

Chemical Oceanography of the Japan Sea, a Unique Marginal Sea in the Northwestern Pacific

Toshitaka Gamo

Atmosphere and Ocean Research Institute, the University of Tokyo

The Japan Sea is a semi-closed marginal sea in the northwesternmost Pacific, surrounded by the Eurasian Continent and the Japanese archipelago. Four straits which connect the Japan Sea with the surrounding seas (northwestern Pacific Ocean, Okhotsk Sea, and East China Sea) have all shallow sills with the maximum depth of only ~130 m, much shallower than the greatest depth of the Japan Sea of ~3,700 m. Such a bathymetric feature allows no inflow and outflow of deep and bottom waters between the Japan Sea and the surrounding seas. Significantly low potential temperature ($<0.1^{\circ}\text{C}$) and high dissolved oxygen concentration ($>200\ \mu\text{M}$) of the bottom water suggest active ventilation from surface to bottom in the northern Japan Sea, where severe winter monsoon from Siberia could form cold and saline surface seawater to sink toward the bottom, driving a unique thermohaline circulation system. The timescale of the abyssal circulation has been estimated to be an order of 100-200 years using radioactive tracers such as ^{14}C , ^3H and ^{129}I . The Japan Sea is often called “a miniature ocean” due to its independent deep convection system.

Long-term observations these 30 years in the Japan Sea have clarified gradual but significant changes of physico-chemical characteristics of the bottom water, probably associated with the global warming. We have found that the bottom O_2 concentration has been decreased by as much as 10% since 1977, which suggests an imbalance between the O_2 supply by the surface water sinking and the in situ O_2 consumption for organic matter decomposition. The O_2 decrease strongly suggests the decline or cessation of the O_2 -rich surface water sinking. The reduction in abyssal ventilation generally leads to a decrease in the nutrient supply by upwelling to the surface, which might cause significant change to the marine food web through the deterioration of new production. The Japan Sea could be regarded as a warning canary for the global environmental change on planet Earth, and further monitoring of the Japan Sea is desirable, not only from geochemical but also biological and ecological points of view.