Importance of the intermediate water nutrient pool and mixing around island chains for constructing HNLC region in the subarctic Pacific

*Jun Nishioka[1,2], Hajime Obata[3], Toru Hirawake[2,4], Youhei Yamashita[5], Hiroshi Ogawa[3], Ichiro Yasuda[3]

1. Institute of low temperature sciences, Hokkaido University, 2. Arctic Research Center, Hokkaido University, 3. Atmosphere and Ocean Research Institute, The University of Tokyo, 4. Faculty of Fisheries Sciences, Hokkaido University, 5. Faculty of Environmental Earth Science, Hokkaido University

A comprehensive and correct understanding of the biogeochemical system at the termination of the global ocean conveyor belt circulation is critical for understanding the global carbon cycle and its changes in geological time scale. Comprehensive observed data of macro-nutrients in the subarctic Pacific and marginal seas indicate the processes that determine the chemical properties of intermediate waters. In the western Bering Sea basin, intermediate water, which is extremely rich in phosphate (PO_4) but low in dissolved Oxygen (DO), was observed in the wide density range of 26.6–27.6 σ_θ. The calculated percentage of regenerated (reg-) PO_4 out of the total PO_4 ((AOU×$R_{P:DO}$)/observed PO_4×100) in the intermediate water indicates that more than half the total PO_4 in the density range of 26.8–27.6 σ_θ is reg-PO_4. The intermediate water with high proportion of the reg-PO_4 is also observed in the same density range in the subarctic Pacific, indicating that the reg-PO_4-rich intermediate water in the Bering sea basin is widely propagated in the subarctic Pacific trough the intermediate water circulation. That is, high nutrients are pooled in the subarctic intermediate water (26.8–27.6 σ_θ); we henceforth call the water the “subarctic intermediate nutrient pool (SINP)”. The formation of the chemical properties of the SINP can only be explained by the consumption of DO and regeneration of PO_4, as particulate organic matter that sink from the surface productive areas decomposes during the intermediate water circulation in the subarctic Pacific and its marginal seas. The enhanced mixing around the Kuril and the Aleutian island chains, combined with winter surface mixing, plays an important role in the supply of nutrient-rich waters from the SINP to the surface and in maintaining HNLC waters in the surface layer of the subarctic Pacific. The intermediate water formation processes play a major role in the connection of nutrients between the deep water and the surface water above it, and sustain biological production, at the termination of the global nutrient circulation.

Keywords: subarctic Pacific, North Pacific Intermediate Water, nutrient pool

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