

The Role of Diagenesis in the Unconventional Reservoir Quality of La Luna Formation in the Middle Magdalena Valley Basin (MMVB), Colombia

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Abstract

La Luna Formation is an upper Cretaceous classic shale system that has been interpreted as the major source rock in the Middle Magdalena Valley Basin (MMVB), Colombia. The unit is divided in three members: upper, middle and lower and named respectively as Galembo (calcareous shales with limestone layers and nodules), Pujamana (claystone, mudstone, gray shale and cherts) and Salada (black shales, black mudstones, black calcareous claystone, black limestone layers and concretions with pyrite). Due to the growing interest in unconventional reservoir exploration in Colombia, an integrated characterization of La Luna Formation and the study of the reservoir quality is crucial. We identified the major diagenetic processes using petrographic descriptions and SEM imaging. This information is used to define the effect of diagenesis in the reservoir quality and the timing of each event improving the reservoir characterization of La Luna Formation. Multiple thin sections from each formation member were analyzed in detailed for petrographic studies and additional geochemistry analysis, XRF and XRD. La Luna Formation exhibits the main target zones within the interbedded strata composed of brittle and ductile couplets. We characterized those intervals to understand the effects of diagenesis in the geomechanical properties of the rocks. La Luna Formation evidences different diagenetic processes in several stages. Proof of these processes are seen in the abundant planktonic foraminifera as calcite, chalcedony and apatite replacements. On the

other hand, we identified evidence of hydrothermal activity related to phosphates replacement in the matrix. Furthermore, numerous veining events that remain sealed by calcite or evidence dissolution. This recrystallization processes with silica and calcite as well as the sealed veins are proven to affect at chemical and geomechanical scale response and are prone to increase the brittleness of the rock, improving the reservoir quality. Finally, we concluded that the Galembó and Salada members (upper and lower) are the potential target zones since show high values in TOC as well as couplets in brittle/ductile, being the clay rich (ductile) the source and the highly-veined and high-chalcedony (brittle) as the rock prone to fracking. In contrast, Pujamana member is considered a lithological barrier because of its low values in TOC but high brittleness index.