

State-of-the-Art of the Geological Knowledge of Unconventional Reservoirs in the Middle Magdalena Valley of Colombia

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Abstract

The Middle Magdalena Valley Basin (MMVB) in Colombia is considered a mature basin in terms of exploration and production of conventional hydrocarbon reservoirs. Hydrocarbon production from over 40 oil fields in the MMVB has reached 1900 MMBOE and 2.5 TCF (ANH, 2007) then suggesting an active and effective petroleum system. During the process of hydrocarbon generation 40% of the fluids are retained and the remaining 60% are expelled-out (Jarvie et al., 2007), then there is a great potential in the MMVB for hydrocarbon accumulations in source rocks. Recent assessments of technically recoverable shale oil and shale gas resources estimate 4,8 BBL of oil in-place and 18 TCF of gas in-place within Cretaceous source rocks in the MMVB (EIA, 2013). Although there is a substantial potential in this basin few studies have addressed the quality of these rocks as an unconventional hydrocarbons reservoir.

Due to the large potential in this basin, Ecopetrol decided to develop a strategy to start proving the quality of the reservoir in the central area of the MMVB. As part of this strategy, we have drilled 5 stratigraphic wells in several locations within the basin to understand the variability in facies distribution, maturation models, total organic content and the possible stratigraphic targets. In all the wells, we have ran a full set of advanced logs and recovered more than 6500 feet of cores taken from La Luna, Tablazo and Rosablanca Formations. An extended analytical program was conducted by Instituto Colombiano del Petroleo (ICP) to obtain geochemical, petrophysical and geomechanical characterization of these source rocks. Using a calibrated reservoir model developed from the analytical results and the electric logs we identified several pay zones within a very thick stratigraphic section of organic shales.

In our study, we found out a stratigraphic section for the Cretaceous with a thickness comparable with those found in the Eastern Cordillera of Colombia. Our analyses show that these Cretaceous units consist dominantly of fine-grained facies with average TOC values greater than 2% for most of the section, and with mineral compositions rich in silica, and carbonate. Additionally, due to the large thickness of the stratigraphic section and the variability of the thermal and maturation model within the basin, we suggest that in the MMVB La Luna Formation is not an unique target for unconventional reservoirs. We proposed that there are multiple targets in different formations depending on the structural and depositional position within the basin.