

GEOCHEMICAL STUDIES OF THE SANDSTONE UNIT FROM THE MAASTRICHTIAN PATTI FORMATION, SOUTHERN BIDA BASIN, NORTH CENTRAL NIGERIA

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Abstract

The sandstone unit of Patti Formation was sampled and subjected to geochemical characterization to determine its classification, maturity, provenance and paleo-environmental depositional settings. Field studies have revealed quartz as the dominant mineral grain observed in hand specimen and the prominent sedimentary structures are cross lamination, flaser bedding, Liesegang rings, burrows and wavy lamination suggesting that the sandstone must have suffered some degree of tectonism. Geochemically, SiO_2 (73.90 to 86.24 wt%), and Al_2O_3 (6.74 and 17.10 wt%) are the dominant oxides followed by Fe_2O_3 (1.06 to 1.92), with relatively low (<1) K_2O , MgO , CaO , Na_2O , P_2O_5 , MnO and TiO_2 . The trace elements analysed are the large lithophile elements- Ba (85 to 1740 ppm), Rb (3.2 to 204.90 ppm) and Sr (15.0 to 489 ppm), the high field strength elements; Hf (0.07 to 4.5), Zr (3.2 to 141.1), Nb (5.37 to 31.01) and Ta (0.3 to 2.50) and the mafic trace elements; Co (0.70 to 29.30 ppm), and Ni (2.7 to 49.70 ppm). Average value of REEs is 209.64 ppm, light rare earth element LREEs is 195.78 ppm and heavy rare earth element-HREEs is 10.58 ppm. Low geochemical ratios of $\text{SiO}_2/\text{Al}_2\text{O}_3$ against higher $\text{Fe}_2\text{O}_3/\text{K}_2\text{O}$ and $\text{Al}_2\text{O}_3/(\text{CaO}+\text{MgO}+\text{Na}_2\text{O}+\text{K}_2\text{O})$ indicate a less mineralogically stable sandstone but with stable mobile oxides, while values of ICV (<1) and log of $(\text{SiO}_2/\text{Al}_2\text{O}_3)$ ratio < 1.5 with log $((\text{Fe}_2\text{O}_3+\text{MgO})/(\text{K}_2\text{O}+\text{Na}_2\text{O})) \geq 0$, confirm a matured lithic-arenite sandstone. Binary plot of $\text{Al}_2\text{O}_3/\text{TiO}_2$ vs SiO_2 and TiO_2 vs. Zr, La/Co, Th/Co ratios and Eu/Eu* with enriched LREE compared to HREE coupled with REE chondrite-normalized patterns suggest felsic a precursor for the sandstone. Ratios of Cu/Zn, U/Th, Ni/Co, $\text{SiO}_2/\text{Al}_2\text{O}_3$ indicate an oxidizing depositional environment, while plots of skewness and standard deviation, sphericity and OP index with roundness vs. I/L suggest a fluvial to marginal marine environment. Therefore, Patti sandstone is lithic-arenite in nature, matured but less mineralogically stable and deposited in a fluvial to marginal marine environment.

Keywords: Patti Formation, Index of chemical variability, Maturity, Provenance, Depositional environment.