Study of iceberg scours across the continental shelf and slope off southeast Baffin Island using the Sea MARC I midrange sidescan sonar

Project 760015

Dan Praeg, Brian MacLean, David J.W. Piper, and Alexander N. Shor[1]
Atlantic Geoscience Centre, Dartmouth

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Abstract

The shelf and slope southeast of Baffin Island were examined along a 280 km long, 5 km swath width Sea MARC I survey line across water depths of 320 to 2100 m. Variations in the abundance, orientation, size and character of iceberg scours suggest division of the scoured seabed along the survey line into four zones: inner, central and outer shelf and upper continental slope. The maximum depth of iceberg scours occurs on the upper continental slope at about 715 m. All or most iceberg scours observed are relict and date from an episode of greater iceberg drafts, probably in the late Foxe or early Holocene. A gradual decrease in iceberg drafts through time is compatible with features observed along the upper slope to central shelf transect, while a contrast in character between scours of the inner and central shelf suggests a different history, possibly related to fluctuations in the sill depth of the inner shelf Resolution Basin.

Résumé

Le plateau continental et le talus continental du sud de l'île Baffin ont été étudiés suivant une ligne de levé constituée d'une bande de 280 km de long sur 5 km de large par Sea MARC I, par des profondeurs de 320 m à 2100 m. Les variations de l'abondance, de l'orientation, de la taille et du caractère des cicatrices d'affouillement par des icebergs laissent supposer une division du fond marin affouillé le long de la ligne de levé en quatre zones: plateau continental intérieur, central et extérieur et talus continental supérieur. La profondeur maximale des cicatrices d'affouillement par des icebergs se rencontre sur le talus continental supérieur à environ 715 m. Toutes les cicatrices d'affouillement par icebergs observées ou presque sont des résidus et datent d'un épisode de dérives plus importantes des icebergs, probablement du Foxe supérieur ou de l'Holocène inférieur. Une diminution progressive des dérives des icebergs à travers le temps est compatible avec des caractéristiques observées le long d'une coupe transversale allant du talus supérieur au plateau central, alors que le contraste des caractères observés entre des cicatrices d'affouillement du plateau intérieur et du plateau central laisse supposer une évolution différente, probablement liée à des fluctuations de la profondeur du seuil du bassin de Resolution du plateau intérieur.

[1]Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964, U.S.A.

INTRODUCTION

In 1984 the Atlantic Geoscience Centre examined selected areas of seabed offshore eastern Canada using the Sea MARC I midrange (5 km swath width) sidescan sonar system (Kosalos and Chayes, 1983). Preliminary results of this program from the Scotian and Labrador continental margins have been presented by Josenhans et al. (1986), Pereira et al., (1985), Piper et al. (1985a, b, in press), and Piper and Sparkes (in press). This paper discusses sidescan sonar imagery collected along a 280 km Sea MARC I survey line across the continental shelf and slope off southern Baffin Island, between water depths of 300 to 2000 m (Fig. 88.1).

Previous investigations of the area indicate the presence of numerous iceberg scours incised into the unconsolidated sediments of the continental shelf and upper continental slope (Woodworth-Lynas, 1983; Praeg et al., 1986a), and suggest the possibility of mass movement on the continental slope (Geonautics Ltd., 1982). A Sea MARC I survey was conducted in order to: (1) examine the type and distribution of iceberg scours, (2) determine the maximum depth of occurrence of iceberg scours on the upper continental slope, and (3) investigate continental slope features. The survey line crosses the sites of two exploratory wells on the continental shelf, Aquitaine et al. Hekja 0-71 (Klose et al., 1982) and Canterra Ralegh N-18; a third well, Esso H.B. Gjoa G-37 (Klose et al., 1982), is 65 km north of the survey line (Fig. 88.1).

DATA COLLECTION

The Sea MARC I survey line was collected during 18-21 September, 1984, over a period of 61 hours, as part of *CSS Hudson* cruise 84-035. The Sea MARC I system comprises a dual channel sidescan sonar with 27 and 30 kHz transducers, and a 4.5 kHz subbottom profiler (Kosalos and Chayes, 1983). The system is housed in a neutrally buoyant vehicle, which was towed up to 2500 m behind the ship, at elevations of about 300 m off the seabed. In addition to the Sea MARC I data, echograms were collected from the ship using towed 3.5 kHz and hull-mounted 12 kHz sources, and seismic reflection pro files were collected using a Bolt Associates 655 cm^3 (40 $inch^3$) airgun source with a single channel Nova Scotia Research Foundation hydrophone. Positioning of the data was by satellite navigation and rho-rho LORAN C, integrated by the BIONAV system (Wells and Grant, 1981). The Sea MARC I vehicle was positioned using a wire-out indicator and vehicle depth.

REGIONAL SETTING

The southeast Baffin Shelf is both broad and deep: it extends approximately 170 km from Loks Land to the shelf break at 450-550 m, and across most of this distance is deeper than 200 m (Fig. 88.1). The continental shelf slopes southeastward in gradients less than 1° toward a large bathymetric depression east of Hudson Strait, and contains an inner basin off the mouth of Frobisher Bay informally referred to as the Resolution basin by Praeg et al. (1986a). The adjacent continental slope descends seaward in gradients less than 2° to about 1500 m depth, beyond which gradients up to 20° and relief up to 180 m occur in association with a bathymetric protrusion of the continental slope (Fig. 1) informally referred to as the Gjoa Spur. The Sea MARC I survey line extends across the continental shelf for 140 km, from the northern margin of the Resolution basin to the shelf break at 460 m, and across the continental slope for another 140 km, crossing the southern tip of the Gjoa Spur (Fig. 88.1).

Surface currents in the area are dominated by the southward flowing Baffin Current, which originates in northern Baffin Bay and flows along the Baffin coast and across the southeast shelf at velocities up to 40 cm/s (Collin and Dunbar, 1964). The Baffin Current carries numerous icebergs across the Baffin Shelf, most of which are calved from glaciers of western Greenland (Murray, 1969). An average of 3500 icebergs cross the latitudes of the study area each year (Ebbesmeyer et al., 1980).

The continental shelf along the Sea MARC I survey line is underlain by gently seaward dipping Tertiary sedimentary strata (Grant, 1975; MacLean et al., 1977), which are separated by an angular unconformity from overlying unconsolidated sediments less than 10 m thick (Fig. 88.2). The unconsolidated Quaternary sediments of the southeast Baffin Shelf have been mapped and discussed by Praeg et al. (1986a). The shelf along the survey line is underlain by gravelly sandy muds mapped as Davis Strait Silt subunit B, which are characterized on high resolution seismic reflection profiles by a general lack of acoustic stratification, and by a rough surface morphology attributed to iceberg scours (Fig. 88.2). Subunit B is laterally equivalent to unscoured, acoustically stratified, gravelly sandy muds of Davis Strait Silt subunit A (Fig. 88.2), which are present in the floor of the Resolution basin below 500-550 m depth (Fig. 88.1, 88.2). In the Resolution basin Davis Strait Silt subunit A laterally interfingers with glacial till of the Baffin Shelf Drift, indicating partial time-equivalency, and is partly overlain by basinal muds of the Tiniktartuq Silt and Clay. The immediate seabed in the area of the survey line has been modified by both the southward flowing Baffin Current and by tidal currents originating from Frobisher Bay (Osterman, 1982), resulting in the formation of an extensive, thin (50 cm) surface veneer composed dominantly of sand and gravel (Praeg et al. 1986a).

SIDESCAN SONOGRAMS

Sea MARC I sidescan sonar data were digitally recorded, and processed in real time to produce orthorectified images with horizontal slant range corrections. These were later manually compiled at a scale of 1:40 000. Examples of the resulting seafloor imagery are presented below (Fig. 88.3-88.5). Reproductions of the original 1:40 000 scale sonograms, and accompanying interpretations, are available as Geological Survey of Canada Open File 1254 (Praeg et al., 1986b).

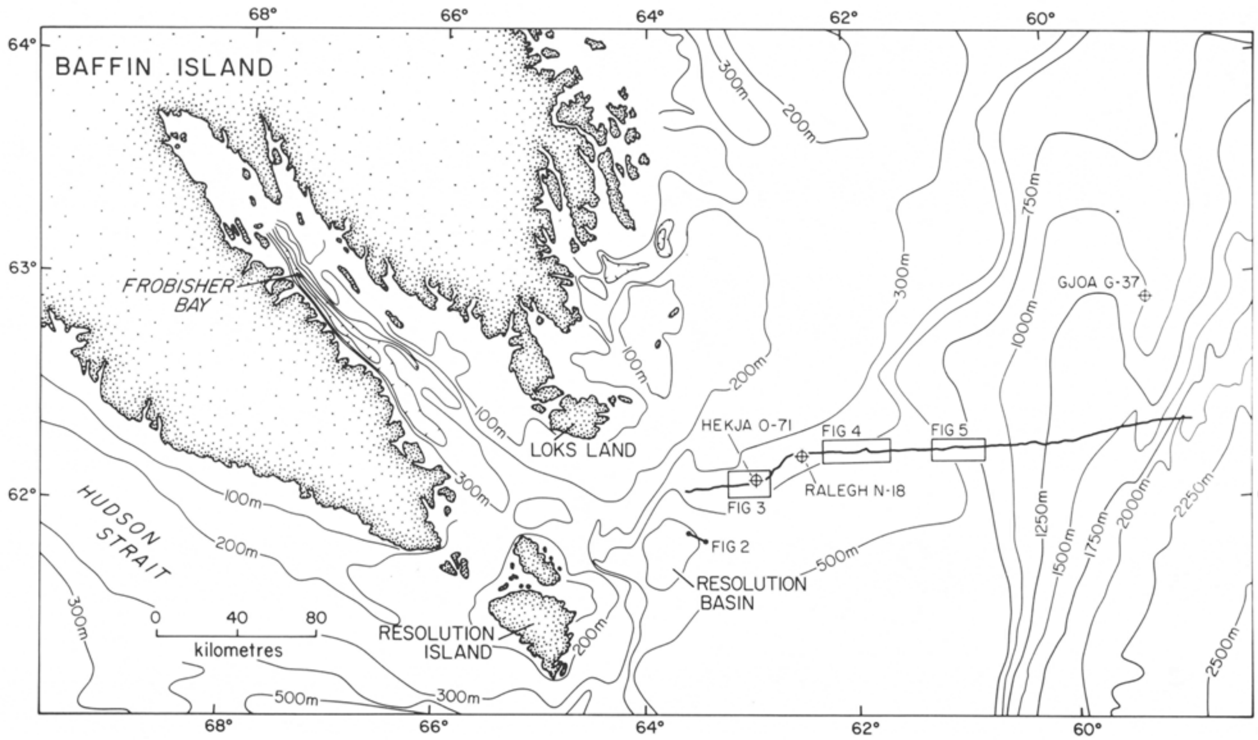

Figure 88.1. Index map of the continental shelf and slope off southeast Baffin Island, showing the Sea MARC I survey line and the location of Figures 88.2-88.6. The positions of three exploratory wells are also shown.

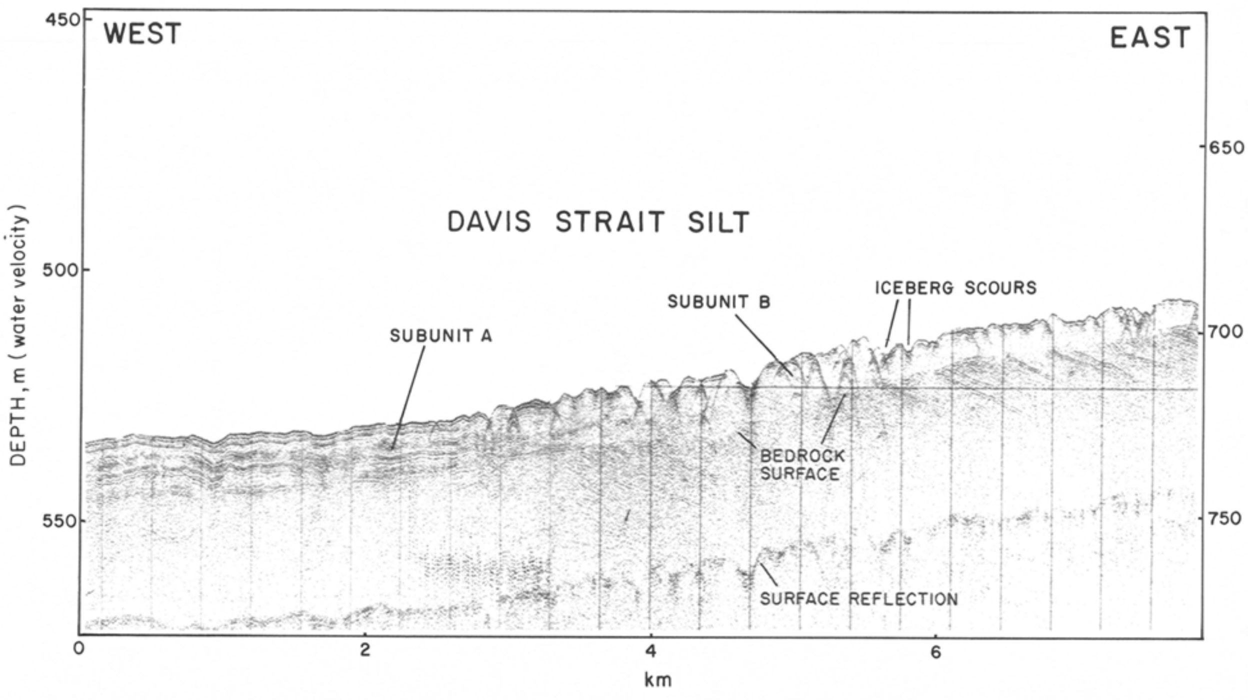

Figure 88.2. Huntec DTS high resolution seismic reflection profile from the Resolution basin (Fig. 88.1), illustrating lateral equivalency between stratified sediments of Davis Strait Silt subunit A and the acoustically unstratified, iceberg scoured sediments of subunit B. In deeper water southwest of the profile the conformable sediments of subunit A are overlain by basinal muds of the Tiniktartuq Silt and Clay. The unconsolidated sediments unconformably overlie gently seaward-dipping strata of semiconsolidated Tertiary sedimentary bedrock. From Praeg et al. (1986a).

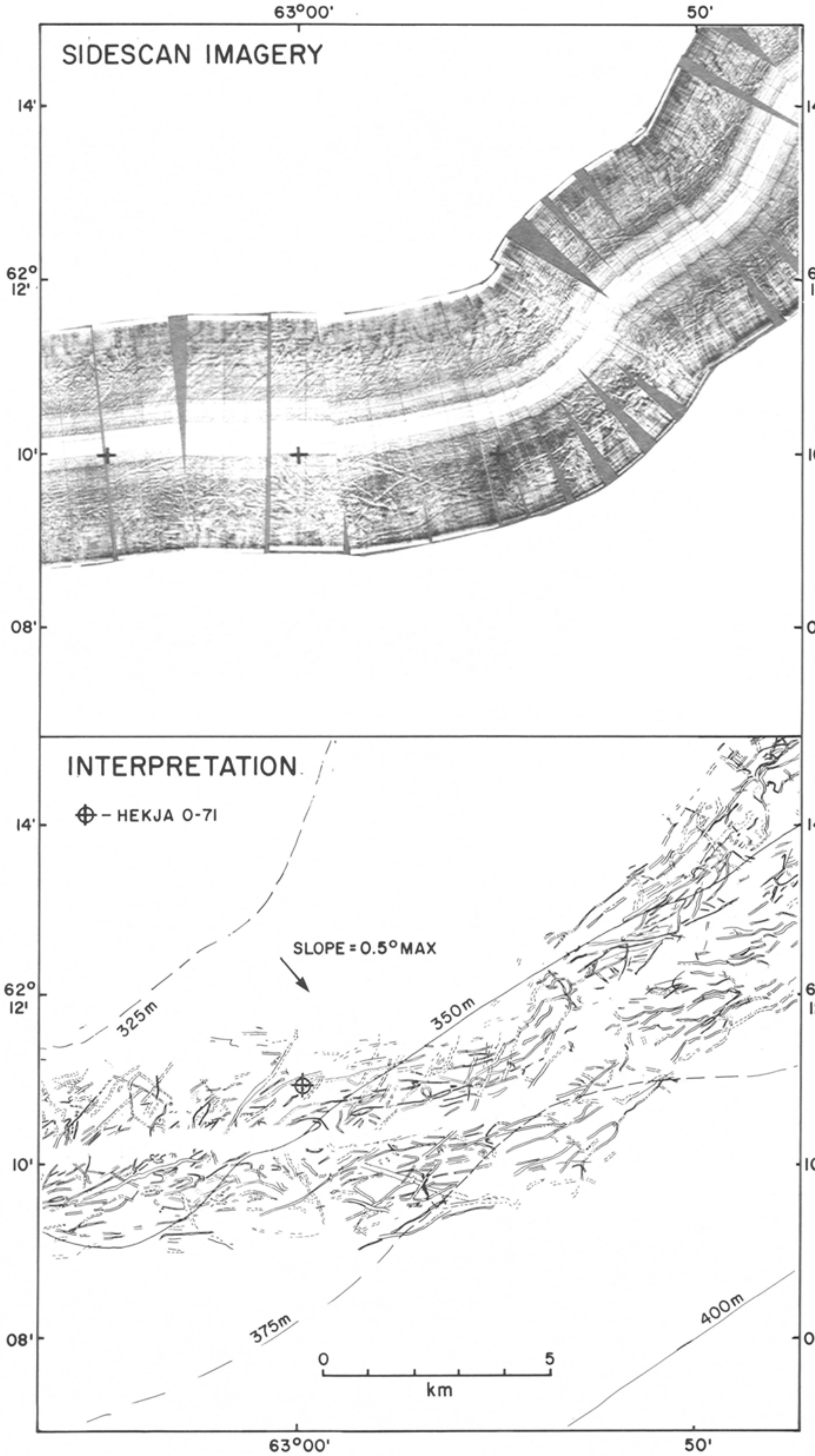

Figure 88.3. Sea MARC I sidescan sonogram and interpretation from the central shelf, in the area of the Hekja well site (Fig. 88.1). The sidescan imagery has been orthorectified, and so constitutes a 'true' picture of the seafloor. The darkness of the grey areas are proportional to the strength of the reflected acoustic energy, e.g. light areas represent weak returns. The outer kilometre of both sidescan channels are dominated by water column interference. Iceberg scours have affected the entire seabed, and are fairly consistently oriented parallel to the isobaths. Most scours are well defined.

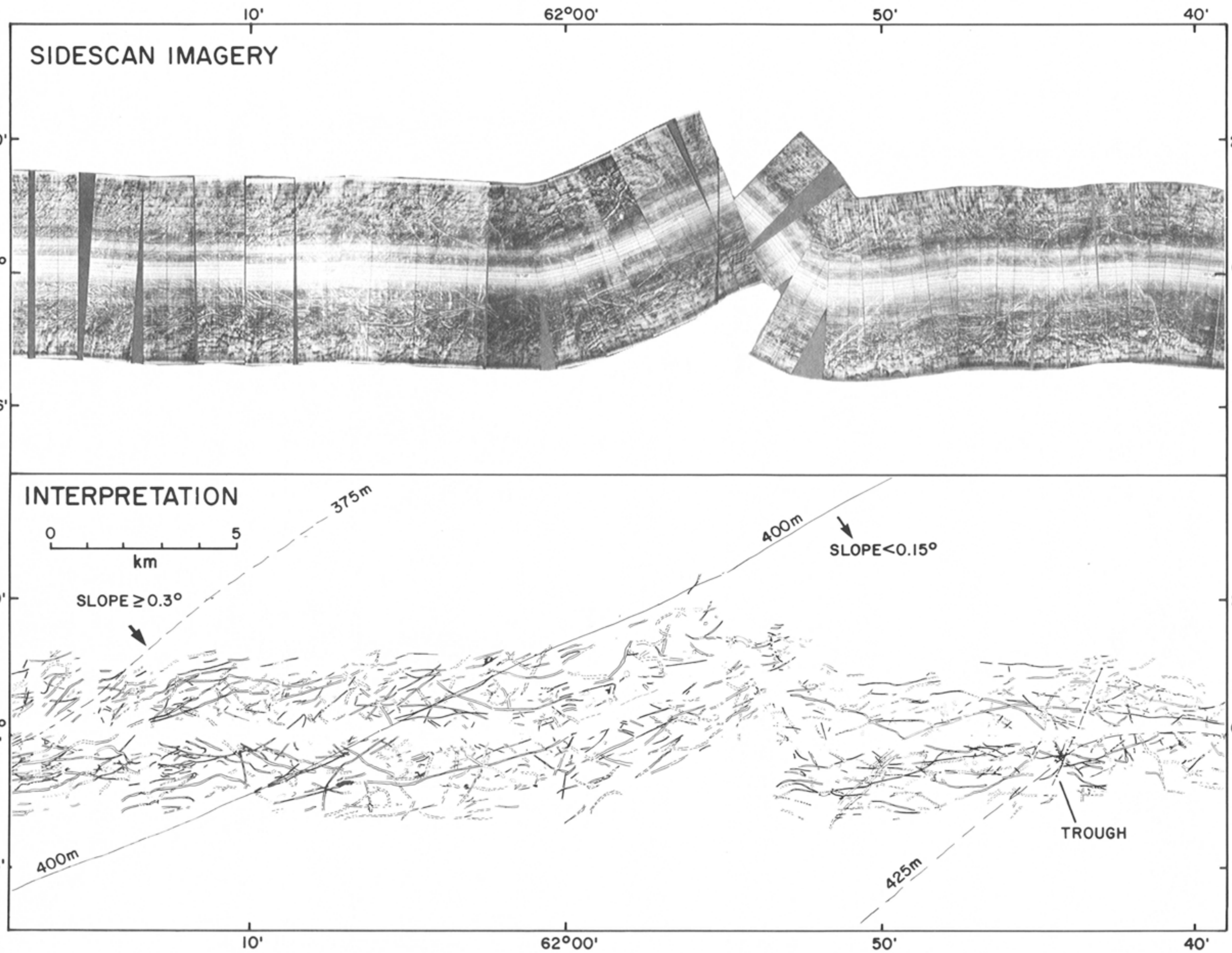

Figure 88.4. Sea MARC I sidescan sonogram and interpretation across the transition from the higher gradients of the central shelf to the lower gradients of the outer shelf (Fig. 88.1). Iceberg scours decrease in both abundance and consistency of orientation from west to east across the transition, which is marked by numerous subcircular low reflectivity patches interpreted as iceberg pits infilled with fine sediment. A large trough 150 m wide and 7 m deep, present to the east, appears to be an exceptionally large scour. See Figure 88.3 for information on sidescan interpretation, and see text for a detailed discussion of seabed features.

Sidescan interpretation

Iceberg scours have been previously reported across the study area (Woodworth-Lynas, 1983; Praeg et al., 1986a), and are recognized on the Sea MARC I imagery by their characteristic form, which ranges from linear (furrows: Harris, 1974) to equant (pits: Fader and King, 1981), and by their crosscutting relationships. Variations in scour abundance, size and orientation have been evaluated qualitatively. Abundance is assessed as proportion of seabed scoured (high, moderate, low). Size is measured directly from the sonograms (width) and echograms (depth), and is generally consistent enough within an area that representative values can be estimated. Orientation is assessed as consistency of the population about a particular direction. Scour orientations observed on sidescan imagery can have some dependence on the direction of sonification, i.e. scours parallel to the survey line can appear more prominent than those transverse to it (Todd, 1984). In the case of the Sea MARC I imagery, scours can generally be observed in numerous orientations in a given area, and apparent scour orientations vary in consistency and direction across the study area despite the generally fixed orientation of the survey line (Fig. 88.1). This suggests that any bias in apparent orientations is not significant, and that true relative variations are being portrayed.

Low reflectivity areas which are not acoustic shadows are observed on the continental shelf and slope, and are interpreted to indicate ponding of finer sediment within coarser, higher reflective areas of seabed. Reflectivity is a relative characteristic, so the actual texture of both finer and coarser sediments may vary across the area. Previous studies indicate that the immediate seabed of the continental shelf is composed primarily of sands and gravels (Praeg et al., 1986a), whereas finer sediments occur on the continental slope (see below). Low reflectivity areas include the troughs of many larger iceberg scours. Such scours often have poorly defined margins, in contrast to well defined or "fresh-looking" scours nearby. Low reflectivity troughs and/or poorly defined margins are interpreted to indicate infilling of scour troughs and/or degradation of berms due to bottom currents, a pattern of seabed modification previously recognized on both the southeast Baffin and Labrador Shelves (Praeg et al., 1986a; Josenhans and Barrie, 1982). Many well defined scours may also have been modified by bottom currents, which have produced an extensive sand and gravel veneer in the area, but at a scale or to a degree too small to be resolved by the Sea MARC I system.

Iceberg scours

Sea MARC I data indicate that the seabed of the continental shelf and upper continental slope is dominated by iceberg scours, which take the form of furrows and some pits. Qualitative assessment of variation in scour abundance, orientation, size and definition suggests that the scoured seabed along the survey line can be divided into four distinctive zones, which roughly conform to physiographic divisions: inner, central and outer shelf, and upper continental slope.

Central Shelf

The central part of the shelf along the survey line corresponds to the interval above about 375 m, up to 320 m, which contains seabed gradients of 0.2-0.5°; it includes both the Hekja and Ralegh well sites (Fig. 88.1). The abundance of iceberg scours is high across this interval and the entire seabed has been affected (Fig. 88.3). High resolution subbottom profiles available from the area (Geonautics Ltd., 1982) show that the characteristically acoustically unstratified sediments of Davis Strait Silt subunit B (Fig. 88.2) form the seabed. Iceberg furrow orientations are fairly consistent, showing a strong trend parallel to the local isobaths, although other orientations up to isobath-transverse are apparent (Fig. 88.3). Furrow lengths are difficult to assess due to a general orientation oblique to the survey line, but features at least 9 km long are observed. Furrows shorter than the width of the sonograms (5 km) also occur, and some iceberg pits. Furrows are generally up to 50 m wide and 3 m deep, but some exceptional features up to 100 m wide are recognized, for example southeast of the Hekja well site (Fig. 88.3). Most scours appear well defined or "fresh-looking" on the sonograms. However, some are poorly defined, often with low reflectivity troughs, and these are interpreted to reflect modification by currents. The well defined scours may also have been modified by currents, to a degree not resolved by the Sea MARC I system, and this is supported by local textural variability evident in bottom photographs and grab samples collected from the area of the Hekja well site.

Inner shelf

The inner part of the shelf along the survey line corresponds to the northern margin of the Resolution basin below about 375 m, to 400 m, which contains seabed gradients of 0-0.7°. In the deeper waters of the Resolution basin south of the Sea MARC I survey line, bottom profiles show an area of seabed unaffected by iceberg scouring below 500-550 m depth (Figs. 88.1, 88.2). Across the northern margin of the basin, the Sea MARC I imagery suggest moderate abundances of iceberg furrows and pits, which in general are poorly defined and of subdued relief (2 m) on bottom profiles. Furrows are difficult to trace laterally, but there appears to be little consistency in orientation. The scours are commonly associated with low reflectivity troughs, indicative of fine sediment infill, which increase in abundance downslope and grade into subcircular low reflectivity patches of ponded sediment. On the eastern flank of the basin above about 375 m, the Resolution basin scours are crosscut by well defined scours which have higher relief (up to 3 m) on bottom profiles, and which appear to be an extension of the well defined population observed on the central shelf. The contrasting poorly defined nature and subdued relief of the Resolution basin scours,

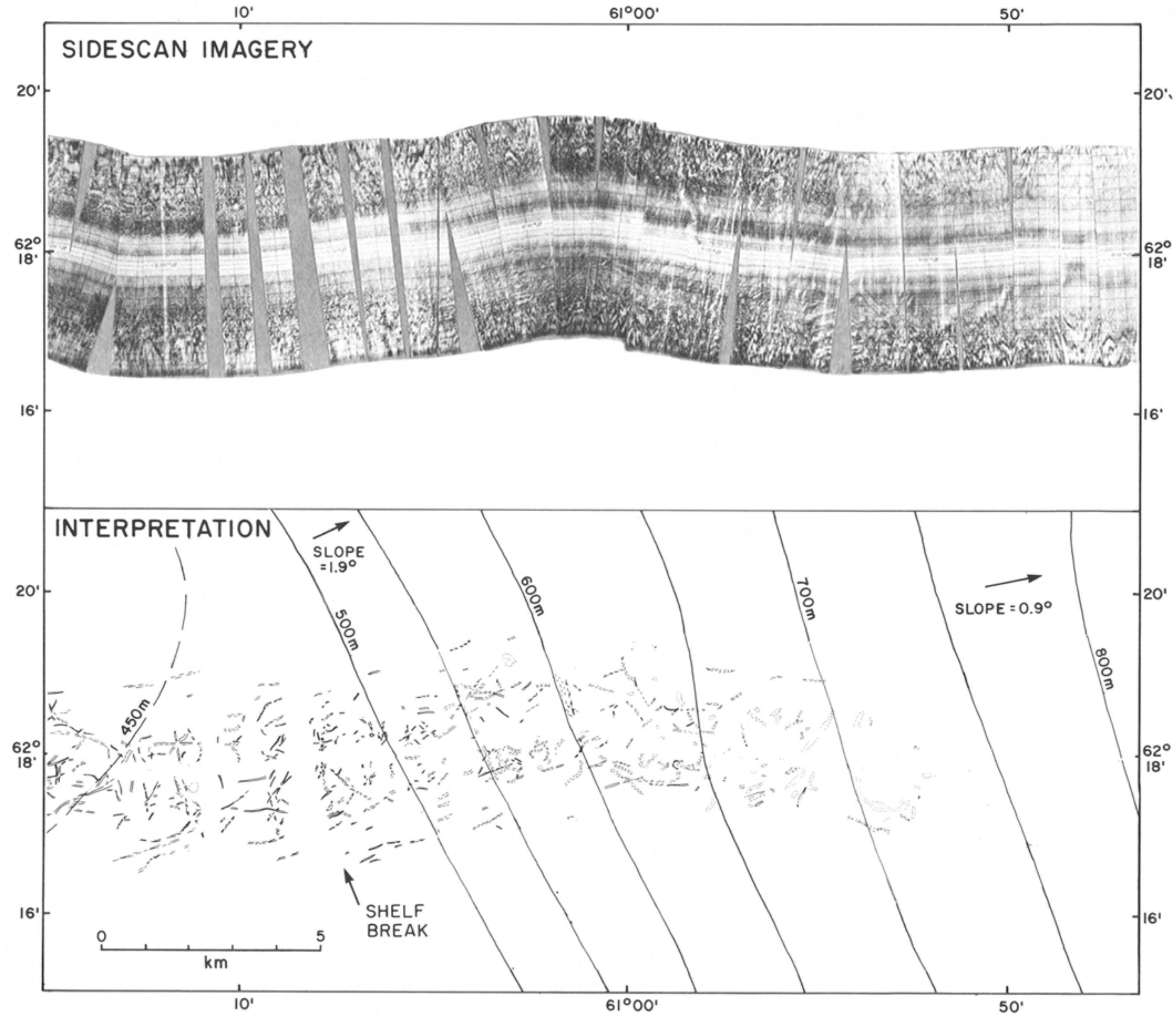

Figure 88.5. Sea MARC I sidescan sonogram and interpretation across the shelf break and upper continental slope (Fig. 88.1). The lower limit of iceberg scour is observed at about 715 m water depth, below which the seabed appears largely homogenous and subbottom profiles indicate a mud layer up to 5 m thick. Iceberg scours have not affected the entire seabed above 715 m, and are inconsistently oriented. Many scours are poorly defined and infilled by low reflectivity fine sediment. See Figure 88.3 for information on sidescan interpretation, and see text for discussion of seabed features.

along with the presence of ponded fine sediment, indicate modification of the inner shelf by currents to a significantly greater degree than observed on the central shelf.

Outer shelf

The outer part of the shelf along the survey line corresponds to a large area with gradients less than 0.1-0.2° extending from about 375 m to the slope break at 460 m (Fig. 88.1). The abundance of iceberg scours is moderate, and patches of apparently unscoured or partly scoured seabed are recognized (Fig. 88.4). These patches correspond to intervals of subsurface stratification on a high resolution subbottom profile along the survey line (Geonautics Ltd., 1982). Iceberg furrow orientations are inconsistent, varying from parallel to transverse to the gentle local gradients, although individual furrows tend to maintain a uniform orientation (Fig. 88.4). Furrow widths are generally up to 50 m, similar to those on the central shelf, but depths are slightly greater at up to 4 m; exceptional features up to 100 m wide and 8 m deep are also observed. A trough approximately 150 m wide and 7 m deep is present on the inner part of the outer shelf (Fig. 88.4). It appears to be an exceptionally large scour, rather than a topographic feature related to the subbottom bedrock surface, as a high resolution subbottom profile across the area (Geonautics Ltd., 1982) shows several large iceberg scours of comparable size and a fairly smooth bedrock surface. The transition from the central shelf to the lower gradients of the outer shelf is marked by an abundance of sub circular low reflectivity patches between water depths of about 370-410 m (Fig. 88.4). The patches are 50-150 m in diameter, and occur as isolated features or in some cases at the head of iceberg furrows. The features are interpreted as iceberg pits, or impact marks, which have been infilled by fine sediment. Many iceberg scours here and to seaward are poorly defined and have low reflectivity troughs, suggesting degradation and infilling due to currents. A grab sample located along the survey line in 400 m of water consists of sand and gravel, demonstrating the significance of current activity in this area (Praeg et al., 1986a).

Upper continental slope

Below the shelf break at approximately 460 m, iceberg scours decrease in abundance seaward across the relatively steep gradients (up to 2°) of the upper continental slope (Fig. 88.5). A high resolution subbottom profile along the survey line shows intervals of subsurface stratification, which abruptly become almost continuous below water depths of about 600 m (Geonautics Ltd., 1982). Iceberg furrow orientations are inconsistent across the upper continental slope, and some individual furrows display changes in orientation (Fig. 88.5). Furrows appear generally shorter than those on the continental shelf, and several pits are present. Furrow sizes are generally up to 50 m wide and 4 m deep, similar to the outer shelf; an exceptional feature at 670 m depth is approximately 100 m wide and 10 m deep. Iceberg scours are generally poorly defined, and low reflectivity troughs and patches suggestive of fine sediment infill increase in abundance in deeper water.

The lower limit of iceberg scours on the upper continental slope is recognized at approximately 715 m water depth on the Sea MARC I imagery, below which a largely featureless seabed occurs. On bottom profiles, this depth is the lower limit of hyperbolic reflections, which are associated with scour relief. Below this depth, subbottom profiles show an acoustically transparent layer up to 5 m thick, interpreted as a mud unit. It has a smooth upper surface, and an irregular basal surface dissimilar to iceberg scour relief.

DISCUSSION

Measurement of iceberg drafts in the Baffin Bay-Labrador Sea area, from both submersible and vertical sidescan sonar observations of several hundred icebergs, suggests present day maximum drafts of about 240 m (Wittman, in Murray, 1969; El-Tahan et al., 1985). Estimates of iceberg drafts from observations of thousands of apparently grounded (stationary) icebergs from drillrigs, shore-based radars, satellites and International Ice Patrol surveys suggest maximum drafts of approximately 300 m, although some uncertainty exists due to poor bathymetric control on many northern charts (El-Tahan et al., 1985). In the area of the Hekja well site (Fig. 88.1), one large iceberg observed during drilling was apparently grounded in water depths of 265 m (Geomarine Associates Ltd., 1980). These observations indicate that present-day iceberg drafts are generally less than 300 m, a depth which is shallower than any examined along the Sea MARC I survey line (Fig. 88.1), and much shallower than the maximum depth of iceberg scours observed on the upper continental slope at 715 m. The implication is that the 715 m maximum depth of iceberg scours dates from a time of greater iceberg drafts and/or lowered relative sea levels, and that most or all grounding features observed along the Sea MARC I survey line are relict. Andrews (1980) proposed a late Foxe (= late Wisconsinan) relative sea level lowstand of 80 m or more to account for the glacial stratigraphy of Baffin Island. However, glacial isostatic modelling has suggested relative sea levels 10 m higher than present during this same period (Quinlan, 1985). Clearly, even 80 m is insufficient to account for more than a part of the increased depth of scour, indicating that greater iceberg drafts were the dominant factor in generating a scour limit of 715 m.

Praeg et al. (1986) discussed the possibility of both syn- and post- depositional scouring in the development of Davis Strait Silt subunit B (Fig. 88.2). On the outer shelf, the coincidence of patches of unscoured or partly scoured seafloor (Fig. 88.4) with intervals of subsurface stratification in Davis Strait Silt subunit B, well above the lower limit of iceberg scours, indicates that reworking of seafloor sediments by iceberg scours was a post-depositional rather than a syn-depositional process. (The same may not apply to shallower areas, where shallower draft icebergs could have been grounding while the outer shelf remained unmodified.) Post-depositional scouring on the outer shelf implies a long period during depositon of the Davis Strait Silt when icebergs were not grounding, due either to shallower iceberg drafts, or to a dearth of calving margins. Extrapolation of a radiocarbon date on a core of the Davis Strait Silt subunit A from the Resolution basin (Fig. 88.1) suggests that the Davis Strait Silt dates back to at least mid-Foxe time, ca. 35 000 BP (Praeg et al., 1986a). Davis Strait Silt subunit A is partly overlain in the Resolution basin and elsewhere by the Tiniktartuq Silt and Clay, which is considered to reflect a change in depositonal style on the southeast Baffin Shelf in the late Foxe or early Holocene (Praeg et al., 1986a). Thus the episode of greater iceberg drafts and lowered relative sea level associated with formation of the 715 m maximum depth of iceberg scours on the upper continental slope appears to date from a relatively discrete interval of time in the late Foxe or early Holocene.

The relict character of scours along the Sea MARC I survey line is corroborated by the evidence on the sidescan imagery for degradation and/or infilling of many scours due to currents. Scour modification is especially prominent on the inner shelf and upper continental slope (Fig. 88.5) and least evident on the central shelf (Fig. 88.3), although even here coarse seabed sediment textures attest to the influence of currents. Significant variation in the degree of scour modification observed in other areas has been used to distinguish scours or scour populations of different relative ages (Josenhans and Barrie, 1982; Fader and King, 1981; Pelletier and Shearer, 1972). On the northeastern margin of the Resolution basin, sidescan imagery and bottom profiles indicate an abrupt transition above about 375 m water depth, from poorly defined, infilled scours of subdued relief to well defined scours of hummocky relief. This transition suggests a clear distinction between older features of the inner shelf and younger features of the shallower central shelf. In contast, along the transect from the central shelf to the upper continental slope the increase in abundance of poorly defined and/or infilled scours is more gradual, and there is a slight increase in scour relief.

The central shelf is also distinguished from the outer shelf and upper continental slope by a greater abundance and more consistent orientation of iceberg scours (Fig. 88.3, 88.4). More numerous iceberg scours imply exposure to greater numbers of grounding icebergs than adjacent (deeper) areas, through a predominance of shallower draft icebergs and/or a longer period of exposure. Bottom gradients may also be a factor, as evidenced by the coincident increase in scour abundance and seabed gradients across the transition from the outer to the central shelf (Fig. 88.4); steeper gradients constitute targets for a broader range of iceberg drafts. Scour orientations, or trajectories of scouring icebergs, are controlled by factors including sediment type(s), gradients and currents. The coincident decrease in consistency of scour orientations and seabed gradients across the central to outer shelf transition (Fig. 88.4) suggests a potential control by gradients, but orientations remain inconsistent on the steeper gradients of the upper continental slope (Fig. 88.5) indicating the influence of other factors. These factors have obviously varied between the upper continental slope and central shelf, either contemporaneously or throughout the history of scouring.

Woodworth-Lynas (1983) analyzed iceberg scours from a mosaic of 1.5 km swath width sidescan sonograms located northwest of the Hekja well site (Fig. 88.1), in water depths of 280-290 m. He found that average scour width decreased with relative age, suggesting a decrease in iceberg size through time. A progressive decrease in iceberg drafts through time would be compatible with many of the scour characteristics recognized along the Sea MARC I central shelf to upper continental slope transect, such as the gradual increase in poorly defined and/or infilled scours and decrease in scour relief, and the greater abundance of scours in shallow water. The more consistent orientation of scours on the central shelf relative to the upper continental slope could reflect variations in conditions such as currents, either contemporaneously or as scouring progressed. On the inner shelf, however, the pronounced distinction between the subdued older scours of the Resolution basin, and the hummocky younger scours above about 375 m indicates that a gradual change in iceberg draft over time is not applicable for this area. The long period of degradation and sediment infilling implied for the older scours may reflect control on iceberg drafts accessible to the area by the effective sill depth of the Resolution Basin (Fig. 88.1), which would change with fluctuations in relative sea level. Alternatively, it could reflect changes in iceberg source, from local calving margins in the west to distant sources in the north.

Continental slope features

The mud layer observed on subbottom profiles below 715 m on the upper continental slope persists in thicknesses up to 5 m to the eastern edge of the Gjoa Spur at about 1500 m water depth (Fig. 88.1). Sea MARC I imagery is largely homogeneous across this interval, and no evidence for recent mass movement is observed on this part of the continental slope. Geonautics Ltd. (1982) identified a possible mass movement feature on the upper continental slope at 850 m depth from a high resolution subbottom profile, located along the Sea MARC I survey line. Examination of this profile shows that the feature is associated with a local change in gradient, which corresponds to two subcircular low reflectivity areas observed on Sea MARC I imagery at this depth. However, no evidence of downslope sediment dispersal is seen on the sidescan imagery, and the mud layer appears undisturbed on subbottom pro files.

Sea MARC I imagery across the Gjoa Spur in water depths of 1350-1550 m indicate the presence of wavy, slope-transverse lineations on both flanks of the spur, on gradients of about 4°. Similar slope-transverse lineations have been observed on Sea MARC I imagery from the Nova Scotia continental slope, where they are interpreted to reflect mass movement (Piper et al., 1985b). Areas of ponded sediments are also observed across the Gjoa Spur, in linear depressions on the crest and seaward flank.

SUMMARY

Qualitative evaluation of the variations in abundance, orientation, size and character of iceberg scours observed along the Sea MARC I survey line suggests division of the seabed into four zones: (1) inner shelf – associated with moderate abundances of poorly defined scours of subdued (2 m) relief, many of which are infilled; (2) central shelf – associated with high abundances of scours fairly consistently oriented approximately parallel to the isobaths, most of which are well defined and of hummocky (up to 3 m) relief; (3) outer shelf – associated with moderate abundances of inconsistently oriented scours generally up to 4 m in relief, some of which are poorly defined and/or infilled; (4) upper continental slope – associated with moderate to low abundances of inconsistently oriented scours generally up to 4 m in relief, which are poorly defined and show increasing evidence of infilling in deeper water. The lower limit of iceberg scours is observed on the upper continental slope at about 715 m. Most iceberg scours observed are relict, dating from an episode of greater iceberg drafts and possibly somewhat lowered relative sea levels, probably in the late Foxe or early Holocene. A gradual decrease in iceberg drafts during this episode is compatible with many of the scour characteristics observed along the upper continental slope to central shelf transect, but the sharp distinction between the scours of the central shelf and the subdued, older features of the inner shelf suggests a different control on scour characteristics in this area, possibly related to fluctuations in the sill depth of the Resolution basin.

No evidence for recent mass movement is observed on the gentle gradients of the continental slope west of the Gjoa Spur. However, slope transverse lineations may indicate mass movement on both flanks of the Gjoa Spur.

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