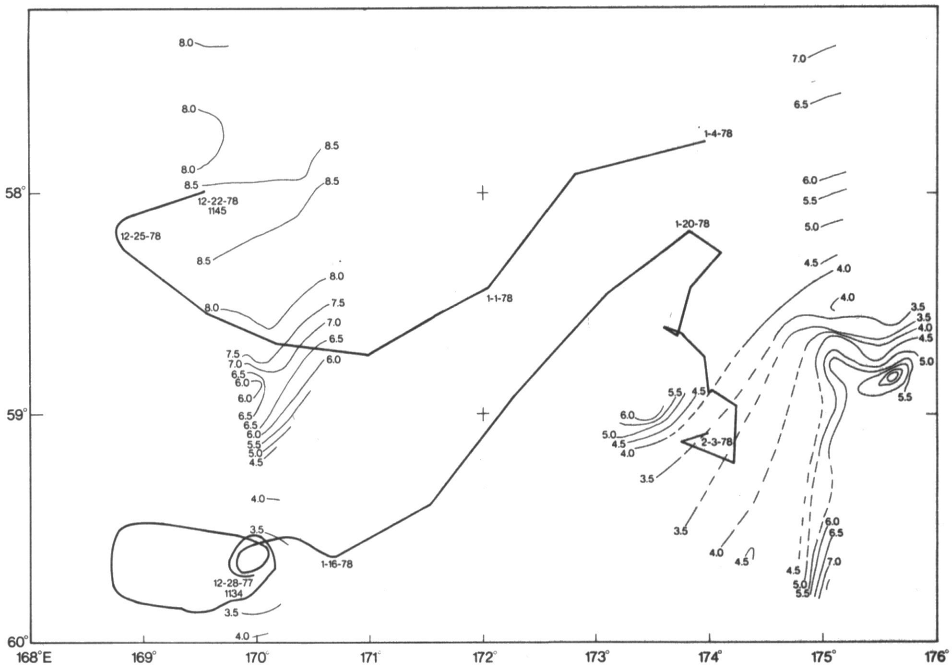

Figure 3. Temperature (°C) at 100 meters from XBT measurements and tracks (dark solid lines) of drifting buoys.

Temperature and salinity fields under the Ross Ice Shelf

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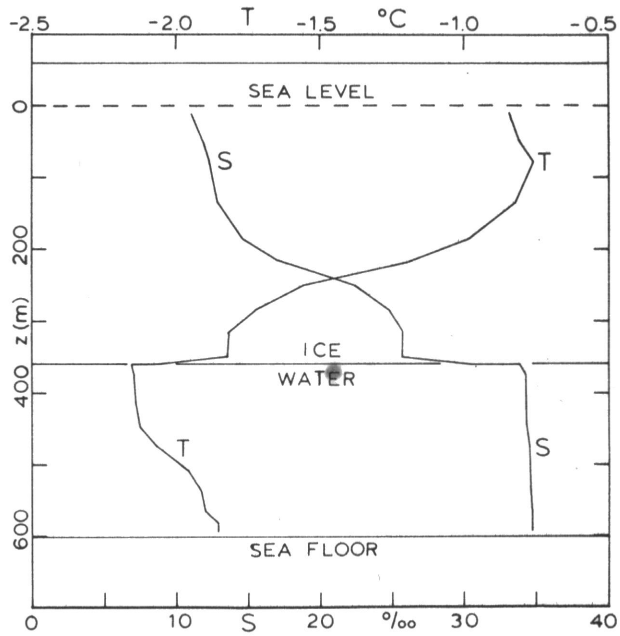
In December 1977 while the Ross Ice Shelf Project access hole at J-9 (82°22.5′S.168°37.5′W.) was open, we were able to make a series of vertical temperature and salinity profiles in the ocean beneath the Ross Ice Shelf. We used a high-resolution electronic conductivity-temperature-depth (CTD) recorder, specially modified to fit down the access hole. The CTD data were recorded on magnetic tapes and will be processed by computer to provide corrected salinity profiles. A preliminary vertical temperature and salinity profile was calculated in the field and is shown in the figure.

During the passage of the CTD through the ice, salinity values from about 10 to 25 parts per thousand were observed, showing that seawater was being mixed with the meltwater left over from the thermal drilling operation. The temperatures in the ice ranged from about -2.0° to -0.7°C with a somewhat irregular pattern probably also attributable to the thermal drilling operation. At the lower edge of the ice shelf the salinity increased sharply to about 34 parts per thousand which is nearly typical of open ocean water, and the temperature dropped sharply to about -2.15°C, which is about the freezing point for seawater with a salinity of 34 parts per thousand and a pressure of 360 decibars (-2.14°C). Just below the ice the temperature was relatively constant in a layer about 90 meters thick; however, this layer was stabilized by a moderate salinity gradient. Just above the sea floor was a nearly constant temperature and salinity layer which varied in thickness from about 20 to 60 meters on different profiles. Between these two layers was a transition zone characterized by relatively strong gradients with irregular step-like structures and inversions in both temperature and salinity.



Preliminary evaluation of one vertical temperature and salinity profile under the Ross Ice Shelf at J-9.

The temperature gradients in the sea floor sediments were measured using a modified Bullard-type probe with two pairs of thermistors between 10 to 110 and 110 to 210 centimeters depth. Both pairs gave exactly the same gradient, 0.00067°C per centimeter. A sediment core about 100 centimeters long was obtained using a standard shipboard gravity corer, and the thermal conductivity was measured at about 15-centimeter intervals. The average thermal conductivity below 10 centimeters depth was 0.00195 calories per centimeter per degree Celsius per second. The geothermal heat flux was thus 1.30 microcalories per centimeter per degree Celsius per second, which is just about the worldwide average heat flux.

The interpretation of the temperature and salinity fields found below the Ross Ice Shelf will require more data, in particular temperature and salinity data at other places under the Ross Ice Shelf and long term current meter records. A very tentative interpretation is as follows. Water from the open ocean is advected in under the ice shelf in the bottom layer near the sea floor. The water subsequently is modified by a net melting at the bottom of the ice shelf. This water then returns to the open ocean in the top layer just beneath the ice shelf. The main evidence for net melting at this time seems to be that the water just under the ice shelf is less saline than the bottom layer. We would expect a nearly constant salinity throughout the water layer because of haline convection if net freezing were taking place.

I appreciate the assitance of my colleagues at J-9 in taking these measurements. This project was supported by National Science Foundation grants DPP 75-14936 and DPP 76-12559.

International Weddell Sea Oceanographic Expedition, 1978

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The third phase of the International Weddell Sea Oceanographic Expedition (IWSOE) began in 1977 when the Norwegian research vessel *Polarsirkel* set out five two-current meter moorings in the southern Weddell Sea. From 1 February 1978 to 6 March 1978 the *Glacier* continued the third phase of IWSOE with an intensive physical oceanographic investigation in the same general area in which the Norwegians operated (see figure 1). This work is aimed at understanding the mixing processes that lead to the formation of bottom water near the edge of the continental shelf.

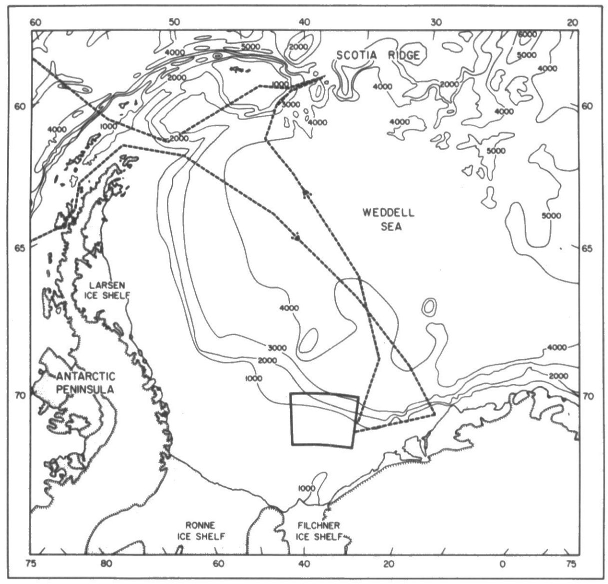

Figure 1. Track of *Glacier* during the IWSOE in 1978 (dashed line) and area where oceanographic operations were carried out (enclosed by heavy line).

Of the 118 hydrographic stations that were occupied, most were in a rectangular grid with a spacing of about 10 kilometers (see figure 2). A high-resolution, electronic conductivity-temperature-depth (CTD) recorder was lowered to within about 10 meters of the bottom on most stations with the aid of an acoustic pinger. Water samples were taken in the surface layer and the bottom layer using 5-liter Niskin bottles. These water samples were analyzed at sea for salinity and oxygen, and part of each sample was frozen for later analysis in the United States for silicate and nitrate. On about half the stations water was also collected for Robert Michel, who will analyze it for tritium. On the other stations the water was filtered. These filters will be examined microscopically for plankton in the United States.

The current meter moorings set by the Norwegians in 1977 had ground lines attached for purposes of retrieval, but heavy sea ice prevented systematic dragging operations and the current meters were not recovered. Five additional current meter moorings were deployed on a line perpendicular to the shelf break (see figure 2). Each of these moorings has two acoustic releases arranged in parallel so that activation of either release will enable the mooring to float to the surface. In addition, the two shallow moorings on the continental shelf have ground lines about 1,200 meters long similar to those used by the Norwegians. Each mooring has two current meters, which will record current speed and direction and water temperature for more than a year. We hope ice conditions will be less severe in 1979, so that we can recover all 10 moorings. It is planned that both the Norwegian research vessel *Polarsirkel* and a U.S. Polar-class icebreaker will operate together in the southern Weddell Sea in February 1979.

Helicopters from the *Glacier* placed a buoy on a large tabular iceberg for the Norsk Polarinstitutt so that the drift of the iceberg can be tracked by satellite.

Although analysis of the CTD data is not complete, some interesting preliminary results have been obtained. At several stations in the eastern part of the survey area extremely cold