Development of a Petroleum System in a Young Rift Basin prior to Continental Break Up: The Albertine Graben of the East African Rift System

Dozith Abeinomugisha
Petroleum Exploration and Production, Ministry of Energy and Mineral Development, Kampala, Uganda.

The Albertine Graben forms the Northern termination of the Western arm of the East African Rift System (EARS). It stretches from the border between Uganda and Sudan in the north to Lake Edward in the south. It is a Tertiary intra continental rift that developed on the Precambrian orogenic belt of the African Craton. Rifting was initiated during Early Miocene about 17 Million Years ago.

The East African Rift System has been interpreted as a continental extension probably caused by a plume head underneath East Africa. It is a classic example of the processes of continental break up, from incipient rifting in the south western branch, in the Botswana Rift, to initiation of sea floor spreading in the Afar depreciation at the Red Sea, Afar and Gulf of Eden triple junction.

The tectonic evolution of the Graben which is at the intermediary stage of rifting is little understood. It does not fit well with traditional models of rifted continental basins, defined by discrete basin bounding faults opposed by a low gradient flexural margin. Almost similar amounts of displacement on the eastern border faults and western border fault produce close to a full graben structure in contrast to half graben structures. The available geological and geophysical data indicate that the Graben has gone through extension and compression episodes resulting into a variety of structures.

Commercial hydrocarbon production has not yet started in the Albertine Graben, but its hydrocarbon generating potential is not in doubt. A total of 35 wells have been drilled in the Graben and of these, 33 have encountered hydrocarbons, making this one of the highest success rates globally and confirming a working petroleum system. Two of the discoveries have progressed to Field Development level. The reasons behind development of a working petroleum system in a young rift basin, probably the youngest in the world to have generated, expelled and trapped hydrocarbons, are not yet clearly understood. However, this could be attributed to high geothermal gradient, lack of initial sufficient clastic sediments due to drainage change allowing deposition of source rocks, rapid deposition during the Pliocene, creating thick sedimentary column and a late compression phase that has created structural traps.