

# Connecting Outcrop to Subsurface: the Mixed Carbonate Siliciclastic System in the Neuquén Basin, Argentina (Year 2)

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## Project Purpose

Mixed carbonate siliciclastic reservoirs are highly complex systems with heterogeneous properties because of the intertwining of different facies and the often complicated diagenesis. Adequate reservoir characterization can only be achieved by integration of geometric, lithologic, and petrophysical data. The level of detail necessary to capture the small-scale variations of reservoir quality lies commonly below seismic resolution and therefore requires the incorporation of detailed outcrop observations with larger scale seismic interpretations. The aim of the proposed project is to combine outcrop and subsurface data for the development of a detailed model of the Upper Jurassic – Lower Cretaceous mixed carbonate siliciclastic system in the Neuquén Basin, Argentina. The depositional model aims to assess the processes and factors that control the mixing of the clastics and carbonates. The integration of the petrophysical data will place the reservoir characteristics into a geometrical framework.

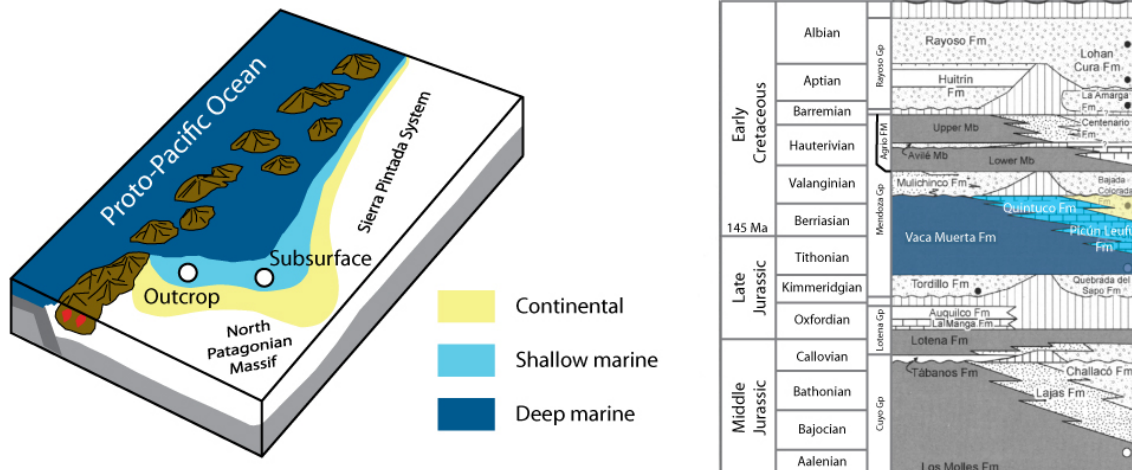


Figure 1. (Left) Paleogeographic setting of the Neuquén Basin with locations of subsurface and outcrop sections. (Right) Middle Jurassic to Lower Cretaceous stratigraphy of the Neuquén Basin, studied interval colored (both modified from Howell et al., 2005)

The studied interval comprises the prograding to aggrading mixed carbonate siliciclastic successions of the Quintuco Formation and the time equivalent basinal shales of the Vaca Muerta Formation (Fig. 1). These two formations form a mixed system that consists of a lower prograding unit composed of siliciclastics with a coarsening upwards trend (Fig. 2 top). The aggrading middle unit can be subdivided into a lower mixed carbonate siliciclastic interval capped by a clean carbonate interval which in turn is overlain by an aggrading upper unit in which siltstones and sandstones alternate with minor carbonates (Fig. 2).

## Scope of Work

In year 1 we examined the lithologic character and the stratal architecture of Vaca Muerta – Quintuco Formations in outcrop. In addition, we evaluated several core intervals from a producing field in terms of sedimentological and petrophysical properties. Initial comparison of lithofacies character and geometries demonstrated general similarities in stratal architecture and lithology types of the outcrop and subsurface units.

In year 2 we plan to establish the sequence stratigraphic and chronostratigraphic correlation between the outcrop and subsurface data. This will help to understand the depositional system on a basin scale. The correlation will include the large-scale geometric analysis on seismic data and its comparison to geometries in outcrop (Fig. 2). In addition, the smaller scale outcrop observations will be integrated within the subsurface framework in order to better understand reservoir and flow barrier distribution.

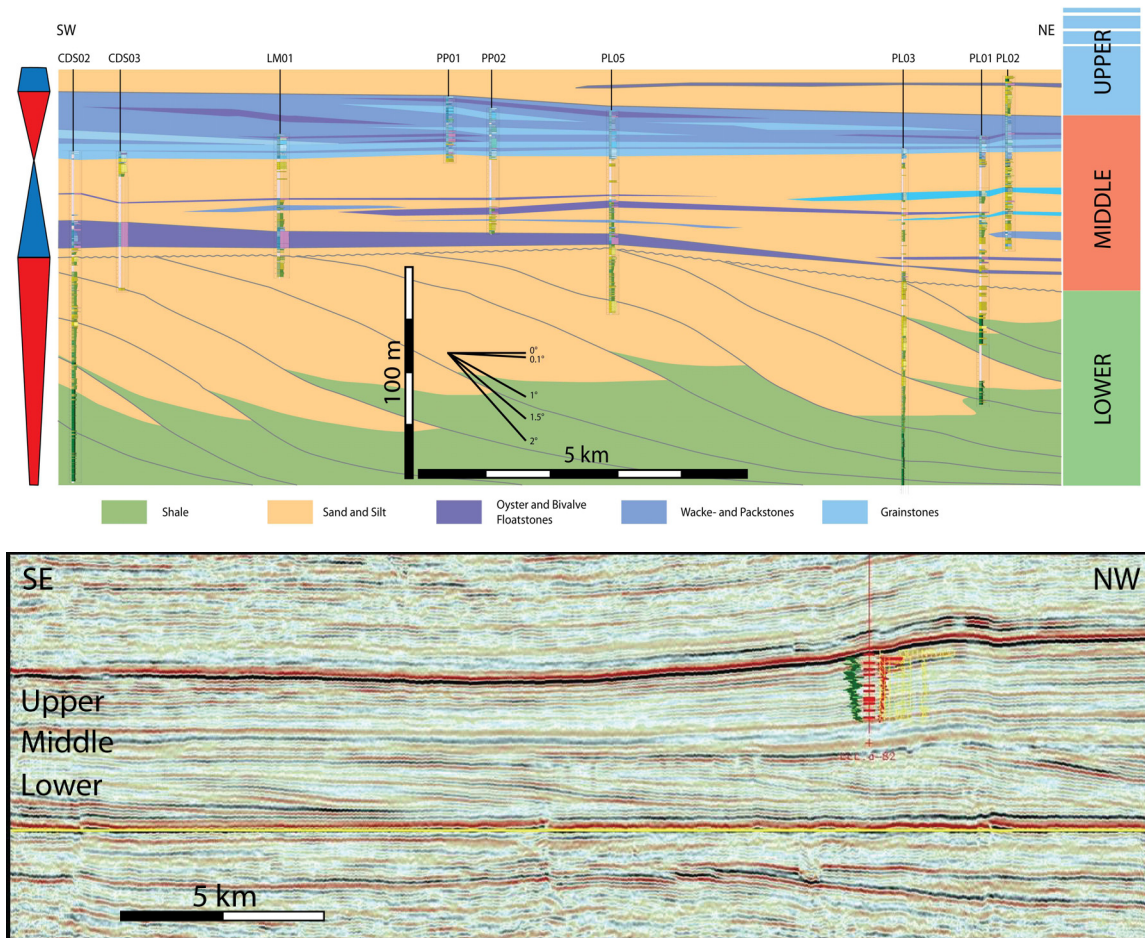


Figure 2. (Top) Outcrop correlation based on logged sections along a 15 km long cross section. (Base) Seismic Line from the Loma de La Lata Field. Note the architectural similarity of the units.

## **Key Deliverables**

The combination of the seismic and subsurface core and log data along with the analysis of the reservoir scale architecture obtained of the outcrop will provide a comprehensive geological model of the mixed carbonate-siliciclastic Vaca Muerta - Quintuco system. The measured outcrop geometries and thicknesses together with subsurface geometries will provide the dimensions and distributions of the reservoir units within the prograding clinoforms and the aggrading topsets. The model can be used in order to enhance predictability of reservoir facies in this and other fields in comparable settings.

## **Project Description**

The following tasks will be carried out:

- 1) Sr-dating of outcrop and subsurface samples will complement other studies that are based on biostratigraphy to establish the chronostratigraphic framework in both outcrop and subsurface.
- 2) Refined and extended seismic analysis to capture geometries and stratal architecture of the subsurface and to link outcrop to subsurface.
- 3) Basin wide cross sections based on mud log and well log data to understand carbonate - siliciclastic distribution throughout the basin.
- 4) Integration of outcrop reservoir geometries and subsurface framework.

## **Expected Results**

The results of this project are expected to produce a geological model that will address two objectives:

- 1) The model will provide insight into the processes of mixing carbonate and clastic facies. In particular, it is expected to reveal the factors controlling the clastic dispersal in the basin and the cause(s) for the onset and end of the carbonate deposition.
- 2) The model will allow the prediction of reservoir facies distribution within the Upper Jurassic - Lower Cretaceous mixed carbonate siliciclastic system in the Neuquén Basin. Furthermore, the established sequence stratigraphic framework and the therein integrated analysis of reservoir scale heterogeneities will help to enhance reservoir predictability in other mixed carbonate-siliciclastic systems.

## **References**

Howell, J.D., Schwarz, E., Spalletti, L.A., and Veiga, G.D., 2005. The Neuquén Basin: an overview. Geological Society of London, Special Publication, 252, 1-14.