A reconnaissance study of the bedrock and surficial geology of Hudson Strait, N.W.T.

Project 760015

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Abstract

The preservation of Paleozoic and possibly younger strata beneath the strait is controlled by half grabens at the eastern and western ends, and in the central part by a regional synclinal structure.

Preliminary lithologic correlations of Paleozoic strata in Hudson Strait were made with rocks exposed on Southampton, Coats, and Mansel islands in northern Hudson Bay and in the Premium Homestead Akpatok L-26 well in Ungava Bay. These correlations and regional stratigraphic relationships recorded on seismic profiles suggest that carbonate rocks of Ordovician age underlie most of the western part of the strait, but occur together with Silurian and possibly younger rocks in the eastern part. The seismic data also suggest that 2000 m or more of strata may be present in the area.

Surficial sediments include glacial till and stratified sediments. Greatest accumulations, 95 m and 130 m, are in the eastern and western basins, respectively. Moraines have been observed on both north and south sides and in the western part of the strait. In places they include more than one till.

Résumé

La préservation des couches du Paléozoïque et de strates probablement plus jeunes sous le détroit est confirmée par la présence de sémi-fossés aux extrémités est et ouest, et dans la partie centrale par une structure synclinale régionale.

Les corrélations lithologiques préléminaires des strates du Paléozoïque dans le détroit d'Hudson ont été effectuées à l'aide de roches exposées sur les îles Southampton, Coats et Mansel dans la partie septentrionale de la baie d'Hudson et dans le puits Premium Homestead Akpatok L-26 dans la baie d'Ungava. Ces corrélations et les rapports stratigraphiques régionaux enregistrés sur des profils sismiques indiquent que des roches carbonatées de l'Ordovicien se trouvent sous la majeure partie de la région occidentale du détroit, mais qu'elles sont mêlées à des roches du Silurien et d'autres roches probablement plus jeunes dans la partie orientale. Les données sismiques indiquent également que cette strate a probablement une épaisseur de 2000 m ou plus à cet endroit.

Les sédiments superficiels comprennent du till et des sédiments stratifiés. Les plus grandes accumulations, 95 m et 130 m, se trouvent respectivement dans les bassins est et ouest. Des moraines ont été observées du côté nord et du côté sud et dans la partie occidentale du détroit. Ă certains endroits, elles comprennent plus d'un type de till.

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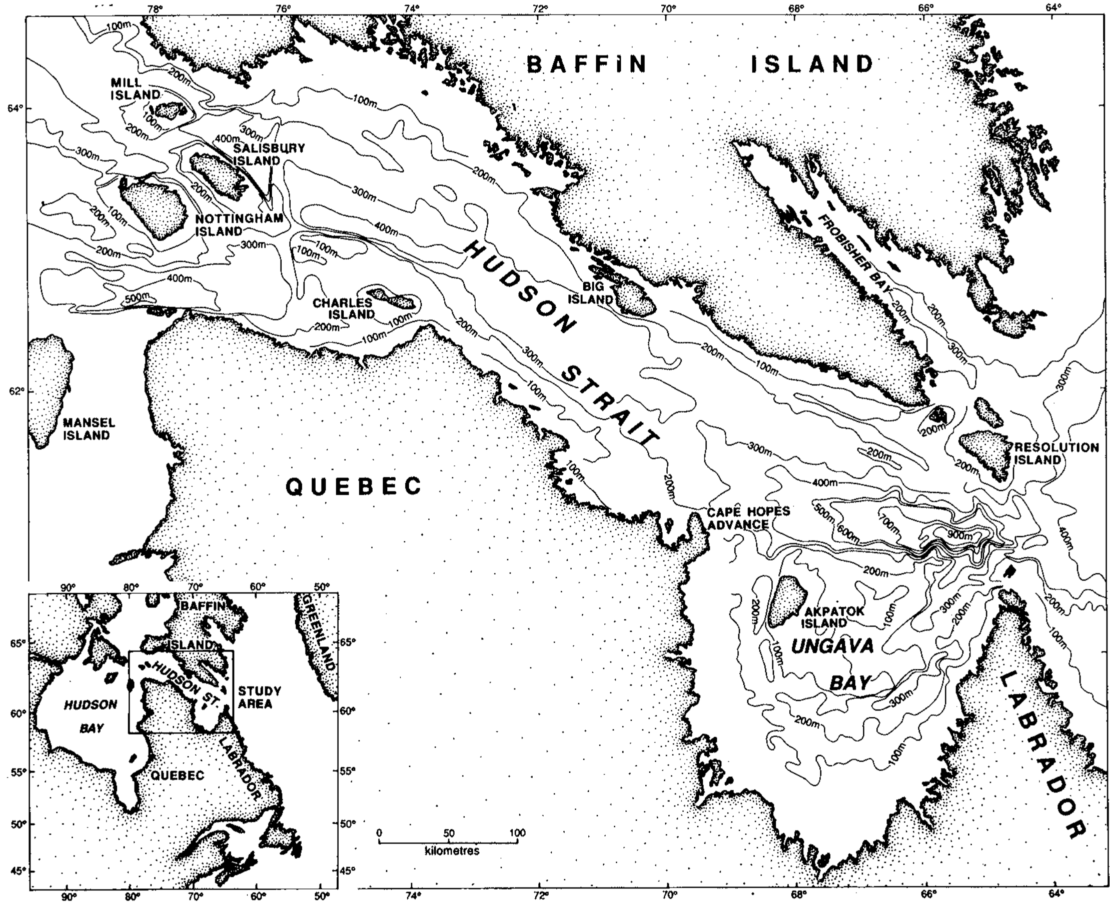

Figure 64.1

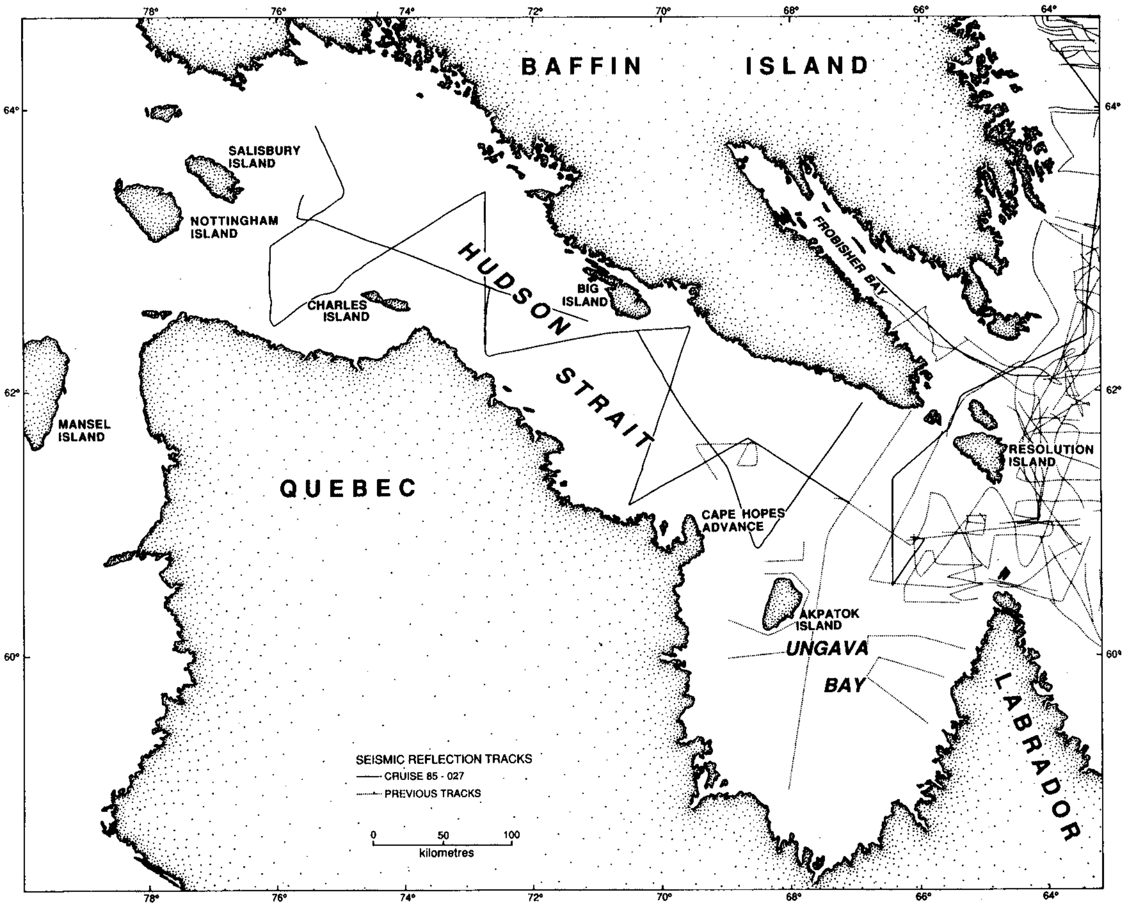

Figure 64.2

Introduction

A reconnaissance survey of the bedrock and surficial geology of Hudson Strait was carried out from **CSS Hudson** from 11 to 24 October 1985, during cruise 85-027.

Objectives of the studies were to delineate the regional distribution of the main bedrock and surficial geological units and to obtain lithostratigraphic, biostratigraphic and physical property data to provide information on their composition, age, depositional history and other properties.

Hudson Strait separates Baffin Island from Labrador and Ungava Bay and northern Quebec and connects Hudson Bay and Foxe Basin with the Labrador Sea (Fig. 64.1). It is 800 km long and ranges in width from 90 km to 340 km across Ungava Bay. Nottingham, Salisbury, and Mill islands constrict the strait at its western end.

Generalized bathymetry is shown in Fig. 64.1. Water depths in excess of 200 m are continuous along the strait from the continental shelf at its eastern end to the west side of Foxe Basin, with branches into Ungava Bay and northern Hudson Bay (Canadian Hydrographic Service, charts 5.04, 5450). Greatest depths, in excess of 900 m, occur in an elongate depression in the eastern end of the strait north of Ungava Bay. This is separated from the Labrador Sea by a narrow sill with a depth of about 400 m. A depression in the western part of the strait contains water depths in excess of 400 m. It commences east of Nottingham Island and extends eastward parallel to the axis of the strait for 130 km. Major fault scarps control the bathymetry along the south side of both of these depressions. Water depths increase progressively southward into these half graben basins. In contrast, the bathymetric profile of the central part of the strait is broadly u-shaped. On a smaller scale, bedrock cuesta or small fault ridges, morainal or other surficial sediment deposits, and small channels locally influence the bathymetry (e.g. Fig. 64.8, 64.9, 64.11).

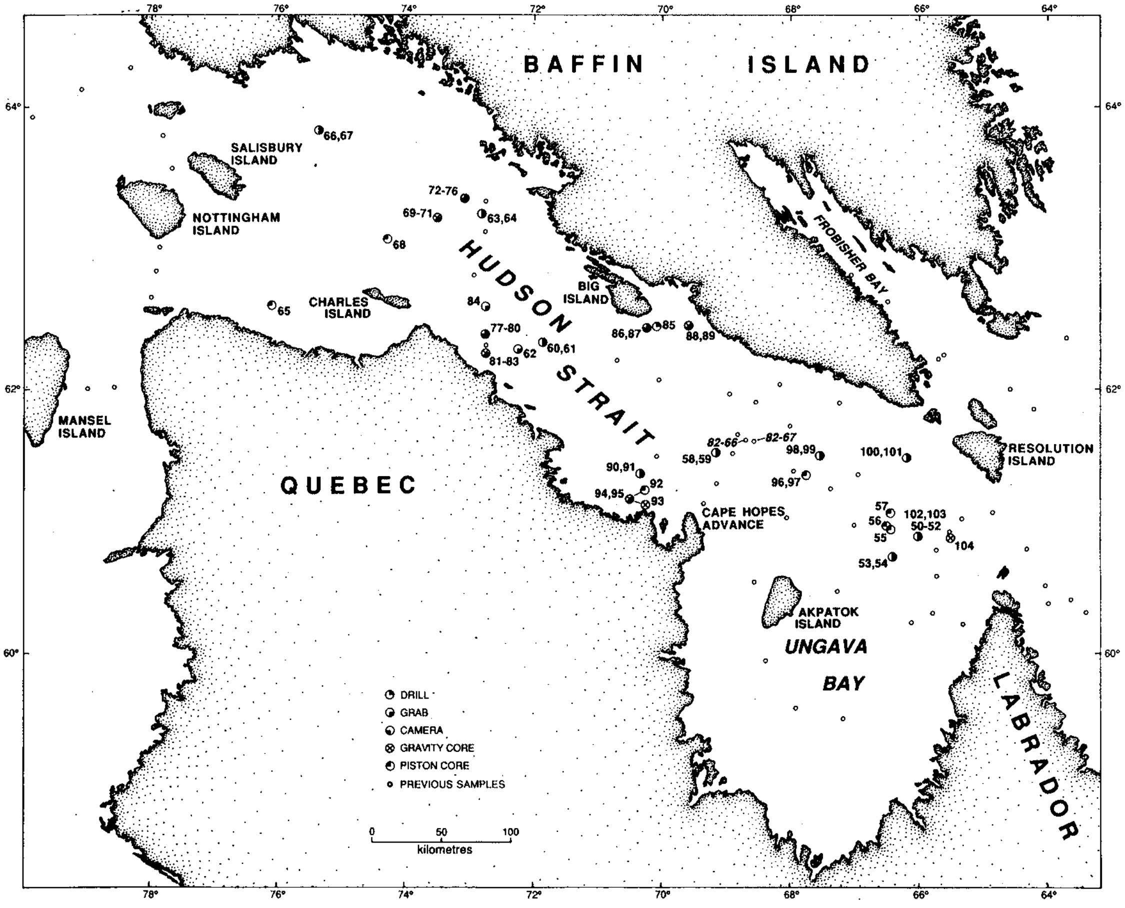

Figure 64.3

Figure 64.1. (opposite) Generalized bathymetry of Hudson Strait.

Figure 64.2. (opposite) Tracks along which single channel seismic reflection data have been acquired. Huntec high resolution seismic data were also acquired along all 1985 tracks. See Grant and Manchester (1970), Grant (1975) and MacLean and Williams (1983) for previous track information in Hudson Strait and Ungava Bay.

Figure 64.3. Sample stations from cruise 85-027 and other cruises, mainly cruises 82-027 and 82-034.

Methods

The survey included the collection of both geophysical data and samples of bedrock and Quaternary sediments (Fig. 64.2, 64.3). Geophysical data were obtained with a single channel seismic reflection system using a 655 cm^3 compressed air source and Nova Scotia Research Foundation and Seismic Engineering hydrophones, a Huntec high resolution seismic system fitted with a towed streamer as well as internal hydrophone, a Varian magnetometer, and a Bedford Institute of Oceanography sidescan sonar.

Bedrock samples were collected at 12 sites (Fig. 64.4). They were obtained with the Bedford Institute of Oceanography underwater electric drill with up to 9 m seafloor penetration capability, which has been used extensively on the Baffin Island shelf and elsewhere, and a newly developed NORDCO drill. The NORDCO unit consists of a 6 m auger through which a diamond drill can be extended 6 m farther. This unit proved very effective in augering through overburden down to the bedrock surface, and thus disposing of gravel fragments that commonly jam in the diamond drill barrel. Some problems, however, were encountered with core retention.

Surficial sediment samples were obtained principally with a Benthos piston corer and large IKU clamshell sampler, but gravity and Lehigh corers also were used, and some grab samples were obtained from the drill legs. Photographs of the seabed were obtained at selected stations with UMEL underwater cameras.

Navigational positioning was by means of BIONAV, the Bedford Institute integrated navigation system which utilizes rho-rho Loran C, Satellite navigation, log and gyro, and by radar.

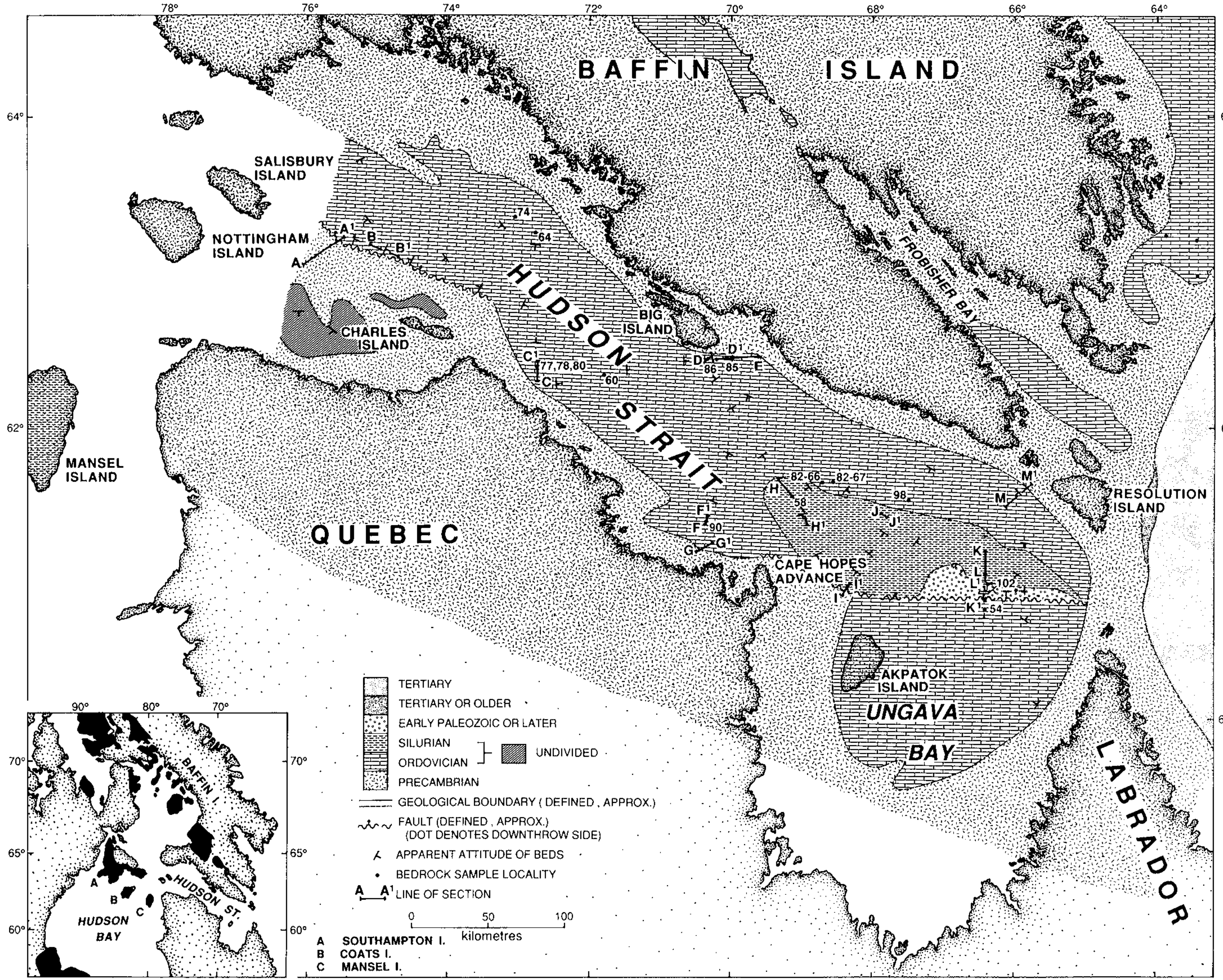

Figure 64.4. Geological map showing tentative units represented. Age assignments are on the basis of preliminary lithologic correlations with rocks on Southampton, Coats and Mansel islands, in the Akpatok well, and seismic relationships. Ungava Bay geology is after Grant and Manchester (1970), Grant (1975) and Sanford et al. (1979). Black areas on the inset map show the distribution of Ordovician and Silurian rocks in the region.

Previous studies

The most pertinent previous onshore investigations relative to bedrock geology are: Sanford in Heywood and Sanford (1976) on the Paleozoic rocks of Southampton, Coats and Mansel islands in northern Hudson Bay; Workum et al. (1976) on stratigraphy from the Premium Homestead Akpatok L-26 well on Akpatok Island in Ungava Bay; Blackadar (1966) – geology of southern Baffin Island; and Taylor (1979 and 1982) – geology of parts of northern Quebec and Ungava. The Quaternary geology of southern Baffin Island has been studied by Blake (1966), Stravers (1986), Stravers and Miller (1984), Miller (1982), and Clark (1985), of northern Quebec and Labrador by Løken (1978), Gray and Lauriol (1985), and Gray et al. (1985). Previous offshore studies included: seismic reflection, magnetometer and dredge sampling investigations of Ungava Bay and eastern Hudson Strait by Grant and Manchester (1970), Grant (1975); synthesis of existing offshore, onshore, and well data by Sanford (1974), and Sanford et al. (1979) to postulate the distribution of Paleozoic rocks in the strait; investigations of surficial sediments at the eastern end of the strait through profiling and sampling by Fillon et al. (1981), Fillon and Harmes (1982); seismic reflection surveys and bedrock sampling in eastern Hudson Strait by MacLean and Williams (1983); collection of sediment samples as part of chemical, physical and biological oceanographic investigations of Hudson Strait by Jones and Drinkwater (1982), and studies of tidal currents by Drinkwater (1983).

For a broader overview of the bedrock and surficial geological data and problems in the region the reader is referred to Andrews et al. (1983), Shilts (1980, 1984), Osterman et al. (1985), Praeg et al. (1986), MacLean (1985), Bolton et al. (1977), and Trettin (1975).

Bedrock geology

A preliminary interpretation of the bedrock geology of Hudson Strait, presented in Figure 64.4, is based on: tentative lithologic correlations of samples recovered from 12 offshore localities (Table 64.1) with strata mapped on Southampton, Coats and Mansel islands in northern Hudson Bay (Heywood and Sanford, 1976), and in the Premium Homestead Akpatok L-26 well on Akpatok Island (Workum et al., 1976); and stratigraphic relations and acoustic characteristics of bedrock units from seismic reflection profiles. The resultant division of units in general agrees quite well with the onshore and well data both lithologically and in approximate formation thickness. Paleontological data, however, is as yet unavailable from the offshore samples so the proposed age of the strata should be considered tentative. The correlations suggest that the strait is underlain mainly by carbonate rocks of Ordovician and Silurian age. Younger strata may also occur adjacent to the fault scarp in the eastern part of the strait (Fig. 64.5, Section K-K^1, 24-34 km along the profile).

Interpretations of data from the Premium Homestead Akpatok L-26 well on Akpatok Island (Workum et al., 1976) and seismic reflection data (Grant and Manchester, 1970) indicate that Ungava Bay is floored mainly by carbonate rocks of the Ordovician Bad Cache Rapids Group. The core samples recovered from station 85-027-54 are lithologically consistent with this. The lower 264 m (70-334 m below sea level) in the well contains poorly consolidated shale, sandstone and carbonate rocks which may outcrop around the periphery of the carbonate platform in Ungava Bay. Precambrian rocks were encountered at a depth of 335 m below sea level.

The eastern part of the strait north of Ungava Bay and the western part north of Charles Island are half graben features in which strata have been down faulted against older rocks to the south (Fig. 64.5, 64.6).

The contact between Precambrian metamorphic rocks that make up the adjacent landmass on both sides of the strait and the Lower Paleozoic rocks under the strait occurs close to the present shoreline in many areas. Precambrian rocks, however, are present locally in the western part of the strait north and west of Charles Island.

Lower Paleozoic (Ordovician) strata onlap Precambrian rocks on the north side of the strait where they commonly form cuesta ridges (Fig. 64.7). However, faulting may be associated with ridges near Big Island (Fig. 64.8).

From Big Island westward the strait is underlain by rocks that appear mainly to be equivalents of the Ordovician Bad Cache Rapids and Churchill River groups, and Red Head Rapids Formation, as well as older Ordovician beds described by Heywood and Sanford (1976) and Workum et al. (1976). Silurian strata possibly occur locally southwest of Charles Island (undivided in Fig. 64.4). The possibility of post-Ordovician beds in the western graben north of Charles Island cannot be ruled out.

The stratigraphy in the eastern part of the strait is more complex. Here a sequence of younger strata that thickens southward (Fig. 64.9) forms a stratigraphic section some 725 m in thickness (using an assumed velocity of 4 km/s). These beds overlie strata that closely resemble Red Head Rapids Formation where sampled at station 82-67 (MacLean and Williams, 1983) and Churchill River-Bad Cache Rapids groups at e.g. stations 85, 86, 90, 82-66. A sample of reddish brown calcareous sandstone was recovered from the younger unit at Station 58. This is tentatively correlated with the Silurian Kenogami River Formation. If this correlation is correct, the section here presumably also includes equivalents of the earlier Silurian Severn River, Ekwan River and Attawapiskat formations. The change in acoustic character (greater penetration and more closely spaced reflectors) of these beds relative to the Ordovician strata which they onlap presumably reflects the less massive nature of some of these beds: for example thin bedded limestones of the Severn River and parts of the Ekwan River formations. Small, irregular, somewhat dome-shaped features interrupt the seismic reflectors in part of the sea floor in the eastern depression. These features may represent reefal developments in possible Attawapiskat and Ekwan River formations, this being a common characteristic of these units on Southampton, Coats and Mansel islands (Heywood and Sanford, 1976).

Strata identified in Figure 64.4 as "Early Paleozoic or Later" occur mainly in an elongated ridge on the floor of the eastern depression adjacent to the fault scarp north of Ungava Bay (e.g. Fig. 64.5, 24-34 km along the section). These rocks have been down dropped relative to the adjacent seafloor to the north as well as to the south (Fig. 64.5). They attain thicknesses of 850 or 1130 m respectively, if velocity corrections to 3 km/s or 4 km/s are applied. The beds were penetrated to a depth of 4.5 m at station 102 by the NORDCO drill, but only a 2 cm core of brown fairly friable sandstone was recovered. Grant (1975) previously obtained a dredge sample of possible Silurian age from this area. The exact stratigraphic and structural position of these beds relative to the Ordovician and Silurian strata to the north and west has not yet been determined due to discontinuities in the reflectors. The general relationships inferred from the seismic reflection profiles and the apparently softer more

Table 64.1. Listing of sample locations, Hudson Strait

STATION NUMBER	SAMPLE TYPE	JULIAN DAY/TIME	LATITUDE	LONGITUDE	DEPTH (MTRS)	GEOGRAPHIC LOCATION	NOTES
50	DRILL	2851306	60 52.98N	66 00.47W	815	HUDSON STRAIT	BIO DRILL. NO SAMPLE. MALFUNCTIONED.
50-G	GRAB/DRL	2851306	60 52.98N	66 00.47W	815	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
51	GRAB	2851350	60 52.95N	65 59.73W	795	HUDSON STRAIT	LARGE VAN VEEN GRAB.
52	DRILL	2851430	60 53.05N	65 58.55W	840	HUDSON STRAIT	BIO DRILL. NO SAMPLE.
53	GRAB	2851714	60 44.71N	66 25.69W	345	HUDSON STRAIT	LARGE VAN VEEN GRAB.
54	DRILL	2851804	60 44.89N	66 25.30W	355	HUDSON STRAIT	BIO DRILL. LENGTH: 50 CM LIMESTONE/21 CM. PEBBLE.
54-G	GRAB/DRL	2851804	60 44.89N	66 25.30W	355	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
55	CORE	2852034	60 56.72N	66 25.84W	805	HUDSON STRAIT	PISTON CORE. LENGTH: 1062 CM.
56	CORE	2852200	60 58.11N	66 29.73W	777	HUDSON STRAIT	PISTON CORE. LENGTH: 1181 CM.
57	CORE	2852325	61 04.26N	66 25.60W	790	HUDSON STRAIT	PISTON CORE. LENGTH: 1190 CM.
58	DRILL	2861730	61 31.89N	69 08.21W	346	HUDSON STRAIT	NORDCO DRILL. 16 CM. OF REDDISH/BROWN LIMESTONE.
58-G	GRAB/DRL	2861730	61 31.89N	69 08.21W	346	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
59	GRAB	2862349	61 31.86N	69 09.45W	355	HUDSON STRAIT	VAN VEEN GRAB.
60	DRILL	2881725	62 20.46N	71 50.30W	357	HUDSON STRAIT	NORDCO DRILL. LENGTH: 5 CM.
60-G	GRAB/DRL	2881725	62 20.46N	71 50.30W	357	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
61	GRAB	2881938	62 20.22N	71 49.40W	357	HUDSON STRAIT	IKU GRAB. 2ND ATTEMPT.
62	GRAB	2882110	62 17.89N	72 14.18W	320	HUDSON STRAIT	IKU GRAB.
63	GRAB	2891631	63 15.08N	72 46.61W	212	HUDSON STRAIT	IKU GRAB.

Table 64.1. (cont.)

STATION NUMBER	SAMPLE TYPE	JULIAN DAY/TIME	LATITUDE	LONGITUDE	DEPTH (MTRS)	GEOGRAPHIC LOCATION	NOTES
64	DRILL	2891855	63 15.19N	72 47.17W	209	HUDSON STRAIT	NORDCO DRILL. LENGTH: 8 CM. OF LIMESTONE.
64-G	GRAB/DRL	2891855	63 15.19N	72 47.17W	209	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
65	CORE	2902111	62 35.92N	76 07.02W	333	HUDSON STRAIT	PISTON CORE. LENGTH: 300 CM.
66	DRILL	2911837	63 49.77N	75 21.86W	230	HUDSON STRAIT	NORDCO DRILL. NO SAMPLE.
66-G	GRAB/DRL	2911837	63 49.77N	75 21.86W	230	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
67	GRAB	2912048	63 49.90N	75 22.23W	228	HUDSON STRAIT	IKU GRAB.
68	CORE	2921124	63 04.50N	74 18.55W	435	HUDSON STRAIT	PISTON CORE. LENGTH: 1060 CM.
69	CORE	2921343	63 14.00N	73 31.47W	305	HUDSON STRAIT	LEHEIGH CORE. NO SAMPLE.
70	GRAB	2921402	63 13.91N	73 31.29W	305	HUDSON STRAIT	IKU GRAB.
71	CORE	2921431	63 13.92N	73 31.33W	310	HUDSON STRAIT	LEHEIGH CORE. LENGTH: 34 CM.
72	DRILL	2921717	63 21.78N	73 03.97W	230	HUDSON STRAIT	BIO DRILL. NO SAMPLE.
73	CAMERA	2921802	63 21.84N	73 04.67W	232	HUDSON STRAIT	UMEL UNDERWATER CAMERA.
74	DRILL	2922011	63 21.76N	73 04.20W	225	HUDSON STRAIT	BIO DRILL. LENGTH: 10 CM
74-G	GRAB/DRL	2922011	63 21.76N	73 04.20W	225	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
75	DRILL	2922129	63 20.22N	73 04.22W	233	HUDSON STRAIT	BIO DRILL. NO SAMPLE.
75-G	GRAB/DRL	2922129	63 20.22N	73 04.22W	233	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
76	GRAB	2922223	63 20.81N	73 04.63W	230	HUDSON STRAIT	IKU GRAB.
77	DRILL	2930920	62 23.09N	72 44.94W	210	HUDSON STRAIT	BIO DRILL. LENGTH 48 CM.

Table 64.1. (cont.)

STATION NUMBER	SAMPLE TYPE	JULIAN DAY/TIME	LATITUDE	LONGITUDE	DEPTH (MTRS)	GEOGRAPHIC LOCATION	NOTES
77-G	GRAB/DRL	2930920	62 23.09N	72 44.94W	210	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
78	DRILL	2931220	62 23.09N	72 44.94W	210	HUDSON STRAIT	BIO DRILL. LENGTH: 35 CM.
78-G	GRAB/DRL	2931220	62 23.09N	72 44.94W	210	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
79	CAMERA	2931543	62 23.28N	72 45.61W	214	HUDSON STRAIT	UMEL UNDERWATER CAMERA.
80	DRILL	2931853	62 23.45N	72 45.77W	216	HUDSON STRAIT	NORDCO DRILL. LENGTH: 61 CM.
80-G	GRAB/DRL	2931853	62 23.45N	72 45.77W	216	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
81	CORE	2932120	62 15.03N	72 45.42W	151	HUDSON STRAIT	LEHEIGH CORE. NO SAMPLE.
82	GRAB	2932132	62 15.15N	72 44.98W	155	HUDSON STRAIT	IKU GRAB.
83	GRAB	2932201	62 14.95N	72 45.45W	155	HUDSON STRAIT	IKU GRAB.
84	GRAB	2940030	62 34.94N	72 45.43W	340	HUDSON STRAIT	IKU GRAB.
85	DRILL	2941518	62 27.02N	70 05.04W	210	HUDSON STRAIT	BIO DRILL. LENGTH: 45 CM
86	DRILL	2941713	62 26.69N	70 13.76W	250	HUDSON STRAIT	NORDCO DRILL. LENGTH: 45 CM.
86-G	GRAB/DRL	2971713	62 26.69N	70 13.76W	250	HUDSON STRAIT	GRAB SAMPLE TAKEN FROM THE LEG OF THE DRILL.
87	CAMERA	2941826	62 26.71N	70 13.59W	250	HUDSON STRAIT	UMEL UNDERWATER CAMERA.
88	CORE	2942037	62 26.85N	69 35.45W	143	HUDSON STRAIT	LEHEIGH CORE. EMPTY ON BOTH ATTEMPTS.
89	GRAB	2942049	62 26.90N	69 35.28W	143	HUDSON STRAIT	IKU GRAB.
90	DRILL	2951352	61 21.73N	70 21.27W	165	HUDSON STRAIT	NORDCO DRILL. LENGTH: 64 CM.
91	GRAB	2951544	61 21.84N	70 20.53W	164	HUDSON STRAIT	IKU GRAB.

Table 64.1. (cont.)

STATION NUMBER	SAMPLE TYPE	JULIAN DAY/TIME	LATITUDE	LONGITUDE	DEPTH (MTRS)	GEOGRAPHIC LOCATION	NOTES
92	CORE	2951747	61 12.50N	70 26.99W	171	HUDSON STRAIT	PISTON CORE. LENGTH: 249 CM. BENT CORE BARREL.
93	CORE	2951839	61 09.48N	70 29.98W	171	HUDSON STRAIT	LEHEIGH CORE. LENGTH: 100 CM.
94	CORE	2951854	61 09.27N	70 29.49W	171	HUDSON STRAIT	LEHEIGH CORE. LENGTH: 94 CM.
95	GRAB	2951928	61 10.09N	70 26.34W	143	HUDSON STRAIT	IKU GRAB.
96	CORE	2961629	61 20.72N	67 44.70W	392	HUDSON STRAIT	PISTON CORE. LENGTH: 717 CM. NO TRIGGER CORE.
97	CORE	2961735	61 20.69N	67 44.43W	392	HUDSON STRAIT	PISTON CORE. LENGTH: 162 CM. NO TRIGGER CORE.
98	DRILL	2962104	61 29.87N	67 30,84W	290	HUDSON STRAIT	NORDCO DRILL. 21 CM. ARGILLACEOUS LIMESTONE.
99	GRAB	2962317	61 29.92N	67 31.21W	285	HUDSON STRAIT	VAN VEEN GRAB.
100	DRILL	2971151	61 28.93N	66 08.72W	203	HUDSON STRAIT	NORDCO DRILL. NO SAMPLE.
101	GRAB	2971329	61 28.99N	66 08.95W	205	HUDSON STRAIT	VAN VEEN GRAB.
102	DRILL	2971857	60 53,14N	65 59.91W	798	HUDSON STRAIT	NORDCO DRILL. LENGTH: 2 CM. OF BROWN SANDSTONE.
103	GRAB	2972156	60 52,76N	65 01.77W	775	HUDSON STRAIT	VAN VEEN GRAB.
104	CORE	2980000	60 52.86N	65 29.52W	950	HUDSON STRAIT	LEHEIGH CORE. NO SAMPLE.

acoustically penetratable character of the strata (Fig. 64.5, 24-34 km), as previously noted by Grant and Manchester (1970), suggest that this section may contain the youngest beds in the strait, but whether they are in part equivalents of the adjacent Ordovician and Silurian rocks, or closely related to them stratigraphically, or significantly younger is not known.

Structural relationships

Calculations along profiles southward from Baffin Island into the eastern depression indicate that the Ordovician-Silurian sections attains a thickness of at least 800 to 930 m when corrected to 3 km/s and 4 km/s velocities, respectively[1]. Inclusion of the beds of the "Early paleozoic and Later" unit (Fig. 64.4) increases the probable minimum thickness to between 1650 and 2060 m. This is in agreement with Grant and Manchester's (1970) estimate of 2000 m depth to basement. They suggested a displacement of 600 m (water velocity) at the fault. The 85-027 cruise data suggest this may be as much 900 m or more after allowing for velocity corrections.

Thickness calculations for Ordovician and Silurian strata along a seismic profile from near Big Island in the north southeastward to the intersection with basement rocks 50 km east of Cape Hopes Advance (Fig. 64.9, section H-H[1])

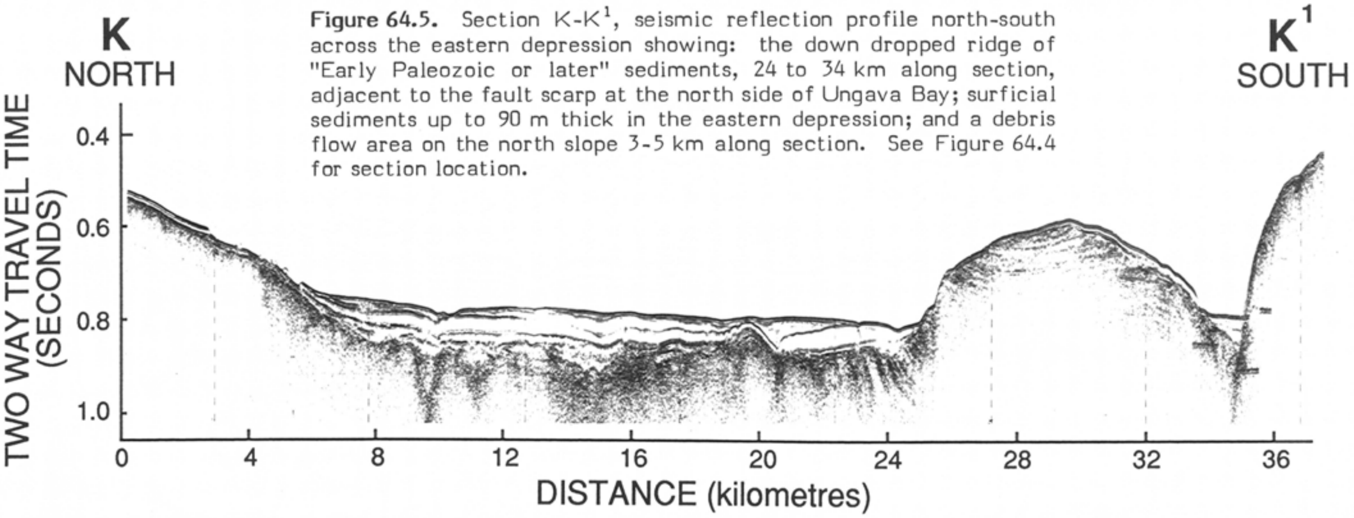

Figure 64.5. Section K-K^1, seismic reflection profile north-south across the eastern depression showing: the down dropped ridge of "Early Paleozoic or later" sediments, 24 to 34 km along section, adjacent to the fault scarp at the north side of Ungava Bay; surficial sediments up to 90 m thick in the eastern depression; and a debris flow area on the north slope 3-5 km along section. See Figure 64.4 for section location.

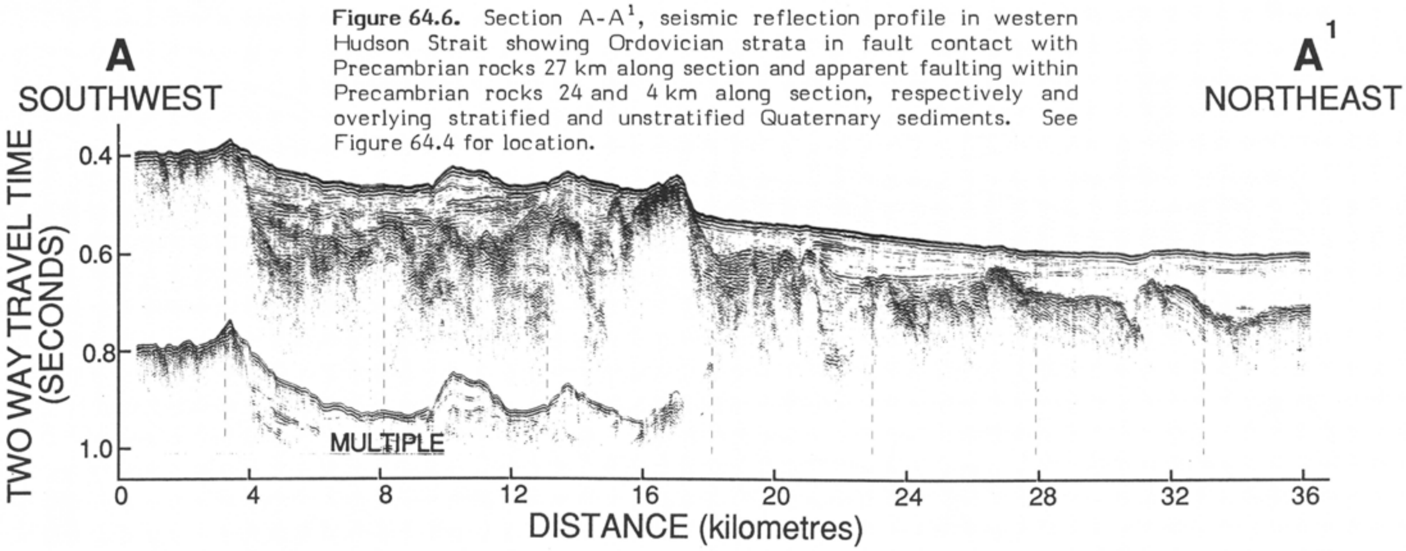

Figure 64.6. Section A-A^1, seismic reflection profile in western Hudson Strait showing Ordovician strata in fault contact with Precambrian rocks 27 km along section and apparent faulting within Precambrian rocks 24 and 4 km along section, respectively and overlying stratified and unstratified Quaternary sediments. See Figure 64.4 for location.

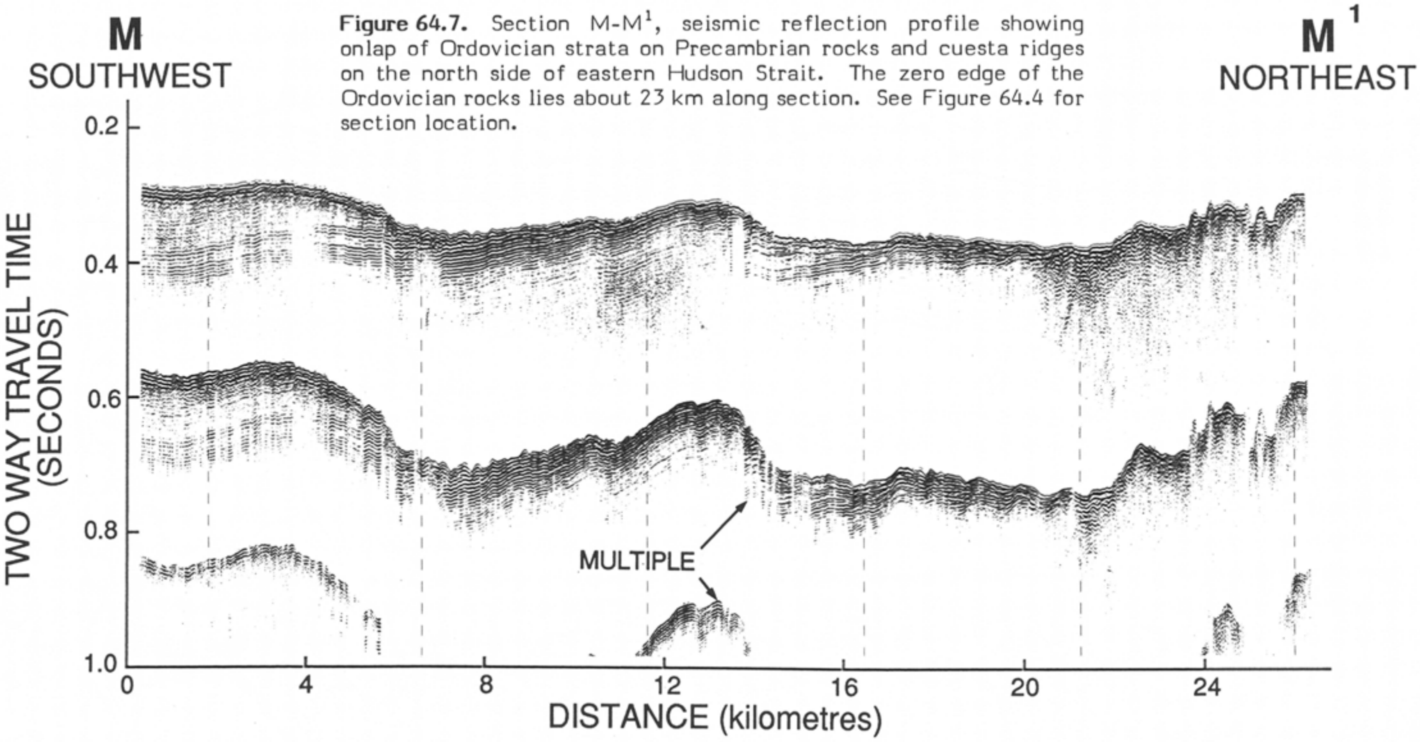

Figure 64.7. Section M-M^1, seismic reflection profile showing onlap of Ordovician strata on Precambrian rocks and cuesta ridges on the north side of eastern Hudson Strait. The zero edge of the Ordovician rocks lies about 23 km along section. See Figure 64.4 for section location.

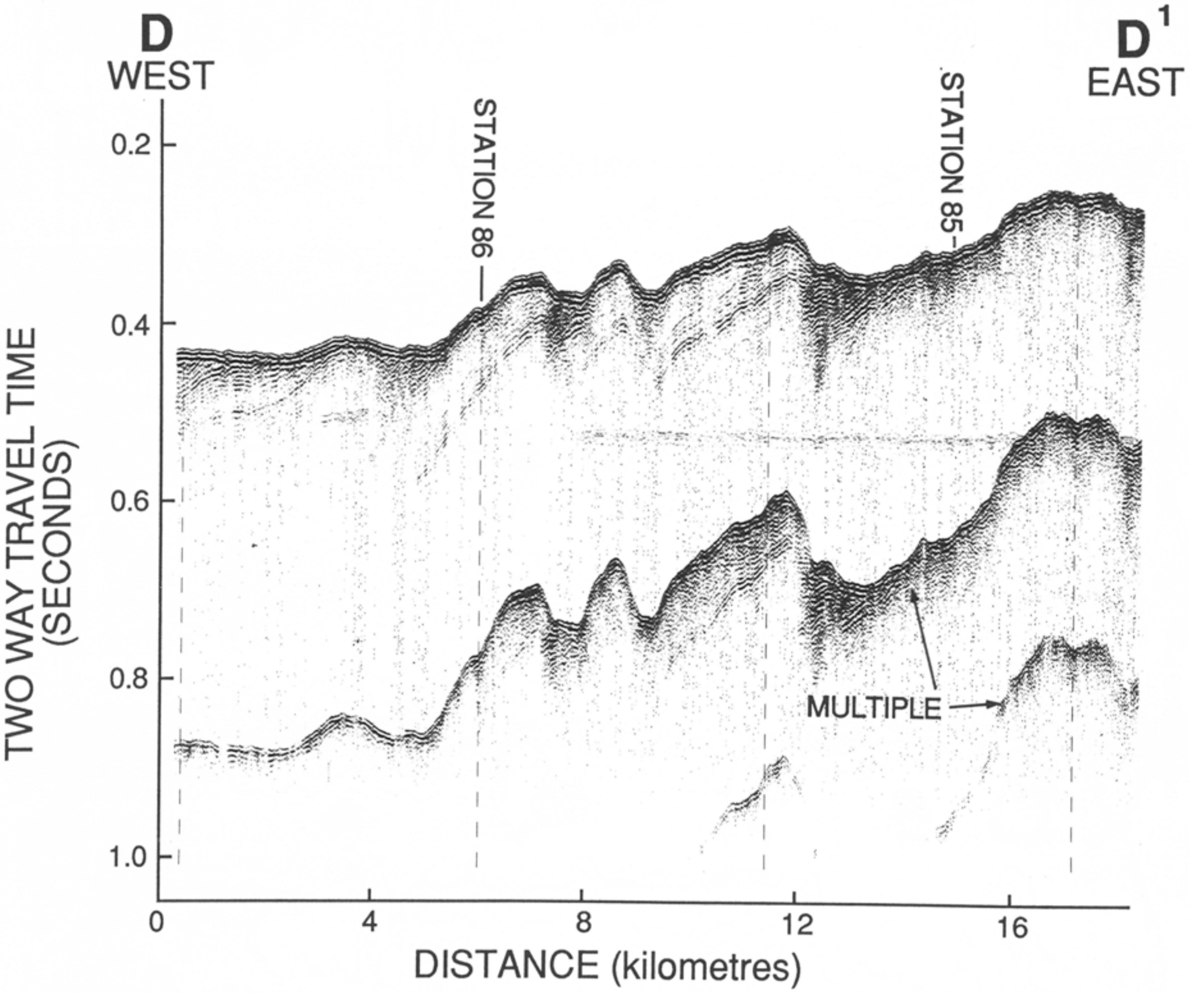

Figure 64.8. Section D-D^1, seismic reflection profile illustrating cuesta-like but possibly fault controlled ridges in Ordovician rocks near Big Island on the north side of the strait. Locations of samples stations 85 and 86 are indicated. See Figure 64.4 for section location.

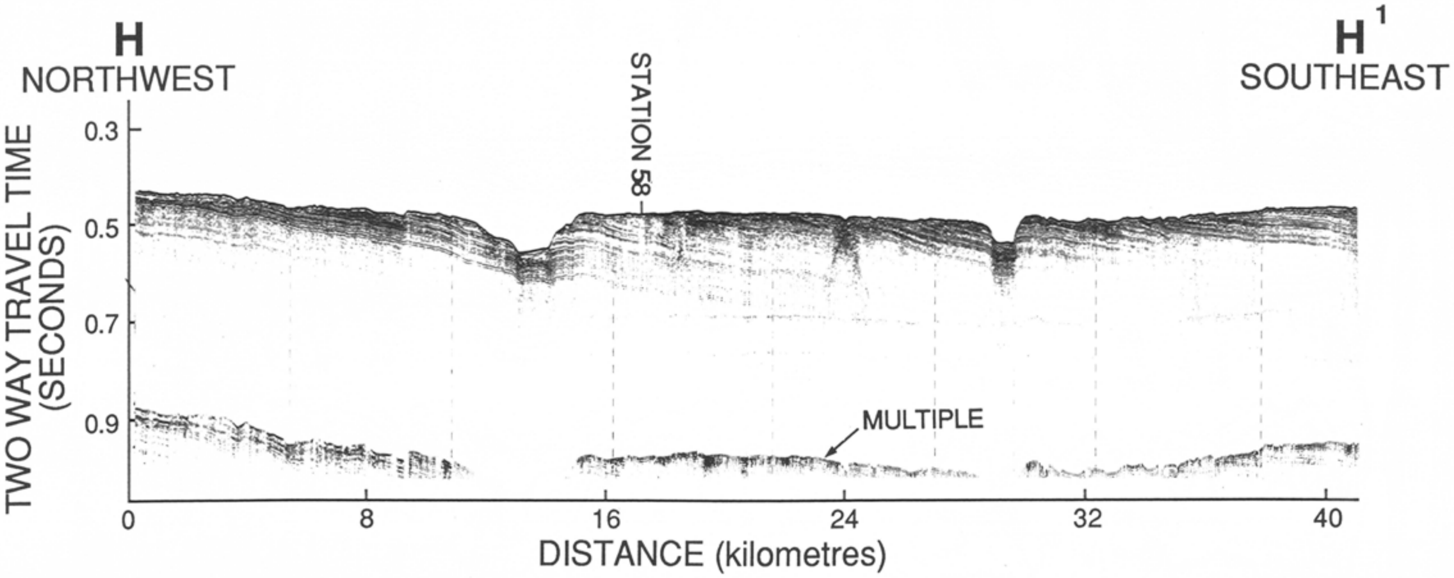

Figure 64.9. Section H-H^1, seismic reflection profile illustrating the southerly thickening succession of "Silurian" strata in eastern Hudson strait. These beds have been extensively bevelled by erosion. Two former erosional channels cut the strata. See Figure 64.4 for location.

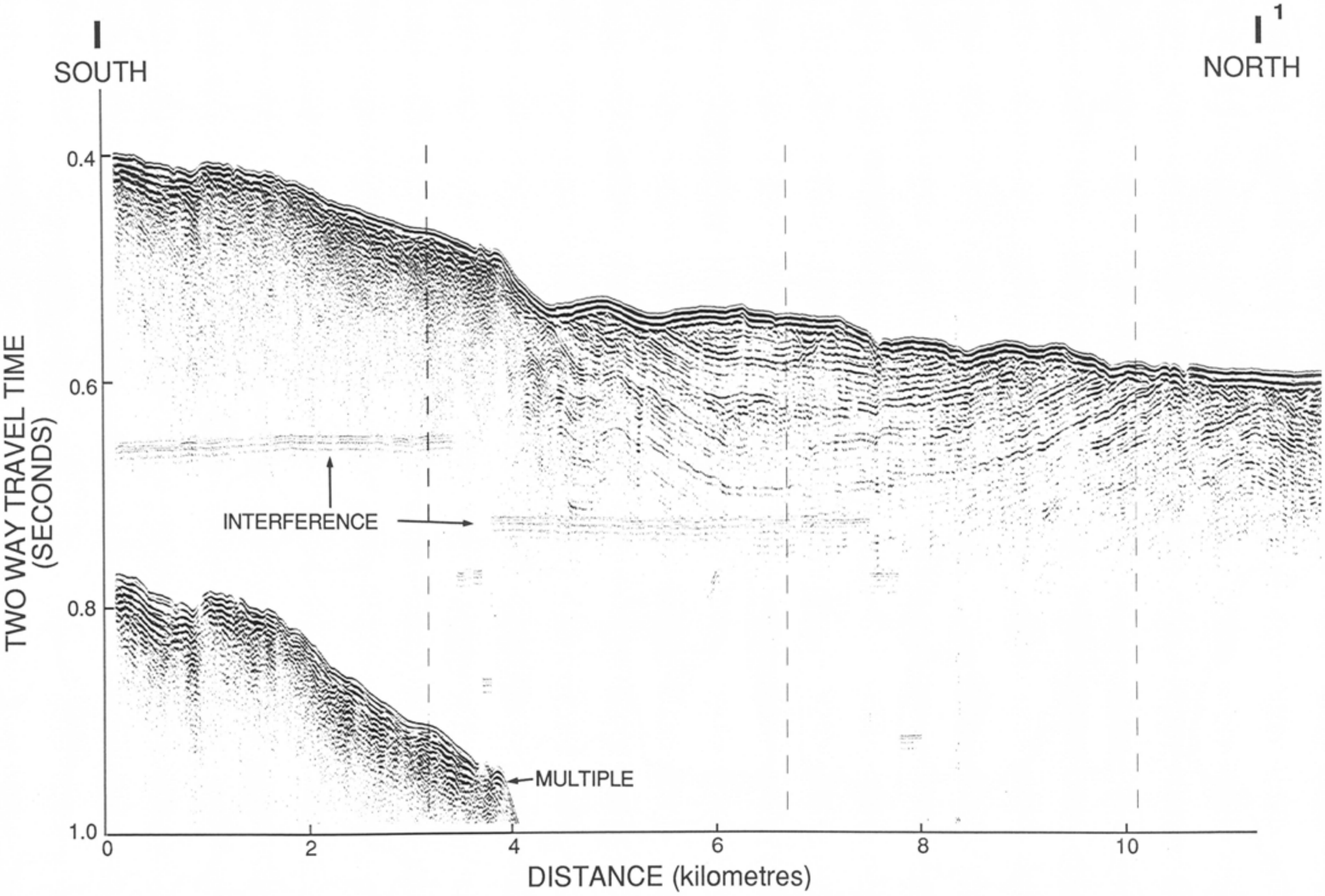

Figure 64.10. Section I-I^1, seismic reflection profile showing "Silurian strata" in fault contact with Precambrian rocks on the south side of the strait 65 km east of Cape Hopes Advance. Calculations of the strata thickness suggest that some 875-1170 m of vertical movement has occurred at the fault. See Figure 64.4 for location.

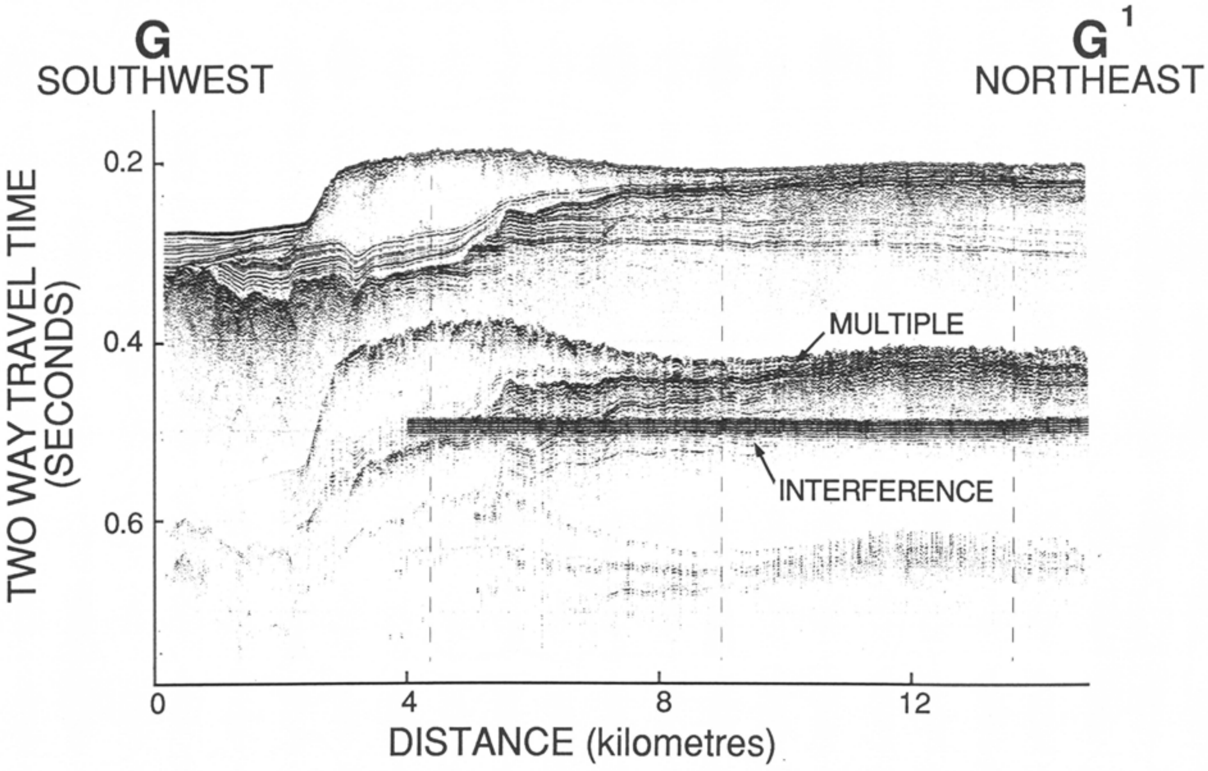

Figure 64.11. Section G-G^1, seismic reflection profile showing a moriane up to 70 m thick lying on earlier stratified sediments ofpresumed Quaternary age, which unconformably overlie truncated Ordovician strata and Precambrian rocks on the south side of the strait 52 km west of Cape Hopes Advance. Shoreward of the moraine the underlying Quaternary sediments are unconformably overlain by a younger sequence of stratified sediments. See Figure 64.4 for location.

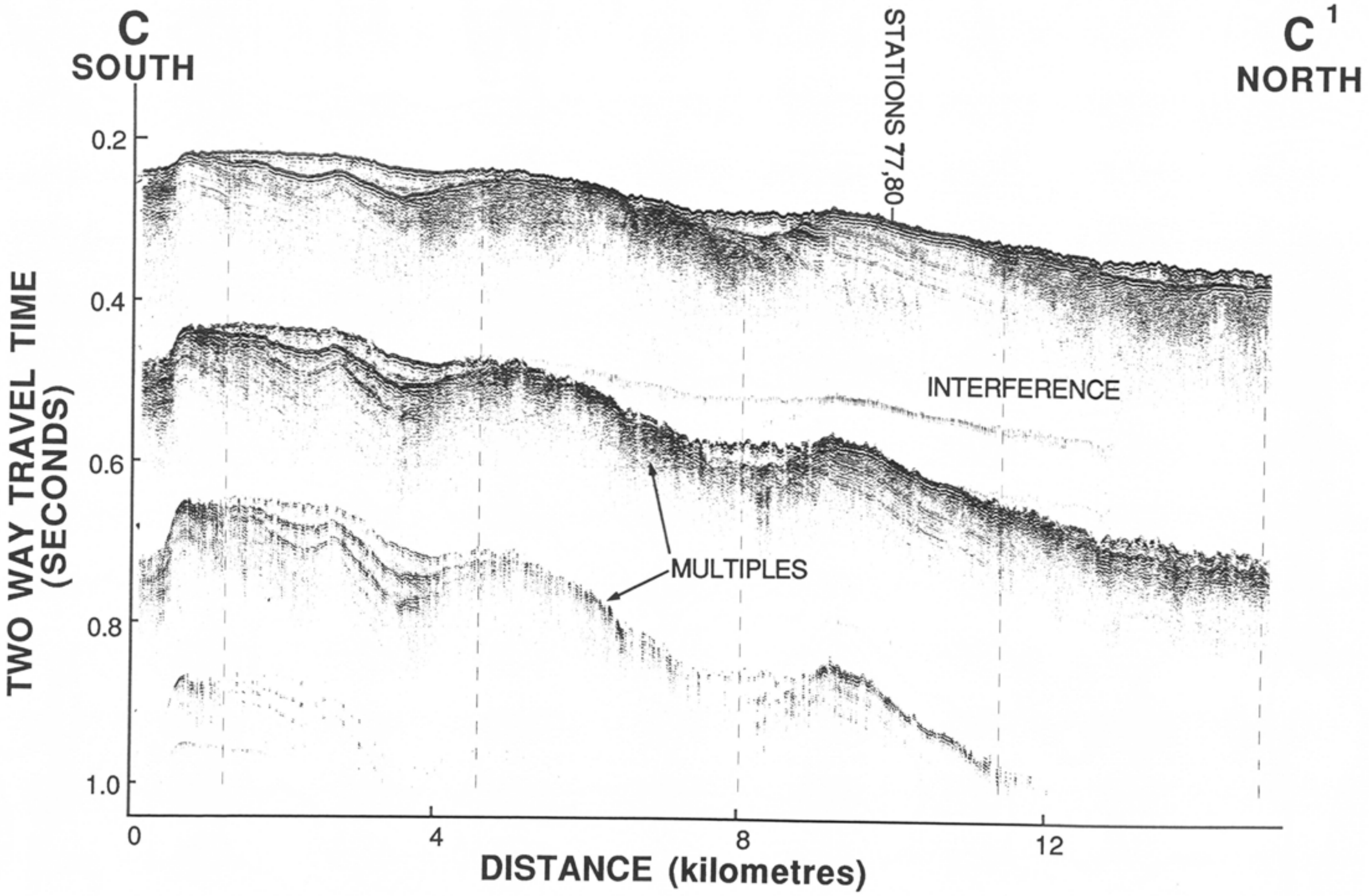

Figure 64.12. Section C-C[1], seismic reflection profile showing cuesta ridges in northward dipping Ordovician strata on the south side of the strait. Glacial drift up to 30 m thick fills the depressions on the bedrock surface. See Figure 64.4 for location.

indicate the section at the south side of the strait in this area is 875 to 1170 m thick assuming velocities of 3 km/s and 4 km/s respectively[1]. The strata here are in fault contact with the Precambrian rocks (Fig. 64.10) and displacement is in the order of 875 to 1170 m on the basis of the measurements and velocities indicated above[1]. This is in good agreement with the calculated displacement farther east indicated above.

Where intersected 52 km west of Cape Hopes Advance the structure there has become more synclinal in character. Ordovician rocks at the contact with the Precambrian have been truncated by erosion (Fig. 64.11). If there has been faulting at this contact it is not evident that the displacement is as large as that farther east. Some structural adjustment, however, occurs at a fold flecture 61 km to the northeast. About 175 km to the west, (Fig. 64.12), a cuesta development in Ordovician rocks on the south side of the strait is covered by Quaternary sediments and is not unlike cuestas along the north side of the strait.

Structural disturbance recorded by the Paleozoic strata in Hudson Strait thus appears to be most intense along the fault north of Ungava Bay.

Surficial sediments

Information on unconsolidated surficial sediments was obtained with high resolution and single channel seismic reflection systems along tracks indicated in Figure 64.2 and from eight piston cores, eighteen grab samples, and three camera stations during cruise 85-027 (Table 64.1). Locations of these and previous sample stations are indicated in Figure 64.3. Bulk samples were also obtained from surficial sediments adhering to the legs of the drill at several stations.

Hudson Strait is an important area in terms of the Quaternary history of the region. It has been regarded as a major dispersal route for glacial ice from one or more inland ice centres. Evidence on eastern Meta Incognita Peninsula (southeastern Baffin Island between Frobisher Bay and Hudson Strait) indicative of northeastward movement of ice has been interpreted to indicate impingement of Hudson Strait ice (Blake, 1966; Stravers, 1986) and also inundation by ice flowing out of Ungava Bay and across Hudson Strait from a dispersal centre on Labrador or Ungava (e.g. Miller, 1982; Andrews and Miller, 1983).

The presence of till in the seafloor of Hudson Strait, moraines, and multiple tills on the shelf at its eastern entrance testify that glacial ice has occupied Hudson Strait. Analyses of the samples obtained during cruise 85-027, except for a preliminary assessment of coarse fraction (gravel size) lithologies, are as yet incomplete and textural, paleontological and geochronological data which are important to delineating the history of late Quaternary events in the strait are not yet available. However, data from the acoustic profiles do permit a preliminary outline of surficial sediment thickness and to some extent their general makeup.

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[1] Determinations on samples from the Ordovician unit indicate velocities in the order of 5-6 km/s (P. Ryall and C. Walls, personal communication, 1986). Probable section thicknesses thus are 100-200 m greater than indicated.

Surficial sediments are generally thin (5-10 m) throughout most of the strait and preferentially thicken in the deep basins (Fig. 64.13). They often completely infill minor bedrock depressions thus smoothing the seafloor morphology of Hudson Strait. Greatest accumulations are found in the eastern and western basins where sediments reach 90 m and 130 m in thickness, respectively (e.g. Fig. 64.5, 64.15). In Ungava Bay the most significant accumulations (up to 70 m) also occur within basins (Grant and Manchester, 1970).

The seismic records indicate that the surficial sediments in Hudson Strait consist of four or more unstratified and stratified units, although the complete sequence is not everywhere present. The stratigraphy is complex in some areas, for example in the thick sedimentary sequence of the eastern basin (Fig. 64.5, 64.14) and in some morainal occurrences (Fig. 64.11).

The lowermost of the surficial units recognized generally is acoustically unstratified and massive, and is interpreted as till (Fig. 64.15). The contact with overlying sediments is well defined and locally the unit thickens to form mounds or ridges interpreted as moraines (Fig. 64.16). Surface and subsurface deposits of till appear to be widespread in the floor of Hudson Strait.

The till unit is overlain in the basins by an acoustically massive unit that is nearly transparent on the Huntec records and appears to lack internal reflectors (Fig. 64.14). The upper contact of this unit commonly is well defined but sometimes is irregular and poorly defined. The origin of this unit has not been established. Acoustically similar units occur in the sediment sequences of Lake Melville (G. Vilks, personal communication, 1985), in Scott Trough on the northeastern Baffin Island shelf, and in the fiords of Baffin Island (Gilbert, 1982). Huntec data indicate that acoustically similar material occurs on the north side of the eastern depression in Hudson Strait where sediments from a debris flow have come to rest adjacent to the bottom of the slope (flow area and sediment accumulation are illustrated in Fig. 64.5, 3-9 km along the profile). The subbottom unit in Hudson Strait thus may represent debris flow sediments. Alternately, a lightly compacted, relatively fine grained till containing few coarse clasts would probably have similar

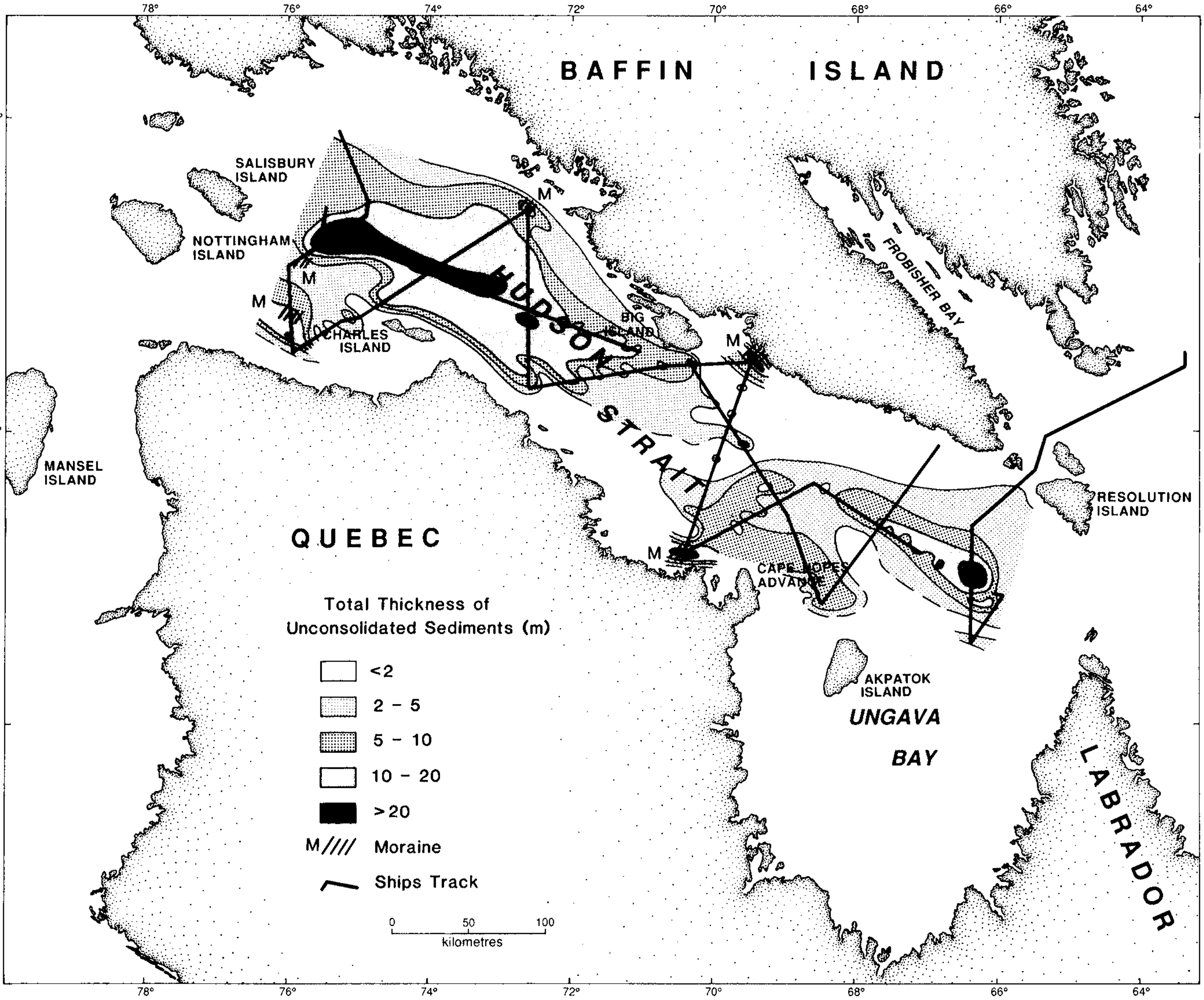

Figure 64.13. Isopach map of Quaternary sediments in Hudson Strait. The interpretation refers only to areas investigated in Hudson Strait in 1985.

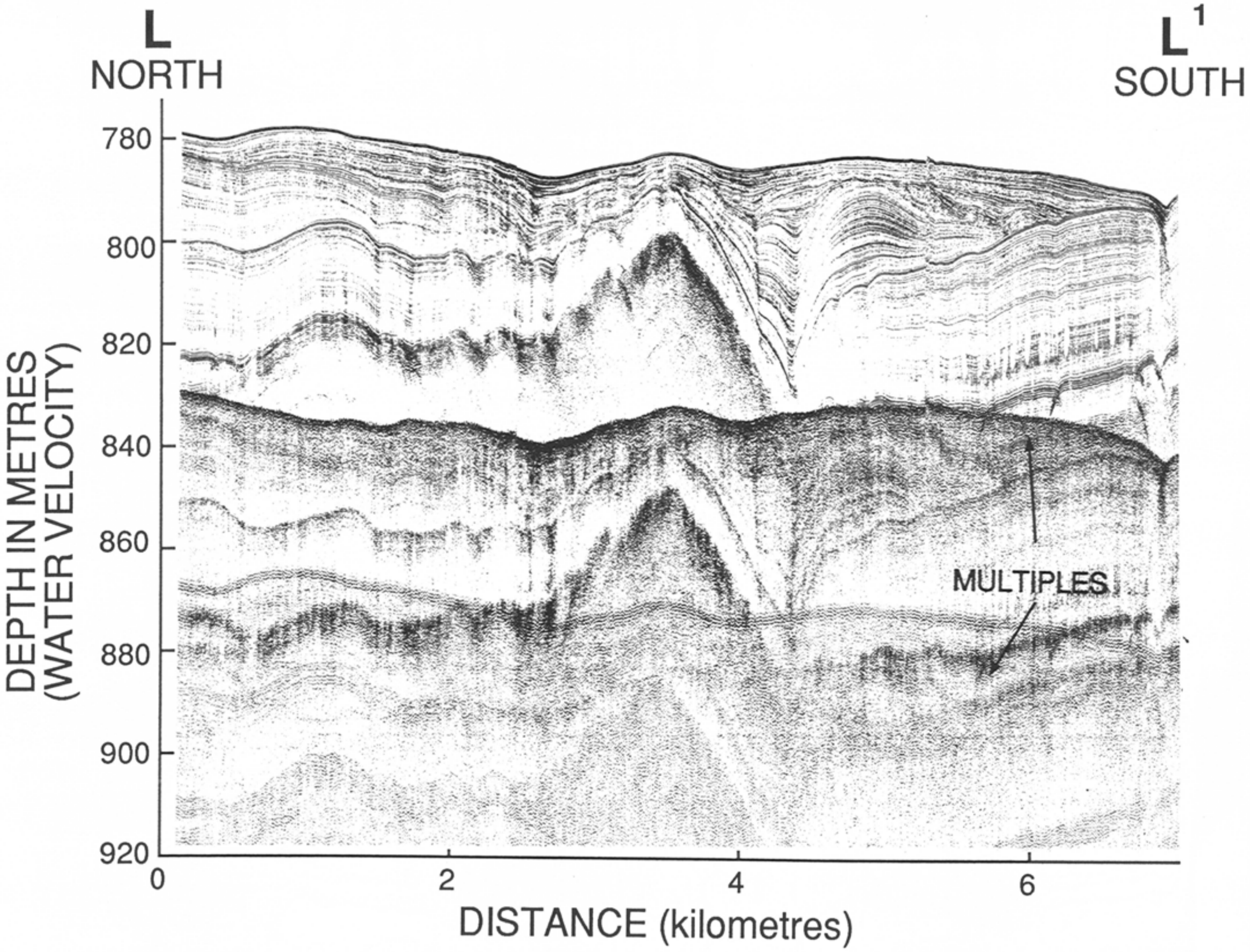

Figure 64.14. Section L-L^1, Huntec high resolution seismic reflection profile illustrating the complex pattern of sediment deposition in the eastern depression. This figure provides greater detail of the area between 16 and 24 km in section K-K^1 (Fig. 64.5).

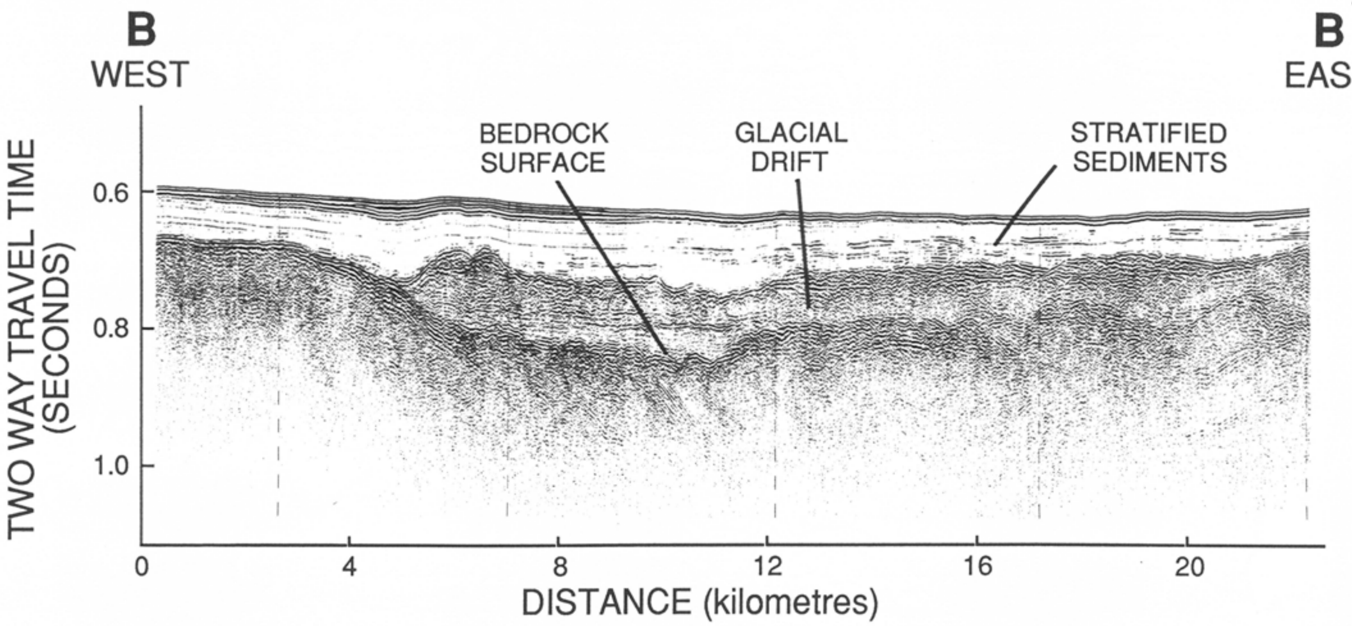

Figure 64.15. Section B-B^1, seismic reflection profile illustrating sediments in the western depression consisting of two or more tills up to 70 m thickness overlain by stratified sediments of about equal thickness. See Figure 64.4 for location.

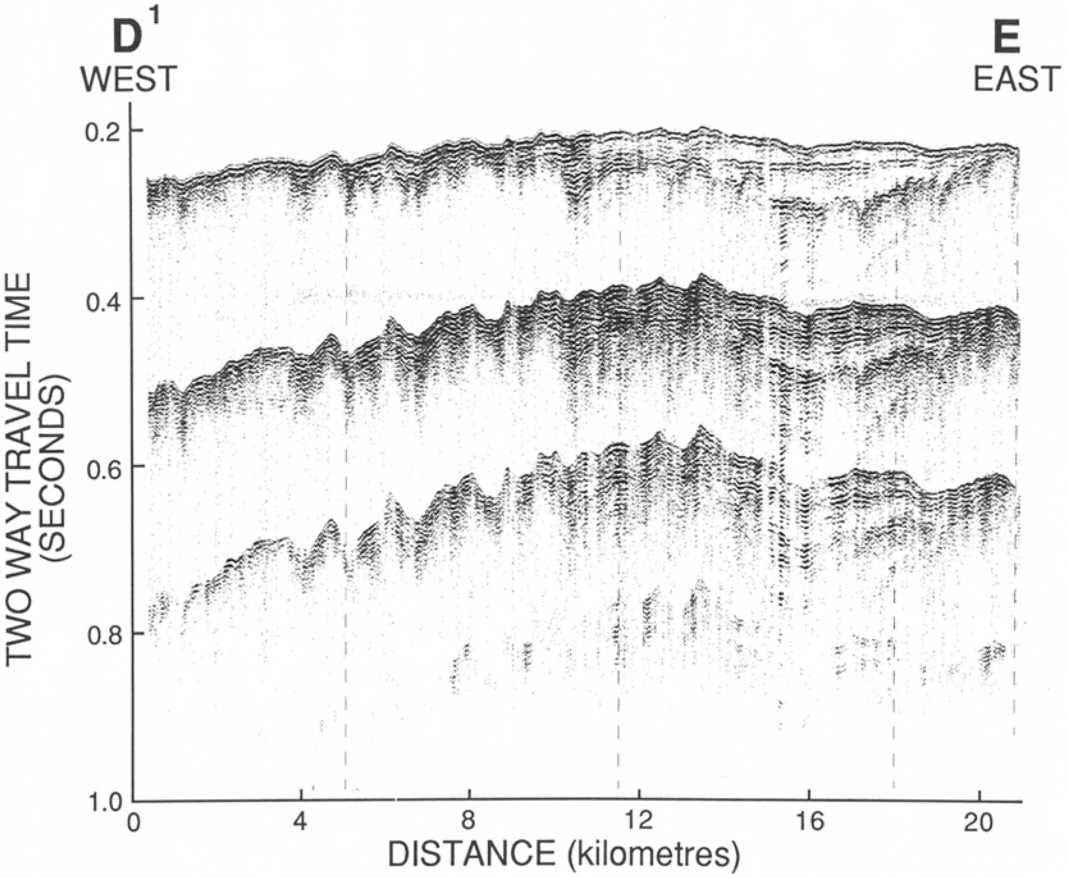

Figure 64.16. Section D^1-E, seismic reflection profile showing multiple till deposits forming moraines near Big Island on the north side of the strait. See Figure 64.4 for location.

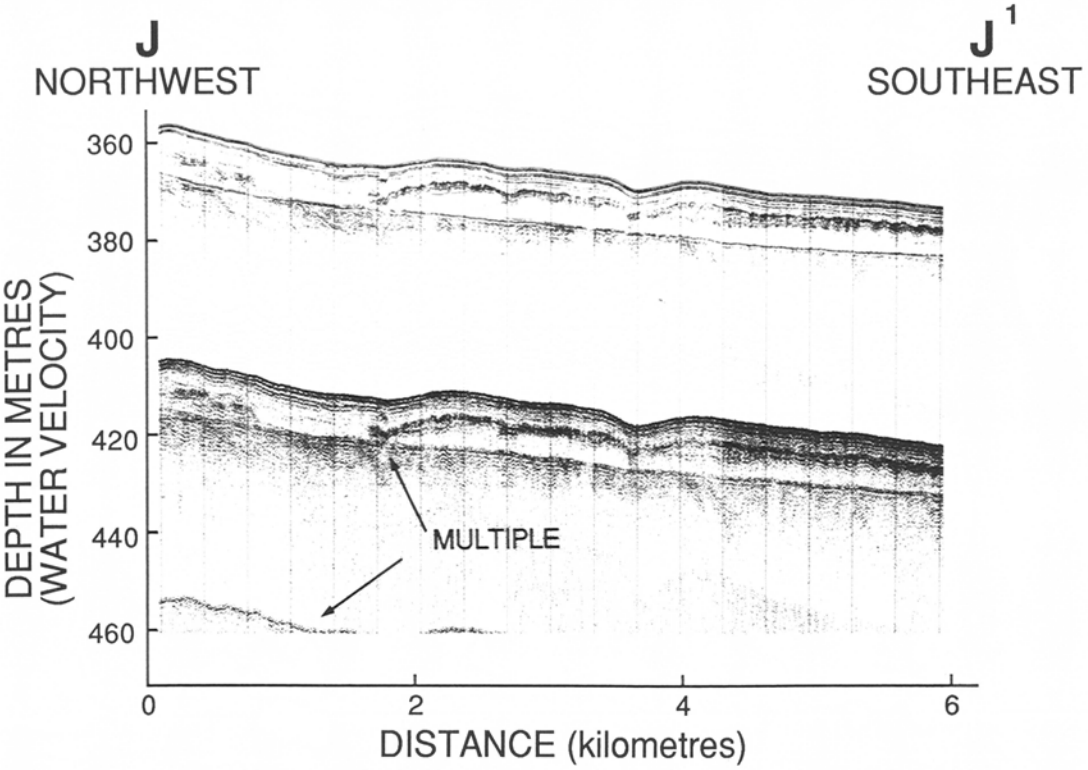

Figure 64.17. Section J-J^1, Huntec high resolution seismic profile illustrating glacial till up to 5 m thick lying on a smooth gently sloping erosional surface on "Silurian" rocks in eastern Hudson Strait. The till is overlain by 1-2 m of a stratified basal diamicton and 5-6 m of softer stratified sediments. See Figue 64.4 for location.

acoustic characteristics. Gilbert (1985) suggested the Baffin fiord unit may consist of fine sediments deposited in quiescent conditions when the glaciers that were the major source of sediment supply had retreated.

The massive units in many areas are overlain by stratified sediments (Fig. 64.15, 64.17) that consist of mud, sandy mud, and some pebbles. The acoustic data indicate that two or more acoustic units often are represented in these sediments. The lower part of the section commonly is characterized by well-defined, evenly spaced acoustic reflectors that are generally conformable with the surface of the underlying sediments.

The uppermost part of the section is well to poorly stratified on acoustic profiles, and the reflecting layers generally are not as well defined as in the underlying sediments. The boundary between these units in some areas is unconformable. In the eastern basin the stratified sediments can be divided into at least three units on the basis of their unconformable relations (Fig. 64.14), but they do not differ significantly from one another in acoustic character. Cores previously collected from sediments in the eastern basin 52 km east of where seismic profiles and cores were obtained in 1985 yielded dates of 8730 and 9100 years BP on shells from core depths 102-110 and 200-300 cm (Fillon et al., 1981; Fillon and Harmes, 1982) and 22 900 BP (Beta No. 8899) on total organic matter from a core depth of 540-550 cm. Extrapolation of these data to acoustic units basin wide is not yet possible because of the complex stratigraphy.

Most of the grab samples collected during cruise 85-027 appear to represent sediments deposited in glacial or glaciomarine environments; post-glacial sedimentation appears to be minimal and represented by relatively thin accumulations that are mainly restricted to basinal areas. The samples indicate that a gravel lag or partially modified sediments apparently resulting from winnowing by seabottom currents are prevalent in many areas except in the deeper parts of the strait where finer sediments and presumably quieter current conditions prevail.

Preliminary studies of pebble lithologies in grab samples indicate there are up to three times as many sedimentary as crystalline rock fragments. The sedimentary rock debris is typically carbonate, carbonate cemented sandstone and mudstone, and is commonly fossiliferous. Possible sources of this material include Palozoic successions in Foxe Basin, Hudson Bay and the floor of Hudson Strait and Ungava Bay. Red clastic sandstones represent less than 1%, although they are a widespread component. The crystalline rock debris is typically grey gneiss and granitic rock characteristic of northern Quebec and southern Baffin Island. Indicator rocks, which are rocks having more clearly defined bedrock source areas, include iron-formation from the circum-Ungava fold belt, and volcanic rocks from the fold belt in northern Quebec. Volcanic rocks, although uncommon, are scattered throughout the strait. Iron-formation, icluding oolitic jasper and hematite and magnetite fragments, appears restricted to the eastern reaches of the strait (approximately east of the longitude of Akpatok Island). The pebble fraction of grab samples from the moraine 52 km west of Cape Hopes Advance is predominantly (80%) of crystalline lithology in contrast with sediments elsewhere in the strait that typically are composed of 50% or more of sedimentary rock. The cyrstalline composition of the rocks of the moraine suggests a northern Quebec origin for the ice that deposited this moraine, although the data are not considered conclusive.

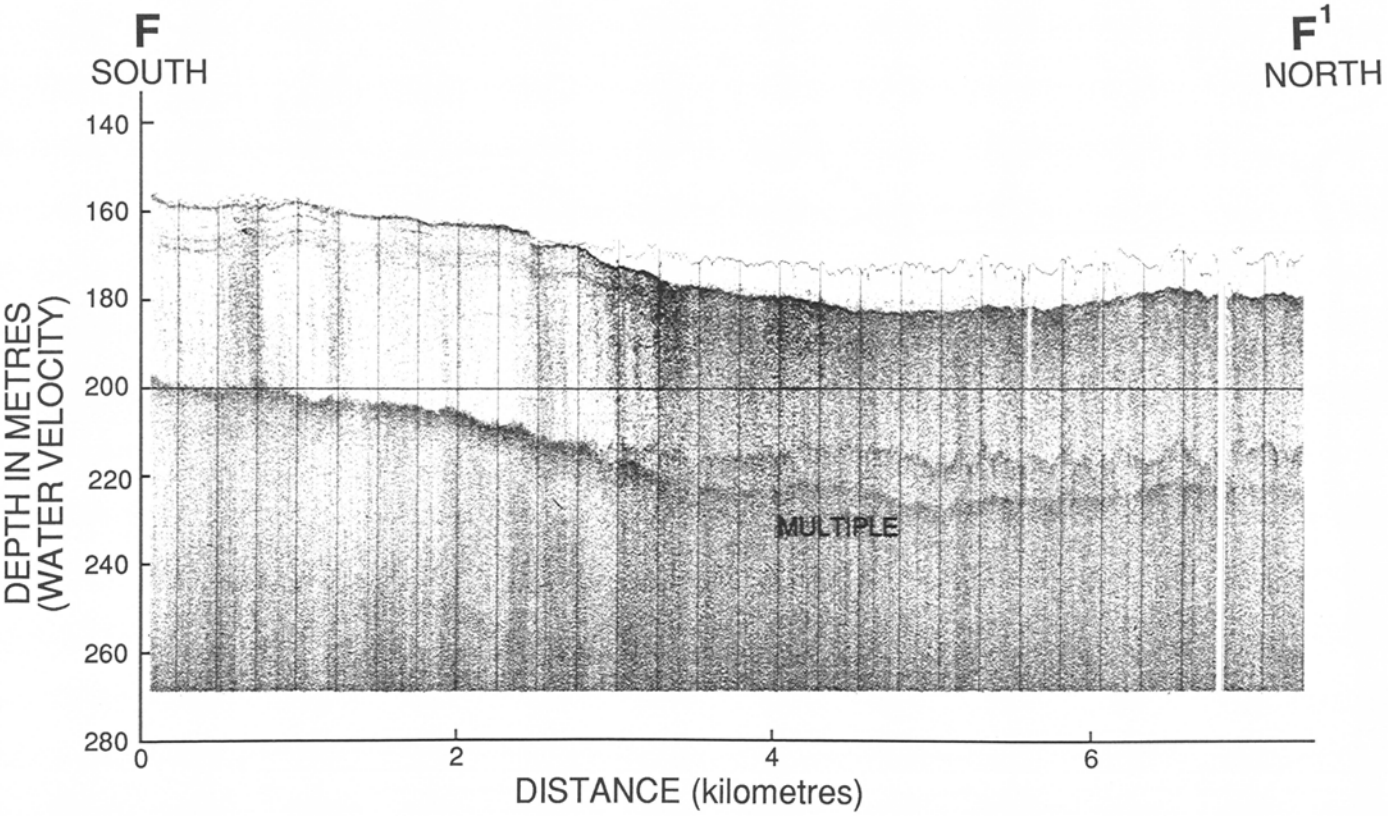

Figure 64.18. Section F-F^1, Huntec high resolution seismic profile illustrating intensely ice scoured, unstratified, acoustically transparent till or other ice modified sediment exposed at the seafloor in 160 m of water. The surficial sediments range from 0 to 12 m in thickness. See Figure 64.4 for location.

Morainal accumulations of glacial sediments have been observed at several localities. Fifty-two km west of Cape Hopes Advance a moraine overlies stratified sediments of presumed Quaternary age at the bedrock contact between Paleozoic strata and Precambrian cystalline rocks (Fig. 64.11). Southwest of the moraine, toward the coast of northern Quebec, stratified sediments underlying the moraine are unconformably overlain by a younger sequence of stratified sediments. Multiple tills occur in a moraine near Big Island on the north side of the strait (Fig. 64.16), and in the western part of the strait, southeast of Nottingham Island two stratigraphically superimposed moraines of contrasting acoustic character are present. The older of these is significantly more acoustically opaque and massive than the succeeding one.

At present the extent of the moraines along the coasts, and their origins are not known. Those observed all lie west of Ungava Bay and thus may be related either to ice flowing into the strait from adjacent land areas, or to ice flowing generally eastward along the strait.

Post depositional modification of the surficial sediments through scouring by grounded icebergs is evident in Hudson Strait down to depths of 350-365 m below sea level (e.g. Fig. 64.18). Scours reach to 5 m in depth and, from limited sidescan sonar records, generally trend along the east-west axis of the strait. As indicated previously, modification of sediments has also occurred through winnowing by seabottom currents and locally through slumping or debris flows.

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