Unconventional Reservoir Characterization of the Cretaceous Agrio Formation, Argentina: A Mixed-Carbonate-Siliciclastic Mudstone Hydrocarbon Reservoir

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Abstract

The mixed-carbonate-siliciclastic, Cretaceous Agrio Formation (Fm) of the hydrocarbon-rich Neuquén Basin of central Argentina is an emerging unconventional mudstone play. Regionally, it transitions from more siliciclastic-rich mudstone facies in the south, deposited in more paleodepositional shoreline-proximal environments, to more carbonate-rich mudstone facies in the north, deposited in more distal, basinal paleonenvironments. The mineralogical trends have implications for reservoir quality. The proposed outcrop and subsurface sequence stratigraphic study aims to characterize the most basinal marine to proximal to shoreline transitional setting of the Agrio Fm in central Argentina. Previous existing outcrop studies have been integrated with a petrophysical model to identify lateral and stratigraphic variability in the proximal to distal mudstone facies. One main technical challenge is quantitatively distinguishing the log signature of a carbonate mudstone (i.e., chalk) from a clay-rich calcareous mudstone (i.e., marl) from a siliciclastic-rich heterogenous mudstone (i.e., interlaminated sandstone, siltstone, and claystone). A petrophysical approach was used to identify Total Organic Carbon (TOC) rich source intervals and mineralogical constituents, integrating well logs, cuttings, and validating with sedimentological outcrop investigations to assess the mudstone's reservoir hydrocarbon potential. Previous existing field studies from northern Neuquén Province have identified stratigraphic intervals with high source rock potential from outcrop in the lower Agrio Fm using

programmed pyrolysis and mineralogical analysis. The Delta Log R (Passey) method was applied, calibrated with cuttings data, and was found to overestimate TOC from logs when compared to measured cuttings data. Instead, a published petrophysical model developed for an analog mixed siliciclastic-carbonate system has been implemented here to calculate and predict TOC rich source rock intervals in the Agrio Formation. The model relies on integrating programmed pyrolysis cuttings data, X-Ray Diffraction (XRD), and electrical logs. Bulk density from cuttings and log data reflects predicted changes in the mudstone litho-facies from the proximal (south) siliciclastic-dominated-to distal (north) carbonate-dominated environment. This study aids in addressing the Agrio Formation’s geographic spatial extent, internal variability, and its potential as a source rock unconventional reservoir.

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