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Kyoto University
Research activities are concerned with geochemistry, oceanography, limnology and analytical chemistry, which are important basic sciences in order to realize the sustainable society. Major research subjects are as follows: (i) Biogeochemistry of trace elements in the hydrosphere. The study also covers hydrothermal activity and deep biosphere. Major parts of these studies are based on field works. (ii) Iron uptake mechanism of phytoplankton. (iii) Ion recognition.

**Scope of Research**

Research activities are concerned with geochemistry, oceanography, limnology and analytical chemistry, which are important basic sciences in order to realize the sustainable society. Major research subjects are as follows: (i) Biogeochemistry of trace elements in the hydrosphere. The study also covers hydrothermal activity and deep biosphere. Major parts of these studies are based on field works. (ii) Iron uptake mechanism of phytoplankton. (iii) Ion recognition.

**Publications**


**Presentations**


Development of Solid-phase Extraction Method Using Chelating Resin for Precise Isotope Analysis of Mo in Seawater

The behaviors of Mo in oxic environments are different from those in anoxic environments. The degree of isotopic fractionations in reactions of Mo in each environment is also different. Figure 1 shows reported Mo isotope ratios in natural samples. Using the isotopic information, the global material balance and circulation of Mo and the redox status of paleocean can be clearly estimated.

For geochemical studies, the isotope ratios in seawater are important reference values, and therefore precise and accurate analytical methods are required. In reported analytical methods, anion exchange resins have been used for separation and enrichment of Mo. These methods possess high procedure blank and low analytical precision and reliability, because the methods require complicated procedures with concentrated acid for elution. The methods give incomplete separation of major elements in seawater. Because of these reasons, although the reported isotopic ratios of Mo in seawater are scarce, they show a large variation. We have developed a solid-phase extraction method using chelating resin to resolve such problems.

TSK-8HQ[5] was used in a column to concentrate Mo. The sample solution that had been adjusted to pH 2.0 with HCl was passed through the column, and then the adsorbed Mo was eluted by the back flushing of 2 M NH₃. The eluate was then evaporated to dryness using a closed evaporation system, and then Mo was re-dissolved in 5 mL of 0.05% tetramethylammonium hydroxide solution. Mo isotope ratios were determined by multiple collector inductively coupled plasma mass spectrometry (MC-ICP-MS).

Seawater samples were collected from 3 stations in the western North Pacific Ocean during the MR05-01 cruise of R/V Mirai using a CTD carousel on which Niskin-X samplers were mounted. Seawater was filtered through a 0.2 µm Nucleopore filter and acidified to pH 2.2 with HCl.

Mo was quantitatively concentrated from 250 mL seawater with a 50-fold concentration factor through the column extraction and evaporation. Procedure blank was only 0.04% of the concentration of Mo in seawater. The residual ratios of major elements between the eluate and seawater were below 10⁻⁵, and their matrix effects on Mo isotope analysis were negligible. The isobaric interference of ions of coexistent elements was also negligible.

The analytical precision of this method was higher than that of reported methods. Isotope ratios of Mo show uniform vertical profiles at all 3 stations. This is attributed to homogenization of Mo in the ocean, because Mo has a longer mean residence time (~10⁻⁵⁻¹₀⁻⁶ years[6]) than ocean circulation time (~10⁻³ years). The overall variation of isotope ratios of Mo in seawater was smaller than previously reported.

This is a joint research with associate professor Takaumi Hirata, Tokyo Institute of Technology.

Figure 1. Summary of existing Mo isotope data from natural samples.

Figure 2. (a) Structure of TSK-8HQ (b) A micrograph of TSK-8HQ (c) A picture of TSK-8HQ column.

Grants