Interpretation of bed sediment trace metal data: methods for dealing with the grain size effect.

STP976

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Published: 0

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Abstract

One of the most significant factors controlling bed-sediment capacity for collecting and concentrating trace metals is grain size—as grain size decreases, metal levels increase. As a result, bed sediments can display marked chemical heterogeneity, even over relatively short distances. Consequently, the interpretation of water-quality trends through space or time based upon bed sediment-trace metal analysis requires consideration of the grain size effect. Commonly, the grain size effect is minimized by either mathematical normalization of bulk chemical data based upon an independent grain size analysis, or physical separation of a size range or fraction followed by a chemical analysis of the separated material. Normalization procedures are useful for clarifying trends but often produce over- or underestimates of metal concentrations. On the other hand, physical separation followed by chemical analysis clarifies trends and produces accurate measurements of metal levels. Based on a detailed grain size and chemical analysis of 17 samples from a wide variety of aquatic settings, and from consideration of factors such as mineralogy, ease of handling, likelihood of contamination, and cost, the most appropriate size separation for reconnaissance surveys or monitoring studies is <63 μm. When an initial survey or study indicates that a trend or potential problem exists, it is advantageous to isolate the metal-bearing fraction for further study. Although many techniques are available for separating material finer than 63 μm into individual size fractions, air elutriation appears to be a method that minimizes such problems as contamination, chemical alteration, and limited masses of separated material. Size distributions obtained by air elutriation are similar to those derived by nonchemically dispersed pipet analyses. Contaminant-free size fractions can be separated from bulk samples for the analysis of copper, zinc, lead, chromium, cobalt, arsenic, antimony, selenium, iron, manganese, aluminum, titanium, and probably cadmium.

Keywords:

sediment, trace metal, grain-size chemistry, grain-size separations

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Committee/Subcommittee: D19.05

DOI: 10.1520/STP26703S

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