

Chemical and Radiochemical Studies of Sediment Samples from the JET Site

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ABSTRACT

Chemical and radiochemical characteristics of sediments obtained from the Japan Deep-Sea Impact Experiment (JET) site. Concentrations of organic carbon, organic nitrogen, calcium carbonate and biogenic silica in top 1cm layer were 0.5%, 0.06%, 0.3% and 13%, respectively. Sediment accumulation rate was estimated to be $0.1 \text{ g cm}^{-2} \text{ kyr}^{-1}$ from excess ^{230}Th profiles. Organic carbon, calcium carbonate and biogenic silica were supplied from water column to sediment at rates of 100, 64 and $70 \text{ mmol m}^{-2} \text{ yr}^{-1}$, respectively, however, almost all of the biogenic components were degraded or dissolved at water-sediment interface.

KEY WORDS: organic carbon, calcium carbonate, biogenic silica, sedimentation rate, pore water, sediment trap.

INTRODUCTION

Deep-sea mineral resources characterized by manganese nodules seem to be extremely useful source for rare metals which are necessary for development of high technology industry, and commercial mining of manganese nodules is expected to begin with in next 20 - 50 years. However, the mining operation will cause extensive resedimentation over large areas of deep sea floor and it is thought to be harmful to the benthic biological community. It is extremely important to assess the effects of deep-sea mining on oceanic life and environment and to establish necessary regulations and standards for environmental conservation. However, our present knowledge for benthic ecosystem is so limited that we cannot predict the impact of the deep-sea mining. Therefore, it is necessary to accumulate more information on the deep sea environment and benthic communities.

To understand relationship between resedimentation and biological reaction, experiments of artificial perturbation of deep sea sediment have been conducted (BIE by NOAA, USA and DISCOL by Hamburg Univ., Germany). The Metal Mining Agency of Japan also commenced environmental studies of deep sea sediment including the artificial perturbation experiment (the Japan Deep Sea Impact Experiment, JET).

Biological community is influenced by energy supply from settling particles and characteristic of sediment, significantly. Therefore, knowledge of chemical characteristics of the sediment and material balance on the sea bottom is very important to understand the benthic ecosystem. This work was carried out to understand background of natural condition of sediment in the JET site.

SAMPLING AND METHODS

Sediment core samples before the artificial resedimentation experiment were collected by a Multiple Corer during cruises of R/V Hakurei-Maru #2 in May, 1993 and R/V Yuzhmorgologiya in Aug., 1994. During the cruise of 1993, the core samples were collected from relatively wide area (10 x 18.5 km) and the samples were collected from narrower area (1 x 2 km) located at bottom of a valley in the cruise of 1994 (Fig. 1). Cores were sectioned in 0.25, 0.5 and 1 cm intervals immediately after sampling. The sectioned sediment samples for pore water extraction were kept in a cold van (2°C) until centrifugation and the samples for solid phase analyses were frozen.

Extraction of pore water from sectioned sediments was carried out on shipboard by centrifugation (10,000rpm, 15min. and 4°C). The water obtained was filtered (0.4µm) and analyzed for nutrients, nitrate + nitrite and silica, immediately after sampling by improved methods of Parsons et al. (1984).

Sediment trap (NICHYU GIKEN KOGYO Model-SMD13W-6000) was deployed at 30m above the bottom at 9°13.45'N, 146°16.00'W on 27th May and recovered on 10th August, 1994. Settling particles were collected in three 15 day periods, 29th May to 13th June, 13th June to 28th June and 28th June to 13th July. The particle samples were filtered onto 0.6 µm membrane filters and the filters were frozen and brought to a laboratory on land.

Dry weight of the sediment trap samples, water content of sediment samples and solid phase measurements were made in the laboratory on land using splits of samples frozen on shipboard. Organic carbon and nitrogen were measured by a CHN analyzer (YANAGIMOTO Model-MT-5), CaCO_3 was measured by coulometric titration (UIC Model 5012) of CO_2 liberated from the samples by addition of phosphoric acid, and biogenic silica was measured by leaching in 2M Na_2CO_3 at 80°C (Mortlock and Froelich, 1989). Radiochemical analyses of ^{230}Th and U were conducted by a liquid scintillation method after acid leaching and selective extraction to scintillator solvents (McDowell and McDowell, 1993; Harada 1994). Excess ^{230}Th was calculated by subtracting ^{234}U activity from ^{230}Th activity.

RESULTS AND DISCUSSION

Chemical composition of solid phase of sediment

Concentrations of organic carbon and nitrogen, calcium carbonate and biogenic silica in the sediment core samples were listed in Tables 1 and 2. Their average concentrations in top 1 cm layer do not change widely from place to place showing 0.55 % (range: 0.45 - 0.73) for POC, 0.11% (0.07 - 0.14) for PON, 0.27% (0.21 - 0.42) for CaCO_3 and 13.7% (11.1 - 15.7) for opal. This suggested that chemical