Evolving Role of Passive Samplers in Whole Sediment Toxicity Identification Evaluations

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In Phase I of whole sediment TIEs, causes of toxicity to freshwater and marine organisms are characterized into broad toxicant classes including ammonia, metals and organic chemicals. In Phase II of the TIE, the specific toxicants causing observed toxicity are identified. For ammonia and metals, this process is often not complex because of the limited number of metals likely to cause toxic effects and because ammonia toxicity is well understood. In contrast, identifying the specific organic chemicals causing toxicity is very challenging because of the thousands of chemicals that may be present and contributing to adverse effects. In effects directed assay (EDA) as developed in Europe, a major focus is on the identification of toxic organic chemicals using sophisticated extraction, fractionation and analytical methods often with cellular endpoints in artificial media. In the TIE approach developed in North America, the emphasis has been on exposing whole organisms in systems emulating environmental conditions including contaminant bioavailability. A consequence of the TIE strategy has been limited development of sophisticated identification methods for organic chemicals. Given that most Phase I whole sediment TIEs indicate organic chemicals are the cause of toxicity, more sophisticated Phase II identification methods are needed. A major challenge is the development of exposure techniques for whole organisms that reduce the mixture of organic chemicals potentially causing toxicity into simpler components that can be analyzed for identification. In this presentation, the evolving role of passive samplers in whole sediment TIEs will be discussed as a means for generating "simplified" sediment-based exposures that allow for identification. Use of whole sediment extraction schemes that better reflect contaminant bioaccessibility and bioavailability will be described. Additionally, the application of semi-permeable membrane devices and reverse polyethylene devices as dosing systems will be reviewed. Toxicological and chemical information will be provided evaluating the different approaches. This presentation will provide information useful for the development of identification processes for organic chemicals causing toxicity to whole organisms in freshwater and marine environments.