The trace element geochemistry of soils in Bloemfontein, South Africa

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Through natural or anthropogenic activities, the Earth can become contaminated with toxic metals/metalloids which can cause a detrimental effect to the environment and to human health. South Africa is no exception, especially with the burning of coal in power stations. Trace amounts of heavy metals in coal are high in South African coals and are released into the atmosphere through coal combustion. One hundred and twelve soil samples, 2 soil profiles, and 6 dust samples, were collected from the areas surrounding a coal-fired power station in Bloemfontein, South Africa. The soil samples were 500 g and were taken at 500 m intervals, at a depth of 5 cm. Soil profile sampling was carried out at 2 localities at depths of 20 cm, 40 cm and 60 cm. Dust samples of 1 g were taken from local shops and on equipment at the Bloemspruit sewage purification plant east of the power station. Analyses of these samples indicate high concentrations of different trace metals such as Hg, As, Cd, Bi, Sb and Se. The purpose of the study is to 1) determine the mineralogy and major element compositions of the samples, 2) investigate the processes which control the local movements of these elements, 3) establish the possible sources of these contaminants, and the possible effects of the contaminants, at the levels found, in the environment. Initial results indicate the mean concentrations of the different trace elements of the soil samples (e.g. Hg - 87 µg kg^{-1}) are considerably lower than that of the dust samples (e.g. mercury-212 µg kg^{-1}). The only exception to these trace elements is As with a mean concentration in the soil samples being slightly higher (4.1 mg kg^{-1}) than the mean concentration of the dust samples (4.0 mg kg^{-1}). Anomalies were found mostly at the sewage plant where one soil sample indicated an anomaly for Hg of 2149 µg kg^{-1} and a dust sample indicated a strong anomaly of 83115 µg kg^{-1}. The possible cause(s) of the high concentration of the contaminants in the environment could be from the burning of coal at the power plant and local houses, the burning of fuel from motor vehicles possibly releasing trace amounts of the contaminants into the atmosphere being later redistributed over the environment and water run-off that collects at the sewage plant containing high concentrations of the contaminants especially mercury, because the results indicate the high concentrations can be considered as hazardous.

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