PRELIMINARY REPORT OF THE OCEANOGRAPHIC OBSERVATION IN THE 22ND JAPANESE ANTARCTIC RESEARCH EXPEDITION (1980–1981)

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Abstract: This report presents the preliminary results of the oceanographic observations, which were carried out in the 22nd Japanese Antarctic Research Expedition in 1980–1981. The oceanographic sections across the Antarctic Sea are given for the two legs, southbound and northbound. For the southbound leg, the observation results for the surface layer are shown. For the northbound leg, the results of serial observation are presented along with the analysis of the geostrophic volume transports. The results of continuous measurements at two fixed stations near Syowa Station are also given in this report.

1. Preface

For summer programmes of the Japanese Antarctic Research Expedition (JARE), oceanographic observations have been routinely carried out by the Hydrographic Department since JARE-7 in 1965–1966. During JARE-22 in 1980–1981, relatively dense observations were made in the area south of 20°S along the route of the icebreaker FUJI. The results of the observations are preliminarily given in this report, though the detailed analysis of the data will be given later.

2. Observation

Oceanographic observations to the south of 20°S, shown in Fig. 1 were carried out in three stages.

(1) During the southbound leg from Fremantle to Syowa Station in December 1980–January 1981, with XBT (33 measurements), GEK (22), and surface water sampling (43).

(2) At two fixed Stations A and B in fast-ice sea which are located near Syowa Station. At Stn. A (68°47′.7S, 38°49′.5E; 272 m depth), temperature down to the 250 m depth was measured hourly for 31 hours on January 8–9, 1981. On the otherh and, at Stn. B (69°02′.2S, 39°20′.1E; 221 m depth), thet emperature down to near bottom, salinity and dissolved oxygen content at three layers (5, 20 and 50 m depths) were measured every two hours for 24 hours on January 31–February 1.

(3) During the northbound leg to Mauritius on February 9–March 9, Nansen-cast (14), XBT (27), GEK (26) and surface water sampling (27) were made. For the stations south of 60°S Nansen-cast observations were taken in mesh with 2.5° (latitude) by 5° (longitude). Surface water sampled in the legs (1) and (3) was used for

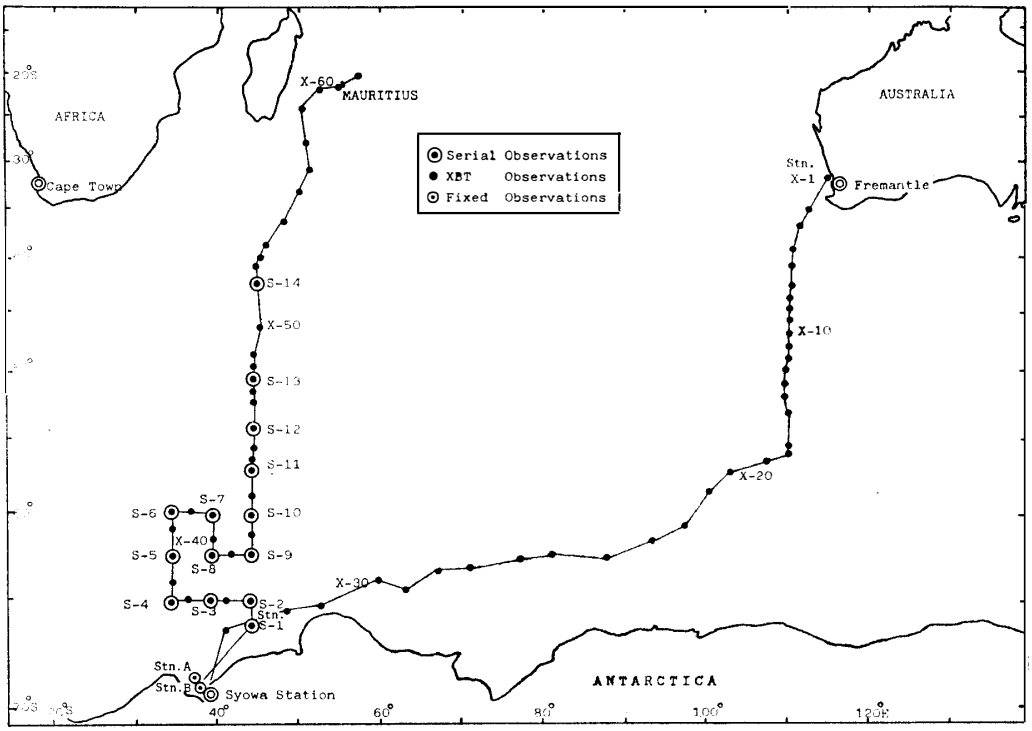

Fig. 1. Location of station along the route of the icebreaker FUJI.

the measurements of temperature, salinity, dissolved oxygen content, pH and nutrient matters.

3. Results

3.1. The route of the icebreaker FUJI

In the sections at 110°E (southbound leg) and at 45°E (northbound leg), a few frontal structures in the vertical profiles and/or latitudinal surface distributions of several elements are found as shown in Figs. 2a–2e. These fronts correspond to STC (Subtropical Convergence), ASF (Australasian Subantarctic Front) and AC (Antarctic Convergence), respectively (SVERDRUP *et al.*, 1946; DEACON, 1937, 1963; GORDON, 1972). STC and AC at 110°E and (45°E) are located on about 38°20′S (41°S) and 54°S (51°30′S), respectively. ASF, being the clearest in the temperature profile, is found at about 45°40′S in the 110°E section.

Geostrophic volume transport referred to 2500 db (decibar) surface, is calculated using the data taken by Nansen-cast (Fig. 3). The maximum value of 34 sv (1 sv= 10^6 m^3/s) is obtained between the Stns. 12 and 13, which are located on both sides of AC. When the reference level is lowered down to 3000 db surface, the above transport value increases by 10 sv up to 44 sv (an increase of 30%). This fact indicates that the baroclinic structure in this region is kept at least until the 3000 m depth (Fig. 4). Between 60°S and 65°S, eastward transports across the sections at 35°E, 40°E and 45°E are 7.5 sv, 5.8 sv and 11.2 sv, respectively. The range of fluctuation seems to be fairly large while the whole transport is relatively small.

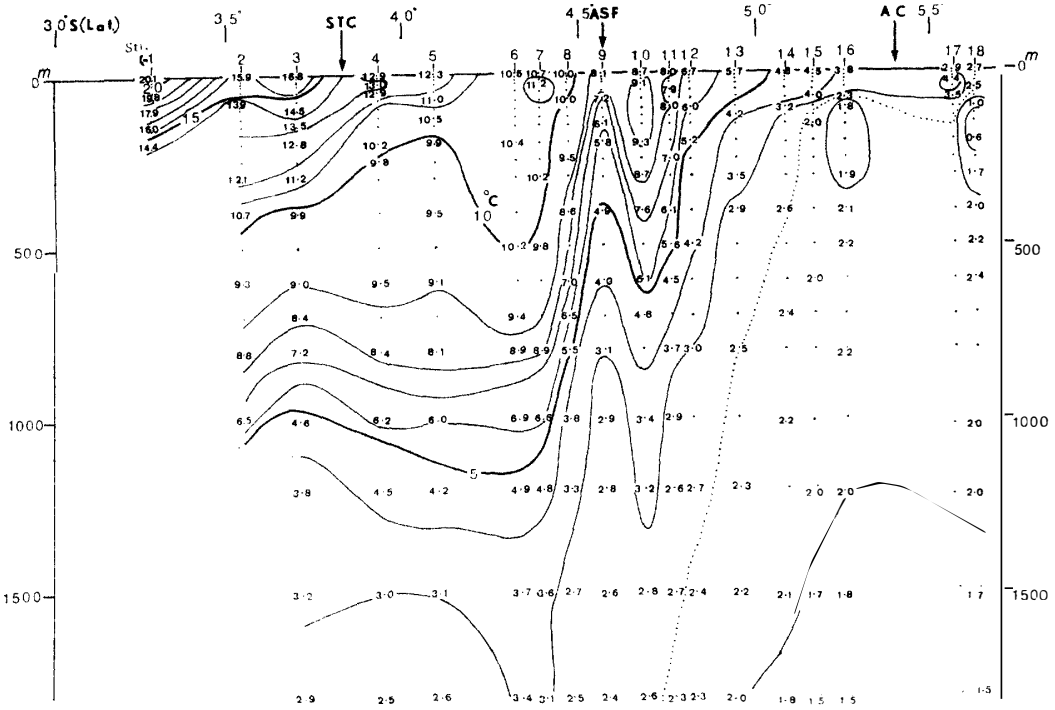

Fig. 2a. From X-1 to X-18.

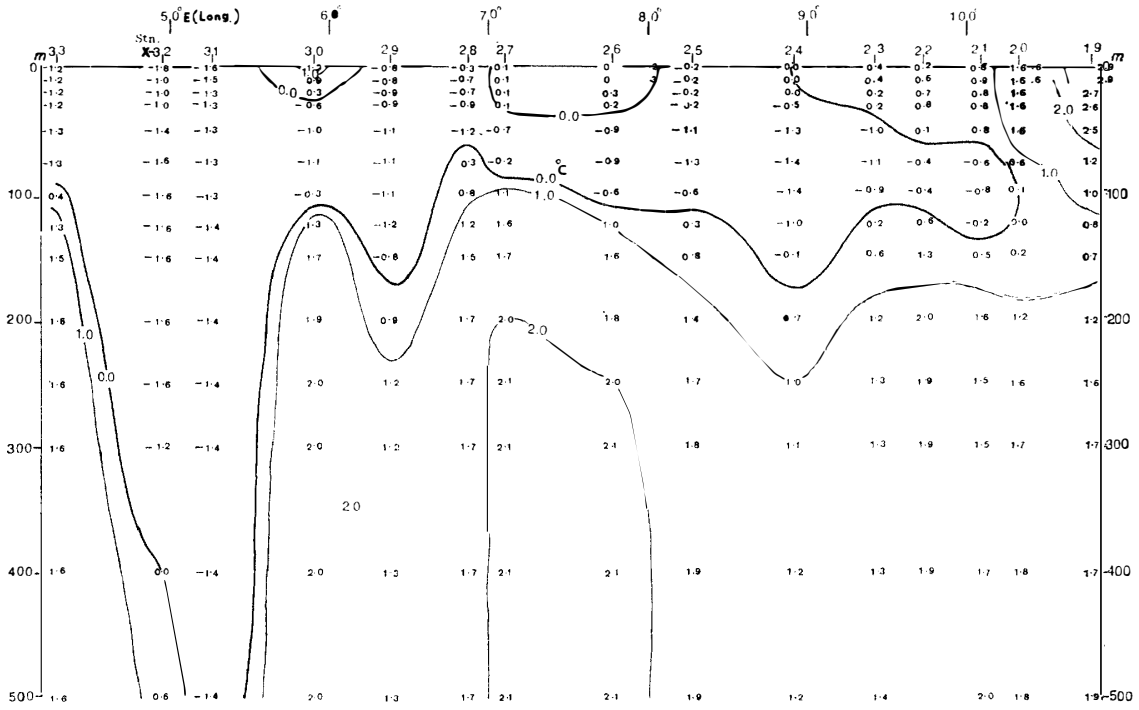

Fig. 2b. From X-19 to X-33.

3.2. Fixed stations in fast-ice sea

Figure 5 shows the locations of Stns. A and B, and Fig. 6 shows the temporal variation of temperature of 0–20 m depth measured at both stations. The temperature

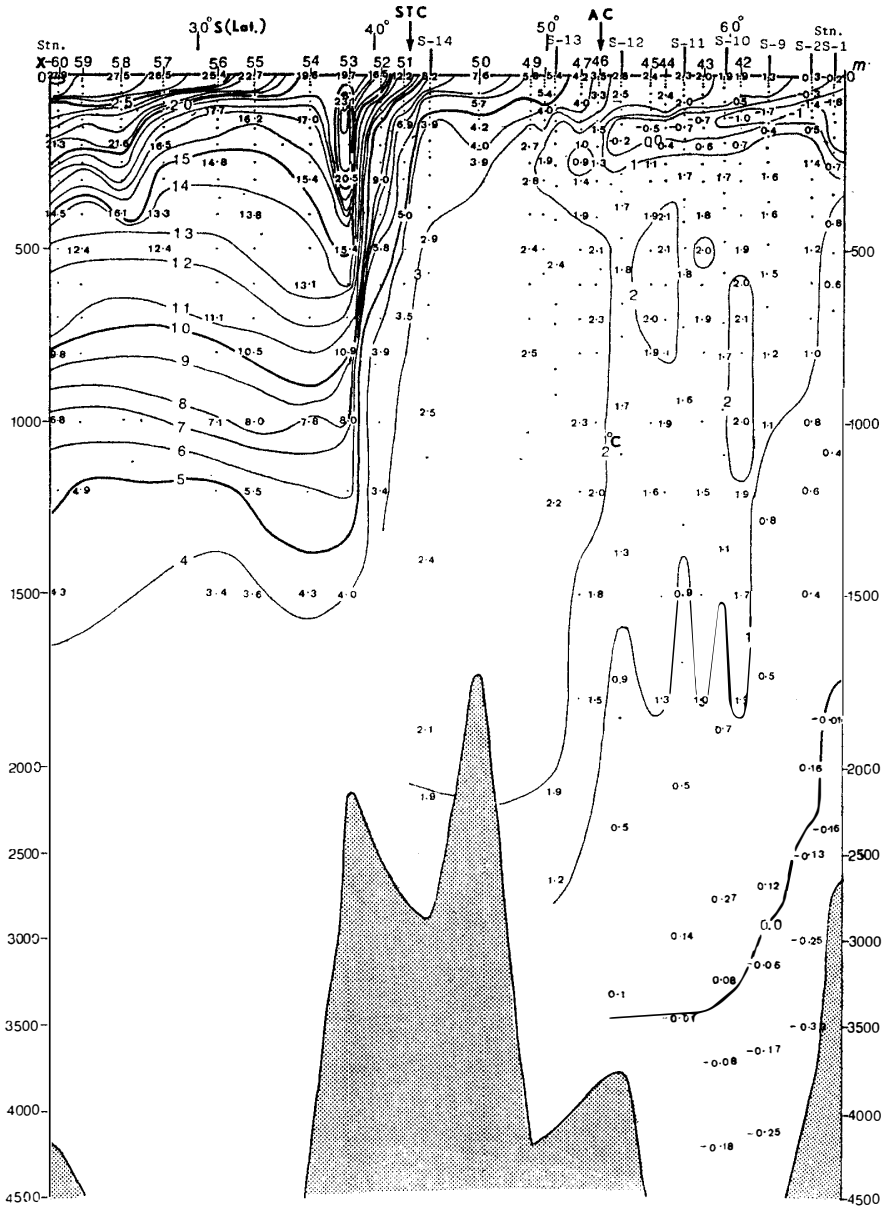

Fig. 2c. Near at 45°E.

Fig. 2a-c. Temperature profiles in the section.

at Stn. A is generally lower than that at Stn. B, with a narrower range of fluctuation. Below 20 m, temperatures lower than −1.8°C are sometimes found at Stn. A, but not found at Stn. B (they are not shown in the figures). These facts may be explained by the general increase of the environmental temperature around Syowa Station as evidenced by the retreat of ice-edge (Fig. 5).

The temporal variations of temperature, salinity, dissolved oxygen content and AOU are shown in three layers of 5 m, 20 m and 50 m for Stn. B (Fig. 7). The mean values and standard deviations of temperature are 0.65 ± 0.2°C, -1.43 ± 0.05°C and -1.55 ± 0.05°C for 5 m, 20 m and 50 m layers, respectively. Similar ranges of variations are in the 20 m and 50 m layers with slightly higher variation in the 5 m

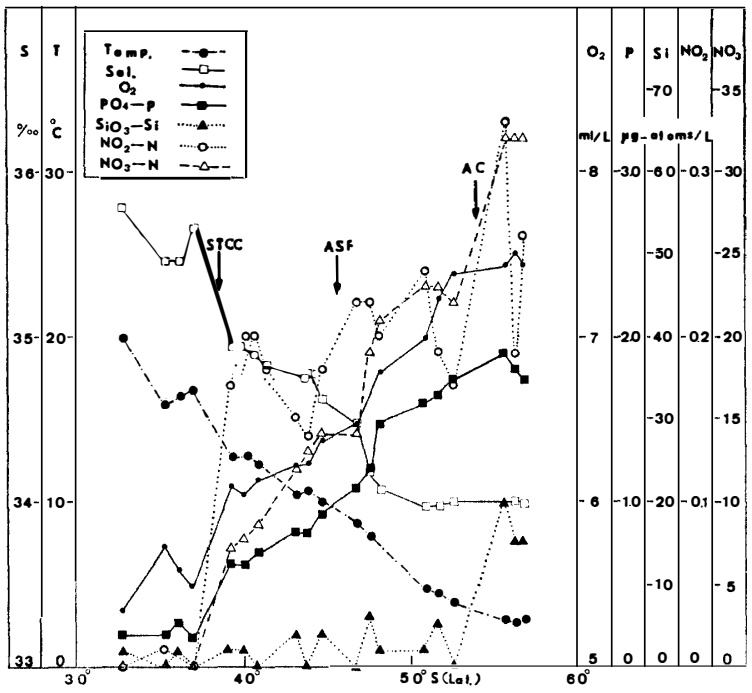

Fig. 2d.

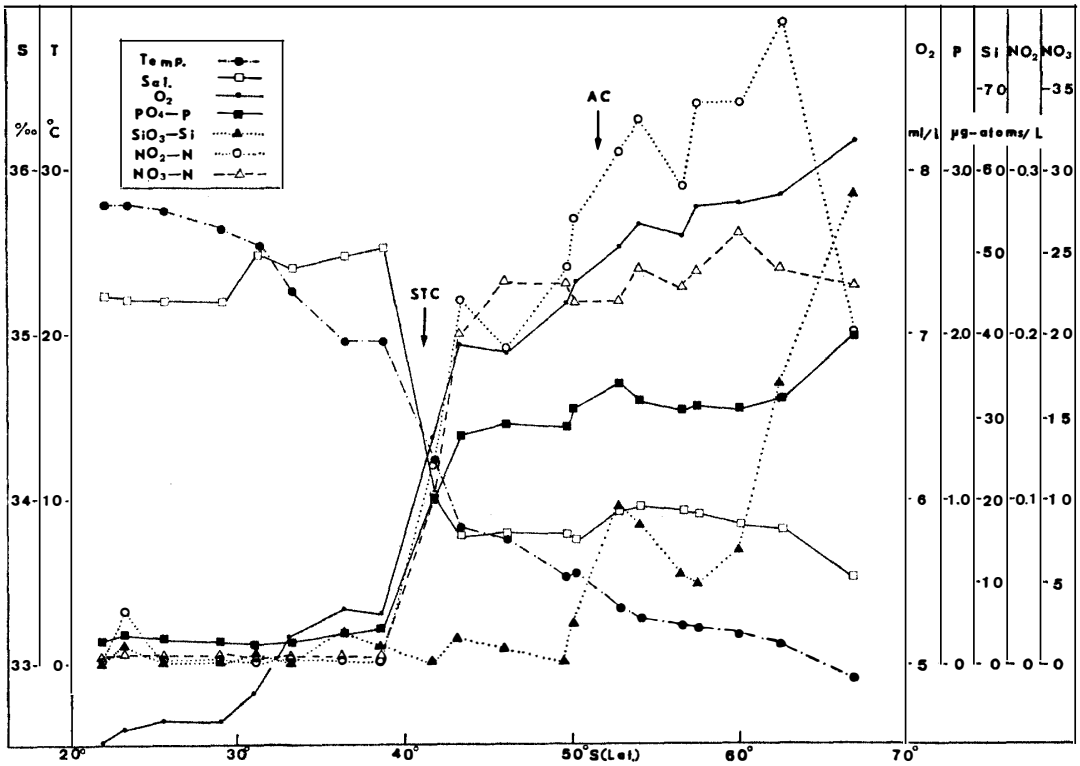

Fig. 2e.

Fig. 2d, e. Latitudinal surface distribution of temperature, salinity, dissolved oxygen content and nutrient matters in the section near at 110° E (Fig. 2d) and 45° E (Fig. 2e).

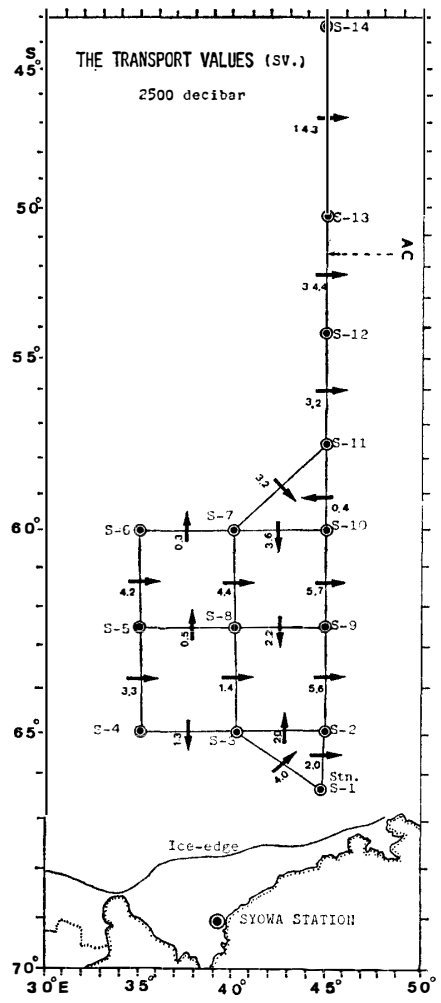

Fig. 3. Geostrophic volume transport referred to 2500 db surface in sv (1 sv=10^6 m^3/s).

layer. Salinity variations are 32.786±0.707‰, 34.126±0.017‰ and 34.202±0.007‰ for the three layers, respectively. The range of variations decreases with depth and almost no fluctuation is found in the 50 m layer. The dissolved oxygen content variations are 13.04±0.31 m*l*/*l*, 8.58±0.64 m*l*/*l* and 9.00±0.04 m*l*/*l* for the three layers. It should be noticed that the maximum fluctuation of dissolved oxygen content is found in the 20 m layer unlike those of temperature and salinity. The AOU values in three layers are about −5 m*l*/*l*, −1∼1 m*l*/*l* and less than 1 m*l*/*l*. It is considerably oversaturated at 5 m, saturated at 20 m and not saturated at 50 m.

Acknowledgments

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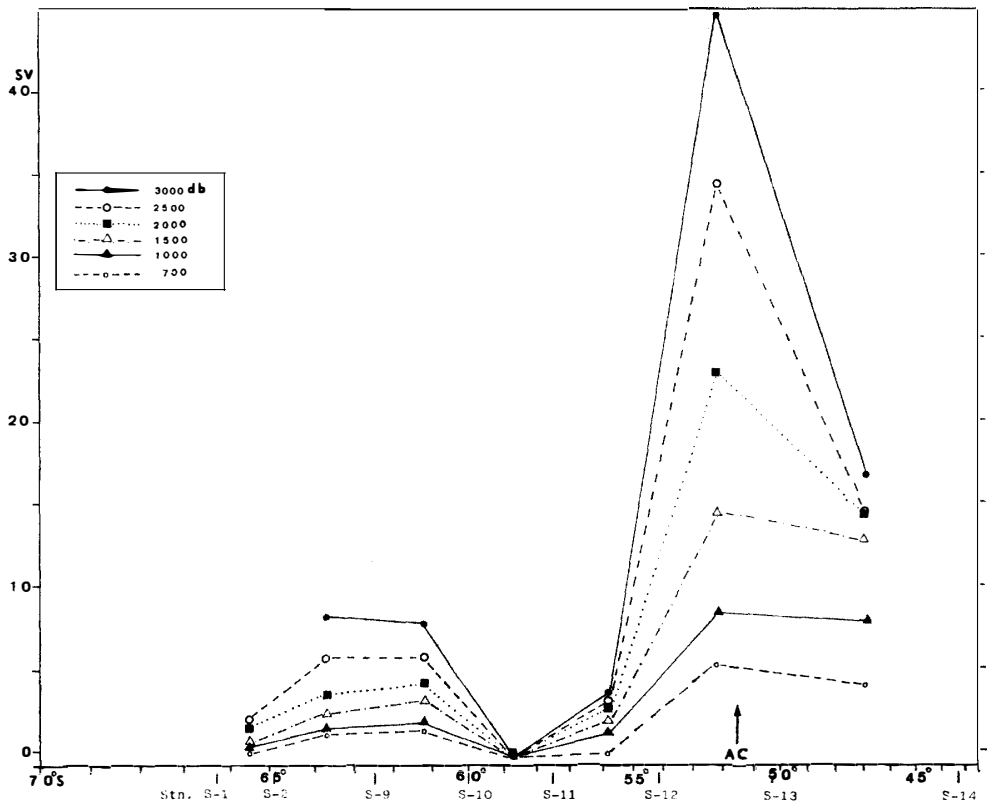

Fig. 4. Geostrophic volume transport at 45°E for the selected reference level.

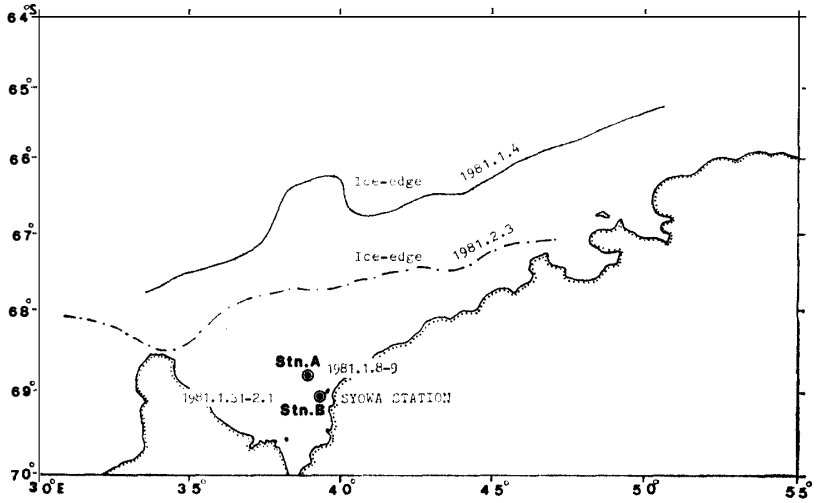

Fig. 5. Locations of two fixed Stns. A and B.

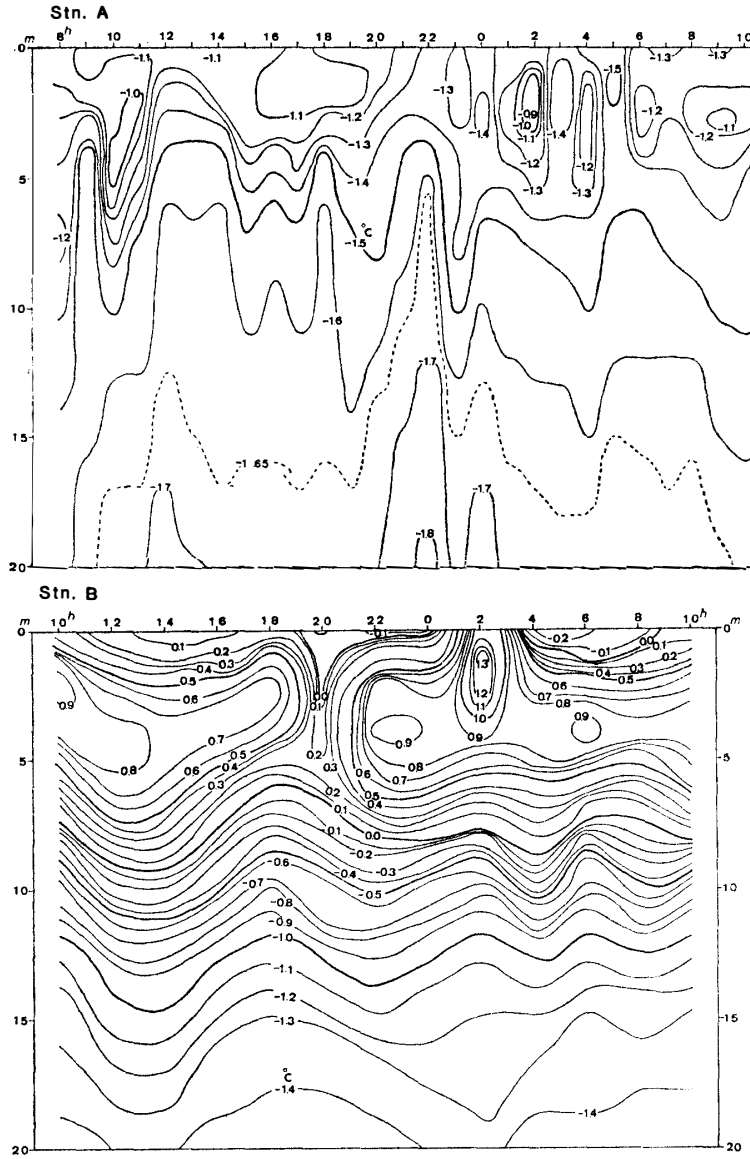

Fig. 6. Time variation of temperature in 0–20 m at Stns. A and B.

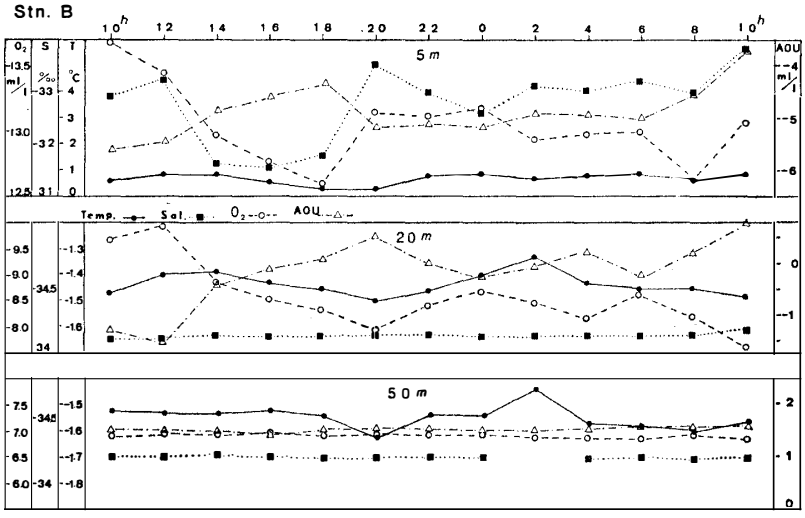

Fig. 7. Time variation of temperature, salinity, dissolved oxygen content and AOU for three layers at Stn. B.