SYNTHESIS AND INTERPRETATION OF BATHYMETRIC, GEOPHYSICAL, GEOLOGICAL AND GEOTECHNICAL DATA: ERKSAK BORROW BLOCK – SOUTH CENTRAL BEAUFORT SEA

Part of the Northern Oil and Gas Action Program (NOGAP Project A4–21)

SUBMITTED TO:

Indian and Northern Affairs Canada
Natural Resources and Economic Development
Les Terrasses de la Chaudiere
Hull, Quebec
K1A 0H4

SUBMITTED BY:
Earth & Ocean Research Ltd.
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Dartmouth, Nova Scotia
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SUMMARY

The Erksak Borrow Block lies on the Tingmiark Plain (O'Connor, 1982a) in 10 to 32 metres of water. This submerged upland physiographic region located in the south central Beaufort Sea is separated from the Akpak Plateau (and Isserk Borrow area) by the Kugmallit Channel, a north-south trending depression that emanates from Kugmallit Bay. The eastern boundary of the Tingmiark Plain is formed by the Niglik Channels which have a south-southwest, north-northeast orientation. The Niglik Channels are believed to emanate from the Kugmallit Channel south of the Tingmiark Plain isolating this plain and the Erksak Borrow Block from the shoreline. The Erksak Borrow Block extends across the southern reaches of the Tingmiark Plain and to some extent over the channel areas to either side.

The physiographic regions of the South-Central Beaufort Sea are predominantly defined by a subaerially generated paleo-topography that has been etched into a glacio-fluvial or glacio-deltaic deposit of Late Wisconsinan age. The basal deposit consists predominantly of sands laid down in channel cut and fill and outwash sheet configurations (Unit C). This topographic surface was further modified by erosion and redistribution of material under a marine transgressive environment. Pulsing of the transgression, incomplete planation of the top of Unit C by this event and the construction and partial preservation of multiple onshore, nearshore, and littoral environments combined to produce a complex lateral and vertical variation in textural facies and morphologic forms (Unit B) on the surface of the lower unit. Following transgression, marine clays (Unit A) were deposited in a hemipelagic environment within the topographic lows and over the seaward flanks of the highs. Recent deposition has been from the west with the source primarily being the sediment plume of the Mackenzie River, and this hemipelagic cover thins generally from west to east.

Through the detailed study of the regional seismic and geotechnical data base within, and adjacent to, the Erksak Borrow Block area, this report has subdivided the Tingmiark Plain into five major sub-regions along with a secondary division of one of these regions into three sub-sub-regions. These divisions represent the more subtle local physiographic features of the Tingmiark Plan that are remnants of the more recent geologic history of this area. This geologic history spans the period from the Late Wisconsin, subaerially exposed shelf (approx 12 to 14 thousand years ago) to the present day.

The five major sub-regions have been given the unofficial names: the West Erksak High, the Uviluk High, the Erksak Channel, the Uviluk Channel and the James Shoal Extension. The West Erksak High has been further sub-divided into the Erksak Crest, the Kogyuk Terrace and the Ukalerk Slope from south to north. The names have been chosen to provide a representation of the physiographic character of these sub-regions.

Borrow materials within the Erksak Borrow Block are discussed based on these sub-regions and the interpretations of the developments of these physiographic regions along with ground-truth information available through some 122 boreholes that have been completed in the area. In overview, 33 potential borrow sites have been identified within the area of the Erksak Borrow Block based on the borehole, sample and seismic information. Based on the borehole evidence, approximately 720 million cubic metres of borrow materials are considered to be Proven. From the seismic mapping study carried out in this study, there are estimated to be approximately 19 billion cubic metres of Prospective granular resource. Using the combined view of the geologic interpretation, the known borehole and sampling information along with the seismic structure mapping in the region there is an estimated 7 billion cubic meters of Probable recoverable granular resource in the region.

The resource quality in the region tends toward fine to medium grained sands with only trace gravels noted in a few of the boreholes which were not correlatable to the seismic data at this time. The regional character of the data base combined with the complexity of the local geology has restricted this study to a relatively broad scope of analysis of the borrow sites. Recommendations for future study are discussed within the final section of the report.

1 INTRODUCTION

1.1 Background

Over the past 10 to 15 years there has been considerable oil exploration activity within the southern regions of the Canadian Continental shelf of the Beaufort, bordering the Northwest Territories and the Yukon Territory. Because of the particular Arctic environment which includes mobile pack ice through approximately 9 months of the year, unique methodologies have been developed to conduct oil exploration drilling activities. These techniques include the building of artificial islands and sediment filled caisson structures to use as drilling platforms that can be occupied throughout the year and will withstand the tremendous forces of the drifting Arctic pack. One standard requirement of these structures is a local source of a large volume of good quality relatively coarse grained borrow material.

As part of the Northern Oil and Gas Action Program (NOGAP Project A4) Indian and Northern Affairs Canada (INAC) is developing an inventory of granular resources within the Beaufort region. Two Borrow areas within the South Central area of the Beaufort Sea have been targeted for evaluation under NOGAP, with subproject A4-21 addressing the Erksak Borrow Block and subproject A4-20 addressing the Isserk Borrow Block.

Earth & Ocean Research Ltd. (EOR) was contracted under D.S.S. Contract No. AO632-7-5011/01ST to prepare for INAC this Synthesis and Interpretation of the Bathymetry, Geophysical, Geological and Geotechnical data of the Isserk and Erksak Borrow Blocks in the South Central Beaufort Sea. The scientific authority for this contract was Mr. Bob Gowan of

INAC. The reporting on this project has been completed in separate volumes for the two NOGAP subprojects related to the Isserk and Erksak Borrow Block areas. This volume is directed specifically toward the Erksak Borrow Block.

The intent of the program is to evaluate the geophysical and geotechnical data that is available for these areas with the primary goals of defining and refining the surficial geological environment and particularly assessing the borrow resources that are present.

Figure 1 shows the location of the two Borrow Block study areas with respect to the Physiographic Provinces of the Beaufort Sea region as defined by O'Connor (1982a). The Erksak Block is primarily confined to the region of the Tingmiark Plain and is defined by the co-ordinates:

ERKSAK BORROW BLOCK

NW:	ZONE 8;	550,000; 7,800,000	($70^0$18'10" $133^0$40'15")
NE:	ZONE 8;	609,000; 7,800,000	($70^0$17'04" $132^0$06'15")
SE:	ZONE 8;	609,000; 7,750,000	($69^0$50'12" $132^0$09'57")
SW:	ZONE 8;	565,000; 7,750,000	($69^0$51'04" $133^0$18'33")

These co-ordinates describe a quadrilateral that widens to the north. At its closest approach to land, the southern edge of the block lies approximately 9 km to the north of the Tuktoyaktuk Peninsula.

Geophysical and geotechnical data has been compiled and collected for this study on an as-retrievable basis from the data archives of the Geological Survey of Canada (GSC) and from the Beaufort offshore operators including Gulf Canada

Resources Ltd (GULF), Dome Petroleum Ltd (DOME) (currently AMOCO) and ESSO Resources Canada Ltd. (ESSO).

The geophysical data base consists of high resolution seismic data collected on behalf of the Industry Operators and the Federal Government over the Borrow Block areas. The extent of the industry data base was identified by McElhanney Services Ltd. (McElhanney) who conducted a data search on behalf of INAC under D.S.S. Contract No. AO632-7-5012/01ST (McElhanney Services Ltd., 1988). That study resulted in the identification, in database form, of all high resolution seismic data collected within the Beaufort Sea area. A subset of this database was made for the south central Beaufort Sea by McElhanney on behalf of this project. The sub-set search area included all data lying between 69°45'N and 70°15'N, and 132°W and 135°30'W. The area was expanded beyond the boundaries of the individual borrow blocks to place the borrow block areas in the regional context. This expanded study area fulfilled the requirements of this study as well as those of a second EOR contract to the Atlantic Geoscience Centre (AGC) (D.S.S. Contract No. 23420-8-M313/01-OSC) to examine the geologic framework of this larger area (Lewis 1989, in prep.). To a significant degree the studies are complimentary, with the findings of one directly relevant to the other.

While the McElhanney contract identified the data that had been collected in the field, the associated navigation track data was collected under a separate INAC contract to Earth & Ocean Research Ltd (D.S.S. Contract No AO632-7-5013/01ST). This latter study resulted in the compilation of a digital trackplot for all navigation data for the industry and government efforts in the Beaufort Sea (Peters, 1988).

The geotechnical data for the Beaufort Sea consisting of borehole locations and logs were assembled by EBA Engineering Consultants Ltd. (EBA) on behalf of INAC under D.S.S. Contract No. AO632-7-5014/01ST (EBA Job No. 0306-34413). The data set is subdivided into two subsets for this project: all boreholes from within the Isserk Borrow Block area (EBA, 1988a), and all boreholes from within the Erksak Borrow Block area (EBA, 1988b). Also as a portion of the present EOR study EBA has provided assistance in the assembly of the geophysical data in Calgary and expertise related to the geotechnical evaluation of the borehole information under subcontract to EOR.

1.2 Acknowledgements

Earth & Ocean Research Ltd. would like to acknowledge the co-operation of Gulf Canada Resources Ltd., Dome Petroleum Ltd (Currently Amoco Exploration Ltd.), ESSO Resources Canada Ltd., and the Geological Survey of Canada for the assistance received from their representatives in providing the data and general background information for this synthesis. In particular Mr Steve Blasco of the GSC was of great assistance both with providing necessary data and numerous discussions regarding the local and regional geology of the central Beaufort Quaternary section. Mr. Bill Livingston, Chris Graham, and Ronna Johnstone of GULF, Kevin Hewitt of DOME, Bob Runnell and Judith Pikering of ESSO, Mr. Mike O'Connor of M.J. O'Connor and Associates and Mr. Craig Naldrett and Tony Walker of McElhanney Services Ltd. assisted in the location and authorization of use of their respective data sets.

The data used through this study includes both public domain data collected by government and proprietary industry

data. The data presented in this report is to be considered "Protected" until approval for release of any proprietary information has been granted.

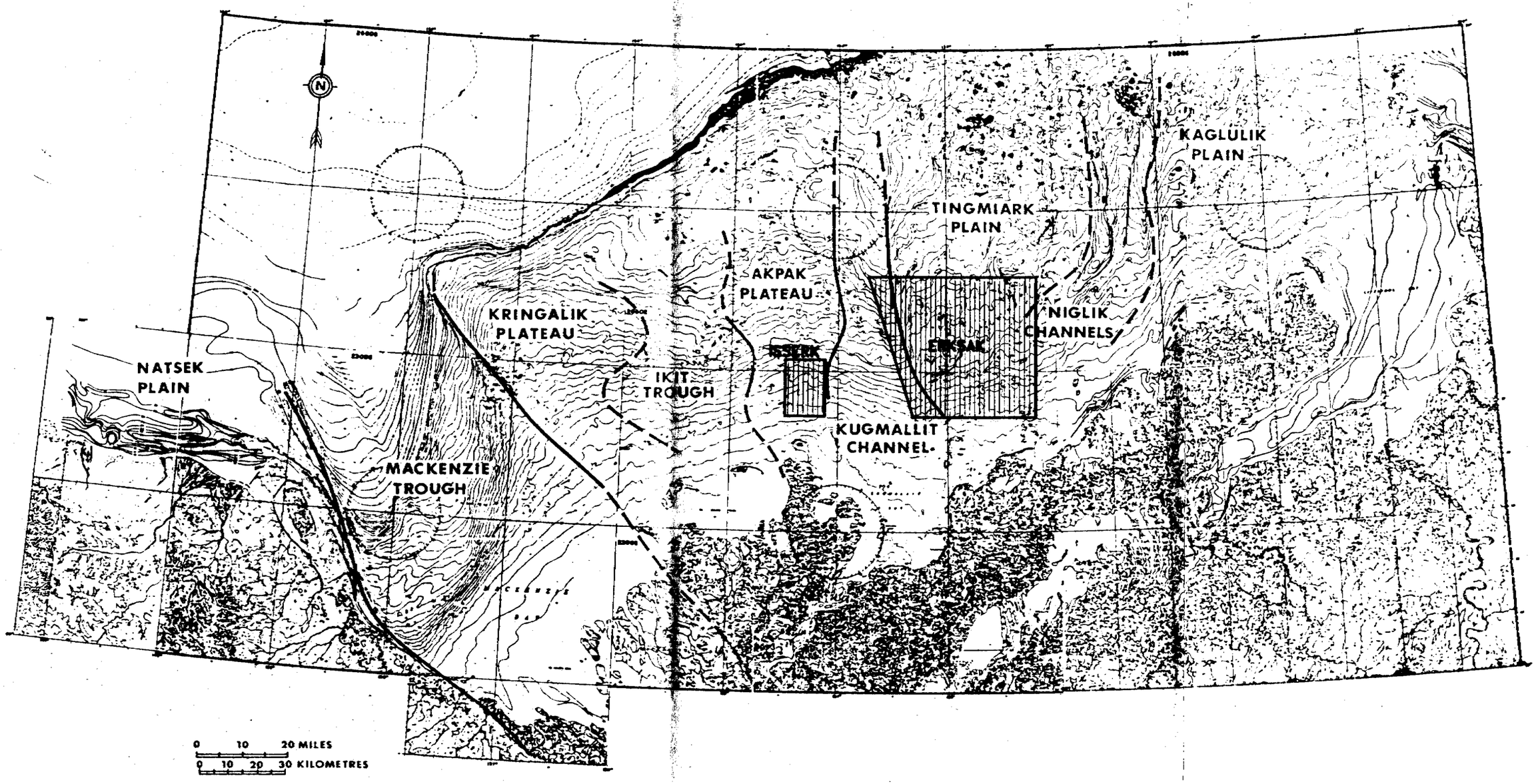


Figure 1 Location of the Erksak and Isserk Borrow Blocks relative to the Physiographic Provinces of the Beaufort Sea (after O'Connor, 1982a)

2 GEOLOGICAL BACKGROUND

2.1 Geologic Setting

The Beaufort Shelf along the north coast of the Northwest Territories represents an area extending some 375 km in the east-west direction by 135 km in the north-south direction. The region represents a major sedimentary basin which is currently dominated by the sediment outflow of the Mackenzie River-Delta system. The area from the Mackenzie Trough toward the east is covered by a veneer of Quaternary sediments that are from a few tens of metres thick to as much as 300 m in thickness within the Mackenzie Trough. Much of this Pleistocene and Recent sedimentation has been associated with a series of rises and falls in the level of the world oceans that have occurred in association with glacial advances and retreats throughout the Pleistocene.

Hill et al (1985) has developed a Relative Sea Level (RSL) Curve for the central Beaufort shelf region over the past 27,000 years based on radiocarbon age dating of peat layers found within geotechnical boreholes that were drilled in the area. His data indicate a relative rise in sea level of 140 m since 27000 years BP. Of this relative rise, 105 m are attributed to glacio-eustatic effects with 35 m being attributed to effects such as basin subsidence, sediment loading and compaction subsidence. Figure 2 shows the Relative Sea Level Curve presented by Hill et al 1985. From these curves it is evident that the Beaufort shelf was subaerially exposed throughout much of the Pleistocene and was most likely inundated by the sea on more than one occasion during that time period.

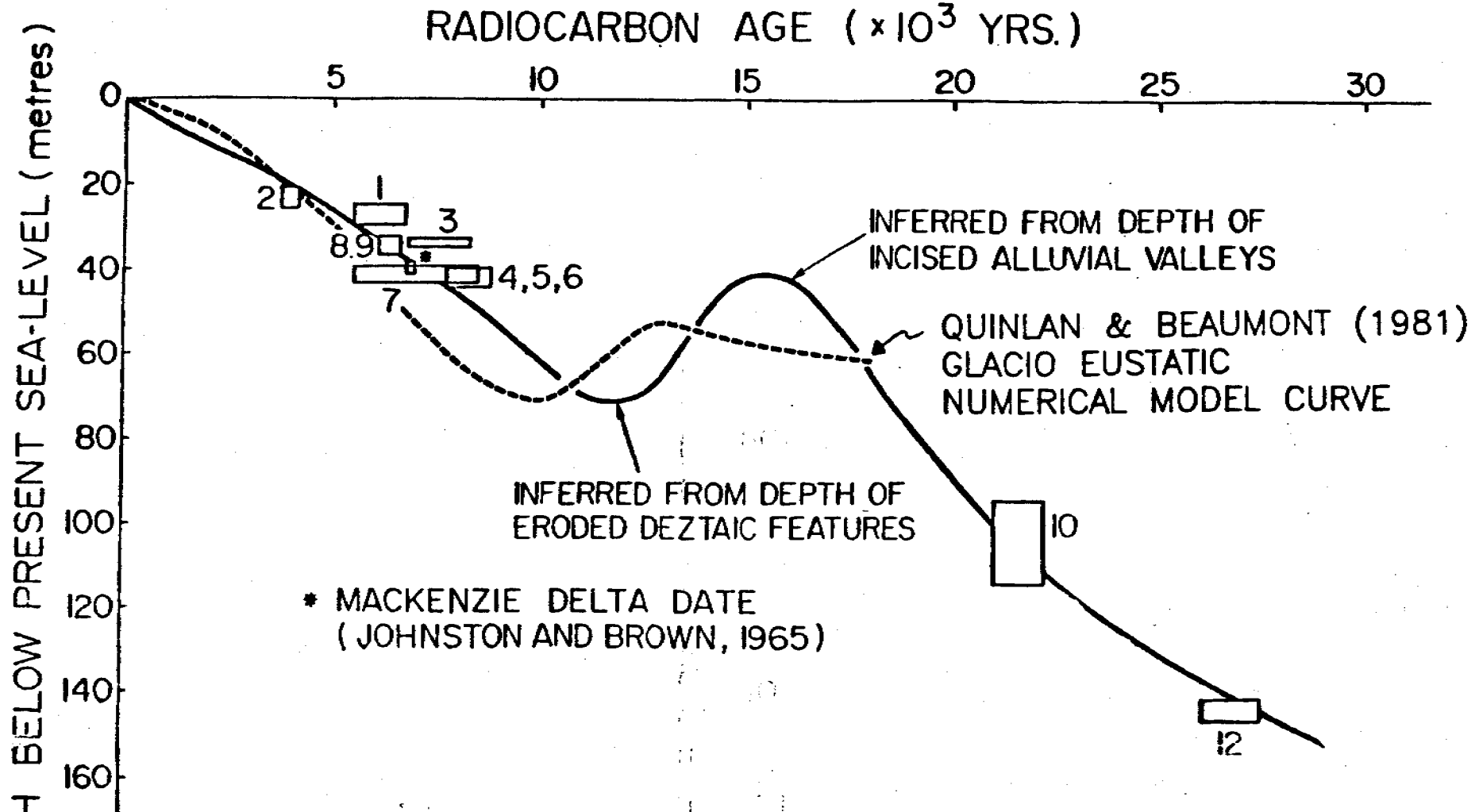
The majority of the Central and Eastern Beaufort was not directly covered by glacial ice throughout the Pleistocene. Studies by Rampton (1982 and 1988) suggest that the early Wisconsin Buckland glaciation (prior to about 35,000 years ago) projected out onto the Beaufort shelf, probably eroding the Mackenzie Trough, and may have occupied parts of Tuktoyaktuk Peninsula but it did not cover the main eastern Beaufort shelf. The late Wisconsin glacial re-advance progressed only part of the way up the Mackenzie river valley and did not extend out onto the shelf areas. During the Middle and Late Wisconsin periods the large fluvio-deltaic or glacio-fluvial plain that developed extended over the western Canadian Beaufort shelf. Detritus released during the retreats of the ice sheets is the probable source of the deltaic sediments of the plain. The areas of the shelf that were exposed by the lowering of sea level experienced a periglacial environment similar to that prevailing in the High Arctic Islands today with the attendant aggradation of permafrost in the middle and inner shelf regions.

Through the joint efforts of the Industry Operators and the GSC, the Quaternary geology of the Beaufort Shelf region has been extensively studied over the past 15 years. The efforts of the operators have been concentrated on their immediate needs related to exploratory drilling in the region, though, by joint efforts with the government agencies working in the region, an extensive regional high resolution seismic and geotechnical data set has been collected. These data have been used by O'Connor (1980) to produce a proposed model for the surficial geology of the southern Beaufort Sea. This work has served well for the offshore regions of the Beaufort though additional survey and borehole information over the intervening time period has extended and refined many of the concepts of the model.

This model has been developed using the offshore data sets and does not adequately cover the nearshore regions of the Beaufort. Because the Canadian Beaufort Shelf represents a retreating shoreline in many areas and an outbuilding delta front in others, much of the nearshore region is represented by extensive zones of very gently sloping, shallow waters. These shallow waters are not conducive to the normal techniques of offshore marine geophysical high resolution survey, and therefore, there exists a zone of from 1 to 15 km in width that presently contains little good quality data. This region has been the subject of a major research program conducted by Dr. Phil Hill of the GSC (presently Hill Geosciences Ltd.) though the results have yet to be fully understood or integrated into the present Beaufort geological models. The geology of this nearshore zone must change significantly within this nearshore zone since the surficial geology on land does not appear to be a continuous extension into the offshore.

The generalized model for the Beaufort Sea surficial geology (O'Connor, 1980) consists of a recent marine sequence of silts and clays, Unit A, overlying a transgressive sequence, Unit B. These sediments in turn unconformably overly an "older" sequence, Unit C which is believed to have been subaerially exposed prior to the most recent sea level rise. At this point the original O'Connor model did not differentiate deeper units though further differentiation has been subsequently incorporated (Blasco pers. comm., 1987). Beneath the Unit C sequence the section grades into a silt/clay unit which also shows evidence of subaerial exposure. This unit is designated as Unit D. At a deeper unconformity surface, the lithology changes back into a sandy environment (Unit E) which commonly represents the top of the

main permafrost zone (the stratigraphically-controlled permafrost of O'Connor 1980) throughout much of the eastern and middle Beaufort Shelf region. These Units may differ compositionally over the Beaufort Shelf due to lateral facies changes. Table 1 summarizes the generalized surficial geologic model.



Relative Sea-Level Curve for the Canadian Beaufort Shelf
(after Hill et al., 1985)

JOB No.: 8803

DRAWN BY:

DATE:

FIGURE 2

TABLE 1 GEOLOGIC MODEL SUMMARY

Unit Designations O'Connor	Unit Descriptions (from O'Connor 1980)
A	A horizontal sequence of recent marine sediments deposited on the shelf following the last sea level rise. The unit consists of grey to black, soft to firm (rarely stiff) clays or silty clays, usually containing traces of fine sand and organics, often in the form of fine laminations. The clays grade shoreward into grey, loose to very loose silts. Unit A may exhibit a complete range of plasticity, depending on the type and quantity of clay present. Coarse materials (sand and gravels) have also been identified within this unit at isolated locations, but are believed to be the result of ice rafting. The base of Unit A grades into:
B	A transgressive sequence which includes deltaic, lagoonal and littoral sediments deposited in a complex transitional environment which existed during the last sea level rise. It is composed of a discontinuous and highly variable sequence of sands, silts and clays. In some regions and at some depths a record of the original depositional environment (deltaic, lagoonal or littoral) has been preserved within the stratigraphy. In other regions the original stratigraphy has been destroyed by a phase of the advancing sea which reworked previously deposited sediments including those of Unit C below. The unit may also contain some organic rich and/or heterogeneous stony clay layers as channel fill near the base of the sequence. Unit B rests unconformably on:
C	An underlying, much (?) older sequence whose original depositional environment is presently unknown, but which probably contains sediments derived from former continental (glacial fluvial and eolian) and transitional (deltaic, littoral) environments. Since the upper boundary of this unit is believed to be an unconformity surface representing a significant period of subaerial exposure and possibly erosion, the occurrence of relic permafrost within this sequence is probably widespread. In the nearshore zones between Garry Island and Toker point, Unit C consists predominantly of fine to medium grained, grey, brown or yellow sand. It normally contains a trace to some silt and only minor organics, but clay, silt and gravel layers have been encountered in some areas. The consistency of this sand varies from loose to very dense.

TABLE 1 GEOLOGIC MODEL SUMMARY cont'd

Unit Designations O'Connor	Unit Descriptions (from O'Connor 1980)
Unit	
C	cont'd In some places Unit C may include a complex sequence of silty, fine sand interbedded with grey to black stony clay. It is reported that stratification of the coarser material and apparent horizontal shear planes were evident in some borehole samples recovered, and that the stiff to hard consistency observed gave this stratum a till-like appearance. The depositional origin of this sandy unit is presently in question but appears to be glacial or periglacial and possibly associated with the retreat of the last glaciation. Hummocky Acoustic Permafrost is sometimes observed within this unit and the base of the unit is poorly defined on most high resolution acoustic records. Unit C rests paraconformably (?) on:
D	a sequence of fine grained silts and clays of fluvial and or marine origin. Boreholes through these materials commonly show abundant salt-stained fissures in the upper few metres and veinlets of ice deeper within the unit indicating permafrost and a substantial period of subaerial exposure. The silts and clays are typically medium plastic with liquidity indices at the top of the unit which are negative or close to zero. Seismo acoustic structure is usually not apparent within these sediments (primarily due to the filtering effects of the overlying materials). Age determinations from the base of this unit within the Uviluk (FUVI-1) site indicate an age of only 21,260 +/- 630 years BP (Hill et. al., 1985). These materials lie unconformably on:
E	a much older sequence of coarser grained sands that are commonly massively ice bonded forming the top of the main body of Acoustic Permafrost in the Beaufort region. Present attempts at age determinations from these materials have always provided an infinite age using normal radio carbon dating techniques, though current research is under way to attempt to resolve these age questions (S. Blasco pers. comm., 1988).

2.2 Physiographic Regions

O'Connor (1982a) has divided the Beaufort Sea continental shelves into nine distinct physiographic regions based on the shallow stratigraphy and geotechnical data that was available at that time. These regions are shown on the map of Figure 1. Their boundaries were formulated on the basis of bathymetric, paleotopographic and shallow stratigraphic information regarding the surficial geology of the continental shelves. Most of these regions are characterized by distinct bathymetric features though often the bathymetric distinction lessens in the nearshore regions. This is generally associated with the higher sedimentation rates in the nearshore which have dampened the topographic/bathymetric character of the zones.

The physiographic regions delineated by O'Connor consist of the Natsek Plain in the west covering the Beaufort Shelf to the north of the Yukon Territory, the Mackenzie Trough representing the major bathymetric incision separating the Yukon Beaufort Shelf from the main Beaufort Shelf and seven subdivisions of the eastern Beaufort Shelf. The subdivisions of the eastern Beaufort Shelf are the Kringalik Plateau, the Ikit Trough, the Akpak Plateau, the Kugmallit Channel, the Tingmiark Plain, the Niglik Channels and the Kaglulik Plateau progressing from west to east. The description of the geologic model given in the previous section holds for the five eastern provinces though as one moves toward the west a facies transition toward generally finer grained materials is noted.

The Erksak Borrow Block lies primarily on the Tingmiark Plain in the south central portion of the Beaufort Shelf. It

is bounded by the Kugmallit Channel to the west and the Niglik Channels to the east.

2.2.1 Kugmallit Channel

The Kugmallit Channel is a gentle channel feature emanating from Kugmallit Bay and trending in a northerly direction to the shelf edge. The channel is observed to contain a considerable thickness of Unit A sediments overlying Unit C. The Unit B sediments are likely present throughout much of the channel though their distinction is normally masked by the saturated scour zone (SSZ, O'Connor 1982a) which is prevalent throughout much of the shallower water portion of the channel. The boundary of Unit B is often masked by the SSZ on the seismic records though is clearly discernable from the geotechnical testing data as the Unit B sediments tend to show a strength parameter of 50 to 80 Kpa while the Unit A materials show strengths of from 10 to 20 Kpa. The eastern side of the Kugmallit Channel is marked by a steep sided boundary up to the Tingmiark Plain. At this boundary there is interfingering of slump debris observed which indicates that the coarser materials were being slumped into the Kugmallit channel over the last 8000 years. The unconformity surface (Top of C) suggests a wave base planation in the records of this region with a second unconformity surface observed on the actual top of the main body of Unit C. O'Connor has designated the two unconformities in the region as U/C1 (upper) and U/C2 (lower). U/C2 apparently represents the most recent subaerially exposed land surface just prior to marine incursion with numerous basin or shallow channel features incised into Unit C. This surface was apparently planed off by the marine incursion to form U/C1 and has

subsequently been covered by the transitional Unit B and marine Unit A sediments.

2.2.2 Tingmiark Plain

The Tingmiark Plain is the largest of the Beaufort Sea Shelf physiographic areas. It is bounded by the north-south trending Kugmallit Channel on the west and the NE - SW trending Niglik Channels on the east. The Plain is characterized by an elevated unconformity, suggesting that prior to marine inundation the region was an exposed upland composed primarily of fine grained sand. The western boundary is clearly defined both bathymetrically and on the unconformity surface by a steep wall marking the edge of the Kugmallit Channel. The eastern boundary is distinct in the offshore region (bathymetrically) but is poorly defined inshore, particularly through the region of the Erksak Borrow Block. O'Connor indicates that his studies have suggested that the Niglik Channels may have been connected to the Kugmallit Channel in the vicinity of 133°W at one time. This implies that the Tingmiark Plain is isolated from the shoreline in the region of the Erksak Borrow area.

Positive geomorphic features have been noted on the Tingmiark Plain that include a number of large, elongate, obliquely attached sand ridges. These have been documented along the western margin of the Plain, but are suggested to be present on a more regional basis as well (O'Connor, 1982a). They rise 2 to 5 m. above the surrounding seafloor and are generally asymmetric in cross section with the steepest side to the east. The sands tend to coarsen upward within the sand ridges and may present a viable borrow source. Surficial cover of Unit A material shows no consistent trends over the area,

and in many areas is believed to be absent. Recent silts and clays may be as much as 7 m in thickness where they infill narrow channels or closed depressions on the plain.

Shallow Acoustic Permafrost (APF - O'Connor, 1980) is common beneath the Tingmiark Plain and is commonly the Hummocky type which is of variable depth and distribution. There are also indications of deeper stratigraphically controlled permafrost within the southern margins of the area and offshore beyond the 60 m isobath. In water depths exceeding 40 m Pingo Like Features (PLF's) are commonly observed.

2.2.3 Ngilik Channels

The Niglik Channels mark the eastern boundary of the Tingmiark Plain and are characterized by twin parallel depressions, each about 5 km wide observed on bathymetric charts. Between 70°45' N and 70°20' N the channels trend in a northerly direction. South of this region the channels are oriented northeast-southwest, parallel to the Tuktoyaktuk Peninsula. Inshore of the 25 m isobath the channel features become increasingly difficult to follow from bathymetry alone and during the time of O'Connor's 1982 compilation there was little subsurface data to work with in these regions.

The 10 to 12 metre high ridge separating the east and west channels is asymmetric in character and steepest on its east side. Seismic evidence shows the unconformity marking the top of Unit C to be overridden by this ridge, suggesting the ridge is, or, has migrated toward the east, possibly during transgression. There is generally little soft surficial cover (normally less than 3 m) within this channel which may be a

function of its distance from the present Mackenzie sediment plume. Both O'Connor (1982a) and Meagher (1978) have indicated that local areas particularly inshore of 70°30'N, may have thicker accumulations of soft clays.

The seismic data indicate the stratigraphy beneath the shallowest regional unconformity (Unit C sediments) to be rather complex, suggesting the pre-Holocene strata are not likely uniform sands, but likely include stiff to hard silty and clayey beds as well. Where acoustic permafrost is observed in this region it is apparently stratigraphically controlled and relatively deep.

3 BORROW DEVELOPMENT CONSTRAINTS

A review of the surficial geology of an area for the purposes of borrow resource evaluation must consider several factors which constrain the development of a potential borrow source. The most important is the distribution and occurrence of suitable materials. However, there are a number of other important factors such as: the depth of the resource below sea level (bathymetry and thickness), the amount, if any, of undesirable surficial cover (mud), permafrost bonding of the resource, and overall complexity of the stratigraphy which might affect the quality and recoverability of the resource material. The relative significance of these factors is also highly dependent on the dredge technology that is used in recovery of the resource.

3.1 Distribution of Resource

This has been restricted to the areas of the pre-defined Isserk and Erksak Borrow Blocks. These regions have been defined for two primary reasons: one that previous studies have identified resources within these regions (O'Connor, 1983 and Olynyk and Quinn, 1985) and they have been successfully used as a source of material; and two that these areas are in close proximity to a highly active development area (ie. Amauligak) which may see some of the first actual production of oil resources from the Beaufort (thus have a near term requirement for the borrow resources).

Within the Beaufort continental shelf, granular resources occur most commonly within Unit C (O'Connor, 1983). Over the shelf there has been noted a trend that these materials

generally fine toward the west and the western limit of the Akpak Plateau is the limit of useful quality granular resource (excepting the Natsek Plain to the west of the Mackenzie Trough). Since these regions of the inner shelf have undergone a marine transgression with some significant erosion of the top of Unit C, areas of relict beaches, spits and bars which are technically considered to belong to Unit B are also prospective for granular resource.

Although fine to medium grained sands are common within Unit C in the region, gravel deposits have been observed only infrequently. These deposits are most commonly associated with beach lag which has resulted from the erosion and concentration of the coarser materials during the transgression. Within this study a primary intent is the detailed review and mapping of the surficial geology with the intent of defining these prospective areas within the Erksak Block.

3.2 Additional Geologic and Equipment Constraints

In addition to the primary geological constraints of location and distribution of the granular resource, there are also significant constraints which are, to a large extent, dependent on the specific dredging equipment available for developing the resource (physical limitations) and on the intended use of the materials (required quality).

The quality factor of the resource material is generally determined by its intended use. This is usually defined in terms of the grain sizes of the material, and in particular

the content of fines[1] that are present in the deposit. As a general guideline Gulf Canada's dredging requirements as defined in 1981 (O'Connor, 1983) considered viable resource material to have a fines content of less than 10% by weight. These factors have been refined over time and Appendix 3 provides a more comprehensive definition of quality factors when describing the coding used on the borehole evaluations. These codes are used throughout the remainder of this report.

Recent practices in the Beaufort Sea have been to use hydraulic dredges for artificial island construction, though mechanical dredges have been used in some very shallow water sites. There are two basic types of hydraulic dredge in use: stationary suction dredges and hopper trailer dredges. These dredges have particular characteristics and limitations which make them useful for particular borrow resources.

The stationary suction dredges such as the **M. V. Beaver Mackenzie** and the **M. V. Aquarius** can access massive borrow deposits in borrow pit depths to 46 and 70 m below sea level respectively. These dredges can also be used to strip substantial thicknesses of overburden muds though this does take additional time and is practically limited to approximately 3 m of overburden fines material. These dredges pump the fill through floating pipelines, generally to its final destination to avoid rehandling, and are therefore normally restricted to borrow sources which are a distance of less than 1.5 km from there intended final use destination.

Hopper trailer dredges, such as the **M. V. Geopotes IX** and **M. V. Geopotes X** are more mobile dredging ships and can therefore access borrow resources that are further away from

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[1]In engineering use, the term "fines" refers to material whose particle size is less than 75 um.

the final destination of the resource. The economics and physical operation of these types of dredges generally restricts their use to deposits that outcrop directly on the seabed and are regionally more extensive such that the dredge can be filled with one or two passes of the area. Because of this mode of operation they are not considered suitable for major overburden stripping operations (restricted to less than 0.5 m of fines overburden). Also because of these same characteristics, these dredges are capable of mining relatively thin (1 to 2 m) deposits, especially if the prospect is large and of uniform quality and thickness.

Sub-seabed permafrost can also be a significant constraint to borrow development as the ice bonded sediments will result in, certainly, unproductive dredge yield, if not actual damage to dredge cutting heads and other hardware. Because significant shallow ice bonding is present on the shelf and because it occurs predominantly within the materials that are most prospective for borrow materials (coarse grained unit C sediments) the distribution of these bonded sediments is an important factor in the mapping and estimates of useable borrow materials available within a region.

4 DATA BASE

The detailed evaluation of the granular resource potential of the Erksak Borrow Block has used four primary data sets: bathymetry, seabed grab samples, geophysical data and geotechnical data. The bathymetric database, which provides seabed morphology and vertical survey control, and the grab sample data base used to supplement the geotechnical database, are described latter, in Sections 5.1 and 5.2 respectively. The geophysical data base is important for outlining the areal extent and distribution and physiographic and stratigraphic features which represent potential candidates for borrow material, however it is a qualitative and mapping tool that does not provide quantitative assessment of the sediment lithology. Thus a direct sampling geotechnical data base is required to determine the quantitative attributes of the potential resource deposits. The geophysical and geotechnical data bases are described in the following two subsections.

4.1 Geophysical Data Base

The geophysical data base consists of seismic data collected on behalf of the Industry Operators and the Federal Government over the Borrow Block areas. The extent of the industry data base was identified by McElhanney Services Ltd. (1988). A sub-set of this database was made for the Isserk and Erksak Borrow Block areas between 69°45'N and 70°15'N, and 132°W and 135°30'W. This subset is listed in Appendix 1.

Using the list of data in Appendix 1, a concerted effort was made to find the actual data in the offices of the respective oil company operators and their contractors. The

review, collection, and copying of the records and associated reports was completed in concert with EBA Engineering Consultants Ltd. of Calgary (under subcontract). Mr. Meagher of EOR and Mr. Lem of EBA contacted and visited with those people responsible for the collection, interpretation and archival of high resolution data from the Beaufort Sea. Through these interviews the location of the original data was determined (all that could be) and permission received to review the data and copy lines that were considered relevant to this study. Additional data was retrieved in the offices of M. J. O'Connor Associates Ltd., and through the GSC data archives at AGC in Nova Scotia.

A summary of the data search is presented in Appendix 2. This appendix lists the data identified as having been originally collected in the field (L), as found during this data search (F), and data that was evaluated as valid and was copied (C) for use in this project. In total over 400 records were copied (at half scale) and subsequently studied for the evaluation of the two borrow sites. These consisted primarily of various types of boomer, microprofiler and high resolution single channel airgun records, and, occasionally, echo-sounder records were included. This accounts for the greater part of the data set collected in this area but it is by no means complete.

The incompleteness of the data set is to a large degree the result of significant personnel shifts and reductions within the oil industry over the last several years. Most of the personnel responsible for the original collection and archival of high resolution seismic data from the Beaufort Sea are no longer with the companies involved. The lack of continuity with their successors, and, to some degree, an informal approach to the archival of the data, has led to the

present uncertainty about what has been collected and where the data resides. Despite this, it is felt that the available data set is adequate for the purpose of this project. The track plot of the located data is displayed in Figure 3 and at full scale as Enclosure 1.

The seismic data quality is, on the whole, good but variable, depending most critically on the sea conditions at the time of collection. Difficult interpretation arises most commonly from real geologic conditions rather than poor collection technique. This is especially evident over the areas of main interest, the borrow sites. Records that display good resolution and are easily interpretable where they cross the channel areas to the east and west of the sites, become congested and the character difficult to determine over the coarser grained materials of the borrow sites.

Of the two main data sources, the boomer and the microprofiler, the microprofiler is the more suitable for the resolution of the nature of the surficial cover. The higher frequency envelope of this system makes the signal more susceptible to reflection and attenuation on coarser substrates and is therefore somewhat calibrated to discern sandy material from silty material. In the present application where the determination of coarse material at or very near the seafloor is critical, the profiler's lack of penetration ability in coarser sediments is of less importance than its ability to discriminate between sand and silt/clay. In comparing microprofiler data to borehole data it is observed that a strong correlation exists between signal attenuation and reflection character and sediment texture.

The boomer data is more valuable in establishing the seismo-stratigraphy of the study site. The reduced sensitivity to textural changes that limits the usefulness of

the tool for discriminating coarse from fine material permits more consistent imaging to greater depths through coarse material. It is also noted that where boomer and borehole correlation is possible, a diagnostic seafloor return is also generated from this source over coarse substrates though it is less obvious than that of the microprofiler data.

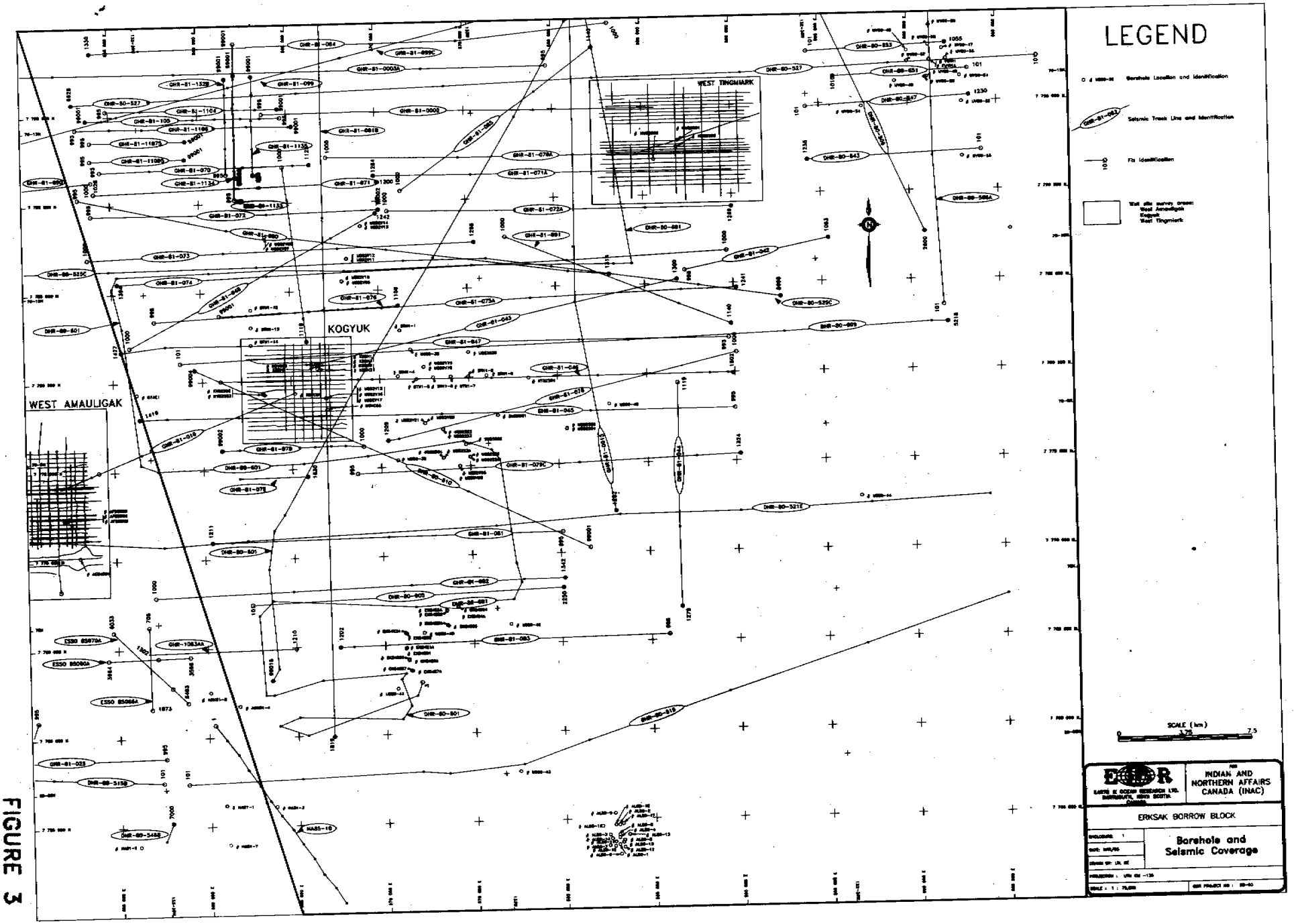

LEGEND
Borehole Location and Identification
Seismic Track Line and Identification
Fix Identification
Well site survey areas:
West Amauligak
Kogyuk
West Tingmiark
WEST TINGMIARK
KOGYUK
WEST AMAULIGAK
SCALE (km)
0
3.75
7.5
EBA ENGINEERING CONSULTANTS LTD.
INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ERKSAK BORROW BLOCK
Borehole and Seismic Coverage

FIGURE 3

4.2 Geotechnical Data Base

Qualitative attributes of the potential granular deposits have been obtained through the use of borehole information that has been collected within the Erksak area by the offshore operators. The geotechnical data base consists of borehole locations and geotechnical logs. The data is presented both in graphical log form in the reports (EBA, 1988a, 1988b and 1988c) and has been compiled within EBA's ESELog, Version 2.01 specially designed geotechnical data base system. All boreholes are referenced to sea level at zero metres elevation and the moisture content, Atterberg Limits, limited grain size analyses and Unified Soil Classification (USC) data have been included within the data base. The ground ice description standard used for the data base follows the guidelines established by NRC and has been supplemented within the soils description category when necessary. Information on all of the available grain size analyses are incorporated within the digital data base, although it is not represented on the plotted borehole logs. The "%Gravel, %Sand and % Fines" fields of the data base are presented in the "Basic Soil Characteristic Data" field. The latter is defined as the total percentage of silt and clay (ie. that passing the No. 200 sieve) as determined from hydrometer and/or sieve analysis.

Initially 94 boreholes were identified within the Erksak Borrow Block (EBA, 1988b). While reviewing this data set it was discovered that an additional 28 boreholes had been drilled within and just beyond the boundaries of the Erksak Borrow Block which proved useful in this study. These additional boreholes were reported within EBA's final (1988c) report. The borehole logs have not been duplicated in this

report, although a listing of the boreholes with their location and borrow material resource utility assessment is presented in tabular form as Appendix 3. Also, the plotted location of the boreholes along with a borrow potential "coding" are displayed on Enclosure 2 which is shown in reduced form in Figure 4. The borehole positions and coding have been duplicated on other appropriate enclosures where they are provided to aid in the representations of regions for borrow assessment.

The borehole naming convention used by EBA represents a general modification from the original borehole names. This was designed to accommodate problems with the original data set such as the fact that several boreholes from different areas within the Beaufort had been assigned the same number, and the fact that the ESELog system would only accommodate seven character borehole names. Thus the renumbering system follows the format below:

ex. UB 80 - 37

Area Abbreviation Year Drilled - Borehole No.
(eg Ukalerk Borrow) (eg. 1980) - (eg. 37)

Borehole numbers were not modified if they were less than 7 characters in length, or were not duplicated at another site (EBA, 1988b). Table 2 summarizes the area abbreviations used for each block within the Erksak data base.

TABLE 2 BLOCK NAMES AND ABBREVIATIONS, ERKSAK BORROW BLOCK

BOREHOLE SITE	ABBREVIATION(s)
Erksak	EK
Alerk	AL
North Tingmiark	NT
Uviluk Borrow	UV
Uviluk Foundation	FUV
Kogyuk	KY
North Ukalerk	NU
South Ukalerk	SU
Ukalerk Borrow	UB

Mr. Neil MacLeod of EBA has reviewed the boreholes for the Erksak Borrow Block and assisted in developing a coding system, which takes into account the sand and gravel quality and current dredging requirements for the Beaufort Sea operators. This coding is described in detail within Table 3A-1 in Appendix 3 along with the borehole summary (Table 3A-2) and has been used throughout the figures and enclosures of this report.

The borehole coverage within the entire Erksak Borrow Block is generally considered to be sparse in relation to the overall size of the region. The boreholes tend to be clustered into 4 or 5 main groups which were drilled for exploration island sites and detailed dredging evaluations at specific locations. The coverage in these detailed regions is probably adequate for the detailed local assessment of borrow quality and quantity, however the detailed re-evaluation of these very limited areas has not been feasible within the context of this regional study.

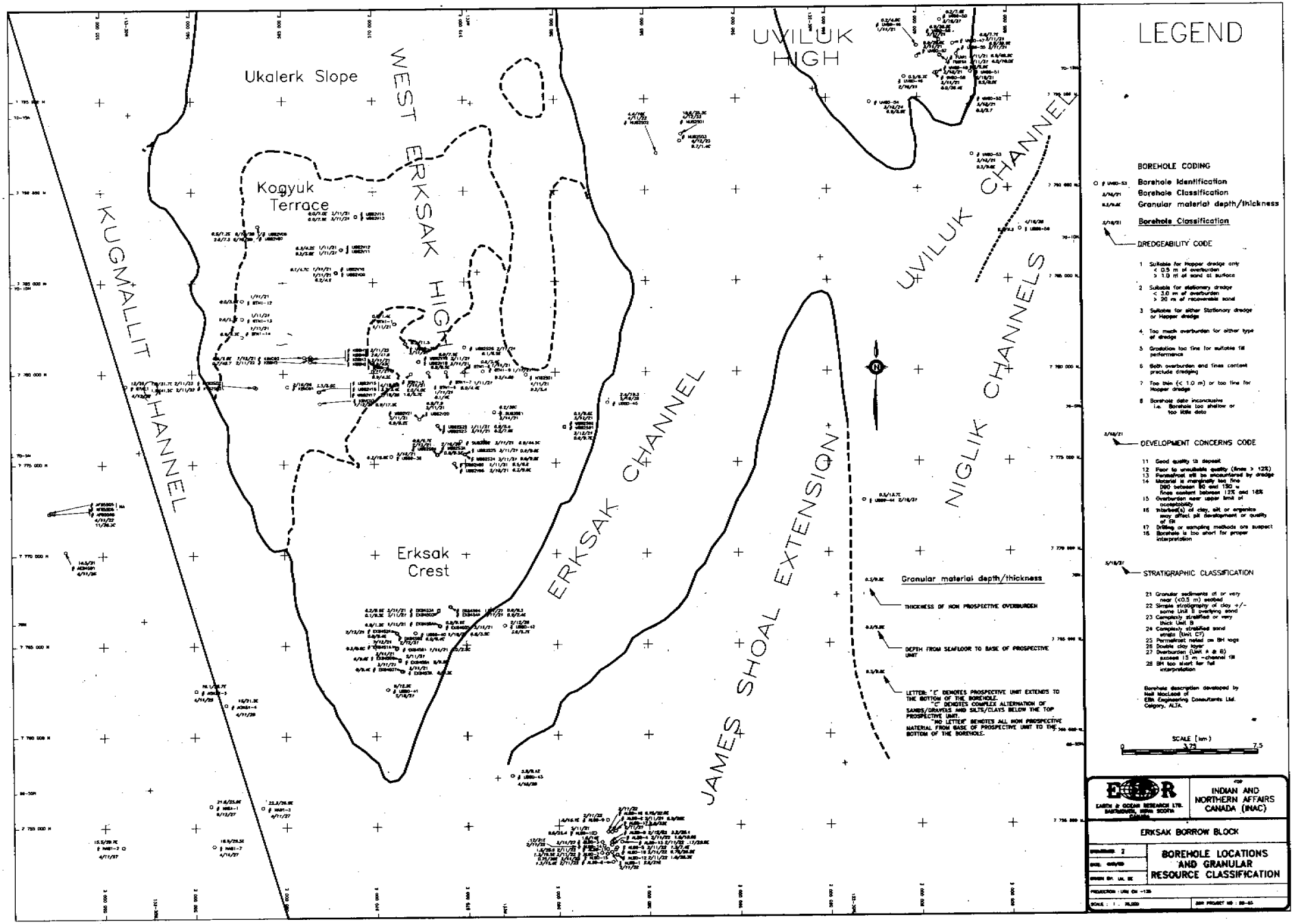

Ukalerk Slope
WEST ERKSAK HIGH
UVILUK HIGH
Kogyuk Terrace
KUGMALLIT CHANNEL
ERKSAK CHANNEL
UVILUK CHANNEL
NIGLIK CHANNELS
JAMES SHOAL EXTENSION
Erksak Crest
LEGEND
BOREHOLE CODING
Borehole Identification
Borehole Classification
Granular material depth/thickness
Borehole Classification
DREDGEABILITY CODE
1 Suitable for Hopper dredge only
< 0.5 m of overburden
> 1.0 m of sand at surface
2 Suitable for stationary dredge
< 3.0 m of overburden
> 20 m of recoverable sand
3 Suitable for either Stationary dredge or Hopper dredge
4 Too much overburden for either type of dredge
5 Gradation too fine for suitable fill performance
6 Both overburden and fines content preclude dredging
7 Too thin (< 1.0 m) or too fine for Hopper dredge
8 Borehole data inconclusive
i.e. Borehole too shallow or too little data
DEVELOPMENT CONCERNS CODE
11 Good quality fill deposit
12 Poor to unsuitable quality (fines > 12%)
13 Permafrost will be encountered by dredge
14 Material is marginally too fine
D60 between 90 and 150 u
fines content between 12% and 18%
15 Overburden near upper limit of acceptability
16 Interbed(s) of clay, silt or organics may affect pit development or quality of fill
17 Drilling or sampling methods are suspect
18 Borehole is too short for proper interpretation
STRATIGRAPHIC CLASSIFICATION
21 Granular sediments at or very near (<0.5 m) seabed
22 Simple stratigraphy of clay +/- some Unit B overlying sand
23 Completely stratified or very thick Unit B
24 Completely stratified sand strata (Unit C?)
25 Permafrost noted on BH logs
26 Double clay layer
27 Overburden (Unit A & B) exceeds 15 m - channel fill
28 BH too short for full interpretation
Borehole description developed by Neil MacLeod of Ellis Engineering Consultants Ltd. Calgary, ALTA.
Granular material depth/thickness
THICKNESS OF NON PROSPECTIVE OVERBURDEN
DEPTH FROM SEAFLOOR TO BASE OF PROSPECTIVE UNIT
LETTER 'E' DENOTES PROSPECTIVE UNIT EXTENDS TO THE BOTTOM OF THE BOREHOLE.
'C' DENOTES COMPLEX ALTERNATION OF SANDS/GRAVELS AND SILTS/CLAYS BELOW THE TOP PROSPECTIVE UNIT.
'NO LETTER' DENOTES ALL NON PROSPECTIVE MATERIAL FROM BASE OF PROSPECTIVE UNIT TO THE BOTTOM OF THE BOREHOLE.
SCALE (km)
0 7.5
EDGER
EARTH & OCEAN RESEARCH LTD.
DARTMOUTH, NOVA SCOTIA
CANADA
INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ERKSAK BORROW BLOCK
BOREHOLE LOCATIONS AND GRANULAR RESOURCE CLASSIFICATION
PROJECTION : UTM ZONE 7
SCALE : 1 : 35,000
JOB PROJECT NO : 20-65

FIGURE 4

5 DETAILED GEOLOGICAL DESCRIPTION: ERKSAK BORROW BLOCK

Throughout this section of the report the discussion and interpretation is restricted to the region of the Erksak Borrow Block. It is aimed primarily at the surficial physiography and shallow sedimentary section for the sole purpose of granular resource borrow evaluation. In order to facilitate the detailed discussion of this region the physiography has been described in significant detail, and additional physiographic names beyond those presented by O'Connor (1982a) have been used to describe the bathymetric and shallow subsurface features within the area. These names are presented as informal names and are used primarily to aid the reader in following the discussions below. Unit names referred to within this section follow the O'Connor (1980) terminology conventions.

This interpretation is directed specifically at the location and identification of coarser grained borrow materials and therefore does not follow the standard convention of most regional geologic descriptions. Thus sub surface maps generated are based on seismo-lithologic interpretations directed at delineating coarse materials and use ground-truth borehole evidence where possible. These maps are specifically <u>not</u> time stratigraphic interpretations which would be the norm for geological interpretation procedures.

5.1 Bathymetry and Physiographic Subdivisions

The bathymetry and physiographic subdivisions of the site are presented in Figure 5 and Enclosure 3. This bathymetry has been developed by a careful contouring of Canadian Hydrographic Service (CHS) field sheet WA 10176 (water depth

postings) which was resurveyed by CHS in 1986. Portions of the map have been constructed from the Natural Resource Series bathymetric map for the area. This latter bathymetric map was used to extend portions of the east and north zones of the site where the detailed newer field sheets were not available at the time of writing. The significant decrease in the crenulation of the contours, apparent on the produced map in these areas, is an artifact of this procedure and is not due to real changes in the seafloor microtopography. Where contours were taken from the Natural Resource map (which is at a scale of 1:500,000) they are shown at a two metre contour interval. Where the data was taken from the new (1:100,000 scale) CHS field sheets, contours are presented at a 1 m. contour interval.

Miss ties between field sheet WA10176 and the Natural Resource Map were encountered and these were smoothed through the transition areas. The miss ties are believed to be the result of the improved navigation and closer line spacing of the 1986 data over that of the earlier years. The Natural Resource Series Map is based on data collected using Decca Lambda Navigation while the 1986 survey used the more precise ARGO system. Additionally, the line spacing of the earlier surveys was variable from about 400 metres to 1500 metres as compared to the more dense approximately 200-400 metre line spacing of the 1986 survey program.

The topography of the site is developed on a regional north-northwestward sloping plane. A minimum depth of 6 metres is recorded at the extreme southeast corner of the site and a maximum depth of 54 metres is noted at the extreme northwest corner. Superimposed on this plane are a number of distinct topographic features of varying scale that impart an irregularity to this surface. The larger topographic features

are the physiographic regions: Tingmiark Plain, Kugmallit Channel, and Niglik Channels, outlined and described by O'Connor (1982a). Local variations in the bathymetry and the underlying paleosurface that influence and control the bathymetry permits the subdivision into smaller component regions. These divisions and subdivisions are outlined on Figure 4 (Enclosure 3). For ease of reference, the subdivisions are given informal names intended for use within the context of this report only.

The Tingmiark Plain has been subdivided into the West Erksak High, Erksak Channel, Uviluk High and Uviluk Channel. The West Erksak High is further divisible into the Erksak Crest, Kogyuk Terrace, and Ukalerk Slope. The southwest corner of the map area is occupied by the James Shoal Extension. The Kugmallit Channel and Niglik Channels are not subdivided.

5.1.1 Kugmallit Channel

The western edge of the site is dominated by a pronounced linear depression which is the surface expression of the eastern side of the Kugmallit Channel. This depression trends north-northwest to south-southeast and descends from a minimum of 11 metres to a maximum of 54 metres within the survey area. It is bounded to the east by the West Erksak High along most of its length, but is joined to the Erksak Channel to the south, thereby isolating the West Erksak High from the coast. It is asymmetric in cross section, being steep sided to the east where it bounds the West Erksak High.

The asymmetry and relief of the feature increase from south to north. In the south, at the juncture of the Erksak

Channel, it is broad, of low relief, and nearly symmetrical in cross section. From the 11 metre contour to the 16 metre contour, the rise to the east is gradual and the cross sectional relief is only one to two metres. The West Erksak High forms the boundary from the 18 metre contour northwards, and from this point to the 38 metre contour, the east flank becomes progressively steeper, and the cross sectional relief increases to as much as 12 metres. From the 38 metre contour the steepness of the flank is lessened but again increases northward until it forms an escarpment that ascends from 50 metres on the channel axis to 38 metres at the shoulder. Thereafter to the survey limit the rise to the West Erksak High is more gradual.

5.1.2 Tingmiark Plain

The Tingmiark Plain represents a large upland area of the Beaufort shelf between the Kugmallit and Niglik Channel features. This is the largest single physiographic area defined on the eastern shelf area by O'Connor (1982a). The region constitutes the primary target region for borrow development of this study and as such has been subdivided to allow description and classification of the area into manageable units. These subdivisions and their broad physiographic descriptions are presented in the following subsections.

5.1.2.1 West Erksak High

The changes in the steepness and local relief of the eastern wall of the Kugmallit Channel are primarily a function of changes in the physiography of the West Erksak High. This

feature covers the west-central portion of the survey area and consists of a north-northwestward plunging irregular surface. It extends to the north beyond the survey boundary but is bounded to the south by the confluence of the Kugmallit and Erksak Channels.

The West Erksak High is divisible into three physiographic components: the Erksak Crest, the Kogyuk Terrace, and the Ukalerk Slope. The Erksak Crest occurs over approximately the lower third of the West Erksak High and extends to the north along the eastern margin, the Kogyuk Terrace covers the central third, and the Ukalerk Slope the northern third. The steepness and local relief of the east flank of the Kugmallit Channel as described above are determined by which of these physiographic features abuts the trough.

5.1.2.1a Erksak Crest

The Erksak Crest is an elevated cuesta-like platform that descends gradually to the north, northwest and west from a pronounced linear ridge that forms the southeast boundary of the West Erksak High. The southeast face of the Erksak Crest forms a three to five metre escarpment where it descends into the Erksak Channel. The descent into the Kugmallit Channel is gradual.

The prominent ridge that forms the spine of the cuesta extends from the southern tip of the West Erksak High to the northeast for a distance of 21 km. A series of isolated highs extend northwards from the north end of the ridge and form a less distinct boundary between the West Erksak High and the Erksak Channel. The northern half of the ridge is narrow (less than 1 km. wide), smooth surfaced, and curves gently until it

is oriented due north-south at its extreme north end. The southern half of the ridge is wider (approximately 3 km. at its widest point), and is covered by an irregular distribution of small knolls. The knolls rise one to two metres from the top of the ridge, which lies generally within the 16 to 17 metre contour, to minimum depths of 14 of 15 metres.

A second, less prominent, western ridge extends from the southern end of the main ridge northwards for a distance of 10 km. A series of isolated highs, aligned with this second ridge, extend to the north northeast over a further distance of 15 km into the central northern portion of the Erksak Crest. Local relief over these ridges is 2 to 3 metres. These mounds do not display the same linearity on an individual basis, but do line up in a linear fashion that is parallel to the western high.

5.1.2.1b Kogyuk Terrace

The boundary between the Erksak Crest and the Kogyuk Terrace is marked by a break in slope that approximately follows the 25 metre contour. North and northwest of this water depth the seafloor slope is markedly decreased to form a near horizontal featureless surface. The terrace is almost flat between the 25 and 26 metre contour and thereafter descends at a shallow angle to about the 30 metre water depth. The "tabletop" surface formed between the 25 and 26 metre contours is approximately 18 km. long and 5 km. wide with a slope of about 1 metre in 5000 (0.01°). The lower portion of the terrace, from the 26 to the 30 metre contours, forms a rough triangle with the surface bulged out to the north on the western side. A minimum slope over this surface is measured as 1 metre in 3000 (0.02°).

Where the "tabletop" surface of the Terrace bounds the northward plunging surface of the Kugmallit Channel, a steep wall of uniform slope is formed that increases in local relief to the north.

5.1.2.1c Ukalerk Slope

Another break in slope marks the transition from the Kogyuk Terrace to the Ukalerk Slope. The Ukalerk Slope descends from the Kogyuk Terrace to the west into the Kugmallit Trough and to the north beyond the boundary of the survey area. To the north the surface slopes at about 1 metre in 1000 (0.06°), while to the west the slope is steeper but variable into the Kugmallit Channel. To the east the surface is bounded by isolated knolls that may be an extension of Erksak Crest. Near the northern boundary of the survey area, the surface descends gently into the Erksak Channel.

5.1.2.2 Erksak Channel

The Erksak Channel is bounded by the West Erksak High to the west, the James Shoal Extension to the south and southwest, and the Uviluk High to the East. It is contiguous with the Kugmallit Channel at the southern tip of the West Erksak High and is possibly joined to the Uviluk Channel between the James Shoal Extension and the Uviluk High.

The channel is between 4.5 and 13 km. in width. It is narrowest at the southern end where it joins the Kugmallit Channel, and widest at the northern border of the survey area. It is broadly arcuate, and swings through a northeast to a north, to a northwest orientation from south to north in the site area.

The feature is bathymetrically well defined and channel-like only over its southern reach where it lies between the prominent ridge of the Erksak Crest and the James Shoal Extension. Here the channel descends in a regular manner from the 17 metre contour to the 25 metre contour and has a cross sectional relief of about 5 metres. The channel axis is well defined and runs close to the Erksak Crest. North of the 25 metre contour, it forms a shallow, irregular depression with poorly defined borders. The trace of the channel axis is intermittent and is situated in the approximate centre of the feature. Cross sectional relief is reduced to one to two metres and numerous linear depressions of limited length suggest secondary axes. These features are much better defined in the subbottom data.

5.1.2.3 James Shoal Extension

James Shoal is an officially named feature located 7.5 km. to the north of Toker Point on the Tuktoyaktuk Peninsula. The actual shoal lies to the south of the Borrow Block boundary. However, the broader regional high that the shoal is located on extends northward into the study area and forms a positive feature. Within the borrow area, the high forms a triangle that narrows to the north between the Erksak Channel on the west and the Niglik Channels on the east. The northern apex is not well defined and may end at an opening between the Uviluk Channel and the Erksak Channel. The axis of the high trends north-northeast from the southern boundary and passes through a shoal that rises three metres above the surrounding seafloor. As defined here, the James Shoal extension shows a minimum depth of 8 metres, near the southern boundary over the main shoal, and descends gradually to a maximum depth of 25 metres at its northern apex.

On the northern portion of the main shoal the top of the high is irregular but displays few features with local elevations of more than one metre. An exception is a small circular knoll located near the Erksak Channel boundary about 10 km. to the north of the main natural shoal. This feature has a two metre local elevation and rises from 19 metres to 17 metres water depth.

Two km. to the west of the main shoal a second shoal has been formed by the construction of the Alerk artificial island. This island is abandoned and is recorded as lying 0.2 metres above "higher high water, low tide". Five kilometres to the west of the Alerk Island a small natural knoll rises from 12 metres water depth to 9 metres.

5.1.2.4 Uviluk High and Uviluk Channel

The Uviluk High and Uviluk Channel occupy the northeastern corner of the survey area. The portion of the Bathymetry map on which these features are located is taken from the Natural Resource Series Map and the resolution and accuracy of the contours is therefore less than for the areas previously described.

The Uviluk High extends southward from the northern boundary of the Borrow area for 9 km. The high is approximately 10 km. wide along the study boundary and narrows to the south. It is dominated by a linear ridge that extends the length of the feature and trends north-northwest to south-southeast. The ridge rises from the 30 metre contour to a minimum water depth of 26 metres.

The high is bounded to the west by the Erksak Channel and to the east by the Uviluk Channel. The Uviluk Channel extends

north south and lies between the Uviluk High to the west and the Niglik Channels to the east. The relationship between the Uviluk Channel and the Niglik Channels cannot be adequately observed within the survey area boundaries and becomes apparent only when the regional Natural Resource Series bathymetric map is examined. On a larger scale map it is observed that the Uviluk Channel forms a distinct north-south depression separated from the northeast-southwest trending Niglik Channels by an intervening high to the north of the survey area. Within the survey area the two depressions meet and they cannot be distinguished one from the other south of the southern tip of the Uviluk High. Although the topography is poorly defined by the contours to the south of the Uviluk High, there is a suggestion that the Uviluk Channel meets the Erksak Channel in a narrow pass between the Uviluk High and the James Shoal Extension.

5.1.3 Niglik Channels

The Niglik Channels occupy the easternmost portion of the survey area. From the regional map it is observed that this feature is far more pronounced to the northeast of the survey area where it forms a deep and well defined channel. Within the survey area a broad and shallow depression that lies to the east of the James Shoal Extension is felt to represent the southern expression of the channel. As noted above, the Uviluk Channel and the Niglik Channels are confluent within the survey area south of the southern tip of the Uviluk High and the boundary placed between them on the map is arbitrary.

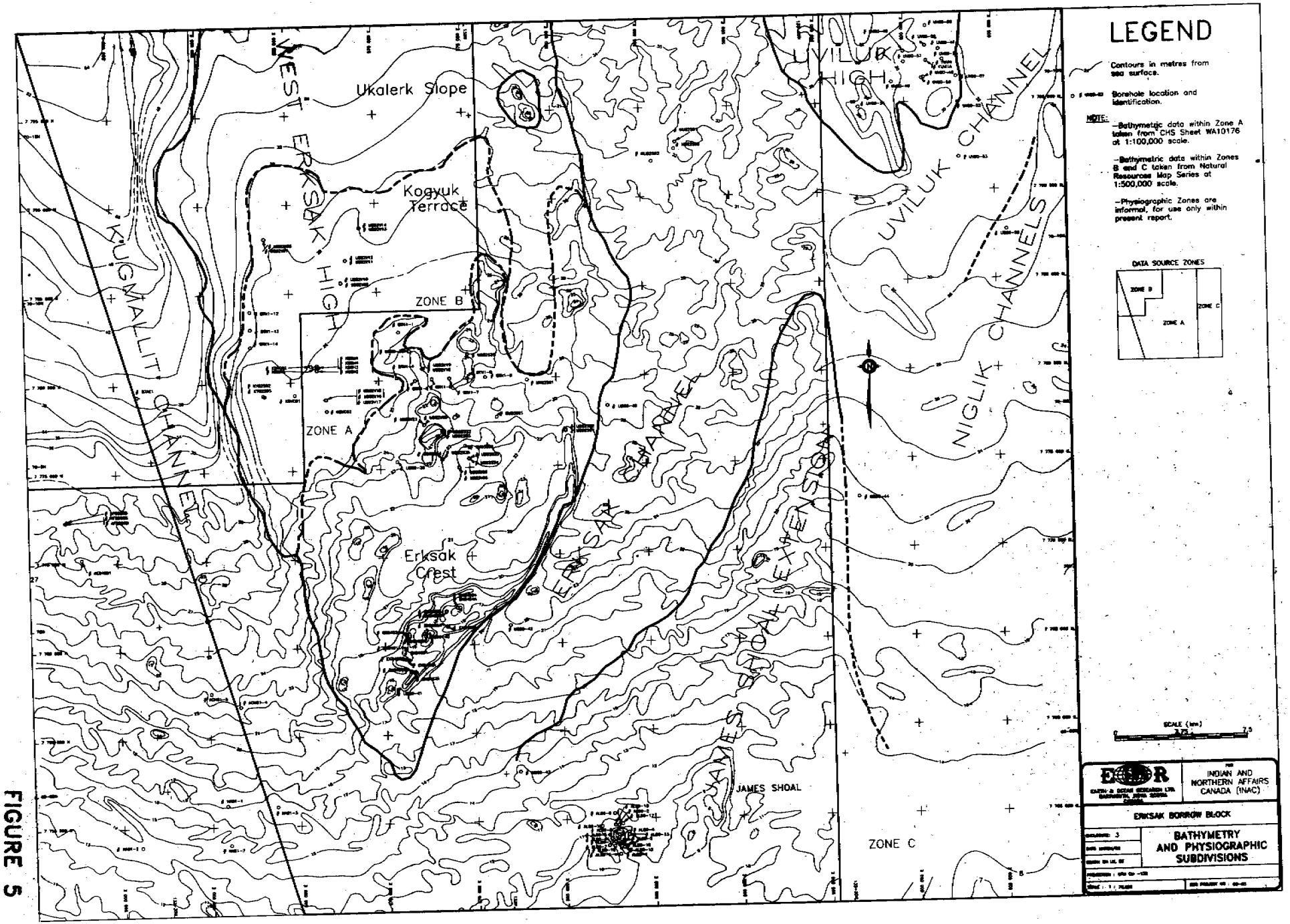

LEGEND
Contours in metres from sea surface.
Borehole location and identification.
NOTE:
-Bathymetric data within Zone A taken from CHS Sheet WA10176 at 1:100,000 scale.
-Bathymetric data within Zones B and C taken from Natural Resources Map Series at 1:500,000 scale.
-Physiographic Zones are informal, for use only within present report.
DATA SOURCE ZONES
ZONE B
ZONE C
ZONE A
SCALE (km)
INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ERKSAK BORROW BLOCK
BATHYMETRY AND PHYSIOGRAPHIC SUBDIVISIONS
Ukalerk Slope
Kogyuk Terrace
Erksak Crest
JAMES SHOAL
ZONE A
ZONE B
ZONE C
KUGMALLIT CHANNEL
ERKSAK HIGH
ERKSAK CHANNEL
UVILUK HIGH
UVILUK CHANNEL
NIGLIK CHANNELS
JAMES SHOAL EXTENSION

FIGURE 5

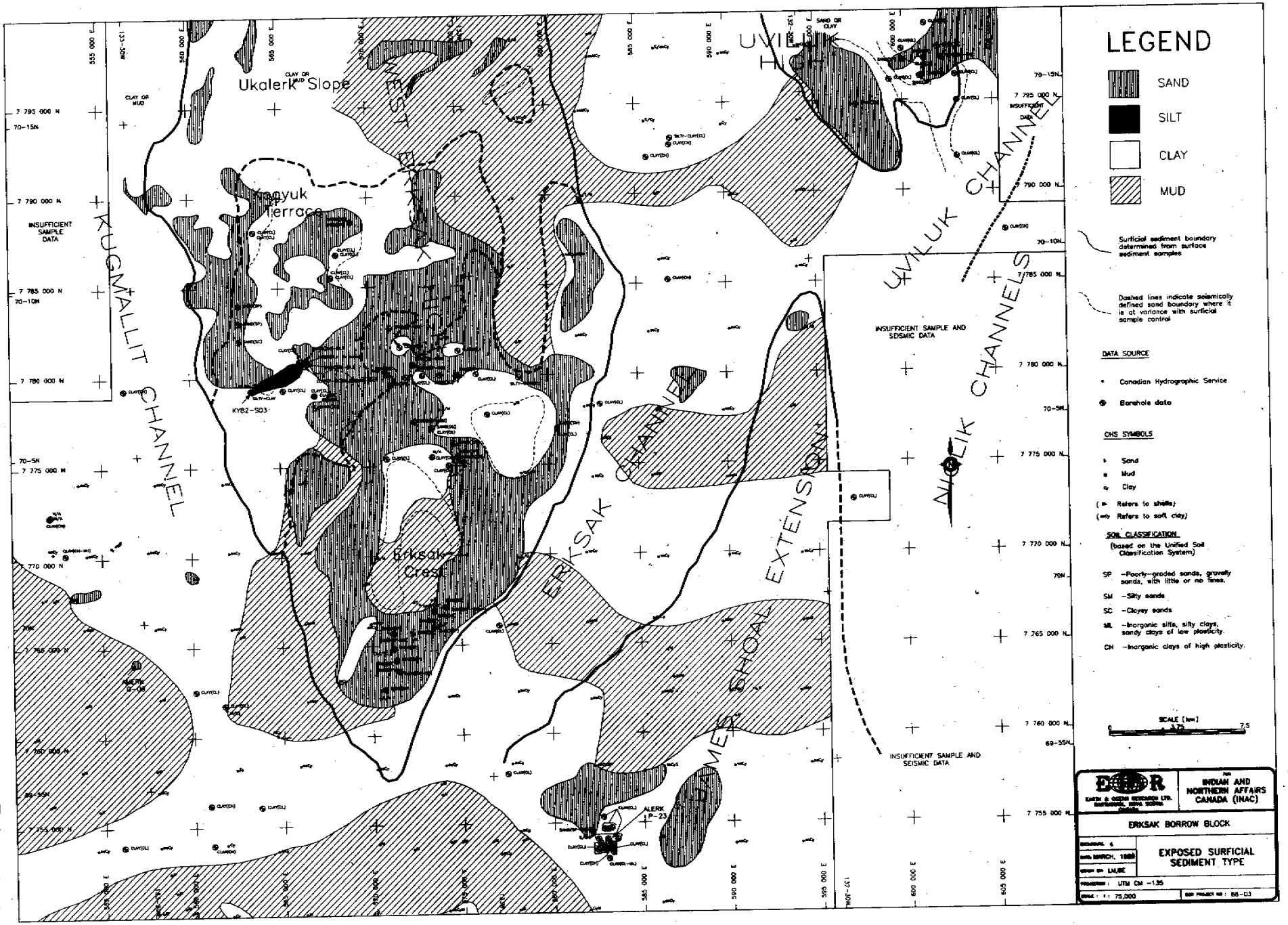

LEGEND
SAND
SILT
CLAY
MUD
Surficial sediment boundary determined from surface sediment samples
Dashed lines indicate seismically defined sand boundary where it is at variance with surficial sample control
DATA SOURCE
Canadian Hydrographic Service
Borehole data
CHS SYMBOLS
Sand
Mud
Clay
Refers to shells
Refers to soft clay
SOIL CLASSIFICATION
(based on the Unified Soil Classification System)
SP –Poorly-graded sands, gravelly sands, with little or no fines.
SM –Silty sands
SC –Clayey sands
ML –Inorganic silts, silty clays, sandy clays of low plasticity.
CH –Inorganic clays of high plasticity.
SCALE (km)
0 3.75 7.5
Ukalerk Slope
Kugmallit Terrace
Eriksak Crest
KUGMALLIT CHANNEL
ERIKSAK CHANNEL
MEA SHOAL EXTENSION
UVILUK CHANNELS
AUKLIK CHANNEL
INSUFFICIENT SAMPLE DATA
INSUFFICIENT SAMPLE AND SEISMIC DATA
KY82-S03
ALERK O-08
ALERK P-23
INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ERIKSAK BORROW BLOCK
EXPOSED SURFICIAL SEDIMENT TYPE
DATE MARCH, 1988
DRAWN BY LMJE
PROJECTION: UTM CM -135
SCALE: 1: 75,000
GSR PROJECT NO: 88-03

FIGURE 6

5.2 Exposed Surficial Sediments

The distribution of the surficial sediment type exposed on the seabed within the Erksak Borrow Block is presented in Figure 6 and Enclosure 4. The mapping of the surficial cover is based primarily on an examination of the seismic data, particularly the microprofiler records, validated wherever possible with visual descriptions of seabed samples. Where the seismically defined textural class boundary differs from that derived from the sample control, it is shown with a dashed line. Seismic data is used exclusively in the northwest and north where there are no boreholes and bathymetric field sheet coverage is not available.

Textural information from the tops of the 122 boreholes has been augmented by 164 seabed samples collected by the Canadian Hydrographic Service during the 1986 field season. CHS collected these seabed samples using a small grab sampler on a 5 km. grid over the area covered by Field Sheet WA 10176. Where shoal examinations were carried out, the seabed texture was determined using a smaller armed leadline sampling device. Size analysis are not routinely performed on grab samples by the CHS, and the samples are routinely discarded at sea after examination. The textures derived from the borehole logs are primarily based on visual description, though in some cases they are supported by lab testing. The surficial cover map is therefore restricted to broad textural classification.

The distribution of surficial sediments is topographically controlled. Sand and sand-dominant material is restricted to shoals although not all shoals are sandy. The Kugmallit Channel, and Erksak Channel are uniformly fine grained. The CHS samples record soft clay, soft muddy clay, or mud throughout these areas. Exceptions to this are a sand

sample taken at the Amerk O-09 artificial island located near the southern end of the Kugmallit Channel and a sand sample taken from a small shoal located 4 km. to the northeast of the Amerk site. This shoal is anomalous in that it rises 6 metres to a water depth of 22 metres from an otherwise low relief plain and consists of sand where the surrounding area consists of soft clay. The feature has the appearance of an artificial island though the CHS field sheet records the location of artificial islands and this shoal is not noted as such.

Over the West Erksak High the sediment distribution is more varied, but still related to the local relief, with sand or muddy sand recorded over the ridges of the Erksak Crest and sandy mud or mud noted within the depressions. The outline of the distribution of sand at the seafloor as determined from the seismic data is displayed on the map with a dotted line. A comparison of this outline with the distribution mapped from the CHS samples shows that the fine cover is more extensive than the seismics alone would suggest. This is most likely the result of a veneer of fine material resting on the sand substrate. The thickness of this veneer would not exceed about 30 cm. or it would be visible on the microprofiler records.

Seismic and borehole data over the Uviluk High indicate that sand covers most of the surface with mud occupying two northwest-southeast trending depressions.

The southern shoreward portion of the area over the James Shoal Extension is generally covered by soft clay or mud. A sand sample is noted next to the Alerk P-23 artificial island and a second sand sample is recorded 3 km. to the east on the flank of the main shoal of the James Shoal Extension. The CHS sample grid did not sample the top of the main shoal but it

is surmised that the sand sample is representative of the surficial cover of this feature.

The fine material surrounding the coarse deposits consist uniformly of inorganic clays with very occasional black organic streaks. They are generally low to medium plastic with a water content that varies from about 20% to 45%. The clays also vary from soft to very stiff. Trace amounts of sand in fine laminations are noted in several samples as well as trace amounts of silt, and shells.

5.3 Thickness of Fine Grained Surficial Cover

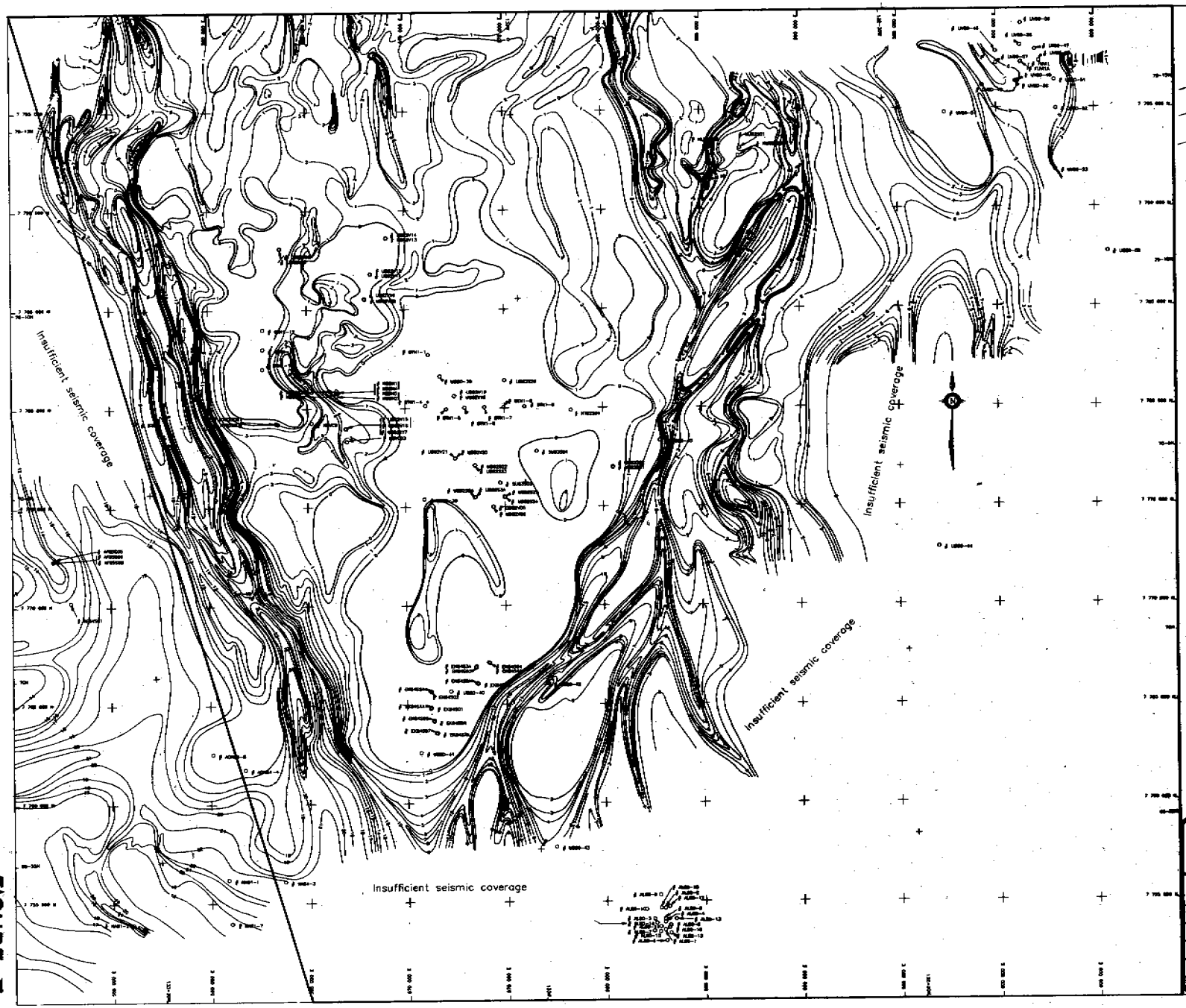
An important concept for the evaluation of an area for borrow potential is the thickness of the undesirable surficial materials that overlie the target resource materials. In the case of the Beaufort Sea this material is composed of the marine clays of Unit A and the silts and clays facies of Unit B (after O'Connor, 1980). The thickness of this soft surficial cover is displayed as an isopach on the top of the regional sand surface in Figure 7 and Enclosure 5. This map is constructed from the seismic data and validated against the borehole data where possible. A velocity of sound through sediments of 1460 metres per second was used to calculate sediment thickness from the seismic data.

The pattern and variability of thickness of the surficial sediments are correlatable generally to the physiographic regions described previously. Within the physiographic depressions, the Kugmallit Channel and the Erksak Channel, the variability of accumulation is high. In these features the distribution is controlled by the well developed topography of the underlying surface (see Section 5.5 below).

The maximum thickness of fine materials within the channel features decreases to the north. In the Kugmallit Channel, a maximum thickness of 24 metres is measured near the south end of the survey. At the north end of the survey area, the maximum thickness recorded is 10 to 11 metres. The variation is slightly less within the Erksak Channel. Here a maximum value of 18 metres is measured to the south and 10 to 11 metres to the north.

Within the Kugmallit Channel, the minimum thickness over the subsurface highs also varies systematically from south to north. Over the southern part of the survey area, a minimum thickness of 12 metres is noted. This decreases northwards and thicknesses of 1 to 3 metres over the subsurface highs are common near the north end of the site. In the Erksak Channel this pattern is not observed. Minimum thicknesses of zero to 2 metres occur over the raised portions of the subsurface through the entire length of the channel.

The accumulation patterns within the Uviluk Channel are not as clearly defined as those observed in the Kugmallit and Erksak Channels. Here the total accumulation is less, generally from 4 to 6 metres with the maximum thickness observed measuring 7 metres.



LEGEND

0 — Zero thickness overburden contour

3 — Three meter thickness overburden contour

5 — All other thickness contours

Sediment Thickness determined from seismic records and correlated to boreholes where possible. Seismic Two Way Travel Times converted to metres using a velocity of sound in sediments of 1480 m/s. Upper Surface is taken as seabed.

Contour interval One metre.

Borehole location and identification

SCALE (km)

0 3.75 7.5

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ERKSAK BORROW BLOCK

ENCLOSURE: 5

DATE: MARCH, 1989

DRAWN BY: LM, BE

SOFT SURFICIAL SEDIMENT ISOPACH ON PROSPECTIVE SAND SURFACE

PROJECTION : UTM CM -135

SCALE : 1 : 75,000

EDR PROJECT NO : 88-03

FIGURE 7

The physiographic highs typically have a thin or absent soft sediment accumulation and irregular patterns of distribution. Much of the southern part of the West Erksak High, approximating the regions of the Erksak Crest and the Kogyuk Terrace, is devoid of soft sediment. Isolated small barren patches occur to the north, associated with local slight rises in the seafloor. Sediment accumulation elsewhere on the High is generally limited to less than two metres. Small and isolated linear accumulations occur on the north-central and west-central part of the High that reach 7 to 9 metres in thickness. These result from the infilling of larger than typical depressions in the subsurface. The Uviluk High is barren of soft sediment cover except for two northwest southeast oriented accumulations of two metres or less that pass through the centre of the feature.

5.4 Seismo-Stratigraphic Characteristics of the Upper Sands

The bathymetry and the physiographic regions and subregions described in section 5.1 are the muted surficial expression of an older complex surface that underlies the entire survey area. The depth structure map on this surface is presented as Figure 8, and as a full scale display in Enclosures 6.

The surface defined on this structure map does not represent a single time-stratigraphic seismic horizon as would be the case if it were intended to represent the top of Unit C. It represents a composite of numerous laterally discontinuous higher amplitude reflecting horizons that are interpreted to represent the top of shallow sands (possible borrow materials) within the area. While the horizons are not time synchronous, as they are observed to overlap one another

along their borders, taken together, they form a morphologic pattern that suggests a depositional system acting over a relatively short period of time. The lateral discontinuities are interpreted to be the result of a spatially and temporally variable energy regime. In some areas the surface is believed to represent the top of Unit C while in others it represents a coarser grained sub-facies that technically belong within Unit B and overlies Unit C. Thus the map represents a lithostratigraphic surface that was developed just prior to and during the marine transgression with both destructional and constructional sedimentary features creating the composite surface.

The common factor linking the various reflecting surfaces is the coarser texture of the sediments that make up the surface. This is deduced from the seismic data and corroborated by the borehole data. Reduced penetration or complete lack of penetration on the microprofiler records occurs at these surfaces, and, where the surface lies at the seafloor, a high amplitude seafloor return is recorded. On the boomer and V-Fin sparker records, penetration occurs, but is reduced, and internal stratification is either absent, or vague, or it occurs as discontinuous, generally high angle reflectors. On records from all systems the upper surface is of high amplitude and well defined.

There is ample borehole verification that the surface mapped from the seismics generally corresponds to the first encounter of significant sand in the subsurface. Three examples are presented in Figures 9, 10 and 11, taken from widely spaced locales, under varying overburden thicknesses, and over "coarse" substrates that display different seismic character. Figure 9 is a portion of boomer line GHR81-116 from the East Amauligak Wellsite area. This site is located

in the Kugmallit Channel near the western edge of the survey area. Superimposed on the profile is the textural log for the borehole AF85S6B. This borehole is situated directly on the seismic track line. The borehole was drilled to a sub-seafloor depth of 53.4 metres. Soft silty clay occurs from the seafloor to 11.0 metres depth. At 11.0 metres depth the top of a 22.4 metre thick sand body is encountered. The seismic profile shows a prominent reflector at 16 msec beneath the seafloor and the seismic return reduces significantly within the sediments below this horizon. This time converts to 11 metres depth using the time/depth curve constructed for this part of the Beaufort Shelf by J. Hunter of the GSC (Torrens et al, 1985).

The second example is taken from the top of the Erksak Crest. Figure 10 presents a portion of boomer profile GHR81-046 with the textural log of vibrocore BTN1-5 superimposed. The core is located on the survey line and indicates sand at the seabed. The boomer record shows limited penetration of the seismic signal, high amplitude return from the seafloor, and high level of backscatter and lack of reflectors in the subsurface. This correlates with an interpretation of a hard, highly reflective, material such as sand at, or very near the seafloor.

The third example (Figure 11) is from the North Ukalerk wellsite area located to the east of the West Erksak High within the Erksak Channel region. The seismic profile is taken from the record GHR821128A. This record displays the microprofiler and V-Fin sparker profiles one above the other. The borehole NU82SO1 is superimposed on the V-Fin profile. The microprofiler record shows a single, continuous and high amplitude reflector at approximately 2 metres below the seafloor. The V-Fin record also shows this reflector, but in

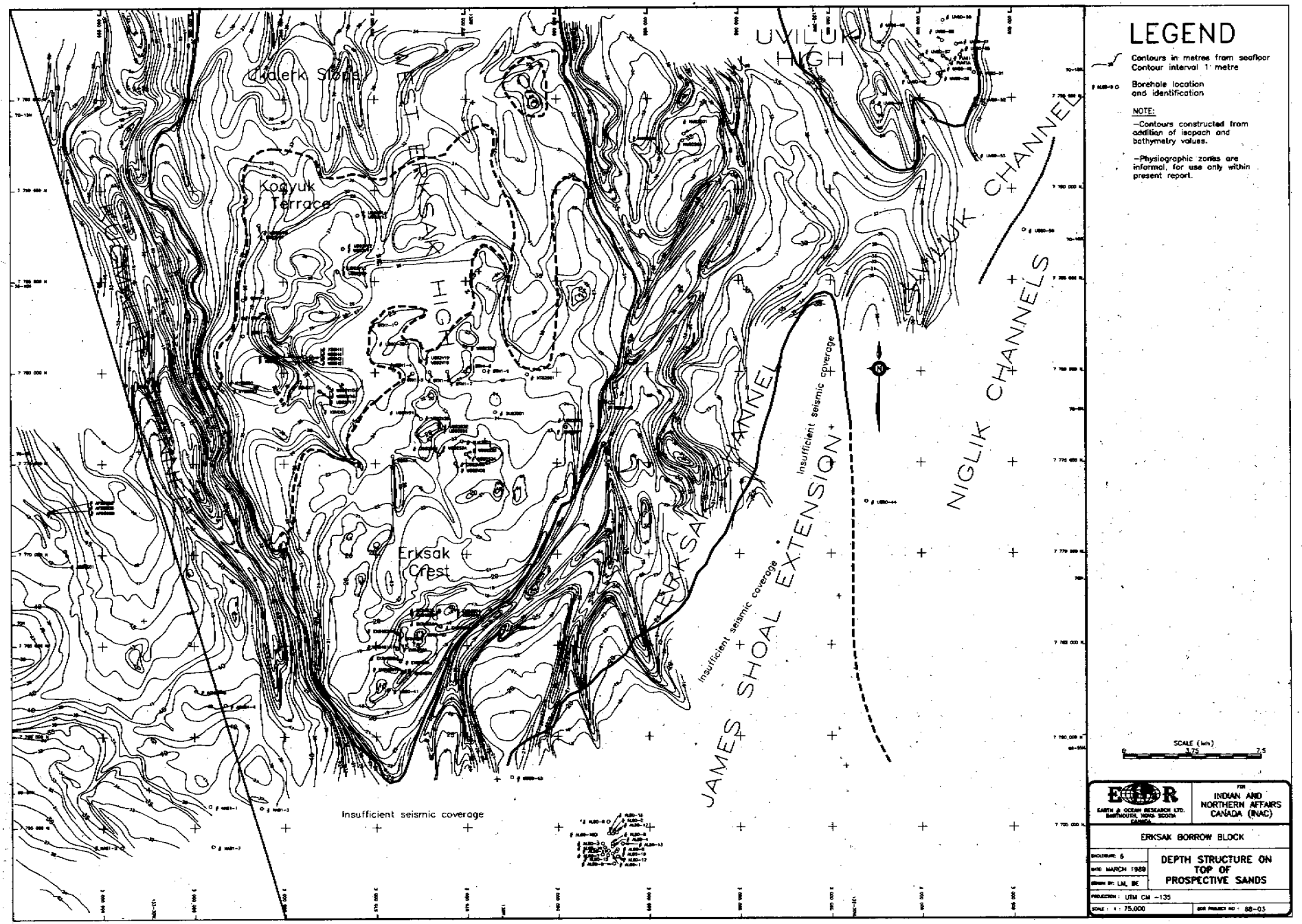
addition displays a series of variable and discontinuous reflectors below this surface. These reflectors show structural patterns that are consistent with deposition under a higher energy regime and are therefore considered to be coarser grained in lithology. An undulating but generally continuous horizon that ascends from west to east is noted at 10 metres sub-seabed at the borehole site. Below this horizon reflector strength and continuity are significantly reduced.

The seismic character observed in Figure 11 is different from the previous examples in that there is significant penetration and delineation of internal reflectors below the subsurface horizon that would normally be interpreted as the top of sand. On the basis of the seismic evidence the shallowest fine/coarse boundary is placed at the first horizon but with the proviso that this coarse material contain a significant fine component. It is further interpreted that the lower boundary represent the transition to a coarser material downsection. The borehole log supports these interpretations. A transition from silty clay to silty sand occurs at 2 metres below the seafloor and a second transition to sand occurs at 10 metres depth.

These examples demonstrate the validity of using the seismic data to determine the upper surface of the coarse material within the survey area. The isopach and structure map of the top of the coarse material have been constructed using these seismic characteristics as criteria. This does not imply, however, that the resulting surface is a time-stratigraphic entity, and as mentioned above, the surface is a composite of surfaces that have been developed at different times. Two further examples from different areas are described below to clarify this relationship.

Figure 12 is a portion of the combined V-Fin sparker and microprofiler record of line GHR821130 from the North Ukalerk wellsite area within the Erksak Channel. The microprofiler record displays distinct subsurface horizons to the east and west of a seismically amorphous zone. The high amplitude of the reflectors and the lack of penetration below the reflectors indicate coarse-textured material. The upper surface of the coarse material, as presented on the map in Figure 8, is mapped on these microprofiler reflectors. It is apparent, however, from the V-Fin sparker record that the reflectors are not the same geologic horizon, with the eastern reflector continuing beneath the western.

A second example shows the microprofiler record of line GHR81070 (Figure 13). This profile is taken from the western boundary of the West Erksak High where it descends into the Kugmallit Channel. The trace of the coarse sand reflector within the Kugmallit Channel ceases abruptly at the channel boundary while the trace of the coarse sand reflector on top of the High descends into the Channel and grades into a conformable reflector typical of finer grained sediments. This reflector overlies the coarse boundary reflector within the Channel.


Uviluk Slope
UVILUK HIGH
Kogyuk Terrace
KOGYUK HIGH
Erksak Crest
ERKSAK CHANNEL
JAMES SHOAL EXTENSION
NIGLIK CHANNELS
Insufficient seismic coverage
Insufficient seismic coverage
Insufficient seismic coverage
LEGEND
Contours in metres from seafloor
Contour interval 1 metre
Borehole location and identification
NOTE:
—Contours constructed from addition of isopach and bathymetry values.
—Physiographic zones are informal, for use only within present report.
SCALE (km)
0
3.75
7.5
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FOR
INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ERKSAK BORROW BLOCK
DRAWING: 6
DATE: MARCH 1989
DRAWN BY: LM, BE
DEPTH STRUCTURE ON TOP OF PROSPECTIVE SANDS
PROJECTION: UTM CM -135
SCALE: 1 : 75,000
EDR PROJECT NO: 88-03

FIGURE 8

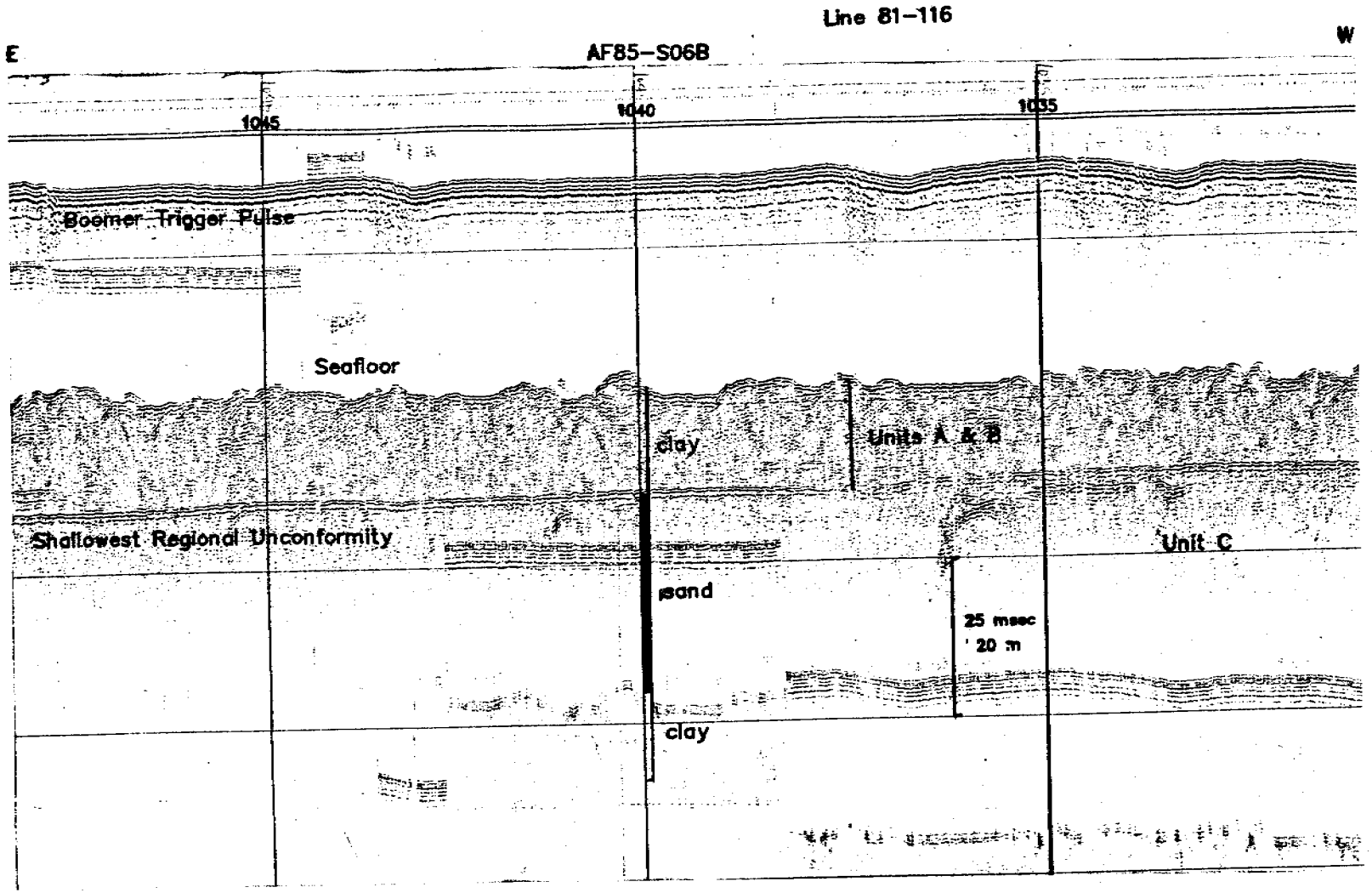

FIGURE 9

Figure 9 Example Boomer line GHR81-116 from the East Amauligak Wellsite showing borehole AF85S6B and indicating the top of sand within the Kugmallit Channel.

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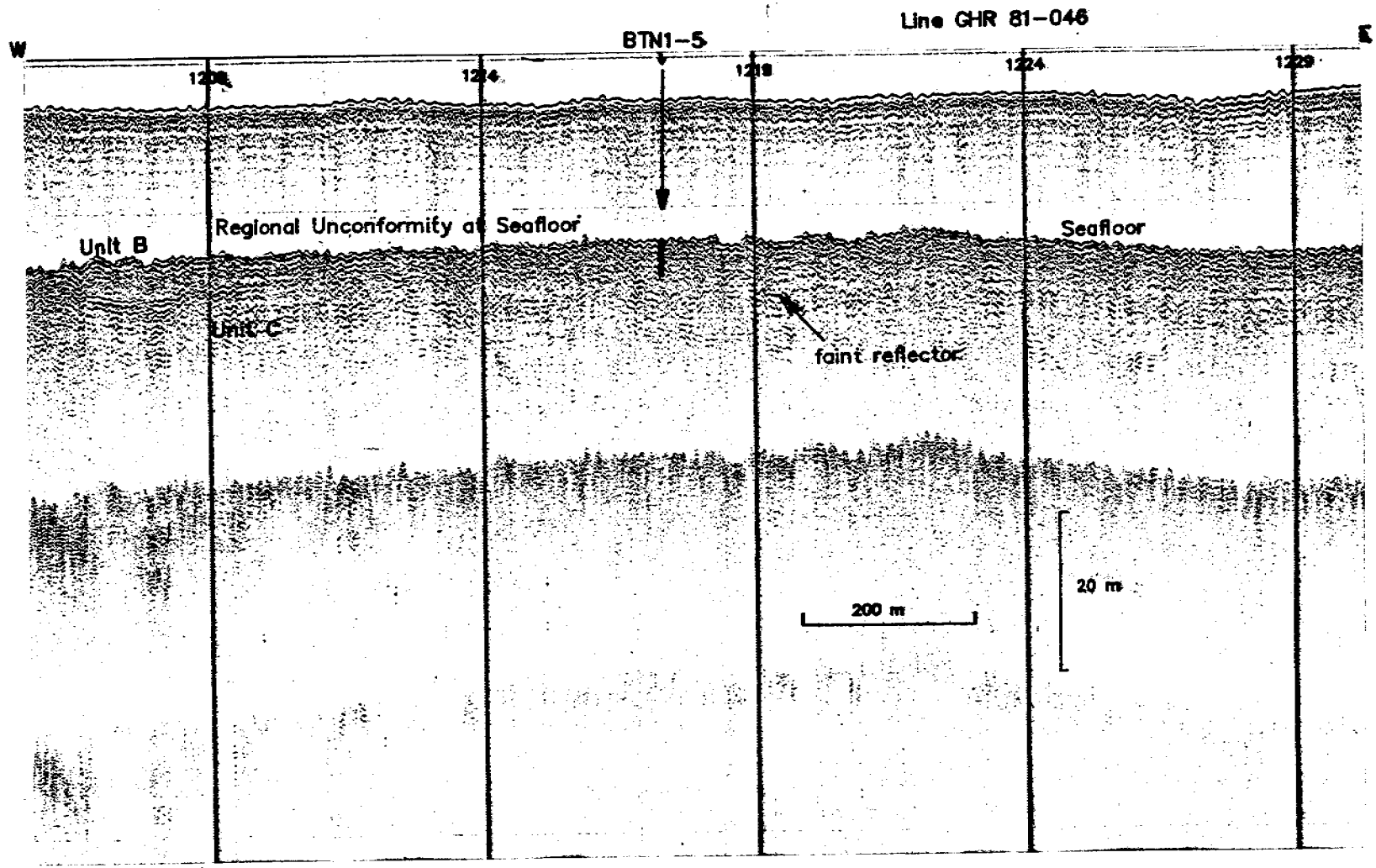

FIGURE 10

Figure 18 Example Boomer record from line GHR81-046 (with vibrocore log BTN1-5) indicating the coarse sandy materials at the seafloor.

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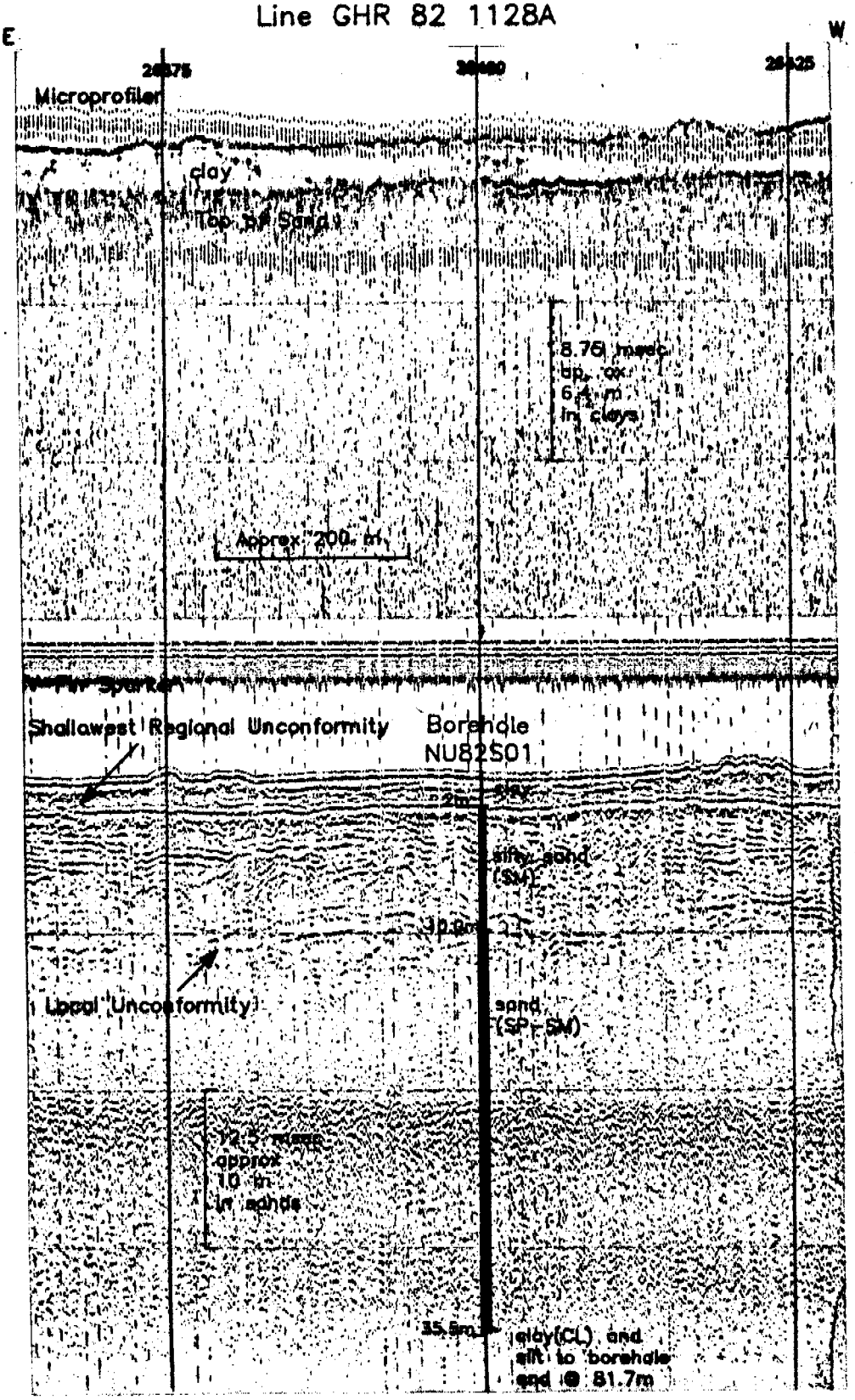

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Figure 11 Example microprofiler and 7-fin record from line GHR82112BA (with borehole NU82S01) showing shallow and deep coarse material reflectors from within the Erksak Channel

FIGURE 11

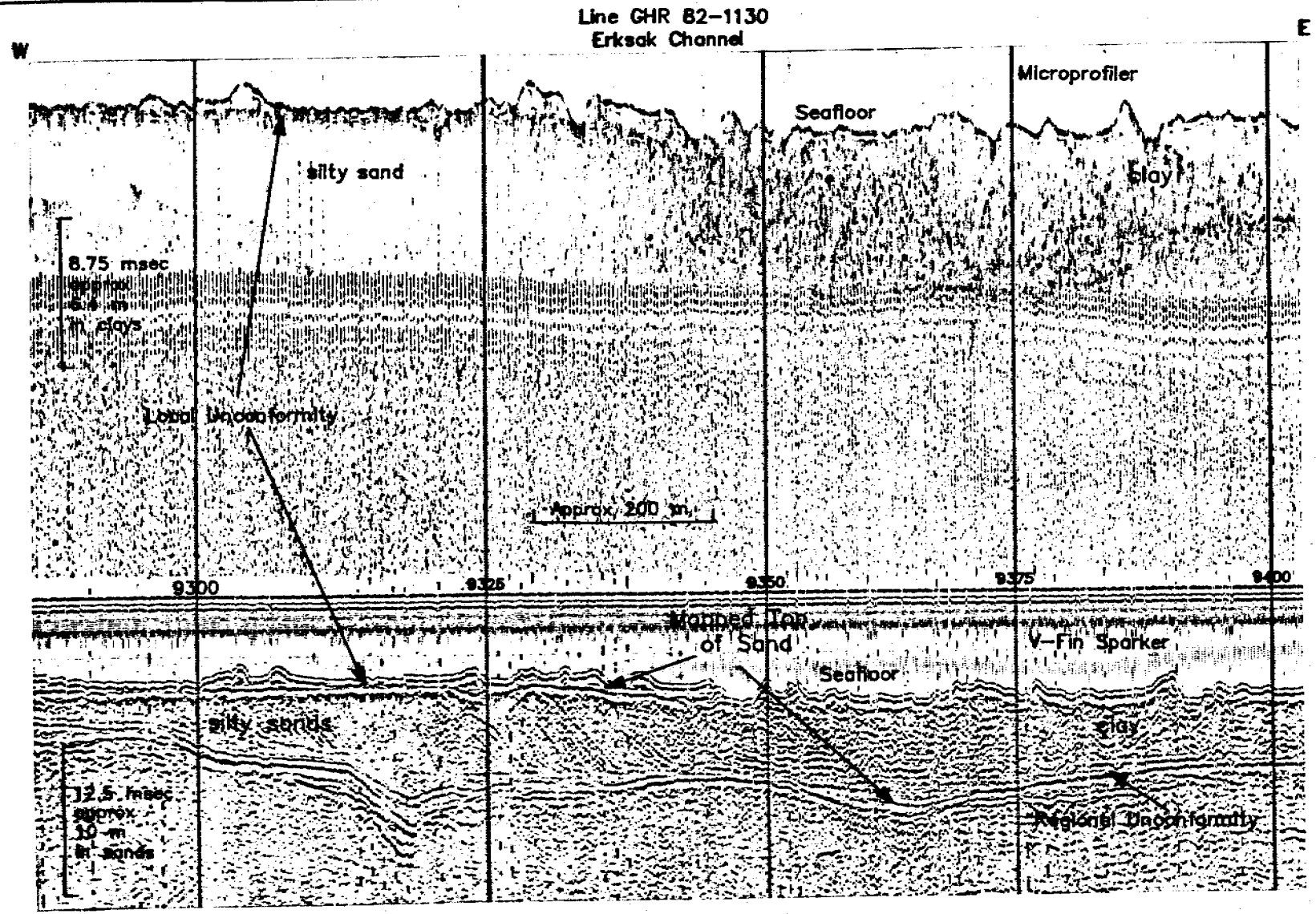

FIGURE 12

Figure 12 Example record from line GHR82-1130 from North Ukalerk showing combined V-Fin and microprofiler data indicating the complex stratigraphy associated with the interpreted sand horizons.

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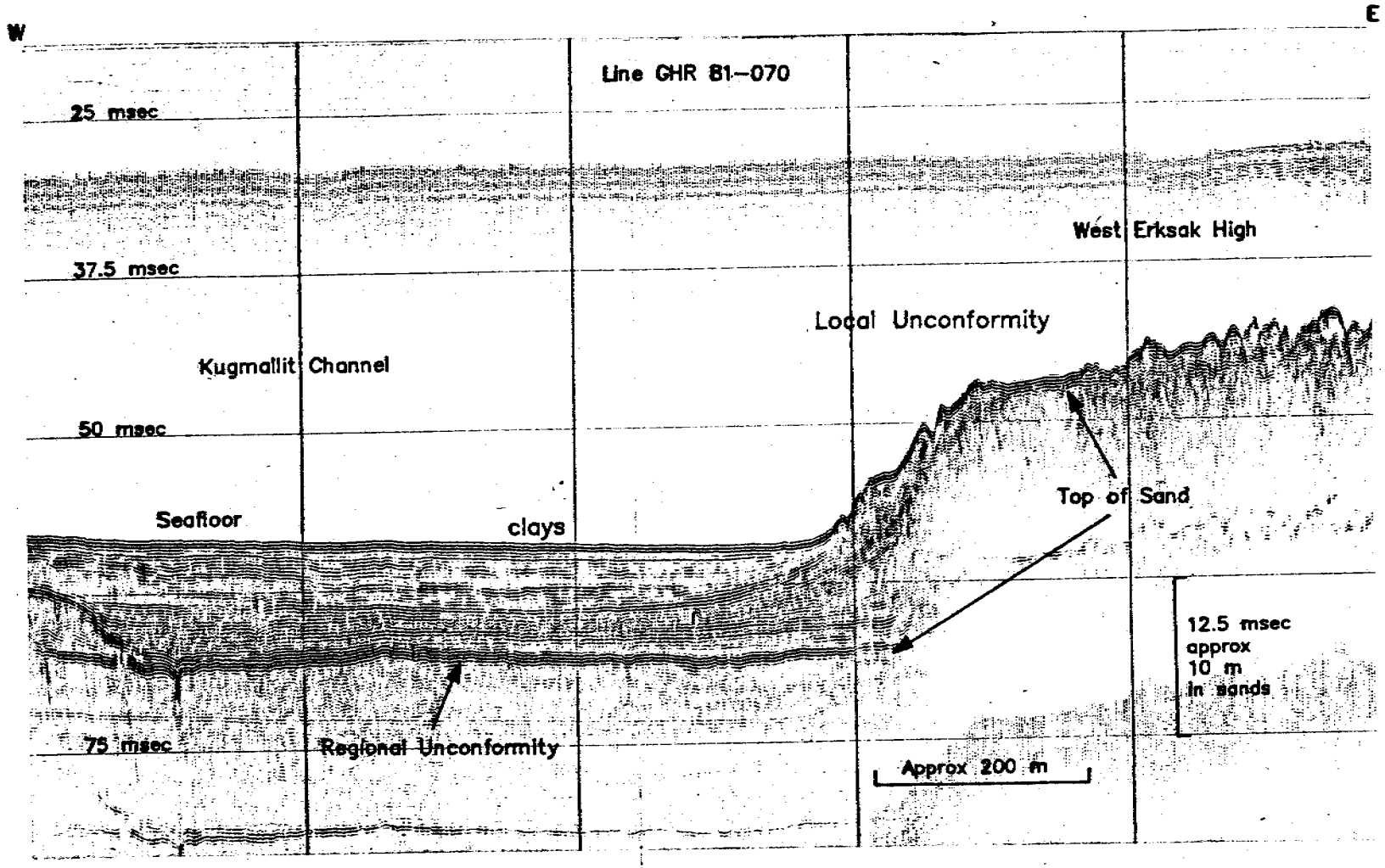

FIGURE 13

Figure 13 Example microprofiler record from line GHR811070 showing the time stratigraphic relationships of the coarse material reflectors near the western boundary of the West Erksak High where they enter the Kugmallit Channel.

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5.5 Morphology of the Top of Sand

The physiographic divisions developed to describe the bathymetry in Section 5.1 are also appropriate to the description of the top of sand surface. This is predicted as removal of the fine grained surficial sediment blanket accentuates the relief both within the various regions and between the regions. The following descriptions are based on the structure map shown in Figure 8 and enclosure 6. They generally indicate the topographic surface that was developed during the transgression but indicate constructional coarser grained elements such as sand bars and spillover dunes etc. developed during or just prior to transgression.

A lack of seismic coverage precludes a detailed discussion of the top of sand surface within the areas of the James Shoal Extension and the Niglik Channels

5.5.1 Kugmallit Channel

The bathymetry map shows the Kugmallit Channel feature to be a broad depression that extends from the Akpak Plateau on the west to the Tingmiark Plain (West Erksak High) on the east. The coarser substrate map (Fig. 8) shows an accentuated depression with a steeper rise to the West Erksak High and a secondary linear shallow channel feature generally hugging the wall of the High. Within the base of the main body of the Kugmallit Channel the contours broaden out into gently rolling terrain with an overall trend down to the north-northwest. Within the areas of rolling terrain there are indications of shallow secondary channels which have been planed off during transgression (Figure 14) though most of these are small and only hinted at on the transgression-eroded structure map of Figure 8.

Within the northern half of the Borrow Block area the western secondary channel divides into two sub-channels which are separated by a long and narrow intervening bar. The western sub-channels are often flat bottomed to slightly irregular in shape (as seen in Figure 13). In the southern area of the Borrow Block only one significant channel is seen adjacent to the southern tip of the Erksak Crest. The channel descends from a depth of 39 metres at the channel axis at the south end of the survey area to 62 metres where the two channels exit the site to the north. This gives an average gradient of 1 metre in 1850 (0.03°). The secondary channel system varies from 500 metres to 1500 metres in width. Where this channel sub-divided to the north the easternmost channel is larger and better defined. The intervening bar is linear and narrow over much of its length but broadens out to the south where it coalesces with the broad highs and lows that characterize the southwestern corner of the area.

At the southern end of this sub-channel system a lack of seismic coverage does not allow the relationship of these channels with the Erksak Channel system to be established.

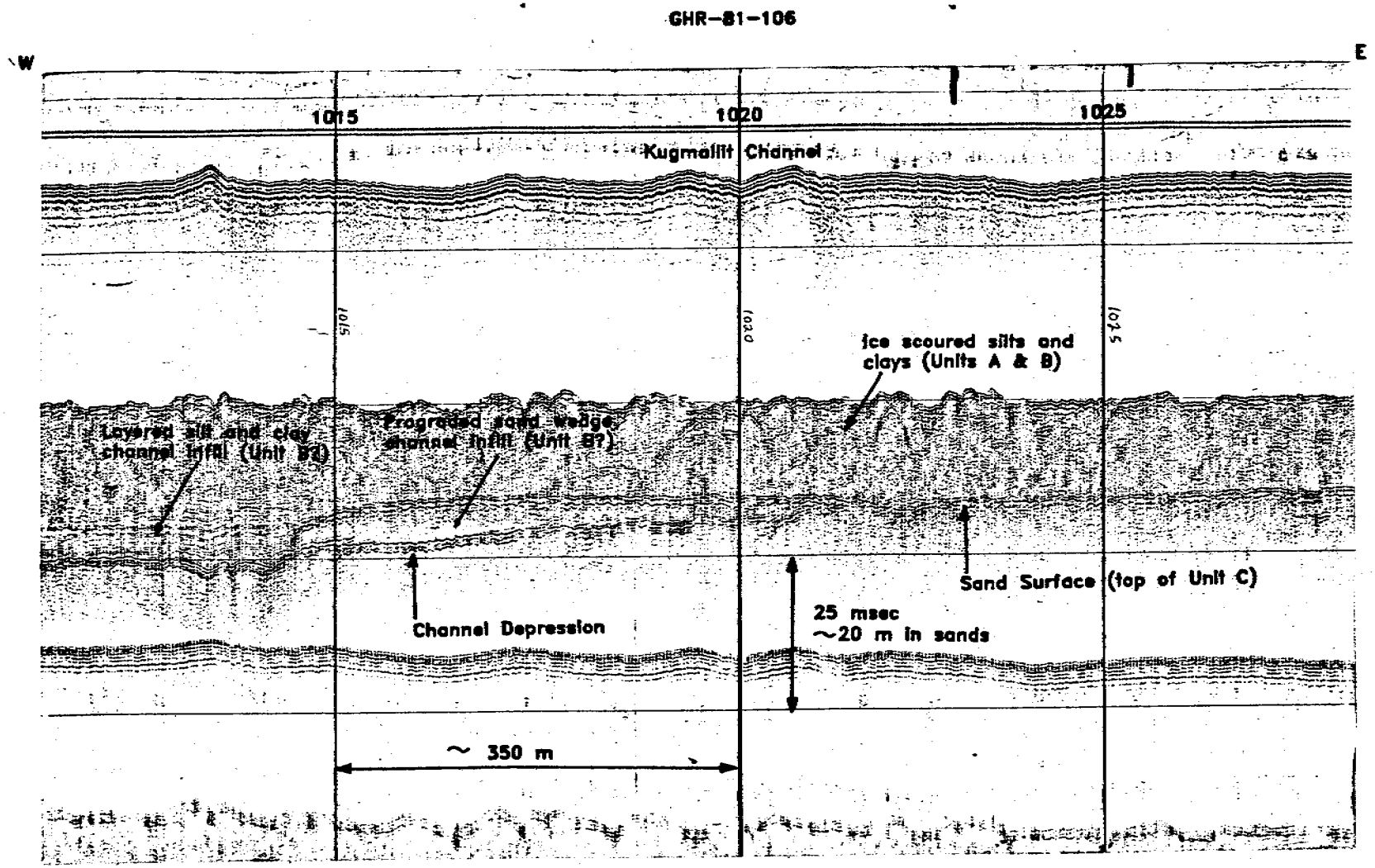

FIGURE 14

Figure 14 Example Boomer record from line GHR-81-106 (Amauligak Site survey) showing the flat sand surface below the Kugmallit Channel cut by channel like depressions

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5.5.2 West Erksak High

The upper sand surface over the West Erksak High forms a complex topography of irregular highs and depressions imprinted on a plain that slopes regionally to the north-northwest. Two ridges, identified on the bathymetry as components of the Erksak Crest, form the high ground of the plain. These ridges form a gently northwest-sloping plateau that covers the south and central part of the high. The southern ridge also extends northwards along the eastern margin of the High almost to the survey area boundary. The depression formed between these ridges is broad and indistinct to the south but channel-like where it passes between the northern ends of the ridges and appears to open onto the Erksak Channel near the northern survey boundary.

To the north and west of the Erksak Crest region the surface is more convoluted with linear highs and depressions interspersed with isolated features. A linear depression extends along the western margin of the Crest northwestward from northing 7,770,000. The depression varies from poorly developed to well developed along its length, and varies from 500 metres to 1500 metres in width. It opens out onto the Kugmallit Channel as a broad embayment in the vicinity of the Kogyuk boreholes (those with prefixes KBB and UBB) but otherwise appears to be isolated from the trough. The depression isolates a series of highs from the main body of the West Erksak High.

Eastward from this trough across the northern sector of the Erksak High, the surface is described by two linear, north-south trending depressions and their intervening highs. Neither the highs nor the depressions are well defined on the

present data and suggest a more complex morphology than can be defined from the seismic data available.

5.5.3 Erksak Channel

The structure on the upper surface of the sand within the Erksak Channel suggests a braided stream system. A series of narrow channels coalesce and bifurcate around several elongate bars. The channels are generally less than 1.5 km wide and in the order of 10 to 13 metres deep. They form a continuous system from the southern boundary of the study area to the northern boundary. A main channel runs along the eastern border of the Erksak Crest and is joined by several tributaries emanating from the James Shoal Extension. This main channel descends from an axial depth of approximately 26 to 28 metres at the southern limit of coverage to a depth of 40 to 45 metres at the northern end for an average gradient of 1 metre in 3000 (0.02°). Lack of seismic coverage to the south and east limit the delineation of the features in these areas and while there is a suggestion that the main channel is linked to the Kugmallit Channel at the south end of the West Erksak High, this relationship is less well defined from the seismic coverage than on the bathymetry (Figure 5).

The intervening bars are variable in length from 7 km. to 15 km. and in width from about 1 km to 4 km. They lie parallel to the channel axes. The bars are steep sided and flat topped and are generally shallower on their southern, upstream end.

While the western boundary of the braided stream system is well defined by the West Erksak High, the eastern boundary is less certain. This is to some degree the consequence of incomplete seismic coverage in the south and east portions of

the survey area. A series of promontories and tributary channels are apparently attached to the James Shoal Extension at their southern end and these may represent the approximate eastern boundary to the channel system. These highs are longer features than the inter-channel bars, with the easternmost high measuring 24 km. long and 5 km. wide at its widest point. The relief and elevation of the promontory shoals is similar to that of the smaller mid channel bars, with the crest depth lying approximately 8 to 10 metres above the axial depths of the troughs. These tributary channels are not observed to extend southward beyond their mapped extents. The easternmost high within the Erksak Channel system is separated from the Uviluk High by a linear depression that extends to the northeast from the Uviluk Channel and possibly joins the Erksak Channel system to the north of the survey boundary.

5.5.4 Uviluk High and Uviluk Channel

The Uviluk High forms a shoal that rises to a minimum of 26 metres below sealevel and is therefore elevated several metres above the bars within the Erksak Channel. In contrast to these bars the shoal is irregular in outline and displays a hummocky, less regular surface. Narrow depressions divide the shoal into east and west segments with the west segment being shallower and more irregular. The shoals and depressions are linear and trend north-northwest to south-southeast.

The dividing depression descends toward the south into the Uviluk Channel. The limited seismic coverage suggests that the channel is confined to the south by highs that are possibly part of the James Shoal Extension.

5.6 Ice Bonding

Sub-seabed permafrost is common within the area and basically occurs as sporadically distributed "Hummocky" type permafrost and as a deeper "stratigraphically controlled" permafrost (names after O'Connor 1982b). It is only the Hummocky type permafrost which is significant to dredging of borrow materials within the area as it is commonly found at depths ranging from about 6 to 30 metres below the seabed. Figure 15 shows an example of this hummocky acoustic permafrost[2] (APF) beneath the West Erksak High on an airgun record from line GHR-81-080. In contrast, the stratigraphically controlled permafrost is normally found at depths greater than 30 metres below the seabed where it is considered insignificant with regard to the dredging operations that are likely to occur in the foreseeable future.

The borehole data set recorded frozen sediments in only 16 of the 122 holes. Virtually all of the holes that recorded permafrost were drilled to depths greater than 20 metres below the seabed (with the exception of AL80-6; depth: 13.4 m) and the majority of the holes that were drilled to depths ranging from 4 to 35 metres recorded no permafrost. Although this implies that permafrost is not a significant problem within the area, because of the localized distributions and presumably biased pre-selection of borehole sites particularly for borrow-related programs, this implication is not considered representative of the entire region.

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[2] The term acoustic permafrost or APF was originally proposed by O'Connor (1977) to describe permafrost delineated on the basis of reflection seismic techniques, rather than the classic definition of "permafrost" on the basis of temperature conditions, as originally suggested by Brown and Kupsch (1974).

It is, however, beyond the scope of this study to map the permafrost detail within the site and such an exercise would be inappropriate in any case as the seismic and borehole coverage is too widely distributed to provide the degree of coverage necessary to avoid being misleading[3]. More detailed discussions on the nature and distribution of frozen subseabed sediments within the Beaufort have been given by O'Connor (1984).

[3] In the authors' experience, based on detailed site survey studies, mapping of the distribution of the Hummocky APF requires survey coverage of 100 to 200 m line spacing to accurately outline its occurrence.

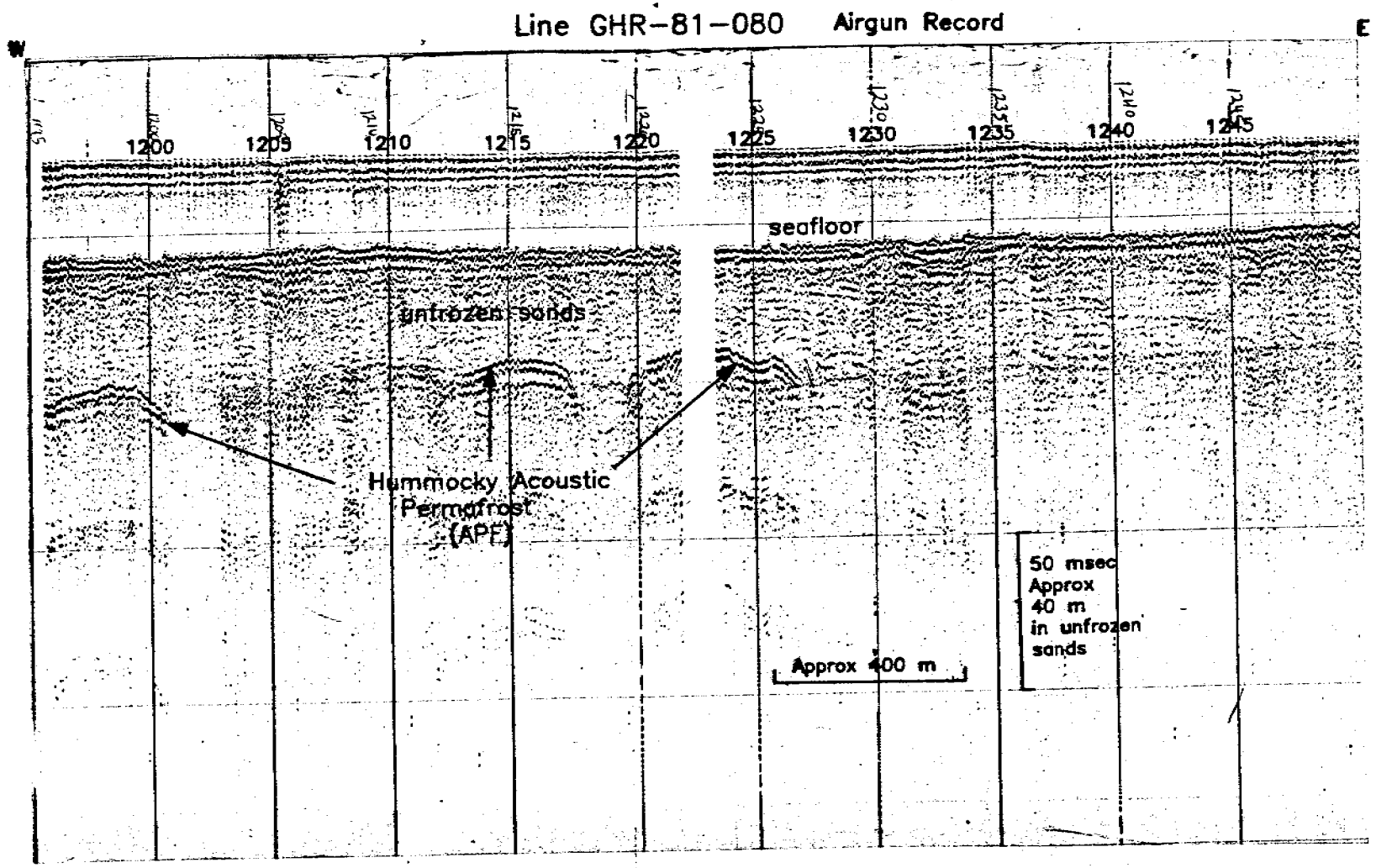

FIGURE 15

Figure 15 Example airgun seismic record from Line GHR-81-080 showing the Hummocky Acoustic Permafrost beneath the West Eriksak High.

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5.7 Depositional Summary

It has been historically surmised that the Quaternary sedimentary sequence within the central Beaufort sea consists of a number of repeated cycles of marine incursion separated by periods of subaerial exposure related to glacially induced low stands of sea level. There may be as many as six sequences of this cyclic nature preserved within the Quaternary sedimentary record of the central Beaufort (S.M. Blasco pers. comm.). The history of these cycles is poorly defined, at present, primarily because of the poor resolution of seismics within regions of subsurface permafrost (as opposed to unfrozen regions) and the generally limited data base of deep boreholes representing the upper 400 to 600 metres of the sedimentary section.

This study is to outline borrow potential within 20 metres of the present seabed and therefore is aimed exclusively at the most recent of these regression-transgression cycles. Following the geological model outlined in Section 2 it is believed that the deeper sands of Unit E represent the penultimate period of regressive subaerial exposure and the deeper clays and silts of Unit D the penultimate marine incursion of the Beaufort shelf. Age dates from the base of Unit D at the Uviluk site indicate an age of only 21,260 years +/- 630 years at a subseabed depth of approximately 84 metres (Hill et. al., 1985). This implies that the last transgression - regression - transgression cycle has taken place over the last 20 to 25 thousand years and that sedimentation rates within this region have been in the order of 3 to 4 metres per thousand years on average.

Throughout this study the term "upper sand" unit is used to describe both the lower sandy facies of the transgressive Unit B and the glacio-fluvial and eolian Unit C sediments of the O'Connor model. This sequence defines the various sand bodies whose surfaces comprise the top of sand mapped in Figures 8 and is distinct from the much deeper sand unit (Unit E) that underlies the region at depth. From borehole data it is observed that the upper sands of Unit C are underlain by the Unit D clay layer on a region wide basis. Within the survey area, 11 boreholes were drilled to sufficient depth to unambiguously penetrate to Unit D and thus give an indication of the thickness of the upper sands which is not interpretable from the seismic data. The boreholes indicate that the thickness of the upper sands (primarily Unit C) varies from 35 to 50 metres within the portions of the study area for which relatively deeper boreholes are available.

It is recognized from previous work in this locale (e.g. Torrens et al., 1985 at the Amauligak Site, Ehrlich et al., 1982 in the Kogyuk area), that the variations observed in the internal seismic character, textural composition, and surface morphology within the upper few metres of the this upper sand surface are in response to a transition from a predominantly subaerial and glacially driven depositional system to an estuarine and near shore marine system. This transition fits within the framework of the geologic model proposed by O'Connor (1980, 1982a) which generally implies the top of the sand unit as a transition from Unit B to Unit C. For this study the sand contact is recognized to not always fit this exact pattern. In many cases the top of the sand is noted above what would normally be considered the top of Unit C and is believed to correspond to the lower facies of Unit B as described by Torrens et al. (1985). These lower facies generally correspond to materials that were laid down during

initial stages of marine incursion as the local region passed through the high energy nearshore breaker zone. Some confusion exists in this definition of the lower facies Unit B materials as there is no seismic method to clearly distinguish these materials from sediments that may have existed in an unfrozen riverine environment prior to inundation (which would be technically Unit C). Because of these depositional conditions these lower facies of Unit B are often composed of the coarser fraction (sands and gravels) that have been eroded from the nearby more prominent Unit C topographic highs, either under inundation or riverine conditions.

A characteristic noted within the seismic records of the upper sands is that they are generally more acoustically variable and are more likely to be interbedded with fine sediments in the upper few metres than at greater depths. Interbeds of silt and clay, much of it organic, as well as peat beds, indicate a significant change in depositional environment near the top of the sand. This may be a function of the acoustic technique related to the sediments filtering the higher frequency components of the seismic signals with depth of penetration which therefore reduces resolution and overall definition within the data, or it may be a true representation of the sediment conditions. From borehole evidence the sands are often described as cleaner and more uniform with increasing depth of penetration

Within the region of the Erksak Borrow Block the physiographic regions as defined in this study are believed to outline the last subaerially exposed topographic conditions prior to inundation. In this condition the Erksak High, the James Shoal Extension and the Uviluk High represented topographic promontories that were bounded by the Uviluk, Erksak and Kugmallit Channels. The channels were likely co-

existent some time prior to inundation though because of the excessive down cutting within the Kugmallit Channel it is speculated that the Erksak Channel was abandoned some time prior to inundation and the main Mackenzie River flow was directed into the Kugmallit Channel. Within this time period the further downcutting of the larger Kugmallit Channel feature took place. Thus the bars developed within the Erksak channel are considered riverine and not transgressive in origin (this will require detailed age dating analysis to verify). During the time of marine incursion the channel features would have been inundated first with basal (top of sands) depths indicating that the Kugmallit Channel would have been the first to be covered. Also because this region had been covered by the warmer fresh waters of the Mackenzie prior to inundation it is postulated that the sediments would not have been bonded by permafrost (talik zones) and thus more prone to extensive erosion and wave base planation than the promontory areas. This is consistent with the observed dearth of hummocky type permafrost observed on the seismic records from within the Kugmallit Channel.

As sea level rose further the Erksak Channel would have been inundated approximately coincident with the Ukalerk Slope. Since the remnant channel and knoll topography is still observable on the top of sand surface of the Ukalerk Slope it is presumed that this area was transgressed quite rapidly. The broader contours seen on the top of sand and bathymetry over the Kogyuk Terrace region imply that sea level rise slowed at this point and the region was cut back further by the shoreline retreat associated with the breaker zone. This factor suggests this region might be richer in gravels than other areas though this is not immediately apparent from the seismic data.

The upland regions of the Erksak Crest, the James Shoal Extension and the Uviluk High would have been the last areas to be inundated, with their offshore regions disappearing first. Both prior to and during the actual inundation of these regions subaerial erosion would have concentrated the coarser fraction of the eroded higher materials along the edges of these highs. This is most obvious along the western edge of the Kugmallit Channel where a progradational wedge is observed along the steep wall (see Figure 13). A similar wedge is observed along the eastern boarder of the West Erksak High where it drops into the Erksak Channel (Figure 16).

In the period just after the marine incursions, within any particular region, the local areas would have undergone a high energy environment which transported the finer materials off into deeper water. As transgression continued and the regions passed below wave base a transition to finer sediment deposition would have occurred with the eventual deposition of the finer facies of Unit B and the Unit A clays (sediment isopach map of Enclosure 5). Areas where sand is exposed at the seabed are presumably still under the influence of wave base erosion and winnowing of the finer sediments, though at present most of the Erksak Borrow block would only be significantly affected during major storm events.

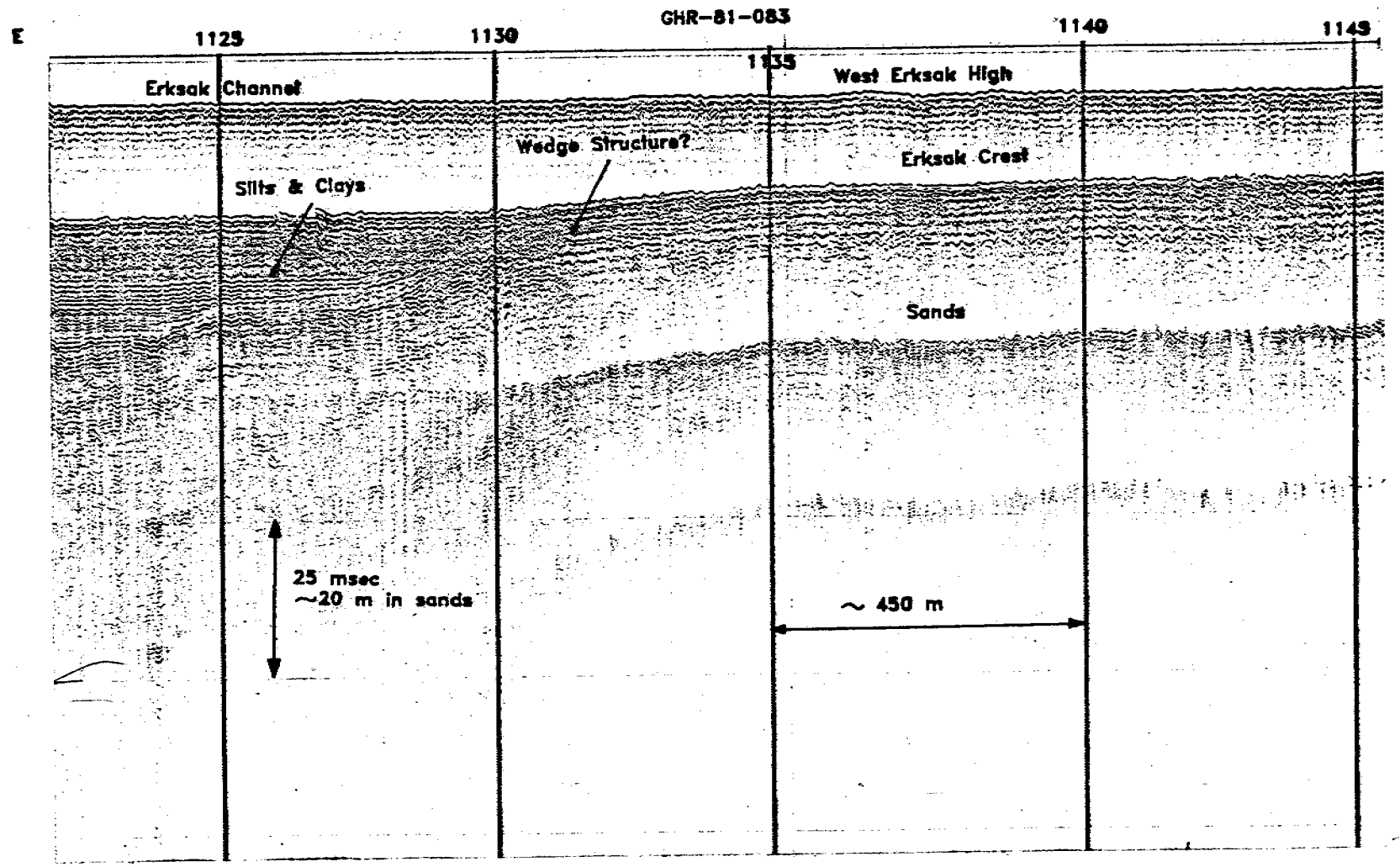

FIGURE 16

Figure 16 Example Boomer record from line GHR-81-083 showing the progradational wedge along the eastern border of the West Erksak High.

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6 GRANULAR RESOURCES - ERKSAK BORROW BLOCK

6.1 Distribution

The distribution of prospective granular resources is presented in Figure 17 and Enclosure 7. The map is constructed primarily from the zero and three metre isopaches of soft surficial cover. Three metres is used as the maximum thickness of overburden for defining the prospective deposits as this is the present day economic limitation of conventional dredging equipment when overburden stripping is necessary. Areas within the zero-cover isopach might be considered as higher priority prospects from a site development perspective.

As an aid to description within the text, the prospective deposits have been numbered. Over the West Erksak High and Uviluk High, which are essentially continuous areas of prospective resources, it is convenient to subdivide the prospects based on those areas defined by the zero contour. The boundaries between the individual prospects are defined whenever possible by the maximum thickness of soft surficial sediment, derived from Figure 7, in the intervening areas. Within the Erksak Channel and the Kugmallit Channel, where the dredgeable sand bodies are discreet but are generally buried by more than one metre of soft sediment, the zero contour method is not applicable and the prospective areas are outlined by the 3 m isopach contours with each isolated deposit being numbered separately. In addition to the seismically defined deposits, additional deposits are defined based on borehole and grab sample control only (primarily on the James Shoal Extension). The boundaries of these deposits are arbitrary and to indicate this the boundaries are dashed in. In total, 33 prospects are defined and Table 3 indicates the areas of each prospect along with a subdivision of area

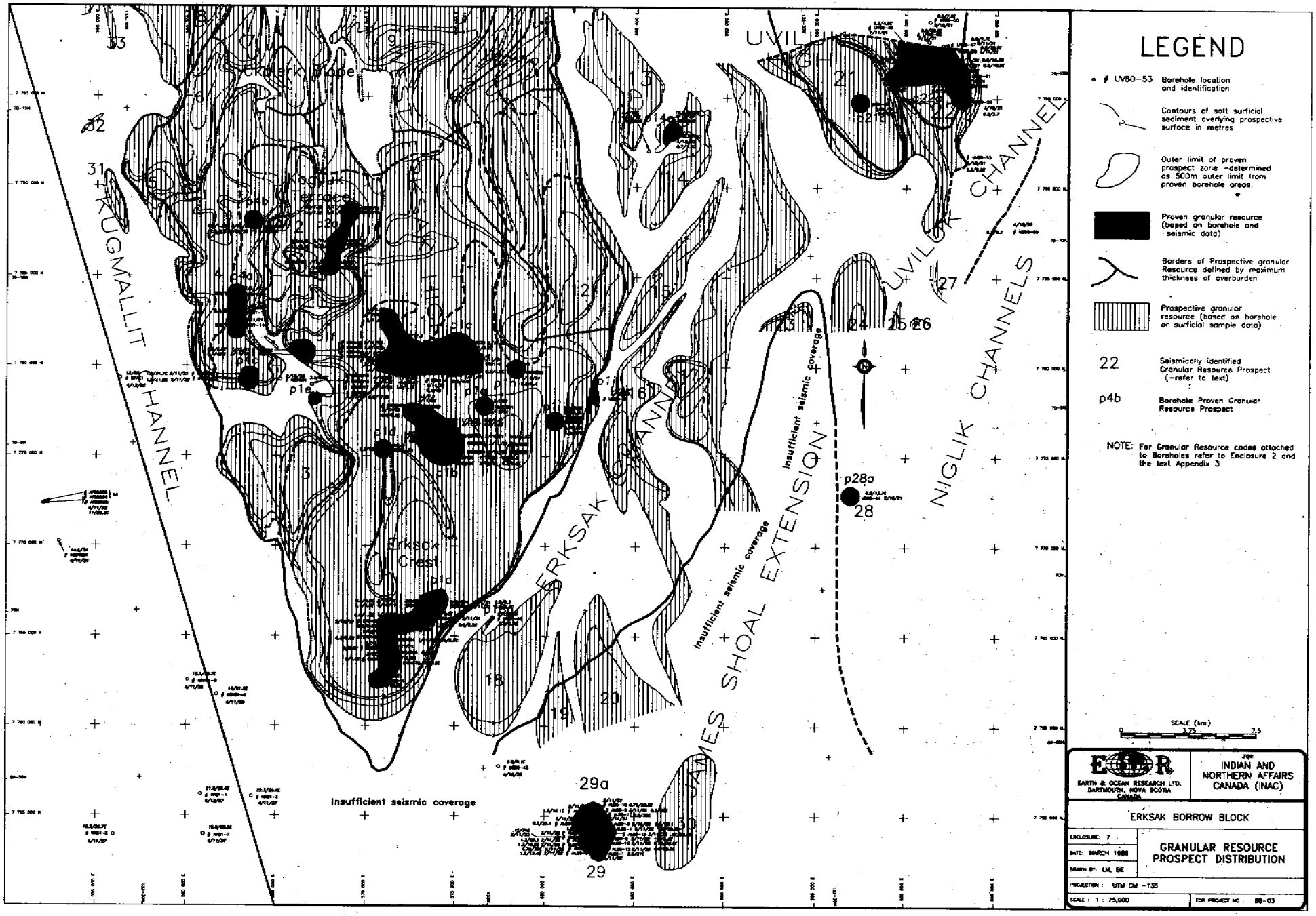
related to the amount of surficial sediment cover within the 3 m contour boundary.

As the distribution is defined for the most part from the seismic data, there occur mismatches between the thickness of overburden as defined by the contours and the thickness as measured in the boreholes. These discrepancies generally occur where the cover is thin and patchy. In these areas, the boreholes may indicate sediment thicknesses of as much as 0.5 metres where the seismic data indicate zero thickness. Given the resolution of the seismic systems and the line spacings within the region, the error bar for the zero thickness is estimated to be a minimum of about +0.5 metres and for the 1, 2, and 3 metre thicknesses, +/-0.5 metres.

It must be noted also [that the available borehole data indicates] that some of the identified prospects, or at least portions thereof, are marginal in terms of their suitability for use as construction materials. Given the limited borehole coverage with regard to the size of the borrow block, and the frequent variance between adjacent boreholes, these less attractive prospects have been included pending further evaluation of their quality with additional direct sampling methods.

TABLE 3 AREAS OF GRANULAR RESOURCE PROSPECTS - ERKSAK

Site No.	Water Depth range (m)	AREA (sq. km) Overburden Cover Thickness 0 m	0-1 m	1-2 m	2-3 m	TOTAL
		West Erksak High				
1	15-26	217.0	42.1	47.8	21.8	328.7
2	26-28	16.8	10.2	16.4	8.4	51.8
3	23-25	10.2	5.8	10.9	5.6	32.5
4	26-34	32.1	13.4	19.6	11.7	76.8
5	36-48	2.1	2.0	7.2	1.7	13.0
6	34-36	2.9	7.2	5.7	2.0	17.8
7	36-38	1.8	3.9	7.8	10.6	24.1
8	37-38	1.2	1.6	7.7	2.7	13.2
9	32-35	5.7	8.7	18.0	6.7	39.1
10	32-34	0.7	2.4	4.6	2.0	9.7
11	28-33	1.6	8.6	14.7	6.9	31.8
12	24-29	8.9	21.0	14.3	15.5	59.7
		Erksak Channel				
13	30-35	-	1.1	13.5	7.8	22.4
14	30-33	-	-	7.3	7.2	14.5
15	28-31	-	-	7.0	5.4	12.4
16	14-19	-	3.3	8.4	15.6	27.3
17	20-33	2.2	4.4	30.9	22.5	60.0
18	16-23	-	-	20.4	6.2	26.6
19	15-19	-	-	-	6.5	6.5
20	14-20	-	-	9.5	10.9	20.4
		Uviluk High				
21	26-30	23.0	2.8	4.8	4.8	35.4
22	30-32	16.6	5.5	5.5	4.5	32.1
		James Shoal Extension				
23	26-28	-	1.1	1.4	0.7	3.2
24	27-30	-	1.1	8.4	1.6	11.1
25	28-30	-	-	0.2	0.3	0.5
26	28-30	-	-	0.1	0.3	0.4
27	28-30	-	-	0.3	0.6	0.9
		JSE (boreholes only)				
28	20-22	0.8	-	-	-	0.8
29	8-11	5.3	-	-	-	5.3
30	8-11	15.0	-	-	-	15.0
		Kugmallit Channel				
31	46-51	-	0.6	1.7	0.7	3.0
32	50	-	-	-	0.3	0.3
33	50-55	-	-	-	0.8	0.8
TOTAL AREAS		363.9	146.8	294.1	192.2	997.0


KUGMALLIT CHANNEL
ERKSAK CHANNEL
UVILUK CHANNEL
NIGLIK CHANNELS
JAMES SHOAL EXTENSION
Erksak Crest
Insufficient seismic coverage
Insufficient seismic coverage
Insufficient seismic coverage
LEGEND
UV80-53 Borehole location and identification
Contours of soft surficial sediment overlying prospective surface in metres
Outer limit of proven prospect zone -determined as 500m outer limit from proven borehole areas.
Proven granular resource (based on borehole and seismic data)
Borders of Prospective granular Resource defined by maximum thickness of overburden
Prospective granular resource (based on borehole or surficial sample data)
22 Seismically identified Granular Resource Prospect (-refer to text)
p4b Borehole Proven Granular Resource Prospect
NOTE: For Granular Resource codes attached to Boreholes refer to Enclosure 2 and the text Appendix 3
SCALE (km)
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INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ERKSAK BORROW BLOCK
ENCLOSURE: 7
DATE: MARCH 1988
DRAWN BY: LM, BE
GRANULAR RESOURCE PROSPECT DISTRIBUTION
PROJECTION: UTM CM -135
SCALE: 1 : 75,000
EOR PROJECT NO: 88-03

FIGURE 17

6.1.1 West Erksak High (Prospects 1 to 12)

Figure 17 indicates that virtually the entire West Erksak High is prospective in that it contains coarse material within three metres of the seafloor. The coarse material is interpreted to lie at the seafloor over most of the south and central part of the West Erksak High, approximating the subregions of the Erksak Crest and the Kogyuk Terrace. The zero contour also encompasses large areas to the west of this main body and a few, scattered and smaller areas to the north and east. The coarse material to the north of the Kogyuk Terrace on the Ukalerk Slope is generally covered by one to three metres of overburden. The variability of depth to deposit is related to the recent infilling of shallow, linear depressions developed on the sand surface prior to or during the last transgression.

A total of 12 zones of seismically defined coarse seabed material are identified in the West Erksak High. These are designated as Prospects 1 to 12. Again for ease of discussion, these can be subdivided into a Central Group (Prospects 1 and 2), Western Group (Prospects 3 to 8), and an Eastern Group (Prospects 9 to 12).

As indicated above, coarse material is predominate at or very near the seafloor (zero contour) in the south and central parts of the High, on the Erksak Crest and Kogyuk Terrace. Prospect 1 is the largest continuous area of little or no surficial cover with the main body of the prospect oriented SW-NE and closely follows the outline of the Erksak Crest. The region is flanked by only a narrow zone of thicker overburden (to the 3 m limit) with two localized regions of thicker soft sediment ponding within the body of the prospect area. The prospect extends toward the north and into the eastern end of

the Kogyuk Terrace. The area of Prospect 1 is calculated as 328.7 km^2. Prospect 2 lies adjacent to the northwest boundary of Prospect 1, separated by a narrow irregular depression infilled with 1 to 3 metres of fine material. The prospect covers an area of 51.8 km^2.

Prospects 3 to 8, the western group, form a string of generally linear deposits that border the Kugmallit Channel. They are separated from the Central Group by a long, narrow, and irregular depression developed on the underlying sand surface. This depression is infilled with generally 1 to 3 metres of soft sediment that increases to 4 to 7 metres in a few localized, linear troughs. The southernmost prospect (Prospect 3), is separated from the others by the opening of this depression into the Kugmallit Channel. The sediment infill between Prospects 3 and 4 varies from 4 to 6 metres. The other prospects are separated by thin accumulations of 1 to 2 metres. The six prospects have a combined area of 177.4 km^2. Prospect 4 is significantly larger than the other prospects and measures 76.8 km^2.

The Eastern Group of deposits are designated Prospects 9 to 12. Prospects 9 and 10, and 11 are situated near the northern survey boundary on the Ukalerk Slope and Prospect 12 is situated on the Erksak Crest adjacent to the Erksak Channel north and east of Prospect 1. The prospects are separated from those to the west by an infilled depression on the top of the sand surface. The depression is oriented north-south with maximum accumulation within the depression measured at 9 metres. Prospects 11 and 12 are located on ridges which are the northern extensions of the Erksak Crest. Prospects 9 and 10 are located on eastward prograded sand bodies deposited within shallow depressions on the underlying older sand

surface. The total area encompassed by these prospects is 59.7 km^2.

6.1.2 Erksak Channel (Prospects 13 to 20)

The prospects within the Erksak Channel are defined somewhat differently from those on the West Erksak High. As can be observed from Figure 17, the overburden within the Channel is most commonly greater than one metre. However, the areas overlain by less than 3 metres of soft sediment form discreet "islands". It is more appropriate to define the prospects on the outline of the three metre contour.

The prospects within the Erksak Channel occur where the accretionary sand bars (prospects 13 to 20)developed on the underlying sand surface rise to within 3 metres of the present seafloor. Eight of these bars are identified as prospective. The outline and distribution of the deposits reflect also the outline and distribution of the bars. They are therefore linear to slightly sinuous, and generally narrow. Of the prospects only Prospect 17, the easternmost and largest of the highs, contains areas where the coarse material is exposed at the seafloor. The exposed zone is located near the south end of the bar, and measures 2.2 km^2 in area. The total area of the prospects within the Erksak Channel is measured as 190.1 km^2.

6.1.3 Uviluk High (Prospects 21, 22, and 27)

The granular resource areas of the Uviluk High are treated in the same manner as those on the West Erksak High. The Prospects are defined by the perimeter of the zero contour, although prospective resource lies between this contour and the three metre contour. The Uviluk High is

divisible into two main bodies, Prospects 21 and 22, and a third body, Prospect 27, which may be an extension of Prospect 22. A gap in the seismic data coverage prevents correlation of the latter two prospects.

Prospect 21 is the westernmost deposit. It is located on a prominent north-south trending ridge and is formed by an eastward prograding dune-like accumulation of sand deposited within a shallow depression on the older sand paleosurface. Prospect 22, to the east and its extension Prospect 27, are formed in like manner. These deposits are therefore similar in mode of formation to prospects such as Prospects 9 and 10 on the West Erksak High. The area encompassed by the zero contour for these two prospects is 39.6 km^2.

6.1.4 James Shoal Extension (Prospects 23 to 26, 28 to 30 and southern extensions of Prospects 16, 17, 19, and 20)

There is limited direct and considerable indirect evidence to suggest that granular resource lies near the seafloor over most or all of the James Shoal Extension. Prospects 16, 17, 19, and 20 extend southward from the Erksak Channel and are terminated by lack of good seismic coverage near the boundary of the James Shoal Extension. Prospects 23 to 26, located at the northern tip of the Extension, are also incomplete due to lack of coverage, but imply continuation of resource to the south. From CHS surface sample data it is observed that mud or clay covers the seafloor over this area. Boreholes indicate, however, that this cover is very thin at least within localized areas.

Data from 18 boreholes clustered around the Alerk artificial island (boreholes A180-1 to 18) indicate sand beneath from 0 to 2 metres accumulation of clay. A CHS grab sample taken from the flank of the shoal located to the east of the Alerk island records sand and it is surmised that sand is exposed at the seafloor over this shoal. In addition, the borehole UB80-44, located slightly to the east of the axis of the James Shoal Extension at N7772869, E596962, records sand below a clay overburden of 0.6 metres.

Without seismic data, assigning areas of potential resource for the James Shoal Extension is only a best guess. Prospects 23 to 26, which cover the northern fringe of the region represent an area of 15.2 km^2. The areas for Prospects 16, 17, 19, and 20 are included in the calculation for the Erksak Channel and their portions within the Extension are therefore not included here. It is prudent to assign no more than a 500 metre radius (see section 6.2) around borehole UB80-44 to arrive at an area for Prospect 28 of 0.8 km^2. Similarly, if a perimeter is drawn within 500 metres of the outermost Alerk boreholes an area for Prospect 29 of 5.3 km^2 is computed.

Prospect 30 is based on a single grab sample close to a bathymetric shoal. The 15 km^2 area of this prospect has been chosen on the basis of this one grab sample of clean sand which was reported by the CHS grab sampling program during the survey of the shoal feature in the southern portion of the James Shoal Extension area. Although, without further conformation and seismic coverage, the region can only be considered as prospective, an outline of the prospect has been derived based on the outline of the 10 metre contour surrounding this prominent shoal.

Summing the above prospect areas within the larger area, only 36.3 km^2 of the total 411 km^2 James Shoal Extension has any significant background information available to this analysis. Because of the bathymetric high associated with this area it is likely that a significantly larger portion of this region is prospective though the present analysis only considers this minimum area.

6.1.5 Kugmallit Channel (Prospects 31 to 33)

Prospects 31 to 33 represent localized bar features within the northern portion of the Kugmallit Channel. they are within the eastern sub-channel feature which is observed in the base of the larger channel. These bars are the northern expression of similar bar features that are noted within the sub-channel further to the south (see section 5.5.1) The southern bars are covered by a thicker blanket of surficial silts and clay which makes them non-prospective. The total area of these prospects only amounts to 4.1 square kilometres and they are all covered by at least 1 metre of soft surficial sediments.

These prospects although technically within the constraints of this borrow evaluation are unlikely targets because of their small size, significant sediment cover and close proximity to other more accessible prospects.

6.2 Proven Resource Quality and Volume Estimates

Proven granular resources are defined as those resources whose occurrences, distributions, thickness and quality are supported by considerable ground-truthing information such as dredging and/or geotechnical drilling data. Of the 33 prospects outlined above only 8 have been sampled by borehole testing with sufficiently detailed analyses to allow designation of the sediments as proven reserves. In many cases, the boreholes are clustered in relatively small subareas within the identified deposits. Even within these groups the boreholes show significant variability of quality within a single prospective deposit. For these reasons, it has not been possible to fully assess the quality and quantity of materials in each prospect, or to further subdivide the volume estimates on the basis of material quality. This section only outlines the general quality and preliminary estimates of quantity of the granular resource for those areas where borehole or vibracore data are available.

Through this evaluation, proven areas have been defined based on the arbitrary assumption that the borehole data represents a region within a one-half kilometre radius of the borehole. On the basis of the widespread extent of the seismically defined sands, this relatively large degree of extrapolation is considered reasonable. Thus a subprospect is defined either by a 1 km diameter circle around a single borehole or by a perimeter defined by a group of 1 km circles when more than one borehole is located within this radius. Also, when these diameters intersect a 3 metre overburden thickness contour, this contour becomes the defining perimeter of the subprospect area.

Material quality for the proven resources has been expressed in terms of the United Soil Classification (USC) system as indicated on the borehole logs. In some cases, the proven subprospect includes a range of material quality, all of which has been included in the quality estimates. However, additional descriptive comments (e.g fines content, layers of fines) are included in the quality evaluation. The regions within the Erksak Borrow Block that can be presently assigned as proven subprospects are shown on Figure 17 by the tight horizontal hatching. These regions are given a subprospect identifier of the form "p4b" with "p" indicating that it is a proven area within a larger prospect (#4) and "b" is an identifier code for that particular subprospect.

Table 3 summarizes the proven subprospects, identifies the boreholes within each and assigns a short summary quality evaluation to each. Borehole summary information is presented in table form in Appendix 3. For additional information refer to the borehole log compilations prepared by EBA (1988b, 1988c). In reviewing the boreholes an estimate of the volume of useable borrow material has been made either on the basis of sampling depths of the boreholes (limit of sample depth), or on layering within the sediments which would indicate that fines are below and it would not be expeditious to attempt deeper dredging. Thus a reasonable volume estimate is obtained for the useable borrow materials. Their dredgeability, in terms of dredge type, is also indicated. This is based primarily on the overburden cover and the granular material.

The following subsections describe each of these proven areas in more detail to aid in comprehension of the quality assessments.

TABLE 4 PROVEN GRANULAR RESOURCE ESTIMATES

PROSPECT ID	WATER DEPTH m	AREA $X10^6$ m^2	BOREHOLES ID REFERENCE NO.'S	QUALITY COMMENTS	DREDGEABILITY	VOLUME $X10^6 m^3$
p1a	14-17	8.57	EK84S01 - EK84S07, EK84S1A - EK84S7A, UB80-40, UB80-41	SP-SM tr silt & clay	variable Hop & Sta	85
p1b	20-23	7.06	UB82S04,S21,S22,S23,S24,S25,83A, U882V05,V06,V20,V21, SUB8301	SM to SP, some silt layers	Hop & Sta	141
p1c	23-25	12.67	BTN1-1,-4,-5,-6,-7,-8,-9, UB80-38, UB82S26, UB82V18,V19	SM, some silt clay layers	Hop & poss. Sta	123
p1d	23-24	0.79	UB80-39	SM to SP	Hop & Sta	16
p1e	25-26	0.44	KBVC03	SP, SP-SM loose S & org to 2.8m	Hop & ?Sta	8
p1f	26	1.52	KBBH1 - KBBH5	SM to SP, clean tr grav.	Sta	30
p1g	24	0.79	SUB83S01	SM to SP	Sta & Hop	16
p1h	25-26	0.79	NT82S01	SP, clay @ 5.5m peat @ 6.5	Hop	4.3
p1i	22-23	0.79	UB82S01,S02	SP to 10m tr silt	Hop & Sta	8
p1j	26-27	0.44	UB80-45	SP, SP-SM 2.5m clay, sand to 10.5m	n/a	0
p2a	26-28	3.36	UB82V09 - B82V14	SP occ SM tr silt	Hop to Sta	27
p4a	28-30	2.77	BTN1-12,-13,-14	SP to SC some silt & clay	Hop ?Sta	14
p4b	29	0.79	UB82V07, V08	sampled to 5 m excessive fines	n/a	0
p4c	26	1.17	KY82S02, S03	marginal SP, SP-SM tr silt & grav	Sta	22
p14a	32	0.91	NU82S01, S03	SM to ML too much fines	n/a	0
p18a	21-22	0.085	UB80-42	SM only sampled to 7 m	Sta	0.4
p21a	26-28	0.79	UV80-54	SM w some silts sampled to 9 m	Hop & Sta	7
p22a	29-32	10.54	FUVI1,1A, UV80-46 to 52, UV80-55 to -58	SP - SM tr silt, clay & grav	Hop & Sta localized	105
p28a	22	0.79	UB80-44	SP-SM some thin silt/clay layers	Sta (to 14 m)	10
p29a	8-12	5.27	AL80-1 to -18	SP, SP - SM some thin silt	Hop & Sta localized	100
	TOTALS	60.335 km^2			TOTAL PROVEN VOLUME	720.7

6.2.1 Prospect 1

A total of 49 boreholes have been drilled into Prospect 1. They are distributed as four clusters of closely spaced boreholes and a few scattered locations. Because of this scatter the region has been sub-divided into 10 subprospects labelled "p1a" through "p1j". Some of these proven areas represent multiple boreholes and therefore larger areas and some represent only single or duplicated boreholes.

Subprospect p1a

The southern tip of the Erksak Crest is sampled by a closely spaced series of 16 boreholes which are confined within the 8.57 km^2 area defined as subprospect p1a. The boreholes are short, and range from 6.2 to 15.9 metres in length with only two longer than 10 metres. Fourteen of the boreholes are noted by the prefix EK84 and two by the prefix UB80. The fourteen EK84 boreholes represent duplicate sampling at seven sites.

The boreholes sample the crest of the large ridge that forms the southeast side of the Erksak Crest. While the quality of the resource and thickness of sand units is variable between boreholes, all record sand either at the seafloor or within 0.2 metres of the seafloor. The sand is generally medium, poorly graded (SP) to fine and silty (SM, SM/SP). Silt beds are common as are traces of clay and silt. Traces of gravel are noted in three boreholes but gravel is otherwise absent. Organic silt and peat beds and traces are recorded in several holes.

Eight of the boreholes, representing five sites, are classified as suitable for either Hopper or Stationary dredge

utilization. Of the remaining 8, three at two sites (EK84S1A, and EK84SO2, EK84S2A), are deemed of marginal quality, while the remaining 5 are suitable for Hopper dredge utilization only. Because of the short length of many of the boreholes and marginal quality of some samples a maximum dredging depth of 10 m below the seabed was used in the volume calculation of this reserve (85 x 10^6 m^3) though it is assumed that the sand is continuous below the sampling depths of the shorter boreholes.

Subprospects p1b, p1d and p1g

Two borehole sets are located over the second large ridge of the Erksak Crest near the north end of the feature. The more southerly set consists of 13 boreholes that define subprospects p1b, p1d and p1g. These proven sites are grouped together as they are in close proximity and are grouped within the single physiographic ridge feature. Together they represent an area of 8.64 km^2. Ten of the boreholes are prefixed by UB82S or UB82V, one is designated UB80-39, and two SU83SO1 and SU83SO2. The UB82S and _V boreholes are duplicate boreholes taken at 5 sites and vary from 6.9 to 9.7 metres long. The borehole UB80-39 is 18.3 metres long, SU83SO1 is 76.1 metres long and SU83SO2 is 69.9 metres long. The majority of the boreholes are within the area defined as p1b while borehole UB80-39 is within area p1d and SUB83SO1 is within the p1g sub region.

Sand is recorded in all 13 boreholes within 0.5 metres of the seafloor, with 6 of the boreholes, at four sites, exhibiting sand at the seafloor. The sand is recorded as uniformly fine grained with trace to some silt (SM) in all boreholes except SU83SO2 which notes medium, dense sand (SP) throughout. The sediment column is more uniform than over the

southern ridge (p1a) with significantly fewer interbeds of silt or clay. Peat and organic silt are noted in boreholes UB82VO6, UB82S22 and 23, UB80-39, and a thin (0.1m) peat lens is recorded in SU83SO2 at 2.8 metres. Gravel was noted in borehole SU83SO1 at 5, 9 (drillers note - gravel in section), 29(tr), 33.5(tr), and 35.5(tr) metres depth.

All of the boreholes indicate dredgeable material. Eight indicate dredgeability by either the Hopper or Stationary dredge method, two by Hopper dredge only, and two by Stationary dredge only. The 13th borehole, UB82S3A, did not sample the top 3.2 metres, so no dredgeability code was assigned. The two boreholes that are suitable for Hopper dredge only, UB82VO5, and UB82S22, are short cores (7 metres and 6.9 metres respectively), and bottom in silt or clay. Borehole SU83SO2, in contrast, records continuous sand with only occasional traces of silt and clay to a sub-seafloor depth of 44.6 metres. A combined volume estimate for these sites indicates a potential of 173 million m^3 though some localized silt or clay layers may be contained within this volume estimate.

Subprospect p1c

The second borehole set on the northern ridge is located approximately 2 km. to the north in an array oriented transverse to the axis of the ridge. Eleven boreholes are recorded and define the p1c prospect area of 12.67 km^2. Six boreholes numbered BTN1-4 through _-9 are aligned east west across the ridge. A duplicate borehole set designated UB82V18 and UB82V19 is located 1 km. to the north of this series on the west flank of the ridge and borehole UB82S26 1.4 km. to the north on the axis. Borehole UB80-38 is situated within a shallow depression to the northwest of UB82V18 and 19 and

the eleventh borehole, numbered BTN1-1, is located on a spur leading to the west of the ridge.

Penetration is limited within this data set. The BTN1-series are Vibrocores and achieve penetrations only of 1.4 to 4.4 metres. The penetration for the remaining boreholes varies from 6.5 to 12.8 metres. All boreholes encounter sand within 0.2 metres of the seafloor with seven showing sand at the seafloor. The sand is typically fine grained with a trace of silt (SM) with occasionally a thin layer of clayey sand near the seafloor. No gravel was observed.

While the boreholes all bottomed in sand, the shortness of the boreholes verifies only the use of a Hopper dredge as suitable for this site. The deposit is evaluated as being suitable for Hopper dredge use but it is suspected that longer boreholes will reveal a continuation of the sand to a greater depth. The volume estimate for this area is based on a confirmed sand reserve to a depth of 10 m below the seabed and is therefore reduced from the maximum that might be obtained from a stationary dredge program. Using this criteria a volume of 123 million m^3 of useable sand resource is estimated within this area.

Subprospects p1e and p1f

A series of six boreholes are located at the northwest edge of Prospect 1 on the flank of a shallow embayment that extends into the Kugmallit Channel (area p1f). This embayment is not seen on the bathymetry (Figure 5) though it is apparent on the sediment thickness (Figure 8) and structure of the top of sand (Figure 7) maps. The boreholes are designated KBBH1 to KBBH5 and KBV-CO2. All boreholes were drilled within a

circle of 250 metres radius. KBBH1, _2, _4,and _5 vary in length from 44.8 to 46.5 metres, KBBH3 is 83.7 metres long, and KBV-CO2 is 6.8 metres long.

Two of the boreholes record sand at the seafloor, two record soft sediment cover of less than one metre, one borehole records 1.2 metres of soft sediment and one records 2.0 metres of soft sediment cover. This variability of thickness of surficial cover over a limited area reflects their location on the flank of a paleo-embayment with those boreholes containing soft sediment lying just within the depression and those showing sand at the surface lying on the lip.

Thick sand layers lie below the surficial cover in all boreholes except KBV-CO2. Uninterrupted thicknesses of from 38.2 to 45.0 metres are measured in boreholes KBBH1 to KBBH5. The sand is fine grained to medium to fine grained, and compact to very dense (SP). The sand bodies are relatively free of silt and clay and show occasional traces of fine gravel.

The variable surficial cover restricts utilization of this resource to Stationary dredging only. The area defined by this grouping of boreholes defines a region of 1.52 km^2 with a potential for 30 million cubic metres of useable sand resource.

Due south of this subprospect, across the apparent embayment feature, a single borehole (KBV-C03) is located on a promontory shown in the surficial sediment thickness contours (Figure 7). This borehole defines prospect p1e which is located on a very localized mound which is only about 200

m to 300 m across and stands 4 m above the surrounding seabed.

The mound is significantly reduced in elevation on the adjacent survey lines to the north and south which suggests it is nominally circular in shape. This feature is not shown on the bathymetry map of Figure 5 and is not delineated on the sediment isopach map of Figure 7 because of scale. The area of this prospect is only estimated to be 0.44 km^2 as it is partially bounded by the 3 m soft sediment contour. The borehole shows sand at approximately 0.2 m depth with some silt and clay content (SM). Numerous minor variations in the sand are noted which indicate that this material has likely been mobile with time at least down to the 3 m depth in the borehole. Figure 18 shows a portion of the survey line GHR-81-315 from the Kogyuk wellsite survey which is believed to be the closest approach to this borehole. Technically the regional mapping of the seismics indicate soft and probably fine materials within the first 3 metres of the site however this is in contrast to the borehole data and the seismic line of Figure 18. The seismics do show a faint continuation of the deeper mapped sands beneath this mound, and the degradation of the deeper seismic signal is consistent with a sand interpretation and concentration within the mound itself.

This area has been classified as suitable for both Hopper and Stationary dredge types based primarily on the borehole information. It is noted that both the seismics and another borehole set (UB82V15 to 17) just to the north indicate thicker surficial cover which implies that Stationary dredging would be required. The volume calculated for this prospect is 8 million cubic metres though it is anticipated that this could be readily increased with further borehole confirmation.

Subprospects p1h, p1i and p1j

Four boreholes are located at more widely spaced locales near the eastern boundary of Prospect 1. The duplicate boreholes UB82SO1 and UB82SO2 (subprospect p1i) are 9.7 and 9.6 metres long, respectively and borehole NT82SO1 (subprospect p1h) is 81.1 metres long. On the very edge of the Prospect 1 area, borehole UB80-45 with a depth of 12.8 metres, defines prospect p1j

Within subprospects p1h and p1i the boreholes show between zero and 0.2 metres overburden over sand. The deposit quality varies, however, with location. Borehole NT82SO1 is located within the shallow depression formed between the two ridges that dominate the Erksak Crest. The prospective sand is fine grained (SP) with trace of silt becoming siltier with depth. A 1 metre clay layer is encountered at 5.5 metres and organic silty sand with peat at 6.5 metres. These finer beds preclude Stationary dredge utilization. A volume of 4.3 million cubic metres are dredgeable by Hopper dredge within this area.

Boreholes UB82SO1 and UB82SO2, however, are located on the northern extension of the main ridge that forms the southeast edge of the Erksak High. Fine grained sand with trace silt continues to the bottom of the cores except for a 0.2 metre bed of silt and sand at 3.6 metres in UB82SO1. The deposit in this area is considered suitable for both types of dredging activities. An estimated volume of 8 million m^3 has been calculated based on the restricted 10 m penetration of the boreholes though it is expected that the sand is continuous with depth.

Subprospect plj is located on the edge of the prospective area and the seismics show approximately 2.5 m of soft surficial cover. The 3 m contour cuts through the site and restricts the area to approximately 0.44 km^2. The borehole (UB80-45) indicates 2.3 m of clay overlying a clean (SP) to trace silt and organic bearing sand which has an increasing fines content with depth. At 10.5 m the borehole penetrates a clay sequence which continued to the borehole termination depth. This prospect would only be suitable for stationary dredging and the quality is questionable for good fill performance. As a result this site is considered unsuitable and no volume estimate is assigned to the resource.

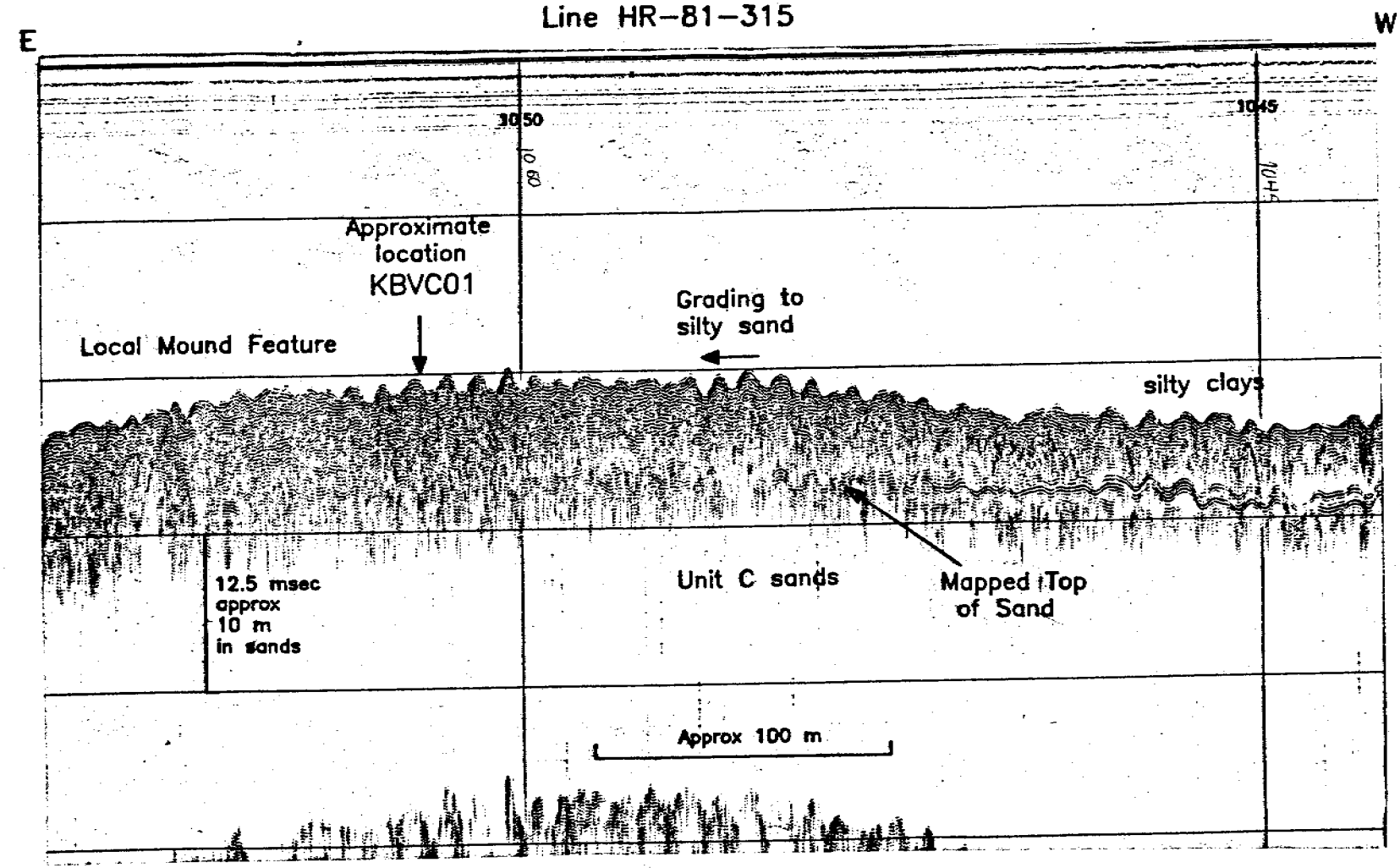

FIGURE 18

Figure 18 Example line GHR-81-315 from the Kogyuk wellsite survey which is the closest approach to borehole KBVC01 showing the localized mound feature, the basin structure and the banded nature of the surficial sediments below the mound.

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6.2.2 Prospect 2

Six Vibrocores have been drilled on this prospect at three locations. The diameters of the 1 km circles surrounding these boreholes have been coalesced to define the 3.36 km^2 area that is designated as subprospect p2a. The cores are designated UB82V-09 to UB82V-14. The length of the cores varies from 3.8 to 7.9 metres. The northern set of boreholes (UB82V-13, -14) indicate sand exposed at the seafloor, while the two southern sets show from 0.1 to 0.3 metres overburden. The sand is uniformly fine grained with a trace of silt and occasionally medium sand. The southern cores (UB82V-09 and -10) bottom out in silt and sand with peat noted in UB82V-09. The rest of the cores record sand to the bottom of the core.

The shortness of cores UB82V-09 to UB82V-14 preclude assessment of the central part of the subprospect as suitable for Stationary dredge use and this area is designated as suitable for Hopper dredge only. Cores UB82V-13 and UB82V-14, located near the northern edge of the prospect, are slightly longer, and this area is therefore classified as suitable for either dredge. Based on the length of the cores a proven reserve depth of 8 metres has been assigned to this region and therefore a volume of 27 million m^3 is calculated for the proven reserves within this subprospect area.

6.2.3 Prospect 4

This prospect is the only one of the seismically mapped groups located along the western side of the Erksak High that has been examined by drilling. Five Vibrocores from 4 locales have been drilled. In addition, a sixth Vibrocore has been drilled close to the southern border of the prospect. Because

of the physical separations of the boreholes three subprospect areas are defined within prospect 4. They are given the ID labels p4a through p4c.

Subprospect p4a

Three Vibrocores (BTN1-12, -13, and -14), aligned north south and separated by about 1 km. are located over the centre of the prospect. The areas surrounding these cores have been linked together to define the 2.77 km^2 area designated as subprospect p4a. The cores are from 3.6 to 4.7 metres long. Each of these cores records sand from the seafloor to the core bottom. The sand is noted as fine grained with some silt (SP) to fine grained with clay (SC). The area is considered suitable for Hopper dredging only based on the present core information but may be suitable for Stationary dredging with additional cores to confirm continuation of the sands with depth. At the present time only 14 million m^3 are assigned to this subprospect based on a 5 m thick known resource.

Subprospect p4b

The northern end of the prospect is sampled by duplicate cores UB82V07 and UB87V08. This core defines the subprospect p4b. Core UB82V07 shows 2.0 metres of overburden and UB82V08 offset 12 metres to the west, shows 0.5 metres of overburden. These values appear to be in conflict with the coarse textural cover interpreted from the seismic data. Figure 19 is a portion of microprofiler line GHR81080 that crosses the core site. The core site is located near the crest of the high. The higher amplitude surface return and the lack of penetration as evidenced by the loss of continuity of the underlying reflector, suggests coarser material over the high.

Diffusion beneath the surface return is variable, however, and increases to the east across the high. This suggests a coarsening to the east and is possibly the source of the mismatch. Because of the variations in the cores and the excessive fines observed in the sediments sampled by the boreholes this region is considered marginal and a 0 volume estimate is assigned to the region.

Subprospect p4c

The southernmost samples are duplicate boreholes taken immediately south of the limit of soft sediment. The boreholes are designated KY82SO2 and KY82SO3. The boreholes measure 31.7 and 76.3 metres long, respectively. Within these boreholes sand is encountered at 1.8 and 1.0 metres, respectively. The sand below the overburden is thick (41.5 metres in KY82SO3) and uniform. It is generally fine grained and dense (SP, SP-SM) with trace of silt and coarse sand and gravel. This subprospect is considered suitable for stationary dredging only and with the considerable thickness of good reserve noted on the boreholes a volume of 22 million m^3 has been allowed.

Overall the boreholes indicate that the northern section of Prospect 4 may be marginally prospective due to excessive fines within the sand. The central part of the Prospect contains good granular resource, and this resource is potentially continuous with depth, as suggested by the thickness encountered in the boreholes located at the south margin.

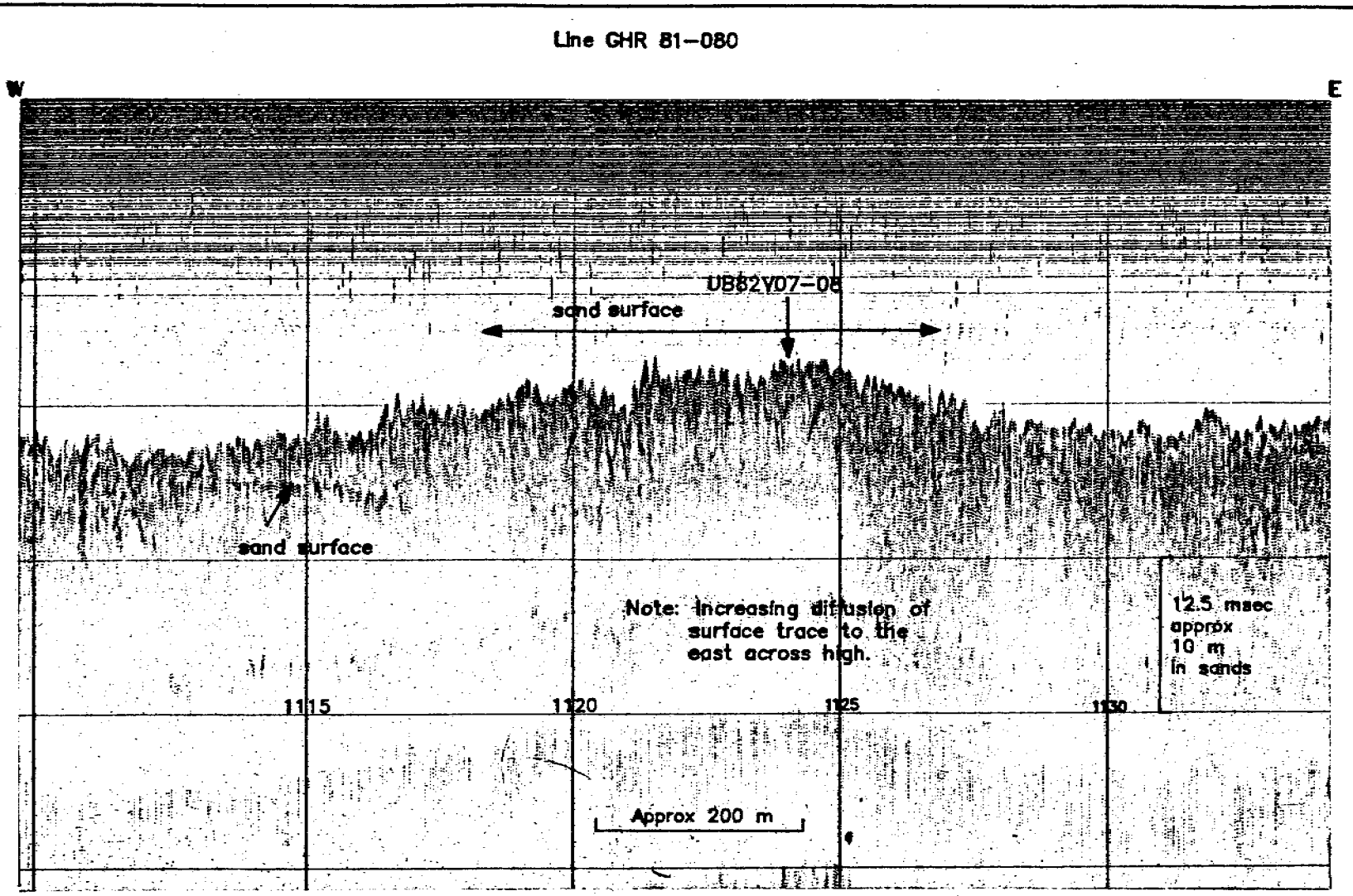

FIGURE 19

Figure 19 Microprofiler record over Prospect p4b (Line GHR81080) indicating high amplitude returns over the crest of the high and suggest a coarsening of the sediments in an eastward direction.

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6.2.4 Prospects 14 and 18

Within the Erksak Channel region only two of the 6 channel bar features have been sampled with boreholes. This allows some measurable quantitative evaluation of these prospects.

Subprospect p14a

This subprospect is located within the northern portion of an island bar feature within the north-central portion of the Erksak Channel. This bar is incised by a shallow embayment feature on its western side and the sampled prospect area is on the northern side of this embayment. The area is sampled by boreholes NU82S01 and NU82S03. An area of 0.91 km^2 is defined around the boreholes which is bounded by the 3 m surficial isopach contour on the southeast side.

Borehole NU82S01 toward the north was drilled to a depth of 81.7 m and borehole NU82S03 ended at 10 m. The northern borehole shows 2 m of soft cover and the southern hole reports 3 m with a 0.8 m thick sand layer noted at .7 m depth. Both boreholes report silty sands (SM) below these depths with significant quantities of silt and sometimes clay layers being present (particularly borehole NU82S03) within these sands. These materials have been classified as unsuitable for borrow development and no volume is estimated for this site.

Subprospect p18a

This site is located at the northern tip of a small spit-like feature attached to the northwestern side of the most southerly bar or promontory feature noted on the sand surface

structure map (Figure 8). Only a very small area of 0.085 km^2 can be allocated to this prospect as the 3 m isopach contour wraps around the borehole site. Borehole UB80-42 was drilled to a depth of 6.7 m and indicates 3 m of clays overlying a marginal quality fine grained uniform sand (SM) with some silts and organic laminae. Due to the surficial cover the site is designated suitable for Stationary dredging only and the proven reserve only amounts to 0.4 million cubic metres. The subsurface sand distribution map strongly implies that greater dredgeable reserves would be available to the south of this location though these would have to be proven by further drilling.

6.2.5 Prospects 21 and 22

Prospects 21 and 22 are located on the Uviluk High and are divided based on the presence of a shallow soft sediment accumulation running northwest to southeast through the site.

Subprospect p21a

The western deposit, Subprospect p21a, is sampled by one borehole, UV80-54 and thus only the 1 km diameter circle (subprospect 21a) is all that can be defined as proven. This borehole records sand directly at the seafloor and continues with fine grained sand (SM, SP, SP-SM) which varies from clean to containing traces of silt and thin banded organic layers to the end of the borehole at 8.8 m. The area is considered dredgeable by either Hopper or Stationary type dredges but is allocated only a volume of 7 million m^3 based on the limited length of the borehole.

Subprospect p22a

Thirteen boreholes have been drilled on deposit p22a in support of the construction of the Uviluk artificial island. These boreholes are identified by the prefixes UV80, or FUV. Borehole depths ranged from a low of 7.3 m up to 108.3 m. Eight of the boreholes record coarse sediment at the seafloor. Of the remaining six, none record overburden thickness in excess of 0.5 metres. Two of the boreholes indicate fine subsurface sediment though these are on the periphery of the site area. Borehole UV80-46 indicates silt and clay layering from a depth of 5 m to the bottom of the borehole at 7.3 m and UV80-52 indicates a 1 m thick clay horizon at a depth of 3 m in the core. Virtually all remaining boreholes indicate moderate to good quality borrow materials (GC in thin layers and traces, SP, SP-SM and SM) through to the end of the cores. Due to the variations in borrow materials seen in the cores the majority of the site is considered recoverable with both types of dredge though some of the peripheral areas are classified as Hopper dredge recoverable only. Based on this a mean depth of proven reserve of 10 metres is allocated for this site and a volume of 105 million m^3 is estimated for the area.

6.2.6 Prospects 28 and 29

The prospect sites outlined within the James Shoal Extension area have not been covered by the seismic information that was available to this study. These prospective sites have been outlined based on borehole samples only and the entire area of the subprospects are considered proven.

Subprospect p28a

Subprospect p28a is represented by the single borehole UB80-44 located on the eastern flank of the James Shoal Extension in 22 m of water. It is covered by 0.6 m of surficial clays overlying clean fine to medium sands (SP). The sands show some traces of silts and gravels to the maximum depth of penetration of 13.7 m. Because of the thin surficial cover the site is considered suitable for Stationary dredging only and is considered to have a proven volume of approximately 10 million m^3 based on the depth of drilling. It is assumed that the sand continue below the depth of borehole termination.

Subprospect p29a

Subprospect p29a constitutes the entirety of Prospect 29 which has been defined on the basis of the 18 AL80 series boreholes that were drilled in support of construction of the Alerk artificial island. These boreholes range in depth from 14 to 33.5 metres and show a surficial cover ranging from 0 to 2.2 m. The sands lying beneath the clay veneer are generally fine to medium grained (SP, SP-SM) which is either clean, or with some traces of silts and organics. Because of the surficial cover the region is considered dredgeable only by Stationary dredge and the 5.27 km^2 area defined by the envelope around the boreholes is estimated to contain approximately 100 million cubic metres of recoverable resource.

6.3 Prospective Granular Resource Volume Estimates

Prospective Resources are defined as granular resource deposits whose existence and extent are speculated on the basis of limited indirect evidence, such as ripple marks on sidescan sonar records or general geological considerations. Table 5 represents a summary of the total volume estimates of the prospective granular resource in each of the 33 prospect areas defined by the seismic mapping program within the Erksak Borrow area. The volumes are subdivided on the basis of zones of overburden thickness, as described in Section 6.1, and their dredgeability (dredge type). The areas of the overburden cover zones for each prospect are given in Table 3.

Areas which are most likely dredgeable by Hopper Trailer dredge constitute only the areas with very little surficial sediment cover. Use of the Hopper Trailer dredge is presently confined to a depth of 2 metres beneath the seabed as a practical limit. For this study those regions have been restricted to the area inside the 1 metre surficial sediment isopach contours. These limits may be conservative subject to (or depending on) recent dredging technology advancements. Prospective volumes for the individual Hopper Dredging sites are calculated using a 2 m thickness multiplier when inside the 0 m overburden contour, and the volume for the area between the 0 and 1 m contour (0.5 m average overburden) is calculated with a 1.5 m borrow thickness.

The prospective volume estimates calculated for the Stationary Suction dredge type include the volumes which would also be dredgeable by a Hopper dredge and basically are taken to constitute the total dredgeable resource within the defined limits of the entire area of the borrow block. On the basis of the seismic evidence and the few deep boreholes in the

borrow block (see Section 5.7), it is assumed that the thickness of the sand is generally not a limitation to the estimation of volumes suitable for Stationary dredging. For comparative purposes, volumes have been calculated for dredging depths of both 5m and 20m below the sand surface.

Table 5 does not include a quality factor estimate since only a few of the potential borrow sites have been tested by borehole sampling (Noted by * on the table). The previous section (6.2) addressed the factor of quality on the proven regions and large quality variations have been pointed out with minimal separation of the boreholes. Thus, these volume estimates must be considered as maximum estimated values and it is likely that they will have to be reduced by some factor when quality is considered. The following section (6.4) attempts to address this quality aspect from the presently available data though detailed site investigations will be necessary prior to actual utilization of any resources within these areas. The area of the entire James Shoal Extension has not been incorporated into this table because of severe limitations in data coverage though the entire area may be prospective. This region encompasses some 411 km^2 and only about 20 to 30 km^2 of this area have been incorporated into the above estimates because of insufficient data in the area.

TABLE 5 PROSPECTIVE GRANULAR RESOURCE VOLUME ESTIMATES

BORROW SITE		WD m range	AREA 0m cont	AREA 0-1m cont	AREA 1-2m cont	AREA 2-3m cont	VOLUME ESTIMATES TIMES 10^6 cubic m. HOPPER DREDGE TO 2m DEPTH under 0m	under 0-1m	TOTAL HOPPER	STATIONARY SUCTION TO 3m OF COVER 5m DEPTH	20m DEPTH
						West Erksak High					
*	1	15-26	217.0	42.1	47.8	21.8	434.0	63.2	497.2	1,496.3	6,426.8
*	2	26-28	16.8	10.2	16.4	8.4	33.6	15.3	48.9	208.3	985.3
	3	23-25	10.2	5.8	10.9	5.6	20.4	8.7	29.1	129.3	616.8
*	4	26-34	32.1	13.4	19.6	11.7	64.2	20.1	84.3	318.7	1,470.7
	5	36-48	2.1	2.0	7.2	1.7	4.2	3.0	7.2	49.0	244.0
	6	34-36	2.9	7.2	5.7	2.0	5.8	10.8	16.6	71.9	338.9
	7	36-38	1.8	3.9	7.8	10.6	3.6	5.9	9.5	80.4	441.9
	8	37-38	1.2	1.6	7.7	2.7	2.4	2.4	4.8	46.9	244.9
	9	32-35	5.7	8.7	18.0	6.7	11.4	13.1	24.5	147.4	733.9
	10	32-34	0.7	2.4	4.6	2.0	1.4	3.6	5.0	35.4	180.9
	11	28-33	1.6	8.6	14.7	6.9	3.2	12.9	16.1	115.4	592.4
	12	24-29	8.9	21.0	14.3	15.5	17.8	31.5	49.3	227.8	1,123.3
						Erksak Channel					
	13	30-35		1.1	13.5	7.8	0.0	1.7	1.7	71.7	407.7
*	14	30-33			7.3	7.2	0.0	0.0	0.0	43.6	261.1
	15	28-31			7.0	5.4	0.0	0.0	0.0	38.0	224.0
	16	14-19		3.3	8.4	15.6	0.0	5.0	5.0	83.3	492.8
	17	20-33	2.2	4.4	30.9	22.5	4.4	6.6	11.0	195.2	1,095.2
*	18	16-23			20.4	6.2	0.0	0.0	0.0	86.9	485.9
	19	15-19				6.5	0.0	0.0	0.0	16.3	113.8
	20	14-20			9.5	10.9	0.0	0.0	0.0	60.5	366.5
						Uviluk High					
*	21	26-30	23.0	2.8	4.8	4.8	46.0	4.2	50.2	156.4	687.4
*	22	30-32	16.6	5.5	5.5	4.5	33.2	8.3	41.5	138.3	619.8
	27	28-30			0.3	0.6	0.0	0.0	0.0	2.6	16.1
						James Shoal Extension					
	23	26-28		1.1	1.4	0.7	0.0	1.7	1.7	11.6	59.6
	24	27-30		1.1	8.4	1.6	0.0	1.7	1.7	38.4	204.9
	25	28-30			0.2	0.3	0.0	0.0	0.0	1.5	9.0
	26	28-30			0.1	0.3	0.0	0.0	0.0	1.1	7.1
						JSE (boreholes only)					
							1.6	0.0	1.6	4.0	16.0
*	28	20-22	0.8				10.6	0.0	10.6	26.5	106.0
*	29	8-11	5.3				30.0	0.0	30.0	75.0	300.0
	30	8-11	15.0								
						Kugmallit Channel					
	31	46-51		0.6	1.7	0.7	0.0	0.9	0.9	10.4	55.4
	32	50				0.3	0.0	0.0	0.0	0.6	4.4
	33	50-55				0.8	0.0	0.0	0.0	1.9	13.1
TOTAL AREAS			363.9	146.8	294.1	192.2	727.8	220.2	948.0	3,990.0	18,945.0

Note: "*" indicates borehole control within the Prospect Area

6.4 Probable Granular Resource Estimates

The above two sections have provided estimates of the proven (Section 6.2) and prospective (Section 6.3) reserves within the Erksak Borrow Block. Within this section a qualitative estimate of the of the probable useable granular resource for the region is attempted. Probable reserves are defined as sands and gravels whose existence, extent and quality has been inferred on the basis of limited ground-truthing information and/or several types of indirect evidence, including sidescan sonar, shallow high resolution seismic, echo sounding and/or bathymetric and/or geological considerations. These estimates are based on an understanding of the proven reserves as determined from boreholes and a comparison with the seismically mapped prospective regions to provide an estimate of probable resource that may represent a viable planning figure for future utilization.

Within the Erksak borrow block there are basically three types of prospective granular resource deposits which have been outlined by the seismic mapping program. The upland regions of the West Erksak High, the Uviluk High and the James Shoal Extension contain two basic reserve types. The bar and island features within the Kugmallit and Erksak Channels are the third type. On the upland regions, the reserve consists of exposed remnants of Unit C sand materials as the basal material and of the reworked coarse materials which are noted as migrational ridges and progradational wedges that have extended the upland regions into the lower lying channels. The reworked materials may represent Unit C materials if they had been deposited prior to transgression within a subaerial or riverine environment or lower facies of Unit B materials if deposited in the nearshore breaker zone or current controlled

deposition associated with the last transgression of the sea across the region. The true distinctions between Units B or C cannot be made solely from seismic and/or borehole evidence alone but would require palynological/paleontological or salinity evidence as well, which is currently not available.

Figure 10 (in Section 5.4) shows an example of the basal type of deposit from Prospect 1, subprospect p1c, where the regional unconformity surface representing the top of Unit C is at the seabed. Within these sediments there are faint internal reflectors and a high amount of acoustic backscatter from within the sediments. In some cases the faint internal reflectors most likely represent localized clay and silt lenses or old channel cut relics that may contain variable qualities of the borrow material however the majority of these sediments tend toward good quality borrow materials. With the mapping scales used in this project and the presently available data coverage it has not been possible to map these localized internal reflections within the prospect areas.

Figure 13 represents the progradational wedges on the edge of the highs and Figure 19 (in Section 6.2) represents the (possibly relict) migrational type sand ridges that are often observed on top of the highs but overlying the regional unconformity surface. These features are expected to be of variable quality with some being clean sand; others may contain some gravels as well as sands; and yet others may contain significant quantities of silt and clay which would make them unacceptable sources of borrow material. Figure 20 shows the migrational sand ridge overlying the Uviluk High region and is characteristic of prospects 21 and 22. These regions have proved to be viable borrow sources based on the boreholes and show a strong upper reflecting surface and relatively unscoured seabed which is characteristic of less

cohesive sands. Localized subbottom reflectors are noted within the deposits which are likely related to the silt and clay pockets that were occasionally encountered on the boreholes. Overall the quality of these deposits proved to be high. As with the basal type of deposits, it is not feasible within this study to provide detailed mapping of the various reworked sand features as the available survey coverage is minimal.

Figures 21 shows an example of the mid-channel sandbar features noted within the central part of the Erksak Channel. From this record it is apparent the tops of the bars have been planed off, presumably by the marine transgression and that deeper inter channel bars exist which do not reach the prospective reserve limits. From these data it is expected that some portions of these bar features will contain high quality borrow materials while other areas will likely be of poor or marginal quality.

Figure 22 shows a prospective site located within the Kugmallit Channel. These deposits tend to have a significant surficial sediment cover and are generally small in size which would make them probable sources of borrow material only under some unusual conditions related to proximity. Therefore they have been excluded from the probable resource total volumes. In any event these possible resources would require careful proving before the expense of stripping the surficial cover could be warranted.

The available data have been reviewed on the basis of probability of occurrence of unacceptable sediment layers or limiting zones within each deposit. Although it has not been possible to map, in detail, specific features which indicate a significant probability of containing higher quality

materials, volumes have therefore been estimated by applying an interpretive reduction factor to the estimates of prospective resources. Table 5 summarizes these estimates of probable resources in the Erksak Block. In particular the area of the James Shoal Extension has been significantly restricted in these evaluations because of the paucity of data over the feature. Therefore the larger area of the entire feature has been excluded from the tables presented here. If it were to be included an additional 4 to 6 billion cubic metres might be added within the prospective category of borrow reserve of which 2 to 3 billion might be considered probable.

TABLE 6 PROBABLE GRANULAR RESOURCE ESTIMATE

SITE ID	PROVEN 10^6 m^3	PROSPECTIVE 10^6 m^3	PROBABLE 10^6 m^3	COMMENTS
	West Erksak High			
1	431.3	6,426.9	3,000	Trend toward increasing fines in a northerly direction with considerable fine bedding noted on the seismic records suggesting an increase in the silt and clay component of the sediments. Resource quality is noted to vary significantly with small positional change in borehole tests thus estimate 50 to 60 percent of the prospective resource will be unacceptable though on a localized basis.
2	27	985.3	400	
3	na	616.8	300	
4	36	1,470.7	500	
5	na	244.0	100	
6	na	338.9	100	
7	na	441.9	150	
8	na	244.9	100	
9	na	733.9	200	
10	na	180.9	75	
11	na	592.4	200	
12	na	1,123.3	400	
	Erksak Channel			
13	na	407.7	40	- Northern reworked - assume low quality factor
14	0	261.1	25	- " " " " " "
15	na	224.0	20	- " " " " " "
16	na	492.8	120	- increasing quality southward
17	na	1095.2	210	- increasing quality southward
18	0.4	485.9	240	- good quality proven borehole
19	na	113.8	70	- J.S. Extension
20	na	366.5	220	- J.S. Extension
	Uviluk High			
21	7	687.4	350	good proven component, therefore estimate 50% utility with some localized fine lenses and ignore prospect 27
22	105	619.8	310	
27	na	16.1		
	James Shoal Extension			
23	na	59.6	10	small targets with probable fair to good quality but sediment cover reduces probability of utilization
24	na	204.9	40	
25	na	9.0	2	
26	na	7.1	1	
	JSE (boreholes only			
28	10	16.0	6	Good potential with some fines component and moderately well proven though significant surficial cover striping required
29	100	106.0	75	
30	30	300.0	150	
	Kugmallit Channel			
31	na	55.4	0	small targets of reworked sediment likely containing significant fines and significant surficial cover to strip off.
32	na	4.4	0	
33	na	13.1	0	
TOTAL	747.7	18,945.0	7,414	

Note: na = no samples available to prove reserve

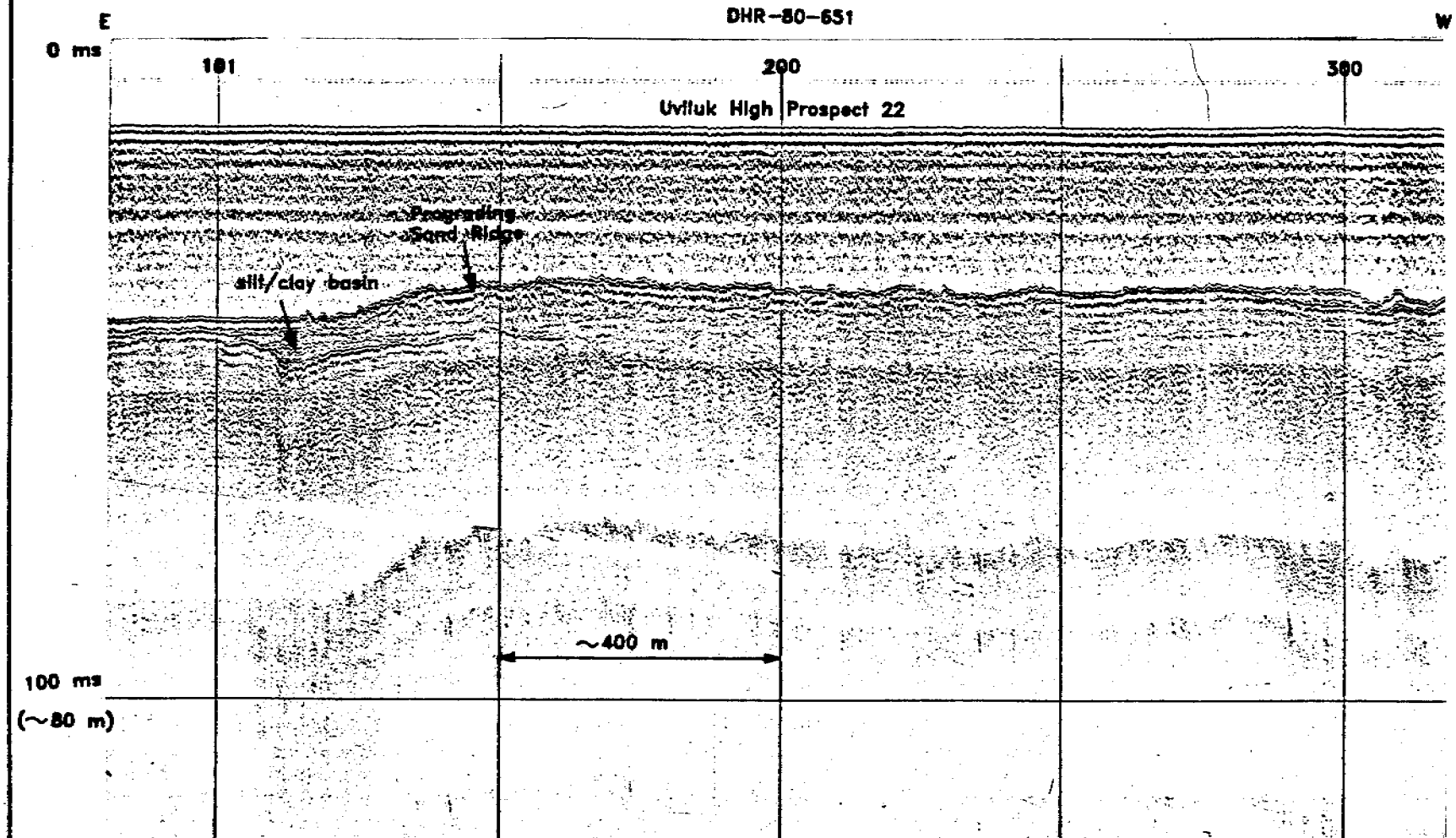

FIGURE 20

Figure 20 Example Boomer record, line DHR-80-651, over the Uviluk High indicating the migrational sand ridge character of the seabed sediments with highly reflective seabed

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22 Waddell Ave.
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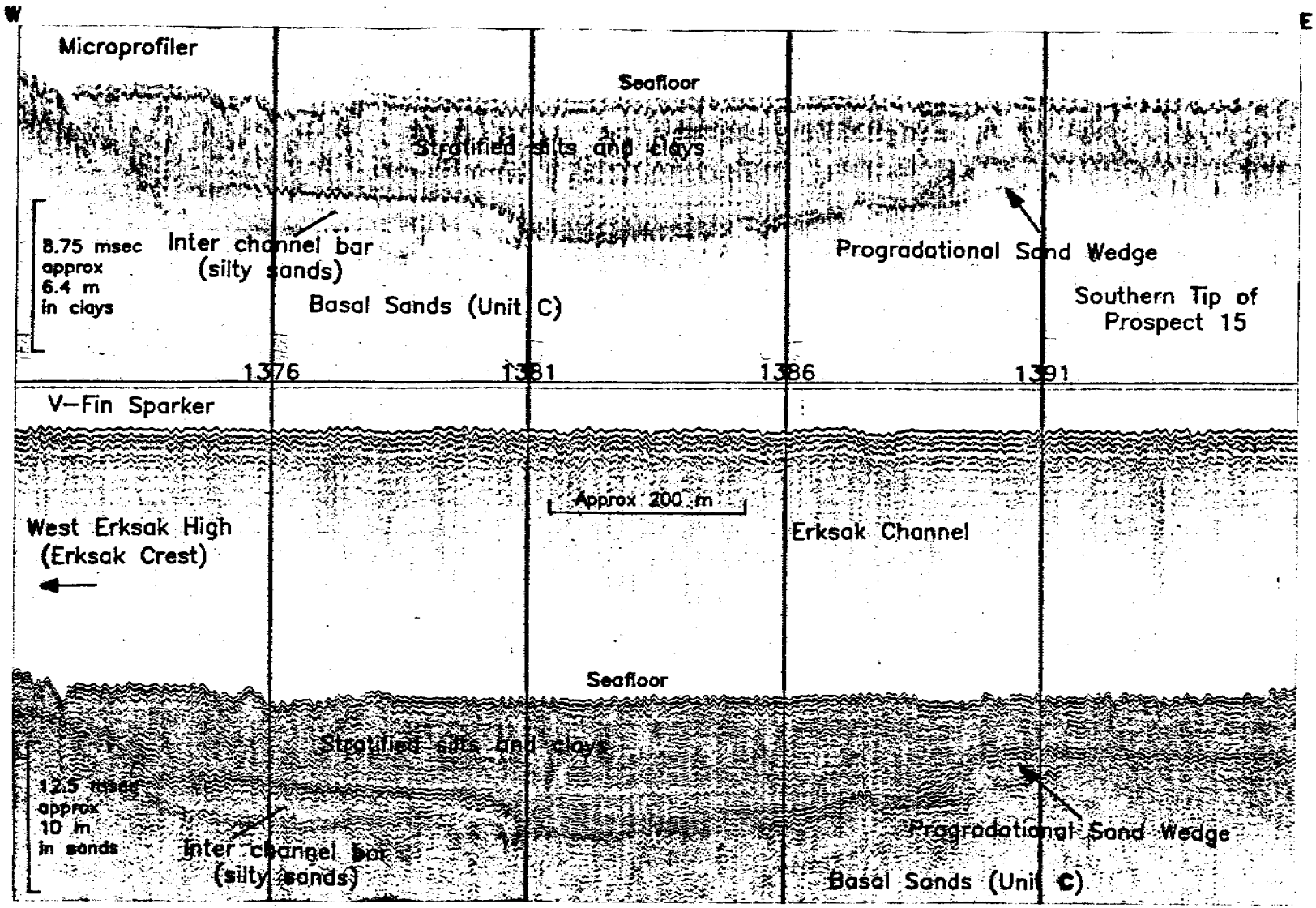

FIGURE 21

Figure 21 Example microprofiler and V-Fin Sparker record from line GHR-81-047 across the Central portion of the Erksak Channel showing the mid channel bar feature associated with Prospect 15.

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EOR

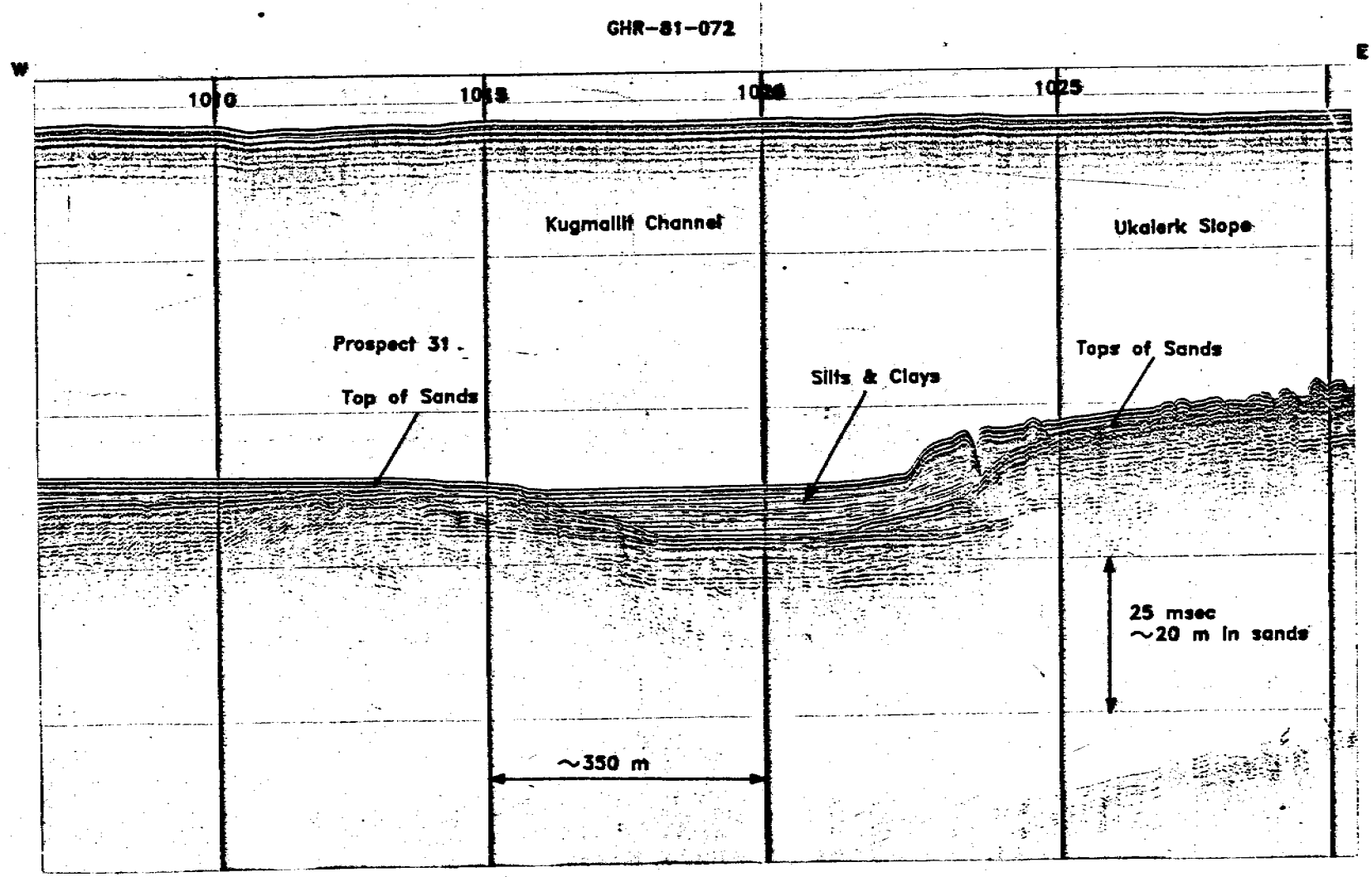

FIGURE 22

Figure 22 Example Boomer record, line GHR-81-072, showing the Kugmallit Channel bar feature associated with Prospect 31 .

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7 CONCLUSIONS

The 2574 square kilometre area of the Erksak Borrow Block located in the south central Beaufort Sea continental shelf contains significant quantities of proven, prospective and probable fine to medium grained sandy granular resource materials. The analysis of this region did not indicate any significant concentrations of coarser grained sand or gravel materials though numerous trace indications were noted from the borehole records.

The region consists of a drowned upland region composed primarily of medium to fine grained sands (Unit C) which had been dissected by a series of channels prior to inundation by the sea within the last 3000 to 10,000 years. During this time range the low lying areas of the Kugmallit Channel were inundated toward the southern block area at approximately the same time as the northern upland areas of the prospect were just commencing the transgression process. During this period, the shallower regions of the possibly more ancient Erksak channel system were partially inundated and at some point left the Uviluk High and the West Erksak High as nearshore island features while the James Shoal Extension area was a promontory point either attached to the mainland or itself cut off from the mainland by the Uviluk/Niglik Channel system further to the east. All through this process the upland regions were being eroded both subaerially and by the nearshore breaker zone and wavebase effects of the advancing seas. As sea level rose further the upland regions were eventually inundated by the sea and were modified by the transgressive erosion activities as the sea progressed through the high energy breaker and wave base erosion zones toward the present day deeper water conditions.

Throughout the transgression process the surficial sediments of the upland areas were reworked to form a transgression unconformity with the finer components winnowed out and transported to quiescent regions for re-deposition as Unit B or Unit A materials. The coarser grained sands tended to be transported shorter distances, if at all, and in some cases formed progradational wedges along the edges of the highs or were localized into sand ridges or sand bar features when conditions were correct. These materials form a portion of the granular resource in the region while the main body of the resource is composed of the deeper Unit C materials.

Similar processes were at play prior to marine inundation within the subaerial channels of the study area. These process were river and or wind dominated and contributed to the progradational wedges seen adjacent to the higher regions and formed the river bar features noted within the Erksak Channel and the sub-channels noted within the eastern portion of the Kugmallit Channel. These sedimentary features are technically attached to Unit C, however in many cases the distinction between this unit and the higher energy transgressive facies of Unit B are not distinguishable from the seismic or borehole data. This distinction would have to rely on other indicators such as marine foraminifers or some other biological or chemical indicator to distinguish the exact timing of commencement of the marine influence on these sediments. These information were not available to this study, and this distinction was not the intent of this study in any event.

As regions of the borrow site passed through these active zones, accumulations of finer grained sediments began to predominate. These accumulations first began in the deeper water zones and topographic lows and progressed higher on the

upland areas as the transgression continued to its present condition.

The original pre-transgression topography and the effects of the transgression process have resulted in the present day conditions within the Erksak Borrow Block. The distribution of the potential borrow materials are concentrated on the upland areas, though significant recoverable materials are available within the Erksak Channel. Much of the eastern portion of the site has not been adequately evaluated within this study as little seismic or borehole data was available. However bathymetric studies suggest that this area likely to be relatively silt or clay covered which reduces its attraction.

The geophysical and geotechnical data utilized through this survey did indicate the presence of shallow subseabed permafrost in the area. It is however of the Hummocky type and relatively randomly distributed. In most cases, it is greater than 10 metres below the seabed. As a result this hazard to dredging will locally be significant to the utilization of deep Stationary dredging methods. On the regional basis however, it is felt that permafrost does not seriously degrade the assessment of the viable resource in the area.

Analysis of the geophysical and geotechnical data base has shown that almost 720 million cubic metres of relatively fine grained granular resource have been proven. Within the entire Borrow Block the geophysical data have outlined a maximum potential of some 19 billion cubic metres of prospective borrow material of which about 950 million m^3 could potentially be recovered by Hopper Trailer dredge (5%). Of this prospective recoverable material it is estimated that something in the order of 7.4 billion cubic metres would be

in the category of probable recoverable resource when quality factors and an estimation of the variability of subsurface conditions are taken into account. It is noted here that the entire James Shoal Extension physiographic region may be considered as a prospective area.

These estimations are based primarily on the relatively large, but variously distributed geophysical and geotechnical data sets that are presently available for the area. It is noted here that these data sets are not sufficient to define an actual borrow utilization development program and further detailed site survey and borehole quality assessment programs are required within any local area prior to commencing any actual dredging activities.

8 RECOMMENDATIONS

The results of this program have outlined some 33 prospective borrow areas within the Erksak Borrow Block. The compilation and analysis of the present data set have highlighted deficiencies and limitations of the present information on the site to which the following recommendations are addressed.

1 There is very limited geophysical and geotechnical data available in the southeastern and eastern regions of the borrow block. This is essential in the assessment of the James Shoal Extension area and leaves areas which are totally blank in the coverage of the inshore Niglik Channel region. A regional survey program is required to allow a reasonable assessment of these areas for borrow potential. Since there are currently only two survey lines penetrating this region, and these are old data that is of marginal quality (see Enclosure 1), it is recommended that survey lines be completed predominantly in an east-west direction on a grid of approximately 5 km line spacing throughout the entire southeast quadrant of the Borrow Block. There should also be north-south tie lines completed on approximately a 10 km line spacing. It is recommended that further geotechnical studies only be completed after the geophysical program is underway and targets for the geotechnical sites be selected based on the geophysical data (ie. the following field season).

The geophysical survey program should consist of 3.5 kHz profiler, a Boomer system (the IKB Seistec - line and cone - limited aperture receiver is strongly recommended with the boomer source), and a deeper penetration small airgun system as the subbottom profiling tools. These

systems should all be run throughout the survey coverage. These data should be complemented by a sidescan sonar and a precision fathometer to asses water depths and seabed features though the sidescan data will most likely be dominated by ice scour features and only of marginal use related to borrow assessment. The survey program should also involve navigation systems of comparable quality to those employed during collection of the industry data sets. It is strongly recommended that some form of active heave compensation system be employed on the boomer and 3.5 kHz systems such that a broader weather window of good quality recording can be obtained. This will allow much more comprehensive lithologic and stratigraphic interpretation of these data such as is only presently obtained during the occasional ideal, flat calm survey day. These systems are presently not commercially available and some development support will likely be necessary.

2 The quality factors of the riverine sand bar features within the Erksak and Kugmallit channels are poorly known at present and it is recommended that additional boreholes be planned in these areas to provide a better assessment of their viability as borrow materials. This suggestion is considered relatively low priority for a regional assessment as there are significant quantities of more certain borrow materials associated with the upland areas. This form of study might be necessary in the event of construction activity within the immediate area and if very localized sources of borrow were desired. Thus, this recommendation is targeted to the operators and their drilling/construction contractors

when and if structures are required in this immediate vicinity.

3 Due to the large areal extent of this study and the limited distribution of boreholes along with limited time resources, it was not possible to comprehensively evaluate small geologic features of potential borrow significance that observed within the seismic data and correlate them with borehole ground truthing. A future program should be addressed to attempt at least some of these correlations. This entails detailed review of the geophysical data for bars, ridges, foreset bedding and regions of internal bedding within the target lithologic units, followed by accurately targeted geotechnical boreholes for ground truthing. Thus a more accurate correlation of the quality factor of some of these individual features can be made.

This program might be carried out using the data from the Kogyuk and or West Tingmiark and or Uviluk (not found in data search) wellsite surveys where closely spaced lines will potentially allow detailed areal mapping of these much smaller scale features. The quality of the high resolution data in these particular study areas is not up to the present day standard however, and it may be more appropriate to conduct detailed grid surveys using current technologies such as the IKB Seistec to allow better seismic evaluation of the features. These correlations should be compiled into an atlas format for distribution such that future borrow evaluations for this and other areas can use it as a reference guide.

4 The present study is based on a mixed regional and site specific data set. Therefore the maps displaying the

prospect boundaries, the physiographic boundaries and the soft sediment cover over the top of sand, particularly near the edges of these features, are likely accurate to within approximately one km or better depending on the data density at any particular local area. Therefore it is strongly recommended that confirmation detailed grid surveys, along with borehole quality assessments be conducted on these features and particularly boundary areas prior to attempting localized utilization of these resource materials.

5 Additional study is required in the vicinity of the prograding spillover wedges noted along the west and southern edges of the West Erksak High. The distribution and quality of the seismic data over this feature did not allow detailed mapping of their basal structures (hints of the basal structure were observed only on a few of the seismic lines available to this study). These features are among the most noteworthy of the potential "high energy zone" constructional features observed in the area and may represent a potentially higher quality resource material. A program of this nature will likely require field survey using boomer and airgun systems (as described above) with possibly special techniques such as very slow survey speeds when crossing the wedge features. This should be conducted on a localized trial basis first to prove the technique and would subsequently require ground truth information by coring and or boreholes over the study area.

6 Further work might be done on the quality assessments of specific localized areas such as those areas considered Proven in this report. It was beyond the resources of this program to compile test and production dredging

results if available for these regions, and if available, these data might be useful when combined with gradational envelopes (available through EBA geotechnical data base) for the various lithostratigraphic units sampled. This would aid in providing a more quantitative understanding of the borrow quality of these Erksak materials. This should be combine with a more targeted geophysical assessment of the lithostratigraphy of these smaller areas with an emphasis on extending the limits of the "Proven" deposits. Because of the regional nature of the geophysical data base this type of program would best be supplemented with additional geophysical survey data however this should be reviewed on a site by site basis.

REFERENCES

EBA ENGINEERING CONSULTANTS LTD., 1988a. Compilation of Borehole Logs for the Isserk Borrow Block Beaufort Sea. EBA Report No. 0306-34413, submitted to Bob Gowan, Indian and Northern Affairs Canada under D.S.S. Contract No. A0632-7-5014/01ST

EBA ENGINEERING CONSULTANTS LTD., 1988b. Compilation of Borehole Logs for the Erksak Borrow Block Beaufort Sea. EBA Report No. 0306-34413, submitted to Bob Gowan, Indian and Northern Affairs Canada under D.S.S. Contract No. A0632-7-5014/01ST

EBA ENGINEERING CONSULTANTS LTD., 1988c. Collection of Borehole Logs - 69° 45' - 70° 10'N - 132° 00' - 135° 30'W Except Isserk and Erksak Blocks. EBA Report No. 0101-4805, submitted to Bob Gowan, Indian and Northern Affairs Canada under D.S.S. Contract No. A0632-7-5014/01ST

EHRLICH, M., L. GODARD and R. QUINN, 1982. Marine Bottom and Sub-Bottom Survey, Kogyuk Area, Beaufort Sea, 1981. Report to Gulf Canada Resources Inc. submitted by Geoterrex Ltd.

HILL, P. R., P.J. MUDIE, K. MORAN and S.M. BLASCO, 1985. A sea-level curve for the Canadian Beaufort Shelf. Can. Jour. Earth Sciences, Vol 22, No. 10, pp 1383-1393.

LEWIS, J.F., 1989. Regional Surficial Geology: South Central Beaufort Shelf - Beaufort Sea: Northwest Territories. Report by Earth & Ocean Research Ltd. submitted to Mr. Steve Blasco of the Atlantic Geoscience Centre under D.S.S Contract No.23420-8-M313/01-OSC.

McELHANNEY SERVICES LTD., 1988. High Resolution Geophysical Survey Data - Data Search Data Base Compilation. Contract report and data base submitted to Indian and Northern Affairs Canada, under D.S.S. Contract No. A0632-7-5012/01ST.

MEAGHER, L.M., 1978. Compilation of the Thickness of Recent Soft Sediment and Ice-Related Features in the Beaufort Sea, Northwest Territories, Canada. Terr. Sci. Div., Geol. Surv. Can. Project No. 77-30.

O'CONNOR, M.J. & ASSOCIATES LTD., 1980. Development of a Proposed Model to Account for the surficial Geology of the Southern Beaufort Sea. A report prepared for the Geological Survey of Canada, Contract No. OSC79-00212.

O'CONNOR, M.J. & ASSOCIATES LTD., 1981. Distribution of Shallow Acoustic Permafrost: a report on the southern Beaufort Sea prepared for the Geological Survey of Canada, Contract No. 08SC.23420-0-M531.

O'CONNOR, M.J. & ASSOCIATES LTD., 1982a. An Evaluation of the Regional Surficial Geology of the Southern Beaufort Sea. A report prepared for the Geological Survey of Canada, Contract No. 07SC.23420-1-M562.

O'CONNOR, M.J. & ASSOCIATES LTD., 1982b. A review of Shallow Acoustic Permafrost: A report on the Southern Beaufort Sea. Prepared for the Geological Survey of Canada, March 1982 (MJOA Job No. 10-116).

O'CONNOR, M.J. & ASSOCIATES LTD., 1983. Regional Inventory of Offshore Gravel Prospects, Canadian Beaufort Sea. Report submitted to Indian and Northern Affairs by M.J. O'Connor and Associates, Contract No. 82-607

O'CONNOR, M.J. & ASSOCIATES LTD., 1984. Distribution and occurrence of frozen seabottom sediments. A comparison of geotechnical and shallow seismic evidence from the Canadian Beaufort Sea. A report prepared for the Geological Survey of Canada, Contract No. OSC82-00489.

OLYNYK, H. and R. QUINN, 1985. Marine Bottom and Sub-bottom Survey Isserk Borrow Site, Compilation Report 1980-81 and 82, Beaufort Sea. Report submitted to Gulf Canada Resources Ltd. by Geoterrex Ltd.

PETERS, J., 1989. Digital Track Plot Data Base - Beaufort Sea. Report and Data Base compiled by Earth & Ocean Research Ltd., submitted to Bob Gowan, Indian and Northern Affairs Canada under D.S.S. Contract No. A0632-7-5013/01ST.

RAMPTON, V.N., 1982. Quaternary Geology of the Yukon Coastal Plain. Geological Survey of Canada Bulletin 317.

RAMPTON, V.N., 1988, Quaternary Geology of the Tuktoyaktuk Coastlands, Northwest Territories. Geological Survey of Canada Memoir 423.

TORRENS, R., B. WILSON and G. FORTIN, 1985. Marine Bottom and Subbottom Survey Amauligak J-44 and I-65 Compilation Report, Beaufort Sea, 1981 to 1984. Report submitted to Gulf Canada Resources Inc. by Geoterrex Ltd.

APPENDIX 1

LISTING OF SEISMIC DATA COVERAGE WITHIN THE SURVEY AREA BOUNDARIES AS DETERMINED BY MCELHANNEY SERVICES

APPENDIX 1

LISTING OF GEOPHYSICAL SURVEYS WITHIN THE ISSERK-ERKSAK

BORROW BLOCK AREAS

COMPILED BY McELHANNEY GEOSURVEYS LTD.

EAR	CLIENT	CONTRACTOR	SURVEY TITLE	LINE COVERAGE	LINES LISTING
984	GULF	GEOTERREX	AMAULIGAK EAST, AMAULIGAK WEST	125 Km (FROM REPORT),APPEARS TO BE MORE	GHR-81-201...231,GHR-82-6101...6108,GHR-81-101...132,GHR-82-5102,5104,5106,5108,5110,GHR-84-205,209,213,215,204,217B,219,201,223...253(ODD #'S),203B,255,259,263,267,226,222,220,218
985	ESSO	McGREGOR GEOSCIENCES 85-45.4	ARNAK K-06 C.D.G.L.A 9426 J1-3E	57 Km, 15 LINES, 4 CORES (AR85S01,AR85S0	E86-282,E86-298,E86-299A,E86-300,E86-301,E86-301A,E86-301B,E86-301C,E86-302,E86-400,E86-401,E86-402,E86-402A,E86-403,E86-404

APPENDIX 1

LISTING OF GEOPHYSICAL SURVEYS WITHIN THE ISSERK-ERKSAK

BORROW BLOCK AREAS

COMPILED BY McELHANNEY GEOSURVEYS LTD.

EAR	CLIENT	CONTRACTOR	SURVEY TITLE	LINE COVERAGE	LINES LISTING
982	GULF	GEOTERREX	NORTH UKALERK SITE	255 Km	EVEN #'S GHR-82-102--GHR-82-1154, GHR-82-1101,1111,1121,1131,1137,1141,1151,1161,1171,1144A
982	AGC	A.G.C.	GRID SITE 1, GRID SITE 2	2 SITES, 8 TIE LINES, TEMPPROBES, CORES	GRID SITE 1..LINES A-B THROUGH RS,SS,GRID SITE 2 LINES A-B THROUGH F6,PINGO SEARCH P30,P32,P28,P39,P28,TIE LINESB99KUO,KUD044,CORGAS,DENNY,P23WAM,WAMB99,B99,S#1,IRKTIM
983	ESSO	GEOTERREX 93-41	NIPTERK L-19	82 Km., 19 LINES, 3 CORES (82-N-1, 83-NH	85118 - 85134, 85136, 85088
983	ESSO	GEOTERREX 93-41	REGIONAL LINES 1983	100 Km, 6 LINES	85-088, 85158, 85159, 83-01, 83-02, 83-03
983	ESSO	GEOTERREX 93-41	KAUBVIK I-43	83 Km, 18 LINES, ONE (1) CORE (83-KHS-SO	85072 - 85 089
983	ESSO	GEOTERREX 93-41	AMERK O-9	74 Km, 16 LINES, 4 CORES (82-A-1,82-A-2,	85054,85056 - 85060,85062 - 85071
983	GULF	GEOTERREX	REGIONAL LINES 1983	278 Km,7 LINES	GHR-83-01,GHR-83-03,GHR-83-05,GHR-83-06, GHR-83-16,GHR-83-17,GHR-83-02
983	GULF	GEOTERREX	KASLUTUT	180 Km,26 LINES	GHR-83-1001....GHR-83-1024, GHR-83-1024A, GHR-83-1016A

APPENDIX 1

LISTING OF GEOPHYSICAL SURVEYS WITHIN THE ISSERK-ERKSAK

BORROW BLOCK AREAS

COMPILED BY McELHANNEY GEOSURVEYS LTD.

AR	CLIENT	CONTRACTOR	SURVEY TITLE	LINE COVERAGE	LINES LISTING
74	ESSO	HUNTEC (70) LTD. (C-2683)	PULLEN ISLAND GRAVEL SEARCH	539 LINE MILES(862KM)	11170,7870,9400,6250,4600,3200,700,1600, 12500,17300,19096,20910,26000,15588,2771 8,24320,22620,20400,17294,17300,12500,14 000,15588,M,D,N,AA,F,K,Z,I,Y,SOUTH,B,J
78	DOME	FAIRFIELD AQUATRONICS	UKALERK C-50	35 Km,11 LINES	42,32,22,12,2,31,21,11,1,33,34
78	DOME	GSI	REGIONAL LINES 1978	360Km,2 LINES	DHR-78-1,2
80	DOME	GEOTERREX	TINGMIARK & UKALERK BORROW STUDY	7 LINES	DHR80-527,601,609,521E,610,605,525C
80	DOME	GEOMARINE	SOUTH KAGLULIK BORROW STUDY	N/A	DHR80-820,821,823,825,827,829
80	DOME	GEOTERREX	ISSERK BORROW STUDY	5 LINES	DHR80-310,311,312,515B,309
80	GULF	GEOTERREX	REGIONAL LINES 1980	50 Km,2 LINES	LINES 10, 20
80	DOME	GEOTERREX	UVILUK BORROW STUDY	8 LINES	DHR80-503,556A,506,643,647,651,527,653
80	GULF	GEOTERREX	AKPAK	36 Km,14 LINES	302,307,312,317,322,780,805,830,855,880, 905,930,955,980
80	GULF	GEOTERREX	NORTH ISSUNGNAK WELLSITE	36 Km,14 LINES	199,204,209,214,219,500,525,550,575,600, 625,650,675,700
81	DOME	GEOTERREX	REGIONAL LINES 1980	1947 Km,35 LINES	DHR80-529(A,B),525(B),525C,501A,530,761, 529C,751B,751,521(C,D),540B,515B,532,546 C,503(1,2),531(A),505,515,523,521E,556(A ,B),546B,533(B,C),533,546A,550A,527,533(C-1),534,531,910,507

APPENDIX 1

LISTING OF GEOPHYSICAL SURVEYS WITHIN THE ISSERK-ERKSAK

BORROW BLOCK AREAS

COMPILED BY McELHANNEY GEOSURVEYS LTD.

EAR	CLIENT	CONTRACTOR	SURVEY TITLE	LINE COVERAGE	LINES LISTING
981	DOME	GEOTERREX	KOGYUK	260.6Km, 40 LINES	GHR81-302 TO GHR81-332,GHR81-078,045,311,046,043,047, 075,018,089
981	DOME	GEOTERREX	NERLERK RIDGE BORROW SITE	24Km,11 LINES	DHR81-140-1 TO DHR81-140-9,DHR81-140-2A,3A
981	GULF	M.J. O'CONNOR & ASSOCIATES	REGIONAL BORROW INVESTIGATION 1981	2200 Km,	81-092--099, 81-0001--0014, 81-0001--089 (NOT CONTINUOUS)
981	GULF	GEOTERREX	WEST TINGMIARK	310 Km,37 LINES	GHR81-071,070,1111,1105,1111A,1110,1109, 1085,1108,1075,1106,099,1104,1103,1102,1 101,0003,1137,1136,1135,1126-34,1120,111 2-1119
981	DOME	GEOMARINE	UVILIK P-66	440.25Km	DHR81-140-1 TO DHR81-140-70, DHR81--140-115,119,131,135,139,147
981	GULF	GEOTERREX	KOGYUK AREA	235 Km,32 LINES	GHR-81-301...GHR-81-332
981	DOME	GEOMARINE	ARLUK E-90	59.2Km,16 LINES	DHR81-130-20,20A,32,34,34A,36,38,42,46,4 8,21,33,35,37,49,49A
981	GULF	GEOTERREX	SOUTH KOAKOAK 1981	31 Km,10 LINES	GHR-81-0004,025,0005,051,350,821,0002,80 1,806,811
982	DOME	GEOTERREX	REGIONAL LINES 1982	226.6KM	DHR82-02 TO DHR82-09
982	GULF	GEOTERREX	ISSERK BORROW COMPILATION 1980-81-82	50 Km, 19 LINES	GHR-81-062A,025,063,069,068,067,GHR-82-7 106,7104A,7104,7102,7116,7118,7118A,7122 ,7120,7124,GHR-80-310,312,311,309,515B

APPENDIX 2

LISTING OF SEISMIC DATA COLLECTED FOR THIS PROJECT FROM WITHIN THE SURVEY AREA

APPENDIX 2

Comments:

1)

Analogue data that are listed under "Profiler" may include boomer, airgun, sub-bottom profilers, side scan, and V-Fin.

Analogue data that are listed under "Near Trace" include near trace and single trace data.

Analogue data that are listed under "echo sounder" include echo sounder only.

2)

The designation "L/F" indicates that a reproduction of the analogue record was located in a report. A search for the original was made but was unsuccessful. Time did not allow for relocating the report and copying the reproduction.

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1980
BLOCK/REGION NAME: Regional Lines 1980
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Regional Lines 1980

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
10			L/F/C	L	L
20			L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1980
BLOCK/REGION NAME: Akpak Wellsite
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Akpak Wellsite

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
302			L/F/C	L	L
307			L/F/C	L	L
312			L/F/C	L	L
317			L/F/C	L	L
322			L/F/C	L	L
780			L/F/C	L	L
805			L/F/C	L	L
830			L/F/C	L	L
302			L/F/C	L	L
880			L/F/C	L	L
905			L/F/C	L	L
930			L/F/C	L	L
955			L/F/C	L	L
980			L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Regional Borrow
TITLE OF REPORT : 1981 Regional Borrow Investigation, Beaufort Sea

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : M.J. O'Connors and Associates Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-0002A			L/F/C	L/F/C	L
GHR-81-0003A			L/F/C	L/F/C	L
GHR-81-099B			L	L/F/C	L
GHR-81-099C			L/F/C	L/F/C	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Kogyuk Area
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Kogyuk Area

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room also found in the Dome Library.
(SEE KOGYUK AREA UNDER DOME 1981 - SAME REPORT)

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81			L	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Regional Borrow
TITLE OF REPORT : 1981 Regional Borrow Investigation, Beaufort Sea

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : M. J. O'Connor Associates Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and file room - reports. Line data was obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-0001			L/F/C	L/F/C	L
GHR-81-0002			L/F/C	L/F/C	L
GHR-81-0003			L/F/C	L/F/C	L
GHR-81-0004			L		L
GHR-81-0005			L/F/C		L
GHR-81-0006			L/F/C		L
GHR-81-0007			L/F/C		L
GHR-81-0008			L/F/C		L
GHR-81-0009			L/F/C		L
GHR-81-0010			L/F/C		L
GHR-81-0011			L/F/C		L
GHR-81-0012			L/F/C		L
GHR-81-0013			L		L
GHR-81-0014			L/F/C		L
GHR-81-0015			L/F/C		L
GHR-81-0016			L		L
GHR-81-0017			L/F/C	L/F/C	L
GHR-81-0018			L/F/C	L/F/C	L
GHR-81-0018B			L/F/C		L
GHR-81-010			L/F/C	L/F/C	L
GHR-81-010A			L/F/C	L/F/C	L
GHR-81-012			L/F/C	L/F/C	L
GHR-81-015			L/F/C	L/F/C	L
GHR-81-016			L/F/C	L/F/C	L
GHR-81-020			L/F/C	L/F/C	L
GHR-81-021			L		L
GHR-81-022			L/F/C	L/F/C	L
GHR-81-022B			L/F/C		L
GHR-81-023			L/F/C	L/F/C	L
GHR-81-024			L		L
GHR-81-025			L/F/C	L/F/C	L
GHR-81-026			L/F/C	L/F/C	L
GHR-81-027			L		L
GHR-81-030			L/F/C	L/F/C	L
GHR-81-035			L/F/C	L/F/C	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Regional Borrow
TITLE OF REPORT : 1981 Regional Borrow Investigation, Beaufort Sea

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : M. J. O'Connor and Associates Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C).

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-040			L/F/C	L/F/C	L
GHR-81-040A			L/F/C	L/F/C	L
GHR-81-041			L		L
GHR-81-042			L/F/C	L/F/C	L
GHR-81-043		L/F/C	L/F/C	L/F/C	L
GHR-81-044			L/F/C	L/F/C	L
GHR-81-045			L/F/C	L/F/C	L
GHR-81-046			L/F/C	L/F/C	L
GHR-81-047			L/F/C	L/F/C	L
GHR-81-048			L/F/C	L/F/C	L
GHR-81-051			L		L
GHR-81-052			L		L
GHR-81-060			L		L
GHR-81-060A			L/F/C	L/F/C	L
GHR-81-061			L/F/C	L/F/C	L
GHR-81-062			L/F/C	L/F/C	L
GHR-81-062A			L/F/C	L/F/C	L
GHR-81-063			L/F/C	L/F/C	L
GHR-81-064			L/F/C	L/F/C	L
GHR-81-065			L/F/C	L/F/C	L
GHR-81-066			L/F/C	L/F/C	L
GHR-81-066A			L/F/C	L/F/C	L
GHR-81-067			L/F/C	L/F/C	L
GHR-81-068			L/F/C	L/F/C	L
GHR-81-069			L	L/F/C	L
GHR-81-070			L/F/C	L/F/C	L
GHR-81-070A			L/F/C	L/F/C	L
GHR-81-071			L/F/C	L/F/C	L
GHR-81-071A			L/F/C		L
GHR-81-072			L/F/C	L/F/C	L
GHR-81-072A			L/F/C	L/F/C	L
GHR-81-073			L/F/C	L/F/C	L
GHR-81-074			L/F/C	L/F/C	L
GHR-81-075			L/F/C	L/F/C	L
GHR-81-076			L/F/C	L/F/C	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Regional Borrow
TITLE OF REPORT : 1981 Regional Borrow Investigation, Beaufort Sea

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : M. J. O'Connor and Associates Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-077			L		L
GHR-81-078			L/F/C	L/F/C	L
GHR-81-079			L/F/C	L/F/C	L
GHR-81-79A			L/F/C	L/F/C	L
GHR-81-79C			L/F/C	L/F/C	L
GHR-81-080			L/F/C	L/F/C	L
GHR-81-081			L/F/C	L/F/C	L
GHR-81-082			L/F/C	L/F/C	L
GHR-81-083			L/F/C	L/F/C	L
GHR-81-083A			L/F	L/F/C	L
GHR-81-084			L/F/C	L/F/C	L
GHR-81-085			L/F/C	L/F/C	L
GHR-81-086			L/F/C	L/F/C	L
GHR-81-087			L/F/C	L/F/C	L
GHR-81-088			L/F/C	L/F/C	L
GHR-81-089			L/F/C	L/F/C	L
GHR-81-090			L/F/C	L/F/C	L
GHR-81-091			L/F/C	L/F/C	L
GHR-81-092			L/F/C		L
GHR-81-092A			L/F/C		L
GHR-81-095			L		L
GHR-81-096			L/F/C		L
GHR-81-097			L/F/C	L/F/C	L
GHR-81-098			L/F/C	L/F/C	L
GHR-81-099			L/F/C	L/F/C	L
GHR-81-099A			L/F	L	L
GHR-81-075A			L/F/C		L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: East Amauligak
TITLE OF REPORT : Marine Bottom and Subbottom Survey, East Amauligak

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at Gulf Canada Square, basement storage.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-007	L		L	L	L
GHR-81-008	L		L	L	L
GHR-81-010	L		L/F/C	L/F/C	L
GHR-81-101	L		L/F/C	L/F/C	L
GHR-81-102	L		L/F/C	L/F/C	L
GHR-81-103	L		L/F/C	L	L
GHR-81-104	L		L/F/C	L/F/C	L
GHR-81-104B	L		L/F/C	L	L
GHR-81-105	L		L/F/C	L/F/C	L
GHR-81-105A	L		L/F/C	L	L
GHR-81-106	L		L/F/C	L	L
GHR-81-107	L		L	L/F/C	L
GHR-81-108	L		L/F/C	L/F/C	L
GHR-81-109	L		L/F/C	L	L
GHR-81-109A	L		L/F/C	L	L
GHR-81-110	L		L/F/C	L/F/C	L
GHR-81-111	L		L/F/C	L/F/C	L
GHR-81-112	L		L/F/C	L	L
GHR-8-113	L		L/F/C	L/F/C	L
GHR-81-114	L		L/F/C	L/F/C	L
GHR-81-115	L		L/F/C	L	L
GHR-81-116	L		L/F/C	L/F/C	L
GHR-81-117	L		L/F/C	L	L
GHR-81-118	L		L/F/C	L/F/C	L
GHR-81-119	L		L/F/C	L	L
GHR-81-120	L		L/F/C	L/F/C	L
GHR-81-122	L		L/F/C	L/F/C	L
GHR-81-122A	L		L/F/C	L/F/C	L
GHR-81-123	L		L	L/F/C	L
GHR-81-124	L		L/F/C	L/F/C	L
GHR-81-125	L		L/F/C	L/F/C	L
GHR-81-126	L		L/F/C	L/F/C	L
GHR-81-127	L		L/F/C	L/F/C	L
GHR-81-128	L		L/F/C	L/F/C	L
GHR-81-128A	L		L/F/C	L/F/C	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: East Amauligak
TITLE OF REPORT : Marine Bottom and Subbottom Survey, East Amauligak

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-129	L		L/F/C	L/F/C	L
GHR-81-130	L		L/F/C	L/F/C	L
GHR-81-131	L		L/F/C	L/F/C	L
GHR-81-132	L		L/F/C	L/F/C	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: East Amauligak
TITLE OF REPORT : Marine Bottom and Sub-bottom Survey, East Amauligak

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at Gulf Canada Square, basement storage.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-121			L/F/C	L	L
GHR-81-129B			L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: West Amauligak
TITLE OF REPORT : Marine Bottom and Subbottom Survey, East Amauligak

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at M.J. O'Connors and Associates, in the store room and at Gulf Canada Square, basement storage.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-005B	L		L/F/C	L	L
GHR-81-015	L		L	L	L
GHR-81-078	L		L/F/C	L/F/C	L
GHR-81-079A	L		L/F/C	L/F/C	L
GHR-81-201	L		L/F/C	L	L
GHR-81-203	L		L/F/C	L	L
GHR-81-205	L		L/F/C	L	L
GHR-81-207	L		L/F/C	L	L
GHR-81-209	L		L/F/C	L	L
GHR-81-211	L		L/F/C	L	L
GHR-81-213	L		L/F/C	L	L
GHR-81-215	L		L/F/C	L	L
GHR-81-217	L		L/F/C	L	L
GHR-81-219	L		L/F/C	L	L
GHR-81-221	L		L/F/C	L	L
GHR-81-222	L		L/F/C	L	L
GHR-81-222B	L		L	L	L
GHR-81-223	L		L/F/C	L	L
GHR-81-224	L		L/F/C	L	L
GHR-81-225	L		L/F/C	L	L
GHR-81-226	L		L/F/C	L	L
GHR-81-227	L		L/F/C	L/F	L
GHR-81-228	L		L	L	L
GHR-81-229	L		L/F/C	L	L
GHR-81-230	L		L/F/C	L	L
GHR-81-231	L		L/F/C	L	L
GHR-81-232	L		L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: North Issungnak Wellsite
TITLE OF REPORT : Marine Bottom and Subbottom Survey, North Issungnak Wellsite
SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
199			L/F	L	L
204			L	L	L
209			L	L	L
214			L	L	L
219			L	L	L
500			L	L	L
525			L	L	L
550			L	L	L
575			L	L	L
600			L	L	L
625			L	L	L
650			L	L	L
675			L	L	L
700			L	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: South Koakoak
TITLE OF REPORT : Marine Bottom and Subbottom Survey, South Koakoak

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-0003			L	L	L
GHR-81-0004			L	L	L
GHR-81-0005			L	L	L
GHR-81-051			L	L	L
GHR-81-350			L	L	L
GHR-81-801			L	L	L
GHR-81-806			L/F	L	L
GHR-81-811			L	L/F	L
GHR-81-821			L/F	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: West Tingmiark 1981
TITLE OF REPORT : Marine Bottom and Subbottom Survey, West Tingmiark 1981

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at M.J. O'Connors and Associates, in the store room and at Gulf Canada Square, basement storage.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-070	L		L/F/C	L/F/C	L
GHR-81-071	L		L/F/C	L/F/C	L
GHR-81-099	L		L/F/C	L/F/C	L
GHR-81-0003	L		L/F/C	L/F/C	L
GHR-81-1101	L		L	L	L
GHR-81-1102	L		L	L	L
GHR-81-1103	L		L	L	L
GHR-81-1103A	L		L/F	L	L
GHR-81-1103X	L		L/F	L	L
GHR-81-1104	L		L	L	L
GHR-81-1105	L		L	L	L
GHR-81-1106	L		L	L	L
GHR-81-1107	L		L	L	L
GHR-81-1108	L		L	L	L
GHR-81-1108X	L		L/F	L	L
GHR-81-1109	L		L	L	L
GHR-81-1110	L		L/F	L	L
GHR-81-1110A	L		L	L/F	L
GHR-81-1111	L		L/F	L	L
GHR-81-1112	L		L	L	L
GHR-81-1113	L		L	L	L
GHR-81-1114	L		L/F	L	L
GHR-81-1115	L		L	L	L
GHR-81-1116	L		L	L	L
GHR-81-1117	L		L/F	L	L
GHR-81-1118	L		L/F	L	L
GHR-81-1119	L		L	L	L
GHR-81-1120	L		L	L	L
GHR-81-1126A	L		L	L	L
GHR-81-1127A	L		L	L	L
GHR-81-1128B	L		L	L	L
GHR-81-1129B	L		L	L	L
GHR-81-1130B	L		L	L	L
GHR-81-1131B	L		L/F	L	L
GHR-81-1132B	L		L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: West Tingmiark 1981
TITLE OF REPORT : Marine Bottom and Subbottom Survey, West Tingmiark 1981

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-1133	L		L/F/C	L	L
GHR-81-1134	L		L/F/C	L	L
GHR-81-1135	L		L/F/C	L	L
GHR-81-1136	L		L	L	L
GHR-81-1137	L		L/F/C	L	L
GHR-81-11075	L		L/F/C	L/F	L
GHR-81-11085	L		L	L	L
GHR-81-11095	L		L/F/C	L	L
GHR-81-11105	L		L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1982
BLOCK/REGION NAME: West Tingmiark 1981-82
TITLE OF REPORT : Marine Bottom and Subbottom Survey, West Tingmiark Site Compilation 1981-82
SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at Gulf Canada Square, basement storage.
(SEE WEST TINGMIARK 1981 FOR GHR-81 LINE DATA)

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81	L		L	L	L
GHR-82-03	L		L	L	L
GHR-82-08	L		L	L	L
GHR-82-3101	L		L/F/C	L/F/C	L
GHR-82-3102	L		L/F/C	L/F/C	L
GHR-82-3104	L		L/F/C	L/F/C	L
GHR-82-3105	L		L/F/C	L/F/C	L
GHR-82-3106	L		L/F/C	L/F/C	L
GHR-82-3108	L		L/F/C	L/F/C	L
GHR-82-3109	L		L/F/C	L/F/C	L
GHR-82-3110	L		L/F/C	L/F/C	L
GHR-82-3112	L		L/F/C	L/F/C	L
GHR-82-3114	L		L/F/C	L/F/C	L
GHR-82-3114A	L		L/F/C	L/F/C	L
GHR-82-3116	L		L/F/C	L/F/C	L
GHR-82-3116A	L		L/F/C	L/F/C	L
GHR-82-3117	L		L/F/C	L/F/C	L
GHR-82-3118	L		L/F/C	L/F/C	L
GHR-82-3123	L		L	L	L
GHR-82-3124	L		L/F/C	L/F/C	L
GHR-82-3132	L		L/F/C	L/F/C	L
GHR-82-3144	L		L/F/C	L/F/C	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1982
BLOCK/REGION NAME: North Ukalerk Site
TITLE OF REPORT : Marine Bottom and Subbottom Survey, North Ukalerk Site

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at Gulf Canada Square, basement storage.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-82-01	L		L/F/C	L	L
GHR-82-02	L		L/F/C	L	L
GHR-82-1101	L		L/F/C	L/F/C	L
GHR-82-1102	L		L/F/C	L/F/C	L
GHR-82-1104	L		L/F/C	L/F/C	L
GHR-82-1106	L		L/F/C	L	L
GHR-82-1108	L		L/F/C	L/F/C	L
GHR-82-1110	L		L/F/C	L	L
GHR-82-1111	L		L/F/C	L/F/C	L
GHR-82-1112	L		L/F/C	L/F/C	L
GHR-82-1114	L		L/F/C	L	L
GHR-82-1116	L		L/F/C	L	L
GHR-82-1118	L		L/F/C	L	L
GHR-82-1121	L		L/F/C	L	L
GHR-82-1122	L		L/F/C	L	L
GHR-82-1123	L		L/F/C	L	L
GHR-82-1123A	L		L/F/C	L	L
GHR-82-1126	L		L/F/C	L/F/C	L
GHR-82-1128A	L		L/F/C	L/F	L
GHR-82-130	L		L/F/C	L/F/C	L
GHR-82-131	L		L/F/C	L/F/C	L
GHR-82-132	L		L/F/C	L/F/C	L
GHR-82-134	L		L/F/C	L/F/C	L
GHR-82-136	L		L/F/C	L/F/C	L
GHR-82-1137	L		L/F/C	L/F/C	L
GHR-82-1138	L		L	L/F/C	L
GHR-82-1140	L		L/F/C	L/F/C	L
GHR-82-1141	L		L/F/C	L/F/C	L
GHR-82-1142	L		L/F/C	L/F/C	L
GHR-82-1144	L		L/F/C	L/F/C	L
GHR-82-1144A	L		L/F/C	L/F/C	L
GHR-82-1146	L		L/F/C	L/F/C	L
GHR-82-1148	L		L/F/C	L/F/C	L
GHR-82-1150	L		L/F/C	L	L
GHR-82-1151	L		L/F/C	L/F/C	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1982
BLOCK/REGION NAME: North Ukalerk Site
TITLE OF REPORT : Marine Bottom and Subbottom Survey, North Ukalerk Site

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-82-1152	L		L/F/C	L/F/C	L
GHR-82-1154	L		L/F/C	L	L
GHR-82-1161	L		L/F/C	L	L
GHR-82-1171	L		L/F/C	L/F/C	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1982
BLOCK/REGION NAME: Isserk Borrow Site
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Isserk Borrow Compilation 1980-82
SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. 1980 and 81 line data was obtained at M.J. O'Connors and Associates, in the store room. 1984 line data was obtained at Gulf Canada, 15 flr. workroom.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-80-309			L/F/C	L	L
DHR-80-310			L/F/C	L	L
DHR-80-311			L/F/C	L	L
DHR-80-312			L/F/C	L	L
DHR-80-515B			L/F/C	L	L
GHR-81-025			L/F/C	L/F/C	L
GHR-81-062			L	L/F/C	L
GHR-81-062A			L/F/C	L/F/C	L
GHR-81-063			L/F/C	L	L
GHR-81-067			L/F/C	L/F/C	L
GHR-81-068			L/F/C	L/F/C	L
GHR-82-7101			L/F/C	L/F/C	L
GHR-82-7102			L/F/C	L/F/C	L
GHR-82-7104			L/F/C	L/F/C	L
GHR-82-7104A			L/F/C	L/F/C	L
GHR-82-7106			L/F/C	L/F/C	L
GHR-82-7116			L/F/C	L/F/C	L
GHR-82-7118			L/F/C	L/F/C	L
GHR-82-7118A			L/F/C	L	L
GHR-82-7120			L/F/C	L/F/C	L
GHR-82-7122			L/F/C	L/F/C	L
GHR-82-7124			L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1983
BLOCK/REGION NAME: Regional Lines 1983
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Regional Lines Interpretation
SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-83-01			L/F	L	L
GHR-83-02			L	L	L
GHR-83-03			L	L	L
GHR-83-05			L/F	L	L
GHR-83-06			L/F	L	L
GHR-83-16			L/F	L	L
GHR-83-17			L/F	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1983
BLOCK/REGION NAME: Kaslutut Site
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Kaslutut Site

SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-83-1001			L	L	L
GHR-83-1002			L/F	L	L
GHR-83-1003			L	L	L
GHR-83-1004			L/F	L	L
GHR-83-1005			L	L	L
GHR-83-1005			L	L	L
GHR-83-1006			L	L	L
GHR-83-1007			L	L	L
GHR-83-1009			L	L	L
GHR-83-1010			L	L	L
GHR-83-1011			L	L	L
GHR-83-1012			L	L	L
GHR-83-1013			L	L	L
GHR-83-1014			L/F	L	L
GHR-83-1015			L	L	L
GHR-83-1016			L	L	L
GHR-83-1016A			L	L	L
GHR-83-1016B			L/F	L	L
GHR-83-1017			L/F	L	L
GHR-83-1018			L	L	L
GHR-83-1019			L	L	L
GHR-83-1020			L	L	L
GHR-83-1021			L	L	L
GHR-83-1022			L	L	L
GHR-83-1023			L	L	L
GHR-83-1024			L	L	L
GHR-83-1024A			L	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1984
BLOCK/REGION NAME: Amauligak J-44 and I-65
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Amauligak Compilation Report 1981-84
SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room - reports. Line data was obtained at Gulf Canada, basement storage. (SEE EAST AMAULIGAK AND WEST AMAULIGAK FOR LINE DATA DONE IN 1981).

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81	L		L	L	L
GHR-82-04	L		L	L	L
GHR-82-05	L		L/F/C	L	L
GHR-82-06	L		L	L	L
GHR-82-5101	L		L/F/C	L	L
GHR-82-5102	L		L/F/C	L	L
GHR-82-5103	L		L/F/C	L	L
GHR-82-5104	L		L/F/C	L	L
GHR-82-5104A	L		L/F/C	L	L
GHR-82-5104B	L		L/F/C	L	L
GHR-82-5105	L		L/F/C	L	L
GHR-82-5106	L		L/F/C	L	L
GHR-82-5107	L		L	L	L
GHR-82-5108	L		L/F/C	L	L
GHR-82-5109	L		L/F/C	L	L
GHR-82-5110	L		L/F/C	L	L
GHR-82-A5102	L		L/F/C	L	L
GHR-82-A5104	L		L/F/C	L	L
GHR-82-A5106	L		L/F/C	L	L
GHR-82-A5108	L		L/F/C	L	L
GHR-82-6101	L		L/F/C	L/F/C	L
GHR-82-6102	L		L/F/C	L/F/C	L
GHR-82-6103	L		L/F/C	L/F/C	L
GHR-82-6104	L		L/F/C	L/F/C	L
GHR-82-6105	L		L/F/C	L/F/C	L
GHR-82-6106	L		L/F/C	L/F/C	L
GHR-82-6107	L		L/F/C	L	L
GHR-82-6108	L		L/F/C	L/F/C	L
GHR-82-A6102	L		L/F/C	L/F/C	L
GHR-82-A6104	L		L/F/C	L/F/C	L
GHR-82-A6106	L		L/F/C	L/F/C	L
GHR-84-201	L		L/F/C	L	L
GHR-84-203	L		L	L	L
GHR-84-203B	L		L	L	L
GHR-84-204	L		L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1984
BLOCK/REGION NAME: Amauligak J-44 and I-65
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Amauligak Compilation Report 1981-84
SPONSOR : Gulf Canada Resources Inc.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Gulf Canada Square, 15 flr., in the working library and the file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-84-205	L		L	L	L
GHR-84-209	L		L	L	L
GHR-84-210	L		L/F/C	L	L
GHR-84-213	L		L	L	L
GHR-84-215	L		L	L	L
GHR-84-217B	L		L/F/C	L	L
GHR-84-219	L		L/F/C	L	L
GHR-84-223	L		L/F/C	L	L
GHR-84-225	L		L/F	L	L
GHR-84-227	L		L	L	L
GHR-84-229	L		L/F/C	L	L
GHR-84-231	L		L	L	L
GHR-84-233	L		L/F/C	L	L
GHR-84-235	L		L/F/C	L	L
GHR-84-237	L		L/F/C	L	L
GHR-84-239	L		L/F/C	L	L
GHR-84-241	L		L/F/C	L	L
GHR-84-243	L		L	L	L
GHR-84-245	L		L/F/C	L	L
GHR-84-247	L		L/F/C	L	L
GHR-84-249	L		L/F/C	L	L
GHR-84-251	L		L/F/C	L	L
GHR-84-253	L		L/F/C	L	L
GHR-84-257	L		L/F/C	L	L
GHR-84-259	L		L/F/C	L	L
GHR-84-263	L		L/F/C	L	L
GHR-84-267	L		L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1983
BLOCK/REGION NAME: Regional Lines 1983
TITLE OF REPORT : Operations Report (NO REPORT AVAILABLE)

SPONSOR : ESSO Resources Canada Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: ESSO Plaza 16 flr., Judy Pickering
(NO REPORT AVAILABLE, LINE NUMBERS WERE OBTAINED FROM
A MAP) Line data was obtained at
M.J. O'Connors.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
83-01	L		L/F/C	L	L
83-02	L		L/F/C	L	L
83-03	L		L/F/C	L	L
85158	L		L/F/C	L	L
85159	L		L/F/C	L	L
85-089		L/F/C	L/F/C	L/F/C	L/F

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1982
BLOCK/REGION NAME: Amerk O-09
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Amerk O-09

SPONSOR : ESSO Resources Canada Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: ESSO Plaza 16 flr., working file room - reports.
Line data was obtained at M. J. O'Connors and Associates
, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
85054	L	L/F/C	L/F/C	L/F/C	L/F
85056	L	L/F/C	L/F/C	L/F/C	L/F
85057	L		L/F/C	L/F/C	L/F
85058	L	L/F/C	L/F/C	L/F/C	L/F
85059	L		L/F/C	L/F/C	L/F
85060	L		L/F/C	ABORT	L/F
85060A	L		L/F/C	L/F/C	L/F
85061	L		L	L	L
85062	L		L/F/C	L/F/C	L/F
85063	L		L/F/C	L/F/C	L/F
85064	L	L/F/C	L/F/C	L/F/C	L/F
85065	L	L/F/C	L/F/C	L/F/C	L/F
85066	L		L/F/C	L/F/C	L/F
85066A	L		L/F/C	L/F/C	L
85067	L		L/F/C	L/F/C	L/F
85068	L	L/F/C	L/F/C	L/F/C	L/F
85069	L		L/F/C	L/F/C	L/F
85070	L		L/F/C	L	L/F
85071	L		L/F/C	L/F/C	L/F
85070A			L/F/C	L/F/C	L/F

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1983
BLOCK/REGION NAME: Kaubvik I-43
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Kaubvik I-43

SPONSOR : ESSO Resources Canada Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: ESSO Plaza 16 flr., working file room - reports.
Line data was obtained at M.J. O'Connors and Associates,
in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
85072	L	L/F/C	L/F/C	L/F/C	L/F
85073	L	L/F/C	L/F/C	L/F/C	L/F
85074	L	L/F/C	L/F/C	L/F/C	L/F
85076	L		L/F/C	L/F/C	L/F
85077	L	L/F/C	L/F/C	L/F/C	L/F
85078	L	L/F/C	L/F/C	L/F/C	L/F
85079	L	L/F/C	L/F/C	L/F/C	L/F
85080	L	L/F/C	L/F/C	L/F/C	L/F
85081	L		L/F/C	L/F/C	L
85082	L	L/F/C	L/F/C	L/F/C	L/F
85083	L	L/F/C	L/F/C	L/F/C	L/F
85084	L	L/F/C	L/F/C	L/F/C	L/F
85085	L	L/F/C	L/F/C	L/F/C	L/F
85086	L	L/F/C	L/F/C	L/F/C	L/F
85087	L	L/F/C	L/F/C	L/F/C	L/F
85088	L	L/F/C	L/F/C	L/F/C	L/F
85089	L		L/F/C	L/F/C	L/F

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1983
BLOCK/REGION NAME: Kaubvik I-43
TITLE OF REPORT : Marine Bottom and Sub-bottom Survey, Kaubvik I-43

SPONSOR : ESSO Resources Canada Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: ESSO Plaza 16 Flr., working file room - reports.
Line data was obtained at M.J. O'Connors and Associates,
in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
85075		abort	L/F/C	L/F/C	L/F
85075A		L/F/C	L/F/C	L/F/C	L/F
85076A		L/F/C	L/F/C	L/F/C	L/F

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1983
BLOCK/REGION NAME: Nipterk L-19
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Nipterk L-19

SPONSOR : ESSO Resources Canada Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: ESSO Plaza 16 flr., working file room - reports.
Line data was obtained at M.J. O'Connors and Associates,
in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
851088	L	L/F/C	L/F/C	L/F/C	L/F
85118	L		L/F/C	L/F/C	L/F
85119	L		L/F/C	L/F/C	L/F
851120	L		L/F/C	L/F/C	L/F
85121	L		L/F/C	L	L/F
85122	L/F	L/F/C	L/F/C	L/F/C	L/F
85123	L		L/F/C	L	L/F
85123A	L	L/F/C	L/F/C	L/F/C	L/F
85124	L	L/F/C	L/F/C	L/F/C	L/F
85125	L	L/F/C	L/F/C	L/F/C	L
85126	L/F	L/F/C	L/F/C	L/F/C	L/F
85127	L	L/F/C	L/F/C	L/F/C	L/F
85128	L	L/F/C	L/F/C	L/F/C	L/F
85129	L	L/F/C	L/F/C	L/F/C	L/F
85130	L	L/F/C	L/F/C	L/F/C	L/F
85131	L/F	L/F/C	L/F/C	L/F/C	L/F
85132	L	L/F/C	L/F/C	L/F/C	L/F
85133	L	L/F/C	L/F/C	L/F/C	L/F
85134	L	L/F/C	L/F/C	L/F/C	L/F
85136	L		L/F/C	L/F/C	L/F
regional line 1		L/F/C			
85121A		L/F/C	L/F/C	L/F/C	L/F

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1985
BLOCK/REGION NAME: Arnak K-06
TITLE OF REPORT : Wellsite Survey Report, Arnak K-06

SPONSOR : ESSO Resources Canada Ltd.
CONTRACTOR : McGregor Geosciences Ltd.

DATA ARCHIVING: ESSO Plaza 16 flr., working file room

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
E86-282	L/F		L	L	L
E86-298	L/F		L/F	L	L
E86-299A	L		L/F	L	L/F
E86-300	L		L/F	L	L/F
E86-301	L		L	L	L
E86-301A	L		L	L	L
E86-301B	L		L	L	L
E86-301C	L		L	L	L
E86-302	L		L	L	L
E86-400	L		L	L	L
E86-401	L		L	L	L
E86-402	L		L/F	L	L
E86-402A	L		L	L	L
E86-403	L		L	L	L
E86-404	L		L	L	L
E86-406	L		L/F	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1978
BLOCK/REGION NAME: Regional Lines 1978
TITLE OF REPORT : Engineering Geophysical Survey in the Beaufort Sea

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geophysical Service Inc.

DATA ARCHIVING: Bank of Montreal (4th Street and 7th Avenue SW), 10th flr.
well file office

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHP-78-1					
DHR-78-2					

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1978
BLOCK/REGION NAME: Ukalerk C-50
TITLE OF REPORT : Volume 4 - Interpretation Report, Ukalerk C-50

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geophysical Survey Inc.

DATA ARCHIVING: Dome Library (Gulf Canada Square east side, 3rd flr.)

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
1			L		L
2			L		L
11			L		L
12			L		L
21			L		L
22			L		L
31			L		L
32			L		L
33			L		L/F
34			L		L
42			L		L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1980
BLOCK/REGION NAME: Uviluk Borrow Site
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Uviluk Borrow Study

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East side), 3rd flr. - reports. Line data was obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-80-502			L	L	L
DHR-80-506			L/F/C	L	L
DHR-80-527			L/F/C	L	L
DHR-80-55GA			L/F/C	L	L
DHR-80-643			L/F/C	L	L
DHR-80-647			L/F/C	L	L
DHR-80-651			L/F/C	L	L
DHR-80-653			L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Tingmiark and Ukalerk Borrow
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Tingmiark and Ukalerk Borrow Study
SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East, 3rd flr.) - reports. Line data was obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-80-521E			L/F/C	L	L
DHR-80-525C			L/F/C	L	L
DHR-80-527			L/F/C	L	L
DHR-80-601			L/F/C	L	L
DHR-80-605			L/F/C	L	L
DHR-80-609			L/F/C	L	L
DHR-80-610			L/F/C	L/F	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1980
BLOCK/REGION NAME: Regional Lines 1980
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Regional Lines 1980

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East side), 3rd flr. - reports. Line data was obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-80-529A	L		L	L	L
DHR-80-529B	L		L	L	L
DHR-80-531A	L		L/F/C	L	L
DHR-80-522	L		L/F/C	L	L
DHR-80-521C	L		L/F/C	L	L
DHR-80-521D	L		L/F/C	L	L
DHR-80-521E	L		L/F/C	L	L
DHR-80-751	L		L	L	L
DHR-80-501A	L		L	L	L
DHR-80-761	L		L	L	L
DHR-80-751B	L		L	L	L
DHR-80-525	L		L	L	L
DHR-80-525B	L		L	L	L
DHR-80-525C	L		L	L	L
DHR-80-556A	L		L/F/C	L	L
DHR-80-556B	L		L/F/C	L	L
DHR-80-533(PT1)	L		L/F/C	L	L
DHR-80-503(1)	L		L	L	L
DHR-80-505	L		L/F/C	L	L
DHR-80-506	L		L/F/C	L	L
DHR-80-527	L		L/F/C	L	L
DHR-80-522	L		L	L	L
DHR-80-550A	L		L	L	L
DHR-80-533B	L		L/F/C	L	L
DHR-80-533C	L		L	L	L
DHR-80-503(2)	L		L	L	L
DHR-80-546A	L		L	L	L
DHR-80-529C	L		L	L	L
DHR-80-534	L		L/F/C	L	L
DHR-80-507	L/F		L	L	L
DHR-80-530	L		L/F/C	L	L
DHR-80-546B	L		L	L	L
DHR-80-533C-1	L		L/F/C	L	L
DHR-80-546C	L		L/F/C	L	L
DHR-80-515	L		L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1980
BLOCK/REGION NAME: Regional Lines 1980
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Regional Lines 1980

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East side), 3rd flr.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-80-515B	L		L/F/C	L	L
DHR-80-540	L		L	L	L
DHR-80-540B	L		L/F/C	L	L
DHR-80-910B	L		L	L	L
DHR-80-531	L		L/F/C	L	L
DHR-80-533(PT2)	L		L	L	L
DHR-80-525A	L		L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Isserk Borrow Study
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Isserk Borrow Study

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East, 3rd flr.) - report. Line data was obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-80-310			L/F/C	L	L
DHR-80-311			L/F/C	L	L
DHR-80-312			L/F/C	L	L
DHR-80-515B			L/F/C	L	L
DHR-80-309			L/F/C	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Arluk -90
TITLE OF REPORT : Geophysical Site Survey Report, Arluk E-90

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geomarine Associates Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East, 3rd flr.)

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-81-130-20	L		L	L	L
DHR-81-130-20A	L		L	L	L
DHR-81-130-32	L		L	L	L
DHR-81-130-34	L		L	L	L
DHR-81-130-34A	L		L	L	L
DHR-81-130-36	L		L	L	L
DHR-81-130-38	L		L	L	L
DHR-81-130-42	L		L	L	L
DHR-81-130-46	L		L	L	L
DHR-81-130-48	L		L	L	L
DHR-81-130-21	L		L	L	L
DHR-81-130-33	L		L	L	L
DHR-81-130-35	L		L	L	L
DHR-81-130-37	L		L	L	L
DHR-81-130-49	L		L	L	L
DHR-81-130-49A	L		L	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Uviluk P-66
TITLE OF REPORT : Geophysical Site Survey Report Uviluk P-66

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geomarine Associates Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East side), 3rd flr.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-81-140-1	L		L	L	
DHR-81-140-2	L		L	L	
DHR-81-140-3	L		L	L	
DHR-81-140-4	L		L	L	
DHR-81-140-5	L		L	L	
DHR-81-140-6	L		L	L	
DHR-81-140-7	L		L	L	
DHR-81-140-8	L		L	L	
DHR-81-140-9	L		L	L	
DHR-81-140-10	L		L	L	
DHR-81-140-11	L		L	L	
DHR-81-140-12	L		L	L	
DHR-81-140-13	L		L	L	
DHR-81-140-14	L		L	L	
DHR-81-140-15	L		L	L	
DHR-81-140-16	L		L	L	
DHR-81-140-17	L		L	L	
DHR-81-140-18	L		L	L	
DHR-81-140-19	L		L	L	
DHR-81-140-20	L		L	L	
DHR-81-140-21	L		L	L	
DHR-81-140-22	L		L	L	
DHR-81-140-23	L		L	L	
DHR-81-140-24	L		L	L	
DHR-81-140-25	L		L	L	
DHR-81-140-26	L		L	L	
DHR-81-140-27	L		L	L	
DHR-81-140-28	L		L	L	
DHR-81-140-29	L		L	L	
DHR-81-140-30	L		L	L	
DHR-81-140-31	L		L	L	
DHR-81-140-32	L		L	L	
DHR-81-140-33	L		L	L	
DHR-81-140-34	L		L	L	
DHR-81-140-35	L		L	L	

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Uviluk P-66
TITLE OF REPORT : Geophysical Site Survey Report Uviluk P-66

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geomarine Associates Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East side), 3rd flr.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-81-140-36	L		L	L	
DHR-81-140-37	L		L	L	
DHR-81-140-38	L		L	L	
DHR-81-140-39	L		L	L	
DHR-81-140-40	L		L	L	
DHR-81-140-41	L		L	L	
DHR-81-140-42	L		L	L	
DHR-81-140-43	L		L	L	
DHR-81-140-44	L		L	L	
DHR-81-140-45	L		L	L	
DHR-81-140-46	L		L	L	
DHR-81-140-47	L		L	L	
DHR-81-140-48	L		L	L	
DHR-81-140-49	L		L	L	
DHR-81-140-50	L		L	L	
DHR-81-140-51	L		L	L	
DHR-81-140-52	L		L	L	
DHR-81-140-53	L		L	L	
DHR-81-140-54	L		L	L	
DHR-81-140-55	L		L	L	
DHR-81-140-56	L		L	L	
DHR-81-140-57	L		L	L	
DHR-81-140-58	L		L	L	
DHR-81-140-59	L		L	L	
DHR-81-140-60	L		L	L	
DHR-81-140-61	L		L	L	
DHR-81-140-62	L		L	L	
DHR-81-140-63	L		L	L	
DHR-81-140-64	L		L	L	
DHR-81-140-65	L		L	L	
DHR-81-140-66	L		L	L	
DHR-81-140-67	L		L	L	
DHR-81-140-68	L		L	L	
DHR-81-140-69	L		L	L	
DHR-81-140-70	L		L	L	

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Uviluk P-66
TITLE OF REPORT : Geophysical Site Survey Report Uviluk P-66

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geomarine Associates Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East side), 3rd flr.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-81-140-115	L		L	L	
DHR-81-140-119	L		L	L	
DHR-81-140-131	L		L	L	
DHR-81-140-135	L		L	L	
DHR-81-140-139	L		L	L	
DHR-81-140-147	L		L	L	

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Kogyuk Area
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Kogyuk Area

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East side), 3rd flr. - reports. Side scan data was obtained at M.J. O'Connors and Associates, in the store room. Other data was obtained at Gulf Canada, basement storage.

PART B: STUDY DETAILS

(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-301			L/F/C	L/F/C	L/F
GHR-81-302			L/F/C	L/F/C	L/F
GHR-81-303			L/F/C	L/F/C	L/F
GHR-81-304			L/F/C	L/F/C	L/F
GHR-81-305			L/F	L	L/F
GHR-81-306			L/F/C	L/F/C	L/F
GHR-81-306A			L/F	L	L/F
GHR-81-307			L/F/C	L/F/C	L/F
GHR-81-308			L	L	L/F
GHR-81-309			L/F/C	L/F/C	L/F
GHR-81-310			L/F/C	L/F/C	L/F
GHR-81-311			L	L	L/F
GHR-81-312			L/F/C	L/F/C	L/F
GHR-81-313			L/F/C	L/F/C	L/F
GHR-81-314			L/F/C	L/F/C	L/F
GHR-81-315			L/F/C	L/F/C	L/F
GHR-81-316			L	L	L/F
GHR-81-316A			L	L	L/F
GHR-81-317			L/F/C	L/F/C	L/F
GHR-81-318			L/F/C	L/F/C	L/F
GHR-81-319			L/F/C	L/F/C	L/F
GHR-81-320			L	L	L/F
GHR-81-321			L/F/C	L/F/C	L/F
GHR-81-322			L	L	L/F
GHR-81-323			L	L	L/F
GHR-81-323A			L	L	L/F
GHR-81-324			L	L	L/F
GHR-81-325			L	L	L/F
GHR-81-326			L/F/C	L/F/C	L/F
GHR-81-327			L	L	L/F
GHR-81-327A			L/F/C	L/F/C	L/F
GHR-81-328			L/F/C	L/F/C	L/F
GHR-81-329			L/F/C	L	L/F
GHR-81-330			L/F/C	L	LF
GHR-81-330A			L/F	L	L/F

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Kogyuk Area
TITLE OF REPORT : Marine Bottom and Subbottom Survey, Kogyuk Area

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East side), 3rd flr.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
GHR-81-321			L/F/C	L	LF
GHR-81-331A			L	L	L/F
GHR-81-332			L	L	L/F
GHR-81-010			L/F/C	L/F/C	
GHR-81-018			L	L	
GHR-81-043		L/F/C	L/F/C	L/F/C	
GHR-81-045			L/F/C	L/F/C	
GHR-81-046			L/F/C	L/F/C	
GHR-81-047			L/F/C	L/F/C	
GHR-81-075			L/F/C	L/F/C	
GHR-81-078			L/F/C	L/F/C	
GHR-81-089			L/F/C	L/F/C	

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1981
BLOCK/REGION NAME: Nerlerk Ridge
TITLE OF REPORT : N.A. (no report located)

SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East, 3rd flr.)
(LINE NUMBERS WERE OBTAINED FROM A MAP)

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-81-140-1					
DHR-81-140-2					
DHR-81-140-2A					
DHR-81-140-3					
DHR-81-140-3A					
DHR-81-140-4					
DHR-81-140-5					
DHR-81-140-6					
DHR-81-140-7					
DHR-81-140-8					
DHR-81-140-9					

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1982
BLOCK/REGION NAME: Regional Lines 1982
TITLE OF REPORT : Engineering Geophysical Programme High Resolution Seismic Survey, 1982 Vol.6
SPONSOR : Dome Petroleum Ltd.
CONTRACTOR : Geoterrex Ltd.

DATA ARCHIVING: Dome Library (Gulf Canada Square East, 3rd flr.)

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
DHR-82-02	L		L	L	L
DHR-82-02A	L		L/F	L	L
DHR-82-03	L		L/F	L	L
DHR-82-03A	L		L	L	L
DHR-82-04	L		L/F	L	L
DHR-82-05	L		L/F	L	L
DHR-82-06	L		L/F	L	L
DHR-82-07	L		L/F	L	L
DHR-82-08	L		L	L	L
DHR-82-09	L		L/F	L	L

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1983
BLOCK/REGION NAME: Nahidik
TITLE OF REPORT : N.A. (NO REPORT AVAILABLE)

SPONSOR : GSC
CONTRACTOR : N.A.

DATA ARCHIVING: (NO REPORT WAS AVAILABLE, A LIST OF LINES OBTAINED FROM EARTH AND OCEANS) Line data was obtained at M.J. O'Connors and Associates, in the store room.

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
NA83-1					
NA83-11					

CATALOGUE OF GRANULAR RESOURCE RELATED FIELD ACTIVITIES
BEAUFORT SEA
STUDY DATA SHEET

PART A: STUDY REFERENCE AND LOCATION

YEAR: 1986
BLOCK/REGION NAME: Nahidik
TITLE OF REPORT : Compilation 1985-86 (NO REPORT AVAILABLE)

SPONSOR : GSC
CONTRACTOR : N.A.

DATA ARCHIVING: (NO REPORT WAS AVAILABLE, A LIST OF LINES OBTAINED FROM EARTH AND OCEANS)

PART B: STUDY DETAILS
(listed= L, found= F, copied= C)

LINE #	MULTI-CHANNEL	NEAR TRACE	PROFILER	ECHO SOUNDER	SIDE SCAN
NA85-14					
NA85-15					
NA85-16					
NA85-17					
NA85-18					
NA85-19					
NA85-20					
NA86-1					
NA86-3A					
NA86-4-1					
NA86-4-1A					
NA86-5-1					
NA86-5-1A					
NA86-7					
NA86-8					
NA86-9					
NA86-9A					
NA86-10					
NA86-11					
NA86-11-1					
NA86-12					
NA86-13-0					
NA86-14					
NA86-15					
NA86-16					
NA86-20					
NA86-21					
NA86-22					
NA86-22-1					
NA86-22-2					
NA86-N-TU					
TY86-7+					
NA83-07			L/F/C	L/F/C	
NA83-08			L/F/C	L/F/C	
NA83-15			L/F/C		

APPENDIX 3

BORROW MATERIAL EVALUATION CRITERIA AND BOREHOLE LISTINGS FOR THE ERKSAK BORROW BLOCK

APPENDIX 3

The evaluation of the quality of the borehole material from the perspective of resource utilization was carried out by Mr. Neil MacLeod of EBA, under sub contract to Earth & Ocean for this study. Mr. MacLeod examined each borehole log and assessed it under five headings. A summary of the criteria within each heading is presented with in Table 3a-1.

Table 3a-2 presents all of the boreholes recorded for the Erksak Borrow Block by EBA Engineering Consultants Ltd. in their report entitled "Compilation of Borehole Logs for the Erksak Borrow Block Beaufort Sea" (EBA 1988b). Within this compilation, a total of 94 boreholes are recorded and presented with accompanying logs. A digital version of the data base was provided to INAC in EBA's ESELog format which incorporated additional detailed information not displayed on the plotted borehole logs which were available to this study.

These data were analyzed and the borehole material classified as to its utility as borrow material. In addition, measurements of the thickness of overburden and resource were taken and the presence of ice bonded material noted.

TABLE 3A-1 QUALITY FACTOR DEFINITIONS USED IN THE EVALUATION OF THE EBA 1988b ERKSAK GEOTECHNICAL BOREHOLE DATA BASE. (Definition of Table 3A-2 headings)

HEADING	EXPLANATION
B.H.	Borehole Number. This number is that constructed by EBA during their compilation to avoid confusion caused by duplicate borehole designations or to fit within their ESElog program.
W.D.(M)	Water Depth. The water depth listed is that measured during the drilling program. The water depth is in metres. It is not corrected for tidal variation, and for holes drilled from the ice during winter programs, the top of the ice is assumed to be at sealevel.
LNTH(M)	Borehole Length. The borehole length is that recorded at the end of the borehole log.

NOTE
A three part classification scheme was developed under this contract by Mr. Neil MacLeod of EBA. The headings for the classification are Dredgeability, Development Concerns and Stratigraphic Classification. In the table these are abbreviated to A, B, and C, respectively. These are ordered in terms of hierarchy, with the Dredgeability code being of primary importance, Development code secondary, and Stratification code tertiary. It will be noted that in some instances the same qualification appears in both the A and the B groups, for instance fineness of material or amount of overburden. This permits an evaluation of the limiting quality as either severe enough to preclude dredging or as a less severe consideration.
** end NOTE**

A	Dredgeability Code. The dredgeability of the material is related to the technology presently available and being employed within the Beaufort Sea. Material is presently excavated using either a Hopper Dredge or a Stationary Dredge. As these methods differ in their ability to utilize a resource, it is important to identify which deposits are suitable for each. If the material is considered unsuitable, it is also important to know why, as advances in dredging technology in a specific area may upgrade some deposits.

HEADING	EXPLANATION

A cont'd

The code numbers refer to the following conditions:

1 - Material suitable for exploitation by Hopper dredge only. The resource is covered by less than 0.5 metres of overburden, is greater than 1 metre thick but less than 5 metres thick.

2 - Material suitable for exploitation by Stationary dredge only. The resource is covered by 0.5 to 3.0 metres of overburden and is up to or greater than 20 metres thick.

3 - Material suitable for exploitation by either method. The resource is covered by less than 0.5 metres of overburden and is greater than 20 metres thick

4 - Material is covered by more than 3 metres of overburden and is therefore unsuitable for either dredge.

5 - Gradation is too fine for suitable fill performance.

6 - Both overburden and fines content are in excess of requirements.

7 - The coarse material is too thin (< 1 metre) or too fine for exploitation by Hopper dredge.

8 - Borehole data is inconclusive. The borehole is either too short or the log contains insufficient data.

B Development Concerns. This group is a modifier of Group A. Although the deposit may be determined to be generally suitable for borrow material, there may be limitations to its quality, or collection of the resource may be difficult due to certain geologic conditions, or the data may be suspect. These limitations may or may not preclude dredging depending on additional data.

The code numbers refer to the following conditions

11 - There are no limitations and the resource is of good quality.

12 - The resource may be of poor to unsuitable quality. The fines content is > 12%.

13 - Permafrost will be encountered by the dredge.

14 - The material is marginally too fine. D90 lies between 90 and 150 microns. Fines content lies between 12 and 18%.

HEADING		EXPLANATION
B cont'd	15 -	The overburden is near the upper limit of acceptability.
	16 -	Interbed(s) of clay, silt, or organics are present and may affect pit development or quality of the fill.
	17 -	Drilling or sampling methods are suspect.
	18 -	Borehole is too short for proper interpretation.

C. Stratigraphic Classification. These are not directly related to the suitability of the borrow material and are rather comments on the borehole material that may be used to correlate the stratigraphy from borehole to borehole or with seismic data. The comments draw on a wider understanding of the stratigraphic framework of the Central Beaufort Shelf and place the material within the existing stratigraphic model or identify stratigraphic patterns that may be useful in geologic interpretation.

The code numbers refer to the following conditions:

21 -	Granular sediments are at or very near (<0.5 metres) the seabed.
22 -	Simple stratigraphy of clay over some Unit B over sand.
23 -	Complexly stratified or very thick Unit B.
24 -	Complexly stratified sand strata (Unit C?).
25 -	Permafrost noted on the borehole logs.
26 -	Double clay layer.
27 -	Overburden (Unit A & B) exceed 15 metres and is possibly channel fill.
28 -	The borehole is too short for adequate interpretation.

HEADING	EXPLANATION

NOTE

In addition to the above evaluation, measurements of overburden and resource thicknesses were made for each borehole. This provides additional information that is not covered above but which is of value both to the engineer concerned with borrow resource, and to the geologist interested in establishing relationships between the boreholes.

Because of the general applicability of the two resource model, the boreholes are described in terms of a first encountered coarse unit and a second encountered coarse unit. From observation it is apparent that where there is only one sand unit present and the borehole longer than about 10 metres, the sand unit present is the older of the two.

end NOTE

The codes describing these aspects of the resource are as follows:

1a Thickness in metres of overburden over the shallowest occurrence of coarse material.

1b Thickness in metres of the shallowest occurrence of coarse material

2a Thickness in metres of overburden over the second occurrence of coarse material.

2b Thickness in metres of the second occurrence of coarse material

3. It is not practical to document in tabular form the variations within a borehole beyond this level. It is useful to know, however, what, in a general sense, occurs beneath the lowest coarse unit measured in the above category. A field has been inserted, therefore, that summarizes the core below this level.

The codes within this field refer to the following:

E - The coarse material extends to the bottom of the borehole

N - Silty or clayey material lie below the lowermost occurrence of coarse material and extend to the bottom of the borehole.

C - Sandy units and silty and clayey units lie below the second occurrence of coarse material.

HEADING	EXPLANATION
ICE	This column records whether or not ice bonding is identified within the borehole. Space permits only a true (T - ice is present) or false (F - no ice observed) statement within this table.

The remaining fields are self explanatory. They consist of UTM and geographic co-ordinates for each borehole. The UTM co-ordinates are taken from the EBA compilation report and the geographic co-ordinates computed from these figures.

TABLE 3A-2 BOREHOLES WITHIN THE ERKSAK BORROW BLOCK

BH	WD(M)	LNTH(M)	A	B	C	1a	1b	2a	2b	3	ICE	NORTHING	EASTING	ZONE	LATITUDE	LONGITUDE
Note: Underlined Boreholes contain dredgeable resource.																
282-1	30.2	122.5	4	16	21	0.6	3.7	3.9	16.2	C	T	7785191	586780	8	70.160174	-132.708603
87AE1	37.3	38.5	4	12	22	12.0	17.0	0.0	0.0	N	F	7779340	556316	8	70.116183	-133.516325
AE84S01	29.7	51.0	4	11	26	14.5	16.5	0.0	0.0	N	F	7770221	552956	8	70.035150	-133.610290
AF85S05	32.6	68.6	0	0	0	65.0	3.6	0.0	0.0	E	T	7772394	552152	8	70.054792	-133.630100
AF85S06	31.5	41.6	0	0	0	38.2	1.8	0.0	0.0	N	F	7772337	552081	8	70.054296	-133.631998
AF85S68	32.6	53.4	4	11	22	12.2	24.0	0.0	0.0	N	T	7772329	552072	8	70.054226	-133.632239
AL80-1	11.5	21.0	2	11	22	2.0	19.0	0.0	0.0	E	F	7753542	582929	8	69.877852	-132.839791
AL80-10	11.7	26.5	3	11	21	0.0	26.5	0.0	0.0	E	F	7754584	581993	8	69.887484	-132.863202
AL80-11	11.5	25.9	2	11	22	1.2	24.7	0.0	0.0	E	F	7753701	582708	8	69.879346	-132.845397
AL80-12	12.0	28.3	2	11	22	1.0	27.3	0.0	0.0	E	F	7753385	583211	8	69.876356	-132.832597
AL80-13	11.6	23.8	2	11	22	1.6	22.2	0.0	0.0	E	F	7753938	582930	8	69.881400	-132.839400
AL80-14	11.0	32.6	2	11	22	1.2	31.4	0.0	0.0	E	F	7753882	582511	8	69.881030	-132.850358
AL80-15	11.0	32.6	2	11	22	0.7	1.5	1.8	28.6	E	F	7753450	582680	8	69.877106	-132.846356
AL80-16	11.0	26.5	2	11	22	0.7	25.8	0.0	0.0	E	F	7753668	583141	8	69.878914	-132.834157
AL80-17	12.2	32.0	2	11	21	0.6	31.4	0.0	0.0	E	F	7754711	583150	8	69.888257	-132.832959
AL80-18	11.3	26.5	2	11	22	0.6	25.9	0.0	0.0	E	F	7754652	582738	8	69.887859	-132.843741
AL80-2	11.6	33.5	3	11	21	0.4	33.1	0.0	0.0	E	F	7754646	582942	8	69.887740	-132.838435
AL80-3	11.3	14.0	2	11	22	1.5	12.5	0.0	0.0	E	F	7754094	582402	8	69.882964	-132.853001
AL80-4	11.6	18.9	2	11	22	1.0	17.9	0.0	0.0	E	F	7754098	583488	8	69.882656	-132.824727
AL80-5	11.7	15.7	2	11	22	1.3	14.4	0.0	0.0	E	F	7753786	583198	8	69.879953	-132.832565
AL80-6	11.0	13.4	2	11	28	1.3	12.1	0.0	0.0	E	T	7752994	583000	8	69.872919	-132.838449
AL80-7	11.1	19.5	2	11	22	1.2	13.3	1.5	3.5	E	F	7753494	582375	8	69.877596	-132.854254
AL80-8	11.3	20.1	2	11	22	2.2	17.9	0.0	0.0	E	F	7754095	582934	8	69.882805	-132.839151
AL80-9	12.6	16.1	2	11	22	1.6	14.5	0.0	0.0	E	F	7755304	582706	8	69.893711	-132.843974
AOK81-4	23.8	21.3	4	11	28	16.0	5.3	0.0	0.0	E	F	7761749	561729	8	69.957273	-133.386053
AOK81-5	24.4	20.7	4	11	25	16.0	4.7	0.0	0.0	E	T	7762536	560103	8	69.964708	-133.428015
BTN1-1	22.2	1.4	1	11	21	0.0	1.4	0.0	0.0	E	F	7782696	571171	8	70.142594	-133.122474
BTN1-12	28.3	3.6	1	11	21	0.0	3.6	0.0	0.0	E	F	7784002	562768	8	70.156481	-133.343089
BTN1-13	30.8	3.7	1	11	21	0.0	3.7	0.0	0.0	E	F	7783009	562768	8	70.147581	-133.343801
BTN1-14	30.5	4.3	1	11	21	0.0	4.3	0.0	0.0	E	F	7782018	562752	8	70.138703	-133.344933
BTN1-4	25.6	4.2	1	11	21	0.0	4.2	0.0	0.0	E	F	7780126	571019	8	70.119604	-133.128564
BTN1-5	24.7	4.0	1	11	21	0.0	4.0	0.0	0.0	E	F	7779946	572063	8	70.117702	-133.101220
BTN1-6	26.8	4.0	1	11	21	0.1	3.9	0.0	0.0	E	F	7780023	572992	8	70.118131	-133.076695
BTN1-7	26.5	4.4	1	11	21	0.0	4.4	0.0	0.0	E	F	7780047	573982	8	70.118065	-133.050607
BTN1-8	24.7	3.4	1	11	21	0.0	3.4	0.0	0.0	E	F	7780038	574966	8	70.117700	-133.024706
BTN1-9	26.8	4.0	1	11	21	0.1	3.9	0.0	0.0	E	F	7780073	576007	8	70.117710	-132.997267
EK84S01	18.5	9.6	1	11	21	0.0	2.6	1.1	3.1	C	F	7764847	571201	8	69.982622	-133.136079
EK84S02	19.0	9.7	7	12	21	0.0	0.4	1.4	6.9	E	F	7765649	571200	8	69.989810	-133.135463
EK84S03	18.8	9.3	3	11	21	0.1	9.2	0.0	0.0	E	F	7766870	573478	8	70.000119	-133.074841
EK84S04	17.5	9.3	3	11	21	0.0	8.3	0.0	0.0	N	F	7767117	574107	8	70.002154	-133.058167

TABLE 3A-2 cont'd

BOREHOLES WITHIN THE ERKSAK BORROW BLOCK

BH	WD(M)	LNTH(M)	A	B	C	1a	1b	2a	2b	3	ICE	NORTHING	EASTING	ZONE	LATITUDE	LONGITUDE
Note: Underlined Boreholes contain dredgeable resource.																
EK84S05	18.7	9.1	3	11	21	0.0	5.0	0.8	3.3	E	F	7766042	573561	8	69.992675	-133.073353
EK84S06	18.9	9.6	3	11	21	0.0	3.3	0.6	5.7	E	F	7764198	571341	8	69.976767	-133.132936
EK84S07	17.5	9.4	3	11	21	0.0	6.8	0.7	1.9	E	F	7763570	571451	8	69.971109	-133.130563
EK84S1A	18.5	6.2	7	12	21	0.3	0.6	2.6	2.7	E	F	7764808	571162	8	69.982283	-133.137130
EK84S2A	19.3	6.2	7	12	21	0.0	0.4	1.5	4.3	E	F	7765678	571159	8	69.990081	-133.136513
EK84S3A	18.9	9.6	3	11	21	0.2	5.7	0.5	3.2	E	F	7766922	573483	8	70.000584	-133.074667
EK84S4A	17.5	9.2	1	11	21	0.0	2.5	1.2	4.8	C	F	7767092	574139	8	70.001921	-133.057350
EK84S5A	18.2	9.6	1	11	21	0.0	1.2	0.7	4.9	C	F	7766070	573519	8	69.992938	-133.074429
EK84S6A	18.8	9.0	3	11	21	0.0	9.0	0.0	0.0	E	F	7764150	571331	8	69.976340	-133.133236
EK84S7A	17.5	9.2	3	11	21	0.0	9.2	0.0	0.0	E	F	7763556	571499	8	69.970970	-133.129319
FUVI1	22.9	108.3	3	11	21	0.0	46.3	0.0	0.0	N	T	7797311	601278	8	70.263452	-132.312160
FUVI1A	20.2	10.0	3	11	21	0.0	10.0	0.0	0.0	E	F	7797290	601262	8	70.263270	-132.312608
KBBH1	27.7	46.5	2	11	22	2.0	39.8	0.0	0.0	N	T	7780799	566495	8	70.126840	-133.247194
KBBH2	26.5	44.8	2	11	21	3.0	40.0	0.0	0.0	N	T	7780908	566505	8	70.127814	-133.246848
KBBH3	27.3	83.7	2	11	21	3.0	38.2	31.3	11.2	E	T	7780798	566596	8	70.126805	-133.244534
KBBH4	27.7	45.9	2	11	22	1.3	41.4	0.0	0.0	N	T	7780630	566497	8	70.125325	-133.247269
KBBH5	27.1	46.2	2	11	22	0.7	45.0	0.0	0.0	N	F	7780799	566358	8	70.126875	-133.250803
KBVC01	30.0	10.0	4	16	26	3.6	4.9	0.7	0.8	E	F	7779272	565215	8	70.113480	-133.282050
KBVC02	28.0	6.8	7	12	21	0.4	6.4	0.0	0.0	E	F	7780882	566159	8	70.127670	-133.255983
KBVC03	24.0	17.3	1	12	21	0.0	17.3	0.0	0.0	E	F	7778323	567010	8	70.104516	-133.235516
KY82S02	28.1	31.7	2	11	22	1.8	29.9	0.0	0.0	E	F	7779260	563420	8	70.113820	-133.329318
KY82S03	28.0	76.3	2	11	22	1.0	41.5	21.3	3.4	C	T	7779220	563500	8	70.113441	-133.327241
NA81-1	18.9	25.6	6	12	27	21.6	4.0	0.0	0.0	E	F	7756186	560851	8	69.907616	-133.412781
NA81-2	15.5	29.6	4	11	27	15.3	14.3	0.0	0.0	E	T	7753935	556004	8	69.888522	-133.540559
NA81-3	18.6	26.5	4	11	27	22.3	4.2	0.0	0.0	E	T	7756081	563690	8	69.905998	-133.338842
NA81-7	16.8	25.3	4	11	27	18.6	6.7	0.0	0.0	E	F	7753970	561003	8	69.887717	-133.410324
NT82S01	35.4	81.1	1	11	21	0.2	5.2	8.6	37.0	N	T	7779880	578370	8	70.115275	-132.935226
NU82S01	34.1	81.7	4	12	23	10.0	25.5	0.0	0.0	N	T	7793065	587000	8	70.230647	-132.694934
NU82S02	34.4	10.0	4	11	22	3.7	0.1	0.5	5.7	E	F	7792010	585645	8	70.221650	-132.731839
NU82S03	34.8	10.0	4	12	23	0.7	0.7	2.1	2.1	N	F	7792690	586925	8	70.227313	-132.697294
SU83S01	26.5	76.1	3	11	21	0.2	35.8	36.0	4.1	E	T	7777810	576605	8	70.097254	-132.983495
SU83S02	22.9	69.9	3	11	21	0.0	44.6	0.0	0.0	N	T	7776215	574760	8	70.083500	-133.033380
UB80-37	37.8	11.0	2	11	28	3.0	8.0	0.0	0.0	E	F	7804440	566584	8	70.338698	-133.226704
UB80-38	26.5	12.8	3	11	21	0.2	11.4	0.9	0.3	E	F	7781615	571751	8	70.132746	-133.108069
UB80-39	26.2	18.3	3	18	31	0.2	18.1	0.0	0.0	E	F	7775393	570938	8	70.077209	-133.134513
UB80-40	16.2	15.9	1	18	21	0.0	5.5	1.0	9.4	E	F	7765666	572198	8	69.989688	-133.109332
UB80-41	19.2	13.1	3	18	21	0.0	13.1	0.0	0.0	E	F	7762566	570664	8	69.962326	-133.151936

TABLE 3A-2 cont'd

BOREHOLES WITHIN THE ERKSAK BORROW BLOCK

BH	WD(M)	LNTH(M)	A	B	C	1a	1b	2a	2b	3	ICE	NORTHING	EASTING	ZONE	LATITUDE	LONGITUDE
Note: Underlined Boreholes contain dredgeable resource.																
UB80-42	22.9	6.7	2	12	28	3.0	3.7	0.0	0.0	E	F	7766052	577103	8	69.991740	-132.980646
UB80-43	16.8	6.1	4	18	28	5.8	0.3	0.0	0.0	E	F	7757776	577458	8	69.917470	-132.978537
UB80-44	19.8	13.7	2	18	21	0.6	13.1	0.0	0.0	E	F	7772869	596962	8	70.046171	-132.453656
UB80-45	29.9	12.8	5	18	28	2.4	8.2	0.0	0.0	N	F	7778320	582879	8	70.099891	-132.818006
UB80-59	29.3	7.5	4	18	28	5.5	0.7	0.0	0.0	N	F	7787737	605644	8	70.175949	-132.208102
UB80-60	24.4	6.2	4	18	28	6.2	0.0	0.0	0.0	N	F	7779674	609848	8	70.101987	-132.107286
UB82S01	26.5	9.7	1	12	21	0.0	3.6	0.2	5.9	E	F	7777002	580487	8	70.088836	-132.882132
UB82S02	26.5	9.6	1	11	21	0.1	9.5	0.0	0.0	E	F	7776965	580485	8	70.088505	-132.882218
UB82S04	24.4	9.7	2	12	21	1.1	8.6	0.0	0.0	E	F	7775475	573483	8	70.077234	-133.067565
UB82S22	22.0	6.9	1	11	21	0.0	5.4	0.0	0.0	N	F	7777098	573494	8	70.091776	-133.065922
UB82S23	27.3	7.6	3	11	21	0.2	7.4	0.0	0.0	E	F	7777081	573505	8	70.091620	-133.065647
UB82S24	21.3	9.5	3	11	21	0.0	9.5	0.0	0.0	E	F	7775495	574989	8	70.076982	-133.027973
UB82S25	21.3	9.6	3	11	21	0.0	9.6	0.0	0.0	E	F	7775508	574974	8	70.077102	-133.028356
UB82S26	25.6	6.5	7	12	21	0.1	6.4	0.0	0.0	E	F	7781399	574996	8	70.129888	-133.022753
UB82S3A	24.1	9.5	0	0	0	3.2	6.3	0.0	0.0	E	F	7775488	573501	8	70.077345	-133.067081
UB82V05	25.0	7.0	1	11	21	0.5	6.2	0.0	0.0	N	F	7775005	574410	8	70.072757	-133.043602
UB82V06	24.1	9.0	4	18	21	0.3	8.7	0.0	0.0	E	F	7775000	574402	8	70.072715	-133.043816
UB82V07	25.9	8.2	6	18	28	2.0	5.5	0.0	0.0	N	F	7788087	563652	8	70.192878	-133.316786
UB82V08	24.4	1.2	8	18	28	0.6	0.6	0.0	0.0	E	F	7788086	563640	8	70.192872	-133.317104
UB82V09	27.7	5.5	1	11	21	0.2	4.4	0.0	0.0	N	F	7785523	567967	8	70.168795	-133.204747
UB82V10	28.9	6.4	1	11	21	0.1	4.6	0.3	1.4	E	F	7785548	567954	8	70.169022	-133.205070
UB82V11	28.0	3.8	1	11	21	0.2	3.6	0.0	0.0	E	F	7786791	568251	8	70.180084	-133.196258
UB82V12	28.0	4.2	1	11	21	0.3	3.9	0.0	0.0	E	F	7786802	568261	8	70.180180	-133.195986
UB82V13	29.3	7.9	3	11	21	0.0	7.9	0.0	0.0	E	F	7788610	569060	8	70.196170	-133.173450
UB82V14	29.6	7.0	3	11	21	0.0	7.0	0.0	0.0	E	F	7788615	569078	8	70.196210	-133.172970
UB82V15	25.6	3.4	4	18	28	2.3	1.1	0.0	0.0	E	F	7778981	566987	8	70.110419	-133.235620
UB82V16	25.6	2.7	4	18	28	1.4	1.3	0.0	0.0	E	F	7778983	566973	8	70.110440	-133.235987
UB82V17	28.3	6.7	4	18	28	1.0	5.7	0.0	0.0	E	F	7778989	566953	8	70.110499	-133.236509
UB82V18	25.0	8.5	3	11	21	0.0	8.5	0.0	0.0	E	F	7780615	572469	8	70.123584	-133.089977
UB82V19	25.3	7.9	3	11	21	0.0	7.9	0.0	0.0	E	F	7780626	572489	8	70.123677	-133.089441
UB82V20	29.6	7.9	3	11	21	0.0	7.9	0.0	0.0	E	F	7777447	572498	8	70.095184	-133.091827
UB82V21	24.1	8.2	3	11	21	0.0	8.2	0.0	0.0	E	F	7777450	572505	8	70.095209	-133.091640
UV80-46	29.0	7.3	1	11	21	0.2	4.6	2.0	0.5	E	F	7797852	599990	8	70.268803	-132.345670
UV80-47	29.0	7.7	1	11	21	0.0	7.7	0.0	0.0	E	F	7797942	601994	8	70.268820	-132.292440
UV80-48	30.8	9.0	2	18	21	0.5	8.5	0.0	0.0	E	F	7796358	601109	8	70.254983	-132.317752
UV80-49	29.3	8.3	2	18	21	0.5	7.8	0.0	0.0	E	F	7796143	599295	8	70.253764	-132.366057

TABLE 3A-2 cont'd

BOREHOLES WITHIN THE ERKSAK BORROW BLOCK

BH	WD(M)	LNTH(M)	A	B	C	1a	1b	2a	2b	3	ICE	NORTHING	EASTING	ZONE	LATITUDE	LONGITUDE
Note: Underlined Boreholes contain dredgeable resource.																
UV80-50	30.5	7.6	3	18	21	0.2	7.4	0.0	0.0	E	F	7799255	601270	8	70.280867	-132.310093
UV80-51	28.1	8.0	3	18	21	0.0	8.0	0.0	0.0	E	F	7796392	602971	8	70.254548	-132.268386
UV80-52	32.0	10.7	3	18	21	0.3	1.9	1.1	6.8	E	F	7794937	603052	8	70.241484	-132.267971
UV80-53	29.6	9.8	3	18	21	0.3	9.5	0.0	0.0	E	F	7791857	603030	8	70.213906	-132.272210
UV80-54	27.7	8.8	3	18	21	0.0	8.8	0.0	0.0	E	F	7794769	597388	8	70.242187	-132.418122
UV80-55	29.6	30.6	3	11	21	0.0	30.6	0.0	0.0	E	F	7797355	602200	8	70.263481	-132.287673
UV80-56	30.5	30.4	3	11	21	0.0	30.4	0.0	0.0	E	F	7796334	601000	8	70.254811	-132.320668
UV80-57	29.3	25.9	3	11	21	0.0	25.9	0.0	0.0	E	F	7797249	599999	8	70.263398	-132.346129
UV80-58	30.2	30.5	3	11	21	0.0	30.5	0.0	0.0	E	T	7798151	601226	8	70.270996	-132.312554