Source-Rock Evaluation and Petroleum Systems Modeling of Chap Basin, Northeastern Nigeria

A. A. Adepelumi and S. I. Olayoriju
Department of Geology, Obafemi Awolowo University, Ile-Ife, Nigeria.

The Nigerian portion of the Chad basin is suspected to be a prolific hydrocarbon basin because the contiguous Termit Basin sharing the same geology have been producing hydrocarbon for over a decade. The thrust of the paper is to determine the source rock potential of the basin by investigating the total organic carbon (TOC), and total organic matter (TOM) contents of Fika shale (source rock in Chad basin) using density and gamma ray Logs. In-addition, thermal and maturity modeling of the Chad basin was carried out. To achieve this aim, twelve well-logs ran by the Nigerian National Petroleum Corporation (NNPC) were used for the determination of TOC, utilizing the well established Schmoker equation. The derived TOC was then converted to TOM using correction factor of 1.72. The concentrations of total organic matter of Fika shale intervals computed were found to be between 2.1 and 55.59 wt% with an average of 15.6 wt%. The concentration of total organic carbon was found to vary between 1.89 and 32.7 wt% with an average of 12 wt%. The results indicate that the total organic carbon contents (TOC) of Fika shale exceed the kerogen threshold of 0.5 wt%, and the TOM exceeds the kerogen threshold of 1wt% for generation of hydrocarbon. The porosity values derived for the wells ranges between 3 and 38%. The increase in porosity in Fika shale in some of the wells suggests the effect of the granitic intrusion in the basin which might have made the Fika shale very brittle and soft. Generally, the average TOC values tend to increase northeastward of the study area towards Chad and Niger republic. It was thus concluded that the Fika shale formation in Chad basin could be considered a very good source rock for hydrocarbon generation. However, it is deduced that the presence of the volcanic materials found in the basin might have contributed to over-cooking this source rocks and during the process converting it to a gas-prone basin.

The average heat flow in Chad basin is 65 mWm-2. The heat generation in the basin is between 0.14 and 2.55 µWm-3. They are all significantly lower than 5.5 µWm-3 quoted by Rybach (1986) for black shale. Chad basin’s thermal maturity, assessed from vitrinite reflectance, indicates that the Gongila Formation and the Bima Formation are within the "oil window", while the Fika Shale Formation is only partly within it (lower Fika shale). We conclude that the possible place to prospect for hydrocarbon in Borno basin is Gongila to Upper Bima