D-1.2.2 Research on long-term change of element cycles in ocean based on microfossils and other sediment components

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Total Budget for FY1991 and FY1992 16,352,000 Yen

Abstract Southern oceans around Antarctica have been focused as one of the most important areas which control global environmental change through ocean circulation, because Antarctic water is very nutritious and behaves as the source of deep ocean water. Sediment core sequences taken around Antarctica are expected to include a plenty of information of paleoceanographic change including the development of Antarctic glaciers. We analyzed sediment cores from the offing of the South Orkney Islands, the Enderby Land Basin, and the Ross Sea Area. Analysis of sand-grain content, water content, microfossil content, magnetic susceptibility are performed. The physical properties of sediments and fossil contents are to be good proxies of ice-rafted supply and productivity in the surface ocean. One core from the Enderby Land area is revealed to be a good core sample for detailed studies for long-term environmental change around the Antarctica.

Key Words Antarctic sea, marine sediment, microfossils, flux, productivity

1. Introduction

Recently, the southern oceans around Antarctica have been focused as one of the most important areas controlling global environmental change through ocean circulation, because there are the most nutrient-rich water masses and source areas of deep waters of oceans. "Iron hypothesis[3]) has been proposed to explain change of carbon dioxides in air contrasting glacial and interglacial times. This hypothesis stated that natural pollution of iron from aeolian dust to the southern oceans caused the flourish of phytoplankton and that carbon dioxide in air sank into deep ocean as organic matters in glacial times.

Marine sediments record long-term environmental changes in the past and are the most useful data source to know succession of element cycles in ocean and to estimate effect of pollution in the ocean.

2. Research objectives

This study is to reveal the environmental change recorded in the sediment cores taken from the oceans around Antarctica through analysis of microfossils, sediment components, physical properties of sediments, and chemical compositions. In this work, we analyzed the sediment cores from the Antarctic seas and tried to reveal environmental change quantitatively including surface productivity, deep water circulation, and glacier development.

3. Samples and Research methods

Preliminary analyses for paleoenvironmental reconstruction are performed on sediment core samples from the South Orkney Islands area and the Enderby Land Basin (Fig. 1). Moreover, the sediment samples from the Ross Sea and its adjacent (Fig. 1) have been also analyzed for studies of proxies of environment and environmental change of the area covered glaciers during the last Glacial Age.

Analyses of sand-grain content, water content, and magnetic susceptibility were performed. Moreover, preliminary analyses of sand-grain compositions, nannoplankton fossils, diatoms, and foraminifers were also tried. The method of *pachyderma* (Ehrenberg). Magnetic susceptibility corresponded to the roughly to sand-grain content and frequency dependence of magnetic susceptibility suggest magnetic grain-size change, which is possibly correlated to the supply of ice-rafted terrigeneous sediments. The foraminiferal contents and sand-grain contents also changes (Fig. 2).

The cores from the offing of the South Orkney Islands yield rare foraminifers because of the dissolution of carbonate during the storage. Only diatom assemblages are available for analysis.

(2) Ross Sea and its adjacent area

In and around the Ross Sea, dry bulk density and wet bulk density of sediment show linear relation and the difference of ratio between these are indebted to the contents of planktonic biogenic components. The vertical changes of water contents and sand-grain contents are highly variable in the Ross Sea (Fig. 3). Lower parts of the core sequences in the Ross Sea show low water content and consolidations, in spite of variety of sand-grain contents, which suggests the presence of glacier-ice loaded sediments below the surface sediments. Fossil assemblages of foraminifers and diatoms dynamically changes corresponding to lithologic change. The middle part of the cores from the edge of the Ross Sea yield abundant foraminiferal tests for ^{14}C age determination.

5. Discussions

The sediment properties, such as magnetic susceptibility and density of sediments, are corresponding to the sand-grain contents, which suggests that the terrigeneous components transported mainly by rafting-ice are easily determined by measurement of magnetic susceptibility. The change of content of planktonic

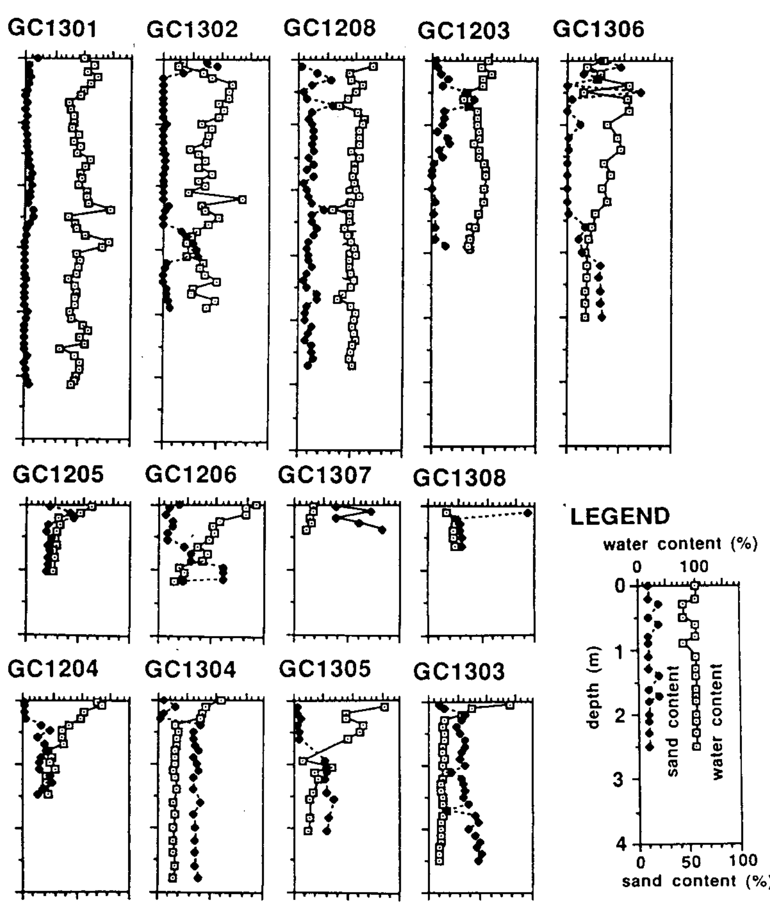

Figure 3. Water content and sand-grain content of the sediment cores samples from the Ross Sea and its adjacent.

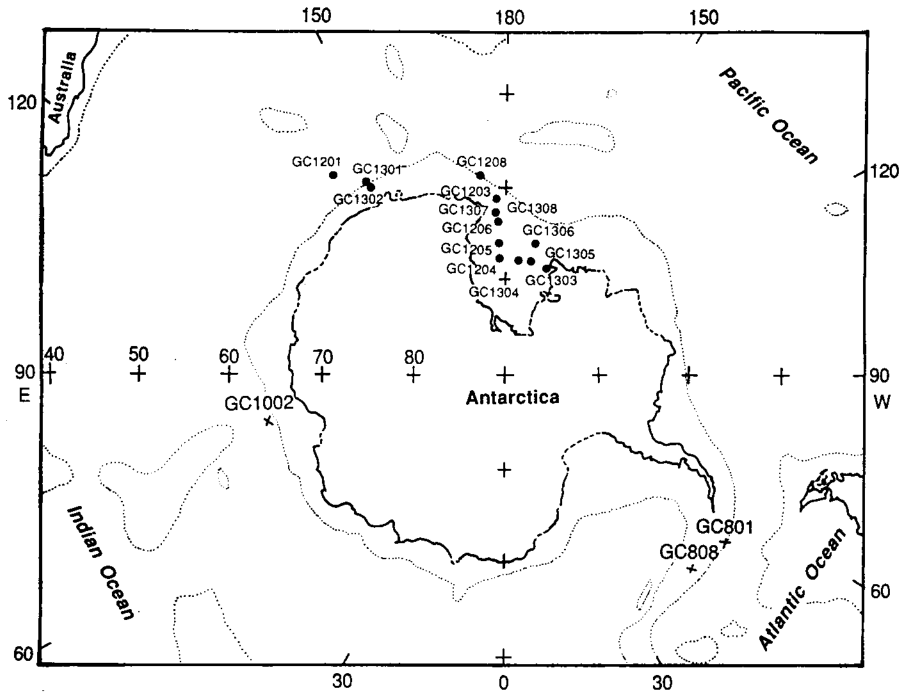

Figure 1. Bathymetric map around the Antarctica and the sampling locations.

carbonate content of sediments and the possibility of age determination of the sediment core samples based on oxygen isotope[1)] and ^{14}C have examined.

4. Results

(1) Enderby Land Basin

A sediment core from the Enderby Land Basin is a good core sample for detailed studies for long-term environmental change around Antarctica. This core is comprised of foraminiferal ooze in the upper and silt in the lower part with fine to very fine sand layers intercalated in the middle part. The upper part of the core is late Pleistocene age and includes planktonic foraminifers, *Neogloboquadrina*

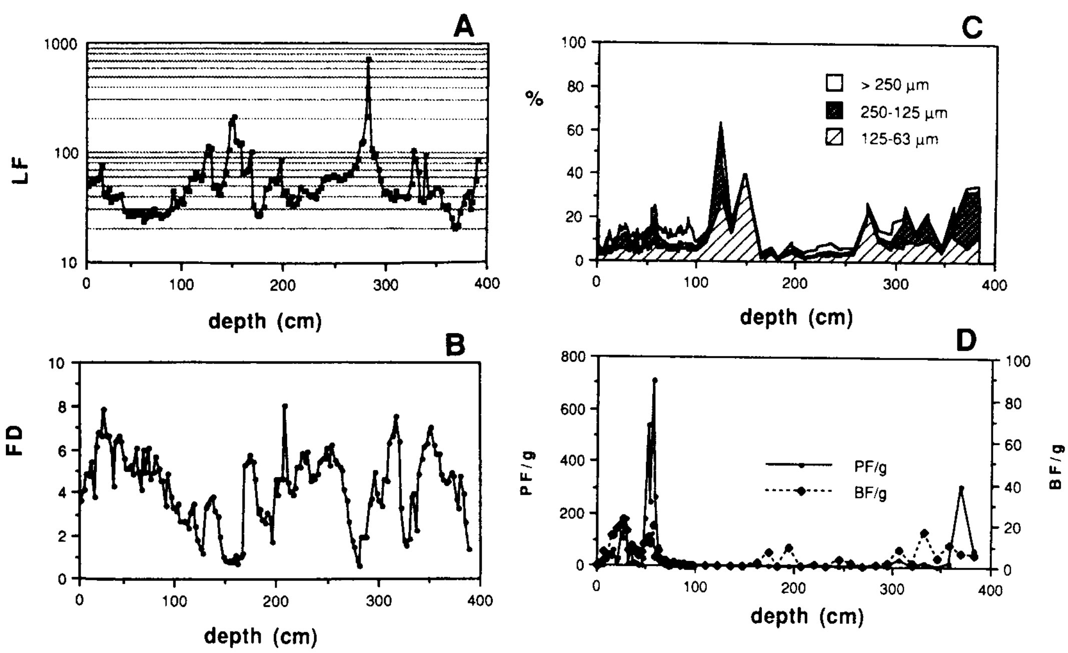

Figure 2. Magnetic susceptibility (A), frequency dependence of magnetic susceptibility (B), sand-grain content (C), and foraminiferal number (PF; planktonic, BF; benthic) in 1 gram (D) of the sediment core GC1002 from the Enderby Land area.

foraminifers suggests the surface ocean productivity, but the possibility of the influence of bottom water properties cannot be ignored. The carbonate contents of the bottom sediment in the Antarctic Seas are dynamically change in the late Pleistocene[1), 2)], which is suggest the change of the bottom water formation near the Antarctica.

Physical properties of sediments in the Ross Sea are strongly influenced by the geologic history. The lower sediments ion the core sequences have low water contents and are highly consolidated, which suggests the loading by the Antarctic Ice Sheet during the last Glacial Age.

The detrailed environmental reconstruction using these cores will be accomplished after the age determination based on isotope stratigraphy and ^{14}C-AMS age determination.

6. References

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