Depositional Patterns in the Lacustrine Cuyana Basin, Argentina*

Yolanda Ruiz[1] and Octavian Catuneanu[2]

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[1]YPF S.A., Buenos Aries, Argentina (yolanda.ruiz@ypf.com)
[2]University of Alberta, Edmonton, Alberta, Canada

Abstract

Rocks associated with lakes account for more than 20% of the current worldwide hydrocarbon production, and lacustrine organic-rich rocks are significant sources of these hydrocarbons. Lacustrine sources and reservoirs are important in many areas of current and future exploration opportunities, including Africa, South America, southeast Asia, and China. Numerous studies of modern lakes and ancient lacustrine basins reveal that lakes are not just small oceans, and that there are significant differences from the *known* patterns in the oceans. These differences influence the occurrence, distribution and character of hydrocarbon source, reservoir and seal play elements. Some of these differences are due to the smaller volumes of sediment and water in the lakes, which make the lacustrine systems much more sensitive to accommodation and climate, as the lake level can fluctuate much more rapidly than the global sea level. Another difference is that the lake level and sediment supply are directly linked in lacustrine systems, in contrast to the marine systems where the sea level and sediment supply are only weakly linked, or with no linkage at all. There are also similarities between lacustrine and marine environments, in the sense that the same types of stacking patterns can be observed. For example, lake shorelines can move basinward either by progradation driven by sediment supply (i.e., normal regression) or by the simple withdrawal of water (i.e., forced regression), both leaving different patterns in the stratigraphic record. The evolution of a lake is fundamentally controlled by the relative rates of accommodation and sedimentation. Accommodation in excess of sedimentation leads to underfilled basins that experience water deepening. Sedimentation in excess of accommodation leads to water shallowing and the eventual shift to overfilled conditions. The Cuyana Basin in Argentina provides a case study of a lacustrine basin with high rates of oil production, which evolved from underfilled to overfilled stages of basin development. The most productive reservoirs of the Cuyana Basin are of late Jurassic and Cretaceous age, but the basin also has Triassic reservoirs, with much more complex patterns associated with syn-depositional tectonic activity. The relationship between the various elements of the petroleum system (i.e., reservoirs, source rocks, seals, and charge) can be analyzed within a sequence stratigraphic framework. Notably, due to the variety of lacustrine basins in terms of local accommodation and sedimentation conditions, lacustrine models are basin specific, and one model is not applicable to all lake-basin types. The case study of the Cuyana Basin provides an example of how sequence stratigraphy can be used to understand and predict the patterns of a lacustrine petroleum system, and to guide the future petroleum exploration.

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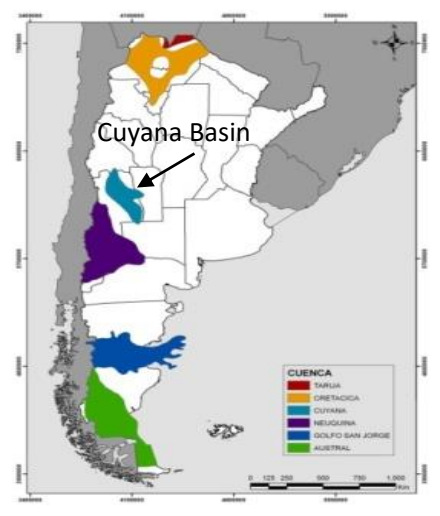
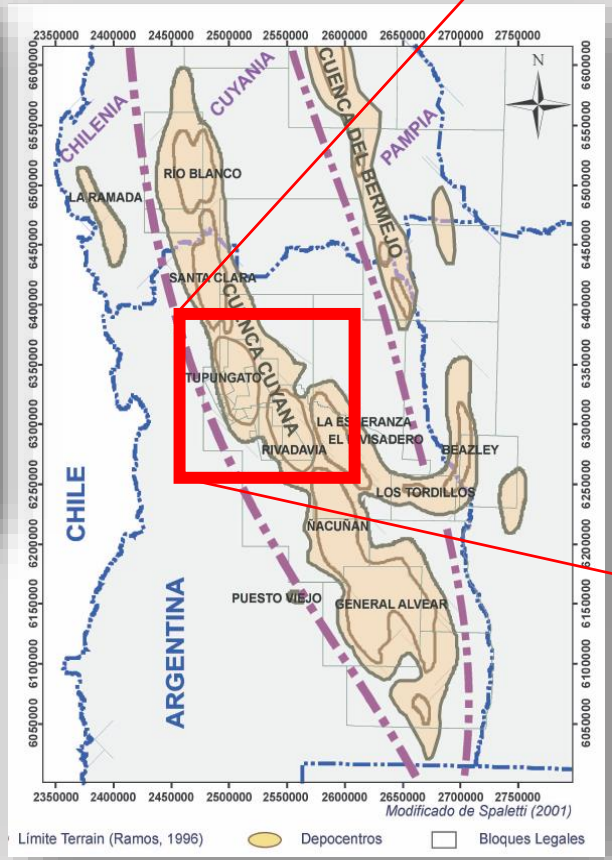
CUYANA BASIN

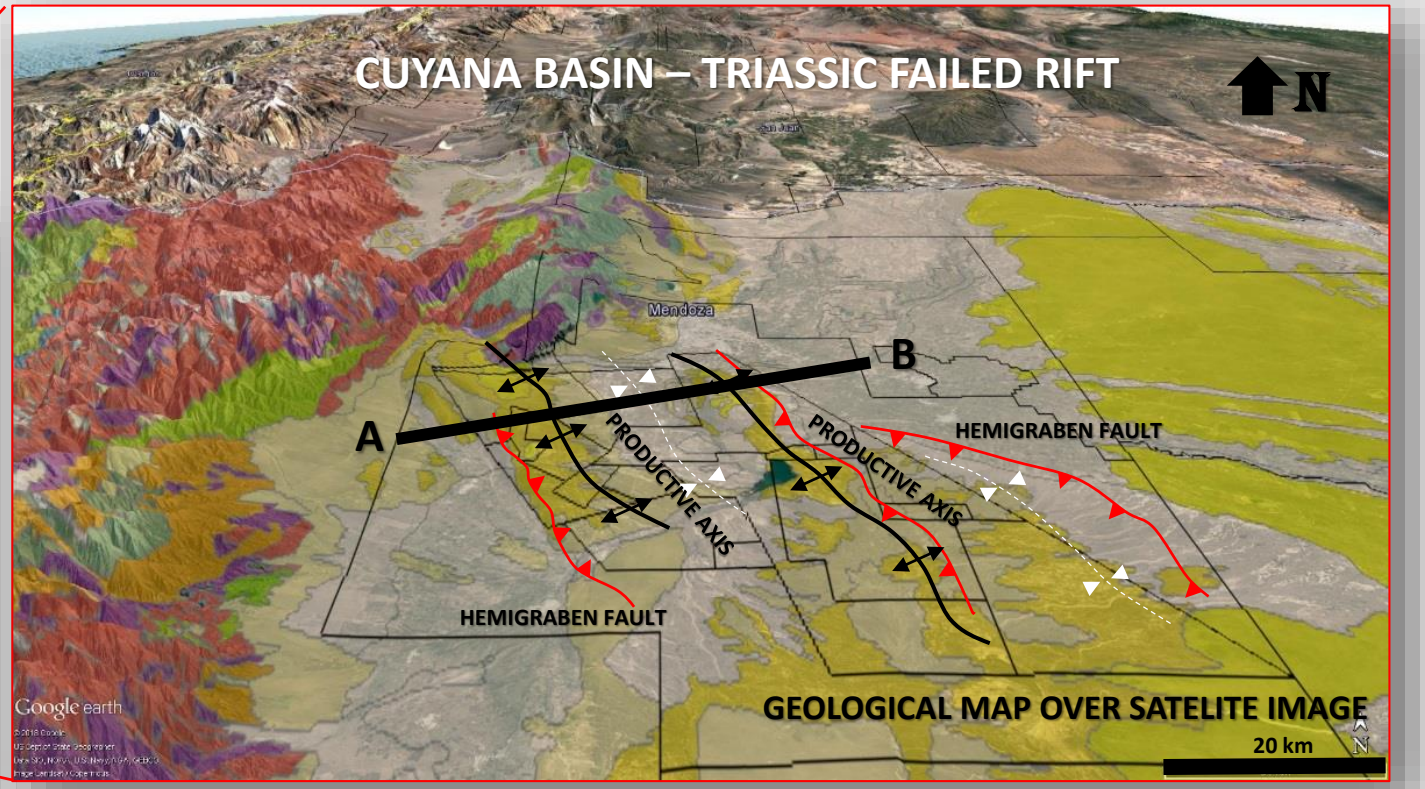


ARGENTINA



Zencich, S., H. J. Villar y D. Boggetti, 2008

CUYANA BASIN



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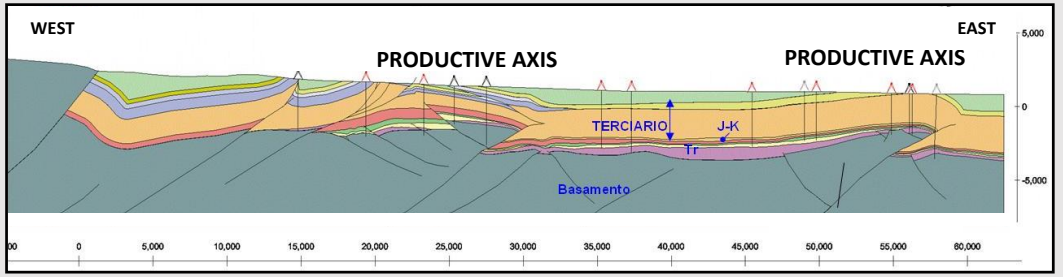

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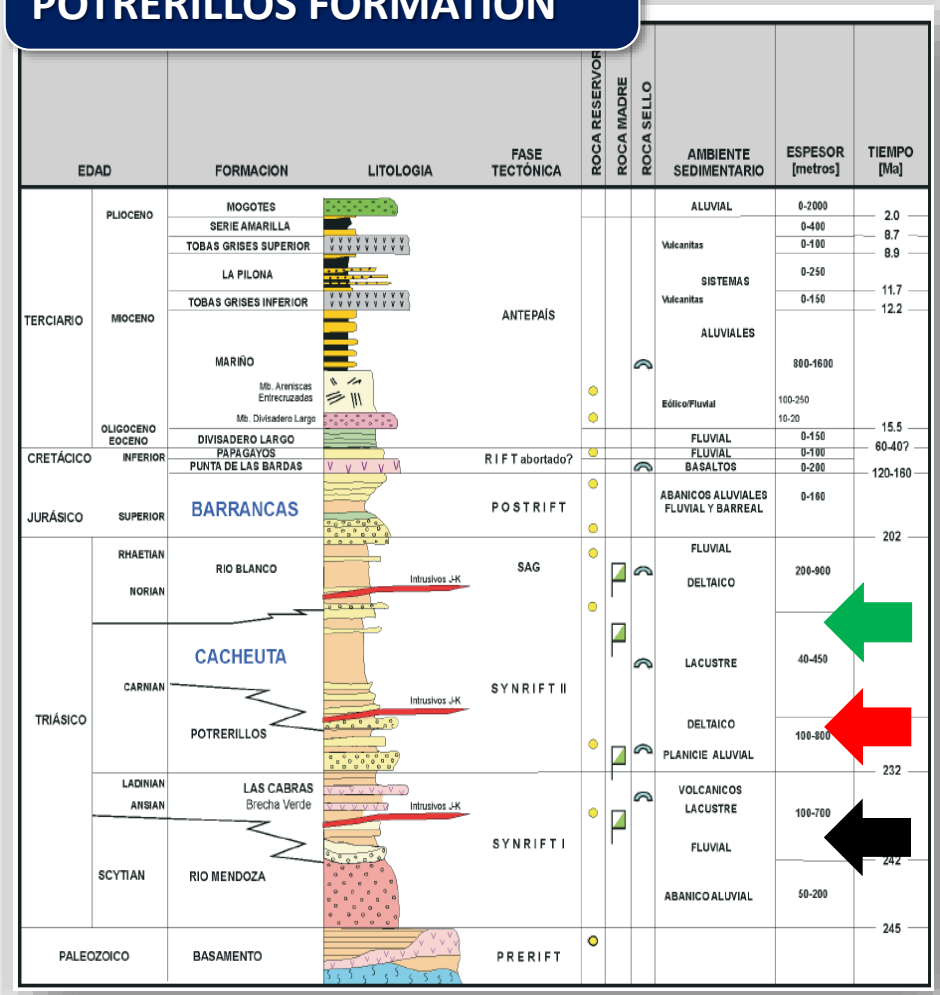
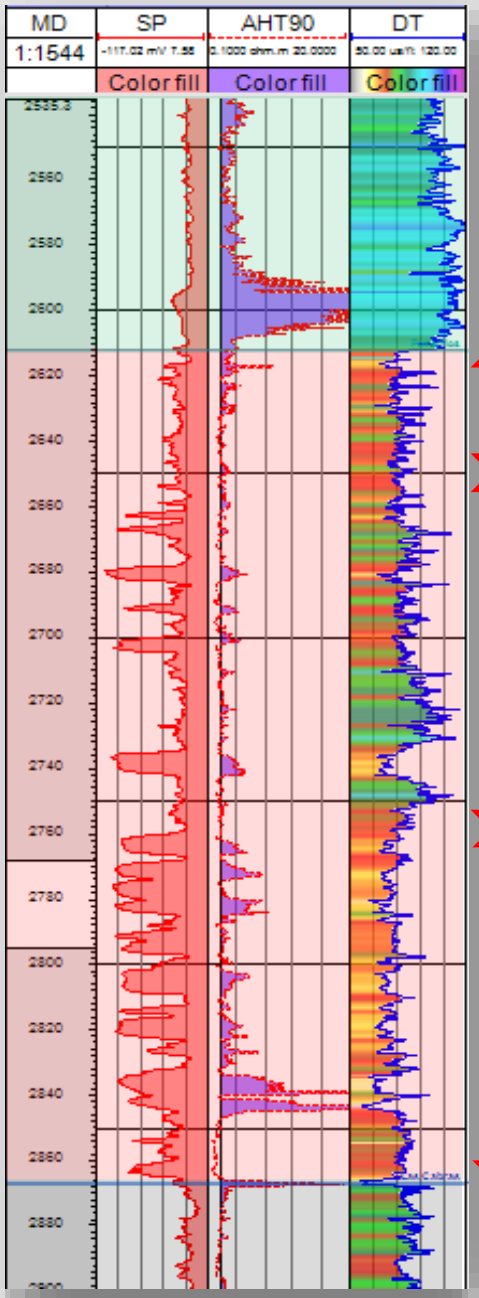
TRIASSIC DEPOSITS
POTRERILLOS FORMATION



Stratigraphic column for the Cuyana Basin. Kokogian et al. (1993) and Irigoyen et al. (2002)



LACUSTRINE SOURCE ROCK
(CACHEUTA FM = ORGANIC SHALE)

UPPER

LACUSTRINE COASTAL SYSTEMS
(SANDS & SHALES)

MIDDLE

LOWER ENERGY FLUVIAL
(SANDS / TUFFS / SHALES)

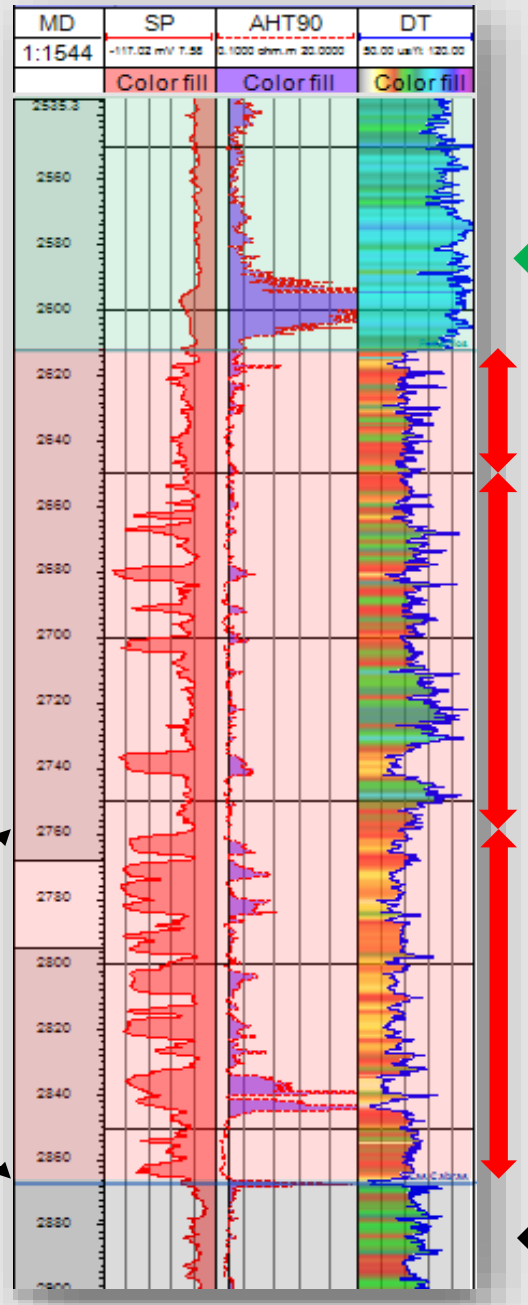
POTRERILLOS FORMATION

LOWER

HIGHER ENERGY FLUVIAL
(SANDS / TUFFS / SHALES)

LAS CABRAS ALLUVIAL FANS
(SANDS / TUFFS / CONGLOMERATES)

TRIASSIC DEPOSITS
POTRERILLOS FORMATION



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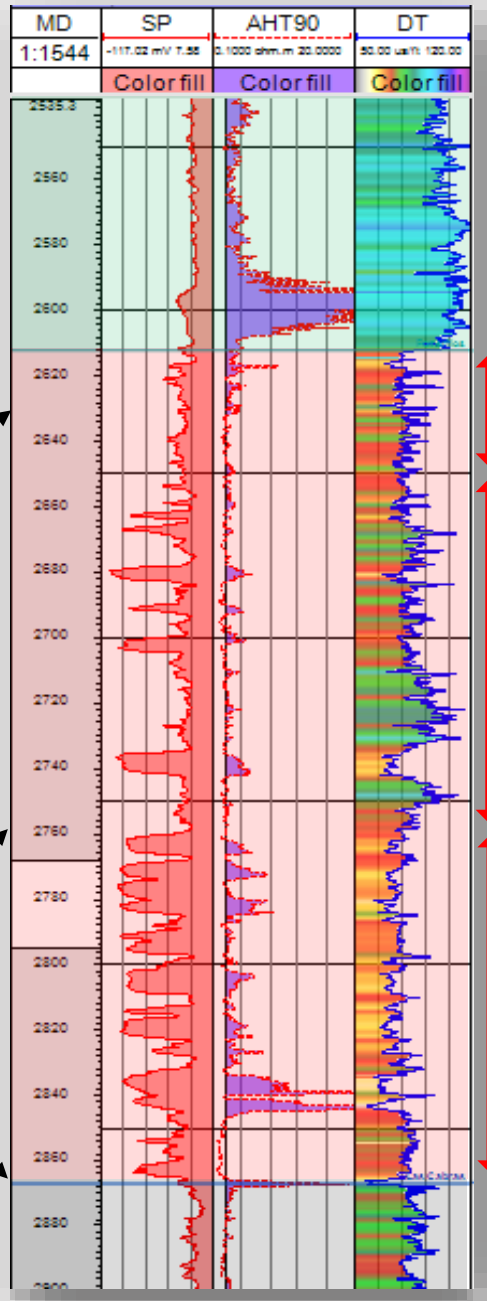

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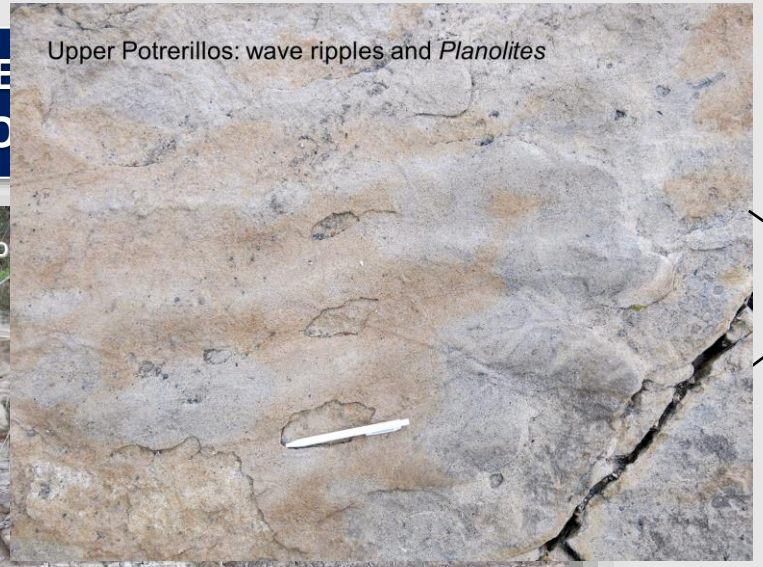

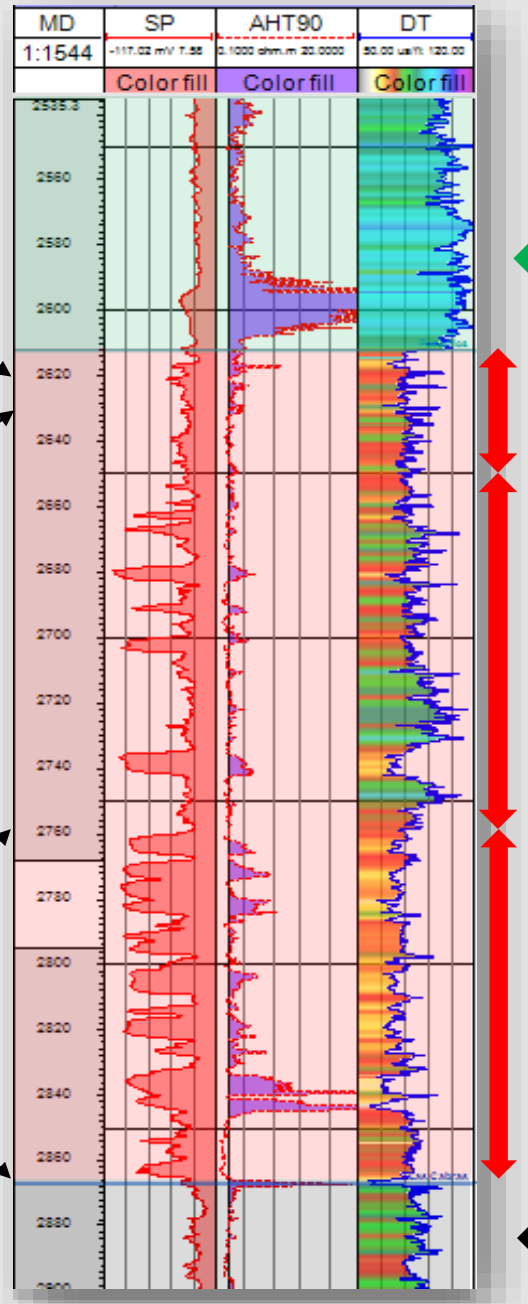

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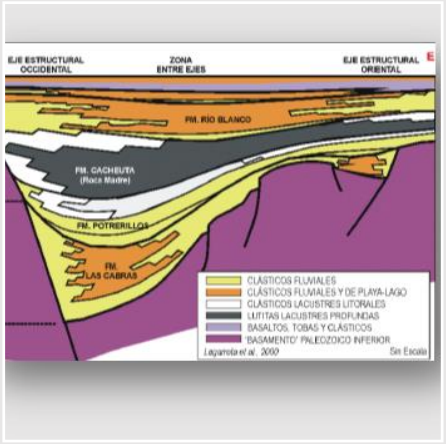
INFORMATION AVAILABLE

BASIN MODEL



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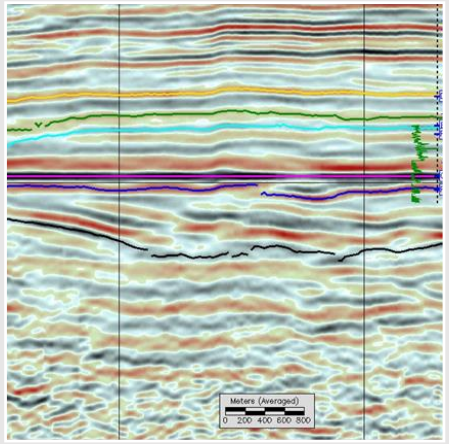

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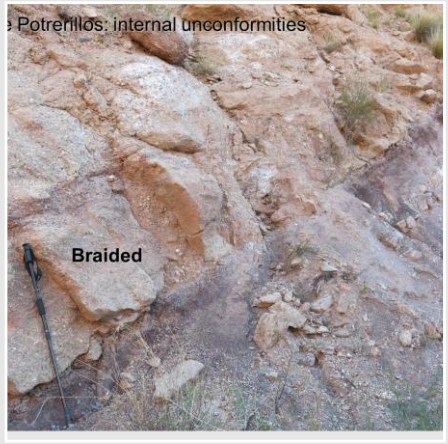

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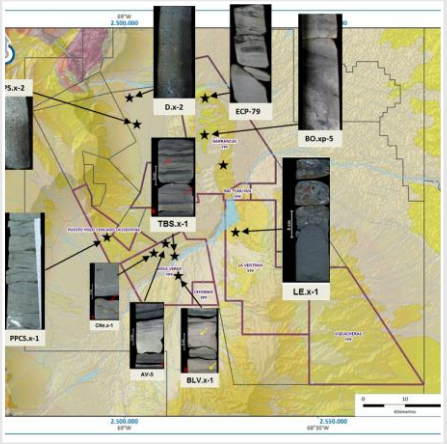
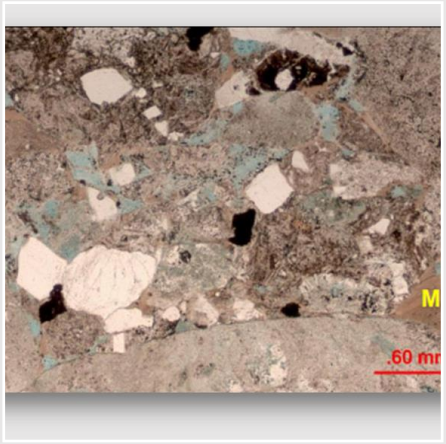
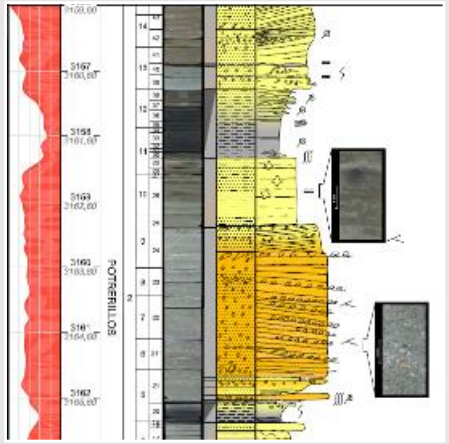


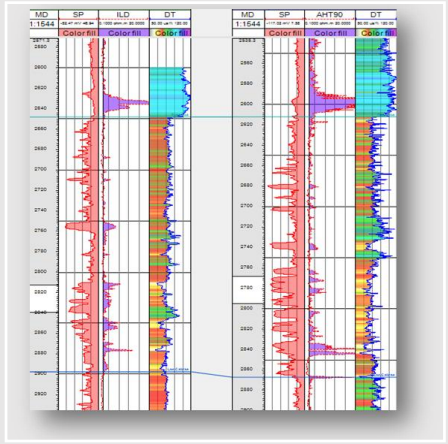
PETROGRAPHY



SEDIMENTOLOGY



WELL LOGS



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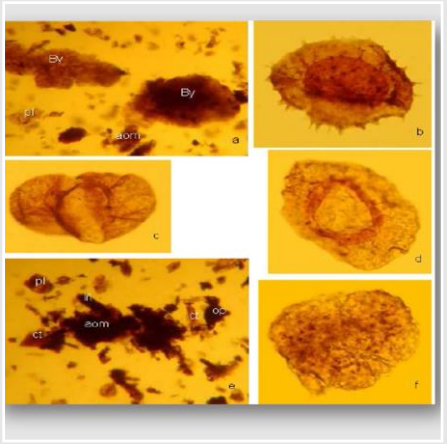
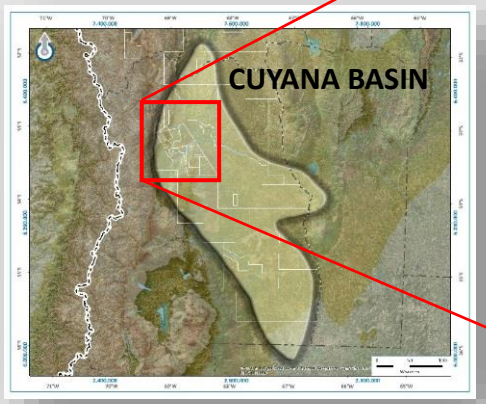


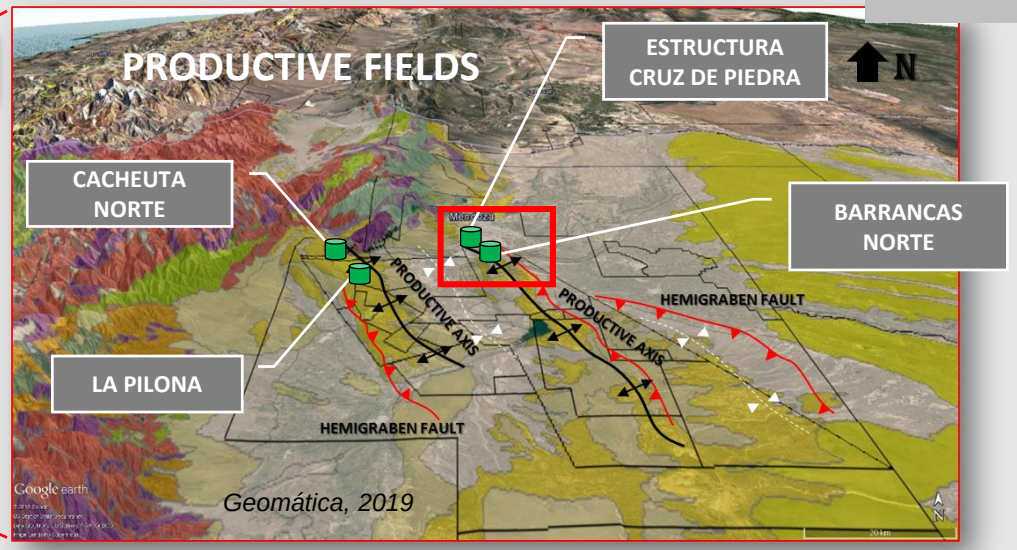
PRODUCTION TO PRESENT DAY

(From January 1973)

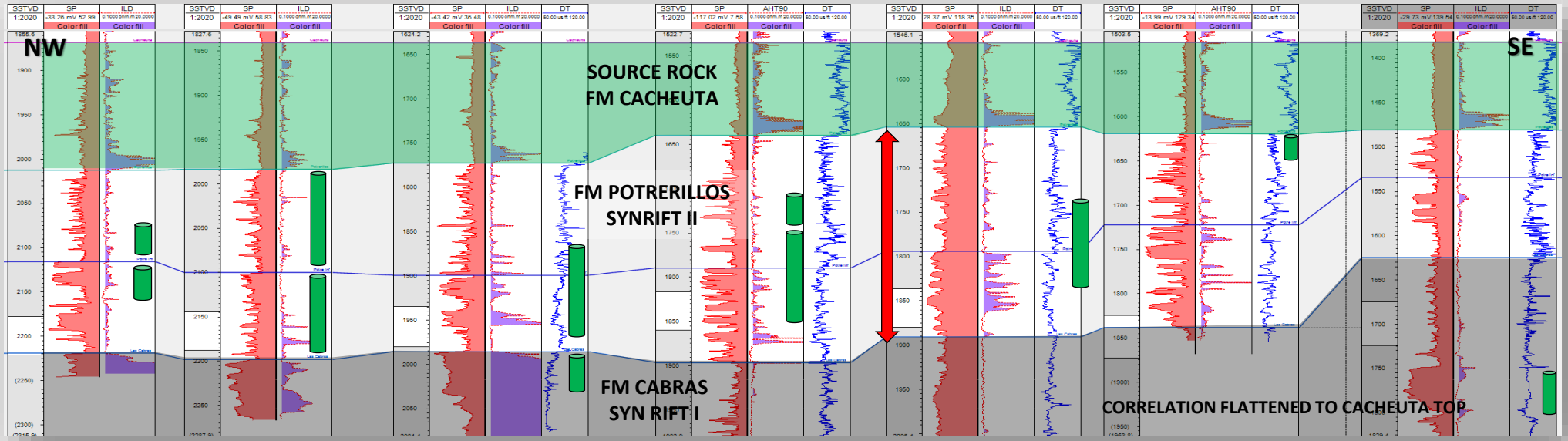
10.000 Km^3 Oil

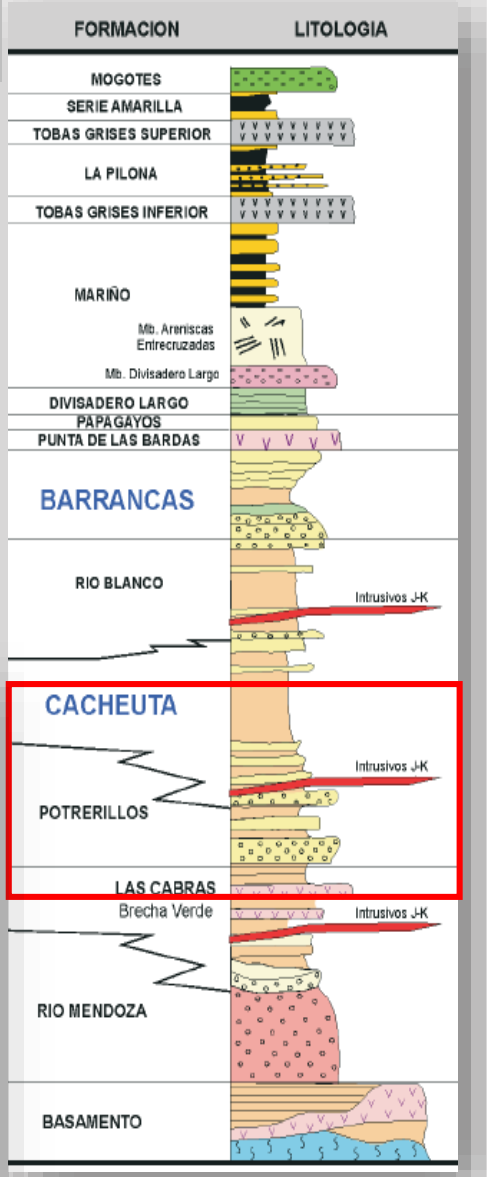
PRODUCTIVE FIELDS





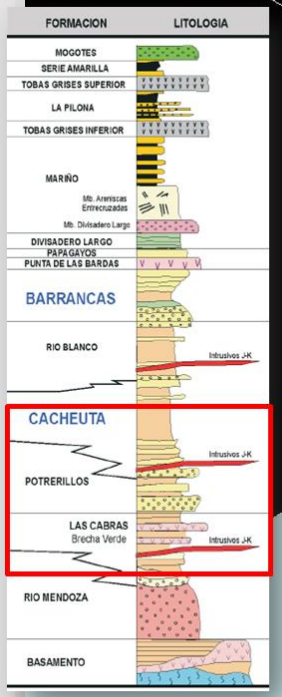
PRODUCTIVE RESERVOIR

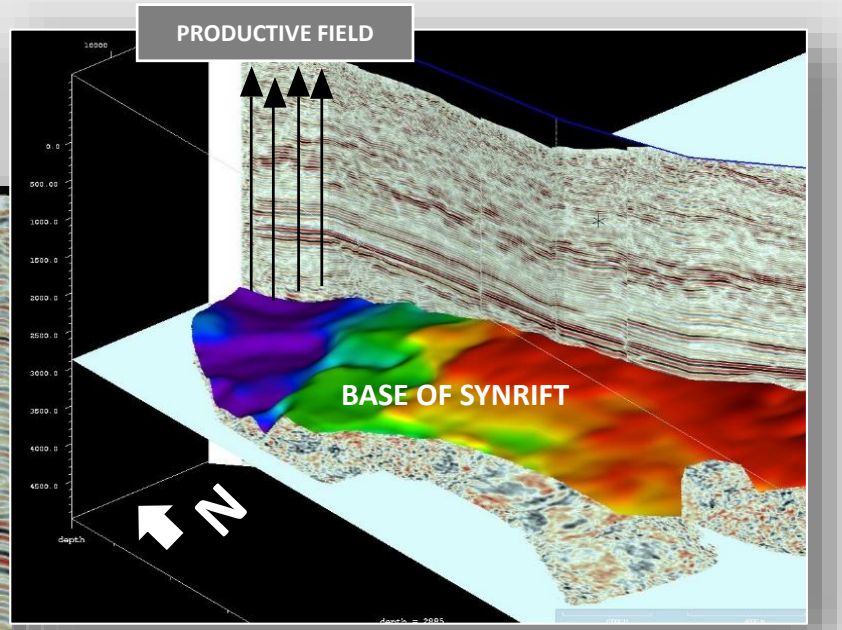


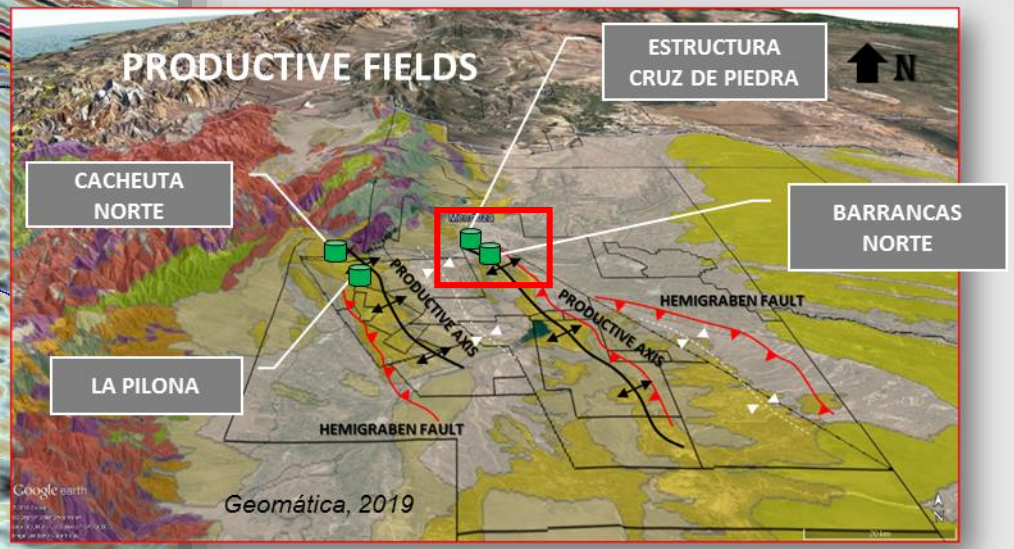


STRATIGRAPHIC COLUMN

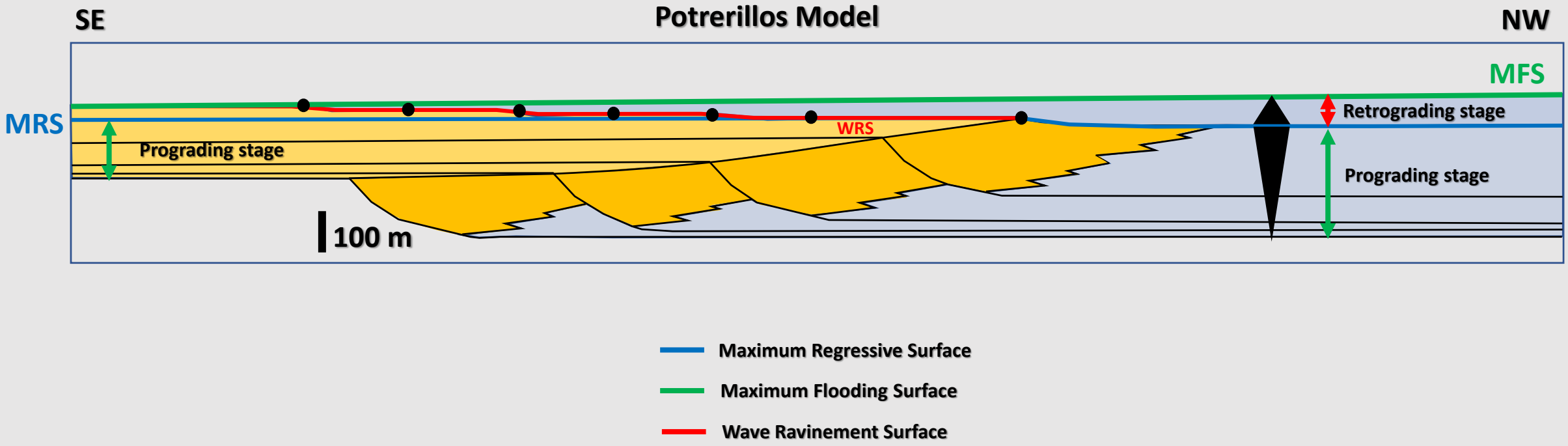
PRODUCTIVE FIELD







SEQUENCE STRATIGRAPHY MODEL



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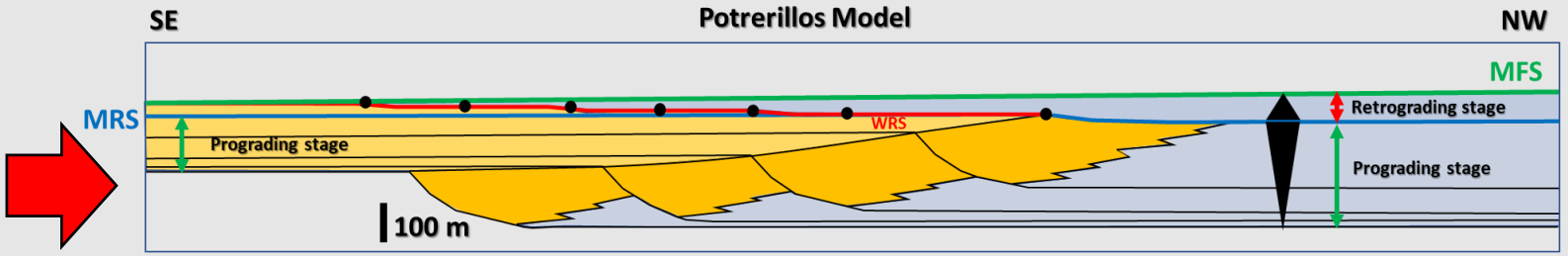
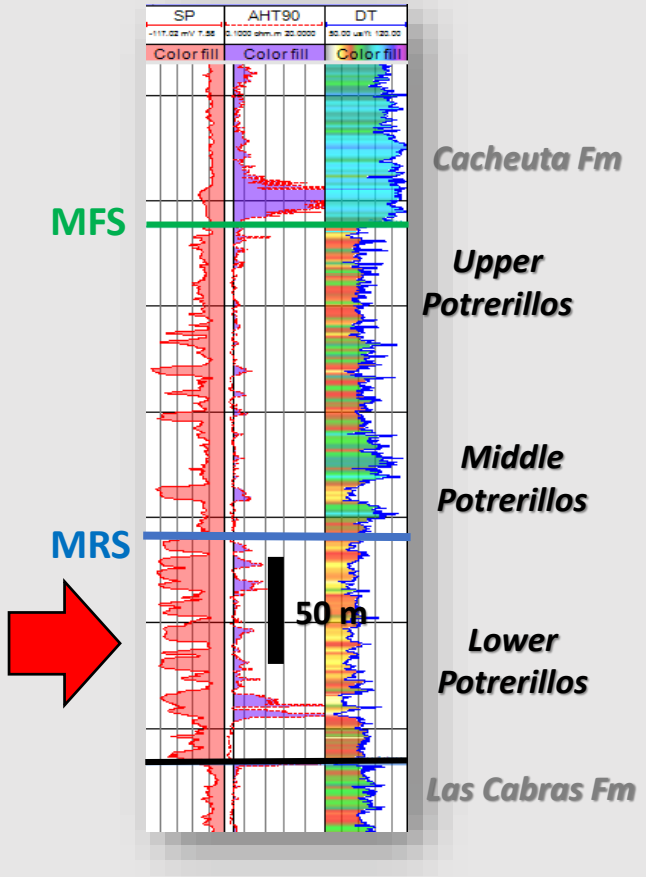
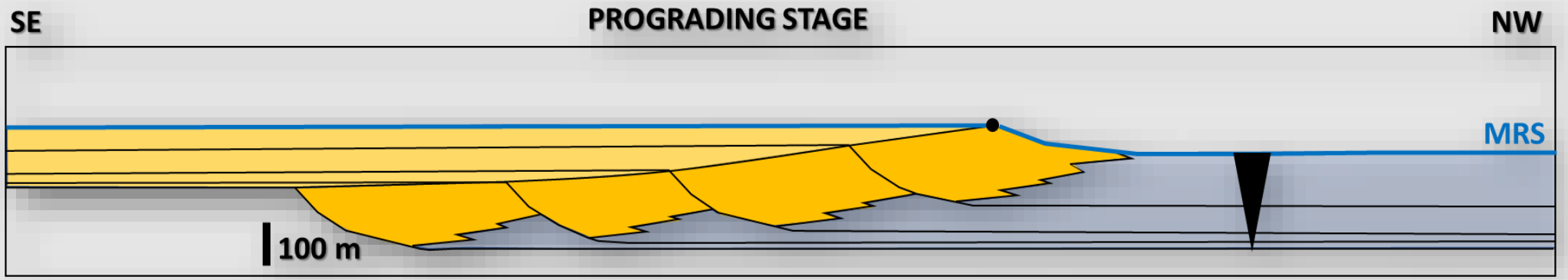


Maximum Regressive Surface

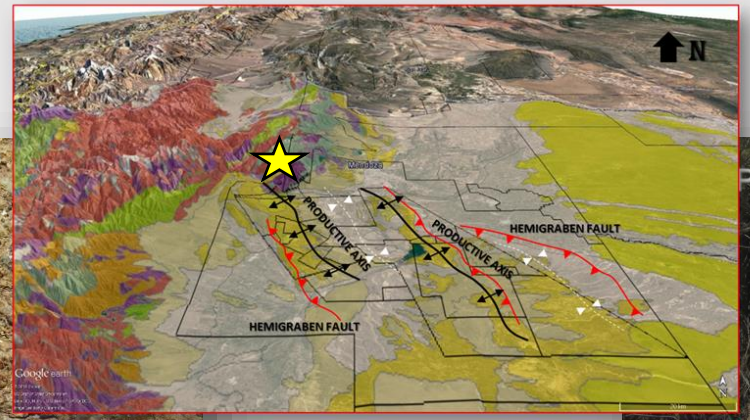
Maximum Flooding Surface

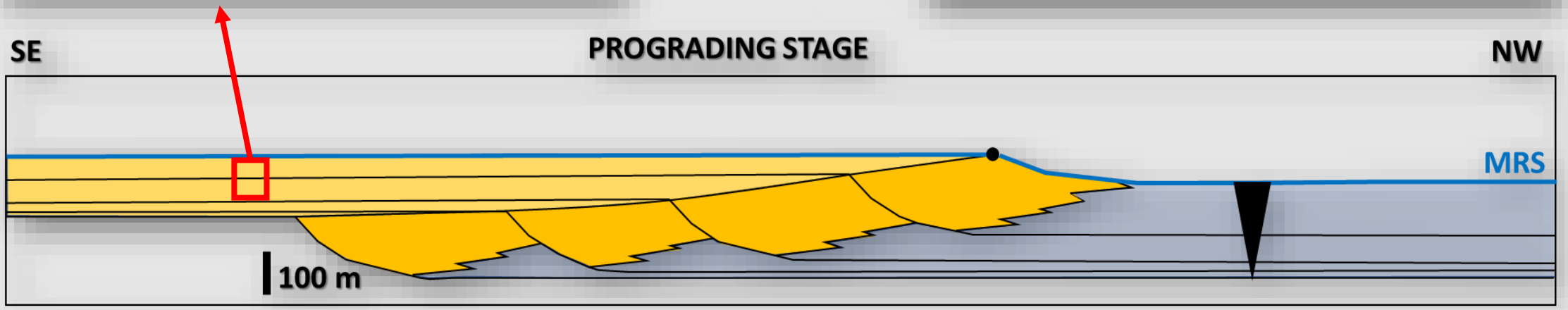
Wave Ravinement Surface



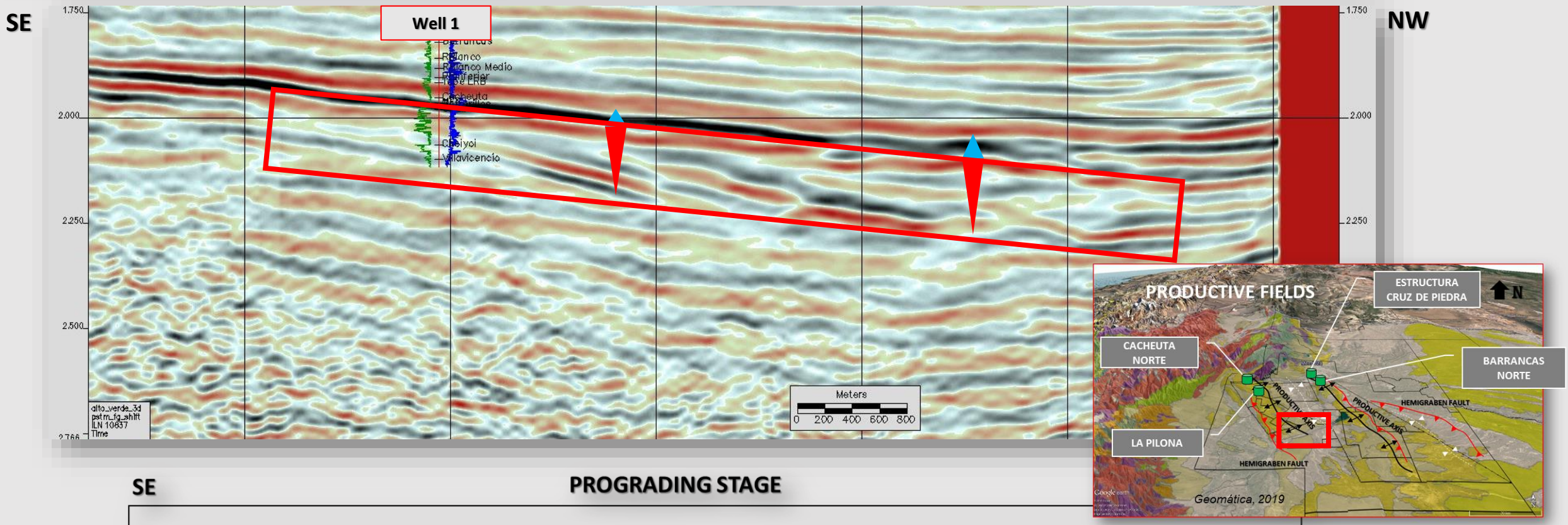


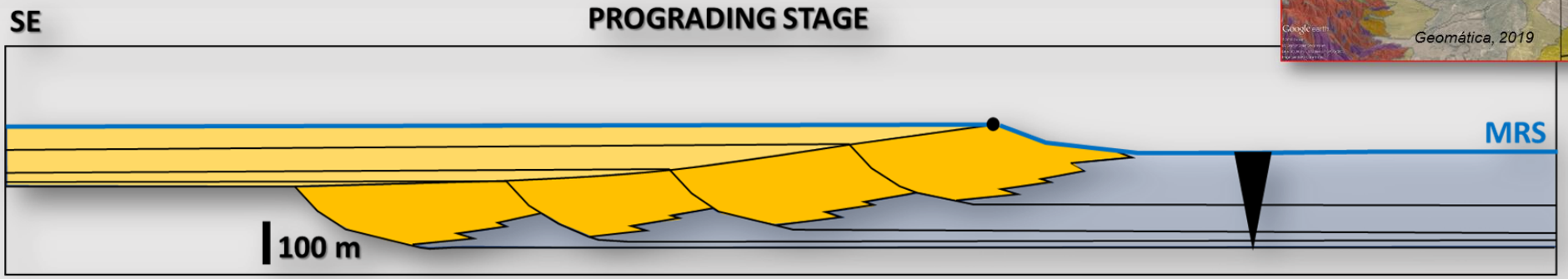
PROGRADING STAGE. OUTCROPS



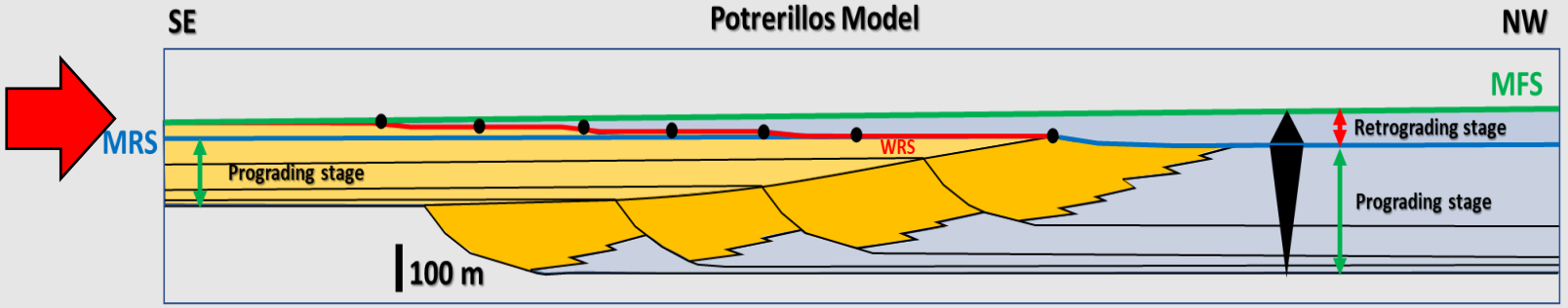


PROGRADING STAGE. 3D SEISMIC LINE





SEQUENCE STRATIGRAPHY MODEL

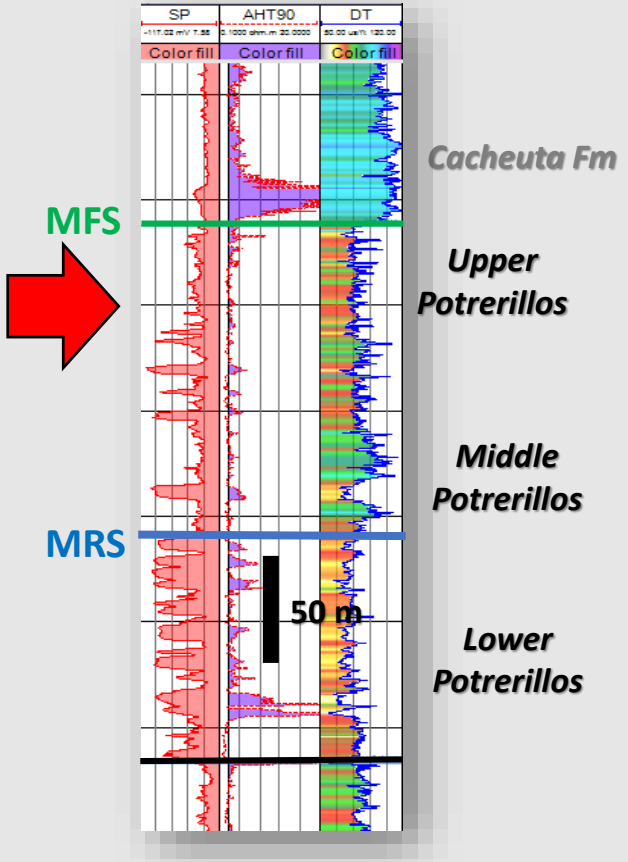


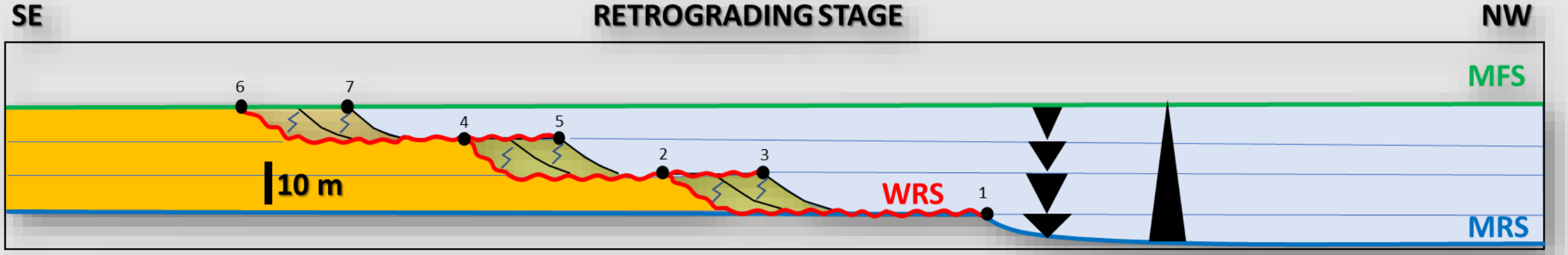
Maximum Regressive Surface

Maximum Flooding Surface

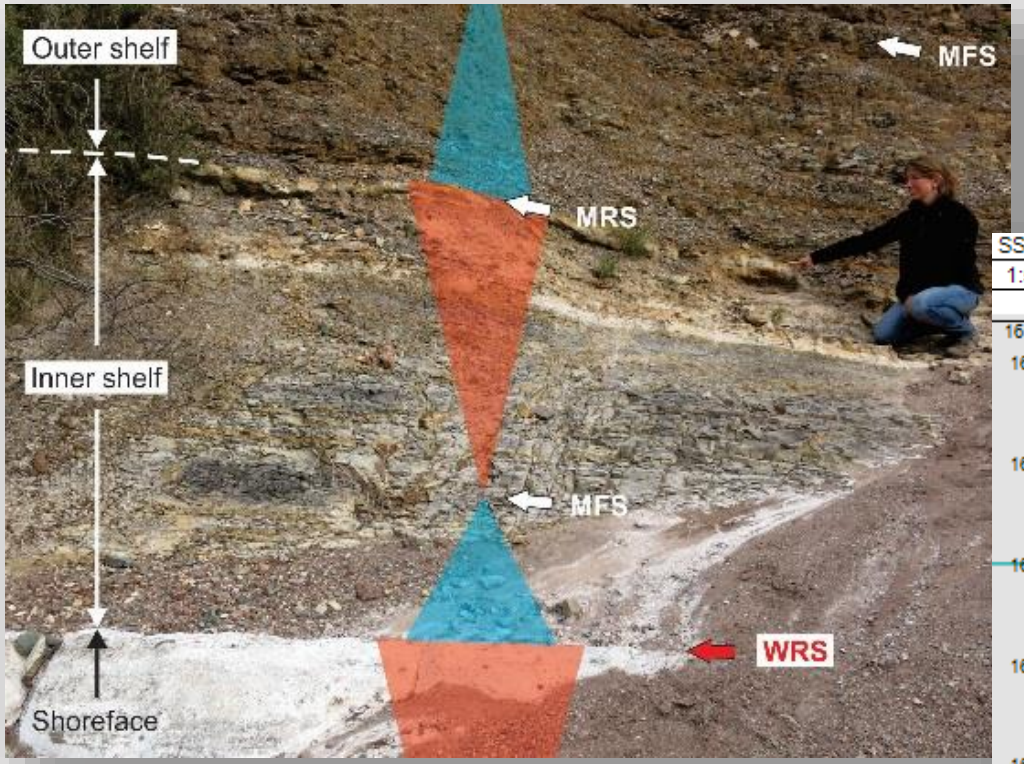
Wave Ravinement Surface

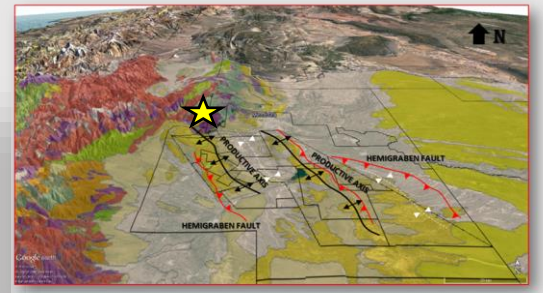
1 The numbers indicate the sequence coast lines

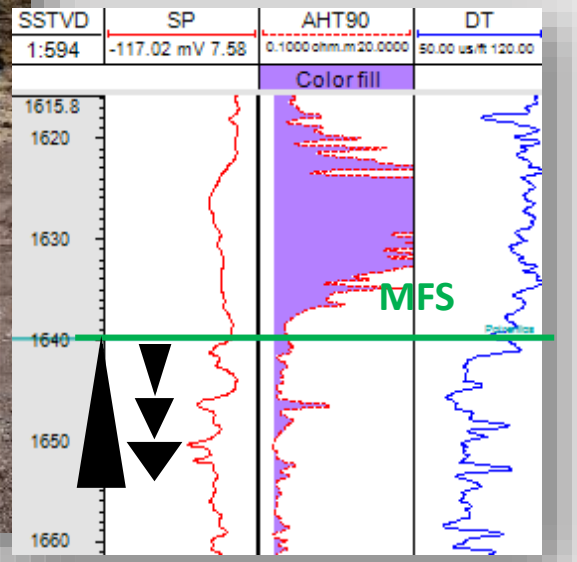


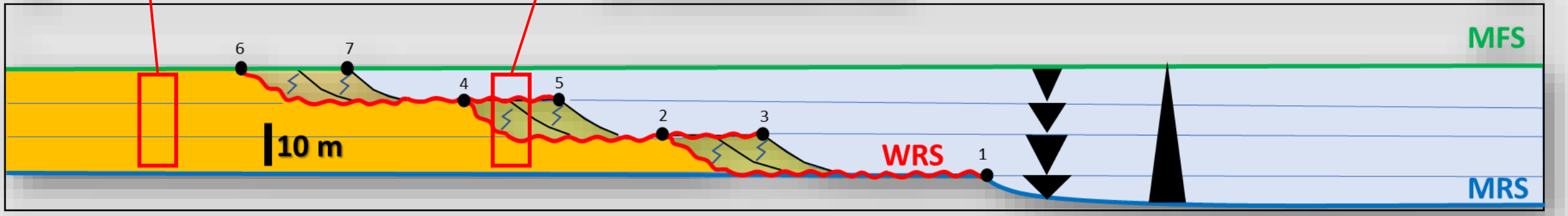


RETROGRADING STAGE. OUTCROPS & LOGS

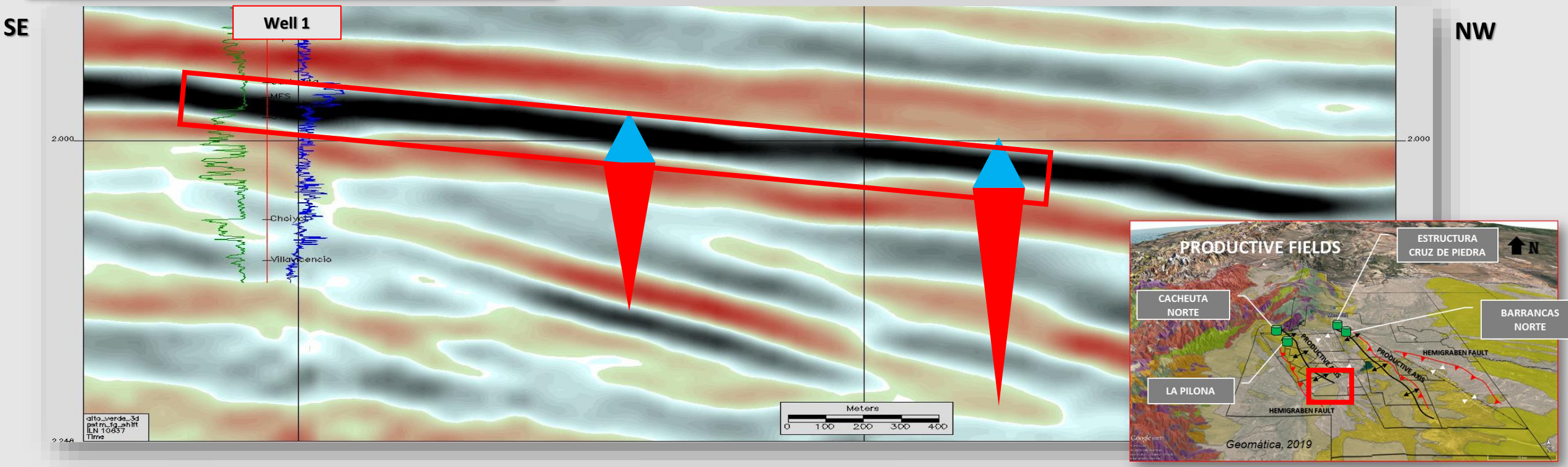


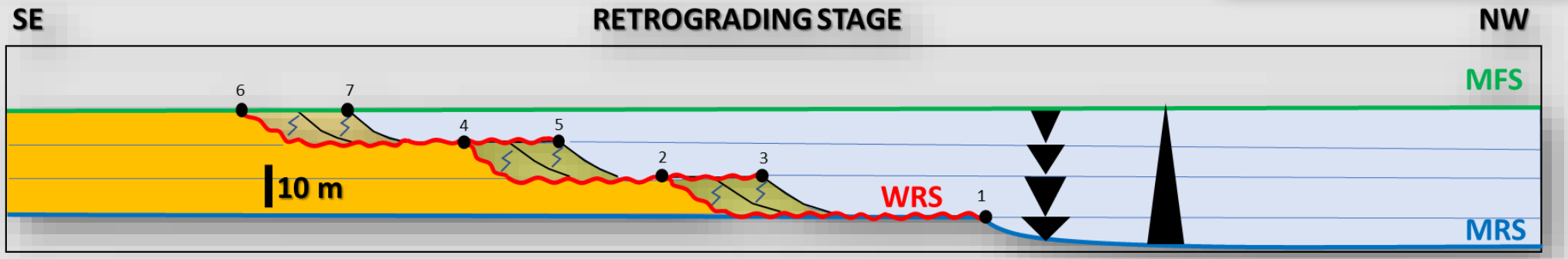






RETROGRADING STAGE. 3D SEISMIC LINE





CONCLUSIONS

- The Potrerillos Formation consists of three genetic units: a fluvial prograding system (Lower Potrerillos), a fluvial transgressive system (Middle Potrerillos), and a coastal transgressive system (Upper Potrerillos)
- Each of the 3 genetic units has an age-equivalent lacustrine system (i.e., Cacheuta facies) towards the depocenter of the basin (downdip).
- The limits between reservoirs (Potrerillos facies) and source rocks (Cacheuta facies) are diachronous.
- The transgression of the Cacheuta lake resulted in the formation of a regional diachronous unconformity (i.e., a wave-ravinement surface) at the limit between the Middle and the Upper Potrerillos.
- The long-term transgression of the Cacheuta coastline was punctuated by higher frequency stages of progradation, visible at well-log scales but below the resolution of the seismic data.
- The sequence stratigraphy model, helps to predict new prospects in this continental basin

SPECIAL THANKS TO:

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René Manceda

Barbara Villoslada

Marcos Asensio

Fernanda Raggio

Juan Pablo Lovecchio

Pedro Kress

Ignacio Brisson

Yanina Basile

Martin Fasola

Viviana Meissinger

Belen Palacio

Jazmin Propato

Maria Eugenia Valverde

Stella Maris Gomez

Juan Carlos Scolari

Lorena Zabala

Karina Mykietuk

Daniela Ancheta

Hernan Scuka

Ricardo Manoni

Fabian Dominguez

QUESTIONS?

AAPG ICE 2019
International Conference & Exhibition
AAPG
27-30 August
Buenos Aires,
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