Restricted distribution

IOC/INF-716
Paris, 18 March 1988
English only

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of Unesco)

REPORTS OF MEMBER STATES AND INTERNATIONAL ORGANIZATIONS ON RESEARCH ACTIVITIES IN THE SOUTHERN OCEAN

This document includes reports of Member States and International Organizations related to scientific activities in the Southern Ocean, presented at the Fifth Session of the IOC Regional Committee for the Southern Ocean (Paris, 9-12 June 1987).

TABLE OF CONTENTS

BRAZILIAN SCIENTIFIC ACTIVITIES IN THE SOUTHERN OCEAN 1983/1987

Since the Fourth Session of the Regional Committee for the Southern Ocean, 1983, the Brazilian Antarctic Program - PROANTAR has sponsored, each summer, a multidisciplinary expedition to Antarctica, carrying out several scientific research projects, with the utmost purpose of increasing the brazilian participation on global studies leading to a better understanding of the Southern Ocean.

Three ships have provided the logistical support for these cruises:

- the Research Vessel "Professor W. Besnard", University of Sao Paulo, has carried out research projects in Physical and Chemical Oceanography, Meteorology and Marine Biology, during those four campaigns;

- the Supply/Research Vessel "Barao de Teffe", Brazilian Navy, basically devoted to personnel and supply transportation, has also carried out research activities in Meteorology, Marine Geology, Marine Biology, and projects on the development of drifting buoys, during the four cruises; and finally,

- the R/V "Almirante Camara", also from the Brazilian Navy, was refitted during 1986, and has been engaged in a Marine Geophysics project, carried out during the last austral summer. Seismic profiles were obtained for approximately 5,000 km, in the areas of the Bransfield Strait, northern Bellingshausen Sea, down to Adelaide Island.

The Antarctic Station "Comandante Ferraz", located in the South Shetland Archipelago, King George Island, and stablished on February 6, 1984, has been supporting scientific activities since that time.

The intersessional activities have been restricted to the area close to the Antarctic Peninsula, from Elephant to Adelaide Island and to the southern Drake Passage.

The tendency for future research activities is the implementation of integrated projects, to be developed also in new geographical areas, towards the south, along the Antarctic Peninsula and eastward, to the Weddell Sea.

Due to an increasing interest of the brazilian scientific community in Antarctic research, especially in those matters related to the Southern Ocean, a project of a home-constructed new oceanographic ship adapted to polar operations, to start operating in 1990, is currently underway.

2.

CHILEAN SCIENTIFIC INVESTIGATIONS CONDUCTED IN THE SOUTHERN OCEAN 1983/1987

Surveys conducted by Chile in the Southern Ocean since 1983 have basically involved the Chilean Antarctic Institute working under the BIOMASS Programme for the SIBEX Phase I and Phase II cruises. Both cruises studied the A/zone of the Bransfield Strait on Research Vessel 'Capitan Luis Alcazar'.

SIBEX - PHASE I - CHILE

The SIBEX - Phase I cruise lasted from 24 January to 15 February 1984. During the survey, a total of 47 bio-oceanographic stations were set up, distributed along 10 transects perpendicular to the axis of the Bransfield Strait. Measurements were taken of temperature, salinity, oxygen content and micro-nutrients (nitrates, silicates and phosphates), at different levels from the sea surface down to a depth of 700 metres.

Samples of zooplankton were taken using bongo nets with a mesh of 333 microns which were trawled across the strait at an oblique angle at a depth of between 0 and 200 metres, obtaining a total of 94 samples. Seven trawls at depths of 200 to 700 metres were also undertaken. This time bongo nets equipped with a locking device were trawled vertically. Phytoplankton collected by the vertical hauls was subjected to taxonomic analysis and water samples were subjected to quantitative analysis for phytoplankton and chlorophyll.

Generally speaking, the SIBEX (1984) cruise observed a marked reduction in temperature, salinity and micro-nutrient components, as in the relative abundance of krill larvae, at the same time as large concentration of salp. Low levels of phytoplankton - a concentration of under 0.5 mg/m^3 of chlorophyll - were found in 60 % of the samples taken in the central area of the strait, while the highest concentrations (1.5 mg/m^3) were found in the Gerlache Strait sector. The data are stored at the Chilean Antarctic Institute and in the Biomass Data Bank at Cambridge, United Kingdom.

Tasks carried out during the SIBEX-Phase I cruise were as follows:

a) Description of the thermal structure of the Bransfield Strait on the basis of XBT observations.
b) Physical oceanography of the Bransfield Strait.
c) Chemical oceanography of the waters of the Bransfield Strait: micro nutrient components and their relationship with watermass.
d) Distribution and abundance of phytoplankton in relation to water mass in the Weddell and Bellingshausen Seas.
e) Antarctic zooplankton ecology.

SCIENTIFIC PUBLICATIONS

Based on the SIBEX - Phase I cruise and published in the periodical 'Serie Cientifica' of INACH No. 33, 1985 (all in Spanish):

1. "The SIBEX Chile-Phase I Project". Patricio Eberhard.
2. "Hydrography of the Bransfield Strait in the austral summer of 1984 (SIBEX-Phase I)". Rolando Kelly, Jose Luis Blanco and Maida Diaz.
3. "Chemical oceanography of the waters of the Bransfield Strait: micro-nutrient components (SIBEX-Phase I-Chile cruise)". Nelson Silva.
4. "Description of the thermal structure of the Bransfield Strait on the basis of XBT observations (SIBEX-Phase I-Chile)". Ricardo Rojas.
5. "Distribution of chlorophyll 'a' in the Bransfield Strait during the austral summer of 1984 (SIBEX-Phase I)". Eduardo Uribe.
6. "Larvae of euphausiid fish and the community structure of zooplankton in the Bransfield Strait (SIBEX-INACH Cruise, 1984)". Armando Mujica and Veronica Asencio.

SIBEX - PHASE II - CHILE

The SIBEX-Phase II cruise, organized by the Chilean Antarctic Institute, was conducted from RV 'Capitan Luis Alcazar' from 20 January to 17 February 1985 and carried out 12 survey operations in which seven Chilean institutions took part. Some 31 bio-oceanographic stations were established and 28 fish trawls were taken with a IKMT net, along 13 transects perpendicular to the axis of the Bransfield Strait.

These bio-oceanographic stations yielded data on temperature, salinity, oxygen content, micro-nutrients, chlorophyll and geo-pigments at various levels between the sea-surface and a depth of 700 metres. Twenty-six bongo net trawls were carried out to obtain samples of zooplankton in the strait between the sea-surface and a depth of 200 metres and 31 with phytoplankton nets for taxonomic analysis.

A hydro-acoustic evaluation was undertaken along each transect in order to determine the biomass and the horizontal and vertical distribution of krill.

Samples obtained from the IKMT net trawls were used also to determine the composition, size, sexual maturity and trophic flows of the population. Eight of these trawls focussed on lantern fish or myctophidae whose diet, otolith morphology and morphometries and length-wet weight ratios were analyzed.

Also analyzed were: the gut content of fish; primary productivity using the c14 method; and enumeration and analysis of the gut content of sea birds.

In general, the physical and chemical data obtained were similar to those for SIBEX-Phase I, although temperature and salinity were slightly higher.

Zooplankton was very varied in nature with copepods, euphausiids and chaetognaths the dominant groups.

The data collected on the cruise have been deposited at the Chilean Antarctic Institute and in the BIOMASS Data Bank at Cambridge, United Kingdom.

SCIENTIFIC PUBLICATIONS

Based on the SIBEX-Phase II cruise and subsequently published in the periodical 'Serie Cientifica' of INACH No. 35, 1986 (all in Spanish):

1. "The hydrography of the Bransfield Strait during the austral summer of 1985 (SIBEX-Phase II)". Rolando Kelly and José Luis Blanco.
2. "The Chemical oceanography of the waters of the Bransfield Strait: micro-nutrient components (SIBEX-Phase II, Chile)". Nelson Silva.
3. "The thermal environment and heat flows in the Bransfield Strait during SIBEX 1985 (SIBEX-Phase II, Chile)". Ricardo Rojas.
4. "The sighting of ice during SIBEX-Phase II, Chile, in the Bransfield Strait, 1985". Roberto Schlatter.
5. "The composition and relative abundance of Antarctic zooplankton in the Bransfield Strait (SIBEX-Phase II, Chile)". Armando Mujica and Veronica Asencio.
6. "Ichthyoplankton in the Bransfield Strait (SIBEX-Phase II, Chile)". Veronica Asencio and Armando Mujica.
7. "Lantern fish (Myctophidae family) collected in the Bransfield Strait (SIBEX-Phase II, Chile)". Enzo Acuna.
8. "The composition of the diet and the size of catches of fish larvae in the Bransfield Strait (SIBEX-Phase II, Chile)". Fernando Balbontin, Marta Garreton and Julio Neuling.
9. "The trophic niche of Pleuragramma antarcticum in the Bransfield Strait area, and a quantitative comparison with other areas of the Antarctic Ocean". Carlos Moreno, Teresa Rueda and Gladys Asencio.

Permanent tide gauges

The Navy's Hydrographical Institute has maintained tide stations at Puerto Montt since 1945, at Punta Arenas since 1944 and at Puerto Williams since 1964 and in 1983 set up a tide station at Prat Base. These tide gauges are part of the Global Sea Level Observing System (GLOSS).

Meteorology

Meteorological stations have been set up at Puerto Montt, Punta Arenas and at the Prat, March and O'Higgins Bases. Two meteorological stations were recently set up in the Antarctic which transmit data by satellite.

Future Projects

Chile will continue to carry out biological surveys supported by physical surveys in the Southern Ocean. Preparations are being made for Chilean participation in the WOCE Programme, and sea-level stations operated in co-operation with GLOSS and permanent meteorological stations will continue to be maintained.

In 1987, Chile will conduct its twenty-fourth scientific expedition to the Antarctic. These are organized every year during the austral summer. Chilean scientists will be conducting research projects, many of which are expected in the future to concern the ocean.

3.

CHINESE SCIENTIFIC ACTIVITIES IN THE SOUTHERN OCEAN

1. TASKS - FIRST EXPEDITION TO THE SOUTHERN OCEAN

1.1 PURPOSE

The main purpose of the expedition was to investigate krills and their environmental conditions. Through the investigations, the expedition planned to obtain comprehensive data of hydrology, biology, chemistry, geology, geophysics and meteorology, to get better understanding of the marine environment and hoped to further and deepen research on some special subjects.

1.2 ORGANIZATION

The expedition was organized and carried out by the National Bureau of Oceanography under the leadership of the National Committee for Antarctic Research of the People's Republic of China and the National Bureau of Oceanography.

The first Southern Ocean expedition of China consisted of 74 scientists and technicians, who mainly came from the Institute II of Oceanography and East China Sea Branch of NBO and other 14 units. It was sponsored by the Institute II of Oceanography.

2. INVESTIGATION AREA, SURVEY LINES, STATIONS AND WORK TIME

2.1 INVESTIGATION AREA

The investigation area was in the west of Antarctic Peninsula (60°S--66°55'S; 55°W--69°30'W), including the area of South Shetland

Islands and northwest of Adelaide Island. The total area is about 100,000 square kilometers.

2.2 SURVEY LINES AND STATIONS

Four continuous lines of gravimetry, magnetometry and bathymetry were carried out.

Survey Line No. 1: Ushuaia harbour of Argentina --- King George Island
Survey Line No. 2: station S_6 --- Point A
Survey Line No. 3: Point A --- station S_21
Survey Line No. 4: King George Island --- Punta Arenas of Chile

The total length of the four lines is about 1,700 nautical miles.

During the survey, 37 station observations were carried out. One of them was a 2-day continuous observatory station, and two of them were current measuring stations.

The measured stations are shown in Table 1

The survey track is shown in the attached Figure entitled "Track Map of the First Southern Ocean Research Expedition of China".

2.3 WORK TIME

The expedition was conducted in two phases, the first phase: January 19-27, 1985, the second phase: February 4-12, 1985. With two days for continuous observation, the total working time was 24 days.

3. RESEARCH PROJECTS AND WORK LOAD

The expedition was involved in 6 specialists with 23 projects.

Track map of the First Southern Ocean Expedition of China

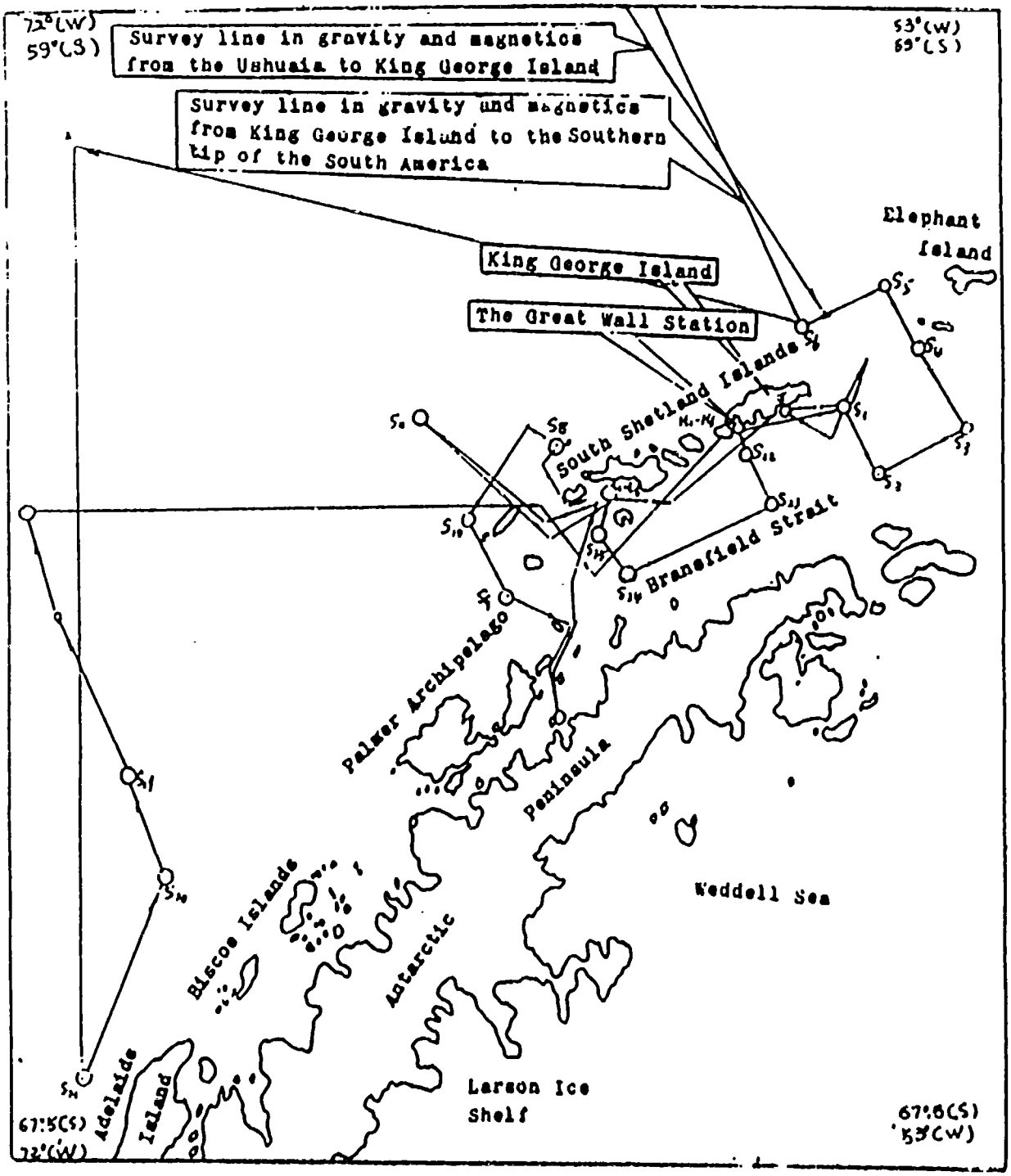


Table 1 Measured Station List

Station No	Data	Latitude	Longitude	Depth (m)
S1	1.19	62° 05'.3S	56° 55'.5W	1234
S2	1.20	62° 33'.1S	56° 28'.6W	278
S3	1.20	62° 17'.3S	55° 06'.2W	528
S4	1.21	61° 44'.3S	55° 43'.3W	1098
S5	1.21	61° 11'.1S	56° 23'.3W	578
S6	1.22	61° 29'.4S	57° 43'.0W	462
S21	1.25	66° 49'.3S	69° 19'.7W	278
S20	1.25	65° 30'.2S	68° 00'.0W	335
S19	1.26	64° 33'.1S	63° 53'.7W	3128
S22	2.1	62° 28'.0S	58° 33'.5W	1464
S23	2.4	62° 51'.6	58° 07'.5W	654
S24	2.5	63° 22'.5	60° 34'.3W	471
S25	2.5	63° 07'.2S	61° 03'.5W	994
L5	2.5	62° 51'.6S	61° 03'.5W	302
L4	2.5	62° 50'.2S	60° 45'.6W	194
L1	2.5	62° 50'.6S	60° 20'.5W	860
L2	2.5	62° 46'.0S	60° 26'.5W	120
L3	2.5	62° 43'.8S	60° 41'.5W	116
L6	2.6	62° 44'.9S	61° 02'.6W	128
S8	2.6	62° 24'.5S	61° 40'.4W	180
S10	2.7	62° 48'.2S	63° 11'.1W	1700
S9	2.7	63° 30'.0S	62° 31'.0W	180
S26	2.7	64° 24'.5S	61° 41'.0W	378
S11	2.9	62° 12'.0S	63° 51'.7W	4198
J	2.10	62° 07'.5S	57° 57'.0W	400
R4	2.10	62° 06'.8S	58° 23'.5W	400
R2	2.10	62° 10'.8S	58° 20'.0W	520
R1	2.11	62° 13'.9S	58° 17'.4W	525
M6	2.11	62° 19'.4S	58° 43'.4W	461

Table 1 (continued)

M4	2.11	62° 15'.8S	58° 45'.9W	510
M5	2.12	62° 15'.5S	58° 42'.1W	370
M3	2.12	62° 14'.4S	58° 51'.7W	345
M2	2.12	62° 11'.7S	58° 48'.5W	230
M_{1-1}	12.26 ~ 12.27	62° 12'.2S	58° 55'.0W	100
M_{1-2}	1.30 ~ 1.31	62° 12'.2S	58° 55'.0W	110

The following are survey lines of gravimetry and magnetometry

(1) Ushuaia Harbor—— King George Island	12.24 12.25	55° 14'.8S	66° 14'.9W	
(2) Station S6—Point A	1.22 1.23	61° 29'.4S 60° 00'S	5743'.0W 69° 25'.0W	
(3) Point A—Station S_{21}	1.23 1.24	60° 00'S 66° 49'.3S	69° 25'.0W 69° 19'.7W	
(4) King George Island — Punta Arenas	2.28 3.1	61° 14'.0S 55° 10'S	57° 53'.0W 64° 54'.0W	

3.1 MARINE BIOLOGY

(i) distribution pattern of abundance of krill and its biological characteristics;
(ii) planktonic organism sampling;
(iii) investigation of primary productivity;
(iv) investigation of benthic organism;
(v) microbial investigation;
(vi) shrimp and fish detection.

3.2 MARINE HYDROLOGY

(i) temperature, salinity and depth observations at stations;
(ii) temperature-depth measurements under way;
(iii) continuously measuring current at stations;
(iv) wave and other sea conditions observations.

3.3 MARINE METEOROLOGY

Observations of marine meteorology elements (wind, atmospheric pressure, air temperature, humidity and cloudage).

3.4 MARINE CHEMISTRY

(i) determination of 5 nutrient elements (SiO_3-Si, PO_4, NO_3, NO_2-N and NH_4-N);
(ii) determination of salinity, dissolved oxygen and pH;
(iii) determination of mercury content in situ and collection of the water samples for measuring trace metals;
(iv) aerosol collection;
(v) organic chemical sampling and collection of interstitial water sample.

3.5 MARINE GEOLOGY

(i) surface sediment sampling, box-core sampling and gravity-core sampling;
(ii) collection of suspended matters and filtering in situ;
(iii) measurement of sediment chemistry in situ;
(iv) collection of the dust in the atmosphere.

3.6 MARINE GEOPHYSICS

(i) gravimetry;
(ii) magnetometry;
(iii) bathymetry.

The details of the accomplished projects and work load are shown in Tables No. 2 and No. 3.

4. VESSELS AND NAVIGATIONAL FIXING

The research vessel (RV) Xiangyanghong No. 10 was operated in the expedition, which belongs to the East China Sea Branch of National Bureau of Oceanography.

The main particulars of the vessel are as follows:

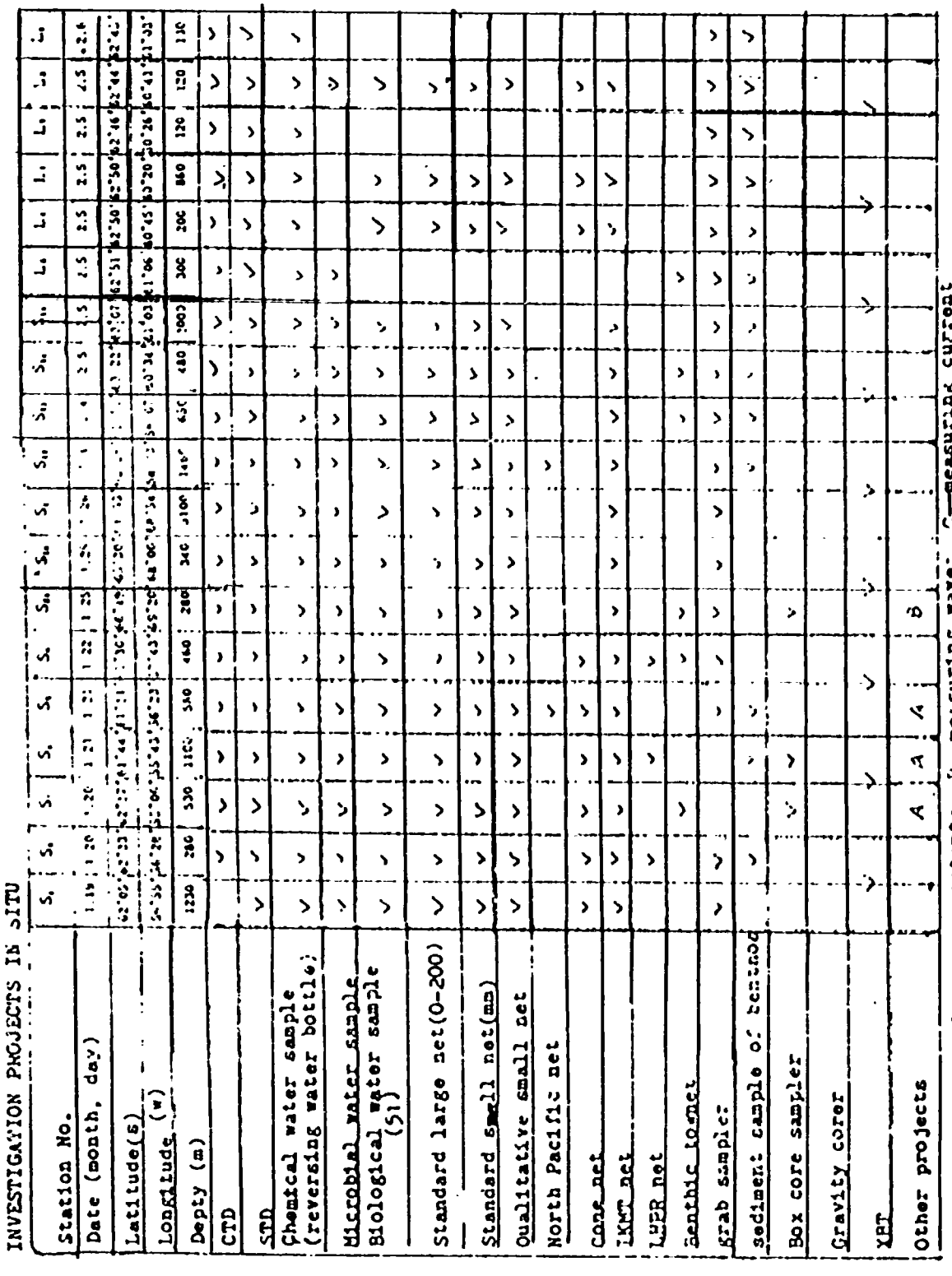
Built date	April 1976
Manufacturer	Jiangnan Shipyard, Shanghai
Length overall	156.20 m
Breadth (mid)	20.60 m
Depth (mid)	11.50 m
Designed displacement	10895.00 tons
Loaded displacement	12950.00 tons
Designed draft	6.80 m
Draft fore end	7.10 m
Draft after end	7.30 m
Loading oil	4000.00 tons
Loading fresh water	1000.00 tons
Mast height	47.00 m
Maximum speed	20.00 kt
Economical speed	18.00 kt
Minimum speed	3.70 kt
Cruising radius	18000 N.M.
Endurance	120 days
Seaworthiness (anti-wind force)	wind force 12
Main engine	MAN-Kz60/105 2 x 9000 Hp
Auxiliary engine	8PSHT6-260 5 x 1040 Hp
Helicopter	one can be carried
Laboratories	48
Oceanographic winches	10
Survey instruments	gravimeter, magnetometer, weather radar
Navigation systems	integrated navigation system. Electrical compass, Omeg, Loran receivers and sperry radar system
Communication system	SATCOM receiving system

In the expedition the vessel's position was fixed by satellite navigation equipment, radar and landmark.

RV Xiangyanghong No. 10 is equipped with two-channel satellite navigation system (MX-200B), single channel satellite navigation equipment (JLE-3850), navigation radar (MX-4016S, MX-4016X), electrical compass (MK-10) and Omeg-Loran receivers.

The stations in the bays were mainly positioned by radar and electrical compass as secondary; the stations around South Shetland Islands were set mainly by radar, and satellite navigation system as secondary; the other stations and survey lines of gravimetry and magnetometry were made by satellite navigation system.

The accuracy of the fix position within 1-1.5 nautical miles was normally set by satellite navigation system and that set by radar and electrical compass within 1.5 nautical miles was used too.



INVESTIGATION PROJECTS IN SITE

Station No.	S_6	S_{10}	S_9	S_{11}	S_{12}	J	R_6	R_5	R_4	$R_{3-1}M$	M_6	M_5	M_4	M_3	M_2	M_{1-1}	M_{1-2}	M_{1-3}
Date (month, day)	2.6	2.7	2.7	2.7	2.9	2.10	2.10	2.10	2.11	2.11	2.11	2.11	2.12	2.12	2.12	12.29	1.30	12.31
Latitude(s)	42°25'	42°48'	43°30'	44°25'	42°12'	42°08'	42°07'	42°11'	42°14'		42°19'	42°16'	42°16'	42°14'	42°12'	42°12'	42°12'	
Longitude (w)	51°40'	53°11'	52°21'	51°49'	53°32'	57°37'	58°24'	58°20'	58°17'		58°43'	58°46'	58°42'	58°32'	58°48'	58°55'	59°35'	
Depty (m)	180	1700	180	300	4200	400	400	520	520	1000	460	510	270	340	230	100	110	
CTD	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			
STD	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Chemical water sample (reversing water bottle)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Microbial water sample	✓	✓		✓	✓	✓	✓				✓	✓				✓	✓	
Biological water sample (51)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓	
Standard large net(0-200)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓	
Standard small net(mm)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓	
Qualitative small net	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓	
North Pacific net		✓															✓	
Cone net							✓		✓		✓	✓						
IKMT net	✓	✓	✓	✓	✓	✓			✓		✓	✓						
LHPR net																		
Benthic townet		✓		✓		✓		✓		✓		✓				✓	✓	
grab sampler	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓		
sediment sample of benthos	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
Box core sampler								✓			✓					✓		
Gravity corer					✓											✓		
XBT																		
Other projects		A	A		A											C	C	C

A--determination of mercury content; B--measuring wave; C--measuring current

4.1 MARINE BIOLOGY

4.1.1 Purpose

It was a multi-project programme in marine biology and we concentrated on the ecological characteristics of krill so as to understand the distribution of krill, the law of krill swarming, the biological characteristics and the relationship between krill and its environment in the investigation area. At the same time, the investigations on the primary production, the species composition and quantitative distributions of plankton, benthos and micro-organism were conducted in the same area. All of these provided a basic data for us to study biology in the Southern Ocean and the further study of Antarctic biology as well as the conservational and rational use of Antarctic marine living resources.

4.1.2 Introduction of the investigations

Investigations on four specialties, i.e. krill, plankton, benthos and micro-organism were described as following respectively:

A. Items and contents

(i) to understand the horizontal and vertical distribution of krill swarm and the image of krill reflection, a 200 KHz echo sounder was used to reconnoitre the krill swarm and record the image reflected from krill under way;

(ii) a 60 feet (mesh six 6 mm) home-made Isaacs-Kidd Midwater Trawl (IKMT) was used at each site to sample obliquely from 150 m to the surface for standard sampling of krill biology and the biomass distribution;

(iii) as soon as the image reflection of krill swarms appeared on the screen of the echo sounder, a target trawl was sent down to test the density and the composition of krill swarms and to check up the image;

(iv) the alive krills caught by a conical net in the vertical trawl were cultured in the low temperature laboratory on-board.

Its feeding rates, moult and growth rates, etc., were observed.

B. The amount of the completed work

(i) the images reflected by krill swarms in the investigation area were recorded by a TCL-204 model echo sounder under way;

(ii) 24 samplings in oblique trawling were taken by a home-made IKMT net on 24 sites. Among them, the maximum catch of krill was 1.25 kg once. In addition, the horizontal target trawls were undertaken and 3.65 kg of krill were caught at a time;

(iii) the horizontal target trawls were carried out by an imported IKMT net (mesh size 8 mm) for 14 times. The total catch was 90 kg of

krill. One catch over 5 kg of krill was gained seven times. The maximum catch was 21 kg, the mean catch was 6.5 kg;

(iv) the random sampling was taken by a conical net in horizontal for 8 times. The maximum catch was 5.13 kg and the mean catch was about 1 kg. To catch the alive krill and to check the image of krill reflection on the echo sounder, the samplings were carried out in vertical trawl for about one hundred times with a total catch of 2 kg of krill. The maximum catch was 1.36 kg. It is estimated that the density of krill swarm was 25.9 g/m^2 in the target trawl;

(v) the feeding rates of krill were measured 5 times on-board in simulated natural environment. The moult rate and growth rate of krill were measured for 3 times.

C. Instruments and equipment

(i) the improved model TCL-204 200 KHz echo sounder performed satisfactorily with a steady running, reliable data and clear image. It showed accurate images reflected from vertical and horizontal distribution of krill swarms;

(ii) the three kinds of nets used were reliable and had their own characteristics. The 6 feet home-made IKMT net was suitable for sampling both adult and juvenile krill as its mesh size was smaller. The improved IKMT net was suitable for catching adult krill as its mesh size was bigger, net thread was harder and filterability was higher. The conical net was an ideal net for catching alive krill as its mesh size was the biggest, filterability was high and had a pot at the bottom of the net;

(iii) the experiments on the spot showed the T.S. towing-depth-distance recorder imported from Japan was satisfactory. It measured accurately the relationship of the warp length and the net depth while at a fixed speed. It had certainty in target trawling of krill swarms. The image and quantity of krill on the echo sounder were quite a lot. The total trawls (excluding vertical trawling) were 53 trawls, which gave information of the krill distributions.

D. Preliminary results

(i) the Antarctic krill Euphausia superba mainly distribute between King George Island and Elephant Island and in the eastern sea area. The catches over 200 g were obtained at stations No. 1, No. 3, No. 4, No. 5, No. 6, No. 8, No. 9. They also appeared at stations No. 19, No. 20, No. 21 near the Antarctic circle. Few of them were seen in Bransfield Strait, and no clear image was shown. Euphausia superba was not found at station No. 11 which was located on the oceanic basin;

(ii) compared with historical data, the biomass of krill Euphausia superba in the investigation area was not as many as that we expected. The maximum catch was 21 kg (at station No. 6). The density of krill was about 6 g/m^2 based on the area of the net

month and the distance of trawling. The real density could not be more than 20 g/m^2 since some krill would escape from the net and the net did not go all the way through the krill swarm. This result is much lower than the experimental commercial catch (100-200 g/m^3);

(iii) krill over 4 cm in length absolutely predominated in the expedition. Juvenile were few. The sex ratio was nearly 1:1. During the first phase (Jan. 19-26), most of the adult females had not spawned, while in the second phase (Feb. 4-12), only a part of them had spawned. It is estimated that the breeding busy period would be around February or a little time later;

(iv) after a preliminary selective examination, 5 species of krill: Euphausia superba, Thysanoessa macrura, Euphausia frigida, Euphausia crystallorophias and Euphausia triacantha were found. Thysanoessa macrura was also abundant in the Bransfield Strait and the continental area;

(v) the image on the echo sounder indicates that krills distribute irregularly in spot way and obviously in aggregation. In general, most of krill swarms distribute vertically in the layer of 20-40 meters, while a few swarms were on the surface or in the layer of 60-80 meters. The thickness of swarms were often 20-30 m. The thickest was over 40 m. The average scale of krill swarms were 100 m. The average scale of krill swarms were 100 m, a few were longer than 100 m. The longest was nearly 4000 m.

4.2 PLANKTON AND MEASUREMENT OF CHLOROPHYLL

4.2.1 Items and contents

(i) samples of the upper 1000 m were collected separately with water-sampling-bottle of 5 liters for the measurement of chlorophyll standing crop, the count of grain and the studies of distribution and composition of phytoplankton and nanoplankton;

(ii) standard phytoplankton net was vertically taken from 200 m deep to surface-layer (according to the Standard of Marine Investigation) for the studies of distribution and composition of phytoplankton in the exploring area;

(iii) improved standard zooplankton net was vertically taken from 200 m to surface-layer for the studies of distribution and composition of zooplankton and krill larva;

(iv) samples were collected separately from various layers with North-pacifica net for the studies of vertical distribution (upper 1000 m) and day-night variation of krill larva and zooplankton;

(v) surface-layer phytoplankton net was taken in surface-layer for the qualitative analysis of phytoplankton;

(vi) samples in surface-layer were collected with water-sampling-bottle for the water analysis with relation to environment protection.

4.2.2 Results

The following results were achieved during the expedition: the investigation on 27 normal observational stations and 2 continual observational stations were completed within 19 days and nights.

(i) 286 water samples for the chlorophyll measurement at different deep layers were obtained. 1144 data of chl. a, b, c were measured with spectrophotometer on-board;

(ii) 286 water samples of phytoplankton at different deep layers were obtained. 246 water samples of nanoplankton were concentrated with 0.45μ filter before fixed in glutaraldehyde;

(iii) the grain composition of surface-layer sea-water was analyzed at 19 normal observational stations and 9 observational stations in bays;

(iv) 93 samples for the studies of composition and distribution of zooplankton and phytoplankton were collected;

(v) 37 qualitative samples of surface-layer phytoplankton and 21 samples of zooplankton at different deep layers including day-night continual observational stations were collected;

(vi) 20 water samples for the water analysis with relation to environmental protection were sampled at 10 stations.

4.2.3 Instruments used and precision evaluation

(i) China-made 5 liter water-sampling-bottle made of organic glass worked very well all the time in sampling of various layers (0, 10, 20, 50, 100, 200, 500, 1000 m);

(ii) using international working method, the content of chl. a, b, c was measured. After filtered through 0.45 acetic-acid fibre filter, the samples were ground and centrifugalized and measured their light density values with spectrophotometer on-board, and then translated them into the content of chl. a, b, c according to the international accepted formula (Unesco);

(iii) the surface-layer water samples were collected with manual water-sampling-bottle. The quantities of the various size of pelagic grain (1-100μ) were counted with Coulter Counter, which was in good condition all the time;

4.2.4 Plankton samplers

(a) Standard Phytoplankton Net: mouth diameter of 37 cm, mouth area of 0.1 m^2 and silk-bolting-cloth of international standard 20#

(68 mesh/cm), which corresponds to the Standard of Marine Investigation.

(b) Improved Standard Zooplankton Net: mouth diameter of 80 cm, mouth area of 0.5 m^2 and silk-bolting-cloth of model GG 52 (18.9 mesh/cm). In order to correspond with the specifications of the international working silk-bolting-cloth and compare the biomass with other country's, the net was remolded by combining the silk-bolting-cloth of model GG 52 with the Standard Zooplankton Net (cf. the Standard of Marine investigation).

(c) North-pacifica Net: mouth diameter of 50 cm, mouth area of 0.2 m^2 and silk-bolting-cloth of model GG 52.

(d) Surface-layer Phytoplankton Net: silk-bolting-cloth is the same as Standard Phytoplankton Net.

(e) The imported Lonthurst-Hardy Plankton Sampler by which samples were collected separately from various layers was not in use as scheduled because its shelf was damaged by the stiff wind and huge wave.

(f) MTD Net System made following a foreign model could not be used as previous plan due to some manufacturing problems. The sampling was substituted by North-pacifica Net.

4.2.5 Preliminary recognition

(i) throughout this expedition, complete data in different environment of the exploring area were obtained. These data would help to present a most complete view of the distribution of plankton in the different waters such as bay, continental shelf, ocean basin and the areas both inside and outside of the polar circle;

(ii) although the exact content of plankton in water need to be examined under the microscope or stereoscope, plankton biomass is very rich in the Antarctic waters by direct perception through the senses. The plankton sampled at different stations was in large quantity, especially in the waters adjacent to Antarctic Peninsula, for example, at station 26, each catch of phytoplankton and zooplankton had to be contained in 7 bottles and 4 bottles (600 ml/bottle) respectively. This had never been found in China seas. High density of phytoplankton was found in Bransfield Strait and near Elephant Island, which is significant for the studies of distribution and swarm of krill;

(iii) the contents of chlorophyll in the exploring area are seemed to be higher than those in some East Antarctic seas, where the maximum value of chl. a content 0.597 mg/m^3 (9.7 m layer) according to the data from the Japanese expedition during the summer of 1983-1984. The content of each layer is about one time higher in our exploring area than that from Japanese data. The maximum value of

chl. a content at station 26 reached to 6.261 mg/m^3. The high density appears in the upper 50 m layer and decline drastically below 50 m. The distribution tendency is the same as data from Japan;

(iv) the dominant species composition of the diatom in ocean basin is different from that near Antarctic Peninsula. According to the preliminary analysis under microscope, the main dominant species at station 11 (open sea) is aggregate Biddulphia, while Rhizosolenia results that nutrient salt descends and transparency of water declines to 3.4 m (water colour is No. 19) except that dissolved oxygen still keeps at the high level of 9.03 ml/l. As amphipoda and krill sampled from Improved Standard Zooplankton Net are very active, it is believed that is why the red current didn't occur.

The high density of diatom is related to the antarctic special environment. The aggregation of the diatom occurs because of mixture of fresh water and salt water in the upper surface-layer, which results from ice and snow melting in summer, rich nutrient salt and longer daylight. Many animals are very much in alive because low temperature of water results in high dissolved oxygen of 9.03 ml/l in surface-layer.

4.3 BENTHOS

4.3.1 Expedition items and contents

(i) Macrobenthos qualitative sampling: samples were collected with a trawl and provided for studying the species composition and distribution of benthos and its relation to marine environment;

(ii) Macrobenthos quantitative sampling: samples were collected with a grab or a spade-boxcorer, and provided for studying the distribution characteristics of biomass and density of benthos;

(iii) Macrobenthos corer sampling: samples were collected with a 15 cm diameter plastic corer inserted into the undisturbed sediment of the spade-boxcorer, and provided for studying the vertical distribution and activity of benthic animal in the sediment and its relation to sediment;

(iv) X-ray corer sampling: samples were collected with a 2 x 30 x 22 cm (internal dimension) plastic cored inserted into the undisturbed sediment of the spade-boxcorer, and provided for X-ray on aboard soon after collection. X-ray photographs were taken for studying the benthos-sediment relation;

(v) Meiobenthos corer sampling: these samples were collected with a 2.6 cm diameter plastic corer inserted into the surface sediment of grab or spade-boxcorer, and provided for measuring the quantitative distribution of meiobenthos.

4.3.2 Statistics of sampler number

(i) Macrobenthos trawl sampling: a total of 17 samples were collected at 12 stations of different water depth between 110-1587 meters;

(ii) Macrobenthos grab sampling: altogether 27 stations of quantitative samples were obtained from 110 to 1800 meters of water depth, among which the area of sampling of 0.25 m^2 was in 8 stations, other 19 stations 0.1 m^2;

(iii) Macrobenthos corer sampling: altogether 3 stations of samples were collected. Each sample was vertically sectioned into interval (0-2, 2-5, 5-10, 10-15, 15-20, 20-30 and > 30 cm);

(iv) X-ray corer sampling: altogether 5 stations of samples were collected, and 5 X-ray photographs were taken;

(v) Meiobenthos corer sampling: altogether 30 stations of samples were collected at different water depth between 110 and 4100 m.

4.3.3 Comments on instruments and equipments

Trawl tools:

(a) Agassiz trawl: mouth width 2 m, with good trawling results at mud-sand-gravel mixed bottom.

(b) Trigonal trawl: mouth width 1.5 m, mostly used for trawling at the rocky hand bottom on the continental shelf of the survey area was proved to be excellent.

Grabs:

(c) Improved petersen grab (sampling area 0.25 m^2) was a comparatively good one in sampling at the soft bottom of the survey areas.

(d) Spade-boxcorer: sampling area 50 x 50 cm, could be well in use while collecting the undisturbed sediment at soft bottom.

(e) RXF-80 X-ray Unit: produced by Xiang Xi General Instrument Factory in Hunan province was used in the survey. Photographs taken were satisfactory.

4.3.4 Preliminary recognition

(i) benthos biomass in the survey region was usually many times higher than those of temperate and tropical seas. At the stations in the continental shelf region, the biomass was about 100 g/m^2 through preliminary determination, while those in the East China Sea and the South China Sea were only 10 g/m^2 or so. The benthos biomass of slope bathyal region in the surveying region was also high, being usually over 10 g/m^2, while that in the East China Sea and the South China Sea was usually less than 3-5 g/m^2;

(ii) species composition of benthos in the survey region was quite different from that of temperate and tropical seas, including China Seas. Sponges were abundantly dominant on the continental shelf, echinoderms were also very rich in the species diversity. Besides, tunicates, bryozoans and hyroids were abundantly found in this survey region. On the contrary, molluscs and crustaceans easily to be met and dominantly distributed in temperate and tropical seas were rarely found here. Particularly, brachyura and stomapod crustaceans never appeared. Apparently, the benthic communities of continental shelf of the Southern Ocean consisting of cold water community was dominated by sponges. In the slope bathyal region of the Southern Ocean, sponges were somewhat decreased however, the kinds and numbers of appeared to be conspicuous;

(iii) sessile epifauna in the Southern Ocean were well developed. Because a large number of rocks, transported to the Southern Ocean through the remarkable glaciation in Antarctic Continent provided a substrate for these benthos, this phenomenon was apparent even at the bathyal of region over 1,000 meter deep, for example, station 22, water depth of 1,450 meters, black rocky bottom, biomass of sessile epifauna was as high as 52.5 g/m^2;

(iv) at the soft sediment bottom of the survey region, the disturbation of benthos was significant, which was apparently related to the factor of no river on the Antarctic Continent;

(v) the size of benthos was large, such these species as giant nemertine (more than 50 cm in length), sea-spider (appendages over 10 cm in length), large holothurian (synaptids, about 750 g weight, more than 20 cm in length), giant sea star (over 50 cm length), giant amphipods (more than 3-5 cm length), etc., were larger than those seen at the temperate and tropical seas;

(vi) benthos trawling conducted in the Southern Ocean could obtain better results by means of the method of anchored haul. Because of the complicated and rocky sea bottom in the survey region, the ordinary trawling method applied would damage trawl tool and ruin the research. We used anchored trawling method, e.g., release steel cable which was about 2 times longer than the water depth, stop the ship to reach steel cable to the bottom, haul up trawl 10 minutes later, it was in good condition when trawl tool got on board, and the specimens collected were very rich, though there were some rocks in the trawl.

4.4 MICROORGANISM

4.4.1 Items and contents of expedition

(i) the aim of this item is to study species composition and quantitative distribution of heterophic bacteria, yeast and filamentous fungus in the sea water and sediments of the survey area. The contents are as follows:

1. zobel bottles were used to collect the surface sea water samples at all stations. The different depth water samples were collected with double drift bottle at six stations. These water samples were filtrated with super filter membranes then inoculated on plate medium and cultivated under different temperatures. Sprouting count method was used to count the colony-forming units (CFU).

2. Sediments were sampled with box corer, analysis of different layers of these sediments was done. The samples diluted with suitable sea water were cultivated on different medium and inoculated under different temperatures. The counting method was the same as above.

3. Strain of heterophic bacteria, yeast and filamentous fungus were separated and purified from the water and sediment samples. Strains are kept alive and further classifications need to be done in the laboratory at home.

(ii) bacteria has been separated from the krill body. It will be provided for studying antisepsision, holding fresh and procession of krill.

4.4.2 Summary of the accomplished work

(i) There were 21 sampling stations in all, among these stationed were six depths water stations and 4 sediment stations. Bacteria has been isolated from 49 water samples (including depths water samples), 13 sediment samples and 1 krill sample, the total of which is 63 analysis samples.

(ii) It has been finished to inoculate on 298 plate mediums. 163 fungal yeast mediums, the total was 461 mediums.

(iii) 461 plate mediums were cultivated at 4°C and 14°C separately. More than 1000 strains were selected for cultivation and breeding incubated.

4.4.3 Comment on apparatus, instruments and their accuracy

(i) Zobel bottle is only suitable for collecting large amount of surface seawater. Double drift bottle is not easy to operate, but its sampling speed is fast and very efficient. The weakness of the bottle is that water amount for each sampling is limited.

(ii) Bacteria was separated with synthetic cellulose filter-membranes, pore size 0.3 μ (made in China), yeast and filamentous fungus using pore size 0.45 u filter membranes (made in U.S.A.).

(iii) Plate mediums separating microorganisms were cultivated at two kinds of temperatures: refrigerator snowflake brand was used to incubate microorganism at 4°C, water insulation incubator (made in China) was used to cultivate bacteria at 14°C. Both showed their stability and reliability in working.

(iv) Sanyo super low temperature refrigerator (made in Japan) kept the breeding and preserved the samples in good condition at -60°C working temperature. The effect of the refrigerator is excellent.

4.4.4 Preliminary recognition

(i) Through the expedition, a large amount of first-hand data about the living CFU of heterotrophic bacteria, yeast and filamentous fungus in the water and sediment samples are collected from the survey area in the Antarctic Ocean. Heterotrophic bacteria, yeast and filamentous fungus are widely distributed in the research area and they are in large amount. However, the total is 1-2 lower than in China Seas. This shows similarity to the data obtained by foreign countries.

(ii) Very little amount of microorganism in the sediment was found, except in the surface of the sediment. The number of bacteria is drastically reduced with the depth of sediment. It was very difficult to cultivate any living bacteria below 25 cm in the sediment.

(iii) It is the first time for us to have selected more than 1,000 strain in the Antarctic Ocean and it will abound greatly to Chinese gene pool.

These materials will be of great value for the further study on marine microorganism, especially on biophysics and biochemistry of marine psychrophile in the future.

4.5 PHYSICAL OCEANOGRAPHY

A. Objectives of investigation

The objectives of the investigation were to understand the structures of temperature and salinity, water masses, spring layer and current, etc. Through basic analysis of their patterns of distribution, try to provide the base of hydrologic environment for clarifying the distributive patterns of biological resources of krill.

B. Items of investigation and accomplished works

Item	Instrument	Sum of observation stations	Sum of data (pairs)	Accumulated depth(meter)	Max.depth (meter)
Temper. Salinity Depth	SZC9-1 STD(China)	34	10368	20724	3080
	Mark-III CTD (U.S.)	34	50000	15700	1500
Temper. Depth	SXBT (U.S.)	62		2790	450
Current	HLJ1-1 Printing current meter(China)	2	3070		90
Wave	Remote measuring wave system	4			8.6 (Max: wave height)
Water colour and transparency	Water colour meter and Transparency plate	22			

C. Comments on accuracy of instruments

4.5.1 Measurement of temperature-salinity-depth

(1) SZC9-1 STD System (China)

Item	Range	Accuracy
Temperature	-2°C - +15°C (-2°C - +5°C)	0.05°C (0.03°C)
Salinity	30 - 36*10-3 (34 - 36*10-3)	0.55*10-3 (0.03*10-3)
Depth	0 - 3000 m	0.35%(All Range)

(2) Mark-III CTD System (U.S.)

Item	Range	Accuracy
Temperature	-32°C - +32°C (-3°C - +32°C)	0.005°C
Salinity	1 - 65 mmhos	0.005 mmhos
Depth	0 - 3000 m	0.1%FS (standard)

4.5.2 Measurement of temperature-depth

(1) SXBT (U.S.)

Item	Range	Accuracy
Temperature	-2°C - +35°C	± 0.2°C(All Range)
Depth	0 - 450 m	± 2% or 4.6 m (All Range)

4.5.3 Measurement of current

(1) HLJ1-1 Printing current meter (China)

Item	Range	Accuracy
Velocity	2 - 145 cm/s	Relative mean squared error ± 2%
Direction	0 - 360°	± 5°

4.5.4 Measurement of wave

(1) Remote measuring wave system (China)

Item	Range	Accuracy
Wave height	0.75 - 8.0 m	0.3% (All Range)

D. Preliminary understanding

The basic analysis of the data derived from this investigation showed the following characteristics of temperature and salinity, etc. in the area:

1. General characteristics (relative to other ocean and neighboring sea area):

(i) The water in the area had the lower temperature and salinity differences: during the investigation, the highest temperature was 2.83°C and the lowest is -1.34°C, and the highest value of salinity is 34.95‰ and the lowest 33.55‰ their differences are 4.13°C and 1.40‰ respectively.

(ii) Thermoclines commonly appeared in the upper layer, the strongest gradient of temperature being 0.04°C/m.

(iii) The temperature inversion layer were observed at a number of stations (there are double thermoclines at a few stations). The lowest values of temperature were between about 70 m and 100 m, and the lowest layer of temperature usually appeared between 40 m and 200 m.

(iv) There existed two water masses at the deep water stations (e.g. Antarctic Surface Water and Deep Warm Water), three water masses at the deep water stations in Bransfield Strait (e.g. Surface Water, Mixing Water and Deep Water), and only one water mass in bays (with the feature of surface water mixed).

(v) The current in Bransfield Strait had the general intention to flow from the southwest to the northeast.

2. The vertical distributions of temperature and salinity could be divided into three types:

(i) Deep water type of continental slope (e.g. stations 10, 11, 19, 20).

The water in the surface layer was characterized by Antarctic Surface Water. The temperature inversion layers appeared between 40 m and 200 m. The lowest layer of temperature was between 70 m and 100 m, and the water above and below this layer had higher temperature. We could see similar phenomena from XBT data on two geophysical exploration sectors. This was because the upper surface water was warmed by the solar radiation during summer season, where as the lower surface water maintained colder temperature (with the characteristics of the winter water).

Antarctic warm deep water has the characteristics of high temperature and high salinity and lay beneath the surface water.

(ii) Strait type (e.g. stations in Bransfield Strait and stations 12, 23, 24, 25 and 34).

There existed the thermocline in the surface layer. Below the layer the distribution of temperature showed a relative uniform, and the salinity increases gradually as depth increases.

(iii) Bay type (e.g. stations in Maxwell Bay, Admiralty Bay and in the bay near Livingston Island).

The properties in the upper water showed high temperature and low salinity, and lower water showed low temperature and high salinity (in the lower layer), where as the properties of the middle layer are between both layers. The vertical distribution of temperature and salinity varied somewhat, but not very obvious. The variation of water properties had certain regularity, that is, the temperature down decreased and the salinity increased with increasing depth.

3. The vertical distributive characteristics of the temperature from XBT's on two geophysical exploration sectors.

(i) The temperature inversion layer appeared from station 2 to station 10 (the section from east to west). The temperature minimum occurred between 75 m and 140 m. The further went west, the deeper the depths of upper bound of thermocline and the lowest temperature and the weaker the strength of the thermocline, and the temperature and the weaker the strength of the thermocline,

and the temperature values within each layers increased. The temperature values of upper and lower uniform, layers approached. Between stations 11 and 14, there were only thermoclines and the temperature inversion layer was not observed. In the water column of 450 m the temperature values decreased gradually with increasing depth except the strong thermocline observed between 40 m and 70 m.

(ii) The temperature inversion layers were also observed between stations 15-27 (the section from south to north), the temperature minimum appeared between 60 m and 160 m. Further more south the temperature inversion layers gradually became shallower and the lowest values of temperature decreased. The phenomena observed at stations 21-29 were different from those on the east-west section, the temperature was higher in the lower uniform layer than in the upper uniform layer, their differences reached to 0.6°C (example: station 26, Tu = 0.8°C, Tl = 1.4°C, where Tu and Tl represented the temperature in the upper uniform layer and in the lower uniform layer respectively). There existed the structure of double thermocline at four stations (stations 7, 9, 19, 22) on two sections. It was not worthy that the lowest values of temperature were lower at four stations than other neighboring stations, the reason of which needs further study.

4. The current and day-night variation of temperature and salinity in Maxwell Bay

(i) The real measuring current velocities were weak in Maxwell Bay. The minimum was only 48 cm/s and the minimum was zero. The tidal current in the bay was mainly the rectilinear current. The tide in the bay showed semidiurnal unequal tides and the highest tide level was 2.6 m.

(ii) The daytime variation of temperature and salinity in Maxwell Bay was not large, with the characteristic of the variation of semi-day period. From the second time observation we found that the values of temperature and salinity within 50 m changed scarcely, but above and below the layer the water properties had clear variation, especially in the lower layer. At 12 and 6 there were the temperature maximum. The highest and the lowest temperature differences reached to 0.3°C.

4.6 CHEMICAL OCEANOGRAPHY

Generally speaking, the southern ocean survey lays stress on physical oceanography and biological oceanography. However, chemical oceanography which has close relation with biological oceanography has not yet been studied very seriously before.

The chemical oceanography was overall surveyed in the study region during present expedition. The purpose of the survey was to understand a regularity of the variation and the distribution of the chemical elements and to find a relation between the inorganic nutrients and the phytoplankton, as well as the krill distribution and the migration. In view

of organic geochemistry, to study the sediment environment and a possibility of oil-gas generation was also covered in the survey. Furthermore, because of requirement of studying marine environment pollution, to determine the background of the heavy metal pollution in the present survey area was again one of the important tasks.

A. The items and the layers of the determining chemical elements in sea water:

Items: seawater salinity, dissolved oxygen, pH values, phosphate phosphorus, active silicate, nitrate nitrogen, nitrite nitrogen and ammonia nitrogen. The total mercury and free-mercury in the water were also determined. The layers were taken at the following levels: 0, 20, 50, 100, 150, 200, 300, 500 and 1000 meters deep. All seawater were first filtered with 0.45 micro-filters, then all inorganic nutrients were determined after the filtration.

The superficial water samples were, respectively, collected at each station from the field, and were then taken to a laboratory for measuring the Cu, Pb, Zn, Cd, and the heavy metal elements.

In order to study the atmospheric-ocean interaction, we also collected aerosol samples and brought them back home for measuring the various nutrients.

For studying the interaction between the surface sediment and the bottom seawater, as well as to make a research on organic geochemistry, we also collected the surface sediments, and brought them back to our laboratory for determining the humic acid, hydrocarbons and heavy metals within them.

B. The accuracy of the main instrument used in the survey

Salinity:	WUS model induction salinment, accuracy 0.01‰.
Dissolved Oxygen:	Winkler method, accuracy 0.03 ml/l.
pH:	HSD and pH_S-3 mod. pH meter, accuracy 0.01 pH.
Phosphate:	Spectrophotometer for using on board in Xiamen Analytical Instrument Factory Phosphomolybdate complex method (STRICKLAND-Parsons). The error was 5%.
Silicate:	Spectrophotometer for using on board by Xiamen Analytical Instrument Factory. The method was the silicomlybdate. The error was 5%.
Nitrate:	Zn-Cd reduction, Diazocompound. The error was 3%.
Nitrite:	The diazotization method. The error was 5%. In general, three Nitrogens were measured with UV-120 Spectrophotometry.
Mercury:	YYG-2 mod. Cold Atomic Fluorescence measuring Mercury. The detection limit was 10-12 g/ml.
Aerosol:	The high capacity total suspended particle collector (Shang Hai Hong Wei Instrument Factory).

C. The accomplished work

A total of the 33 stations in a large area and the day-night continuous station in the Maxwell Bay for measuring the various items mentioned above were undergone twice. The various data and samples acquired as follows:

1. The determined data:

Salinity 317 layers, Silicate 317 layers, Dissolved Oxygen 317 layers, Nitrate 317 layers, pH value 317 layers, Nitrite 317 layers, Phosphate 317 layers, Mercury 104 layers. A total of 2 640 layers analytical data above.

2. The collected samples:

Sediments 74, suspended particle matter 30, aerosol 19, seawater 48, a total of 171 samples were collected.

D. The characteristic of the distribution variation of chemical elements in the survey sea area

1. The distribution of the salinity exists in two basic trends. Firstly, the salinity decreased from the southeast towards the northwest in the northeast of the measuring area; secondly, the salinity in surface layer increased from the southwest toward the northeast. The salinity on the surface was always less than 34,000‰ at stations 21, 19 and 20 within the polar circle. The main reason that made the salinity reduce was a very rapid ocean current from the southwest toward the northeast in the Bransfield Strait. Even in the summer, the stability of seawater was still low. Due to the strong sea wind and the high waves and the effect of the low temperature seawater in the Weddell Sea, the stability was also very low on the surface seawater at the stations 3 and 4 in the northeast of the observed sea area. The mixture was relatively stronger between the surface and the subsurface seawater. Because of this a special trend of the salinity distribution was formed. Since no magnitude fresh water flowing into the survey sea area, and only the wilting ice fresh water into the area, therefore, a little variation of salinity could be found, and the salinity was just about 34,000‰.

2. The distribution tendency of the dissolved oxygen in surface seawater: the dissolved oxygen concentration was high near the Antarctic peninsula, and decreased in the distance seaward gradually. Obviously, the dissolved oxygen concentration was controlled by the seawater temperature and phytoplankton growth. Due to the effect of the Weddell Sea's low temperature seawater (respectively 0.25 and 0.27°C). The dissolved oxygen concentration was 7.94 and 7.83 ml/l for stations 3, 2 respectively. Station 21 located at the polar circle, the seawater temperature was 0.71°C and the dissolved oxygen concentration was 7.86 ml/l. Station 26, however, differed from the stations mentioned above, at which the water temperature was 2.38°C, the dissolved oxygen concentration was 9.03 ml/l, which was the highest in the survey area. It was primarily due to the result of phyto-

plankton phytosynthesis to produce oxygen. It should be proved by the dissolved oxygen saturation (i.e. 120.7%). Another main characteristic in the survey area was the dissolved oxygen concentration being high in the surface.

3. The surface distribution of the nutrients was divided into three regions.

First, the sea area near the South Shetland Island. The phosphate maximum concentration was 1.75 μg/l at station 3, 2 and 25 near the Antarctic Peninsula. The silicate and the nitrate concentration were 75.0 μg at Si/l and 23.84 μg at N/l respectively in the surface seawater. At the Bransfield Strait, the various nutrients were very rich and the concentration decreased slightly in the distance northward.

Second, stations 21, 20 and 19 located at the polar circle. The nutrient concentration distribution appeared to be opposite to the concentrations of the phosphate, Nitrogen were low near the area south of the peninsula while the nutrient concentration, on the contrary, increased seaward, the silicate concentration had an opposite result. Because the silicate concentration was primarily high in the sea area the silicate concentration which was absorbed by photosynthesis was infinitely small in comparison with the original concentration in the seawater. Therefore, the silicate concentration maintained a relatively high level along the coast.

And third, at station 26 in the bays of the antarctic peninsula, the nutrient concentration was greatly reduced and which it was the lowest of any of the present survey area since a great deal of the nutrients was spent by the phytoplankton growth. The concentration of P, Si and N was 0.45, 58.5 and 6.74 μg atomic/l, respectively. In spite of such a low concentration, we still think that the concentration didn't limit the phytoplankton growth. In general, the high concentration of the inorganic nutrients was one of the characteristics in the investigation sea area.

4. The vertical distribution of the chemical elements

It could be divided into three types to be discussed. Station 26 represents the high primary production area; stations 19 and 10 represent open sea area; while stations 2 and 6 represent the channel area.

The station 26 located within the Bay of the Antarctic Peninsula, the surface water temperature was more than 2°C, there were a great number of floating icebergs, the colour of which was grey-green. An abundance of the brown algae was filtered out with the 0.45 μ paper filter from the surface and the 20 m deep water. The results show that the dissolved oxygen concentration was high up to 9.03 and 9.01 ml/l, and the oxygen saturation being 120.7% and 118.1%, respectively, in the surface and the 20 m deep water, however, the dissolved oxygen concentration was only 77.7% at 50 m in depth. The nutrient concentrations were the lowest of any of the survey area in the surface and 20 m. The nutrient concentration increased suddenly at the 50 m in depth. There was a much concentration gradient of the hydrochemical elements from the 25 m to 50 m in depth. Therefore, the characteristic of station 26 was that the top limit of the concentration gradient layer was shallow. The thickness of the concentration gradient

layer was small and its strength was powerful. Station 21 which located within the polar circle had a similar characteristics to that of station 26. However, the top limit of the concentration gradient was relatively deep, the strength was weaker than that of the station 26.

Stations 10 and 19 located at the area outside of the investigation area. The surface dissolved oxygen concentration was 7.79 ml/l and 7.70 ml/l at the 90 m depth. The concentration of the dissolved oxygen dropped down to 6.40 ml/l at the 134 m depth when the strong concentration gradient layer appeared. The concentration linearly decreased with the depth being deeper. The inorganic nutrients concentration increased with the depth being deeper. There was a drammatical concentration gradient layer of the nutrients from the 90 m to the 130 m deep layer. The silicate concentration increased from 4.23 to 69.7 μg at Si/l. The phosphate and the nitrate existed in the strong concentration gradient layer too, the top limit of the concentration gradient was deeper than that of the station 26. The concentration gradient later increased and the strength decreased. This was a characteristic of the vertical distribution of the chemical elements in the sea area off the survey area.

Stations 6 and 2 were located in the east of the survey area. Because of the effects from the Drake Passage and the Bransfield Strait and low temperature water of the Weddell Sea, the variation trend of the vertical distribution of the chemical elements was less than those at the stations mentioned above and concentration gradient was not obvious. The reason for that was the fierce wind and the rapid sea current in this area, and the effect of the low temperature water of the Weddell Sea, so that the mixture was homogeneous between the surface and the subsurface water.

During the investigation, a considerable amount of krill was found near station 6, which indicated the characteristic in the vertical distribution of ammonia. The ammonia concentration was only 0.67 μg at N/l in the surface layer. We know very well that the ammonia level in the seawater, in general, decreased with the depth from surface to going deeper. However, an abnormal phenomenon existed at station 6, the ammonia level was relatively high at the depth from 46 m to 138 m and it was suspected that this phenomenon had a relation to the action of krill, because the fish and the krill drained off excrements which contained a higher ammonia. If the parameter could quickly be determined, it would possibly be used as an useful indicator for finding krill. This discovery should be farther certified in the Ocean investigation in the future.

E. Evaluation

During the present survey a great deal of the reliable data and information have been acquired, which can represent water chemistry characteristics in the survey area. No only has the nutrient concentration been determined, which representing typical concentration of the antarctic area, but also the low nutrient concentration of the high productivity area (station 26), the rarely high dissolved oxygen concentration (9.03 ml/l) have also been determined and the high ammonia concentration in the water region of the krill active area as well. However, the area surveyed was small and divided into two separate parts since lack of two sections.

4.7 MARINE GEOLOGY

4.7.1 Expeditionary aim

The aims of the expedition are:

(i) to understand the recent sedimentation and its material source on the sea bottom of the Southern Ocean;

(ii) to provide the actual information on geology and sedimentary environment;

(iii) to lay a foundation for the theoretical study in paleoceanography, environgeology, and sedimentology in the southern polar region;

(iv) to understand the content, composition and distribution of suspended matters in the seawater of the polar region;

(v) to collect and study the cosmic dusts in the atmosphere;

(vi) to develop advisably geology and geomorphology research on the coast and borderland.

4.7.2 Preliminary conclusion

(i) The sediment compositions on the neritic-bathyal bottom, which are poor in sorting, are relatively complicated. The degree of rounding of the gravel and cobblestones in poor, and in the lithologic compositions of them consist mainly of volcanic rock and granitoid, corresponding to the lithologic character on the borderlands. Thus, it is evident that they belong to the sediments derived from the glaciation. It is worth mentioning, especially, that the most black and fragile lavas with vesicular structure and golitic structure were collected at station S22. They are considered as the autochthonous products which are exposed on the sea floor.

(ii) Because there are no big rivers which carry sediments into sea in the study area, the sediments here are dominated by glaciation and mainly transported by icebergs or drifting ice. Thus, the sediment distribution is so irregular in the horizontal direction is so irregular in the horizontal direction that the stones and cobblestones are observed all over.

(iii) The relict sands on the shelf were almost not found, but a few of stations in the area.

(iv) The sediments in the area are largely composed of the moraine deposits, particularly on the shallow water shelf. However, few of moraine debris were carried into the deep sea by icebergs and drift ice.

(v) The sediments in the deep sea are predominated by the siliceous ooze. From the results of foraminiferal preliminary analysis, the surface sediments at stations S19 and S11 are considered as the products near or below the carbonate compensation depth (CCD), that is, the CCD in the area is located at about 3,000 m. The depth may be the bottom boundary of the Circumpolar Deep Water or the top boundary of the Antarctic Bottom Water in the area.

(vi) The activity of benthic organism is particularly strong on the shallow water shelf, in which the benthos are very abundant and large in size and have distinct influence on the sediments at the sea bottom. The content of organic matters is higher and the grey-black organic bends and masses were commonly found in the sediments. Based on the determination of sediments chemistry, it is found that resolution of the organic remains mainly occurred between 2-20 cm of surface sediments. In addition, the oxidation of the surface sediments shows an increase trend with increasing water depth. The trend may be related to sedimentation rates and activities of benthic organisms in the area.

(vii) The higher concentration of suspended matters which are mostly yellow-green in colour occurs commonly in the seawater of the Southern Ocean. It is inferred that they may be due to abundant algae.

(viii) The grits on the flat of each bay are relatively complicated in size, of which boulders can be as large as over 100 cm in diameter. The causes may be:

(a) physical weathering was strong; the rocks were violently broken and the rocks along the coast directly collapsed;

(b) the glaciation was obvious, and the rocks and ice masses slipped together to the coastal region.

(ix) The volcanic rocks are dominating on the borderlands, such as basalt, andesite, turf and breccia. The intrusive body of granite and other rocks is more widespread, indicating that there are fracture structures. The base rocks on the land were intensely weathered. The rocks with well-developed vertical joints were broken badly. A thick layer of relict sediments was accumulated. And one will have a feeling of walking on the soft and sinking layer.

(x) The shelf of the Southern Ocean shows the following characteristics:

(a) the water depth of the shelf (400 to 600 m) is commonly deeper than shelves of other continents;

(b) the shelf is narrow in width (generally ranging from several to tens nautical miles);

(c) the topographic relief varies greatly. And its relative height may be over 100 m, especially on the island shelves.

(xi) The water depths of the bays are commonly deeper so that they are good for large ship anchoring. The reasons are as follows:

(a) the coasts are mainly characterized by base rocks;

(b) the sedimentation rate is lower.

(xii) The coast and flat were mainly characterized by the capes of the base rock and grits respectively. The capes of the base rocks or ice covers were located at the margin of the coast. There is not much land running off into the sea carrying the sediments and the strong wind erodes the coast.

(xiii) The glacier geomorphology is well-developed and its landscape is very magnificent. There are weirdly-shaped icebergs, unbroken drifting ices, steep valleys of the glacier, extensive ice covers, steep ice cliffs, as well as wave-cut ice caverns and leaching glacial caves.

(xiv) Some gravel levees and comb-shaped gravel ridges are well-developed in the Antarctic Peninsula, being considered as the results of glaciation and wave action.

(xv) Volcanic geomorphology was observed and the typical ones were found in the Penguin Island near the King George Bay and deception Island, where the distribution of basalt and andesite is alternated. There are no snows covers and some phanerogans occur on the volcanic zone, indicating higher ground temperature in the area.

4.8 MARINE GEOPHYSICS

The survey of marine geophysics includes measurements of gravity field, geomagnetic field and variations of sea-floor relief. Data of seven sections were obtained, i.e., the Pacific Section (to and from China and South America), two sections west of Antarctic Peninsula, two sections in Drake Passage (to and from) and one section off the west coast of the Atlantic, south of Chile with 22,100 nautical miles of gravity data, 21,178 nautical miles of magnetic data and 25,900 nautical miles of bathymetric data. Analyses of these data and the preliminary understandings on the three subjects are as follows:

4.8.1 Marine Gravity Measurement

Gravimetric data was one of the basic information in study of marine geotectonics and its evolution. Data of this kind in the west sea area of the Antarctic Peninsula and the Drake Passage were obtained in the survey, which would help us to understand the features of gravity field in the Antarctic Sea and the evolution of Gondwanaland.

1. Instruments

(i) DZY-2 marine gravitometer produced by the Institute of Seismology attached to the State Bureau of Seismology was used in the survey. It was of horizontally swing type with high strengthened capacitance micrometer and quick feed-back system. The platform used together with the gravimeter was the WP-1 gyrostabilized platform made by Factory No. 411 and the platform's long-term accuracy was 5 cm. Main technical indexes of DZY-2 marine gravitometer were as follows:

Accuracy of measurement: 5 mgal at a vertically disturbing-acceleration of 100 gal and the accuracy of the gravitometer was 2.8 mgal.
Tear: $\leq$ 5 mgal/30 days
Maximum bearable disturbing acceleration: 450 gal
Measurement range: 7,000-8,300 mgal all over the earth
System lag: 1.5 minutes
Environmental temperature: 25 $\pm$ 3°C

(ii) All-weather comprehensive satellite navigation system was used for locations in the cruise. The instrument was MX-1107 satellite locator of Magnavox with a two-channel meridian instrument satellite receiver. Its accuracy was 30 m of static location error plus 0.2 miles of dynamic location error caused by the speed error per knot.

(iii) 683 echo-sounder made by Shanghai No. 22 Radio Factory was used for depth sounding. Its bathymetric error was 1%.

2. Measurement

(i) Drake Passage (Ushuaia-Antarctic Peninsula) Section. The speed was 17.0-17.9 kn. The environmental factors were normal during measurement with the environmental temperature of the instruments at 22 $\pm$ 1°C and sea condition within 100 gal.

(ii) The west section of Antarctic Peninsula (6*-A-21*). The speed of the vessel was 15 kn. and the environmental temperature of the instrument was 15-18°C. The sea condition was about 100 gal on 6*-A and some 250 gal harsh condition often occurred on A-21*. The section was intended to extend into the polar circle, but was forced to stop by harsh condition.

(iii) Round sections of the Drake Passage (King George Island-Ushuaia) and Atlantic Ocean south of Chile. The section began from King George Island. The vessel moved at a stable speed of 17.5-18 kn. On the first half of the section, the sea condition was around 100 gal. When approaching the southern end of South America, wind and wave strengthened and sea conditions turned bad. The vertical disturbing-acceleration was about 200 gal. In the section off the

Western Atlantic coast to the south of Chile, sea condition was good with 50 gal in general. The speed was 17.5-19.0 kn. and the recorded curves were fine.

3. Quality of data and primary conclusion

(i) Quality of data: the original records of the survey were of good quality and the gravitational curves were clear. The survey was carried out section by section with no abrupt tear happened and the reliability of data was good. Twin instruments used during the cruise produced the good relativity of curves. The accuracy of final measurements was increased due to the equal accuracy of the two instruments.

(ii) Primary conclusion: primary viewpoints on two gravity profiles of the Drake Passage: gravity profiles in reduced-scale were made after smoothing and readings on the two sections of Drake Passage. Based on the analysis of the gravity data together with magnetic and bathymetric data, the following primary viewpoints were concluded. Gravity profiles made in Drake Passage were 548 nautical miles long between 55°31.6'S, 65°59'W and 61°40.98'S, 57°9.5'W, and the round section's was 439 nautical miles from 61°14'S, 57°59'W, to 55°10'S, 64°53'W. The southern end of the round section was to the south of the original section while its northern end was to the north of the original one (see tracks of gravity and magnetism). Both of the two sections located between the South America Continent and the Antarctic Continent. From the comparisons between reduced-scale gravity profiles and magnetic and bathymetric data, the linear decreased from the Southeast to Northwest in the gravity survey area and the gravity anomalies corresponded with sea-floor relief features one by one. This showed that normal field and sea-floor relief were two main factors controlling gravity values of the two profiles. Though the two sections didn't coincide with each other, the relativity of two recorded curves was good, which showed that the tectonic lines in the survey area were roughly perpendicular to the survey lines. At 56°41'S, 64°26'W (the water depth was nearly 4,000 m) the gravity value was 40 mgal lower than that at the two sides, for it was affected by sea-floor relief. It could also be seen on the magnetic profiles that this area was the changing demarcation of magnetic anomaly. Therefore, this area might be the boundary of oceanic crust and continental crust as well as the convergence zone of Antarctic Plate and South American Plate. This coincided with the previous knowledge that Antarctic Plate subducts beneath South American Plate. The position of 58°25'S, 61°54'W was magnetic anomaly quiet zone on the magnetic profiles, but it showed low gravity on the gravity profiles and low relief on the bathymetric profiles. This suggested that there exists a fracture zone. And we doubt that it may be a transform fault. At 59°62'S, 61°05'W a negative anomaly of about 40 mgal occurred, which was resulted from sea-floor relief. At 61°17'S, 57°53'W gravity value showed a sudden decrease and then an abrupt increase. It was the largest observed difference on this section. The reason was that the sea floor relieve was high (see Table). Primary viewpoints on

the 6*-A-21* gravity profile: gravity data of 741 nautical miles in the Antarctic Sea could be divided into two sections. First was from station 6 (61°23'S, 58°26'W) to Point A (60°07.9'S, 69°25.5'W) and the second was from Point A to Station 21 (65°41'S, 61°19'W). On 6-A profile the anomalies roughly occurred on two parts from 61°23'S, 58°26'W to 61°02'S, 61°28'W and from 61°02'S, 61°28'W to A. The first part had a 70-80 mgal of negative anomaly corresponding to low sea-floor relief, of which the largest amplitude was at 6*-A. It was primarily estimated that there were still tectonic activities in the Western Antarctic Peninsula for this part just traverses the local subduction zone in the Western Antarctic Peninsula. Observed gravity anomalies in the second part did not change greatly except a 30 mgal anomaly in the middle corresponding to the sea-floor relief. The gravity values fell down linearly. The magnetic field was characterized by a violent alternating of positive and negative anomalies while the gravity anomalies were rather quiet. There are on obvious relations with each other. So it was a typical ocean basin. On A-21* profile, a sudden change of gravity observation value of about 50 mgal occurred at A because of a sudden change of the ship route. Then they showed a quick rising trend (mainly because of the increase of normal field). At 61°01'S, 69°20'W there was a gravity height corresponding to a magnetic height. At 62°18'S, 69°19'W there was a gravitational height resulted from a seamount of 1000 m high, corresponding to a magnetic height. These two anomalies were both caused by the seamount. In short, on this profile a speculating trench anomaly at 61°01'S, 69°20'W, several seamount anomalies and a typical gravity profile of ocean basin, were obtained which provided information for the study of these three tectonics forms.

(iii) Comments on the instruments: testing the home-made gravimeter was one of our tasks in the survey. The field-work showed that full trans-Pacific gravity profiles and gravity profiles of southern ocean were obtained successfully with the home-made gravitometer. The technical indexes of DZY-2 marine gravitometer have been all completed. It possessed a strong anti-disturbance ability. The performance of WP-1 gyro-stabilized platform was also satisfactory. Results showed that the use of home-made gravitometer and gyro-stabilized platform was successful and they could meet the demands of global gravity survey. Through this expedition, we gained rich experience in oceanic survey. We realized that storms in Antarctic region were not only frequent but also severe and the sea conditions were Hostile. The anti-disturbance ability of the instruments should be improved as well as the shakability of the platform. In addition, as the work is hard and the working time is long in oceanic survey, it requires the increase of automation degree of the instruments so as to decrease the intensity of labour.

Sections	Number of instruments used	Total length	Effective length	Time	Location	Work hour	Number of recording paper
Drake Passage Ushuaia-Antarctic Peninsula	8302	584	548	84.359 84.360	55 31.61'S 65 59.52'W 61 40.98'S 57 09.46'W	25.6	9
Section West of Antarctic Peninsula 6*-A-21*	8301 8302	741	700	85.22 85.24	61 28'S 57 42.9'W 60 35.9'S 64 52.5'W	46.25	10
Backward Section the Drake Passage	8301 8302	439	439	85.59 85.60	61 14.39'S 57 53.31'W 55 09.9'S 64 52.50'W	24.5	11.12
Section of the Western Antarctic Coast of the Southern of Chile	8301 8302	192	192	85.61 85.61	54 29.87'S 65 09.81'W 52 23.46'S 68 56.56'W	10.8	11.12
Sum		1920 nautical miles	1879 nautical miles			737.9 hour	

4.9 MARINE MAGNETIC SURVEY

4.9.1 Purpose

Marine geomagnetic information is one of the essential marine environmental information. The geomagnetic data collected from the southern ocean provide the first hand information for us to study the geological structure of the southern ocean, the evolution of Gondwanaland, the appearance of the Drake Passage and especially to study the plate tectonics by using sea-floor spreading magnetic anomalies. Moreover some experiences of the magnetic survey on the ocean were obtained.

4.9.2 Method

The total magnetic intensity (T) was measured in the survey with the proton precession magnetometer model CHHK-2 made by Beijing Geological Instrument Factory. The machines were in the way of one working and the other two in reserve. The ship's speed was usually kept at 18 nautical miles/hour. Methods of simulated recording and typing in digit (typing a value of total intensity per 15 seconds) were used.

4.9.3 Statistics of accomplished work

The data of 1,682 nautical miles have been acquired after 107 hours in the Southern Ocean (Table 1).

4.9.4 Quality and editing of data

The recording as good and clear. The original recordings were smoothed and the cable length was altered. The interval of collecting samples was every ten minutes of the counted 246 values of vibratility of the instruments in the magnetic quiet zone, 19% is more than 1.5 gamma, and 81% is less than 1.5 gamma.

4.9.5 Preliminary conclusion

The preliminary conclusion on the Drake Passage magnetic profiles: the Drake Passage is situated between the southern America and the Antarctic Peninsula. Based on the roughly collated magnetic profile data, it seems that the magnetic field is characterized by a striking alternation of positive and negative anomalies. The amplitudes of anomalies generally are about 170 gamma. The maximum is about 800 gamma which indicates the anomaly of the seamount based on the bathymetric centered around 58°24'S, 61°50'W is a magnetic quiet zone about 13 nautical mile wide. It may be formed by the decreasing of magnetism which was caused when the magnetic body was extruded and fractured. We think that those are the reflections of the fracture zone. The magnetic anomalies occurred nearly symmetrically on the both sides of the magnetic quiet zone.

Elementary viewpoint on the 6-a-21 magnetic profile: it is known that the magnetic profile can be divided in three parts:

(i) the magnetic quiet zone of the continental shelf;
(ii) the undulational anomalies zone of the continental slope;

(iii) the striking alternating zone of the positive and negative anomalies of the ocean basin.

There is a seamount one kilometer high, of which the peak of the magnetic anomaly corresponds to the top of the seamount. It indicates that the seamount's magnetic anomaly was formed at the high latitude area in the geomagnetic reversal period. It was already recognized that Antarctica was part of Gondwanaland. From Mesozoic era, Gondwanaland was dismembered step by step because of the sea floor spreading and continental drifting. Although our data were limited to a small region, the whole history of the evolution of Gondwanaland could not be deduced completely. We might affirm that the alternating of the positive and negative anomalies was the result of later sea-floor spreading string to northwest-southeast. We think that the youngest anomaly in the region was the anomaly No. 3 from primarily sorted data. Thus, we might deduce that the large scale spreading of the Drake Passage stopped 5 m y B.C.

Table 1

Survey line	Time	Length (nautical mile)	Physical point	The cable length behind the ship (meter)
Drake Passage 1	84.12.24 84.12.25	503	211	500
6-a-21	85.1.22 85.1.24	741	323	490
Drake Passage 2	85.2.29 85.3.1	438	153	480
Sum		1682	687	

4.10 BATHYMETRIC SURVEY

4.10.1 Aim

In the Southern Ocean comprehensive environmental investigation, bathymetric survey not only researched sea-floor relief but also provided services for other purposes. So it was carried out through the whole expedition so as to fill in the charter and understand the features of the sea-floor relief.

4.10.2 Fulfilled work

(i) During the two days of continuous work from Argentina to George Island, 560 nautical mile of self-recorded sea-flow relief profiles and 250 groups of point records were obtained.

(ii) In 15 days and 16 hours of continuous work in the whole survey area, 3,429 nautical miles of self-recorded sea-floor relief profiles and 1,488 groups of point records were obtained.

(iii) In 46 hours of continuous work from George Island to Chile, 771 nautical miles of self-recorded sea-floor relief profiles and 275 groups of point records were obtained. The total amount of survey was 4,850 miles of self-recorded sea-floor relief profiles and 2,013 groups of point records in 19 days and 14 hours of working hours.

4.10.3 Preliminary conclusion

(i) Area of S19, S20 and S21: In this area continental shelf was wide and the depth varied slowly but the amplitude of variation was great. At the connection of the shelf and slope, the depth was about 500 m and the slope was about 8 degrees. The whole slope was even and the surface of the slope was smooth. Outside the slope, water depth increased gradually from 2,500 m to 3,000 m or 4,000 of the deep-sea plain.

(ii) North of the South Shetland Islands: Compared with the above area, the shelf of this area was narrow and the depth varied abruptly and greatly. At the west end of the islands (near S10) the upper part of the slope was not even, being 12-20 degrees. At the east end of the islands (near S6) the slope of the upper part was about 20 degrees, while the lower part was small. There were a good number of rifts in the lower part. Down the slope there was a trench from 60°50'S 57°00'W to 62°45'S 64°00'W. The deepest part of the trench occurred in its east and where the width was around 6 nautical miles and the depth was more than 5,200 m. North of the trench was the Drake Passage in 300 m-400 m deep. The sea-floor was rugged and rough.

(iii) Bransfield Strait: In the central part of the strait, there was a deep area from the east to the west with water depth of 1,500 m -2,000 m. The shelf was wide on the side of the peninsula and narrow on the islands side. The depth of the whole shelf that had

a winding boundary varied greatly and abruptly. From the depth profiles of S23 to S25 and Maxwell Bay to S1, S25 and S9, V-shape deep areas often occurred along the shelf, with depth of 800 m-1,700 m. The slope inclined greatly at the edge. Whether they were glaciated valleys or fjords was not yet clear. The water depth of the strait varied greatly and the gradient was great too. In some places it could reach about 40-50 degrees.

4.11 MARINE METEOROLOGY

Surface meteorological observations were made for 136 days in total during the period of the Southern Ocean Survey from 21 November 1984 to 5 April 1985.

En route, the surface meteorological observations were carried out 8 times a day (00, 03, 06, 09, 12, 15, 18, 21 GMT). The observations were coded and transmitted by radio at 00, 06, 12, 18 hours GMT, except that the sea-surface temperature was recorded twice a day. The code form in the marine report was based on "Code Format for Ship's Report of Hydrographical and Meteorological Observation HD-06" (National Bureau of Oceanography, China). The surface meteorological observations were made according to "Manual of Surface Meteorological Observation" issued by National Bureau of Meteorology, China. Sea wave observation was based on "Manual of Ship's Auxiliary Report of Hydrographical and Meteorological Observations".

In Maxwell Bay, hourly observations were obtained for 25 days in need of the requirement at that time.

During the Survey of Southern Ocean, we took standard observations 8 times a day, and coded messages were transmitted by radio 4 times a day.

The observational elements and their instrumental precisions are described as follows:

wind direction in degree, $\pm$ 2;
wind speed in m/s, $\pm$ 0.1 m/s at speed less than 10 m/s
$\pm$ 0.2 m/s at speed greater than 10 m/s pressure in mb;
temperature in c, $\pm$ 0.1°C;
humidity;
cloud: visual observation, cloudiness in octanes;
visibility in nautical mile, visual observation;
weather phenomena: visual observation;
wave height and direction: observing with the naked eye.

The observational instruments used in this survey are as follows:

2 sets of ship meteorograph (the Meteorological Instrument Factory of Shanghai, China);
a set of multi-digit anemograph (made in Qingdao, China);
a 1/H4 type aneroid barometer (the Meteorological Instrument Factory of Shanghai, China);
a DYJ-1 type recording barometer (made in Shanghai, China);
a DIH type thermometer (made in Shanghai, China).

The observational instruments were installed in the following ways: the anemometer is mounted on the signalling deck (Monkey Island) 22.5 meters above the sea-surface. The aneroid barometer and aneroid recording barometer were fixed in the sea-surface working laboratory of the bridge deck, 15.0 meters above the sea-surface. The dry-and-wet bulb hygrometer was set on the signalling deck, 18.3 meters above the sea-surface.

In the entire cruise, 1,848 sets of data and 18,480 data groups of meteorological observation were obtained, and 300 telegrams were sent for transmitting coded messages.

4.11.1 Preliminary conclusions

(i) The occurrences of gales were very frequent and the durations were usually very long. During this survey, gales occurred on 31 days which made up about 43% of the total observation days, and maximum duration for winds of force 8 or higher lasted over 24 hours.

(ii) The weather was changeable. The occurrences of various weather phenomena, especially the rain, snow, and fog constantly came into being. During the survey, fog occurred on 25 days, snow on 35 days and rain occurred more frequently. Sometimes, several weather phenomena took place alternatively within a day.

(iii) The chance of encountering overcast sky was great. From the primary statistical analysis of the total cloudiness during the period from 26 December 1984 to 20 January 1985, 25 days in all, the occurrence of overcast sky constituted more than 90%. Therefore, this was an important characteristic of the weather over Antarctic.

5. CONCLUSIONS AND SUGGESTIONS FOR FURTHER WORK

In general, all works on the first southern ocean expedition were accomplished well and were satisfactory. On specialties and projects, this is not only a comprehensive investigation of the oceanic environment, including 6 specialties and 23 projects, but also the special subject researches on krill ecology and others. Practical data obtained are comprehensive, large typical and with high accuracy. The used instruments and equipments, all of which are advanced in China, made the exploration successful. The exploration region consists of various environments, such as gulf inlet, shallow continental shelf, semi-deep sea continental slope and deep-ocean basin in the Antarctic sea region and along the Antarctic circle, a large number of data are very useful and important for understanding the Antarctic sea region and future research. The first southern ocean expedition successfully achieved two anticipated objectives: a comprehensive research in the survey area was accomplished and some jerky progress was made on some specialties. After determination analyses in the laboratory and arrangements on the large number of the data, specimens and samples, a comprehensive expedition report, an oceanic environment atlas and a corpus of the investigation data will be published. Some specialties, such as synthetical oceanic ecology environment, new species of oceanic biology, microstructure of water mass and modern sedimentation, will be predetermined to obtain some discoverings and advancings.

The preliminary conclusions on this exploration are as follows:

(i) The completion of the tasks in the survey area in the Antarctic Sea region with an area of 100,000 km^2, the comprehensive measurements of oceanography were successfully completed, including 6 specialties and 23 projects which were biology, hydrology, meteorology, chemistry, geology, geophysics, krill plankton, chlorophyll, benthos, microorganism, CTD, current, wave, water colour and transparency, wind, nutrient salt, dissolved oxygen, pH, trace metal, aerosol, organic chemistry, bottom sediments suspended matter, sediment chemistry, atmospheric dust, gravimetry, magnetometry and bathymetric survey. The total measurement stations completed are 34 with a total length of 3,600 nautical miles, measured various depth from 100 meter to more than 4,000 meters, and with a total of 24 working days.

(ii) A large number of first-hand measuring data, specimens and samples were obtained which were mainly on gravimetry in 1920 nautical miles, magnetometry in 1682 nautical miles, bathymetric survey in 4,850 nautical miles, CTD in total surveying depth of 35,716 m and 60,000 sets of data recorded by 4 patterns, 158 XBT recordings in which 53 records were in the survey area, nutrient salt and the other 10 forms of chemical analyses in 2,536 layer-time, 674 bottles of plankton samples, chlorophyll in 1,224 sets of data, benthos specimens in 255 bottles, 49 bags and 2 large buckets, microorganism in 461 culture mediums, nearly thousand strains, 109 kg of krill, among which 51 living krills were feed for 3 months and brought home, and sediment samples about 800 kg. These valuable data, specimens and samples posses the features of a large scope, good representation and an integrate datum system. All subjects of oceanography were almost completely measured. The investigation region covers 7 latitudes from the north to the south, 14 longitudes from the east to the west, geomorphology including gulf, inlet, shallow continental shelf semi-deep sea continental slope and deep ocean basin, so that the data and samples possess a god representation. Because of some advanced instruments and equipments used in the exploration, combined with various conventional instruments, the data and samples obtained are relatively systematic and accurate.

14 items of outstanding achievements

(i) Crossing the Antarctic circle, a large number of complete measuring data and samples in the Antarctic circle and adjacent sea region were obtained.

(ii) The gravitometer and the magnetometer made in China were fully tested. In speed of a ship as fast as 18 knots and often in strong stormy waves, they showed good quality and clear records were obtained.

(iii) Some blanks on the nautical chart were filled around the Antarctic circle and the northwest of the South Shetland Islands in the surveying region.

(iv) The data of abnormal variation of magnetic field lineation on alternate positive-negative, and the symmetric abnormal value of a large scope, as well as gravity abnormal value in the Pacific Ocean - the Antarctic ocean middle ridge were obtained. Therefore, these data will provide an evidence for explaining oceanic basin spreading and geology tectonics in the surveying region.

(v) 5 out of 6 kinds in total of krill specimens with 109 kg of krill in weight by scientific tow net were obtained. The living krill being observed biologically were reared for 3 months and now bought in safety home for ecologic study.

(vi) By using the tow net made in China benthos of cold water group in various ocean bottom from 100-1500 m deep with a large number of organisms were obtained. Three noticeable features of large in number, various in kind and huge in size were outlined on the benthos in the Antarctic sea region.

(vii) About a thousand strains of different class bacteria mould and saccharomycete from water, sediment and living krill through the culture were obtained.

(viii) Diatom and other plankton samples with high concentration at different layer locations at some tens stations were obtained.

(ix) Data on high nutrient salt and high chlorophyll contents were obtained.

(x) An integrated data on STD by using 3,000 m STD auto-record meter made in China, practically with the deepest 3,080 m were obtained. Systematic data on T.S.D. measured by CTD made in USA for microstructure study was good.

(xi) Measured by throw-up type wave high meter made in China, the highest wave was 8.6 m when force 10 stormy wave was near the Antarctic circle.

(xii) Obtaining a sediment core sample 3.41 m in length with entering 6.3 m below the bottom at more than 4,000 m deep, 10 m core sampling equipment made in China was used.

(xiii) Having obtained the meteorological record data continually for 2 months and a strong cyclone record at 12 force wind.

(xiv) Complete accurate measuring data of oceanography in investigation region about 100,000 km^2 were achieved.

5.1 PRELIMINARY CONCLUSIONS

(i) The Antarctic sea investigated is a region with a high organism productivity and rich resources. The nutrient salt content in the seawater is some tens times as high as that in general temperate zone and tropical zone sea region. The dissolved oxygen content

in the seawater, which marine organism depends on, is 10-20% higher than that in other area of the seawater. The chlorophyll content here which is an indicator for explaining high or low productivity is also important. The krill source in the sea region is richly endowed by the nature. In addition, it is astonishing that the number is so great, the body is so huge, the distribution is so wide on benthos, birds, beasts in the Antarctic sea region.

(ii) Krill in the Antarctic sea region is with a feature of living concentrated-group. While a large number of krill are caught at some stations, they would be generally appeared clearly on the screen of the fish detector. We found a miles long krill group from which we caught 42 kg in a net by using a sampling net with 1.8 m^2 open mouth. The concentration of the krill groups were estimated 20 g/m^2 and 25 g/m^2 respectively. Krills lived in a certain depth, generally at 10-50 m deep in this season. In addition, the distribution of krill and their relation with the oceanic environment were preliminary understood.

(iii) The water mass structure and the flowing route in the investigative region have preliminarily been understood. The temperature difference and density gradient of the seawater in this area are not much. A thermal layer and temperature inversion layer presented generally about 200 m deep. From vertical structure of water mass, they could be divided into three types: continental slope, strait and gulf, consisting of different water masses. The current in Bransfield Strait flows from the northwest to the southeast.

(iv) The geomorphology features of the Antarctic continental shelf are as follows: the water depth is deep; the width is narrow; the topography is an irregularity; the shelf break zone presents tectonic movement; the sediment on the shelf underwent glaciation and reaction of the ocean and benthos.

THE SECOND SOUTHERN OCEAN EXPEDITION OF CHINA (BRANSFIELD STRAIT AND WATER AROUND ELEPHANT ISLAND)

1. PURPOSE

The main purpose of the expedition was to study the krill ecology. The expedition planned to obtain multidisciplinary data of hydrology, chemistry and biology to get better understanding of the distribution and abundance of krill (*Euphausia superba*) and its environmental factors.

2. INVESTIGATION AREA

The investigation area was in the Bransfield Strait and waters around Elephant Island (60°09'-61°11'S; 50°21'-60°04'W). The total area

covered is about 50,000 square kilometers. During the survey, 28 station observations were carried out. The position of the stations are shown in figure 1.

3. WORK TIME

The expedition was conducted in three phases from January 16 to February 25, 1987.

4. RESEARCH PROJECTS

The expedition was involved in 3 specialties with 14 projects.

4.1 MARINE BIOLOGY

(i) Horizontal distribution of krill
(ii) Biology of krill
(iii) Vertical distribution of the larval stages of krill
(iv) Species composition and abundance of zooplankton
(v) Species composition and abundance of phytoplankton
(vi) Microorganisms in air
(vii) Microorganisms in surface sediment
(viii) Microorganisms from krill body
(ix) Observation of sea-birds

4.2 MARINE CHEMISTRY

The following elements were analyzed: salinity, dissolved oxygen, pH values, phosphate phosphorus, active silicate, nitrate nitrogen, nitrite nitrogen and ammonia nitrogen.

Aerosol analysis was also made.

4.3 MARINE HYDROLOGY

(i) Salinity, temperature, depth, water colour and transparency measurements
(ii) Current measurements
(iii) Tide observation

5. VESSELS

The logistics/research ship "JI DI" was operated in the expedition. The main particulars are as follows:

Overall length	153.02 m
Breadth	20.00 m
Draft	7.60 m
Depth	10.00 m
Gross tonnage	8760.00 T
Speed	14-16 Kn
Cruising radius	2000 Nm
Main engine	8300 HP

Laboratories	4
Winches	2 geological winches with operation depth of 6000 m 1 hydrographical winch with operation depth of 3000 m
Ship classification	ice class: 1A

4.

SOUTHERN OCEAN OCEANOGRAPHIC STUDIES OF THE FEDERAL REPUBLIC OF GERMANY

The Federal Republic of Germany has intensified the marine research in the Southern Ocean since 1983 when the new ice-breaking research vessel "Polarstern" was commissioned.

Since the beginning of 1983 this ship regularly supports multidisciplinary research work during the Austral summer in the Atlantic sector of the Antarctic Ocean (see the attached table of Antarctic expeditions). The expedition programmes are co-ordinated by the "Alfred-Wegener-Institut fuer Polar- und Meeresforschung" in Bremerhaven, FRG. Generally, scientists and technicians from several national and foreign institutions carry out the research work cooperatively.

In addition to the summer cruises a winter investigation, namely the "Winter Weddel Sea Project (WWSP) 1986" was executed from June to December 1986. Scientists from seven nations have contributed to a multidisciplinary programme which contained studies of:

- physical and chemical oceanography including tracer methods
- sea ice physics and sea ice biology
- meteorology
- marine and terrestrial biology

The winter part of the cruise ANT V of RV "Polarstern" was composed of three legs:

ANT V/1: During May/June 1986 biological and oceanographic investigations were carried out near the Antarctic Peninsula (Elephant Island to Adelaide Island).

ANT V/2: From June to September 1986 the work focussed on a meridional pack ice transect along the Greenwich Meridian with

investigations in physical and chemical oceanography, meteorology, sea ice and marine biology.

ANT V/3: From October to December 1986 the studies were concentrated on biological, oceanographical and meteorological and sea ice topics along the southern and eastern coast of the Weddell Sea.

During the Winter Weddell Sea Project 1986 (WWSP) (Ant V/2 and Ant V/3) RV "Polarstern" also supported passive microwave and in situ measurements of NASA to improve the actual SMMR sea ice algorithms for the Antarctic.

The participants of the WWSP'86 met from 25 to 27 May 1986 in Bremerhaven to discuss the actual status of the data analysis and to support the forthcoming preparation of the scientific results. The encouraging outcome of the meeting is that the field programme has achieved a comprehensive data set of the physical, chemical and biological conditions in the Weddel Sea during the winter season. In particular the 20 Argos surface buoys have to be mentioned, which have gathered continuously valuable sea surface data for a period of nearly 12 months. These measurements provide useful forcing quantities for coupled ocean-, ice-, atmosphere models.

Preliminary analysis of the data suggest that e.g.

- Maud Rise has an important influence on the easterly part of the Weddell Gyre Circulation.
- No deep oceanic mixing occurs during winter either in the ice belt region or at the eastern coast of the Weddell Sea.
- The spring bloom of phytoplankton starts as late as early December in the coastal zone of the eastern Weddell Sea.
- During winter krill is abundant all over the ice covered region within a thin layer immediately under the ice where it feeds on ice diatoms.

The Institut fuer Seefischerei, Bundesforschungsanstalt fuer Fischerei, Hamburg has occupied the following oceanographic stations in the waters between Elephant Island, the Bransfield Strait and Adelaide Island west of the Antarctic Peninsula:

Year	Period	CTD-Profiles/Rosette	XBT's (Deep Blue)
1983	15 Oct-20 Nov	79	75
1984	14 Nov- 7 Dec	56	76
1985	24 Jan- 4 Mar	155	2
1985	7 Mar-16 Apr	121	52
1986	6 May-19 Jun	111	33

RV "Polarstern" and the Georg-von-Neumayer-Station are equipped with receiving stations for IR and visible satellite pictures. Both stations produce - whenever possible - several images per day in order to document cloud and sea ice features.

The Ministry for Research and Technology is investigating the possibility to provide a SAR receiving station to obtain images of the Weddell Sea sector during the active phase of ERS-1. The SAR data will be complemented by intensive measurements of sea ice, oceanic and atmospheric quantities during a full year's cycle presumably in 1992.

The regular Antarctic summer cruises of RV "Polarstern" will be continued with the ANT VI-expedition from October 1987 to March 1988. The expedition will be mainly concerned with biological, oceanographic, geological and geophysical research in the Antarctic Peninsula area from October to December 1987. Comprehensive geological, geophysical and geomorphological investigations in the southern Weddell Sea will follow in January/February 1988. The geological programme will be completed by sedimentological samplings in the Maud Rise area during March 1988.

The Alfred-Wegener-Institut fuer Polar- und Meeresforschung is preparing for long-term sea level and current measurements in the Weddell Sea which are planned to start in 1988. Adequate moorings will be deployed and replaced regularly during the annual supply cruises of RV "Polarstern".

Sea level gauges and current meter moorings are planned to be stationed near Bouvet Island and near Vestkapp. Both will form the initial part of a joint FRG/Norwegian research programme of long-term measurements of the near bottom outflow from the Filchner shelf-ice where a large part of the bottom water of the world ocean seems to be formed. It is hoped to complete the measuring system in time so that adequate data can be obtained during the central phase of WOCE, 1990-1995.

Antarctic Expeditions of the Federal Republic of Germany

Year	Vessel	Scientific coordinator	Area	Discipline	Main Publication
Dec 1982/April 1983	RV Polarstern	Hempel	Weddell Sea	ANTARKTIS-I-Expedition, meteo., oceanogr., biol., geol., ice technology	Ber. Polarf., 14, 1983 (still unpublished); Ber. Polarf. Sonderheft 2, 1983; Jahrbuch Wittheit Bremen, 20, 1984
Dec 1982/March 1983	MS Polarqueen	Tessensohn	North Victoria Land	GANOVEX-III, geol.land exp.	Geol.Jb., B 60, 1984
Sept 1983/April 1984	RV Polarstern	Fütterer, Kohnen Sahrhage	Bransfield Strait, Scotia Sea, Weddell Sea, Filchner Ice-shelf	ANTARKTIS-II-Expedition incl. FILCHNER-I glac.; SIBEX-I, biol., hydr.; geol., geophys., meteo.	Ber. Polarf., 10/19, 1984 Arch.Fisch.Wiss. 37 Beih. 1, 1986
Oct. 1984/April 1985	RV Polarstern	Sahrhage, Hempel	Bransfield Strait, Weddell Sea	ANTARKTIS-III-Expedition, incl. SIBEX-II biol., hydr., meteo.	Ber.Polarf., 25, 1985
Oct 1984/Feb 1985	Do-228 aircraft	Dürbaum	North Victoria Land, Ross Sea	GANOVEX-IV, geol., geophys.	Geol.Jb.
Jan/April 1985	FRV Walther Herwig	Sahrhage, Kock	Scotia Sea to Weddell Sea	SIBEX-II biol., hydrogr.	Arch.Fisch.Wiss. 37 Beih. 1, 1986
Sept. 1985/ April 1986	RV Polarstern	Fütterer, Kohnen	Antarctic Peninsula, Weddell Sea, Queen Maud Rise	ANTARKTIS-IV-Expedition geol., biol., bathym., oceanogr.; incl. FILCHNER-II glac.	Ber.Polarf., 32, 1986
May 1986/ March 1987	RV Polarstern	Sahrhage, Augstein, Hempel, Miller, Ernst, Kohnen	Antarctic Peninsula; pack ice zone at 0° and in northern Weddell Sea; southern Weddell Sea	ANTARKTIS-V-Expedition biol., meteo., oceanogr., chem., sea-ice, geophysics; terrestrial geology; incl. FILCHNER-III glac.	

5.

SCIENTIFIC RESEARCH CONDUCTED IN THE SOUTHERN OCEAN BY INDIA

(prepared by S.G. Prabhu Matondkar)

1. PROGRAMME CARRIED OUT BY THE INDIAN ANTARCTIC SCIENTIFIC EXPEDITIONS

The Indian scientific programme in the Southern Ocean started during the First Indian Scientific Expedition to Antarctica (1981-82) and so far, India has completed six summer expeditions in Southern Ocean and Antarctica. In addition to this three winter programmes are completed after establishing the Indian permanent Antarctic station "Dakshin Gangotri" during 1983-84 period.

The multidisciplinary studies on the Southern Ocean ecosystem comprising of biological - physical and chemical oceanographic observations are continued on a working oceanographic track in South Western Indian Ocean area. In this, ecosystem approach is followed by studying bacteria-phytoplankton - zooplankton (krill) and benthic population. The Subantarctic and Antarctic (including pack ice) are the area covered. In marine geological programme bottom topography is studied in addition to the magnetometer data.

Besides oceanic transect studies, the fixed ice-edge station (70°S 12° E) was studied for day to day variations (Jan-Feb.) in physical-chemical - biological and meteorological parameters.

The extensive X-BT observations were taken during 1981-82 and 1986-87 summer period as part of the study of the characterization of water masses in Subantarctic and Antarctic zones.

During winter observations sea-ice cover was drilled and sea water (surface) and sea ice (bottom) samples were taken and examined for biological parameters. The high bacterial biomass is the characterics feature recorded and identified as one of the future line of the work during winter. The laboratory experiments on phytoplankton - bacteria will also forum part of the winter work.

During the last five years following oceanographic parameters were routinely recorded and published in the form of reports (By Dept. of Ocean Develop. New Delhi, India) and scientific papers time to time, including 2 papers presented at Krill Variability Seminar, Paris, 2-6 June 1987.

PARAMETERS

Physical: (First 2000 m water column)
temperature, salinity

Chemical: (First 2000 m water column)
oxygen, phosphate, nitrate, nitrite, silicate

Biological: (In euphotic zone)/zooplankton 0-250 m
Bacteria: Biomass
Phytoplankton: Biomass, production, texonomic groups
Zooplankton: Biomass, texonomic groups
(whales, seals and birds observations)

Meteorological: Air temperature, pressure, wind speed, wind direction, cloud cover, sea surface temperature, few stations - for ozone content

Recently, the specially designed nets were towed along the bottom of the ice-shelf and collected variety of the bottom dwellers for identification work. Area is found rich in benthic organisms. Underwater camera with grabs and sediment traps were tried.

2. FUTURE LINE OF THE WORK IN THE SOUTHERN OCEAN

(1) Ecosystem approach for study of the Southern Ocean food chain will be continued in off Queen Maud Land area of the Indian Ocean.

(2) Use of underwater camera attached to grabs for the study of benthic biomass production.

(3) Study of the Antarctic and Subantarctic zones simultaneously using two ships at a time during summer.

(4) Computerization of data collected.

JAPANESE INTERSESSIONAL ACTIVITIES IN THE SOUTHERN OCEAN 1983/1987

(prepared by Takahisa Nemoto, Director, Ocean Research Institute, University of Tokyo and Mitsuo Fukuchi, National Institute of Polar Research)

Japanese scientific activities in the Southern Ocean can be divided into two groups: one is the on-board activities by Japanese Antarctic Research Expedition (JARE), Fisheries Agency and Universities and the other is the shore based activities by JARE. Some of these activities are closely related with the international BIOMASS programme.

On-board activities

(1) Icebreaker "SHIRASE", Japanese Antarctic Research Expedition (see page 57-73 of the following inventory).

Routine oceanographic observation of marine physics, marine chemistry and marine biology on-board the icebreaker "FUJI" had been carried out in the Indian Antarctic Ocean since 1965/66 and these observations have now been continued on-board "SHIRASE" since 1983/84. Marine physical and chemical programmes are operated by Hydrographic Department, Maritime Safety Agency, and marine biology programme is operated by National Institute of Polar Research. In addition to these routine observations, the more research oriented works were carried out in 1983/84, 1984/85 and 1985/86, which are part of Japanese BIOMASS programme.

(2) Research Vessel "HAKUHO MARU", Ocean Research Institute, University of Tokyo (see page 74-78).

"Hakuho Maru" participated in the SIBEX-I (1983/84) and covered the Australian sector between 115°E and 150°E.

(3) Training ship "UMITAKA MARU", Tokyo Fisheries University (see page 79-82);

"Umitaka Maru" also participated in the SIBEX (1983/84) and covered the Australasian sector.

(4) Research Vessel "KAIYO MARU", Fisheries Agency (see page 82-91).

"Kaiyo Maru" participated in the second BIOMASS experiment phase I (SIBEX-I) in 1983/84 and SIBEX-II in 1984/85, while she also had made another research cruises in 1979/80 (Pre-FIBEX) and 1980/81 (FIBEX). SIBEX-I and II cruises covered the Indian Antarctic Ocean and the Atlantic Antarctic Ocean, respectively.

Shore-based activities (see page 92-96)

Japanese Antarctic station, Syowa, was founded in 1957 on the East Ongul Island (69°00'S, 39°35'E). Since then, scientific programmes covering many disciplines have been carried out. Among them, the intensive marine biological programme was made in 1983, 1984 and 1986, when Japanese BIOMASS programme was also intensively made.

Above-mentioned activities are summarized in the Summary table and the scientific data inventory are also attached.

Summary table of Japanese intersessional activities in the Southern Ocean, 1983-1987 (Numbers in parentheses refer to page numbers in the attached inventory.

On board activities

Ship's name	SHIRASE	HAKUHO MARU	UMITAKA MARU	KAIYO MARU
Year	1983/84 (57-59)	1983/84 (74-78)	1983/84 (79-82)	1983/84 (83-86)
	1984/8 (60-64)	x	x	1984/85 (87-91)
	1985/86 (65-68)	x	x	x
	1986/87 (69-73)	x	x	x

Shore-based activities

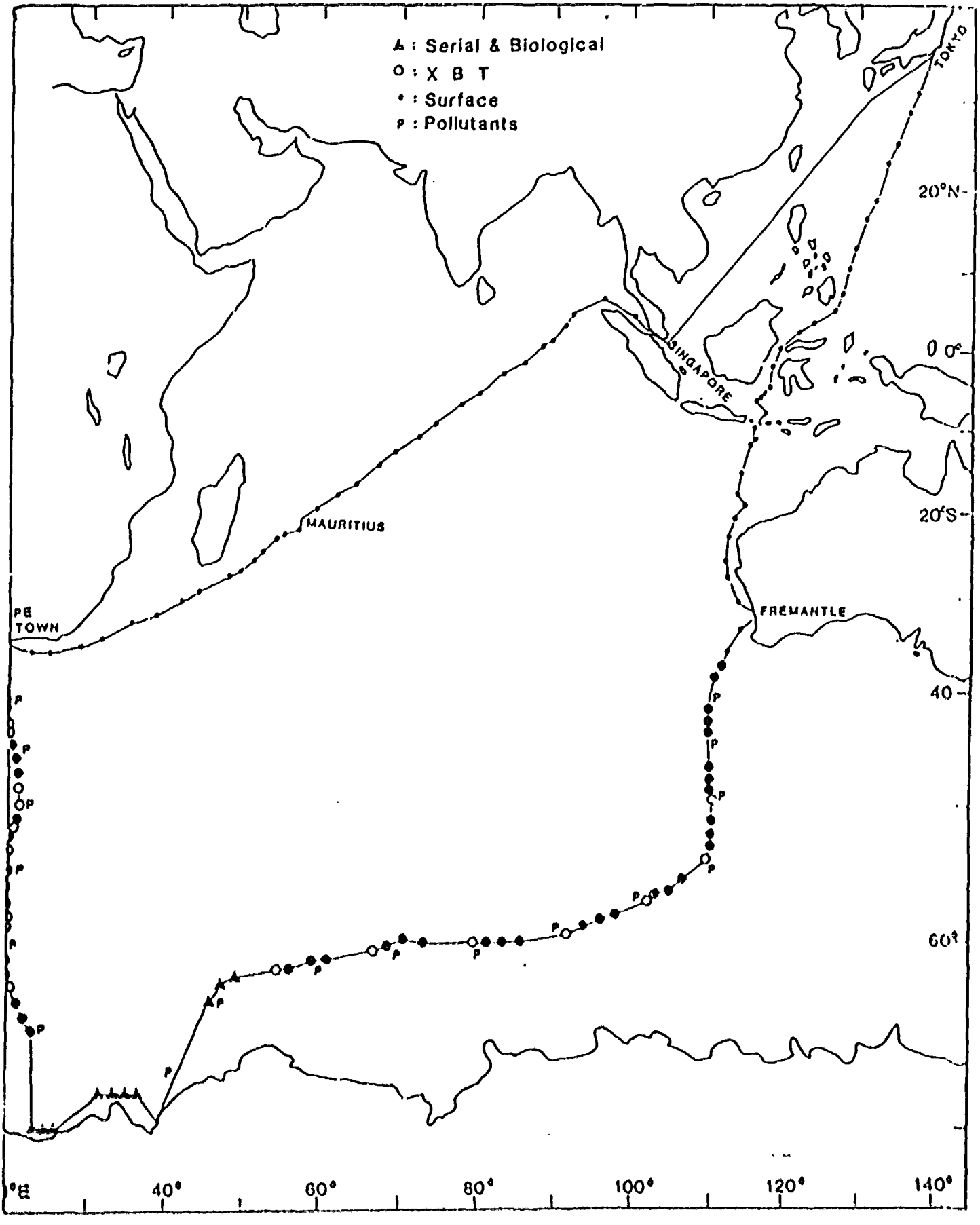
Station	Syowa(69°00'S, 39°35'E)
Year	1983 (92-93)
	1984 (94-95)
	1986 (96)

SCIENTIFIC DATA INVENTORY

Shirase	Relief cruise for Japanese Antarctic Research Expedition Second international BIOMASS experiment
Agency	National Institute of Polar Research
Dates and Cruise Details	Departed Tokyo 14 Nov 1983 Arrived Fremantle 28 Nov Departed Fremantle 3 Dec Arrived Ice edge 17 Dec Departed Ice edge 25 Feb 1984 Arrived Cape Town 3 Mar Departed Cape Town 5 Mar Arrived Port Louis 14 Mar Departed Port Louis 20 Mar Arrived Singapore 2 Apr Departed Singapore 8 Apr Arrived Tokyo 19 Apr
Study Area	Along the cruise track and the pack ice area south of 67°S between 24°E and 45° E.
Cruise Objectives	Deliver cargo and passenger to Syowa Station. Participate in SIBEX.
Scientific Acticities	Observations of physical and chemical oceanography Observations of marine biology Analysis of ecosystem in the pack ice zone
Sampling Program	Sampling of surface water for temperature measurement and chemical analysis (108 stations) Temperature profile XBT (76 stations) DBT (12 stations) Salinity-Temperature profile CTD (10 stations) Surface current GEK (16 stations) Serial observation Nansen cast (7 stations) Van Dorn bottle sampling (18 stations)

	Measurement of chlorophyll a in surface water (61 stations)
	Cotinuous recording of chlorophyll a in surface water
	Zooplankton sampling NORPAC net (25 stations) MTD net (4 stations) ORI net (3 stations) Discovery net (2 stations)
	Benthos sampling Beam trawl (2 stations)
	Benthos observation with an underwater TV vehicle system
	Sampling of surface water for monitoring of artificial unclear wastes (1 stations) residues of petroleum (19 stations) and heavy metals (10 stations)
Data reduction and Analysis	Reduction of physical and chemical data is made by Hydrographic Department, Maritime Safety Agency
	Processing of plankton samples is made at Tohoku University
	Processing of benthos samples is mede at National Institute of Polar Research
Availability of Data	Results of physical and chemical observations will be published as JARE DATA REPORTS.
Request for Data	Data to be published are available on request. Request for publications should be made to Library of National Institute of Polar Research
Cruise Track	

Shirase Track Chart (1983-84)



Shirase	Relief Cruise for Japanese Antarctic Research Expedition Second international BIOMASS experiment
Agency	National Institute of Polar Research

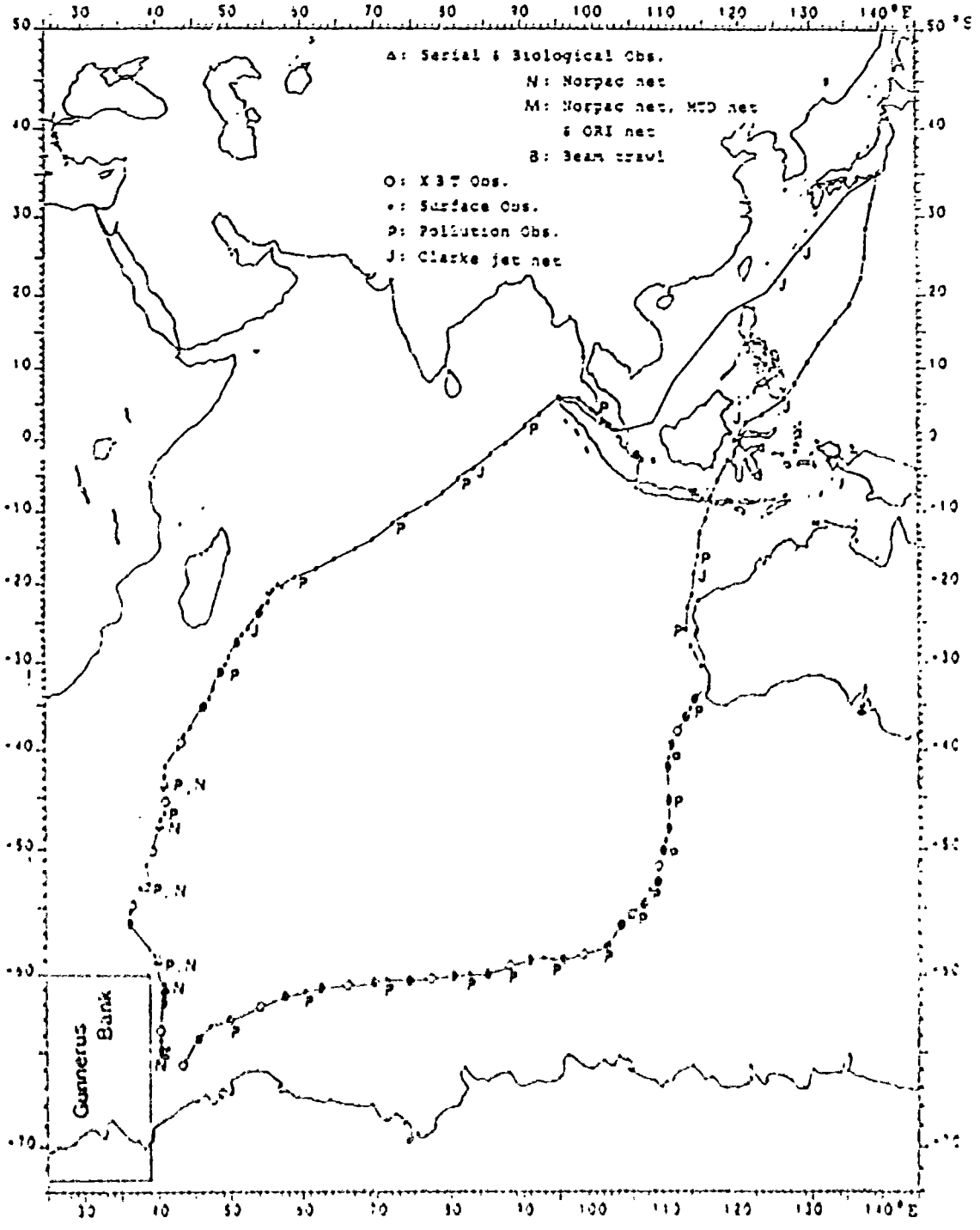
Dates and Cruiese Details

Departed	Tokyo	14 Nov 1984
Arrived	Fremantle	28 Nov
Departed	Fremantle	3 Dec
Arrived	Ice edge	14 Dec
Arrived	Breid Bay	19 Dec
Departed	Breid Bay	1 Jan 1985
Arrived	Syowa	4 Jan
Departed	Syowa	2 Feb
Arrived	Breid Bay	7 Feb
Departed	Ice edge	2 Mar
Arrived	Port Louis	15 Mar
Departed	Port Louis	21 Mar
Arrived	Singapore	3 Apr
Departed	Singapore	9 Apr
Arrived	Tokyo	20 Apr

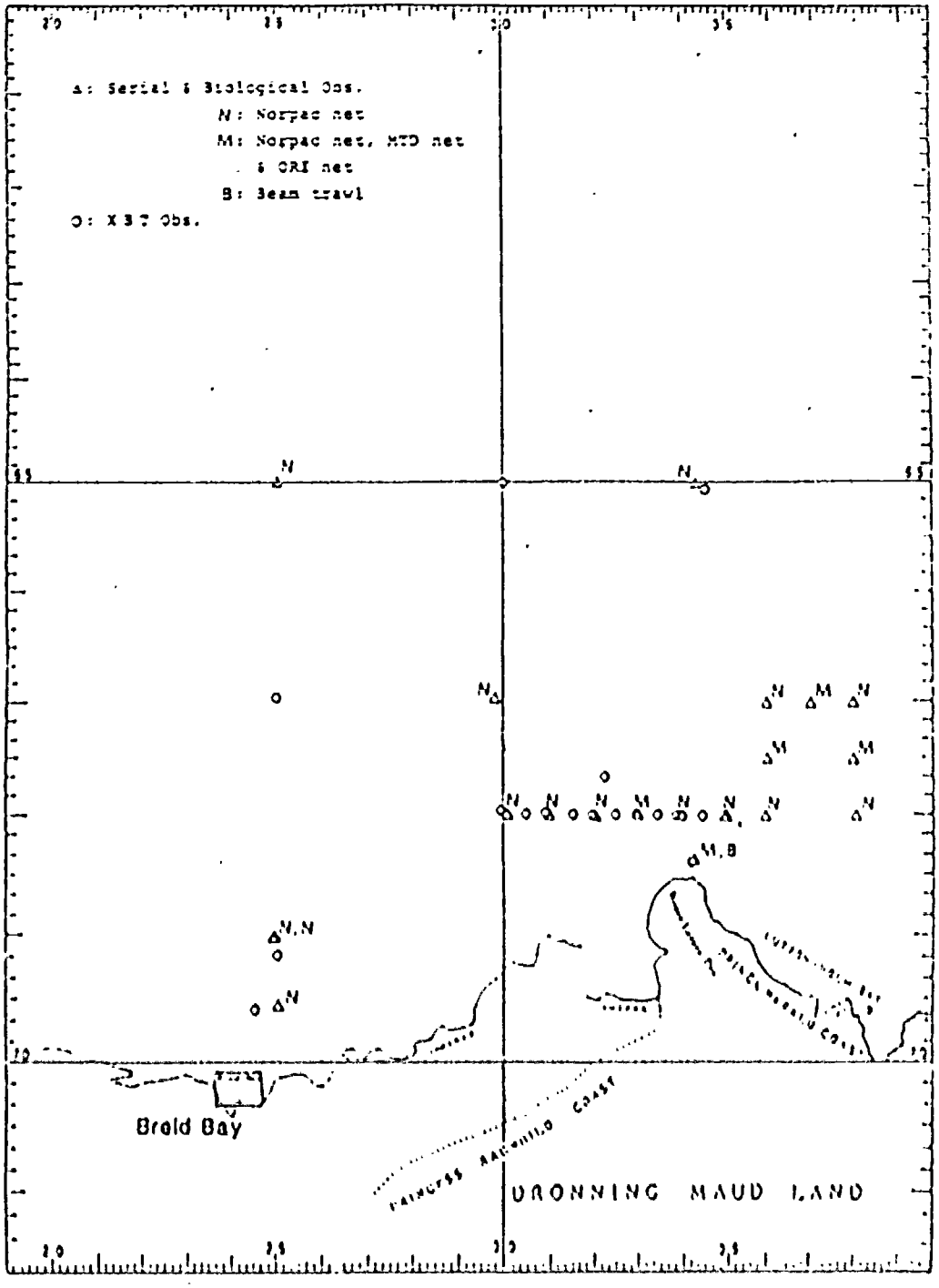
Study Area	Along the cruise track and the pack ice area south of 67°S between 24°E and 45°E.
Cruise Objectives	Deliver cargo and passenger to Syowa Station. Participate in SIBEX.
Scientific Activities	Observations of physical and chemical oceanography Observations of marine biology Analysis of ecosystem in the pack ice zone
Sampling program	Sampling of surface water for temperature measurement and chemical analysis (128 stations) Temperature profile XBT (60 stations) Salinity-Temperature profile CTD (40 stations) Serial observation Nansen cast (46 stations) Van Dorn bottle sampling (18 stations) Measurement of chlorophyll *a* in surface water (61 stations)

	Continuous recording of chlorophyll *a* in surface water
	Zooplankton sampling NCRPAC net (44 stations) MTD net (11 stations) ORI net (11 stations) Clarke Jet net (7 stations)
	Benthos sampling Beam trawl (4 stations)
	Sampling of surface water for monitoring of artificial unclear wastes (5 stations) residues of petroleum (19 stations) and heavy metals (10 stations)
Data reduction and Analysis	Reduction of physical and chemical data is made by Hydrographic Department, Maritime Safety Agency
	Processing of plankton samples is made at National Institute of Polar Research
	Processing of benthos samples is made at National Institute of Polar Research
Availability of Data	Results of physical and chemical observations will be published as JARE DATA REPORTS.
Request for Data	Data to be published are available on request. Request for publications should be made to Library of National Institute of Polar research
Cruise Track	

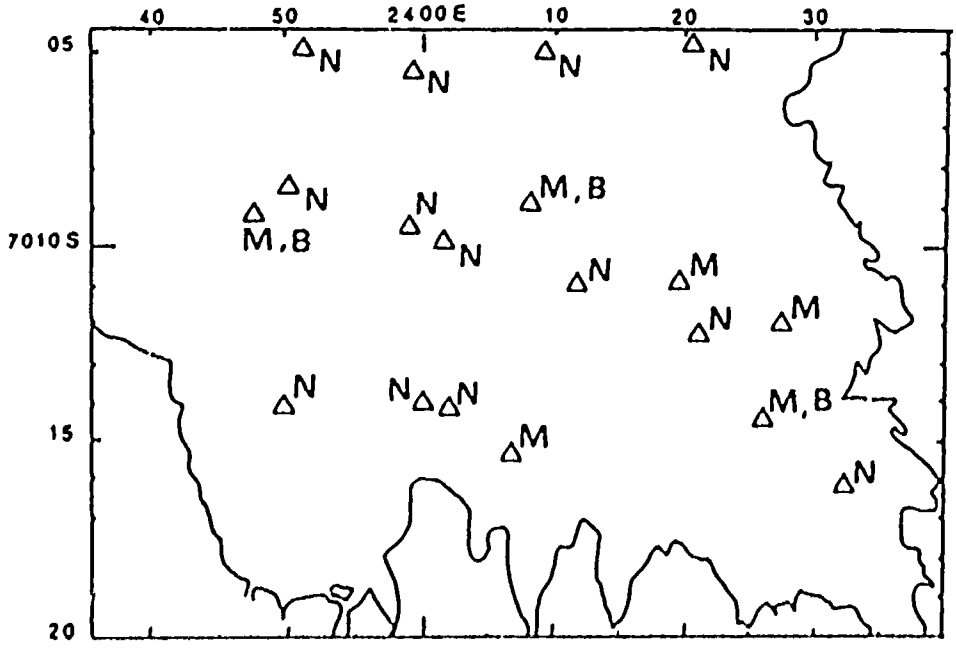
Shirase cruise track (1984-85)



Stations in the Gunnerus Bank



Stations in the Breid Bay



Δ: Serial & Biological Obs.

N: Norpac net

M: Norpac net, MTD net & ORI net

B: Beam trawl

Shirase	Relief Cruise for Japanese Antarctic Research Expedition
	International BIOMASS experiment
Agency	National Institute of Polar Research

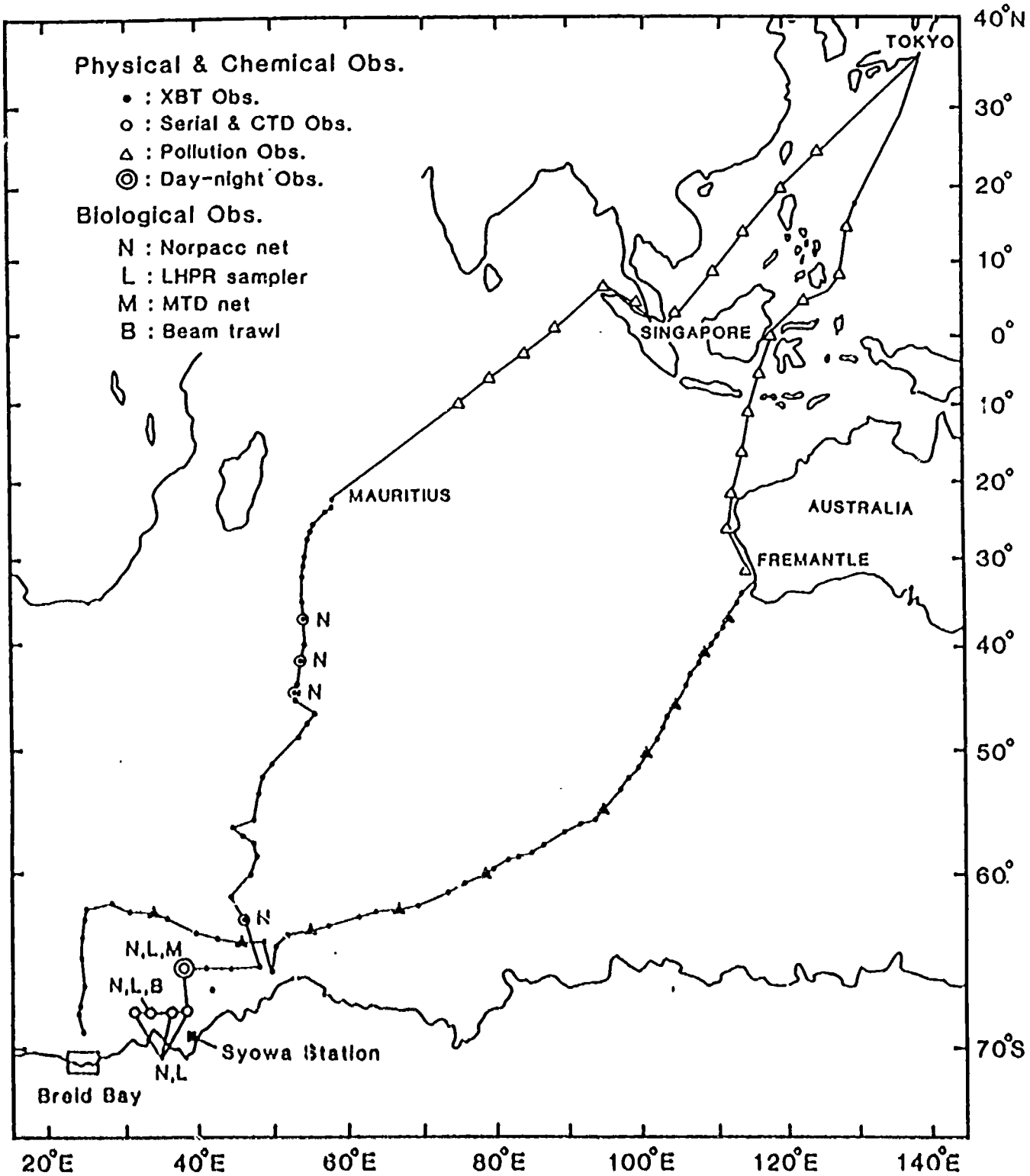
Dates and Cruiese Details

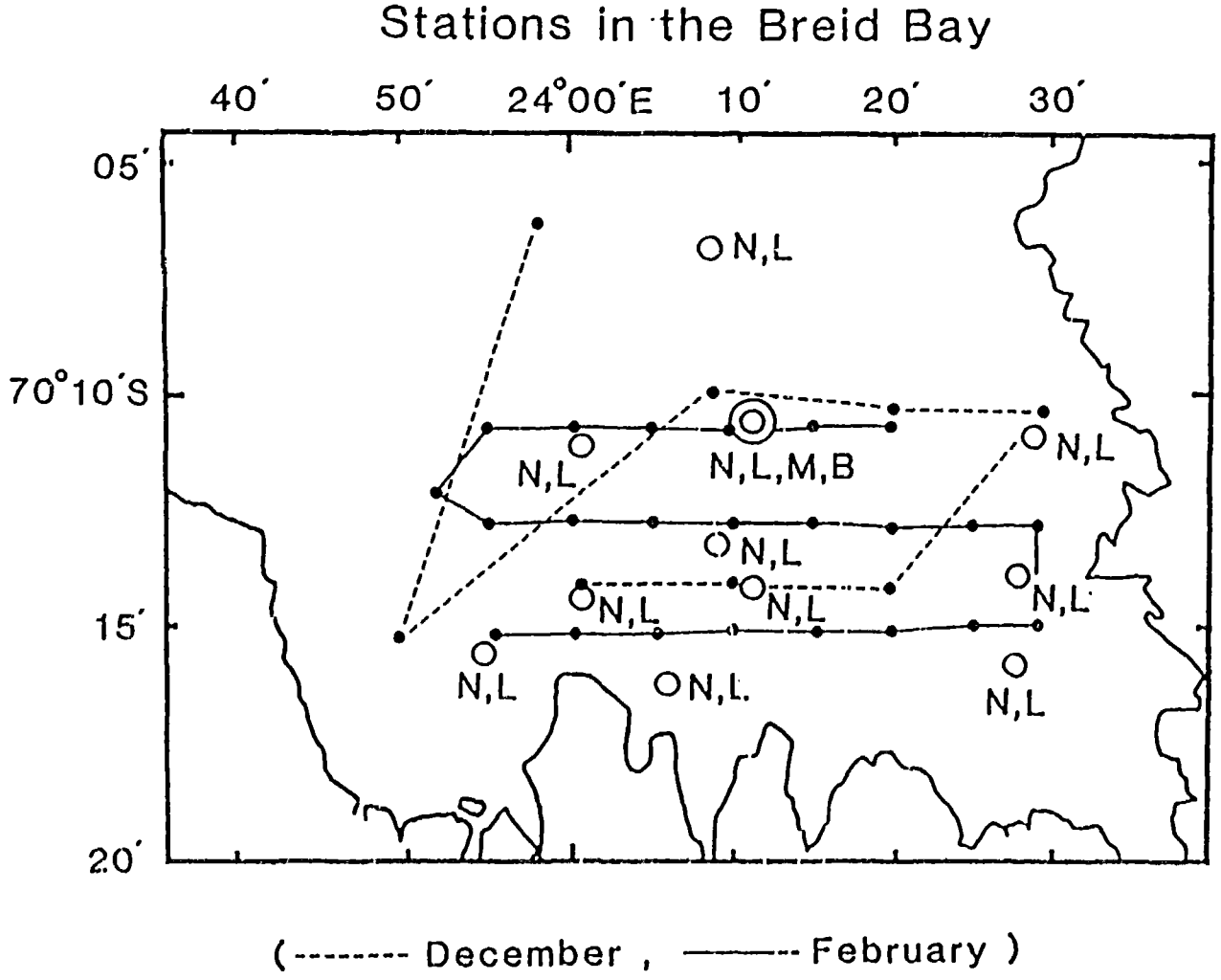
Departed	Tokyo	14 Nov 1985
Arrived	Fremantle	28 Nov
Departed	Fremantle	3 Dec
Arrived	Ice edge	13 Dec
Arrived	Breid Bay	20 Dec
Departed	Breid Bay	31 Dec
Arrived	Syowa	4 Jan 1986
Departed	Syowa	6 Feb
Arrived	Breid Bay	11 Feb
Departed	Breid Bay	15 Feb
Departed	Ice Edge	25 Feb
Arrived	Port Louis	15 Mar
Departed	Port Louis	21 Mar
Arrived	Singapore	2 Apr
Departed	Singapore	9 Apr
Arrived	Tokyo	20 Apr

Study Area	Along the cruise track and the pack ice area south of 67°S between 24°E and 45°E.
Cruise Objectives	Deliver cargo and passenger to Syowa Station. Participate in BIOMASS experiment.
Scientific Activities	Observations of physical and chemical oceanography
	Observations of marine biology
	Analysis of ecosystem in the pack ice zone
Sampling program	Sampling of surface water for temperature measurement and chemical analysis (151 stations)
	Temperature profile XBT (120 stations)'
	Salinity-Temperature profile CTD (27 stations)
	Serial observation Nansen cast (26 stations) Van Dorn bottle sampling (27 stations)
	Measurement of chlorophyll a in surface water (107 stations)

	Continuous recording of in-situ chlorophyll a in surface water along the cruise track
	47 days continuous recording of in-situ chlorophyll a with a mooring buoy system in Breid Bay
	Zooplankton sampling NORPAC net (27 stations) MTD net (8 stations) LHPR sampler (22 stations)
	Benthos sampling Beam trawl (2 stations)
	Sampling of surface water for monitoring of artificial radio nuclides (5 stations) residues of petroleum (20 stations) and heavy metals (10 stations)
Data reduction and Analysis	Reduction of physical and chemical data is made by Hydrographic Department, Maritime Safety Agency
	Processing of plankton samples is made at National Institute of Polar Research
	Processing of benthos samples is made at National Institute of Polar Research
Availability of Data	Results of physical and chemical observations will be published as JARE DATA REPORTS.
Request for Data	Data to be published are available on request. Request for publications should be made to Library of National Institute of Polar Research
Cruise Track	

Shirase cruise track (1985 - 86)




Stations in the Breid Bay
40′
50′
24°00′E
10′
20′
30′
05′
70°10′S
15′
20′
N,L
N,L
N,L,M,B
N,L
N,L
N,L
N,L
N,L
N,L
N,L
N,L
N,L
(-------- December , ——— February)

Shirase	Relief cruise for Japanese Antarctic Research Expedition
Agency	National Institute of Polar Research

Dates and cruise details

Departed	Tokyo	14 Nov 1986
Arrived	Fremantle	28 Nov
Departed	Fremantle	3 Dec
Arrived	Ice edge	16 Dec
Arrived	Breid Bay	17 Dec
Departed	Breid Bay	5 Jan 1987
Arrived	Syowa	9 Jan
Departed	Syowa	4 Feb
Arrived	Breid Bay	6 Feb
Departed	Breid Bay	15 Feb
Departed	Ice edge	23 Feb
Arrived	Port Louis	14 Mar
Departed	Port Louis	21 Mar
Arrived	Singapore	3 Apr
Departed	Singapore	9 Apr
Arrived	Tokyo	20 Apr

Study area	Along the cruise track
Cruise objectives	Deliver cargo and passenger to Asuka and Syowa
Scientific activities	Observations of physical, chemical and biological oceanography
Sampling program	Sampling of surface water for temperature measurement and chemical analysis (205 stations) Temperature profile XBT (151 stations) Salinity-Temperature profile CTD (15 stations) Serial observation Nansen cast (13 stations) Van Dorn bottle sampling (5 stations) Continuous recording of in-situ chlorophyll a with water temperature, salinity, dissolved oxygen and particulates in the surface water Micronekton and zooplankton sampling NORPAC net (14 stations) IKPT (10 stations) Sampling of surface water for monitoring of heavy metals (9 stations)

Data reduction and analysis	Reduction of physical and chemical data is made by Hydrographic Department, Maritime Safety Agency Processing of plankton sampling is made at National Institute of Polar Research
Availability of data	Results of physical and chemical observations and surface chlorophyll a data will be published as JARE DATA REPORTS
Request for data	Data to be published are available on request Request for publications should be made to Library of National Institute of Polar Research

Cruise track

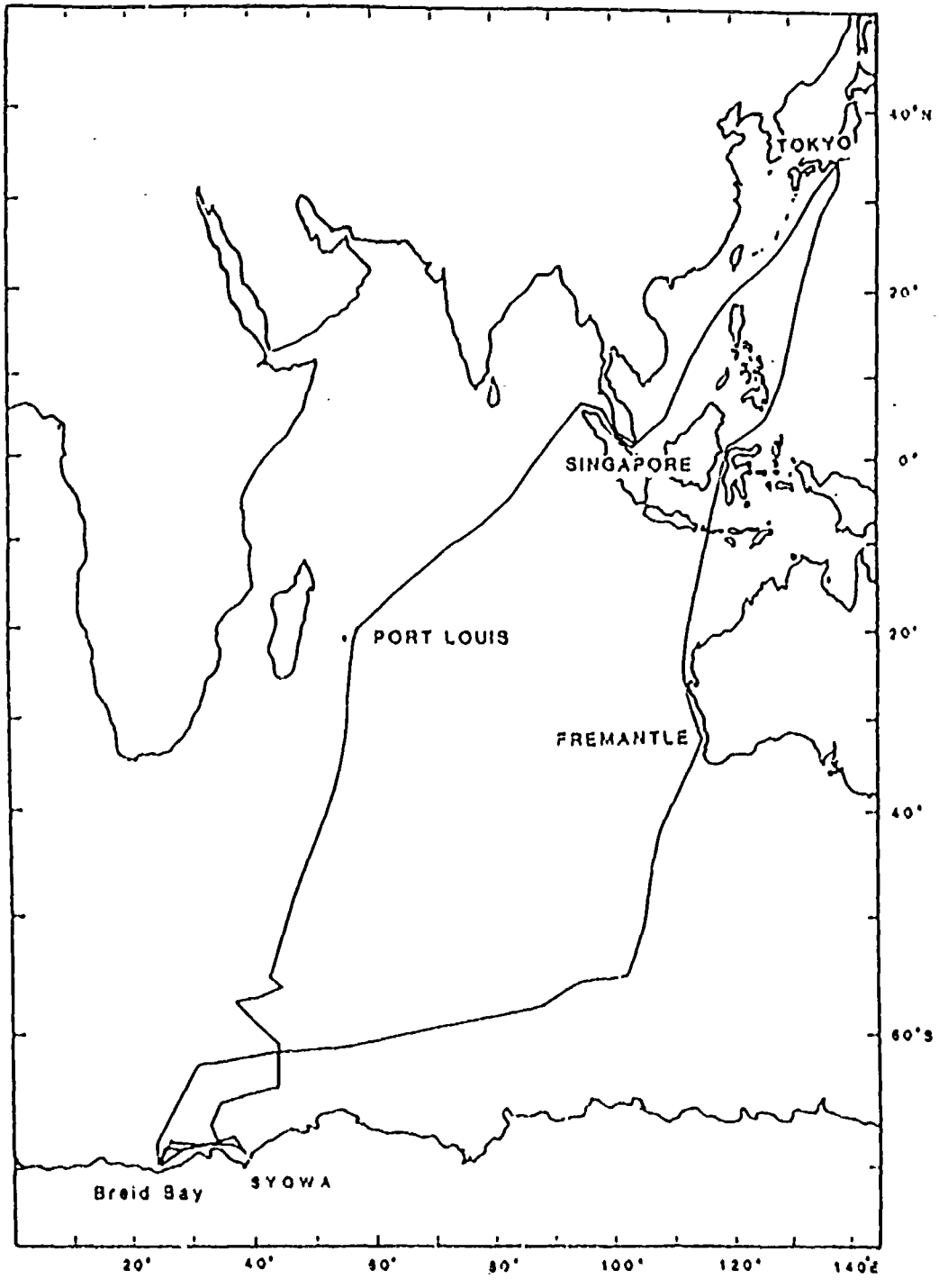


Fig 1 Cruise track of SHIRASE in 1986-87

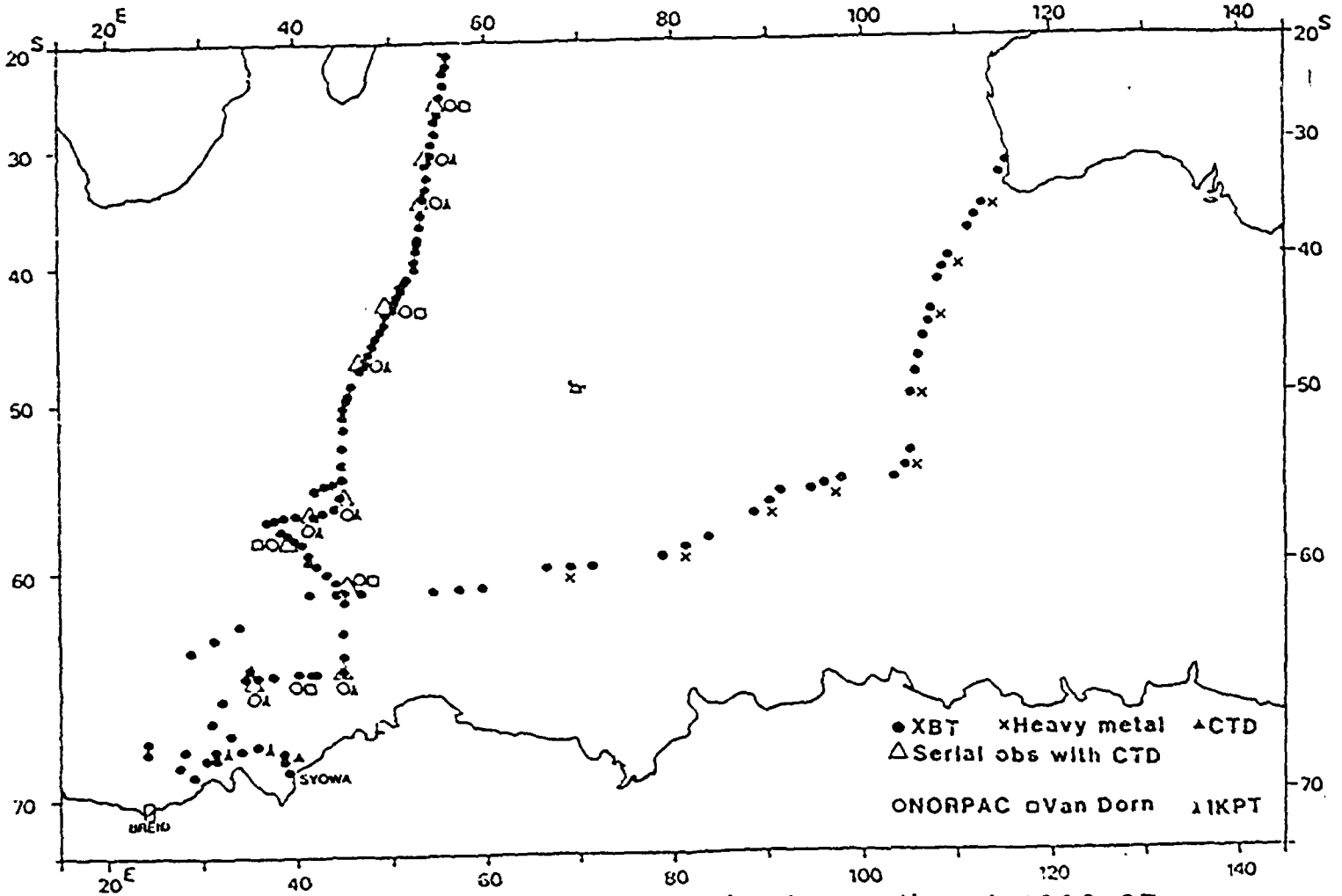


Fig 2 Stations for oceanographic observations in 1986-87

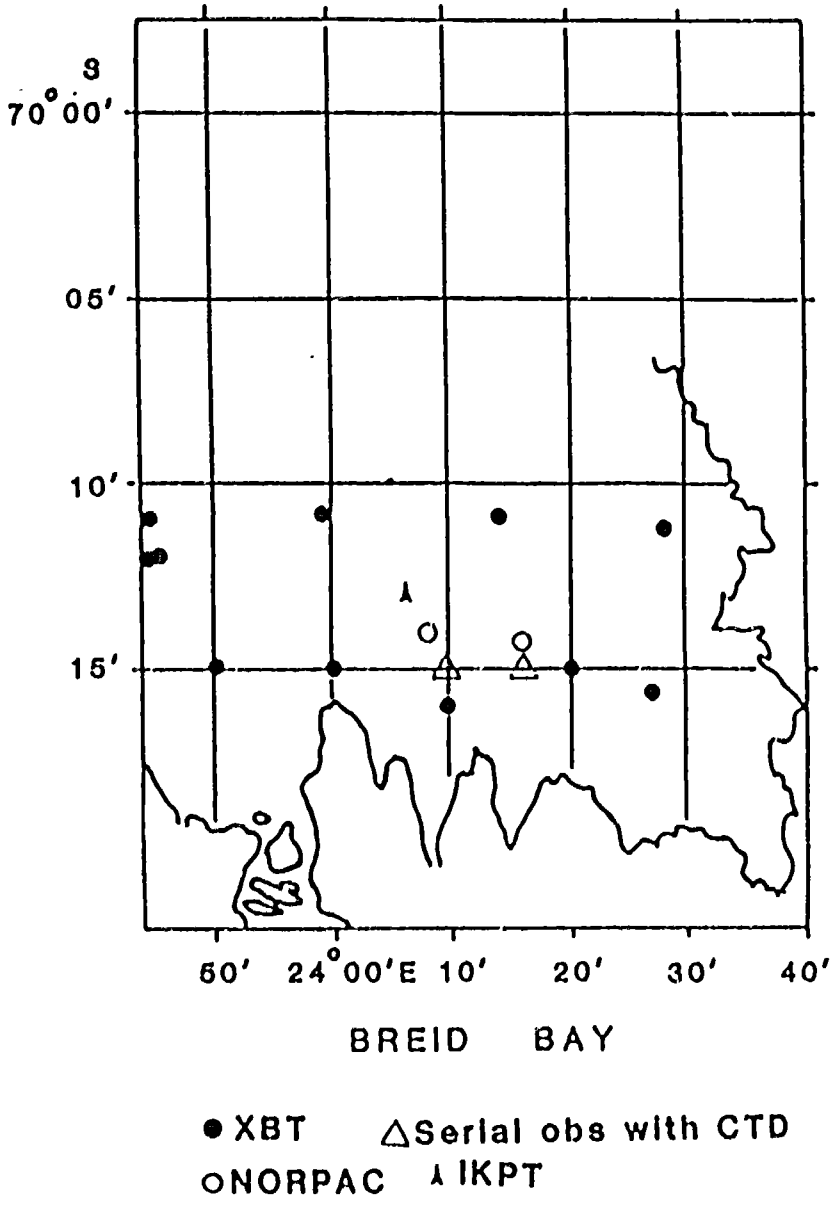


Fig 3 Stations for oceanographic observations in 1986-87 (II)

R.V. Hakuhō Maru	SIBEX (Second International BIOMASS Experiment)
Agency	Ocean Research Institute, University of Tokyo
Dates and Cruise Details	Departed Tokyo 22 November 1983 Arrived Sydney 7 December 1983 Departed Sydney 11 December 1983 Arrived study area 13 December 1983 Departed study area 1 January 1984 Arrived Hobart 3 January 1984 Departed Hobart 8 January 1984 Arrived study area 9 January 1984 Departed study area 28 January 1984 Arrived Fremantle 31 January 1984 Departed Fremantle 4 February 1984 Arrived Cebu 13 February 1984 Departed Cebu 17 February 1984 Arrived Tokyo 24 February 1984 Marine research undertaken over 15 days between 13 December and 28 January.
Study Area	South of 40°S to the Antarctic Ocean (- 65°47' S) between 115° E and 150° E.
Cruise Objectives	Participate in Second International BIOMASS Experiment.
Scientific Objectives	-Studies on distribution, specific compositions and production of plankton and micronekton. -Studies on the grazing activity of zooplankton such as copepoda, euphausiacea and thaliacea on phytoplankton. -Ecological studies on marine bacteria.

-Study on the characteristic of biological activity under low temperature and illumination condition.

-Studies on counting the echo pattern of the krill (Euphausia superba) by the fish finder.

-Measurements of gravity and magnetics.

-Sighting of marine mammals, whales and sea birds.

-Measurements of the biological environmental factors

Sampling Program

-Hydrographic stations (18 CTD stations to 2000 m). temperature, salinity, dissolved oxygen, depth.
15 OCTOPUS stations to 200 m (temperature, salinity dissolved oxygen, depth, chlorophyll-a, PO_4, Si, NO_3, NO_2, NH_4).
Expendable bathy thermographs (64 probes to 700 m)

-Phytoplankton- Rosette water sampling at 18 CTD + 15 OCTOPUS stations. Van Dorn water sampling at 8 stations.

-Zooplankton sampling.
IKMT (25 oblique tows), IKMT with five bar electronic multiple plankton sampler, MTD net (18 series at 13 stations), ORI net (11 oblique tows + 18 horizontal tows), Bongo net (4 oblique tows), LHPR (3 vertical tows), Discovery net (11 series at 11 stations), Larvae net (18 horizontal tows), Norpac net (18 vertical tows), Circle net (2 operations).

-Bacteria sampling.
Niskin water sampling at 3 stations, Niskin bacteriological butterfly- and chopstick-type water samplers at 5 stations. Okean and Box-Corer Sampler at 3 stations.

-Seawater analysis - Three sediment traps and Large Volume Filter System at 61°- 30' S, 150° E, Niskin water sampling (0 - 4000 m) at 15 stations, Pump sampling at 9 stations.

-Sea birds - observed 10 mins / every 4 hours for all daylight hours.

-Whales and marine mammals - observed for all daylight hour

-Acoustic survey - Quantitative echosounding 0-200 m at 200 KHz and 50 KHZ.

Data Reduction and Analysis

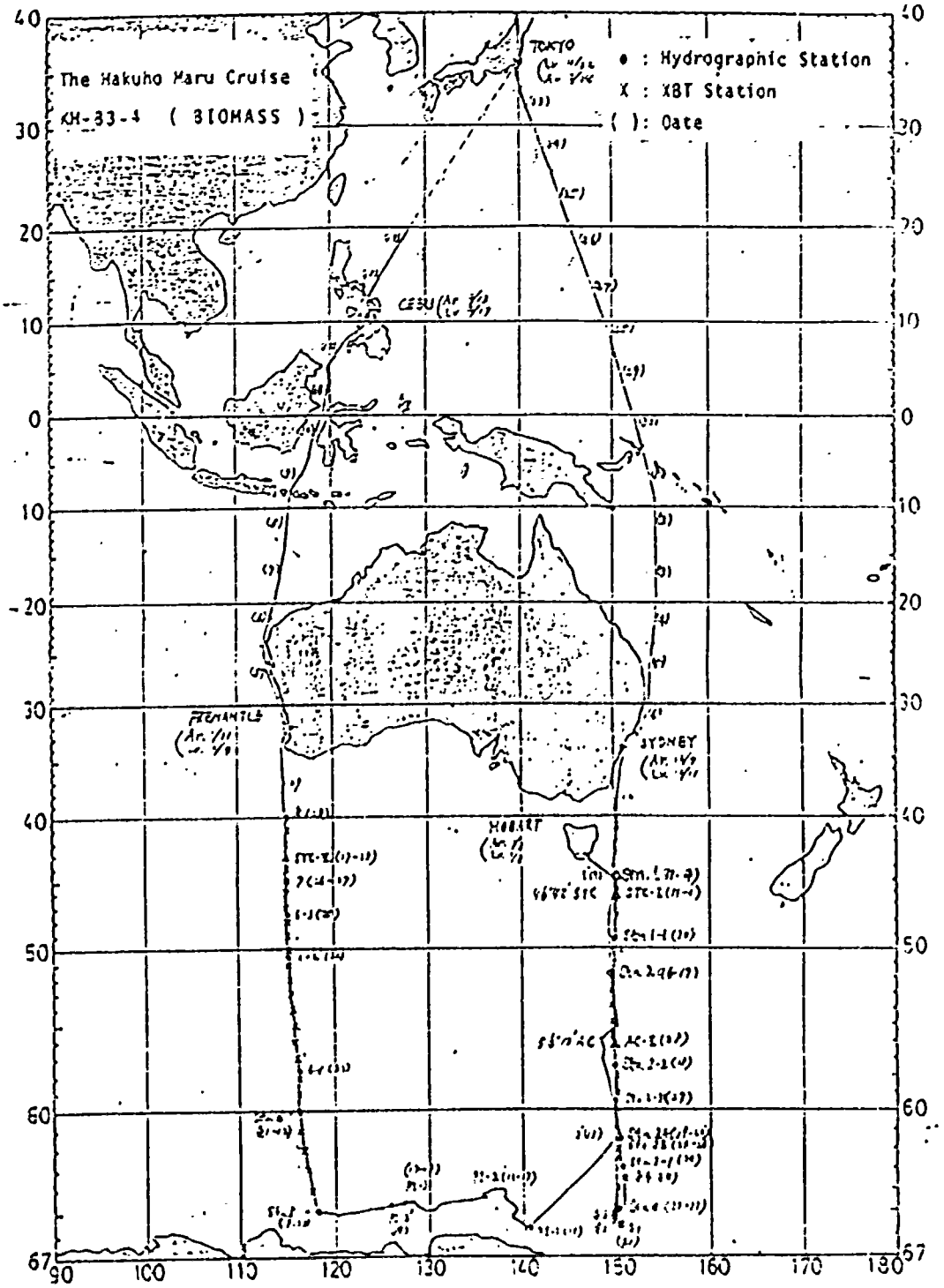
Oceanography. Full set temperature, salinity, dissolved oxygen and nutrient salts data at standard depths for each station. XBT data for each drop available for standard depths.

Phytoplankton. Light microscopy on material for enumeration and identification. Preservation for materials for later analysis and ecological studies by electron microscopy and image analyzer (Luzex-500). Quantitative chemical analysis for pigments including chlorophyll.

Zooplankton. Sorted into major groups and then species wherever possible. E. superba was sorted for sex and maturity. Length frequency and weight determined.

Bacteria. Total heterotrophic bacterial counts were determined by the drirect microscophic method. Growth rate was measured by 3-H labelled thymidine

	uptake Method.
	Marine mammals, whales and sea birds. Distribution and abundance of all species observed.
Availability of Data	Oceanographic data available on request for each station and standard depths.
	Magnetic tape - Full SIBEX data set including acoustic and oceanographic data recorded on magnetic tape in the formats required for the Post-FIBEX data workshop in Hamburg.
	These data as a general principl are available to scientific organizations on an exchange basis.
Requests for Data	Published data, data reports etc. are available on request. Data stored on magnetic tape will in general be made available on request providing proprietorial rights of the Ocean Research Institute and the appropriate scientists are respected.
	Requests for data should be made to the -
	Prof. Takahisa NEMOTO Marine Planktology Division Ocean Research Institute, University of Tokyo, 1-15-1 Minamidai, Nakano, Tokyo, 164 Japan
Cruise Track	To be attached


The Hakuho Maru Cruise
KH-83-4 (BIOMASS)
• : Hydrographic Station
X : XBT Station
( ): Date
TOKYO
CEBU
FREMANTLE
SYDNEY
HOBART
40
30
20
10
0
10
20
30
40
50
60
67
90
100
110
120
130
140
150
160
170
180

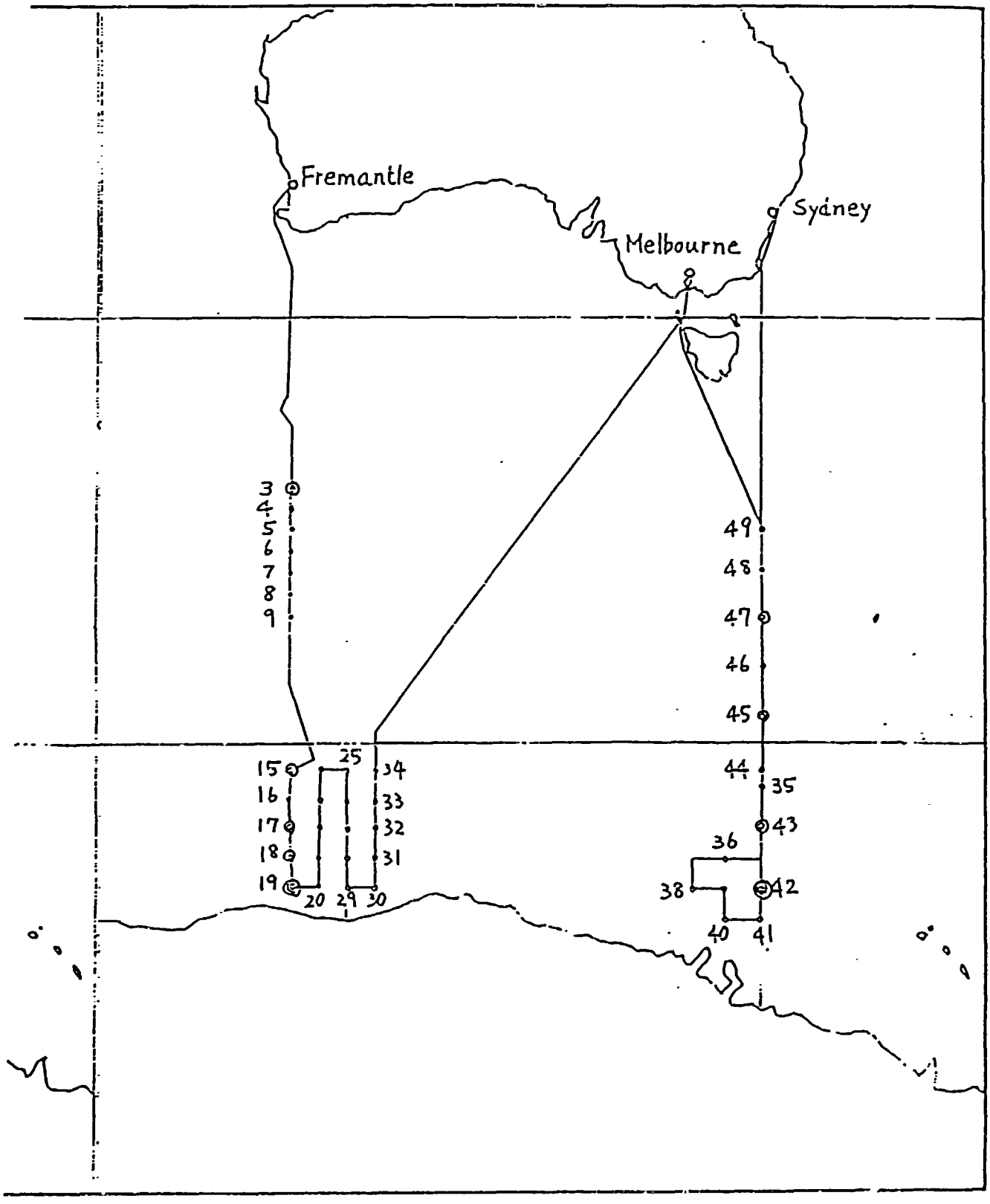
Ship's Name	Umitaka Maru
Cruise Identification	SIBEX (Second International BIOMASS Experiment)
Agency	Tokyo University of Fisheries
Dates and Cruise Details	Departed Tokyo 22 November 1983 Departed Fremantle 4 January 1984 Arrived study area 8 January Departed study area 19 January Arrived Melbourne 26 January Departed Melbourne 31 January Arrived study area 5 February Departed study area 14 February Arrived Sydney 17 February Arrived Tokyo 14 March Oceanographic research undertaken over 22 days in two Antarctic areas south of Australia.
Study Area	Between 49°S to 65°S Latitude and 116°E to 122°E Longitude in First leg. Between 51°S to 66°S Latitude and 145°E to 150°E Longitude in Second leg.
Cruise Objective	Participate in SIBEX and Training of cadets.
Scientific Objectives	-Acoustic survey for quantitative estimation of krill- -Measurements of water temperature, salinity, dissolved oxygen, chlorophyll a. -Measurement of primary productivity. -Survey of phytoplankton. -Survey of zooplankton. -Quantitative measurement of nutrients (phosphat silicate, nitrate, nitrite and ammonia) -Quantitative measurement of heavy metals. -Quantitative measurement of pollutants. -Quantitative measurement of POC and DOC.

	-Physiological experiments of krill.
	-Seabird distribution and abundance.
	-Marine mammal distribution and abundance.
Sampling Program	-IKMT towing for krill (12 oblique tows).
	-Bongo-nets for zoo- and phytoplankton (14 oblique tows) and conical net (49 vertical tows).
	-Hydrographic stations (42 CTD stations to 2000m or bottom).
	-Conductivity, temperature, depth and water sampling with rossette sampler at 42 CTD stations.
	-Expendable bathythermographs (152 probes to 450m).
	-Chlorophyll a - Rossette water sampling at 42 CTD stations to 200m.
	-Nutrients and DO - 42 CTD stations to 2000m or bottom.
	-Heavy metals - 9 CTD stations to 2000m.
	-Pollutants - 2 stations (65°S, 116°E and 65°S, 150°E).
	-Acoustic survey - Carried out in south of 60°S. Quantitative estimation - 10 to 100m at 120KHz.
Data Reproduction and Analysis	Zooplankton. Catch preserved in formalin seawater and then weighed.
	Phytoplankton. Net samples preserved in formalin seawater for identification. Water sample preserved in lugol for counting and identification.
	Oceanography. Full set of salinity and temperature data at standard depths for each station. Continuous CTD data available. XBT data for each drop available for standard depths.

	Nutrients. Data at 0, 10, 25, 50, 75, 100, 125, 150, 200, 500, 1000, 1500 and 2000m available.
	Chloroohyll a. Data at 0, 10, 25, 50, 75, 100, 125, 150 and 200m available.
	Sea birds and marine mammals. Distribution and abundance of all species observed.
Available of Data	Data, including temperature, salinity, DO, nutrients and chlorophyll a, will be published in spring of 1985.
	Magnetic tape - SIBEX data set including acoustic, oceanographic data will be recorded on magnetic tape in the formats required for the Post-FIBEX Data Workshop in Hamburg.
Requests for Data	Published data are available on request.
	Data stored on magnetic tape will be available on requests providing proprietorial rights of the scientists aboard Umitaka Maru are restricte
	Requests for data should be made to -
	Prof. M. Murano Tokyo University of Fisheries, 4-5-7 Konan, Minato-ku, Tokyo 108, JAPAN
Cruise Track	To be attached.

Umitaka Maru SIBEX

Cruise Track



Kaiyo Maru	SIBEX I	
Agency	Fisheries Agency	
Dates and Cruise Details	Departed Tokyo	4 November 1983
	Arrived Fremantle	21 November
	Departed "	26 November
	Arrived study area	4 December
	Departed "	25 December
	Arrived Port Elizabeth	3 January 1984
	Departed "	9 January
	Arrived study area	19 January
	Departed "	3 February
	Arrived Fremantle	12 February
	Departed "	18 February
	Arrived Singapore	26 February
	Departed "	2 March
	Arrived Tokyo	14 March
Study Area	A longitudinal line along 75°E from 45° 59.5'S to 61°00'S	
	South of 61°S to the ice edge (around 64°S) between 65°E and 75°E	
Cruise Objective	Participate in SIBEX Phase 1	
Scientific Objectives	Observation on physical and chemical oceanography	
	Chemical analysis of particulate matter	
	Survey of nano- and phytoplankton	
	Biological investigation on krill and other zooplankton	
	Genetic study of krill	
	Acoustic survey for quantitative estimation of krill	
	Observation on marine mammal and seabird	

distribution and abundance

Sampling Program

- Serial observation
  Nansen cast (69 stations)
- Temperature profile
  XBT (1830 m, 49 stations)
  " (460 m, 149 stations)
- Surface current
  GEK (57 stations)
- Water sampling for particulate matter
  Winter Water and its upper and lower layers (4 stations)
  Ten layers in the upper 200 m (6 stations)
- Water sampling for nano- and phytoplankton
  Ten layers in the upper 200 m (6 stations)
  Surface layer (62 stations)
- Water sampling for chemical analyses (104 stations)
- Net sampling for phytoplankton
  Conical net (0.16 m^2)
  63 vertical hauls each from 100 m and 20 m
- Zooplankton sampling
  Rectangular midwater trawl (9 m^2)
  88 hauls
  Conical net (2 m^2)
  65 oblique hauls from 100 m, 13 horizontal tows at surface layer
  Conical net (0.25 m^2)
  multi-layers horizontal tows down to 1500 m (5 layers at 8 stations), 62 vertical hauls each from 100 m and 500 m
  Conical closing net (0.25 m^2)

	6 hauls each through 2 horizons (1500-1000 and 1000-500 m) - Fish sampling Vertical lines (2 stations) - Acoustic survey Quantitative echosounding 0-200 m at 200 KHz, 4079 n miles - Sighting Surface krill patch daylight hours Seabird 10 min every 4 hrs Marine mammal from 06:00 to 18:00
Data Reduction and Analysis	Reduction of physical and chemical data completed Analyses of nano- and phytoplankton and particulate matter completed Zooplankton collected with larger nets and trawl were sorted into major groups and weighed; krill was sub-sampled, sorted for sex, measured and weighed individually Marine mammals and seabirds were identified into species and counted Electrophoretic study of krill is in progress
Availability of Data	Results were published in Preliminary Report of JFA R/V Kaiyo Maru's Cruise in 1983 Fiscal Year, the Third Antarctic Ocean Survey Cruise (1985), and Yamada (1985)

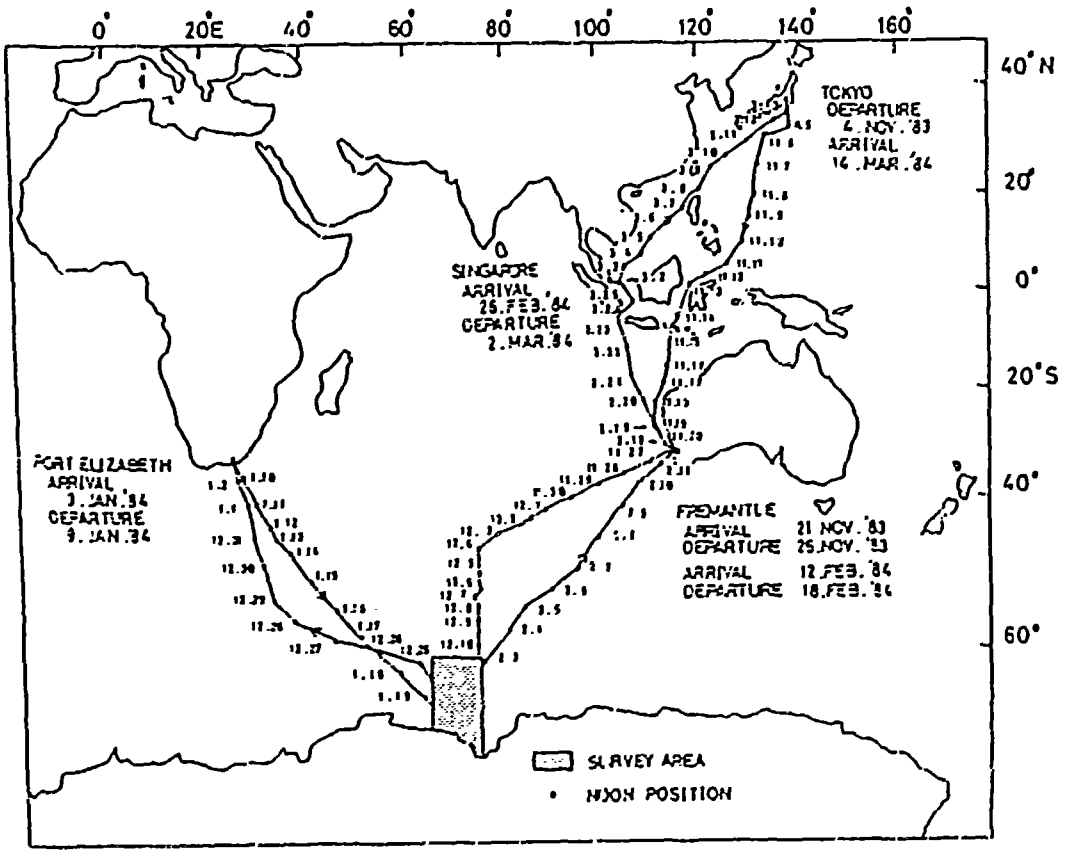
Requests for Data

The first publication above is available on request

Requests should be made to

Southern Ocean Living Resources Section
Far Seas Fisheries Research Laboratory
7-1, 5 Cho-me Orido, Shimizu 424, JAPAN

Cruise Track



Kaiyo Maru	SIBEX II		
Agency	Fisheries Agency		
Dates and Cruise Details		Departed Tokyo	9 October 1984
		Arrived Honolulu	23 October
		Departed "	27 October
		Arrived Valparaiso	17 November
		Departed "	22 November
		Arrived study area	27 November
		Departed "	17 December
		Arrived Montevideo	22 December
		Departed "	29 December
		Arrived study area	3 January 1985
		Departed "	28 January
		Arrived Port Elizabeth	30 January
		Departed "	3 February
		Arrived Singapore	22 February
		Departed "	27 February
		Arrived Tokyo	10 March
Study Area	A longitudinal line along 90°W from 44°S to 67°40'S		
	A transverse line north of Antarctic Peninsula from 90°W to 54°50'W		
	A longitudinal line in eastern Drake Passage		
	A longitudinal line along 30°-20°W from 39°00'S to 67°04'S		
	A transverse line along the ice edge off Queen Maud Land from 17°59'W to 9°10'E		
	A longitudinal line along 12°30'E from 69°37'S to 38°00'S		

Cruise Objective	Participate in SIBEX Phase 2
Scientific Objectives	Observation on physical and chemical oceanography
	Chemical analysis of particulate matter
	Survey of nano- and phytoplankton
	Biological investigation on krill and other zooplankton
	Genetic study of krill
	Acoustic survey for quantitative estimation of krill
	Observation on marine mammal and seabird distribution and abundance
Sampling Program	- Serial observation Nansen cast (34 stations) - Temperature profile XBT (1830 m, 85 stations) " (460 m, 53 stations) - Water sampling for particulate matter Winter Water and its upper and lower layers (10 stations) Ten layers in the upper 200 m (11 stations) - Water sampling for nano- and phytoplankton Ten layers in the upper 200 m (11 stations) Surface layer (86 stations) - Water sampling for chemical analyses Surface layer (72 stations) - Net sampling for phytoplankton Conical net (0.16 m^2) 102 vertical hauls each from 100 m and 20 m

- Zooplankton sampling

  Rectangular midwater trawl (9 m^2)

  56 blind hauls and 56 aimed hauls

  Conical net (2 m^2)

  57 oblique hauls from 100 m; 54 horizontal tows at surface layer

  Conical net (0.25 m^2)

  multi-layers horizontal tows down to 1500 m (9 stations), 57 vertical hauls each from 100 and 500 m

- Conical closing net (0.25 m^2)

  10 vertical hauls each through 2 horizons (1500-1000 and 1000-500 m)

- Acoustic survey

  Quantitative echosounding 0-200 m at 200 KHz, 4866 n miles

- Sighting

  Surfae krill patch

  daylight hours

  Seabird

  10 min every 4 hrs

  Marine mammal

  from 06:00 to 18:00

Data Reduction and Analysis

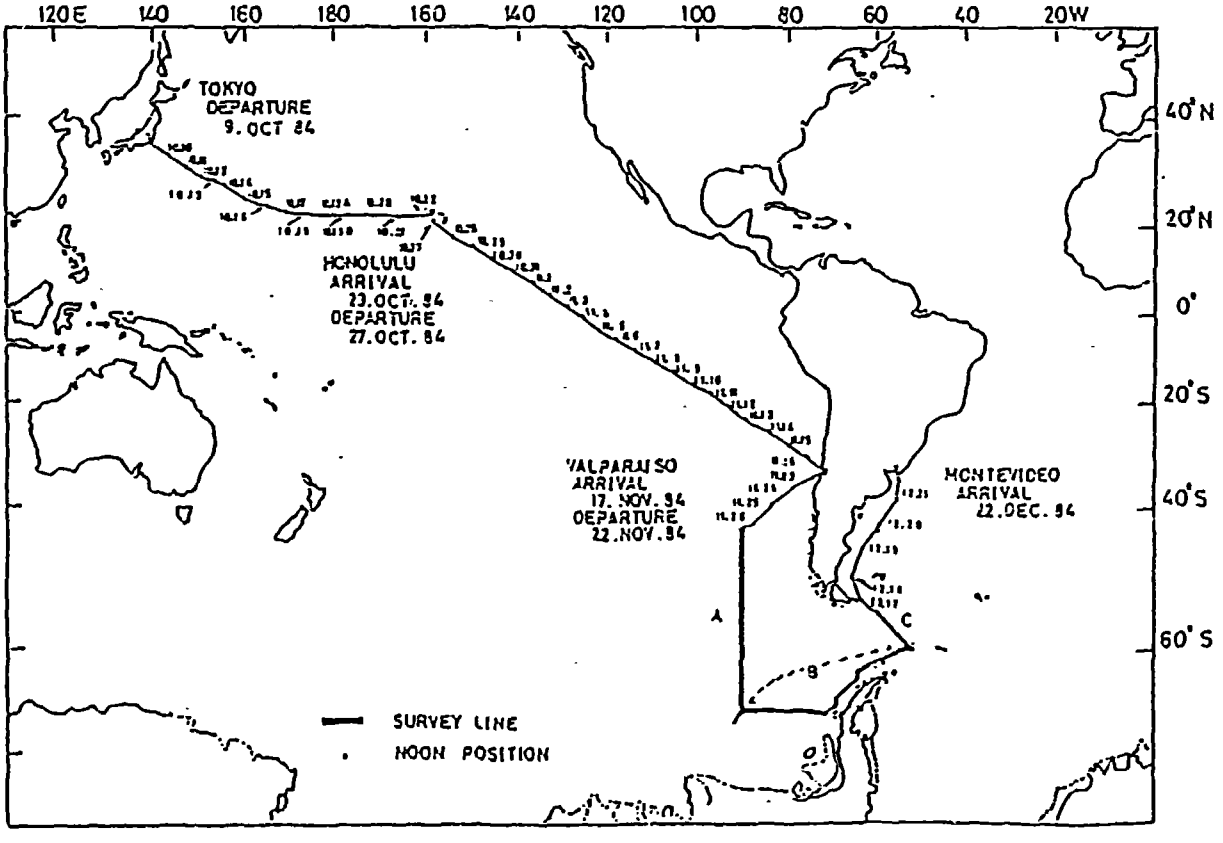
Reduction of physical and chemical data completed

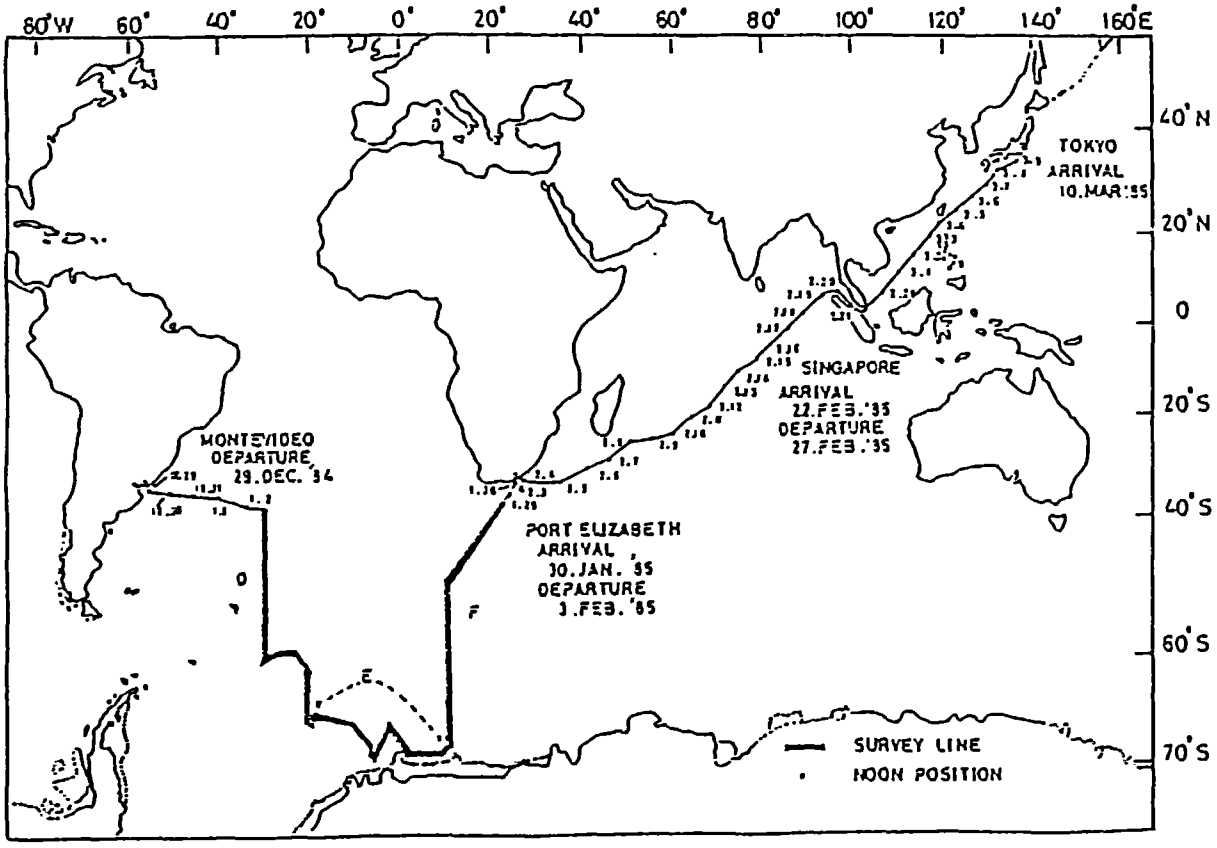
Processing of phytoplankton and particulate matter is in progress

Zooplankton collected with larger nets and trawl were sorted into major groups and weighed; krill was sub-sampled, sorted for sex, measured and weighed individually

	Marine mammals and seabirds were identified into species and counted
	Electrophoretic study of krill is in progress
Availability of Data	Results will be published in Preliminary Report of JFA R/V Kaiyo Maru's Second Cruise in 1984 Fiscal Year, the Fourth Antarctic Ocean Survey Cruise
Requests for Data	The above publication will be available on request
	Requests should be made to
	Southern Ocean Living Resources Section Far Seas Fisheries Research Laboratory 7-1, 5 Cho-me Orido, Shimizu 424, JAPAN

Cruise Track




80°W
60°
40°
20°
0°
20°
40°
60°
80°
100°
120°
140°
160°E
40°N
20°N
0
20°S
40°S
60°S
70°S
TOKYO
ARRIVAL
10.MAR.'85
SINGAPORE
ARRIVAL
22.FEB.'85
DEPARTURE
27.FEB.'85
MONTEVIDEO
DEPARTURE
29.DEC.'84
PORT ELIZABETH
ARRIVAL
10.JAN.'85
DEPARTURE
3.FEB.'85
SURVEY LINE
NOON POSITION

Syowa Station	69°00'S 39°35'E
Agency	National Institute of Polar Research
Period	January 1983 to January 1984
Study area	In the vicinity of Syowa Station
Scientific Objectives	Year-round observation of hydrographic conditions under the sea-ice including tidal observation
	Year-round observation of phytoplankton
	Ecological studies on ice-algae
	Primary productivity under the sea-ice
	Preliminary study of marine bacteria
	Taxonomical and ecological studies of choanoflagellates
	Census of Adélie penguin populations
	Census of Emperor penguin populations
Sampling program	Routine water and plankton samplings 11 times between February 1983 and January 1984 at three fixed stations
	Water samplings Nansen bottles for measurement of salinity, pH, dissolved oxygen and nutrient salts. Van Dorn bottles for measurement of plant pigments including chlorophyll a and water sampling for enumeration and identification of phytoplankton
	Ecology of ice-algae Samplings of ice cores at four fixed stations once to five times a month from March 1983 to January 1984. Occassional samplings at other sites. Direct observation of ice-algae by SCUBA diving
	Primary productivity under the sea ice Measurement of primary productivity by ^{13}C method in spring and summer
	Marine bacteria Observations with the viable counting method between May 1983 and January 1984

Choanoflagellates study
Sampling and observations by a SEM

Adélie penguin census
Seasonal change of populations at five rookeries between October 1983 and January 1984

Emperor penguin census
Aerial observations of populations at two rookeries

Tidal observation
Pressure-type tide gauge with a straingauge (Kyowa Shoko Co, SWL-7)

Data reduction and analysis

All data reduction is in progress.

Availability of Data

Information on the data reduced will be reported in due time.

Syowa Station	69°00'S 39°35'E
Agency	National Institute of Polar Research
Period	January 1984 to January 1985
Study area	In the vicinity of Syowa Station
Scientific Objectives	Year-round observation of hydrographic conditions under the sea-ice including tidal observation
	Year-round observation of phytoplankton
	Ecological studies on ice-algae
	Primary productivity under the sea-ice
	Preliminary study of marine bacteria
	Taxonomical and ecological studies of choanoflagellates
	Census of Adélie penguin populations
	Census of Emperor penguin populations
Sampling program	Routine water and plankton samplings 11 times between February 1984 and January 1985 at three fixed stations
	Water samplings Nansen bottles for measurement of salinity, pH, dissolved oxygen and nutrient salts. Van Dorn bottles for measurement of plant pigments including chlorophyll a and water sampling for enumeration and identification of phytoplankton
	Ecology of ice-algae Samplings of ice cores at four fixed stations once to five times a month from March 1984 to January 1985. Occassional samplings at other sites. Direct observation of ice-algae by SCUBA diving
	Primary productivity under the sea ice Measurement of primary productivity by ^{13}C method in spring and summer
	Marine bacteria Observations with the viable counting method between May 1984 and January 1985

	Ecology of krill and fish Measurement of oxygen consumption
	Adélie penguin census Seasonal change of populations at five rookeries between October 1984 and January 1985
	Emperor penguin census Aerial observations of populations at two rookeries
	Tidal observation Pressure-type tide gauge with a straingauge (Kyowa Shoko Co. SWL-7)
Data reduction and analysis	All data reduction is in progress.
Availability of Data	Information on the data reduced will be reported in due time.

Syowa Station	69°00'S 39°35'E
Agency	National Institute of Polar Research
Period	January 1986 to January 1987
Study area	In the vicinity of Syowa Station
Scientific Objectives	Ecological studies on benthos Census of Adélie penguin populations Census of Emperor penguin populations
Sampling program	Benthos ecology Observation by a submersible TV system Adélie penguin census Seasonal change of populations at five rookeries between October 1986 and January 1987 Emperor penguin census Aerial observations of populations at two rookeries Tidal observation Pressure-type tide gauge with a straingauge (Kyowa Shoko Co, SWL-7)
Data reduction and analysis	All data reduction is in progress.
Availability of Data	Information on the data reduced will be reported in due time.

7.

POLISH NATIONAL PROGRAMME OF PARTICIPATION IN THE INTERNATIONAL OCEANOGRAPHIC RESEARCH PROJECTS AIMED AT ELUCIDATING THE ROLE OF OCEAN INFLUENCE ON THE SHORT-TERM CLIMATIC CHANGES IN THE NORTHERN HEMISPHERE

1. MAIN OBJECTIVE OF THE POLISH RESEARCH PROGRAMME

Determination of intermonthly and interannual variability of hydrophysical fields of the upper active ocean layer and the dynamics of the near-surface boundary atmosphere layer in selected regions of the Norwegian Sea. Elucidation of the role of these factors in modelling the climatic variability of the ocean-atmosphere interaction processes in summer season July-August.

2. OUTLINE OF RESEARCH TASKS

2.1 Study of the variability of selected parameters characterizing thermohaline structure of the upper active ocean layer, and the dynamics of ensued anomalies / deflections from mean many-years', annual and seasonal states / on the basis of the following experimental characteristics:

- momentum flux, heat flux, wind parameters, coefficient of surface resistance, concentration of marine aerosols, in near-surface atmosphere layer,
- thickness and temperature of an upper mixed ocean layer, a seasonal thermocline layer and an under-thermocline layer down to 500 m depth,
- distribution of vertical and horizontal turbulent heat exchange coefficient,
- distribution of vertical and horizontal velocities of the thermal inhomogeneities decline,
- components of heat balance for the ocean surface / radiation balance, apparent and latent heat flux,
- components of heat balance for the upper active ocean layer / heat content in the layer, heat advection by currents and downward transport.

2.2 Investigation into the nature of variability of parameters characterizing the thermohaline structure of the upper active ocean layer using a two-layers mathematic model which includes the macroscale advection processes.

It is assumed here that the processes conditioning the upper active ocean layer have a mesoscale character and are generated by inhomogeneity of thermodynamic processes in the atmosphere over / above the oceanic surface / variability of solar energy flux, unstability of anemobaric conditions, etc., and these processes are stationary and develop within the macroscale oceanic circulation. The basic mathermatic equations of this model are as follows:

$$\frac{\partial}{\partial z} K_z \frac{\partial u'}{\partial z} - f v' = 0$$

$$\frac{\partial}{\partial z} K_z \frac{\partial v'}{\partial z} + f u' = 0$$

$$\frac{\partial T_1}{\partial z} + (\bar{u} + u') \frac{\partial T_1}{\partial x} + (\bar{v} + v') \frac{\partial T_1}{\partial y} + (\bar{w} + w') \frac{\partial T_1}{\partial z} = \frac{\partial}{\partial z} K_T \frac{\partial T_1}{\partial z} + R$$

$$\frac{\partial T_2}{\partial t} + \bar{u} \frac{\partial T_2}{\partial x} + \bar{v} \frac{\partial T_2}{\partial y} + (\bar{w} + w') \frac{\partial T_2}{\partial z} = \frac{\partial}{\partial z} K_{TT} \frac{\partial T_2}{\partial z}$$

$$\frac{\partial}{\partial x} (\bar{u} + u') + \frac{\partial}{\partial y} (\bar{v} + v') + \frac{\partial}{\partial z} (\bar{w} + w') = 0$$

where:

u', v', w'	-	components of the mesoscale drift current velocity vector
u, v, w	-	components of the macroscale current velocity vector
R	-	component describing heat sources in the water mass
T_1, T_2	-	temperatures of the homogenous water layer and the thermocline layer in mesoscale processes
K_z	-	vertical turbulent momentum exchange coefficient
K_T, K_{TT}	-	vertical turbulent heat exchange coefficient in homogenous and thermocline layers, resp.
f	-	Coriolis parameter

2.3 INVESTIGATION INTO ANOMALIES OF THE FLOW ENERGY BALANCE COMPONENTS IN THE UPPER ACTIVE OCEAN LAYER

On the basis of climatic data coupled with results of measurements obtained during sea going expeditions an assessment of flow field components will be made direct methods / an analogue dynamic depth method, a spiral method or an inverse Wunsch method / as well as their deviation from the respective climatic mean values. Thence, the following components of the flow field energy balance will be computed:

- kinetic energy

- potential energy and its effective resource

- the work of tangential wind generated shear stress and the atmospheric pressure forces
- energy dissipation caused by the turbulent horizontal diffusion and outflow of water masses

Successful realization of these tasks will enable a diagnosis of the energetic state of the upper active ocean layer and its mesoscale anomalies.

2.4 STUDIES OF RELATIONSHIPS BETWEEN FLUCTUATIONS OF HYDROLOGICAL REGIME AND QUANTITATIVE CHANGES IN MARINE BIOCENOSIS

The following characteristics will be studied in particular:

- quantitative changes in the vertical distribution of phytoplankton concentration,

- quantitative changes in populations of individual planktonic species.

3. INVESTIGATION METHODOLOGY

The main approach in the investigation consist of a diagnosis of hydrological and aerodynamical regime in the region of investigation, made on the basis of experimental data collected "in situ" by the R/V "Oceania" of the Institute of Oceanology of the Polish Academy of Sciences during regular cruises organized annually in a fixed period of year from 1 July to 30 August.

On each cruise, the following measurements will be made:

- atmospheric pressure, temperature, humidity, solar radiation and the concentration of aerosols in near-surface atmosphere (impactor gages),

- intensity of wind waves and degree of sea surface coverage by white horses (photometry),

- vertical distribution (down to 500 m depth) of salinity and temperature (standard STD) light attenuation coefficient (optical sensors) temperature and salinity finescale profiles (high frequency STD), and fluorescence intensity (fluorimeter),

- thickness of the upper mixed layer and the pynocline layer (vertical acoustic sounding),

- concentration of chlorophyll, phyto- and zooplankton, and their speciation, in the upper water layer (bathymetric rosette and planktonic nets).

Additionally, facsimile charts showing anemobaric situation, radiation balance, sub-surface water temperatures and near-surface air temperatures in the summer months July-August will be analyzed in detail.

The stations network (Fig. 1) comprises main hydrological stations on which full measurement programme will be executed and ancillary stations on which only the STD, meteorological observations and the state of sea surface will be measured and recorded.

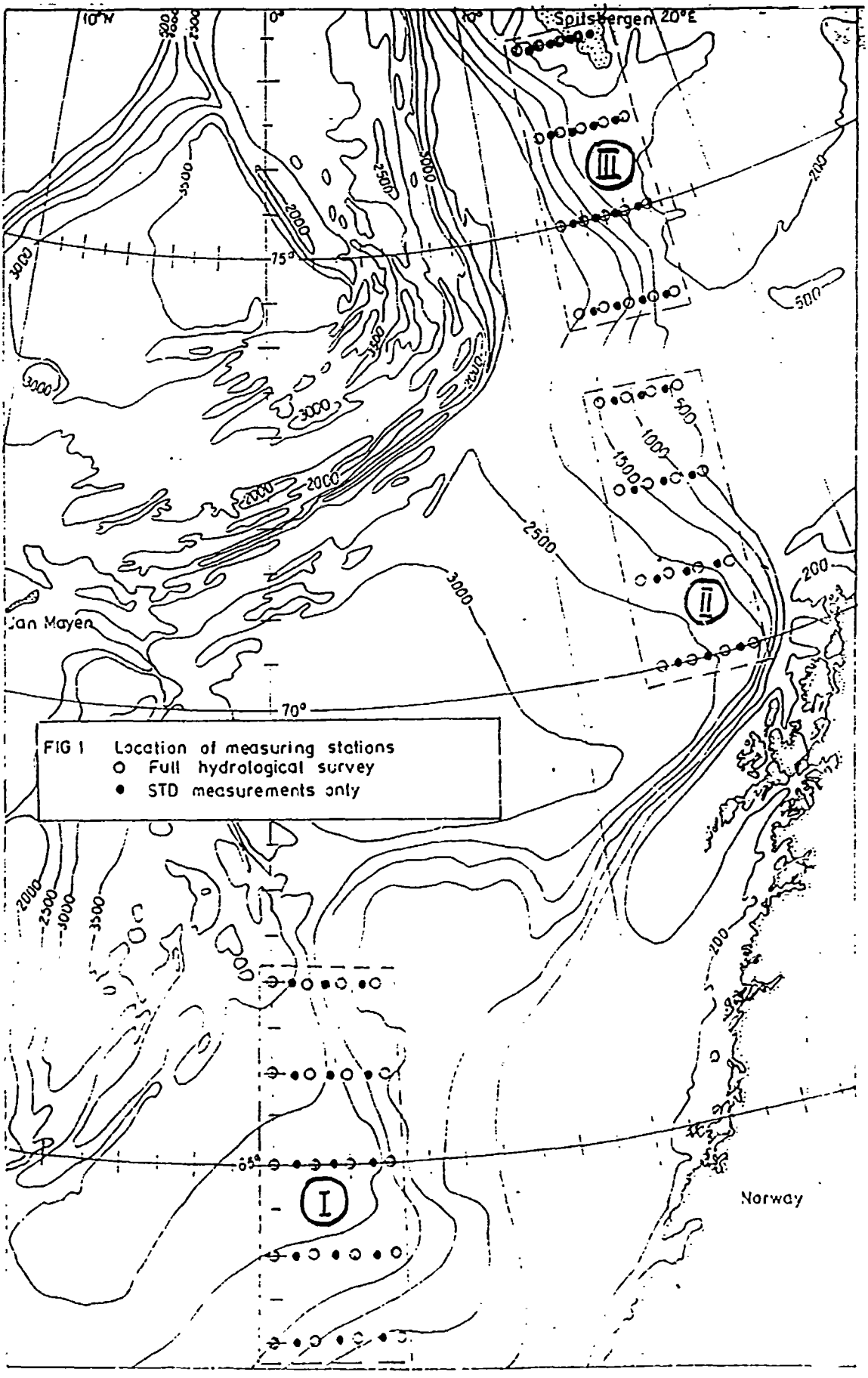


FIG 1 Location of measuring stations
○ Full hydrological survey
● STD measurements only

4. CHARACTERISTICS OF THE STUDY AREA

The regions of the Norwegian Sea in which the investigations under the Research Project will be carried out are shown in Fig. 1. They were chosen taking into account several oceanographic features which were considered advantageous such as: intensive ocean-atmosphere interaction processes (large fluxes of momentum, apparent and latent heat, significant heat content, anomalies, etc.) and strong horizontal movement of upper water masses conveying heat southwards. As it follows from Figs. 2-5 (in: G.V. Alexeev et al., "Itogi Nauki i Tekhnikyi", vol. VII, 1986) the circulation of water masses in the Norwegian Sea and the heat contents in different water layers justify the selection of two survey areas delimited by the following co-ordinates:

- survey area I : $0^{o}E$ - $3^{o}E$ and $63^{o}N$ - $67^{o}N$
- survey area II: $13^{o}E$ - $16^{o}E$ and $70^{o}N$ - $73^{o}N$

In these areas the dynamics of the upper ocean layer is intensive. This is visualized by strong meridional water flows with a distinct lateral meandering. The selected regions are also characterized by intense heat exchange processes across the ocean-atmosphere interface. A long-term course of this exchange is illustrated in Fig. 5 showing differences in spatial distributions of heat content in the water layer of 0-300 m, between July 1976 and July 1983.

The co-ordinates of the third survey area ($13^{o}E$ - $17^{o}E$ and $74^{o}N$-$77^{o}N$) delimit a region of intense mixing of the Atlantic water with the Barents Sea water of arctic origin (confluence zone).

The hydrographic station network covers the area between the Bear Island and the South Spitsbergen and was chosen such as to include the channel through which the arctic waters outflow.

5. FRAMEWORK OF THE INTERNATIONAL RESEARCH CO-OPERATION

- World Climate Research Programme, co-ordinated by the World Meteorological Organization and supported by the Intergovernmental Oceanographic Commission/Unesco and the International Council of Scientific Unions

- Resolutions of the International Committee on Climatic Changes and the Ocean, created and supervised by the IOC-Unesco and the Scientific Committee on Oceanic Research

- International Research Project: "Energoactive Ocean Zones" realized by oceanological and meteorological scientific institutions of Socialist Countries

- International Research Project: "Greenland Sea Project" realized by European Countries with participation of the USA and Canada.

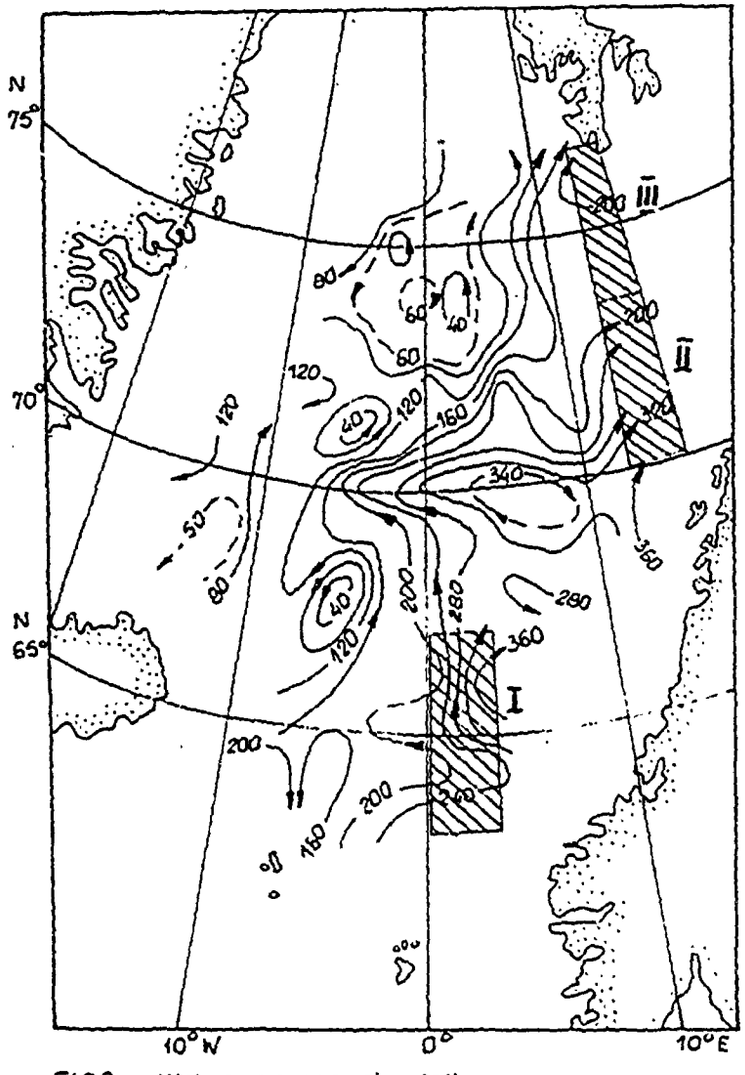


FIG.2. Water-masses circulation
[dynamical method refered to 1000 dbar]

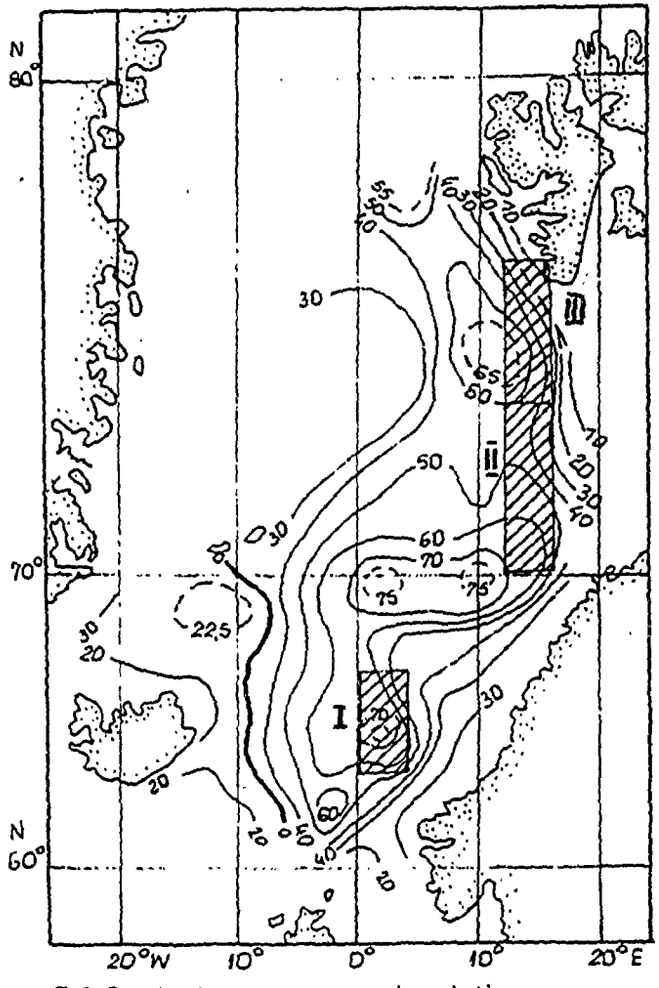


FIG.3. Water-masses circulation
[numerical diagnostic model]

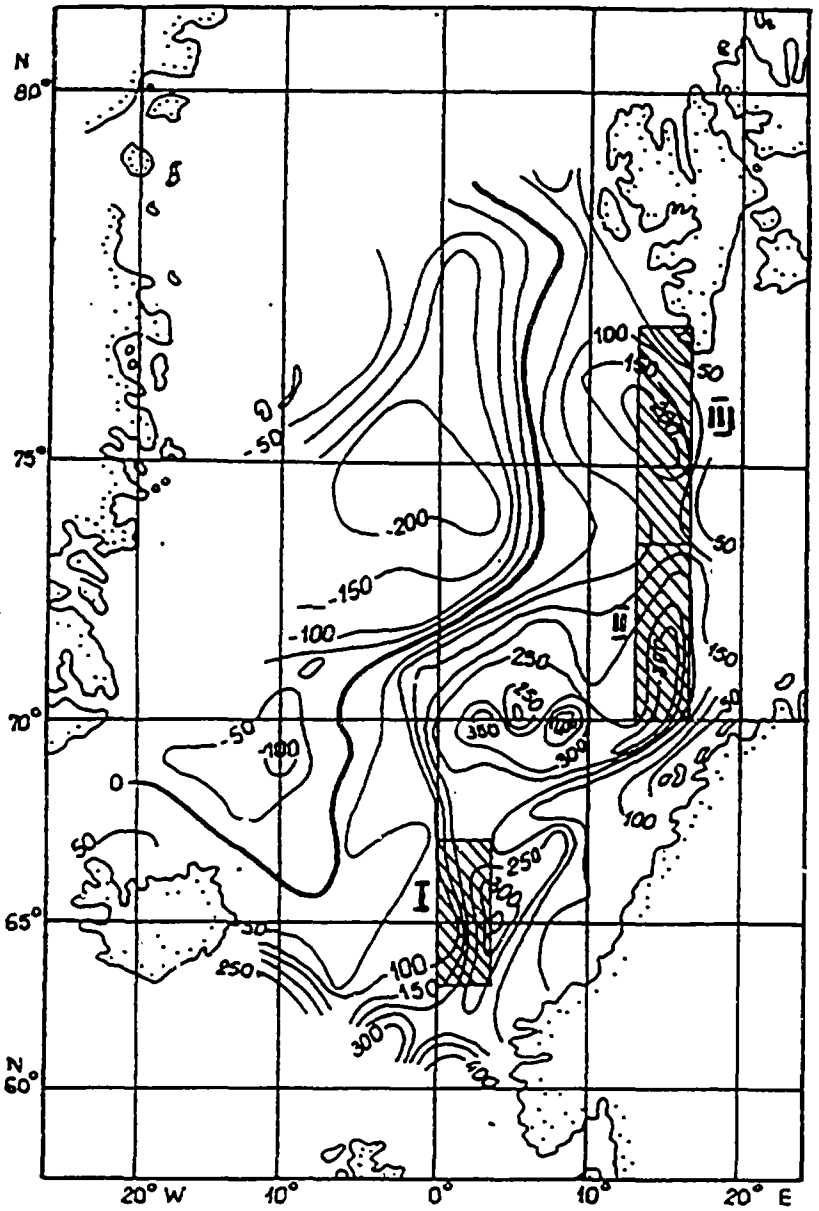


FIG 4 Heat content for May 1976
[Layer thickness: 0-2000 m, isolines-Kcal/cm^2]

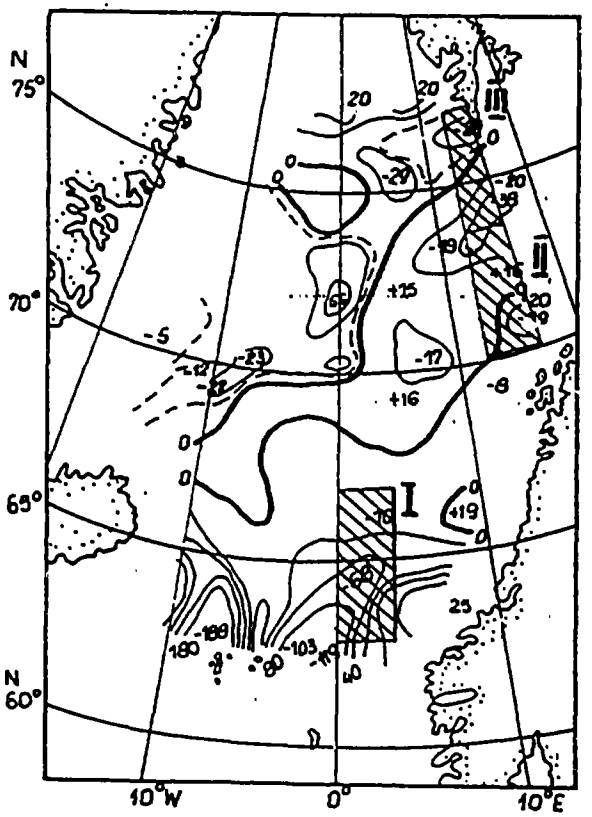


FIG 5 Heat content differences between July 1976 and 1983
[Layer thickness: 0- 300 m, isolines-Kcal/cm^2]

6. FINANCIAL BASIS OF THE PROJECT

Polish Central Programme of Fundamental Research No. 03.03 "Studies of the living resources, the lithosphere and the polar zone environment" Thematic group C: "Oceanological investigations into the polar environments influencing the climate and the biosphere.

7. PLANNED DURATION OF THE PROJECT

Phase I - until 1990 - further phases - after 1990.

8. INSTITUTION RESPONSIBLE FOR CO-ORDINATION OF RESEARCH ACTIVITIES IN POLAND AND FOR INTERNATIONAL CO-OPERATION

Polish Academy of Sciences, Institute of Oceanology
Address: 81-967 Sopot, Powstancow Warszawy 55
Telex: 0512785 OPAN
Tel.: 51-21-30
Responsible national co-ordinator: Prof. Dr. Hab. Czeslaw Druet

8.

MAIN RESULTS OF THE USSR SOUTHERN OCEAN STUDIES IN 1983-1987 AND LONG-TERM PLANS FOR STUDIES UP TO 1990

(prepared by Treshnikov, A.F.; Danilov, A.I.; Ivchenko, V.O.; Pryamikov, S.M. -
The Arctic & Antarctic Research Institute, 38 Bering str., 199226 Leningrad)

1. MAIN RESULTS

In 1983-1987 the Soviet Union continued oceanographic studies in the Southern Ocean by the "Polar Experiment (POLEX) - South" programme. The studies were carried out in the Atlantic, Pacific and Inidan Ocean sectors of the Southern Ocean, their main objectives being similar to those of the "Polex-South" programme. They envisaged studies of the structure and dynamics of the Antarctic Circumpolar Current (ACC) and its interaction with subtropical and subpolar gyres, studies of ocean synoptic variability, of water masses formation and spreading dynamics, studies of sea-air interaction (in the presence of sea ice cover and in ice free conditions). During the period under study special emphasis was laid on studies of subpolar gyres which appear to be the least investigated regions in the Southern Ocean.

In 1983 the studies were made aboard 4 vessels in the following areas:

- the R/V "Professor Zubov" - in the Atlantic sector in the Argentine basin area (40-53°S, 38-53°W);
- the R/V "Dmitry Mendeleyev" - in the Pacific sector from the Balleny Islands to the shelf area of the Campbell Island;
- the R/V "Vityaz" - in the Indian sector between the Kerguelen and St Paul Islands;
- the R/V "Akademik Mstislav Keldysh" - at the section along 25° E between 40 and 53.5°S.

The main goal of the above studies was to investigate the ACC and its synoptic variability. Thus as a result the existence of a two-axis ACC structure in the New Zealand sector was confirmed. It was noted that the ACC dynamic activity decreased with time during a warmer part of the year (from December to March). Direct current and water temperature measurements in the bottom layer made for the first time for two months at 3 submerged buoy stations in the western George basin confirmed the suggestion that Antarctic Bottom Water (AABW) from the Weddell basin enters the Argentine basin across this very area. The AABW transport across the George basin is estimated to be 3.25 SV on the basis of instrumental data measurements.

As concerned synoptic variability eddies of different signs were found at each of the four polygons. Thus at the polygone in the Argentine basin area three eddy-like structures were revealed which can be defined as the Brazil current rings in different stages of dissipation and thereby their path in the subantarctic zone can "traced" (Fig. 1). At the other polygones cyclonic rings with cold cores were observed. Repeated mesoscale hydrological surveys of the areas where eddies were identified allowed estimates of spation scale and velocities of their movement. In particular a cold-core eddy found in the New Zealand sector in the northern PFZ had an elleptical shape, its large axis directed by latitude and being 90 miles, and its small axis being about 60 miles. During the observation period (about 20 days) the eddy centre was shifting to the east-north-east with a rate about 5 miles per day, the phase velocity in the ring by far exceeding one knot. Synoptic disturbances found in the region of the R/V "Vityaz" operation were shifting to the south-south-east with a rate about 4 km a day. The R/V "Akademik M. Keldysh" observed a cyclonic eddy with a centre located at approximately 47.5°S and 26°W. During the observations the centre of the eduy remained in the vicinity of the indicated point, it was ellipse-shaped with a quasilatitudinal orientation of its large axis, its size being 80 x 50 miles.

In 1984 the R/V "Professor Viese" and the R/V "Akademik Krylov" carried out expedition studies in the Atlantic sector of the Southern Ocean. The structure of hydrophysical fields in the subpolar Weddell Gyre (WG) system was investigated with observations planned in the following regions:

a) the eastern boundary current (Warm Weddell Counter-current-WWCC);

b) the central Weddell Gyre - the Maud Rise;

c) the western boundary current (eastward of the Antarctic Peninsula tip).

The scheme of the expedition activity is given at Fig. 2.

The expedition's programme envisaged:

1. To study the structure of hydrophysical fields in the subpolar Weddell Gyre System.

2. To study the character of interaction between the subpolar Weddell Gyre and the Antarctic circumpolar current.

It was expected that the data set obtained by the expedition would provide a better understanding of the following problems:

1. To estimate water transport and to define structure of the warm deep water flow in the eastern branch of the WG circulation called the Warm Weddel Counter-current (WWCC). The section II was taken.

2. To determine density field structure in the perturbation area of the WWCC when it flows onto the Maud Rise. Hydrological surveys at the Site A and Site B were made.

3. To estimate transports using as many gyre cross-sections as possible to gain a better insight into the heat transfer by the subpolar gyre system; it is important that all sections are made during one season. The sections 1, 2 and 3 were taken; at the Site A a section along 0° meridian was made.

4. To estimate the state of the ocean active layer as related to the state of the atmosphere and deep-water.

The data collected by the expedition allow one to a greater or lesser extent to solve the above problems.

Figure 3 shows isolines of T max. values by the data of Section II and Site A. The current can be seen to reach the Maud Rise as two well-pronounced jets. One of them (southern) appears to transfer heat directly to the internal WG area, while the other (northern) flows onto the Maud Rise inducing perturbations in the thermohaline structure behind it with a horizontal scale about 100 km (see Fig. 4). It seems that the existence of such perturbations is quite important for further transformation of heat and other properties to the west of the Maud Rise. In particular it affects the development of vertical processes (intensity, location in space). It is difficult to determine the character of these perturbations in deep-water (eddies or waves) however, it is clear that eddy transport in this area should play a significant role. The obtained data allow some estimates of heat transfer in the deep-water layer in the Weddell Gyre system.

According to the scheme of deep water circulation such estimates were based on the data of Sections I, II, III and along 0° meridian. Mean temperature of deep waters in the western branch of the Weddell Gyre circulation ($0.15^{\circ}C$) was assumed to be To temperature, relative to which

heat transfers were calculated. Therefore heat transfer at the section across the WWCC was assumed as an estimate of heat amount lost in the Gyre, that is as a value characterizing meridional heat transfer through the subpolar Weddell Gyre System. About (6,5-7.0) x 10^{13}W is lost in the Gyre. For the WWCC it amounts to a heat flux of 0.19 cal cm^{-2} s^{-1}. When comparing this value with known estimates for the PFZ by Gordon and Bryden (0.12-0.29) cal cm^{-2} s^{-1} it can be said at least that in the eastern branch of the subpolar gyre circulation the poleward heat flux can be as high as its climatic value.

In addition available data set contributes to our understanding of how the WWCC heat is transferred to the Gyre area. A large portion of the heat content of the WWCC southern branch is transferred southward of the Maud Rise by a strong and narrow westward flow. Oceanographic data for this area indicate that near the Maud Rise part of the WWCC turns eastward. The section II showed a weak eastward current in its southernmost part, but regretfully only at two stations. The section at the outflow of a presumed western boundary current was not extented to continental slope and it appears to demonstrate a thermohaline structure of its eastern periphery, i.e. water masses characteristic of the western Weddell Gyre.

In winter of 1985 observations of the Pacific Ice Massif development carried out aboard the drifting research expedition vessel "Mikhail Somov" and the icebraker "Vladivostok" yielded important information on the ice regime of the Southern Ocean. The data on the ice cover structure, ice drift, distribution of main ice cover parameters from the edge to the coast were collected.

Marine expedition activity of the AARI in the austral summer of 1985-1986 was aimed at studying the structure of water circulation in the south-western part of the Pacific sector of the Southern Ocean. The water basin of this region appears to be extremely interesting both in terms of oceanography and hydrobiology.

The so-called Ross Gyre is one of the most pronounced components of the hydrology of the south-western Pacific sector of the Southern Ocean. This is an extensive (150°E - 130°E) water circulation system of a cyclonic type, which intensifies heat and properties exchange between temporal and high latitudes. Most important result of the Ross Gyre existence appear to be: "the Ross Sea phenomenon" - every year in summer the southernmost marginal antarctic sea is practically free of ice, with the ice break starting off the Ross ice shelf; inflow of modified circumpolar deep waters to the Ross Sea shelf area and farther under the Ross ice shelf; unique nature of the western limit of the Pacific ice massif, forming under the influence of dynamic factors.

In December of 1985 - March 1986 the expedition aboard the R/V "Professor Viese" and "Professor Zubov" studied water circulation structure of the Ross Gyre in the south-western Pacific sector of the Southern Ocean (165°E - 130°W). The analysis of the data (240 oceanographic stations, 2 submerged buoy stations, 41 series of instrumental current observations from the drifting vessel, 102 hydrobiological stations) showed that within the investigated area of the Ross Gyre there are two internal branches of the cyclonic circulation, its centers located to the north-east of the Balleny

Islands (western) and to the south of the South-Pacific ridge in the area of 150°W meridian (eastern). The divide between them goes along a meridionally-oriented range of underwater ridges eastward of the 180° meridian (Fig. 5).

At the eastern boundaries of both branches southward flows of warm circumpolar deep waters are induced, extending to the edge of continental shelf with a temperature in the layer about 1.5°C, while at the western boundaries a poleward outflow of these waters was observed along the 180° meridian, its transport being 10 Sverdrups (Fig. 6).

The strongest southward flow of circumpolar deep waters with a transport about 20 SV is identified along a meridional corridor of 135-145°W after the ACC crosses the Udintsev break ("USARP").

According to calculations a southward heat flux across 67°S in the western and eastern circulation branches was found to be 2.9 10^{13} and 6.3 10^{13} W respectively within the area under study.

In the area of the expedition works features of Antarctic Bottom Water (AABW) were investigated. In particular the southern periphery of the South-Pacific Ridge was found to be the northern boundary of AABW spreading. Northward of the Ridge only lower circumpolar deep water can be identified. A dense and saline bottom water of the Ross Sea was observed near the continental slope at the Ader Cape, which appears to move westward along the slope. Northward of this flow the AABW moves eastward.

Two cyclonic gyres with centres near 65°S, 175°E and 63°S, 145°W respectively can be distinguished in the studied area of AABW circulation. The above mentioned AABW circulation features are in good agreement with the bottom topography field (Fig. 7).

The distribution of the AABW properties suggests that in the studied area of the Ross Gyre their formation is influenced both by advection and horizontal diffusion and by vertical exchange with the upper layers.

Comparison of the Pacific Ice Massif limits in summer of 1985-86 with earlier published data showed the northern boundary of the ice massif in February to be located 2° to the north of its northernmost extension for the whole observation period. Preliminary combined analysis of data on the atmospheric circulation features and ice situation suggests that such anomalous northward shift of the Pacific Ice Massif boundary can be attributed to unusually strong meridional motions of atmospheric processes. As a result it was constantly under the impact of the south winds.

Thus a regular oceanographic survey carried out for the first time in the South-western Pacific sector of the Southern Ocean resulted in determination of spatial scale and circulation structure of the Ross Gyre waters.

The data of oceanographic and meteorological observations carried out in the Southern Ocean aboard the R/V "Professor Viese", "Professor Zubov", the R/V "Dmitry Mendeleyev", the R/V "Vityaz", the R/V "Akademik

Mstislav Keldysh" and the oceanographic research vessel "Akademik Krylov" were sent for international exchange.

2. LONG-TERM PLANS FOR SOUTHERN OCEAN STUDIES IN 1987-1990

It is planned to direct main efforts to the studies of subpolar Weddell and Ross Gyres. The primary goal of these studies is to investigate large-scale and thermohaline structure of the gyres. It is necessary to clearly understand the boundary between the gyres and the ACC, how the interaction of the gyre circulation and circulation of the waters to the north of the gyre occurs (studies of the front divides). The eastern boundary of the Weddell Gyre will be also studied, what factors govern spatial location of southward flow of the ACC warm and saline waters. It is planned to investigate the structure of western boundary currents, their transports and velocity distribution along with the northward outflow of bottom and deep waters. It is aimed to investigate bottom and deep water formation at the southern periphery of the gyres including their interaction with the antarctic shelf waters.

In addition traditional hydrological surveys will be conducted. Direct circulation measurements, that is deployment of submerged buoy stations will play an important role. Particular attention will be given to synoptic scale motions affecting heat transfer and redistribution. Any observations yielding information on the structure of synoptic eddies, their origin and transformation in the subpolar area of the Southern Ocean will be extremely useful.

Important information on the ice cover can be obtained from satellite data.

All the sets of data will enable us to determine in what way heat and salinity exchange between high and temperate latitudes occurs. The role of wind and thermohaline forcing, topography effects on the formation of cyclonic subpolar gyres will be studied allowing us to account for similarities and differences in the observed circulation system.

Along with research in physical oceanography emphasis will be given to studies of interaction in the ocean-ice-atmosphere system. Seasonal variations in the upper mixed layer of gyres and in general in the south-polar region are not studied. That is why our knowledge of the heat exchange between the ocean and the atmosphere appears to be very limited. The studies of the mixed layer will contribute to a better understanding of deep-reaching convection processes in the open ocean, which play an important role in the formation of bottom and deep waters of the World Ocean as well as in the formation of such anomalous phenomena in the ice cover as polynyas of the open ocean (for example the Weddell polynya). All this is also important when describing the development of the ice cover itself. Thus observations are to be carried out in the winter period of the Southern Hemisphere.

To achieve the above objectives the R/V "Professor Viese" and the R/V "Professor Zubov" will be employed along with the research-expedition vessel "Akademik Feodorov" which will become operation in autumn of 1987.

In 1987-88 the R/V "Professor Zubov" will operate in the area to the west of the Maud Rise. The processes occurring in the southern branch of the Gyre will be also investigated. The "Akademik Feodorov" will make her first voyage to the Southern Ocean which will be mainly of an experimental character. The studies in the Weddell Gyre are envisaged.

In 1988-89 the "Professor Viese" and the "Akademik Feodorov" will operate in the southern area of the Ross Gyre.

In 1989-90 the "Professor Zubov", the "Professor Viese" and the "Akademik Feodorov" will conduct studies in the Indian Ocean sector, consisting of the winter and summer stages. In winter main emphasis will be placed on studies of the upper active ocean layer and the ice cover. In summer these studios will be continued. Efforts will be also aimed at investigating synoptic scale motions.

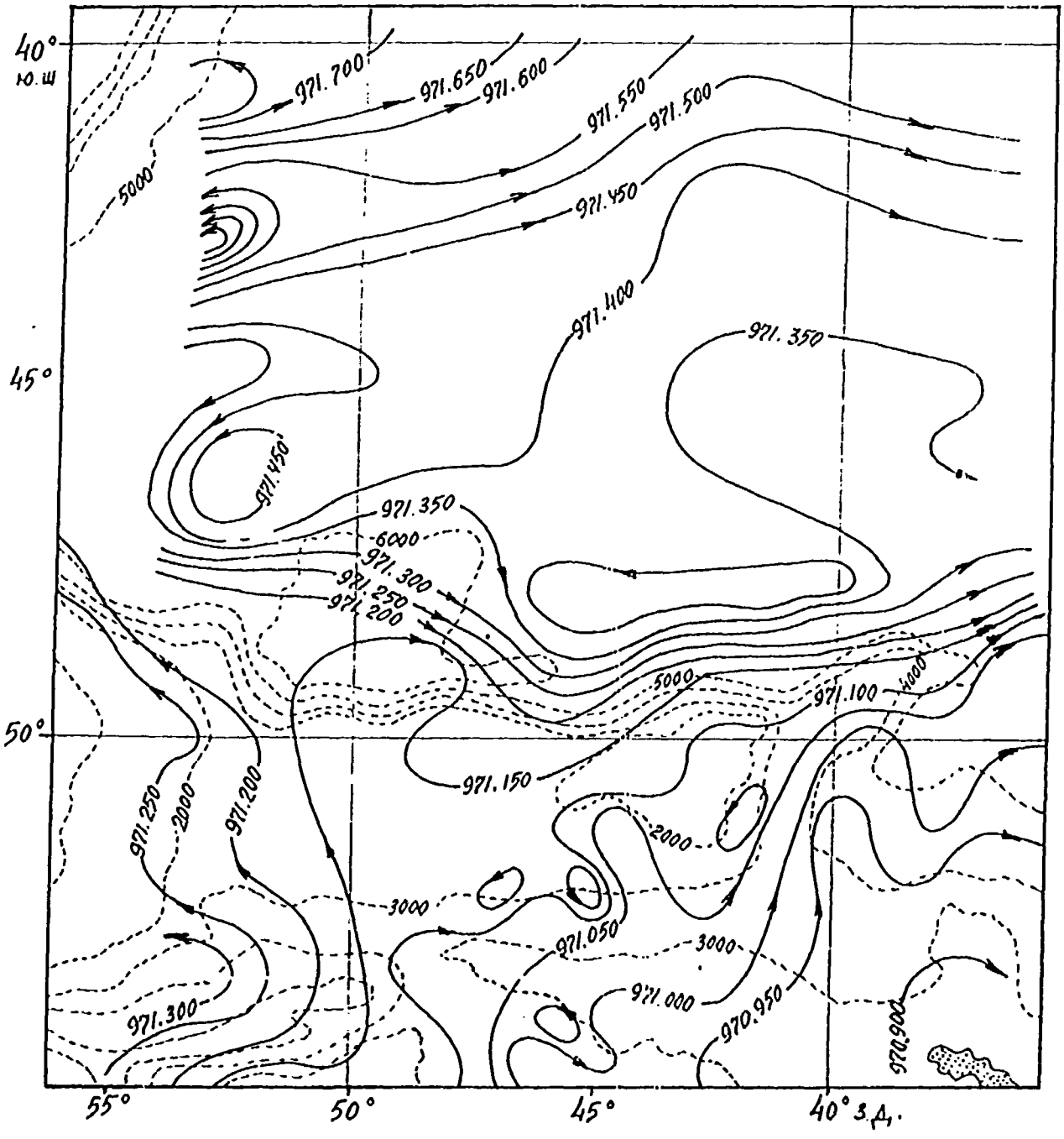


FIGURE 1. Dynamic topography 0/1000 dbar by the data of the"POLEX-South-83" expedition (December 1982 - February 1983).

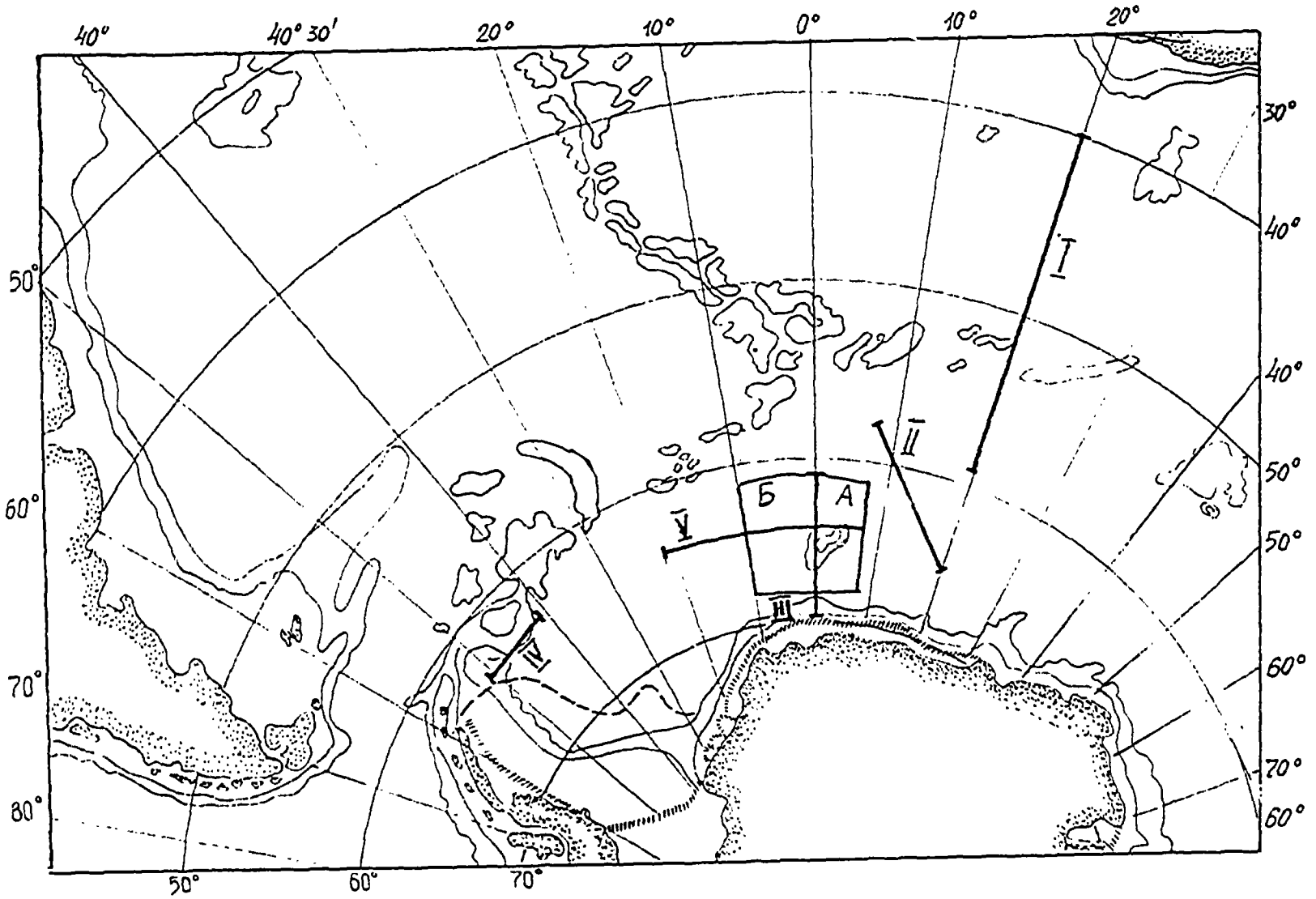


FIGURE 2. Scheme of the "POLEX-South-84" expedition activity.
Roman numerals denote hydrological sections.
A, B - hydrological stations arrays.

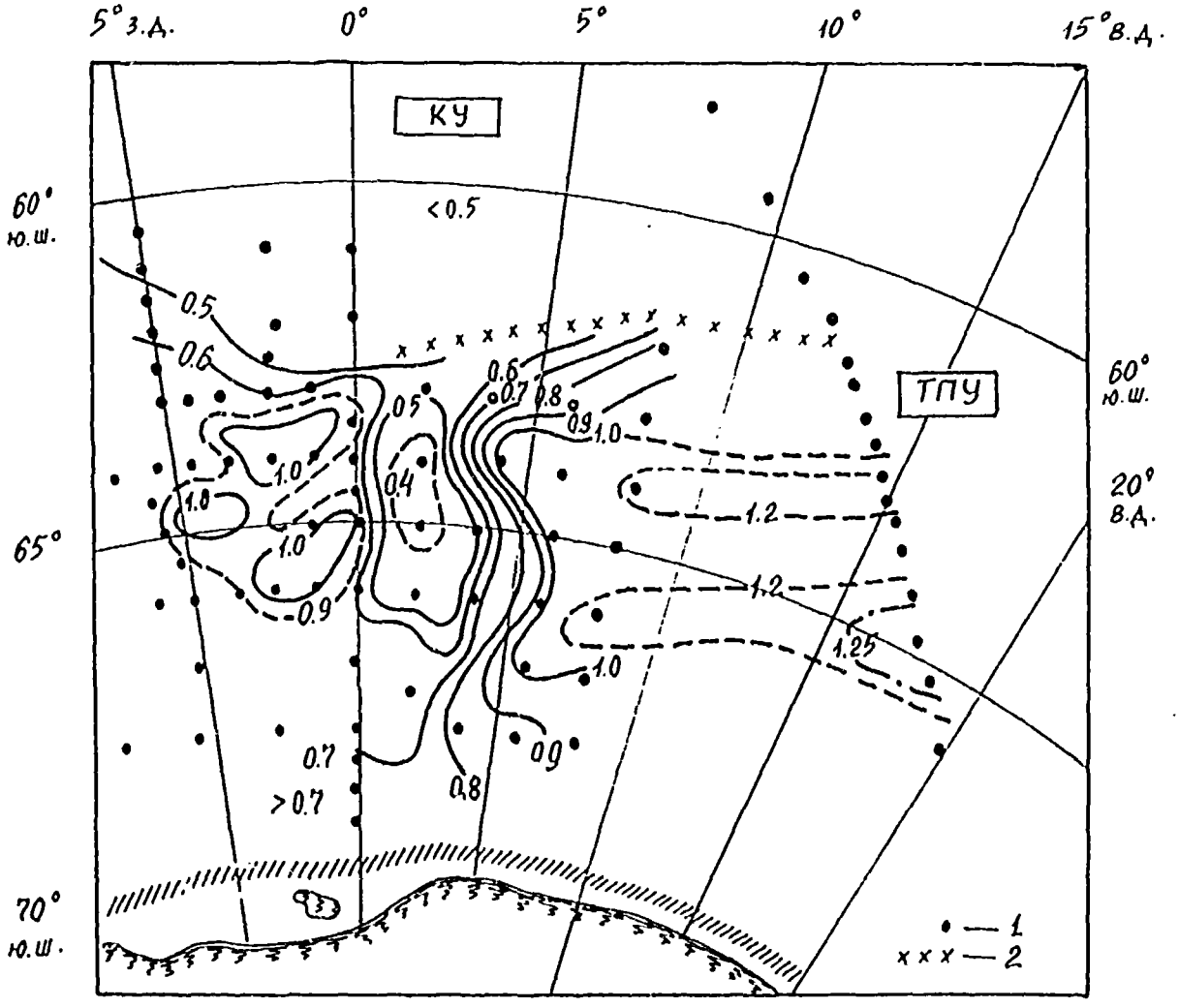


FIGURE 3. T_{max} distribution in the area of the "POLEX-South-84" expedition activity.
I - hydrological stations; 2 - frontal zone location

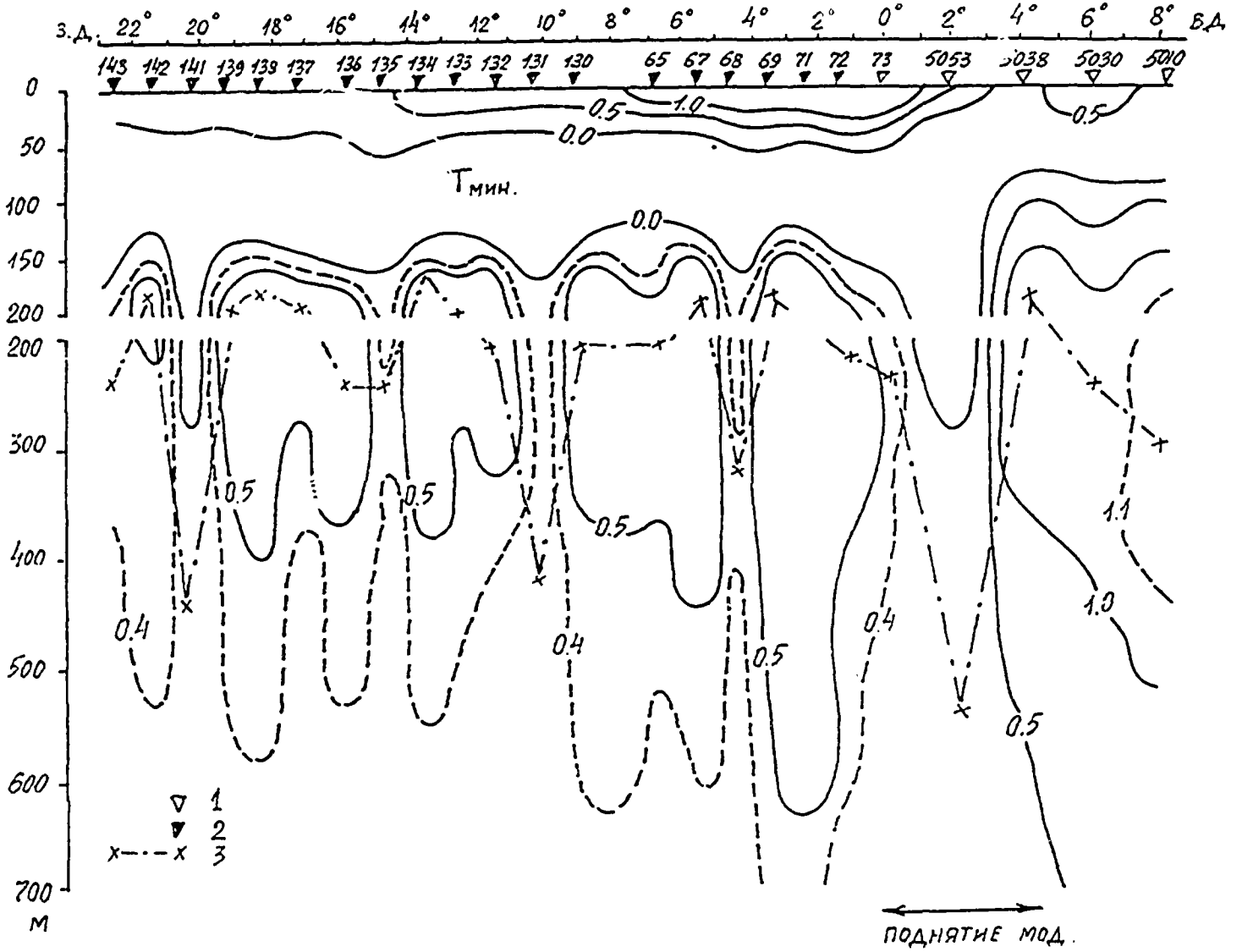


FIGURE 4. Temperature distribution at the 64°s section.

1 - stations carried out by the "Professor Viese"

2 - stations carried out by the "Akademik Krylov"

3 - T ma:

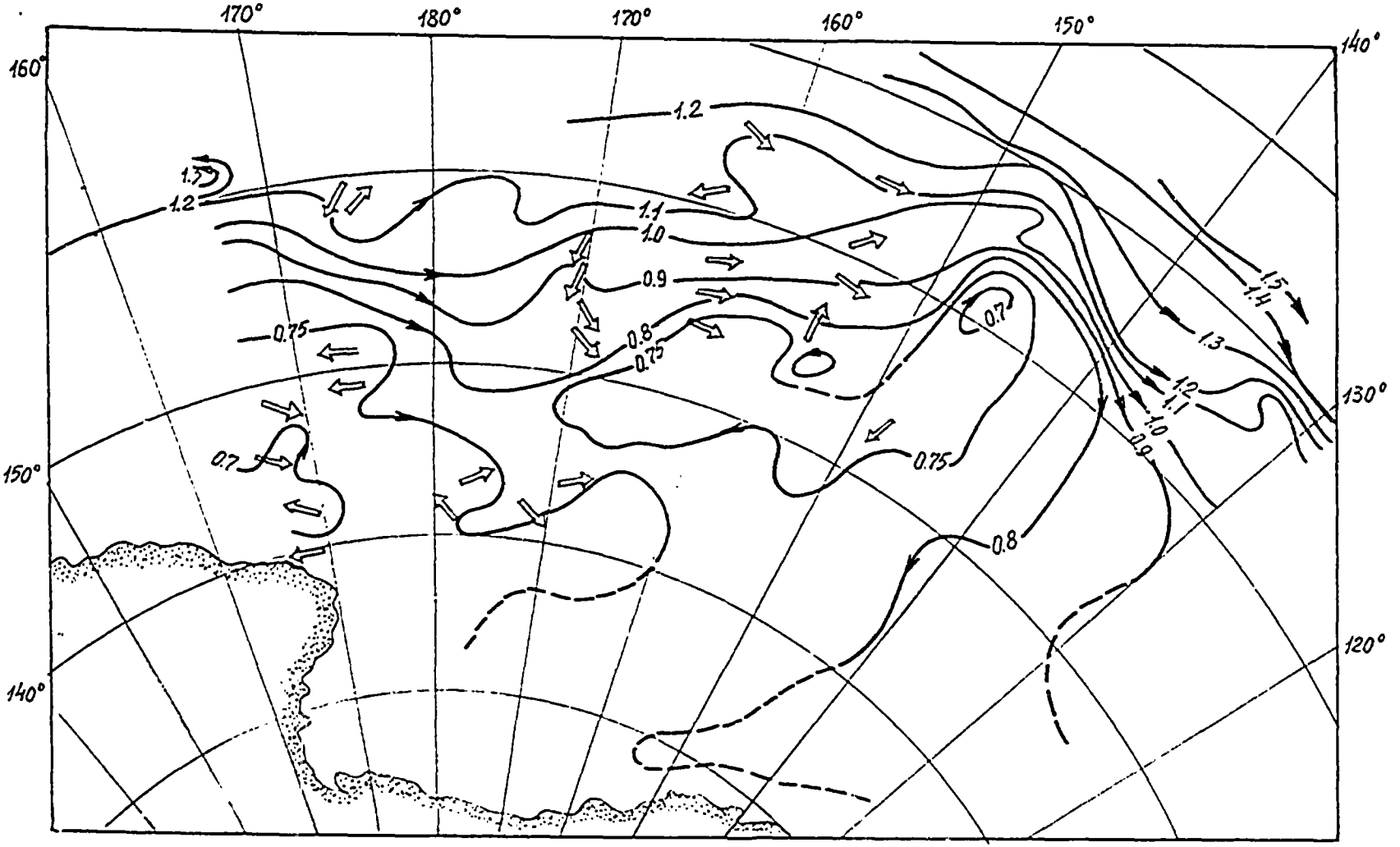


FIGURE 5. Dynamic topography 0/1000 dbar by the data of the "POLEX-South-86" expedition (December 1985 - February 1986).
I - direction of gradient currents determined by the drift of the ship.

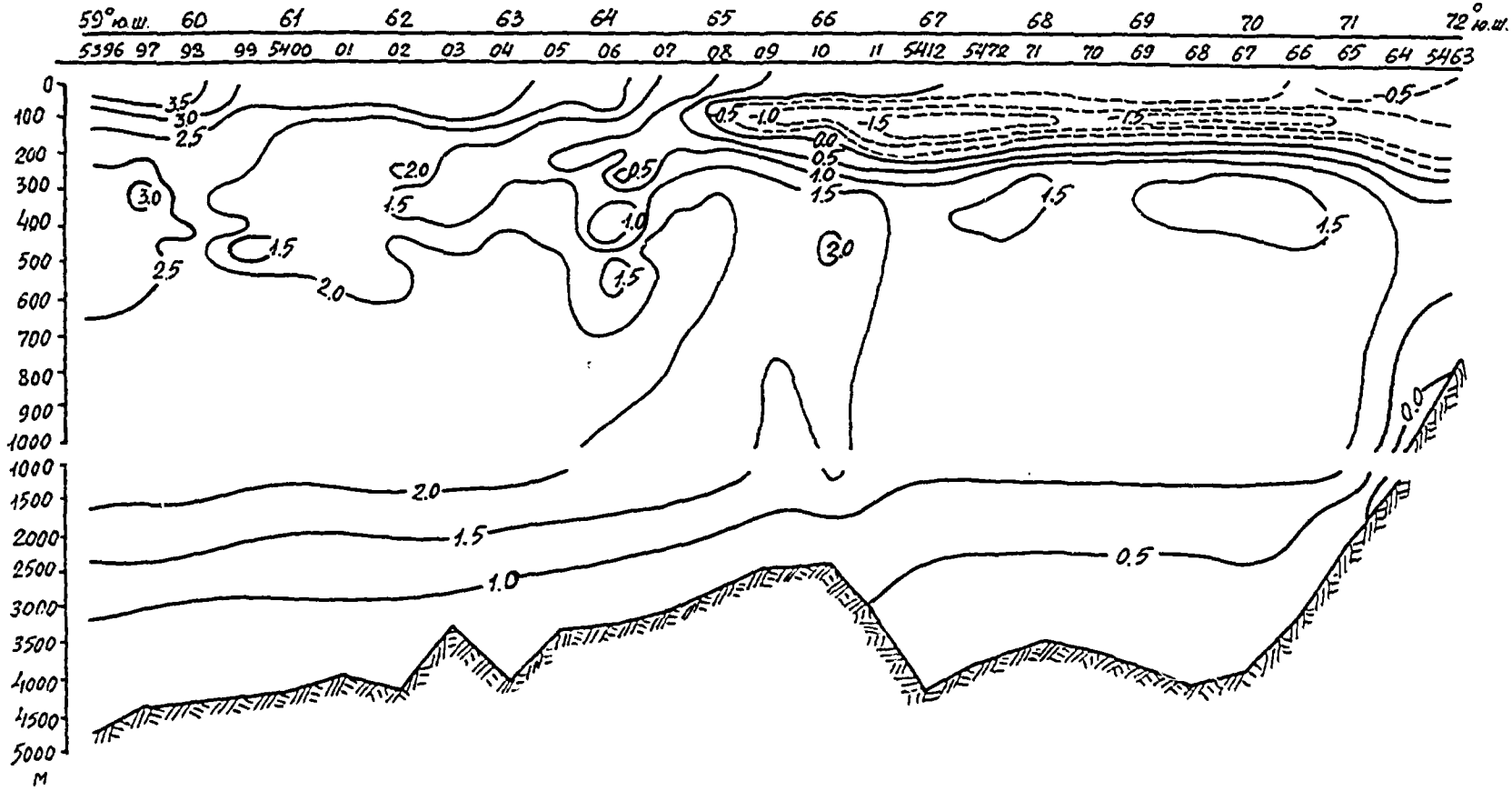


FIGURE 6. Water temperature distribution at the section along 177.5°W by the data of the R/V "Professor Viese" (February 1986).

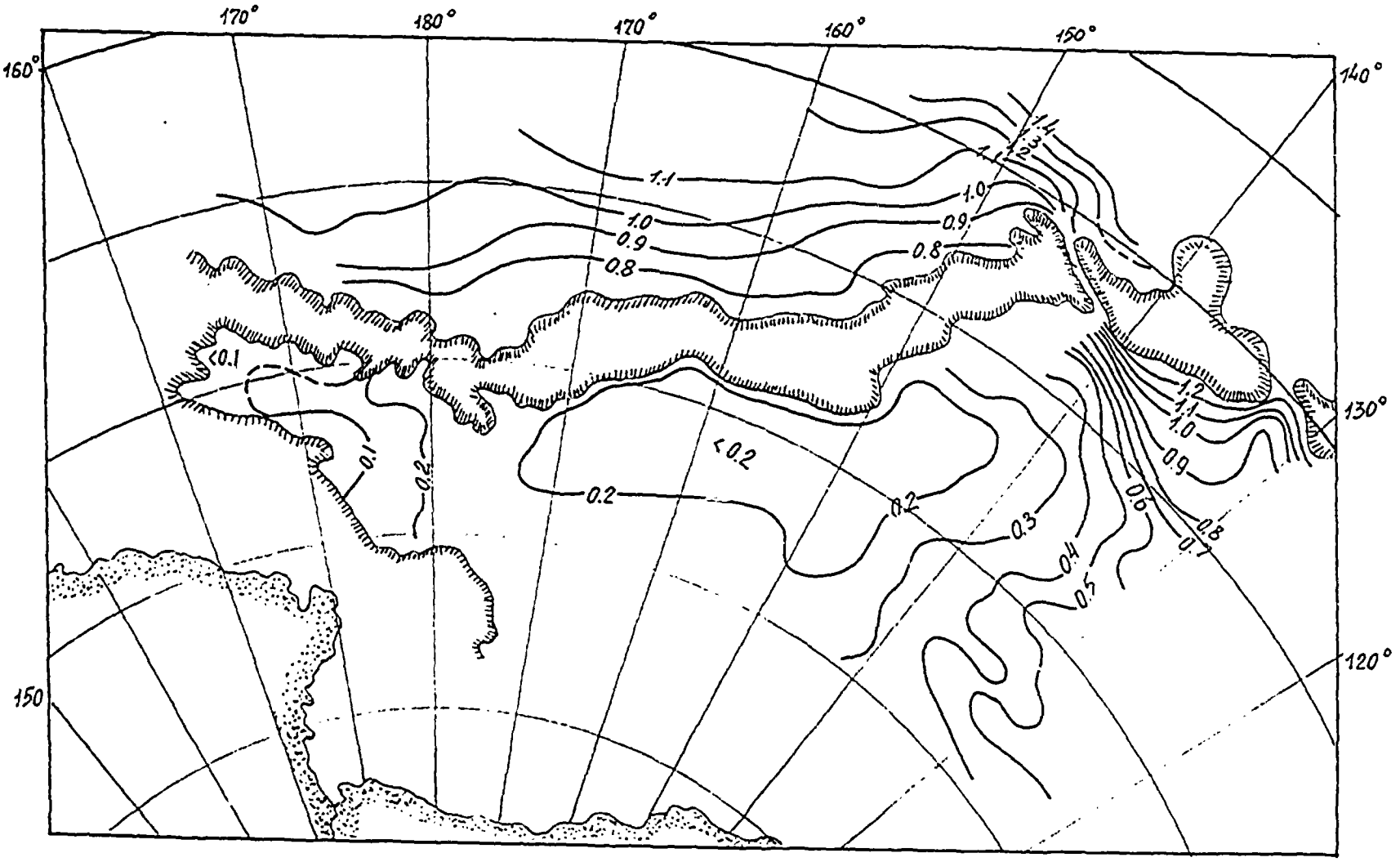


FIGURE 7. Water temperature distribution at 3000 m level by the data of the "POLEX-South-86" expedition (December 1985 - February 1986).

9.

SCIENTIFIC RESEARCH CONDUCTED IN THE SOUTHERN OCEAN SINCE 1983 BY THE UNITED KINGDOM

The British Antarctic Survey has continued its multidisciplinary programme of Antarctic research, much of which is relevant to the study of the Southern Ocean.

There have been four more cruises in the Offshore Biological Programme (OBP); an independant National study of the Southern Ocean ecosystem with particular reference to krill, Euphausia superba, and its principle predators, which with associated land-based studies is making a major contribution to BIOMASS and CCAMLR.

OBP4, August-September 1983, investigated the winter distribution and abundance of krill around South Georgia, and provided the first indication of the very low concentrations that would be found in the Scotia Sea area during the 1983/84 austral summer. Proposed studies on krill diet, feeding behaviour and swarm microstructure had to be replaced by work on the ichthyoplankton over reputed South Georgian fish spawning grounds.

OBP5, January-March 1985, was centered on the Bransfield Strait and southern Drake Passage, and included the UK contribution to the Second International BIOMASS Experiment (SIBEX). There were additional studies on bird/krill-predator/prey interrelationships, in collaboration with the University of California, Irvine; the effect of a topographically-fixed, stationary eddy on the local distribution of phytoplankton and krill; the homogeneity and microstructure of krill swarms; krill net avoidance.

OBP6, December 1985-March 1986, was designed to investigate the apparent discrepancy between the numbers of krill detected in previous surveys around South Georgia, and estimates of predator (breeding birds and seals) demand. All the studies were carried out within a 100 nautical miles radius of Bird Island, covering open ocean, shelf break and shelf areas. During the first part of the cruise a detailed description of the physical environment was obtained from CTD and XBT profiles, and nutrient flux through the algal and bacterial components of the pelagic microbiota was investigated to determine the availability of food for krill. The second part of the cruise was an investigation of the abundance and distribution of krill within the foraging range of the parent predators, combined with further studies of bird/krill, seal/krill-predator/prey interrelationships, in collaboration with the University of California, Irvine. Concomitant studies were carried out on the diet and energetics of breeding birds and seals, at the Bird Island Research Station (see also below).

OBP7, January-February 1987, investigated the distribution, abundance and diet of ichthyoplankton, mesopelagic and benthic adult fish, and squid around South Georgia.

A comprehensive study of krill hydroacoustic target strength is planned for the 1987/88 season. It will be carried out in large experimental cages anchored within the sheltered confines of Stromness Harbour, South Georgia.

Future cruises will continue the investigation of microbial nutrient flux around South Georgia and within the Bransfield Strait, in collaboration with the Deacon Laboratory IOS, Plymouth Laboratory IMER and the University of East Anglia (OBP8 - 1987/88), krill feeding and swarming behaviour (OBP9 - 1989/90), fish and squid biology (OBP10 - 1990/91, OBP12-1992/93) and predator/prey interactions (OBP11 - 1991/92). In 1993/94 it is hoped to mount a two-ship research project within the UK GOFS programme-Biogeochemical Ocean Flux Study (BOFS) - in collaboration with the Deacon Laboratory IOS (OBP13). Projects during OBP14 (1994/95) will be designed to provide sea-truth data for the Columbus Programme.

During all the cruises the structure and position of the Subantarctic Front, Polar Frontal Zone, Polar Frontal Zone, Polar Front and Weddell-Scotia Confluence have been studied by XBT profiles (and occasional CTD profiles) along standard transects, based on the usual cruise tracks of the vessel on passage between South American ports, the Falkland Islands, Bransfield Strait, South Georgia and the South Orkney Islands; a ship-of-opportunity project as recommended by SCAR WG 74. Profiles were obtained at 10 km intervals while passing over the actual fronts. This project will be continued with, it is hoped, the enhancement of an undulating profiler. The BAS intention is to use the data with Advanced Very High Resolution Radiometer (AVHRR) Sea Surface Temperature data from the NOAA satellite, and Meteorological Office pentad mean charts of 500 m atmospheric pressure, to develop a prognostic model for use during the biological research cruises. The physical data, which include CTD profiles obtained to describe the environment as an integral part of the biological investigations, are storred in the BAS OHP Database and the BIOMASS Database, and have also been sent to the Hydrographic Department, Taunton (XBT) and MIAS, Wormley.

A collaborative research project to develop and test a model of water circulation in the Atlantic Sector of the Southern Ocean with Southampton University, is planned for the austral summers 1987/88 onwards. BAS will provide sea-truth data on the density field of the Scotia Sea by working standard CTD stations, spaced 60 km apart, along one, and sometimes two, standard transects. At present it is planned that these transects should lie along the usual routes between South Georgia and the South Orkney Islands, and between the Falkland Islands and the South Orkney Islands or Elephant Island, to have a minimum demand on sea time.

BAS has recently agreed with USA National DataBuoy Centre to deploy up to six buoys each year for the next eight years, south of 20°S, as part of the TOGA programme. The buoys will be deployed so that they provide information on atmospheric forcing of water and ice movement in the Scotia and Weddell Seas.

BAS is exploring with the Proudman Laboratory IOS, the possibility of a collaborative venture within the GLOSS (Global Sea-Level Observing System) programme, starting in the 1988/89 season. BAS would assist in the installation of near-shore, pressure-sensor sea-level gauges at its bases on

Signy Island, South Orkney Islands, and Bird Island, South Georgia. When installed BAS would assume responsibility for maintaining and servicing the equipment, and the daily transmission of data to UK. A desirable extension of this project is the deployment of mid-ocean bottom pressure recorders and inverted echosounders in the Scotia Sea to investigate variations in the Antarctic Circumpolar Current; BAS again providing the facilities, the Proudman Laboratory the instrumentation.

Land-based biological studies on Bird Island (South Georgia) have centered on the energy flux from the Southern Ocean ecosystem to seabirds and seals, and on the annual variation in reproductive performance, population size and structure of many species, including several albatross, petrels and penguins, and the Elephant and Fur seals. An innovation was the charter of the private French yacht, Damien II, in October-December 1985 to carry out a census of Elephant Seals around South Georgia, and penguins on Willis Island (HMS Endurance assisted in the latter survey by providing helicopter support for aerial photography). Biochemical, physiological and ecological studies on zooplankton, including krill, and fish of commercial interest, have been carried out at the BAS Grytviken (until the Falklands conflict) and Signy (South Orkney Islands) Research Stations.

BAS studies on ice and climate are providing data of direct relevance to the objectives of WOCE in the Southern Ocean. The Antarctic Coastal Current and the Antarctic Circumpolar Current form a possible climate feedback mechanism influencing sea ice distribution and the main atmospheric circulation patterns which give rise to 3-5 y cycles in annual mean temperature along the Antarctic coasts. The extent of sea ice in any one sector is a direct function of atmospheric forcing which may be influenced by events elsewhere such as El Nino and the Southern Oscillation. On longer time scales (>100 y) the increase or decrease in discharge of land ice from the main continental ice sheets by ice shelf claving (icebergs) is a response to large scale climate variation. The phenomenon probably acts as a negative, i.e. stablilising, feedback mechanism - a warmer climate increased ice discharge rates which cool the ocean and reverses the warming trend.

The role of the Weddell Sea and the Antarctic Peninsula on the climate of Antarctica is an ongoing research project. One component is a study of the Atmospheric Boundary Layer at Halley Research Station (76°S, 27°W), and how it is influenced by continental and oceanic air masses. It is planned to broaden the investigation into a mesoscale study of the energetics and synoptic influence of broad scale katabatic outflow from the continent, and its interaction with the Weddell Sea air masses. As a corollary, one of the Winter Weddell Sea Projects (organized by the Alfred-Wegener-Institut fuer Polar- und Meeresforschung), in which BAS was involved in 1986, was a study of the baroclinic coastal zone of the eastern Weddell Sea as weather systems approached and developed.

During the same WWSP the movement of the main Weddell Sea Pack (ice) was monitored in relation to atmospheric forcing by tracking a BAS ice-strengthened buoy inserted at 76°S, 33°W, and comparing its movement with the synoptic pressure field. One of the TOGA buoys, mentioned above, will be deployed at the same initial position in January each year to establish the climate variability of pack ice motion over a period of eight

years. It is hoped that additional buoys can also be inserted nearby to elucidate pack ice deformation, behaviour of the thermocline, and to separate surface current from the deeper main (Weddell) Gyre current (see also SPRI studies below). BAS funded during the 1985/86 season a seven month ship-borne joint project with **Oxford University**, named Radiometric Observations of the Sea Surface and Atmosphere (ROSSA). It is involved deploying a highly sensitive, downward-looking radiometer forward of the bow of the BAS vessel whenever sea conditions allowed on passage from the UK to the Antarctic and back. The results are being compared with those obtained from US NOAA satellites passing overhead and also with direct thermometric measurements. To ensure that correct atmospheric parameterisation could be applied to the satellite radiometer data, the troposphere temperature and humidity profiles were obtained using radio-sondes which were released at times to coincide with satellite overpasses. An improved instrument is proposed by Oxford University and it is hoped that repeat experiments will be carried out in 1988/89 and 1990/91 (to coincide with ERS1).

Investigation of the nourishment, decay and discharge of the Filchner and Ronne Ice Shelves at the head of the Weddell Sea has continued. Ocean Current outflow at the base of the ice shelves is also being investigated. The climate variation of temperature and precipitation on time scales greater than 25 y is an important aspect of the ice core studies being carried out.

More geophysical research cruises have been undertaken to continue the study of Scotia Island Arc evolution. During January-April 1985 work was carried out on the Antarctic Peninsula margin near Anvers Island, in the northern Weddell Sea and off the southern South Sandwich Islands. A two-ship operation in February-March 1987 was designed to further the study of the influence of Weddell Sea Bottom Water (WSBW) on sedimentation in the northern Weddell Sea, so as to examine glacial/interglacial fluctuations in WSBW production. Moored current meter and transmissometer arrays have been deployed, one with a sediment trap, initially for one year.

Scientists from the **Deacon Laboratory IOS**, carried out SeaSoar, Acoustic Doppler Profiler and CTD sections across the Subtropical, Subantarctic and Polar Fronts in the southwest Indian and Southern Oceans during December 1986 and January 1987. The work was designed to document the incidence and nature of frontal structures in this area of the Southern Ocean; to document downstream (zonal) variations in the structure of the Antarctic Circumpolar Current and to estimate its transport in this region; to observe spatial variations in the T/S properties of mode waters and compare the observations with theories of mode water information; to explore the potential of the SeaSoar and Acoustic Doppler Profiler for

quantifying the scales and meridional transport of mesoscale eddies in the Subantarctic Zone. Aspects of micro-, nano- and pico-plankton were also investigated and related to changes in the physical characteristics over a large latitude change, and with high resolution at the Fronts.

The **Scott Polar Research Institute, Cambridge University**, also participated in the Winter Weddell Sea Project (WWSP), June-September 1986, and carried out four research projects.

The winter ice thickness distribution between the ice edge and the Antarctic coast in the region 10°W to 10°E was measured using helicopter-borne impulse radar and by direct drilling. Concurrent aerial photography was used to estimate the areas occupied by distint ice types and thus allow the direct measurements to be generalized to area-averaged ice thickness distribution. Directional wave spectra were measured near the ice edge using an IOS directional wave buoy, and in the ice interior using a heave-tilt sensor and strainmeter arrays. The data are being analyzed to determine the attenuation, scattering and reflection of the waves by the ice, and the effect of the waves in causing ice breakup. The evolution of Antarctic first-year ice was observed visually and an hourly log was maintained throughout the cruise. Iceberg distribution was investigated by measuring numbers and sizes from the Subantarctic Front to the Antarctic coast using the ship's radar. The data shed light on iceberg deterioration rates in the open ocean and iceberg fluxes in the Antarctic Coastal Current. Antarctic fast ice microphysics have been studied from February to November 1986 at Scott Base, Ross Sea. Measurements were made of growth rate, structure, thermodynamics and underlying water structure. Two Argos buoys, equipped with temperature and wind sensors, were placed on multiyear flows from a BAS ship in the south and nortwest Weddell Sea in February and April 1986, respectively. Their subsequent motion has been tracked, analyzed and compared with theoretical predictions and with the motion of FRG buoys deployed during WWSP. The Bratchie model of ice dynamics-thermodynamics is currently being applied to the Weddell Sea and compared with the ARGOS buoy data.

A Fine Resolution Antarctic Model (FRAM) of water circulation in the Southern Ocean, with eddy resolving capabilities, is being developed by a consortium of UK groups to run on the UK Research Councils' Cray computer. The Robert Hooke Institute, Oxford is providing the supporting core team. This project is one element of a UK contribution to the World Ocean Circulation Experiment (WOCE) of the World Climate Research Programme. Plans are being formulated with the UK Marine research community for a major field contribution, also. The International Planning Office for WOCE is located at the Deacon Laboratory, IOS.

10.

COMMISSION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES (CCAMLR)

CCAMLR RESEARCH ACTIVITIES, 1986-1987

The principle objective of the CCAMLR Convention is the conservation of Antarctic marine living resources and to this end all harvesting and associated activities in the Convention Area should be conducted in accordance with the principles of conservation formulated in Article 2 of the Convention.

The proper implementation of the conservation principles depends on the availability of reliable assessments of the status of each individual stock and its interaction with other components of the Antarctic ecosystem. This is the ultimate goal of the Long-Term Programme of Work of the CCAMLR Scientific Committee. The following specific elements of the programme are currently being undertaken.

The CCAMLR Ecosystem Monitoring Programme is a long-term programme to detect and record changes in critical components of the Antarctic ecosystem as a basis for the sound management of its marine living resources. The purpose is divided into monitoring of parameters of selected indicator species and monitoring of harvested species.

The programme has been developed over the last two years by a specifically established Working Group on Ecosystem Monitoring. Three areas have been identified for monitoring predator-prey interactions in the Southern Ocean system: Prydz Bay, Antarctic Peninsula and South Georgia areas.

In the coming season (1986/87), thirteen CCAMLR Mmembers will be involved in work on various aspects of the Ecosystem Monitoring Programme as part of existing national research activities. Tasks of immediate importance are to standardize data collection, handling and analysis so as to facilitate the integration of the results of this work, and to examine developments in technology for remote-sensing. These tasks will be pursued by the Working Group at a meeting in mid 1987.

Fish Stock Assessment Surveys are planned by seven countries in 1986/87 in support of the CCAMLR management objectives. Joint operations will be conducted in the Kerguelen area by France and the USSR. In the South Georgia area, three fish stock assessment surveys will be conducted: one by Spain, another in a joint effort by Poland and the USA, and a thrid by the German Democratic Republic. In the South Orkney Islands area, the USSR and Spain will each conduct a survey. A survey will be conducted by Spain in both the South Shetland Islands area and the South Sandwich Islands area. Australia will survey fish stocks in the Prydz Bay area. .

The surveys will concentrate on stock distribution and abundance, recruitment, and mesh selectivity experiments. It is expected that the results of this research will considerably improve the CCAMLR data-base for fish stock assessment.

Reliable assessment of the status of krill stocks in various parts of the Southern Ocean is vital for conservation of the marine living resources in Antarctica. In 1985, the Scientific Committee decided to undertake a special Theoretical Study to evaluate the possibility of using catch per unit effort data (CPUE) from the krill fishery as an index of krill abundance. The study involves the analysis of all aspects of krill fisheries. A combined mathematical model will be developed to explore the relationships between various measures of CPUE with changes in simulated krill abundance.

Another objective of the Study will involve determination of the extent to which the CPUE of individual vessels and fleets can be used as an index of krill abundance over large scale areas of the Southern Ocean. This aspect of the Study will require data from independent research vessel surveys for comparison with results obtained from the analysis of data from the commercial fishery. A special joint CCAMLR/BIOMASS Workshop under the convenorship of Dr. I. Everson (U.K.) has been tentatively planned for 1988 to compare data obtained during BIOMASS surveys with that from commercial fishing. The study is due to be completed before the 1988 meeting of CCAMLR.

A Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill, jointly organized by CCAMLR and the Intergovernmental Oceanographic Commission (IOC) in co-operation with SCAR and SCOR, was held at Unesco Headquarters in Paris from 2-6 June 1987.

The topics which were discussed at the Seminar included the structure and processes in the Antarctic Ocean circulation system and its variability, and the influence of Antarctic Ocean variability on primary production, zooplankton and other organisms. Special attention will be given to the distribution and abundance of krill and krill predators in relation to oceanographic conditions and their changes.

The following CCAMLR meetings are scheduled for 1987:

2-6 June	:	CCAMLR/IOC Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill, Unesco Headquarters, Paris
10-16 June	:	Working Group for the CCAMLR Ecosystem Monitoring Programme, Paris
Tentatively scheduled for Hobart, 19-22 October	:	Ad Hoc Working Group on Fish Stock Assessment
26 October - 6 November	:	CCAMLR-VI SC-CAMLR-VI

11.

INTERNATIONAL WHALING COMMISSION (IWC)

REPORTS ON SCIENTIFIC RESEARCH
(Extracts from the Commission's Annual Reports for 1983-1987)

1983

The series of minke whale marking and sighting cruises carried out in Antarctic Area IV in 1978/79, Area III in 1979/80, Area V in 1980/81 and Area II in 1981/1982 was continued by a fifth cruise in Area I from 30 December 1982 to 26 February 1983. This activity is a major item under the International Decade of Cetacean Research, and was supported by the IWC Research Fund, the provision of two vessels from Japan and one from the USSR, and participating scientists from Argentina, Australia, Japan, New Zealand, the USSR and the USA. A total of 241 minke whales was marked. One Japanese vessel also conducted a whale sighting and marking programme off the coast of Peru prior to the Antarctic activity.

SOUTHERN HEMISPHERE

AREA	LONGITUDES
I	120°W- 60°W
II	60°W- 0°
III	0° - 70°E
IV	70°E-130°E
V	130°E-170°W
VI	170°W-120°W

1984

Because of the financial constraints within the Commission, only one research project was supported this year - the 6th Antarctic Minke Whale Assessment Cruise and related data analses. The cruise took place in Area VI, completing a circumpolar survey of whales begun in 1978. Three Japanese and one Soviet vessels took part from 29 December 1983 to 1 March 1984, with scientists from Argentina, Chile, Japan, New Zealand, USSR, UK and USA. A total of 2,925 minke whales were sighted and 133 marked.

1985

Because of continuing financial constraints within the Commission this year, only one research project was supported - the 7th Antarctic Minke Whale Sightings Cruise and the related data analyses. This cruise put particular emphasis on experiments designed to validate the sightings techniques developed in earlier cruises. Three Japanese and one Soviet vessels were engaged from 21 December 1984 to 1 March 1985, carrying scientists from Argentina, Chile, Japan, New Zealand, USSR, UK and USA. A total of 4,158 minke whales was sighted.

1986

Because of increasing financial restrictions within the Commission, only two research projects were supported this year - the 8th Antarctic Minke Whale Sightings Cruise in Area V (including the Ross Sea), and the related data analyses. Three Japanese and one Soviet vessels were engaged from 18 December 1985 to 24 February 1986, carrying scientists from Argentina, Japan, USSR, UK and USA. A total of 5,057 minke whales was sighted.

1986-1987

In 1986/87 the 9th Antarctic Minke Whale Sighting Cruise is taking place in Area II from 23 December 1986 to about 20 February 1987. Three Japanese and one Soviet vessels are taking part carrying thirteen scientists from six nations.

12.

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH (SCOR)

This report will be brief since SCOR belives it has already provided considerable input to the Regional Committee in the form of the Final Report of SCOR WG 74, "General Circulation of the Southern Ocean: Status and Recommendations for Research". This report was published by WMO as Number 108 of the WCRP Report Series in mid-1986. It identifies questions which remain to be resolved in the field of Southern Ocean physical oceanography and makes recommendations for their elucidation.

During the period since the establishment of WG 74 in 1982, the contents of this report have been presented directly, or indirectly to the IOC/SOC group on two occasions. A preliminary outline for this report with substantial information on the major questions it would address and some related recommendations, was presented to the last meeting of what was then known as PG/SOC, more than four years ago. A review of the report of that meeting shows that the information received from SCOR WG 74 was sufficiently well developed, even at this early stage, that the Programme Group took into account in formulating many of its recommendations. The report of the Fourth Session of PG/SOC was subsequently accepted by the Seventeenth Session of the IOC Executive Council although there is little evidence of the Programme Group's recommendations or proposals having been implemented.

In 1984 SCOR WG 74 participated in a Meeting of Experts on Oceanography Related to the Dynamics of the Antarctic Ecosystem which was organized by the IOC PG/SOC in Kiel. By this time the WG 74 report had been fully developed and was presented by Dr. Nowlin. On this occasion WG 74 members also provided considerable input to BIOMASS planners with regard to the incorporation of physical and chemical oceanographic investigations in the second field phase of SIBEX. SCOR continues to co-operate with SCAR in ensuring that physical and chemical oceanographers participate in the ongoing series of BIOMASS data analysis workshops.

In summary, SCOR wishes the final report of WG 74 to stand alone as its report to the Regional Committee. It hopes that the many scientific recommendations contained therein will be considered in detail by the Committee. It should be noted that WG 74 was formally disbanded by the SCOR General Meeting in late 1986, having discharged its terms of reference in a most exemplary manner.

The Committee should, of course, take into account another important regional scientific activity in which SCOR has a substantial interest. This is the Southern Ocean Core Project which is being planned unter the umbrella of the World Ocean Circulation Experiment (WOCE Core Project 2). SCOR, of course, is also involved in this activity through its cosponsorhip of CCCO. Many of the recommendations of WG 74 have already been addressed by the Scientific Steering Group for WOCE in planning Core Project 2, and the report of the group will be considered again by CCCO at its Eighth Session in May 1987. This matter may be discussed in some detail under Agenda Item 5.1 by Dr. J. Crease who will attend the Regional Committee meeting as a representative of both the WOCE SSG and SCOR. Dr. Crease is familiar with the contents of the WG 74 report, especially in the context of its use by the WOCE Core 2 Project planners.

Reference was made above to the involvement of SCOR in BIOMASS activities. SCAR has traditionally taken the lead in these and the representative of SCAR will no doubt be prepared to discuss this matter under Agenda Item 5.2. SCAR and SCOR continue to co-operate in the field of antarctic marine studies and SCOR cosponsors two SCAR Groups of Specialists on Antarctic Sea Ice and on Southern Ocean Ecology. Finally, the Regional Committee may wish to note that SCOR has recently established a new working group, WG 86, on the Ecology of Sea Ice which will bring together specialists in this subject working on both Arctic and Antarctic ice. This group will be cosponsored by SCAR and has the following terms of reference:

(i) to review the presente knowledge on sea ice biology in Arctic and Antarctic regions and relate it to the physical and chemical properties of the various types of sea ice;

(ii) to review methods of sampling, in-situ observations, as well as experiments in the field and in the laboratory, with the aim to compare various ways and means of estimating abundance, respiration, production, and trophic relationships in ice communities;

(iii) to explore the desirability and feasibility of co-operative multidisciplinary studies;

(iv) to plan a workshop on biological sea ice studies.

13.

WORLD METEOROLOGICAL ORGANIZATION (WMO)

WMO ACTIVITY IN THE ANTARCTIC

WMO activities in the Antarctic are directed primarily to the implementation of World Weather Watch components (Global Observing System, Global Data-Processing System and Global Telecommunication System), but are related also to the Joint WMO/IOC IGOSS programme and the WMO/ICSU World Climate Research Programme. The main task of WMO Executive Council Working Group on Antarctic Meteorology is to co-ordinate the meteorological programmes in the Antarctic. Noting that SCAR had dissolved its Working Group on Meteorology in June 1986, Tenth Congress which has just met agreed that the work of EC Working Group on Antarctic Meteorology should be continued and expanded, as appropriate, to include all relevant studies covered by the former SCAR Working Group.

At its fourth session held in Geneva in September 1986, the EC Working Group on Antarctic Meteorology reviewed the Antarctic activities relating to the WWW and other WMO programmes. The Working Group noted that the observing system in the Antarctic as part of the GOS comprised:

- the surface-based subsystem, the main elements of which comprised 35 surface land stations of the regional basic synoptic network, including 18 upper-air stations, as well as mobile ships and aircraft stations;

- the space-based subsystem, consisting of the four polar-orbiting satellites and five geostationary satellites and the associated ground receiving stations for the reception and processing of data.

The level of implementation of the basic synoptic network is 82% for surface stations and 60% for upper-air stations. According to annual monitoring carried out over a 15-day period in October, the number of ship reports received from the region in WMC Washington has risen from 122 in 1984 to 431 in 1985.

Taking into account the importance of meteorological data in the Antarctic, the working group drew a draft resolution, later endorsed by the thirty-ninth session of the Executive Council (June 1987), which urges Members to ensure that:

(i) all supply vessels operating in the Antarctic make regular synoptic observations at the main synoptic hours and transmit these data to appropriate radio or coastal ground stations;

(ii) supply vessels, whenever practicable, also make upper-air observations and transmit these reports on a real-time basis;

(iii) aircraft operating south of 60°S make observations as a matter of routine and transmit them to the appropriate radio stations or satellites for further distribution in AIREP or ASDAR form.

The Working Group also noted that considerable work had been done to develop new components of the GOS which would contribute significantly to an improved and enhanced observing system. These included the Automated Shipboard Aerological Programme (ASAP), the Aircraft to Satellite Data Relay (ASDAR) and drifting buoys. Recognizing that many Members participate in these activities, the working group and the Executive Council urged Members, particularly those party to the Antarctic Treaty, individually and collectively to participate in the deployment and use of new observing systems in the Antarctic and to provide additional surface observations in the Antarctic using the Voluntary Observing Ship Scheme, automatic land weather stations, buoys and suitable fixed platform and arrange where possible for the transmission of these observations on the GTS.

In this connexion, Tenth Congress noted that continuing developments in marine telecommunication facilities, particularly those which are satellite-based, are capable of providing great potential benefit to Members in the collection of marine environmental data from ships and in the dissemination of marine meteorological information to shipping. In particular, it noted that the INMARSAT maritime satellite communications' system was already having a substantial impact on the collection of ships' weather reports. In noting with satisfaction the actions already under way on the future use of the INMARSAT system for marine meteorological purposes, Congress nevertheless agreed with the concern of Members through the further expansion in the use of the system. It, therefore, felt that CMM and CBS should remain the focal points within WMO for the development of new procedures and regulations concerning the use of this system and that major efforts should be made to develop appropriate cost-sharing mechanisms for the collection of ships' weather reports and BATHY/TESAC reports via INMARSAT.

As regards the IGOSS Programme, Congress noted with satisfaction that IGOSS had developed significantly in close co-ordination with the WWW and Marine Meteorology Programme. Congress also noted the importance which was being attached to IGOSS by the WCRP as the appropriate mechanism for the provision of the sub-surface thermal structure data which were essential to large-scale ocean monitoring and climate research. In expressing satisfaction that the numbers of BATHY/TESAC reports which were distributed over the GTS continued to grow, Congress nevertheless agreed that these numbers would have to increase substantially if IGOSS was to provide the quantities of data required by the maritime users of operational oceanographic services, as well as by the WCRP. Congress, therefore, urged all Members to take action whenever possible to assist in the expansion of the IGOSS observation system, and to ensure the further expansion of the IGOSS Data Processing and Services System (IDPSS), particularly through the establishment of IGOSS Specialized Oceanographic Centres (SOC). Congress also urged that every effort to be made to encourage the implementation of IGOSS in developing countries, including through experts' missions, demonstrations of the economic value of IGOSS and implementation co-ordination activities, as appropriate, as well as in countries already significantly involved in oceanographic activities.

WMO/ICSU World Climate Research Programme has two sub-programmes closely related to Southern Ocean studies. The first is the WCRP World Ocean Circulation Experiment (WOCE), and the second is the Cryosphere Research Sub-programme. Tenth Congress expressed its appreciation of the active role taken by CCCO in planning WOCE of the actions taken by IOC and SCOR to assist in mustering the oceanographic resources required to implement WOCE. Congress also noted that several major oceanographic satellite missions were being prepared for the intensive observing period of WOCE in the year 1990-1995 and expressed its confidence that the world oceanographic community will give its full scientific support to this undertaking and make available resources and ship time. At present WOCE divided into three core-projects. One is Core 2, "The Southern Ocean", for which the WOCE Scientific Steering Group has established a working group. This group is now developing the Implementation Plan for the Project with the active involvement of a representative of the WMO Secretariat.

In order to carry out the Cryosphere Research Sub-programme, the Working Group on Sea Ice and Climate was established. This working group at its second session (Seattle, USA, October 1986) reviewed major aspects of this problem and recommended the establishment of ocean and ice observing projects for both the Arctic and Antarctic regions. Both these projects would be aimed at monitoring sea ice extent and motion and oceanic forcing but with different emphasis. The Antarctic ocean and Ice Observing Project should be developed in co-operation with WOCE and the SCAR Antarctic Sea Ice Zone Project. The emphasis of the project is on the implementation of a network of buoys in the sea ice zone to measure atmospheric, oceanic and sea ice parameters. The Working Group on Antarctic Meteorology, at its fourth session (1986), also stressed the importance of deploying drifting buoys in the Antarctic sea ice zone and prepared an appropriate draft resoltuion which was endorsed by the Executive Council. In addition, the Working Group on Sea Ice and Climate recommended that field studies including ship-based measurements be undertaken in the winter time sea ice zone to provide detailed data for air-sea ice interaction studies and that a programme of studies of various processes in the Antarctic near-shore zone be organized.