

What do Total and Dissolved Metal Concentrations in Groundwater Samples Really Tell Us? Metal Speciation, Analytical Definition and Toxicity

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Accurate quantification of metal concentrations in aqueous-phase samples poses a number of challenges for environmental monitoring and assessment of potential risks to human and ecological health, that are both chemical and physical in nature. These challenges have been a focal point of discussion recently in Alberta with Alberta Environment and Sustainable Resource Development's (ESRD's) proposed requirement for metals analysis in groundwater. Proposed was that total metals be analyzed in groundwater samples from domestic use aquifers (DUAs) and dissolved metals be measured in samples collected from non-DUA formations. In a two-part presentation, we will discuss the foremost issues with the proposed approach, and quantification of metals concentrations in groundwater more generally.

Current standard practice divides metal concentrations in groundwater into two fractions, dissolved and total metals, based on filtration through a 0.45 µm membrane. This is an arbitrary or operational definition. Accordingly, it is of critical importance to understand what chemical species are being included in each of these fractions and, ultimately, their relative availabilities and toxicities to human and ecological receptors.

Part 1 of the presentation will include discussion of species encountered in groundwater for commonly measured metals, the operational nature of almost all metal analyses in aqueous solutions and pitfalls in interpreting analytical results. Also discussed will be derivation of regulatory guidelines for metals and where problems can arise in estimating risk to a receptor on the basis of the current "two-fraction" system. Finally, some of the emerging novel techniques that allow specific metal species/fractions to be assessed in aqueous-phase samples will be introduced.

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Elizabeth Haack is a Staff Environment Scientist in WorleyParsons' Mississauga, ON office. She is a geochemist, with extensive understanding of metal speciation both in the aqueous and solid phases. She also has over five years expertise in screening level and quantitative risk assessments (human and ecological) for sites impacted with a wide variety of metal and organic contaminants.