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The Petroleum Geology and Hydrocarbon Potential of the Atlantic Margin Basins of Namibia

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The Atlantic Margin basin of Namibia is part of the passive African margin conjugate with the Pelotas Basin of Brazil. Both conjugate margin segments have seen limited exploration and are consequently data poor but nevertheless recent seismic and drilling has led to significant advances in understanding the hydrocarbon potential especially in the Namibian margin.

Atlantic Basin development began with rifting in Early Cretaceous times with prolific volcanism producing extensive plateau basalts on both margins. This volcanism is associated with the Walvis Ridge which lies at the northern end of the Namibian margin, effectively forming a barrier in Early Cretaceous times and now defining the southernmost limit of the "Aptian Salt Basin". In Namibia earliest known post–rift sediments are late Barremian marine facies and whilst carbonates are developed in the Lower Cretaceous section, clastic sediments predominate through the depositional sequence, especially in the Upper Cretaceous. The Orange River delta is a long-lived major system influencing sedimentary facies in southern Namibia from Early Cretaceous times. Seismic data identifies other large fan-delta systems that appear to play an important role, both in introducing siliciclastics into the basin to form potential reservoirs but also in burying and maturing potential source rocks. Exploration wells have penetrated excellent oil prone source rocks in Cenomanian to Turonian ('C-T') sediments and, more recently, wells have encountered equivalent source potential in thick Aptian marine shales.

Exploration in the Namibian Atlantic has taken place in three principal phases with the first confined to former South African waters (in what is now southernmost offshore Namibia) when the Kudu gas field was found at a depth of over 4km within the Orange delta. Following independence in 1991, the second phase in the 1990's tested plays on the Namibian shelf where, in the absence of Aptian salt, there proved to be a paucity of structural trapping geometries and a lack of 3D seismic to effectively identify valid stratigraphic traps. Limited petroleum indications resulting from this effort reinforced a perception at the time that south of the Walvis Ridge there is a lack of mature oil prone source rocks; those encountered at the time in the C-T section being largely sub-mature. The third exploration phase, starting in 2008 has seen the drilling of wells penetrating significant deepwater geological sections and the last three wells all appear to have encountered excellent oil prone Aptian source rocks. These results corroborate the evidence from DSDP 367 of a high quality Aptian source which is probably widely developed in deepwater south of the Walvis Ridge.

The key step now for successful exploration offshore Namibia is to map facies and maturity for the Aptian source interval. Based on reported source richness and thermal history data and with the benefit of regionally extensive seismic data that provides reliable stratigraphic correlation between wells, there is a good basis for identifying extensive source kitchen areas. These maps combined with reservoir and seal facies mapping and migration studies form the basis for play fairway and common risk segment mapping of the Namibian offshore. Whilst existing wells are sparse, analysis of their failure gives results consistent with prediction from the play fairway mapping work.

Trapping potential is identified in a range of settings but the greatest potential is believed to occur in Cretaceous marine clastic reservoirs with potential charge access to identified Aptian kitchens. Prospects with an element of stratigraphic trapping are numerous and often large. Attribute analysis presently lacks good calibration hampering risk reduction at this exploration stage but, nevertheless, exploration to date in the Namibian Atlantic basin has assembled all geological elements to describe a basin with prolific hydrocarbon potential.