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The prospectivity of the deep water Orange Basin, offshore Namibia and South Africa

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The southwest margin of Africa is a divergent plate margin with rift basins underlying post-rift passive margin clastic sequences. Rifting started in the Late Jurassic during the initial opening of the proto-South Atlantic. The earliest rift basins are filled with late Jurassic-Hauterivian terrestrial and lacustrine deposits, interbedded with volcanic rocks. Uplifted rift shoulders, clearly resolved on gravity and magnetic data, have influenced Early Cretaceous depositional systems, limiting the amount of clastic material able to reach the centre of the incipient basin and increasing the potential for carbonate deposition in this area. By the end of the Aptian a regional source rock blanketed most of the Orange Basin. This rich source rock is observed in the Kudu wells and in Moosehead-1 amongst many others along the southwest African margin. Thermal modelling suggests that these source rocks are mature for oil and gas in most of the basin.

Following infill of the rift topography by the Albian-Cenomanian, the major Orange River Delta developed, depositing a thick deep water clastic package that spans the late Cretaceous. The Tertiary section in the basin is relatively thin, consisting of further deltaic deposits of the Orange River.

Albian-late Cretaceous basin-floor and toe-of-slope fans have been deposited immediately above the regional Aptian source rock, and are analogous to recent discoveries along the West African Transform Margin. The slope channel complexes feeding these fans have also been recognised on seismic and provide further reservoir potential.

A prominent structural feature known as the Outboard High can be traced along much of the South African and Namibian margin. This broad NW-SE trending basement high delineates the westernmost extent of syn-rift sediments in the Orange Basin, with the outboard area marking the transition to oceanic crust. Thus, this high is likely to represent the most sediment starved part of the Orange Basin during the initial marine transgression in the Barremian/Aptian and therefore a prime location for the deposition of shallow marine carbonates. Structural variations along the crest of the Outboard High also localise potential leads in the overlying section, forming 4-way closures with draping lower Cretaceous turbidite fans, or large 3-way stratigraphic traps.

In the past, exploration targeted the inboard shallower water late syn-rift to post-rift sequences. Discoveries have been made in Kudu (1974, gas in aeolian to shallow marine Barremian reservoirs), Ibhuesi (1987, gas in Albian shallow marine to fluvio-deltaic reservoirs) and A-J1 (1988, oil in Hauterivian fluvial sands). The frontier deep water is highly underexplored but the presence of multiple source rocks, deep water clastics and shallow marine clastics and carbonates is likely, with good evidence in the basin, as well as from analogues in the greater South Atlantic. All the elements of a working world class petroleum system are present, making this an attractive exploration area.

