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Title: Novel uses of enriched stable isotopes to assess the bioavailability and toxicity of metals, including metal-based nanoparticles

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Abstract:

Metal contamination is a complex and ubiquitous environmental issue. Widespread uses of metals, the legacies of past contamination and new technologies continue to pose important risks for aquatic environments. Understanding the bioavailability and toxicity of metals to aquatic animals and developing monitoring tools are crucial research needs to determine their environmental implications. A major challenge in understanding the environmental implications of metals lies in characterizing their bioavailability to organisms after environmentally realistic exposures. Typically, high exposure concentrations are needed to trigger measurable effects and to detect accumulation above background. Application of tracer techniques can overcome these limitations. Enriched stable isotopes overcome many of the shortcomings of radioactive tracers, and their application is growing rapidly as a result of new developments in mass spectrometric instrumentation. In this seminar, I will describe how enriched stable isotopes can be used to assess the bioavailability of metals and to characterize the processes that control their bioavailability. I will provide examples for aqueous and particulate metals, including engineered nanoparticles, synthetic colloidal particles and natural particles. I will also show how enriched stable isotope tracers can help answering whether nanoparticle impacts depend upon their dissolution. If they must dissolve to be toxic, then the issue is similar to other contaminants like metals. However, if the nanoparticle itself is taken up by organisms and humans, then novel impacts are possible. To date differentiation of these two possibilities has been addressed only indirectly. A second problem with engineered nanoparticles is that, despite the poor understanding of impacts, a new generation of multiple metal nanoparticles is being produced. New tracer approaches can help address both the particle uptake and the multiple metal NP questions.