

Definition of baseline metal concentrations for assessing metal enrichment of sediment from the south-eastern Cape coastline of South Africa

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Abstract

Assessing metal contamination of sediment is complicated since metals are a ubiquitous, naturally occurring component of sediment, their concentrations in un-contaminated sediment can vary by orders of magnitude over relatively small spatial scales, and naturally occurring and anthropogenically introduced metals tend to accumulate in the same areas. To meaningfully interpret sediment metal data, factors affecting metal concentration variability in sediment must first be compensated for before naturally occurring and anthropogenically introduced concentrations can be differentiated. This can be accomplished through the procedure of geochemical normalisation. Baseline metal concentration models developed through this procedure can then be used to interpret metal concentrations measured in sediment from areas where anthropogenic metal inputs are suspected. In this study baseline metal concentrations in sediment from the coastal zone between the Kromme River estuary in St Francis Bay and the Nahoon River estuary in East London on the south-eastern Cape coastline of South Africa are defined, for the purpose of differentiating between natural and anthropogenically introduced metal concentrations in sediment from this region. Baseline concentration models were initially defined for three sub-regions of the coastline, and then for the region as a whole. Aluminium and iron were found to be suitable for normalising the concentrations of copper, cobalt, chromium, manganese, nickel, lead and zinc, but not concentrations of arsenic, cadmium and mercury. Baseline concentrations of arsenic, cadmium and mercury above which enrichment can be inferred were defined using cumulative probability and univariate plots. The manner in which the baseline models are used to interpret metal concentrations is demonstrated, using metal concentrations measured in sediment from the Port of East London. The baseline models are used to assess the suitability of sediment quality guidelines (SQGs) developed by the Department of Environmental Affairs and Tourism (DEAT) for assessing the quality of sediment from the coastal zone of South Africa. The Special Care Level Guideline for chromium is unsuitable for assessing the quality of sediment from the south-eastern Cape coastline since the guideline for this metal specifies a concentration that is below the baseline concentration in sediment from this region.

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