

Division of Environmental Chemistry - Hydrospheric Environment Analytical Chemistry -

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Prof LI, Yuan-Hui University of Hawaii, USA, 24–29 April 2008

Scope of Research

(i) Biogeochemistry of trace elements in the hydrosphere: Novel analytical methods are developed for trace metals and isotopes. Distribution of trace elements in the hydrosphere and its effects on ecosystem are investigated. The study also covers hydrothermal activity, deep biosphere and paleocean.

(ii) Ion recognition: Novel ligands and ion recognition systems are designed, synthesized and characterized.

Research Activities (Year 2008)

Publications

Sohrin Y, Urushihara S, Nakatsuka S, Kono T, Higo E, Minami T, Norisuye K, Umetani S: Multielemental Determination of GEOTRACES Key Trace Metals in Seawater by ICPMS after Preconcentration Using an Ethylenediaminetriacetic Acid Chelating Resin, *Anal. Chem.*, **80**, 6267-6273 (2008).

Lai X, Norisuye K, Mikata M, Minami T, Bowie AR, Sohrin Y: Spatial and Temporal Distribution of Fe, Ni, Cu and Pb along 140°E in the Southern Ocean during Austral Summer 2001/02, *Mar. Chem.*, **111**, 171-183 (2008).

Kurahashi K, Umetani S, Sohrin Y: Solvent Extraction of Divalent Metal Ions with Azacrown Ether Substituted Acylpyrazolones, *Anal. Sci.*, **24**, 225-229 (2008).

Presentations

Multielemental Determination of GEOTRACES Key

Trace Metals by Column Concentration and ICP-MS, Norisuye K, Urushihara S, Nakatsuka S, Kono T, Higo E, Minami T, Sohrin Y, 18th Annual V.M. Goldschmidt Conference, 14 July 2008.

Precise Mo Isotopic Analysis on Pacific and Antarctic Seawater, Nakagawa Y, Firdaus ML, Norisuye K, Sohrin Y, Irisawa K (Tokyo Institute of Technology), Hirata T (Tokyo Institute of Technology), 18th Annual V.M. Goldschmidt Conference, 14 July 2008.

Behaviors of Incompatible Elements in the Western North Pacific Ocean, Firdaus ML, Nakagawa Y, Norisuye K, Sohrin Y, 18th Annual V.M. Goldschmidt Conference, 15 July 2008.

Design of Extraction Reagents of High Selectivity Based on Steric Factors, Umetani S, Fukui Y, Uezu K (University of Kitakyushu), International Solvent Extraction Conference, 16 September 2008.

Multielemental Determination of the Bioactive Trace Metals in Seawater by Solid Phase Extraction-ICPMS and Its Application to the Bering Sea

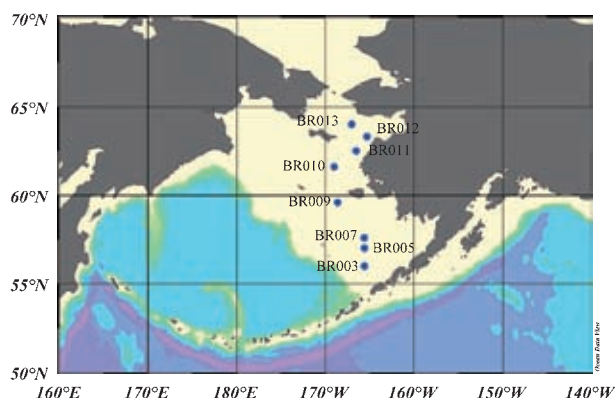


Figure 1. Location of stations.

The temporal and spatial distributions of trace metals in seawater are controlled by biological, chemical and physical processes. Al, Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb, which are referred to as bioactive trace metals, strongly influence marine organisms. Since direct determination of these metals is not possible due to the very low concentrations and the interference from major ions, it is necessary to separate and concentrate them. Solid phase extraction with chelating absorbents, such as iminodiacetic acid chelating resin (Chelex 100), vinyl polymer resin-immobilized 8-hydroxyquinoline (TSK-8HQ), fluorinated metal alkoxyde glass-immobilized 8-hydroxyquinoline (MAF-8HQ), have been widely used for the preconcentration. However, it is difficult for these adsorbents to collect Mn quantitatively and to remove alkali and alkaline earth metals. We have developed a preconcentration method of Al, Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb from seawater using a novel chelating resin with ethylenediaminetriacetic acid group, NOBIAS CHELATE-PA1 (Hitachi High-Technologies Co. Ltd.), packed in PFA tubes.⁽¹⁾ This is the unique method that realize the quantitative collection of these metals without contamination and the removal of alkali and alkaline earth metals. We applied this method to

elucidate the spatial distribution of trace metals in the Bering Sea.

The Bering Sea, which is located between the Aleutian Islands and the Bering Strait, has continental shelf in the eastern area and a deep basin in the western area. The eastern area shows the highest biological productivity in the world, whereas the western area is characterized by high-nutrient low-chlorophyll. Seawater samples were collected from 8 stations in the eastern Bering Sea during the MR00-K06 cruise of R/V Mirai using a CTD carousel on which Niskin-X samplers were mounted (Figure 1). Filtered and unfiltered seawater samples were acidified to pH 2.2 with HCl. These were used for the determination of dissolved (D) and acid-dissolvable (AD) metals, respectively.

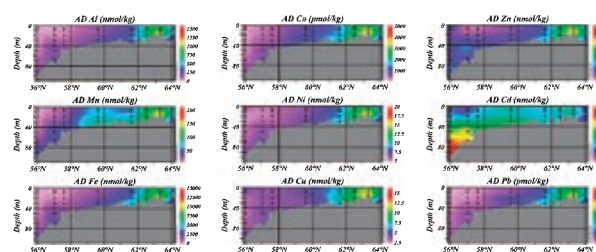


Figure 2. Sectional distributions of acid-dissolvable trace metals in the Bering Sea.

Figure 2 shows the sectional distribution of AD species. The AD species include D and labile particulate species (such as those adsorbed onto iron oxyhydroxides and clay minerals, and those incorporated into organisms) which dissolve during storage. The concentrations of the AD species are high at BR011 and 012. These stations are located near the estuary of the Yukon River, where salinity was low because of the inflow of the river water. Therefore, the AD species should be supplied by the river. AD-Cd showed maximum above the bottom of BR003 and 005. The concentration of chlorophyll *a* was highest in surface water at BR005 among all stations. Therefore, it is likely that Cd was taken up by phytoplankton, precipitated with sinking particles, and remineralized in the depth.

[1] Y. Sohrin *et al.*, *Anal. Chem.*, **80**, 6267 (2008).

Grants

Sohrin Y, Development of Redox Proxy Using Molybdenum and Tungsten and Reconstruction of Environmental Changes in the Japan Sea, Challenging Exploratory Research, 1 April 2008–31 March 2010.

Norisuye K, Development of a Method for Determination of Divalent Iron and Elucidation of the Behavior in the Ocean, Steel Industry Foundation for the Advancement of Environmental Protection Technology, 1 November 2007–31 October 2009.