Reference: *Biol. Bull.* **187:** 290–291. (October, 1994)

Analysis of Acid Volatile Sulfide and Metals to Predict the Toxicity of Boston Harbor Sediments

Cristina Zago (Instituto per lo Studio della Dinamica delle Grandi Masse, ISDGM, Venice, Italy) and Anne E. Giblin

The bioavailability and toxicity of metals in sediments is related to the geochemical speciation and chemical activity of the metals in the interstitial water of the sediment. Di Toro *et al.* (1) conducted laboratory tests with marine and freshwater organisms to determine which factors controlled the toxicity of metals in sediments. Test results showed that the mortality of the animals was related to both the quantity of toxic heavy metals (Cu + Zn + Cd + Ni + Hg + Pb) and the acid volatile sulfide (AVS) released from acidified sediments. Metals extracted with the AVS are termed the *simultaneously extracted metals* (SEM). If the SEM/AVS ratio was greater than 1 or 2, the sediments were toxic; if the ratio was below 1, the sediments were not toxic regardless of the total metal concentration. Di Toro *et al.* (1) proposed that when the SEM/AVS ratio was less than 1, the toxic metals were all precipitated as insoluble metal sulfides and hence not biologically available.

We applied this technique to study the potential toxicity of sediments in Boston Harbor, Massachusetts. Samples were collected from two well-studied harbor sites (2, 3) that differ in their geochemical characteristics, total metal content, and benthic fauna. One station (T3) is located off Long Island in an area that received sewage sludge prior to January 1992. Large numbers of benthic amphipods and other organisms have been routinely observed at this site. The second site (T2) is on Governor Island Flats and is often devoid of macrofauna, although amphipods were observed there at the time of this study.

To achieve better mixing of the acid with the sediment, we modified the extraction technique (1) by adding the acid to the sediment and heating for 1 h.

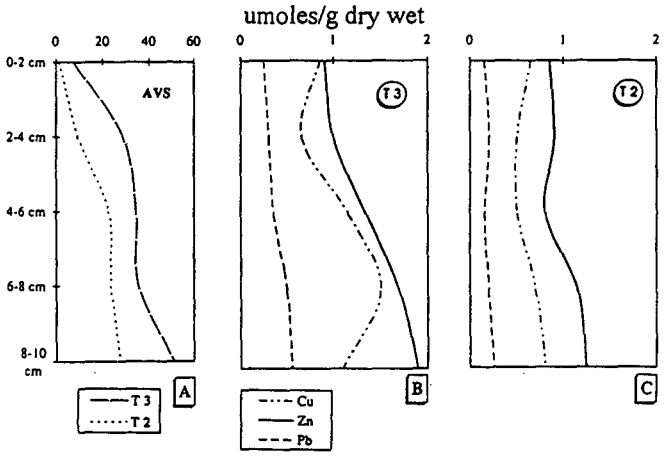

Figure 1. *Concentrations (μmoles/g dry weight of sediment) of acid volatile sulfide, Cu, Zn, and Pb in sediments from Boston Harbor. Sediments were sectioned in 2-cm intervals to a depth of 10 cm. (A) AVS profiles at stations T2 and T3. (B) Metal profiles at site T3. (C) Metal profiles at site T2.*

At both sites, AVS concentrations were low in surface sediments and increased with depth (Fig. 1A). Station T3 had higher concentrations of AVS and metals than T2 (Fig. 1A, B, C).

To test the toxicity of the sediments, we calculated the SEM/AVS ratio. We compared the sum of Cu, Pb, and Zn with the AVS concentration. Cd was not included because it was below our detection limits and therefore insignificant. Hg and Ni were not analyzed, but they are present in such low concentrations at these sites (4) that their omission should not affect our calculations. The (Cu + Zn + Pb)/AVS ratio was lower than 1 except in the 0–2 cm section from site T2, which had a value of 1.38.

These data would allow us to classify the sediments as nontoxic. This is consistent with our observations that infaunal animals were present. However, future studies should focus on site T2, where we have observed a large inter-annual variability in metal concentration, sediment texture, and animal abundance (unpub. data).

C. Zago was sponsored by an MBL Associate's Fellowship and by the Environmental Division of the Instituto per lo Studio della Dinamica delle Grandi Masse, National Research Council of Italy, Venice. Support for A.E.G. came from NOAA Sea Grant and from the Massachusetts Water Resources Authority.

Literature Cited

1. **Di Toro, D. M. 1992.** *Environ. Sci. Technol.* **26:** 96–101.
2. **Giblin, A. E., C. Hopkinson, and J. Tucker. 1993.** Massachusetts Water Resources Authority, Boston, MA. Tech. Rep. 93-2.
3. **Giblin, A. E., C. Hopkinson, J. Tucker, B. Nowicki, and J. R. Kelly. 1994.** Massachusetts Water Resources Authority, Boston, MA. Tech. Rep.
4. **Shea, D., and J. R. Kelly. 1991.** Massachusetts Water Resources Authority, Boston, MA. Tech. Rep. 92-4.