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Yemen Red Sea Multiphased Cenozoic Rifting: Petroleum System Insight from Subsalt Interpretation

Southern Red Sea subsalt petroleum system analysis is complicated by the corruption of seismic imagery owing to the attenuation and multiple generation heterogeneous (anisotropic), thickness varying, interbedded, 14 Ma evaporite-sediment layers ('salt'). However, in the Yemen Red Sea region, redundant velocity analysis using the integration of borehole sonic logs, far-field seismic refraction velocities, and near-field seismic reflection stackingvelocities helps to accurately define several operational sequence boundaries otherwise obscured by intra-and inter-salt reverberations.

Fault mechanical stratigraphy of the seismic, borehole-constrained basin modeling, and structural mapping reveal four distinct, rift-related fault populations at: 25 Ma, 17-15 Ma, 11 Ma, and 5-4 Ma. Structuring is additionally modified by a variety of halokinetic styles. The evidence of these four crustal extensional events contradicts the classical singular rift paradigm and lithofacies relationship of the Red Sea: pre-rift (sub-salt), syn-rift (intra-salt), and post-rift (supra-salt) and introduce new variables into exploration strategies. The thermal implications of this multi-phased rifting of varying initial crustal thicknesses and magnitudes of stretching, coupled with the anisotropic thermal conductivities of the evaporite, and the subsalt existence of potential source and reservoir quality lithofacies, provide a spatial variation in hydrocarbon prospectivities within the Red Sea as a whole. Within the Yemen Red Sea in particular, favorable combinations of these parameters provide optimal subsalt prospectivities for both liquid and gaseous hydrocarbons.