

Preliminary Report of Oceanographic Observation
of the Japanese Antarctic Research
Expedition I, 1956-1957,
with the "SOYA"

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第1次日本南極観測隊における海洋観測予報

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要 旨

第1次日本南極観測隊は、海上保安庁巡視船“宗谷”(排水量4200トン, 4800馬力)によって1956年11月8日に東京を出港し, 1957年4月24日に帰国した。この間において, 南極大陸 Prince Harald 海岸の Ongul 島に観測基地“昭和”(39°35'24"E, 69°00'22"S)を建設した。“宗谷”は太平洋, 印度洋, 南氷洋の三大洋を航海し, この間には航走中の表面観測, 停船時の表面下の各層観測, 氷海域での海水観測を実施した。観測行動を大別して示すとつぎの如くである。

1956年11月8日(東京発)—11月23日(シンガポール着)

11月27日(シンガポール発)—12月19日(ケープタウン着): 表面観測(採水, 測温, ミクロプランクトン用採水)。採水は毎00時(G.M.T.)と12時。測温は3時間間隔。プランクトン用採水は毎12時。

12月29日(ケープタウン発)—1957年1月24日(現地着): 3時間間隔の採水, 採測。1月8日より現地着までは連続海水観測。各層観測3回。

1月25日—2月14日(現地停泊): 基地建設。

2月15日(現地発)—3月10日(ケープタウン着)

3月15日(ケープタウン発)—4月5日(シンガポール着)

4月13日(シンガポール発)—4月24日(東京着): 表面観測を実施。

表面観測の結果としてとくに南氷洋水域においては従来知られている亜熱帯収斂線, 南極収斂線が再確認された。南極表面水(水温0~2°C, CI 18.6~18.8%)は南極収斂線(約50°S附近)以南に見出された。流氷域においては, 低温・低鹹の表層水が発達していた。往航時の氷山初認位置は35°00'E, 53°55'S(1月4日)。復航時には24°27'E, 53°42'S(3月4日)であつた。今回氷山は南極収斂線以南にのみ見出されている(第1図)。1月8日より“宗谷”の羅針甲板上より, 地学関係隊員全員により連続海水観測を実施した。氷形は国際海水命名(World Meteorological Organization 制定)の術語により, あらかじめ作成した観測記録紙に1時間おきに海水状況の記入をおこなつた。同時に船の進路にそつた海水の見取図(視界約7哩)を連続作成した。Enderby Land 沖(53°E)における氷縁は距岸40哩にあり, 氷縁は南西につらなり, 34°E(Riiser-Larsen 半島沖合)附近では距岸40哩であつた。1月16日, 40°E附近より南下し, 多数の氷山および氷厚1~2mの海水(多くは氷丘をなしている)が散在し, その大きさは直径数mより数10m程度の氷盤よりなる密流水であつた。船はおおむね水路中を南下したが, 所により氷量9~10に達する水域もあつた。一般に氷上の積雪

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は少なく、吹溜りの部分で約 50 cm 程度であつた。観測水域である Prince Olav 海岸, Prince Harald 海岸沖合の流氷は、西ないし西南へ 0.2~0.3 ノットで漂流している模様であつた。1月24日宗谷の砕氷能力を越える氷厚約2mの定着氷に接岸した(39°09'E, 69°00'S)。定着氷上には多数の puddle (深さ 1m に達するものもある。多くは氷殻で覆われている。)が北東風によるスカヴラの低地帯に発達しており、基地への資材輸送に多大の困難を感じた。2月15日帰途についたが、

28日まで最密流氷に氷塞され、35°E, 68°S 附近まで漂流した。特に2月21日より漂流は激しく、速度は約 0.6 ノットに達した模様である。海水観測の結果は氷状図として示しておいた(第2図 A, B, C, D)。今回の観測においては、観測のため特に停船することなく、基地建設に主力を注いだので、十分な海洋観測をなし得なかつたが、未整理の資料も残つているので、これらの整理を終えてさらに最終的な報告を発表する予定である。

Introduction

The first mission to the Antarctic of the Japanese Antarctic Research Expedition was made with the "SOYA" (displacement tonnage of 4,200)—ice-strengthened patrol ship of the Maritime Safety Agency, Ministry of Transportation—between November 8, 1956 and April 24, 1957. This expedition was organized for the purpose of making observations in the Antarctic during the International Geophysical Year, 1957-1958. The first mission successfully accomplished the establishment of the Japanese wintering base "Syowa" at Ongul Island off the eastern part of Prins Olav Coast.

Oceanographic observations were previously planned for this cruise to the Antarctic. However, the present writer was the only person in charge of oceanographic observations, so the emphasis was laid on the work in the Antarctic Ocean. The programme originally planned did not envisage any hydrographic stations, but several stations were temporarily occupied when the ship stopped in the open water in pack ice. Surface observations were carried out from Tokyo to Cape Town via Singapore; the time intervals between observation were shortened in the cruise of the Antarctic Ocean. In the region between Enderby Land and Riiser-Larsen Peninsula the visual observation was made by the scientific personnel of the sections of Geography, Geology, Cartography, Seismology and Oceanography. The cooperation of Mr. M. YASUI, a member of the Meteorological Section, in the surface and serial observations is greatly appreciated. Gratitude is also due to the Hydrographic Department of the Maritime Safety Agency, Japan Meteorological Agency, University of Tokyo and Hokkaido University which provided the oceanographic instruments.

A brief description will be offered in the present article; as the arrangement of the records is still in progress, results of ice observations will mainly be described.

Outline of cruise and observation

The cruise of the "SOYA" in 1956-57 to the Antarctic will be divided into

several parts as follows:

November 8, 1956 Left Tokyo—November 23, 1956 Arrived Singapore;

November 27, 1956 Left Singapore—December 19 Arrived Cape Town; Surface observations were carried out during those periods.

December 29, 1956 Left Cape Town—January 24, 1957 Arrived Antarctic; Surface, serial and ice observations.

January 25, 1957—February 14 Morning at the ice; Surface and ice observation in the intervals of labour for the construction of the wintering base.

February 15, 1957 Left Antarctic—March 10 Arrived Cape Town;

March 15, 1957 Left Cape Town—April 5 Arrived Singapore;

April 13, 1957 Left Singapore—April 24 Arrived Tokyo; Surface observations.

Surface observation Items of observation included under this title were the measurement of surface temperature, the state of the sea (wave and swell) and the sampling of surface water which was subjected to the analysis of chemical elements and the examination of microplanktons. Observations at 3-hour intervals were carried out during those parts of the cruise except the sampling of water. The sampling of water was made in every 00-00 and 12-00 G. M. T. from Tokyo to Cape Town, but samplings were carried out at the standard synoptic hours in the Antarctic Ocean.

Serial observation Four hydrographic stations were occupied in the Lützow-Holm Bay of the Antarctic. Temperature observations were obtained at a number of depths, water samples were collected, hauls for phytoplankton and zooplankton were made, and bottom samples were taken. Bathythermograph was casted in each station to the depth of about 250 m. As no heavy hydrographic winch was installed on the ship, the depth of observation was limited to within 1500 m.

Sea ice observation Visual observation of sea ice, including ice of land origin, was made on the compass deck at a height of 11m. The observers were changed every three hours; the ice conditions were sketched and checked up on the prescribed recording forms with the aid of binoculars, optical range-finder and marine radar. An ice chart was compiled after each watch. During the period of southward penetration, a number of flights were made by seaplane and helicopters in order to find the appropriate leads and open waters. Printed copies of aerophotographs taken from the seaplane were not supplied before the preparation of this article, so the information of ice conditions obtained by aerophotographs was not taken into consideration in compilation of the present ice chart. Concerning the icebergs, measurement of location, height above sea level and length were made.

Results

Surface observation The arrangement of the obtained data, as mentioned

above, is not completed, so only the surface temperatures and chlorinities of the Antarctic Ocean from Cape Town to off Enderby Land will be shown in Fig. 1.

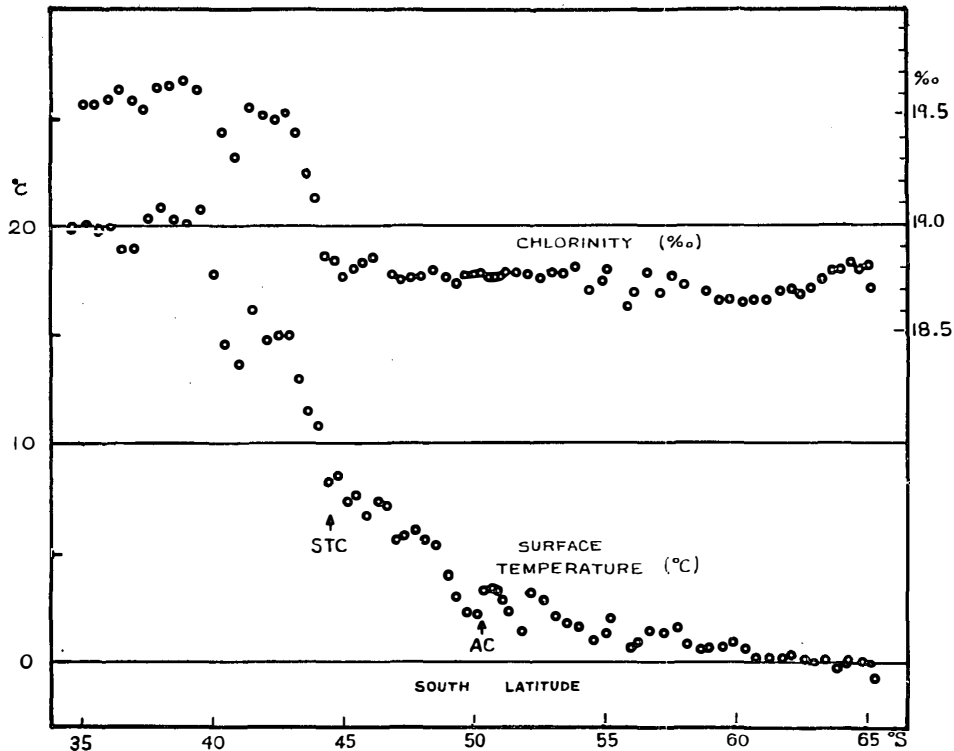


Fig. 1. The distribution of surface temperature and chlorinity from Cape Town to 65°S, 53°E, ice-edge off Enderby Land. December 1956-January 1957. (STC=Sub-Tropical Convergence. AC=Antarctic Convergence)

Two marked horizontal discontinuities will easily be recognized in the figure. Those lines or zones represent the sub-tropical convergence and the Antarctic convergence which has already been pointed out by earlier researchers (Deacon 1937, Mackintosh 1946 etc.). Their positions have not significant deviation from those noted by other research vessels. It will also be recognized that within the Antarctic convergence the Antarctic surface water characterized by its temperature of 0~2°C and chlorinity of 18.6~18.8‰ is always found. Surface temperatures in the pack ice region were quite near to the freezing point of surface water which corresponds to the chlorinity.

Sea ice observation Ice conditions in the Antarctic Ocean have been investigated by many authors, Mackintosh and Herdman (1940) compiled charts of the mean extent of pack ice in every month based on the data of the Discovery Committee's ships, factory ships and others. Of course, the ice edge each year changes within a wide range which often reaches 100 nautical miles. So the addition of new records on the geographical feature of ice might still have important meaning in the southern ocean hydrography. During the present mission the geographical features of ice were mainly observed.

In order to make records of ice condition, ice terms established by the World Meteorological Organization (WMO) were adopted in the present observation.

Two recording forms were prescribed, the one is rather in detailed form and similar to the suggested codes by Armstrong (1955), the other is the WMO code for the use of ships. The WMO code is easily abstracted from the former recording form; the ice conditions expressed in the WMO code were sent at three-hour intervals to the Weather Bureau of Pretoria, Union of South Africa. The hourly ice conditions were checked up on the form and sketches were made following the ship's track.

On January 4, 1957, an iceberg was first sighted at $53^{\circ} 55'S$, $35^{\circ} 00'E$ and the ship reached the ice edge off Enderby Land on January 7. Routine observation began on the next day and continued until January 24. At first "SOYA" navigated westward along the ice edge to about $33^{\circ}E$ and then retired eastward to $40^{\circ}E$ on January 16. Southward penetration into the pack ice was not stopped until January 24 when the ship had to moor at the edge of fast ice with a thickness of 2 m. This southernmost position was $69^{\circ} 00'S$, $39^{\circ} 09'E$ where the unloading and transportation of facilities and equipment to the wintering base were continued during three weeks. On February 15, the ship started the return voyage, but shortly became icebound in the very closely packed ice and drifted westward to about $35^{\circ}E$ until February 28. The results of observation during those periods are shown in Fig. 2 (A, B, C, D).

The ice chart shows the ship's position, ice edge, ice concentration, ice type, surface features, water openings, iceberg and so forth. It cannot be helped that the coverage of observation is very limited within a narrow range due to the observations having been made only from on board the ship. The visual range from the compass deck was about 7 miles. Of course, the conditions far beyond this range were observed with aid of the marine radar.

Attention must be paid to the fact that the ice chart is constructed upon the basis of sequential observation, so that the line of ice edge essentially does not represent the line at any given time. It is the same with respect to the general ice conditions. The ice conditions are always continually changing due to such factors as wind, wave, current and solar radiation.

According to the observations made by the accompanying ship "UMITAKA-MARU" of the Tokyo Fisheries College, the average speed of ocean currents in the outer region of the ice edge was about 0.2~0.3 knots and direction was west or west-southwest. Taking these current conditions into consideration, it must be noted that the whole pattern was moving from east to west or southwest.

In describing the ice conditions the observers felt no inconvenience in using the WMO terminology so far as the present mission is concerned. It must be said that fine days without clouds were very few during the expedition, so that the accurate determination of ship's position by astro-fixing was very difficult. There must exist some errors in the records of the ship's position in the ice chart.

The ice conditions will be summarized as follows:

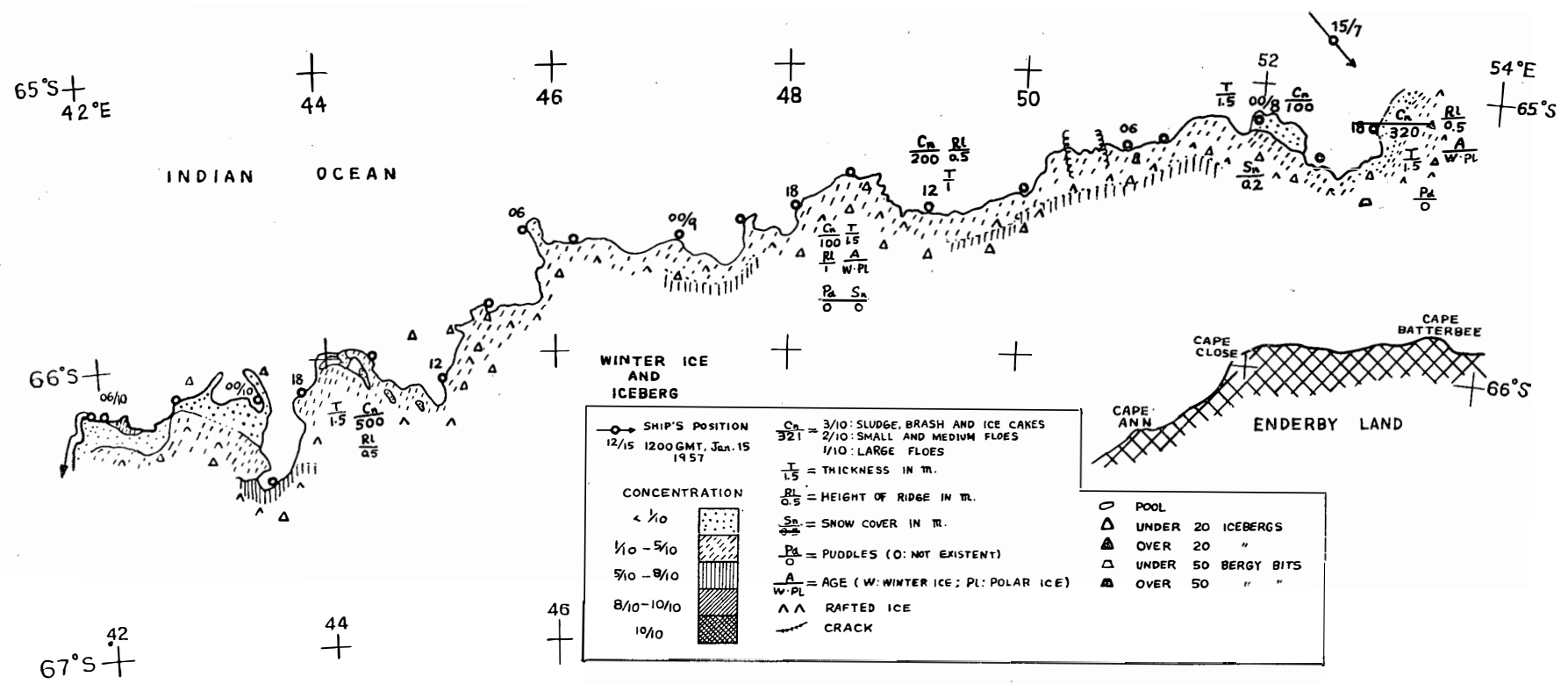


Fig. 2. (A) Ice chart. From January 7 to January 10, 1957.

only the geographical features of sea ice, but also the physical and chemical properties of sea ice. At the present expedition synoptic observation was emphasized; during the next expedition and wintering at the base, it is fully expected that more detailed observation will be carried out on the sea ice and land ice.

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