Multielemental determination of GEOTRACES key trace metals by column concentration and ICP-MS

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Al, Mn, Fe, Cu, Zn and Cd are assigned as GEOTRACES key trace metals and their global ocean distributions are going to be determined through a number of cruises. A simple, rapid, accurate and precise method is invaluable for the GEOTRACES section study. However, it has been difficult to determine these metals at the same time due to contamination and interference from major constituents. This work introduces a novel method of solid phase extraction for determination of Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb in seawater by inductively coupled plasma-mass spectrometry (ICP-MS) [1].

The trace metals were collected from 120 mL of seawater using a column of ethylenediaminetriacetic acid-immobilized vinyl polymer resin and eluted with 15 mL of 1 M HNO_3. Then Mn and Fe in the eluate were measured by ICP-MS (ELAN DRC II, Perkin-Elemer) using a DRC mode and the other metals were measured using a normal mode.

By the procedure, the trace metals were collected quantitatively, while >99.9% of alkali and alkaline earth metals in seawater were removed. For each trace metal, the procedural blank was <16% of the mean concentration in the open-ocean, and the precision was <9% in RSD. Moreover, this method was free from contamination even in a non-clean room laboratory. Our values for the trace metals in the certified reference materials of seawater NASS-5 and nearshore seawater CASS-4 agreed with the certified values (except that there is no certified value for Al). This method was also successfully applied to the reference materials of open-ocean seawater produced by the SAFe program. Our Fe concentrations were 5.9 ± 0.7 ng/kg for surface water (S1) and 50.4 ± 2.9 ng/kg for deep water (D2), being in agreement with the interlaboratory average of 5.4 ± 2.4 ng/L and 50.8 ± 9.5 ng/L, respectively. The data for other metals were oceanographically-consistent.

[1] Sohrin *et al.* (submitted) *Anal. Chem.*

Microbial catalysis of jarosite formation under environmentally relevant AMD conditions

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The formation of jarosite in acid mine drainage (AMD) accompanies microbial catalysis of S oxidation associated with reduced sulfidic minerals such as pyrite and pyrrhotite. Little documented information on jarosite formation under environmentally relevant conditions currently exists, despite its increasing interest as a tracer of water and potentially life on other planets, and for mine mitigation strategies. Such information is critical for more accurate understanding of acid/metal leachate generation in AMD systems, and more robust biosignatures for the search for life elsewhere. The objective of this study was to examine the conditions for jarosite formation associated with microbial oxidation of pyrrhotite-rich slurry by a natural AMD microbial enrichment under constrained laboratory conditions. Sterilized slurry (>60% pyrrhotite) from the Xstrata Nickel concentrator (Onaping, ON) was inoculated with the natural enrichment and run parallel to abiotic controls at an initial pH of 6 in batch experiments. Samples were collected at predetermined pH values for sulphate and mineralogical analyses to identify initiation of jarosite formation. Results indicate that microbial processing of the slurry was required for acid generation and mineralogical changes accompanied the pH decrease (XRD). These environmental AMD microbial enrichments catalyzed jarosite formation at pH values of 3.5 in contrast to literature reports of a maximum pH of 3 for jarosite formation. These mineralogical changes will be discussed in conjunction with observed microbial S processing and characterization of the environmental enrichment consortia.