

Physical, Chemical, and Geological Changes of Marine Environment Caused by the Benthic Impact Experiment at the IOM BIE Site

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ABSTRACT

In order to predict potential effects of mining of polymetallic nodules, Interoceanmetal Joint Organization (IOM) carried out, in 1995, a Benthic Impact Experiment (IOM BIE) in its pioneer area within the Clarion-Clipperton Fracture Zone. The IOM BIE study involved pre-disturbance (baseline), disturbance and post-disturbance stages as well as subsequent monitoring sampling in 1997. Comparison of data on physical and chemical characteristics of bottom sediment, near-bottom and pore water collected before and after experiment showed alterations in those characteristics. Contents of nutrients (silicates, nitrates, nitrites, and phosphates) and heavy metals (Cu, Zn, Pb, Cd) as well as the mineralogical and grain size composition of the discharged sediments were determined on material collected by sediment traps, water bottles, and a multiple corer. Preliminary data on characteristics of the disturbed and resettled sediment layer obtained during the 1997 monitoring cruise are presented and discussed.

KEY WORDS: benthic disturbance, near-bottom and pore water, resuspended sediment, siliceous clayey ooze, nutrients, trace metals

INTRODUCTION

Generally, the IOM environmental program was designed to cover the following 3 phases:

Phase I (1994-1995): Baseline geological, oceanographic, and biological data collection from the 330 km long environmental reference transect situated in the mineable sector within the IOM claim area, with the purpose of obtaining background environmental data based on monitoring of their temporal variability, and of selecting - within the transect - a site for a benthic disturbance experiment (Kotlinski at al., 1996).

Phase II: An in situ benthic experiment (IOM BIE-95) using a device simulating operations of a nodule collector (Benthic Disturber) and assessment of disturbance impact upon the benthic ecosystem (Tkatchenko et al., 1996).

Phase III: Monitoring changes in the environmental parameters.

This presentation is aimed at summarizing results of water and sediment chemistry of the bottom environment as well as assessing changes in its characteristics, based on comparison of data collected during IOM BIE-95 and the initial monitoring activities.

The IOM BIE-95 was carried out during the June-August 1995 cruise of RV YUZHMOREGEOLOGIYA at a 2 x 1.5 km test site located in the eastern part of the Clarion-Clipperton Fracture Zone, with central coordinates: 119°40.1' W, 11°03.7' N and 4380 - 4430 m depth range. The experiment was divided into the following three stages (Tkatchenko et al., 1996):

Stage 1. Pre-disturbance research: control CTD casts, side-scan sonar and acoustic surveying, mooring recovery and deployment, detailed photo- and TV-surveys, sediment sampling.

Stage 2: Sediment disturbance: redeposition of the bottom sediments created by towing the Disturber along the predetermined tracks. During the two initial tows, water samples with resuspended sediments were collected with water bottles mounted in a rosette on the Disturber.

Stage 3: Post-disturbance survey: photo- and TV-surveys, sediment sampling, recovery of the mooring stations.

The first IOM monitoring cruise was conducted during late March - early May 1997 on board RV PROFESSOR LOGACHEV. The IOM BIE test site was revisited twenty one months after the experiment and multiple corer samples from the disturbed and undisturbed areas were collected; in addition, the area was surveyed with side-scan sonar and Continuous Deep-sea Camera (CDC). Samples collected for sediment lithology, geotechnical parameters of soil, near-bottom and pore water chemistry, and benthic community characteristics are being processed. So far, data obtained on board on water and sediment chemistry are available for the purpose of this presentation.

In accordance with the plan of work for exploration approved by International Seabed Authority, the subsequent IOM monitoring cruise is planned for 1999.

MATERIALS AND METHODS

Location of the multiple corer samples, sediment traps, and water sampling sites along tow tracks within the IOM BIE-95 test site is