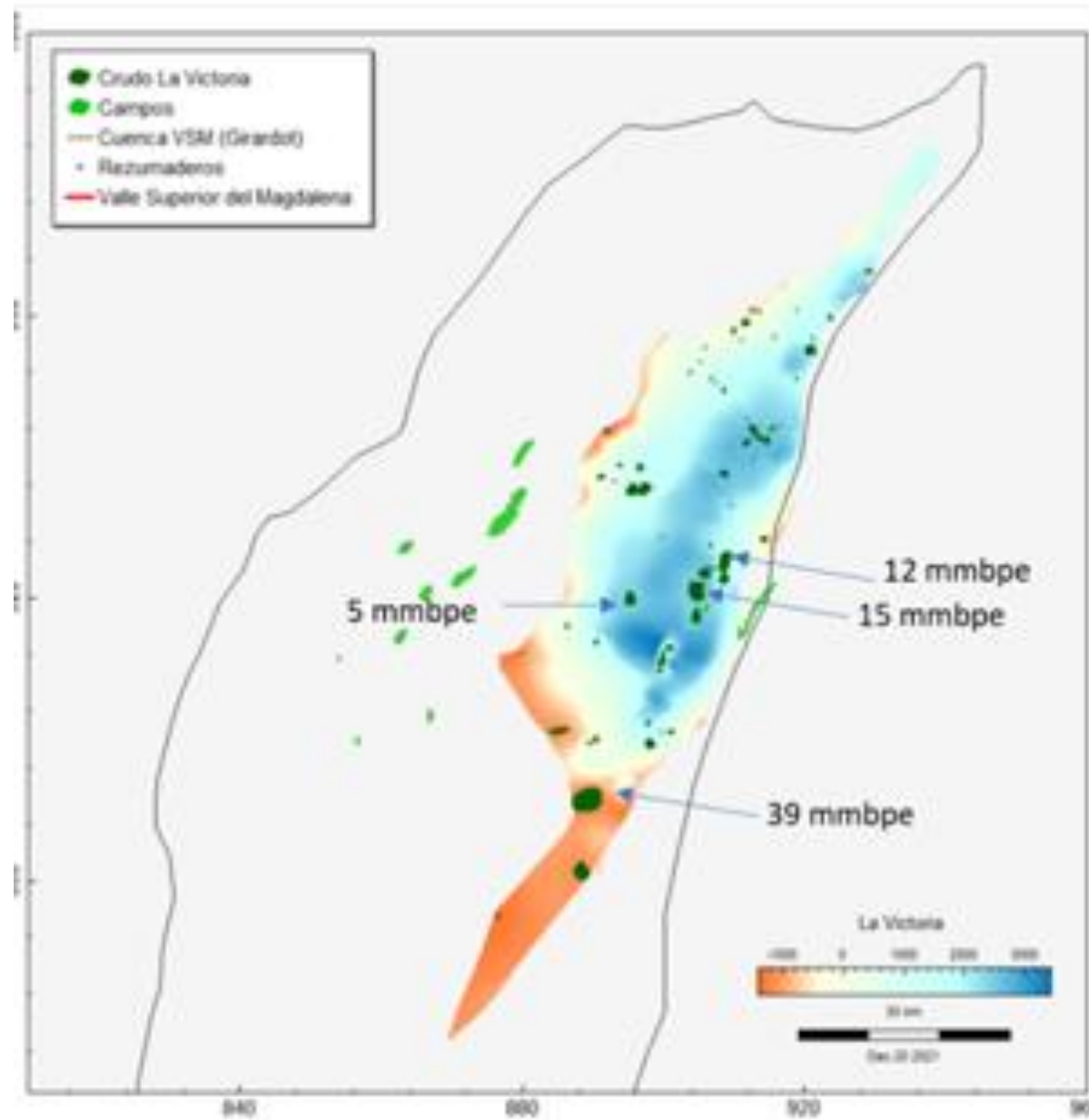


Petroleum Systems Modelling

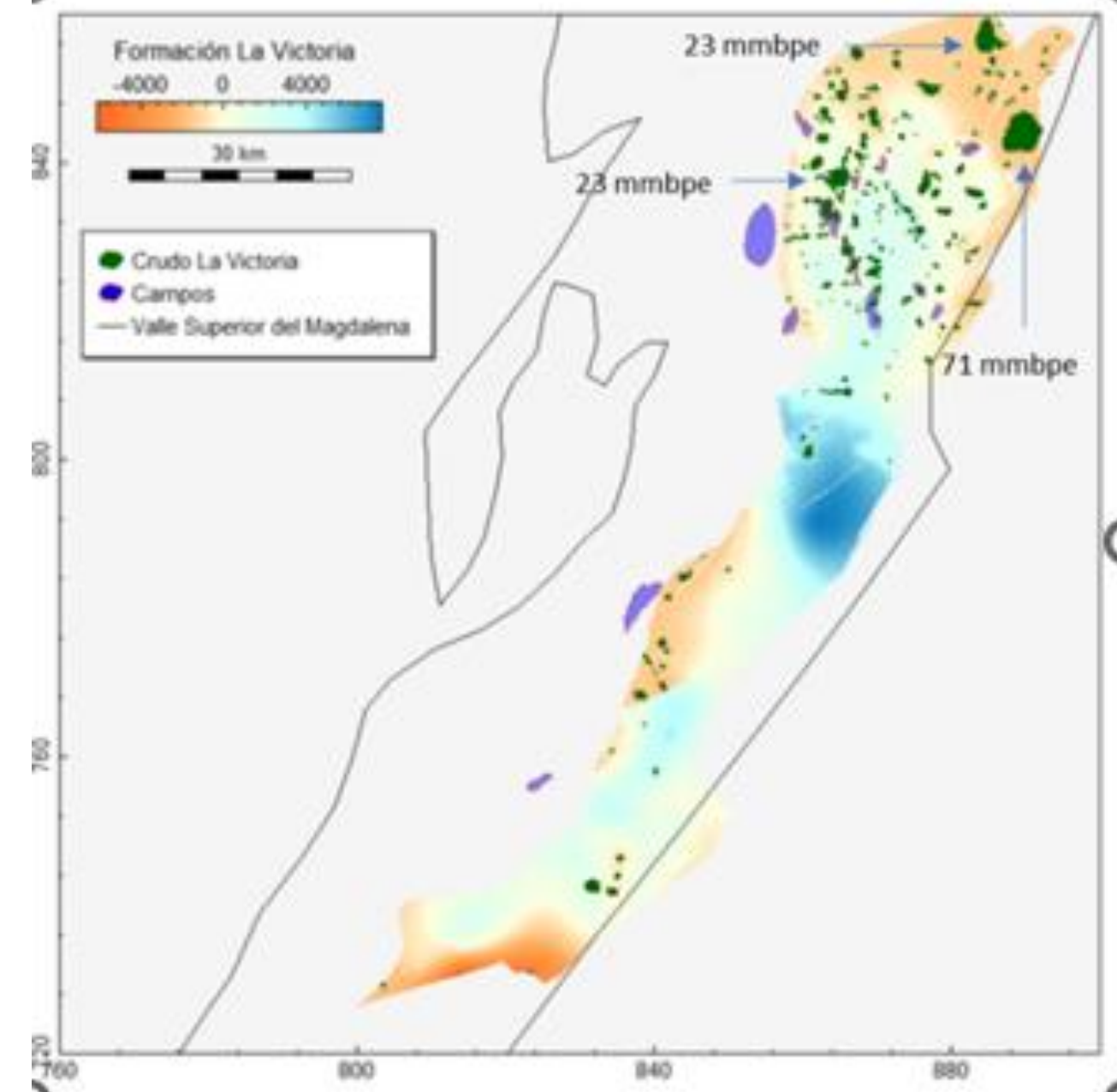
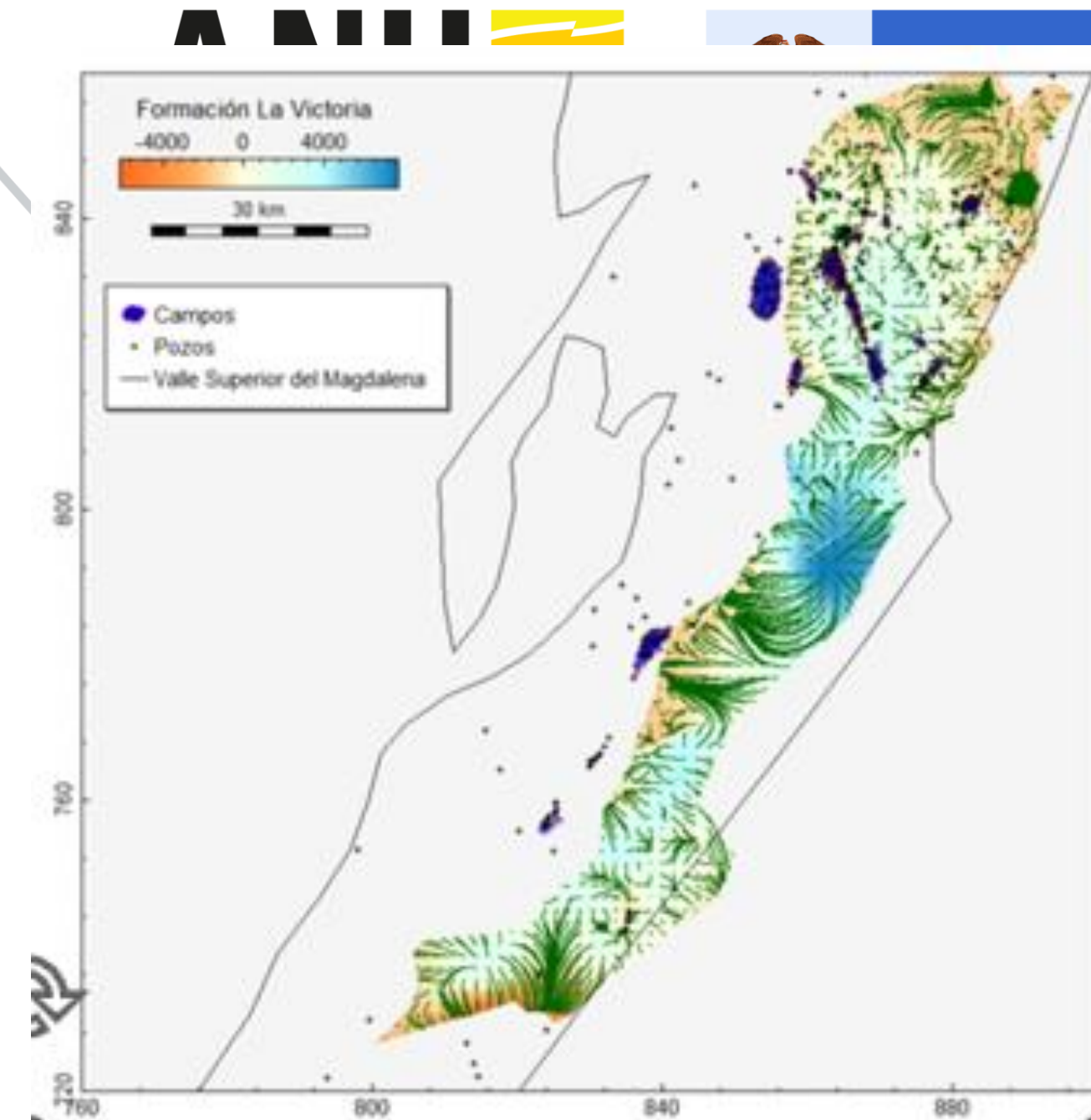
Girardot
Sub Basin



Migration, Hydrocarbon
Charge & Leads
La Victoria Formation

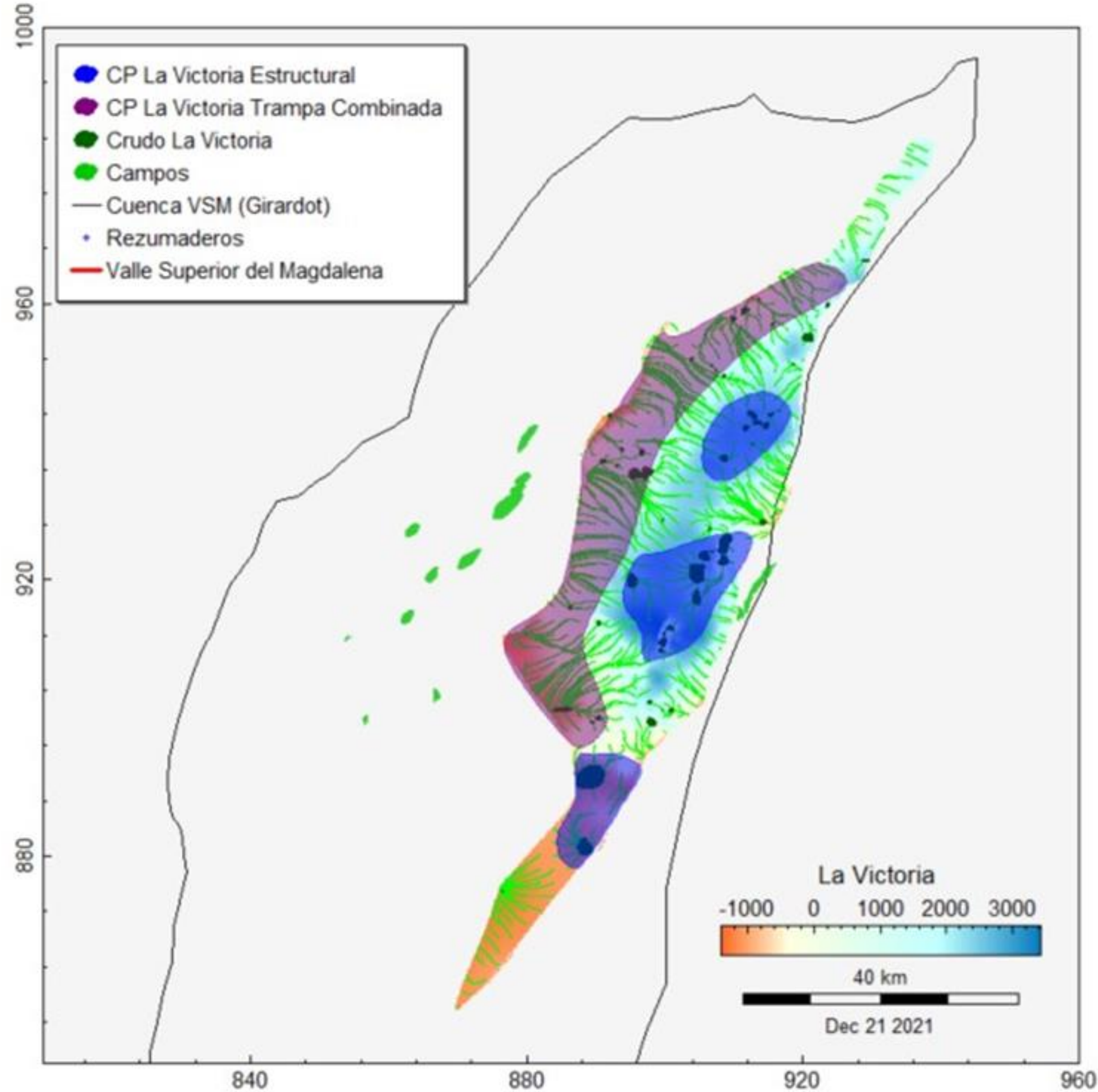


Neiva
Sub Basin

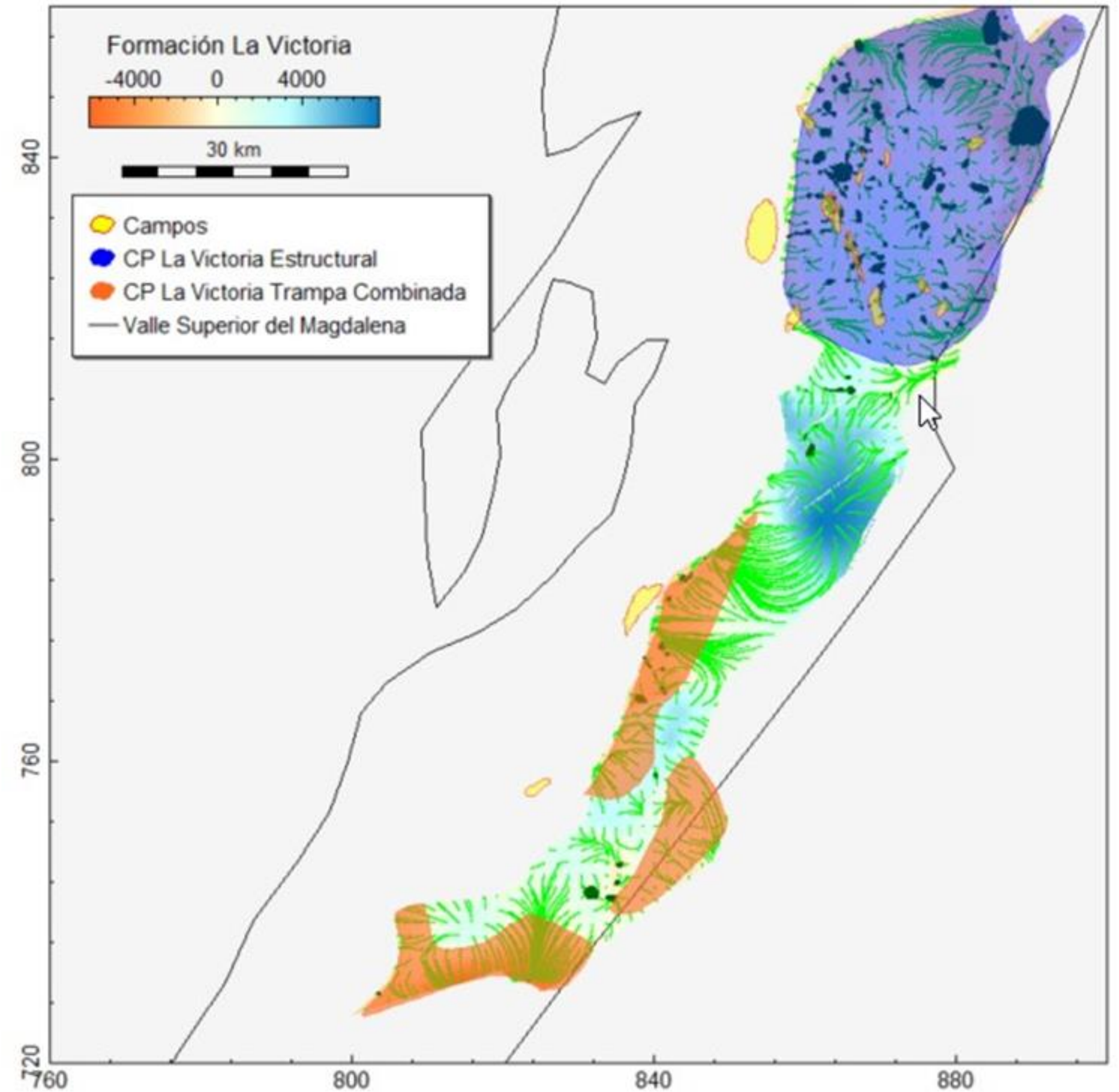


Play Fairway Maps

PFW / La Victoria Girardot SB

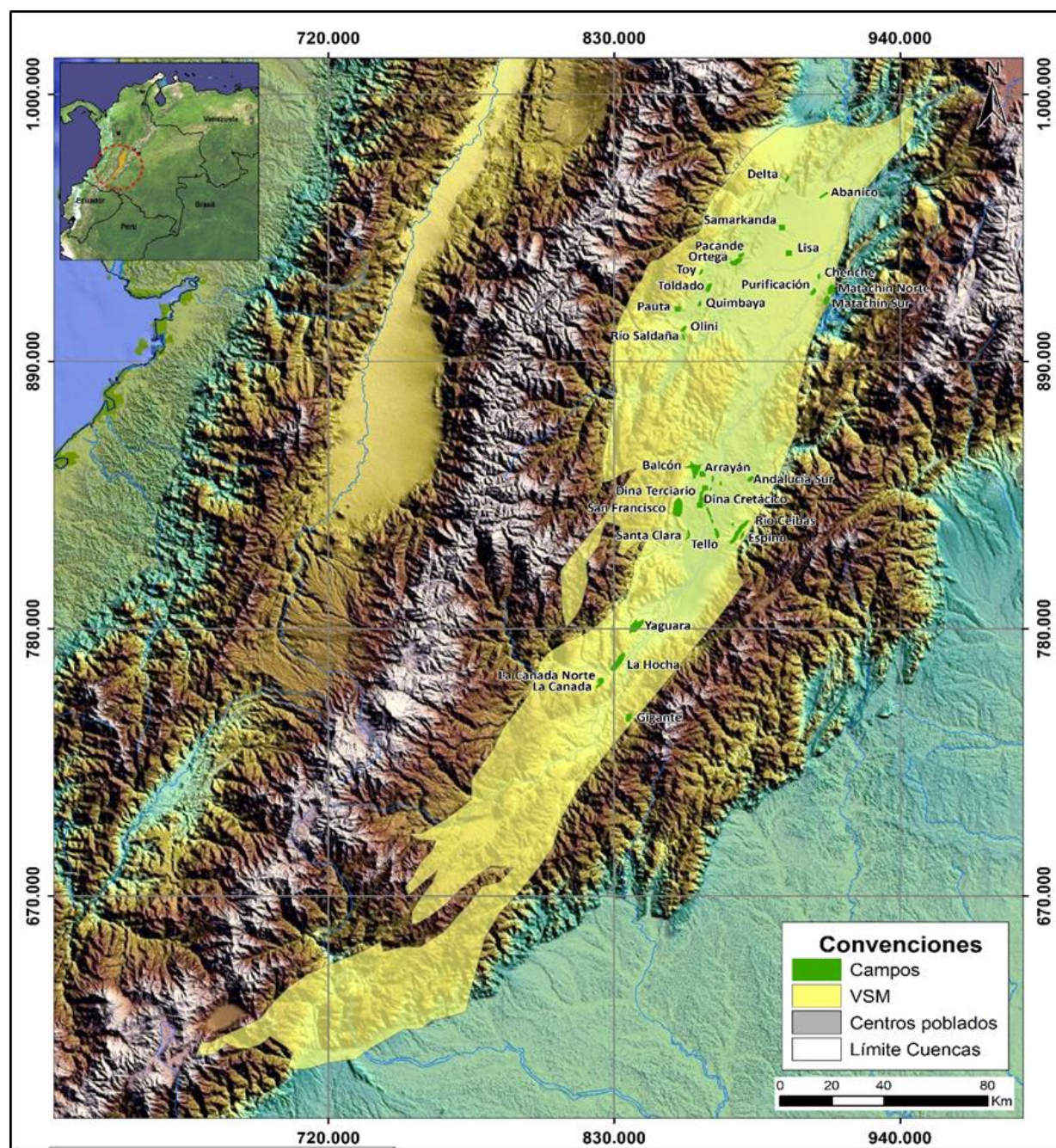


PFW / La Victoria Neiva SB



Yet to Find Evaluation

Discovered Resources OOIP

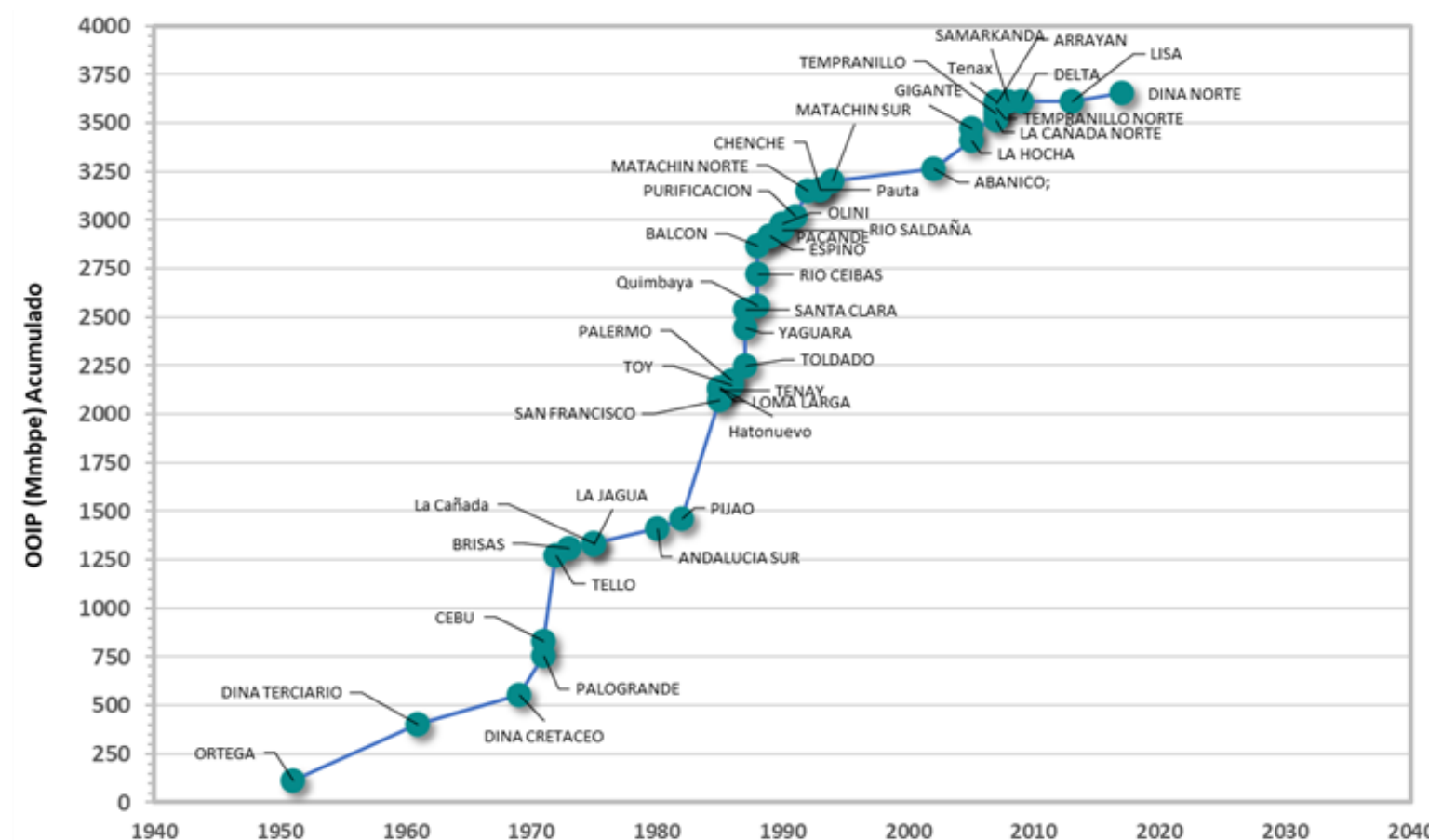


44 Fields

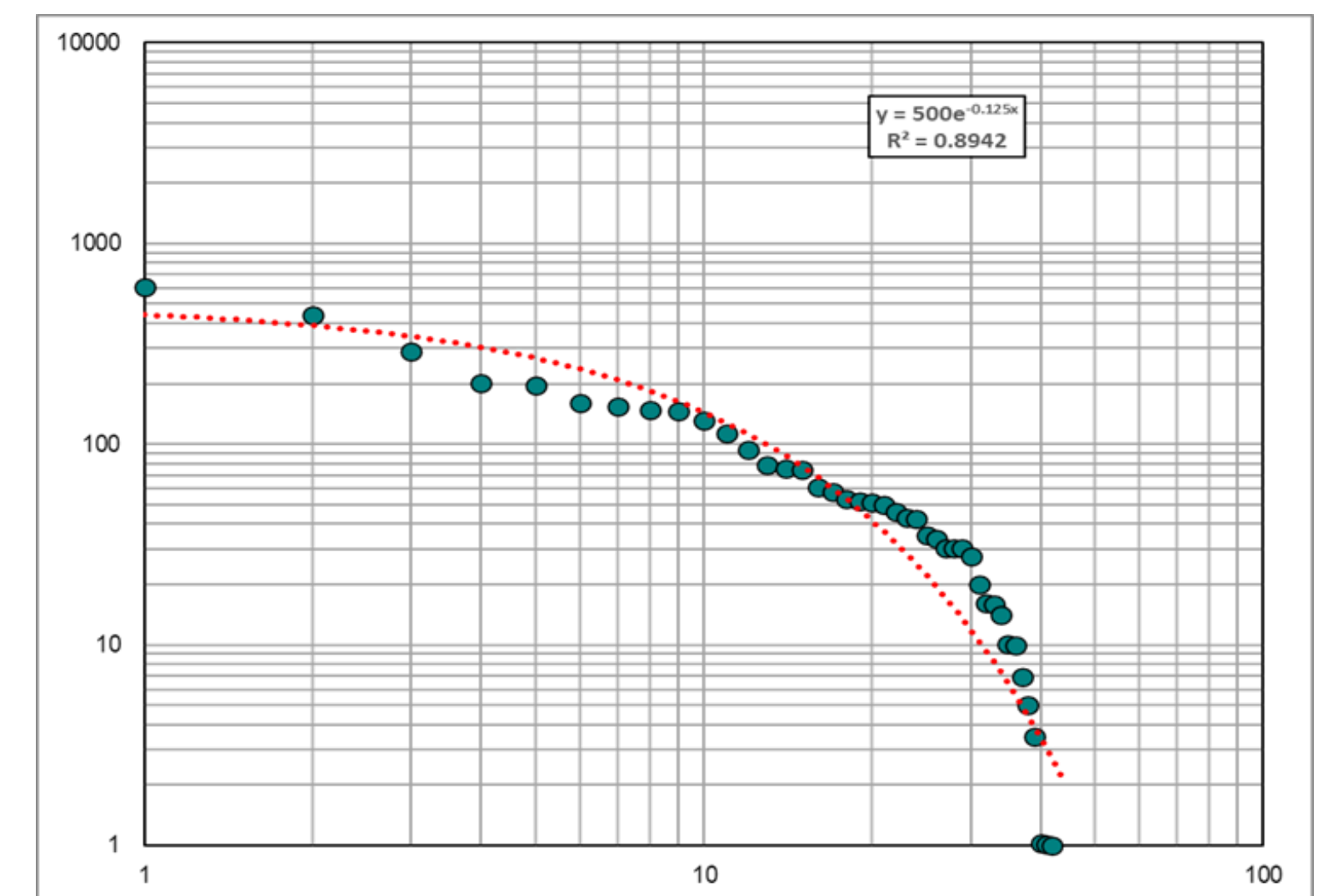
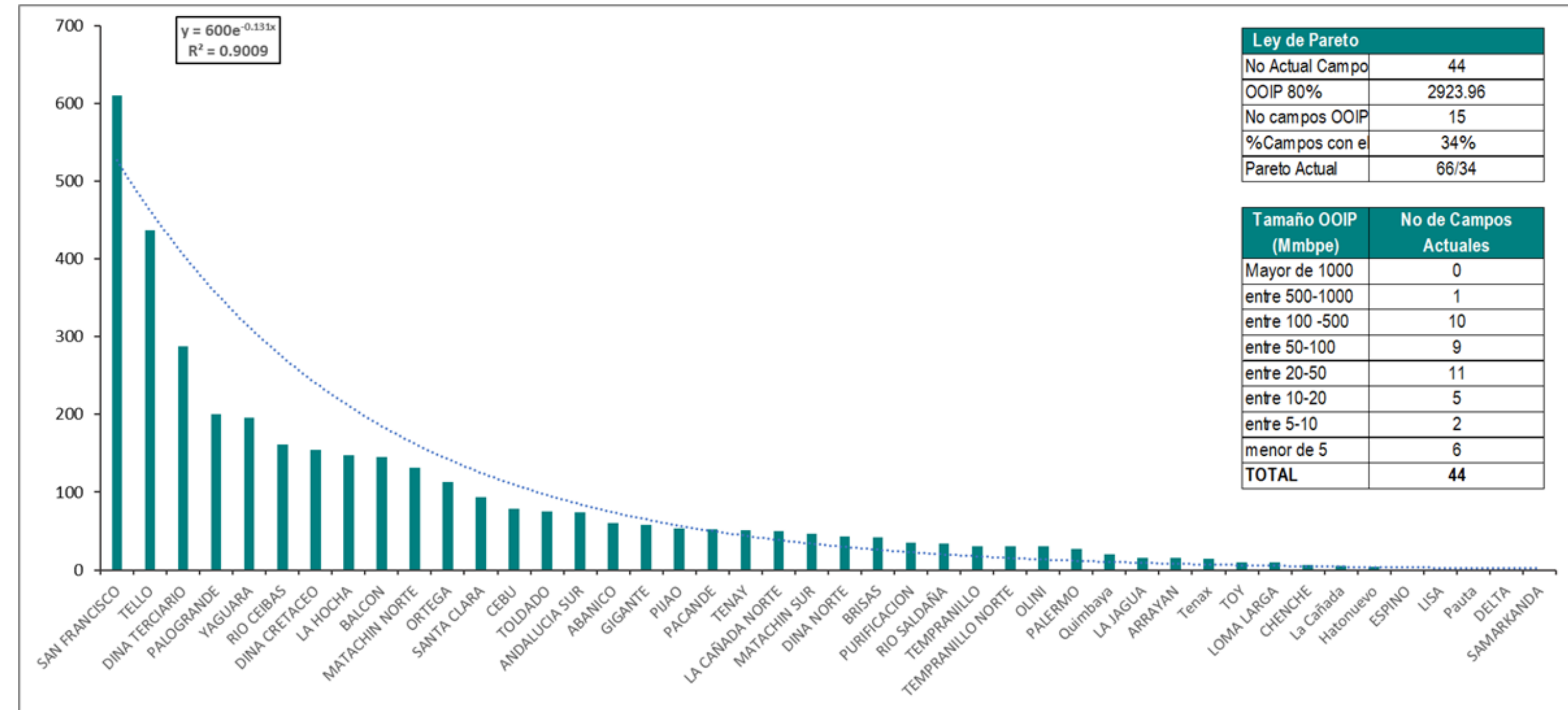
Campo	Año de descubrimiento	OOIP (Mmbpe) ANH 2020
Ortega	1951	112.90
Dina terciario	1961	287.84
Dina cretácico	1969	154.37
Palogrande	1971	200.58
Cebu	1971	78.32
Tello	1972	437.10
Brisas	1973	42.47
La jagua	1975	16.06
La cañada	1975	5.00
Andalucía sur	1980	74.54
Pijao	1982	53.13
San francisco	1985	610.00
Tenay	1985	51.21
Loma larga	1985	10.00
Hatonuevo	1985	3.50
Toy	1986	10.07
Palermo	1986	27.46
Toldado	1987	75.09
Yaguara	1987	195.55
Santa clara	1987	93.94
Quimbaya	1988	20.00
Rio ceibas	1988	161.22
Balcon	1988	145.01
Pacande	1989	52.10
Espino	1989	1.00
Rio saldaña	1990	33.84
Olini	1990	30.37
Purificacion	1991	35.00
Matachin norte	1992	131.00
Chenche	1993	6.93
Pauta	1993	1.00
Matachin sur	1994	46.00
Abanico	2002	60.70
La hochoa	2005	148.01
Gigante	2005	58.07
La cañada norte	2007	49.74
Tempranillo	2007	30.40
Tempranillo norte	2007	30.40
Arrayan	2007	15.92
Tenax	2007	14.00
Samarkanda	2008	0.51
Delta	2009	0.57
Lisa	2013	1.01
Dina norte	2017	43.00
TOTAL		3654.93

44 Fields & 3,6 Bboe

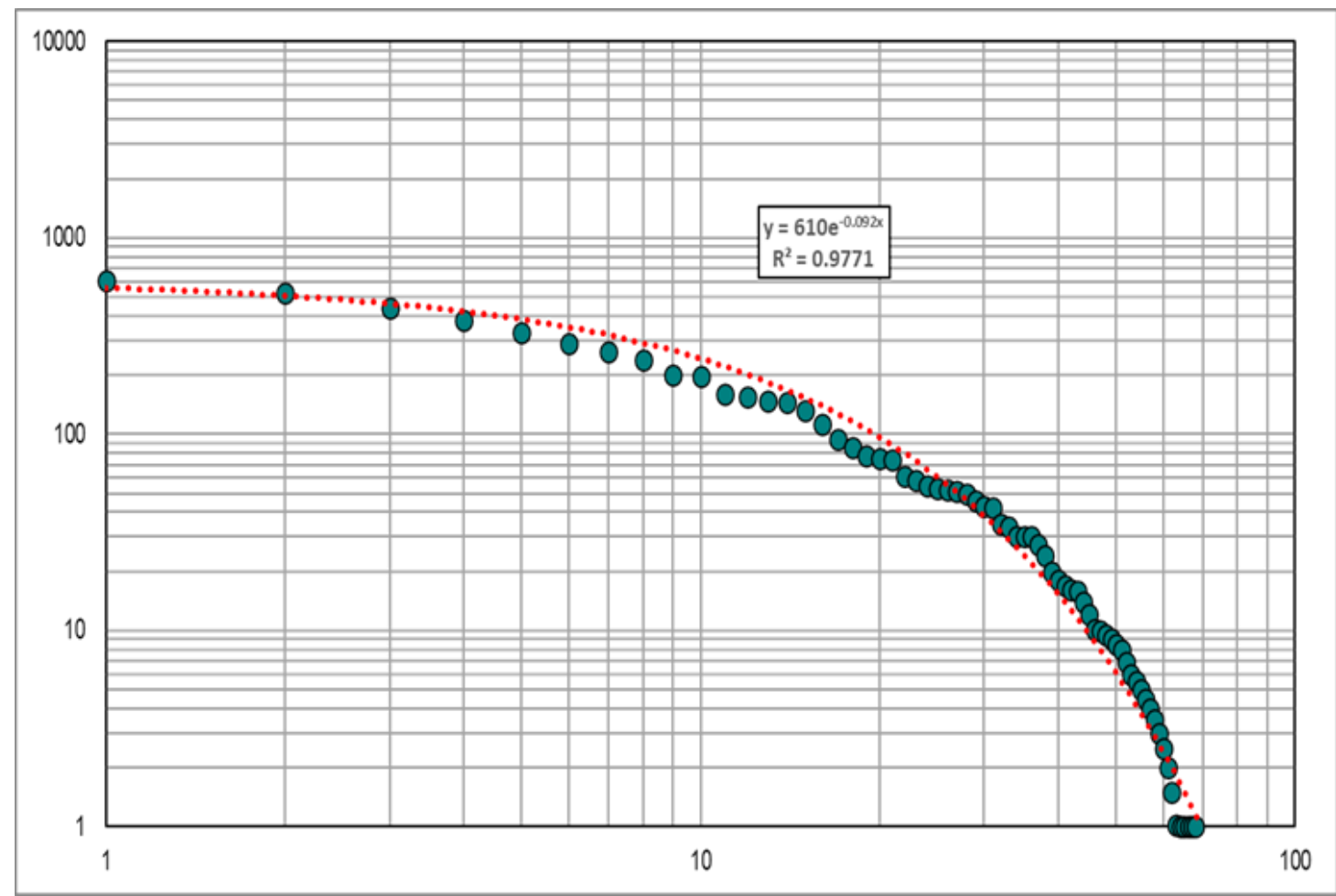
San Francisco Field = 0,6 Bboe



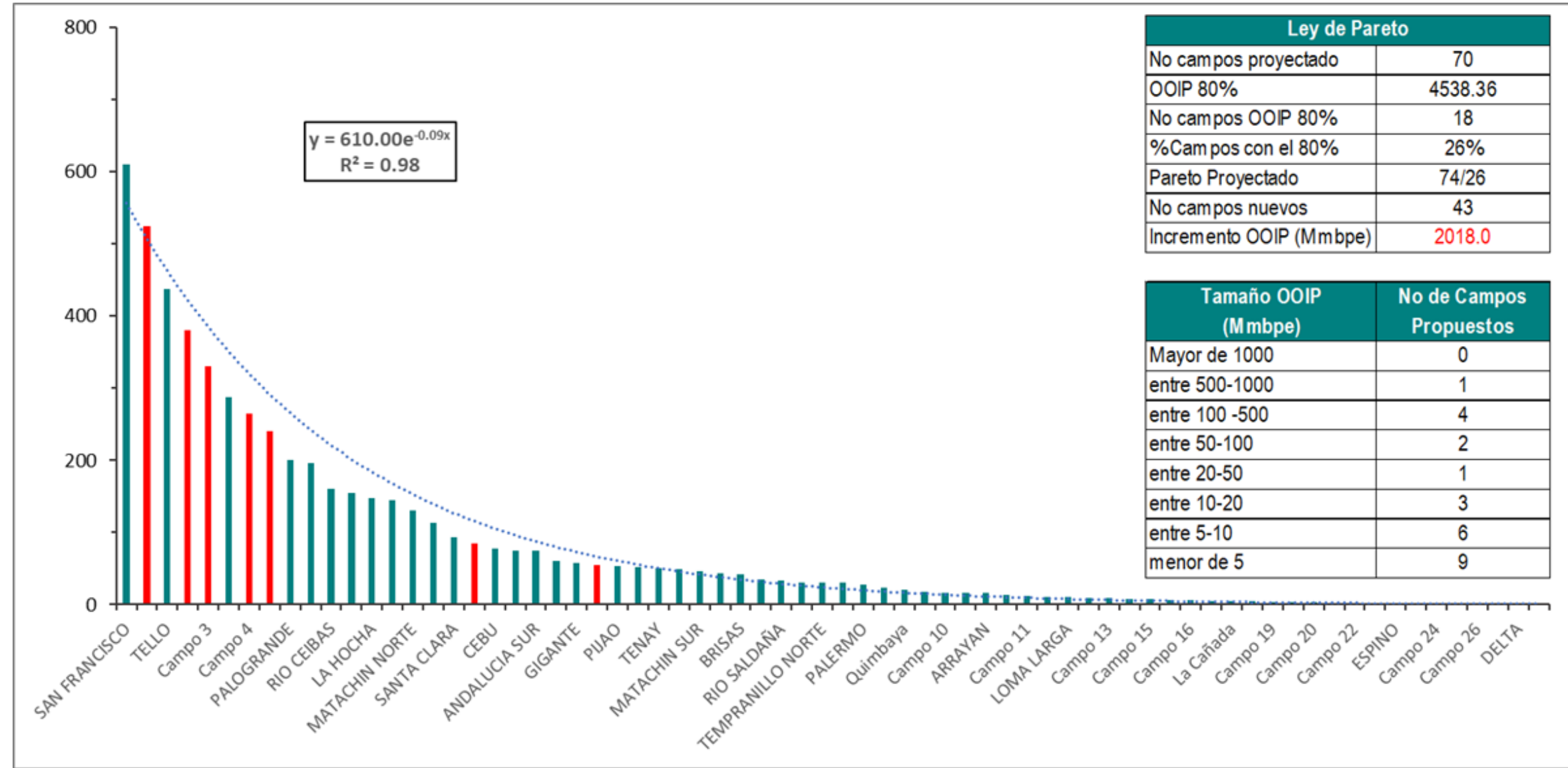
Current Fractal Analysis



Yet to Find Evaluation



Fractal Analysis Prognosis

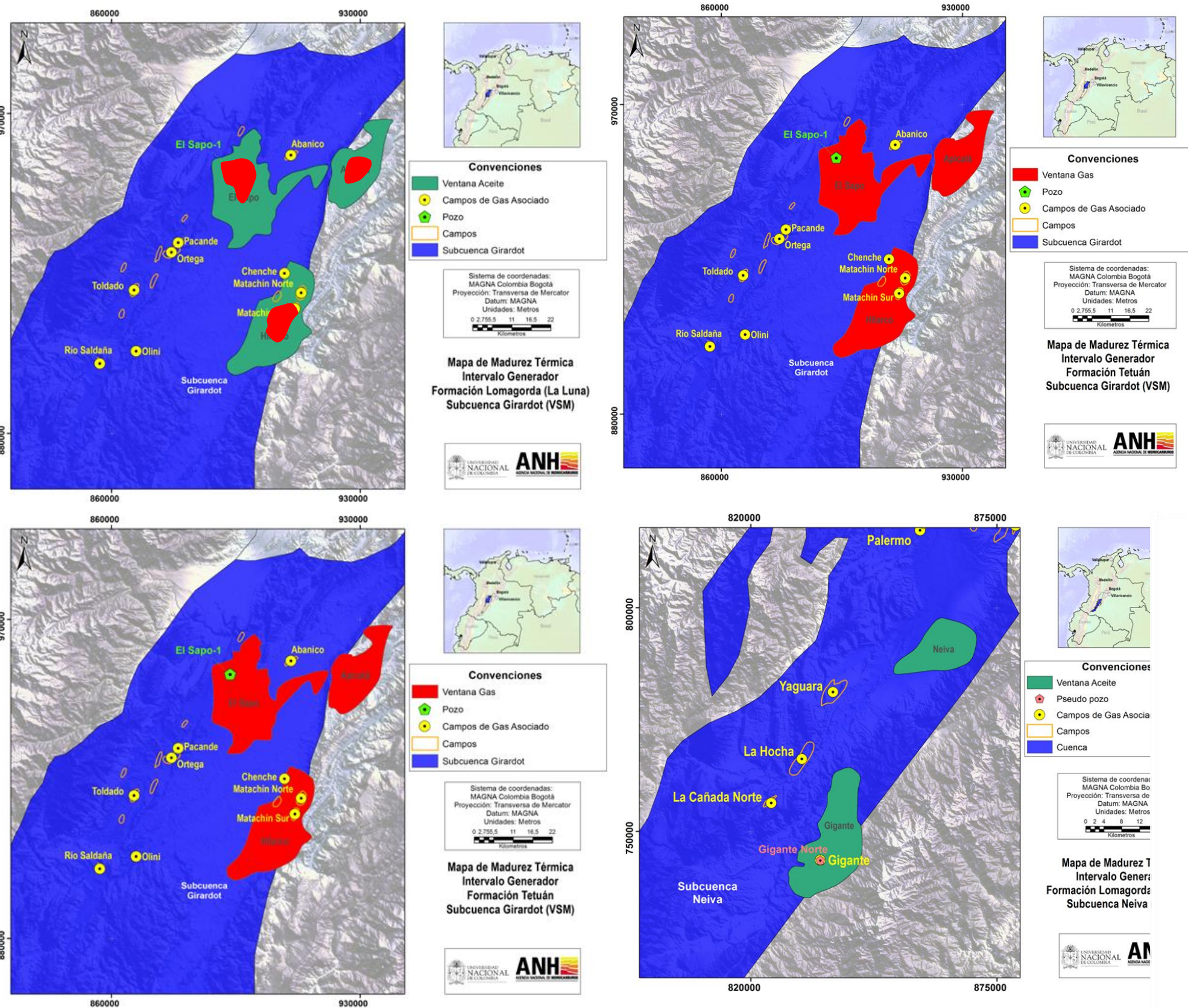


Tamaño OOIP (Mmbpe)	No. campos actuales	No. campos pronóstico	No. total campos
Mayor de 1000	0	0	0
Entre 500-1000	1	1	2
Entre 100 -500	10	4	14
Entre 50-100	9	2	11
Entre 20-50	11	1	12
Entre 10-20	5	3	8
Entre 5-10	2	6	8
Menor de 5	6	9	15
TOTAL	44	26	70

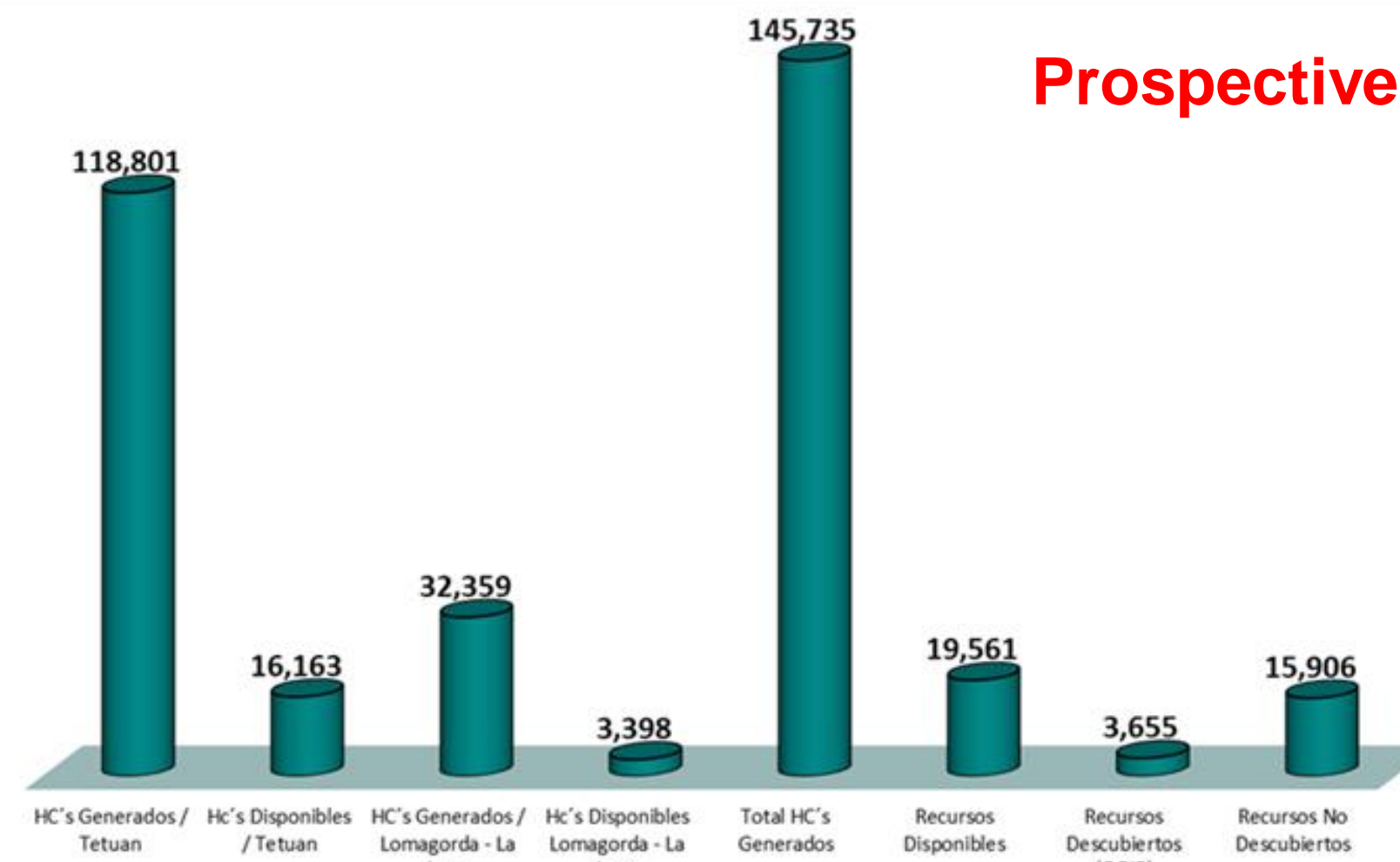
26 Additional Fields

Prospective Resources (OOIP) = 2 Bboe

Yet to Find Evaluation / Mass Balance



PARÁMETROS	UNIDADES	CUENCA VSM		TOTAL
		SUBCUENCA GIRARDOT	SUBCUENCA NEIVA	
HC's Generados / Tetuan	Mmbpe	64,232	54,570	118,801
Hc's Disponibles / Tetuan	Mmbpe	8,796	7,367	16,163
HC's Generados / Lomagorda - La Luna	Mmbpe	26,297	6,062	32,359
Hc's Disponibles Lomagorda - La Luna	Mmbpe	2,761	637	3,398
Total HC's Generados	Mmbpe	90,529	55,206	145,735
Recursos Disponibles	Mmbpe	11,558	8,003	19,561
Recursos Descubiertos (OOIP)	Mmbpe	617	3,038	3,655
Recursos No Descubiertos	Mmbpe	10,941	4,966	15,906
Probabilidad de Hallazgo	%	15%	15%	
Recursos Prospectivos (OOIP)	Mmbpe	1641	745	2386
Recursos Prospectivos Recuperables (FR = 25%)	Mmbpe	410	186	596



Prospective Resources (OOIP) = 2.3 Bboe

