

**Facies Distribution and Stratigraphic Architecture of Continental  
to Shallow-Marine Deposits on a Lowstand Wedge:  
Basin-Scale Analysis of the Mulichinco Formation (Neuquén Basin, Argentina)\***

**Maria E. Pascariello<sup>1</sup>, Maria F. Rincon<sup>1</sup>, Sebastian M. Arismendi<sup>1</sup>, and Ernesto Schwarz<sup>2</sup>**

Search and Discovery Article #51518 (2018)\*\*

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**Abstract**

The Valanginian Mulichinco Formation represents an exceptional example of a 3rd order lowstand wedge formed after a major sea-level fall. The Mulichinco Formation comprises continental, transitional and shallow-marine deposits, but their proportion varies significantly across the basin, and from outcrops to subsurface. For many decades, this prevented on generating a basin-scale evolutionary model of the unit. In this study, the basin-scale sequence stratigraphy and stratigraphic architecture of the unit was assessed by defining regional seismic and well sections along strike. Facies and facies associations were identified in cores and well logs and then related with equivalent strata exposed in outcrops. Seismic data were key to understand facies distribution and lateral continuity. This work proposed a new sequence stratigraphic model, in which the Mulichinco Formation evolution can be synthetized in five stages. Stage 1, immediately above a first subaerial unconformity (SU1), is represented by eolian to fluvio-eolian strata, which are truncated at their top by a new subaerial unconformity (SU2), which suggest a second basin reconfiguration. Stage 2 was accumulated basinward during relative sea-level rise. Stage 2 is composed of fluvial, coastal and shallow-marine facies. Stage 3 is characterized by the appearance of mixed (carbonate/siliciclastic) offshore and shoreface deposits. The dilution of siliciclastics and retrogradational stacking suggests a decrease in hinterland supply and transgressive conditions. Stage 4 is represented by fluvial, coastal and shallow to deep-marine facies. Stage 5 represents the shift of the fluvial system landward associated to the continuous rise in relative sea level. During this stage, the stratigraphic architecture differs from the northeastern to southwestern regions of the basin. Whereas on the northern part it evidences a regressive pattern, on the

southwestern sector it suggests a transgressive trend, evidenced by the installation of estuary deposits onto previous fluvial strata. This difference could be explained by localized subsidence, triggered by a tectonic inversion pulse. The results of this study have important implications for understanding the evolution of the oil-and-gas-bearing Mulichinco Formation of the Neuquén Basin, illustrating the complexity of depositional-environment distribution within a lowstand wedge.

### **Selected References**

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## Facies Distribution and Stratigraphic Architecture of Continental to Shallow-Marine Deposits on a Lowstand Wedge: Basin-scale Analysis of the Mulichinco Formation (Neuquén Basin, Argentina)



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<sup>2</sup> Centro de Investigaciones Geológicas, Universidad Nacional de La Plata - CONICET, La Plata, Argentina.

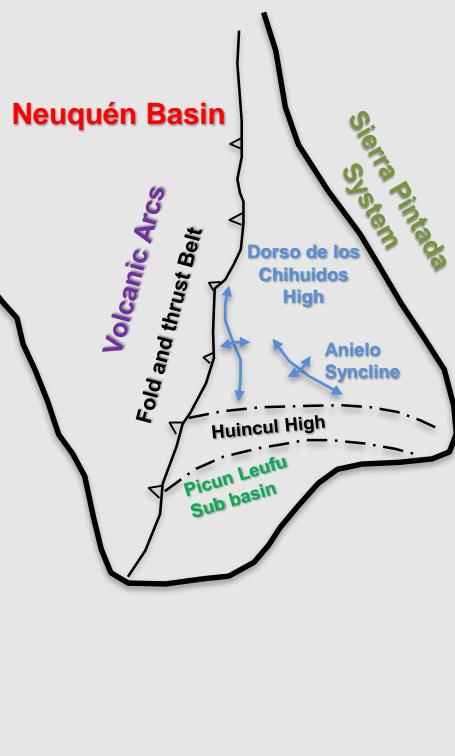
# INTRODUCTION

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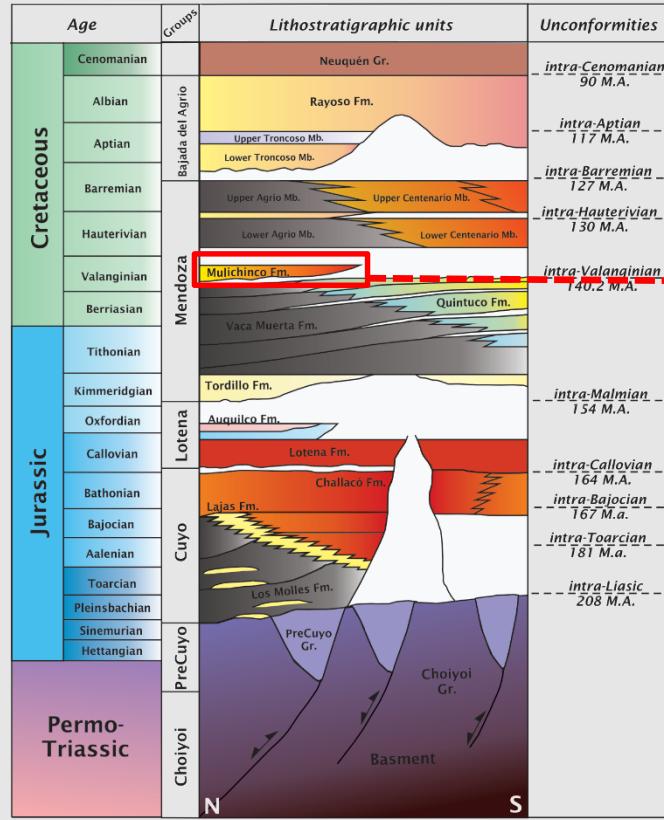
## General Location

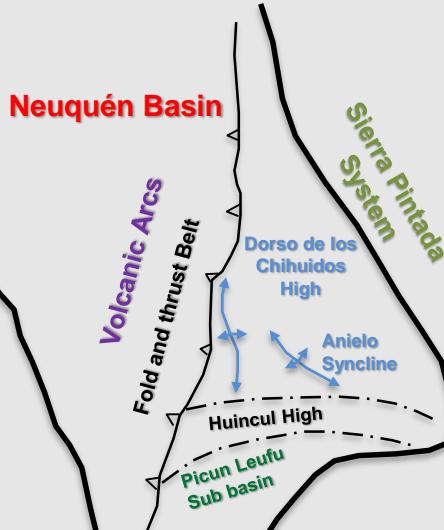


## Tectonic Setting

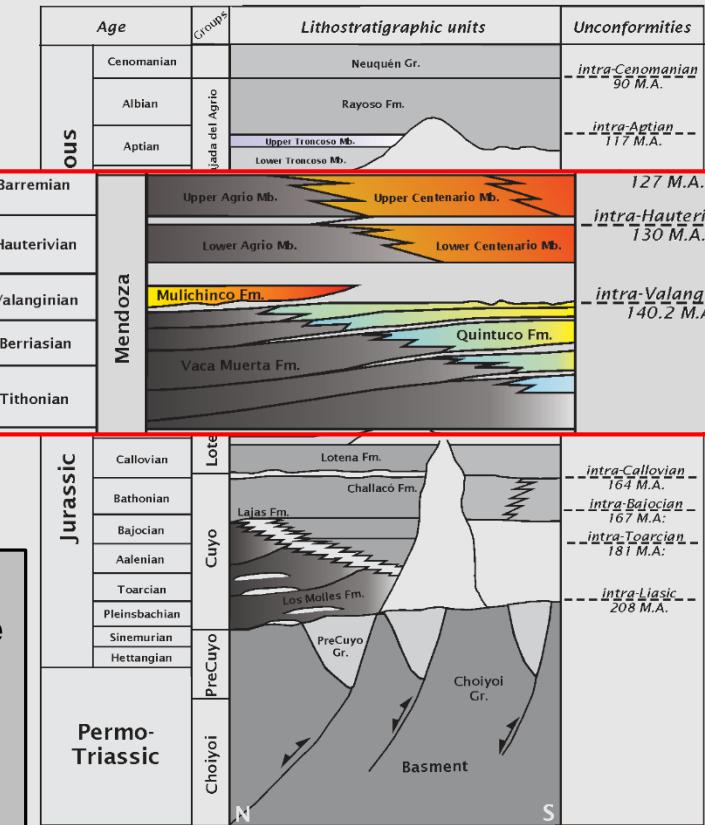


## General Stratigraphy



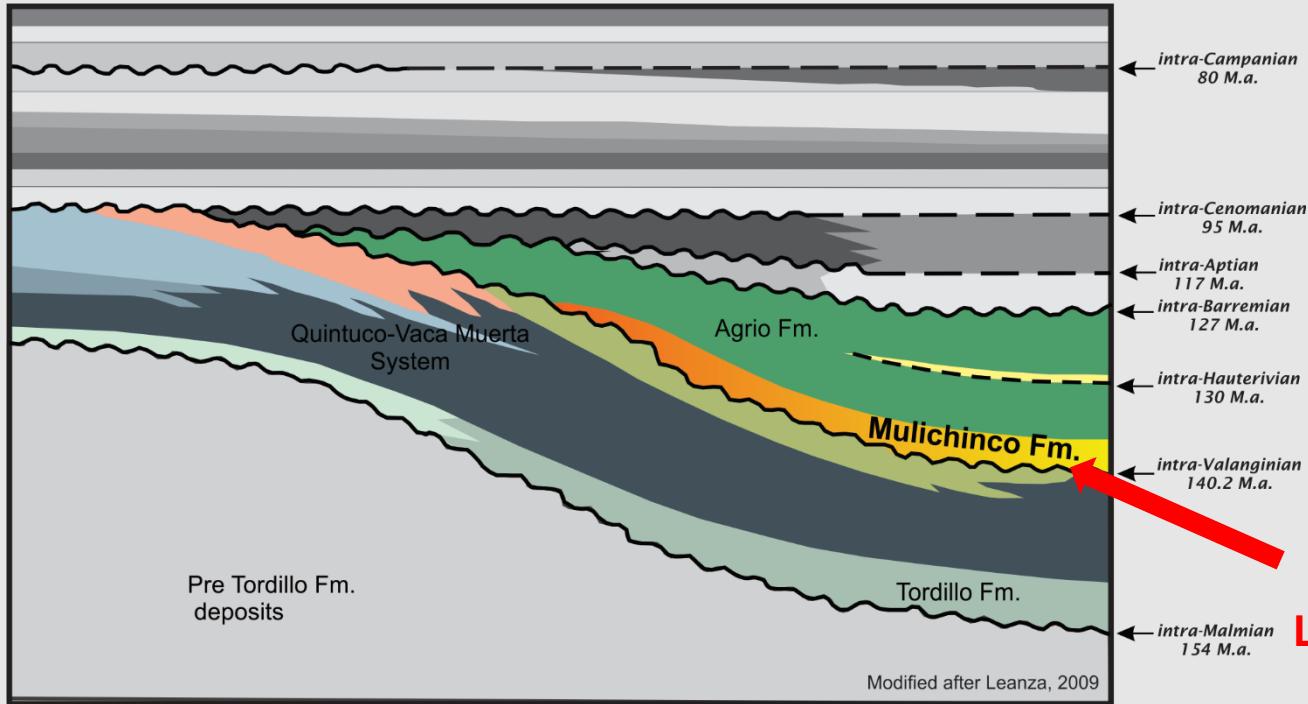
**General Location****Tectonic Setting**

**Mulichinco Lowstand Wedge:**  
Continental, transitional and marine sedimentary rocks deposited in a ramp setting above the SB named IntraValanginian unconformity.

**General Stratigraphy**

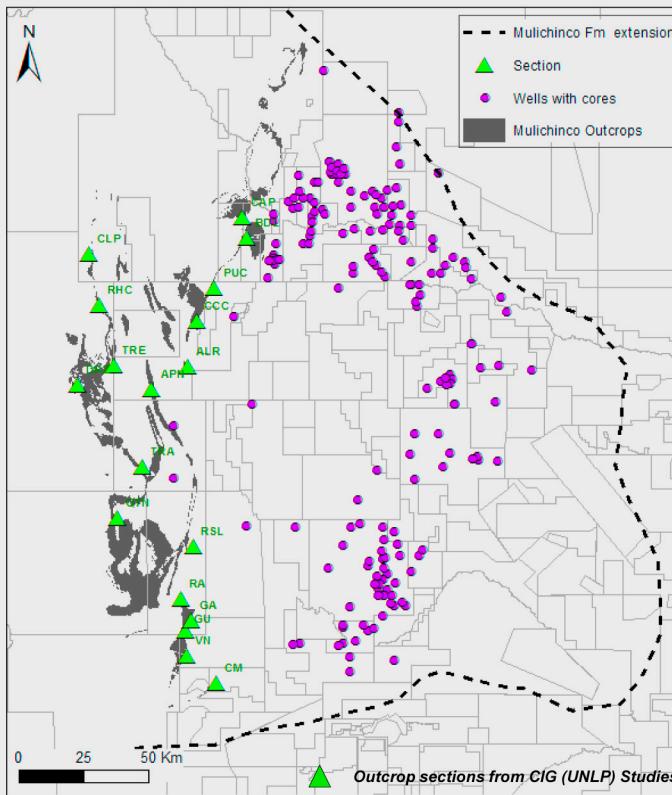
# GENERAL STRATIGRAPHY

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Classic Mulchinco Fm.  
subdivision for  
Oil&Gas Industry

2 M.y.  
Lowstand  
Wedge



### Outcrop Location Sections (21)

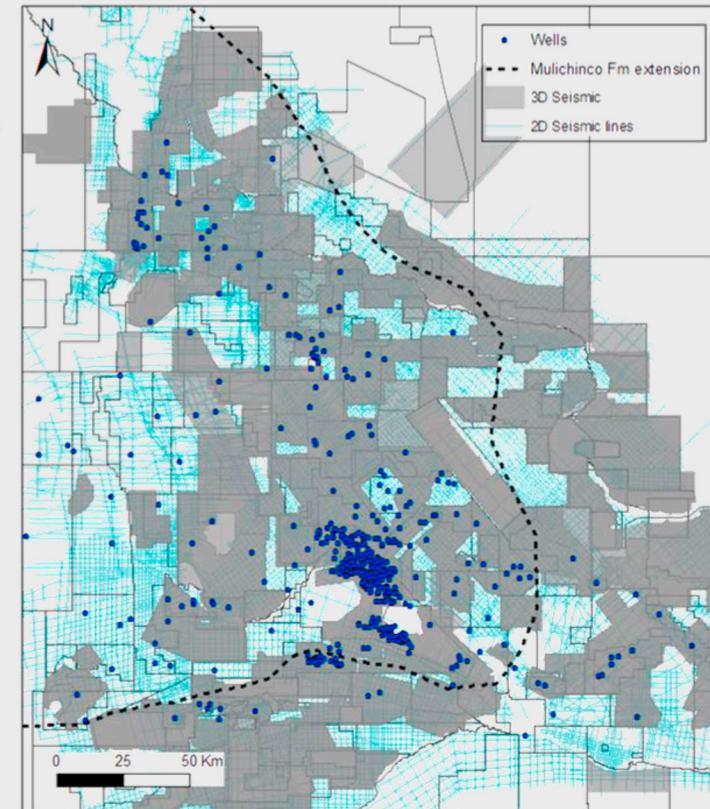
Mulichinco Core Data (98 Wells & more than 2000 m)

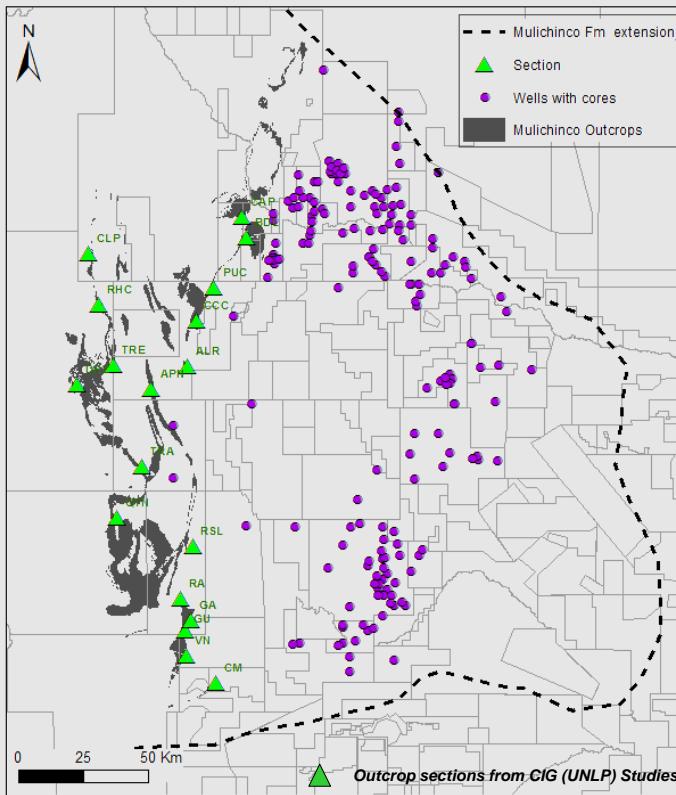
3D Seismic (36000 km<sup>2</sup>)

More than 60% of the study area

2D Seismic (Filling Gaps)

1600 Wells (Sonic and Density)





### Outcrop Location Sections (21)

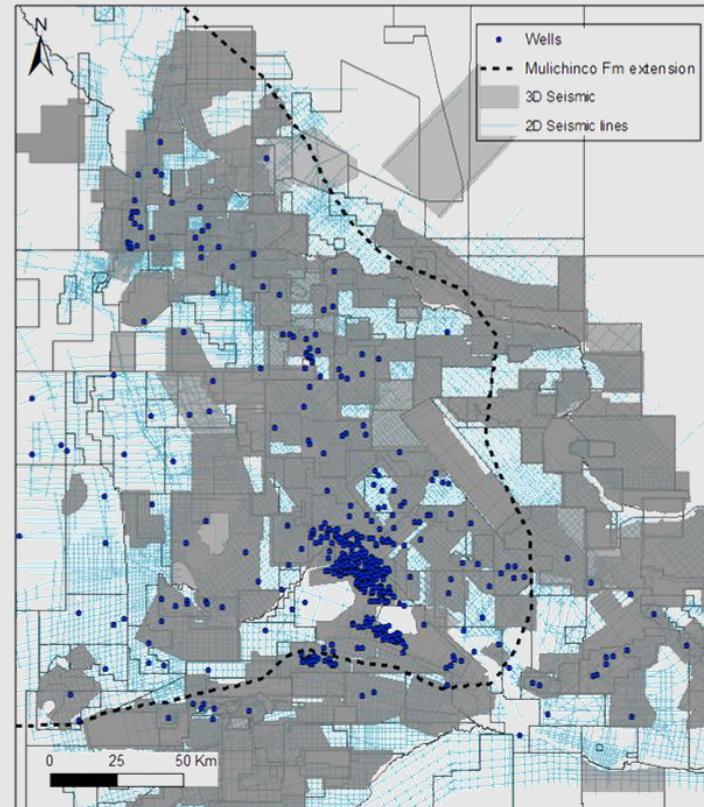
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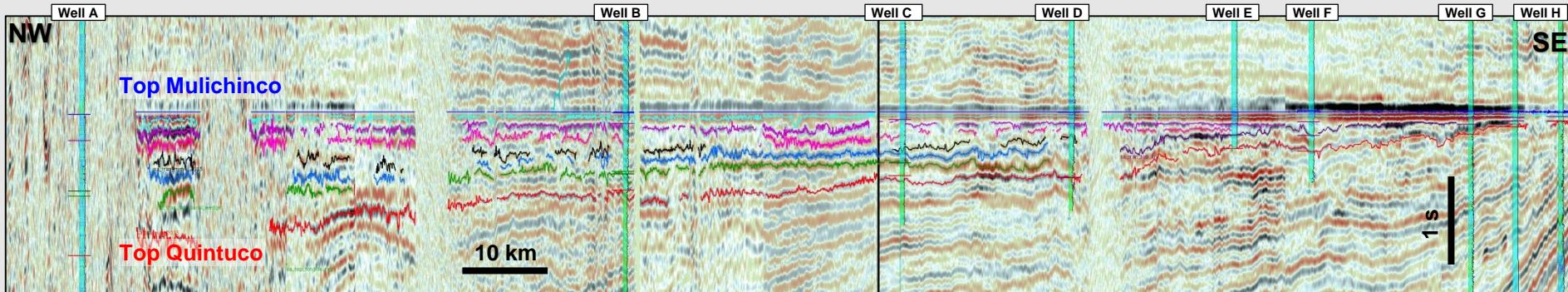
1600 Wells (Sonic and Density)



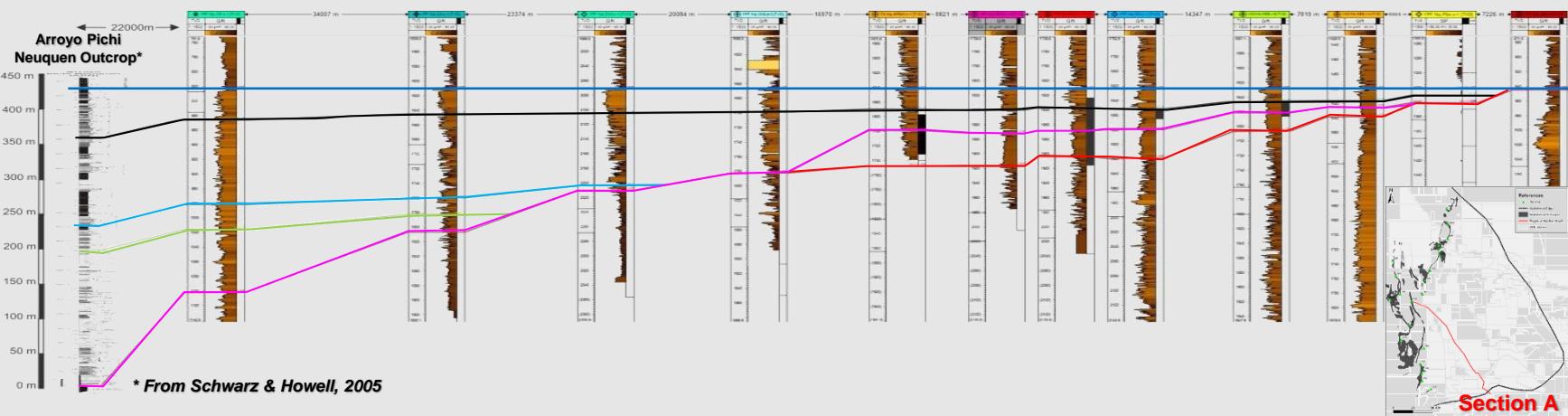
# WORKFLOW - Seismic & Well Data

YPF

- Seismic Section (and sonic logs) & Horizon Interpretation



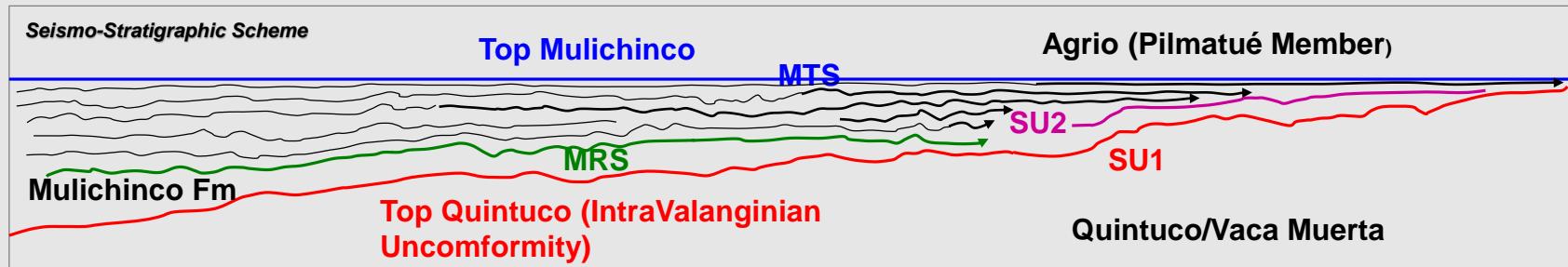
- Wells (GR logs and cores) and Outcrop Section



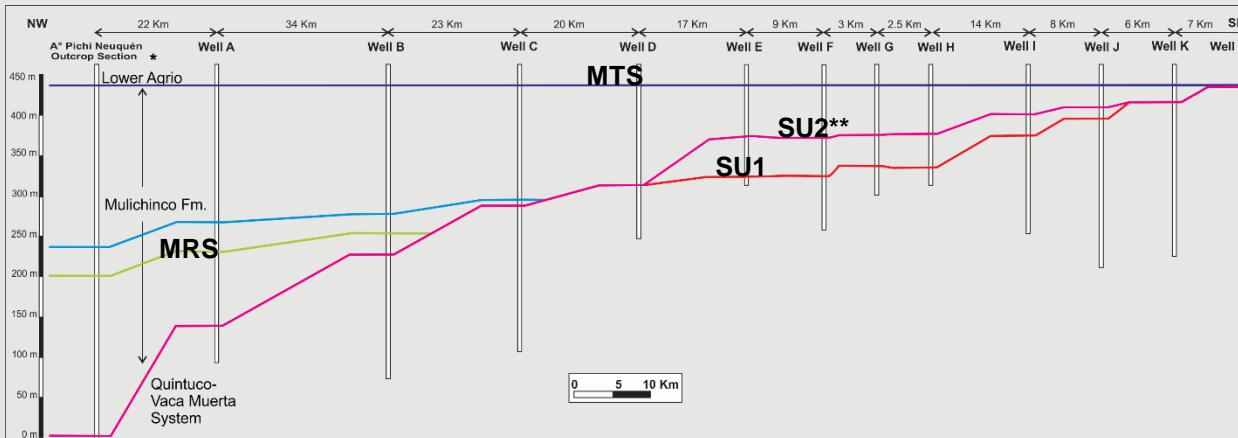
NW

SE

- Seismic Section (and sonic logs) & Horizon Interpretation

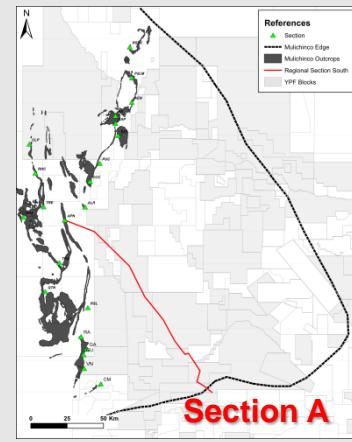


- Wells (GR logs and cores) and Outcrop Section



\* From Schwarz & Howell, 2005

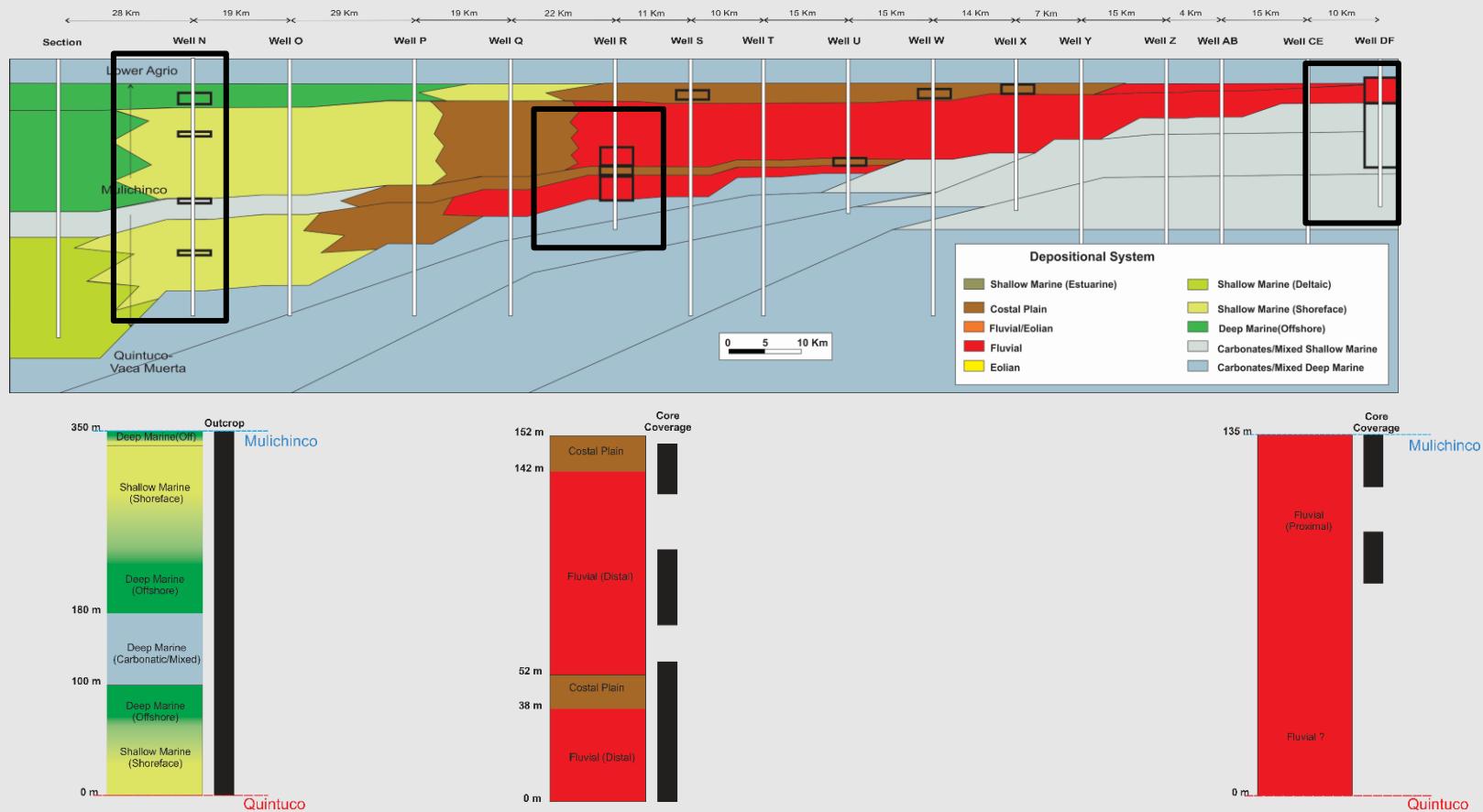
\*\* After Olivo, 2016



YPF-CIG(UNLP) Consortium Work

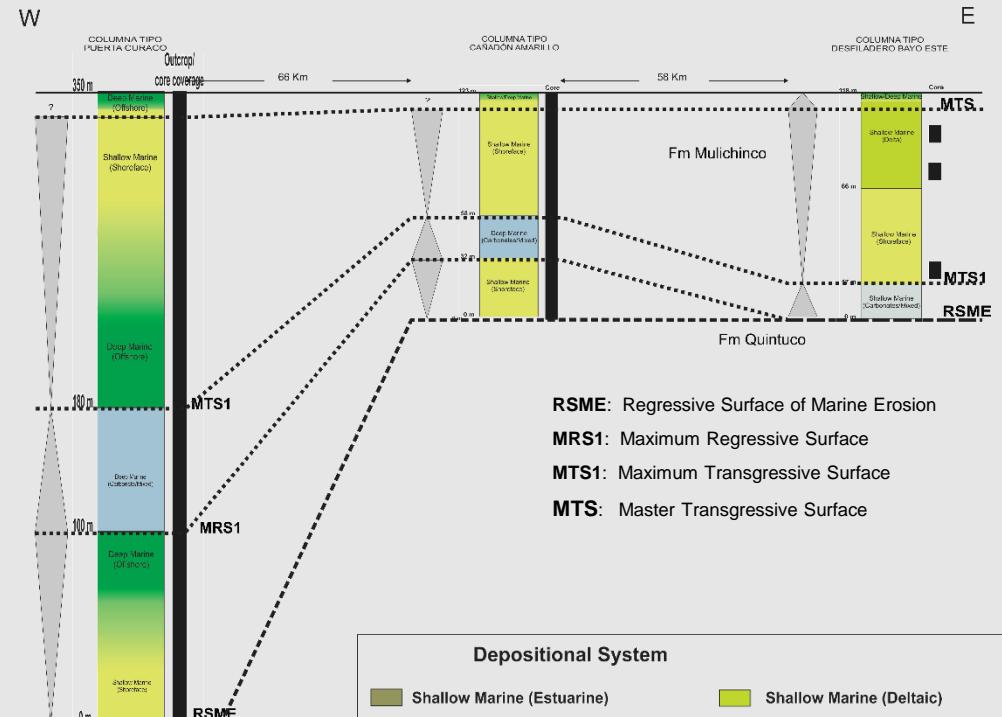
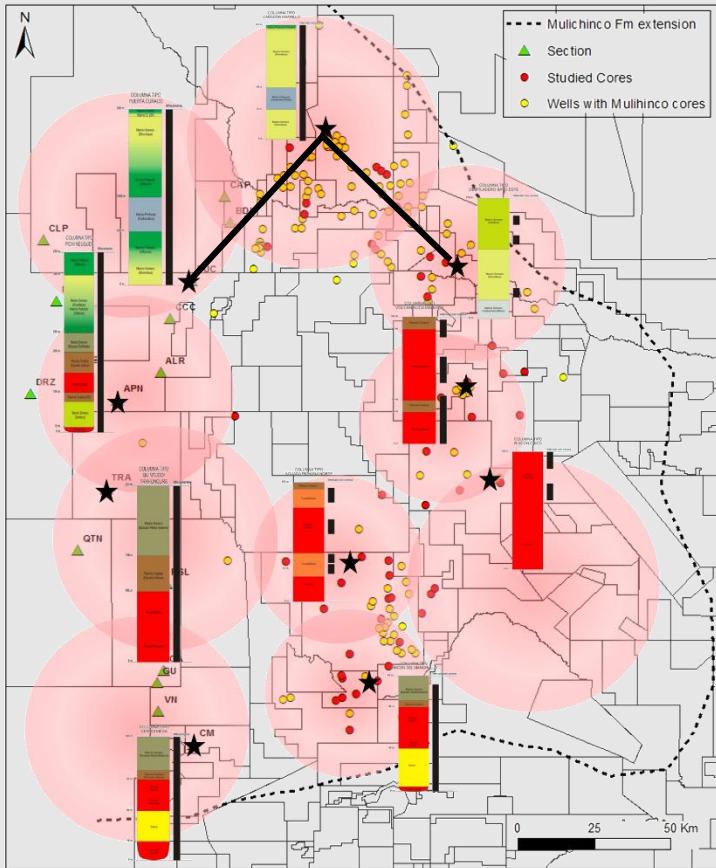
# CORE ANALYSIS

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# STRATIGRAPHIC SURFACE DEFINITION

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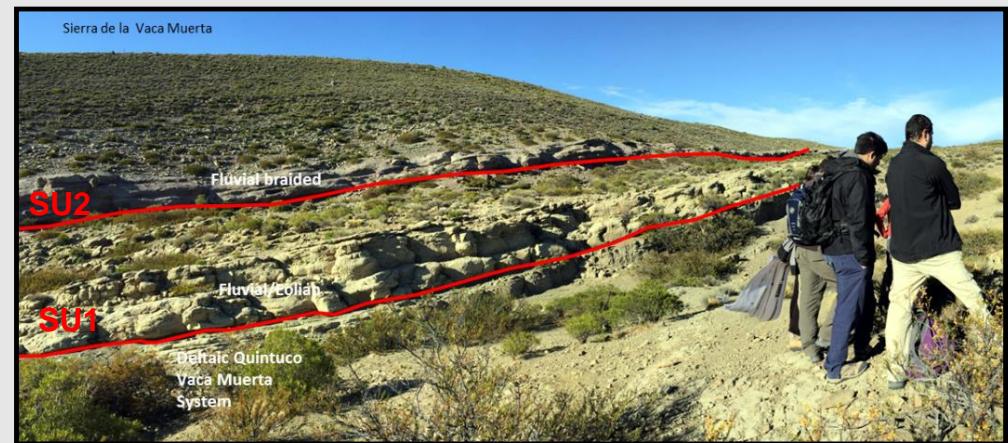
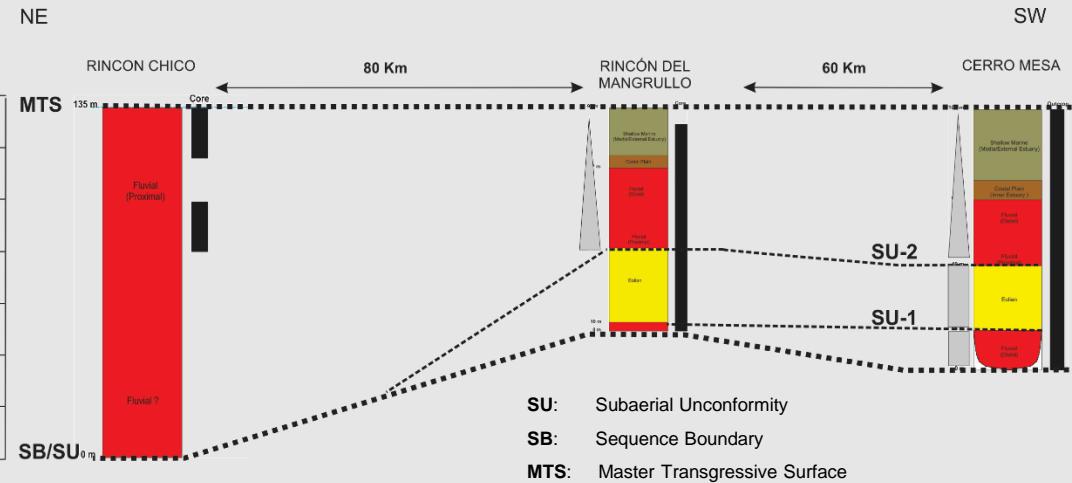
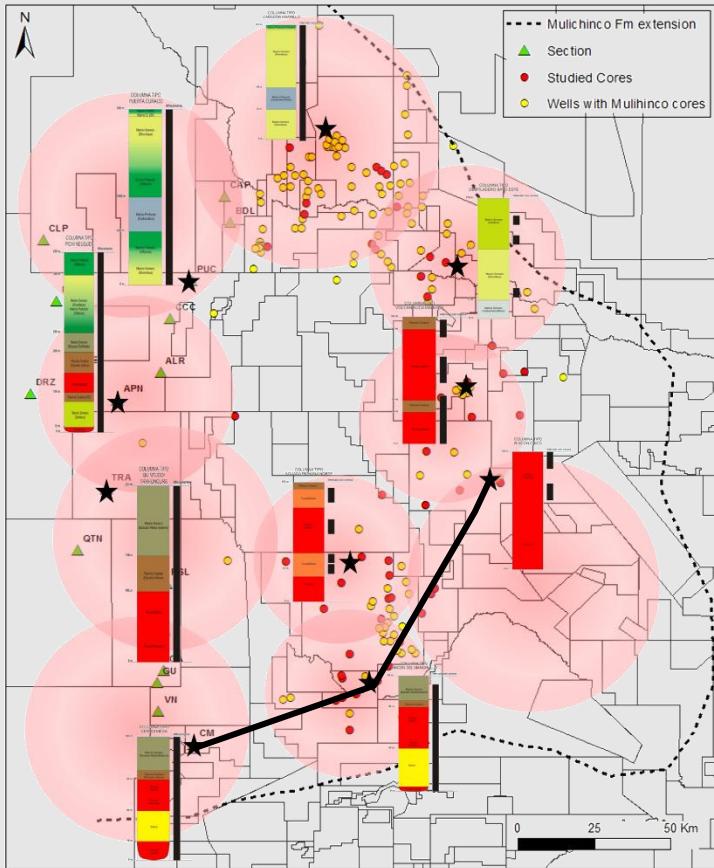


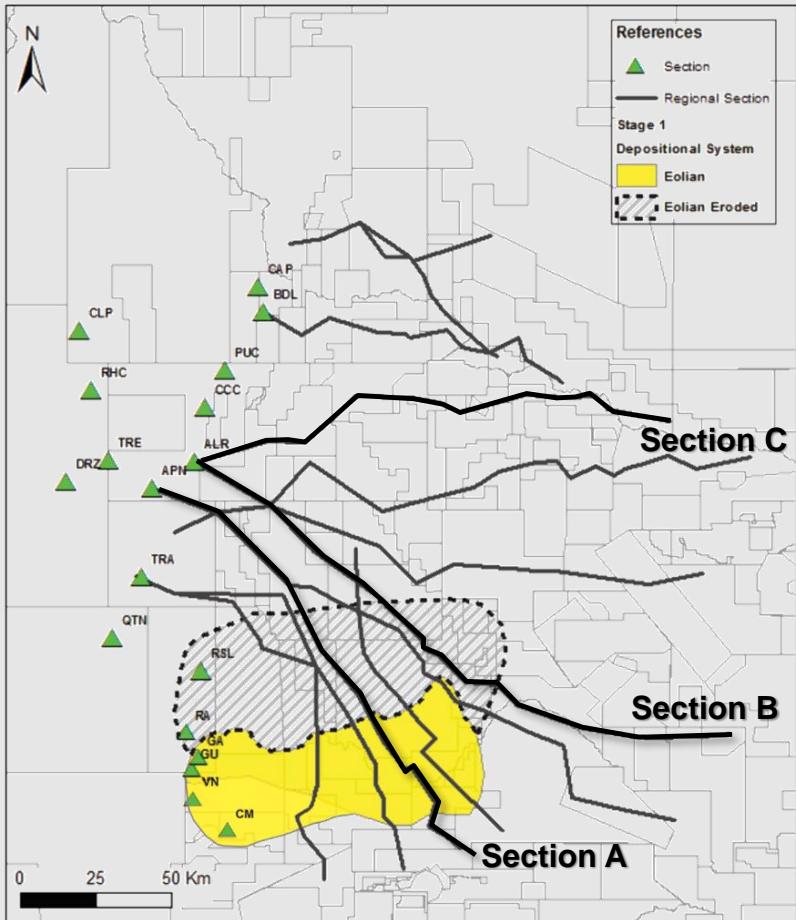
## Depositional System

Shallow Marine (Estuarine)	Shallow Marine (Deltaic)
Costal Plain	Shallow Marine (Shoreface)
Fluvial/Eolian	Deep Marine(Offshore)
Fluvial	Shallow Marine (Coraline)
Elolian	Carbonates/Mixed Shallow Marine
	Carbonates/Mixed Deep Marine

# STRATIGRAPHIC SURFACE DEFINITION

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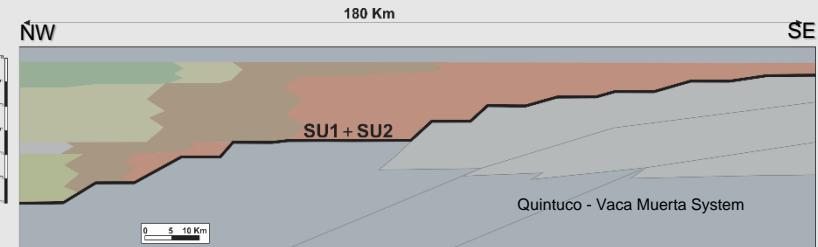




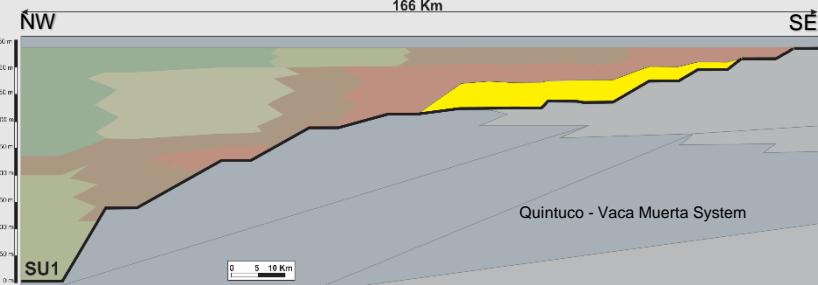
Regional Section North

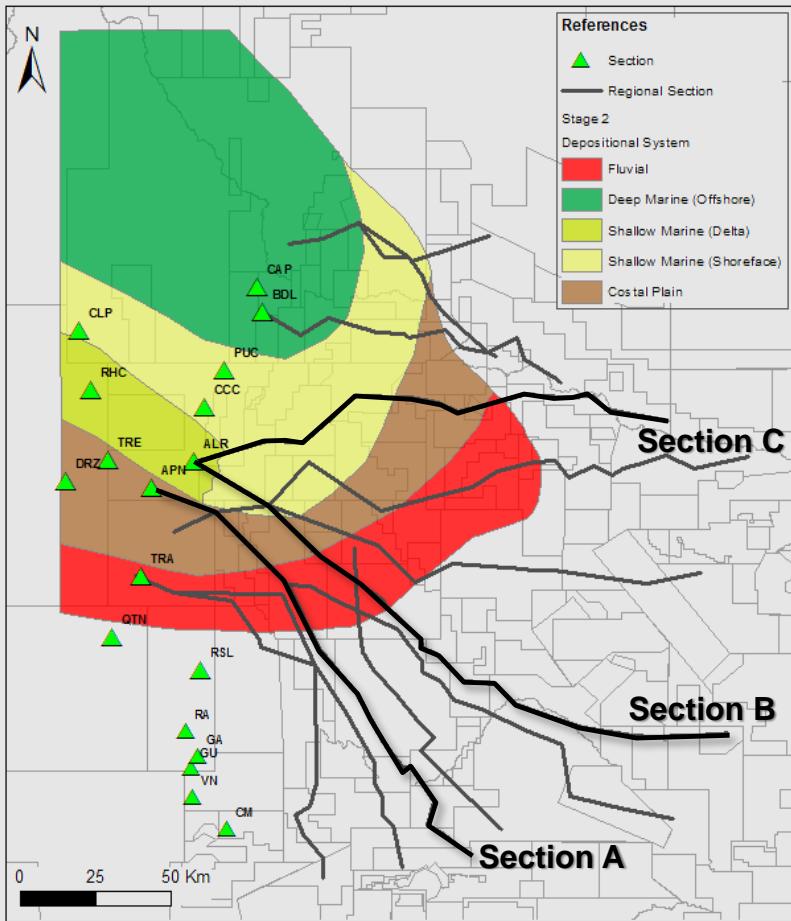


Regional Section Center

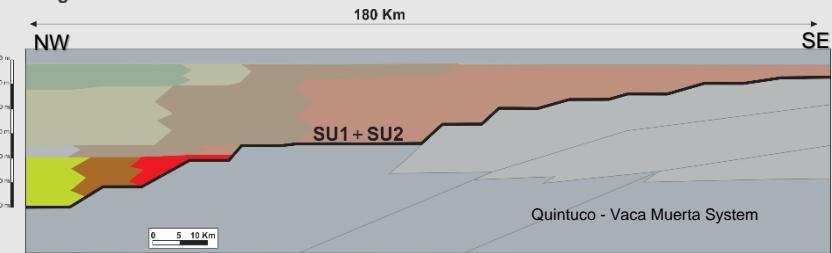


Regional Section South

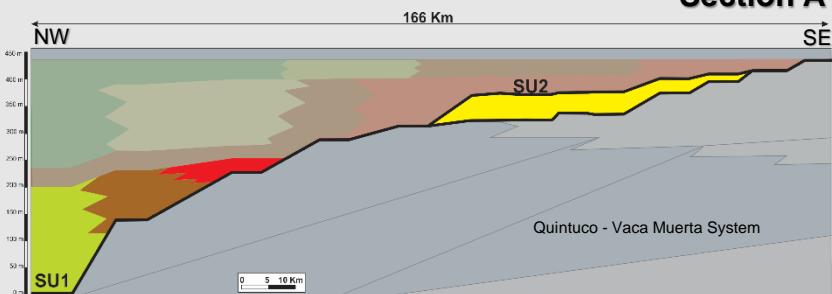
**Section B****Section A**

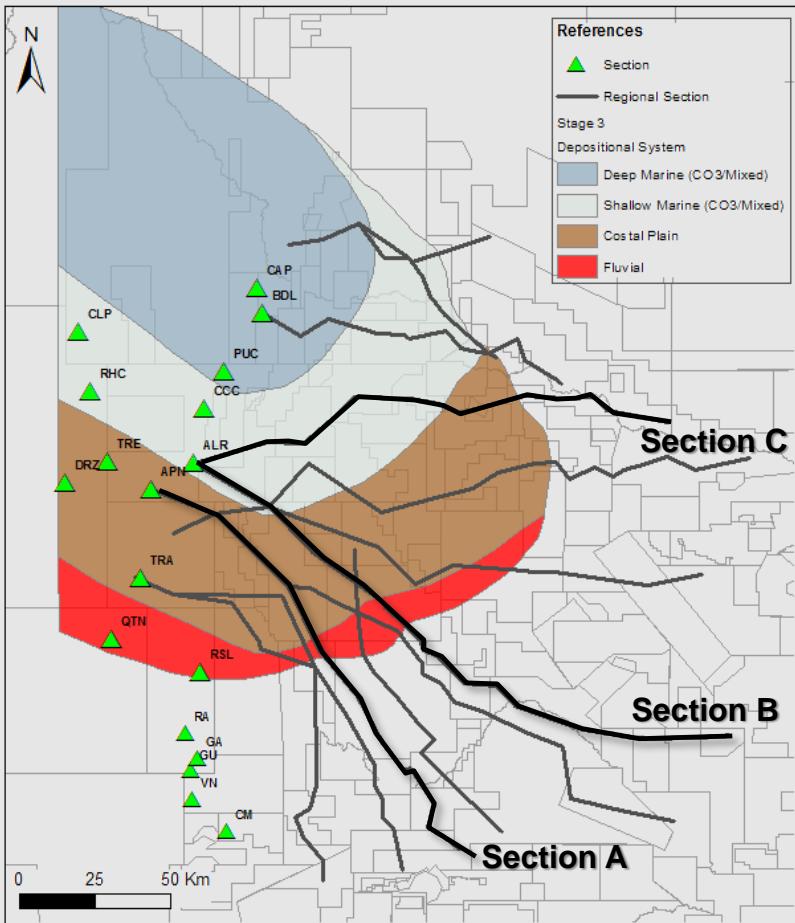


Regional Section North

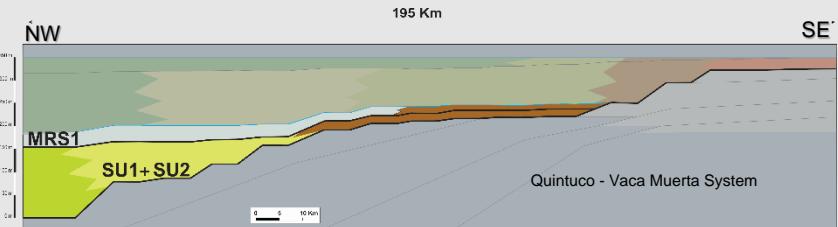
**Section B**

Regional Section South

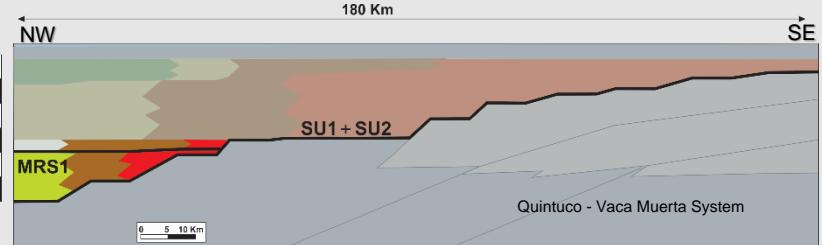
**Section A**



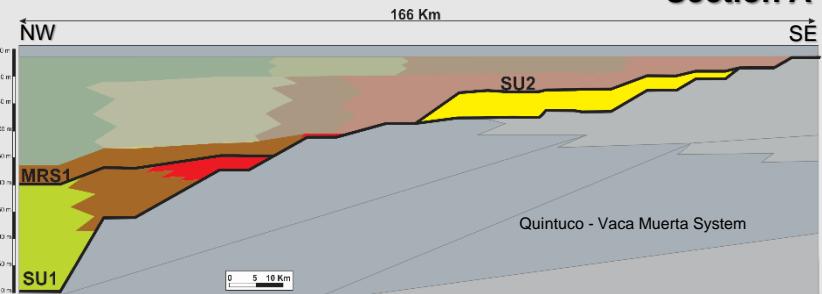
Regional Section North



Regional Section Center



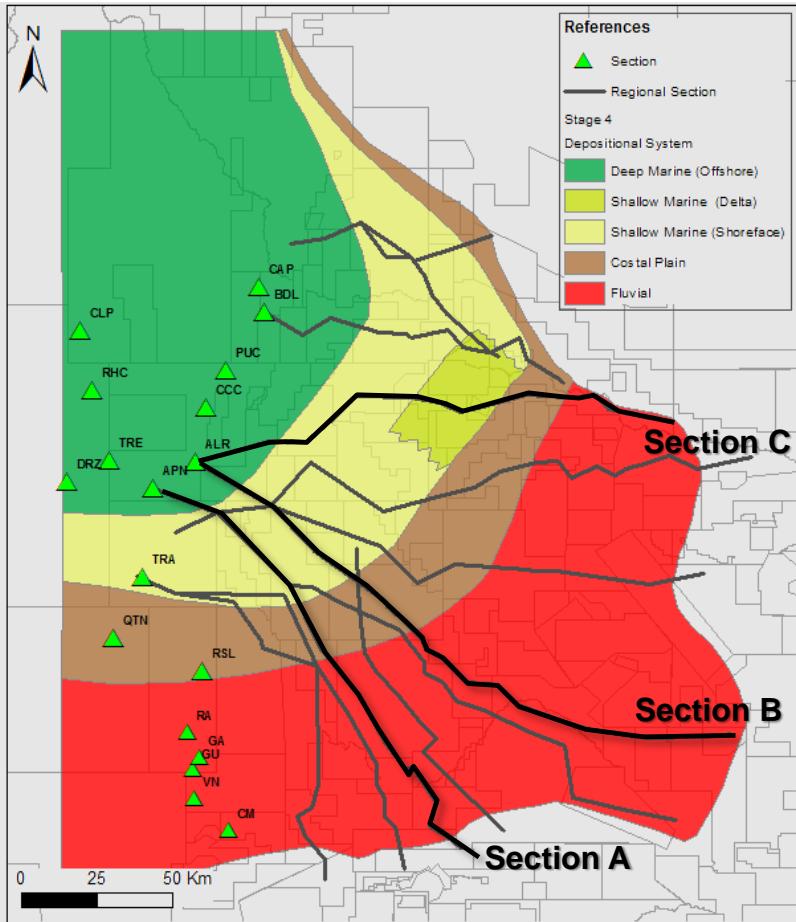
Regional Section South

**Section C****Section B****Section A**

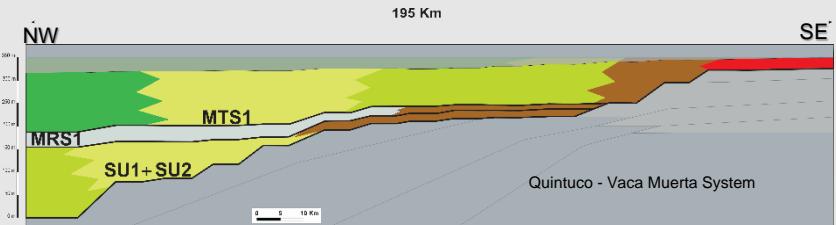
# PALEOENVIRONMENTAL AND SEQUENCE-STRATIGRAPHIC EVOLUTION

Stage 4

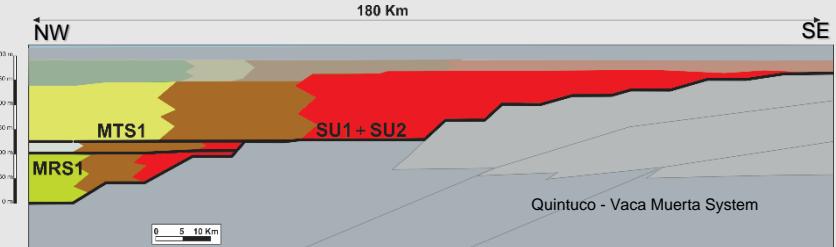
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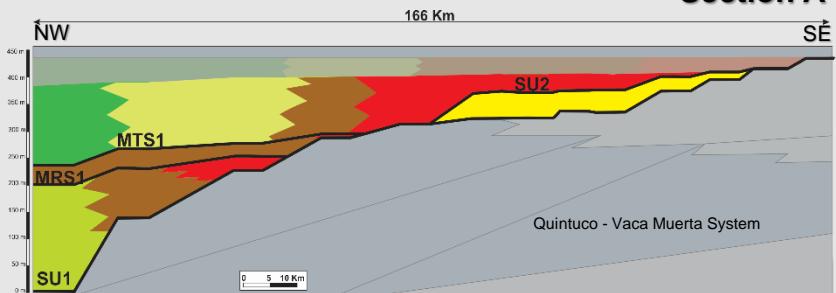
Regional Section North



Regional Section Center



Regional Section South



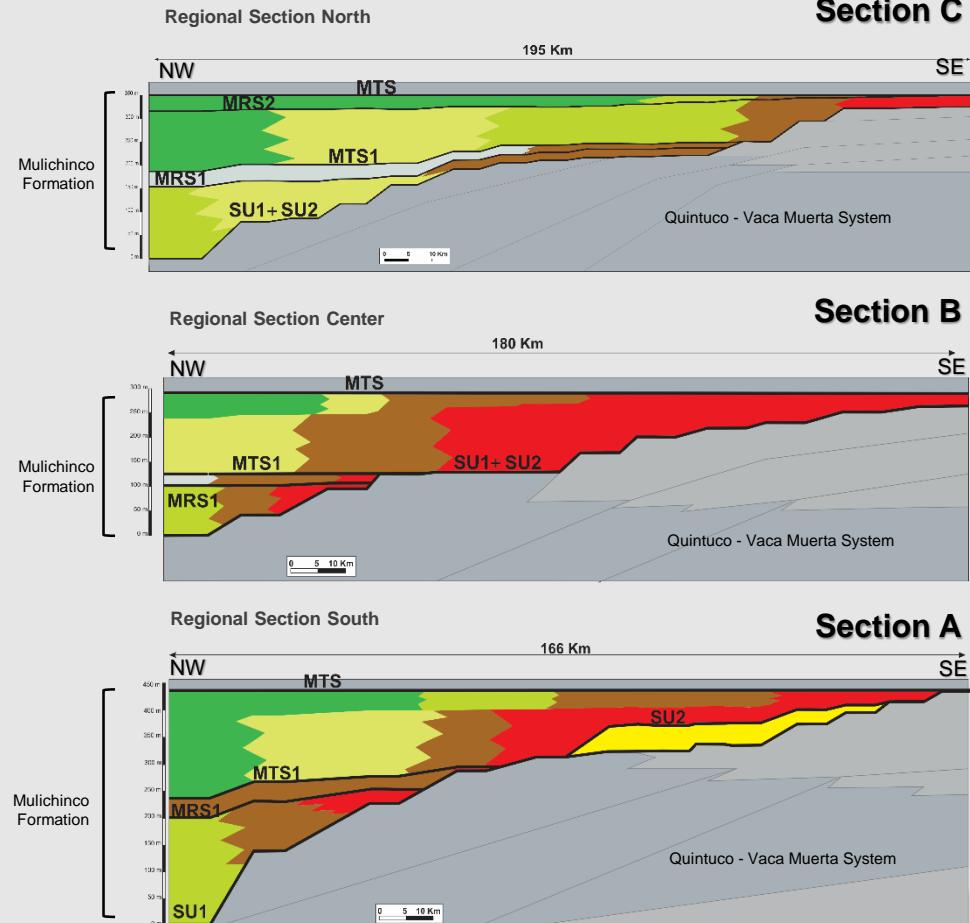
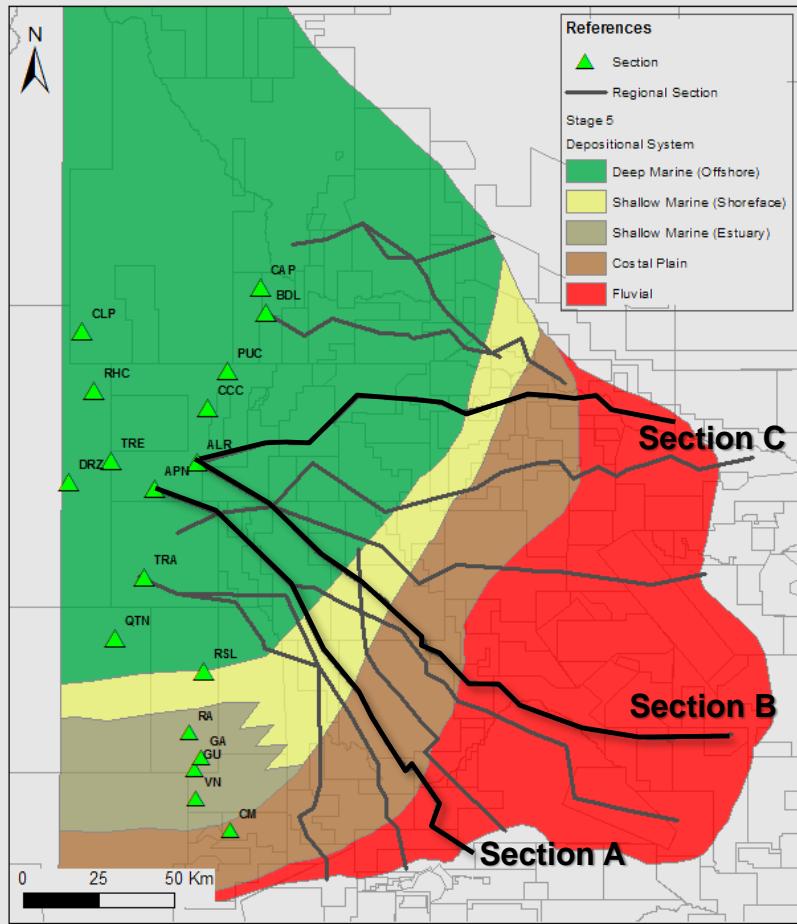
Section B

Section A

# PALEOENVIRONMENTAL AND SEQUENCE-STRATIGRAPHIC EVOLUTION

Stage 5

YPF

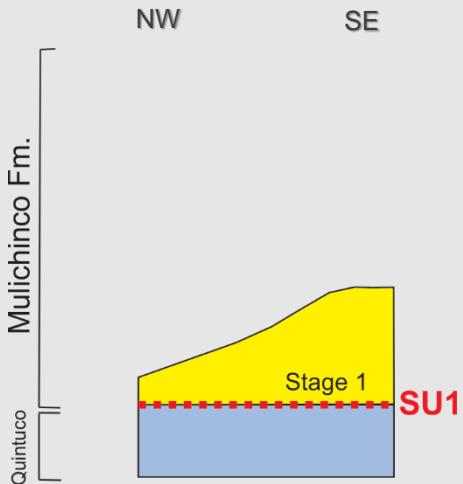


# MULICHINCO FORMATION GENERAL STRATIGRAPHIC EVOLUTION

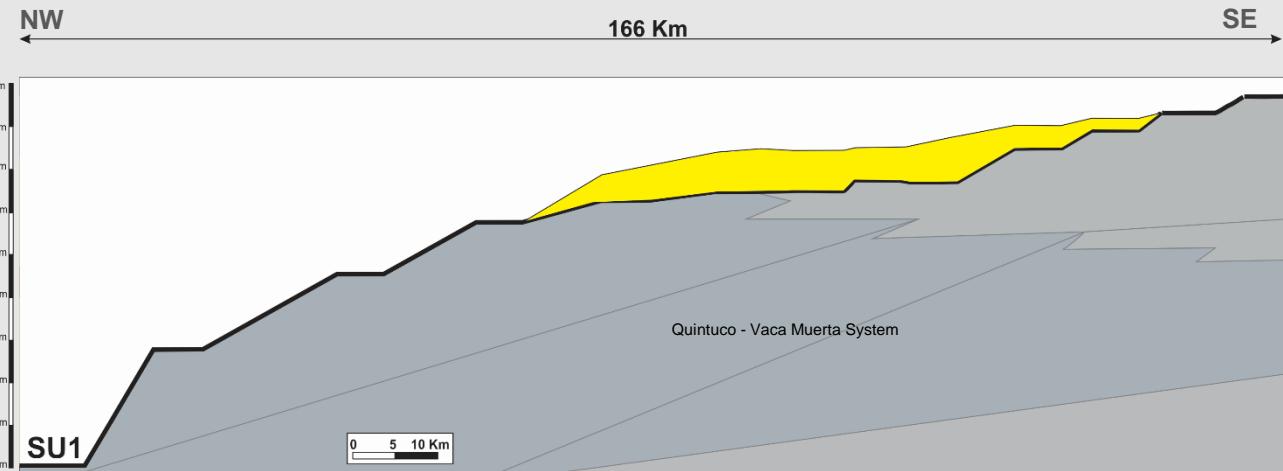
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## Stage 1

Schematic Stratigraphic Column



Schematic Southern Regional Section



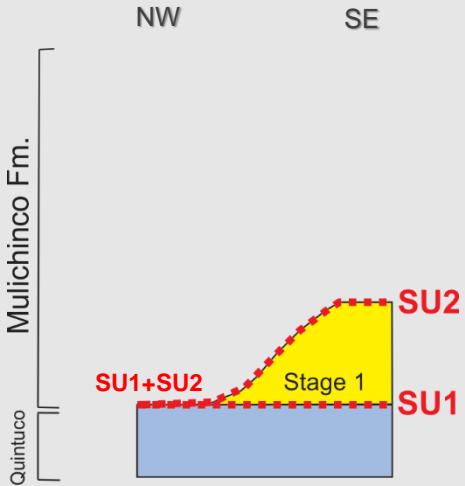
SU: Subaerial Unconformity

### Depositional System

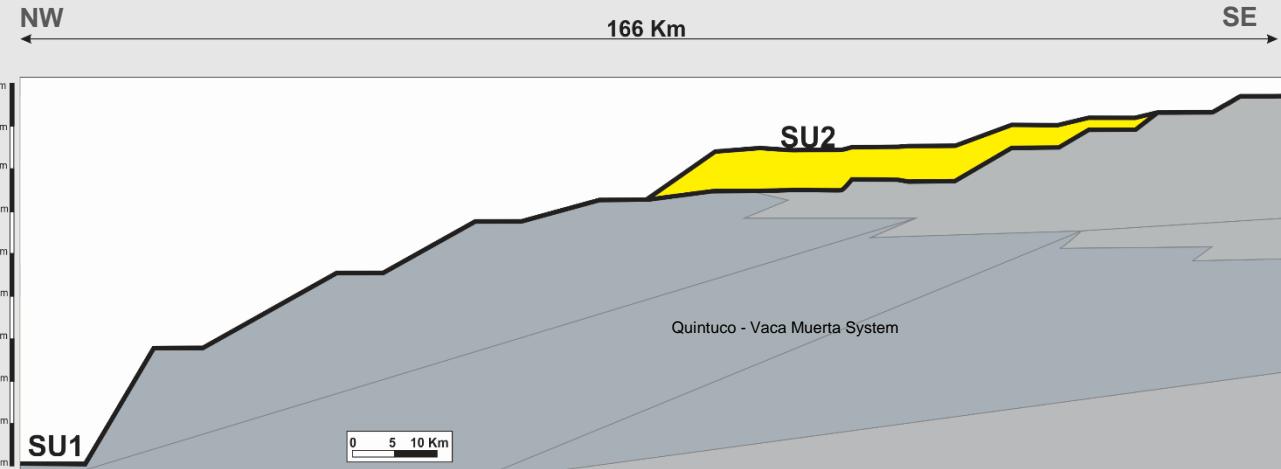
Shallow Marine (Estuarine)	Shallow Marine (Deltaic)
Costal Plain	Shallow Marine (Shoreface)
Fluvial/Eolian	Deep Marine(Offshore)
Fluvial	Carbonates/Mixed Shallow Marine
Eolian	Carbonates/Mixed Deep Marine

## Stage 1 + SU2 Erosion

Schematic Stratigraphic Column



Schematic Southern Regional Section



SU: Subaerial Unconformity

### Depositional System

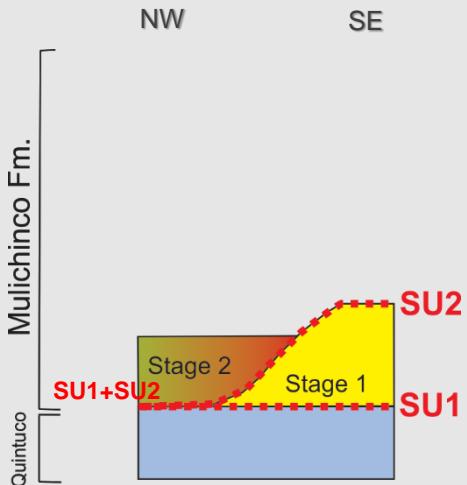
Shallow Marine (Estuarine)	Shallow Marine (Deltaic)
Costal Plain	Shallow Marine (Shoreface)
Fluvial/Eolian	Deep Marine(Offshore)
Fluvial	Carbonates/Mixed Shallow Marine
Eolian	Carbonates/Mixed Deep Marine

# MULICHINCO FORMATION GENERAL STRATIGRAPHIC EVOLUTION

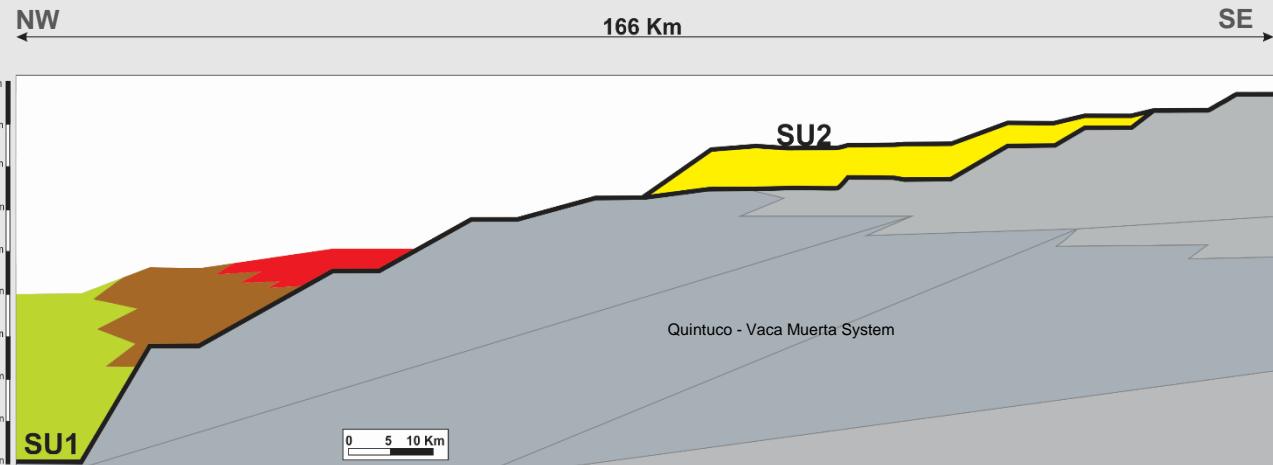
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## Stage 2

Schematic Stratigraphic Column



Schematic Southern Regional Section



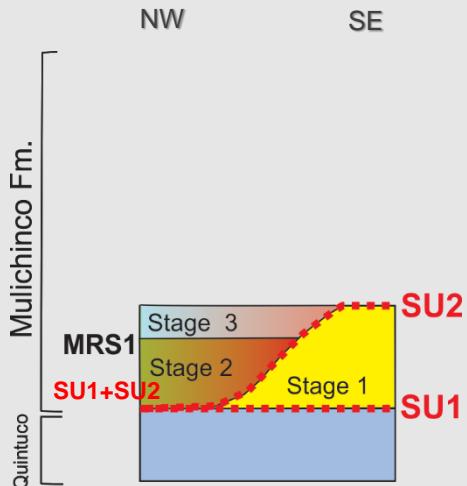
SU: Subaerial Unconformity

### Depositional System

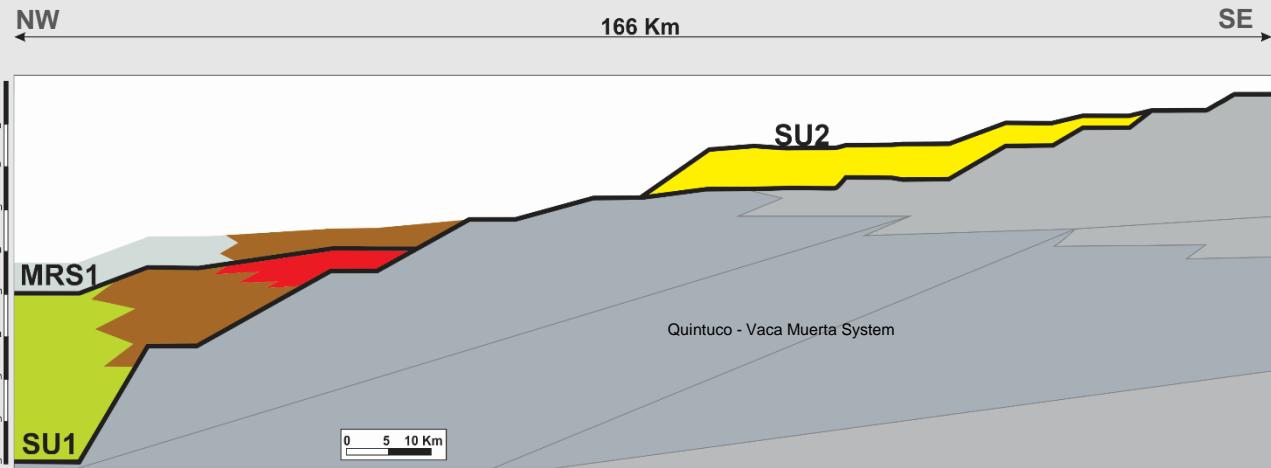
Shallow Marine (Estuarine)	Shallow Marine (Deltaic)
Costal Plain	Shallow Marine (Shoreface)
Fluvial/Eolian	Deep Marine(Offshore)
Fluvial	Carbonates/Mixed Shallow Marine
Eolian	Carbonates/Mixed Deep Marine

## Stage 3

Schematic Stratigraphic Column



Schematic Southern Regional Section



**SU:** Subaerial Unconformity

**MRS1:** Maximum Regressive Surface

### Depositional System

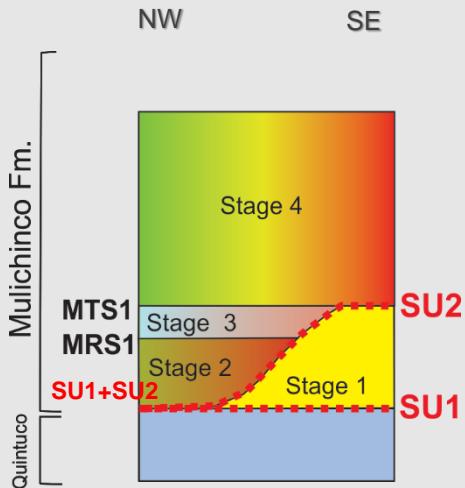
Shallow Marine (Estuarine)	Shallow Marine (Deltaic)
Costal Plain	Shallow Marine (Shoreface)
Fluvial/Eolian	Deep Marine (Offshore)
Fluvial	Carbonates/Mixed Shallow Marine
Eolian	Carbonates/Mixed Deep Marine

# MULICHINCO FORMATION GENERAL STRATIGRAPHIC EVOLUTION

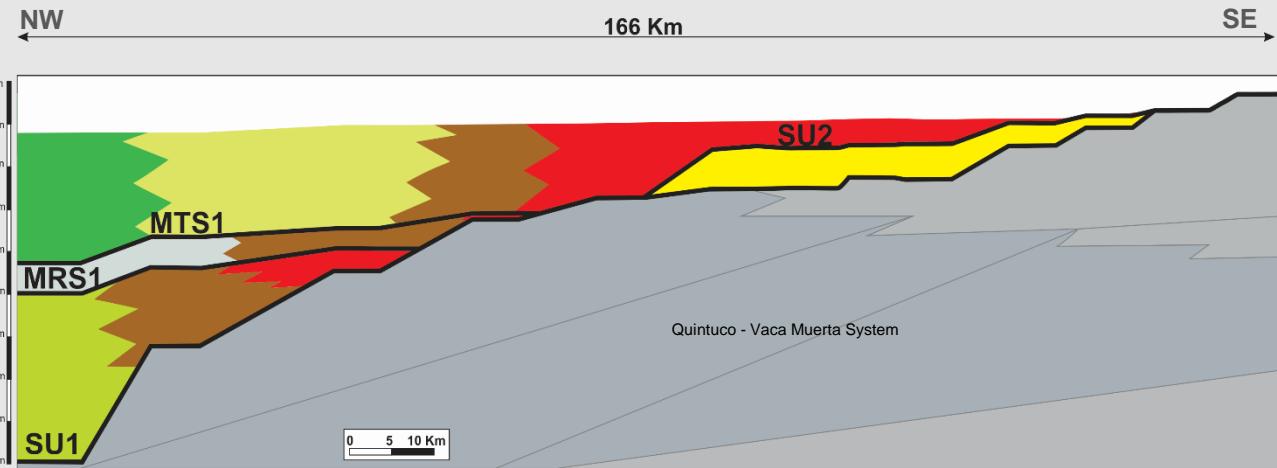
YPF

## Stage 4

Schematic Stratigraphic Column



Schematic Southern Regional Section



**SU:** Subaerial Unconformity

**MRS1:** Maximum Regressive Surface

**MTS1:** Maximum Transgressive Surface

### Depositional System

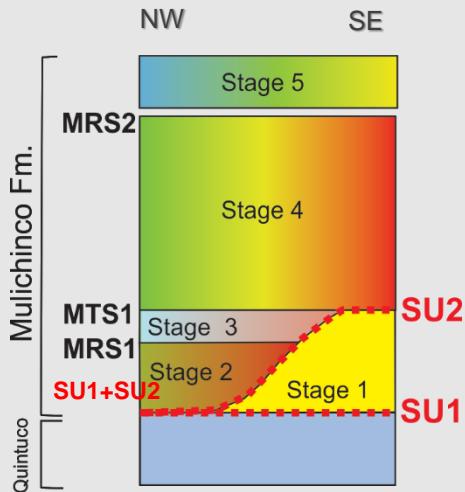
Shallow Marine (Estuarine)	Shallow Marine (Deltaic)
Costal Plain	Shallow Marine (Shoreface)
Fluvial/Eolian	Deep Marine(Offshore)
Fluvial	Carbonates/Mixed Shallow Marine
Eolian	Carbonates/Mixed Deep Marine

# MULICHINCO FORMATION GENERAL STRATIGRAPHIC EVOLUTION

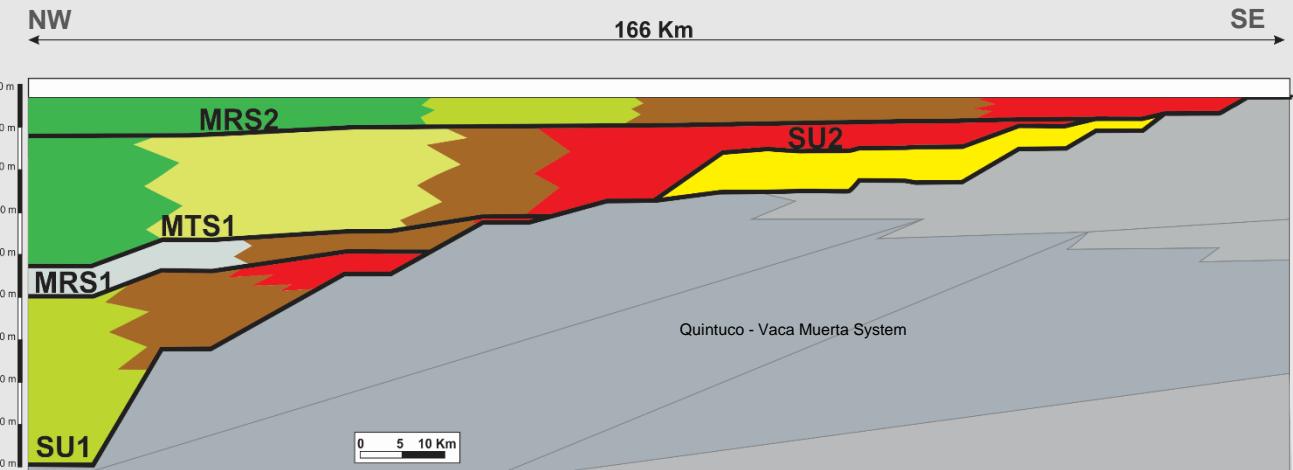
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## Stage 5

Schematic Stratigraphic Column



Schematic Southern Regional Section



**SU:** Subaerial Unconformity

**MRS1:** Maximum Regressive Surface

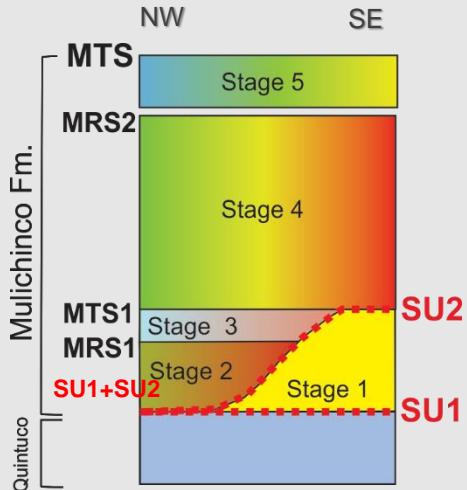
**MTS1:** Maximum Transgressive Surface

### Depositional System

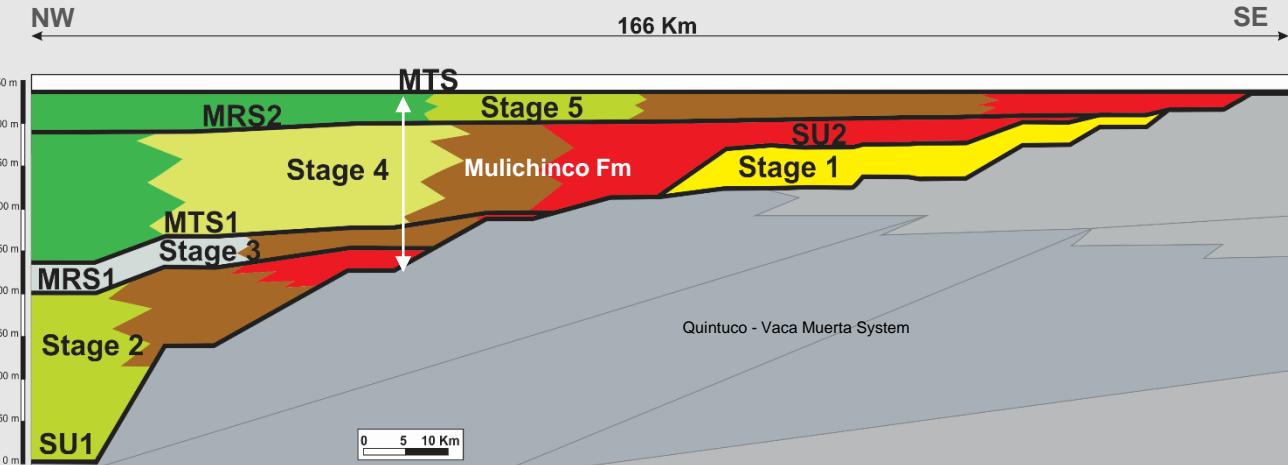
Shallow Marine (Estuarine)	Shallow Marine (Deltaic)
Costal Plain	Shallow Marine (Shoreface)
Fluvial/Eolian	Deep Marine(Offshore)
Fluvial	Carbonates/Mixed Shallow Marine
Eolian	Carbonates/Mixed Deep Marine

## General Evolution

Schematic Stratigraphic Column



Schematic Southern Regional Section



**SU:** Subaerial Unconformity

**MRS1:** Maximum Regressive Surface

**MTS1:** Maximum Transgressive Surface

**MTS:** Master Transgressive Surface

## Depositional System

Shallow Marine (Estuarine)	Shallow Marine (Deltaic)
Costal Plain	Shallow Marine (Shoreface)
Fluvial/Eolian	Deep Marine(Offshore)
Fluvial	Carbonates/Mixed Shallow Marine
Eolian	Carbonates/Mixed Deep Marine

- The Mulichinco Formation represents an **exceptional example of lowstand wedge**. It thickens gradually from a few meters at the basin borders up to 400 m in the distal portions, having an average length of 150 km. This wedge morphology is clearly represented on the regional sections.
- This work comprises a **regional synthesis of the Mulichinco Formation** using all the available outcrop and subsurface information on the basin.
- It is a remarkable fact the **great lateral and vertical variability of facies** within the unit, representing the development of different depositional systems in a relatively short period of time (2 My).
- Two important erosive surfaces that suggest different internal pulses of basin reconfiguration has been identified. Three more key stratigraphic surfaces (MRS1, MTS1, MSR2) helped understanding the temporal evolution.
- **5 evolutive stages were recognized and mapped from the integration of available data.**
- A better regional understanding of the Mulichinco Formation will help to be **more predictive when exploring its remaining potential. New exploratory opportunities.**

**Thank You for Your Attention!**



## REFERENCES

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