High-Resolution 3-D Stochastic Mapping of Lithofacies within the Multi-Reservoirs Upper Bentiu Member - Implication of a Rifted Stratigraphic Setting

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Abstract

The Upper member of Late-Cretaceous Bentiu Formation represents a high prolific multi-reservoirs interval that was deposited in complex stratigraphic and tectonic settings. This complexity resulted from three rifting stages that occurred in the basin. This study aims to establish 3-D geocellular stochastic models of the lithofacies to characterize the reservoir geometries and potentiality within the Upper Bentiu Member in the northeast part of the Muglad Rift Basin. A comprehensive lithofacies classification, structural and stochastic modeling workflow were used to deliver the study objectives. The lithofacies prevailed in the study area were determined based on core examination. However, a model-based cluster analysis was used to generate the lithofacies from the available 20 wells. Accordingly, three distinctive lithofacies were identified; medium to coarse sandstone, fine to silty sandstone and shale/claystone. The structural framework of this member in the studied area indicates clear control of the rifting. This structural model reviled a dome-like structure that elongated in a north-south direction along the major fault and intersected by five minor faults mainly in the NW-SW direction. Four locally fining-upward lithological cycles were observed from the 3-D stochastic simulation. Each of these cycles is dominated by medium to coarse sandstone lithofacies at the bottom and capped with shale/claystone lithofacies. The clear vertical staking of the lithological cycles and zones is distorted laterally due to the rifting. These findings increase the current knowledge of the reservoir geometries and reservoir potentiality, which is expected to provide new insight into the petroleum exploration and future development of the studied member.