Agrio Formation of Neuquen Basin, Argentina: Delineating Sweet Spots in an Emerging Unconventional Play

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Abstract

The Cretaceous Agrio Formation (Fm) is the tertiary source rock unit in the prolific Neuquén Basin, Argentina, third to the Vaca Muerta and Los Molles Fm, respectively. It is an emerging unconventional play with an estimated 675 MMBO, 674 BCFG, and 11 MMBNGL of undiscovered, technically recoverable resources (USGS, 2016). However, the key elements for Agrio play success are still undefined. In part, because the Agrio Fm is a thick (~1000 m) mudstone succession, there has been no systematic assessment of source rock potential and reservoir quality. This study aims to present the results of a five-year, detailed study of the sedimentology, stratigraphy, geochemistry and geomechanics of the Agrio Fm, as it pertains to sweet spot identification and source rock and reservoir quality. Based on our integrated assessment of outcrop localities in northern Neuquén Province correlated to previous studies to the south, the most prospective sweet spot is found in northernmost Neuquén Province, within a ~30 m thick stratigraphic interval in the middle of the Pilmatué (lower) member. This interval displays a combination of favorable source rock and reservoir quality. The interval possesses high source rock potential with TOC ≥ 2 wt.%, S2 ≥ 5 mg HC/g rock, HI ≥ 300 mg HC/g TOC, and type II kerogen. In the Agrio fold-thrust belt in northernmost Neuquén Province, the Agrio Fm is in the early oil window in outcrop. In terms of reservoir quality, the interval contains a high proportion of distal basinal deposits, specifically carbonate mudstone beds (i.e., “chalks” with evidence of coccolithophores and radiolaria). Carbonate mudstone beds display brittle behavior in geomechanical tests and an abundance of calcite mud matrix and amorphous silica cement. Porosity and permeability measurements (n = 5) from calcareous mudstone (chalk) beds range

from 1 to 5 % and 50 to 90 nD, whereas interbedded detrital silt-bearing calcareous mudstone (i.e., “marls”) display significantly higher porosity (9%) and permeability (100 nD). Matrix pore space is found in fecal pellets containing coccolithphores, micro-fractures developed during silica diagenesis, and organic matter. The presence of natural fractures in carbonate mudstone beds in outcrop suggest that, if present in the subsurface, the natural fracture network may be critical to enhanced reservoir permeability, particularly in brittle calcareous mudstone (chalk) beds. This prospective, ~30 m thick, stratigraphic interval coincides with a maximum transgression recorded in the Agrio Fm that likely correlates globally with the Valanginian Weissert Oceanic Anoxic Event. Future work will delineate the northern edge of the sweet spot into the Mendoza Province to the north. This detailed study de-risks the Agrio Fm play and informs future unconventional resource development.

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