X. PHYSICAL PROPERTIES OF BOTTOM SEDIMENTS RELEVANT TO MANGANESE NODULE MINING

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Introduction

Shipboard measurements of physical properties of bottom sediments were taken on Cruise GH77–1 for the purpose of collecting basic data for the manganese nodule mining. Measured properties were vane shear strength and water content. The former was measured on 24 grab samples and the latter was on 25 grab samples.

In this paper the measuring method used on board and the preliminary results obtained on board are described.

Instruments

The measuring method used on board was similar to that used on Cruise GH76–1.

A small portable vane tester, shown in Fig. X–1, was used for measuring the vane shear strength. The vane is a manually operated device using a calibrated torsional spring. The four blades are 4 cm in height and 2 cm in diameter, and the length of the rod is 25 cm. The capacity of the torsional spring is 2 kg·cm.

To calculate the water content of the sediments, the dry and wet sample weights were necessary. The electrical weighing method was applied to eliminate the effect of vibration and sway of vessel. It is composed of small electrical load cell (capacity 2 kg), amplifier, electrical filter and pen recorder. The mean value after two minutes recording was adopted as sample weight.

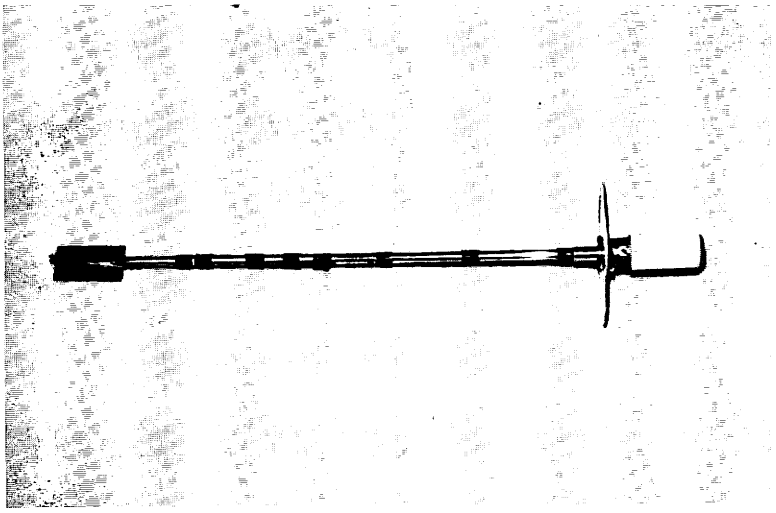

Fig. X–1 Vane tester.

Measuring procedure for grab samples

The grab sampler used on this cruise was Okean-70. After the Okean-70 was recovered onto the deck, photographs were taken to record the manganese nodules occurrence on the sediments surface. Then the manganese nodules were removed to be observed and studied on board as for size classification, measurement of weight and other properties. After removing of manganese nodules, the vane tester was penetrated into the sediments and the tester was rotated by hand with the rate of about 2 r.p.m. in order to measure the inner vane shear strength. It was calculated from the maximum torque value through the following equation.

$$Sv = Tm \Big/ \left(\frac{\pi D^2 H}{2} + \frac{\pi D^3}{6} \right)$$

where Sv: vane shear strength
Tm: maximum torque value
D: vane diameter
H: vane height

The depth measured along the sample column were 6, 11, 16, 21 and 26 cm respectively,

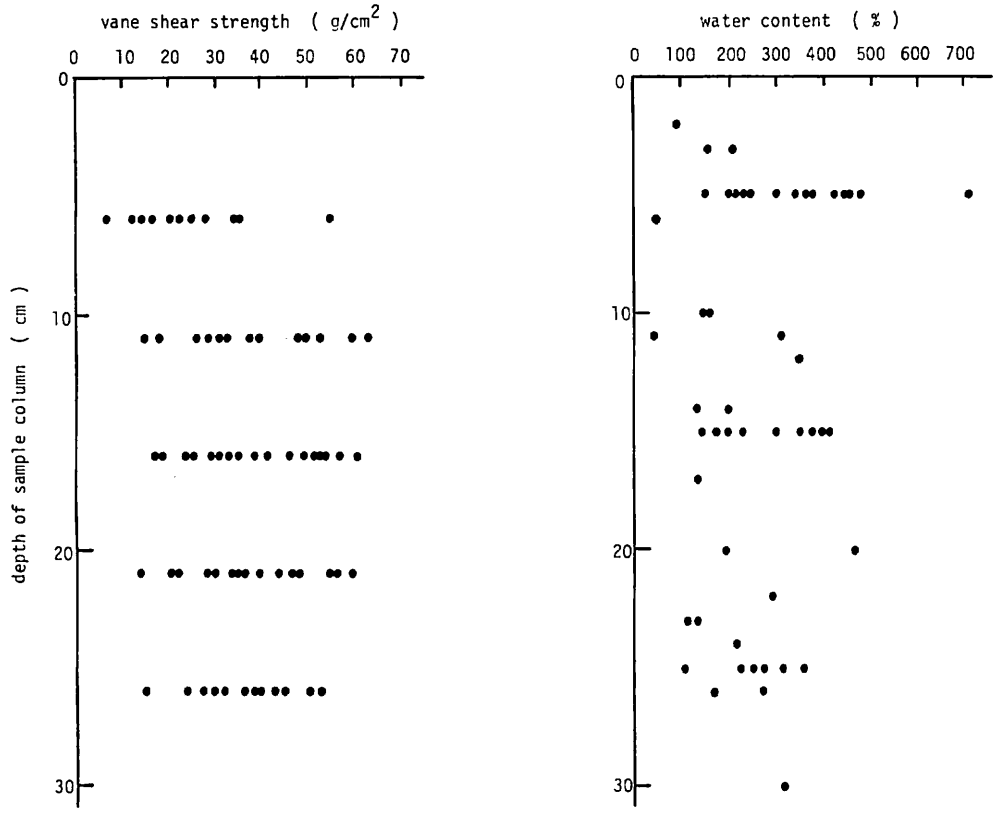

Fig. X–2 Relationships between physical properties and sample column of grab samples.

represented as the distances from the sediments surface to the center of the blades of the tester.

After measuring vane shear strength the two-split thin wall tube, 6 cm in diameter, was penetrated into the sediments and the cylindrical sample was resampled from the grab sample. Immediately the cylindrical sample was carried into the wet laboratory on board. Approximately 2 cm thick sample cakes were taken from every several centimeters depth. These sample cakes were applied to measure the wet weight respectively. After 24 hours drying under 105°C the dry weight of each cake was measured. The water content was calculated through the following equation.

$$w = \frac{Ww - Wd}{Wd} \times 100(\%)$$

where w: water content in percent
Ww: wet weight
Wd: dry weight

Results

The statistical relationships between the physical properties and sample column of the grab samples, except calcareous ooze, are plotted on Fig. X–2.

Detailed relationships between sediment type and physical properties are not mentioned in this paper. The sample and statistical results will be correlated in further study.