Plant biomarker records for the last 120 kyrs in the northwestern Pacific off central Japan

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Plant biomarkers were investigated in two cores of Nishishichitou Ridge located in the northwestern Pacific off central Japan to assess changes in paleoproduction patterns of phytoplanktons and to reconstruct the variations of transport fluxes of terrestrial materials from land to sea surface over the last 120 kyears. It was found that fluxes of alkenone (Gephyrocapsacean algae marker) and dinosterol (dinoflagellate marker) were tended to be increase during glacial period and decrease during interglacial periods. The fluctuations were synchronous with those of terrestrial biomarkers off central Japan, and thus, increase of productivity in sea surface were caused by the increace of terrigenous transport fluxes to sea surface off central Japan.

A knowledge of long-term changes in productivity and spatial distributions of individual types of marine phytoplanktons, such as calcareous and siliceous phytoplanktons, in the sea surface layer is important for understanding the interation between climatic changes associated with carbon cycling and marine biogeochemical processes. Recently, the past changes in the primary productivity of individual phytoplanktons were reconstructed by the plant biomarkers in marine sediments in several ocean regions. However, there have been few studies for evaluating the paleoproductivity in sea surface of northwestern Pacific regions. In this study, plant biomarkers were investigated in two cores (KT92-17 St. 14 and St. 20) of Nishishichitou Ridge located in the northwestern Pacific off central Japan to assess changes in paleoproduction (sedimentation) patterns of primary producers over the last 120 kyears. Analysis of alkenone thermometry in St. 20 core was made on approximately 1-2 kyear basis for 120 kyears in the present study. In addition, analyses of terrestrial plant biomarkers were investigated to reconstruct the variations of transport fluxes of terrestrial materials from land to sea surface.

Mass accumulation rates (MAR) of total organic carbon (TOC) in both St. 14 and St. 20 cores were tended to increase during glacial periods (oxygen isotope stages (OIS 2 and 4) and to decrease during interglacial periods (OIS 1, 3 and 5), which especially observed the pronounced maxima (ca. 280 mg/cm2/kyr) for the last glacial maximum (LGM) during OIS 2 in St. 14. MARs of alkenone (Gephyrocapsacean algae marker) and dinosterol (dinoflagellate marker) were tended to be high value during glacial period and to be low value during interglacial, which agreed with the variation pattern of MARs of TOC. Therefore, fluctuations of paleoproductivity for Gephyrocapsacean algae and dinoflagellate off central Japan could be concordant with global climatic glacial-interglacial cycle. MARs of brassicasterol, which has been used as diatom indicator while the Gephyrocapsaceae also synthesized, were found to be similar to those of alkenone in both cores. In addition, diatom paleoproductivity was reconstructed from the analyses of highly branched isoprenoid (HBI) alkenes. Only C25 monounsaturated (C25: 1) HBI alkenes could be detected in all sedimentary layers of both cores, and MARs of the compound were insignificantly varied throughout 120 kyears. The results indicated that diatom production off central Japan was possibly independent of climatic glacial-interglacial variation in the sea surface, although the evaluation of diatom paleoproductivity from biomarkers remains to be elucidated.

MARs of terrestrial plant biomarkers (long-chain (C27-C33) n-alkanes and (C26-C30) fatty acids) in both cores showed the pronounced maxima during the OIS 2. These trends coincided with those in Japan Sea as reported previously (Ishiwatari et al., 1994). It was suggested that increase of terrigenous fluxes in OIS 2 indicated that the wind strength of the westerlies in the northwestern Pacific and/or aridity of Eurasian continent were presumably high. Furthermore, the fluctuations were found to be synchronous with those of terrestrial biomarkers off central Japan. From the insights, increase of productivity in sea surface were caused by the increace of terrigenous transport fluxes to sea surface off central Japan.

The variation of alkenone sea surface temperatures in St. 20 core over the last 120 kyears well coincided with that of global surface temperatures caused by glacial-interglacial cycle. The warming or cooling of the sea surface can affect the productivity of Gephyrocapsaceae and dinoflagellate off central Japan, although the examination are needed.