

## Organic Geochemistry of Coal and Interbedded Shale of Mamu Formation, Benue Trough, Nigeria: Implication on Petroleum Potential

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Coal and its interbedded shale samples were collected from Okaba and Onyeama seams in the Mamu Formation, Lower Benue Trough, Nigeria. In the present study, source rock evaluation, biomarker distribution and carbon isotopic composition of n-alkanes in the samples were investigated by Rock-Eval pyrolysis, vitrinite reflectance measurement, gas chromatography-mass spectrometry (GC-MS) and Gas Chromatography-Combustion-Isotope Ratio Mass Spectrometer (GC-IRMS) analysis. The samples have total organic carbon (TOC), genetic potential (GP) and hydrogen index (HI) values ranging from 4.14 to 66.79 wt.%, 5.16 to 173.62 mg/g and 118 to 343 mg/gTOC respectively. These values indicate that the organic matter contained in the samples is sufficient to serve as good source rock for oil and gas. Several plots from the Rock-Eval pyrolysis classified the organic matter in the samples as type II/III kerogen. The abundance of hopanes, homohopanes (C31-C35), benzohopanes, and C29 steranes in most of the samples indicates terrigenous materials, phytoplankton, and cyanobacteria contributions to the organic matter that formed the coal. High Pr/Ph ratio (1.73-12.47) recorded in the samples indicates suboxic - oxic (Okaba) and oxic (Onyeama) condition of organic matter deposition. The distribution patterns of C32-C35 benzohopanes in the samples confirmed the redox condition of organic matter deposition within the formation. There is occurrence of olean-18-ene, olean-13 (18)-ene, and olean-12-ene in Okaba samples. The  $\delta^{13}\text{C}$  isotopic values for n-alkanes range from -31.7 to -29.2  $\delta^{13}\text{‰PDB}$  and -30.1 to -28.2  $\delta^{13}\text{‰PDB}$  in Onyeama and Okaba samples respectively. Heavier  $\delta^{13}\text{C}$  isotope values were observed in the short chain (nC15-nC18) alkanes in all the samples. The n-alkanes profile, carbon isotopic compositions and occurrence of oleanene isomers indicate that Mamu samples consist of both terrestrial and marine organic matter deposited in fluvial/deltaic (Onyeama) or lacustrine-fluvial/deltaic (Okaba) settings. The Ts/Ts + Tm, moretane/hopane, 22S/22S+22R C32 homohopane, 20S/20S+20R and  $\beta\beta/\beta\beta+\alpha\alpha$  C29 steranes maturity ratios range from 0.02 to 0.24, 0.46 to 0.93, 0.16 to 0.59, 0.04 to 0.39 and 0.16 to 0.56 respectively. The biomarker maturity ratios and the vitrinite reflectance values (0.48-0.60% Ro) showed that the samples from Okaba are immature, whereas Onyeama are at the beginning of the oil window.