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Reconstruction of marine production changes from middle to late Miocene in the Ishikari Basin, Hokkaido, Japan

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Diatom production in sea surface layer has been known to increase throughout North Pacific Ocean during the middle -late Miocene (Barron, 1998). The enhanced diatom production might result from change of biogeochemical cycles associated with coevolution between herbaceous C_4 plant and marine diatom (Falkowski et al., 2004), although the increase of diatom production was explained by change of deep water circulation. In addition, Sawada (2006) reported that increase of kerogen delta ^{13}C was almost simultaneous to increase of diatom biomarker concentrations in Neogene neritic sediments of central Japan, and suggested that marine production was presumably enhanced by more efficient input of terrigenous matter in the Neogene paleo-Japan Sea. However, there are few studies on the Neogene-order linkage between terrestrial and marine environmental changes. In the present study, we analyzed marine and terrestrial biomarkers in mudstones of the Miocene Kawabata Formation, which is mainly composed of turbidite, to evaluate interaction between marine productivity and terrestrial input.

We analyzed mudstones from the Kawabata Formation in the Higashiyama route, Yubari area, Hokkado, Japan. This formation was formed in the Ishikari Trough that had be associated with birth of Japan Islands and was filled by turbidite. The Kawabata Formation is important for evaluating tectonic history of Hokkaido including uplift of Hidaka Mountains, and therefore, deposited age was determined by fission track dating of tuff layers and diatom biostratigraphy (Kawakami et al., 2002). We used mudstone samples deposited from ca. 13Ma to ca. 10Ma. We determined total organic carbon (TOC), and analyzed solvent-extractable biomarkers by GC/MS.

The TOC values of all samples are nearly constant (0.5 % ~ 0.8 %). Sterane and hopane isomer ratios indicate that organic matters in these sediments are immature. Concentrations of diatom biomarker such as higher branched isoprenoid (HBI) alkane and HBI thiophenes, as well as dinoflagellate biomarkers such as dinosterane were higher before ca. 13Ma and after ca. 10Ma. Moreover, increase of these algal biomarker concentrations are almost simultaneous to decline of Pr/Ph ratios, so that higher primary production in sea surface layer might result in occurrence of anoxic bottom waters.

It is also found that terpenoid biomarkers originated from terrestrial higher plants are abundantly contained in the Kawabata Formation. The terpenoid biomarker-based higher plant parameter (HPP), which varies depending mainly on conifer abundances, decreased from the lowermost layers except around 10 Ma. This suggests that conifer-dominant vegetation declined in paleo-Hokkaido areas from the late to middle Miocene. In addition, concentrations of terrestrial plant terpenoids frequently varied throughout the Kawabata Formation. This variation might be attributed to those of terrestrial input as organic matters in the Ishikari Basin. We will present more detailed discussion for marine productivity change related to terrestrial organic matter input by using both marine and terrigenous biomarkers.

Keywords: Neogene paleoceanography, land - ocean interaction, marine primary production, paleo-Japan Sea, turbidite, biomarker