



Apache Energía Argentina

AUSTRALIA

ARGENTINA

CANADA

EGYPT

NORTH SEA

U.S. CENTRAL

U.S. GULF



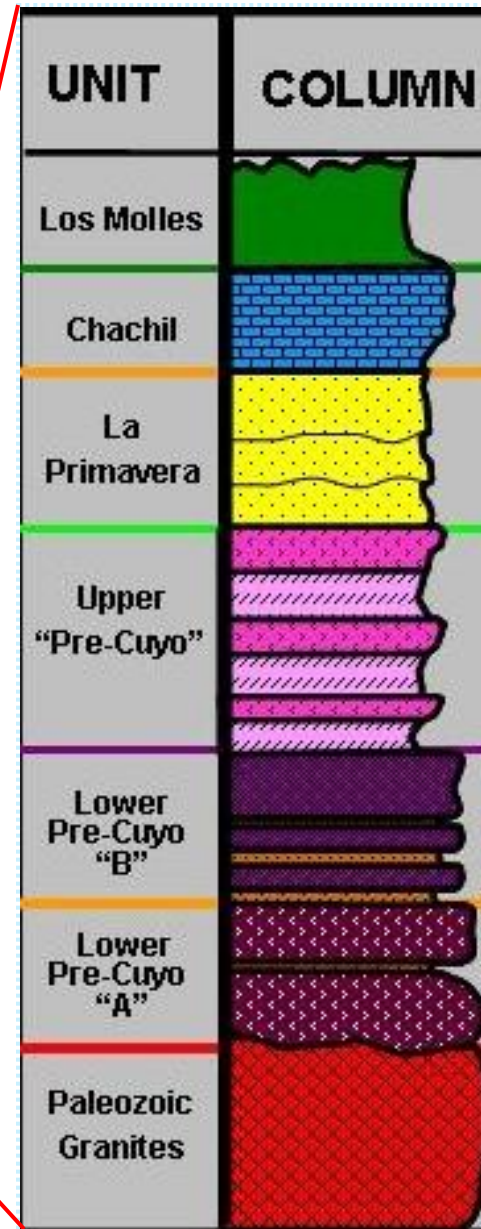
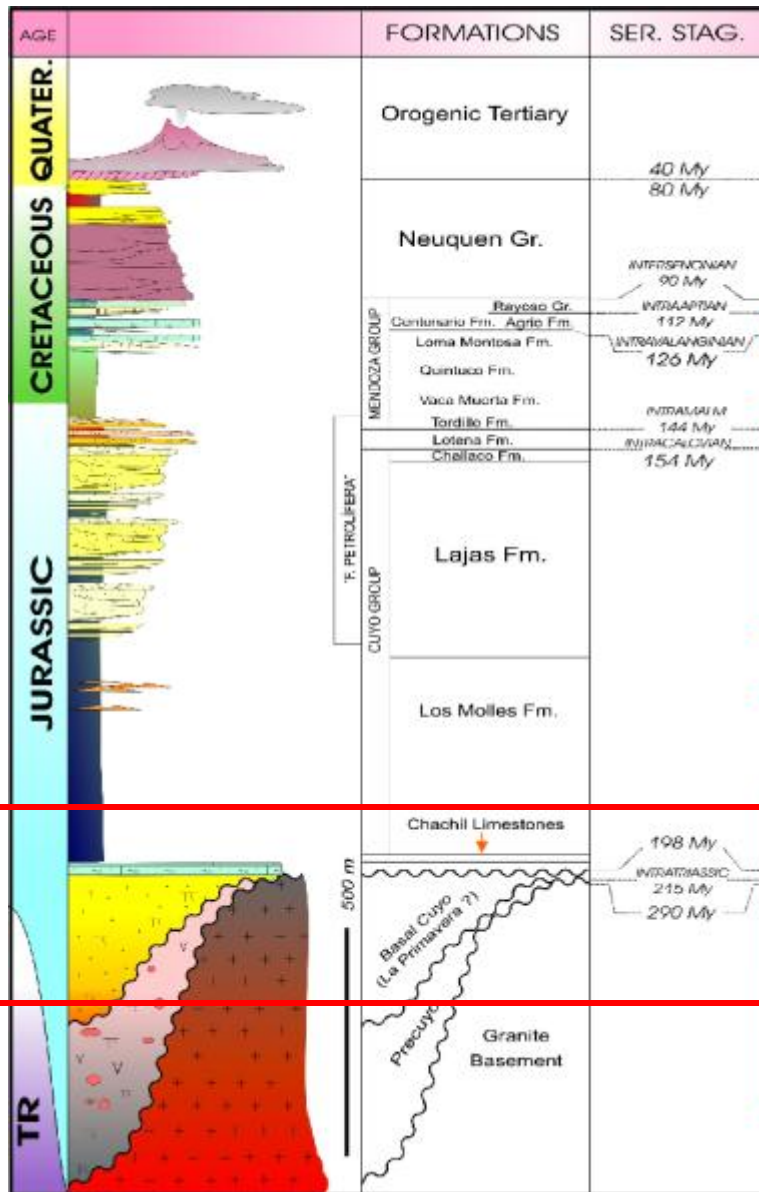
Algunos ejemplos Precuyo-Basamento en AND

S. Lopez-V. Sissini-L Rodriguez-Mi. Lavia-G.Borges-S.Vargas

Setiembre 2010

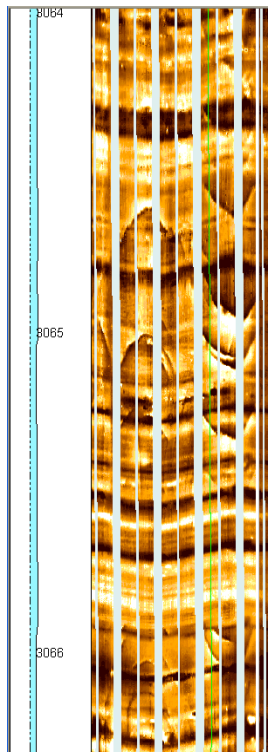
Apache Corporation is one of the world's top independent oil and gas companies with exploration and production interests in the United States, Gulf of Mexico, Canada, Egypt, Australia, North Sea, Argentina and Chile. Our mission is to grow a profitable company for the long-term benefit of our shareholders by building a portfolio of core areas which provide long-term growth opportunities. Apaches' strategy includes constructing a balanced portfolio of assets and maintaining financial flexibility, while maximizing earnings and cash flows by controlling costs.

Columna Estratigráfica

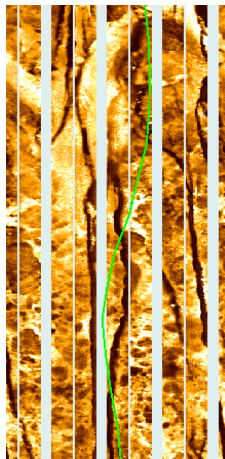


Reservoir Facies

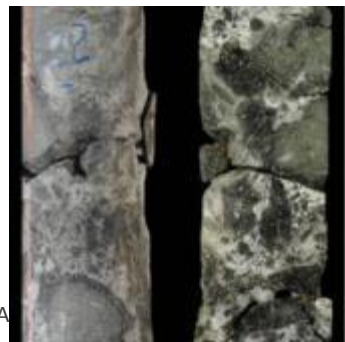
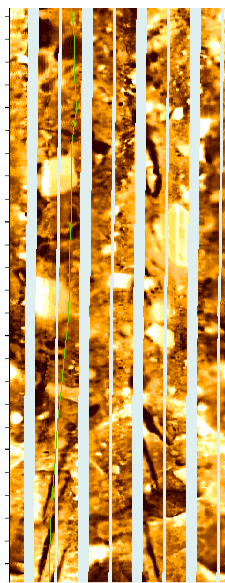
Los Molles



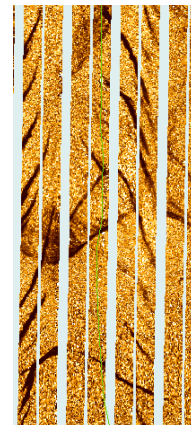
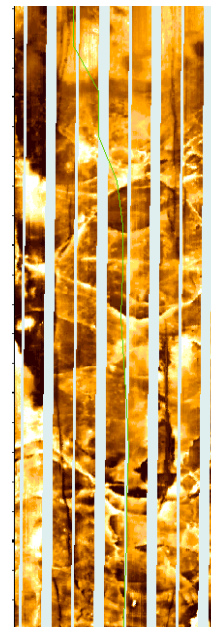
Volc. Bx



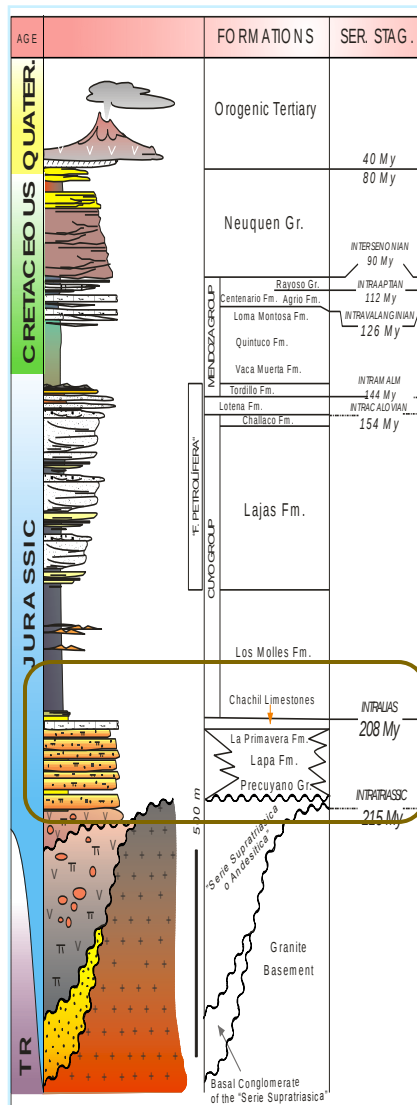
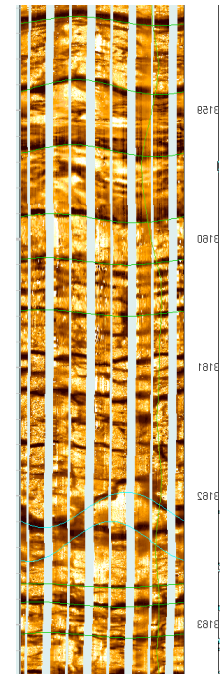
Volc. Bx



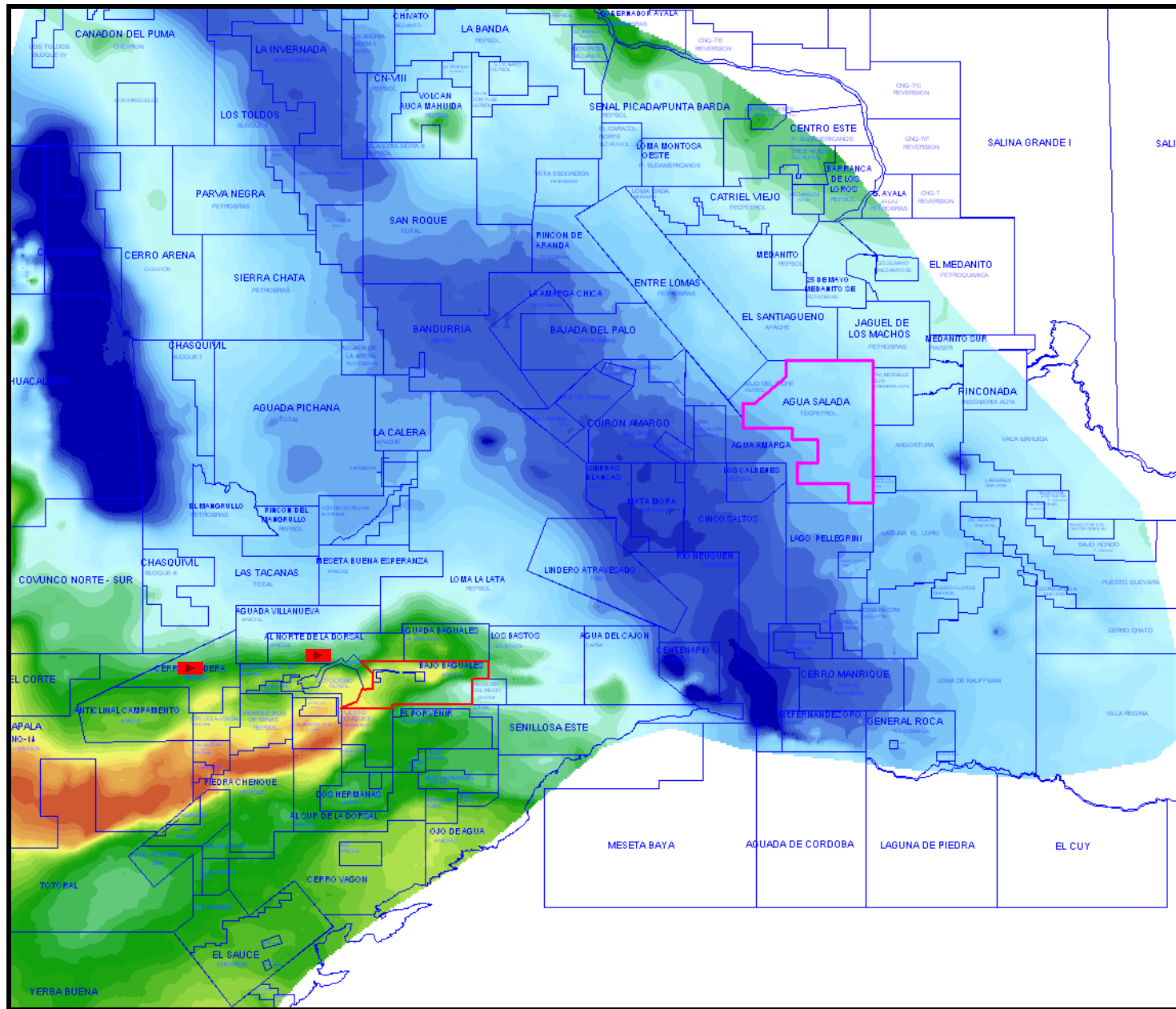
Massive Volc



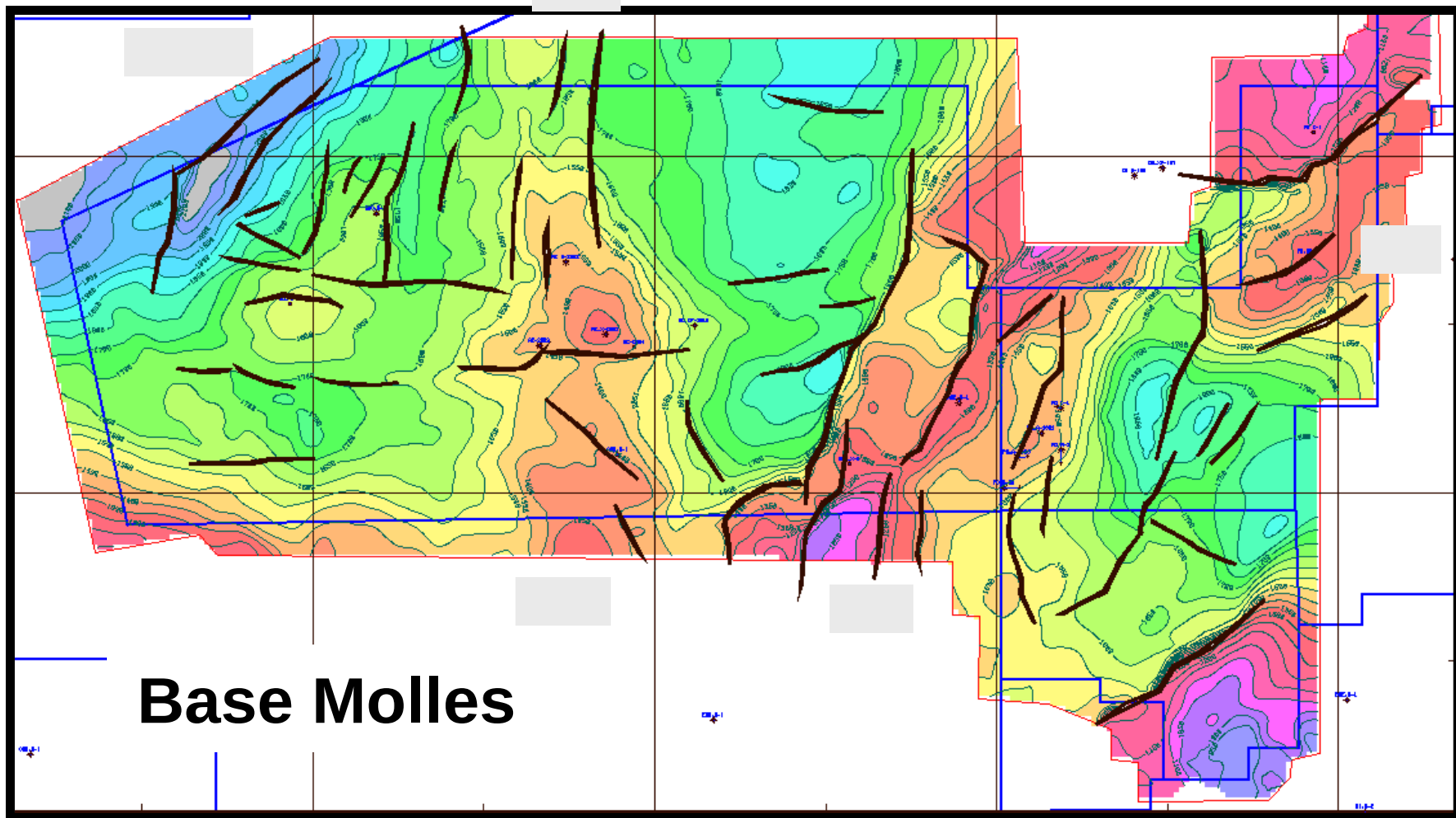
Chachil Limstn.



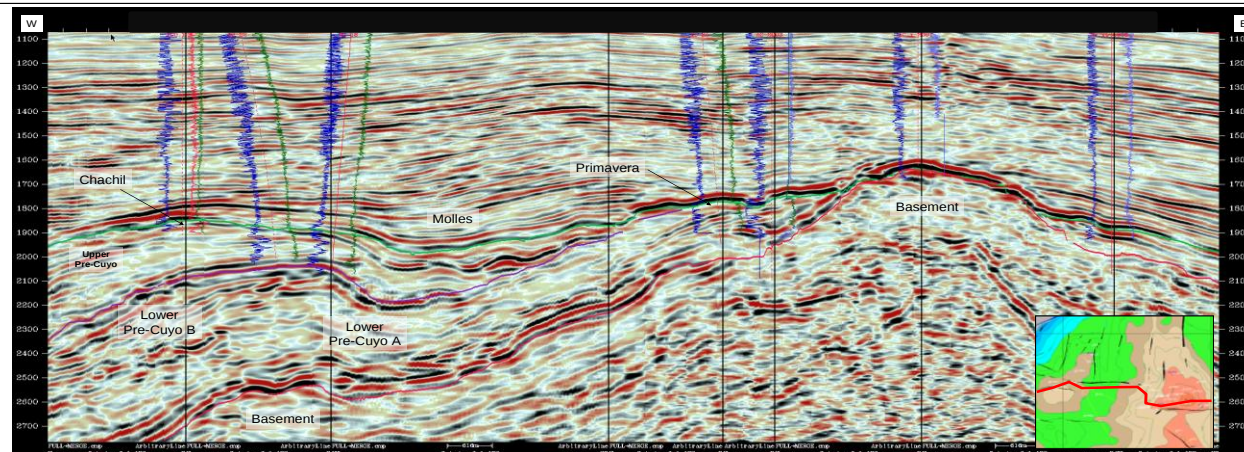
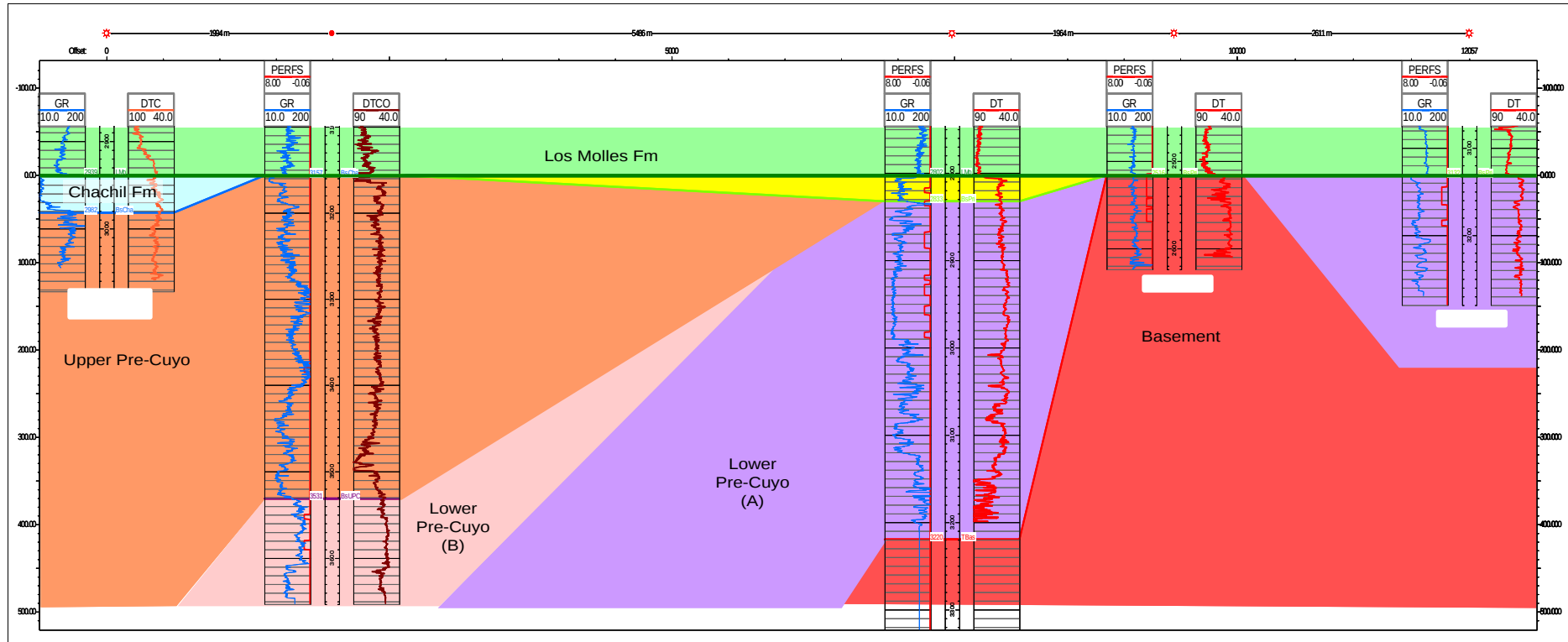
Gas Profundo en Basamento de la Cuenca Neuquina



Mapa Estructural a la base de la Fm Molles



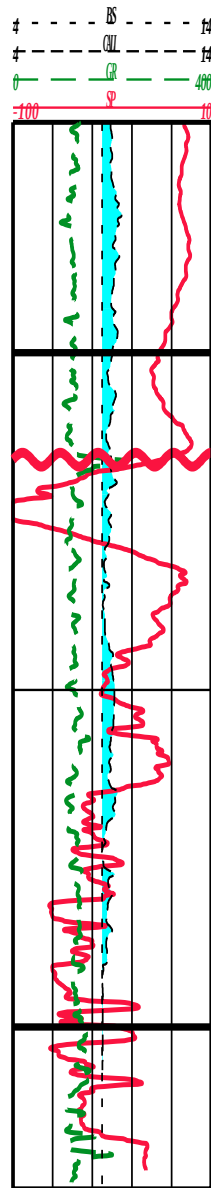
Distribución de las Facies



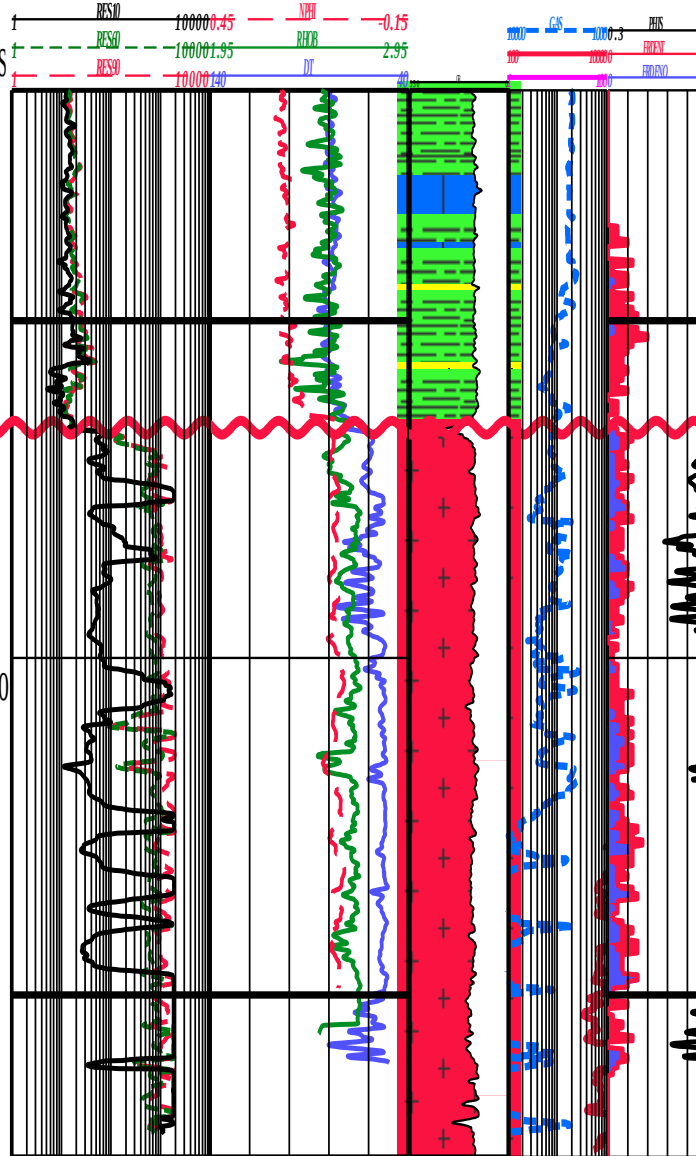
Basamento Granítico

(Anticlinal Campamento Main) COMPOSITE

LOG



Meters MD TVDSS



Meters TVD

PLT @10/04

Top Basement
2516 m MD
(-1662) m TVDSS

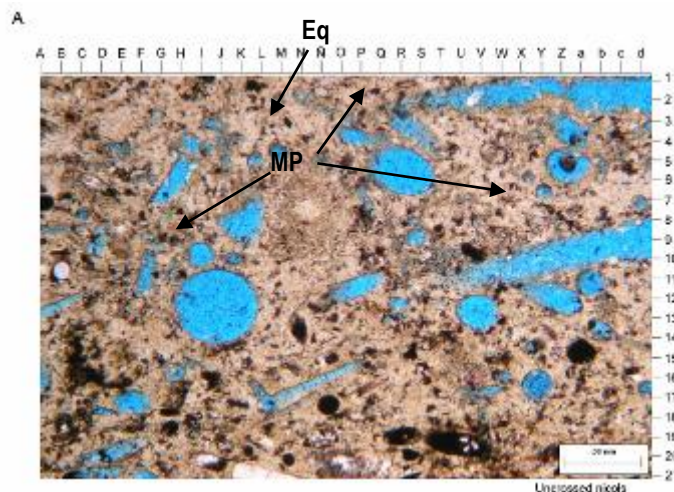
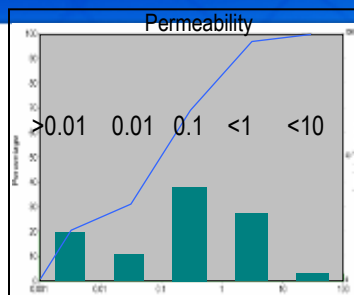
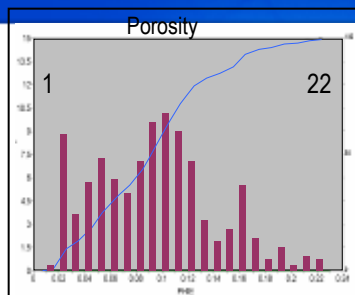
0%
1%
98%
1%

2515/69 – After Acid
Flow x12mm Dry Gas,
Qg: 262,000m3/d,
WHFP: 1680 psi

(Anticlinal Campamento Oeste) COMPOSITE LOG

← 4 1/2" CSG k-55 PERFORATED 11.6
LB/FT , 140.73 m from 2,930.27 to
3.071 m

Silicified Limestone

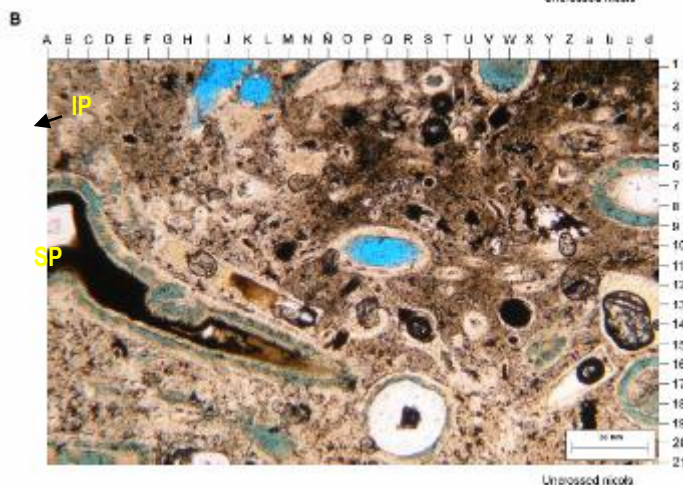


MP = Moldic Porosity

IP = Intraparticle Porosity

SP = Spicules

Eq = Echinoderms



Sidewall core DEPTH: 2946.60 mbgl

CLASSIFICATION: PACKSTONE / GRAINSTONE (SILICIFIED)

Compositional table

GRAINS	MATRIX-CEMENT	POROSITY	PETROPHYSICAL DATA	
			Porosity	Permeability
61%	24%	15%	11.2%	nd mD

Mineralogic table

SILICA	CALCITE	DOLOMITE
97%	3%	-

GRAINS

Carbonate grains:

Sclerites: 96% of traxon, tetraxon and monoaxon sponge spicules (0.05-0.20 mm) entirely or partially replaced, mainly by chalcedony. 3% echinoderms of 0.45-0.82 mm (A: N-Z) and 1% valve fragments, both calcitic in composition.

GRAIN SIZE: fine to medium sand (0.15-0.25 mm).

SORTING:

Moderately well sorted.

TYPE OF GRAIN-TO-GRAIN CONTACTS:

Point: dominant.

Straight: scarce.

GENERAL TEXTURE: clast supported.

MATRIX / CEMENT

Intergranular material consists of microcrystalline silica (B: C-10, B-15) which masks the original composition and texture. Calcite (0.5%) as pore filling.

POROSITY

Primary and secondary.

• **Abundance:** good.

• **Pore size:** average size is 0.15 mm. 52% mesopores (0.07-0.23 mm), 40% micropores (0.02-0.06 mm) and 8% macropores (0.27-0.32 mm).

• **Sorting:** moderate to poor.

• **Distribution:** heterogeneous (in laminae).

• **Texture:** selective fabric: 81% moldic (A: J-13; B: J-2) and 12% intraparticle (B: D-9, C-6); non-selective fabric: 7% microfissures.

DIAGENESIS:

Several diagenetic events have been identified. They are listed below in an approximate chronological order.

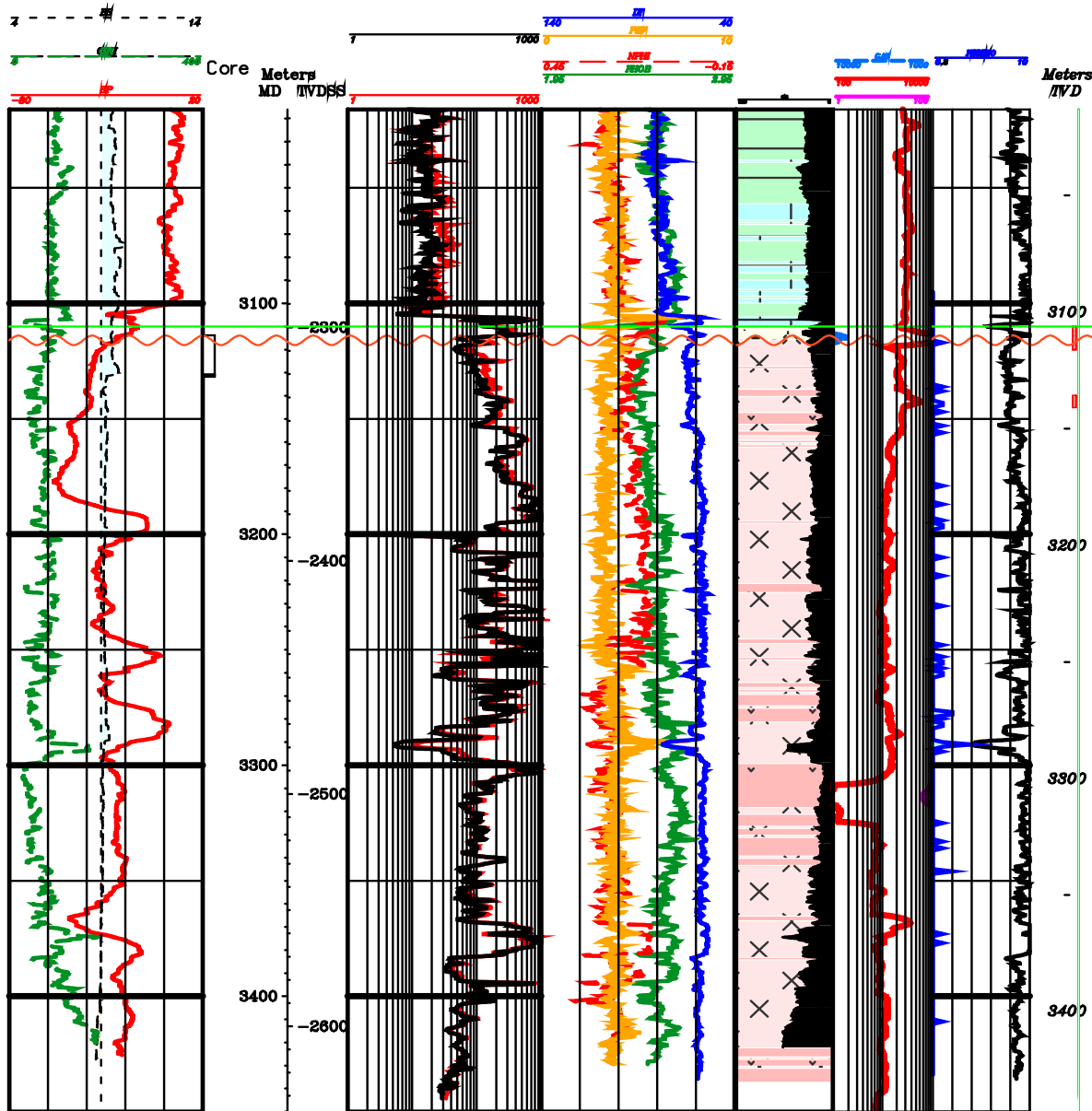
- Compaction.
- Dissolution.
- Silicification.
- Calcite.

OBSERVATIONS:

The sample shows levels composed of microcrystalline silica without bioclasts, probably micritic in origin.

Pre-Cuyo

[Anticlinal Campamento Oeste) COMPOSITE LOG



Ignimbritas



Sidewall core 2619.00 mbgl

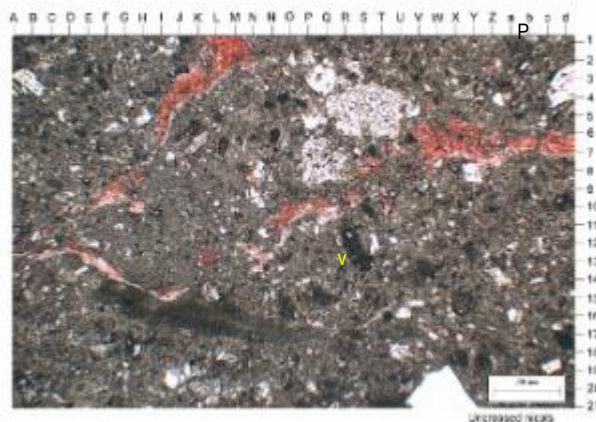
Ignimbrite: very fine ash sized vitric shards and fiammes with chloritic alteration are seen. Crystalloclasts are very fine ash sized and consist of plagioclases and quartz. Andesite lithoclasts are recognized. Scarce fissures are observed.

Color: light greenish gray (5GY 8/1).

sidewall core

DEPTH: 2619.00 mbgl

A



CLASSIFICATION: INGNIMBRITE (andesitic-dacitic)

VITRIC MATERIAL	CRYSTALLOCLASTS	LITHOCLASTS	POROSITY
76%	10%	14%	—

Vitric material is made up of very fine ash and dust sized *vitric shards* and common *fiammes* (A: K-16) altered to chlorite. It is slightly devitrified and partially altered to clays.

Crystalloclasts are very fine ash, dust and subordinate medium to coarse ash sized. They consist of subhedral to euhedral *plagioclases* (B: F-18) and scarce *quartz*. Some *plagioclases* are partially replaced by *calcite*.

Lithoclasts are represented by fine to very coarse ash and scarce lapilli sized, angular to subangular *andesites* (B: H-2) and *vitric tuffs*.

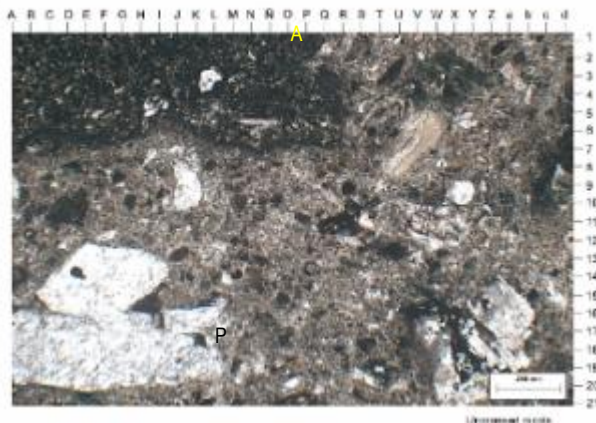
Calcite (2%) is found as *replacement*.

The following **diagenetic** processes and products have been identified, they are listed below in a relative chronological order:

- Clay alteration.
- Devitrification.
- Compaction.
- Microfissures.
- Calcite replacement.

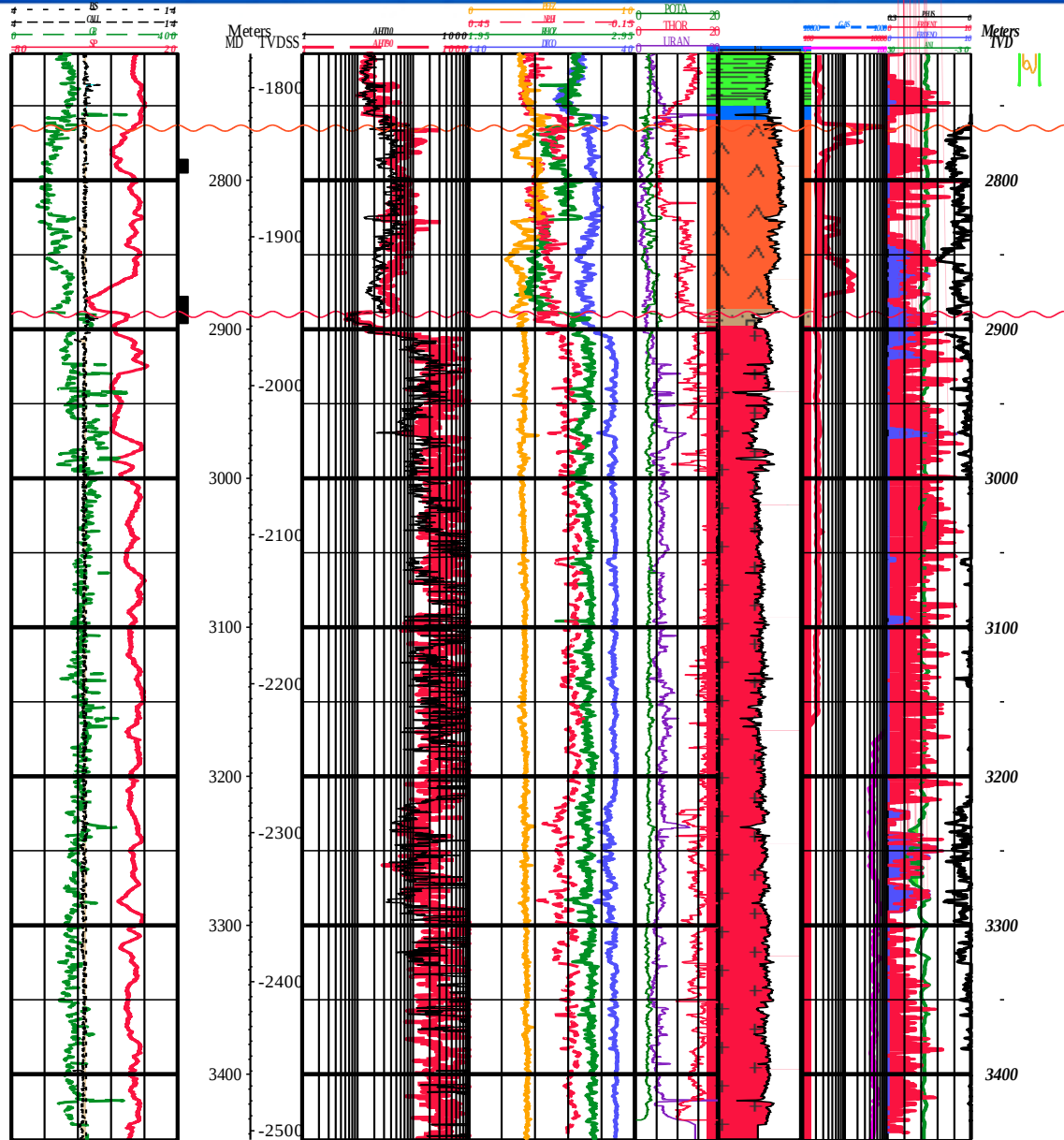
Observation: discontinuous microfissures from 0.05 to 0.25 mm filled with *calcite* (A: K-3). Moderately welded ignimbrite.

B



Pre-Cuyo

ACS x-1(Anticlinal Campamento Main) COMPOSITE LOG



PLT @10/05

Top PreCuyo
2765 m MD
(-1817) m TVDSS

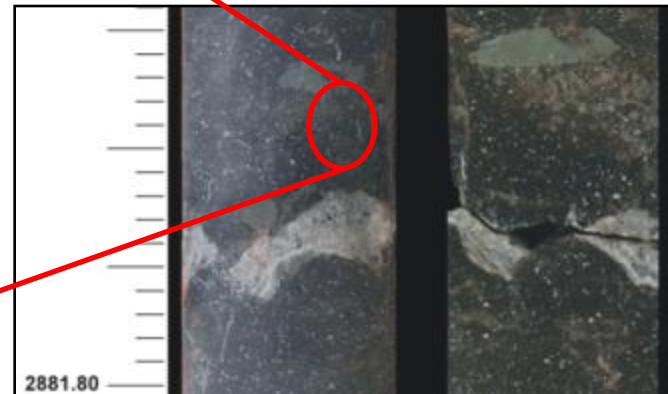
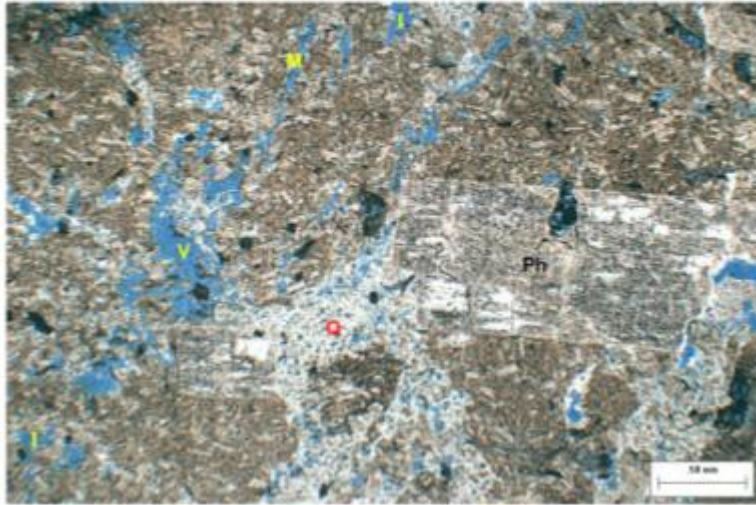
98%

2% Top Basement
2890 m MD
(-1965) m TVDSS

Open Zone: 2736/3444
Flow Gas x12mm,
Qg: 203,249m3/d,
WHFP: 1500psi

Corona en Andesita

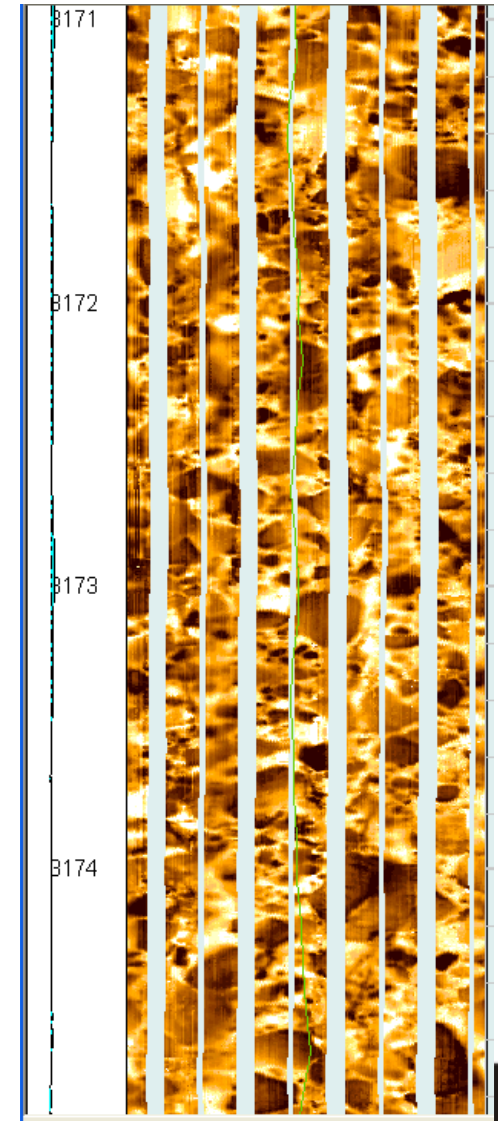
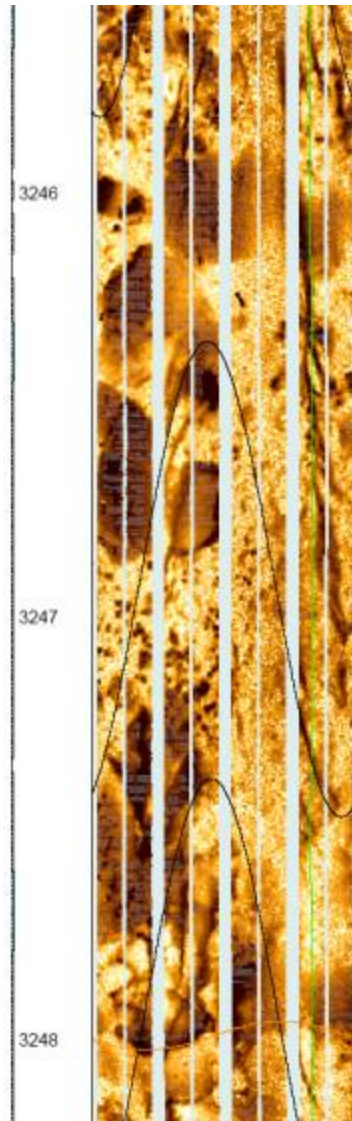
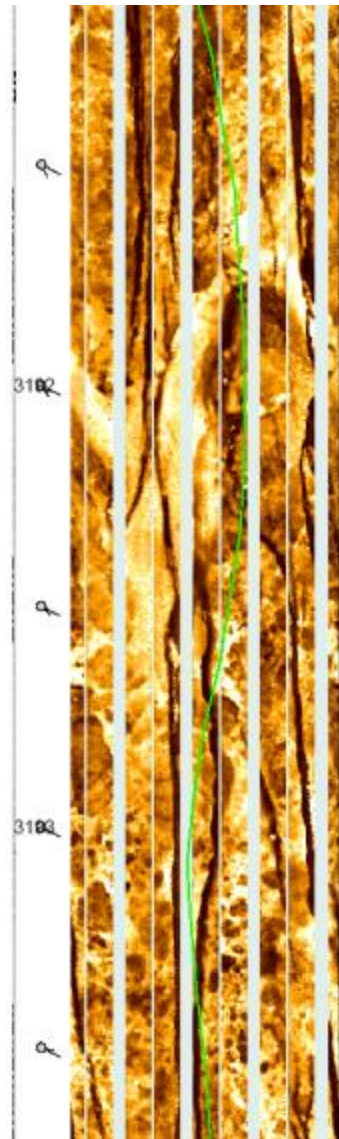
A.- Sample 2-16-10 (2881.70 mbgl). Volcanic rock with porphyritic texture made up of phenocrysts (Ph) set in a mass with intersertal texture. Quartz microcrystals (Q) as partial pore and fissure filling. Moderate porosity (9%) with open microfissures (M), irregular pores (I) and vugs (V) related to fracturation. Uncrossed nicols.



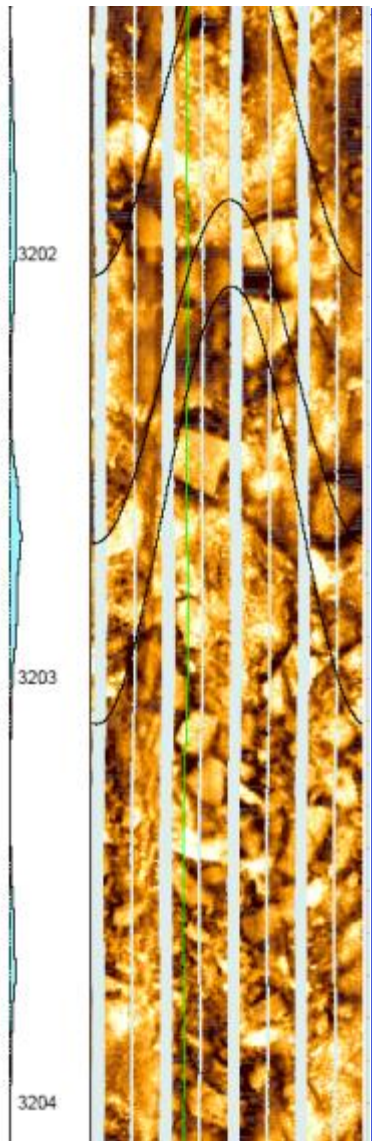
B.- Sample 2-14-18 (2883.58 mbgl). Volcanic rock with porphyritic texture made up of phenocrysts (Ph) set in a mass with intersertal texture. Quartz microcrystals (Q) and chlorite (Ch) as partial to total fissure filling. Moderate porosity (10%) with open microfissures (M). Uncrossed nicols.



Breccias con matrix resistiva

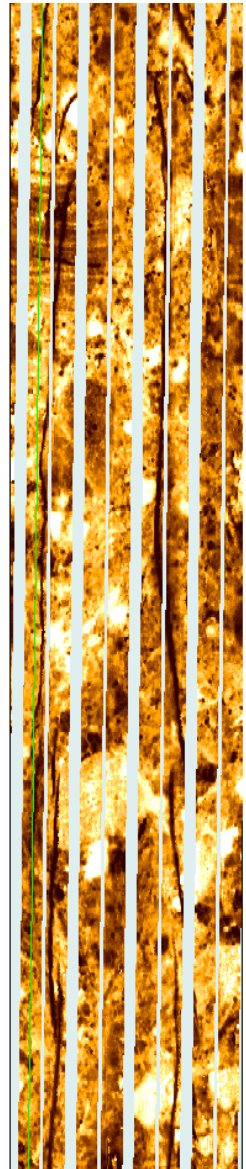


Breccias con matriz conductiva

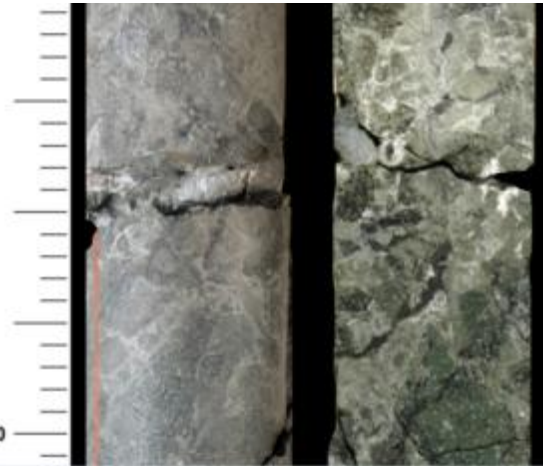


3479

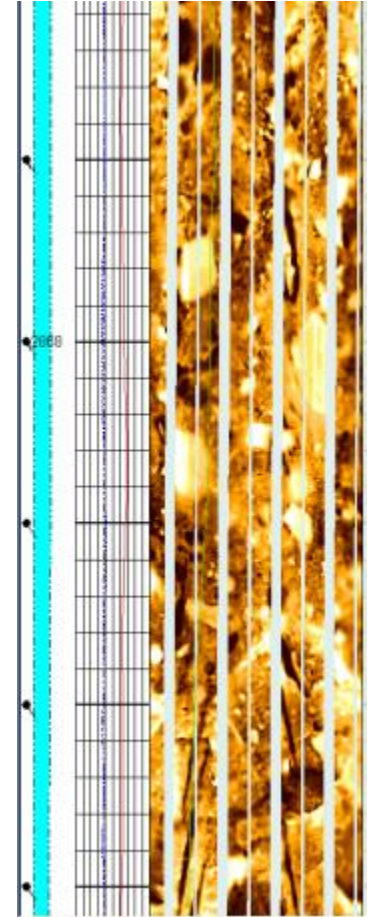
3480



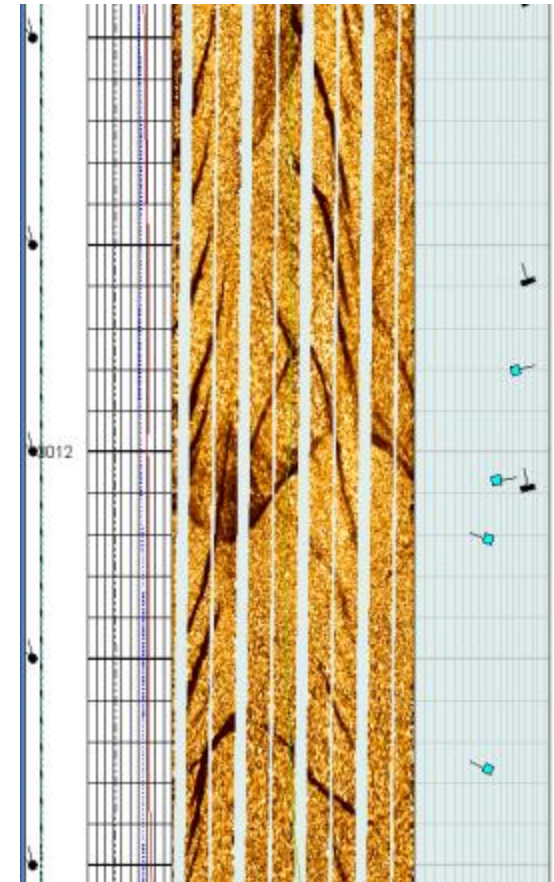
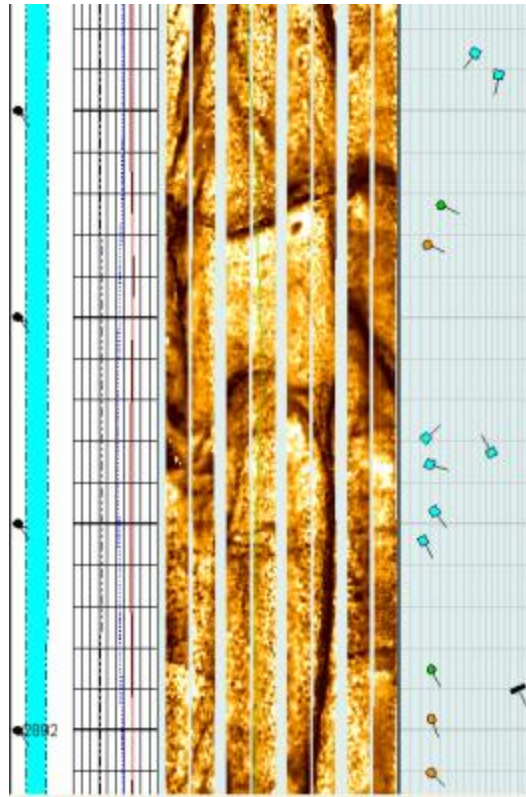
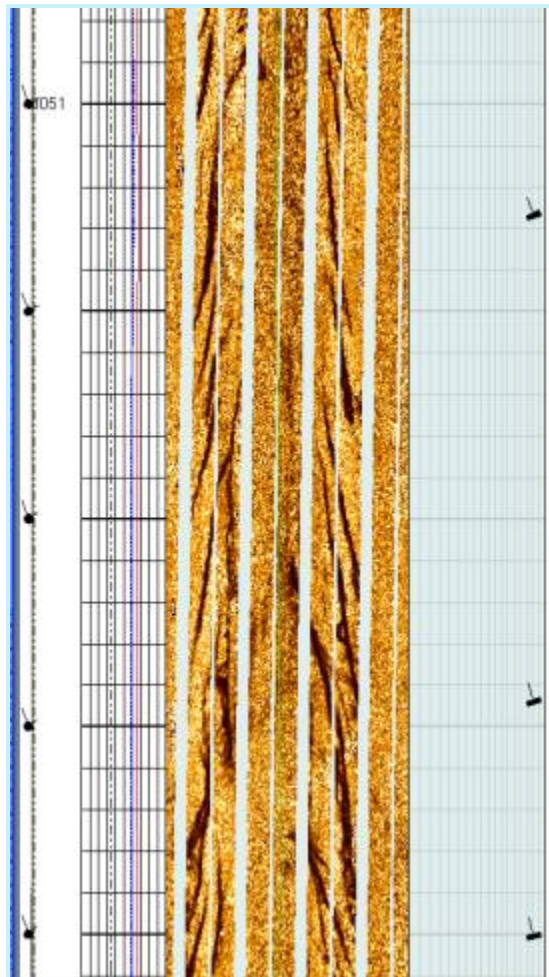
2793.00



2791.80



Bimagen en basamento Granítico

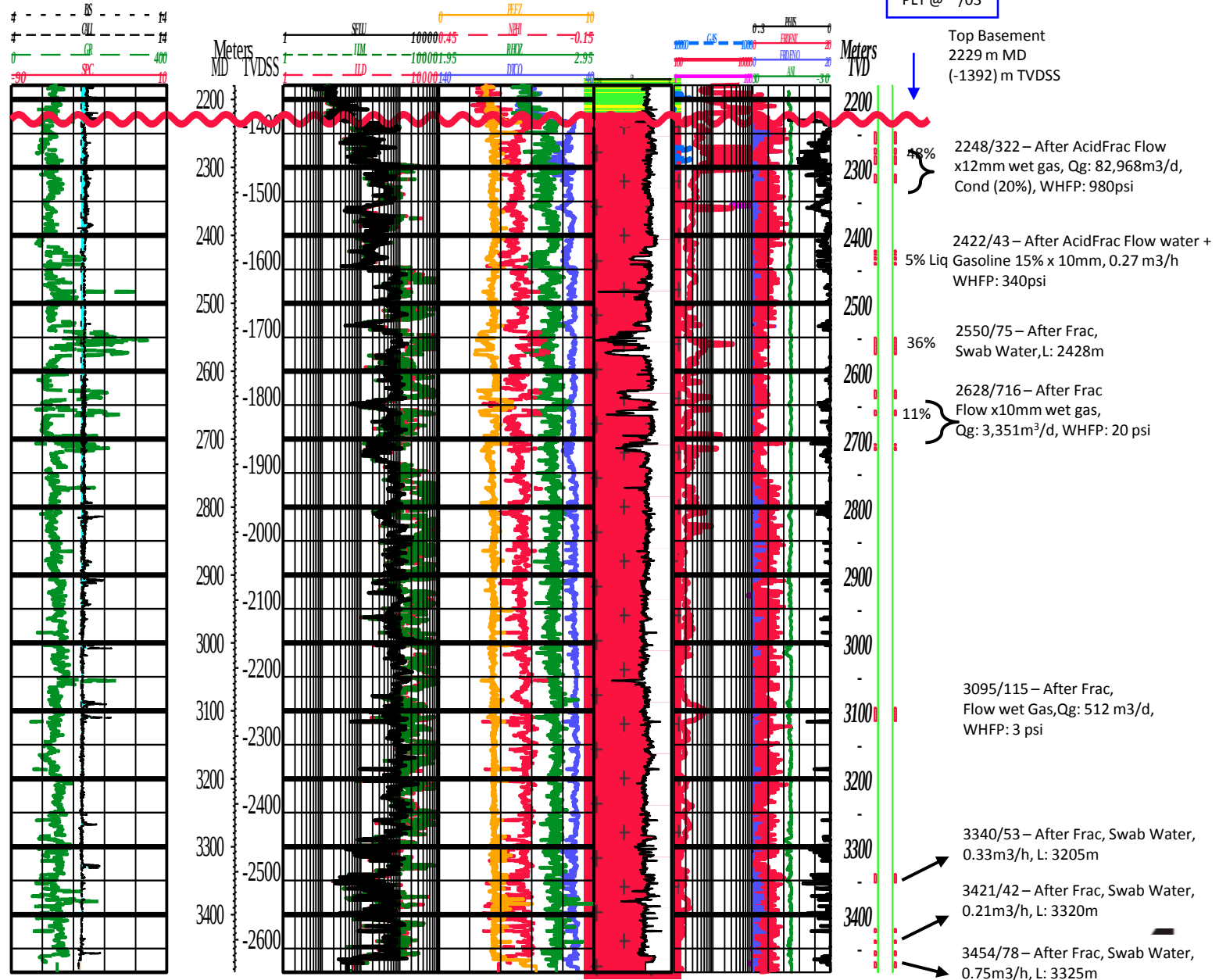


Basamento Granítico

PLT @ /03

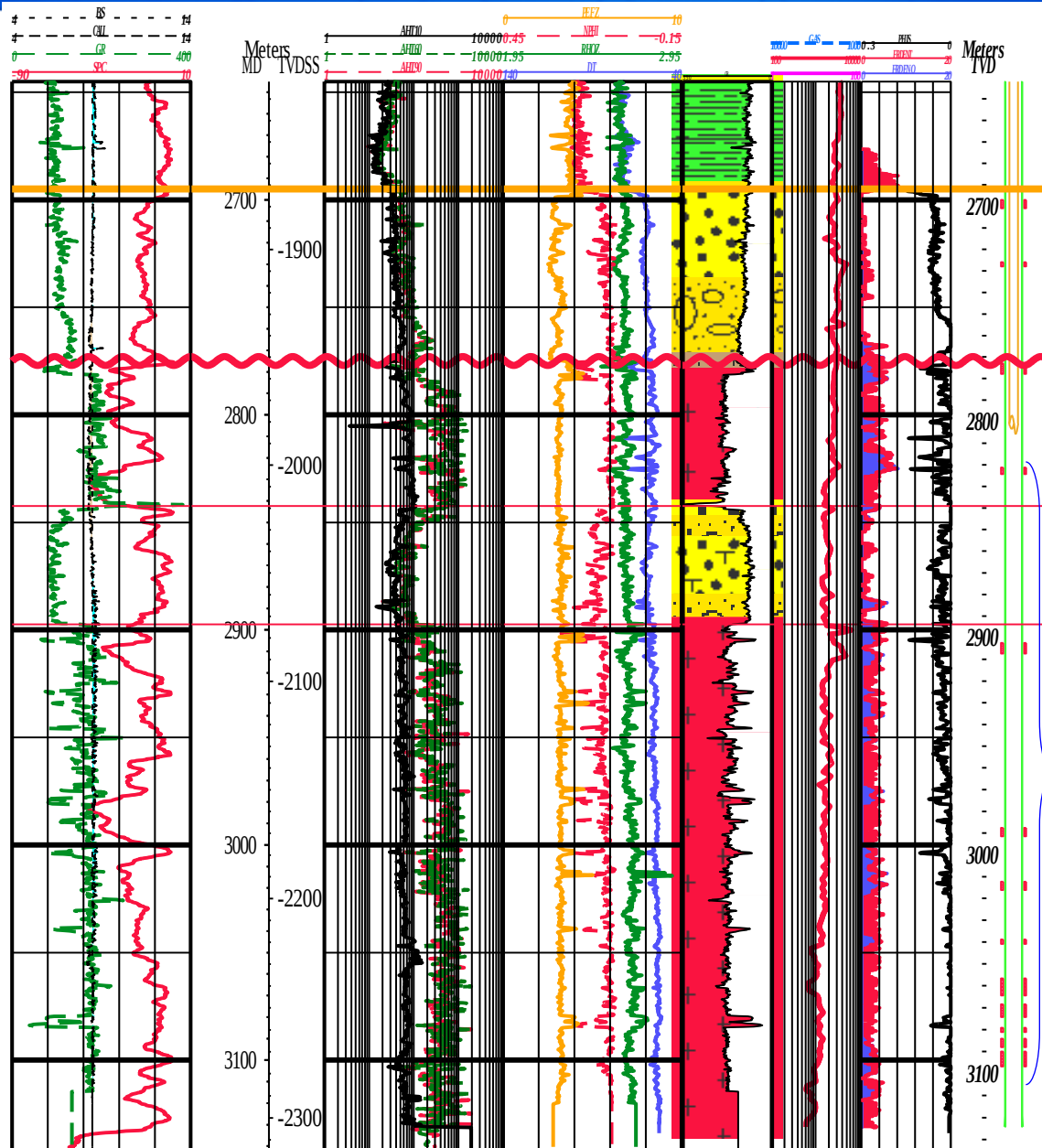
Top Basement
2229 m MD
(-1392) m TVDSS

COMPOSITE LOG



Basamento + Primavera (Primavera?)

COMPOSITE LOG



PLT @ /04

Top CGL
2695 m MD
(-1872) m TVDSS

2700/81 - WHFP: 3110 psi
Flow x 14mm, Og: 89,168
m³/d

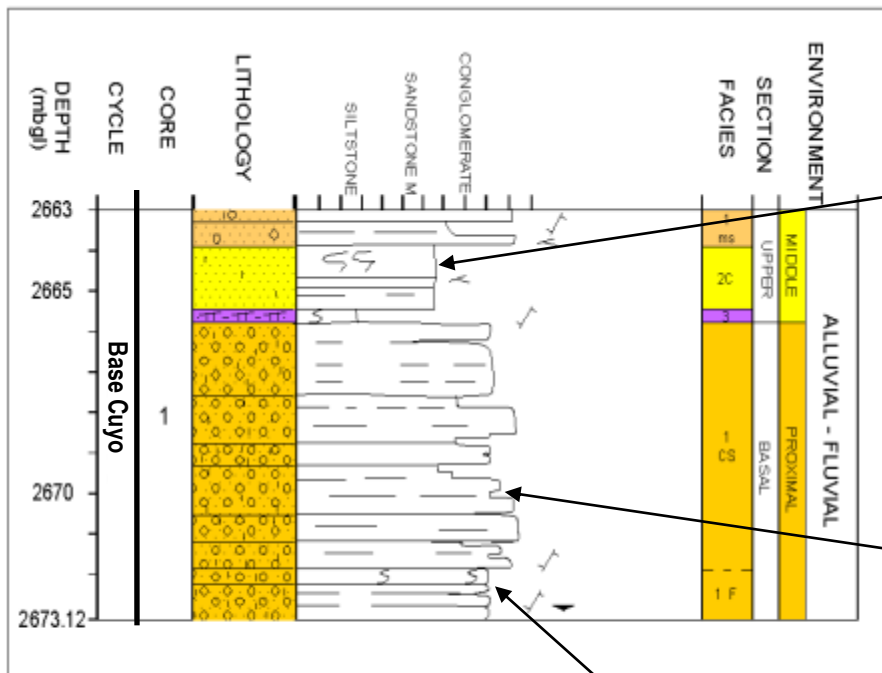
Top Basement
2775 m MD
(-1952) m TVDSS

Top CGL II
2842 m MD
(-2010) m TVDSS

Top Basement
2897 m MD
(-2074) m TVDSS

2824/3103 – After Frac
Flow x10mm 0.35 m³/h,
Cond (25%),
Og: 92.800 m³/d,
WHFP: 880 psi

Primavera



1 ms Matrix-supported conglomerates
1 cs Clast-supported conglomerates

2c Cross-bedded sandstones
1 F Fractured conglomerates
3 Tuffites

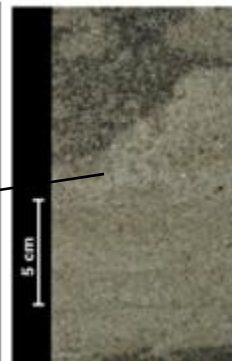
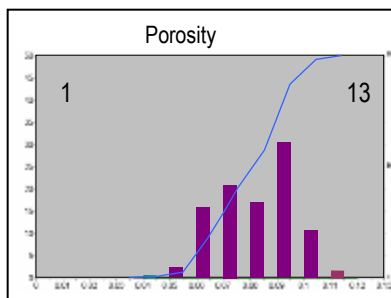


Figure 2: LITHOFACIES 2c (Cross-bedded sandstones)

A - Cross-bedded sandstone with diagenetic alterations, probably related to irregular calcite-cement distribution. The darker color corresponds to bitumen.
Near petrophysical data: $\phi = 2.15\%$, $K = 0.019$ mD.
Depth: 2664.21-2664.42 mbgl.

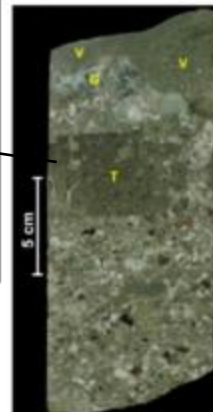
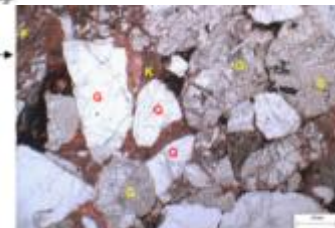


Figure 5: LITHOFACIES 1cs (Clast-supported conglomerates)

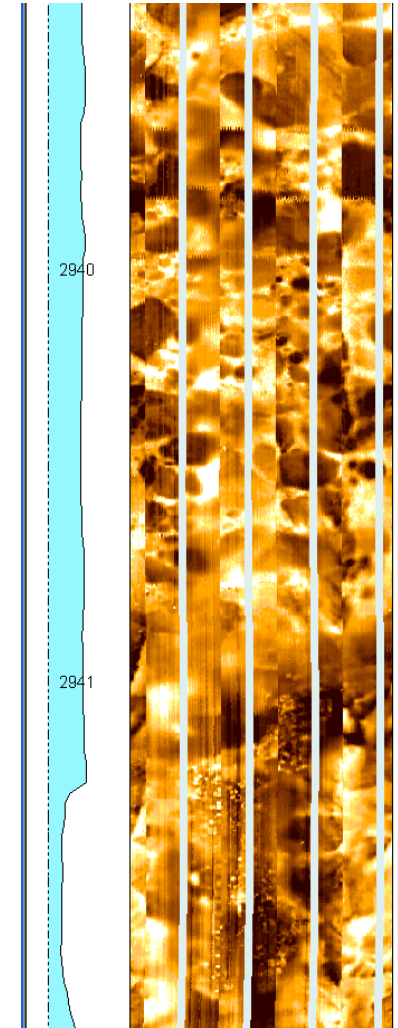
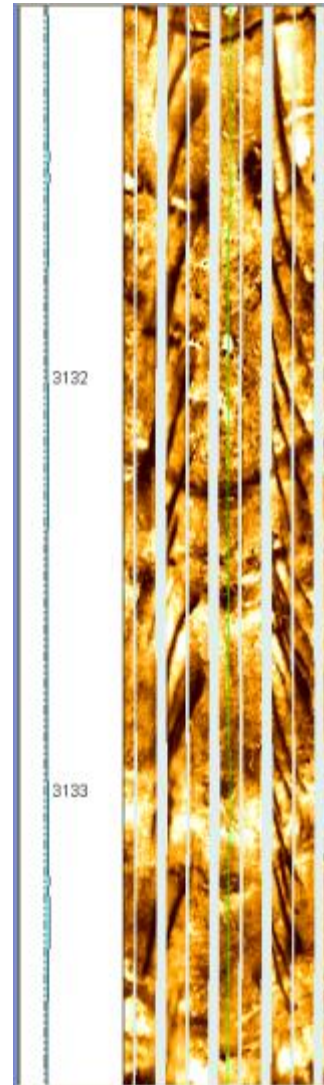
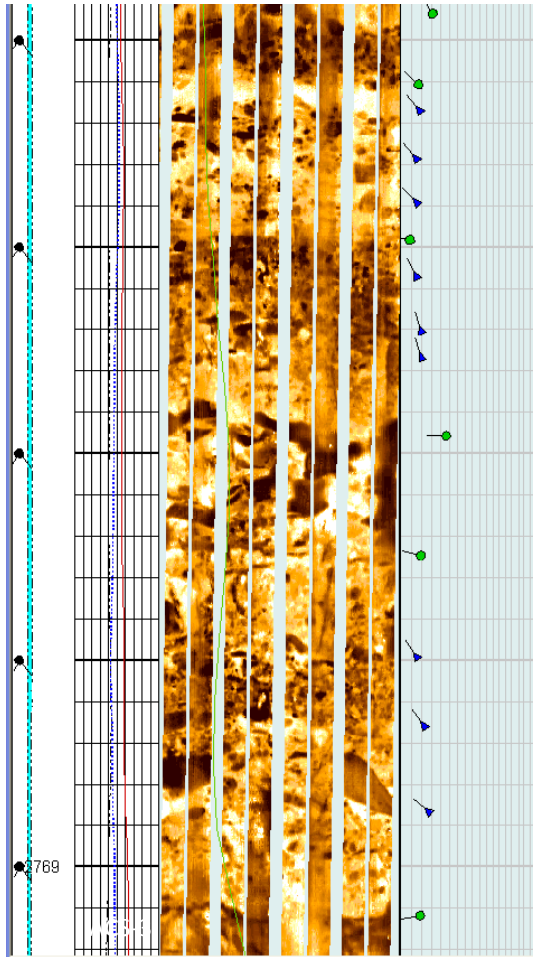
A - Crude stratification. Clast alignment. Clast are subangular to subrounded. Lithic clasts consist of tuffs (T), volcanics (V) and granodiorites (G).
Near petrophysical data: $\phi = 2.22\%$, $K = 0.0504$ mD.
Depth: 2670.51-2670.72 mbgl.



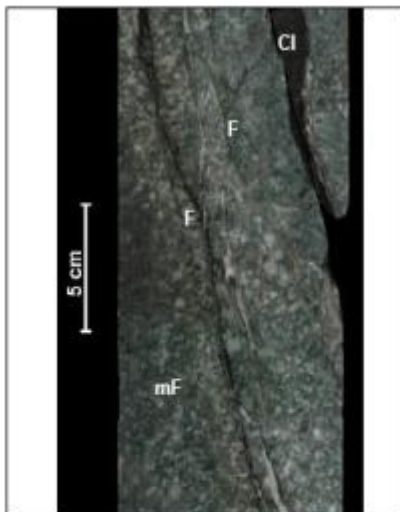
Figure 6: SUBLITHOFACIES 1F (Fractured conglomerates)

Vertical fracture (F) filled with grinded dark material and calcite. Diffuse horizontal bedding (arrows).
Petrophysical data: $\phi = 2.32\%$, $K = 0.0016$ mD.
Depth: 2672.81-2673.12 mbgl.

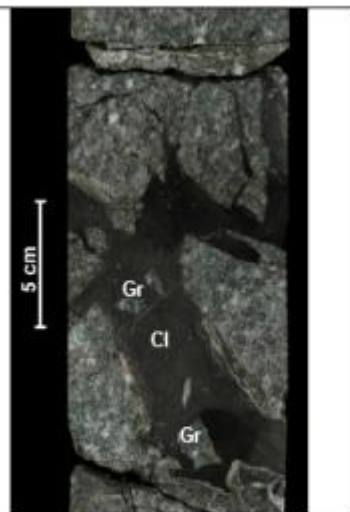
AC-Primavera



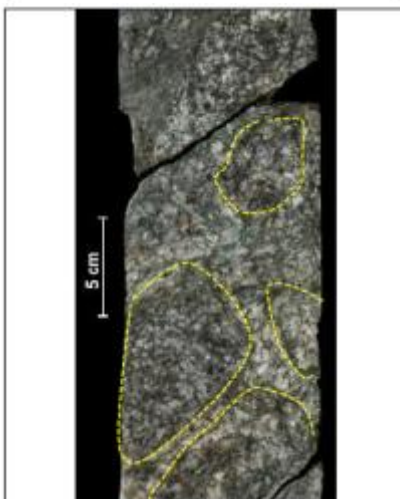
Corona en Basamento Granítico



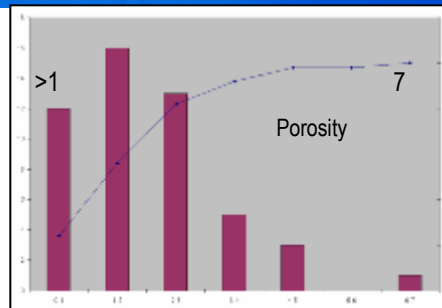
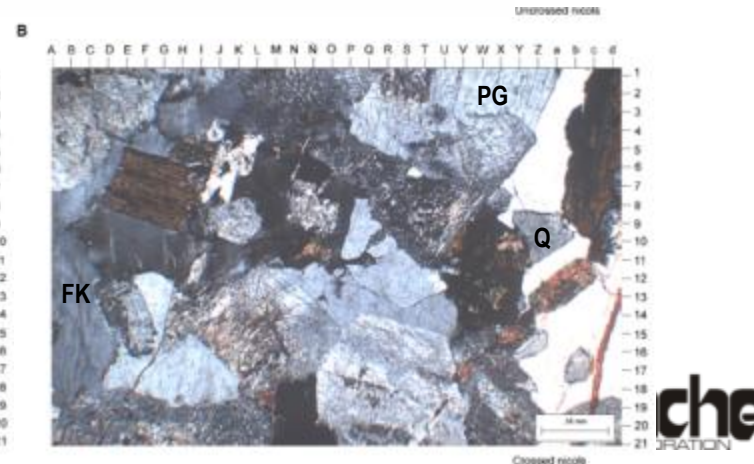
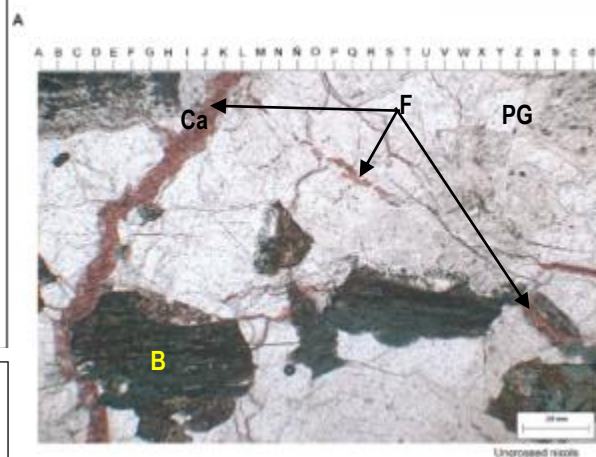
2A.- Detail where fractures of probable tectonic origin are seen (F). They are grouped with irregular traces and filled with calcite and a dark clayey material (Cl). After slabbing, some subparallel and perpendicular microfractures were recognized (mF). Depth: 2703.60-2703.80 mbgl.



2B.- Detail of a brecciated zone. A dark clayey material (Cl) is the dominant filling being calcite scarce in the edge of clasts. These clasts have the same composition of the host rock and sometimes appears floating in the filling (Gr). Depth: 2702.62-2702.82 mbgl.



2C.- Detail of a breccia zone probably generated during the cooling of the body, being part of it still at a plastic state. Subrounded granodiorite clasts (dash lines) are separated by a very recrystallized material. Depth: 2706.35-2706.60 mbgl.



WELL: PI.Nq.PO.a-2

SLAB: 54

DEPTH: 2711.54 mbgl

CLASSIFICATION: GRANODIORITE

It corresponds to a plutonic rock with, dominant medium-grained, inequigranular texture.

It is mainly made up of tabular plagioclase crystals, andesine in composition, from 1.50 to 3.70 mm. They are twinned according to Albite and Carlsbad twin laws and are altered to clays and calcite. Some individuals show crystal zoning.

Quartz is found as anhedral crystals. Poikilitic texture (with plagioclases) is found (D, Z 9).

Potassium feldspars (B; B-13) are altered to clays and sericite.

Brownish biotite with chlorite alteration and iron-oxide segregation (A; G-19).

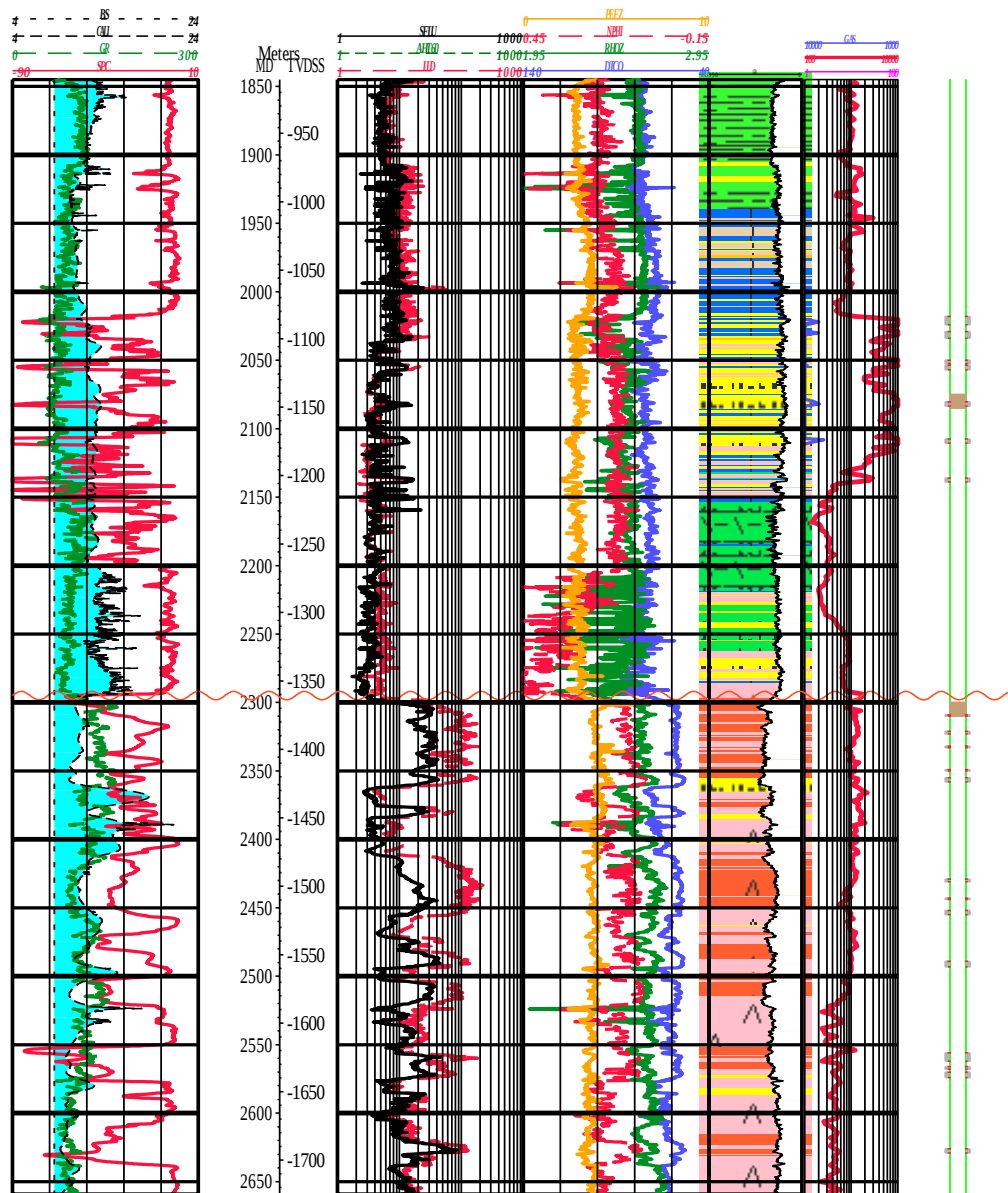
Hornblende shows scarce epidote alteration.

Titanite is found as an accessory mineral.

The mineralogic composition over whole rock is: 47% plagioclases, 20% quartz, 18% potassium feldspars, 10% biotite and 5% hornblende.

Microfracture from 0.05 to 0.20 mm wide (A; H-6) and discontinuous microfractures <0.05 mm wide are filled with calcite.

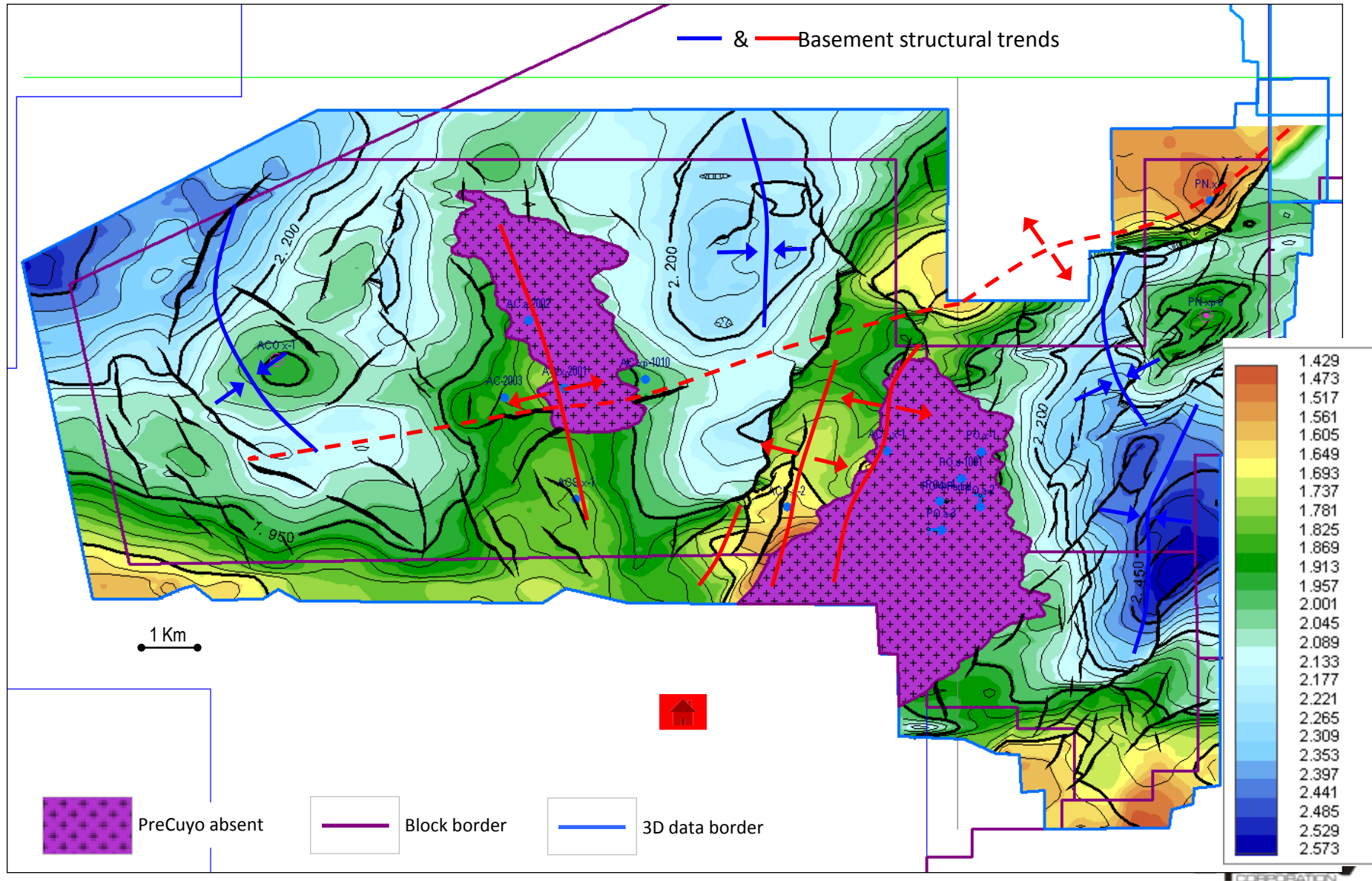
COMPOSITE LOG



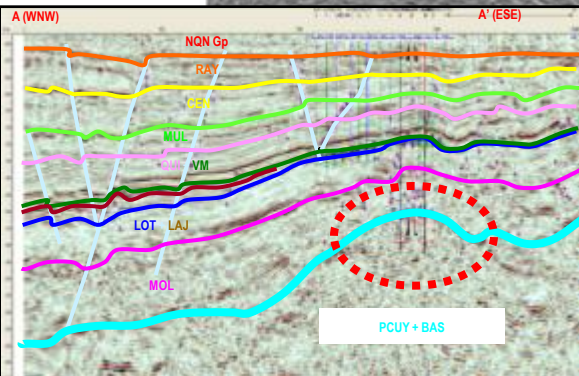
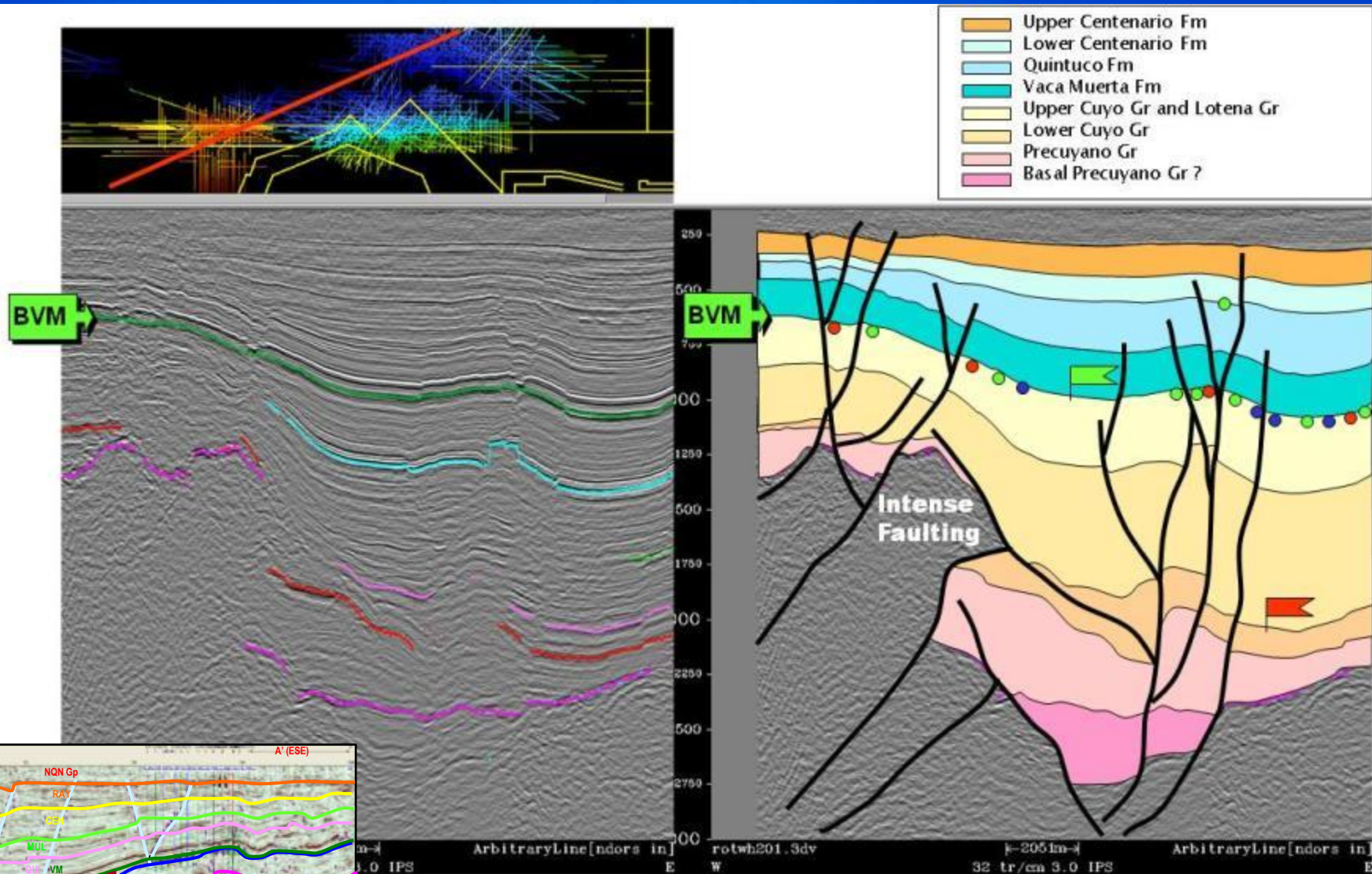
2489/2688 – Dry

Mapa estructural-altos de basamento

Mapa Estructural en Tiempo Bloques Anticlinal Campamento-Portezuelo-Collòn Cura



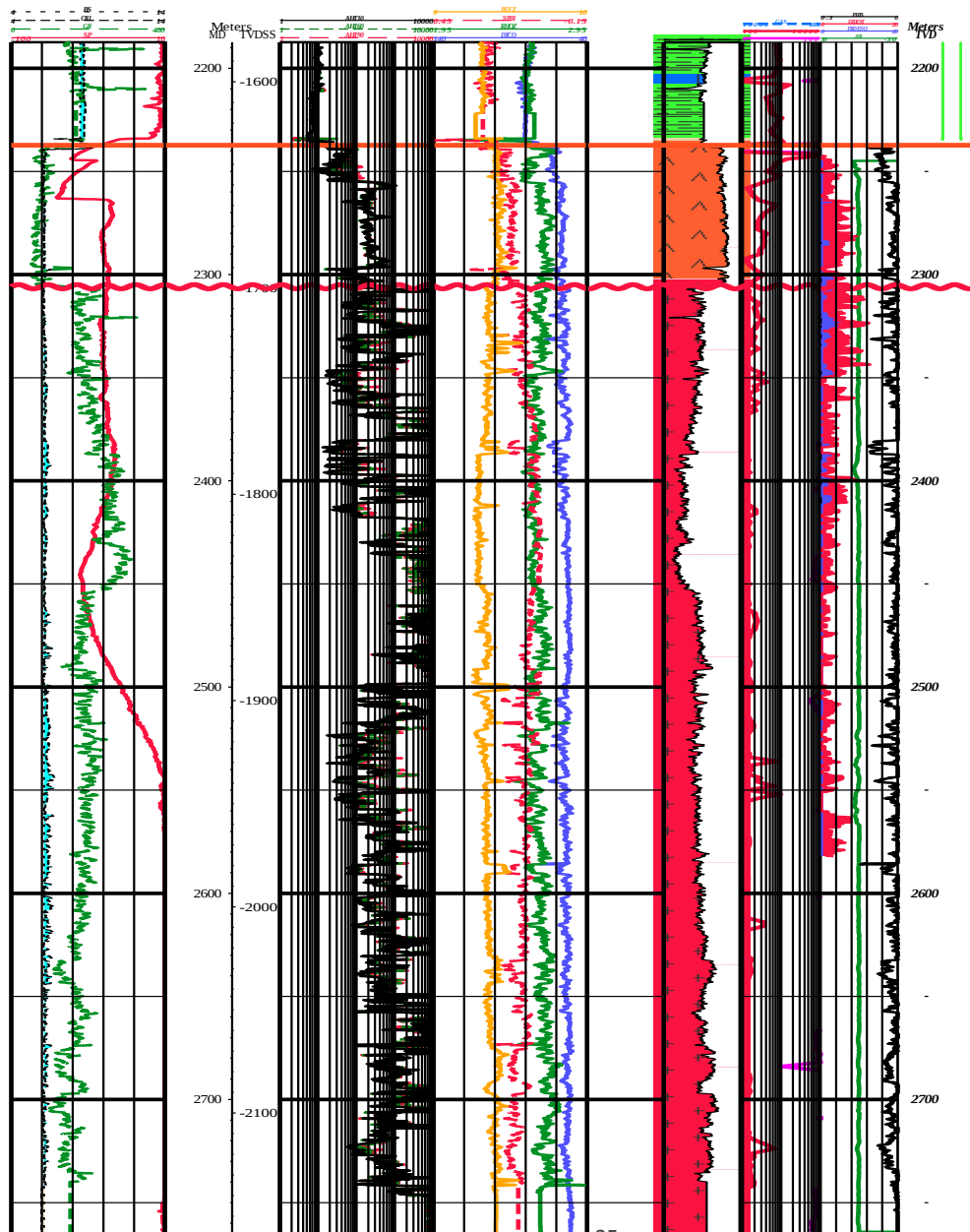
Guanaco



Pozo Tipo en Guanaco

PLT @ 05/04

(Guanaco Deep) COMPOSITE LOG



Top PreCuyo 2237 m MD (-1631) m TVDSS

Top Basement 2306 m MD (-1699) m TVDSS

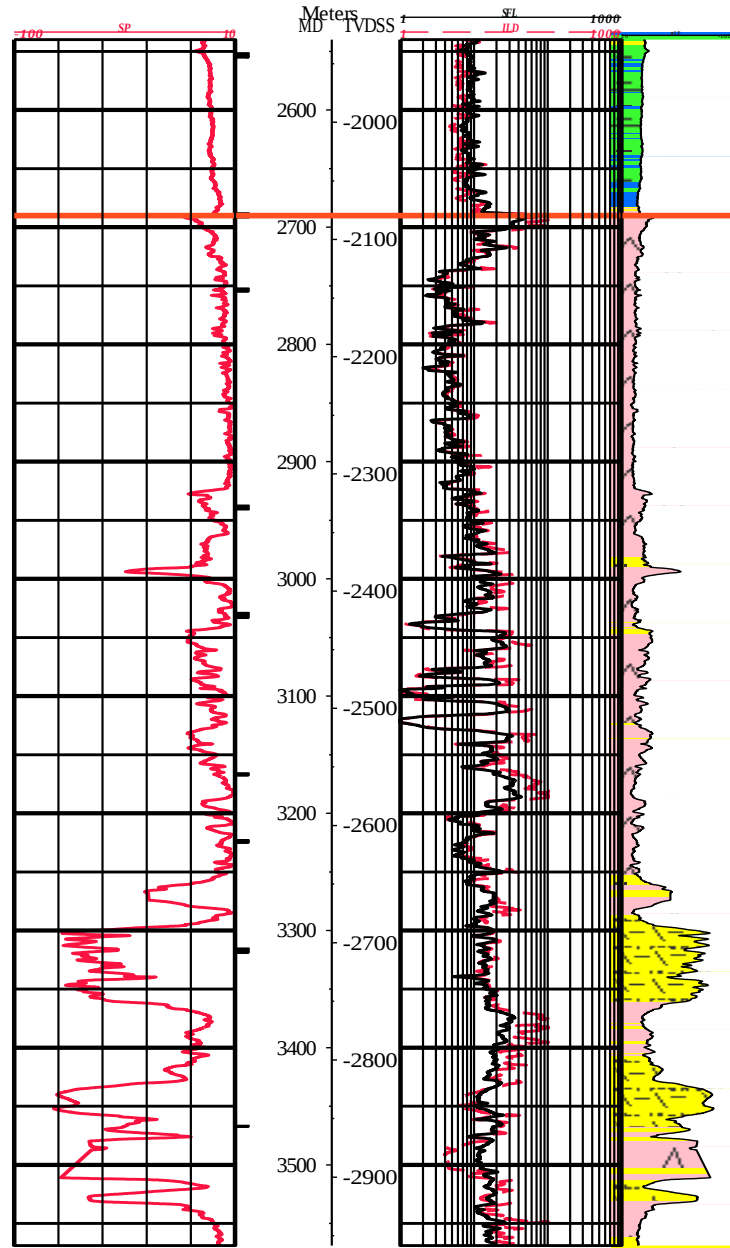
88%

Open Hole
Flow x10mm wet Gas,
Qg: 133,575 m³/d
WHFP: 1580 psi

12%

Pre-Cuyo- Pozo abandonado antiguo

SP x-2 (Sendero Pedregoso) COMPOSITE LOG



Top PreCuyo 2690 m
MD (-2080) m TVDSS