Unconventional Oil Potential in the Cretaceous Shales of the Middle Magdalena Basin, Colombia

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Abstract

The Middle Magdalena Valley (MMV) of Colombia is a prolific intermontane basin with a long history of conventional hydrocarbon production. Basin development began in the Triassic with rifting and separation of North and South America (Cooper et al. 1995). During the Cretaceous, the basin formed part of a larger regional back-arc basin east of the Andean subduction zone. The back-arc succession was dominated by easterly-sourced clastics; the formerly contiguous Llanos and Eastern Cordillera basins to the east contain conventional sandstone reservoirs, but the more distal MMV is dominated by marine shale and carbonates including several source rock intervals. The most prolific of these, the Turonian-Coniacian La Luna Formation and its lateral equivalents, are the major source of petroleum in most of the sub-Andean and marginal basins of northwest and northern South America. Marine deposition in the MMV was terminated in the Maastrichtian by the accretion of the Andean Western Cordillera (Cooper et al. 1995). Tertiary sedimentation was dominated by non-marine clastics. Renewed Andean deformation during the Miocene in the Eastern Cordillera isolated the MMV from the Llanos basin. Historical discoveries in the basin (1.9 billion barrels and 2.5 TCF) have largely been from Tertiary clastic reservoirs in conventional structural traps sourced from the Cretaceous shales, but there are a number of wells with shows, tests and production from the Cretaceous source rock interval.

Canacol Energy entered the MMV in 2011 via the acquisition of Carrao Energy and its three contiguous blocks Santa Isabel, VMM2 and VMM3 covering a combined 260,464 acres. Based on sparse well control of mostly 1950s vintage, very limited geochemical data and a grid of regional 2D seismic data, mapping indicated that these blocks should contain thermally mature La Luna source rocks with considerable unconventional resource potential. The La Luna formation is 1000-1400 feet thick throughout the area, contains 3-12% TOC and porosity of 6-13%. It extends from surface outcrop on the basin margin to depths of greater than 15,000 feet. A second source rock in the deeper Paja-Tablazo formation is 300-600 feet thick with TOC of 2-8% and porosity of 5-9%.There is additional potential for tight carbonate resource plays in the underlying Rosblanca formation as well as thicker carbonate units interbedded with the source shales. An independent third party resource evaluation prepared for Canacol in December 2011 recognized best estimate (p50) gross undiscovered unconventional petroleum initially in place (UPIIP) of 4.49 billion barrels on Santa Isabel and VMM2. Lack of nearby well control precluded an estimate for VMM3, but using the same methodology an additional 871 million barrels can be envisaged. The comparable high case (p10) estimate is 11.6 billion barrels. Canacol subsequently farmed out a portion of its working interest in each of the three blocks. The farmouts will result in up to 19 wells being drilled to test the unconventional resource potential of the Cretaceous shales. The first of these wells, Mono Araña-1 on the VMM2 block, spud in September 2012 and drilled to a depth of 9,942 feet. Approximately 760 feet of La Luna was drilled with good oil and gas shows throughout the interval before drilling was halted due to high overpressures of 16.5 ppg (0.86 psi/ft) and high levels of gas and oil flowing from the formation. Petrophysical analysis indicates approximately 230 feet of potential net oil pay with an average porosity of 13.8%. The well was cased and the partnership plan to re-enter and test it in January 2014. The nearby Totumal-1 well, drilled in 1953, tested 1,102 bopd of 25°API

with 0.1% BSW from the same interval from a vertical unstimulated wellbore. In June 2013, the EIA estimated an unconventional resource of 79 billion barrels and 135 TCF for the MMV.

References Cited

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