学位論文の要約

学位論文題目: Study of biogeochemical processes at ocean interfaces: using multiple tracers to analyze coccolithophorid blooms in the Bering Sea shelf and asphalt seep in the Brazilian margin

(海洋境界における生物地球化学的プロセスの研究: 化学トレーサーによるベーリング陸棚の円石藻ブルーミング発生の要因とブラジル沖のアスファルト湧出の解明)

地球生命環境科学専攻

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Research was conducted on the biogeochemical processes at ocean interfaces. Ocean interfaces are the most active areas in the oceans where many biogeochemical processes and environmental problems occur there. It includes four interfaces: continental-ocean, atmosphere-ocean, sediments-ocean and ocean crust-ocean. In this study, Bering Sea shelf was chosen as representative to study the biogeochemical processes occur at continental runoff-ocean and atmosphere-ocean interfaces. Where asphalt seep discovered in the Brazilian margin was chosen to study biogeochemical processes occurred at sediment-ocean and ocean crust-ocean interfaces.

It aimed to develop a basic method which can be used to figure out various factors of biogeochemical processes and environment changes in the ocean interfaces by using multiple tracers. In the western Arctic shelfs, we have conducted a series of long-term field observation in the Bering Sea shelf in the summer and autumn from 2000 to 2013 during the scientific cruises of R/V Mirai (in September 2000, 2001, 2004, 2006 and 2012) and of T/S Oshoro-Maru (in July 2002, 2003, 2004, 2005, 2013). In the Brazilian margin, we originally conducted a series of deep-sea dives using the

manned research submersible SHINKAI 6500 in May 2013. Sea water samples and sediment samples were taken back to the laboratory on land. Sea water samples can provide the real-time information of environment condition while sediment samples can offered historical information that environment events happened in the past. The parameters used in this study include CTD data, DO, nutrients, rare earth elements (REEs), oxygen isotope, carbon and nitrogen isotope, bacterial communities.

The technique process of this method basically includes the following four parts. First, roughly clarity the various water sources of the research area by hydrologic data (Temperature, salinity, DO). Second, calculate the precision water structure by REEs, salinity and□18O. Third, calculate the related chemicals fraction from the different water sources. Fourth, analysis the changes of water mass structure and related chemicals in different seasons or years. Finally, analysis the factors of environment problems and predict its future potential changes combined other tracers, such as nutrients, phytoplankton data and so on.

In the eastern Bering Sea shelf, diatoms were dominant species in the fall bloom. However, coccolithophorid blooms were frequently observed in this area after 1997. It was thought that the changes of water mass structure was possible reason of coccolithophorid blooms. To clarify the relationship between the coccolithophorid blooms and water mass composition, we present CTD, Chl-a, nutrient, phytoplankton and oxygen isotope compositions (0.005‰) data. CTD data shows that in the Bering Sea shelf, water mass is a mixture of the Pacific water, river water, sea ice melting water and brine water. The water sources fraction was calculated by salinity and ^{18}O using a three-end-member model. Results indicate that Pacific water is more than 96%, sea ice melting water is about 1% and river water is less than 5%, respectively. And from out shelf to inner shelf, the percentage of Pacific water is slightly decreased, while river water is increased from 1% to about 5%. Different water sources carried

different fraction of nutrients to the Bering Sea. The changes of water structure directly affected the supply of nutrients. Nutrients from North Pacific water and river water are two major outer sources and the changes of water fraction between Pacific water and river water influenced the total amount of nutrients and its horizontal distribution. While strength of water column stratification, wind and storms in the summer time affected the nutrient vertical distribution. And these were thought as the main factor of coccolithophorid blooms in the Bering Sea shelf. It was thought that the changes of N/P ratio and also dissolved organic nutrient released by diatoms growth and death are the main reason of coccolithophorid blooming in the Bering Sea shelf.

In the Brazilian margin, deep-sea dives led to find a roughly 5.6-km asphalt seep band at a depth of 2700 m. Silica concentration in the pore water indicated the possibility of an active brine system operating in the seepage area. In the middle and southwest asphalt seep band, relatively low rare earth element concentrations and weakly positive Ce anomalies of sediment revealed the asphalt seep was newer than that in the northeast. Stable carbon and nitrogen isotopes are good tracers for understanding the food sources of heterotrophs and trophic pathways within food webs. Our results estimates that the asphalt provided 29% - 56% of the carbon source for benthic animals.

Keyword: Ocean interface, coccolithophorid bloom, water mass, asphalt seep, chemical tracers, Bering Sea shelf, Brazilian margin