

Multi-Scale Morphodynamic Reconstruction of Cretaceous Linear Dunes in the Neuquén Basin, Argentina: Implications for Reservoir Characterization and Modeling

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Abstract

The dynamics and internal structure of linear sand dunes have been extensively discussed during the past decades. Several examples of this dune type, exceptionally preserved in the geologic record by transgressive events, constitute important hydrocarbon reservoirs (e.g. North Sea and Neuquén basins). Linear sand dunes present, among their constituents, a high proportion of wind-ripple strata, representing lower quality petrophysical properties. In this context, constraints provided by outcrop and modern analogs are of relevance to generate robust facies distribution models for these depositional successions in the subsurface. The preserved eolian bedforms in the upper section of the Lower Troncoso Member (Early Cretaceous), commonly considered of linear type, represent one of the major hydrocarbon reservoirs within the Neuquén oil province of Argentina. The aim of this study is to characterize the sedimentary heterogeneity of the Troncoso linear dunes at multiple scales, combining outcrop and subsurface information, in order to better constrain subsurface detailed models needed for mature fields in their EOR stage of production. Sedimentary logs, panels and virtual outcrop models, built from photogrammetry and total station, provide a wealth of information from laterally and vertically continuous, high-quality outcrops. Core and seismic data were analyzed for the subsurface sector. At the local scale, morphological parameters of the large-scale bedforms and interdunes such as height, width, wavelength and symmetry, were measured in detail, supporting previous classification of these dunes as linear. At the intermediate scale, the arrangement and hierarchy of internal bounding surfaces suggest that the large-scale bedform dynamics were characterized by a strong longitudinal component accompanied by the development of smaller superimposed dunes. Detailed-scale observations provided important insights on the dimensions and relative positions of architectural elements and their control on the distribution of eolian stratification types. As an overall result, facies distribution, dune dimensions and morphological parameters were obtained, representing valuable information for subsurface reservoir characterization and modeling of major reservoir units in Argentina.

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