Late Quaternary paleoceanographic change in the Okhotsk Sea: Based on analyses of opal, $CaCO_3$, TOC, and microfossils in MD01-2412 core

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The Okhotsk Sea represents the lowest latitude region in the world with seasonal sea-ice cover. The process of sea-ice formation plays a significant role in both local and global climate change. The Okhotsk Sea Intermediate Water (OSIW, approximately 200-500 m), which is relatively fresh, cold and oxygen-rich, is considered to be a possible source of the North Pacific Intermediate Water (NPIW). The OSIW formation is mainly responsible for the sinking of the brine water, which is the product of the sea-ice rejects, in the northwest shelf of the Okhotsk Sea. We present the variations in the opal, $CaCO_3$, total organic carbon (TOC) and microfossil records of Core MD01-2412 (44° 31.65' N, 145° 00.25' E; water depth: 1225 m; core length: 58.11 m), which was obtained from off Hokkaido in the southwestern Okhotsk Sea during the IMAGES cruise in 2001. The purpose of this study is to reconstruct the paleoceanography such as sea-ice cover and biological production changes using these proxies. A preliminary age model was adopted based on the biogenic opal curve, which showed a similar pattern with the normalized $\delta^{18}O$ curve, as well as the prior study on another core (XP98-PC1) from off Kamchatka . The variation in TOC (wt%) showed a similar trend with that of biogenic opal. This suggests that the past contribution of siliceous plankton such as diatoms and radiolarians in biological production were high throughout the core. The variation pattern of diatoms (No. valves g^{-1}) also showed a similar trend with the biogenic opal curve, which significantly increased near the core top (0-500 cm). Relative abundance changes of three sea-ice indicator diatom species (*B. fragilis*, *N. cylindra*, and *T. antarctica*) may well represent the past change in magnitude of sea-ice coverage. On the other hand, the variation pattern of radiolarians (No. shells g^{-1}) increased in the 500-1000 cm interval and then decreased near the core top, which was significantly different from the diatom variation. In particular, *C. davisiana* was the most abundant species contributing substantially to this trend. The variation in $CaCO_3$ (wt%) decreased near the core top (0-500 cm), where high primary productivity persisted based on the high values of TOC, biogenic opal, and diatoms. In addition, a significant increase in %foraminiferal fragment was found near the core top. These results suggest that the dissolution of $CaCO_3$ became intense with the active oxidation of organic matter as a result of the high primary production.

Particle flux in the eastern Indian Ocean derived from ^{228}Ra -^{228}Th, ^{234}U - ^{230}Th

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Particle cycling in water column is important to understand the marine biogeochemistry of carbon, nutrients, and trace elements. Settling particles scavenge dissolved substance from the surface to deep ocean through the interaction between particle and seawater. The disequilibrium between ^{238}U and ^{234}Th (half life: 24.1 days) is caused by settling particles because Th is a particle-reactive element. Using this equilibrium, the export flux of particulate organic carbon was estimated on a time scale of days to week in the surface ocean (Buesseler et al., 1992). However, the disequilibrium between ^{238}U and ^{234}Th is nearly absent below the euphotic zone. In order to evaluate the efficiency of the 'biological pump', the longer-lived ^{228Th} (half life: 1.91 years) is a more suitable tool which can estimate the particle flux through the picnocline. In this study, we investigated the particle flux in the eastern Indian Ocean using naturally occurring ^{228}Ra -^{228}Th, and ^{234}U - ^{230}Th in upper 1000m of the water column to estimate the transfer efficiency of particles through the picnocline.

The particle flux were derived from the vertical profiles of ^{228}Ra-^{228}Th and ^{234}U-^{230}Th. From the calculated particle flux, the particle transfer efficiencies at the 1000 m were estimated to be 2-6% and 8-50% at the picnocline. The highest transfer efficiency of 50% at the picnocline was observed near the Southern Ocean (PA4), and the lowest efficiency of 8% was in the Bay of Bengal (PA9). These results correspond to the estimates of new production derived from ^{228}Ra vertical profiles (Nozaki and Yamamoto, 2001). The high transfer efficiency is possibly related to a high new production caused by diatom.

Reference

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