Tectono-Sedimentary Systems of Rift Basins in the Red Sea: Insights from Integrated Numerical Stratigraphic Modelling

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ABSTRACT

The rift basins along the Red Sea continental margin are important prospective hydrocarbon target areas. However, because of the highly complex structural development of the Red Sea continental margin, one of the crucial geological challenges in exploration is to understand the sedimentary systems development and their characteristics. Key challenges include improving imaging of the graben fills, developing a sediment dispersal model and describing the characterization of source and reservoir rocks at higher resolution. Traditional sequence stratigraphic conceptual models cover relative changes in accommodation space and infill, however, they provide only a qualitative insight to major controlling factors (eustatic sea-level, subsidence/uplift, sediment input, etc.). Therefore, in this study an integrated methodology, combining qualitative sequence stratigraphy studies, quantitative stratigraphic modelling and inversion module development, has been adopted in the modelling of sandbodies of Sidr Member in the Jizan Basin. Based on conceptual sedimentary models, two different scenarios were built to test the development of sedimentary systems with different sediment source locations. An in-house inversion module was developed to systematically retrieve input parameters such as sediment flow components used in forward numerical modelling. The resulting best-fit model with two sediment sources came close to the observed subsurface data (deposit thickness and vertical lithological trends). Our research concludes that two sediment sources in the area of interest give rise to development of two base-of-slope fan complexes. The presented integrated workflow/methodology leads to a reduction of uncertainties in predicting distribution, geometry and characteristics of reservoir in frontier basins.