

# Division of Environmental Chemistry – Hydrospheric Environment Analytical Chemistry –

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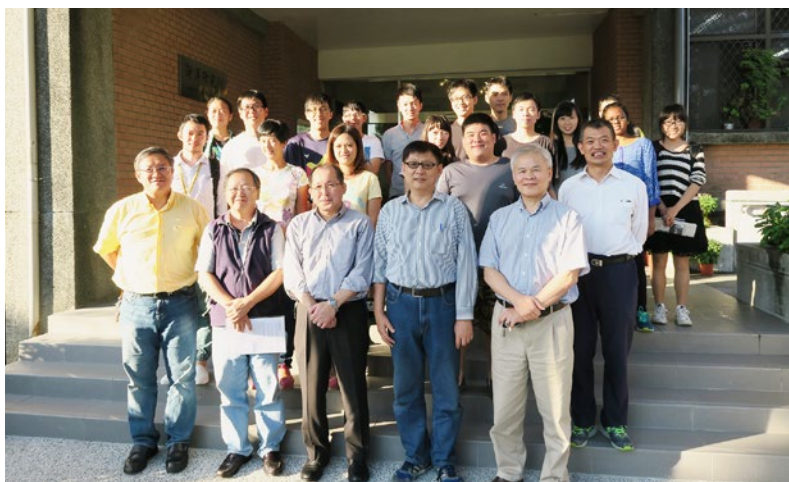
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## Scope of Research

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

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



### KEYWORDS

Marine Chemistry    Analytical Chemistry  
Trace Elements    Stable Isotopes  
Metal Ion Recognition

## Selected Publications

Nakashima, Y.; Shimizu, A.; Maruo, M.; Sohrin, Y., Trace Elements Influenced by Environmental Changes in Lake Biwa: (I) Seasonal Variations under Suboxic Hypolimnion Conditions during 2007 and 2009, *Limnol.*, **17**, 151-162 (2016).

Sohrin, Y.; Nakashima, Y.; Maruo, M., Trace Elements Influenced by Environmental Changes in Lake Biwa: (II) Chemical Variations in the Hypolimnion over the Last Half-century, *Limnol.*, **17**, 163-173 (2016).

Minami, T.; Konagaya, W.; Zheng, L.; Takano, S.; Sasaki, M.; Murata, R.; Nakaguchi, Y.; Sohrin, Y., An Off-line Automated Preconcentration System with Ethylenediaminetriacetate Chelating Resin for the Determination of Trace Metals in Seawater by High-resolution Inductively Coupled Plasma Mass Spectrometry, *Anal. Chim. Acta*, **854**, 183-190 (2015).

Takano, S.; Tanimizu, M.; Hirata, T.; Sohrin, Y., Isotopic Constraints on Biogeochemical Cycling of Copper in the Ocean, *Nat. Commun.*, **5**, [5663-1]-[5663-7] (2015).

Vu, H. T. D.; Sohrin, Y., Diverse Stoichiometry of Dissolved Trace Metals in the Indian Ocean, *Sci. Rep.*, **3**, [1745-1]-[1745-5] (2013).

Firdaus, M. L.; Minami, T.; Norisuye, K.; Sohrin, Y., Strong Elemental Fractionation of Zr-Hf and Nb-Ta across the Pacific Ocean, *Nature Geosci.*, **4**, 227-230 (2011).

## Stoichiometry of Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb in Seawater around the Juan de Fuca Ridge

We have studied the distributions of Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb around the Juan de Fuca Ridge (JdFR) in total dissolvable (td), dissolved (d), and labile particulate (lp) fractions, which represent a fraction in unfiltered samples, filtered samples through an AcroPak capsule filter, and the difference between td and d, respectively. Al and Fe were dominated by lp-species, while Ni, Zn, and Cd were dominated by d-species with undetectable amounts of lp-species. Major findings in this study are as follows: (i) The continental margin (CM) provided large sources of Al, Mn, Fe, and Co from the surface to ~2000 m in depth. The supply from CM caused high surface concentrations of dMn and dCo, a subsurface (100–300 m depth) maximum of dCo, and intermediate (500–2000 m depth) maxima of lpAl and lpFe. The supply of dFe from CM was ~10 times that from the high-temperature hydrothermal activity at station BD21, which is located at ~3 km from the Middle Valley venting site and ~200 km from Vancouver Island. (ii) DPb was maximum at the top layer of North Pacific Intermediate Water, probably owing to isopycnal transport of anthropogenic Pb via advection of subducted surface waters. Although dCo and dPb had different sources in the upper water, they showed a strong linearity below 300 m ( $r^2 = 0.95$ ,  $n = 38$ ), indicating concurrent scavenging. (iii) A high-temperature hydrothermal plume occurred at a depth of 2300 m at BD21, accounting for maxima of dAl, dMn, dFe, lpCu, and lpPb and a minimum of dCu. (iv) Strong bottom maxima of lpAl, lpMn, lpFe, lpCo, and

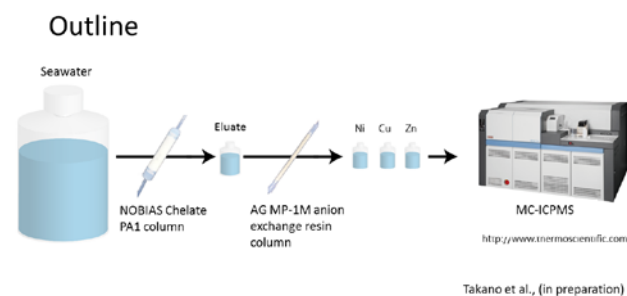


**Figure 1.** Members of the Hakuho-Maru KH-12-4 cruise, during which samples for this work were collected.

lpPb occurred above the abyssal plain at the western foot of the JdFR, indicating resuspension of sediments. However, bottom maxima of d-species were apparent only for dAl and dCu.

## A Simple and Rapid Method for Isotopic Analysis of Nickel, Copper, and Zinc in Seawater Using Chelating Extraction and Anion Exchange

Stable isotope ratios of Ni, Cu, and Zn are powerful tools to elucidate biogeochemical cycling of the trace metals in the ocean. However, analytical difficulties have retarded development of isotopic study of these metals. Especially, isotopic analysis of seawater Ni is troublesome, because Ni is not retained on anion exchange resin and passed through the column with seawater matrix. We have developed a simple and rapid method for simultaneous analyses of Ni, Cu, and Zn isotope ratio in seawater using NOBIAS Chelate-PA1 resin and anion exchange resin. A NOBIAS Chelate-PA1 resin column quantitatively collected Ni, Cu, and Zn from seawater and effectively removed seawater matrix. Subsequent anion exchange purified Ni, Cu, and Zn from each other. The blanks of this method (0.22 ng for Ni, 0.29 ng for Cu, and 0.53 ng for Zn) were sufficiently low to determine isotope ratios of Ni, Cu, and Zn in surface seawater. Using this method, we analyzed GEOTRACES reference seawater samples, i.e., SAFe D1 and SAFe D2, and seawater samples collected from some depths in the subarctic North Pacific. The results were consistent with reported values.



**Figure 2.** Outline of the analytical method.