

Particle flux and paleoceanographic studies in the subarctic Pacific and the Arctic Ocean

TAKAHASHI, Kozo^{1*}

¹Hokusei Gakuen University

Particle flux studies employing time-series sediment traps have been very useful in obtaining novel knowledge concerning the environmental conditions in ever changing upper water columns of the subarctic Pacific since there had essentially been no such information available prior to our attempt. We employed T/S Oshoro-maru of the Hokkaido University in deploying the sediment traps in two remote areas of the subarctic Pacific during 1989-2010, for >20 years: one in the pelagic central subarctic Pacific (49.5 degree N, 174 degree E) and the other at a hemipelagic site of the Aleutian Basin of the Bering Sea (53.5 degree N, 177 degree E). Major biogenic particles in the flues include siliceous shells such as diatoms, radiolarians, and silicoflagellates as well as carbonate shells such as coccolithophores, foraminifers.

These shell-bearing plankton particles are useful in identifying detailed environmental conditions concerning seasonal and inter-annual changes. In particular, the effectiveness of biological pumps has been clarified, showing uptake of atmospheric CO₂ into the upper water columns at a different extent depending of the sites for the first time. Another important aspect of the biogenic particles is initial fossilization process during the settling phase in the water column, which also will be discussed.

Furthermore, application of what had been learnt from the particle flux studies to the sediment records of the past climate changes has been quite a challenge, but rewarding. Integrated Ocean Drilling Program (IODP) Expedition 302 (Arctic Coring Expedition: ACEX) in the vicinity of the North Pole at 88 degree N on the Lomonosov Ridge provided an opportunity of studying the middle Eocene environmental conditions of the paleo-Arctic. The conditions revealed for the first time mainly by siliceous microfossils such as diatoms, silicoflagellates, ebridians and chrysophytes are: fresh water at the top, brackish water next within the euphotic layer, and salty marine water supplied from the outside palegic realm. Another important aspect of the paleoceanographic exploration had been focused on the Bering Sea as IODP Expedition 323, for which the author proposed during the ODP era and materialized during the IODP era after 14 years of drilling preparation effort. The successful drilling down to ca. 5 Ma led to novel knowledge of many aspects such as evolution of sea-ice, the linkages both to the Pacific Ocean and the Arctic Ocean through the Beringian gateway. The Bering Sea drilling data linking to the intensification of the Northern Hemisphere Glaciation (NHG) ca. 2.7 Ma as well as the Mid-Pleistocene Transition (MPT) during 1.2-0.8 Ma are of extremely of interest and will be discussed in details.

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