Geologic and Financial Analysis of Microbial Carbonates in the Sapinhoa Oil Field for Hydrocarbon Production and Carbon Capture Utilization and Storage

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Carbonate reservoirs account for half of the world's hydrocarbon reserves, and the pre-salt reservoirs offshore Brazil represent the most significant carbonate discovery in the past two decades. Carbonate reservoirs form through the combination of physical and biologic processes resulting in highly complex pore networks and permeability pathways. These systems thus require careful integration of core, wireline log, and seismic for characterization and efficient field development. This study focuses on the Sapinhoa Field, located within the pre-salt Santos Basin of Brazil, featuring highly productive microbial carbonate reservoir facies. The Santos Basin is representative of classic rift-sequence, pre-salt plays and has estimated reserves surpassing 100 billion barrels. Lucrative investments for deploying Carbon Capture Utilization and Storage projects (CCUS) have also been recently made in the Santos Basin, yielding carbon sequestration and increased recovery efficiency of pre-salt fields.

Given the proprietary nature of data from the Sapinhoa Field, an integrated geologic approach, including the use of a 3-D seismic dataset, three well logs, and analog field data from the West African margin, was utilized to stochastically determine estimated ultimate recovery of the field, exceeding two billion barrels. Results for the Sapinhoa Field feature a net pay of 217 feet, a porosity of 14.5%, and an oil saturated pay interval of microbial carbonates located on a structural and stratigraphic high. A production profile was modeled for the field locating optimal producer wells and projecting leading edge annual and cumulative production forecasts. Additionally, financial analysis modeled associated costs and revenue forecasts for the Sapinhoa field. Finally, application of carbon dioxide injection-enhanced oil recovery (CO2-EOR) was modeled for the field, including anticipated carbon sequestration through CO2 injection.

Key results of this study include that the techniques and modeling performed replicated other methods of geologic characterization and were consistent with estimated ultimate recovery of the field projected through previous studies. The application of CO2-EOR in this study is representative of significant carbon sequestration potential, in addition to increased recovery efficiency. Financial analysis conducted for this study shows that field development yields outstanding cash flows and profitability, attracting further exploration and investments into undeveloped pre-salt blocks in the Santos Basin. The approaches taken in this study can be replicated for analog pre-salt fields, especially those where data is limited, with an increased degree of confidence.