Late Quaternary variations of sea-ice distribution in the Southern Ocean based on ice-rafted debris analysis

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1. Introduction

The Southern Ocean is known to play an important role in the global climate system, because the Antarctic Cryosphere represents the largest accumulation of ice on the Earth's surface. The latitudinal migration of the oceanic fronts and sea-ice coverage in the Southern Ocean should have an influence on the surface water circulation, as well as primary productivity, heat transport, and temperature gradient. We need to understand the distribution of several proxies in the surface sediments to reveal the paleoceanographic changes in the Southern Ocean.

2. Materials and Method

Surface sediments were collected from a latitudinal transect in the Australian sector of the Southern Ocean during the two R/V Hakuho-Maru cruises KH94-4 and KH01-3. We analyzed for these sediments by the X-ray CT scan, ice-rafted debris, total organic carbon contents, and biomarkers. In addition, we used a sediment core collected at near Antarctic continental slope (AMR-2PC, 64 40S, 139 59E, WD 2965m) to reconstruct the past variation of sea-ice distribution.

3. Results and Discussion

(1) Dropstones (larger than 2 mm) were observed in surface sediments between 60 degrees S and Antarctica, indicating that the modern iceberg reaches up to about 60 degrees S in the Australian sector of the Southern Ocean. Magnetic susceptibility was also increased in the southern part of the Southern Ocean.

(2) Grain size distributions of non-biogenic particles in the surface sediments near Antarctica are apparently larger than those of pelagic sites at about 60 degrees S. These results indicate that the ice-rafting process from the Antarctic ice sheet contributes largely to the deposition of the modern Southern Ocean sediments.

(3) The major boundary of sedimentological and geochemical compositions in the surface sediments is in approximately 60 degrees S. As for the sediments in the south, the percent of TOC is high, and $CaCO_3$ is extremely low.

(4) The amount of IRD was decreased during the glacials at the core AMR-2PC, suggesting that the core site was covered by a perennial ice at the ice ages.