MEASURING TRACE METALS AT THE ULTRA- LOW CONCENTRATIONS FOUND IN NATURAL FRESHWATERS: FACTS AND ARTEFACTS

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OUTLINE

INTRODUCTION AND BACKGROUND

1. Metal-free clean lab environment: justification, theory, design and practice. Successful, sequential air filtration strategies for the establishment of clean labs for reagent preparation, analysis, and sample handling.

2. Clean water and acids. Suitable plasticware and cleaning procedures. Sample handling. Trace and ultra-trace concentrations in perspective: the need to go “low”. Development of “clean intelligence”.

3. Measurement of trace metals using ICP-Sector Field MS (ICP-MS). Integration into the clean lab environment. Sample introduction, calibration, reference materials, mass resolution. Measuring Pb isotope ratios.

APPLICATIONS

4. Polar snow and ice cores. Coring, decontamination, sample handling. Effects of global climate change and atmospheric pollution on “average abundance” of trace metals. The special case of Sc and its use as a reference element. Enrichment factors, Pb isotope ratios, and the antiquity of global metal pollution. Snow pit sampling and seasonal variations in pollution sources to the Arctic.

5. Surface waters. Designing an analytical strategy for water samples from streams and lakes. The importance of particulate material. Total versus dissolved concentrations of trace metals: importance of ionic potential. Tracing the sources of atmospheric and aquatic Pb contamination using Pb isotope ratios.

6. Groundwaters. Conventional sampling approaches: strengths and weaknesses. Particles, colloids, filtration and filter blank values. Design of a dedicated groundwater sampling station for the study of an artesian flow system in Springwater Township, Simcoe County: comparison of water samples from wells in stainless steel versus HDPE. Isotopic composition of Pb and its significance. Unleaded water ?

7. Bottled water. Worldwide survey of trace elements in bottled waters; comparison with groundwaters. Effects of packaging: leaching of Sb from PET, leaching of As, Pb, Th and Zn from glass.

8. Sediment pore water. Obtaining pore waters using *in situ* sampling. Evaluation of filters and establishment of blank contributions.

BIOGRAPHICAL SKETCH

William Shotyk received his B.Sc. (Agr.) in Soil Science and Chemistry from the University of Guelph in 1981 and a Ph.D. in Geology from the University of Western Ontario in 1987. Following postdoctoral research at the University of California, Riverside and UWO, he worked at the University of Berne in Switzerland where he completed a Habilitation in Geochemistry, in 1995. After 12 years at the University of Berne, he became Professor at the University of Heidelberg and Director of the Institute of Environmental Geochemistry, in October of 2000. His research group is responsible for Inorganic Environmental Geochemistry, with state-of-the-art metal-free clean lab facilities and sector-field ICP-MS for measuring trace elements and Pb isotope ratios at extremely low concentrations. The main research areas are human impacts on the geochemical cycles of potentially toxic trace elements such as Pb, Sb, As, Cd and Hg, including archives of atmospheric change (ombrotrophic peat bogs and polar ice cores), fate in soils and sediments, and impacts on natural freshwaters. A member of the American Chemical Society, American Geophysical Union, and the Geochemical Society, he has published more than 170 articles, including 130 in refereed journals, as well as in conference proceedings, books, and newspapers.

TARGET AUDIENCE

For anybody seriously interested in the accurate and precise determination of trace elements in water and their significance, the “clean lab” methods developed for studies of polar ice cores are absolutely necessary. This course is designed from the perspective of both earth and environmental sciences for beginners to advanced specialists. Analytical chemists, lab managers, quality control personnel, aquatic chemists, hydrogeologists and toxicologists will be presented with some of the most recent advances and developments in ultratrace analysis.

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