



SCIENCE BRIEF (June 2004)

PREDICTING METAL BIOAVAILABILITY IN LAKES

ISSUE

Assessing the significance of releases of metals, from whatever source, into any freshwater lake requires answers to two key questions. First, what will be the metals concentration in the lake? Second, what form(s) will the metal take in the lake? It is important to know the forms, or species, of metal in the lake because it is the form of the metal that determines whether or not there will be any harm to organisms in the lake. Also, the form(s) of metals influence the biologically accumulated concentrations that will result from any metals release.

SIGNIFICANCE

This research has provided a mathematical model that addresses two key issues: metal concentrations in lakes and their form relative to their potential to cause harm. This model will assist both regulators and industry. Regulators can use the model to help them set reasonable guidelines for the release of metals into lakes. Industry can use the model to help them develop control or management strategies to meet regulatory guidelines.

BACKGROUND

Measurements of the total concentrations of metals in lakes provide little information as to whether and to what extent such metals may be harmful to lake organisms. Metals can comprise different forms or species, which change depending on the physical and chemical characteristics of different lakes. Some metal forms are potentially harmful to organisms; others are not. Knowledge of which forms of metals will occur in different lakes and to what extent they occur is necessary to predict and protect against harmful effects from metal releases to lakes. In addition to knowing present concentrations of metals, it is important to understand the factors controlling those concentrations and how the concentrations may change over time as inputs of metals to a lake change.

FINDINGS

This research, carried out through the Metals in the Environment Research Network (MITE–RN) program, has resulted in a coupled metal TRANsport and SPECiation model, TRANSPEC, which estimates metal speciation (the different forms in which metals can occur) and their fate, in other words the distribution of the metal species in a lake. Initial applications of this model have focused on zinc and copper; however, the model can be used for most metals including mercury. The model has already provided useful data regarding the conditions under which zinc can be remobilized from the sediments in a lake in Manitoba and the forms in which this remobilized metal will occur. The model results can be used to assess whether particular metal concentrations and forms predicted by the model will cause harm to lake organisms and thus to the ecology of the lake.

CONTINUING RESEARCH

The model has been evaluated for a lake with high concentrations of zinc in its sediments and which had a relatively complex water chemistry. Additional field evaluation is required for other metals and other lakes. The model currently can be used for most but not all metals; additional research is being conducted on those few metals for which the model is not yet applicable.

ADDITIONAL INFORMATION

S. P. Bhavsar, M. L. Diamond, L. J. Evans, N. Gandhi, J. Nilsen and P. Antunes. 2004. Development of a coupled metal speciation-fate model for surface aquatic systems. *Environmental Toxicology and Chemistry* volume 23, number 5, pages 1376 to 1385.

S.P. Bhavsar, M.L. Diamond, N. Gandhi and J. Nilsen. 2004. Dynamic coupled metal TRANsport SPECiation (TRANSPEC) model: Application to assess a zinc contaminated lake. *Environmental Toxicology and Chemistry* (in press).

<http://www.mite-rn.org/research/era/era.shtml>

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