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PII: S0375-6742(17)30243-1
DOI: doi:10.1016/j.gexplo.2018.03.006
Reference: GEXPLO 6119

To appear in: *Journal of Geochemical Exploration*

Received date: 5 April 2017
Revised date: 9 March 2018
Accepted date: 12 March 2018

Please cite this article as: M.R. Gbadamosi, T.A. Afolabi, A.L. Ogunneye, O.O. Ogunbanjo, E.O. Omotola, T.M. Kadiri, O.B. Akinsipo, D.O. Jegede , Distribution of radionuclides and heavy metals in the bituminous sand deposit in Ogun State, Nigeria – A multi-dimensional pollution, health and radiological risk assessment. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Gexplo(2017), doi:10.1016/j.gexplo.2018.03.006

Distribution of Radionuclides and Heavy Metals in the Bituminous Sand Deposit in Ogun State, Nigeria – A multi-dimensional Pollution, Health and Radiological Risk Assessment.

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Abstract

Pollutants in soils and other environmental matrices can directly pose significant human health risks through various exposure pathways, especially for local population. The concentration and distribution of heavy metals (Pb, Ni, Cd, Cr, Fe and Zn) and the gamma ray emitting (^{238}U, ^{232}Th, and ^{40}K) radionuclides in bituminous soils were analyzed using well calibrated atomic absorption spectrophotometer (AAS) and γ-ray spectrometry using NaI(TI) detector. The average concentration of Pb, Ni, Cd, Cr, Fe and Zn were 28.2, 24.1, 5.16, 42.5, 170 and 226 mgkg^{-1} respectively. The average activity concentration of ^{238}U, ^{232}Th, and ^{40}K were 42.6 ± 6.50, 113 ± 10.5 and 461 ± 24.3 Bqkg^{-1} respectively. These values were above the world average value, although only six samples were higher than the world average value. The average activity concentrations, radium equivalent and dose rate of measured radionuclides were compared with other literature values and country's maximum allowable limit for heavy metals. The geo-accumulation index (Igeo), contamination factor, pollution loading index (PI), enrichment factor, and potential ecological risk index (PERI) were calculated to assess the heavy metals pollution level in soils. The total hazard index (THI) and carcinogenic risk (CR) were used to assess human health risk of heavy metals. The pollution level using the four pollution assessment model were in the order Pb > Cd > Ni > Cr > Fe > Zn. The estimated carcinogenic risk (CR) for children and adults obtained were all higher than the safe limit (1 x 10^{-6}) while the non-carcinogenic risk (THI) were below the safe limit (THI < 1). Pollution sources were identified using multivariate statistical analysis. It was found that Cr contributed more than 97 % to the overall cancer risk (CR) for children and adults. The pollution sources were identified using