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Iron supply processes which support biological production in the western subarctic Pacific

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Iron is an essential nutrient and plays an important role in the control of phytoplankton growth. Atmospheric dust has been thought to be the most important source of iron, supporting annual biological production in the Western Subarctic Pacific (WSP). We argue here for another source of iron to the WSP. Multi-year (2003-2008) time series observations along the A-line provided information on the temporal variability of the dissolved iron (diss-Fe) concentration in the Oyashio region of the western subarctic Pacific and the data indicate that an annual cycle of surface diss-Fe occurs every year. Diss-Fe was supplied into the surface water in this region every winter and supports the spring phytoplankton bloom after development of the thermocline. The diss-Fe concentration was drawn down during the phytoplankton bloom period, and was depleted in summer in some water masses. Then diss-Fe increased from autumn to winter with the increasing depth of the surface mixed layer. The high diss-Fe concentrations in the surface layer in winter were controlled by mesoscale oceanic intrinsic processes, such as vertical winter mixing and horizontal Fe-rich intermediate water transport. Difference in magnitude of the winter mixing processes among different water masses caused the heterogeneous distribution of diss-Fe concentration in the surface layer. Moreover, the vertical section profiles along a cross-Oyashio transect showed the occurrence of Fe-rich intermediate water, and upward transport of materials from the intermediate water to the surface layer via winter mixing processes are important mechanisms to explain the high winter surface diss-Fe concentrations. Additionally, the substantially higher diss-Fe/NO3 ratio in the winter surface layer in this studied area than the other HNLC region indicating that the winter surface water in the Oyashio and the Oyashio-Kuroshio transition zone has a high potential to stimulate phytoplankton growth.

Keywords: ocean, iron, supply processes, phytoplankton