

# **Impact of Detailed Geological Modeling on Field Development: Alluvial Papagayos Formation Case Study, Vizcacheras Field, Cuyana Basin, Argentina\***

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## **Abstract**

The Papagayos Formation is a continental siliciclastic alluvial succession (Lower Cretaceous?) deposited in the Cuyo Basin, Western Argentina. The Papagayos Formation is the main producing reservoir of the mature Vizcacheras Field (220 wells, STOIIP 76 Mm<sup>3</sup>) with excellent reservoir properties (~F 27%, 13D). New development opportunities were identified in 2011 after a new conceptual model revealed reservoir development to the west of the main field in very low structural positions. Understanding the depositional setting of the Papagayos Formation has become a key issue for further field development. Unpredicted thicknesses and reservoir quality variations meant that only 60% of wells were successful. The objective of the reservoir characterization study was to reduce drilling risk, assess infill well placement and reservoir delineation.

Based on the results of the integrated study, we subdivided the Papagayos Formation into two depositional units. The lower unit is characterized by an alluvial-fan facies association dominated by debris-flow deposits (chaotic, matrix supported conglomerates and gravels). This unit shows low transport capacity and changes laterally into fine-grained floodplain deposits (fan toe deposits). The upper unit is characterized by fluvial-fan facies association showing amalgamated, poorly confined channel deposits in proximal areas changing towards variable to low N/G fluvial system in the far-from-source portions of the fluvial system. Changes in discharge and bedload capacity between the two units were linked predominantly to climate variation causing a transition from an episodic to a perennial flow regime. Implications of such changes are visible in terms of extension and development of both units. Short ranges for mass-transport deposits and limited extent of the alluvial fan reservoir facies are expected in the lower unit. Conversely, better reservoir quality and greater extent, together with thinning and lower N/G towards distal areas is expected in the upper unit. Detailed paleoflow study (FMI) together with sand maps and seismic control confirmed local migration of the system towards the west-northwest of the main field. Deterministic geological modeling generated from constraining the depositional model with seismic and well-data, enabled prediction of sand- facies distribution within and nearby to the field. As a result of this study, the infill drilling campaign was redesigned and the potential of future water-flooding demonstrated.

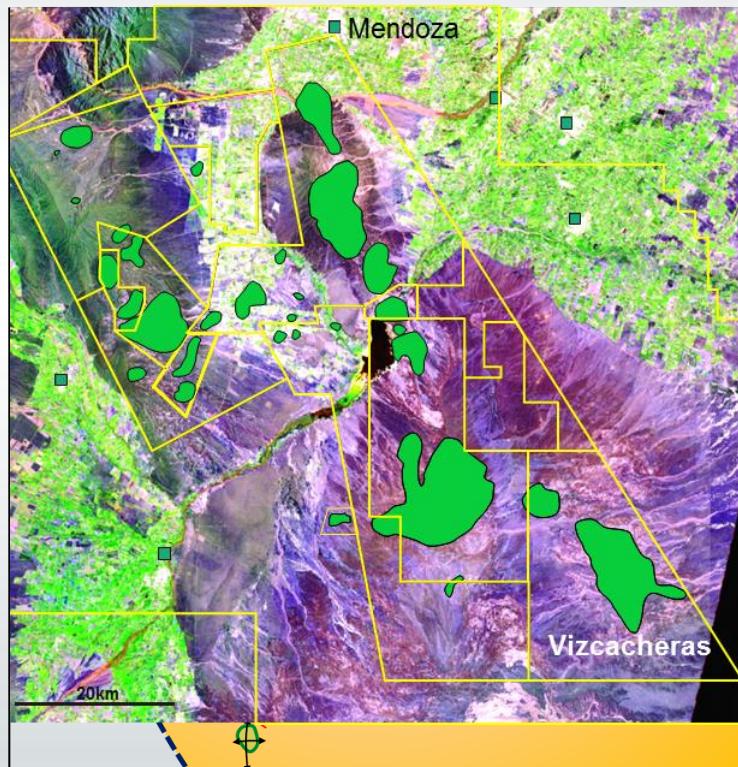
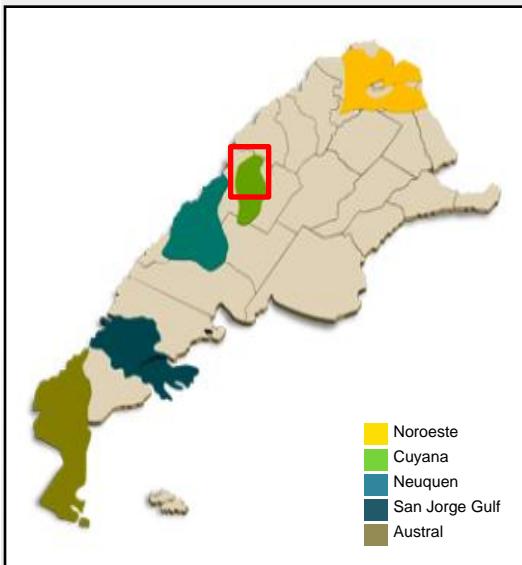


# Impact of detailed geological modelling on field development: the alluvial Papagayos Formation case study

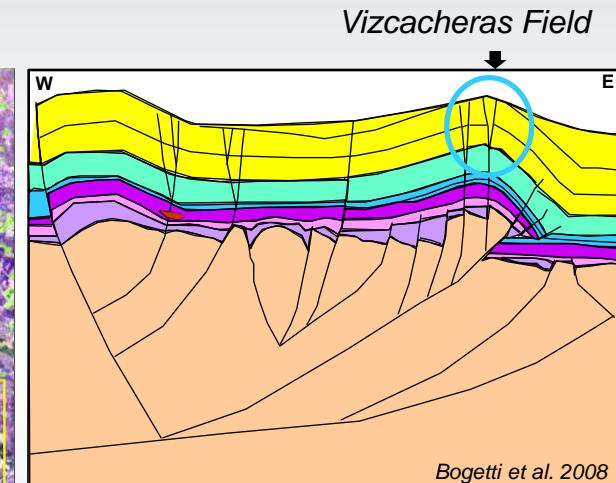
(Vizcacheras Field, Cuyana Basin, Argentina)

*Pablo Barros & José María Jáuregui*

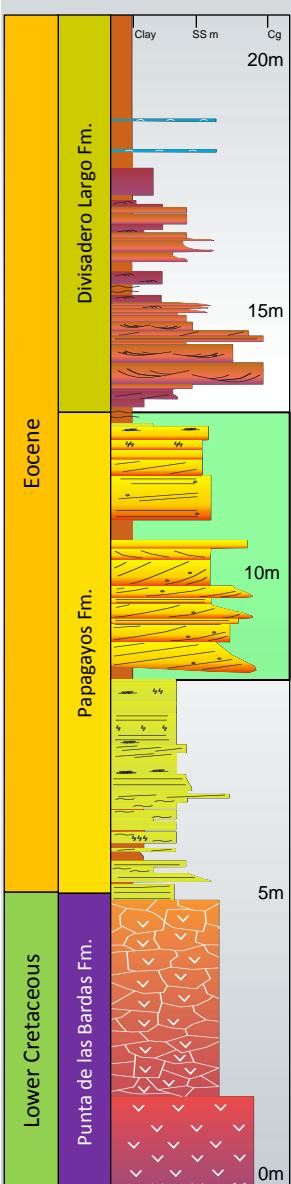
## Argentina's Oil Provinces



Productive fields along SE-NW axis



W-E schematic structural cross-section of the Cuyana Basin.

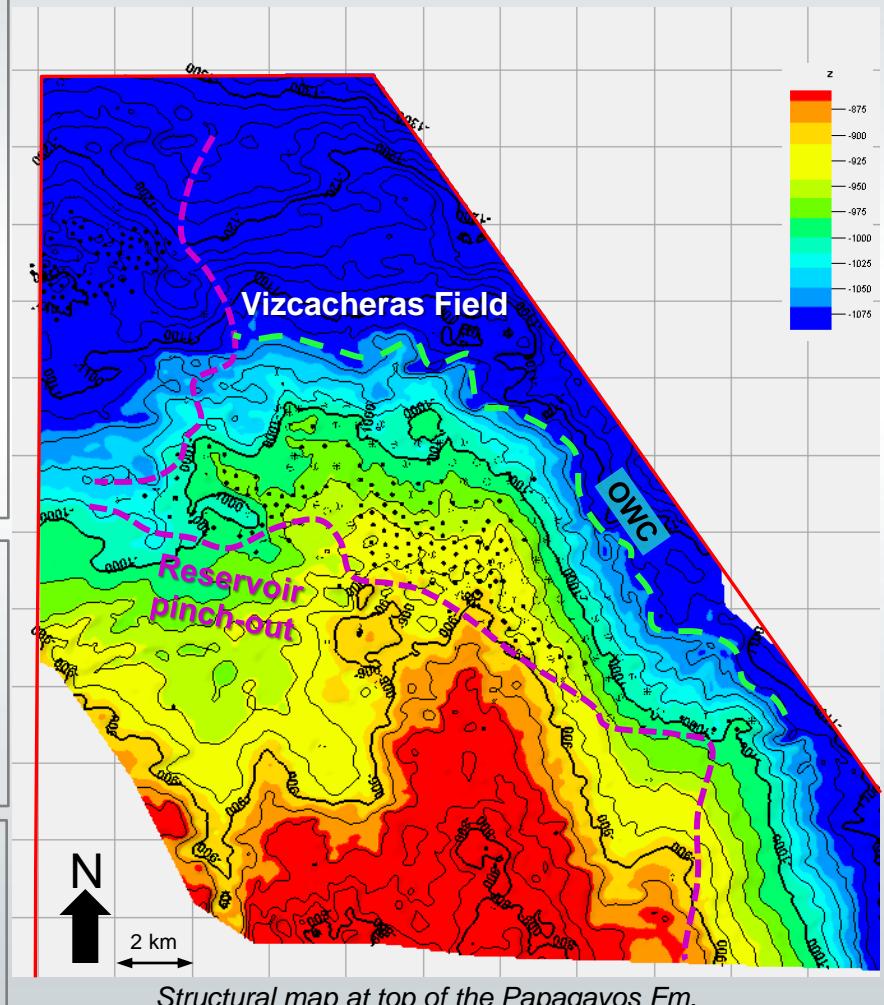


Characteristics	Field discovery: 1962
	Total Daily Prod. ~ 1000m <sup>3</sup>
Cumulative Prod. = 40.3 Mm <sup>3</sup>	
Producing wells = 220	
Wells producing from Papagayos Fm = 140	
WCUT ~ 97 %	
<i>2013 Activity</i>	
Drilled wells = 15 producers	
<i>2014 Activity</i>	
5 producers, 2 injectors	

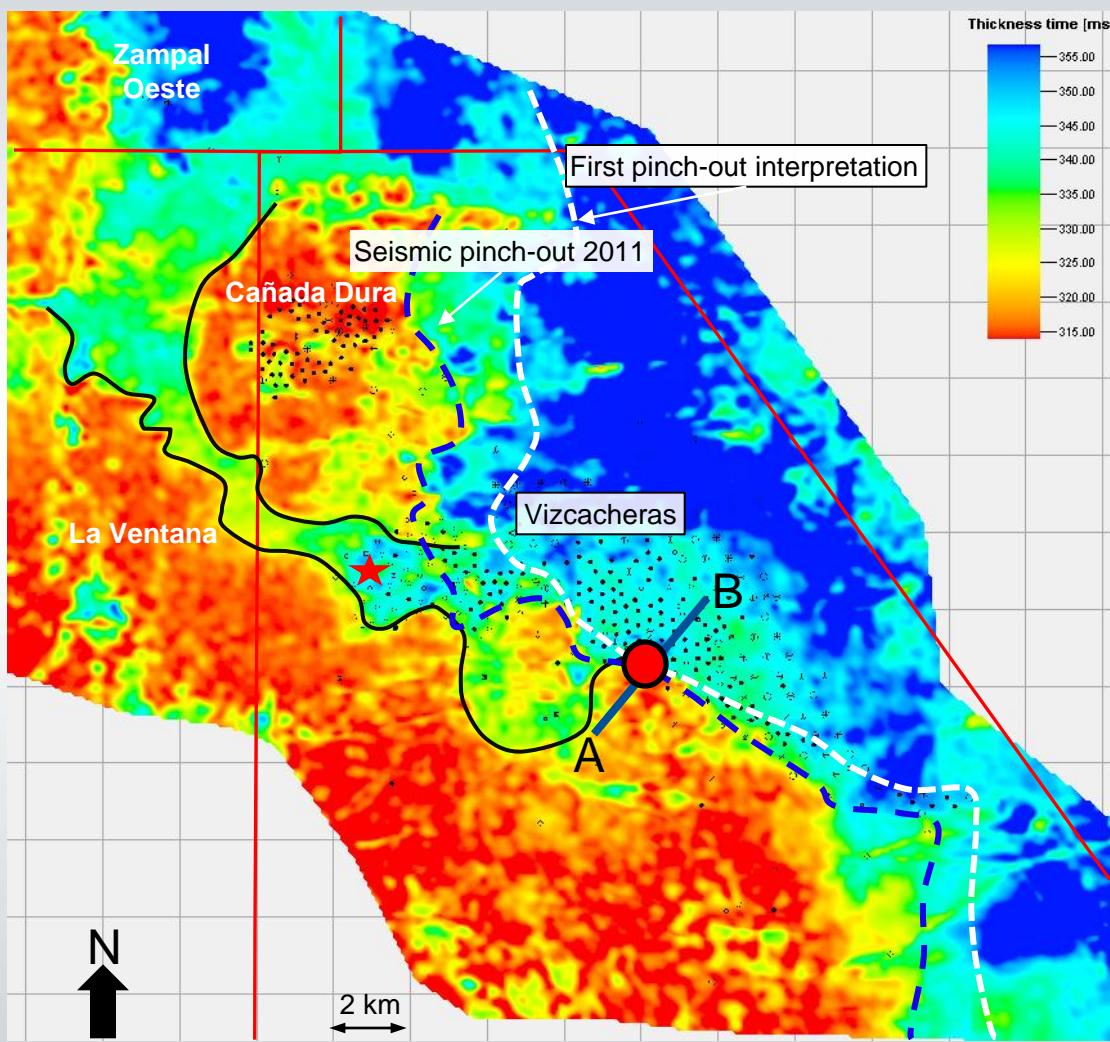
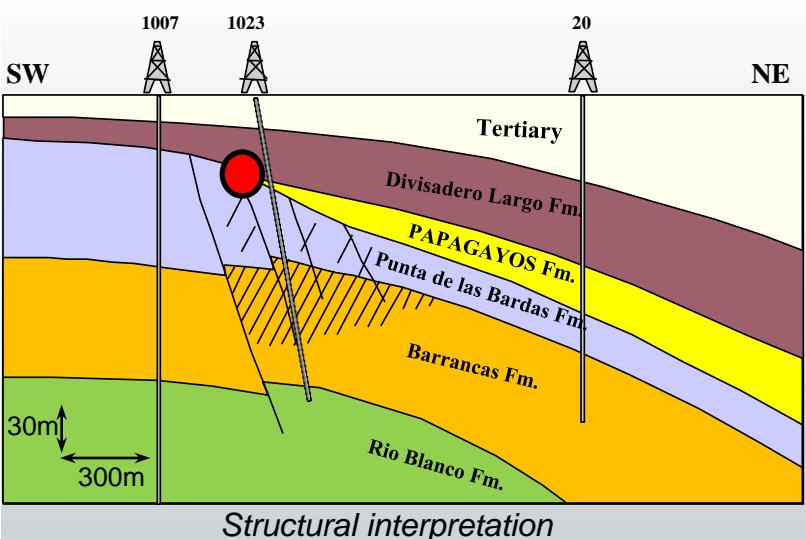
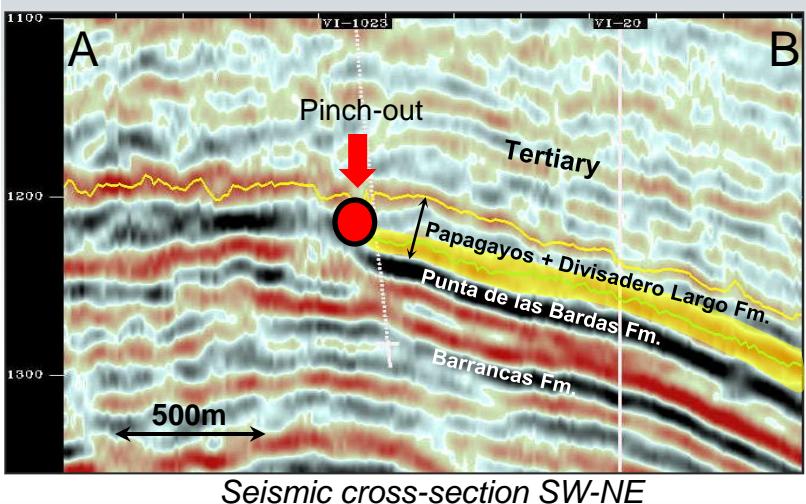
**Objectives**

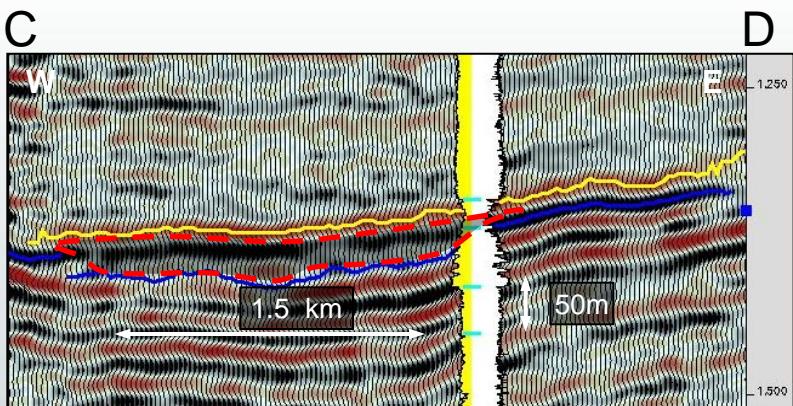
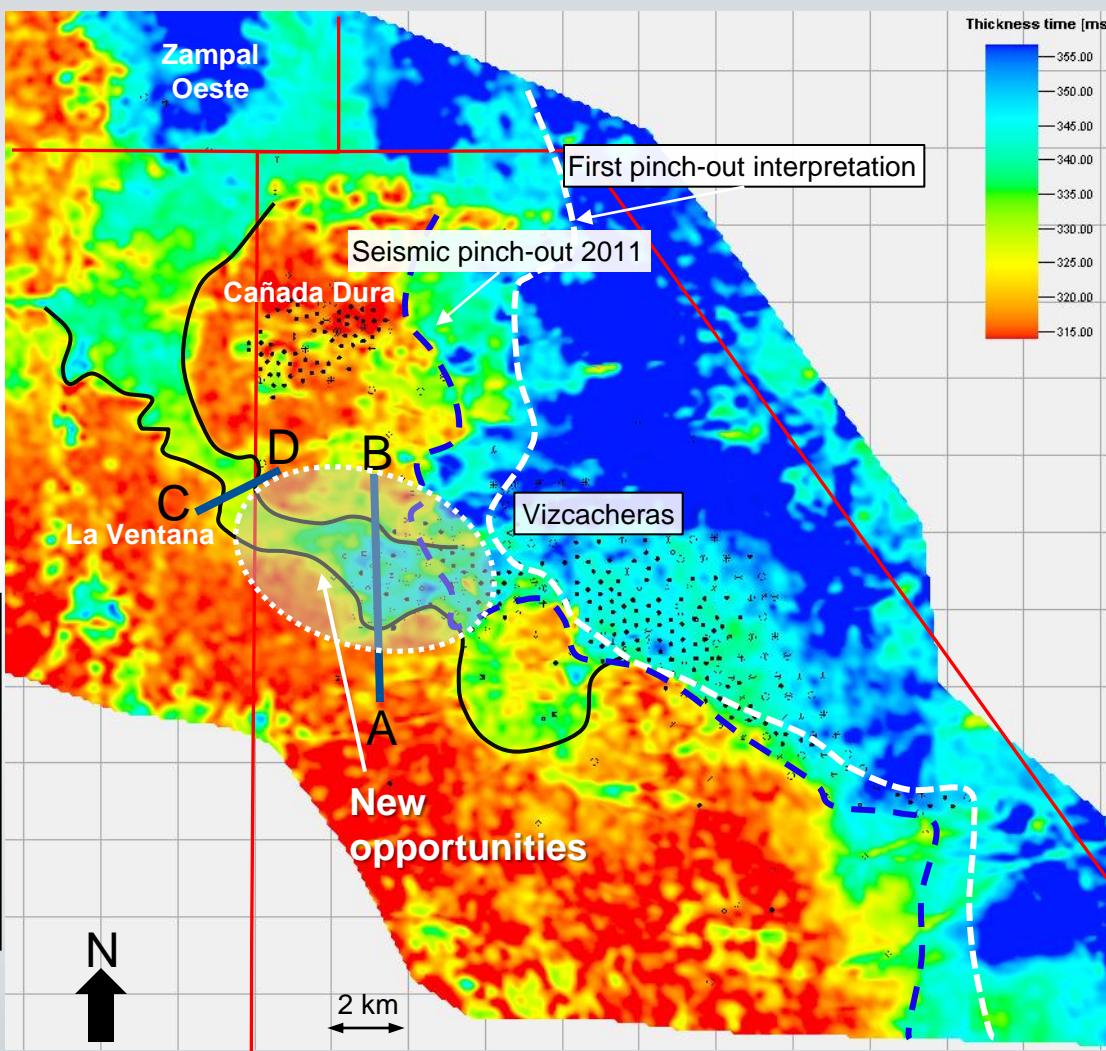
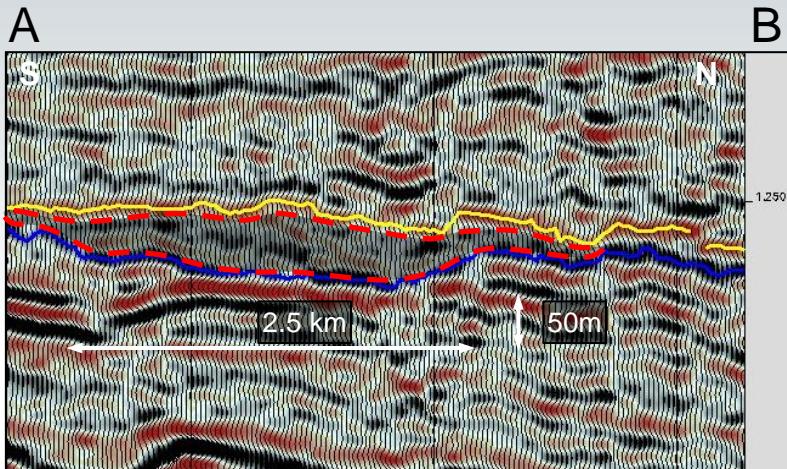
Build a geological predictive model to define reservoir presence and reduce drilling risks

- Opportunity**
- Evaluate development scenarios
  - Waterflooding potential

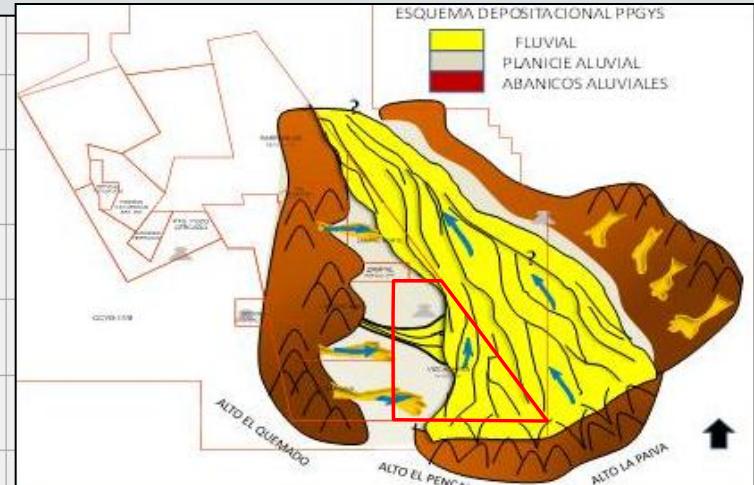
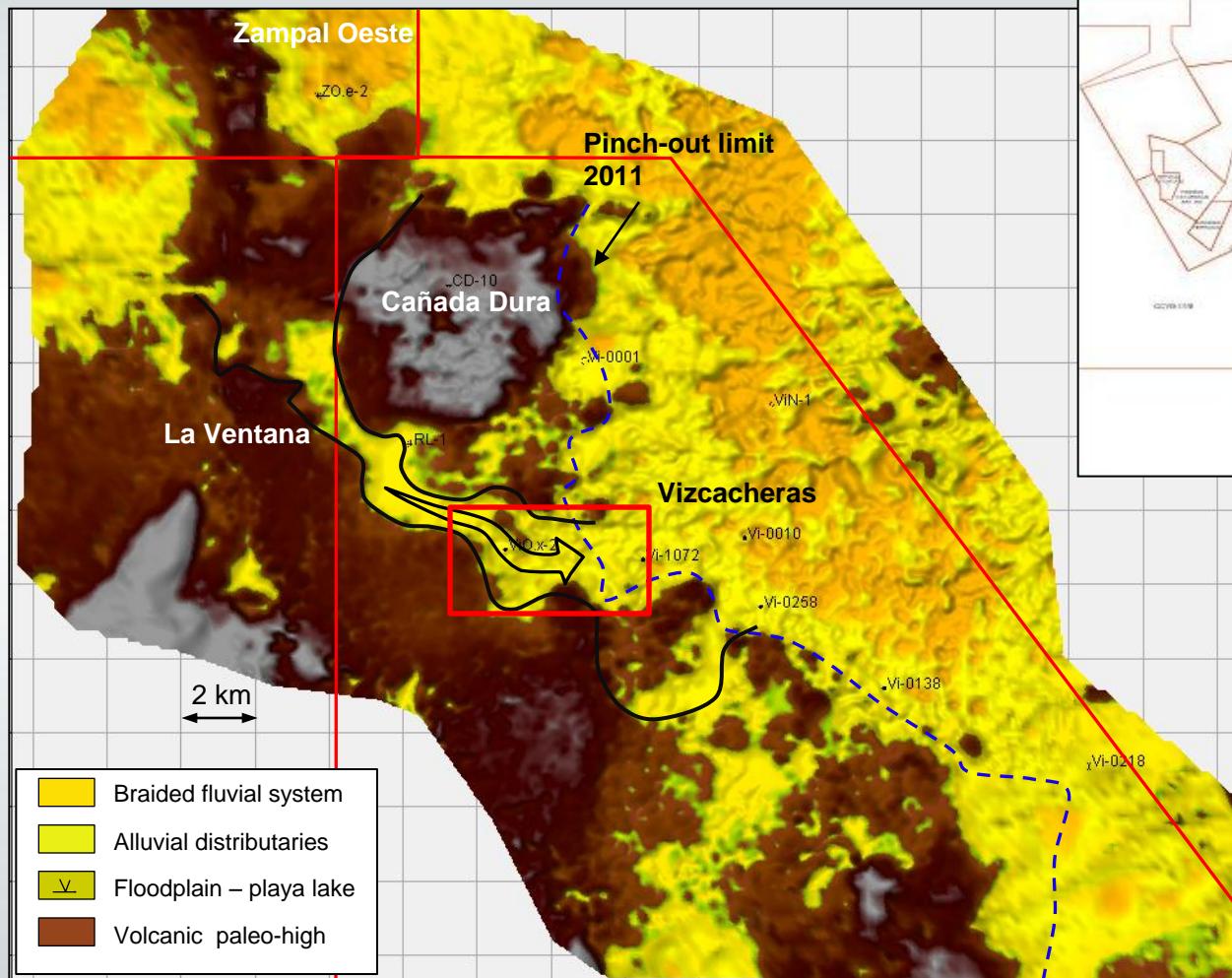


# Reservoir Extension: Previous Interpretations





Isopach map (in time) of the Papagayos and Divisadero Largo Fm. interval

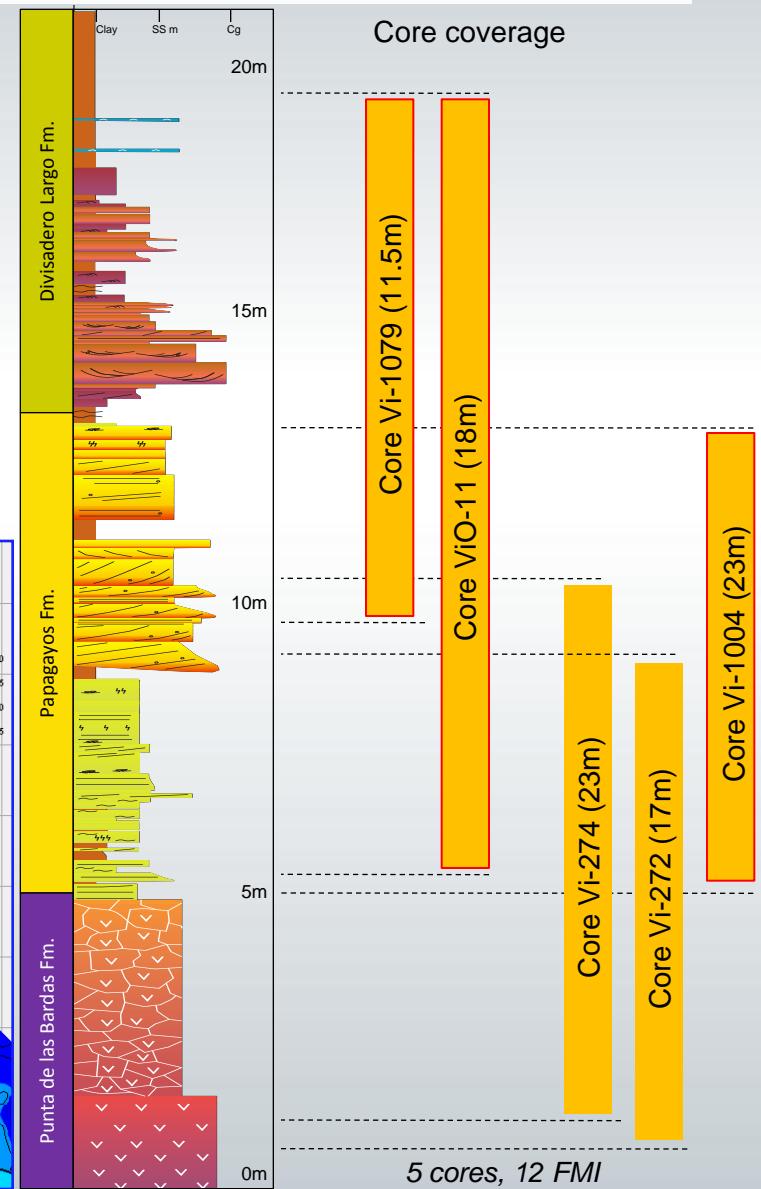
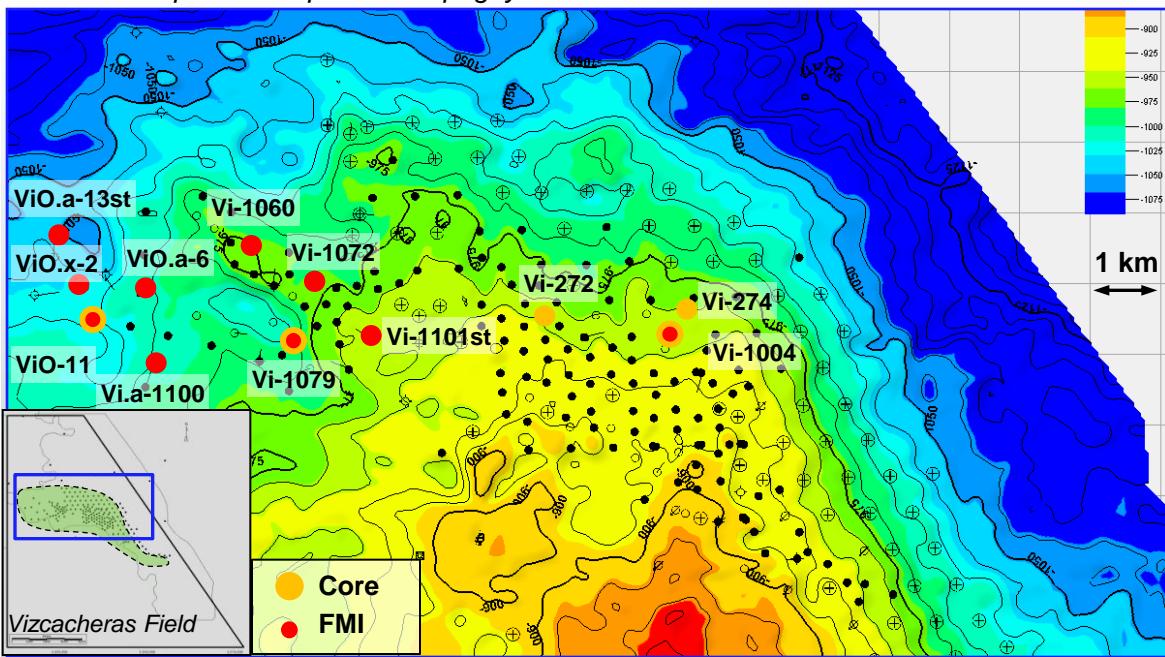


Papagayos Fm. depositional model

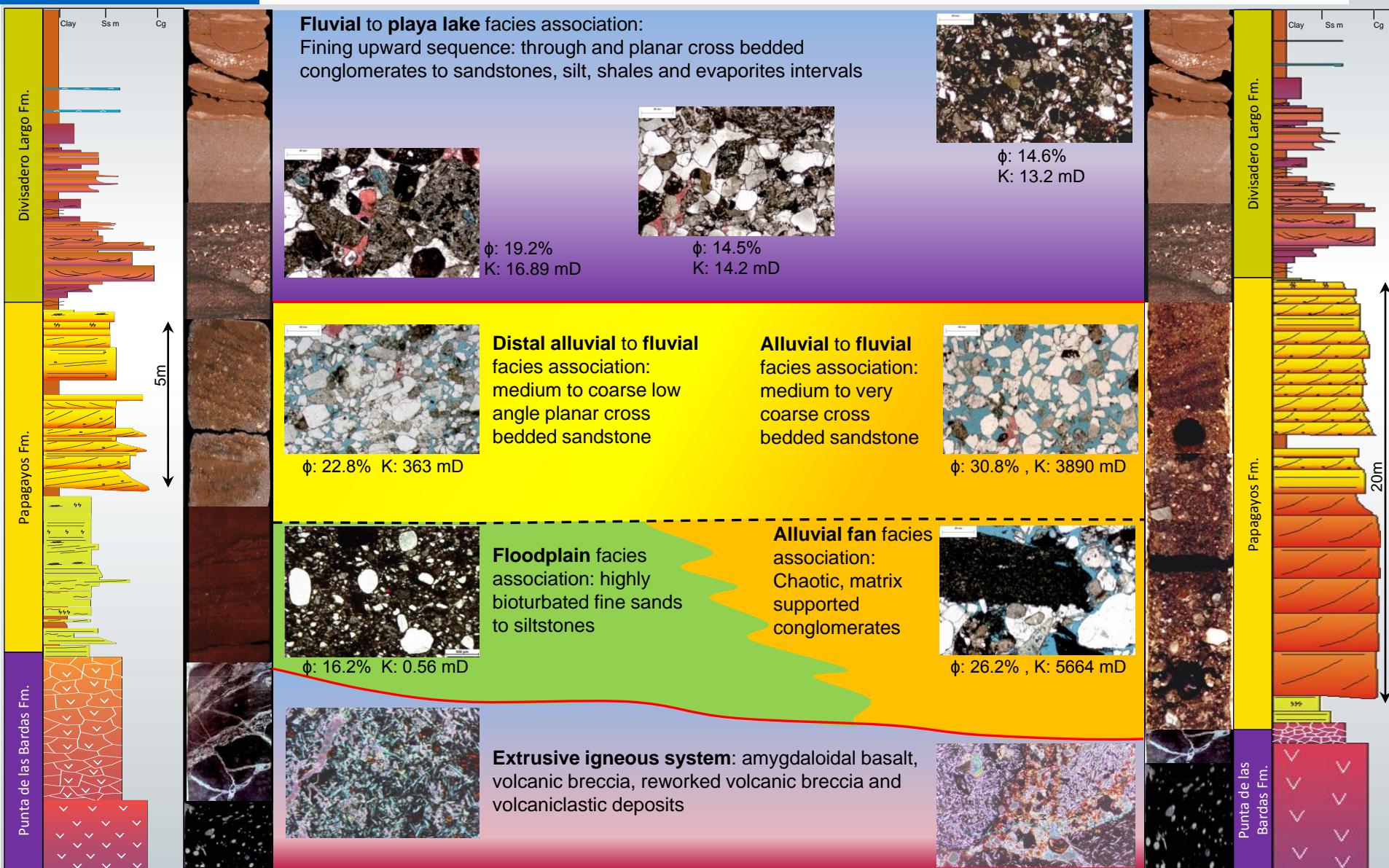
- Possible **distributary alluvial system** from the west.
  - Ambitious FDP > 30 wells
- Only **60%** of drilling success

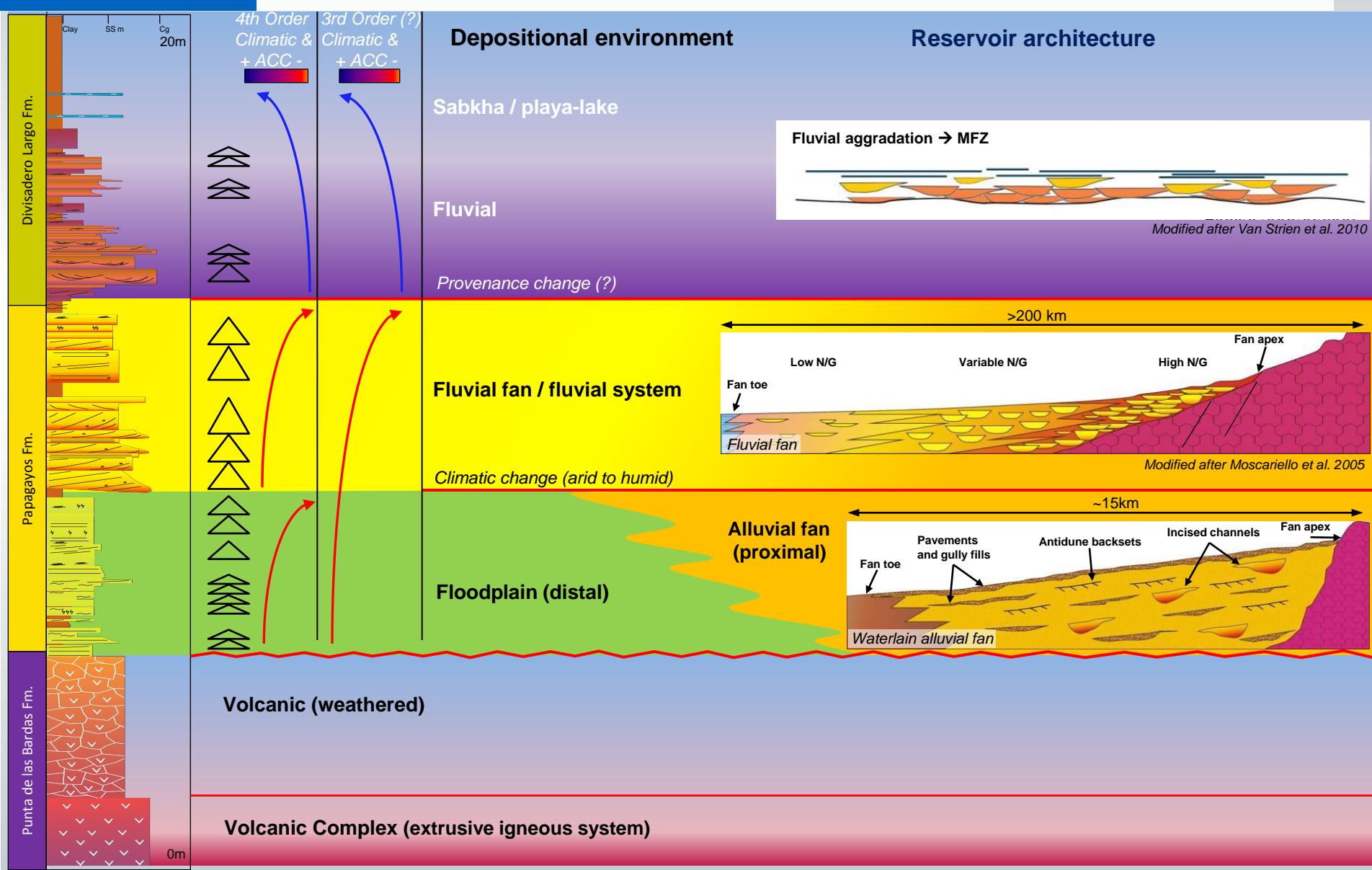
- Integrate core, FMI and well log data to establish a high resolution stratigraphic framework for the Papagayos Fm.
- Re-interpret seismic thickness maps
- Generate predictive geological model

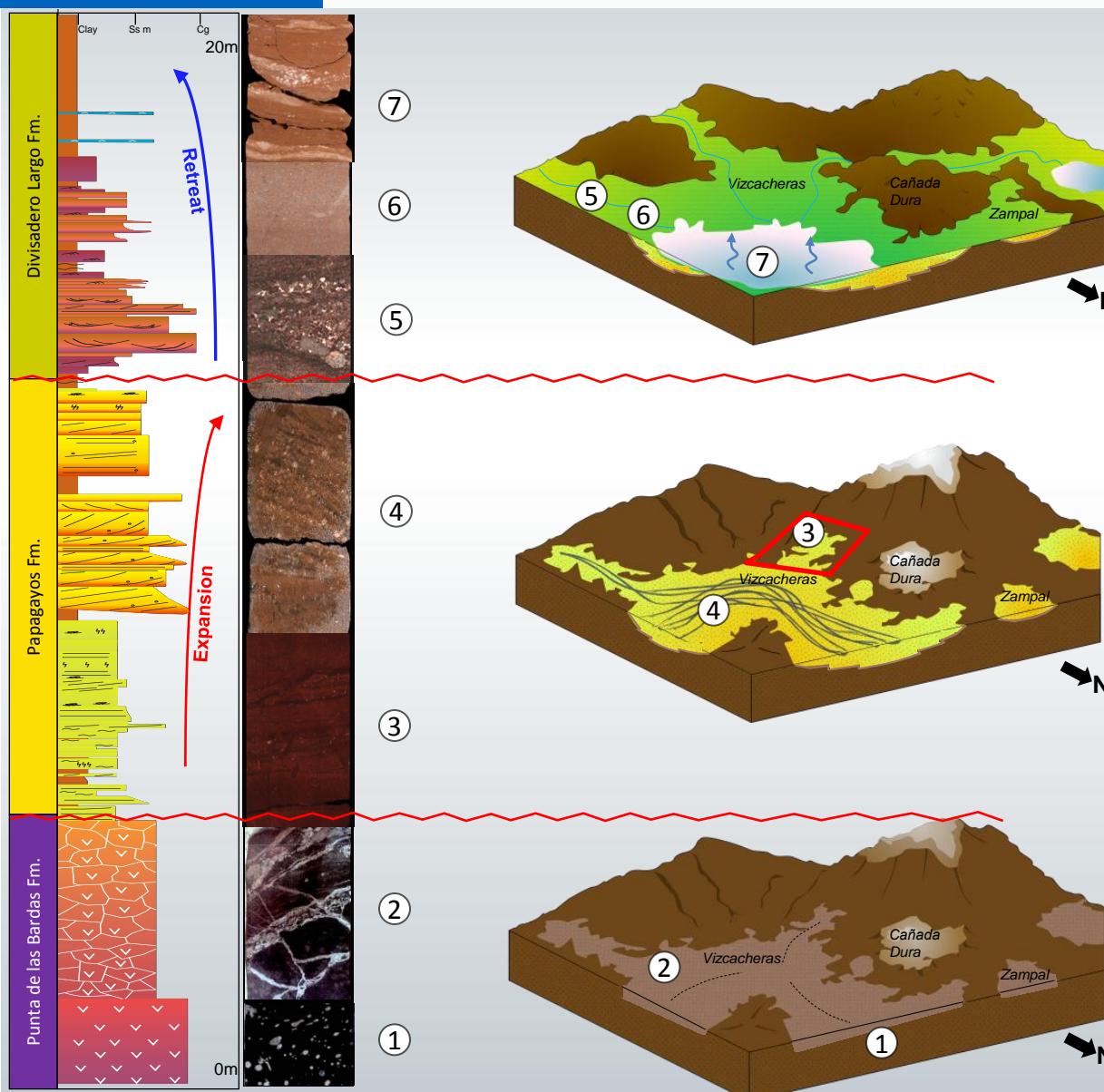
Structural map at the Top of the Papagayos Fm.



# Reservoir Characterization







### Divisadero Largo Formation

Fluvial to sabkha/playa lake depositional system. Rapid transition towards **low energy and evaporite facies**. Evaporites intervals correlate field-wide.

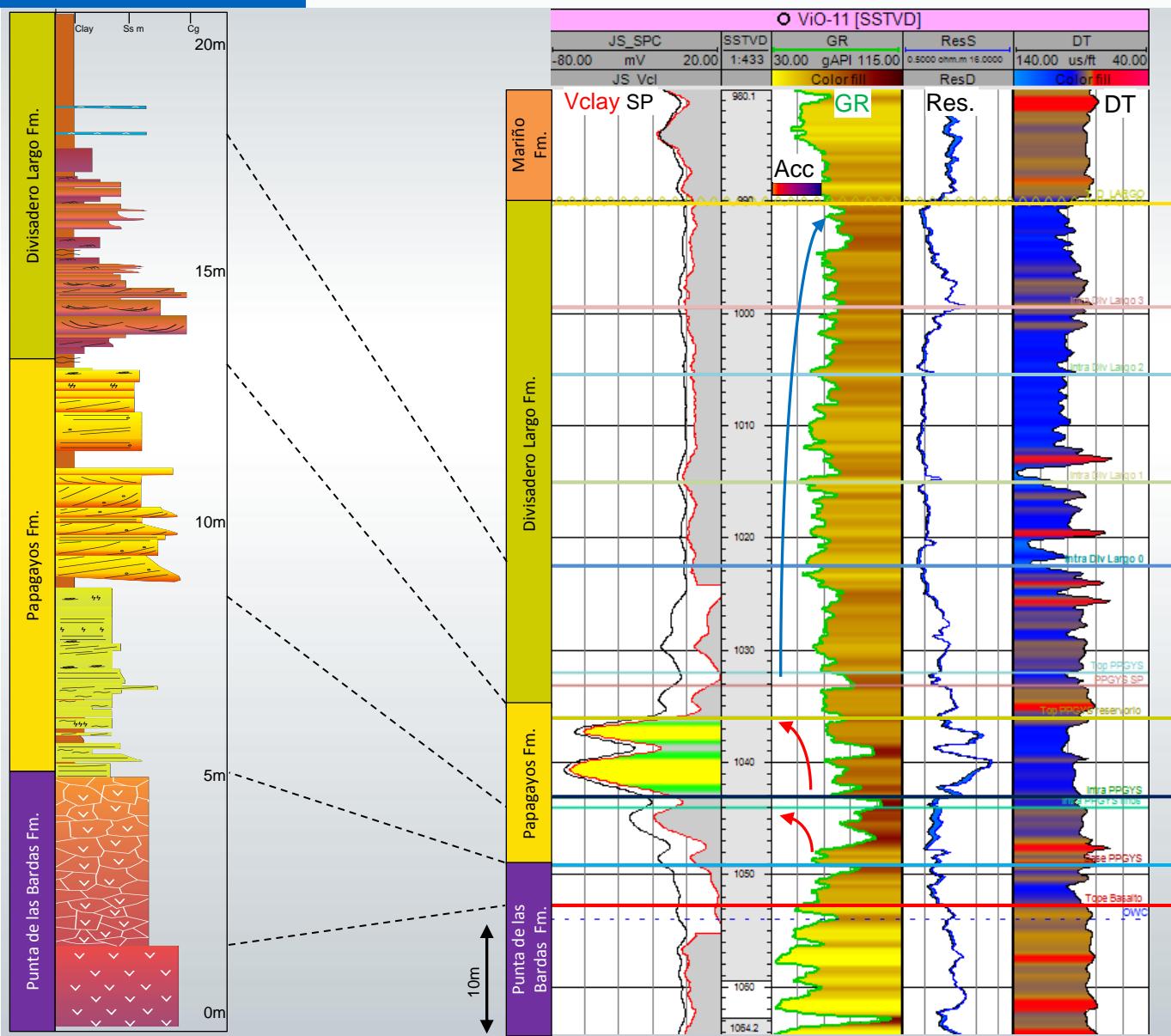
### Papagayos Formation

Alluvial to fluvial system with paleotopography-controlled deposition (Punta de las Bardas Fm.)

### Punta de las Bardas Formation

Volcanic and magmatic events related to **aborted rifting** within late **sag** stage in the Cuyana Basin.  
Severe weathering due to exposure.

## Core-log calibration



Markers:

Top Divisadero Largo Fm.

Intra Divisadero Largo 3

Intra Divisadero Largo 2

Intra Divisadero Largo 1

Intra Divisadero Largo 0

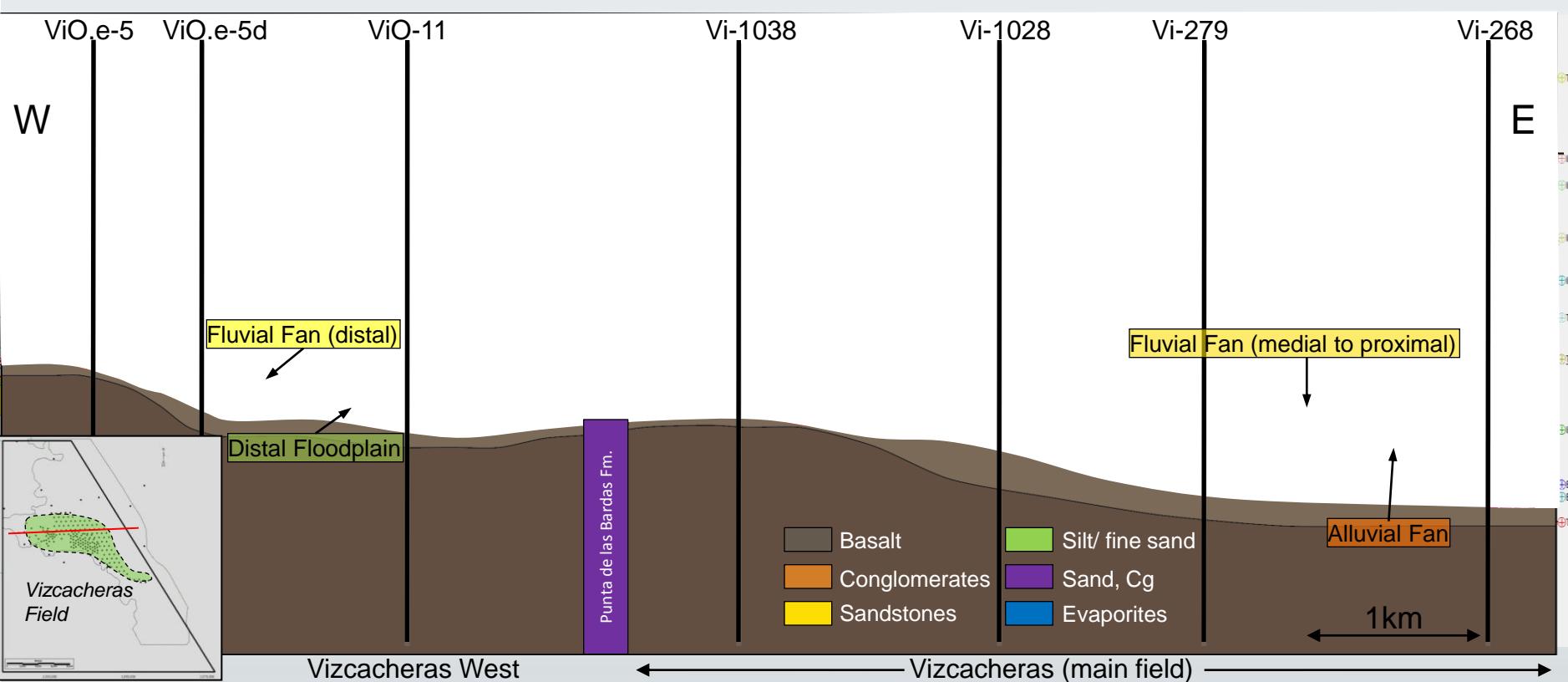
Top Papagayos Fm.

Intra Papagayos Fm.

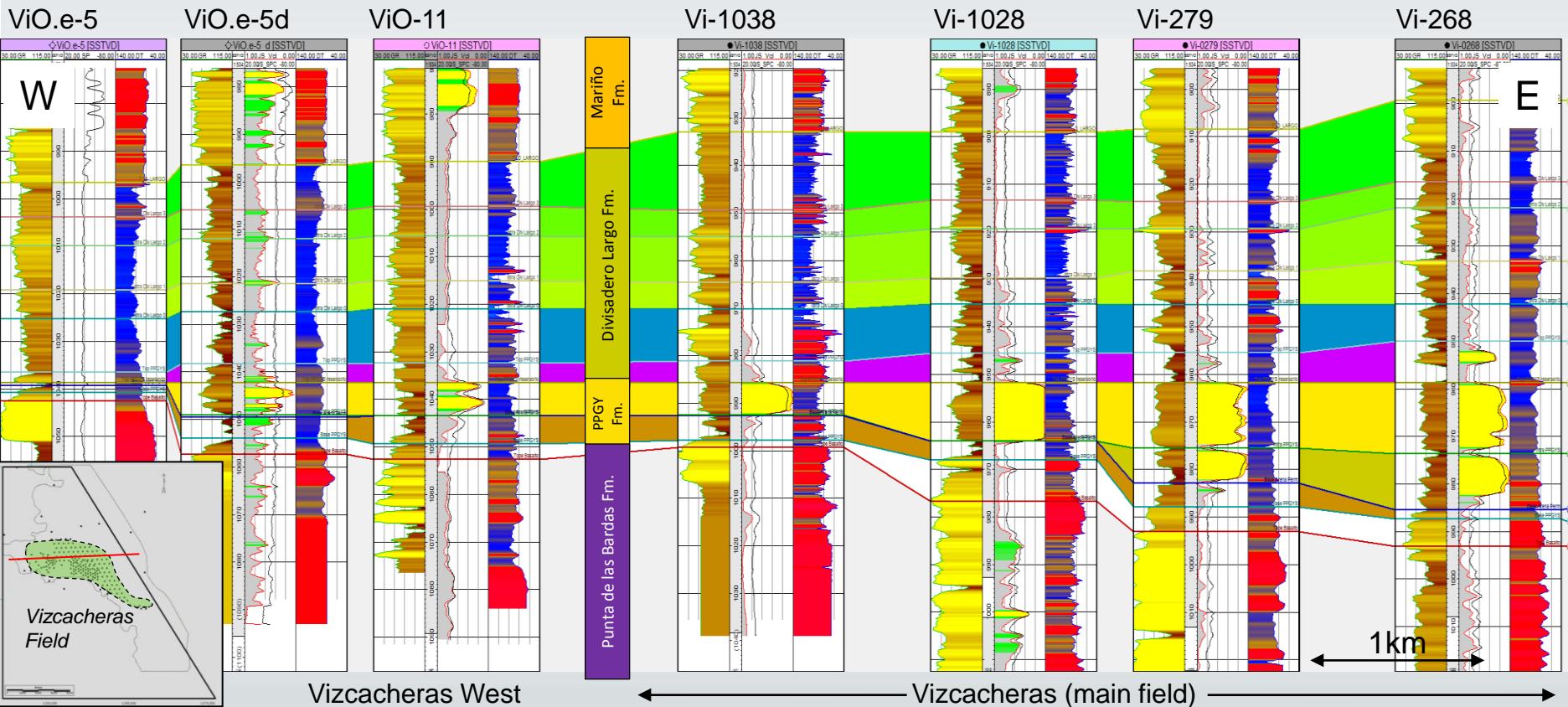
Base Papagayos Fm.

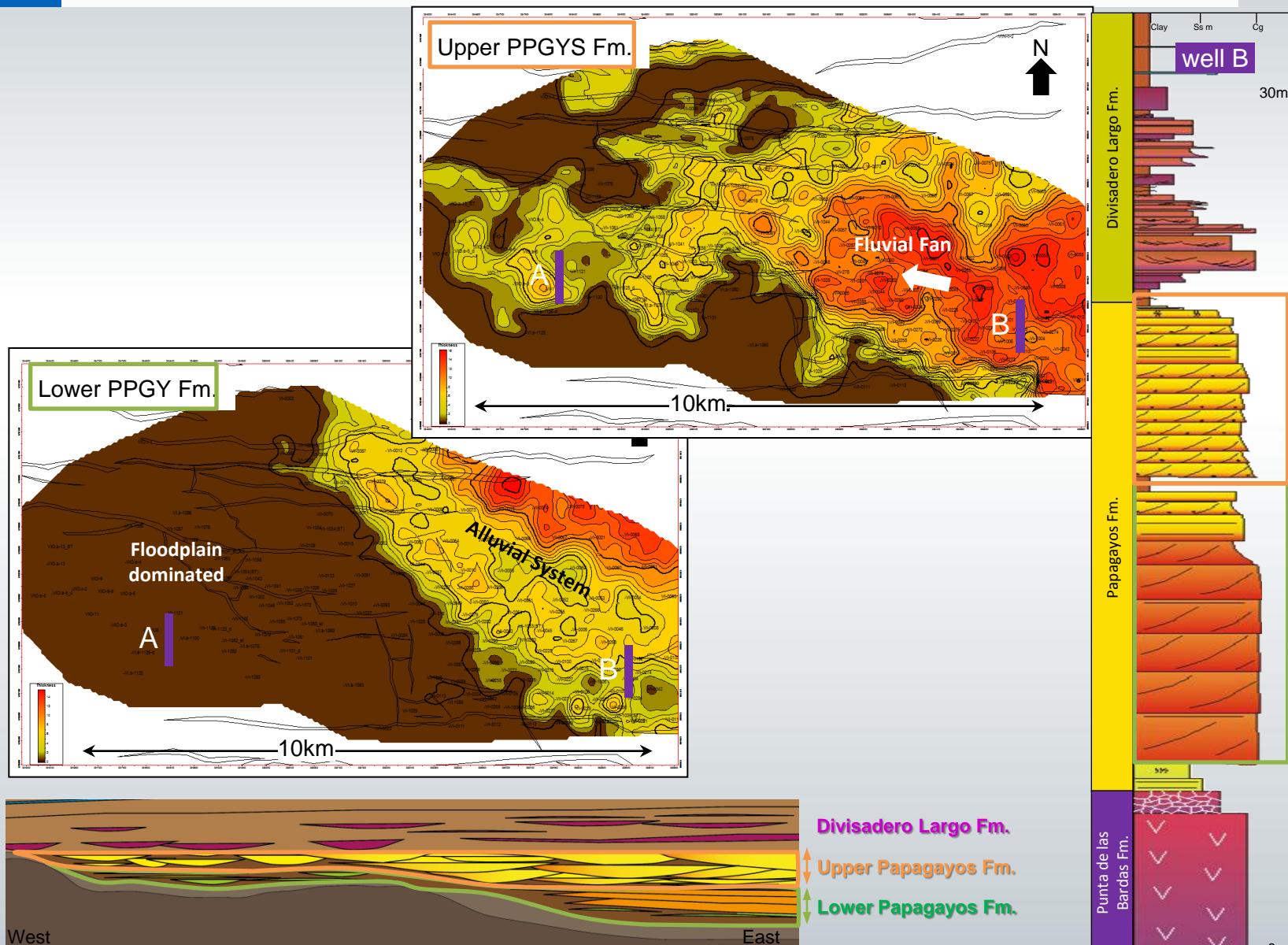
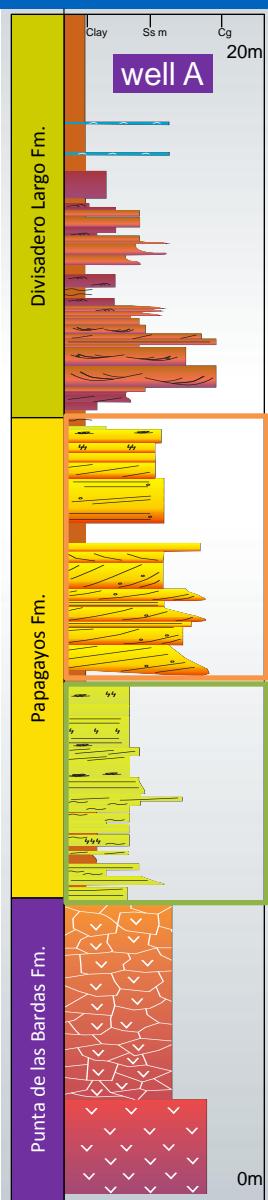
Top Basalt

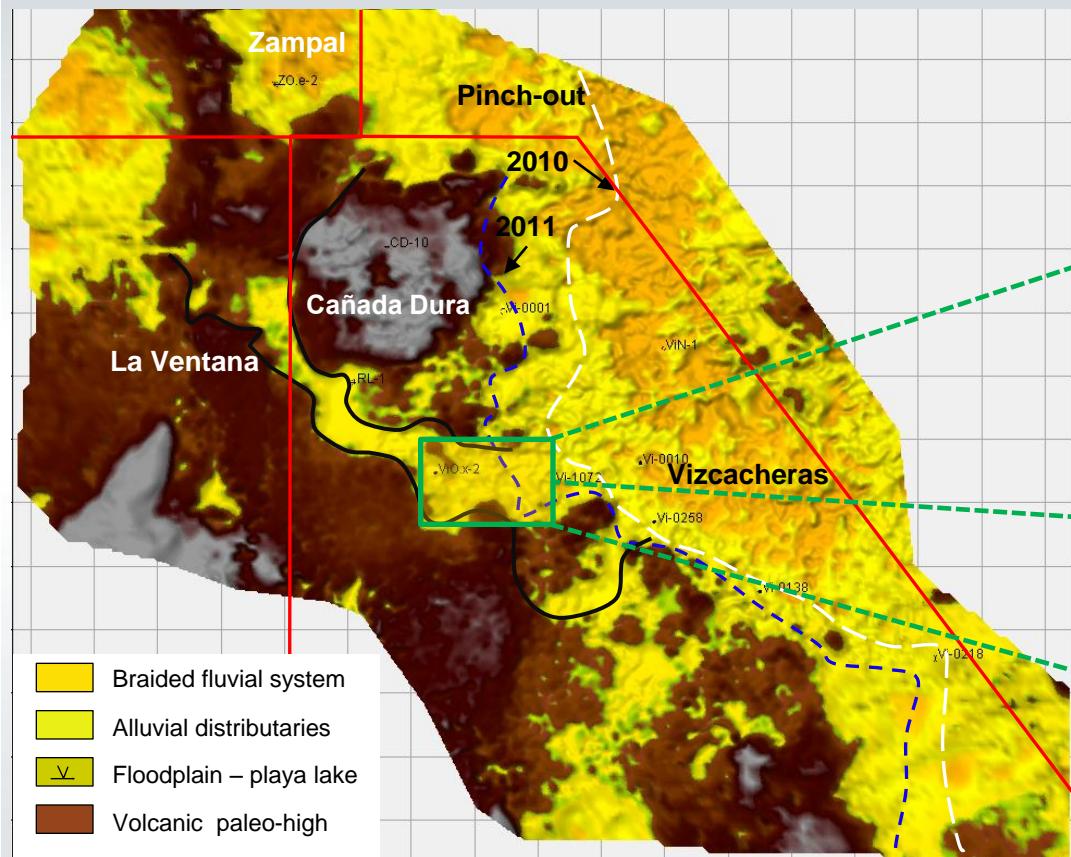
Geological model and interpretation of W-E correlation panel showing the pinch-out of the Papagayos Fm to the west and the lateral facies change



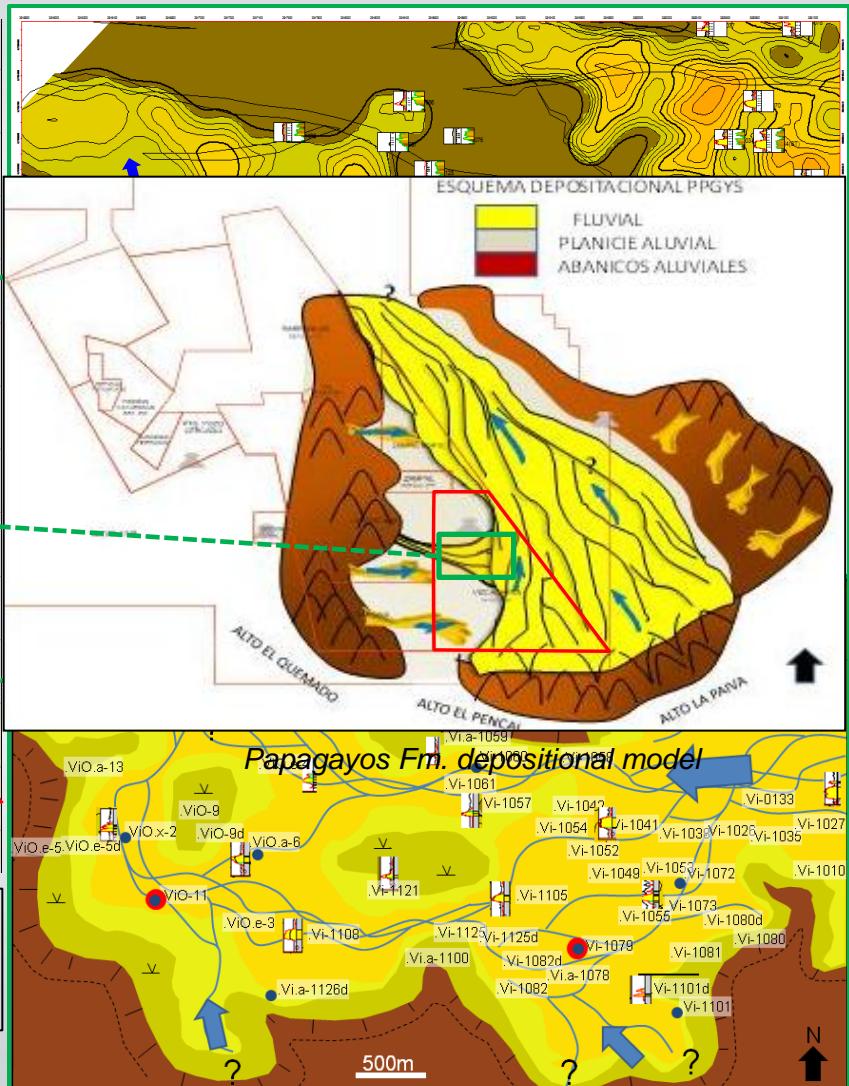
*W-E correlation panel showing the pinch-out of the Papagayos Fm to the west*



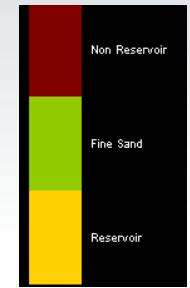




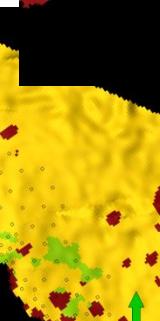
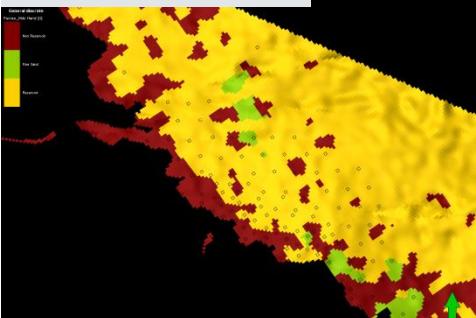
- New detailed geological model based on core data and paleoflow measurements (FMI interpretation)
  - New interpretation: **Fluvial** fan prograding from the **East** to the **West**.



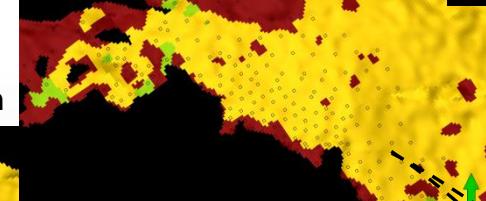
Facies model



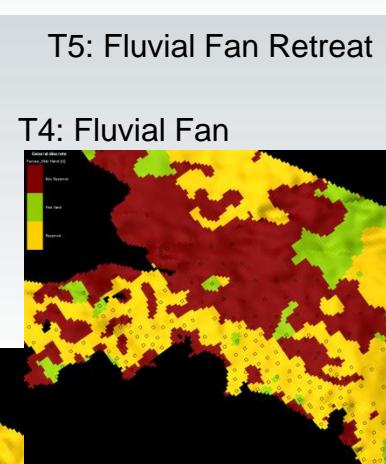
T1: Initial Alluvial Fan



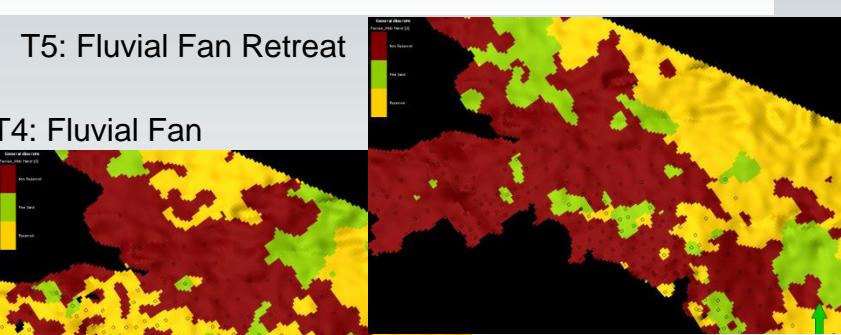
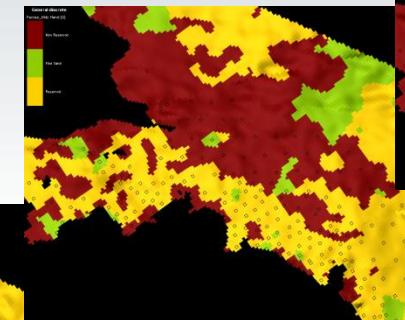
T2: Alluvial Progradation



T5: Fluvial Fan Retreat

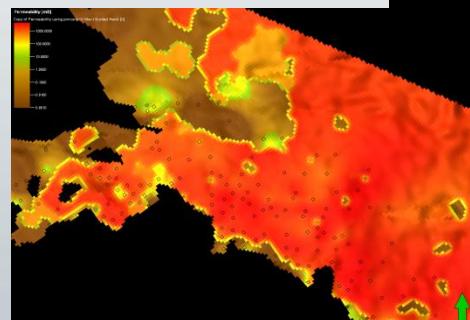
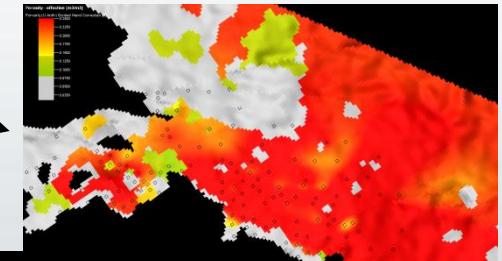


T4: Fluvial Fan

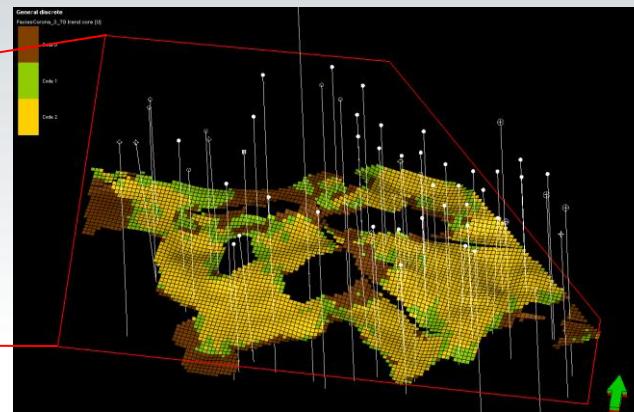
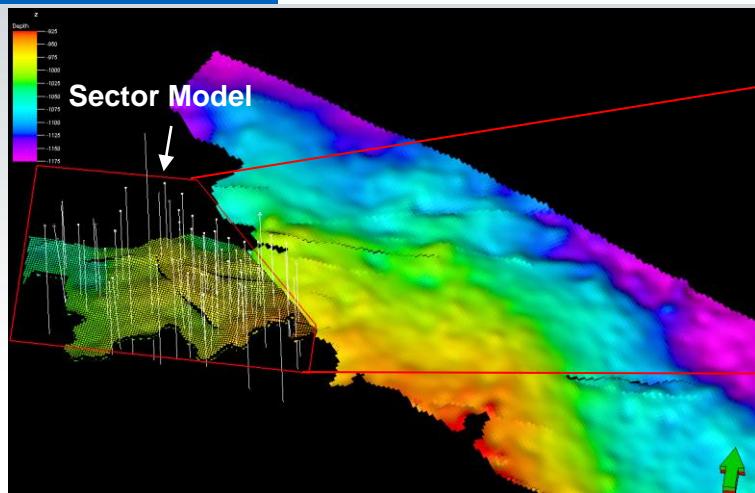


Property  
modelling

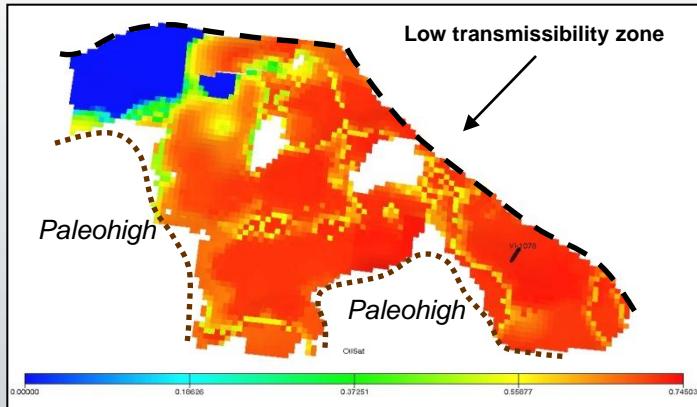
Porosity model



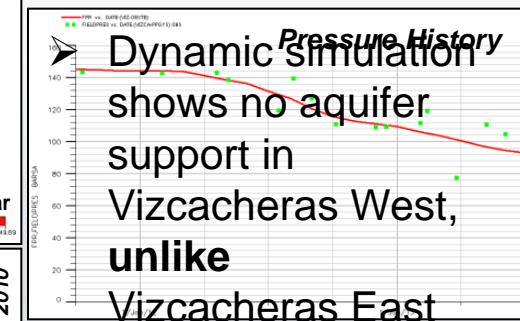
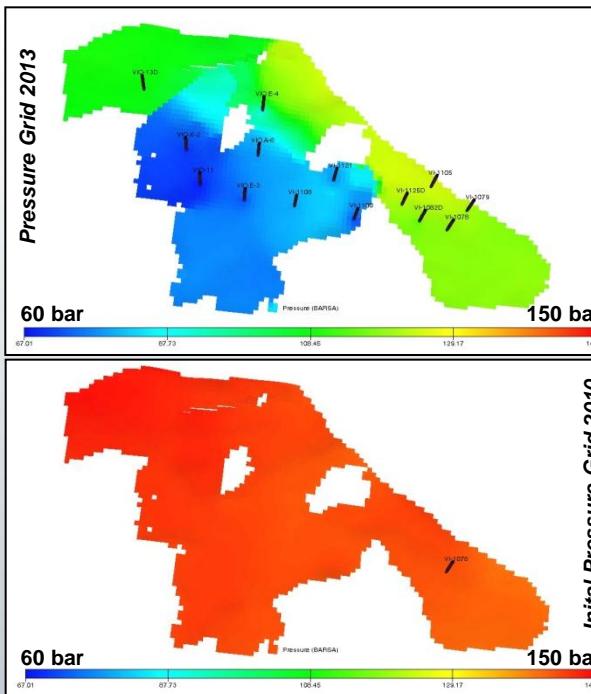
Permeability model



*Local grid  
for Vizcacheras West*

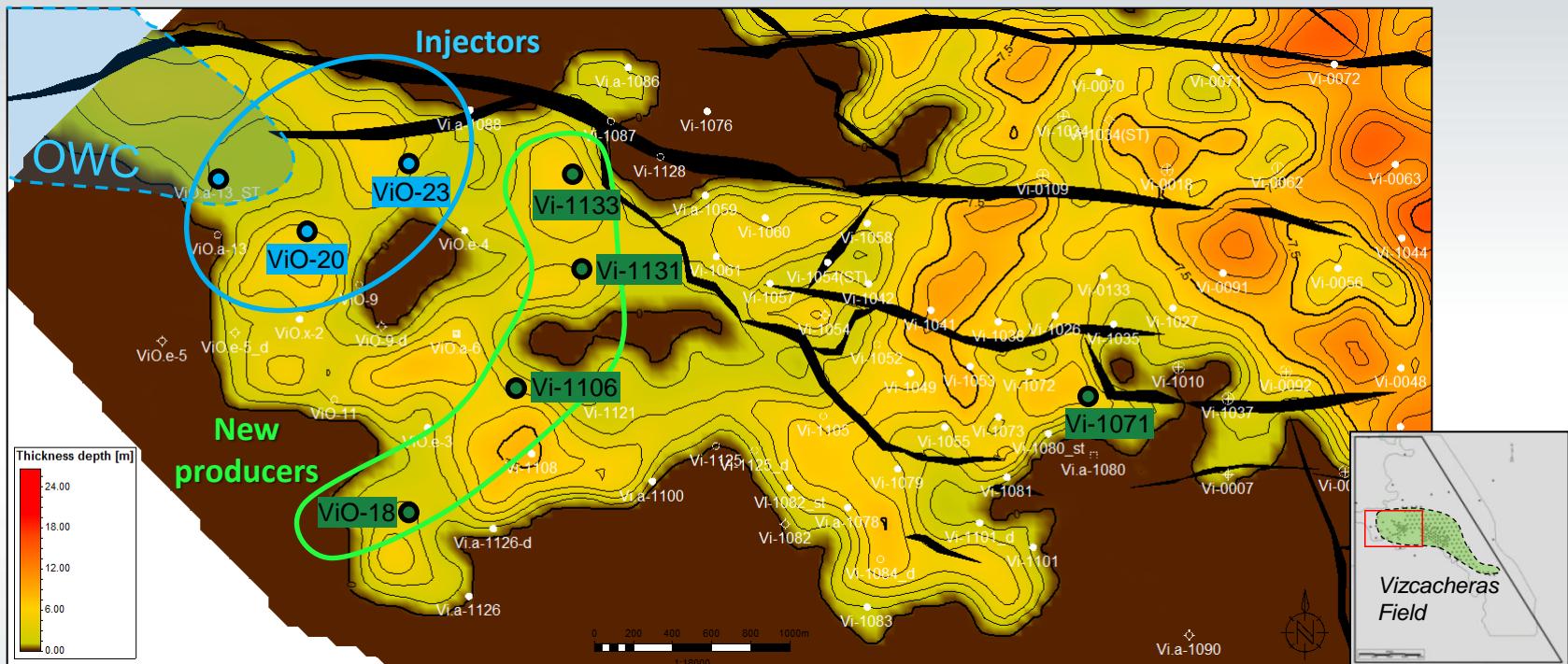


*Initial Oil Saturation Grid*



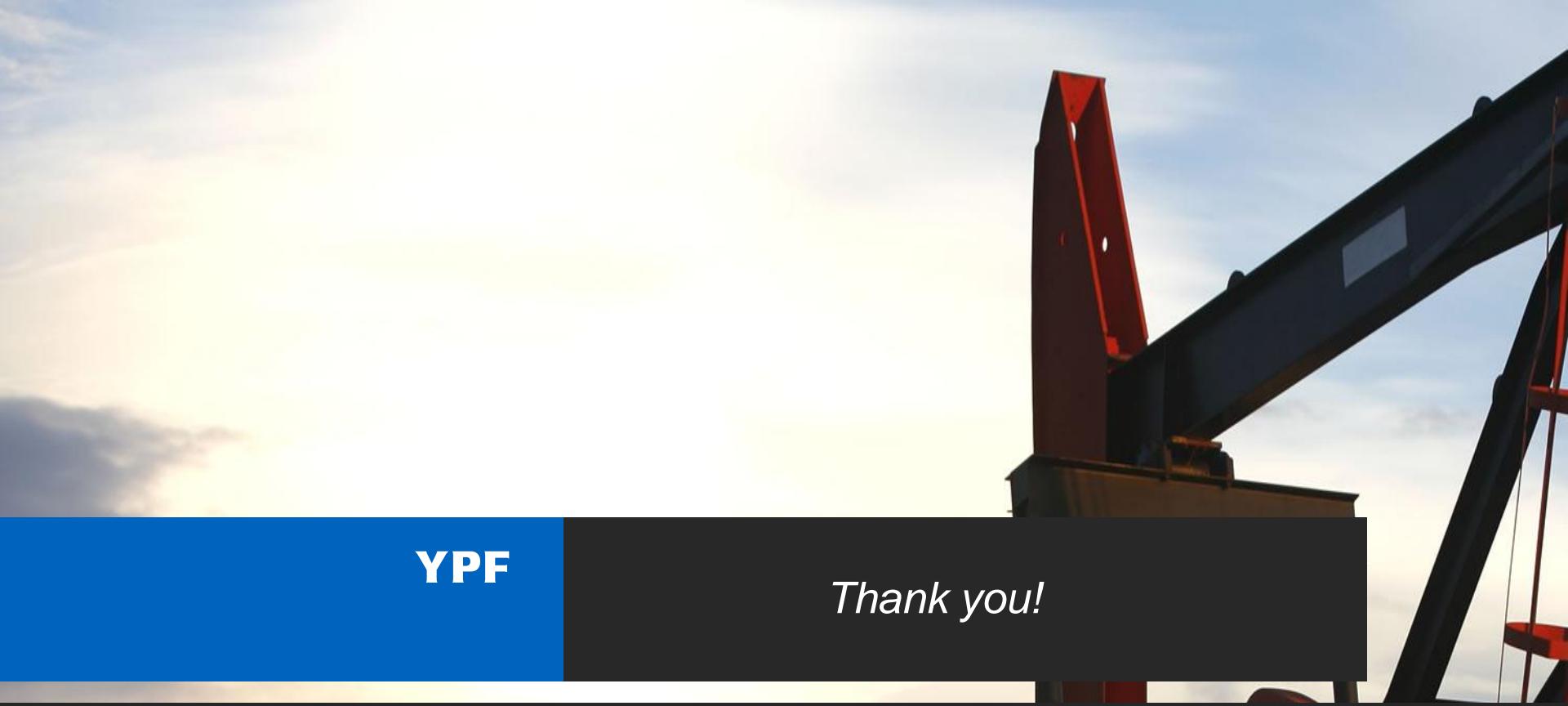
*Dynamic Pressure History  
shows no aquifer support in  
Vizcacheras West,  
unlike  
Vizcacheras East*

# Results and Conclusions



Net Sand Map Papagayos Fm. and new wells proposal

- ✓ Re-interpretation of previous exploratory model
- ✓ Facies and NtG re-distribution
- ✓ Re-evaluation of infill locations
- ✓ New Field Development Plan
- ✓ Dynamic simulation for waterflood

A photograph of an oil pumpjack against a backdrop of a warm, cloudy sunset. The pumpjack's mechanical arms are silhouetted against the bright sky.

**YPF**

*Thank you!*

*Acknowledgments:*

P. Ataniya, R. Carbonari, S. Acosta, U. Gomez (Mendoza Development Team)  
E. Morettini, L. Loss, JL Massaferro, A. Thompson (Subsurface Studies, Buenos Aires)  
E. Schwarz & G. Veiga (La Plata University)

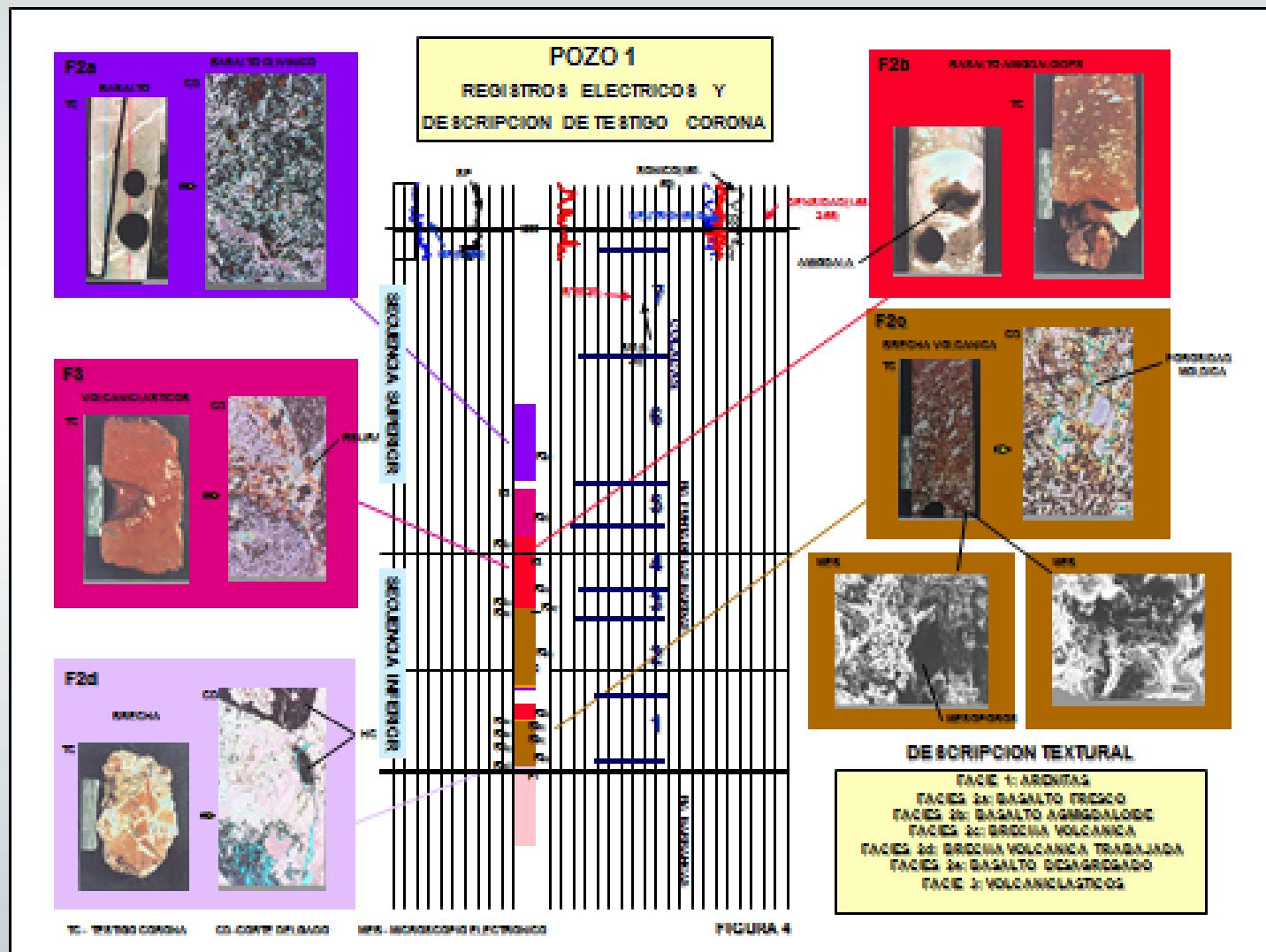
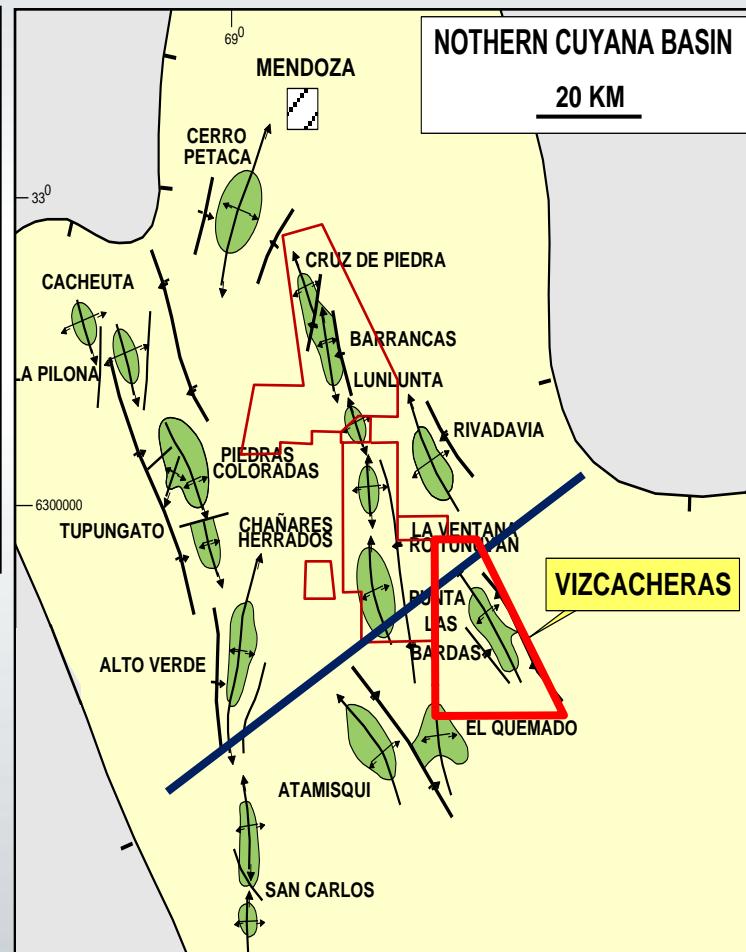
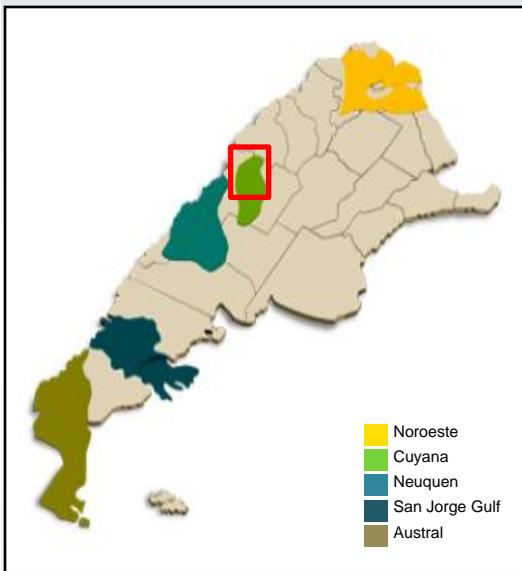
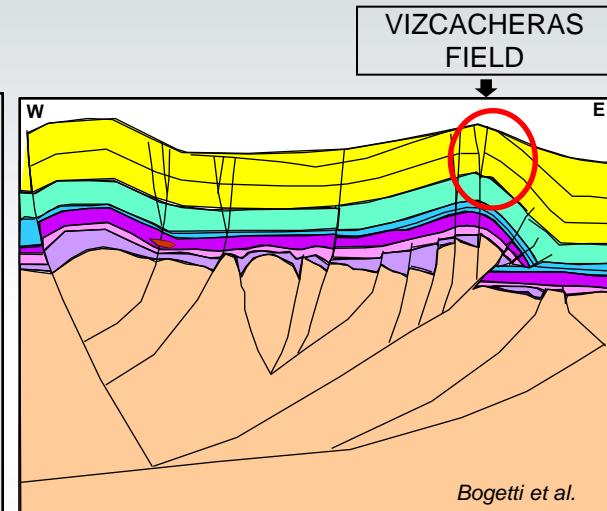


FIGURA 4

## Argentina's Oil Provinces

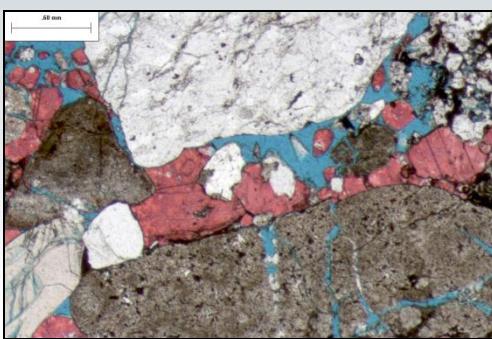
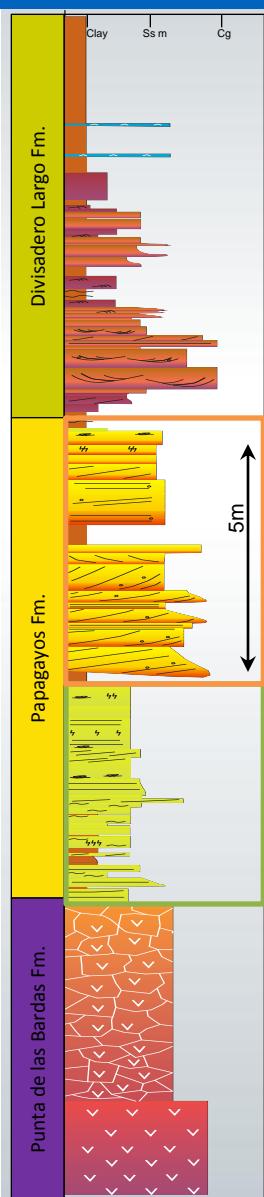


Productive fields along SE-NW axis



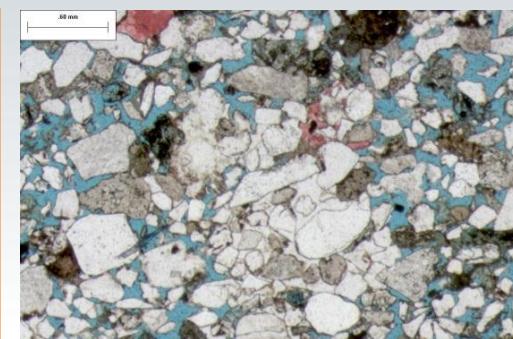
*W-E schematic structural cross-section of the Cuyana Basin.*

## Reservoir Characterization: Papagayos Fm.

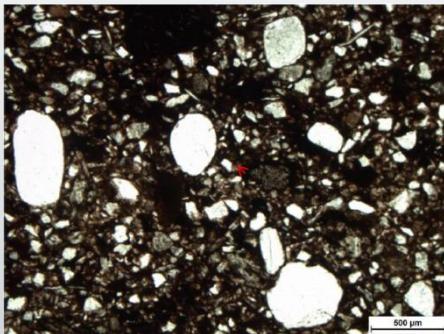
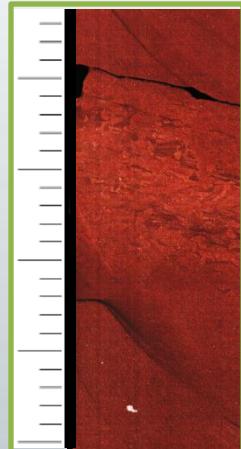


$\phi$ : 16.7% K: 1063 mD

Distal alluvial to fluvial reservoir facies association



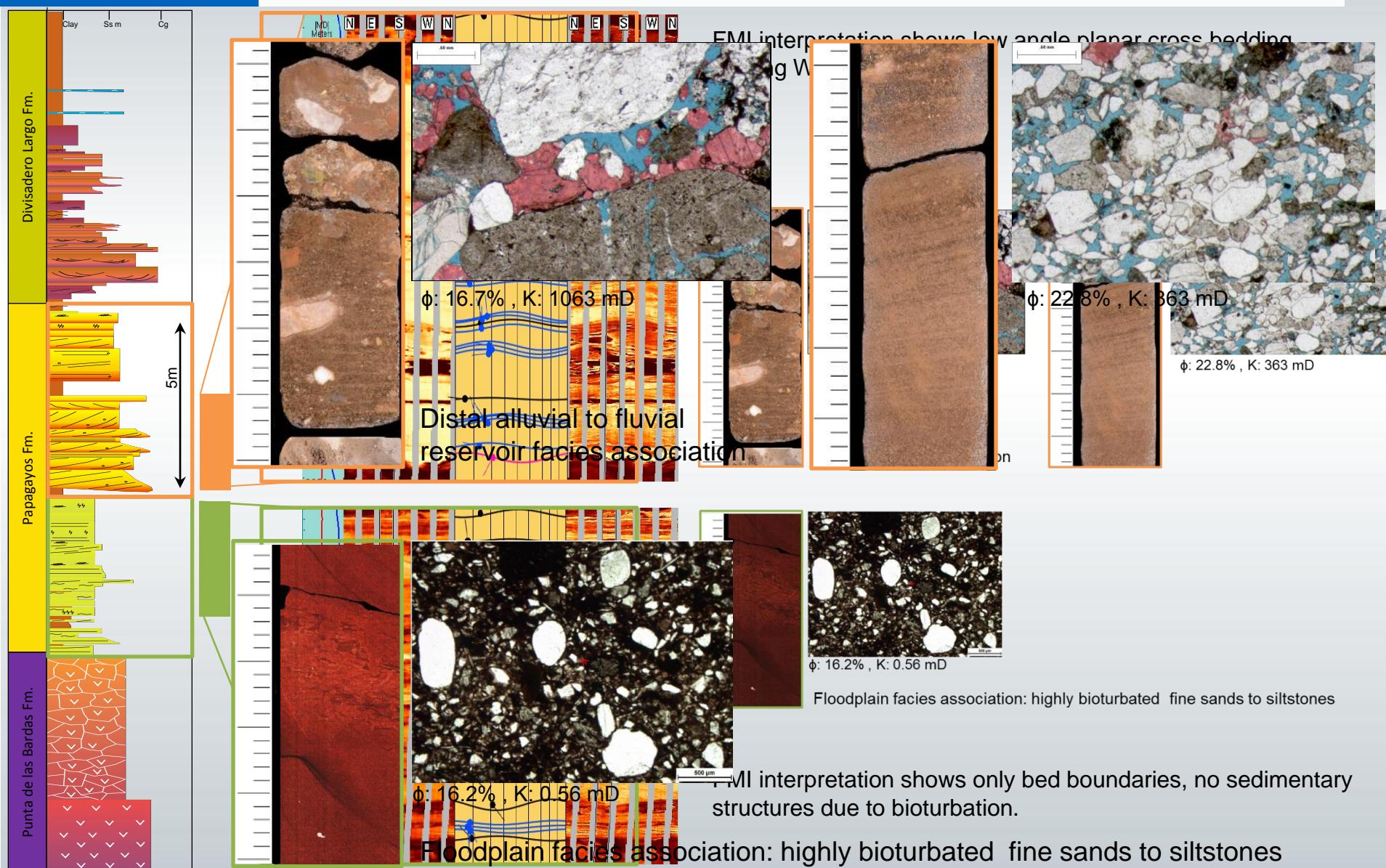
$\phi$ : 22.8% K: 363 mD

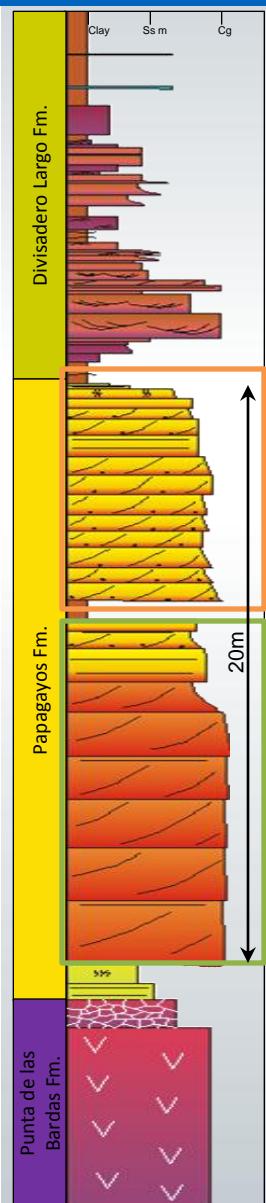


$\phi$ : 16.2% K: 0.56 mD

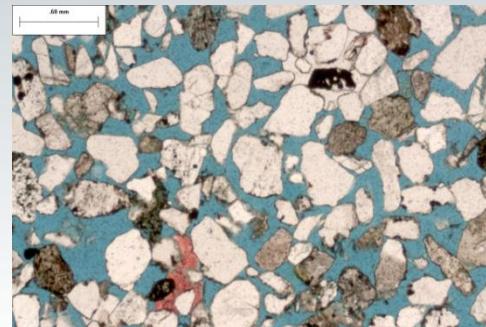
Floodplain facies association: highly bioturbated fine sands to siltstones

# Reservoir Characterization: Papagayos Fm.

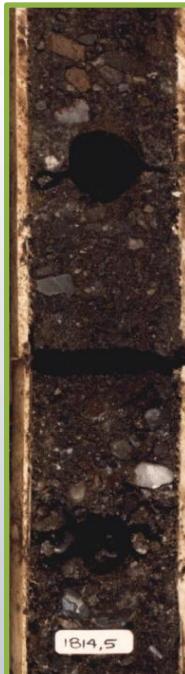




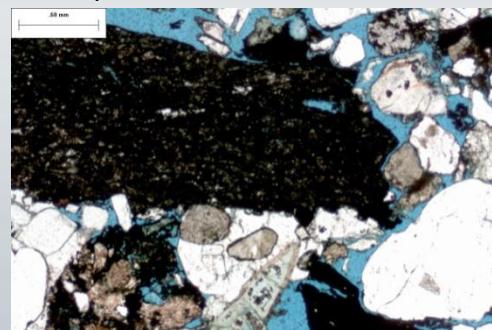
Alluvial to fluvial reservoir facies association



$\phi: 30.8\%$ , K: 3890 mD

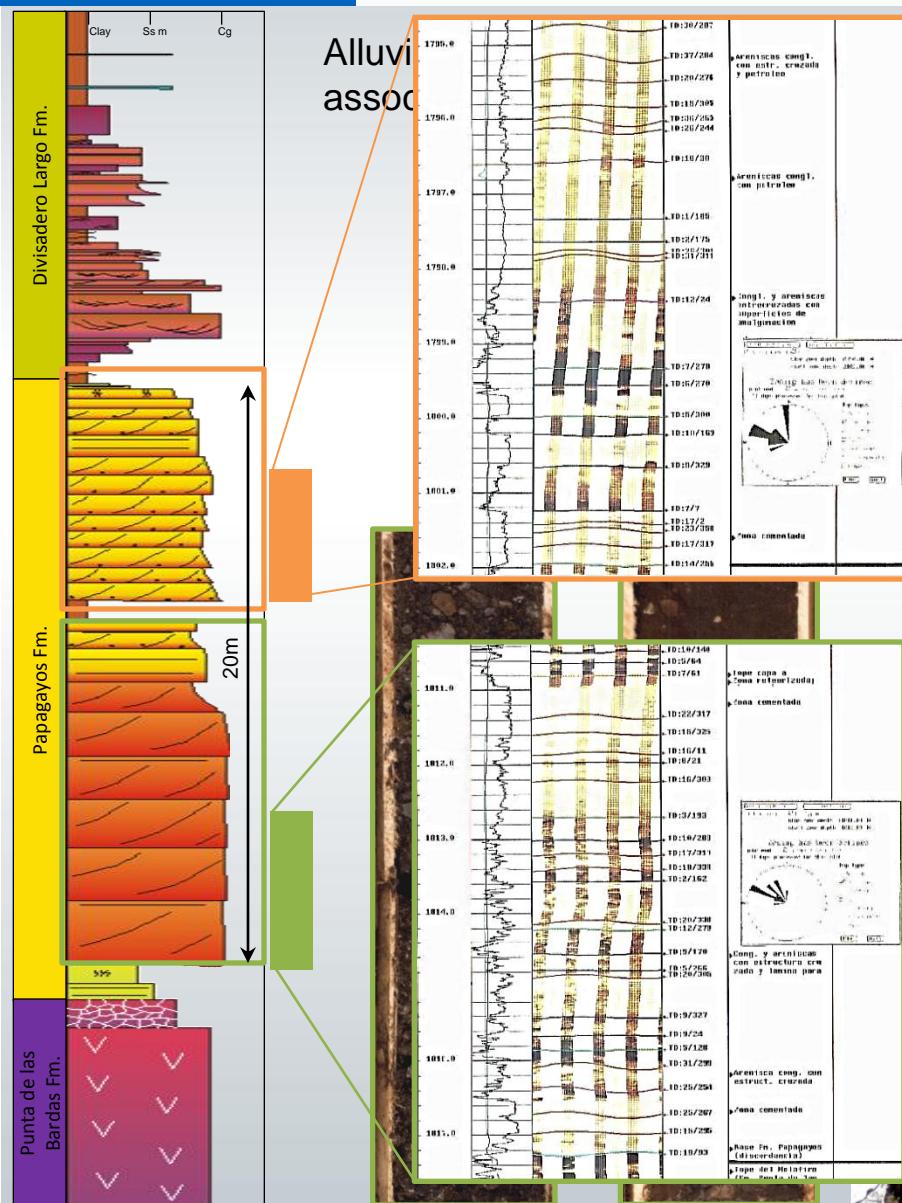


Alluvial fan facies association



$\phi: 26.2\%$ , K: 5664 mD

# Reservoir Characterization: Papagayos Fm.



## Alluvial associations

FMI interpretation shows low angle planar cross bedding dipping W to NW

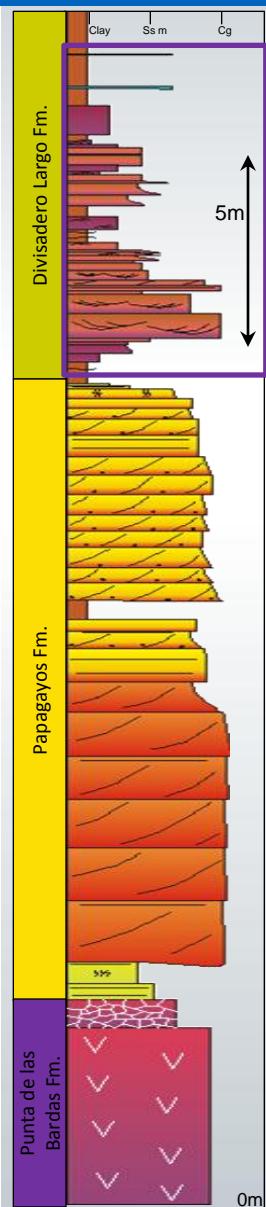
#### Alluvial to fluvial reservoir facies association

$\phi$ : 30.8% , K: 3890 mD

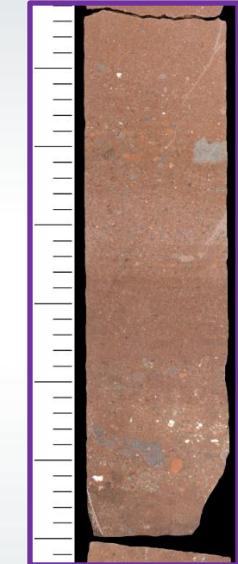
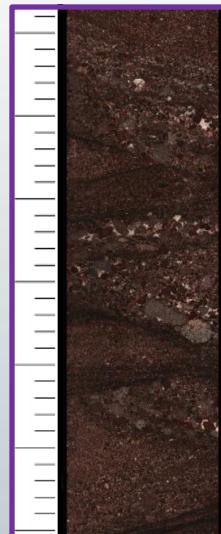
Φ: 30.8% , K: 3890 ml

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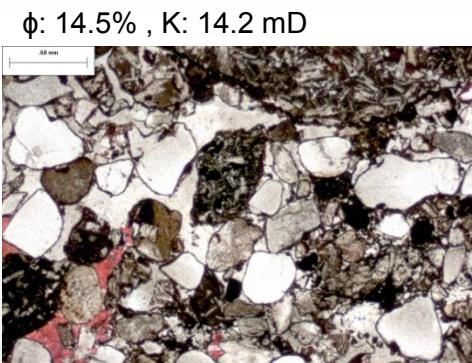
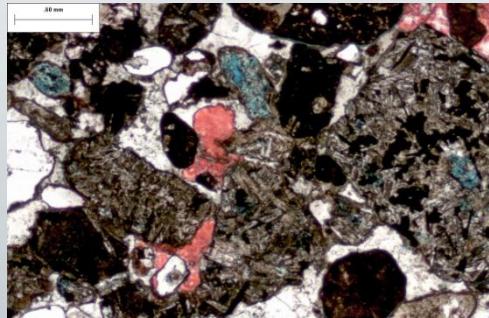
Interpretation shows sedimentary structures dipping NW



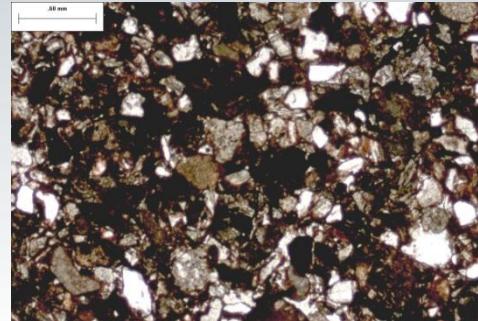
Fluvial to playa lake facies association



$\phi: 19.2\% , K: 16.89 \text{ mD}$



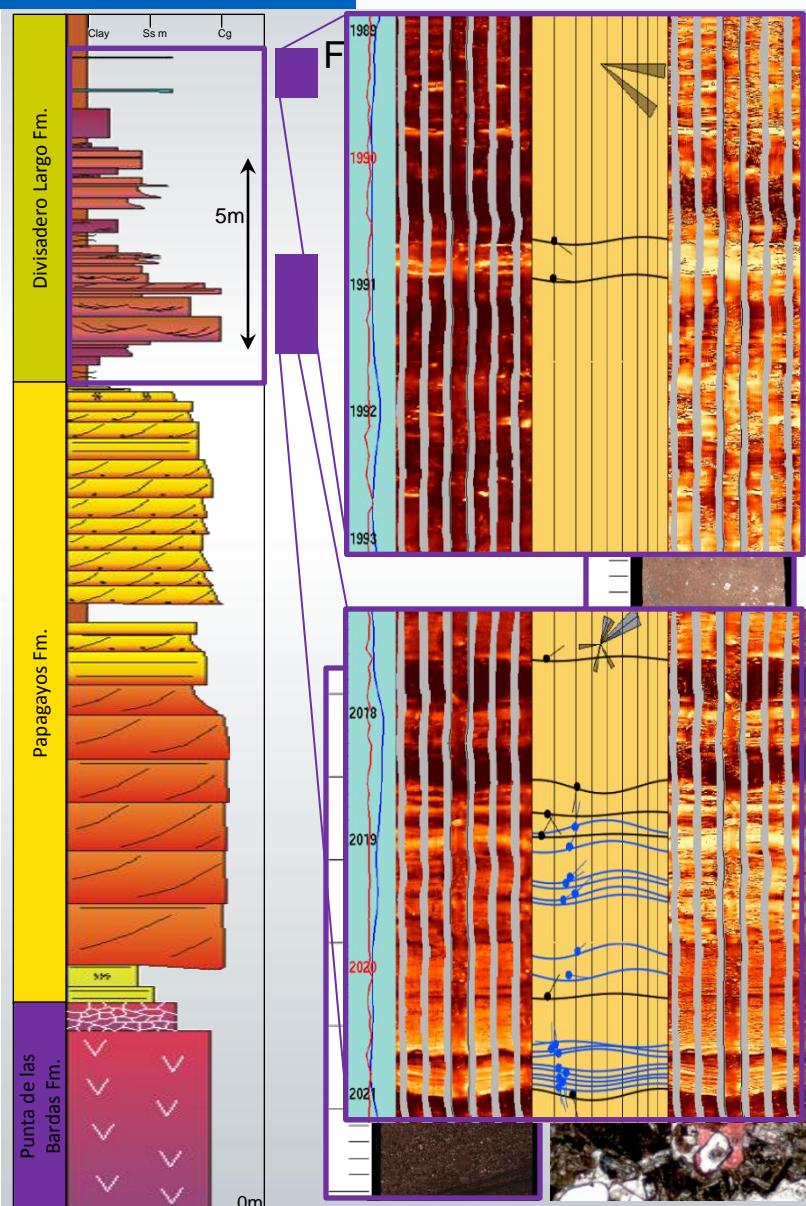
$\phi: 14.5\% , K: 14.2 \text{ mD}$



$\phi: 14.6\% , K: 13.2 \text{ mD}$



# Reservoir Characterization: Divisadero Largo Fm.

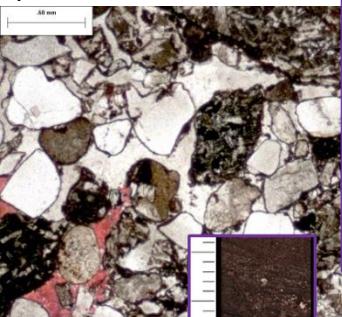


sociation

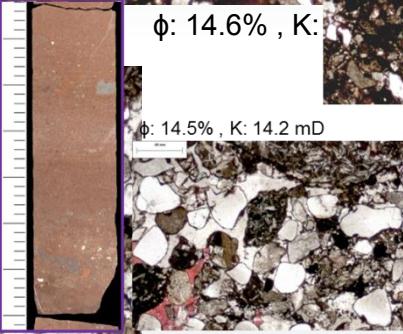
FMI interpretation shows high resistivity evaporites layers.



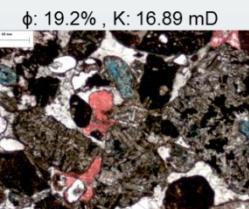
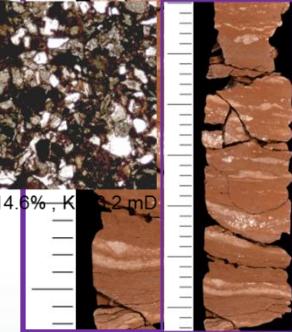
$\phi: 14.5\%$ , K: 14.2 mD



$\phi: 14.6\%$ , K: 14.2 mD

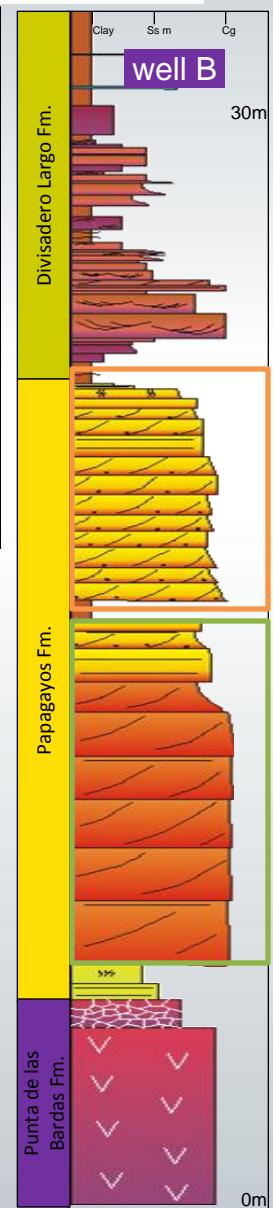
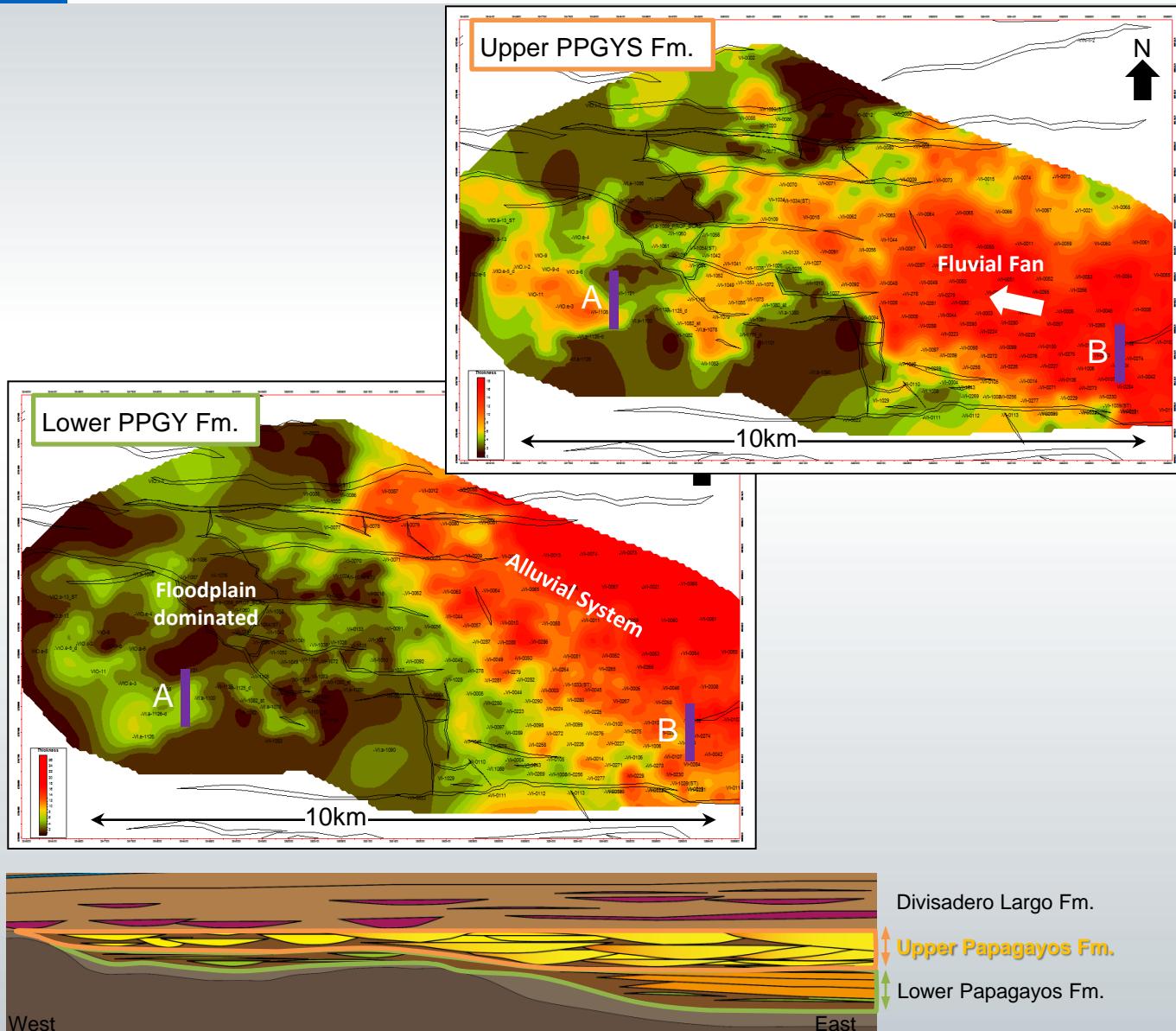
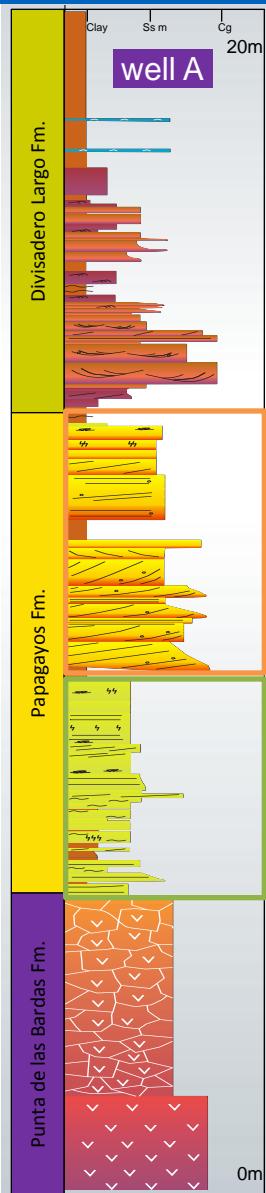


$\phi: 14.6\%$ , K: 16.89 mD

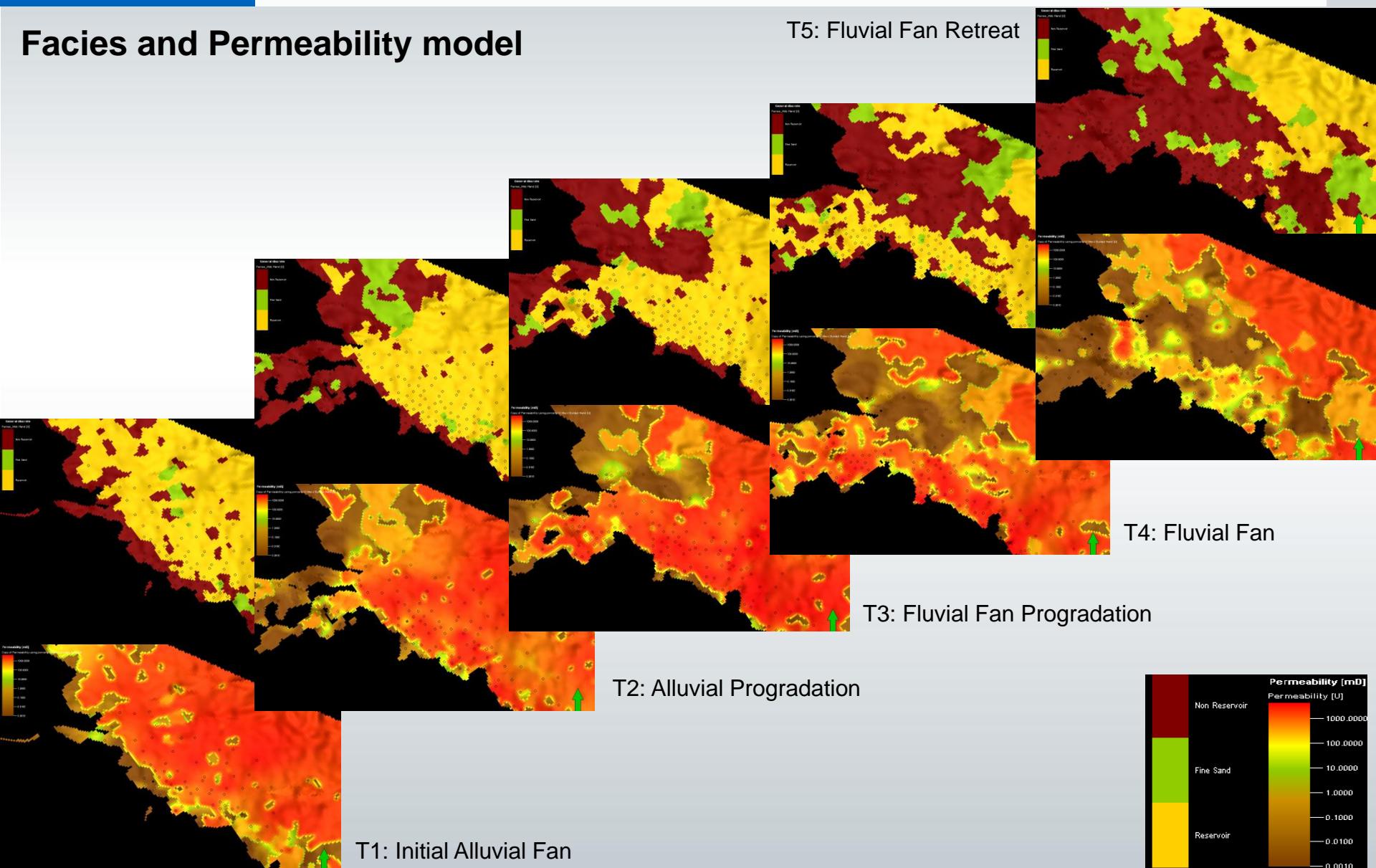


9 mD

FMI interpretation shows low angle planar cross bedding and through-cross-bedding dipping NE.

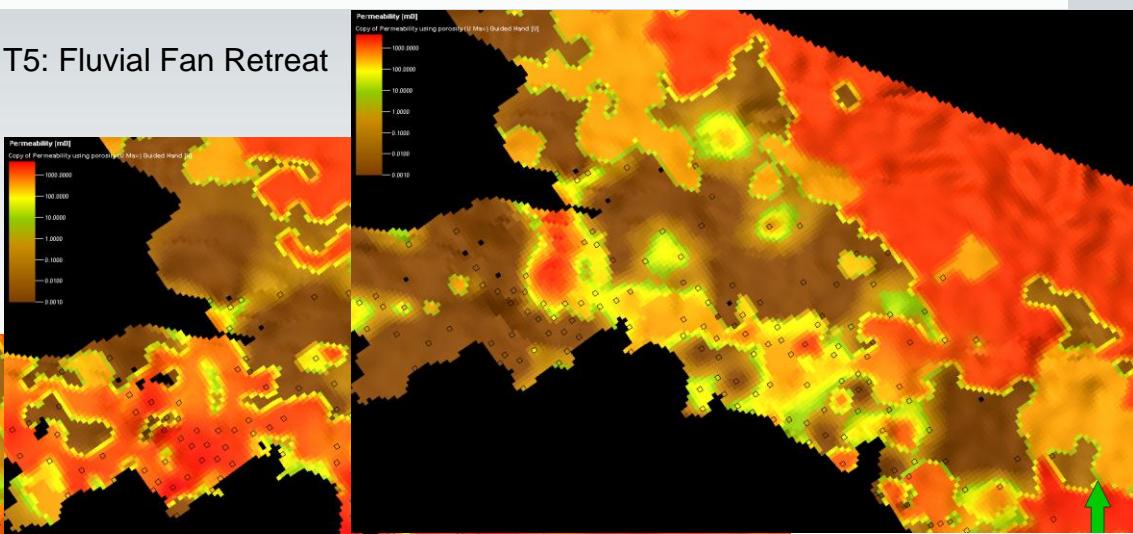


## Facies and Permeability model

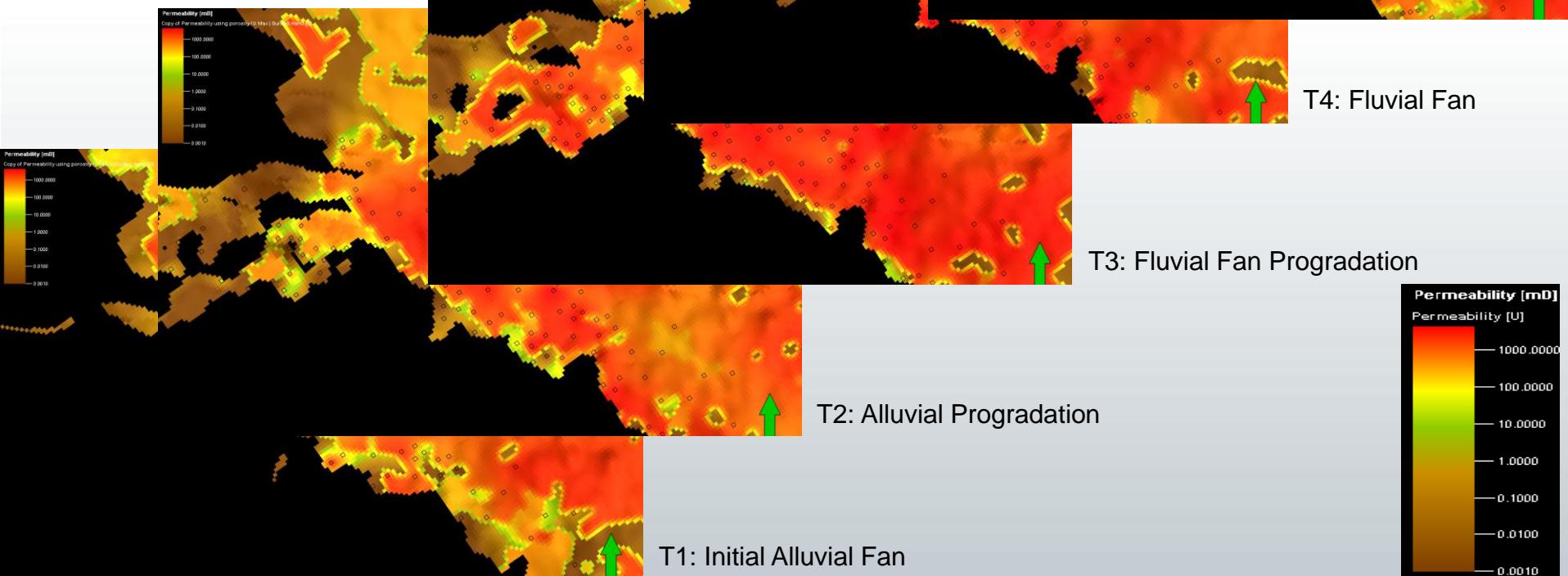


Permeability model:

T5: Fluvial Fan Retreat



T4: Fluvial Fan

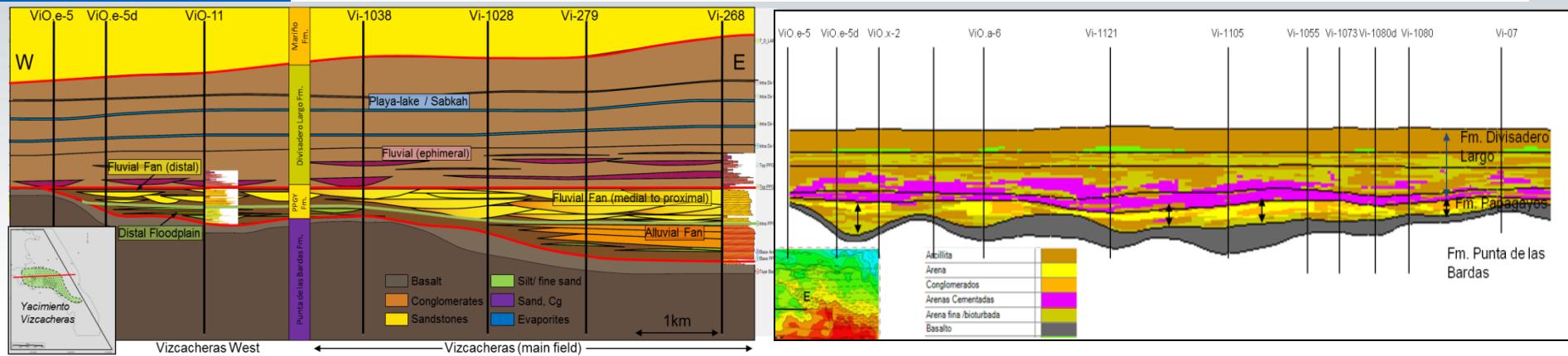


T3: Fluvial Fan Progradation

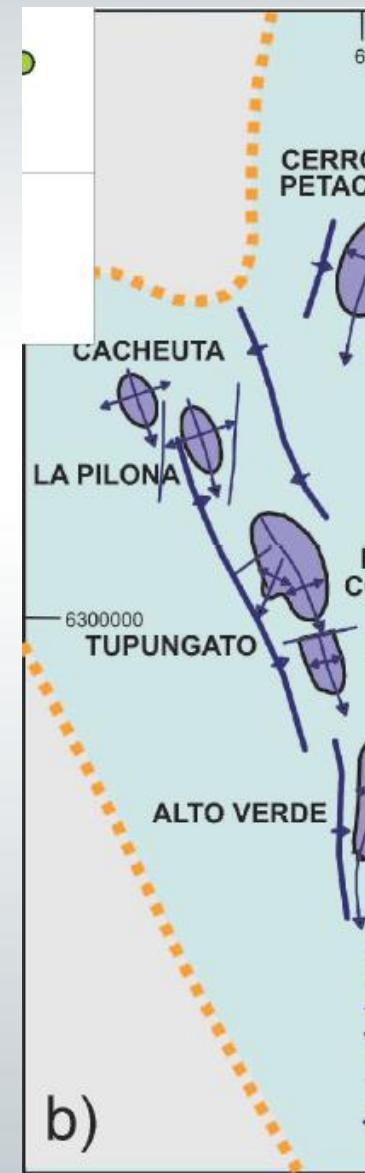
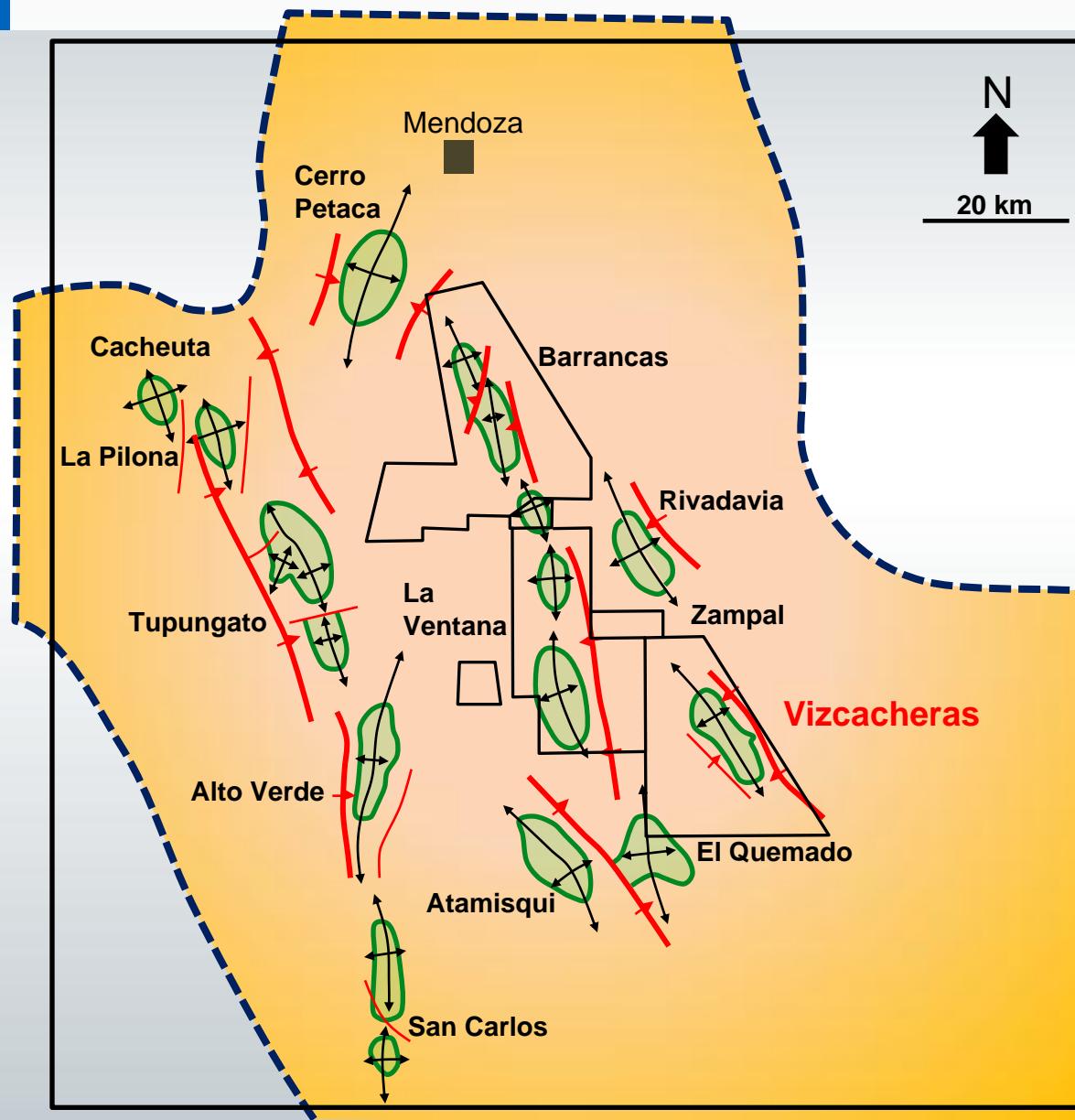
T2: Alluvial Progradation

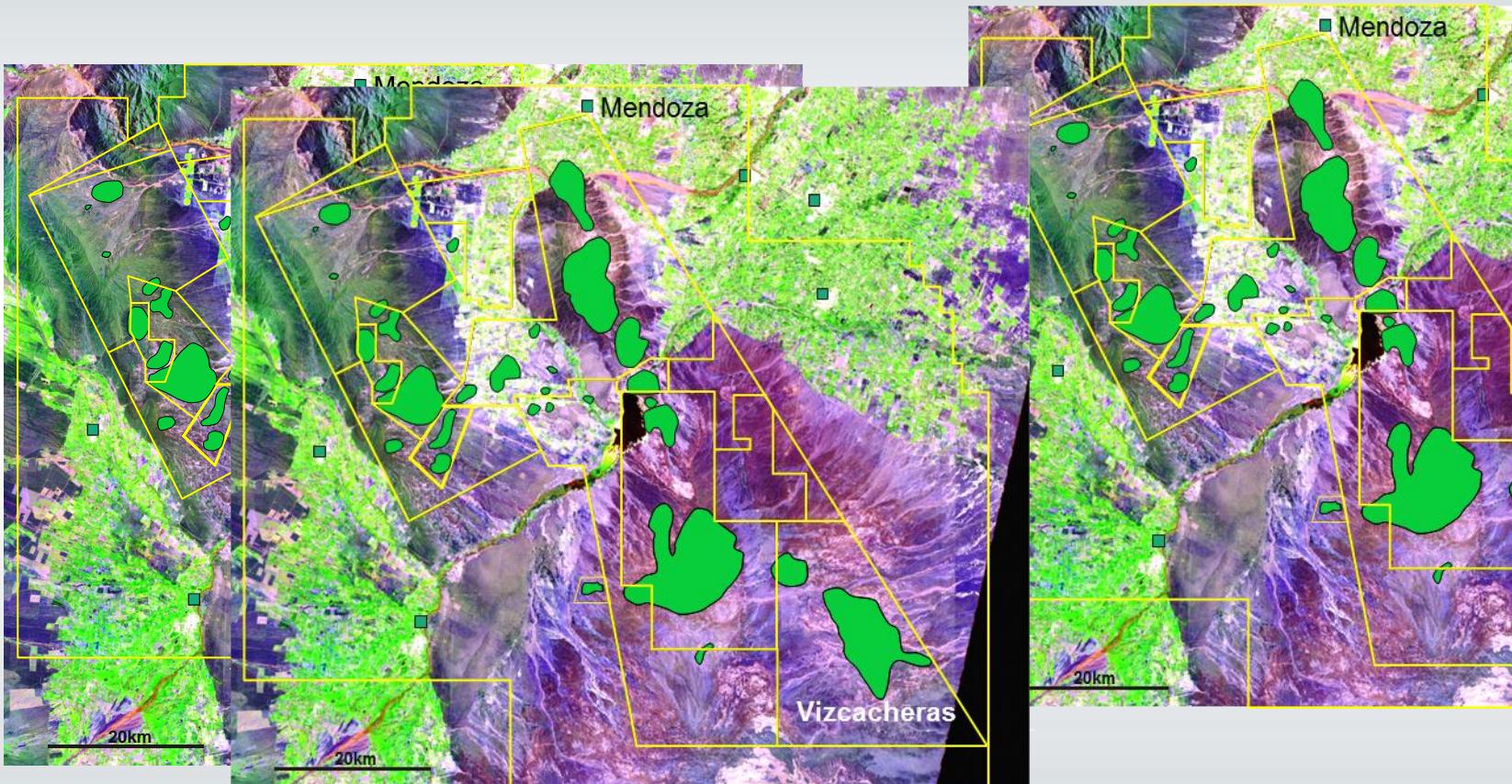
T1: Initial Alluvial Fan

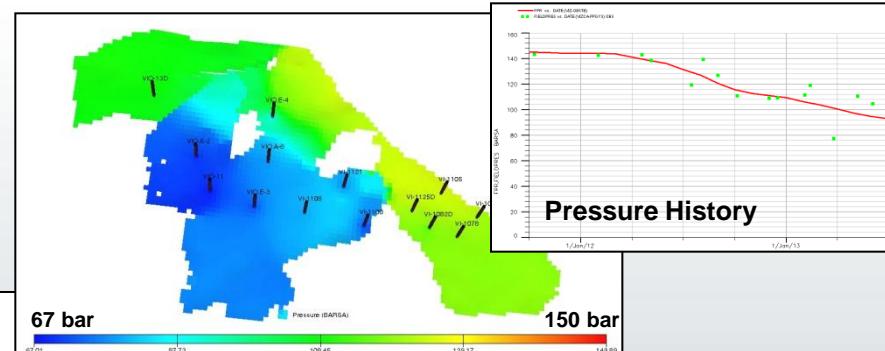
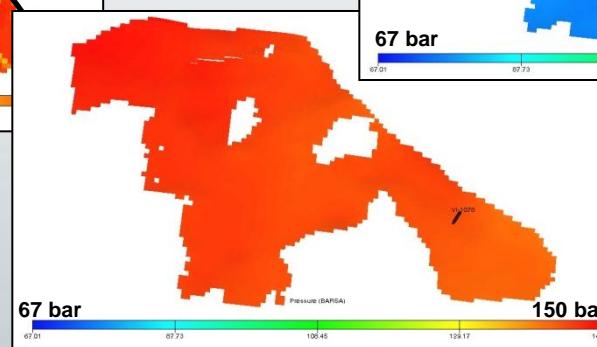
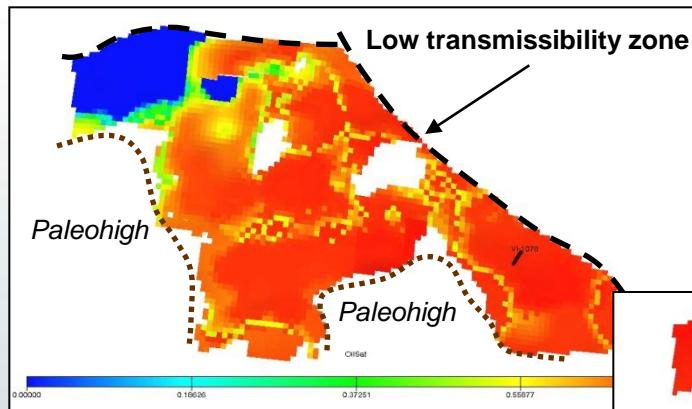
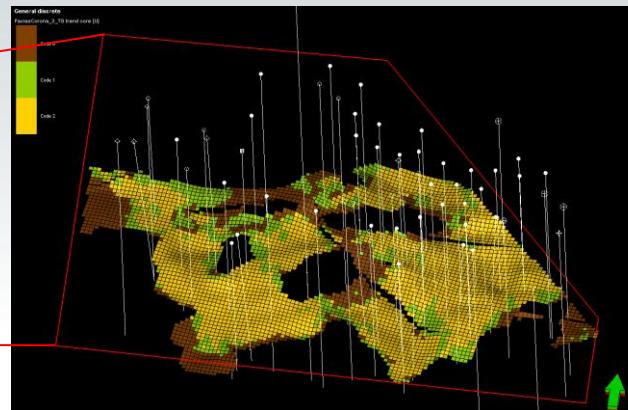
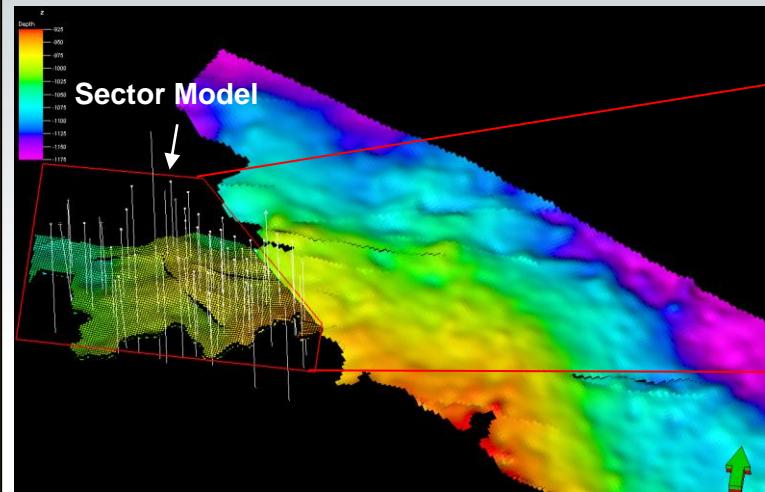
# Results and Conclusions



- Re-interpretation of previous exploratory model
- Facies and NtG re-distribution
- Re-evaluation of infill locations
- New FDP
- Dynamic simulation for waterflood







- Dynamic simulation shows no aquifer support in Vizcacheras west, unlike Vizcacheras east