ANNUAL REPORT ON GEOTRACES ACTIVITIES IN SOUTH KOREA

April 1st, 2019 to March 31st, 2020

New GEOTRACES or GEOTRACES relevant scientific results

• GEOTRACES-related research is continuing in South Korea in a 3rd year. The Korean trace-metal communities in Korea Institute of Ocean Science and Technology (KIOST) reported a first result of trace element data from 2017-2018 Indian Ocean cruise based on clean sampling using a Korean 5000t grade research vessel, R/V *Isabu*. In this work, S.H. Kim et al. (2019, *Ocean Science Journal*) also reported an inter-comparison results of trace elements in crossover station in Indian Ocean (below figure, lower left). and as technical notes, they also noted some technical matters that happen in the process of operating PRISITINE UCC.



Figure 1. Photographs of operating the PRISTINE UCC at sea and of subsampling (upper left). Sampling station in the Indian Ocean (yellow dots) (Apr 2018. Yellow star (station 19) indicates the GEOTRACES crossover station ($69.54^{\circ}E-5.16^{\circ}S$) where samples were also collected in 2017. Yellow dotted arrow line denotes the cruise track (upper center). Intercomparison results at the Indian Ocean crossover station ($69.54^{\circ}E-5.16^{\circ}S$) where samples were also collected in 2017. Yellow dotted arrow line denotes the cruise track (upper center). Intercomparison results at the Indian Ocean crossover station ($69.54^{\circ}E-5.16^{\circ}S$). Pink dots denote previous results from a Japanese GEOTRACES cruise (2009-2010), and blue and green dots denote the results from this study, i.e., the 2017 and 2018 cruises of R/V Isabu, respectively (lower left). Contour maps of dissolved trace element concentrations (Mn, Cr, Ni, Cu, V, Co, Pb, and Nd as LREE) along the western Indian Oceans ($60^{\circ}E$ and $68^{\circ}S$) (upper right). The direction of contour (left to right) is the same as the cruise track in Figure 2. Longitudinal distributions of dissolved Cd and PO4 3- along the western Indian Ocean transect ($60^{\circ}E$ and $68^{\circ}S$). The direction of contour (left to right) is the same as the cruise track in Figure 2 (lower right).

• Cho et al. (2019, *Geophysical Research Letters*) presented a nutrient fluxes in the Northwest Pacific Ocean (below left figure), using a radioactive Radium tracers. The cross shelf fluxes are estimated to be approximately 40% of the atmospheric depositional flux of nitrogen and 2 orders of magnitude greater than that of phosphorus. These results suggest that the cross shelf fluxes of nutrients are an important, yet previously

underappreciated, pathway of nutrients to the North Pacific Ocean, controlling carbon sequestration and biological production.

Because the shelf fluxes of nutrients were estimated to be approximately 10%–20% of the nutrient fluxes from the subsurface layer, this pathway seems to play a measurable role in new production and carbon sequestration. So their approach of estimating cross shelf nutrient fluxes using ²²⁸Ra as a tracer can be applied to other major continental regions to scale up our results to the global scale.



Figure 2. The study areas and schematic diagrams for the (a) DIN and (b) DIP inputs from various sources to the North Pacific Ocean (right figures). The atmospheric depositional flux of P to the North Pacific is the total phosphorus flux. The fluxes from the subsurface layer by water mixing in the North Pacific Ocean gyre are from literatures. Fluxes of DIN and DIP through the Changjiang River to the northwest Pacific Ocean are from literatures. DIN = dissolved inorganic nitrogen; DIP = dissolved inorganic phosphorus.

GEOTRACES or GEOTRACES relevant cruises

• A cruise (R/V *Isabu* from Republic of Korea) were conducted in East/Japans Sea (Mar. 2020)



Figure 3. The trace element-clean sampling stations (with blue dot, left) and actual cruise tracks of two-sectional lines (E- and S- Line) (right) with R/V Isabu in the East/Japan Sea (Mar. 2020) cruise. The trace element measurements are still ongoing. Here, we got a radioactive tracer 234 Th data by an onboard measurements of dissolved-/particulate 234 Th.

New projects and/or funding

• "Study on biogeochemical behavior trace elements in the ocean based on chemical species" funded by National Research Foundation of Republic of Korea (PI: Dr. Intae Kim, personal projects)

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

- Kim, S. H., Ra, K., Kim, K. T., Jeong, H., Lee, J., Kang, D. J., ... & Kim, I. (2019). *R/V Isabu-Based* First Ultraclean Seawater Sampling for Ocean Trace Elements in Korea. *Ocean Science Journal*, 1-12.\
- Cho, H. M., Kim, G., Kwon, E. Y., & Han, Y. (2019). Radium Tracing Cross Shelf Fluxes of Nutrients in the Northwest Pacific Ocean. *Geophysical Research Letters*, 46(20), 11321-11328.
- Kwon, H. K., Kim, G., Han, Y., Seo, J., Lim, W. A., Park, J. W., ... & Han, I. S. (2019). Tracing the sources of nutrients fueling dinoflagellate red tides occurring along the coast of Korea using radium isotopes. Scientific reports, 9(1), 1-9.
- Kim, I., Kim, S. H., & Kim, G. (2020). Anthropogenic gadolinium in lakes and rivers near metrocities in Korea. Environmental Science: Processes & Impacts.

GEOTRACES presentations in international conferences

- Jeong, H., Lee, J., Ra, K., Kim, I., KIm, K. T., Choi, J. Y., ... & Kang, D. J. (2019). Distribution of dissolved trace elements in seawater using ultraclean CTD on the *R/V ISABU* from the East Sea, Korea. AGUFM, 2019, OS33B-1790.
- Kim, I. (2019). Substantial gadolinium enrichments in lake and river near metrocities in Korea. AGUFM, 2019, H41J-1842.
- Han Y., Cho H. M. and Kim G. (2019.10) Estimating the vertical fluxes of nutrients using 228Ra as a tracer in the East/Japan Sea, PICES-2019, Victoria, Canada
- Lee H., Kim S.H., Kim I., Hong G.H. (2019.09) ENVIRA 2019, Prague, Ceczh
- Seo H. J., Kim G., Kim Y. I. and Kim I. (2019.08) The atmoshperic depositional fluxes of seawater-dissolvable Pb in the East/Japan Sea estimated using a 210Pb tracer, Goldschmidt 2019, Barcelona, Spain.
- Cho H. M. and Kim G. (2019.08) The Flux of nutrients in continental shelf waters to the Northwest Pacific Ocean, Goldschmidt 2019, Barcelona, Spain.
- Kim I., Lee, H. and Kim S.H. (2019.08) Latitudinal Distributions of 234Th in the Upper Western Indian Ocean, Goldschmidt 2019, Barcelona, Spain.

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