



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

JUN 13, 2000

OFFICE OF  
WATER

Chair  
Science Advisory Board  
U.S. Environmental Protection Agency  
1200 Pennsylvania Ave., NW  
Washington, D.C. 20460

Dear Chair:

The Office of Water received your letter on March 2, 2000, transmittal of: *An SAB Report: Review of an Integrated Approach to Metals Assessment in Surface Waters and Sediment*, EPA-SAB-00-005, February 28, 2000. Thank you for the comprehensive review of the Agency's research into metals bioavailability and its use as the technical foundation for setting guidelines for sediment assessment and protection. The SAB provided both high praise for the research conducted to date and recommendations for future research that would further our understanding of metals bioavailability. It is the goal of the Agency to provide sound science for use in regulatory programs, by States and Tribes, and by the regulated community. The commendations reassure us that we are providing a sound scientific basis for our decisions and the recommendations define new paths to improvement.

It is the Agency's intent to move forward with the current guidelines, adjusted to reflect the SAB's concerns and cautions, along with existing sediment assessment tools in regulatory programs in line with the SAB's recommendation that "... SEM-AVS be incorporated into sediment assessment guidelines in a way that assures that SEM-AVS will continue to be used in conjunction with other assessment tools to characterize the safety of sediments, rather than being used as stand-alone tests." The *Implementation Framework for Equilibrium Partitioning Sediment Guidelines* has been very carefully crafted to promote this implementation strategy. The Agency also intends to investigate the research recommendations presented by the SAB so that the guidelines' underpinnings will become even stronger.

-2-

Enclosed is a detailed response from the contaminated sediment research team addressing the SAB's major concerns and recommendations. If you have any questions or outstanding concerns, please contact Jeanette Wiltse, Director, Health and Ecological Criteria Division, at 202-260-7317.

Sincerely,

*/ Signed /*

J. Charles Fox  
Assistant Administrator

Enclosure

**Contaminated Sediment Research Team**  
**Response to:**

**An SAB Report:**  
**Review of an Integrated Approach to Metals Assessment in**  
**Surface Waters and Sediments**

***Dietary Exposure/Bioaccumulation (pp.11 - 14)***

The SAB expressed concern that "... the importance of dietary accumulation [of metals] and the potential for toxicity has not been systematically examined." The Agency agrees. However, to date the data collected demonstrate that although benthic organisms may accumulate a body residue of metal when the AVS concentration exceeds the SEM concentration no toxic effects are realized. The database supporting the metal mixtures ESG includes a number of sediment ingesting organisms that could be expected to have significant dietary exposure. That these organisms do not show toxicity lends support to the expectation that bioaccumulation of metals under these circumstances ( $SEM-AVS < 0$ ) does not lead to acute or chronic toxicity. Several researchers are actively exploring factors controlling accumulation of metals from sediments and the Agency will continue to keep abreast of these research efforts.

To further evaluate these assumptions the Agency is scoping a research plan for a systematic investigation of dietary exposure to metals and potential for toxic effects. This research includes the use of sediment ingesting organisms (exposed to metals through sediment) as prey. An initial Agency workshop on this topic was held in March 2000. The Agency research team is also co-chairing a session at the upcoming Society of Toxicology and Chemistry Annual Meeting (November 2000) on the topic of dietary exposure and bioaccumulation.

Nonetheless, the striking uniformity of the toxicological data with SEM-AVS based analysis, even in organisms showing accumulation of metals, compels the Agency to move forward with releasing the current metal ESG, particularly when considering the current absence of guidance.

***Biological and Ecological Processes (pp 14-17)***

***Exposure/Ecological Processes (pp 14 - 16)***

The SAB expressed the concern that the sediment environment is very complicated, with high variability and gradients both in the horizontal and (especially) in the vertical, and called into question whether a simple sampling protocol (such as sampling the top 2 centimeters) can account for this variability. The Agency acknowledges that sampling the top strata of a sediment column may not fully describe the sediment column, especially in some cases where contaminated sediments are overlain with more recent, cleaner sediments. As would be true with any sediment guideline, the most robust approach would be to take multiple cores to the maximum penetration of the benthos at any particular site, and then to measure the SEM and AVS at a number of different horizons, providing a complete characterization of the sediments in

a particular area. This would seldom be practical, unless there is reason to believe that there may be vertical stratification of metals concentration at a particular site. Although some understanding of the variability in a particular area is essential, there is no reason to believe that the SEM-AVS guideline will be more susceptible to this variability than any other. The same problem is also faced with toxicity testing of field-collected sediments. The surface layer is generally chosen because this is the zone of highest biological activity, and the zone most prone to oxidation. In the few cases where there have been apparent mismatches between measured SEM and AVS concentrations and biological effects, the mismatches can be explained if only the measurements from the surface sediments are used. In general, however, sampling and analysis based on the top 2 cm has shown good correspondence with measured effects, suggesting that it is a reasonable guideline for the general case.

Effects/Biology (pp 16 - 17), e.g. life stage sensitivity, feeding strategy.

The SAB expressed concern that there are many different kinds of benthic organisms, and that the ESG, especially if it is applied to the surface sediments, may not be protective of all species and life stages. As stated in the previous section, sampling of the surface sediments theoretically may not show a problem that may manifest itself with organisms that are deeper burrowing. However, as the SAB points out, the data from the array of colonization and other toxicity tests done to date are impressive. Biological effects have not been found in any of the colonization tests done to date in sediments with an excess of AVS, even though these tests expose many different species, many in their most sensitive life stages. Of course these tests generally only run for several months, and some of the large, deep-dwelling species may not have had time to develop during the course of these experiments. The Agency has not compiled a list of organisms tested in the course of validating the ESG. The intent is, as it is for all ambient water quality documents, to test a sufficient number of species to verify that it is reasonable to expect that the theory is applicable to a variety species and feeding types.

### ***Sampling and Handling Protocols (18-20)***

The SAB expressed the need for properly designed sampling and handling protocols so that a number of sediment characteristics can be addressed including their temporal and spatial variability, non-equilibrium conditions, and oxidizing conditions. The Agency agrees that establishing the proper sampling and handling protocols and strategies are critical to conducting a robust and meaningful site assessment. In light of this, the Agency is preparing a sediment sampling and handling protocol manual outlining its recommendations. This document is scheduled for completion (inclusive of peer review) in March of 2001. The Agency is also beginning discussions on what research would help answer questions about non-equilibrium conditions.

### ***Organic Carbon Normalization (pp. 21 -22)***

The SAB recommended that the organic carbon normalized metals mixture ESG not be implemented as a stand alone value but rather along with other supporting biological data because of concerns about the variability of it's usefulness across metals and its spatial and temporal variability. By way of clarification, the Agency is not proposing that any of the ESGs

be used as stand alone determinations. The *Implementation Framework for Equilibrium Partitioning Sediment Guidelines*, which will be available for public comment in the near future, outlines the Agency recommendations for ESG implementation which hinges on the use of both ESGs and bioassays in regulatory applications.

The Agency recognizes that the organic carbon normalization is a relatively new evaluation approach and, while promising, has not had opportunity for extensive evaluation. For that reason, the metals ESG has been structured such that the SEM-AVS and interstitial water metals guidelines are the primary basis for the ESG. The organic-carbon normalization has been included in the document in section 3.4 (and removed from the guidelines statement in chapter 6) as a supplementary analysis that can be used to further evaluate the potential consequences of an excess of SEM.

### ***Application of the Biotic Ligand Model (BLM) to Sediment Guidelines***

The SAB does not recommend that the BLM be incorporated into the ESGs at this time. This recommendation comes from concerns about the complexity of sediment and pore water chemistry. The SAB recommended that the ability of the BLM to appropriately predict pore water toxicity under a variety of chemical conditions be evaluated prior to its incorporation in the sediment guideline. The Agency accepts the SAB's recommendation and will postpone the incorporation of the BLM into the ESG until these complexities can be more thoroughly assessed.

### ***Inclusion of Chromium and Silver in the Metals Mixture ESG***

The SAB expressed reservations about the applicability of the EqP approach to chromium and silver. The SAB established a number of areas of needed research for chromium in particular: additional acute and chronic toxicity data, oxidizing conditions of Chromium (III) to Chromium (VI), conditions when  $MnO_2$  are expected in sediments, types of food, and biokinetics. The Agency agrees with the SAB that chromium is not yet ready for inclusion in the guidelines. The data presented by the Agency was designed to demonstrate what research had been conducted and to solicit recommendations from the SAB for additional investigations.

The SAB also identified concerns for the incorporation of silver in the guideline. These included from page 25 (g-j): questions about the bioavailability of silver, quantity of chronic data, elimination of toxicity by AVS binding, and acute mortality of >24% when IWTU are less than 0.5. The Agency has reviewed the SAB's concerns and the data presented in the review package and has concluded that it is appropriate to include silver in the metals mixture guidelines.

Specifically the Agency found that for the concerns expressed on page 25:

- g) though laboratory and field data demonstrate that silver may be bioaccumulated by some organisms, there is no demonstrated toxicity.
- h) it is correct that no chronic sediment testing has been done with silver-spiked sediments to date. Chronic sediment tests have been done using all of the other

metals covered under the metals ESG. It was never the Agency's intention to perform chronic tests with all of the metals before the ESG was released because it would not be possible to check all effects to all organisms. Rather, it was the Agency's intention to conduct a sufficient number of chronic tests with a variety of metals and species to show that AVS normalization worked as would be predicted by theory and that it would be reasonable to apply it to metals of similar characteristics. To our knowledge there are no published data which show directly that chronic effects occur with silver or any of the other metals when AVS is in excess in sediments.

- i) the data presented in Figure 8, p. 2-36 demonstrate clearly that AVS binding eliminates silver toxicity, but is easily misinterpreted, because the X axis does not contain 0.0. This is because the data are plotted on a logarithmic scale to make a point about TOC normalization. Note that for all points plotted on the graph metals are in excess of sulfide, and therefore the sediments are likely candidates for silver toxicity.
- j) the interstitial water toxic units guideline is not applicable to silver, only to the other metals in the mixture guideline. This is specifically stated in sections 4.2.2, 5.2.2, and in the guidelines statement (chapter 6).

### ***Integrated Approach to Metals***

The Agency presented to the SAB an example conceptual model of how metals assessment may be integrated to provide more holistic aquatic ecosystem. The SAB made a number of recommendations for the Agency to consider as the model moves from an example to an actual model that will assist the Agency in determining research and guidance needs. The Agency will incorporate the SAB's recommendations in the model as the model matures.

### ***ESG Implementation***

The SAB has stated at the conclusion of each of four reviews of ESGs that to accommodate the uncertainties about the methodology the guidelines not be used as stand alone, pass/fail criteria for determining whether a sediment is toxic or not. The Agency is preparing to release for public comment the proposed *Implementation Framework for Equilibrium Partitioning Sediment Guidelines*. The Framework is very specific in its recommendation that the guidelines not be used as stand alone, pass/fail criteria. Rather the Agency recommends the ESGs be used in conjunction with whole sediment bioassays, and when necessary with benthic assessments as well, when a determination on sediment toxicity must be made.