PREDICTION OF PETROLEUM GENERATION INTERVALS IN THE SOUTHERN NIGERIA RIFT BASINS BY MEANS OF CLAY TRANSFORMATIONS, VITRINITE REFLECTANCE AND FLUID INCLUSION STUDIES

AKANDE, S. O.,[1] VICZIÁN, I.,[2] ERDTMANN, B.[3]

[1] Department of Geology, University of Ilorin, Ilorin, PMB 1515, Nigeria
[2] Hungarian Geological Survey [Magyar Geológiai Szolgálat], Stefánia út 14., Budapest, 1143, Hungary
[3] Institut für Angewandte Geowissenschaften, Technische Universität, Str. des 17. Juni 135, Berlin, 10623, Germany
E-mail: sakande@skannet.com; samoakande@hotmail.com

Cretaceous to Tertiary rift basins in Southern Nigeria comprise of the Abakaliki and the Anambra basins, which form a part of the Lower Benue Trough. While hydrocarbon prospectivity in the Abakaliki basin was considered as high risk in view of the shallow thickness (cca. 2000 m) of the Pre-Santonian sediments, the adjacent Anambra basin with over 8000 m of both Pre-Santonian and Post-Santonian sediments have estimated reserves of 1 billion barrels of oil and 30 trillion cubic feet of gas.

A combined study of clay types especially smectite proportions in illite-smectite (S% in illite-smectite), mixed layers and illite "crystallinity" (IC) of clay constituents, vitrinite reflectance (Rom) on coaly particles and fluid inclusions microthermometry in the intraformational vein minerals from the Cretaceous to Tertiary sequences was carried out to evaluate the burial stages and thermal maturation of the sediments in selected oil exploratory wells and traverses across the two basins.

In the Abakaliki basin, where estimated palaeotemperatures vary from 170°C to 230°C; the clays are devoid of smectites S = 0%; illite "crystallinity" (IC) values are between 0.4 to 0.9°2Θ and vitrinite reflectance in oil (Rom) vary from 2.46 to 4.30%. In the adjacent Anambra basin where palaeotemperatures vary from 100 to 140°C, S% range from 20 to 30% and IC values are between 1.4 to 1.6 °2Θ, with maturity (Rom) values from 0.7 to 0.9%. If the zone of catagenesis, petroleum generation and expulsion is set at palaeotemperatures between 70°C and 130°C comparable with proportions of smectites in mixed layers (S% in I-S) between 40 to > 10% and maturity (Rom) values between 0.6 to 1.3%, our data suggests that source rocks in the Abakaliki basin have undergone burial diagenesis plus magmatic and hydrothermal effects leading to high palaeotemperatures. This level of overmaturity on the major axis of the Abakaliki basin indicate that the Albian to Cenomanian source rocks have higher chances of generating only gas. In the adjacent Anambra basin, the successions have undergone normal burial diagenesis (consequent to subsidence). The level of maturity attained suggests that the sediments are dominantly within the zone of petroleum generation and source rocks here comprising the Albian through Maastrichtian sequences have continued to generate hydrocarbons to date at stratigraphic intervals at least below the Cretaceous-Tertiary unconformity in the basin.