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Regional Geology and Tectonic Settings in the Muglad Basin of Western Sudan

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SUMMARY

The Muglad Basin is a northwest-southeast trending rift depository in Central Sudan, and forms an important part of the West and Central African Rift System (WCARS).

The combination of both fluvial (reservoir) and lacustrine (seal / source) rocks in conjunction with the tectonic history of the basin-fill has created favorable juxtaposition of source, reservoir and seal lithologies.

This intercontinental rift is linked to the South Atlantic rift-spreading centre in the west by the dextral west-southwest trending Central African Shear Zone (CASZ) and to the Indian Ocean in the east through the northwest trending Anza rift in Kenya. It is characterized by thick non-marine clastic sequences of Early Cretaceous to Tertiary age. Well penetration is limited to the 15 km of sedimentary section that is inferred from seismic data in the main trough. Three major rifting episodes are documented for the basin. The first rifting occurred in the Early Cretaceous, the second in Late Cretaceous and the third in the Tertiary. Structural framework of the basin is largely controlled by two sets of faults: an approximately north-south trending set of Cretaceous faults, and northwest-southeast trending Tertiary faults.

Introduction

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In general, basins of the WCARS share much in common in characteristics and evolution because they were developed in a similar tectonic setting, though individual basins show their unique histories due to local influences. Basins in the WCARS are arranged in two distinct orientations, NE-SW and NW-SE, respectively. The most prominent basin among the NE-SW striking group is the Benue Trough, and the others are distributed along the Central African Shear Zone (CASZ), such as, from west to east, the Doba, Doseo, Salamat and Bagarra basins. All these basins are interpreted as reflecting pull-apart structures as a result of strike-slip faulting along the CASZ, as evidenced by their basin geometry, intra-basin flower structures, and tectonic nature.

Methodology

Regional 3D seismic data from the GNPOC, Sudan was utilised for this study, and the data have been zero-phase processed and its polarity is Normal SEG. The lower and upper cretaceous sedimentary section has a dominant frequency of 30Hz, with an estimated vertical resolution of 35m. Synthetic techniques have been applied to the seismic volume to identify major horizons, by using ISEX, Geoframe software major unconformities, strati-structural and traps has been identified. Generally, the area is tilted along the regional sinusoidal interconnection of the half-grabens. Two models are presented to illustrate how hydrocarbon migration and entrapment is controlled by (a) the interconnection of source, reservoir and seal during structural development and (b) the interconnection of border faults and rotated inter-basinal ridges.

The basement is predominantly Precambrian and Cambrian metamorphic rock with limited occurrences of intrusive igneous rock. From the Cambrian to the Mesozoic, the area was an extensive continental platform.

Figure 1 Schematic geological map of Northern Africa, Central Africa and Arabia. The major fault zones and Mesozoic-Cenozoic rifts are located. AG, Abu Ghariga; B, Bioko; WCAZF, Central African Fault Zone; Cyr., Cyrenaica; E, Eratosthenes Seamount; JP, Jos Plateau; P, Principe; Pag, Pagalu; S, Salamat; ST, Sao Tome; Te, Termit (Compiled from Wilson and Guiraud [1998]).

Conclusions

The rift sub-basins of Blocks 1, 2 and 4 within the Muglad Basin are shown to possess half-graben geometries. Their interconnection and structural framework had significant controls on the migration and accumulation of the generated hydrocarbons.

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References

- 1- Dickinson, W.R. [1985] Interpreting provenance relations from detrital modes of sandstones. In: *Provenance of Arenites* (Ed. by Zuffa, G. G.), pp. 333-361, Reidel, Dordrecht.
- 2- Wilson and Guiraud [1998] Schematic geological map of Northern Africa, Central Africa and Arabia. *Journal of African Earth Sciences*, **43** (2005) 83–14