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Geochemistry and distribution of heavy metals from Itakpe iron-ore mine tailings on soils

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ABSTRACT - Eight dry season soil samples were collected around the tailings dam in order to evaluate the impact of tailings on the soils. The mean concentrations of cations and heavy metals observed are: K(94.66)>Ca(75.92)>Na(18.47)>Mg(5.24) and Fe(29714.13)>Cd(1.51)>Cu(1.30)> Zn (1.20)> Ni (0.64) >Pb(0.55), respectively. Moderate to strong correlation relationship exist between cations and heavy metals.Among the heavy metals, fewer cases of moderate to strong correlations were observed. The factor and cluster analyses reveal both natural and anthropogenic influences on the variables. Three indices were used for heavy metal evaluation. Contamination factor (CF), enrichment factor (EF) and index of geo-accumulation (Igeo). The degrees of heavy metal impact were also evaluated using pollution load index (PLI). Among the three indices, CF and EF recorded this order: Fe>Pb>Cu>Zn>Ni>Cd and Igeo recorded this order: Fe>Pb>Cu>Zn>Cd>Ni among the heavy metals. The pollution load index suggests that all sites have experienced various degrees of deterioration with locations ITK12, ITK21, ITK23, ITK11 and ITK22 severely deteriorated. This study has revealed the need for statistical and quantitative data evaluation and presentation. From these indices used, Fe, Pb, Cu and Zn are the most impacted of the heavy metals. While long term treatment methods such as phytostabilization, phytoextraction and rhizofiltration are recommended, there is also the need to treat the soil and put monitoring measures in place to forestall further contamination.

Key words - Itakpe, Contamination factor, Enrichment factor, Pollution load index, Multivariate analysis

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Exploratory work on Itakpe iron ore deposit started 1963 by Geological Survey of Nigeria (GSN). Detailed investigations such as pitting, trenching and drilling of boreholes were carried out by Nigerian Steel Development Authority (NSDA) and Techno-Export of Russian. These investigations were later complimented with large scale geological mapping (1:500), trenching and drilling of boreholes by NIOMP at the mine development stage. The feasibility report of these work indicated a reserve of 306,854,000 tones of iron ore made up of 189,672,000 tones of mine able reserve and 117,182,000 tones of geological reserve (Akinrinsola and Adekeye, 1993). This deposit was expected to supply the required iron ore to the Ajaokuta iron and steel company.

Itakpe iron ore deposit consists of two mine sites-one on the east and the other on the west. The eastern mine has been abandoned and not accessible. Within the mining area on the western site are the view point, overburdened dumps, primary and secondary crushers, washing pond, concentrate area and tailing dam point. Parallel to these areas is a seasonal river called PomPom. The topography of the area is rough and hilly. Mining is by surface method.

Iron-Ore mining either by surface or underground methods have severe consequences on the environment. Surface mining involves tearing up large tracts of earth surface; removing materials and throwing the removed soil back into the cut (Priester and Hentschel, 1993; Kozo and Jaoquin, 1982).