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Petroleum Prospectivity and Geological Challenges of the Offshore East African Margin

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The East African Margin (EAM), extending from Somalia to South Africa, is a composite geological region with a complex geodynamic history. Compound plate kinematics produced elongated crustal segments, with important transform components. A further complication is the different settings of the Continent-Ocean Transition (COT), which can be either a narrow and slightly stretched belt or a broad hyper-extended area of continental crust. The combination of crustal segments with different evolution and COT type allows the 6500 km long EAM to be divided into several distinct domains. The local load of Cretaceous to Tertiary deltas and their associated gravity-driven tectonics provides additional complexity.

Offshore hydrocarbon exploration dates back to the late 1960s; the first commercial gas discovery, Songo Songo (1974, Agip) was in Tanzanian waters. However, the offshore EAM remained largely underexplored, and with limited exploration success, compared with the West African margin, until 2010 when vast amounts of natural gas were discovered by exploration consortiums led by Eni and Anadarko in the Rovuma Basin, Northern Mozambique deep offshore, and by Statoil and BG, in the adjacent Tanzania deep offshore.

The successful exploration plays are primarily stratigraphic, and Direct Hydrocarbon Indicators (DHI) play a fundamental role in both identifying many of the gas accumulations and de-risking the exploration activity. Hydrocarbon-bearing reservoirs along the entire offshore EAM are almost exclusively siliciclastic, consisting of deep-marine deposits, ranging from Late Cretaceous to Miocene in age.

Thermogenic gas, with minor amounts of associated condensate, is the fluid phase of almost all the existing discoveries. The discovered recoverable resources are of the order of 28.3 billion barrel of oil equivalent (154 tcf of gas and 150 Mbbl of liquids). Despite the huge amount of hydrocarbon

discovered, the occurrence, stratigraphic position, characteristics and distribution of the source rocks remain poorly understood. Large parts of the EAM remain poorly explored, and positive results from future hydrocarbon exploration are likely in areas such as the Somali basin offshore, the Mozambique Angoche sub-basin and the South Africa Durban basin. Key elements for the success of future hydrocarbon exploration reside in enhancing the understanding of occurrence, maturity and effectiveness of the petroleum systems. Important aspects that need to be analysed in more detail include (i) seismic facies analysis and associated litho-sedimentological interpretation (ii) geothermal history reconstruction and (iii) type, age and influence of magmatism on the petroleum systems. All these will be of great help in unlocking additional hydrocarbon resources along the offshore EAM, the exploration of which is far from finished.