

Projects 760039 and 760015

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In 1976 the Bedford Institute of Oceanography's ship *CSS Hudson* operated on an eastern Arctic cruise from July 26 to October 23. There were two primary programs for the season: (1) work in Lancaster Sound-Barrow Strait for the period August 19 – September 03 (Cruise 76-025); and (2) work in Baffin Bay and Labrador Sea prior to (Cruise 76-023) and after (Cruise 76-029) the Lancaster Sound work. The Lancaster Sound work was led by C.F.M. Lewis of Terrain Sciences Division, Ottawa and has been reported earlier (Lewis et al., 1977a). The Baffin Bay and Labrador Sea programs are the subject of this report.

The planned 1976 Baffin Bay program was a continuation of work carried out in 1974 (Ross and Falconer, 1975), and in previous years (Keen et al., 1974). Numerous Atlantic Geoscience Centre and Dalhousie University scientists have participated in this work. The 1976 bedrock program off southeastern Baffin Island was a continuation of work begun in 1975 (MacLean and Srivastava, 1976; MacLean et al., in press).

The primary objectives for the season were:

- 1) to study the margins of Baffin Bay with geophysical techniques; primarily seismic reflection, gravity and magnetic profiles, extending the work of Jackson et al., (in press) and Keen et al., (1974).
- 2) to extend surveys carried out in central Baffin Bay in 1974 which had revealed magnetic and gravity lineations (Appleton et al., 1975).
- 3) to extend studies of the crustal structure of central Baffin Bay (Keen and Barrett, 1972), in particular to obtain good quality seismic reflection data penetrating to oceanic basement.
- 4) to continue studies of the bedrock geology of the southeast Baffin Island shelf (MacLean et al., in press) by obtaining bedrock cores with an electric drill.

Once the initial shiptime allocation had been received, several secondary objectives were identified. Secondary projects are an important part of making full use of the capabilities of *CSS Hudson* and the facilities available at Bedford Institute. These objectives were:

- 5) to extend previous geophysical studies of the northern Labrador Sea, and Labrador Shelf and slope (Srivastava, Evolution of the Labrador Sea and its bearing on the early evolution of the North Atlantic; Paper submitted to Geophys. J. Roy. Astr. Soc., 1977).
- 6) to carry out a 3-day geophysical survey on the Labrador Shelf as part of a joint project with the Eastcan Group in order to study the distribution of boulders on the banks.
- 7) to provide opportunities for ornithology studies in the eastern Arctic (R.G.B. Brown, Canadian Wildlife Service, Department of the Environment)

- 8) to initiate chemical oceanography studies in Lancaster Sound (Chemistry Division, Atlantic Oceanographic Laboratory, Department of the Environment, Bedford Institute).
- 9) to obtain sediment cores in Baffin Bay as part of continuing studies of the sedimentology of the Bay, under the leadership of D. Piper, Dalhousie University (A. Aksu, Dalhousie University).

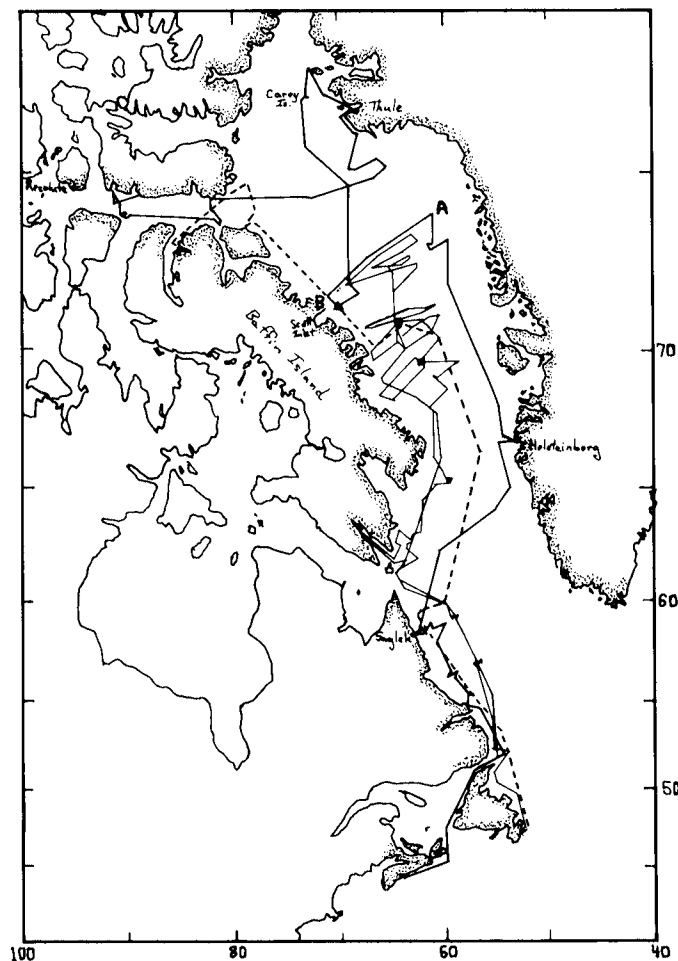


Figure 46.1. *CSS Hudson* 1976 tracks in Baffin Bay and Labrador Sea. Solid lines are cruises 76-023 and 76-029. Dashed line is the return track from Lancaster Sound of cruise 76-025. Filled squares indicate positions of buoy magnetometer moorings. Triangle off Scott Inlet is position of oil slick.

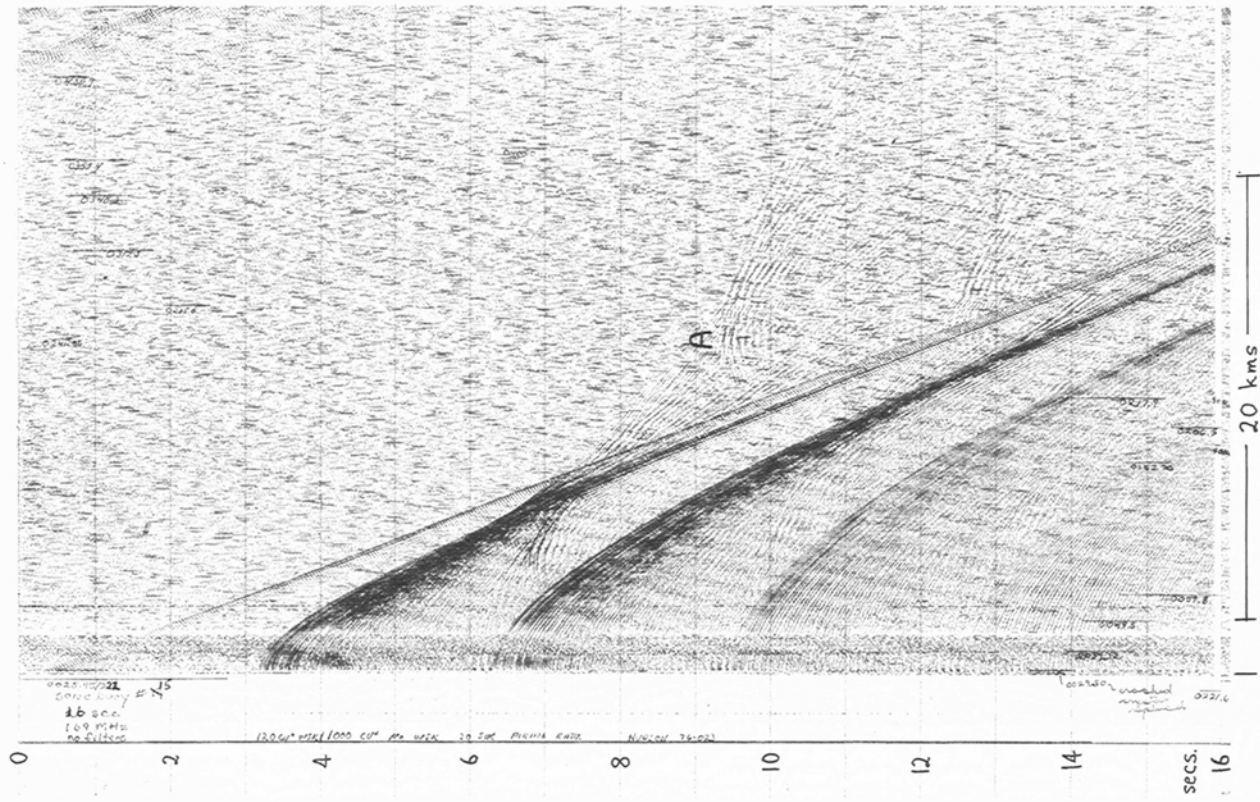


Figure 46.2. Seismic reflection record from Baffin Bay, on line AB. Vertical scale is two-way travel time in seconds. Water depth 2300 m. Letter A marks position of feature seen in Figure 46.3.

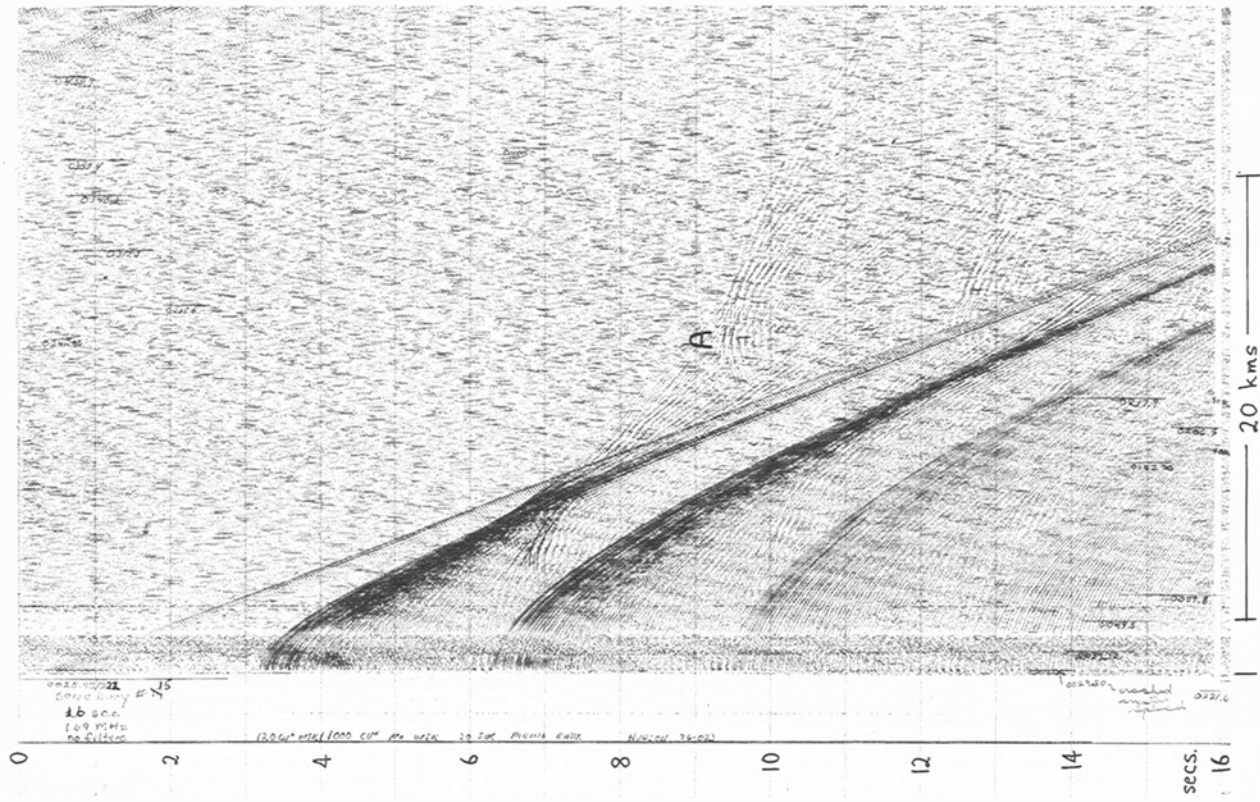


Figure 46.3. Expendable sonobuoy record from Baffin Bay, on line AB. Hyperbolic reflectors at A relate to feature labelled in Figure 46.2.

- 10) to initiate a geochemical study of eastern Arctic sediments (U. Lobsiger, Dalhousie University).
- 11) to assist in the calibration and maintenance of the Defence Research Establishment Pacific acoustic range in Lancaster Sound.
- 12) to compare the performance of Loran C, satellite, and TORAN navigation systems on the Labrador Shelf (D.E. Wells, Navigation Group, Atlantic Oceanographic Laboratory, Bedford Institute).
- 13) to undertake co-operative research with the Danish Greenland Geological Survey on the northwest Greenland margin.

The planned schedule had to be drastically altered when the ship lost a propeller in Lancaster Sound on August 17, just prior to the end of cruise 76-023. The loss meant that **Hudson** could not operate in ice and had to return for repairs to St. John's, Newfoundland on September 11. The ship sailed again from St. John's on September 22. The main effect of the schedule changes on the Baffin Bay program was that there was not time to do planned work in northern Baffin Bay and most of the planned survey of margins of the bay was abandoned. The ships tracks in Baffin Bay and Labrador Sea for the 1976 season are shown in Figure 46.1.

The first work of the arctic season was a three day geophysical survey of the Labrador Shelf in conjunction with the Eastcan Group, who are carrying out a major petroleum exploration and drilling program on the shelf. A three day extension of the season's shiptime in order to do this work was made possible by direct funding from Eastcan. They defined the survey track and ran a TORAN navigation system which they installed. The Atlantic Geoscience Centre provided and operated: 12 kHz wide-beam and 50 kHz narrow beam echo sounders, air gun seismic reflection, Huntex high resolution deep tow seismic reflection, and sidescan. The data obtained are confidential to Eastcan and the Atlantic Geoscience Centre for 15 months. The survey was very successful and the Eastcan representatives onboard said that the quantity and quality of the data obtained was most satisfactory. This joint program has provided opportunities for closer liaison between Bedford Institute and Institut Français du Pétrole scientists. R.H. Fillon of the Atlantic Geoscience Centre has already visited Paris to consult on the data obtained.

The Eastcan program personnel were dropped off at Saglek on August 2 and the ship then ran a seismic reflection line across the Labrador Sea to Holsteinborg. This line passed close to the Cabot drillsite on the northern Labrador Shelf, and it is interesting to note that there, and at other localities on the Labrador Shelf, gas is visible in the water column and in the nearbottom sediments. At Holsteinborg, M. Roksandic of the Greenland Geological Survey joined, and the ship then headed north to commence surveys of the Greenland margin of Baffin Bay. Unfortunately an extensive tongue of ice extended northward over the margin and it was not possible to carry out the planned surveys south of 72°N.

The unseasonably late ice meant that most of the margins were inaccessible so it was decided to concentrate on obtaining a single good seismic line across the bay. The line (AB in Fig. 46.1) extending from shelf to shelf was done at 4 knots using a 1000 cubic inch airgun.

Five expendable sonobuoys provided almost continuous high quality refraction data in the deep part of the bay. Data from two buoys yielded velocities corresponding to 'Moho' at 10 and 14 kms depth. A layer with velocity of 6.4 to 7.0 km/sec was detected at about 8 km depth on records from three of the buoys. Four other sonobuoy refraction lines were shot later farther south in the Bay. Two of these lines were along the axis of the mid-bay gravity negative (Appleton et al., 1975) and there the 6.8 km/sec layer is at least 2 km deeper than elsewhere in the Bay. Velocities typical of oceanic layer 2 were not generally seen on the sonobuoy data. Oceanic basement was not seen on the seismic reflection records as the sediments extend to below the bottom multiple. Sediment thickness is at least 5 km in the centre of the Bay. Diapiric-like structures were observed on line AB near the Greenland margin on both the vertical reflection record (Fig. 46.2) and the sonobuoy record (Fig. 46.3).

On completion of the long seismic line AB some seismic and sidescan work was done on the Baffin Shelf. In the course of that, an oil slick was discovered just off Scott Inlet (Fig. 46.1), as reported earlier by Loncarevic and Falconer (1977). Analysis of the oil samples obtained on cruises 76-023 and 76-025 has not provided a definitive answer on whether the oil is natural or refined. Further investigation of the area is planned for 1977 when the **Hudson** will be engaged on a Bedford Institute chemistry cruise in the area.

Following the work on the Baffin Shelf, the **Hudson** proceeded to Thule for calibration of the gravimeter. En route, a field party from Terrain Sciences Division, Geological Survey (Blake, 1977) was picked up from the Carey Islands. Ornithology studies by R.G.B. Brown were made at the Careys, Haklyut I. north of the Careys, and the coastal areas toward Thule. After the Thule call these studies were continued towards Cape York and at several places in Lancaster Sound. Valuable data were obtained on the breeding and feeding habits of birds in the large breeding colonies of northwestern Greenland and Lancaster Sound.

Sidescan data were obtained at three areas of northwestern Greenland and surprisingly there was virtually no evidence of iceberg scour, despite the areas being infested with large icebergs, some of which are known to ground. The bottom in the surveyed areas was very hard and possibly the lack of scour reflected only lack of sediment soft enough to reveal scour. Figure 46.4 shows data from near the Carey Islands. The "pock-like" marks may be iceberg grounding marks but note the lack of linear scours. Sidescan data obtained earlier off Holsteinborg also showed no scour. However, surveys on the Labrador Shelf and on the Baffin Shelf revealed intensive scouring to water depths of at least 250 m (Fig. 46.5). Sidescan data will be presented at the Geological Association of Canada meeting in Vancouver in April 1977 by C.F.M. Lewis, S.M. Blasco, R.K.H. Falconer, and G. Martin.

In Lancaster Sound the main work was ornithology and chemical oceanography. Two chemistry sections with CTD casts and deep sampling were done, one near the mouth of Lancaster Sound, the other in eastern Barrow Strait. These sections provided preliminary data for the definition of major chemical oceanography programs in the eastern arctic. A 27 day chemistry cruise onboard **CSS Hudson** is scheduled for the eastern arctic in 1977.

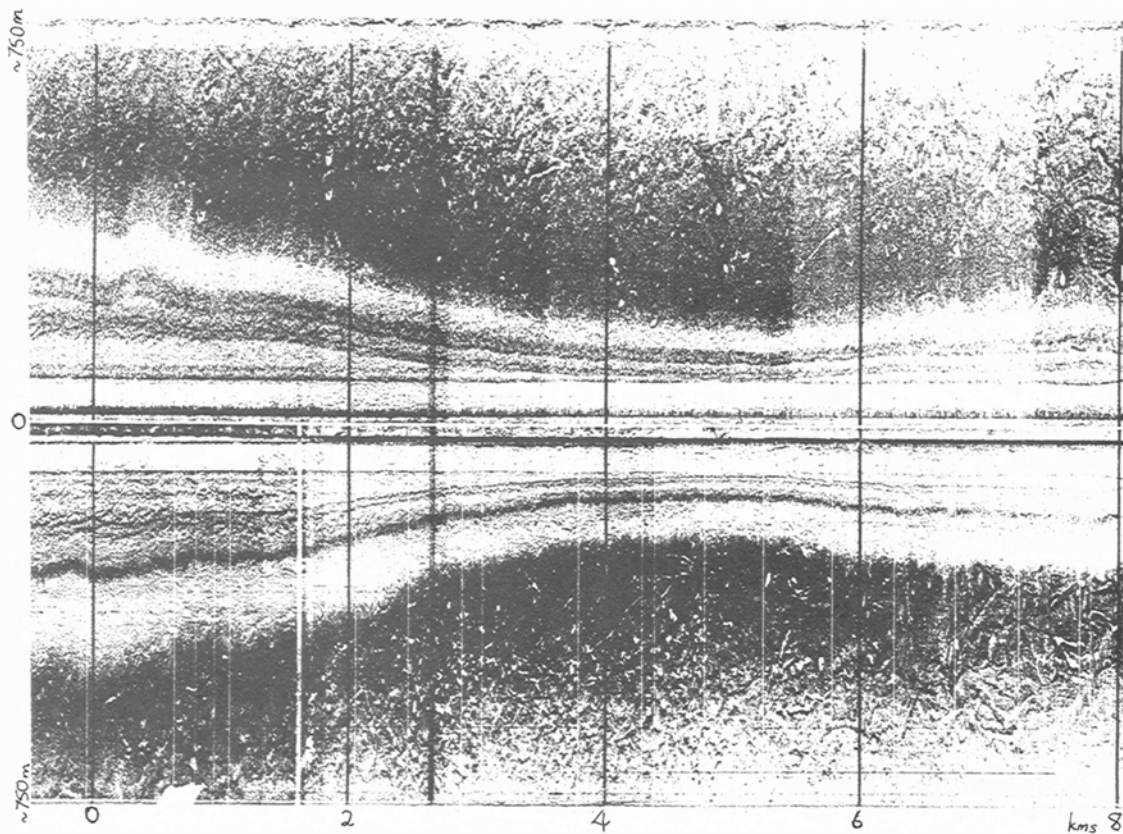


Figure 46.4. Sidescan record from 60 km north of the Carey Islands. Water depth shallows from 300 m to 150 m.

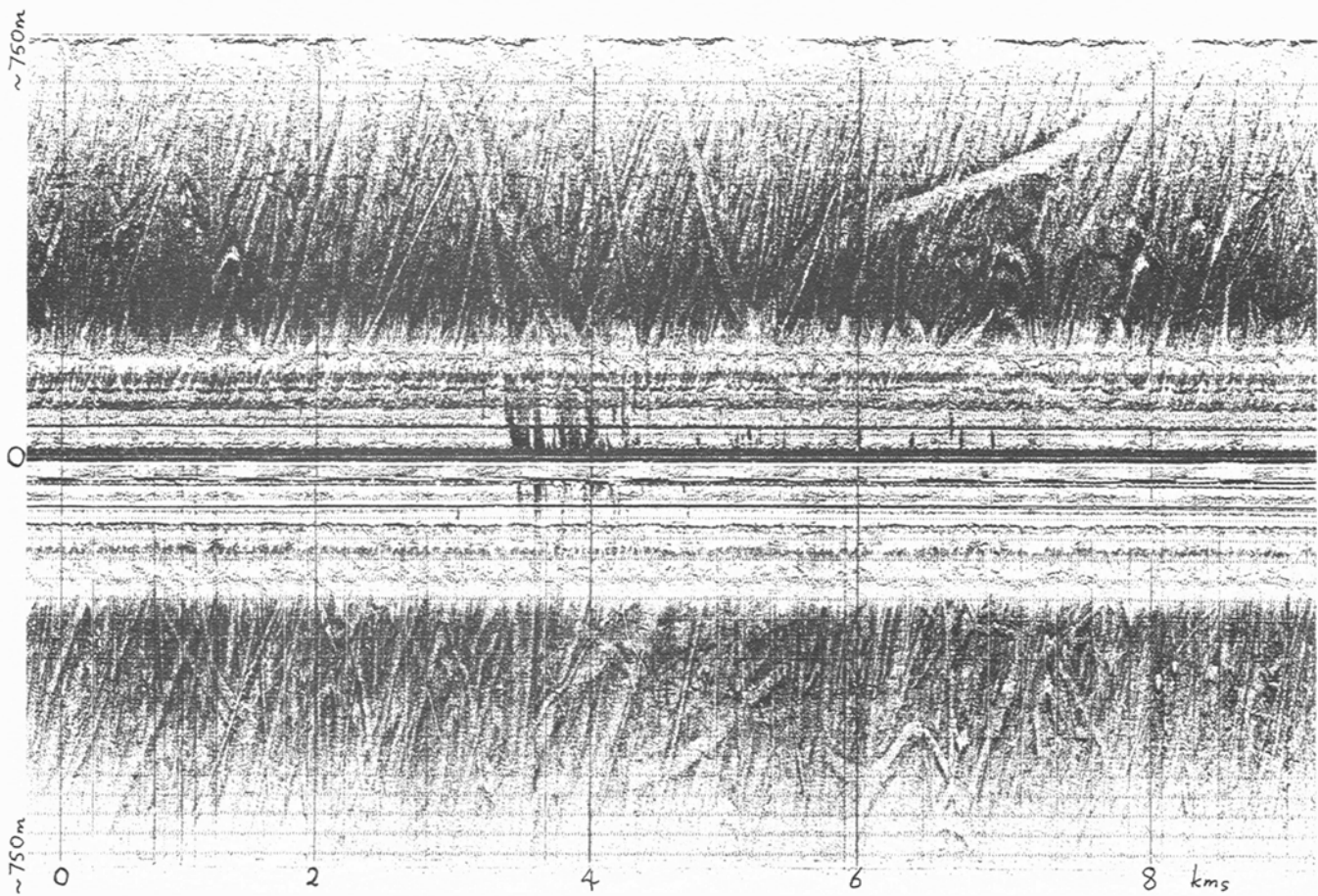


Figure 46.5. Sidescan record from Saglek Bank northern Labrador Shelf, in approximately 150 m water.

Cruise 76-023 had been scheduled to end at Resolute, August 19, but the loss of the ship's propeller on August 17 near Prince Leopold Island altered that. The Defence Research Establishment Pacific work was postponed. The **Hudson** could not go to Resolute because of ice. Scientific and ship's personnel were transferred to Resolute from Maxwell Bay and Gasgoyne Inlet with the help of the Polar Continental Shelf Project.

Cruise 76-025 (Lewis et al., 1977) then worked in Lancaster Sound for 15 days before returning to St. John's, Newfoundland. The return trip provided much good en route data in Baffin Bay and Labrador Sea: the oil slick was investigated, sidescan and seismic reflection data were obtained on the Baffin Shelf, seismic reflection data were obtained in part of Baffin Bay and on the Labrador Shelf, gravity and magnetic profiles were continuous.

The **Hudson** sailed on cruise 76-029 from St. John's after repairs were completed on September 22. En route to the southeastern Baffin Shelf, a small survey was done of steep scarps which had previously been observed at the foot of the Labrador Shelf slope. That survey and more work on the return trip indicate that there has been massive slumping along at least 400 km of the Labrador slope. A seismic reflection profile parallel to the slope crossing toes of some slumps is shown in Figure 46.6.

Bedrock drilling was carried out off southeastern Baffin Island on both the way northward and the return southward. Cores of consolidated and semi-consolidated rocks were obtained at 6 out of 10 sites. Details of the bedrock program are described by MacLean and Falconer (1977).

In Baffin Bay magnetic surveys were the major work. A buoy magnetometer was used to monitor diurnal variations. It was laid first in the southern area (Fig. 46.1) and picked up 2 days later drifting free 3 miles from its mooring. It appeared that ice had broken the nylon mooring line. The buoy was then moved northward to just south of the 1974 survey. Lines were run south and north of that survey. The magnetic lineations mapped in 1974 (Appleton et al., 1975) do not appear to extend far either side of the 1974 survey but there are other lineations in the southern part of the bay. A limited amount of seismic reflection data was obtained across the Baffin Island margin in the Home Bay area. A thick sedimentary basin is evident in Home Bay.

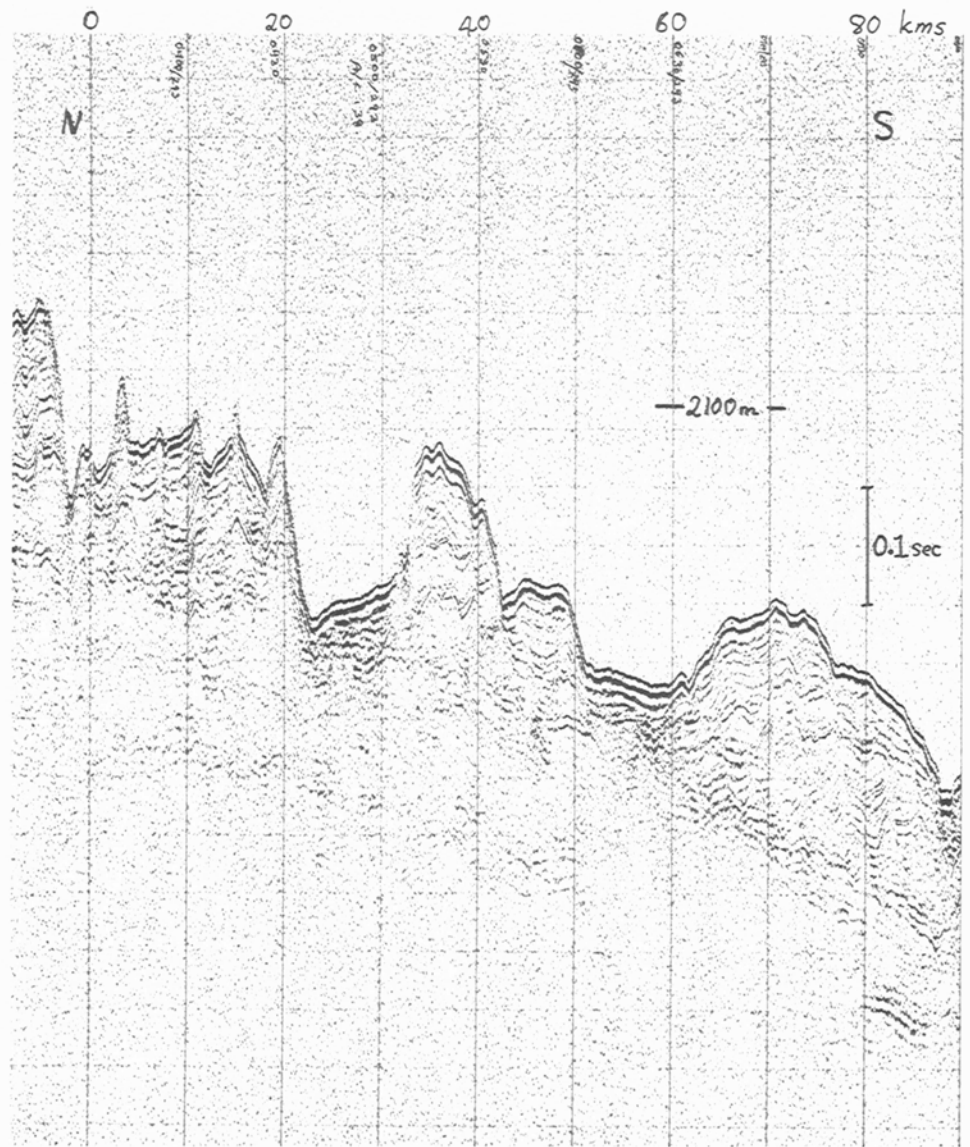


Figure 46.6. Seismic reflection record parallel to the slope off Saglek Bank northern Labrador Shelf. Two-way travel time of 0.1 sec represents about 100 m in the sediments.

Piston cores were obtained at 11 sites in Baffin Bay as part of a Dalhousie University project. Analysis of these cores (A. Aksu, pers. comm.) has revealed important marker horizons, mainly ash, which can be mapped in the bay. Material from the cores and grab samples taken at other localities are being used by U. Lobsiger of Dalhousie University in a geochemical study of sediments in the eastern arctic.

Acknowledgments

The success of the 1976 **Hudson** arctic cruises is due in large measure to the support of the Officers and Crew of **CSS Hudson** under the leadership of Captains L. Strum and D. Deer. The contribution of each individual in the scientific party to the results of the whole program is appreciated. The support facilities of Bedford Institute were very valuable. Polar Continental Shelf Project through F. Alt assisted with the transfers through Resolute.

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