Division of Environmental Chemistry
– Hydrospheric Environment Analytical Chemistry –

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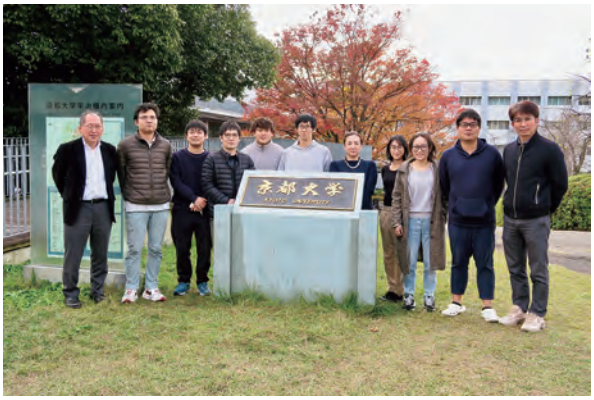
Scope of Research

(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

Recent Selected Publications

Zheng, L.; Minami, T.; Takano, S.: Sohrin, Y., Distributions of Aluminum, Manganese, Cobalt, and Lead in the Western South Pacific: Interplay between the South and North Pacific, *Geochim. Cosmochim. Acta.*, **338,** 105-120 (2022).

Sohrin, Y., Geochemical Study of Trace Metals in the Hydrosphere Based on Stoichiometry and Stable Isotope Ratios, *Chikyukagaku*, **56,** 21-28 (2022) (in Japanese).

Takano, S.; Liao, W.-H.; Ho, T.-Y.: Sohrin, Y., Isotopic Evolution of Dissolved Ni, Cu, and Zn along the Kuroshio through the East China Sea, *Mar. Chem.*, **243,** 104135 (2022).

Nakaguchi, Y.; Sakamoto, A.; Asatani, T.; Minami, T.; Shitashima, K.; Zheng, L.; Sohrin, Y., Distribution and Stoichiometry of Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb in the Seas of Japan and Okhotsk, *Mar. Chem.*, **241,** 104108 (2022).

Alam, M.; Tripti, M.; Gurumurthy, G. P.; Sohrin, Y.; Tsujisaka, M.; Singh, A. D.; Takano, S.; Verma, K., Palaeoredox Reconstruction in the Eastern Arabian Sea since the late Miocene: Insights from Trace Elements and Stable Isotopes of Molybdenum ($\delta^{98/95}$Mo) and Tungsten ($\delta^{186/184}$W) at IODP Site U1457 of Laxmi Basin, *Palaeogeogr. Palaeoclimatol. Palaeoecol.*, **587,** 110790 (2022).

Distribution and Stoichiometry of Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb in the Seas of Japan and Okhotsk

Trace metals play an important role in marine biogeochemistry. However, the detailed distribution of trace metals in the Seas of Japan and Okhotsk remain unknown. Herein, we report the full-depth and section distributions of the dissolved (d), total dissolvable (td), and labile particulate (lp) phases of Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb in seawater samples collected from the Seas of Japan and Okhotsk during the GEOTRACES-Japan program. High lpM/tdM ratios suggest active scavenging in the Seas of Japan and Okhotsk. The lpAl and lpFe species were dominant in tdAl and tdFe, showing a strong positive correlation to each other in the both the Seas of Japan and Okhotsk. The maximum lpAl, lpFe, lpMn, and lpCo concentrations were observed at σ_0 = 26.8–27.0 for dense shelf water (DSW) in the Sea of Okhotsk, implying that a metal source is laterally transported to the western subarctic North Pacific. The high enrichment factors of dMn, dCo, dNi, dCu, dZn, dCd, and dPb in the surface water of the Sea of Japan were attributed to anthropogenic emissions of these metals. In addition, temporal variations of the trace metals were examined in the Sea of Japan. The distribution of dCd did not change significantly during 1984–2010; however, data suggest that lpMn and lpFe exhibited dynamic temporal and spatial variations. This is a collaborative study with the group of Prof. Nakaguchi, Kindai University.

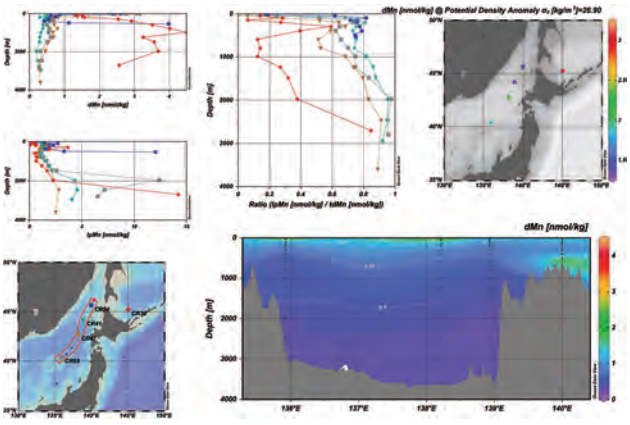


Figure 1. Distribution of dissolved Mn (dMn), labile particulate Mn (lpMn), and the lpMn/total dissolvable Mn (tdMn) ratio in the Seas of Japan and Okhotsk.

Isotopic Evolution of Dissolved Ni, Cu, and Zn along the Kuroshio through the East China Sea

We have investigated the evolution of concentrations and isotope ratios of dissolved Ni, Cu, and Zn from the North Equatorial Current in the western North Pacific to the Kuroshio in the East China Sea. The concentrations and isotope ratios for Ni, Cu, and Zn in the deep water of the East China Sea are similar to those of the western North Pacific. The concentrations of Ni, Cu, and Zn in the Changjiang diluted water (<34.0 of salinity) are 3.0–4.1 nmol/kg, 2.0–2.7 nmol/kg, and 0.5–1.1 nmol/kg, respectively, which are significantly higher than those in the surface water of the western North Pacific, thereby indicating the impact of the riverine input. In the Changjiang diluted water, isotope ratios of Ni range from +0.8 to +1.4‰, which is lower than +1.7‰ observed in the surface water (<150 m) of the western North Pacific. The distribution of concentrations and isotope ratios for dissolved Ni fit with simple mixing among the three endmembers, Changjiang diluted water, Kuroshio surface water, and deep water in the western North Pacific. A mixing model using isotope ratios and concentrations for Ni quantitatively evaluates the sources of dissolved Ni in the East China Sea. The ranges of the isotope ratios are +0.4 to +0.5‰ for Cu and −0.1 to +0.2‰ for Zn in the Changjiang diluted water, which are similar to those in the surface water of the Okinawa Trough but lower than those in the distal ocean, such as the central Pacific. Compared with published data from the global ocean, dissolved Ni, Cu, and Zn are isotopically lighter in the surface water of some coastal regions than in the pelagic regions, indicating that isotopically light Ni, Cu, and Zn are supplied from the continents. This is a collaborative study with the group of Dr. Ho, Academia Sinica, Taiwan.

Figure 2. Seawater sampling during the GEOTRACES Japan KH-15-3 cruise of R/V Hakuho Maru.