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Understanding controls on mobility, toxicity and speciation of tungsten.

Nikolay Strigul, Philip Steenstra, and John Harrison
Washington State University Vancouver, School of the Environment, Vancouver, WA, United States (nick.strigul@wsu.edu)

Tungsten (W) is a heavy metal with the potential to impact human health and aquatic ecosystem function. For a long time W was considered an insoluble metal without serious toxicological or environmental effects. However, over the last decade this view has been challenged and discredited as numerous studies have highlighted the toxicological and environmental effects of W. W has recently been nominated as a priority substance by the U.S. National Toxicology Program in 2002, designated an emerging contaminant in 2008 by the U.S. EPA, and listed as a priority chemical for biomonitoring in 2014 by the state of California. Our studies showed unexpectedly high corrosion rates for metallic W and its alloys in environmental systems, resulting in release of soluble, bioavailable monomeric and polymeric W compounds, polyoxometalates (Strigul 2010, Does speciation matter for tungsten ecotoxicology? Ecotoxicology and Environmental Safety, 73(5): 1099-1113). These soluble W compounds are toxic to aquatic organisms, alter nitrogen cycling and enter food chains via uptake by vegetation and aquatic organisms. Our new project focuses on assessment of W occurrence in aquatic systems in the areas of tungsten deposits in the State of Washington (US Pacific Northwest). Watersheds of the Pacific Northwest, which are tungsten-rich, provide an opportunity to understand how chemical, edaphic, and climatic factors control the solubility and transport of W through watersheds. It was reported that W concentrations in urine of WA State citizens are consistently higher than the national average, and elevated W in urine is linked to higher probabilities of stroke, diabetes, peripheral arterial disease, and altered thyroid function. Despite this, W levels in WA waters have not been measured, and controls on W solubility, W speciation, and effects of W on ecosystems are not well-understood. Building on recent progress in W analytic chemistry and toxicology, we test fundamental hypotheses concerning W mobility and speciation in surface waters downstream from W deposits and collect data for an ecotoxicological risk-assessment model. In particular, we collect and analyze water samples in the areas surrounding tungsten deposits, conduct multivariate statistical analysis in order to determine biogeochemical factors that control W concentration in samples, and establish a series of laboratory-based dissolution and geochemical experiments to examine and quantify these factors. In this presentation we will review our published results concerning W dissolution, speciation and environmental occurrence and present our new unpublished results on W aquatic biogeochemistry in the State of Washington.