（第３号様式）(Form No. 3)

学 位 論 文 要 旨
Dissertation Abstract

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学位論文題目：
Title of Dissertation

Studies on biophilic elements and nutrient regeneration in the coastal sediments（沿岸海域における堆積物中の生元素と栄養塩溶出に関する研究）

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The quality of a coastal sediment is influenced by the organic matter loading from primary production in water column and from the land. Also, it is influenced by the aquaculture activity, where aquaculture field is located. Particulate organic matters in the water column sink and accumulate on the surface sediments. Moreover, organic matter is released as inorganic form of nutrients from surface sediment to overlying water by biological organic matter decomposition in a biogeochemical process. Therefore, the study of biochemical processes and nutrient regeneration of the coastal sediments were interested.

This study was a research in the biogeochemical processes of biophilic elements and nutrient regeneration in a shallow coastal sediments. The main objective is to understand the behavior of biophilic elements and their controlling cycles in a coastal environment. The surface sediments were collected from a semi-enclosed coastal environment of Shido Bay, an active aquaculture area, the Seto Inland Sea. In this study, at first, the horizontal distribution of organic matter and heavy metal content in surface sediments were determined, and second, upward nutrient fluxes at sediment-water interface were investigated.

Horizontal distribution of total organic carbon (TOC), total nitrogen (TN), total phosphorus (TP), water content, grain size and heavy metals (Cd, Cu, Pb, Zn, Mn, As, Cr, Ni, Co, Al, Fe and Li) in surface sediment were determined at 29 sites in Shido Bay. In the horizontal distributions, TOC, TN and heavy metals (except Co and Mn) were higher in the inner part of the bay than in the mouth and they were significantly related to the mud content as finer sediment. On the other hand, high TP and Ca-bound phosphorus content were observed nearby fish cages due to the residue of fish feed, and also the increase of organic matter content from 2001 to 2012 was observed in the aquaculture area. These results suggested that the aquaculture activities in Shido Bay

affected the amount of organic matter in this area, and TP content was a good indicator of effect of fish farming. In Shido Bay, organic matter loading from the land and river was not noticeable, because an atomic C/N ratio on surface sediments (6.3–10.5) was similar to the C/N ratio in Redfield ratio (6.6) and was lower than that of terrestrial matter. Nevertheless, this area was not contaminated by heavy metals based on comparing sediment quality guidelines and the results found in other marine environments of the Seto Inland Sea. Also, the relative enrichment factor (EF value) used to evaluate heavy metal contamination had a value close to 1, which showed that the heavy metals in the surface sediment of this area was a background level of sediment and did not originate from aquaculture activity or other sources. The results of this study showed source of organic matter was mainly the primary production by phytoplankton in water column. This study also indicated that aquaculture activity influenced organic matter accumulation but did not influence heavy metal contamination in the surface sediments, although the horizontal distribution of organic matter and heavy metals (except Co and Mn) were quite similar and were significantly related to mud content.

Surface sediments not only act as sink of organic matter, but also a source of nutrients (N, P and Si) regeneration from the sediment to overlying water particularly in shallow coastal system. Therefore, the role of the superficial layer (SL), which is the top 2-3 mm of the surface sediment, on nutrient regeneration was investigated by sediment core incubation method. The results showed that total fluxes were higher than SL-less fluxes. In addition, the effect of benthic fauna and bacteria activity on measuring nutrient upward fluxes were measured. In coastal environment, the upward nutrient flux was fundamentally regulated by temperature and high temperature period promoted high nutrient fluxes. Bacterial and microphytobenthos activities were also important on nutrient regeneration on shallow coastal system, because the benthic fauna on nutrient regeneration was negligible. Moreover, it was thought that bacterial activity was a major biological factor, because microphytobenthos (benthic diatom) was active during only winter period when sufficient light penetrated to the sea bottom.