Bedford Institute of Oceanography

Field Report
90300

COASTAL STUDIES IN THE CANADIAN ARCTIC ARCHIPELAGO

Brock, Devon, Prince Patrick and the Polynia Islands, N.W.T.

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ABSTRACT

Field surveys in 1990 included the examination of more than 20 coastal sites along Prince Patrick, Brock and the Polynia Islands. Oblique aerial video of the Polynia Island shores and 235 km of the northern coast of Prince Patrick Island provide the first continuous aerial record of these shores since the vertical photography taken in 1960. A large paleo-shore ridge fringes the Arctic Ocean from Prince Patrick to Borden Island and along some of the adjoining channels. The ridge is 3 to 11 m in height and it can occur up to 0.5 km inland. It is suggested, on the basis of surficial sediment sampling and surveying at eight coastal sites, that this paleo-shore ridge is the product of episodic sea ice ride-up or ice pile-up and minor reworking by wind and sea. Local variations in ridge crest elevation by as much as 7 m can occur as a result of differing exposure to sea ice pressure. Nevertheless, a general decrease in shore ridge elevation in a southwest direction across the study area suggests regional delevelling. The age of the ridge is unknown. Plant debris collected in 1990 from the base of the shore ridge on west Brock Island produced a ^{14}C age of 5820 ± 130 years BP. Sea level history in the area is poorly defined. However, the presence of swash ridges overtop of backshore colluvium and drowned river estuaries along the southern shores of Prince Patrick Island suggest recent coastal transgression. The reworking of the paleo-shore ridge by sea ice may be further evidence of recent submergence. Evidence of recent submergence along the more northern shores, e.g. Brock Island, is present but not as clear.

Sequential coastal surveys along selected beaches on southwest Devon Island since 1968 have confirmed that the older "raised" beach ridges can experience episodic change, particularly at the distal end of coastal forelands and spits. As much as 40 m of Cape Ricketts, including three raised beach ridges, were removed during the 22 year observation period. Since the mid-1980s the cape has begun to recover and prograde with the formation of a major new beach ridge. In Radstock Bay drift-aligned, gravel beach ridges have developed through a long term wave cut and build process. The lower beach slope was initially built up and then sediment was transferred to the upper beach slope (above HTL) and the seaward edge of the lowest "raised" beach. The observed beach changes are interpreted as a natural response to a decrease in sediment supply , particularly from alongshore and offshore, and the need to derive sediment from the older beach deposits.

TABLE OF CONTENTS

<u>Cover Photo</u> : An aerial view of one of the Polynia Islands showing the distinctive ridge that marks the present shoreline. The ridge is roughly 4 m asl and is composed of sand and gravel derived from the unlithified Beaufort Fm (photo by R. B. Taylor, July 1990).

INTRODUCTION

Responsible Agency Geological Survey of Canada

Geological Survey of Canada [GSC] projects 900018, 760010
Polar Continental Shelf Project [PCSP] programs 243-90, 88-76
Northwest Territories Scientific Research Licence 10119

Areas of Operation (Fig. 1,2)

Queen Elizabeth Islands, District of Franklin, N.W.T. :
Phase 1: Prince Patrick and Polynia Islands
Phase 2: Brock Island
Phase 3: Southwest Devon Island (Fig.1, 2)

Dates of Operation

Phase 1: July 4 - 11 1990
Phase 2: July 11 - 20 1990
Phase 3: July 20 - 24 1990

Objectives

(1) To extend the coastal geological information base and to build on a sedimentological model for beach development (Taylor and Forbes, 1987) for the northwest Arctic Archipelago by extending aerial video coverage to these shores and by examining 'type' coastal settings on Brock, Prince Patrick and Polynia Islands.

(2) To determine the processes responsible for the formation of the large shore ridge observed along Brock, Prince Patrick and the Polynia Islands.

(3) To compile evidence of recent relative sea-level changes in the northwest Arctic Islands.

(4) To measure longer term (18-22 yr) shoreline changes at established survey sites along Barrow Strait.

Quaternary geological investigations and ground-truth measurements for aerial photographic analysis of the surficial sediments and terrain were also primary objectives of the field program led by D. A. Hodgson. Only the coastal observations are discussed in this report.

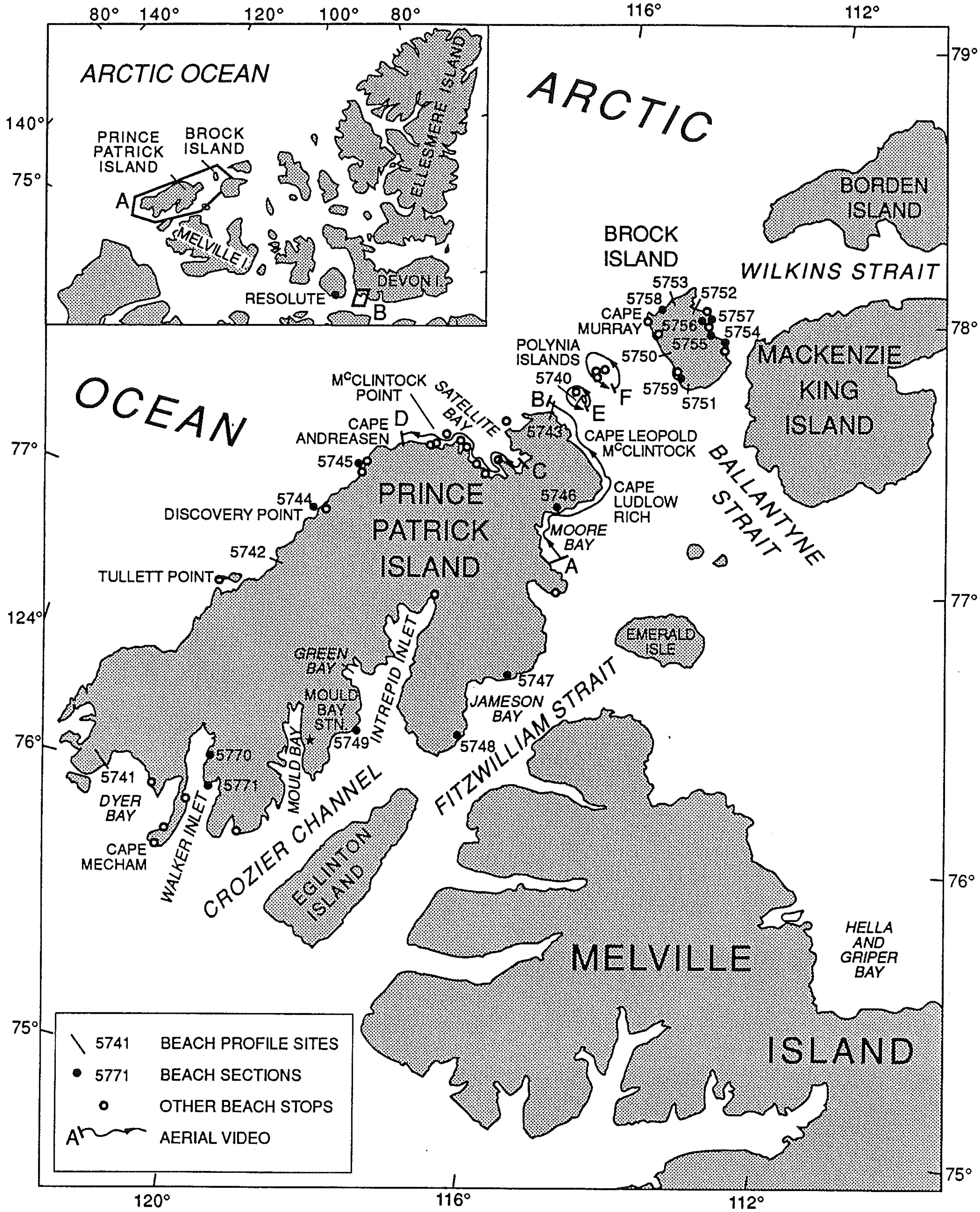

Figure 1. The 1990 coastal field program was completed in areas A and B (inset) within the Canadian Arctic Islands. Location map (1:2 million scale) of area A shows the locations of all beach sites examined as well as the coverage of aerial oblique video completed during the first two phases of the 1990 program. Figure 2 provides a more detailed map of study area B.

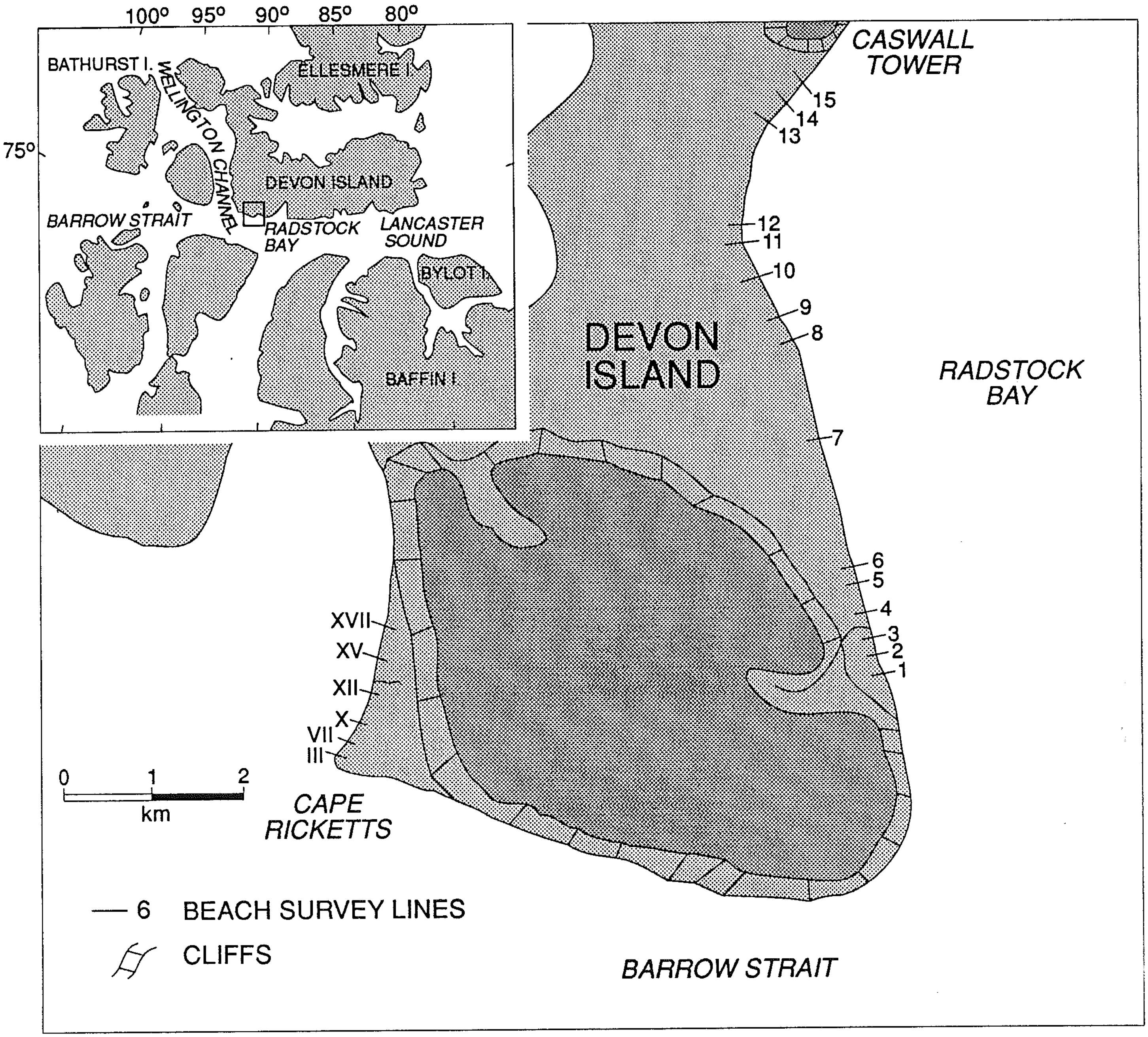

Figure 2. Map of study area B (Fig. 1-inset) showing the location of beach lines surveyed along the shores of Cape Ricketts (site 5581) and Radstock Bay (site 5583), southwest Devon Island.

Personnel

R. B.	Taylor	(GSC)	coastal geologist
D. A.	Hodgson	(GSC)	Quaternary geologist
N.	Giroux	(student)	field assistant
V.	Cobb	(Canadian Helicopters)	pilot
J.	Fisher	(Canadian Helicopters)	pilot
G.	Haydon	Kenn Borek Air	pilot

Transport

air: DeHavilland-Canada Twin-Otter CG-XXB (large tires)
(Kenn Borek Air Services, Calgary Alberta)
Bell Helicopter 206 CG-CSH and CG-AHT (on floats)
(Canadian Helicopters, Calgary, Alberta)

ground: 3 Honda-110 all-terrain cycles [ATCs]

SUMMARY OF OPERATIONS

Phase 1

Personnel at the Polar Continental Shelf Project [PCSP] base at Resolute Bay (Fig. 1) provided logistics support for the 1990 field operations. Taylor arrived in Resolute Bay on July 3 after an overnight stop in Montreal. During mid-afternoon on the 3rd of July, all field gear was organized and prepared for shipment to the Atmospheric Environment Service (AES) weather station at Mould Bay, Prince Patrick Island (Fig.1). Helicopter CG-CSH left for Mould Bay on July 3 and Hodgson and Giroux were transferred by Aklak Airways to Mould Bay from their previous field camp location on Banks Island. Taylor departed Resolute Bay on July 4 at 13:30 Central Standard Time (CST) after the fog lifted, and arrived at Mould Bay Station at 17:30 Atlantic Standard Time (AST). The Twin Otter transported 5 barrels of jet fuel to the abandoned Satellite Bay wellsite airstrip for use during the helicopter surveys. After supper an aerial reconnaissance was made along coastal summits between Mould Bay and Walker Inlet (Fig. 1) to look for evidence, e.g. striae, erratics, of former glacial ice movements. The helicopter returned to the Mould Bay Station at 23:00 AST.

July 5 09:15: Clear and sunny weather. Flew to Discovery Point, on the northwest coast of Prince Patrick Island where altimeter measurements, photographs and pits were dug in 6-10 shore ridges located between Discovery Point and Cape Leopold M'Clintock (Fig. 1, 3). After refuelling, a flight was made to the Polynia Islands where additional measurements were made of shore ridges, particularly on the southern island (Site 5740, Fig. 1). A potential camp site (for phase 2) on the northeast part of Brock Island was inspected for fixed-wing landing and a brief search for dateable shell and organic material was made along two of the larger river valleys on southwestern Mackenzie King Island. By late afternoon many fog banks had formed over the sea ice, reducing visibility and flying conditions. Returned to the Mould Bay station by 20:30 AST via the east coast of Prince Patrick Island.

July 6 09:00: Variable cloud cover with intermittent rain showers. A series of sites were visited along Walker Inlet, and Dyer Bay to look for evidence of glacial ice movements and elevated shorelines, and also to examine the seaward edges of the Beaufort Fm. (Fyles, 1990). At the same time observations were made of several coastal types, including colluvial shores, high talus-banked and low rill- washed slopes, and ice-modified shores (Fig. 1, 4, 5). A shore survey was completed at site 5741 at the head of Dyer Bay (Fig. 1, Appendix 2). Returned to Mould Bay station at 17:00 AST.

July 7 09:00: Hodgson and Giroux flew to examine Quaternary deposits in central Prince Patrick Island while Taylor completed aerial photographic analysis of coastal types and prepared the video equipment for aerial surveys. Oblique aerial video coverage of the Prince Patrick Island coastline was begun in Moore Bay at 15:00 AST. (Fig. 1, Appendix 3). The flight continued in a northwestward direction toward Cape Leopold M'Clintock where low stratus clouds (< 50 m altitude) prevented further coverage. Video was resumed at the head of Satellite Bay (following refuelling) at 17:00 AST and continued southward along the west coast to Cape Andreasen, where low stratus clouds again prevented photography. Some problems with the camera focus were encountered during the latter part of the filming. The helicopter flew at an altitude of 100-130 m, and a cruising speed of 60-75 mph, except where low clouds forced the helicopter to fly as low as 60 m altitude. Total video coverage completed on July 7 was 235 km. Arrived back at Mould Bay station at 19:30 AST.

July 8 09:00: Flew toward the north coast of Prince Patrick Island but the helicopter was turned back at Green Bay by freezing rain. A small raised beach sequence (Site 5749, Fig. 1) was examined at the small embayment north of Disappointment Point. Returned to Mould Bay until 13:00 when the weather cleared sufficiently to allow us to fly north again. A stop was made along Moore Bay at beach site 5746 (Fig. 1). Aerial video coverage of the two larger of the Polynia Islands began at 15:56 and was completed at 16:24 AST (Fig. 1, Appendix 3). Shore profiles were completed at sites 5740 and 5743 (Fig. 1, 6) and then another attempt was made to video tape the shores between Cape Leopold M'Clintock and Satellite Bay but fog rolled in and again prevented video taping of that coast. Aerial observations of the small islands fringing the west coast of Prince Patrick were also limited. However, one stop was made at an island (Site 5745) south of Cape Andreasen where a sediment sample was collected and observations were made of the extensive shore ice piles (Fig. 3c). Arrived back at

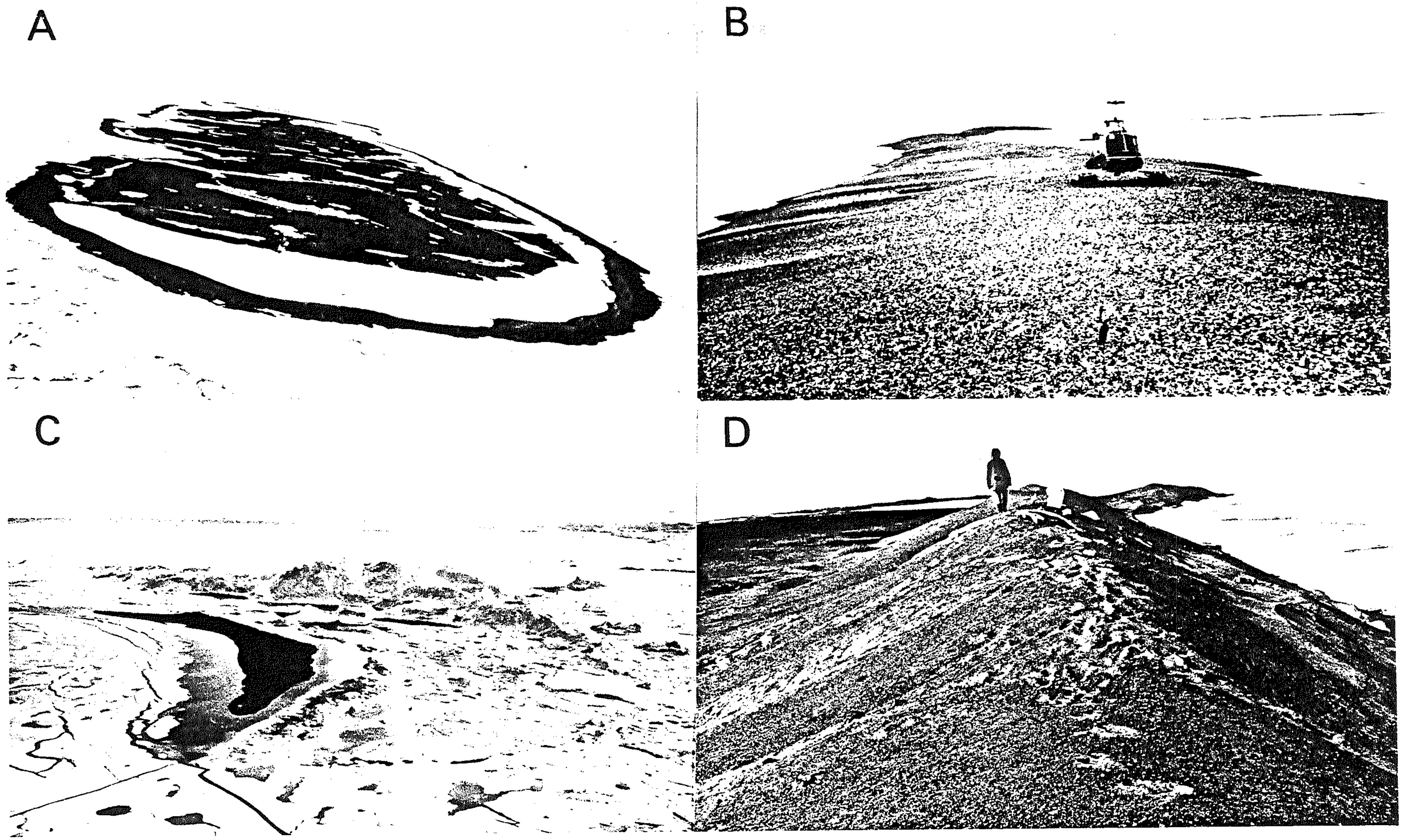

Figure 3. A distinctive shore ridge or berm has formed along the Arctic Ocean and adjacent shores. The sand and gravel ridge fringing the Polynia Islands, (A) Aerial view and (B) ground view, are analogous to the sea ice built ridges around artificial islands in the Beaufort Sea. Sea ice pile-ups commonly marked the seaward edge of the small islands off western Prince Patrick Island. At site 5745 the ice piles extended to elevations of 30 m asl (C). A large shore ridge such as the one at Tullett point (D) has been built over the tundra surface. The age of the ridge is unknown however the whale bone shown pushed up on this ridge (D) yielded a ^{14}C age of 980 ± 130 years (Dyck et al., 1966).

Mould Bay station about 21:30 AST.

July 9 09:15: Travelled to the northern end of Intrepid Inlet, Moore Bay and the unnamed inlet which lies between the two, to look for evidence of former glaciations and marine limits. Aerial observations of the shoreline of Intrepid Inlet and the western shore of Fitzwilliam Strait were completed along with stops at sites 5747 and 5748 (Fig. 1, 4, 5). Returned to the station by 17:30 AST. Hodgson and Giroux resumed Quaternary investigations in the vicinity of Walker Inlet between 18:30 and 21:30 AST while Taylor examined the sheltered shores of a small embayment (Site 5770) along east Walker Inlet.

July 10 08:30: Flew toward Discovery Point on the west coast of Prince Patrick Island. Stopped at a river bank exposure in the central Island where a peat bed was sampled. The sample was collected for a more detailed analysis by J. V. Mathews Jr (GSC) to determine its age, ie. whether the deposit is part of the Beaufort Fm or a younger Quaternary deposit. At the outer coast low stratus clouds restricted visibility. A shore profile was surveyed at site 5742 (Fig. 1) approximately 20 km north of Tullett Point. At Tullett Point fog prevented further travel to the south however a brief reexamination was made of the site where, in 1964, J. Fyles sampled a beached whale which yielded ^{14}C ages of 930 to 1110 years BP (GSC -355, 488, 489, Dyck et al., 1966). Returned to Mould Bay station by 13:30. The helicopter departed for Resolute Bay by 15:00. This marked the end of Phase 1. The remainder of the day was spent organizing gear for the camp move to Brock Island and going over field notes from the past six days.

Phase 2

July 11 12:30: Transferred personnel and equipment by Twin Otter to the new base camp (77° 55.5' N, 114° 12' W) on Brock Island. The camp was 5 km inland of beach site 5755 (Fig. 1). Plane picked up the empty fuel drums which had been cached at Satellite Bay, and returned them to Resolute Bay. Spent next four hours establishing camp and preparing the ATC's for travel the next day. At 19:00 CDT radio contact was made with PCSP Resolute Bay.

July 12 07:00: Weather observations and radio contact with PCSP. Travel overland on Brock Island can be extremely difficult in fog because of the low relief and the similar visual appearance of most streams. Since the weather was clear and sunny (Appendix 4) it was decided to travel to the west coast and back to camp along the north coast if the visibility remained good. Altimeter heights of the shore ridge and a detailed survey of the ridge at Site 5750 (Fig. 1) were completed. At site 5750 a stream cut was cleared off to allow a rare examination of sediment facies within the shore ridge. Control elevations marked on topographic map 89D (1:250,000) were remeasured and found to be incorrect by as much as 10 m (100%). J. Fyles observed a similar

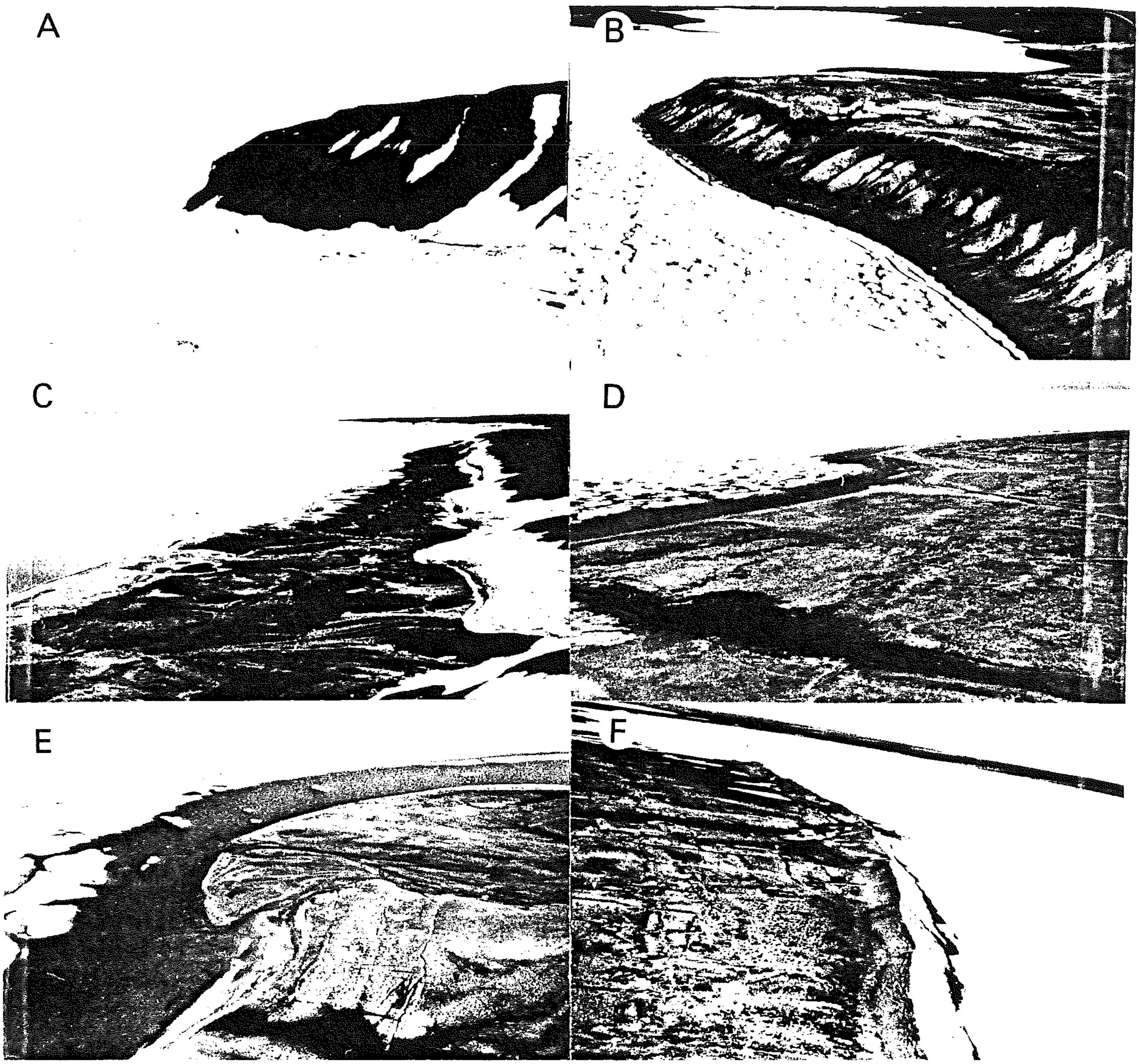

Figure 4. Coastal environments of Prince Patrick Island. The southeast coast with its higher relief is dominated by colluvial shores of differing morphology and composition including: (A) talus banked rock cliffs, (Cape Mecham), (B) steep, gullied colluvium (Intrepid Inlet) and (C) lower, rill-washed slopes (Jameson Bay). Sandflat (D) shores are most common along the eastern and northeastern coast. Large braided river deltas (E) and coalescing delta fronts are found along the lower east and west coast. Along western Prince Patrick the shores are composed of sand and gravel from the unlithified Beaufort Fm (Fyles, 1990). These shores are characterised by a large, narrow shore ridge (F- Dyer Bay) which overlies an older backshore surface.

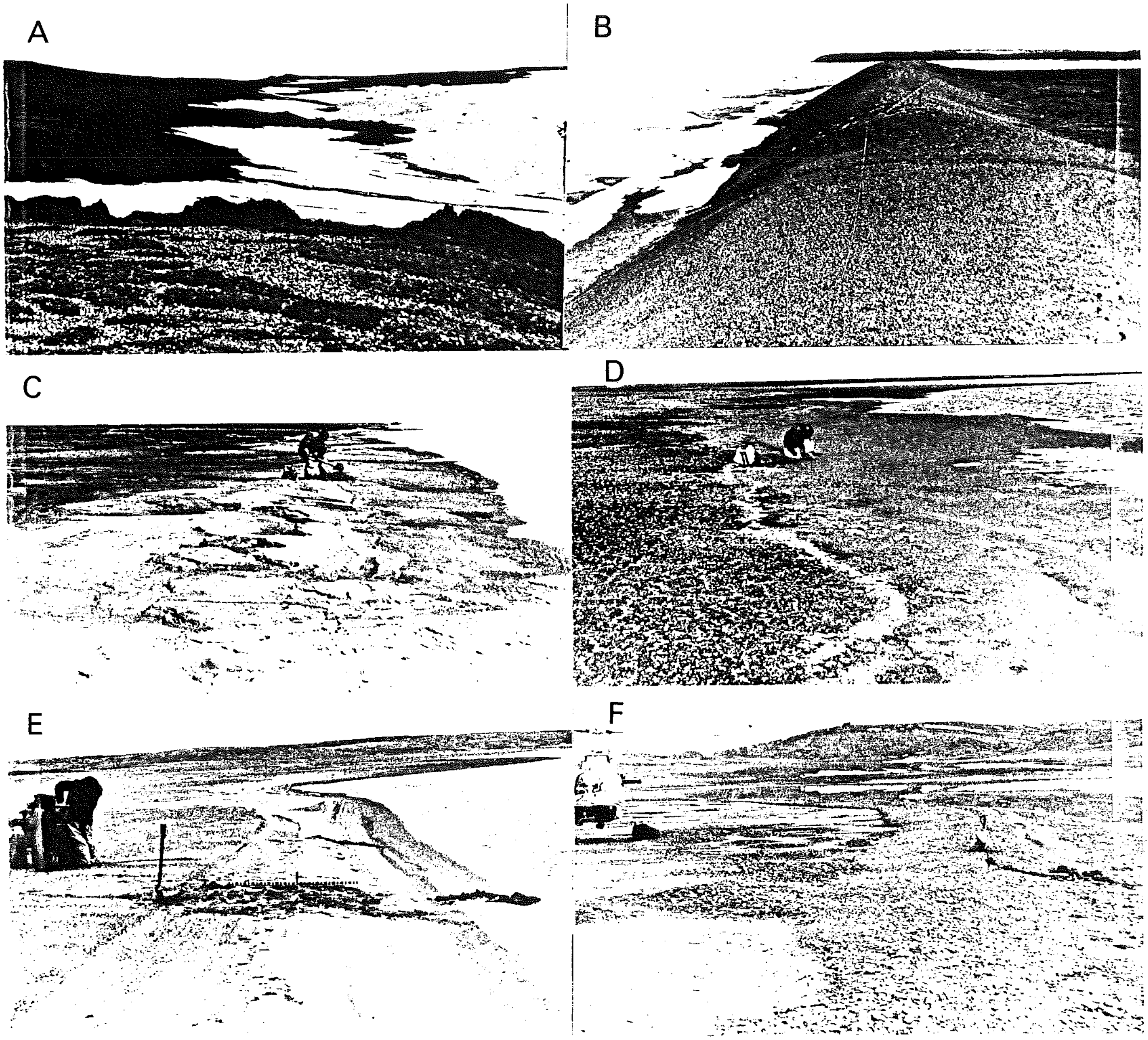

Figure 5. Beach morphology within study area A. Many of the steeper shores were fringed by semi-permanent snow patch (A- site 5757, N.E. Brock Is.). A steep sloping, sand and gravel ridge marked the Arctic Ocean shores (B- site 5742, W. Prince Patrick Is.) whereas a low ice-modified sand berm marked much of the east coast of Prince Patrick Is. (C-site 5747). Wave-formed features were almost non-existant along the low gradient east shore (D-site 5755) but were better developed within the small embayments of northeastern Brock Is. (E-site 5752). Small gravel beach ridges were most common along southern Prince Patrick Is. (F-site 5771).

inaccuracy of 6-7 m with these spot heights in 1964. Returned to camp at 19:30 CDT; completed weather observations and radio contact with PCSP.

July 13 07:00 : Weather observations and radio contact with PCSP. Travelled to the east central coast which is underlain by late Triassic sandstones of the Pat Bay Fm. Pits were dug at several shore sites, (5755-5757, Fig. 5d) and marine shells were sampled for radiocarbon dating from the bank of one river and two coastal headlands. Returned to camp by 18:00 CDT; weather observations at 19:00, but poor radio reception with PCSP.

July 14 07:00: Weather observations and radio contact with PCSP. Travelled overland to the southwest corner of the Island where a survey of a large linear shore ridge (Site 5751, Fig. 1, 6) was completed in fog. Observations were also made along the intertidal flats and the cut banks of a large stream (site 5759). The marine water appeared to extend hundreds of metres inland along the larger streams. The carrier on one ATC broke and equipment loads had to be redistributed; furthermore some difficulties were encountered crossing some of the smaller, mud-filled creeks. Returned overland to camp by 19:00 CDT; weather observations and radio contact with PCSP.

July 15 07:00: Weather observations and radio contact with PCSP. Travelled overland to the northeast coast which is very irregular in both profile and plan form (Fig.5a). A detailed survey of a suite of beach ridges formed from Beaufort Fm material was completed at site 5752 (Fig. 1, 5e). Observations of beach morphology and sediment also were recorded enroute to the survey site. Hodgson traversed and sampled many hill tops and river banks in an attempt to understand the Quaternary evolution of this hilly area. Returned overland to camp by 18:00 CDT. Weather observations and radio contact with PCSP at 19:30.

July 16 07:00: Weather observations and radio contact with PCSP. Traversed overland via the larger stream channels to the north coast to complete a detailed survey and sampling of an arcuate shaped shore ridge (Site 5753, Fig. 1, 6). An abundance of Precambrian boulders was observed near Cape Murray at the northwestern end of the Island. Sources may be either the mainland shield or northern Ellesmere Island, however additional analysis will be required to identify the source of these erratics. Hodgson returned to the east coast of the island to continue investigations of the hilly terrain. Both survey groups met back at camp by 19:00 prior to a major deterioration in weather (Appendix 4). Radio contact with PCSP at 19:30.

July 17 07:00: Weather observations and radio contact with PCSP. Strong southwesterly winds and rain delayed departure to the southeast coast until 10:00 CDT. Travel was difficult along this shore because of very soft, wet shores below the

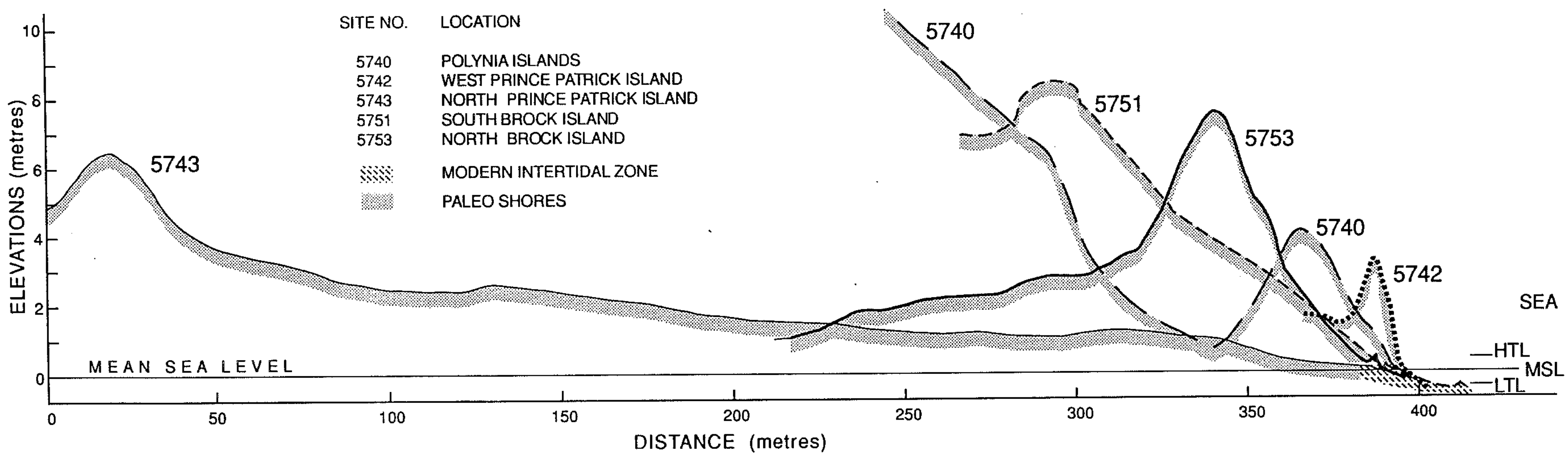

Figure 6. Surveys were completed across the shore ridge at selected sites. A general decrease in ridge height in a north to south direction along the Arctic Ocean coast suggests a delevelling. However local variations in ridge height occurred because of varying exposure to sea ice pressures. The ridge existed farthest inland along the north and south shores of Ballantyne Strait (e.g. Site 5743). The ridge, except site 5751, was composed of Beaufort Fm sand and gravel. Refer to Figure 1 for site locations.

snowpatches, and very sharp felsenmeer along the upper slopes. Observations were completed for approximately 10 km alongshore to site 5754 (Fig. 1). Headed overland for camp by 15:30 because of very strong winds and rain. Fog blanketed the island for the remainder of the day. Weather observations and radio contact with PCSP at 19:30 CDT. Strong winds persisted throughout the night.

July 18 07:00: Weather observations and radio contact with PCSP to determine whether the Twin Otter was going to move us to Prince Patrick Island today. Strong winds, low overcast skies and later fog and snow showers prevented the camp move. Labelled samples and worked on field notes. Weather observations and radio contact with PCSP at 19:30 CDT.

July 19 07:00: Weather observations and radio contact with PCSP. Fog and drizzle still persisted on Brock Island. By mid-day the satellite pictures received at Resolute Bay showed clearing in the western Arctic but our low ceiling would prevent most planes from attempting a landing. However at 16:30 we were informed that CF-XXB was one hour away from our station. Camp was dismantled only after the aircraft had landed. Flew toward Green Bay on eastern Prince Patrick Island but after several attempts to find an opening in the low cloud the Twin Otter was forced to fly to Rea Point on east Melville Island to refuel because Mould Bay was also reporting poor weather. We remained in Rea Point until 20:30 CDT and then flew toward Green Bay and Mould Bay station. Only one opening was found in the clouds near Mould Bay station where we arrived at 01:30 CDT July 20. This ended phase 2 of the field program.

Phase 3

July 20 08:00 AST: Received weather forcast from Resolute Bay and Mould Bay. Although low cloud cover and drizzle persisted an attempt was made at 09:00 to reach Green Bay and Resolute Bay. Hodgson and Giroux were left to set up camp at Green Bay. However, poor weather in Resolute Bay forced the Twin Otter back to Mould Bay station where Taylor spent the day transcribing taped field notes. Departed Mould Bay for Resolute Bay at 17:20 CDT and arrived at approximately 20:30 after a brief stop to deliver mail to Walker River field camp, Bathurst Island.

July 21 08:00 CDT: The helicopter scheduled to assist with the coastal surveys in Barrow Strait was weathered in at Truelove Inlet, Devon Island. Poor weather in Resolute Bay also prevented other aircraft from reaching Resolute Bay. The day was spent preparing for the upcoming surveys and in the plotting of shore profiles completed on Brock, Prince Patrick and the Polynia Islands. Arranged with a student working at South Camp to assist with the beach surveys, if and when a helicopter became available.

July 22 08:00 CDT: Foggy in Resolute Bay. Checked for the arrival of the helicopter with the base camp manager at Resolute. Continued with the analysis of field data and the packing of samples for sending south. Helicopter arrived from Devon Island in the evening.

July 23 08:00: Partly foggy in Resolute with occasional showers. The helicopter was not available until after supper. Taylor, Harold Welch and Arve Kristiansen, from South Camp Biological Station departed at 19:30 for Radstock Bay (Site 5583) and Cape Ricketts (site 5581), S. W. Devon Island (Fig. 2). Excellent visibility and lighting for completing aerial observations along the coast. Four beach profiles and a detailed survey at the end of Cape Ricketts was completed together with one shore profile along Radstock Bay (Appendix 2). The helicopter pilot flew H. Welch to the summit of the coastal cliff west of Cape Ricketts where a time lapse camera was installed to monitor whale and cod movements in and out of Gascoyne Inlet (Fig. 2). At 23:00 CDT we were forced to return to Resolute Bay because the daily time limitations on flying had been reached. We arrived back at Resolute Bay at 00:00 CDT July 24 with much less accomplished than had been originally planned for phase 3. Since the weather forcast was poor and there was no guarantee of helicopter support for the next few days, the decision was made to travel south on July 24 as originally planned.

July 24 14:30; Foggy again. Departed Resolute Bay on Canadian flight to Montreal and arrived Montreal 21:40 EDT on schedule.

SEA ICE OBSERVATIONS (July 1990)

Northwest Arctic Island Channels

On route to Mould Bay on July 4th, low cloud prevented aerial observations of sea ice conditions and shoreline character except along parts of Hecla and Griper Bay, northwestern Melville Island, Fitzwilliam Strait and the shores of eastern Prince Patrick Island (Fig.1). Between the 4th and the 10th the channels surrounding Prince Patrick and Brock Islands were ice covered except for a narrow shore lead which became more extensive at river mouths and less extensive along the higher shores lined by snow drifts. The shore lead varied from a few metres to more than 50 m wide in early July. Despite the open water at river mouths many of the delta fronts were fringed by anchor ice. By the10th the shore leads were nearly continuous along most bays and inlets (Fig. 4). Open water was most extensive within the drowned river mouths along southern Prince Patrick Island. Leads of open water extended offshore from most headlands but in many cases they began 10s-100s of metres from the shore. Within **Intrepid Inlet** there was less multi-year ice than in the outer channels. Streaks of wind blown sand covered the sea ice for 300-400 m offshore in the upper parts of the Inlet. An ice island fragment was present at the southeast entrance to Intrepid Inlet. Sea ice ridging was common in the outer channels and shore ice pile-up and ice ride-up was most severe along the cliffed shores at and west of Cape Mecham (Fig. 4a).

Ballantyne Strait was 10/10ths ice covered with an estimated 50 m wide shore lead along both Prince Patrick and Brock Islands. The shore leads were poorly developed along the Polynia Islands where a snow drift/icefoot fringed the shore (Fig.3a,b). Younger, smooth ice existed within the inner barrier fringing the larger north Polynia Island. There were several wide, refrozen leads in the strait which suggested that open water may have occurred during the winter.

A major lead extended across the narrow portion of the unnamed strait between **Brock and Mackenzie King Island** where a mother polar bear and cub were spotted on July 5.

Along the **Arctic Ocean coast** the shore leads were poorly developed except off the larger river deltas (Fig. 5b). The sea ice was very hummocky and ridged seaward of the the small islands and shoals. Landward of the islands the sea ice was younger and smoother. Multiple shore ice pileups extended to heights of 5 to 30 m asl within 50 m of the offshore islands. Smaller ice piles were also observed across some of the smaller islands and shoals (Fig. 3c,d)

Barrow Strait

On July 3 the main sea ice edge across Barrow Strait was as far west as Cornwallis Island where it extended south from the cape just east of Resolute Bay. The northern ice edge formed a relatively straight line along the south shores of Devon and Cornwallis Islands. At the headlands and coastal forelands only a narrow icefoot remained whereas the bays were covered by shorefast ice. Spring melt had removed much of the snow covering the nearshore ice but there was little evidence of an extensive shore lead at that time. By July 23rd open water existed along most of the outer coasts and only the inner parts of the bays remained ice covered. The main ice edge still extended across the south end of Wellington Channel although some ice had broken away along the east side of the Channel by the 23rd. A small iceberg or ice island fragment existed at the southeast corner of Cornwallis Island, near Cape Hotham. At Cape Ricketts, Devon Island, open water extended north to profile line X and along the eastern side of the cape. In Radstock Bay open water extended to just north of Caswall Tower (Fig. 2) where the fast ice edge extended across the bay. Shore leads were well developed along the inner bays yet remnant icefoot remained along the lower foreshore. Also, an icefoot and permanent snow patches lined many of the steeper talus slopes along southern Cornwallis Island. Ice floes and ice cakes were scattered along many of the shores and large shore ice-pileups were observed along Cornwallis and Devon Islands on the south and east facing sides of capes, e.g. just east of Capes Dungeness and Riley and at Cape Ricketts.

DESCRIPTION OF COASTAL SURVEY SITES

Coastal investigations of Prince Patrick, Brock and the Polynia Islands were focussed on the large shore ridge which occurs mainly along the shores of the Arctic Ocean and Ballantyne Strait (Fig. 1). Detailed survey and sediment sampling (push cores and grab samples) transects were completed at eight beach profile sites (Fig. 1). Benchmarks, established at these sites, consisted of 1.5-2.0 m long reinforcing rod which was pounded into the ground to the surface of permafrost. In this report reference is made to mean sea level (MSL), high tide level (HTL) and low tide level (LTL). At Mould Bay Station the spring tidal range is 0.5 m (Canadian Hydrographic Service (CHS) 1990). For this report mean sea level was calculated using published tide tables (CHS, 1990) and the position of sea level at the time of the survey. Altimeter measurements of coastal features were taken in relation to higher high tide level (HHTL). At the survey sites, plus 14 other beach sites (Fig. 1, 5, 6), excavations were dug at the primary beach features to examine sediment structure, texture and ground thaw depths. A brief geomorphological description of each beach site is provided in this section. Additional beach sites were examined but generally only photographs and altimeter measurements were taken for future reference. Sediment cores (pushed by hand and mallet) were collected at the shore ridge using wide diameter plastic core liner. The cores were shipped south for making resin peels and for detailed subsampling. Sediment samples and survey data are listed in appendix 1 and 2 respectively. All sediment samples have been submitted to the sediment laboratory at the Atlantic Geoscience Centre for textural analysis.

The beach sites on Devon Island have been monitored intermittently since the late 1960s when the survey lines were established (Fig. 2). The last survey was in 1986 (Taylor, 1987). The surveys in 1990 were needed to confirm some unusual changes observed in 1986, e.g. new beach ridge at Cape Ricketts, and to provide a 20-year record of beach change within this arctic setting. Long-term data bases on beach evolution for arctic shores are few in number.

Polynia Islands

Beach Site 5740

A beach profile was established on the south shore of one of the larger Polynia Islands (Fig. 1, 3a, 6). Two shore ridges fringed the island, one at roughly 4 m and the other at 10 m asl. This site was selected for survey because of the proximity of the lower to the higher ridge which unfortunately was less well defined at this locality (Fig. 6). Benchmarks were established at the crest of the two ridges, at 10.5 m and 4.4 m above msl. The shore ridge morphological characteristics are summarized in Table 1. The ridges (Fig. 3b) were covered by a deflation surface of coarse sand and pebble clasts and were composed of well drained, poorly compacted sand and gravel derived from the unlithified Beaufort Fm (Fyles, 1990). The homogeneity of the sediment composition was also indicated by the uniform spacing of ice-wedge furrows across the ridges.

Push cores of the sediment were collected from the crest and base of the seaward slope of the lower shore ridge (Appendix 1-samples 9007000-9007002). The ridge crest was composed of a poorly sorted, medium sand with pebble clasts of 15-30 mm. At a depth of 20-30 cm, thin parallel laminae of fine pebble overlay medium sand. Below 40 cm this unit contained less structure and fewer large pebble clasts. The seaward base of the shore ridge contained fewer large pebbles than the crest and a laminated sediment structure was restricted to depths of 28 to 42 cm where the frost table was encountered. Beach thaw depth at the ridge crest was 75-80 cm. At the lower pit water was flowing downslope along the surface of the permafrost. Offshore the shorefast ice was very hummocky because of the abundance of multi-year ice blocks.

Prince Patrick Island

Beach Site 5741

A shore profile was completed at the head of Dyer Bay (Fig. 1) where a steep, sharp-crested, ice-modified ridge marked the present shoreline (Fig. 4f). The site was selected as an example of where sea ice was modifying the shore ridge. One benchmark was established landward of the shore ridge. Preliminary analysis of the survey data suggests that there may be problems with the position of the water level. On the basis of altimeter measurements the crest elevation of the shore ridge was 3.5 m above HHTL, whereas the survey results suggested a height of 4.9 m above MSL (Table 1). Pits were dug into both slopes of the ridge and sample 9007003 (Appendix 1) was collected from the landward pit. At the base of the seaward slope, poorly sorted sand and gravel overlay a lighter coloured sand with orange coloured laminae, similar to those observed in the modern upper interidal zone. A mottled grey- and white-coloured sediment, which visually resembled the sediment beneath the backshore tundra surface, existed at the base of the excavation. Ground thaw depths were 80 cm at both pits. The absence of a well-defined shore lead and the presence of snow drifts on the shorefast ice may have caused the problems with the sea level positioning.

Beach Site 5742

A profile was established mid-way along the west coast of Prince Patrick Island, where a large, partially-rounded ridge lined the shore (Fig. 1, 5b, 6, Table 1). A benchmark was established at 3.4 m above msl at the crest of the shore ridge (Fig. 5b). Seaward of the ridge a 5 to 7 m wide sand beach existed. Water depths exceeded 1.5 m within 20 m of HTL. Pits were dug beneath the backshore tundra, at the shore ridge crest, and at high tide level (HTL). Sample 9007007 (Appendix 1) was collected from the upper 10 cm of the shore ridge. The backshore tundra was underlain by 20 cm of light coloured sand over a coarser, dark brown mixture of sand and gravel similar to the

TABLE 1 Morphological parameters of the shore ridge observed along Prince Patrick, Brock and the Polynia Islands, N.W.T..

Location	Height(m) Altimeter (above HHTL)	Height(m) Surveyed (above MSL)	Height(m) Surveyed (above backshore)	Width # of Ridge (m)	Distance from MSL (m)	Slopes (°) † Swd	Slopes (°) † Lwd
Site 5753 N. Brock	7.5	7.6	4.0	42	58	12.5(Upper) 7.2 (Lower)	10.2 -
Site 5750 W. Brock	6.5	-	0.9	15	~300	11.1	5.3(Upper) 4.7(Lower)
Site 5751 S.W. Brock	7.5	8.6	1.5	34	118	7.0(Upper) 4.2 (Lower)	11.3 (Upper) 4.2 (min) 6.2 (avg)
Site 5740 Polynia Is.	4.0 10.0	4.3	3.2	48	32	7.8 5.1 (upper) 9.8 (Lower)	8.2 - -
Site 5743 C. Leopold M'Clintock	5.0	6.4	1.6	35	371	3.3 (Upper) 7.3 (Lower)	5.0 -
Site 5746 Moore Bay	9.0	-	-	25	~270	8.0	10.0
Site 5742 W. Prince Patrick	3.0	3.4	1.1	14	10	18.8	7.3
Site 5741 Dyer Bay	3.5	4.9	1.6	7	16	33.4	25.0

Width across intersect with backshore terrace
† Slope from base of slope to crest

material observed beneath the shore ridge. At HTL there were well defined, parallel laminae of coarse sand. Ground thaw depths decreased from 110 cm at the ridge crest to 58 cm beneath the backshore tundra (water table existed at 37 cm) and < 20 cm beneath the beach at HTL. Shore lead development was discontinuous alongshore at the time of the survey.

Beach Site 5743
A shore profile was established at Cape Leopold M'Clintock at the north end of the island where a large, sinuous shore ridge existed 371 m inland from the present sea level (Fig. 1, 6, Table 1). A benchmark was established at the crest of the ridge at 6.4 m above msl. Between the main shore ridge and the modern beach there were 3 and possibly 4 subtle beach ridges each less than 25 cm in relief. Open water extended an estimated 50 m offshore. In water depths of <1.0 m anchor ice was observed covered by a thin layer of silt. Across the narrow intertidal zone the surface algal mat was underlain by anoxic sands with a strong odour. Sediment samples were collected from the present swash ridge (sample 9007004), and from the shore ridge at the surface and at a depth of 10-20 cm (Appendix 1- 9007005, 006). Ground thaw depths decreased from 55 cm at the ridge crest to 28 cm at the swash ridge and 13 cm at the present sea level.

Beach Site 5744 and 5745
Altimeter measurements of shore ridge height were completed at several of the islands lying off the northwest coast of Prince Patrick Island. Most of the islands were composed of Beaufort Fm sands and gravels. However, one island at the north west corner of Satellite Bay was composed of silts and clays thought to be derived from the shaly Kanguk Formation. At site 5744 a series of excavations were dug to investigate the shallow stratigraphy of the island whereas at site 5745 only photographs and one sediment sample (9007008, Appendix 1) were collected from the surface of the island (Fig. 1, 3c). The islands at sites 5744 and 5745 were less than 4 m in elevation and both were characterised by a low hummocky topography. Along the landward facing eastern shores small wave-built features and a wave eroded scarp of 60-70 cm height were more continuous than along the west facing shores, where features built by sea ice dominated the morphology.

Both the subaerial and subaqueous portions of the islands were covered by a distinctive red-coloured lag deposit. At site 5744, pits were dug across the east-facing shore at HTL, the wave-cut scarp, and in an ice-push mound on the western side of the island. At HTL, well-defined seaward- and landward-dipping sedimentary structures confirmed the formation of small, multiple wave-built ridge and swale features. At the beach scarp the upper 40 cm of sediment had a more complex structure. The most distinctive stratigraphy was a suite of orange-stained coarse sand laminae which occurred at depths of 28-40 cm. These laminae resembled those found across the present intertidal zone. A massive deposit of disturbed coarse sand and gravel with inclusions of well stratified material existed below 40 cm.

The height of shore-ice pileups which were measured using the helicopter altimeter, varied from 6-8 m at site 5744 and up to 30 m at site 5745 (Fig. 3c). Ice cover prevented an examination of the nearshore topography adjacent to the ice pileups. Smoother, younger sea ice extended between the islands and Prince Patrick Island.

Beach Site 5746

This site along northern Moore Bay marks the southeast limit of the large shore ridges. The shore ridge extended 700-900 m alongshore and to an elevation of 9 m asl (Fig. 1, Table 1). It was fringed by a low wet terrain on the landward side and a series of small, shore-parallel, discontinuous ridges on the seaward side. The shore ridge crest consisted of an aeolian lag surface deposit underlain by a light brown sand and pebble deposit which extended to 70 cm depth (frost table). The sediment structure became more complex in a seaward extension of the pit. A discontinuous dark coloured soil, pods of gravel, and a more homogeneous light brown sand with scattered pebbles, 4-10 cm thick, was interfingered with the massive sand and gravel deposit at the ridge crest. Compacted, fine-grained, convoluted structures in the upper 50 cm of the seaward slope probably represent the product of periglacial slope processes. No samples were collected.

Beach Sites 5747 and 5748

These sites lying at the north and south ends of Jameson Bay (Fig. 1, 5c) are representative of a large proportion of the east coast of Prince Patrick Island. The shores consist of a high (30 m) bedrock scarp fronted by a low-gradient rill-washed or drier sandy slope with discontinuous, shore-parallel, low ridges (Fig. 4c,d). The degree of water saturation in the backshore was a function of the presence and proximity of semi-permanent snowpatches at the base of the bedrock scarp. For example, the backshore slope was steeper and wetter at site 5747 than 5748. The shore lead was continuous but less than 50 m wide along these shores by early July.

At both sites the present beach consisted of a low, pitted, sand berm backed by a lower swale which was flooded at high tide (Fig. 5c). The berm at the present beach was composed of 6-12 cm of light coloured, medium sand overtop of interlaminated grey leached and light brown sand. Black, anoxic sediment existed at depths ranging from 12-20 cm. Ground thaw extended to between 26 and 38 cm beneath these beaches. At site 5748 a beach ridge at 1-1.5 m asl was composed of a cryoturbated reddish stained upper unit overtop of light brown sand interbedded with reddish-stained sand laminae.

Beach Site 5749

The small foreland north of Disappointment Point was composed of a series of well-defined swash aligned gravel beach ridges. The maximum elevation of the emerged beach ridges was 2 m asl. The more exposed east side of the foreland has been eroded by waves and overridden by sea ice which formed a continuous ice-pushed ridge over top of the beach deposits. A well-defined bed of imbricated gravel clasts was exposed in the eroded scarp at 1.1 m below the crest of the ice-built ridge. The more sheltered side of the foreland consisted of small beach ridges. The seaward slope of the beach ridges was 7-10° and they were composed of thin platy sandstone pebbles of < 40 mm diameter. The raised beach ridges were steeper (~14°) and were composed of clasts up to 50 mm diameter.

Beach Sites 5770 and 5771
These sites are representative of the sheltered wave environments of Walker Inlet where many of the shores are composed of gravel derived from backshore colluvium (Fig. 1, 5f). Small wave-refracted ridges and beach accumulation forms, e.g. barriers or spits, were formed just inside the headlands and across many of the smaller streams. However, waves appeared to be competent to transport platy sandstone clasts of only 4-8 mm size which was the composition of the small swash ridges. Clasts of 15-50 mm diameter or larger were more common across the intertidal and backshore zones. In many places such as site 5771 the swash ridges were built on top of the backshore colluvium (Fig. 5f) or waves have cut 30-50 cm high scarps into the higher colluvium deposits. The depth of beach thaw was less than 42 cm. At both sites, ice was buried by 10-20 cm of sediment across the lower intertidal zone. Shore leads were 15-25 m in width. Ice-push and ice-override features were most common at the headlands of Walker Inlet.

Brock Island

Beach Site 5750
A large, well defined, sinuous shore ridge existed along northern Ballantyne Strait similar to the ridge along the southern shore of the strait. The continuity of the ridge was broken by small stream channels which had cut through it after the ridge had formed. A survey (Table 1, Appendix 2) was completed across the shore ridge. The ridge extended to 6.5 m asl. Its crest was an estimated 300 m inland from the present sea level. A seaward section of the ridge was examined, photographed and sampled (Samples 9007009-014, Appendix 1) at a stream cut located just south of the survey line. A sample of compressed moss yielded a ^{14}C age of 5830 ±130 years BP (GSC-5109). This is a minimum age for the formation of the shore ridge in this area. The upper composition of the ridge was poorly sorted sand and gravel with little coherent structure whereas the lower part of the section consisted of seaward dipping coarse sand and gravel laminae over top of more flat lying beds containing a greater abundance of mud and organic debris. The latter sedimentary structures closely resembled the modern beach stratigraphy.

Beach Site 5751

A shore survey was completed across a large well-defined shore ridge at the southwest corner of Brock Island (Fig. 1). Benchmarks were established at the ridge crest and on the lower seaward slope. Morphological and sedimentological differences between this ridge and those farther north (Sites 5750, 5753 Fig. 1, 6) were attributed to differences in local source materials for ridge building. At this site the bedrock was late Triassic Pat Bay Fm sandstone whereas at the northern sites it was Beaufort Fm sand and gravel. This shore ridge had a more subdued shape (Table 1, Fig. 6) and a wider flatter crest than some of the other ridges. Semi-permanent snowpatches along the upper slopes were drained by a network of rill-wash channels. The intertidal zone was roughly 20 m wide. The lower intertidal was covered by shorefast ice. In the upper intertidal zone, 10-12 cm of grey or brown sand overlay black, anoxic sediment. The shore ridge crest consisted of a mixture of sand and gravel which appeared to have been disturbed by slope or periglacial processes on the seaward slope. Ground thaw depths decreased from 60 cm at the ridge crest to less than 20 cm across the lower, water-saturated, seaward slope and a maximum of 32 cm beneath the upper beach. Sediment samples (9007015-017, Appendix 1) were collected from the present HTL, the shore ridge crest and a discontinuous fluvial terrace landward of the shore ridge.

Beach Site 5752

A shore profile was completed within the embayed shores of northeastern Brock Island (Fig. 1, 5e). The site was selected to illustrate the better defined wave-built features formed within these embayments. The occurrence of swash ridges and small berms was attributed to the seasonal melting of sea ice within the bays. This contrasts with the outer coast, which rarely clears of ice. The beach profile was surveyed to an elevation of 3.5 m above msl and marked by two benchmarks. At mean sea level, a 0.9 m high slope was marked at the top and base by anchor ice. Push cores were collected from the HTL swash ridge (Sample 9007019, Appendix 1) and from the backshore at 0.7-1.0 m above msl (sample 9007018). Beneath the HTL swash ridge, 4-6 cm of low-gradient coarse-sand beds overlay a series of much more steeply dipping foreshore sands. Beneath the backshore, stratified sand only occurred in the upper 9-12 cm. The deeper sediment consisted of a very mottled and contorted sand. Discontinuous orange-coloured coarse-sand laminae, similar to those found in the modern beach, were observed at depth. Thaw depths increased from <25 cm beneath the intertidal, to 37 cm at HTL, and 54 cm beneath the backshore. The beach sediment consisted mainly of Beaufort Fm sands and gravels.

Beach Sites 5753 and 5758

Shore ridges along the north coast of Brock Island extended to average heights of 7.5-8.0 m above HTL. Their height increased to 11 m at their seaward end and decreased to 4 m farther inland. At several of the offshore shoals sea ice appeared to be piling sediment up to estimated heights of 6-10 m asl. At site 5753 (Fig. 1) a beach profile was surveyed across a very large arcuate ridge which extended to 7.3 m above msl

(Table 1, Fig. 6). Landward of the ridge a beach terrace was fringed by an area of ponded water with rillwash and patterned ground. A small sand berm marked the backshore water level which was more than 1 m higher than the sea level. A series of eight shallow pits were dug across the beach profile. Push cores were collected from the ridge crest (9007021) and from the ice-push modified modern beach (9007020). A sample was also taken from the aeolian sands which were being deposited at the time of the survey by strong southerly winds. Thaw depths varied from 40-58 cm beneath the low, wet backshore, to 60-70 cm at the raised beach terrace and shore ridge crest; and 35-40 cm beneath the seaward (north) slope of the ridge.

A stream cut in the low end of the shore ridge at site 5758 provided a cross-sectional view of the shore ridge structure. In both pits excavated, aeolian deposits appeared to extend to a depth of 8-10 cm. Sedimentary structure in the sand was best defined at depths of 26-42 cm where layers of fine gravel accented the bedding. At the same depth, farther seaward, a sand bed with thin, iron-stained, gravel laminae occurred instead of the thicker gravel beds. Above and below this zone a more chaotic mixture of sand and gravel occurred. The thickness of the active layer was 40-55 cm. The beach sediment at both sites consisted of sands and gravels derived from Beaufort Fm. deposits.

Beach Site 5754

A survey was not completed at this site (Fig. 1); however, two suites of sediment samples were collected for comparison. Three samples were collected from a possible raised beach 7 m above HTL (Appendix 1-Samples 9007023-026) and three samples (9007027-029) were taken from the present beach. At both sample sites, dark brown medium-coarse sand and pebbles overlay one or two beds of lighter grey coloured silty sand. At the base of the pits a reduced black, silty sand coincided with the position of the frost table at 32-36 cm depth.

Beach Site 5755

This site is representative of the low, gently sloping shores of east-central Brock Island (Fig.1, 5d). The backshore consisted of a lichen covered brown, silty sand with scattered pebbles. The abundance of frost-shattered platy sandstone along a terrace at 3.5 m asl, within the frost wedge polygons, and across the lower intertidal zone suggested that bedrock lay just below the ground surface. Where the backshore slope was steeper it was commonly fringed by a snow-filled nivation hollow. Down-slope of the snow patches the backshore was water saturated and modified by rillwash. The backshore/foreshore interface was marked by either a low (<0.3 m) erosional scarp or a poorly developed swash ridge of less than 0.1 m relief. The swash deposits varied from 10-30 mm pebbles to sand depending on the local sediment source. Where rill wash was very active, slope deposits covered or interfingered with the beach deposits. The intertidal zone was 4-6 m wide (Fig. 5d). Pits dug at high and low tide level confirmed that swash-formed features, identified as light brown sands, were less than 20 cm thick.

Algal mat formed a discontinuous cover across the intertidal zone. Anoxic sediment occurred less than one cm beneath the lower intertidal surface but was deeper beneath the high tide level. Beach thaw depths varied from 26 to 30 cm.

Beach Site 5756
Along the shores of the unnamed inlet at this site the intertidal zone was 2-5 m wide. At high tide level, sand swash ridges or berms of less than 10-15 cm relief existed. Beneath the swash ridges the beach consisted of two or more units of 3-5 cm of lighter coloured sand over 1-8 cm thick, darker brown, muddy sand. The thicker swash ridges were underlain by one or more units of oxidized, iron-stained layers over black anoxic sediment. In many cases a zone of greyish leached sediment separated the anoxic from the oxidized layers. Where sandstone fragments were more abundant the swash ridges consisted of well sorted pebbles (5-20 mm). Pebbles were also common across the lower intertidal zone and within the swales adjacent to the sand beach deposits. Thaw depths beneath the gravel shores were less than 20 cm and only slightly deeper beneath the mixed sand and pebble shores.

Beach Site 5757
This site is representative of the steeper, snow-lined and ice-overriden shores of northeastern Brock Island (Fig. 1, 5a). In the backshore the hills reached 44 m asl. Their slopes were characterised by patterned ground consisting of very sharp, frost-shattered sandstone. In 1990, ridges of sea ice 10 m high occurred an estimated 20-100 m from shore. Ice ride-up produced an irregular lower backshore topography of ridges and scars of 0.5-1.0 m relief (Fig. 5a). Modern ice-override features extended to 5-9 m asl within an 50 m of present sea level. The higher features formed at the more exposed headlands. The backshore consisted of gravel clasts of 40-80 mm diameter.

Beach Site 5759
A beach profile was not completed; however, a series of pits were dug across the intertidal-beach zones. The site is representative of the low gradient 50-100 m wide tidal flats which fringe parts of southwest Brock Island. The paleo-shore ridge was absent and sediment input from streams was greater. Grounded pieces of ice had formed small 10-30 cm high mounds across the intertidal flats. The beach was poorly defined except near the river mouths where a low 0.5-2.5 m scarp was cut into the backshore. The intertidal surface was covered by an algal mat which was dessicated and broken up when exposed above HTL. At LTL, reduced sediment lay just below the algal mat cover. Across the upper intertidal, either a deposit of 1-2 cm thick brown sand interbedded with black reduced sand, or a 10-16 cm thick deposit of oxidized, orange sands over partially leached (grey) sand was observed. The latter unit was interpreted as discontinuous swash deposits which were best-defined at HTL. Beneath the backshore the swash deposits were modified by cryoturbation. The upper 10-20 cm of contorted sands were a bright orange and light grey. Thin, light coloured sand

laminae interpreted as swash deposits occurred at a depth of 16-23 cm. Below this, anoxic sediment extended to the frost table at 30 cm.

Devon Island

Cape Ricketts (Beach Site 5581)

Line 3 (III) - The landward benchmark (BM) and seaward temporary benchmark (TBM) were rock cairns. The cairns (44 m apart) were found undisturbed (Fig.2). Little change was observed on the raised beach, hence the survey was only completed seaward from the TBM. Since the last survey in 1986, an ice-push ridge had formed at 2.5 m above msl. The melted character of a large shore ice pile-up at the eastern tip of the cape (Fig. 2) suggested that these ice features had existed for at least one season. Seaward of the new ice-push ridge, the foreshore slope had been eroded; however, the construction of new swash ridges, thought to have formed in 1989, has resulted in a net beach progradation of 5 m since 1986. There was little net change in the beach position below msl. The beach build-up contrasts with the 14 m of retreat recorded on the upper foreshore between 1981 and 1986 (Fig. 7-inset).

Line 7 (VII) - BM and TBM cairns 33.5 m apart were intact in 1990 however the painted numbers on the markers had nearly worn away. This line was not surveyed in 1986. Since 1981 the upper foreshore retreated 5-8 m. The profile of the beach was similar in both years but the main swash ridge had been extended to a slightly higher elevation by 1990 (1.9 m above msl). Minor beach pitting just landward of the swash ridge suggested that it had formed during a storm in late 1989.

Line 10 (X). - The TBM cairn was not found, therefore a new cairn was built 39.3 m seaward of the BM cairn at the crest of a relict ice-push ridge (Fig. 2, 8). Only photographs were taken of this line in 1986. Since 1981 the beach had retreated 6-7 m landward; the old storm ridge was reworked by waves to an elevation of 2.9 m above msl and beach pebbles had been thrown up onto the lowest raised beach ridge (Fig. 8). A comparison of photographs suggested that most of the beach changes occurred between 1981 and 1986. By 1990 the foreshore slope was steeper than in 1981. Also, the lower beach was still covered by an icefoot in 1990.

Line 17 (XVII) - The BM cairn and the painted boulder were present but the TBM cairn was gone. Net beach change between 1986 and 1990 was very small. There was only minor erosion below msl and fewer swash ridges existed than in 1986. In 1990 a gravel covered icefoot extended across much of the lower foreshore slope. A minor scarp (<10 cm high) cut along the upper foreshore marked the upper limit of the icefoot. Since 1981 the lowest raised beach was cut back and the beach had retreated 3-4 m. Most of the erosion occurred between 1981 and 1986.

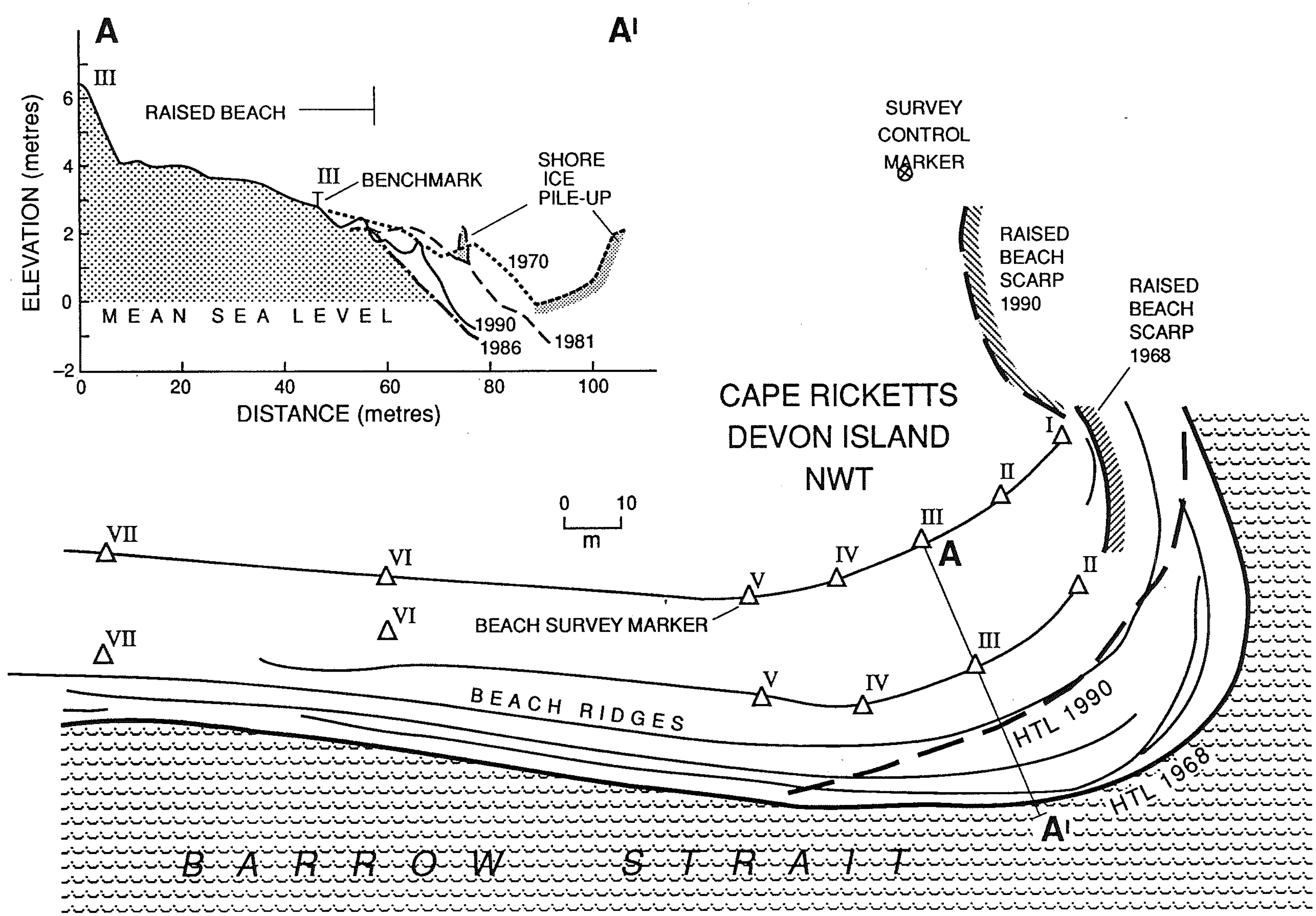

Figure 7. A comparison of plan maps and cross-sectional surveys (inset line III) completed between 1968 and 1990 at Cape Ricketts, Devon Island, indicated that the shoreline has receded by as much as 40 m. Between 1981 and 1986 a new beach ridge was formed roughly where the third raised beach existed in 1968. The development of major beach ridges similar to the older "raised" beach ridges depends on an abundance of available sediment which shoreline recession can provide.

Figure 8. A longshore view of the gravel beach at line X, Cape Ricketts, Devon Island (see Fig. 2 for location). Buried icefoot still extends across much of the lower beach face on July 23, 1990. The beach ridge adjacent to the surveyor represents the gradual recovery of the beach since its erosion between 1981 and 1986.

Radstock Bay (Beach Site 5583)

Line 5 - BM and TBM cairns were 10.9 m apart and both undisturbed (Fig. 2). The survey, completed seaward of the TBM, confirmed that the main storm ridge had prograded since 1976. The 1986 storm swash ridge appeared intact and another swash ridge had been added at HHTL since 1986. Farther downslope the upper intertidal zone had been scoured back by 2-3 m to a position landward of the 1972 beach slope. There were scattered ice cakes grounded alongshore and some evidence of a buried icefoot at water level. Only minor wave reworking of the beach had occurred in 1990. The 1990 beach survey was completed at 23:00 CDT, 3.5 hours after predicted low tide. Large tidal range at this site is 2.8 m (CHS, 1990).

Three new observations of note were made during the flight to and from Resolute Bay.
1) There were several coastal forelands similar to Cape Ricketts along both southern Cornwallis and Devon Island. In each case the southeast side of the foreland was a steep truncated slope whereas the southwest side was a more gradual slope covered by a suite of gravel beach ridges. At Cape Ricketts the 1-3 m thick surficial beach deposits overlay a 7-10 m thick deposit containing steeply dipping beds which resembled foreset beds. A basal unit of unknown material, possibly 'till', 7-10 m thick, thinned toward the southern tip of the cape. Unfortunately time did not permit ground observations. Also, surveys will be required at the other coastal forelands to confirm their stratigraphy. One explanation for these forelands is that they are ice-contact deposits which formed during a longer glacial still stand. Similar foreland features have been observed in the fiords of Baffin Island (J. Syvitski, pers comm, 1990).
2) Between Cape Riley and Cape Ricketts, Devon Island well developed sea caves, and notches were cut by waves and sea ice into an exposed shore platform composed of dolomitic rock.
3) Most of the shoreline is characterised by an ice-scoured, bedrock platform which extended several hundred metres offshore. Small boat surveys in 1976 and 1981 in Radstock Bay recorded a platform of 60-120 m width down to a depth of 2-3 m below low tide level. The nearshore platform was covered by a thin, discontinuous layer of pebble-cobble clasts. Loose sediment was only abundant adjacent to the present beach.

DISCUSSION

Coastal environments of the northwest Arctic Islands

The 1990 aerial and ground reconnaissance surveys of Prince Patrick, Brock and the Polynia Islands provided a broad overview of the coastal environments of these islands. The aerial oblique coastal video, although not high quality, provided the first continuous record of the Polynia Islands and over 200 km of northern Prince Patrick coastline (Fig. 1) since the general vertical air photographic coverage of the Arctic

Islands (1:60,000) completed between 1958 and 1960.

In an earlier coastal study of Lougheed Island, Taylor and Forbes (1987) described four main coastal types, sandflat, mudflat, scarred and deltaic, but recognized that variations of these types and the presence of other types existed as a result of local geology, topography and processes. Along south and southeast Prince Patrick Island where the topography is higher and the weathering of older bedrock units produces gravel clasts, the coastal character differed significantly from Lougheed Island. The higher, moderate to steep sloping colluvial shores (Fig. 4a,b) with gravelly beaches more closely resembled those on Melville Island and the other south-central Queen Elizabeth Islands (Taylor, 1973, Owens, et al. 1981, McLaren, 1982). The low-lying Arctic Ocean coast in many places resembled the deltaic and sandflat coastal types described on Lougheed Island (Taylor and Forbes, 1987) but the discontinous chain of offshore shoals, small islands, and the large shore ridge that fringes the main islands, plus the uniform sediment composition of quartz-rich sand and gravel set this coast apart. The Arctic Ocean coast is underlain by the unlithified Beaufort Formation (Fyles, 1990) fluvially deposited sand and gravel which are the primary source of beach sediment. The paleo-shore ridge (Fig. 3a,b) which fringes the Arctic Ocean coast is discussed in more detail below.

The coastal environments of Brock Island consisted of low shores composed of sand and pebbles with sea ice modified islands and shoals along the northern part of the Island. Higher colluvial slopes along the east and south coasts were dominated by an upper slope of frost shattered felsenmeer and an often soupy, rill-washed lower slope with a narrow, poorly defined beach. Wider intertidal flats along the southwest coast and a more irregular hilly, embayed coast along the northeast coast provided additional variations in coastal character. The wide, low, coalescing deltas of the north coast contrasted sharply with the deltas of southern Brock Island which have prograded seaward in a lobate shape with almost no channel bifurcations. Despite the extremely small tidal range (<0.5 m) these low-gradient rivers were affected by marine waters at high tide for hundreds of metres upstream.

The morphological and sedimentological character of these shores reflected the extreme low-wave energy and the dominance of sea-ice and terrestrial geomorphic processes. Wave modified beach features (Fig. 5e) were rarely greater than 0.2 m in relief and were only well developed within the inlets and small embayments where sea ice melted during most years, resulting in a wider, yet limited, wave fetch. These coasts represent the low wave-energy end of the coastal spectrum (Taylor and McCann, 1983).

Shore Ridges-implications for sea-levels and coastal processes

A large, discontinuous shore ridge (Fig. 3) fringed the Arctic Ocean from Prince Patrick to Borden Island and along some of the adjoining coasts. The continuity of the ridge was broken by small stream cut channels and by large river deltas. Multiple ridges were only observed around the Polynia Islands and at a river delta near M'Clintock Point, Prince Patrick Island (Fig. 1). The plan form of the ridge varied from linear to arcuate and on some of the smaller islands it was nearly circular. The ridge most commonly occurred within a distance of 50 m from present sea level. However along Ballantyne Strait the ridge was 100-300 m from the present sea level. In cross-section, the ridge was 3 to 11 high and 7 to 50 m wide. Where the ridge was larger, it tended to have a more rounded crest than smaller examples of the ridge which were sharp crested, e.g. site 5741 (Fig. 1). The ridge crest was 0.9-1.6 m above the adjacent backshore except where it formed seaward of the main shoreline the crest was 3-4 m above the backshore. Local variations in ridge crest height existed because of differing exposure to sea ice pressures. Nevertheless, a general decrease in ridge elevation from Brock Island to southern Prince Patrick Island suggests regional delevelling. The ridge was best formed within the poorly consolidated Beaufort Fm sands and gravels, although on shores adjoining the Arctic Ocean, e.g. eastern Ballantyne Strait, the ridge is composed of other Tertiary sediment. At many sites, long, small levees of sediment, resembling ice-push mounds marked both the seaward and landward slopes of the ridge.

A suggested hypothesis for the formation of the shore ridge is its build-up through episodic sediment accretion by sea ice processes during a period of coastal transgression. The shore ridge marked the landward limit of an earlier major coastal transgression. The ridge is presently being eroded by waves and sea ice especially along the southern areas of ridge occurrence.

Evidence in support of the above hypothesis is as follows. The size of the shore ridge was much greater than any wave-formed features which were less than 0.3 m high in the present ice-congested, microtidal environment. The large size of the ridge, the presence of sediment levees across the ridge slopes and the chaotic sediment composition all suggested that sea ice has been at least partially responsible for their formation. Hudson et al. (1981) compared the shore ridges on the Polynia Islands to those formed by sea ice pressures around artificial drilling platforms in the Beaufort Sea. Furthermore, Reimnitz et al. (1990) provided evidence for sea ice build-up of barrier islands along the Alaskan Beaufort Sea. There were many similarities between the shore ridge we observed and the ice built barrier islands in Alaska. The fact that the ridge wrapped completely around islands or headlands and that no spits or other wave-built accumulation forms were observed suggested that sea ice processes were the dominant agent of formation. The roundness of the ridges can be explained by the physical properties of the Beaufort Fm sands and gravels which were poorly compacted and easily reworked by winds. Aeolian deflation surfaces and wind blown sand deposits existed along the crest and flanks of the shore ridge. However, it is still difficult to explain the very sinuous plan form of the shore ridges along both shores of Ballantyne Strait. The arcuate shape of the more isolated ridges suggested that they were formed originally as islands. In 1990, shoals and small islands off the Arctic Ocean coast were being impacted by sea ice (Fig. 3c). These islands were built to elevations similar to the paleo ridge. However, it was not known if these offshore shoals were drowned older shore ridges or newly formed features. Sea ice cover and time prevented a more detailed examination of the seabed around these islands.

The occurrence of more than one set of shore ridges around the Polynia islands and the position of the shore ridge much farther inland along Ballantyne Strait suggest that uplift may have been greater in this area. The multiple shore ridges near M'Clintock Point were built to the same elevation above sea level. One possible explanation for the formation of the seaward second ridge is a change in position of the river mouth and increased fluvial deposition in front of the first ridge. The seaward shift in shoreline position resulted in sea ice building the second ridge.

The only numerical age available for the shore ridge is the 5820 ± 130 years derived from a ^{14}C analysis of plant debris collected within the base of the ridge at site 5750 on western Brock Island. This date was considerably younger than expected- shells on a pebble beach 9 m asl on the southeast shore ^{14} C dated at 10,580 ± 260 years (GSC-352, Lowden et al. 1967). Whale bone and baleen shoved up by ice override onto the ridge at Tullett Point (Fig.3d) were ^{14} C dated at 930 to 1110 ± 130 years BP. (Dyck et al., 1966).

Evidence of sea-level trends along the northwestern Arctic Islands

There are no sea-level curves available for the northwest arctic islands. One of the major problems is the absence of dateable material in the coastal zone, particularly on Beaufort Fm sand. In 1990 some new samples were collected which may begin to define a general sea-level curve. In area A (Fig. 1-inset) raised beaches were best defined along northeastern Prince Patrick and adjacent islands. Marine limit has been reported at 10-30 m in the north and 6 m along southern Prince Patrick Island (Tozer and Thorsteinsson, 1964). On southeastern Brock Island the highest beach was at roughly 16 m asl (Fyles, in Lowden et al. 1967). Along the Arctic Ocean a large shore ridge marked a marine limit. The shape of the more northern ridge suggested that it may have once formed as a chain of barrier islands. In contrast, many of the ridges south of Discovery Point and within Dyer Bay (Fig. 1) were built on top of an older tundra surface (Fig. 4f). This stratigraphic relationship suggested that they were the product of a recent coastal transgression which continues today. The mean elevation of the shore ridges increased in a northerly direction suggesting that emergence may have been greater toward the north. Many of the other shores along Dyer Bay and Crozier

Channel (south of Intrepid Inlet) were characterised by flooded estuaries and river mouths, beach ridges built over top of backshore colluvium, and erosional scarps topped by near continuous ice-override or ice-push deposits. On Brock Island, at high tide stage, the larger rivers were flooded by sea water for several hundred metres, and in many areas a low scarp has been cut in the backshore colluvium by water motion.

Long term beach changes along Barrow Strait

Beach surveys began at Cape Ricketts and Radstock Bay, Devon Island in 1968 and 1969 respectively. These shores have been reexamined on at least six occasions since then. The beach changes observed on July 23,1990 represent changes that occurred before 1990, as these shores only became free of sea ice a few days before our survey. Surveys of four lines at Cape Ricketts indicated that the beach has been partially rebuilt since the severe erosion that occurred between 1981 and 1986 (Taylor, 1987). The net beach recession since1981 has decreased from 10 m at the southern tip of the cape to less than 2 m at line 17 (Fig. 7).

Since the first surveys in 1968 (Owens, 1969) the southern tip of Cape Ricketts has been cut back by as much as 40 m (Fig. 7). The remainder of the shoreline has experienced only minor erosion. It is not known where the eroded sediment was transported, but judging from the ice floes grounded off the end of the cape, it may have been combed downslope to a position farther offshore. Some of the eroded sediment was transported back onshore during the construction of the new 1.2 m high beach ridge at the end of the cape. This new beach ridge was first observed in 1986 (Taylor, 1987) and it was little altered by 1990. The new beach ridge was built at approximately the same position as a large raised beach ridge which was mapped by Owens (1969) as the third beach ridge from the 1968 sea level (Fig. 7). The observed beach changes are interpreted as a natural response to a decrease in sediment supply, paticularly from alongshore and offshore and the need to derive sediment from older beach deposits.

At Radstock Bay, the 1990 survey of line 5 confirmed that the most seaward raised beach terrace had prograded 0.5 m and aggraded by 10-15 cm between 1981 and 1986. By 1990 the upper beach slope also had aggraded by 20-30 cm. Sequential surveys at this site have shown that the beach initially prograded by 1.0-2.5 m across the lower slope between 1972 and 1976. Subsequent wave action planed off the large storm ridges at HHTL and gravel was transported upslope between 1976 and 1986 (Taylor, 1987). Since 1986 the upper slope has not been altered but the lower slope has experienced severe downcutting.

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APPENDICES

APPENDIX 1
Sediment Sample Inventory for Coastal Field Program 90300

Sample Number (9007xxx)	Latitude (°)	Longtitude (°)	Elevation (m above MSL)	Depth Sample (cm)	Site No.	Feature	Material	Sample Type	Date
Polynia Islands									
000	77° 37.4'	116° 00.5'	3.85	0-20	5740	shore ridge	sand/grav	section	05/07/90
001	77° 37.4'	116° 00.5'	3.85	0-55	5740	" "	sand/grav	core	08/07/90
002	77° 37.4'	116° 00.5'	0.65	0-45	5740	mod beach	sand/grav	core	08/07/90
Prince Patrick Island									
003	75° 58.3'	122° 10.8'	4.00	10-20	5741	shore ridge	sand/grav	section	06/07/90
004	77° 33.4'	116° 26.0'	0.15	0 - 2	5743	swash ridge	sand	grab	08/07/90
005	77° 33.4'	116° 26.0'	6.30	surface	5743	aeolian lag	gravel	grab	08/07/90
006	77° 33.4'	116° 26.0'	6.20	10-20	5743	shore ridge	sand/grav	grab	08/07/90
007	76° 49.4'	120° 20.0'	3.15	0-10	5742	shore ridge	sand/grav	section	10/07/90
008	77° 15.0'	119° 24.5'	~1.0	10-20	5744	barrier bch	sand	grab	10/07/90
Brock Island									
009	77° 49.5'	114° 43.0'	~4.0	100-105	5750	shore ridge	fine sand	section	12/07/90
010	77° 49.5'	114° 43.0'	~4.2	85-95	5750	shore ridge	sand/grav	section	12/07/90
011	77° 49.5'	114° 43.0'	~4.6	45-80	5750	shore ridge	sand/grav	section	12/07/90
012	77° 49.5'	114° 43.0'	~3.3	125-130	5750	shore ridge	organics	section	12/07/90
013	77° 49.5'	114° 43.0'	~3.0	105-115	5750	shore ridge	silty sand	section	12/07/90
014	77° 49.5'	114° 43.0'	~3.2	85-90	5750	shore ridge	silty sand	section	12/07/90
015	77° 42.5'	114° 16.5'	1.35	0 - 10	5751	swash ridge	med. sand	section	14/07/90
016	77° 42.5'	114° 16.5'	~9.1	23-37	5751	shore ridge	sand/grav	section	14/07/90
017	77° 42.5'	114° 16.5'	----		5751	fluv. terrace	med. sand	grab	14/07/90
018	77° 59.5'	114° 18.3'	0.7-1.1	0- 42	5752	raised bch	sand/grav	core	15/07/90
019	77° 59.5'	114° 18.3'	0.2-0.5	0- 32	5752	swash ridge	med. sand	core	15/07/90
020	78° 00.0'	114° 46.5'	0.4-0.6	0- 23	5752	ice push	sand	core	16/07/90
021	77° 59.5'	114° 18.3'	7.2-7.7	0- 49	5753	shore ridge	sand/grav	core	16/07/90
022	77° 59.5'	114° 18.3'	5.8-5.9	0 - 5	5753	aeolian dep.	sand	grab	16/07/90

APPENDIX 1 continued
Sample Inventory

Sample Number (9007xxx)	Latitude (°)	Longtitude (°)	Elevation (m above MSL)	Depth Sample (cm)	Site No.	Feature	Material	Sample Type	Date
023	77° 53.4'	113° 43.0'	~7.0	0- 19	5754	raised bch	sand	section	17/07/90
024	77° 53.4'	113° 43.0'	~7.0	19-25	5754	raised bch	silty sand	section	17/07/90
025	77° 53.4'	113° 43.0'	~7.0	25-36	5754	raised bch	silty sand	section	17/07/90
026	77° 53.4'	113° 43.0'	~7.0	36-37	5754	raised bch	silty sand	section	17/07/90
027	77° 53.4'	113° 43.0'	~0.5	0 - 5	5754	mod.beach	sand/grav	section	17/07/90
028	77° 53.4'	113° 43.0'	~0.5	5 -23	5754	mod.beach	silty sand	section	17/07/90
029	77° 53.4'	113° 43.0'	~0.5	23-32	5754	mod.beach	fine sand	section	17/07/90

APPENDIX 2 BEACH SURVEY DATA

SITE 5740 SOUTH POLYNIA ISLAND, NWT
LINE 1
1990/07/08 (AST)
WL=0.40

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00	1 BM1 0.80M	SP		
3.00	-0.23		SP		
3.00	-0.31		SP		
3.00	-0.25		SP		
3.00	-0.22		SP		
3.00	-0.31		SP		
3.00	-0.31		SP		
3.00	-0.37		SP		
3.00	-0.22		SP		
3.00	-0.16		SP		
3.00	-0.21		SP		
3.00	-0.28		SP		
3.00	-0.34		SP		
3.00	-0.26		SP		
3.00	-0.18		SP		
3.00	-0.45		SP		
3.00	-0.62		SP		
3.00	-0.72		SP		
3.00	-0.94		I		
3.00	-0.63		I		
3.00	-0.36		I		SN=38CM
3.00	-0.36		I		SN=38CM
3.00	-0.22		I		
3.00	-0.30		I		
3.00	-0.28		SP		
3.00	-0.14		SP		
3.00	-0.16		SP		
3.00	-0.16		SP		
3.00	-0.15		SP		
3.00	-0.13		SP		
3.00	-0.08		SP		
3.00	-0.16		I		
3.00	0.24		SP		
3.00	0.31		SP		
3.00	0.32		SP		
3.00	0.42		SP		
3.00	0.53		SP		
3.00	0.58		SP		
3.00	0.64		SP		
4.50	0.44	2 BM2 0.69 M	SP		0.80

SITE 5740 SOUTH POLYNIA ISLAND, NWT

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
3.00	-0.22		SP		
3.00	-0.34		SP	9007000/001	0.80
3.00	-0.46		SP		
3.00	-0.60		SP		
3.00	-0.58		SP		
3.00	-0.40		SP		
3.00	-0.30		SP		
3.00	-0.61		SP	9007002	0.45
2.60	-0.60		ISP		
3.00	-0.09		I		
2.50	-0.20	3 WLO 17:20			

****Sediment Types**: I (ICE); O (ORGANICS); M (MUD); S (SAND); P (PEBBLE); C (COBBLE).

SITE 5741 DYER BAY, PRINCE PATRICK ISLAND, NWT
LINE 1
1990/07/06 (AST)
WL=0.00M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00	1 BM1 0.82M	OSP		
3.00	-0.07		OSP		
3.00	-0.08		SP		
3.00	-0.03		SP		
3.00	-0.08		SP		
3.00	-0.20		SP		
0.40	0.10		SP		
1.75	0.86		SP	9007003	0.80
1.76	0.78		SP		
1.68	-1.13		SP		
1.43	-0.97		SP		
0.80	-0.57		SP		0.80
1.02	-0.80		SP		
0.86	-0.36		I		
0.68	0.16		I		
4.90	-0.37		I		
4.35	-0.60		I		
0.30	-0.27	3 WLO 16:25	I		

SITE 5742 TULLETT, PRINCE PATRICK ISLAND, NWT
LINE 1
1990/07/10 (AST)
WL=0.45M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00		OS		
3.00	-0.03		OS		
3.00	-0.06		S		
3.00	-0.15		S		0.58
3.00	-0.05		S		
3.00	0.37		SP		
3.00	0.89		SP		
2.44	0.66	1 BM1 0.52M	SP		
1.34	-0.24		SP	9007007	1.10
1.98	-0.76		SP		
1.90	-1.00		SP		
2.10	-1.14		S		0.15
2.70	-0.28	3 WLO 10:50	S		
3.40	-0.18		SP		
1.35	-0.15		SP		
0.25	0.37		I		
17.00	-1.00				

SITE 5743 CAPE LEOPOLD M'CLINTOCK, PRINCE PATRICK ISLAND, NWT

LINE 1
1990/07/08 (AST)
WL=0.60M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00		SP		
3.00	0.16		SP		
3.00	0.38		SP		
3.00	0.36		SP		
3.00	0.32		SP		
3.00	0.25		SP		
3.00	0.11		SP		
1.73	-0.04	1 BM1 0.92M	SP	9007005/006	0.55
3.00	-0.24		SP		
3.00	-0.16		SP		
3.00	-0.36		SP		
3.00	-0.45		SP		
3.00	-0.39		SP		
3.00	-0.34		SP		
3.00	-0.28		SP		
5.00	-0.28		S		
5.00	-0.26		S		
5.00	-0.11		S		
5.00	-0.19		S		
5.00	-0.08		S		
5.00	-0.11		S		
5.00	-0.10		S		
5.00	-0.17		S		
5.00	-0.17		S		
5.00	-0.10		S		
5.00	-0.08		S		
5.00	-0.07		S		
5.00	-0.03		S		
5.00	-0.02		S		
5.00	0.03		S		
5.00	-0.04		S		
5.00	0.04				
5.00	0.12		S		
5.00	0.02		S		
5.00	-0.04		S		
5.00	-0.06		S		
5.00	-0.10		S		
5.00	-0.05		S		
5.00	-0.05		S		
5.00	0.02		S		
5.00	-0.06		S		
5.00	-0.04		S		

SITE 5743 CAPE LEOPOLD M'CLINTOCK, PRINCE PATRICK ISLAND, NWT

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
5.00	-0.04		S		
5.00	-0.06		S		
5.00	-0.09		S		
5.00	-0.07		S		
5.00	-0.06		S		
5.00	-0.06		S		
5.00	-0.03		S		
5.00	-0.06		S		
5.00	-0.02		S		
5.00	-0.02		S		
5.00	-0.05		S		
5.00	-0.08				
5.00	-0.05		S		
5.00	-0.06		S		
5.00	-0.04		S		
5.00	-0.08		S		
5.00	-0.02		S		
5.00	0.02		S		
5.00	0.02		S		
5.00	-0.03		S		
5.00	-0.06		S		
5.00	-0.04		S		
5.00	-0.04		S		
5.00	0.03		S		
5.00	0.08		S		
5.00	0.06		S		
5.00	0.04		S		
5.00	-0.06		S		
5.00	0.00		S		
5.00	-0.09		S		
5.00	-0.06		S		
5.00	-0.09		S		
5.00	0.01				
5.00	-0.11		S		
5.00	-0.17		S		
5.00	-0.17		S		
5.00	-0.14		S		
5.00	-0.10		S		
5.00	-0.04		S		
5.00	-0.05		S		
5.00	-0.04		S		
0.80	-0.01		S		
1.18	0.03			9007004	0.28
1.80	-0.03		S		
0.95	-0.02		S		

SITE 5743 CAPE LEOPOLD M'CLINTOCK, PRINCE PATRICK ISLAND, NWT

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.57	0.04		S		
2.84	-0.14	3 WLO 19:50	S		0.13
3.00	-0.12		IS		
5.00	-0.08		ISM		

SITE 5750 WEST BROCK ISLAND, NWT
LINE 1
1990/07/12 (AST)
WL=0.0M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00		SP		
3.00	0.17		SP		
3.00	0.28		SP		
3.00	0.32		SP		
1.60	0.10	1 BM1 0.79M	SP		
3.00	-0.33		SP		
3.00	-0.58		SP		
3.00	-0.66		SP		
3.00	-0.81		SP		
1.60	-0.28		SP		
3.00	-0.28		SP		
3.00	-0.32		SP		
3.00	-0.11		SP		
3.00	-0.29		SP		
3.00	-0.18		SP		
3.00	-0.24		SP		
3.00	-0.22		SP		
3.00	-0.14		SP		
3.00	-0.08		SP		
3.00	-0.07		SP		
3.00	-0.04		SP		
3.00	-0.14		SP		
3.00	-0.14		SP		
3.00	-0.10		SP		
3.00	-0.08		SP		
3.00	-0.07		SP		
3.00	-0.02		SP		
3.00	-0.07		SP		
200.00	-1.50	3 WLO 15:00			

SITE 5752 NORTHEAST BROCK ISLAND, NWT
LINE 1
1990/07/15 (AST)
WL=0.60M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00	1 BM1 0.79M	SP		0.54
3.00	-0.07		SP		
3.00	-0.08		SP		
3.00	-0.04		SP		
3.00	-0.08		SP		
3.00	-0.12		SP		
3.00	-0.10		SP		
3.00	-0.06		SP		
3.00	-0.11		SP		
3.00	-0.02		SP		
3.00	-0.05		SP		
3.00	-0.12		SP		
3.00	-0.10		SP		
3.00	-0.10		SP		
3.00	-0.11		SP		
3.00	-0.10		SP		
3.00	-0.12		SP		
3.00	-0.20		SP		
3.00	-0.10		SP		
3.00	-0.12		SP		
3.00	-0.10		SP		
3.00	-0.09		SP		
3.00	-0.08		SP		
3.00	-0.10		SP		
3.00	-0.12		SP		
1.58	-0.07		SP	9007018	
1.72	-0.08	2 BM2 1.05M	SP		0.48
3.00	-0.10		SP		
3.00	-0.13		SP		
1.15	-0.12		SP		
2.06	-0.23		SP	9007019	0.37
0.58	-0.04		S		
1.30	-0.19		SP		
1.07	-0.07	3 WLO 16:15	SP		
2.85	-0.30		S		0.23
0.05	-0.91		IS		

SITE 5753 NORTH BROCK ISLAND, NWT
LINE 1
1990/07/16 (AST)
WL=0.40M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00		S		
3.00	0.02	4 WLL 11:30	S		
3.00	0.05		S		0.50
3.00	0.08		S		
3.70	0.10		OS		
4.00	0.18		OS		
5.80	0.26		S		
4.00	0.10		S		
4.00	-0.04		S		0.43
4.00	0.06		S		
4.00	0.06		S		
4.00	0.04		S		
4.00	0.07		S		
4.00	0.06		S		
4.00	0.02		S		
4.00	0.02		S		
4.00	0.00		S		
4.00	0.07		S		
3.80	0.08		S		
4.00	0.24		S		
4.00	0.12		S		0.70
4.00	0.08		S		
4.00	-0.04		S		
4.00	-0.01		S		
3.80	0.03	1 BM1	S		0.44
4.00	0.22		S		
4.00	0.16		S		
4.00	0.24		S		
2.50	0.04		SP		0.44
4.00	0.64		SP		
4.00	0.70		SP		
4.00	1.02		SP		
4.00	0.78		SP		
4.00	0.67		SP		
2.40	0.23	2 BM2 1.51M	SP	9007021	0.54
3.00	-0.15		SP		
3.00	-0.66		S		
3.00	-0.84		SP	9007022	0.35
3.00	-0.90		S		
3.00	-0.78		S		
3.00	-0.66		S		
3.00	-0.54		S		

SITE 5753 NORTH BROCK ISLAND, NWT

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
3.00	-0.48		S		
3.00	-0.47		S		
3.00	-0.29		S		
3.00	-0.43		S		0.36
3.00	-0.28		S		
3.00	-0.34		S		
3.00	-0.29		S		
3.30	-0.21		S		
1.10	0.03		SP		
1.60	0.22		SP	9007020	0.37
1.30	-0.38		SP		
2.30	-0.11		SP		
6.50	-0.11	3 WLO 11:45	SP		

SITE 5751 SOUTHWEST BROCK ISLAND, NWT
LINE 1
1990/07/14 (AST)
WL=0.50

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00		SP		
3.00	0.02		SP		
3.00	0.02		SP		
3.00	0.01		SP		
3.00	0.10		SP		
3.00	0.18		SP		
1.37	0.12		SP		
2.00	0.60		SP		
3.00	0.30		SP		
3.00	0.14		SP		
3.00	0.08		SP		
3.00	0.00		SP		
1.78	-0.02	1 BM1 0.98M	SP		0.55
2.65	-0.20		SP		
0.70	-0.40		SP	9007016	0.60
3.00	-0.27		SP		
3.00	-0.34		SP		
3.00	-0.44		SP		
3.00	-0.28		SP		
3.00	-0.33		SP		
3.00	-0.33		SP		0.20
3.00	-0.50		I		
3.00	-0.30		I		
3.00	-0.36		I		
3.00	-0.22		I		
3.00	-0.18		I		0.19
3.00	-0.21		I		
3.00	-0.19		MSP		
3.00	-0.19		MSP		
3.00	-0.19		MSP		
3.00	-0.18		SP		
3.00	-0.20		SP		
3.00	-0.21		SP		
3.00	-0.19		SP		0.19
3.00	-0.22		SP		
3.00	-0.24		SP		
3.00	-0.22		SP		
3.00	-0.28		SP		
1.22	-0.11	2 BM2 1.20M	MSP		0.28
3.00	-0.22		MSP		
3.00	-0.26		MSP		
3.00	-0.27		SP		

SITE 5751 SOUTHWEST BROCK ISLAND, NWT

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
3.00	-0.28		SP		
3.00	-0.24		SP		
3.34	-0.19		SP		0.15
0.92	0.01		S		0.23
2.33	-0.12		S	9007015	0.14
4.00	-0.16		IMS		
4.00	-0.16		MSP		
4.00	-0.14		SP		0.32
4.00	-0.12	3 WLO 14:10	IS		0.02
3.43	0.04		IS		
1.08	0.12		I		
1.65	-0.18		IS		

SITE 5581 CAPE RICKETTS, DEVON ISLAND, N.W.T.
LINE 3
1990/07/23 (CDT)
WL= 0.60M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00	2 TBM	P		
0.32	-0.02		P		
2.96	-0.54		P		
2.33	-0.11		P		
3.17	0.32		P		
2.77	-0.69		P		
1.95	0.01		P		
2.94	-0.30		P		
2.10	-0.06		P		
1.67	0.33		P		
1.56	-0.61		P		
2.41	-0.55		P		
2.45	-0.70		P		
3.22	-0.58		P		
1.07	-0.04	3 WLO 21:30	P		

SITE 5581 CAPE RICKETTS, DEVON ISLAND, N.W.T.
LINE 7
1990/07/23 (CDT)
WL= 0.60M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00	1 BM	P		
2.94	-0.48		P		
2.92	-0.49		P		
3.12	-0.34		P		
1.61	-0.10		P		
2.83	0.12		P		
1.73	0.04		P		
2.92	-0.38		P		
3.11	-0.51		P		
2.95	-0.09		P		
3.02	-0.22		P		
2.95	-0.27		P		
3.40	-0.49	2 TBM	P		
2.92	-0.32		P		
2.97	-0.22		P		
2.43	-0.19		P		
1.77	-0.63		P		
0.63	-0.08		P		
2.43	-0.56		P		
2.33	0.03		P		
1.06	0.11		P		
0.94	-0.33		P		
0.41	-0.07		P		
0.97	-0.42		P		
1.87	-0.38		P		
3.17	-0.58		P		
1.92	-0.18		P		
2.90	-0.54		P		
0.95	-0.20	3 WLO 21:15	P		

SITE 5581 CAPE RICKETTS, DEVON ISLAND, N.W.T.
LINE 10
1990/07/23 (CDT)
WL= 0.50M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00	1 BM	P		
2.91	-0.20		P		
2.92	-0.3		P		
2.92	-0.37		P		
2.57	-0.32		P		
2.70	0.02		P		
2.92	-0.28		P		
2.92	-0.28		P		
2.92	-0.24		P		
2.92	-0.28		P		
2.90	-0.09		P		
3.07	-0.25		P		
2.90	-0.16		P		
2.99	-0.18		P		
1.50	0.17	2 TBM	P		
1.82	-0.53		P		
1.54	-0.45		P		
0.73	0.04		P		
2.42	0.70		P		
0.77	-0.10		P		
1.61	-0.51		P		
2.97	-0.45		P		
1.40	-0.11		P		
2.74	-0.72		P		
2.04	-0.16		P		
2.42	-0.41		P		
2.03	0.11		P		
1.23	-0.16		P		
1.44	-0.58		P		
2.88	-0.45		P		
1.73	-0.22		I		
2.12	-0.24		I		
1.04	-0.21		I		
2.31	-0.40		I		
0.70	0.05		IP		
1.25	-0.55	3 WLO 20:50	P		

SITE 5581 CAPE RICKETTS, DEVON ISLAND, N.W.T.
LINE 17
1990/07/23 (CDT)
WL= 0.30M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00	1 BM	P		
2.90	-0.58		P		
3.20	-0.87		P		
3.00	-0.71		P		
1.42	-0.58		P		
3.15	-0.53		P		
3.20	-0.23		P		
1.58	-0.11		P		
1.08	-0.63		P		
3.00	-0.75		P		
1.50	-0.23		P		
2.70	0.10		P		
1.30	-0.48		P		
0.42	-0.18		P		
1.99	-0.42		I		
2.20	-0.41		I		
0.99	0.25		I		
0.56	-0.46		I		
1.05	-0.30		IP		
0.65	0.15		P		
1.60	-0.58		P		
1.55	-0.37	3 WLO 20:00	P		

SITE 5583 RADSTOCK BAY, DEVON ISLAND N.W.T.
LINE 5
1990/07/23 (CDT)
WL= 1.40M

DIST. (m)	ELEV. (m)	CONTROL POINTS	SEDIMENT TYPE**	SAMPLE NUMBER	THAW DEPTH (m)
0.00	0.00	2 TBM	P		
2.88	0.10		P		
3.02	0.18		P		
3.81	-1.02		P		
2.28	-0.30		P		
1.76	-0.13		P		
1.09	-0.01		P		
0.68	-0.37		P		
0.39	-0.02		P		
1.02	-0.43		P		
1.81	-0.40		P		
2.63	-0.56	3 WLO 23:00	P		

APPENDIX 3

Aerial Coastal Video Tape Summary (see Figure 1 for locations)

Field Tape Number	Start Time (CDT)	Location	Stop Time (CDT)	Location	Flying Height (m)
07/07/1990	**Prince Patrick Island**				
1	14:00	A	15:29	B	67-128
2	16:05	C	17:14	D	67-85
Total Coverage: 235 km.					
08/07/1990	**Polynia Islands**				
3	14:56	E	15:24	F	107-122
Total Coverage: 35 km					

APPENDIX 4

Weather Observations (July 11-July 19, 1990), Brock Island Base Camp (77°55.5'N, 114°12'W)

DATE	TIME (CST)	SKY CONDITION* (100's feet)	VIS. (mi)	TEMP. (°C)	WIND Dir	WIND Vel.	CLOUDS	REMARKS
11	1900	250 ⌀	15+	5	31	07	CS2	
12	0700	clear	15+	0	27	09	clear	
12	1900	E 200 ⦸	15	2	21	11	AS4, CC4	
13	0700	E 100 ⌀, 200 ⦸	15	2	21	11	AS4, CC4	
13	1900	E 150 ⌀, 200 ⦸	15	5	22	12	AS4, CC5	
14	0700	E 3 ⌀, 150 ⦸	15	2	25	04	St3, AC6	Stratus increases to S &W
14	1900	E 3 ⌀, 150 ⊕	15	3	22	08	Sf1, St9	
15	0700	E 5 ⊕	10	1	22	12	St 10	
15	1900	E 20 ⦸	15	6	22	03	St 9	
16	0700	200 ⌀	15	8	17	05	CI 1	
16	1900	E20 ⌀, 100 ⦸	15	11	20	13	SC6,AC3	
17	0700	E20 ⌀, 100 ⦸	15	7	18	08	SC2,AS7	
17	1900	E500 ⊕	15	4	21	16	SC10	fog, rain all day
18	0700	E3 ⊕	10	1	21	23	St 10	
18	1900	E5 ⊕	10	2	22	19G	St 10	rain\snow showers; ceiling lowering to NW

***SKY CONDITION (CLOUDS)**

⌀ SCATTERED
⦸ BROKEN
⊕ OVERCAST