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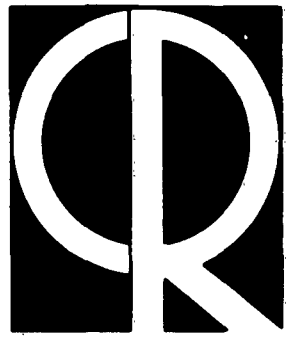

Research Translation

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Detailed Oceanographic Research in the Region of the Kurile-Kamchatka Deep in May-June 1953

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TRANSLATION OF

DETAILED OCEANOGRAPHIC RESEARCH IN THE REGION OF THE KURILE-KAMCHATKA DEEP IN MAY-JULY 1953

(Kompleksnye okeanograficheskie issledovaniia v raione Kurilo-Kamchatskoi vpadiny v mae-iiule 1953 g)

by

L. A. Zenkevich and A. N. Bogoiavlenskii

Institut Okeanologii, Trudy, 16: 24-46, 1959

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BASIC PROBLEMS AND PROGRAM OF OPERATIONS

The main task of the described voyage of the expeditionary ship Vitiaz was to make complex oceanographic investigations in the region of the Kurile-Kamchatka deep. We planned to study the bottom relief, bottom deposits, the hydrological structure of water masses, heavy (rough) seas, and also the distribution of bottom fauna and flora (plankton, benthos, fish, microbes). Geological investigations of the Kurile ridge necessitated our extending the operations to the southeast and to the north - into the region of the Pacific Ocean, i. e., the range of the entire Kurile-Kamchatka sector of the western-Pacific line of watersheds of the earth's surface: the southern basin of the Okhotsk Sea, the area of the Kurile ridge, the Kurile deep and the adjacent subsurface plateau of the Pacific Ocean, and also the area of the junction of the Kurile-Kamchatka and Aleutian systems.

The importance of the problem of the geological study of the Kurile insular arc and of the areas adjacent to it was noted by academician A. N. Zavaritskii in the preface of his book Insular Arcs (1952).

Even foreign science has devoted much attention to the study of the western-Pacific deep-water basins. The works of deep-water expeditions have been devoted to the solution of this very problem - the Swedish expedition on the Albatross, the Danish on the Galatee, and the English on Challenger II.

Until recently no detailed study had been made of the bottom relief in the Kurile basin, nor even a measurement by sounding. We could assume that after the given voyage, our conception of the bottom relief will change considerably.

An important part of the operations was the study of the botton relief in the northeastern part of the Kurile deep, in the area of great seismic activity,

where epicenters of numerous subaqueous earthquakes are located, which sometimes cause tsunami.

The geological branch of the expedition intended to make detailed surveys by sounding along the entire route, and also to study the structure of the bottom deposits with a simultaneous determination of the quantity and composition of the suspensions in the aqueous stratum. The latter is not only necessary to understand the problems of recent deposit formation, but it also gives supplementary material to explain the origin and dynamics of water masses, and also their chemical structure.

The basic task of the hydrological branch was the collection of data on the distribution and structure of the water masses in the investigated area in connection with their interaction with the Okhotsk and Bering seas. In order to determine the magnitude and nature of high-water phenomena, the hydrological detachment not only had to determine the variations in temperature and salinity, but had to make instrument measurements of the currents at the anchor station. The supplementary work of the detachment was to record the drift of the ship, which was necessary to make the measurement co-ordinates exact. With up - to - date methods of investigations to obtain the desired data on the currents, we simultaneously had to make a survey with several ships. Therefore the detachment was not faced with the problem of the determination of the currents. The data obtained had to serve only as material for the construction of preliminary surveys of the transfer of waters by indirect methods.

Works on water chemistry, on the one hand served to give supplementary material on the genesis and dynamics of water masses; on the other hand, they served to aid the evaluation of the productivity of the investigated area, and the solution of the problems of authigenous deposit formation.

With the aid of the hydrological and hydrochemical data obtained on the voyage, we can approximate an evaluation of the different quality and the individualization of the waters of the abysses of the Kurile deep from the deep waters of the Okhotsk and Bering seas and from the deep waters of the adjacent part of the Pacific Ocean. The obtained hydrological and hydrochemical characteristics will help to explain the factors of habitat which determine the zoogeographical division into districts of the World and Ocean.

The problem facing the biological groups which participated in the journey, consisted in obtaining qualitative and quantitative characteristics of the pelagic and bottom flora and fauna in the area of the voyage-bacteria, phyto- and zooplankton, benthos , and fish. Moreover, all the biological groups had to pay particular attention to the study of life at great depths.

On the present journey, we first had to study rather completely the distribution of the population of the abysses in the ocean. The Kurile-Kamchatka deep and the northwestern part of the Pacific Ocean were of special interest in this respect.

The ichthiological and plankton sections on the journey not only studied the features of life at great depths, but had to collect data on the distribution of life in the upper layers of the ocean, to conduct works on the study of the vertical migration of zooplankton and small deep-water fish. A special diurnal station had to be taken on the voyage to show the peculiarities of the diurnal migrations of zooplankton.

The microbiological group had to study the problem of the qualitative and quantitative distribution of microorganisms in an aqueous medium and in the deposits of the investigated area; and we had to pay special attention to the study of the bacteria of the so-called "nitrate" maximum, and also to the distribution and physiological characteristics of the so-called barofile bacteria.

The wave group and the meteorological station had to collect data on swells and on the characteristics of the meteorological processes in the region investigated, which were studied little or not at all in the operations of previous voyages.

To solve the enumerated problems, the Scientific Council of the Institute of Oceanography of the Academy of Sciences of USSR accepted a plan of operations and an expedition route.

The route of the expedition covered the region from the southern part of the Kurile-Kamchatka deep up to the Commander Islands with an exit into the ocean beside the Kurile Islands to 200-300 miles (Fig. 1). . The first

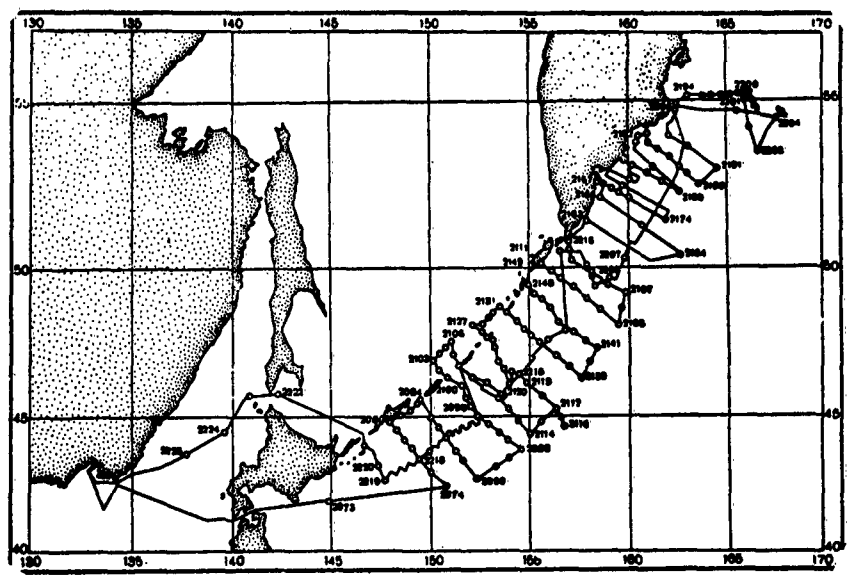

Fig. 1. - The numerals at the circles and on other maps of the routes of the voyage of the Vitiaz are the station numbers.

stage of operations was the investigation of the deep by transverse tacks with a calculation of the tacks, made in previous years. The second stage was the study of the bottom relief of the Pacific Ocean to the south of the Commander Islands and east of southern Kamchatka. The total length of the route was set at 7570 miles, the total duration of the voyage at 70 days, the total amount of stations at 136 (36 of them deep-water). Exit for the voyage was provided through the Tsugaru Strait, the return-through the La Pérouse Strait (Soya Strait).

EXPEDITION PERSONNEL

Directions: Prof. L. A. Zenkevich, doctor of biology, (Institute of Oceanography of the Academy of Sciences) was head of the expedition, deputy head of the science section and the chemical section head was junior research associate A. N. Bogoiavlenskii (IOAS), deputy administration head was V. P. Simakov (IOAS), and junior research associate, and S. V. Suetov (IOAS) was scientific secretary.

Hydrological Section: Junior research associate K. V. Moroshkin (IOAS) was the section head, junior research associates were V. S. Arson'ev (IOAS), B. S. Keifman, G. Kh Iar-Mukhamedov and L. I. Vodop'ianova, senior technician was N. I. Platonova (IOAS), assistants were I. V. Ivanova, V. S. Gorelova and V. M. Greenberg (IOAS), and V. P. Nefed'ev and V. I. Voitov (students-Moscow State University).

Chemical Section: Junior research assistants E. D. Zaitseva and O. K. Bordovskii (IOAS), senior technicians A. B. Isaeva, E. V. Zlobina and M. K. Velichko (IOAS).

Geological Section: Section head was E. A. Ostroumov (IOAS), doctor of chemical sciences, junior research assistants were candidates in geographical sciences G. B. Udintsev and E. N. Nevesskii (IOAS), senior technician was N. L. Zenkevich (IOAS), technicians were V. M. Shilov, N. K. Golovashev and P. N. Fominykh, research associate was A. G. Gainanov associate in the physical-mathematical sciences, junior research associate was R. T. Kupliantseva (Scientific Research Institute of Geophysical and Geochemical Prospecting Methods).

Benthos Section: Senior research associate was Ia. A. Birshtein, doctor of biological sciences (Moscow State University), junior research associates were G. M. Beliaev and F. A. Pasternak (IOAS), candidates in biological sciences, senior technician was N. G. Vinogradova (fellow of the IOAS), technician was N. G. Barsanova (student-Moscow State University).

Plankton Section: Section head was senior research associate L. A. Ponomareva (IOAS), candidate in biological sciences, junior research assistant M. E. Vinogradov (IOAS), technician Iu. D. Chindonova (student-Moscow State University), and technicians N. M. Voronina and V. V. Rashetniak (Zoological Institute of the Academy of Sciences of the USSR).

Ichthiological Section: Section head was junior research associate E. B. Kulikova (IOAS), candidate in biological sciences, technicians V. S. Samoilova, A. M. Vysotskii and A. D. Martynenko (IOAS).

Microbiological Groups: Junior research associate L. A. Rozenberg (IOAS), candidate in biological sciences, junior research associate N. A. Gerasimova (IOAS), A. E. Kriss, doctor of biological sciences (Institute of Microbiology of the Academy of Sciences of the USSR), technician A. A. Bushueva (Institute of Microbiology of the Academy of Sciences of the USSR).

Marine Technology Section: Head of the group was senior engineer A. I. Kuznetsov (IOAS), mechanics F. I. Ganpantserov and A. A. Shenkapenko (IOAS) and senior engineer L. P. Barinov (IOAS).

Wave Group: V. V. Vinogradov was the group leader, junior assistants were M. B. Vishniakova and N. I. Man.

Hydrographic Group: A. A. Astakhov and V. I. Krasov.

Hydrometeorological Station: L. M. Bakutova, aerologist was S. V. Belozerov, synoptician was N. N. Nesterenko, observers were V. A. Koshkin and A. G. Lapina.

Besides associates of the Institute of Oceanography of the Academy of Sciences of the USSR, representatives from the following learned institutions participated in the voyage: The Pacific Research Institute on Fish Economy and Oceanography, the Zoological Institute and the Institute of Microbiology of the Academy of Sciences of the USSR, the Bio-earth Faculty of Moscow State University, the Geographical Faculty of Moscow State University, the Research Institute of Geochemical and Geophysical Survey Methods, and other institutions.

The crew of the Vitiaz named I. V. Sergeev as captain of the long voyage. From the senior staff of the command the following participated in the voyage: senior captain's mate B. N. Rumiantsev, first captain's mate I. I. Malenkov, second captain's mate A. F. Shun'gin, third captain's mate Iu. F. Litovskii, fourth mate P. I. Kalmykov, senior electronavigator A. S. Leonov, second electronavigator A. K. Shako, senior mechanic L. I. Rutkovskii, second mechanic A. L. Andrievskii, third mechanic N. P. Tikhii, fourth mechanic P. E. Kolesnichenko senior electromechanic B. N. Artiukh, second electromechanic I. A. Bugaenko.

ORGANIZATION OF THE OPERATIONS

Utilization of the research material not only of the ocean but also extra-ocean depths of 10, 000 m (for whichwe had full opportunity on the voyage) has great scientific research significance. Formerly, the Vitiaz seldom had to work at depths above 3000-4000 m. On our journey, 30 stations were taken above 5000 m and 14 - above 7000 m.

The characteristic difficulty of operations carried out at great depths is the considerable weight of the cable, eroded so that the instrument might reach bottom. In many cases the weight of the cable exceeds the weight of the instrument. Therefore without special instruments, it was difficult to note when it reached bottom. This leads to recorrosion of the cable; the cable lies at the bottom, and then, when the load decreases, it spins and becomes entangled. When the instrument is lifted, pegs are formed on the cable, which lead to a decrease in these places of stability of the instrument and cause it to break away. We must consider that when working at great depths the very weight of the cable attains half its breaking strength a fact which necessitates special care when working with heavy instruments. Moreover, on former voyages while working at relatively small depths, instruments of greater weight and, correspondingly, cables of larger diameter were used than was foreseen in the planing of the hoists of the Okean. Therefore on the present voyage, the hoist of the geological section repeatedly went out of order because of the overweight. Only with the measures taken on the vessel (rearrangement of the drum and motor) did we succeed in finally obtaining uninterrupted operation of this hoist.

In general, one should note that in spite of many difficulties connected with working at great depths, the basic equipment of the Vitiaz successfully underwent the tests. This proved that the Vitiaz is a ship on which it is possible to carry out any oceanographic works at all depths of the World Ocean, down to the maximum depths.

On the voyage, we experimented with the ships bathythermograph which was manufactured at "Gidrometpribor". These tests showed some deficiencies in this instrument. These deficiencies made it impossible with the bathythermograph to obtain those data, forwhich similar instruments were designed.

We should note the application on the present voyage of plankton nets and ringtrawls to make horizontal recoveries, which yielded a large amount of interesting forms of the pelagic population in the ocean, particularly macroplankton and deep-water fish for collections. The ringtrawls and plankton nets were connected with special clamps onto the cable of the trawl hoist, at the end of which there was a heavy weight or a bottom trawl. In order to avoid catching organisms from other levels, we had to use special nets with switches, working at a specific depth for the level recovery. On our voyage we did not have such switches, which caused some mixing of the forms due to the catch when lifting the series on deck.

CONDUCTION OF THE VOYAGE

On 4 May at 1520 hours, the Vitiaz lifted anchor and set sail. To avoid probable encounters with ice in the La Pérouse Straits and in the southern part of the Okhotsk Sea, the route was charted through the Tsugaru Straits.

On the morning of 6 May, we passed through the Tsugaru Straits.

At 2330 hours, we passed through the Japanese fishing grounds, where obviously there are numerous masses of plankton, and the fish fed by it. This was noted by soundings. On that same day we conducted an aerial hydrological station to refine the corrections of sounding measurements.

At 1535 on 7 May, we started the first station along the first cross-section 2074 of the voyage. At this cross-section, we first crossed the channel of the Kurile-Kamchatka deep with the sounding device. The depth of the channel in this place is more than 9000 m.

On 12 May, we ended the first cross-section, and along Iturup Island (Etorofu) we started the second, taking shallow-water hydrological stations on the way.

On 13 May at the second cross-section, while going from station 2087 to station 2088, we found a depth of 10,280 m, and thus established that the Kurile-Kamchatka deep was considerably deeper than was earlier supposed.

On 14 May we concluded the second cross-section with station 2090 and, while starting the third, we started work on it on 15 May from station 2093. Having completed the third cross-section, we entered the Okhotsk Sea on 17 May through the Uruppu Straits. Having taken 6 hydrological stations in this sea, we went back into the ocean through the Bussol' Straits and began the fourth cross-section.

On 20 May we concluded the fourth cross-section with station 2114 and on 21 May started the fifth with station 2116. Like the first cross-section, we made the fifth cross-section with all the operations. On the second, third and fourth cross-section, we carried out only hydrological works, plankton to 200 m, and partly geological. Taking advantage of the good weather, we studied the diurnal vertical migration of plankton at the station.

After we completed the fifth cross-section, we again entered the Okhotsk Sea through the Kruzenshtern Straits and, having completed stations 2125 and 2132 in the Okhotsk Sea, we returned to the ocean to make the sixth cross-section.

On the evening of 29 May we finished the sixth cross-section with station 2139, converting it into an anchor diurnal hydrographical station. We carried out only hydrological, partly geological and plankton operations at the stations of the sixth, seventh, andeighthcross-sections.

At the seventh cross-section, the weather was conducive to the operations. Completing the work on 2 June, we left for the Fourth Kurile Straits. We finished the eighth cross-section toward the evening on 4 June with station 2155 and started the ninth cross-section with station 2157.

Because of the severely deteriorating weather, the ninth cross-section was interrupted. Anticipating that the storm would soon end, we drifted. However, because the weather did not improve, we decided on 6 June to head for Petropavlovsk-Kamchatka, and to carry out the work of the ninth cross-section on the return trip. On the morning of 7 June, we approached the shores of Kamchatka and before setting out for Petropavlovsk-Kamchatka, we made two measuring echo-sondes tenth and eleventh in the region of the epicenter of the underwater earthquake of 1952 in order to study the bottom relief. These measuring echo-sondes were completed by 9 June with station 2164.

At 0900 on 9 June, we headed for Petropavlovsk-Kamchatka, and at 0300 hours on 11 June, we left for the sea to continue the operations. During 11 and 12 June we made two more echo-sondes (the twelfth and thirteenth cross-sections) through the region of the epicenter of the underwater earthquake of 1952.

On the evening of 12 June, having completed the thirteenth cross-section, we passed to the fourteenth. During 13-16 June, we worked on the 15th, 16th, 17th, 18th, 19th cross-sections and on the morning of 17 June we left for the first station (2194) of the 20th cross-section through the outer part of the Kamchatka Straits. Having completed the cross-sections at the Bering Islands, we arrived at Nikol'skoe station for a few hours on the 18th of June, where we landed the geological, chemical, and biological parties; on that same day we were sea-bound to conduct further operations. We made a cross-section southward through the northwestern outskirts of the Aleutian basin and to the northeast through that same basin toward Mednyi Island on the evening of 18 June, we began the 23rd cross-section from Mednyi Island to Cape Kronotskii; we completed it on the evening of 20 June. We took only one station 2207 for this passage, where we made a horizontal catch of plankton of the ringtrawl series.

On the night of 21 June we arrived at station 2208, from which we had to begin the 24th cross-section to Lopatka Cape. This cross-section was a continuation of a part of the earlier 9th cross-section which was interrupted because of

stormy weather. We took 4 stations along the 24th cross-section at the last of which (2211) we experimented with underwater photography.

Having completed the cross-section on 24 June, we headed toward station 2212 where we arrived at midnight of 24-25 June. We passed through the 25th and last cross-section along the Kurile-Kamchatka deep. During 25 June we took stations 2212, 2213, 2214, and 2215 with some deterioration of the weather towards evening.

On the morning of 26 June near the time we arrived at station 2216, the weather again worsened: the wind reached 7/10, but it began to abate quickly, and the station passed through it safely.

On 27 June we completed station 2216, and stopped at the Kurile Islands from where we proceeded to station 2217. We spent the entire day of 28 June searching for the greatest depth. Because of the strong drift and the extreme narrowness of the sub-surface channel, we succeeded in finding a part of the channel with depths greater than 10 km only at night from 28 to 29 June. Station 2217 was started from a depth above 10 km. At the same time with the lowering of a geological tube and trawls, the vessel was carried to a depth of about 9000 m. After trawling was completed, we searched for the greatest depth and stopped in order to continue the operations at a depth of 10, 240 m. However while drifting, we quickly lost that depth and left for a depth of the order of 9 km.

Station 2218 was taken on 30 June and 1 July at a depth of about 10, 000 m, and the last one along the cross-section to station 2219 was taken on 2 July at about 9000 m. From this station we passed the cross-section through the Ekaterina and La Pérouse Straits with several stations (2200-2223), and thereupon a direct course to Vladivostok, where we arrived on 5 July at 1430 hours. On the way to the Sea of Japan, we took two underwater hydrological stations (2224 and 2225).

THE SCOPE OF OPERATIONS

In all, the voyage covered 8500 miles. We were afloat for 63 days, 32 days 7 hours were required for passing, lay-overs in Petropavlovsk-Kamchatka around the Bering Island, and for drifting without any operations during the storm, and 30 days 17 hours for work at the stations.

While underway, we took 153 stations, 45 of which were at a depth above 3000 m. From the 45 deep-water stations, 30 were taken at a depth above 5000 m and 14 above 7000 m.

THE MAIN SCIENTIFIC RESULTS OF THE JOURNEY

The greatest part of the results of the operations carried out on the Vitiaz on the given voyage have already been published in volume XII of the "Trudy Instituta Okeanologii ANSSSR" (Transactions of the Institute of Oceanography of the Academy of Sciences of the USSR) and in other publications (see the bibliography). Therefore, we shall limit ourselves here only to a brief exposition of some of the results, which havenot yet been published

The hydrological section took 131 stations, 20 at a depth of 5000 m. 2600 temperature determinations were made and more than 3500 salinity tests. Observations were made of the drift of the ship at all the stations; a series of instrument observations of the currents at the station were also made.

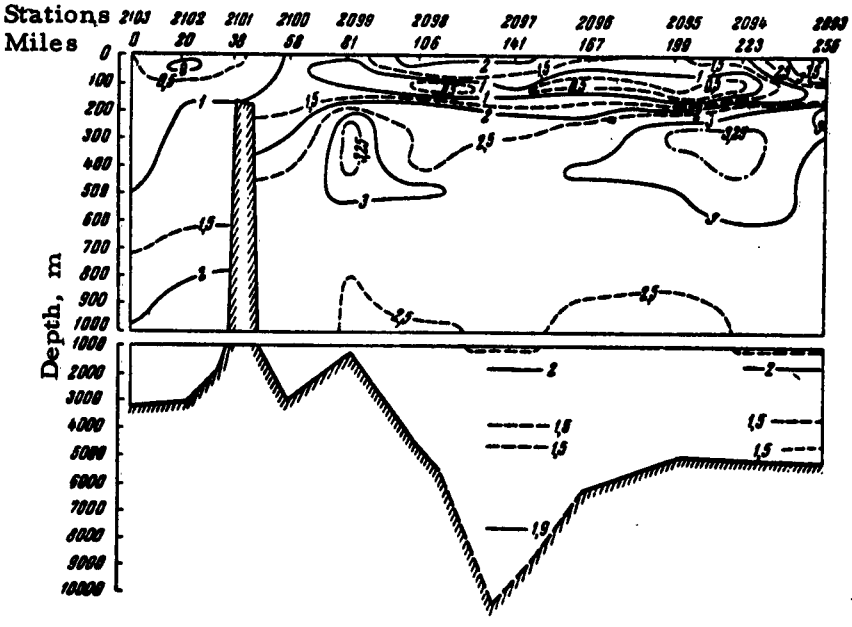

Fig. 2. - Temperature distribution on the Okhotsk Sea - Pacific Ocean cross-section through the Uruppu Straits (15-18 May, 1953).

Data on the characteristics of the water masses in the region of the Kurile-Kamchatka deep and on their vertical distribution were published in an article by K. V. Moroshkin (1955).

The structure of the waters in the entire investigated region was rather homogeneous and very similar to the structure of the waters of the Bering Sea (Fig. 2, 3). The upper layer to 20-40 m was slightly heated (1.5-3° - opposite the Kurile Islands and 3-4° between Kamchatka and Bering Island) (Fig. 4). The salinity throughout the examined area was almost the same (33.2-33.3‰). Below the upper layer, there was a rather weakly expressed layer of temperature change, at which the cold intermediate layer with lowest temperature at 100-125 m began. In a large part of the region investigated, the minimum temperature varied within the limits 0.25-0.50°. A temperature below 0° was noted in the Okhotsk Sea and near the East Kamchatka Coast. At the lower boundary of this cold layer at 150-175 m, there was a rather sharp drop in temperature and salinity, after which there was a warm intermediate layer with a temperature of more than 3°. The center of the layer had rather complex topography, which differed considerably according to depth (from 250-700 m). The temperature of the warm layer which is located from 200 to 600 m, is rather uniform (3.2-3.35°). Only in the Friza and Bussol' Straits does it decrease to 2.8°. The entire stratum of water below 400-600 m is characterized by a uniform decrease in temperature and increase in salinity with depth. The sub-surface temperature minimum is found at 3000-4500 m; (1.42° - 1.49°) and furthermore, the temperature increases with depth and reaches 1.98 - 2.12° at the bottom of the Kurile-Kamchatka deep. Beginning at 5000-6000 m, there is a slight decrease in salinity (0.01-0.02‰).

At diurnal anchor station 2139, we established that the diurnal temperature rate in the open ocean is rather weak and does not exceed 0.4° at certain longitudes (Fig. 5). The diurnal temperature amplitude exceeded 1° only at the limits of the layers of temperature decrease.

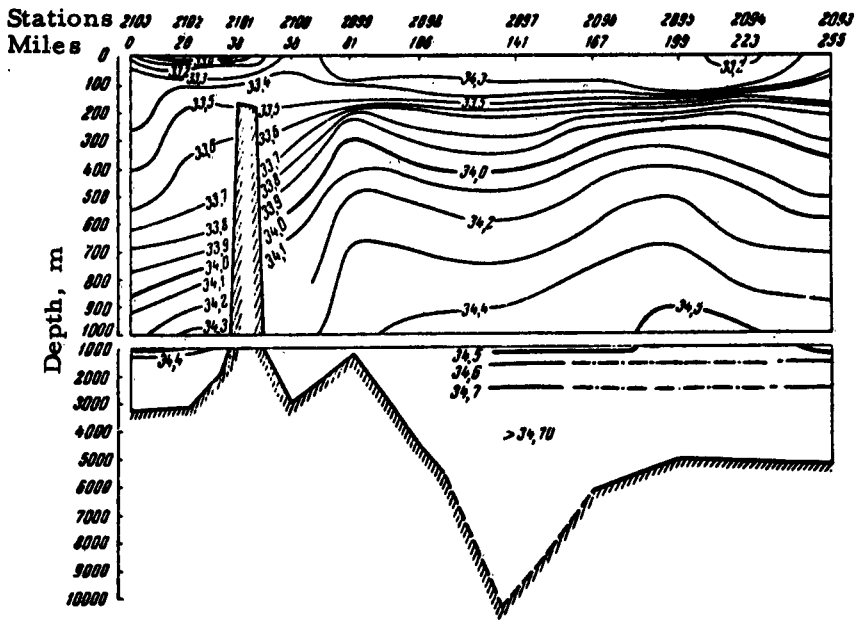

Fig. 3. - Salinity distribution (in ‰) at the Okhotsk Sea - Pacific Ocean cross-section through the Uruppu Straits (15-18 May, 1953).

The method of K. V. Moroshkin, the director of the hydrological section, was used to analyze the T, S curves, T- potential temperature in the region of the Kurile-Kamchatka deep. This method distinguishes five water masses; 1) the surface-water mass which changes in spring, 2) the cold intermediate, 3) the warm intermediate, 4) the sub-surface, and 5) the bottom. The water masses are characterized in averaged form by the following symbols (table 1).

TABLE I

Characteristics of the Water Masses in the Region of the Kurile-Kamchatka Deep

Basic characteristics	Water masses				
	1	2	3	4	5
Layer depth m	0—60	60—200	200—850	850—3000	3000 (bottom)
Thermohaline indexes T, S potential	2,6	0,1	3,8	1,7	1,0
Salinity, ‰	33,2	33,3	34,1	34,7	34,7
Oxygen, ml O_2/l	>8	7,5—8,0	0,4—0,8	from 1 to 3	3,5
pH	>8	8,0—8,1	7,5—7,7	7,9—8,0	до 8,15
Alkaline reserve, mg-equiv/l	2,30	2,30	2,40	up to 2,50	up to 2,56
Phosphates, mg P/m^3	<60	45—65	85—100	80—70	70—60
Partial pressure of CO_2, 10^{-4} atm	3—4	4—5	10—12	6—10	4—7

Figure 6 shows the vertical distribution of the hydrological and hydrochemical data at a station in the region of the maximum depths of the Kurile-Kamchatka deep.

During the voyage, the hydrochemical group made determinations of the dissolved oxygen, active reactions (pH), phosphates, silicon, nitrates, and of the alkaline reserve in 3300 tests of the waters collected from different levels at 120 stations. During the voyage more than 14,000 determinations were made.

The group that studied the chemical characteristics of the bottom and bottom solutions made determinations of the moisture, consistency, volumetric weight, maximum molecular water capacity, and of the composition of argillaceous minerals in the tests of the natural bottoms. They determined the alkalinity, ammonia, nitrates, chlorine, phosphates, and silica in the bottom solutions.

In all, 735 determinations were made of 24 bottom samples and 13 monoliths.

Data on the hydrochemical characteristics of the waters in the region of the Kurile-Kamchatka deep were published in an article by A. N. Bogoiavlenskii (1955).

The geological section made soundings throughout the entire route. Tests were made of the bottom deposits at 51 stations, 28 by dredge and 31 by a single-pass tube (13 tests from 5000-7000 m and 11 from more than 7000 m). Tests were made of the suspended matter at 34 stations from 115 levels. 208 determinations were made of bottom samples: four-valence manganese, ferrous iron, moisture content and pH.

The results of the investigation of the bottom relief were published in the works of G. B. Udintsev (1954 and 1955); the results of the works on the characteristics of bottom deposits and suspended material in the works of P. L. Bezrukov (1955), A. P. Lisitsyn (1955), A. P. Zhuze and T. V. Sechkina (1955).

As a result of the investigations of the bottom relief, we succeeded in making a bathymetric chart of the region of the Kurile-Kamchatka deep, which is given in the work of G. B. Udintsev (1955).

In connection with the underwater earthquake that took place in the autumn of 1952, particular attention concerning its location was payed in the Kurile-Kamchatka deep to the investigation of the relief of the sea bottom in the region of the epicenter in accordance with the data of the Geophysical Institute of the Academy of Sciences of the USSR. In the region of the epicenter 7 measuring Echo-sondes were layed out in all at a distance of 10-15 miles from each other. Two echo-sondes from station 2167 to station 2174 and from 2174 to 2175 were layed out so as to repeat the two measuring echo-sondes of previous years. Because of the

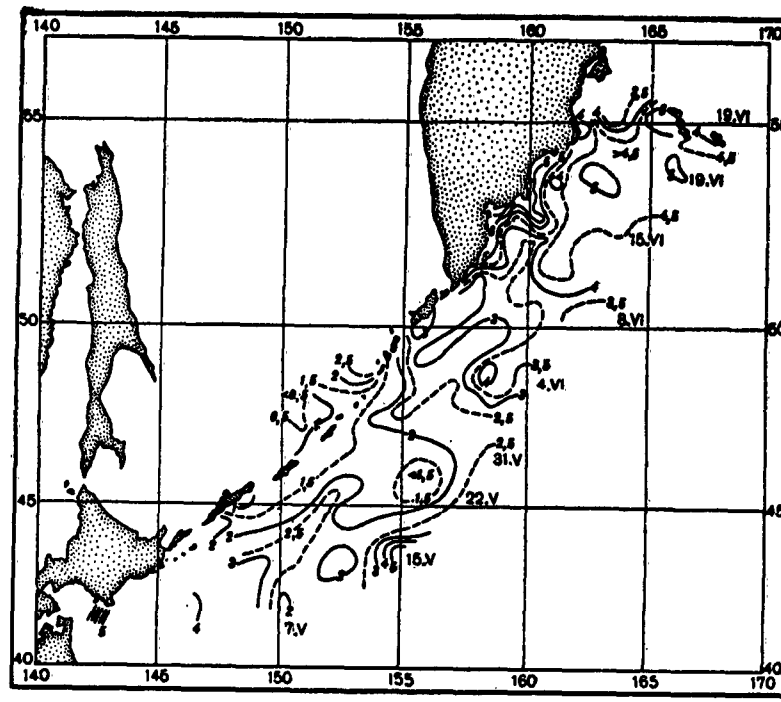

Fig. 4. - Temperature distribution at the surface in the region of the Kurile-Kamchatka deep. (7 May-31 July 1953).

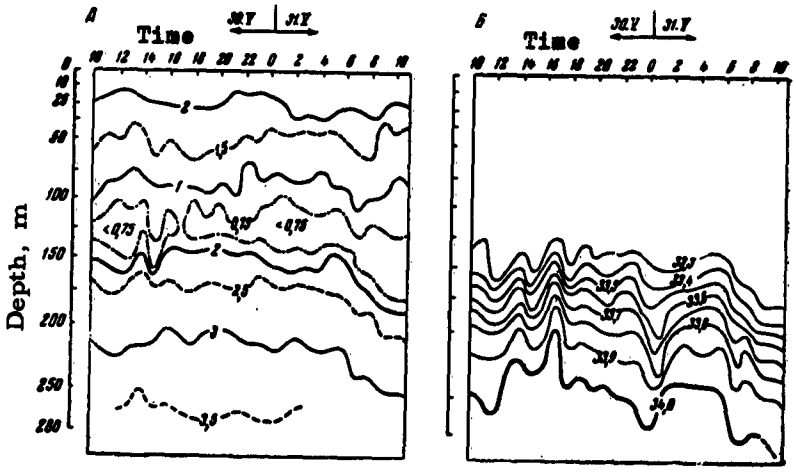

Fig. 5 - Graph for the temperature variation (a) and salinity (b) at levels at the diurnal anchor station 2139.

difficulty of a preliminary calculation of the wind and current drifts, new echo-sondes were made with insignificant displacements. By measurement from the new echo-sondes, we established the deviations in depth (reaching 100-200 m) from a comparison with the former, although the general character of the profiles according to the new echo-sonde more or less correspond to what was established in previous works. In connection with this, the question arises, as the the causes of the divergence in depths, in the changes of the relief, which took place during the earthquake or in the fact that we were not successful in making given echo-sondes. At present it is difficult to answer this

question. A preliminary comparison of the measurement data with the profiles with respect to the of previous voyages and with a bathymetric chart with a scale of 1:500000, compiled on the basis of the operations of the Vitiaz in 1950-1952, forces one to conclude that on the cross-section between the stations 2167-2174 (see Fig. 4 in the article by G. B. Udintsev 1955) the divergences in depth should be explained as a result of the deviation from the given whereas the divergences in depth according to the echo-sondes between stations 2174 and 2175 can be explained as the result of changes in the relief which are connected with the earthquake.

We should note that the investigations of the bottom relief in the region of the recent manifestations of seismic activity made it possible to show the extensive distribution here of forms of a tectonic origin: the steep faults of shoulders and steps. In addition to this we noted the extensive development of slides which were recorded by sounding devices in the form of very characteristic recordings. The presence of such relief forms in a state which has been changed little or not at all by other processes of underwater relief formation testify to the recent tectonic movements which have taken place in the given region. However, for an explanation of a more detailed picture of the properties of the tectonic relief, we need more detailed investigations; and especially those geomorphological investigations provided with the accurate coordination which should be accompanied by a detailed ground survey. It seems expedient that such operations on the investigation of the region of increased seismic activity should be the problem of a special voyage of the Vitiaz.

It was interesting to note how the seismology of the investigated region and with its very recent manifestation, was reflected on the bottom deposits. The maximum number of epicenters of underwater earthquakes in the deep lies in the ocean approximately on the Petropavlovsk-Kamchatka traverse at about 40-50 miles from the shore. The bottom deposits of this region are dense argillaceous sediments almost stripped of the brown surface layer. Examination of a core taken from this region showed that the argillaceous sediment here is not homogeneous and consists of chunks some of which are completely irregular thin interlayers of a brownish color. It was obvious that the deposit was mixed. Such a phenomenon could take place as the result of landslides, similar to those landslides recorded in this region with a sounding device.

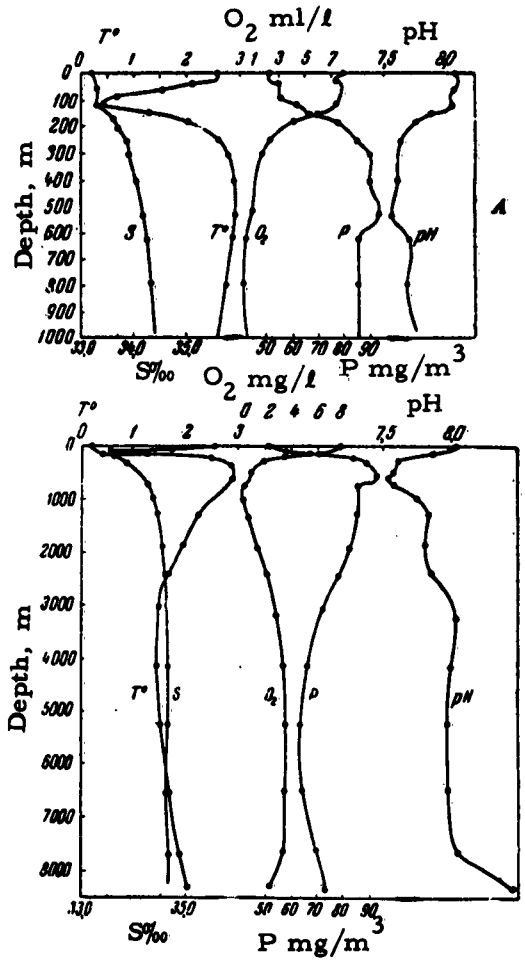

Fig. 6. - Graph of the vertical distribution of the basic hydrological and hydrochemical data at station 2087 in the region of the maximum depths of the Kurile-Kamchatka deep. (a) in upper layer (b) throughout.

The wave section studied the wave elements with an OM-47-TM wave graph at 65 stations and the stereophotograph of sea swell (172 stereo pairs were taken).

The meteorological group made 716 standard observations of the weather elements according to the standard program of hydrological-meteorological stations by means of daily radio soundings and several pilot-balloon observations. All the data of the meteorologicalsection were passed on to the Vladivostok branch of "Gidrometsluzhby" (The hydrological-Meteorological Service).

The plankton section carried out operations at 87 stations. 761 samples were collected, 397 from a Dzhedi net, 90 from a BR net and 258 from bathymeters. A special diurnal station (2116) was taken to study the vertical migrations of plankton. Interesting fauna specimens were obtained as a result of horizontal catch.

The results of the treatment of the data are described in articles by M. E. Vinogradov (1954 and 1955), K. A. Brodskii (1955), Ia. A. Birshtein and M. E. Vinogradov (1955), L. A. Ponomareva (1955), Iu. G. Chindonova (1955). Moreover, data on the characteristics of the vertical migration of plankton in the region of the Kurile-Kamchatka deep can be found in a work by M. E. Vinogradov (1955_2).

According to the plan of the ichthiological operations, this section made otter trawls at three shallow water stations. At the deep-water stations, data on deep water bottom fish were collected by the bottom trawl Sigsbi-Gorbunov. Ichthioplankton and pelagic deep water fish were caught with BR nets and ringtrawl. Vertical catches were made at 13 stations.

Several specimens of deep water fish were obtained by horizontal catch ringtrawls, attached to the cable of the bottom trawl. Moreover, three catches were made (one of them was unsuccessful) with a large pelagic net, 7 mm in diameter. During the voyage, the ichthiological section worked at 70 stations and collected 193 samples, 68 of them deep water fish. They collected 626 examples of mature deep water fish and more than 60 larvae and frys.

The results of the processing of the collected data are described in an article by T. S. Rass (1955) and A. P. Andriashev (1955).

The benthos section made 14 trawl catches during the voyage at depths of 1000 to 9950 m (6 trawlings were at depths of more than 6000 m) by the Sigsbi-Gorbunov trawl with a frame 2. 5 m long.

Grab samples were obtained from 1000 to 5570 m. Due to the application of the trawlograph of the E. I. Kudinov system, it was possible to make a qualitative evaluation with the trawl of the benthos of great depths, where, because of the great rarity of fauna, the grab samples do not give any idea of the biomass of microbenthos.

All the trawl catches made at different depths, up to maximum, yielded rich samples of bottom fauna. As a result of these works, we may consider as finally proven the presence of bottom life at all depths of the ocean.

As the depth increases, the species abundance of different groups of bottom fauna gradually decreases. At the greatest depth of the trawling (9700-9950 m), only six forms of bottom life were found. With an increase in depth the total biomass of benthos also decreases regularly: at depths of 1000-4000 m it varys from 15 to 3. 5 g/m^2, and at a depth above 8000 m it is only tenths of hundreths of a g/m^2.

Results of preliminary processing of the collected data are described in the works of L. A. Zenkevich, Ia. A. Birshtein and G. M. Beliaev (1954, 1955), P. V. Ushakov (1955) and E. P. Turpaeva (1955).

Two groups of associates studied the bacteria life of the ocean: one under the direction of L. A. Rozenberg and the other under the direction of A. E. Kriss. Both groups collected extensive data on the distribution and physiological characteristics of the bacteria of the water stratum and the bottom deposits of the region of the Kurile-Kamchatka deep. They also tried to determine the productivity of the microbiological population of the ocean and to separate the barophile groups of bacteria.

EXPLANATORY NOTES TO THE LOG

The determination of the station coordinates and the course of the expeditionay vessel Vitiaz on all the voyages was made by hydrographs and the pilot staff of the ship under the general direction of the captain. Moreover, we

used a "Kurs-3" type gyrocompass, SO-13 radar and "Neptun", a Gauss-25 hydraulic log, a direction finder, chronometers, astronomical and measuring sextants, protractors, a Kavraiskii pitch meter and maritime navigational charts.

When the shores were visible, the ship's position was determined by a simultaneous measurement of two contact angles by sextants between three supporting points or orienting points. If it were impossible to measure these angles, the ship's position was determined by methods, accepted in navigation; in order to obtain maximum accuracy, different methods were combined. Radar was used in fog and at night.

On an open sea, the ship's position was determined astronomically with the necessary determination of the drift of the ship at the stations. Between the observed points, a graphic calculation was made of the ship's course with a consideration of the drift and current. The discrepancy obtained by this was eliminated analytically, in proportion to the time that the ship traveled in the echo-sondes and to the time that it lay in drift.

In connection with the fact that the latitude and longitude on the given voyages was determined by a similar method, the designations "ob" (observed) or "reck" (reckoned) are written in the log only before the latitude.

The depths of the beginning and end of the stations were measured by sounding recorders and corrected by the workers of the geological section. On those rare occasions when the depth was not measured, a line is drawn on the corresponding graph.

Zonal time is entered in all the logs.

Station Coordinates of the Expeditionary Vessel Vitiaz (May-July 1953)

Stations	Date	time according to the 10th zone		Duration of station	Depth, M		Coordinates of beginning of stations*		Coordinates of end of stations	
		Beginning	End		Beginning of station	End of station	Latitude north	Longitude east	Latitude north	Longitude east
1	2	3	4	5	6	7	8	9	10	11
	4.May	1625 hrs	Departure from Vladivostok				ob. 43°02,1′	131°57,8′		
2073	6.May	20 02	2120 hrs	0118 hrs	3973	3963	rec. 41 52,0	144 52,6	rec. 42°52,6′	144°52,6′
2074	7—8.May	15 31	23 47	32 16	4990	5135	» 42 28,0	150 19,0	» 42 32,2	150 41,5
2075	9.May	03 36	08 03	04 27	5217	5267	» 43 05,4	149 57,0	» 43 05,5	149 55,9
2076	9—11.May	11 04	04 40	41 36	9243	7783	» 43 38,9	149 23,7	» 43 41,0	149 21,0
2077	11.May	06 47	12 12	05 25	4075	3613	» 43 56,0	148 57,4	» 44 54,7	148 54,9
2078		13 53	19 55	06 02	1699	943	» 44 09,0	148 38,8	ob. 44 11,2	148 30,0
2079		21 45	23 21	01 36	284	283	ob. 44 28,3	148 09,1	» 44 29,0	148 09,1
2080	12.May	01 10	02 27	01 17	268	257	» 44 43,8	147 42,9	» 44 44,0	147 42,9
2081		05 34	06 54	01 20	217	205	» 44 58,2	148 14,0	rec. 44 57,0	148 13,0
2082		09 09	10 03	00 54	295	332	rec. 45 10,9	148 39,5	ob. 45 11,6	148 41,1
2083		12 12	14 01	01 49	742	748	ob. 45 24,0	149 09,9	» 45 22,7	149 08,9
2084		15 05	15 34	00 29	79	74	» 45 32,2	149 21,8	rec. 45 33,5	149 20,2
2085		19 36	21 48	02 12	2100	2033	rec. 44 57,0	150 00,0	» 44 57,8	150 05,6
2086	13.May	00 00	02 28	02 28	5111	4627	» 44 37,3	150 24,7	» 44 38,2	150 19,0
2087		05 36	14 42	09 06	8664	8715	» 44 13,9	150 56,6	» 44 12,8	150 42,1
2088		19 35	21 30	01 55	5870	5910	» 43 52,4	151 14,5	» 43 52,0	151 11,9

* In this and in all the other tables of the station coordinates in the given issue of the "Trudy", the abbreviation "ob" means that the coordinates are determined by the observation method, "rec" - by reckoning.

Stations	Date	time according to the 10th zone		Duration of station	Depth, M		Coordinates of beginning of stations*		Coordinates of end of stations	
		Beginning	End		Beginning of station	End of station	Latitude north	Longitude east	Latitude north	Longitude east
1	2	3	4	5	6	7	8	9	10	11
2089	13.May	2343 hrs	0233 hrs	0250 hrs	5043	5003	rec. 43°35,1′	151°35,2′	rec. 43°35,1′	151°31,5′
2090	14.May	07 28	15 32	08 04	5117	4997	» 42 52,5	152 21,5	» 42 54,8	152 10,3
2091	14—15.May	22 31	00 07	01 36	5263	5269	» 43 17,4	153 11,4	» 43 18,3	153 10,1
2092	15.May	05 12	07 00	01 48	5407	5387	» 43 35,7	153 53,0	» 43 38,0	153 53,5
2093		08 45	17 01	08 16	5271	5451	» 43 48,9	154 20,3	» 43 53,7	154 39,0
2094	15—16.May	20 53	02 15	05 22	4977	5137	» 44 10,6	153 50,0	» 44 12,4	153 55,7
2095	16.May	04 54	06 37	01 43	4933	5013	» 44 24,8	153 22,0	» 44 24,8	153 22,9
2096		09 11	15 53	06 42	5807	6028	» 44 46,0	152 47,9	» 44 44,7	152 46,6
2097	16—17.May	18 07	12 17	18 10	8322	8760	ob. 45 05,0	152 21,9	» 44 58,0	152 14,5
2098	17.May	16 06	18 08	02 02	4615	4605	rec. 45 33,8	151 49,5	» 45 32,9	151 48,0
2099		20 08	21 40	01 32	1095	1124	» 45 55,3	151 35,7	» 45 55,0	151 35,0
2100	17—18.May	23 30	01 03	01 33	2822	2782	» 46 12,6	151 14,8	» 46 12,5	151 13,4
2101	18.May	03 00	03 45	00 45	143	135	ob. 46 22,2	150 46,0	ob. 46 21,0	150 45,0
2102		05 36	07 30	01 54	3007	2968	» 46 37,5	150 29,9	» 46 37,5	150 31,4
2103		09 13	11 42	02 29	3127	3120	rec. 46 52,7	150 10,0	rec. 46 51,7	150 10,3
2104		13 15	16 49	03 30	3157	3177	» 47 04,3	150 35,4	» 47 05,6	150 36,4
2105		18 11	20 02	01 51	3332	3362	» 47 16,5	150 58,6	» 47 17,2	151 00,0
2106		21 35	23 22	01 47	3330	3340	» 47 30,0	151 21,5	» 47 30,7	151 22,7

1	2	3	4	5	6	7	8	9	10	11
2107	19.May	0118 hrs.	0256 hrs	0138 hrs	3083	3093	rec. 47°08,2'	151°27,6'	ob. 47°09,8'	151°28,8'
2108		05 01	05 23	00 22	105	129	» 46 48,0	151 41,0	» 46 48,0	151 41,6
2109		07 52	10 28	02 36	2702	2643	» 46 27,2	152 15,5	rec. 46 28,8	152 18,6
2110		12 53	20 23	07 30	3633	3941	» 46 10,6	152 50,7	» 46 17,0	152 58,6
2111	19—20.May	23 00	07 02	08 02	8642	7727	» 45 48,9	153 28,0	» 45 47,8	153 39,3
2112	20.May	12 25	14 18	01 53	5489	5359	» 45 18,9	153 53,0	» 45 17,9	153 54,9
2113		16 51	18 44	01 53	5285	5148	» 44 53,7	154 26,0	» 44 52,0	154 29,0
2114	20—21.May	21 10	03 05	05 55	5223	5354	» 44 27,5	154 59,5	» 44 23,0	155 05,8
2115	21.May	06 40	08 31	01 51	5027	5047	» 44 50,5	155 36,9	» 44 50,0	155 37,8
2116	21—23.May	11 44	17 32	53 48	4551	5030	» 45 16,5	156 13,1	» 44 43,1	156 49,0
2117	23.May	21 05	22 40	01 35	4660	4850	» 45 15,3	156 10,2	» 45 14,8	156 11,9
2118	24. May	01 49	05 30	03 41	4856	4790	» 45 44,0	155 33,8	» 45 41,2	155 36,9
2119	24—25.May	08 44	03 15	18 31	4485	5107	» 46 11,0	154 55,8	» 46 07,8	155 16,0
2120	25—26.May	06 53	17 56	35 03	7661	7924	» 46 31,0	154 22,5	» 46 13,9	154 11,0
2121	26—27.May	20 30	00 35	04 05	4741	4701	» 46 39,2	153 50,1	» 46 37,1	153 47,2
2122	27. May	03 07	08 27	05 20	2755	2795	» 46 59,0	153 21,6	» 46 56,2	153 18,0
2123		11 01	12 13	01 12	2172	2141	» 47 26,2	153 09,0	ob. 47 26,4	153 06,5
2124		13 10	18 30	05 20	1232	704	» 47 35,7	153 03,7	» 47 36,1	153 00,5
2125		19 22	21 03	01 41	1658	956	» 47 40,7	152 50,0	» 47 43,6	152 53,4
2126		22 13	23 45	01 32	3174	3223	» 47 50,7	152 35,8	» 47 51,1	152 35,1
2127	28.May	00 59	03 15	02 16	3272	3283	» 47 59,7	152 18,7	» 47 59,7	152 15,7

Stations	Date	time according to the 10th zone		Duration of station	Depth, M		Coordinates of beginning of station		Coordinates of end of stations	
		Beginning	End		Beginning of station	End of station	Latitude north	Longitude east	Latitude north	Longitude east
1	2	3	4	5	6	7	8	9	10	11
2128	28.May	0450 hrs	0723 hrs	0233 hrs	3236	3243	rec.48°08,0′	152°38,4′	ob. 48°05,5′	152°41,7′
2129		09 02	10 00	00 58	2856	2787	» 48 21,2	153 00,4	» 48 19,8	152 59,4
2130		11 23	12 14	00 51	2239	2288	» 48 32,0	153 18,0	» 48 30,0	153 17,2
2131		13 38	14 33	00 55	1977	1918	» 48 42,6	153 35,8	» 48 42,1	153 36,8
2132		15 54	16 29	00 35	113	543	» 48 38,5	153 56,5	» 48 40,0	153 53,4
2133		18 26	20 45	02 19	1289	1231	» 48 24,2	154 15,1	» 48 23,7	154 17,6
2134		22 39	23 27	00 48	197	493	» 48 09,0	154 42,2	rec.48 08,1	154 43,0
2135	29.May	00 48	03 26	02 38	3638	3728	» 47 57,2	155 00,5	» 47 56,6	155 01,0
2136		06 00	09 44	03 44	7671	7955	» 47 35,0	155 37,0	» 47 33,5	155 40,5
2137		12 09	16 23	04 14	4980	4821	» 47 12,2	156 16,9	» 47 11,1	156 22,5
2138		18 35	19 51	01 16	4907	4907	» 46 52,8	156 54,2	» 46 52,2	156 55,2
2139	29—31.May	22 20	14 44	40 24	4825	4915	» 46 31,6	157 32,0	» 46 32,0	157 28,0
2140	31.V	18 30	19 36	01 06	4895	4905	» 46 55,0	158 00,2	» 46 54,3	157 59,5
2141	31.V—01.June	22 40	04 03	05 23	4491	4909	» 47 23,5	158 25,0	» 47 20,5	158 23,0
2142	1.June	06 54	08 29	01 35	5087	5107	» 47 44,0	157 43,0	» 47 44,5	157 43,6
2143		12 19	13 48	01 29	6008	5877	» 48 06,0	157 02,7	» 48 05,5	157 04,7
2144	1—02.June	16 30	01 55	09 25	6572	7399	» 48 24,0	156 23,0	» 48 25,2	156 34,2
2145	2.June	04 57	06 31	01 34	3750	3750	» 48 47,5	155 59,7	» 48 47,0	156 01,0
2146		08 19	09 06	00 47	830	869	» 48 59,2	155 36,6	ob. 48 59,7	155 35,0

1	2	3	4	5	6	7	8	9	10	11
2147	2.June	1057 hrs	1135 hrs	0038 hrs.	374	374	rec. 49°13,1'	155°14,6'	ob. 49°13,1'	155°14,3'
2148		12 45	13 20	00 35	246	248	» 49 22,7	155 00,3	» 49 22,7	155 00,0
2149		19 37	20 00	00 23	40	43	ob. 50 05,4	155 36,7	» 50 04,8	155 36,5
2150		21 51	22 28	00 37	116	117	rec. 49 51,6	156 06,1	rec. 49 51,4	156 06,1
2151	2—3.June	21 54	01 12	01 18	927	996	» 49 39,3	156 26,5	» 49 38,5	156 26,7
2152	3.June	03 07	06 55	03 48	3770	3839	» 49 23,0	156 57,5	» 49 20,5	156 57,9
2153		09 40	14 24	04 44	7935	7975	» 49 00,0	157 40,8	» 49 01,0	157 40,8
2154		17 33	22 02	04 29	5601	5566	» 48 39,6	158 25,4	» 48 37,4	158 26,3
2155	4.June	01 14	10 40	09 26	5575	5616	» 48 14,1	159 15,8	» 48 12,3	159 20,9
2156		13 05	14 21	01 16	5594	5620	» 48 35,4	159 30,6	» 48 34,0	159 32,0
2157	4—5.June	16 45	18 14	25 29	5565	5595	» 48 55,3	159 45,0	» 48 54,4	159 43,2
2158	5—6.June	23 33	14 05	14 32	6219	6580	» 49 26,2	158 42,3	» 49 12,6	158 35,0
2159	6.June	18 45	20 24	01 39	3466	3495	» 49 49,6	157 47,4	» 49 48,7	157 45,0
2160	6—7.June	23 25	00 51	01 26	825	892	» 50 14,8	157 00,0	» 50 14,0	157 00,0
2161	7.June	03 16	03 43	00 27	81	81	» 50 39,6	156 52,5	ob. 50 39,2	156 52,0
2162		04 56	05 25	00 29	47	44	» 50 52,9	156 54,4	» 50 52,6	156 54,6
2163		09 18	09 52	00 34	56	55	» 51 28,7	157 44,2	» 51 27,9	157 43,4
2164	8.June	02 00	11 35	09 35	5511	5591	» 50 27,2	162 33,8	rec. 50 20,6	162 33,8
2165		18 15	19 41	01 26	7389	7329	» 51 07,1	160 37,3	» 51 06,5	160 37,4
2166		02 54	03 20	00 26	127	129	» 51 59,3	158 26,4	ob. 51 59,0	158 27,5
2167	11.June	06 45	07 20	00 35	68	66	ob. 52 35,5	158 32,7	» 52 35,2	158 32,1
2168		08 23	09 34	01 11	1012	613	» 52 29,3	158 46,3	» 52 29,7	158 45,6

Stations	Date	time according to the 10th zone		Duration of station	Depth, M		Coordinates of beginning of stations		Coordinates of end of stations	
		Beginning	End		Beginning of station	End of station	Latitude north	Longitude east	Latitude north	Longitude east
1	2	3	4	5	6	7	8	9	10	11
2169	11.June	1120 hrs	1254 hrs	0134 hrs	2643	2722	rec. 52°20,5′	159°13,0′	rec. 52°20,3′	159°12,0′
2170		14 17	15 54	01 37	2859	2781	» 52 13,0	159 35,0	» 52 13,9	159 34,5
2171		17 27	19 01	01 34	2409	2501	» 52 03,7	160 00,0	» 52 03,4	160 00,8
2172		21 27	23 05	01 38	4648	4648	» 51 46,0	160 40,8	» 51 46,5	160 40,8
2173	12.June	00 22	02 09	01 47	7333	7303	» 51 38,5	161 00,3	» 51 39,0	161 00,0
2174		05 01	07 44	02 43	5460	5480	» 51 20,2	161 48,0	» 51 21,0	161 47,8
2175		15 50	16 36	00 46	2542	2526	» 52 23,0	159 45,5	» 52 23,2	159 45,9
2176	12—13.June	23 57	00 30	00 33	1717	1685	» 52 37,1	159 56,9	» 52 37,0	159 57,5
2177	13.June	06 15	06 58	00 43	138	140	ob. 53 02,8	160 08,5	ob. 53 02,3	160 08,9
2178		09 11	10 34	01 23	3326	3168	rec. 52 48,3	160 47,8	rec. 52 48,0	160 49,0
2179		13 07	14 25	01 18	6373	6342	» 52 30,0	161 38,5	» 52 29,8	161 39,1
2180		17 30	18 42	01 12	5120	5190	» 52 08,1	162 36,5	» 52 08,4	161 36,5
2181	13—14.June	23 49	00 53	01 04	2358	2363	» 52 55,8	161 14,0	» 52 56,1	161 14,5
2182	14.June	07 48	12 00	04 12	100	102	» 54 12,3	160 29,0	ob. 54 12,8	160 30,8
2183		12 24	14 43	02 19	252	91	» 54 09,1	160 30,0	» 54 08,7	160 22,1
2184		16 28	18 53	02 25	294	186	» 54 12,2	160 55,3	» 54 10,6	160 48,5
2185		19 57	21 31	01 34	700	712	» 53 56,5	160 47,4	» 53 56,0	160 46,5
2186	15.June	00 00	01 30	01 30	3690	3710	» 53 37,0	161 22,2	» 53 37,6	161 20,3
2187		04 27	07 05	02 38	5907	5988	» 53 14,6	162 08,0	» 53 16,2	162 08,5

1	2	3	4	5	6	7	8	9	10	11
2188	15. June	0843 hrs	1030 hrs	0147 hrs	7920	7920	rec. 53°02,4'	162°33,4'	rec. 53°03,6'	162°33,9'
2189		12 14	13 34	01 20	6028	6028	» 52 49,8	162 55,0	» 52 50,3	162 54,2
2190	15—16. June	16 40	04 45	12 05	5200	5180	» 52 23,5	163 42,2	» 52 29,6	163 47,1
2191	16. June	07 30	08 54	01 24	3006	3146	» 52 54,0	164 22,0	» 52 54,6	164 22,0
2192		14 42	16 12	01 30	7006	7077	» 53 35,5	162 59,0	» 53 36,1	162 58,5
2193		19 00	20 14	01 14	2393	2639	» 53 57,4	162 05,0	» 53 58,1	162 05,6
2194	17. June	01 20	02 13	00 53	436	298	ob. 54 52,5	162 20,0	ob. 55 51,4	162 19,5
2195		04 18	05 52	01 34	3873	3927	rec 55 05,8	162 54,0	rec. 55 05,1	162 53,5
2196		08 00	09 40	01 40	4648	4488	» 55 04,6	163 35,4	» 55 04,0	163 35,3
2197		11 12	21 47	10 35	5948	5968	» 55 06,1	163 49,1	» 55 03,1	161 54,6
2198	18. June	00 04	01 48	01 44	5471	5491	» 55 07,4	164 39,6	» 55 06,6	164 39,6
2199		03 37	05 15	01 38	5367	5267	» 55 10,3	165 14,5	» 55 10,2	165 15,0
2200		06 36	07 13	00 37	82	82	ob. 55 12,6	165 39,0	ob. 55 12,0	165 39,6
2201		08 28	17 45	09 17	25	21	» 55 12,1	165 58,9	» 55 12,1	165 58,9
2202	18—19. June	23 54	03 24	03 30	6342	6302	rec. 54 18,0	166 05,0	rec. 54 15,8	166 00,0
2203	19. June	07 30	10 54	03 24	4860	4790	» 53 33,0	166 23,6	» 53 32,9	166 27,6
2204		18 11	19 10	00 59	114	115	ob. 54 33,6	167 30,8	ob. 54 33,3	167 31,8
2205	20. June	00 19	03 10	02 51	6707	6757	rec. 54 37,0	165 40,0	rec. 54 41,3	165 36,5
2206		11 57	12 20	00 23	628	310	ob. 54 44,9	162 18,6	ob. 54 44,7	162 16,8
2207	21. June	13 20	16 15	02 55	7660	7670	» 50 15,9	159 43,0	rec. 50 16,3	159 45,3
2208	21—23 June	22 34	11 26	36 52	7904	7367	» 49 29,3	158 41,0	ob. 49 21,5	158 03,1

Stations	Date	time according to the 10th zone		Duration of station	Depth, M		Coordinates of beginning of stations		Coordinates of end of stations	
		Beginning	End		Beginning of station	End of station	Latitude north	Longitude east	Latitude north	Longitude east
1	2	3	4	5	6	7	8	9	10	11
2209	23—24.June	1417 hrs	0141 hrs	1124 hrs	3515	4205	rec. 49°48,9′	157°45,5′	rec. 49°46,1′	157°48,6
2210	24. June	03 21	07 43	04 22	2300	2673	» 50 02,5	157 38,7	» 50 01,8	157 39,2
2211		12 56	13 31	00 35	60	66	» 50 27,0	156 23,8	ob. 50 27,8	156 23,6
2212	25. June	00 14	01 42	01 28	7965	8238	» 48 10,9	156 42,8	rec. 48 12,0	156 43,8
2213		05 45	07 06	01 21	6652	6594	» 47 39,9	155 47,5	» 47 40,0	155 48,2
2214		08 38	14 58	06 20	8153	7940	» 47 36,0	155 58,0	» 47 36,6	156 01,6
2215	25—26.June	23 25	03 57	04 32	7670	7822	» 46 26,0	155 37,8	» 46 27,0	154 34,0
2216	25—27.June	10 25	16 43	30 18	8875	8459	» 45 41,4	153 23,8	» 45 46,0	153 30,1
2217	29—30.June	06 21	14 52	37 01	—	—	» 44 07,8	150 26,7	» 44 08,1	150 32,5
2218	30.VI—2.July	18 32	03 54	33 22	9414	9389	» 43 47,6	149 54,8	rec. 43 40,0	149 31,0
2219	2. July	11 34	16 19	04 45	8480	8221	» 42 57,5	148 14,0	» 42 59,5	148 12,1
2220		18 54	20 49	01 55	3002	2883	» 43 23,0	147 41,1	» 43 25,2	147 41,2
2221	3. July	03 21	03 50	00 29	96	95	ob. 44 00,6	146 42,8	» 44 00,5	146 42,0
2222	3. July	21 32	21 50	00 18	39	39	» 45 56,9	142 21,1	» 45 56,8	142 20,2
2223	3—4. July	23 58	00 23	00 25	66	76	rec. 45 46,9	141 43,2	» 45 47,0	141 42,5
2224	4. July	09 44	10 35	00 51	949	1027	» 44 31,9	139 42,0	rec. 44 31,6	139 42,0
2225		16 44	17 26	00 42	2410	2958	» 43 51,4	138 00,3	» 33 51,0	138 00,1

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