Static and Dynamic Modeling of a Complex Alluvial-Fluvial Reservoir: Middle Jurassic Lotena Formation, Aguada Toledo Field, Neuquén Basin, Argentina*

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Abstract

The Aguada Toledo Field consists of a fault-bounded east-west anticlinal structure, producing oil (5 MMbbls) from a mixed alluvial-fluvial system (Middle Jurassic Lotena Formation). In order to expand current water-flooding development to the northern sector of the field, an integrated reservoir model was built.

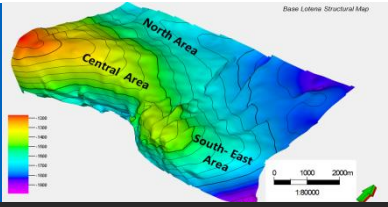
Seismic interpretation shows that four main tectonic phases have affected the structural evolution of the Field: (1) Bajocian compression generating the east-west fault-bounded paleo-high structure, (2) Callovian tectonic inversion reactivating the main fault system through extensional growth faulting at the time of Lotena deposition, (3) Tithonian-Berriasian compression and uplift generating folding and truncation/erosion of Lotena at the centre of the field, (4) Tertiary compression resulting in the current Aguada Toldeo Anticline.

Core analysis reveals the existence of four main accommodation cycles (C1-C4) deposited in an alluvial-fluvial environment. C1, C3 and C4 consist of fluvial sands fining upward into flood-plain shales interpreted as retrograding fluvial-dominated cycles associated with periods of tectonic quiescence. C2 consists of erosive alluvial conglomerates/coarse sands fining upward into overbank finer sands interpreted as a prograding alluvial cycle associated with active tectonic pulses.

Based on this structural and stratigraphic framework, we generated a static model where proximal-distal facies arrangement, especially in the prograding C2, determined a deterioration of reservoir properties, moving away from the main active fault.

Dynamic modeling identified that pressure regimes between the northern and southern sectors of simulated areas were not in communication, confirming the existence of erosion and truncation across the structure, and of facies-associated reservoir property variations. The general degradation of reservoir properties to the north of the field was confirmed, and refinement of correlation at sub-cycle level required. Initial dynamic realizations proved to be over-estimating reservoir net-to-gross due to log resolution issues. The modeling of cemented beds observed in core (cross-bedded fluvial facies), initially not captured in the static model, was critical to replicate reservoir behavior and decrease excessive reservoir volumes. This case study shows the importance of integrated approaches and of static-dynamic iterations to identify areas of reservoir property variation impacting water-flood development.

Static and dynamic modelling of a complex alluvial-fluvial reservoir :Middle Jurassic Lotena Formation



Aguada Toledo Field, Neuquén Basin, Argentina

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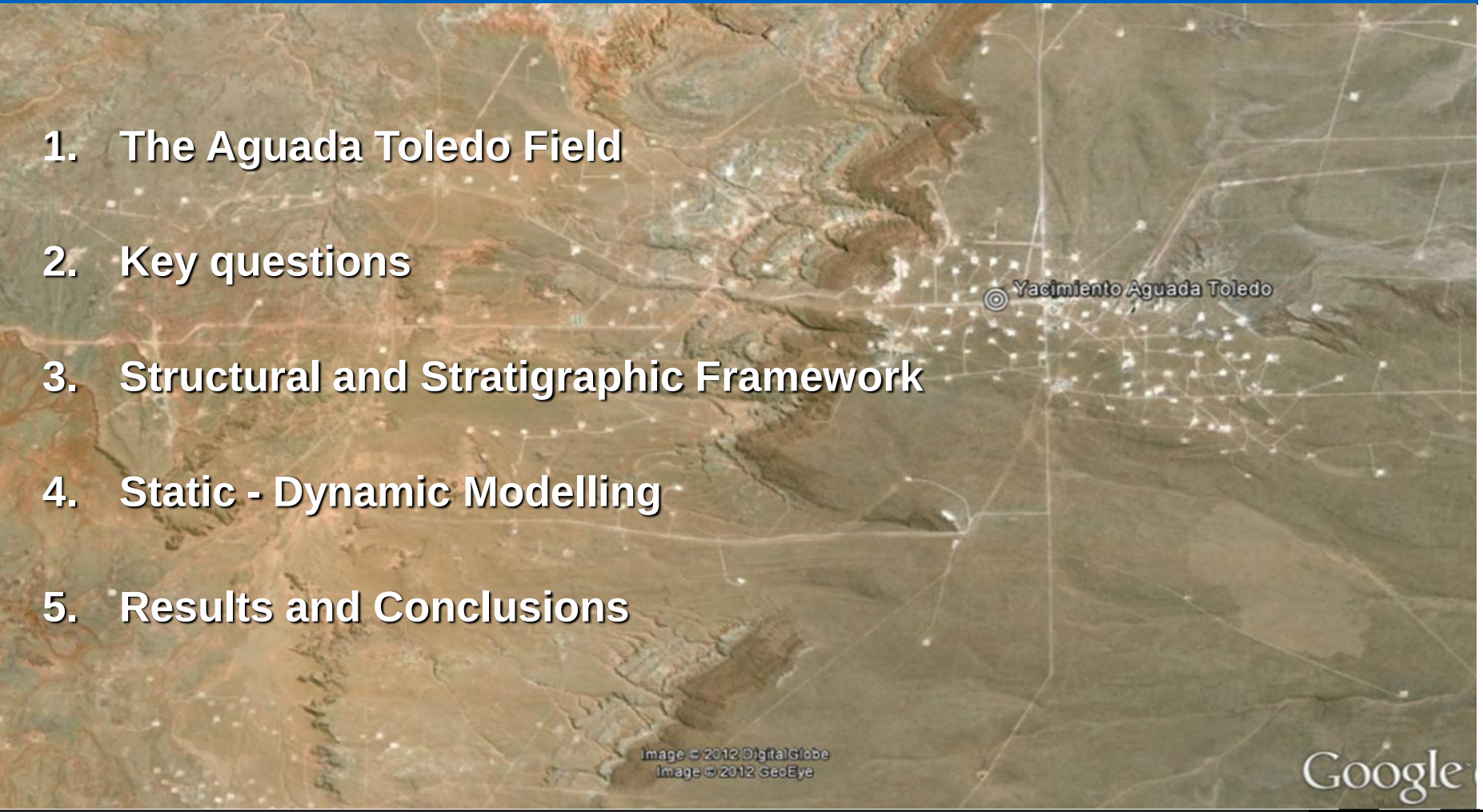
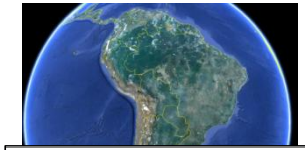
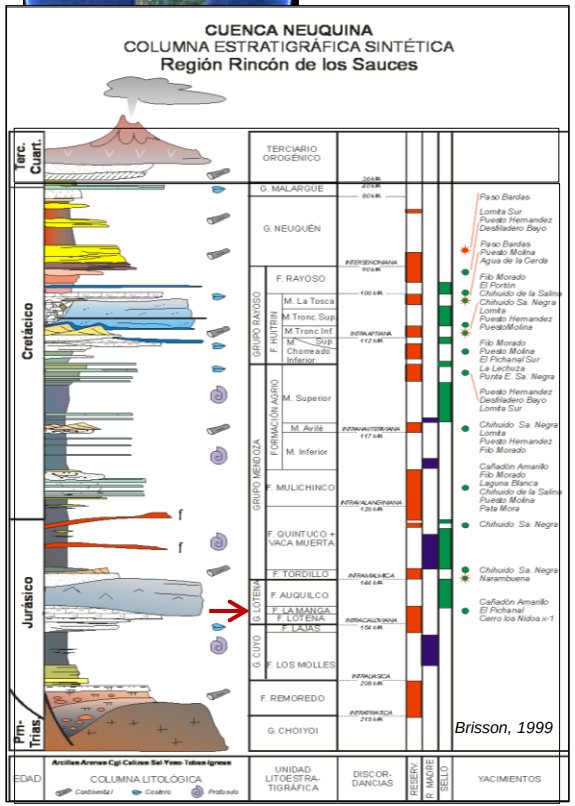
Outline of presentation

1. The Aguada Toledo Field
2. Key questions
3. Structural and Stratigraphic Framework
4. Static - Dynamic Modelling
5. Results and Conclusions



YPF Aguada Toledo Field

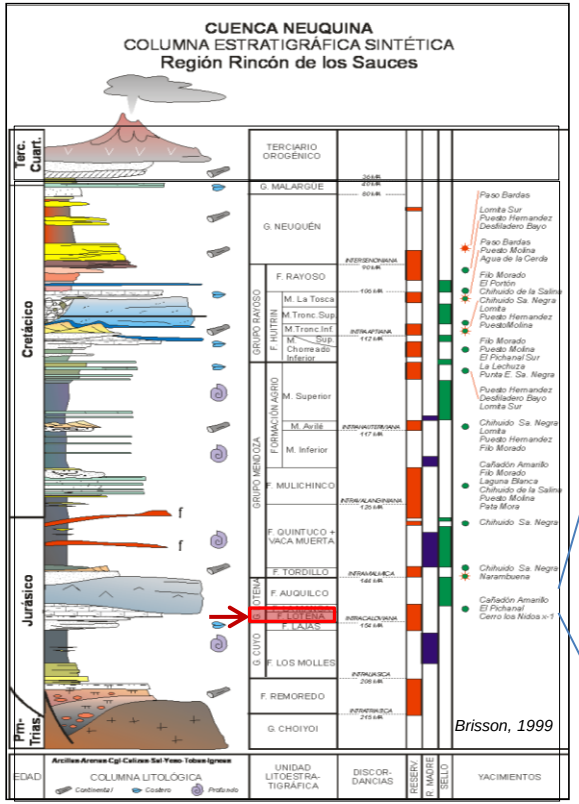




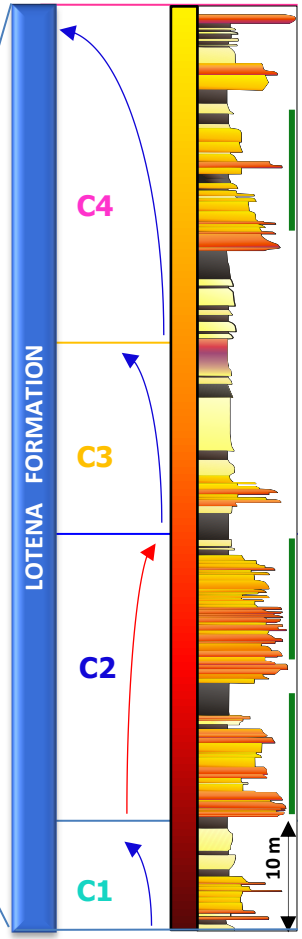
Tomado de I. Brissón, 1999

Aguada Toledo Location ***Neuquen Basin***

YPF Aguada Toledo Field



Tomado de I. Brissón, 1999



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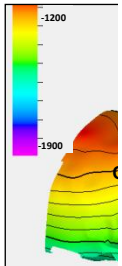
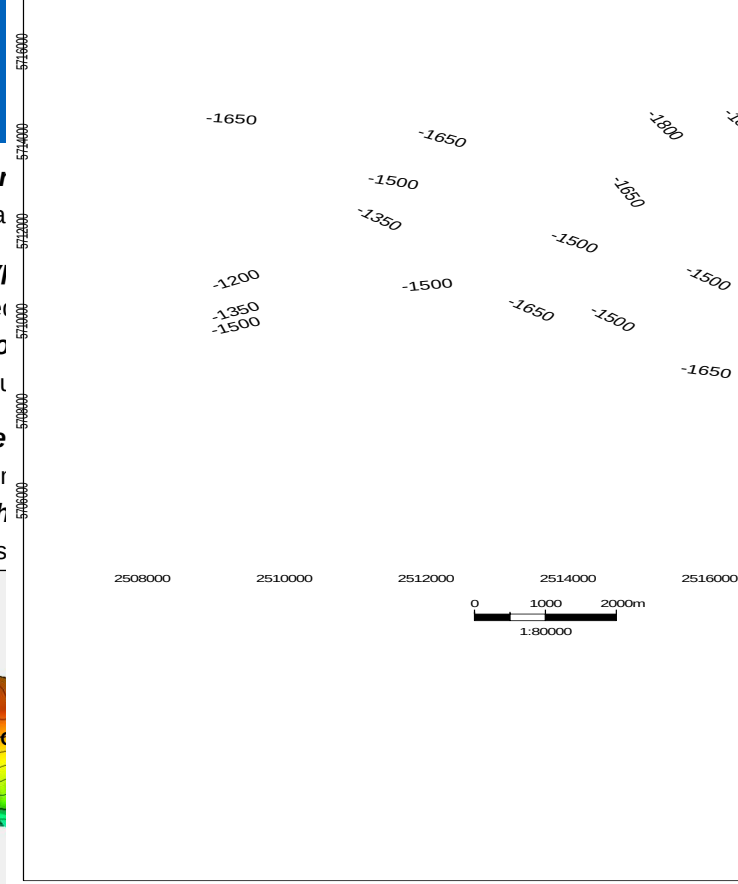
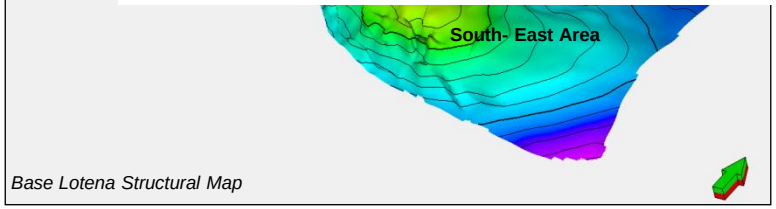






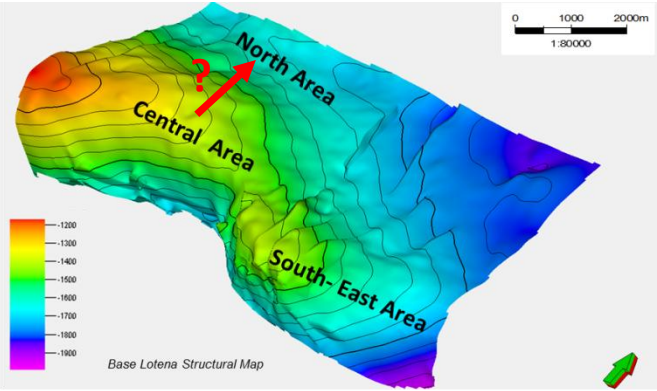
Base Lotena Structural Map

Study Objectives

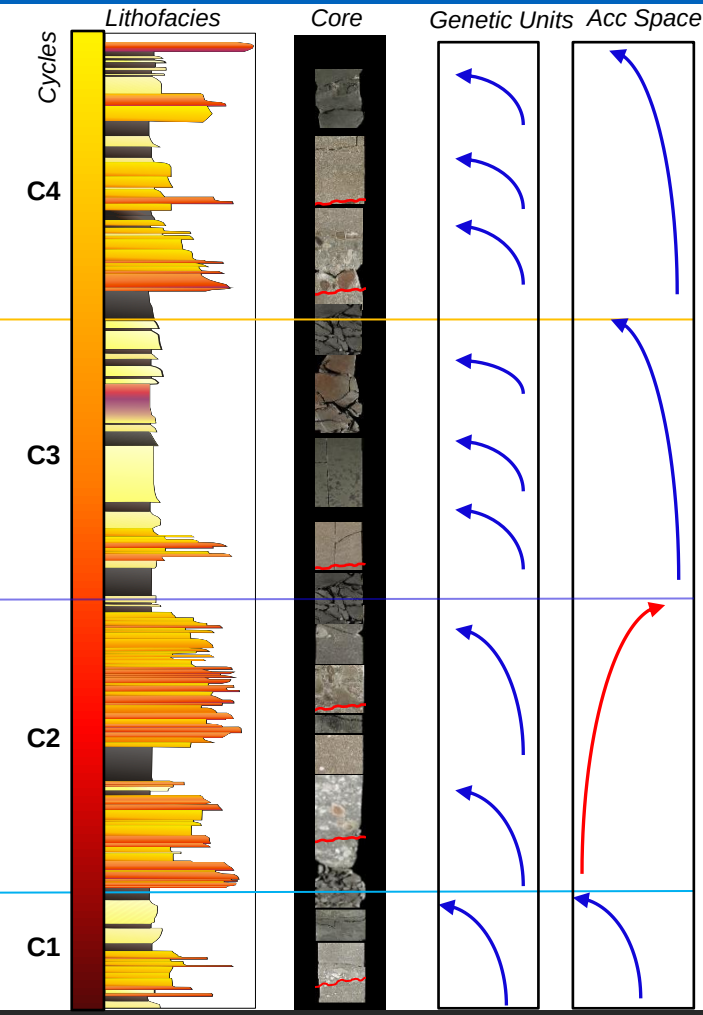
- Asses potential for secondary recovery expansion to Northern area
- Identify drilling opportunities according to static-dynamic model

Key Questions

- *Lotena: a homogeneous or heterogeneous reservoir?*
- *South and North Development: possible analogies?*

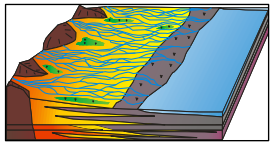


Stratigraphic Architecture

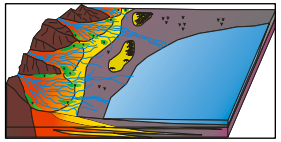


Depositional Environments

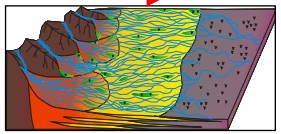
Retrograding Alluvial-fluvial



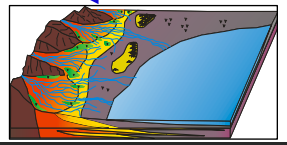
Low energy retrograding lacustrine



Prograding Alluvial Fan



Retrograding Sheet flows



Reservoir

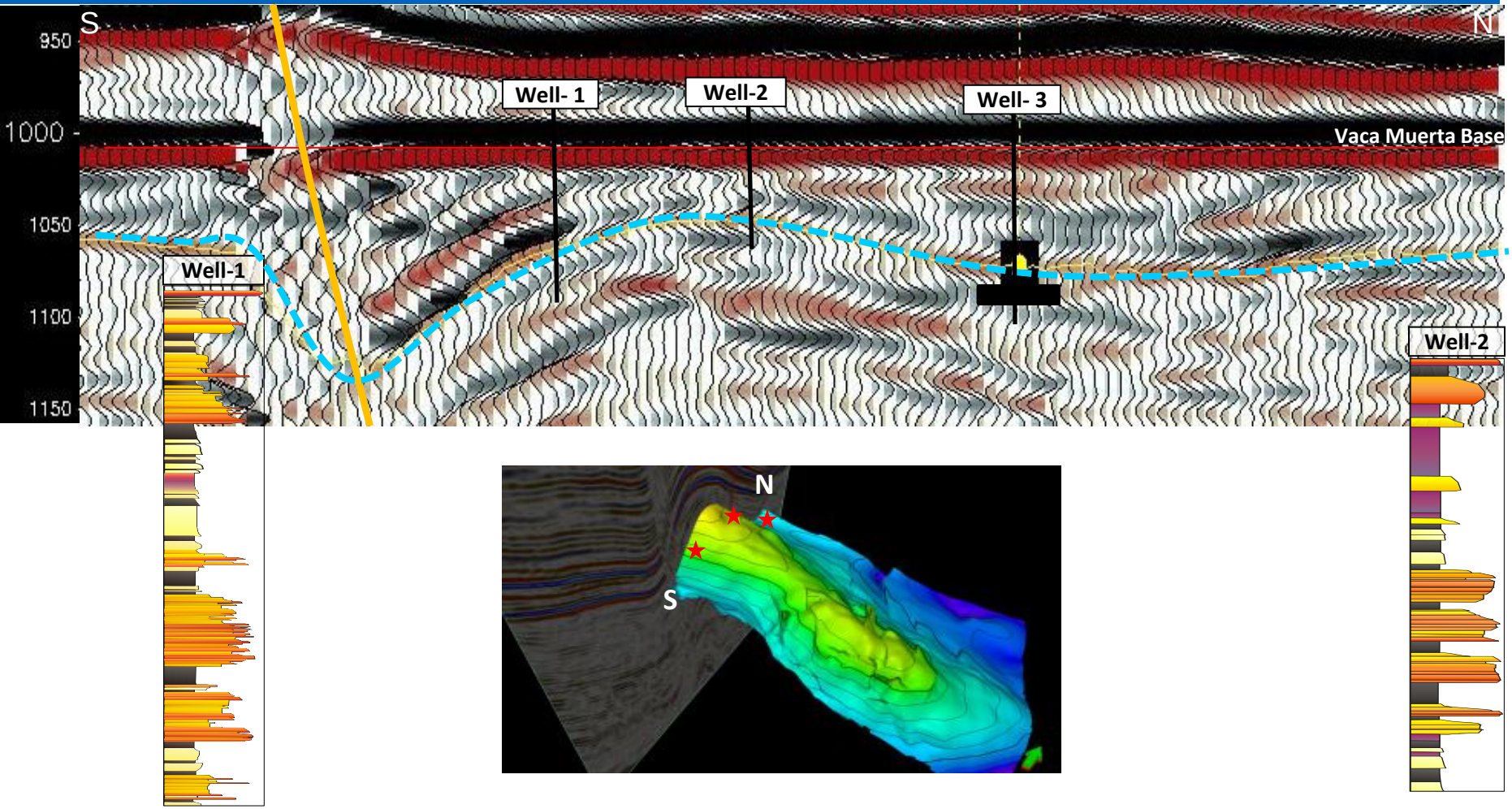
Medium - coarse grained, good porosity

Fine grained, Low porosity

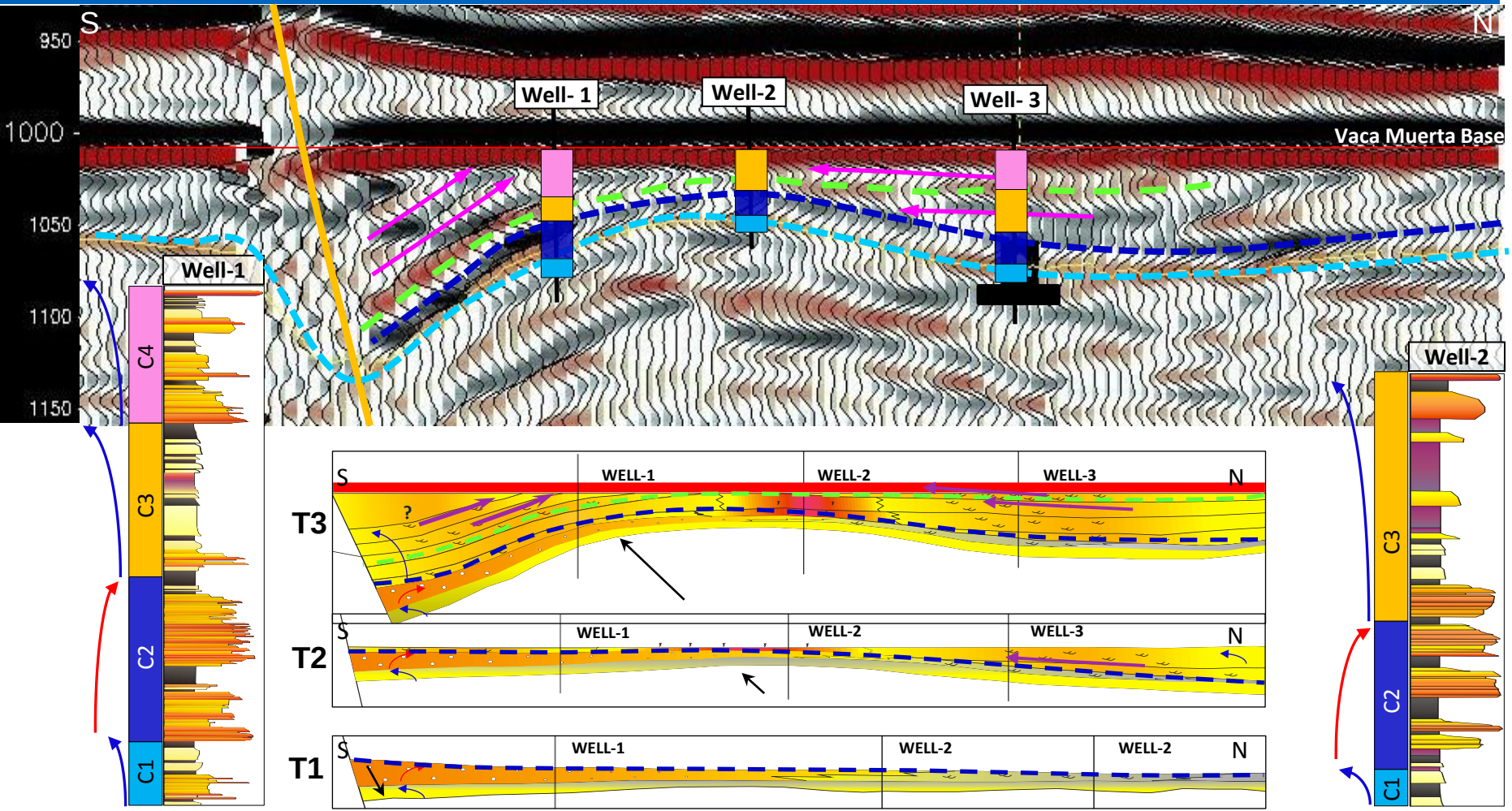
Coarse, highly heterogeneous

Fine grained, low porosity

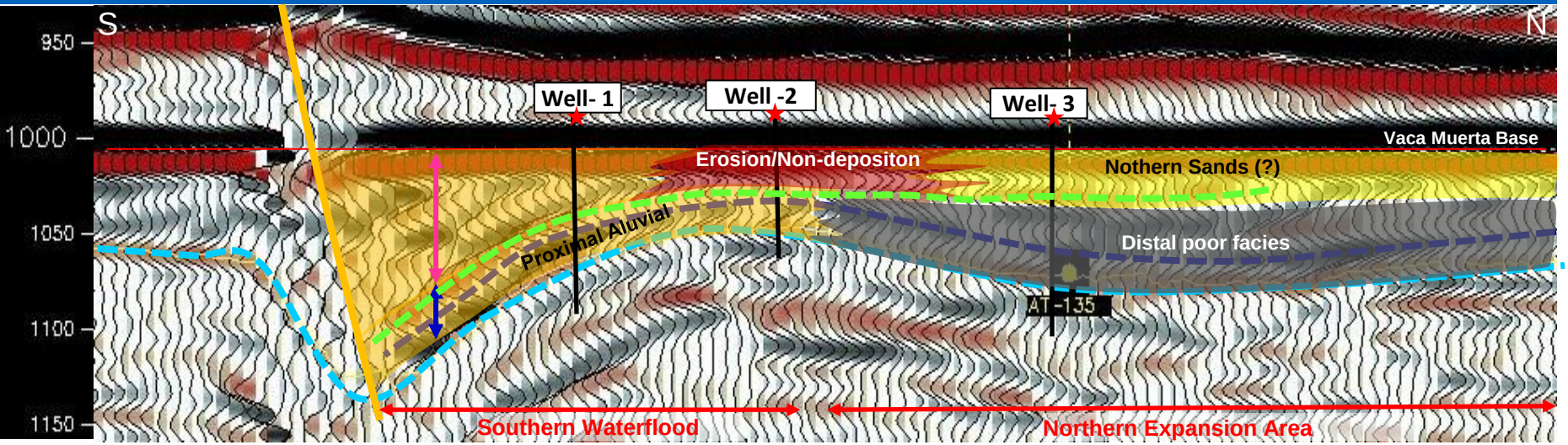
Seismic data show…

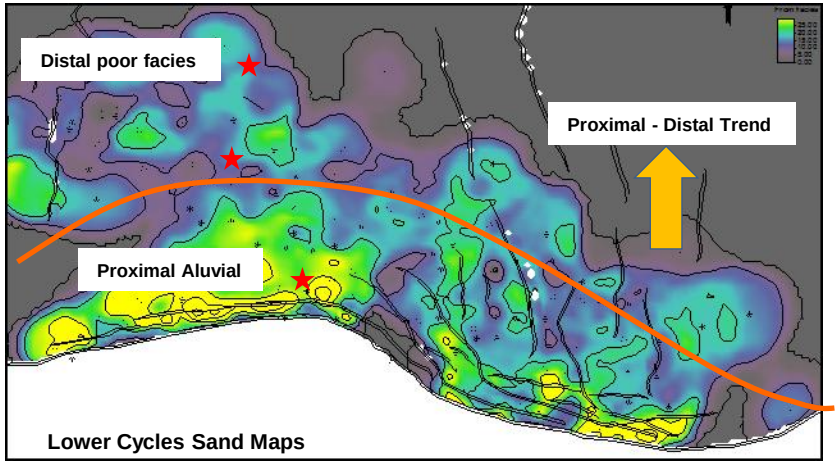


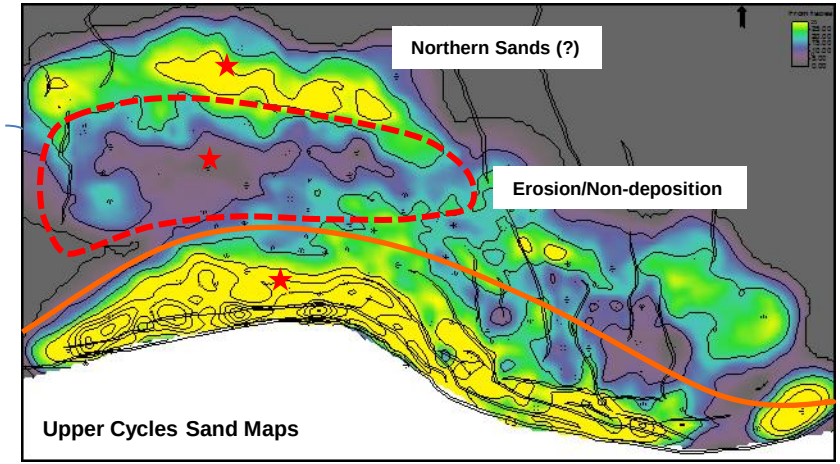
YPF Seismic data show…



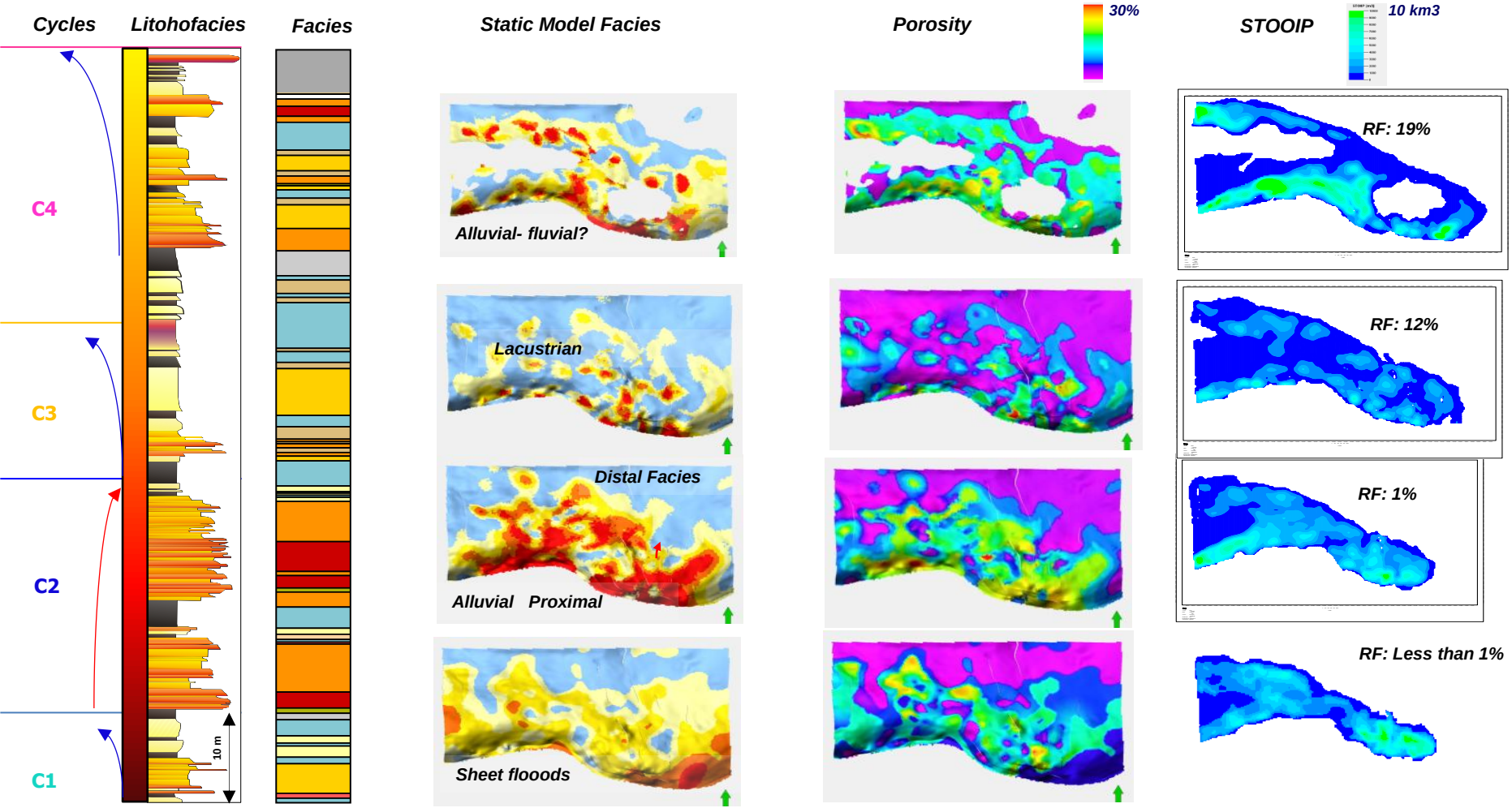
YPF Seismic Data and Sand Distribution







3D Modelling



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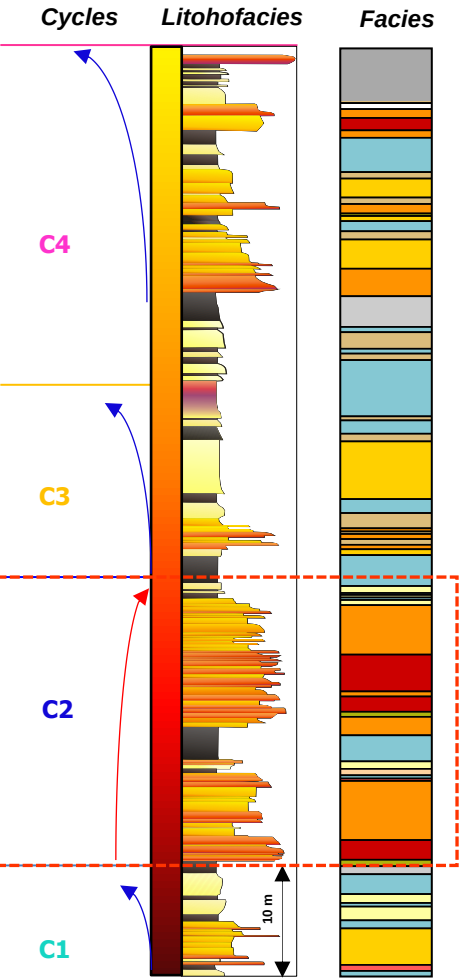
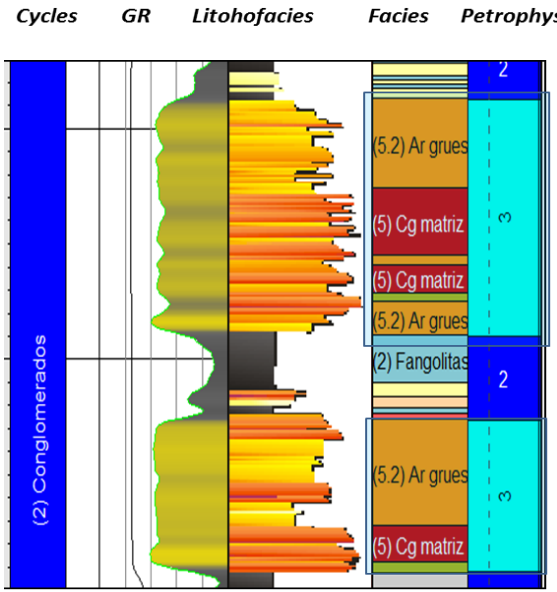
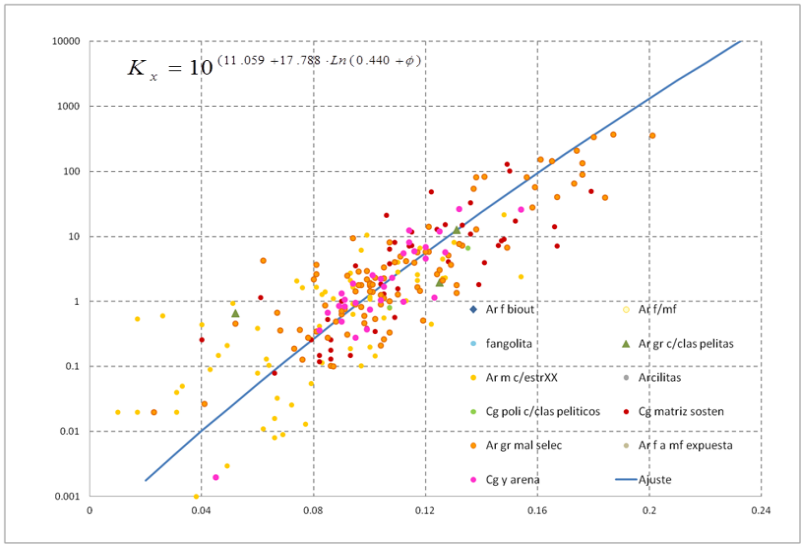
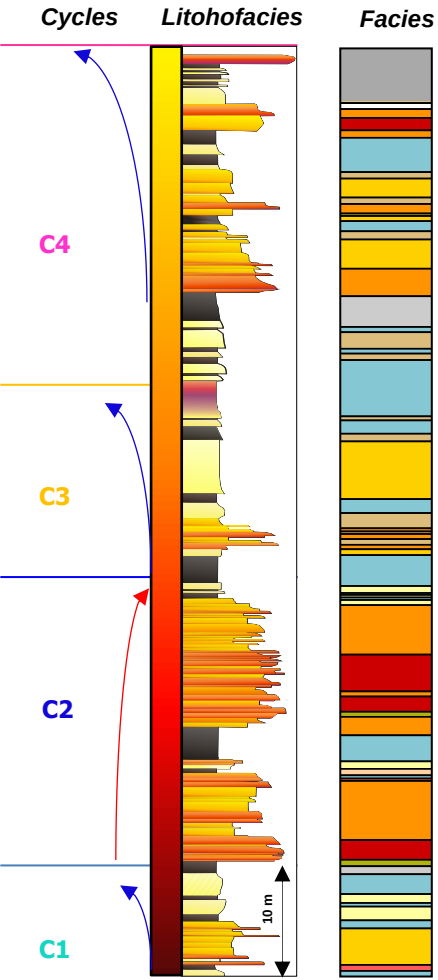


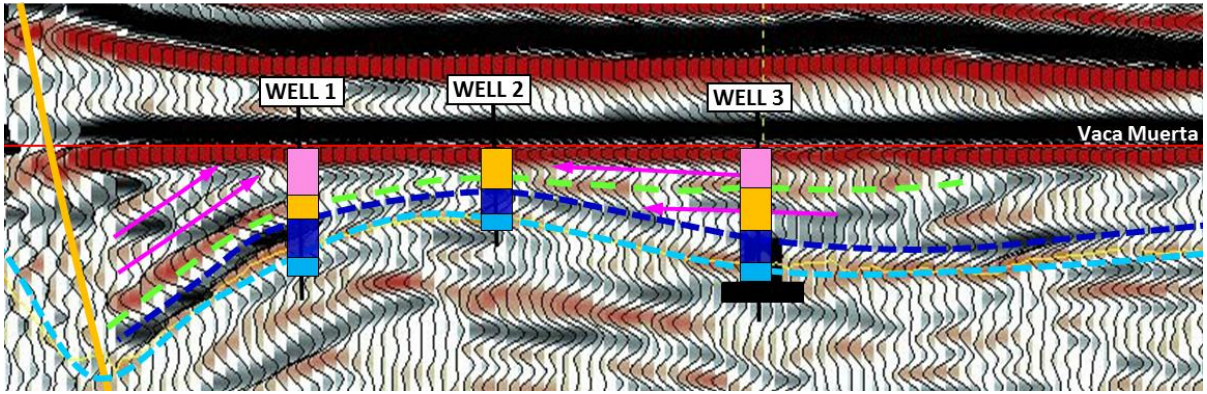
Petrophysical Units for permeability

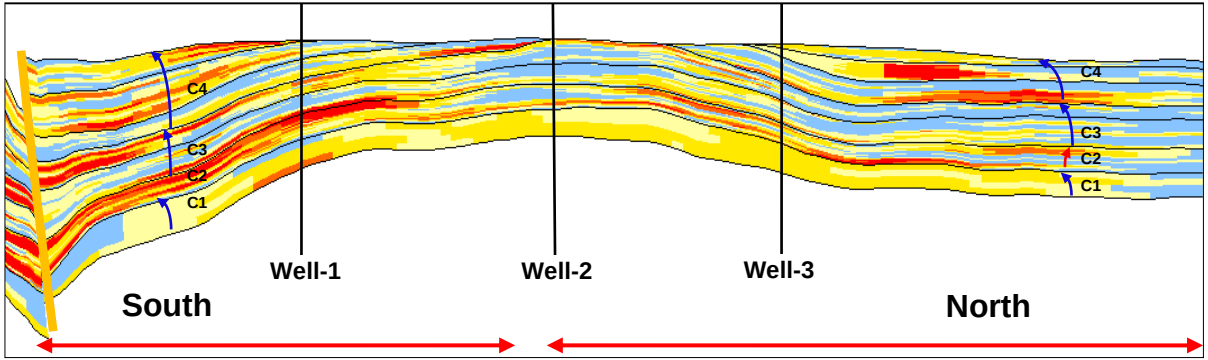




3D Modelling



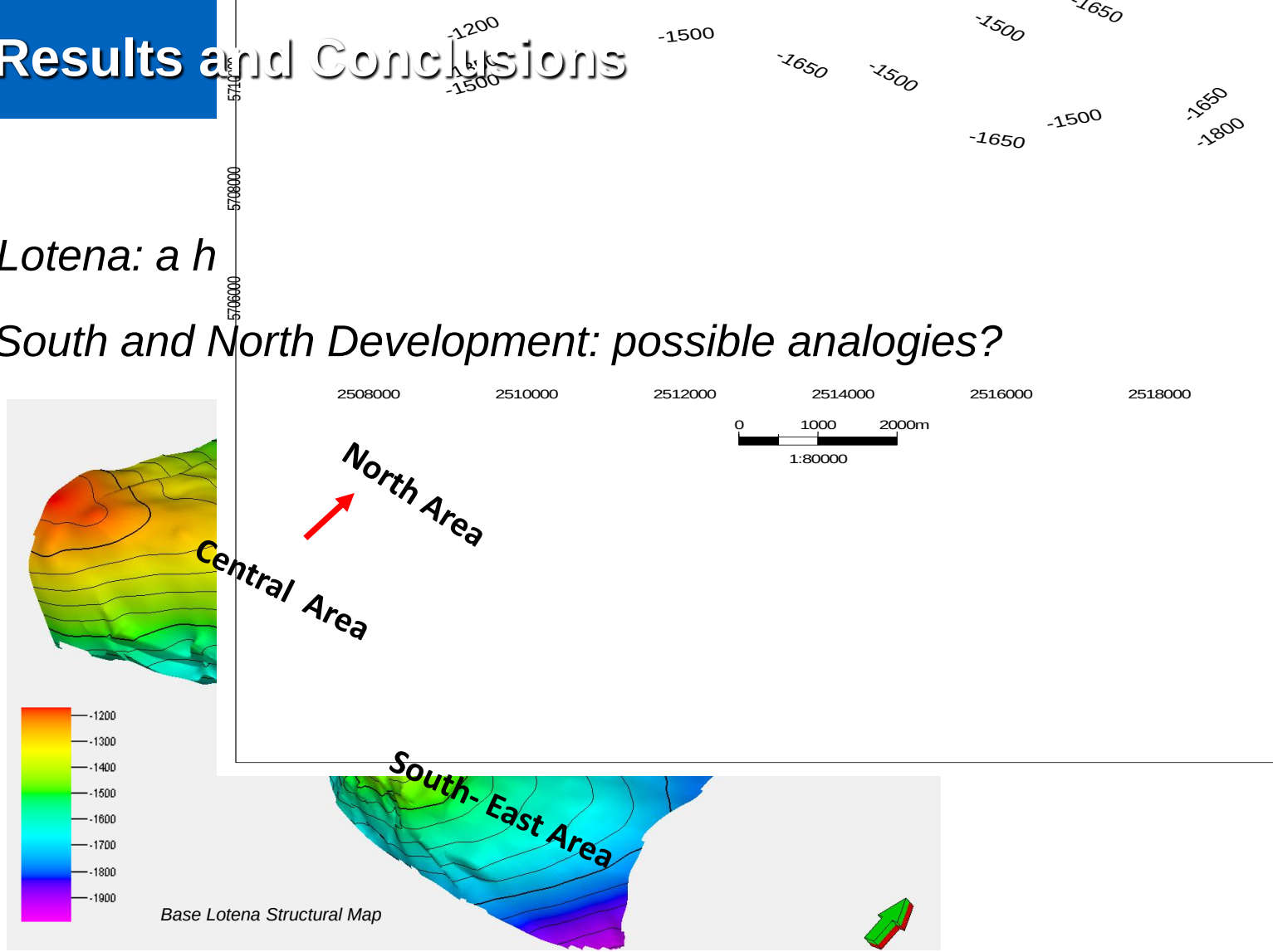




Static model shows no analogies

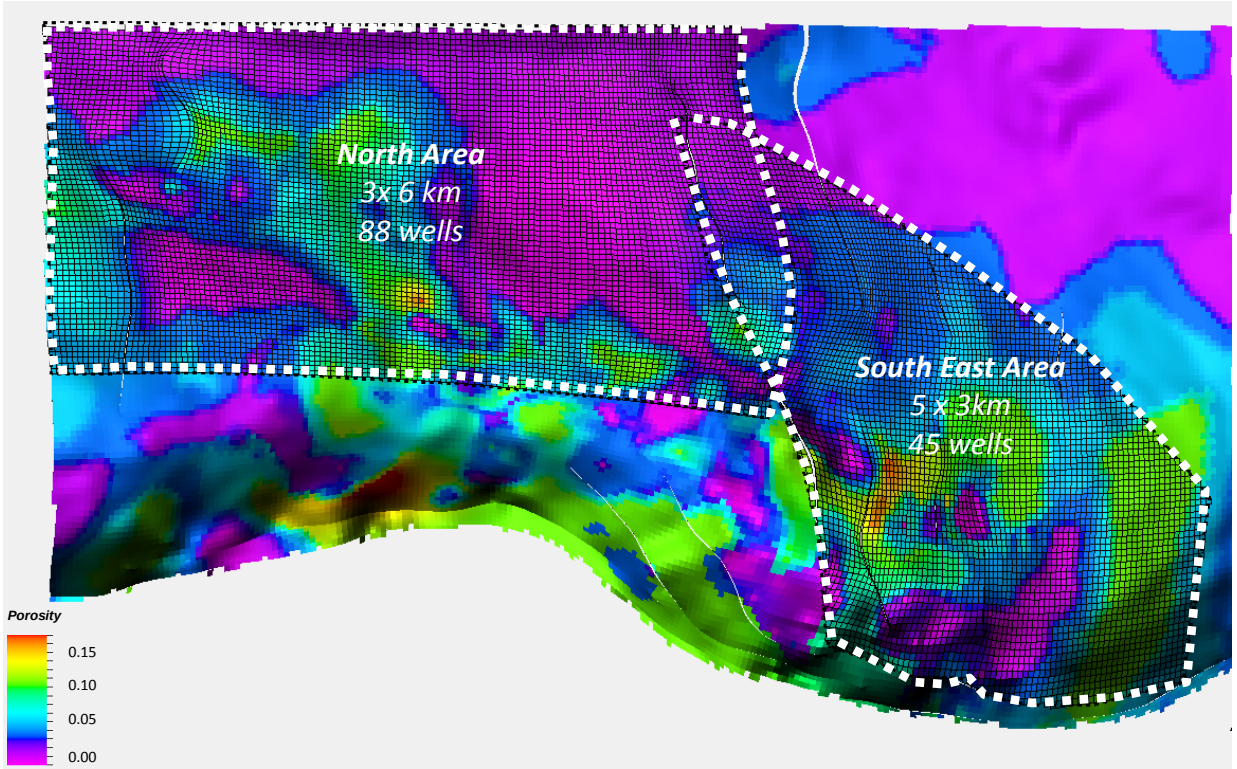
Results and Conclusions

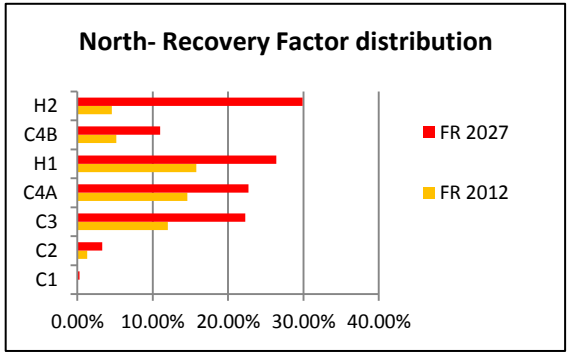
- *Lotena: a h*
- *South and North Development: possible analogies?*

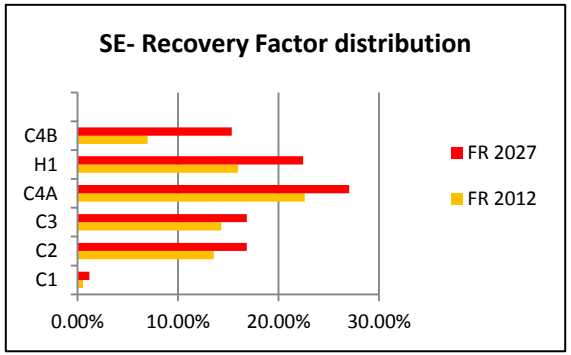


Base Lotena Structural Map

Dynamic data show…

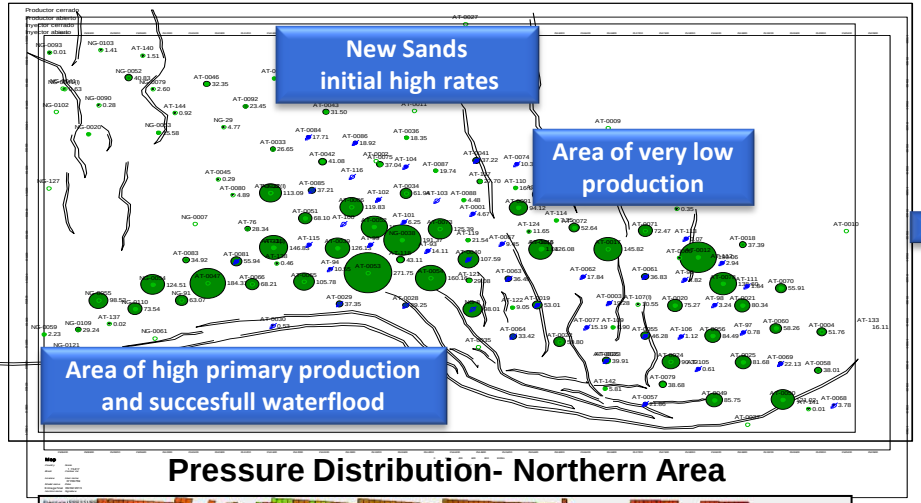




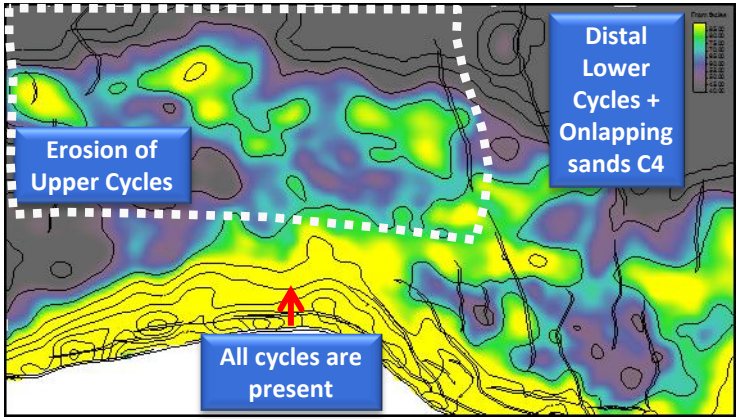


Results and Conclusions

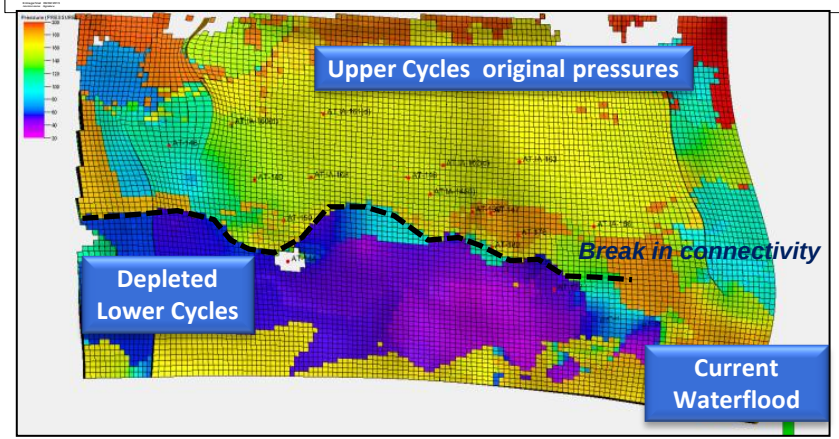
Production data



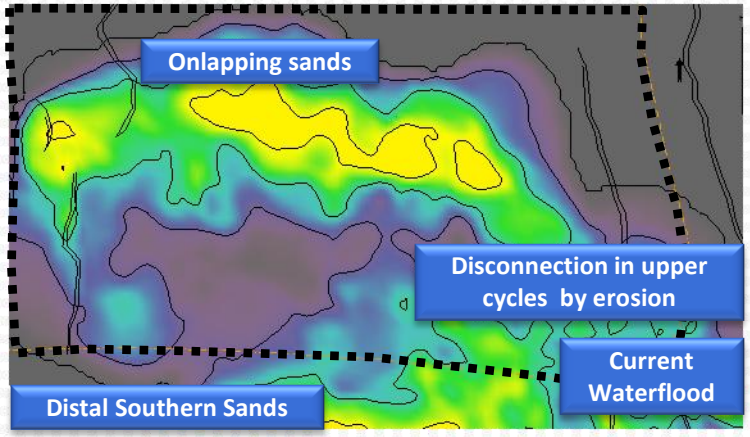
Sand Distribution (all cycles)



Pressure Distribution- Northern Area



Sand Distribution (cycle 4)



Acknowledgments:
Mario Grimberg, Gastón Manestar, Gustavo Potas, Mirta Suarez and the rest of the integrated modeling team of YPF