博士論文

Hydrological evolution of the eastern tropical Pacific during the last 430,000 years

（過去４３万年間の東部熱帯太平洋の水理学的変化）

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博士(環境科学)学位申請者

地球圏科学専攻
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学 位 論 文 題 名

Hydrological evolution of the eastern tropical Pacific during the last 430,000 years

過去 43 万年間の東部熱帯太平洋の水理学的変動

主要論文要旨

The eastern tropical Pacific (ETP) is a key region in paleocenography to understand the response of upwelling, the position of the intertropical convergence zone (ITCZ), and the zonal and meridional atmospheric circulations to orbital forcing. In this study, the author reconstructed the hydrological evolution of the ETP by analyzing glycerol dialkyl glycerol tetraethers (GDGTs), alkenones and the oxygen isotopes of foraminifera and bulk carbonate in sediments from Ocean Drilling Program Sites 1237, 1239, and 1241 during the last 430,000 years.

In the first chapter, the author describes the outline of modern oceanography of the ETP and the history of paleoceanographic studies for the ETP. He also presents the purpose and strategy of this study.

In the third chapter, the author proposes that the difference between TEX_{86}^{H}- and $U^{K}_{37}{}'$-derived temperatures (ΔT) and the abundance ratio of GDGTs to alkenones (GDGT/alkenone ratio) are potential upwelling indices which show consistent results with other upwelling indices, and discusses changes in upwelling intensity in the eastern equatorial Pacific (EEP) at the offshore of Ecuador (Site 1239) over the past 430 ka. The ΔT and GDGT/alkenone ratio were maximal during the last five deglaciations, suggesting intensified upwelling. The intensification of upwelling in the EEP coincided with those at

the Peru margin and in the Southern Ocean. This coincidence suggests that the reorganization of the Southern Hemisphere atmospheric circulation induced the intensification of the subtropical high-pressure cell, causing stronger southeast trade winds along the west coast of South America and the southern westerlies over the Southern Ocean, enhancing upwelling in both regions.

In the fourth chapter, the author discusses the hydrological evolution of the eastern Pacific warm pool region (EPWP) at the offshore of Panana (Site 1241) during the last 150,000 years. GDGTs and alkenone concentrations showed higher values in MIS 2 and MIS 6, which suggest the enhancement of primary production at glacial periods. The TEX_{86}^{H}- and U^{K}_{37}'- derived temperature depicted the different surface temperature evolution. U^{K}_{37}'-derived temperature was marked by small variation during the glacial-interglacial cycles, whereas TEX_{86}^{H}- showed a pronounced variation that was similar to Mg/Ca-derived temperature records obtained at a nearby core in the EPWP. Given that enhanced primary productivity during glacials suggest nutricline shoaling, unchanged U^{K}_{37}' over glacial-interglacial cycles can be interpreted to be related to the shift of alkenone production depth. TEX_{86}^{H} seems not to be influenced by glacial-interglacial changes in nutricline depths, recording an integrated temperature in surface and thermocline water. The shallow nutricline in the EPWP during glacial maxima most likely reflected the intense formation of Antaractic intermediate water.

In the fifth chapter, the author describes the SST evolution in the Peru margin (Site 1237) and discusses changes in the intensity of the Peru Coastal Current (PCC) by reconstructing the latitudinal gradient of SST along the western margin of Central and South America during the last 90,000 years. GDGTs and alkenones were analyzed for

sediment samples retrieved from ODP Site 1237 (Peru margin) and compared the SST record with the records at Site 1241 (off Panama) and Site 1239 (off Ecuador). A decrease of temperature gradient between the Peru margin (Site 1237) and the EEP (Site 1239) during the last deglaciation suggests that the PCC intensified over the coastal boundary region. The intensification of the PCC coincided with the thermocline shoaling in the EEP and the enhanced upwelling in the EEP and the intensified anoxia at the Peru margin during the last deglaciation. This coincidence suggests that the intensification of the PCC is a part of regional hydrological change in the eastern Pacific during the last deglaciation.

In the last chapter, the author summarizes the results and discussion this study. Both the enhanced upwelling in the EEP and the intensification of the PCC, along with other evidence from published records, suggest the intensification of the South Pacific subtropical gyre circulation during deglaciations. In the EPWP, thermocline shoaled in glacial maxima, likely reflected the intense formation of the AAIW.