Paper Number: 3608

Petrology and lithogeochemical characteristics of Basement rocks of Southwestern Nigeria: implications for weathering induced metal release and redistributions in soils.

Oke, S.A.[1,2] and Vermeulen, D.[2]

[1]Alhikmah University, Faculty of Sciences, Ilorin Nigeria, okesaheed@gmail.com, okesa@ufs.ac.za.
[2] Institute for Groundwater Studies, Faculty of Natural and Agricultural Sciences, University of Free State Bloemfontein South Africa, vermeulend@ufs.ac.za.

The study investigates the petrology, weatherability status, geochemical characteristics as well as metals distribution within in situ chemical weathering derives soils located on the Basement Complex rocks of Southwestern Nigeria. The study involves detailed description and sampling of 2 lithological profiles each from the granite (P1), gneiss (P2) and migmatite (P3) rocks and their respective topsoil, weathered unit and sap rock units sampled for geochemical analysis. Petrographic analysis of the bedrock units were undertaken to assess the mineralogical composition and possible weatherability status of the mineral components.

Petrography reveal presence of quartz, plagioclase feldspar, biotite, muscovite and hornblende as major mineralogical composition of the bedrock while about 70-75% of the geochemical composition in the soil consists of silica, alumina and iron oxides. Analysis shows chemical weathering intensify from Granite > Gneiss > Migmatite. This is derived from the values calculated from six weathering indices which are ruxton ratio (RR) [1], chemical index of alteration (CIA) [2], chemical index of weathering (CIW) [3], plagioclase index of alteration (PIA) [4], Vogt weathering indices (V) [5] and weathering index of parker (WIP) [6] for the granite, gneiss and migmatite rocks respectively. The optimum fresh and weathered values of the weathering indices with the ideal weathering trend up profile serves as control for the study.

The results show that maximum trace metals depletion occurs at the weathered unit sections which have extreme weathering conditions and enrichment at the sap rock and top soil respectively. The high field strength elements (HFSe) of Nb, highest concentration is at the top soil and least concentration at the weathered units while Zr and Y trend are inconsistent in the three rock types. The distribution of rare earth elements (REE) of Sc shows enrichment from top soil to the weathered unit and depletion at the sap rock in the gneiss and migmatite weathered rocks and further depletion at the weathered unit as compared to the top soil and sap rock in the granite weathered profile. Co and Ni were below detection limit.

High rate of granite weathering result from the presence of ferromagnesian minerals such as biotite, hornblende and iron oxides dominant in its composition which are highly unstable, easily ferrugenized and oxidized on exposure to rainfall and sunshine abundant in tropical regions of the study area.

References:

[1] Ruxton BP (1968) Measures of the degree of chemical weathering of rocks. Journal of Geology 76:518-527

[2] Nesbitt HW and Young GM (1982) Early Proterozoic climates and plate motions inferred from major element chemistry of lutites Nature 299:715-717
[3] Harnois L (1988) The CIW index: a new Chemical Index of Weathering. Sedimentary Geology 55, 319-322
[4] Fedo CM et al. (1995) Unraveling the effects of potassium metasomatism in sedimentary rocks and paleosols, with implications for paleoweathering conditions and provenance. Geology 23:921-924
[5] Vogt T (1927) Sulitjelmafeltets geologi og petrografi. Norges Geologiske Undersokelse 12:(1)1-560.
[6]Parker A (1970) An index of weathering for silicate rocks Geological Magazine 107:501-504