

ANNUAL REPORT ON GEOTRACES ACTIVITIES IN JAPAN

May 1st, 2023 to April 30th, 2024

New GEOTRACES or GEOTRACES relevant scientific results

Ueki et al. (2024) reported the distributions of zirconium (Zr), hafnium (Hf), and niobium (Nb) in the Indian Ocean (Japanese GEOTRACES cruise by R/V *Hakuho-maru*, GI04). They discussed the results considering the distributions of silicon (Si), aluminum (Al) and neodymium isotope composition. The concentrations of dZr and dHf in the deep waters of the Indian Ocean were higher than those in the North Pacific Ocean, which is different from nutrients like Si. The surface dZr and dHf distributions were strongly affected by lithogenic inputs. This feature is similar to that of dAl, a good tracer for lithogenic supplies. In deeper layer (<1400 m), the dZr/dHf ratio increased northward, which suggests the preferential removal of dHf over dZr along the water mass age together with the strong lithogenic supply in the Indian Ocean. The authors proposed that dissolved Zr/Hf molar ratio is promising as a tracer for global ocean circulation in the Indian and Pacific Oceans.

Citation: Ueki, R., L. Zheng, S. Takano, and Y. Sohrin, 2024. Distributions of zirconium, hafnium, and niobium in the Indian Ocean: Influence of lithogenic sources on incompatible elements. Marine Chemistry, 260, 104365. doi: <https://doi.org/10.1016/j.marchem.2024.104365>.

GEOTRACES workshops and meetings organized

- The domestic session entitled “Marine Geochemistry” related to GEOTRACES studies was held during the annual meeting of Geochemical Society of Japan 2023 (September 21 – 23, in person at Tokyo University of Marine Science and Technology). We had 14 oral and 11 poster presentations.
- The domestic session entitled “Biogeochemical cycles of trace elements, isotopes, and radionuclides” related to GEOTRACES studies was held during the fall meeting of The Oceanographic Society of Japan (September 25 – 27, 2023, in person at Kyoto University). We had 10 oral and 4 poster presentations.

Outreach activities conducted (please list any outreach/educational material available that could be shared through the GEOTRACES web site)

A special issue was published in the Japanese journal “Chikyukagaku” by the Geochemical Society of Japan (Editorial committee: Hajime Obata, Yoshiko Kondo, Keiji Horikawa, Shotaro Takano, Kazuya Tanaka). 13 review articles (Main text was written in Japanese, Free access) were published.

- Obata, H. et al. “Findings on marine geochemistry of trace elements and their isotopes: recent achievements by GEOTRACES project”
- Nishioka, J. et al. “Building a GEOTRACES global dataset of trace elements and isotopes in the ocean”
- Kumamoto, Y. “Radiocarbon as a tracer for ocean circulation”

- Horikawa, K. “Studies of past ocean circulation based on neodymium isotope analysis”
- Takano, S. “Isotopic distributions of iron, nickel, copper, zinc, and cadmium in the ocean and their analytical methods”
- Sakata, K. et al. “Relationships of emission sources and atmospheric processes of aerosol Fe with its solubility”
- Kanna, N. “Dynamics of trace metals in the Antarctic ice sheet, glaciers and sea ice”
- Mashio, A. S. et al. “Present status and next issues of platinum group elements studies in seawater”
- Marumoto, K. et al. “Distribution and fate of mercury in the ocean”
- Tada, Y. “Microorganisms involved in the mercury transformations in the ocean”
- Kondo, Y. “Dynamics of vitamin B₁₂ and its importance in the ecosystem in the ocean”
- Misumi, K. et al. “Modelling of marine iron cycle”
- Kobayashi, H. “Modelling the ocean carbon cycle during glacial periods”

Cruise

Two GEOTRACES section cruises (GP22), KH-22-7 (30 June - 1 September 2022) and KH-23-2 cruise (1 - 25 June 2023), were conducted by using R/V *Hakuho-Maru* (PI: Hajime Obata). During these cruises, we collected clean seawater samples for trace element analyses in the western Pacific.

Other GEOTRACES activities

New GEOTRACES or GEOTRACES-relevant publications (published or in press)

During the past year, Japan GEOTRACES investigators published a total of 20 peer-reviewed journal articles. The underlined first author is the ECR.

- Alam, M., T. Muguli, G. P. Gurumurthy, M. Arif, Y. Sohrin, A. D. Singh, T. Radhakrishna, D. K. Pandey, and K. Verma, 2023. Hydroclimatic conditions and sediment provenance in the northeastern Arabian Sea since the late Miocene: insights from geochemical and environmental magnetic records at IODP Site U1457 of the Laxmi Basin. *Geological Magazine* 2023, 160 (4), 813-829. doi: 10.1017/S0016756822001273 From Cambridge University Press Cambridge Core.
- Chan, C.-Y., L. Zheng, and Y. Sohrin, 2024. The behavior of aluminium, manganese, iron, cobalt, and lead in the subarctic Pacific Ocean: boundary scavenging and temporal changes. *Journal of Oceanography*, 80 (2), 99-115. doi: 10.1007/s10872-023-00710-8.
- Fukazawa, T., H. Obata, S. Matsuoka, S. Usui and K. Norisuye, 2024. Determination of ultra-trace Te species in open ocean waters based on Mg(OH)₂ coprecipitation, anion exchange resin column separation and inductively coupled plasma sector-field mass spectrometry using a ¹²⁵Te-enriched isotope spike. *Analytica Chimica Acta*, 1300, 342430: doi.org/10.1016/j.aca.2024.342430.
- Hamilton, D. S., A. R. Baker, Y. Iwamoto, S. Gassó, E. Bergas-Masso, S. Deutch, J. Dinasquet, Y. Kondo, J. Llort, S. Myriokefalitakis, M. M. G. Perron, A. Wegmann, J.-E.

Yoon, 2023. An aerosol odyssey: Navigating nutrient flux changes to marine ecosystems. *Elem Sci Anth* 11(1), 00037. <https://doi.org/10.1525/elementa.2023.00037>.

- Ikhsani, I. Y., K. H. Wong, T. J. Kim, A. Mashio and H. Obata, 2024. Biogeochemistry of dissolved trace metals in the Bay of Bengal. *Marine Chemistry*, 260, 104394. doi.org/10.1016/j.marchem.2024.104394.
- Kong X., J. Zhang, Y. Li, S. Otsuka, Q. Liu, and Q. He, 2023. Selenium in the liver facilitates the biodilution of mercury in the muscle of *Planiliza haematocheilus* in the Jiaozhou Bay, China. *Ecotoxicology and Environmental Safety*. doi: 10.1016/j.ecoenv.2023.114981.
- Kondo, Y., N. Takahashi, T. Takatani, T. Suzuki, M. Wada, S. Takeda, and S. A. Sañudo-Wilhelmy, 2024. Temporal variation in vitamin B₁₂ concentration and their impact on phytoplankton composition of surface waters of a coastal ocean off Japan (Ariake Sea). *Journal of Oceanography*, 80, 117-128. <https://doi.org/10.1007/s10872-023-00711-7>.
- Matsuoka, K., T. Tatsuyama, S. Takano, and Y. Sohrin, 2023. Distribution of stable isotopes of Mo and W from a river to the ocean: signatures of anthropogenic pollution. *Frontiers in Marine Science*, 10, Original Research. doi: 10.3389/fmars.2023.1182668.
- Obata, H., A. Mase, N. Kanna, S. Takeda, J. Nishioka and K. Kuma, 2024. Dissolved Fe(II) and its oxidation rates in Kuroshio area, subarctic Pacific and Bering Sea. *Geochemical Journal*, 58, 71–79. doi.org/10.2343/geochemj.GJ24006.
- Sieber, M., N. T. Lanning, X. Bian, S. C. Yang, S. Takano, Y. Sohrin, T. S. Weber, J. N. Fitzsimmons, S. G. John, and T. M. Conway, 2023. The Importance of Reversible Scavenging for the Marine Zn Cycle Evidenced by the Distribution of Zinc and Its Isotopes in the Pacific Ocean. *Journal of Geophysical Research: Oceans*, 128 (4), e2022JC019419. <https://doi.org/10.1029/2022JC019419>. doi: 10.1029/2022JC019419.
- Takano, S., H. Kanamura, and Y. Sohrin, 2024. Multielemental isotopic analysis for trace metals in geochemical samples, part 1: dissolved iron, nickel, copper, zinc, cadmium, and lead in seawater. *ACS Earth and Space Chemistry*, 8 (4), 702-711. doi: 10.1021/acsearthspacechem.3c00305.
- Takano, S., H. Kanamura, and Y. Sohrin, 2024. Multielemental isotopic analysis for trace metals in geochemical samples, part 2: nickel, copper, zinc, cadmium, and lead in sediments, atmospheric particles, and plankton. *ACS Earth and Space Chemistry*, 8 (3), 547-553. doi: 10.1021/acsearthspacechem.3c00306.
- Teresa Nakajima, M., N. Takahata, H. Obata, T. Kagoshima, and Y. Sano, 2024. An easier approach for helium isotope flux estimation in a submerged caldera. *Geochemical Journal*, 58, 2, 46-50.
- Ueki, R., L. Zheng, S. Takano, and Y. Sohrin, 2023. Distributions of zirconium, niobium, hafnium, and tantalum in the subarctic North Pacific Ocean revisited with a refined analytical method. *Geochemical Journal*, 57 (5), 143-154. doi: 10.2343/geochemj.GJ23013.
- Ueki, R., L. Zheng, S. Takano, and Y. Sohrin, 2024. Distributions of zirconium, hafnium, and niobium in the Indian Ocean: Influence of lithogenic sources on incompatible elements. *Marine Chemistry*, 260, 104365. doi: <https://doi.org/10.1016/j.marchem.2024.104365>.

- Wiwit, K. H. Wong, H. Fukuda, H. Ogawa, A. S. Mashio and H. Obata, 2023. Organic complexation of copper in Japanese estuarine waters using reverse titration method. Journal of Oceanography, 79, 335 – 348. doi.org/10.1007/s10872-022-00674-1
- Wong, K. H., H. Obata, T. Kim, H. Tazoe, A. S. Mashio, H. Hasegawa and J. Nishioka, 2024. Dissolved zinc in the western Bering Sea and near Kamchatka Strait: Supplies from coastal sources and transport to the subarctic Pacific. Marine Chemistry, 260, 104375: doi.org/10.1016/j.marchem.2024.104375.
- Yamada, M., 2023. No long-term variation of $^{240}\text{Pu}/^{239}\text{Pu}$ atom ratio in liver of Japanese common squid (*Todarodes pacificus*) collected from seven sea areas around Japan during 2003-2018. Marine Pollution Bulletin, 194, 115347. doi:10.1016/j.marpolbul.2023.115347.
- Yamada, M., A. Suzuki, and N. Iwasaki, 2023. Growth rate estimation by ^{210}Pb chronology in precious corals collected off the southern coast of Japan. Frontiers in Marine Science, 10, 1091594. doi:10.3389/fmars.2023.1091594.
- Zhu, S. J., J. Zhang, T. Matsuno, E. Tsutsumi, S. Kambayashi, K. Horikawa, K. Takayama, M. Inoue, and S. Nagao, 2023. Quantifying the water contribution of subtropical mode water and related isopycnal/diapycnal water mixing in the western Pacific boundary current area using radiocesium: A significant nutrient contribution from subtropical Pacific gyre to the marginal region. Journal of Geophysical Research: Oceans, 128, 4, doi: 10.1029/2022JC018975.

Completed GEOTRACES PhD or Master theses (please include the URL link to the pdf file of the thesis, if available)

- Ryuta Ueki (2024), Marine geochemistry of zirconium, niobium, hafnium, and tantalum in the subarctic North Pacific and Indian Oceans. PhD (Sci), Kyoto University
- Zhu Siteng (2024), Quantifying ocean mixing in the North Pacific and adjacent marginal seas using multiple chemical tracers. PhD (Sci), University of Toyama
- C. Rojubally (2024), Sectional distribution and source contribution of lead (Pb) isotopes in the eastern Indian Ocean. M.S. (Sci), Niigata University
- Kodai Shimizu (2024), Sectional distributions of suspended particulate trace elements in the western North Pacific in relation to sea region characteristics. M. S. (Sci), Niigata University
- Koki Marui (2024), The distributions and behavior of platinum in the aquatic environment. M. S. (Engineering), Kanazawa University
- Tetsuhiro Ueno (2024), Establishment of an analytical method for precious metals in hydrothermal fluid using dithiocarbamate-modified cellulose resin. M. S. (Engineering), Kanazawa University
- Yuki Sakashita (2024), Establishment of analytical method of palladium in marine sediments using isotope dilution-inductively coupled plasma mass spectrometry. M. S. (Engineering), Kanazawa University

GEOTRACES presentations in international conferences

- Chan, C.-Y., L. Zheng, and Y. Sohrin, 2023. Factors affecting the supply and scavenging of trace metals in the subarctic North Pacific Ocean. In Goldschmidt2023, Lyon, France, July, 2023.

- Deng, H., K. Suzuki, I. Yasuda, H. Ogawa, and J. Nishioka, 2024. Phytoplankton responses to iron and macronutrient fluxes from subsurface waters in the western North Pacific. Ocean Sciences Meeting, New Orleans, USA, February 2024.
- Fukazawa, T., H. Obata, and K. Norisuye, 2023. Distribution of Te species in the eastern Indian Ocean. Goldschmidt Conference, Lyon, France, July 2023.
- Fukazawa, T., H. Obata, and K. Norisuye, 2024. Distributions of dissolved Te(IV) and Te(VI) in the eastern Indian Ocean. Ocean Sciences Meeting, New Orleans, USA, February 2024.
- Norisuye, K., Y. Hayashi, H. Obata, T. Gamo, H. Minami, and Y. Nakaguchi, 2023. The sectional distributions of several particulate trace elements in the western South Pacific. Goldschmidt Conference, Lyon, France, July 2023.
- Norisuye, K., H. Kuriyama, S. Kakuta, and H. Obata, 2024. Distributions of dissolved bismuth and lead isotope ratios in the East China Sea and adjacent waters. Ocean Sciences Meeting, New Orleans, USA, February 2024.
- Obata, H. Wiwit, K. H. Wong, C.-J. Lu, H. Fukuda, H. Ogawa, K. Takahashi, A. S. Mashio, and S. Takeda, 2024. Effect of copper-binding organic ligands on phytoplankton growth in Japanese coastal waters, Ocean Sciences Meeting, New Orleans, USA, February 2024.
- Rojubally, C., J. A. Sheba, T. Fukazawa, H. Obata, K. Okamura, K. Nagaishi, T. Ishikawa, and K. Norisuye, 2023. The distribution and origins of Pb isotopes in the Northeast Indian Ocean. Goldschmidt Conference, Lyon, France, July 2023.
- Shimizu, K., T. Fukazawa, H. Obata, J. Nishioka, H. Minami, Y. Nakaguchi, and K. Norisuye, 2024. North-south longitudinal distributions of suspended particulate trace elements in the western North Pacific. Ocean Sciences Meeting, New Orleans, USA, February 2024.
- Toyoshima, E., H. Obata, N. Kanna, and H. Ogawa, 2023. Distributions and biogeochemical cycles of dissolved Mn, Fe, Cu, Zn and Pb in the eastern South Pacific, 17th International Symposium on Water-Rock Interaction and the 14th International Symposium on Applied Isotope Geochemistry, Sendai, Japan, August 2023.
- Ueki, R., L. Zheng, S. Takano, and Y. Sohrin, 2023. Distribution of zirconium, niobium, hafnium, and tantalum in the subarctic North Pacific Ocean and the Indian Ocean. In Goldschmidt2023, Lyon, France, July 2023.
- Zheng, L., T. Minami, C.-Y. Chan, S. Takano, and Y. Sohrin, 2023. Basin-scale distributions of 9 trace metals (Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb) in the entire Pacific Ocean. In Goldschmidt 2023, Lyon, France, July 2023.

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