

Spatial Variability of Heavy Metals in Sediments of Two Streams of the Olifants River System, South Africa

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Abstract : Many freshwater ecosystems have been subjected to prolonged and cumulative pollution as a result of human activities such as mining, agricultural, industrial and human settlements in their catchments. The objective of this study was to investigate spatial variability of heavy metal pollution of sediments and possible sources of pollutants in two streams of the Olifants River System, South Africa. Stream sediments were collected and analysed for Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Nickel (Ni) and Zinc (Zn) concentrations using inductively coupled plasma-mass mass spectrometry (ICP-MS). In both rivers, As, Cd, Cu, Pb and Zn fell within the concentration ranges recommended by CCME and ANZECC, while the concentrations of Cr and Ni exceeded the standards; the results indicated that Cr and Ni in the sediments originated from human activities and not from natural geological background. The index of geo-accumulation (I_{geo}) was used to assess the degree of pollution. The results of the geo-accumulation index evaluation showed that Cr and Ni were present in the sediments of the rivers at moderately to extremely polluted levels, while As, Cd, Cu, Pb and Zn existed at unpolluted to moderately polluted levels. Generally, heavy metal concentrations increased along the gradient in the rivers. The high concentrations of Cr and Ni in both rivers are of great concern, as previously these two rivers were classified to be supplying the Olifants River with water of good quality. There is a critical need, therefore to monitor heavy metal concentrations and distributions, as well as a comprehensive plan to prevent health risks, especially those communities still reliant on untreated water from the rivers, as sediment pollution may pose a risk of secondary water pollution under sediment disturbance and/or changes in the geo-chemistry of sediments.

Keywords : geo-accumulation index, heavy metals, sediment pollution, water quality

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