[PS]Seismic Architecture of Outer Shelf Canyon Segments in the Lüderitz Basin, Offshore Namibia*

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Abstract

The Lüderitz Basin is the least explored basin of the Namibian passive continental margin. So far one exploration well has been drilled on the outer shelf, but the 2D and 3D seismic coverage is fair. Working petroleum systems have been proven with the Kudu Gas Field in the adjacent Orange Basin to the South and with the oil shows in the Wingat-1 well in the Walvis Basin to the North.

Seismic imaging reveals a number of canyons and submarine fan systems along the entire Namibian margin. For this study the canyon architecture in the outer shelf has been analyzed using 2D sections. Seismic imaging displays the external canyon geometries well and reveals three distinct seismic facies of the canyon fills. Conspicuous erosive surfaces developing downwards from the Base Tertiary unconformity and from an Intra-Santonian unconformity delineate the external canyon geometries. Canyons incise as deep as into the Albian, implying that they formed during major lowstands. Canyons are typically V-shaped and exceed 10 km in width and can be more than 500 ms TWT deep. Seismic facies of the canyon fills include discontinuous to chaotic reflections occurring at the basal canyon fills and along the lower flanks, followed by a second seismic facies of more continuous moderate amplitude reflections that partly mimic the flank geometry. Horizontal to slightly mounded high amplitude reflections characterize the third facies that dominates the upper canyon fill and drapes the canyon walls.

The three facies are interpreted as (1) debris flows and slump deposits originating from unstable canyon walls, (2) as transgressive estuarine-fluvial deposits, and (3) as submarine sediment drape, respectively. Sand bars in the estuarine-fluvial facies are potential hydrocarbon reservoirs. Furthermore, the canyon architecture assists in predicting reservoirs in the associated down-did submarine fans.

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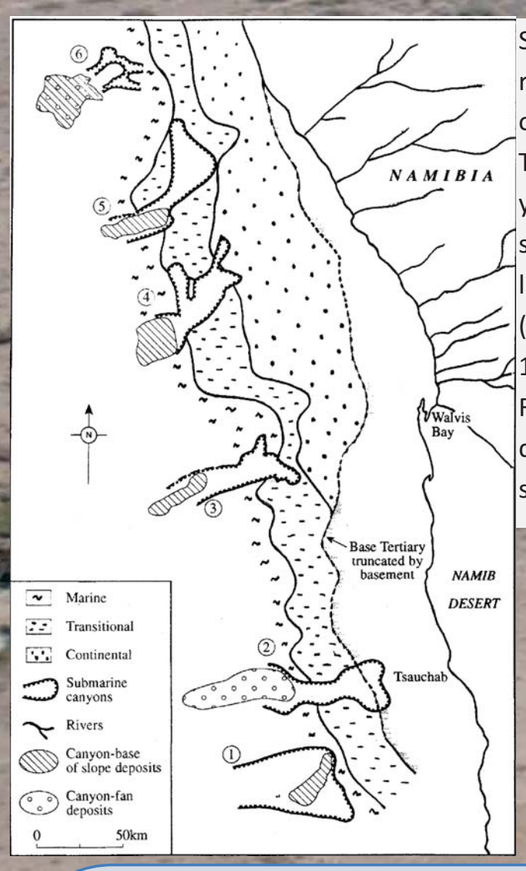
The Namibian Passive Margin

The Namibian margin covers an area of approximately 706500 km^2 and divides into four main basins, namely the (1) Namibe Basin in the northern part (crossing the Namibia-Angola border), (2) the Walvis Basin south of the Walvis Ridge, (3) Lüderitz Basin and the (4) Orange Basin offshore Namibia-South Africa border. The basins are believed to have formed as a result of rifting prior to the break-up of Gondwana and subsequent post-breakup subsidence.

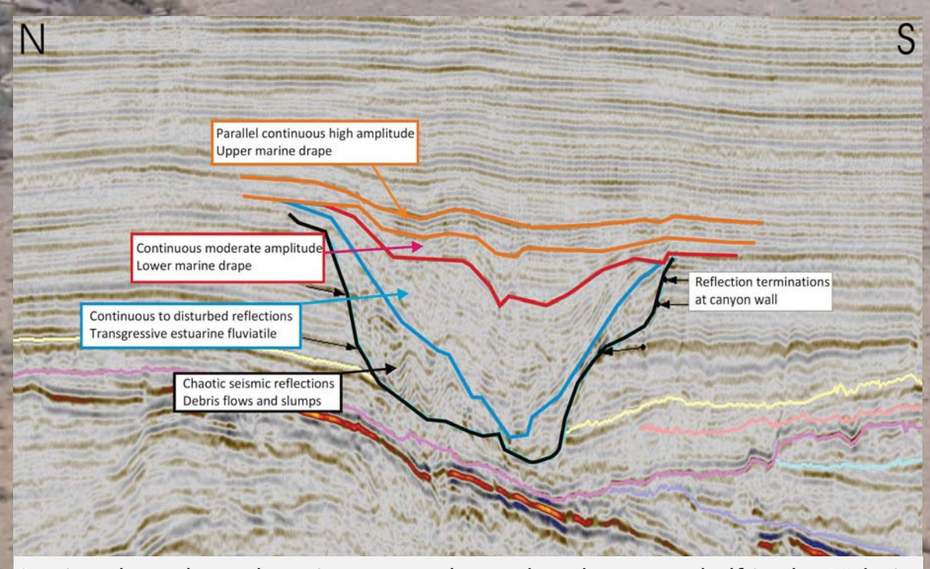
The sediment cover subdivides into a classical passive margin sequences with an Upper Jurassic to Early Cretaceous (Hauterivian-Barremian) syn-rift sequence, a transitional sequence, and a post-rift sequence (from the Upper Aptian). The syn-rift is presumed to consist of mostly terrestrial sediments and volcanics. The overlying post-rift is characterized by a 3-5km thick largely progradational wedge of clastic sediments which migrated seaward during the development of the margin (Bray et al., 1998; Aizawa et al., 2000).

Geology of the Namibian margin. Copied form Bray et al. (1998).

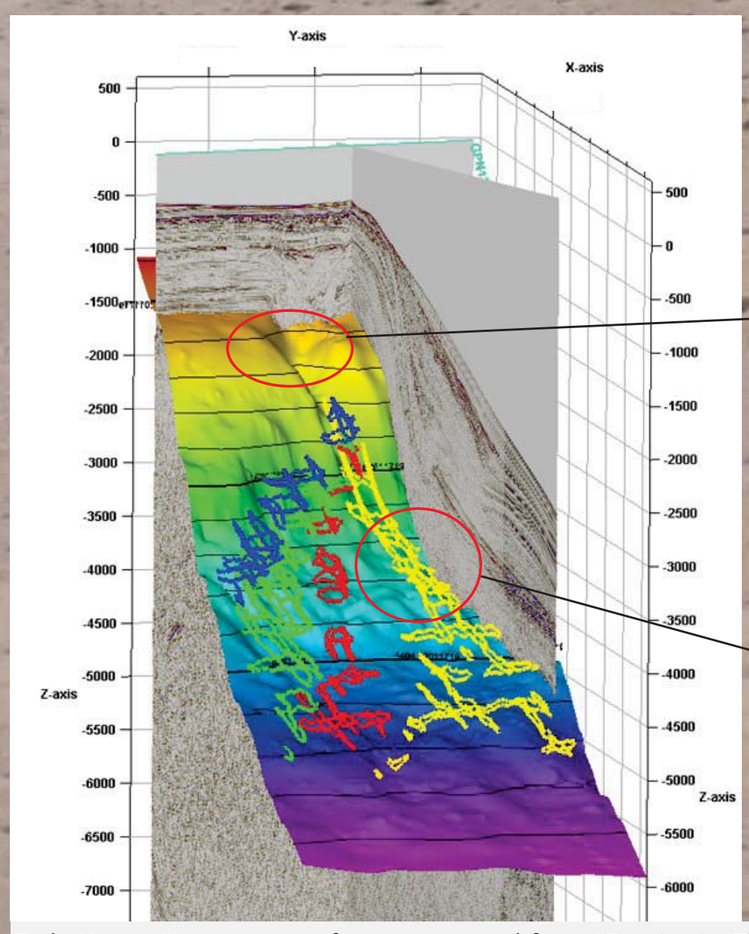


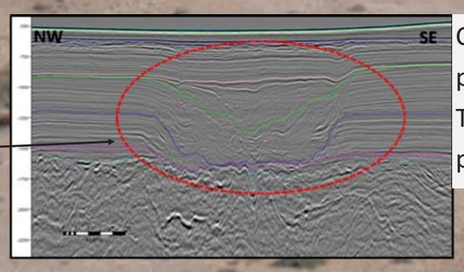
Spatial distribution of submarine canyon systems developed at the Cretaceous-Tertiary boundary. The canyon system in the Lüderitz Basin (circle 2) was probably linked to the Tsauchab River (after Bagguley and Prosser, 1999). The modern Tsauchab River is terminated by the dune field of the Namib desert.

The Sossusvlei is the dead end of the modern Tsauchab River. In the past this river was a main source for the sediment deposited the fan systems of the Lüderitz Basin.

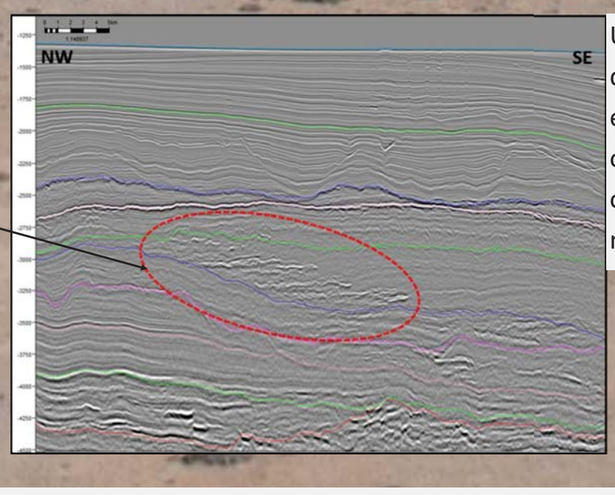


Section through a submarine canyon located at the outer shelf in the Lüderitz Basin. The internal architecture reveals three distinct seismic facies that are interpreted as 1) debris flows and slump deposits, 2) transgressive-estuarine, and 3) submarine drapes. This canyon has been initiated within the Santonian and incised down into the Albian.





Canyon that serves as stationary entry point for stacked channels downdip. This canyon developed in the early Upper Cretaceous.



Upper Cretaceous channel deposits downdip from the entry point. At least four sets of stacked channels are recognized. They migrate in a northwards direction.

Early Upper Cretaceous surface constructed from 2D seismic. This surface shows clearly the entry point of a major canyon on the shelf. Upper Cretaceous channels are marked with yellow, red, green, and blue outlines that follow a stratigraphic order. A northwards migration of the channel axis is observed while the entry point remains stationary.

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