Tectono-Stratigraphic Controls on Reservoir Distribution in Offshore Sierra Leone Basin

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The offshore deepwater Sierra Leone Basin is a frontier exploration area which is attracting increased exploration effort. This basin is located at the junction between the NW African Central Atlantic margin and Gulf of Guinea Petroleum provinces. The WNW-ESE oriented Sierra Leone Transform (SLTF) projects through into the central part of the Sierra Leone Basin, where the shelf margin changes strike from NW-SE to WNW-ESE. Across this structural change the basin configuration also changes. To the NW is a broad area of continental shelf (the Sierra Leone Shelf), the bounding shelf margin is steep and characterised by an irregular stepped 'basement' topography. To the south east of the SLTF the shelf is narrow and the ocean-continent transition is relatively close to the shelf edge with seismic data showing features typical of rifted margins. This work investigates the effect of these variations in transform structure on the tectono-stratigraphic evolution of the basin and its petroleum potential. Approximately 5300 line-km of 2D proprietary survey data are included. Sequence stratigraphic techniques have been applied to constrain the timing of normal faults, tectonic folds, gravity driven structures (slump folds and extensional faults) and sequence boundaries generated by relative sea-level changes. The change in continental margin structural style across the eastward extension of the Sierra Leone Transform corresponds to fundamental change in the nature of the continental slope type. This is likely to be the fundamental control on the distribution and nature of deep-sea reservoir sandstones in offshore Sierra Leone. Adjacent to, and north of, the Sierra Leone Transform (SLTF), the slope is characterised by shelf parallel to oblique ridges which are the result of structural highs and lows generated during syn-transform transtension and post-transform contraction. There is evidence for long-wavelength flexure of the post-rift deposits over basement highs. These open folds above basement highs are interpreted to be the result of either (i) differential compaction or (ii) minor amounts of contractional deformation above basement structures resulting from far field stresses during the Palaeogene and Neogene. In this paper the influence of differential compaction verses tectonic contraction on the maintenance of stepped bathymetry during the late Cretaceous and Tertiary has been constrained.