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Characteristic Properties of Hydrodynamic Conditions in Near-bottom Layer of Clarion-Clipperton Ore Zone of Pacific Ocean in 1993

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ABSTRACT

Long-term (11-month) series of current velocities for the near-bottom (5 m above the sea bottom) layer of the water column in the Clarion-Clipperton province of the North Pacific Ocean are measured at depths of 4846 to 4888 m. Analysis is followed by discussions. Observed characteristics in the current field represent the superposition of fluctuations of different periods and amplitudes. Duration of the start series allows to separate, with a high degree of accuracy, the fluctuations with 60-day periods in the current field. Total kinetic energy of the currents close to the sea bottom is provided 90% from the energy of fluctuating movements, and only about 10% is accounted for by the average settled current.

INTRODUCTION

In the process of the ecological experiment BIE (Benthic Impact Experiment) in which the investigations of geological, biological, chemical and hydrophysical conditions near the oceanic bottom were carried out, 3 mooring stations equipped with current meters were deployed in September 1993 to perform hydrophysical measurements.

STATIONS AND INSTRUMENTS

The coordinates of these stations, sea depths and their distances from the bottom were as follows:

- **St. 24**—12° 55.499 N and 128° 34.988 W; sea depth, 4888m, equipped with the RCM-8 instrument; 5 m from the bottom;
- **St. 25**—12° 56.385 N and 128° 36.192 W; sea depth, 4885m; 5 m from the bottom; 5 m from the bottom, with the Potok-2M instrument;
- **St. 26**—12° 56.942 N and 128° 36.192 W; sea depth, 4846 m; with 2 Potok-2M type instruments, 5 m from the bottom, and 950 m from the bottom, respectively.

The Potok-2M had 120-min discretion of measurements and was operational from 04.09.93 to 25.07.94. So the duration of these measured series was about 11 months. The RSM-8 had 60-min discretion and was operational from 04.09.93 to 18.02.95.

The stations were located along the shores of the bottom in a small oceanic depression greatly extended meridionally. The greatest distance along the parallel at the place of the station deployment between adjacent points of the 4850-m isobat, bordering the depression, was about 3 km; along the meridian, it was more than 17 km. Sts. 25 and 26 were located at the foot of the west shore in the depression; St. 24, at the east shore. Average inclination of the bottom at the latitude direction in the location of St. 26 was 0.08; for nearby St. 25, 0.05, and for St. 24, 0.02. In the meridional direction the inclinations were minor due to the notable extension of the depression bottom in this direction.

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KEY WORDS: Deep sea, bottom currents, circulation, fluctuations, kinetic energy.

DATA PROCESSING

Because the data obtained by the Potok-2M and the RCM-8 were processed by the same programmes realizing the same algorithm, the results did not differ due to the application of different methods for data processing and analysis. So the revealed differences will characterize different hydrodynamic conditions at the points of measurements.

Peculiarities in the data processing obtained by the instruments of different types are that output data of the Potok-2M represent both the magnitude values of velocity projections on the parallel (component U) and on the meridian (component V). The RCM-8 output information is the magnitude of module of velocity vector and direction (the angle between the velocity and the magnetic meridian).

Magnitudes of the velocity projections for the Potok-2M and the module of velocity vector for the RCM-8 are calculated by the ratios:

$$\begin{aligned} U(\text{cm/s}) &= N_1 \times K_1 + K_2 \\ V(\text{cm/s}) &= N_2 \times K_1 + K_2 \\ \mathbf{V}(\text{cm/s}) &= N_3 \times K_1 + K_2 \end{aligned} \tag{1}$$

where N_1, N_2, N_3 are codes for U and V components (Potok-2M) and vector $\mathbf{V}$ (RCM-8) is formed by the logical scheme of the instrument for the time equal to the set discretion of the measurements. Coefficients K_1 and K_2, differ for each of the instruments, are obtained by calibrating of the current meters, and are written in the data sheet of each instrument.

It is important to note that, when the current meter does not operate and the N_1, N_2, N_3 codes are zero, the magnitude of the velocity components for the Potok-2M and vector $\mathbf{V}$ for the RCM-8 take values equal to the corresponding coefficient K_2. These coefficients are fairly small: For the Potok-2M they are negative and amount to minus 0.5, minus 1.2 and minus 1.8; for the RCM-8, $K_2 = 1.1$. Vane testers are used as velocity sensors in both instrument types that force the logical scheme to produce the corresponding N code.

A threshold of sensitivity is available for every sensor when the vane tester does not rotate, and so the N code does not form. The threshold accounts for 1.5-2.0 cm/s for the instruments used in the experiment. As a consequence, when the magnitude of current