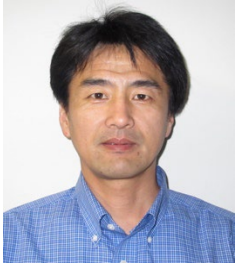
【Grant-in-Aid for Scientific Research (S)】

Broad Section K



Title of Project : Formation of water nutritional property including iron and silicate at the termination of global ocean conveyor belt

NISHIOKA Jun
(Hokkaido University, Institute of Low Temperature Science, Associate Professor)

Research Project Number : 21H05056 Researcher Number : 90371533
Term of Project : FY2021-2025 Budget Allocation : 145,400 Thousand Yen
Keyword : iron, silicic acid, chemical properties, North Pacific, diatom

【Purpose and Background of the Research】

The growth of diatom in the North Pacific supports fishery resources and CO_2 absorption by biological pump. For the diatom growth, silicic acid (Si) is essential for the formation of their outer frustule. In addition, diatoms require a higher amount of iron (Fe) than other phytoplankton. Therefore, the key to diatom become dominant species in the surface ocean is how Si and Fe are supplied to the ocean surface layer in a higher ratio to other nutrients such as nitrate (N) and phosphate (P) (High Si and Fe chemical property). This study aims to elucidate the mechanisms that control the chemical properties of Fe and nutrients that support the diatom growth in the North Pacific.

Our research group has previously shown that the formation of high nutrient (N and P) pools in the North Pacific intermediate water (NPIW) layer and the mixing that occurs at the straits play an important role in connecting intermediate and surface nutrients. Si dissolves at deeper depths and should be removed from this surface-intermediate layer loop. However, the NPIW is known as Si-rich water mass in the world and supporting the production of diatoms in the surface layer. Here, there is fundamental question, "Why is the North Pacific so rich in Si?" has not been clarified. In addition, it has been found that Fe is supplied from the sediments of the Okhotsk Sea continental shelf and is transported over long distances by the NPIW circulation driven by sea ice formation, but “Why Fe, which is easily removed, stays in the NPIW and is transported over long distances” is still unclear. In this study, we will try to understand "Why does the NPIW become a Si and Fe rich water mass?” and elucidate the mechanism of diatom growth in the western North Pacific and the Sea of Okhotsk.

【Research Methods】

Develop a dataset of nutrients (Fe, Si, N, P) in the NPIW circulation region, including the marginal seas of the Russian EEZ.

Two hypotheses will be evaluated in order to clarify why the NPIW becomes Si-rich. Hypothesis 1 assumes that Si is taken up from the continental shelf from the eastern to northern part of the Sea of Okhotsk into the NPIW circulation, and we will test this hypothesis through new observations and analysis of data sets. Hypothesis 2 assumes that Si is taken into the NPIW circulation from deep water with the world's highest Si concentration in the western Bering Sea basin, and will be verified through observation.

- In order to clarify the mechanism of long-distance transport of Fe from the continental shelf of the Sea of Okhotsk to the North Pacific Ocean, we will conduct the chemical speciation study for Fe in the NPIW.
- In order to clarify the mechanism of diatom growth in the western North Pacific and the Sea of Okhotsk, we will measure the nutrient flux ratio from the intermediate layer to the surface layer and the physiology of diatoms in the surface layer in the off-shore of Sanriku Japan and the southern Sea of Okhotsk.

【Expected Research Achievements and Scientific Significance】

This study will quantitatively reveal the mechanisms that control the chemical properties of Fe and nutrients that support the diatom growth in the North Pacific, where is located at the end of the global ocean conveyor belt. This study also will be able to predict how future sea ice loss and weakened intermediate circulation due to global warming will affect to the biological production. This study will lead to the direction of "Conserve and sustainability use the oceans, seas and marine resources for sustainable development" as stated in SDG 14 "Life below water" of the United Nations Sustainable Development Program. It will also contribute to the UN Decade of Ocean Science for sustainable development, which will be undertaken by the United Nations over 10 years starting in 2021 to achieve SDG 14, by providing scientific knowledge.

【Publications Relevant to the Project】

- Nishioka, J., et al., Sub-polar marginal seas fuel the North Pacific through the intermediate water at the termination of the global ocean circulation, *Proc. Natl. Acad. Sci. USA*, 117 (23) 12665-12673, doi:10.1073/pnas.2000658117, (2020).
- Nishioka, J., et al., A review: iron and nutrient supply in the subarctic Pacific and its impact on phytoplankton production, J. Oceanogr., doi:10.1007/s10872-021-00606-5, (2021).
-

【Homepage Address and Other Contact Information】

https://nishioka48.wixsite.com/nishioka