Passive continental margin basins in offshore east Africa (PCMBOEA) include Somali, Lamu, Tanzania, Ruvuma, Mozambique, and Zambezi Delta basins totaling over 2,000,000 km² in area. Gas discoveries date back to the 1970s; however, since 2010, about 141 Tcf gas discoveries make it an area of extreme interest. The basin evolution mainly involves three stages. First stage was the NE-SW trending intracontinental Karoo system developed in the Permo-Triassic with facies ranging from fluvial to lacustrine to deltaic. The second stage was the initiation of the Gondwana break-up, occurring in the Middle Jurassic, resulting in the southward drift of Madagascar away from east Africa. A passive continental margin developed along the western coast of Madagascar and eastern coast of Africa from the Middle Jurassic to the Early Cretaceous represented almost by continental-transitional to shallow marine deposits, followed by development of widespread marine transgression. The third state is seen after the end of the sea-floor spreading between Madagascar and Africa and the initiation of India's separation from Madagascar in late Cretaceous as a passive margin developed along the eastern coast of Africa. Several potential lacustrine and marine organic-rich source rocks are present in the PCMBOEA, ranging in age from Triassic to Middle Jurassic to Tertiary, respectively. Cretaceous sandstones represent a regional proven reservoir, while Tertiary deltaic sandstones or limestones are a local proven reservoir. The Permo-Triassic Karoo Group sandstones and Jurassic sandstones or limestones are considered potential reservoirs. Cretaceous siltstones and shale are regional seals and Jurassic evaporates, if present, may provide local effective seals whose quality deteriorates towards the eastern Africa coast. Three distinct structural phases corresponding to basin evolution are recognized: E-W Karoo rifting, S-N extension during the early stages of Gondwana break-up, followed by Tertiary extension and listric fault growth. Hydrocarbon generation from different levels of source rocks probably occurred at various times throughout late Cretaceous and Tertiary times, followed by vertical and lateral migration with a relatively short and long distance, respectively, lead to the hydrocarbon accumulation within the drift sequence such as delta sand bodies and deep-sea turbidite deposits. Area 4, whose main reservoir is Paleocene-Oligocene sand, is operated by EniEAfrica and is the largest gas discovery with total recoverable reserves over 10,000 mmboe, and occurs in such a setting.
Passive Continental Margin Basin Evolution and Giant Gas Discoveries in Offshore East Africa

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1. BASIN LOCATION AND THE GIANT FIELDS

2. GEOLOGICAL SETTINGS, PALEOPLATE RECONSTRUCTIONS AND REGIONAL CROSS SECTION

3. PLAYS, BURY HISTORY AND MAIN STRUCTURES

4. SUMMARY AND CONCLUSIONS

(1) Paleoplate reconstructions and cross sections indicate three stages, including E-W Karoo rifting, S-N extension during the early stages of Gondwana break-up, followed by Tertiary extension and listric fault growth.

(2) Giant gas discoveries located within the Tanzanian Coastal and Rovuma basins with Cretaceous sandstone as regional proven reservoir and Tertiary deltaic sandstones or limestone as local proven reservoir.

(3) Giant gasfields within the Tanzanian coastal basin distribute within the sandbody between the normal faults affected by the basement uplift, mainly the vertical migration. While Fields within the Rovuma basin distribute within the sandbody between the updip and downdip faults above the salt diapir structures.

(4) Unconformities make the long-distance lateral migration to be possible.

SELECTED REFERENCES

Table 1. Giant gas fields of the eastern Africa, for locations see Figure 1.

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Figure 3. Enlarged regional cross section of the Tanzanian Coastal and Rovuma basins (Modified from Black, Grabenski et al., 2012).

Cretaceous sandstone can represent a regional proven reservoir, while Tertiary deltaic sandstones or limestone is a local proven reservoir. Permo-Triassic Karoo Group sandstone and Jurassic sandstone or limestone is considered as the potential reservoirs. Cretaceous shales and slates is a regional seal and Jurassic evaporites if present may locally provide effective seals.

The two basins came to the oil windows at the early Cretaceous time following the peak oil mature period at the mid-Cretaceous, while the gas windows start between Eocene and Miocene. Affected by the salt diapir the strata within mid-Cretaceous undergo the obvious uplift and the upper stratum have a thrust structure.

The three distinct structural phases corresponding to the basin evolution are recognized: E-W Karoo rifting, S-N extension during the early stages of Gondwana break-up, followed by Tertiary extension and listric fault growth.