The Crustal Structure and Petroleum Potential of the Conjugate Austral South Atlantic Margins: New Insights Into Break-Up Processes and the Tectonostratigraphy of Magma-Rich Rifted Margins

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ABSTRACT

The rifted margins of the austral South Atlantic are classically magma-rich and consist of all the volcanostratigraphic elements that are commonly observed on other magma-rich margins globally: stretched continental crust, inner and outer SDR (seaward dipping reflector) packages, an outer (volcanic) high, a zone of high-velocity lower crust, and relatively thick early oceanic crust. However, the South American and West African Margins (as well as other margin pairs) are often considered independently. Here, through palaeogeographic reconstructions of ION's South Atlantic mega-regional, conjugate seismic datasets we consider the margins as they once were; a single basin through their shared geological history. Observations from these seismic data provide new and important insights into the principle mechanisms involved in highly magmatic continental break-up. Through a well-tied stratigraphic and crustal structure interpretation, a new tectonostratigraphic model for the formation of the austral South Atlantic is presented. This model, which describes the development of magma-rich margins influenced by plume magmatism may have global applications. The model consists of four distinct crustal domains (continental, magmatic, oceanic, oceanic plateau) with two important crustal boundaries; the limit of continental crust (LoCC), and limit of oceanic crust (LoOC). These crustal domains are delineated with respect to, and reflect the effects of variable melt volume during continental stretching and break-up. The model describes strongly diachronous post-rift and drift phase subsidence as well as highlighting the role the Walvis Ridge – Rio Grande Rise system played in the separation of the central and austral segments of the South Atlantic Ocean and reveals intriguing correlations between distribution of major source rock intervals and evaporite deposition in the Lower Cretaceous through time and space. The observations and processes described here underpin the development of a regional petroleum systems model, allowing prediction of regional heatflow through time as well the likely location of source and reservoir lithologies along the entire Austral South Atlantic Basin allowing for reduction in exploration uncertainty of commercial hydrocarbons.