Structural Evolution of Offshore Mozambique with a Focus on the Davie Fracture Zone — Insights Into Transform Margins

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Abstract

Recent exploration successes along offshore East African have increased the interest in understanding the evolution along the entire margin, specifically, the key question of the geometry, timing and nature of the Davie Fracture Zone (DFZ). This structure plays a critical role on the regional tectonics from the perspective of Gondwanian crustal stretching and subsequent strike-slip deformation but also controlling sediment transportation and trap formation. The DFZ is a 2000km long, continent-ocean transform boundary, that crosses the Mozambique Channel and has a complex and much debated evolution. This study uses six regional scale 2D seismic lines of Offshore Mozambique, from the TGS Mozambique MC 2D seismic survey, alongside gravity and magnetic data, to investigate the structural evolution and crustal architecture of the area. Different crustal types and thicknesses are analysed along with the change in deformation from north-south along the DFZ. The Angoche Basin formed as East-Gondwana and West-Gondwana supercontinents broke apart during the Middle Jurassic. East Gondwana continued to move southwards along the DFZ and instantaneous rotation pole changes meant that East Gondwana rotated slightly clockwise, leading to compression west of the DFZ. A continental block was translated towards the south along the DFZ and with the rotation, it was emplaced on top of the adjacent passive margin sequence. This load resulted in compression and tilting of the western block, which formed the dipping reflectors observed in seismic. Elsewhere these dipping reflectors have been interpreted as SDRs, but

they do not have a continuous concave reflection geometry, which is typical of SDRs and we consider that they are pre-rift architecture of Palaeozoic sequences. Thrusts then formed with the onset of compression during the Late Jurassic, which controlled syn-kinematic sedimentation, and these packages thicken onto the DFZ. Volcanism also plays an important role in the evolution of this area and controlled the formation of the wedge geometries seen across the region. The insights from this study provide new constraints not only on the petroleum system along the margin, but also on the nature and timing of fracture zones, associated volcanism, and the early crustal attenuation of the margin prior to Gondwana break-up. This study provides new ideas of the DFZ system but also provides insights into the evolution of transform margins more widely.