The hydrocarbon potential of the East Africa continental margin


The East Africa continental margin includes a wide onshore belt that extends from Somalia and Ethiopia, through Kenya, Tanzania, Mozambique and northeastern South Africa and encompasses the islands of Madagascar, Mauritius and the Seychelles, and the adjacent offshore portions of the Western Indian Ocean. The East Africa Rift System is excluded from this presentation.

Since 1950 approximately 250 new-field wildcats have been drilled and 300,000 km of reflection seismic has been acquired over an area 5,000 km long and up to 2,000 km wide.

Gas and condensate discoveries have been made at Calub (Ethiopia), Afgoi (Somalia), Songo Songo and Mnazi Bay (Tanzania), Pande, Buzi and Temane (Mozambique). Several have reserves of more than $28 \times 10^9 \text{m}^3$ (1 TCF). Madagascar contains the Tsimiroro heavy oil field and Bemolanga tar sands. Although long considered a gas-only region, oil and gas shows are found in wells and outcrops in all 13 basins studied. Oil seeps occur along the Blue Nile Gorge and Ganale River in Ethiopia, in Jurassic outcrop near Tarbaj in Kenya, on Pemba Island, at Wingayonqo and Mnazi Bay and within an evaporite sequence in the Mandawa Basin of Tanzania, and at Nhangela Lake in Mozambique. Heavy oil and tar seeps occur in Madagascar.

The tectonic evolution of the basins is reflected in the stratigraphic record. The section is roughly separated into the syn-sedimentary rift sequence and an overlying drift sequences associated with a passive margin.

The rift basins were active from the Permian to Early Jurassic. An initial Permian rift system, oriented north-south is evident in Madagascar. The later, northeast trending, pull-apart, rift system (Triassic/Liassic) is represented by the Mandera Basin (Kenya), Bodle Deep (Ethiopia) and the Selous Basin (Tanzania).

The rifting phases were succeeded in the Middle Jurassic by a period of drifting, during which East and West Gondwana separated and Madagascar moved southward along the Davie Fracture Zone to reach its present location. In the Early Cretaceous, Africa separated from South America and the Falkland Plateau moved away from the east coast of South Africa. The northeast-trending Central African Shear Zone and the genetically related Sudan and Anza Riffs became active. The Indian subcontinent (initially with the Seychelles in tow) started to separate from Madagascar in the Late Cretaceous. Later, in the Paleocene, the Seychelles separated from India and the continental margins underwent gradual subsidence, accompanied by widespread magmatic activity. During the Tertiary, large volumes of sediments were deposited off the mouths of major rivers. The modern East African Rift System was developed and the related normal and strike-slip deformation was accompanied by widespread volcanics over much of East Africa, particularly in Ethiopia and Kenya.

A consistent series of unconformity-based megasequences from basement to Tertiary can be correlated regionally across the region.

**Megasequence 6 (Permian/Triassic/Early Jurassic).** The thick, syn-rift, mainly continental sediments include several importantmarine flooding events. The shales, close to the Permo-Triassic boundary, are the source of the tar and heavy oil in Madagascar and the gas and condensates in the Calub Gas Field of Ethiopia. Towards the end of the rift period, restricted marine deposition of Liassic evaporites produced a rich, regional source-rock in Madagascar and Tanzania.

**Megasequence 8 (Middle/Late Jurassic).** As a result of a marine incursion from the north, carbonate banks developed over much of Ethiopia, Kenya, Madagascar and northern Mozambique. The distal, condensed equivalent of these carbonates contain an outstanding source-rock in Madagascar. The Late Jurassic, transgressive, marine shales host rich source beds in Ethiopia.