

Geochemical Baseline and Origin of Trace Elements in Soils and Sediments around Selibe-Phikwe Cu-Ni Mining Town, Botswana

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Heavy metals may occur naturally in rocks and soils, but elevated quantities of them are being gradually released into the environment by anthropogenic activities such as mining. In order to address issues of heavy metal water and soil pollution, a distinction needs to be made between natural and anthropogenic anomalies.

The objective of the current study is to characterize the spatial distribution of trace elements and evaluate site-specific geochemical background concentrations of trace elements in the mine soils examined, and also to discriminate between lithogenic and anthropogenic sources of enrichment around a copper-nickel mining town in Selibe-Phikwe, Botswana.

A total of 20 Soil samples, 11 river sediment, and 9 river water samples were collected from an area of 625m² within the precincts of the mine. Major and minor elements were determined using ED-XRF.

The average metal concentration in soil samples and geochemical baseline values of Cu, Ni, Cr, As, and Co in the study area were 73.27, 78.10, 61.43, 4.28 and 6.43 mg/kg, and 16.28, 24.28, 27.83, 4.96 and 2.55 mg/kg, respectively. Soil and river water pH levels ranged from basic (9) to very acidic (3) in areas closer to the mine. The mean metal concentration of Cu, Ni, Cr, Pb, and Co were 0.007, 0.025, 0.003, 0.007 respectively and almost undetectable for Co.

All sampling locations had heavy metal mean concentration values higher than the geochemical baseline values showing evidence of anthropogenic enrichment, which may lead to a potential danger for the environment at the study area. The calculated Igeo values revealed moderate pollution level by the same metals. The spatial distribution of elements indicate that the heavy metals in soils decreased with respect to distance from the mine, controlled mainly by water movement, wind direction, and topography.