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

Part of the Northern Oil and Gas
Action Program (NOGAP Project A4–20)

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.
22 Waddell Ave.
Dartmouth, Nova Scotia
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SUMMARY

A study was undertaken by Earth & Ocean Research Ltd. (EOR) of two granular resource borrow block areas in the South Central Beaufort Sea for Indian and Northern Affairs Canada (INAC). The purpose of the study was two-fold: to establish the proven, probable, and prospective granular resource in the borrow block areas, and to fit this information within the context of a geologic framework and geologic model for the region. This report deals with the area designated by INAC as the Isserk Borrow Block. The Erksak Borrow Block area is described under separate cover.

Throughout most of the Isserk Borrow Block region, the original older, pre-marine, transgression paleosurface (top of Unit C) has been preserved over large areas. It is observed to form a highly dissected subaerial erosion surface that is elevated in a northwest - southeast trending ridge across the Akpak Plateau. The surface has been planated along the shallow southern edge of the site as it rises toward the shoreline and along the eastern and western flanks of the Akpak Plateau where it descends into the Kugmallit and Ikit Troughs, respectively. Elsewhere a texturally varied deposition of predominantly clays with silts and sands infills the interval between the older erosion surface and the transgressive unconformity, suggesting that the episode that produced the unconformity does not mark the initial marine incursion and onset of Unit B deposition.

Within the Isserk study area there are two possible granular resource deposits that are described within this report. The first is a shallow sand body which has most likely been derived from the older paleosurface materials (Unit C) but has been reworked and redistributed during transgression. The second is a near surface exposure of the older Unit C materials.

The lower pre-transgression sedimentary unit (Unit C) is exposed at or very near to the seafloor within the southeast quadrant of the site. Elsewhere it is covered by an overburden of transgressive clays and sands (Unit B). The transgressive sands occupy the west central part of the survey site. The sand deposit is thin, from 1.5 to 5 meters in thickness. It is exposed on the seafloor over this area and in a narrow deposit that extends from the main body which is located in the southeast. The sand body is of local extent and does not extend laterally to the south, east, or west beyond its surface exposure. The sand body does extend to the north where it is buried beneath younger finer sediments.

The upper transgressive sand body is separated from the lower Unit C sands by a clay layer of variable thickness throughout the area of borehole coverage. It is surmised that the upper material is derived from the lower source and originated from the southeast where Unit C is possibly exposed on the seafloor. The material is interpreted to be a littoral deposit and its present distribution is the result of redistribution by wave action at the paleoshoreline and wave and current action in the shallow nearshore area.

The transgressive clays and sands are exposed at the seafloor over the central to southern half of the site. A wedge of recent clays blankets the deposits across the northern portions of the site area.

Prospective granular resources derive from both the exposure of Unit C and exposure of the transgressive unit B. Within the transgressive unit, borehole and seismic control permit the classification of proven, probable, and prospective resource. Proven resource covers 19.062 $m^2 \times 10^6$ in area, probable, 18.006 $m^2 \times 10^6$, and prospective 16.711 $m^2 \times 10^6$. Borehole control also permits a volume of 45.03 $mm^3 \times 10^6$ to be calculated for the proven resource. Assuming a minimum thickness of one meter for the probable and prospective zones, volumes of 19.06 and 18.01 $m^3 \times 10^6$ are calculated.

The resource from the shallow exposure of the lower Unit C sediments is defined as prospective since there is virtually no quality factor associated with borehole control and limited seismic control within these areas. The area of this prospective resource is measured as 40.84 $m^2 \times 10^6$. Without borehole control, thickness of the deposit is conjectural. Assuming average thicknesses of 1, 5, and 20 meters, volumes of 40.84, 204.2, and 816.0 $m^3 \times 10^6$ are calculated respectively.

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 Sea, 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 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 Isserk 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 (1980). The Isserk Block is primarily confined to the region of the Akpak Plateau and is defined by the co-ordinate boundaries:

ISSERK

NW:	ZONE 8;	520,000E; 7,770,000N	(70°02'16"N;	134°28'30"W)
NE:	ZONE 8;	535,000E; 7,770,000N	(70°02'10"N;	134°04'53"N)
SW:	ZONE 8;	520,000E; 7,750,000N	(69°51'31"N;	134°28'47"W)
SE:	ZONE 8;	535,000E; 7,750,000N	(69°51'25"N;	134°05'22"W)

These co-ordinates describe a 20 km x 20 km square with an area of 400 km^2. The southern edge of the block lies approximately nine km to the north of Pullen Island, the nearest land.

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 Sea 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 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. Bill Livington, Chris Graham, and Ronna Johnstone of GULF, Kevin Hewitt of DOME, Bob Runnell and Judith Pikering of ESSO, Mike O'Connor of M.J. O'Connor and Associates and 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.

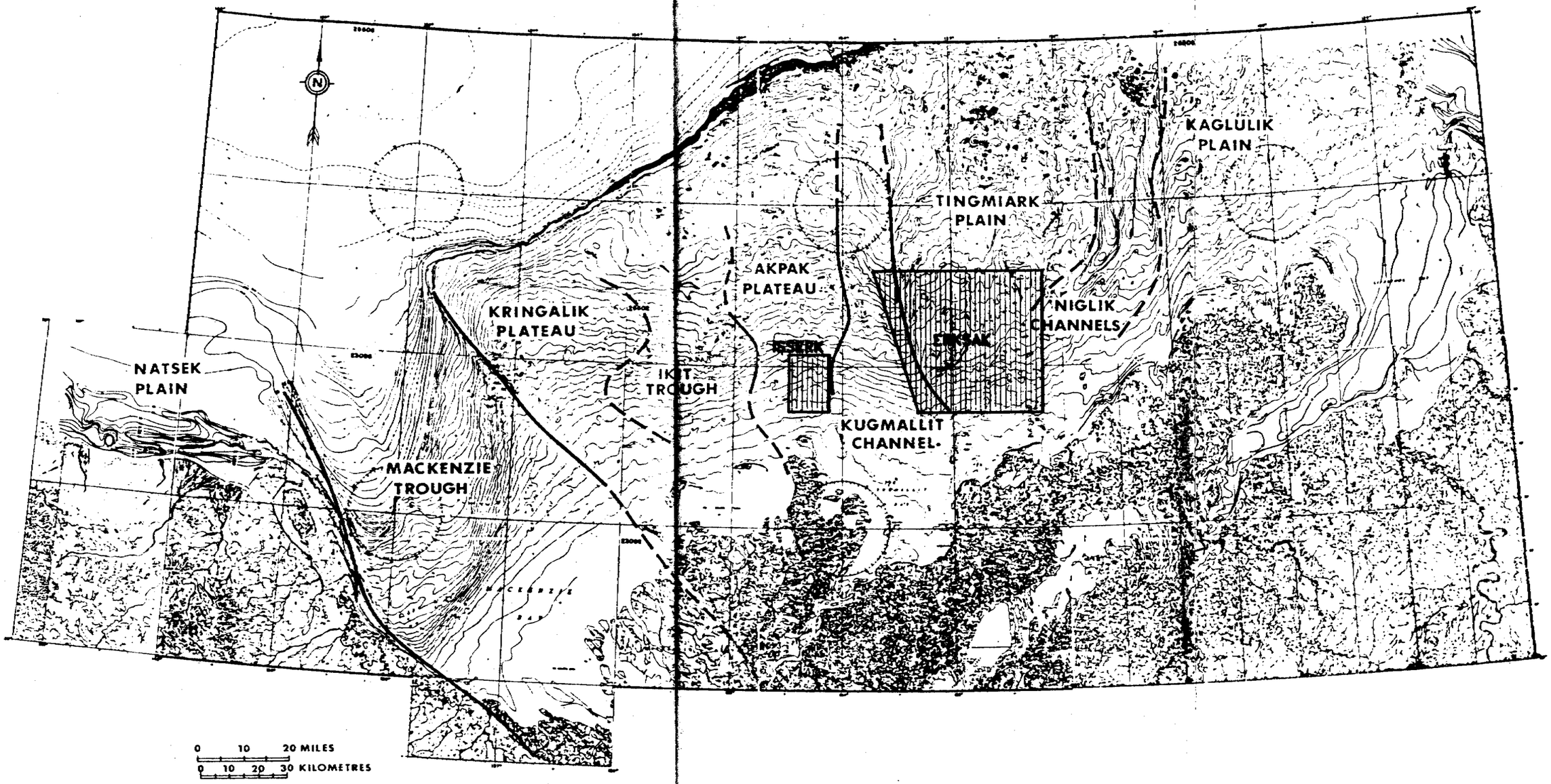


Figure 1 Location of the Erksak and Isserk Borrow Blocks relative to the Physiographic Provinces of the Beaufort Sea (after O'Connor, 1982a)

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

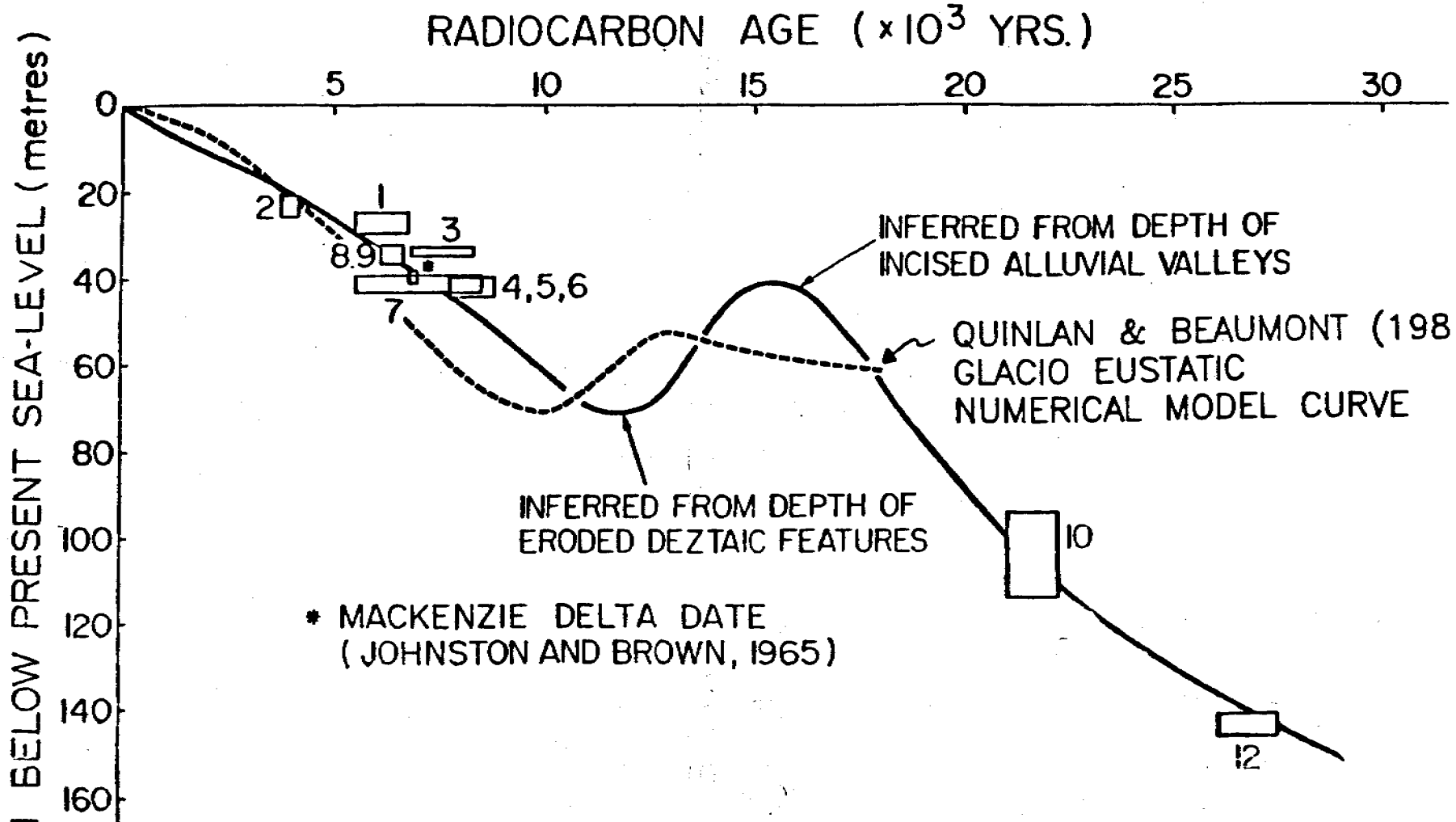
Arctic Islands today with the attendant aggradation of permafrost in the middle and inner shelf regions.

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 gentle slopes in 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 the 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	EBR
DRAWN BY:	
DATE:	FIGURE 2

TABLE 1 GEOLOGIC MODEL SUMMARY

Unit Designations O'Connor Unit	Unit Descriptions (from O'Connor 1980)
A	A horizontal sequence of recent marine sediments deposited on the shelf <u>following</u> 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 <u>during</u> 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	Unit Descriptions (from O'Connor 1980)
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 where these 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.

Within the eastern Beaufort area the physiographic regions are defined by a dominantly subaerially generated paleo-topography that has been etched into a glacio-fluvial or glacio-deltaic deposit. The basal deposit consists predominantly of sands laid down in channel cut and fill and outwash sheet configurations. This surface was further modified by erosion and redistribution of material under a marine transgressive environment. Pulsing of the transgression, incomplete planation 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 on the surface of the lower unit. Following transgression, marine clays were deposited in a hemipelagic environment within the topographic lows and over the seaward flanks of the highs. Recent and present day 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.

The Isserk Borrow Block lies on the Akpak Plateau in 8 to 24 meters of water, the Erksak Borrow Block on the Tingmiark Plain in 10 to 32 meters of water. These are submerged upland

physiographic regions located in the south central Beaufort Sea. They are separated from each other by the Kugmallit Channel, a north-south trending depression that emanates from Kugmallit Bay. The western boundary of the Akpak Plateau is formed by the Ikit Trough and the eastern boundary of the Tingmiark Plain by the Niglik Channels. The Ikit Trough also trends in an approximate north-south direction while the Niglik Channels have a south-southwest, north-northeast orientation. The Niglik Channels emanate from the Kugmallit Channel south of the Tingmiark plain, isolating this plain and the Erksak Borrow Block from the shoreline. A narrow part of the eastern edge of the Isserk Borrow Block extends over the Kugmallit Channel while the Erksak Borrow Block extends across the Tingmiark Plain and over the channel areas to either side to some extent. Below are presented brief descriptions of the physiographic regions in the vicinity of the Isserk Borrow Block.

2.2.1 Akpak Plateau

The Akpak Plateau is a trapezoidal shaped region of slightly convex (seaward) contours, trending almost northerly from the area of North Point on Richards Island virtually out to the shelf edge. Its boundaries are not easilly discerned from the bathymetry alone, especially inshore of the 30 m isobath, but are defined by changes in the morphology of the most recent unconformity. The Akpak Plateau has an elevated unconformity surface relative to the adjoining depressions. In the subsurface the region has a thin veneer of Unit A in most regions overlying a sandy Unit C with occasional occurrences of Unit B. The Unit C unconformity is observed to outcrop or very nearly outcrop in many areas. On the eastern margin the unconformity surface drops gradually into the depression of the Kugmallit Channel. The western margin is more complex; in the shallow water area the unconformity drops sharply into the depression of the Ikit Trough, but in deeper water it drops off much more gently and is accompanied by a gradual thickening of the Unit A recent marine materials.

2.2.2 Kugmallit Channel

The Kugmallit Channel is a gentle channel feature observed to be 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 and B 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 1982) 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 it 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 two unconformities in the region as U/C1 (upper) and U/C2 (lower). U/C2 apparently represents the most recent subareally 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 over by the transitional Unit B and marine Unit A sediments.

3 BORROW DEVELOPMENT CONSTRAINTS

A review of the surficial geology of an area for the purposes of borrow resource evaluation must consider 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 Isserk Borrow 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 the final destination of the resource. The economics and physical

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

operation of these types of dredges generally restricts their use to deposits that outcrop directly on the seabed and that 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 certainly result in 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 Isserk Borrow Block has used three primary data sets: bathymetry data, geophysical data, and geotechnical data. The bathymetric database, which provides seabed morphology and vertical survey control, is described later in Section 5.2. The geophysical data base is important for outlining the areal extent and distribution, and the physiographic and stratigraphic features which represent potential candidates for borrow material. It is however, a qualitative 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 this data base for the Beaufort area 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. 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 within the Isserk Borrow area is displayed in Figure 3 and at full scale as Enclosure 1.

The seismic data quality of the total geophysical data set on the whole, is 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.

Seismic data for the Isserk Borrow Block is an exception and of limited use in determining the stratigraphic equivalency of textural units between boreholes. There are several reasons for this. Significant data sets collected for Gulf Canada Resources in 1983, 1984, and 1985 were not found. Within the remaining dataset, the line density is too low over much of the area to accomodate the high variability in texture and elevation of units within and between boreholes. In the example seismic profile in Figure 4 it can be seen that the lower horizon forms five depressions that are separated from each other by rises of at least 4 meters local relief over a horizontal distance of about 4 km. To confidently map the detail of this horizon, a line spacing of 500 meters is required, a line spacing which is not achieved within the available data set for this block. As a result of the wide line spacing, there is considerable interpretation applied to the construction of the structure of this horizon. The paucity of check lines also inhibits correlation. There are only four check lines (north-south

lines) in the grid and these do not intersect all east-west lines.

Added to this limitation is the lessor quality of the seismic data set over the Isserk Block. Figure 5 is an example of the Gulf 1982 seismic data. This data comprises about 35 % of the available data set. The display consists of the microprofiler record displayed on the top half of the record and the boomer record displayed on the lower half. The microprofiler record is of reasonable quality, but as is typical of this type of system, has limited penetration into coarse sediments. The boomer data, however, is severely degraded by system noise from some source and identification and correlation of reflectors is dubious.

An additional problem is that of vertical scale. The stated scale of these records is 125 msec (approx. 94 m) per channel. A comparison of similar features on the profiler and boomer displays indicates that they are not, in fact, the same scale. Through comparisons with water depths recorded at boreholes located near the seismic lines it was determined that the boomer records are displayed at the correct scale of 125 msec and the microprofiler records are displayed at approximately 90 msec (68 m) full scale. The mechanism of this problem has not been determined, but this discrepancy casts some doubt on the validity of depth picks from these records.

The above data limitations largely restrict the litho-stratigraphic correlation of the Isserk Borrow Block to a study of the borehole stratigraphy. To the extent that the seismic data can contribute to the model it is included.

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.

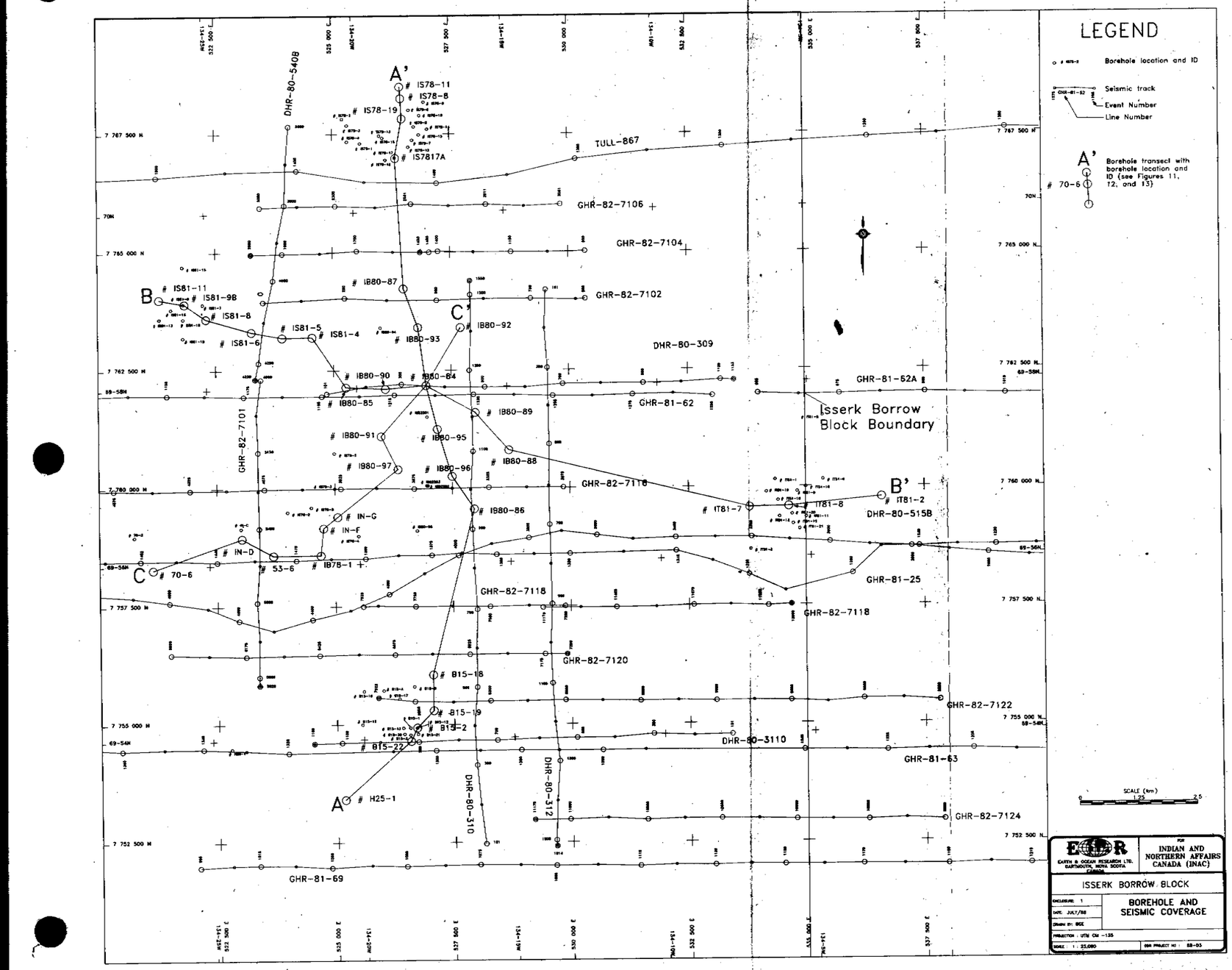

LEGEND
Borehole location and ID
Seismic track
Event Number
Line Number
Borehole transect with borehole location and ID (see Figures 11, 12, and 13)
A'
70-6
A
B
B'
C
C'
IS78-11
IS78-8
IS78-19
IS7817A
IS81-11
IS81-98
IS81-8
IS81-5
IS81-4
IS81-6
IB80-87
IB80-92
IB80-93
IB80-90
IB80-84
IB80-85
IB80-89
IB80-91
IB80-95
IB80-97
IB80-96
IB80-88
IB80-86
IT81-7
IT81-8
IT81-2
IN-G
IN-F
IN-D
53-6
IB78-1
70-6
B15-18
B15-19
B15-2
B15-22
H25-1
DHR-80-5408
TULL-867
GHR-82-7106
GHR-82-7104
GHR-82-7102
DHR-80-309
GHR-81-62
GHR-82-7101
GHR-82-7116
DHR-80-515B
GHR-81-25
GHR-82-7118
GHR-82-7120
GHR-82-7122
DHR-80-3110
GHR-81-63
DHR-80-312
DHR-80-310
GHR-82-7124
GHR-81-69
GHR-81-62A
Isserk Borrow Block Boundary
SCALE (km)
EOR
EARTH & OCEAN RESEARCH LTD. DARTMOUTH, NOVA SCOTIA CANADA
FOR INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ISSERK BORROW BLOCK
BOREHOLE AND SEISMIC COVERAGE
DATE: JULY/88
PROJECTION : UTM CM -135
SCALE : 1 : 25,000
EOR PROJECT NO : 88-05

FIGURE 3

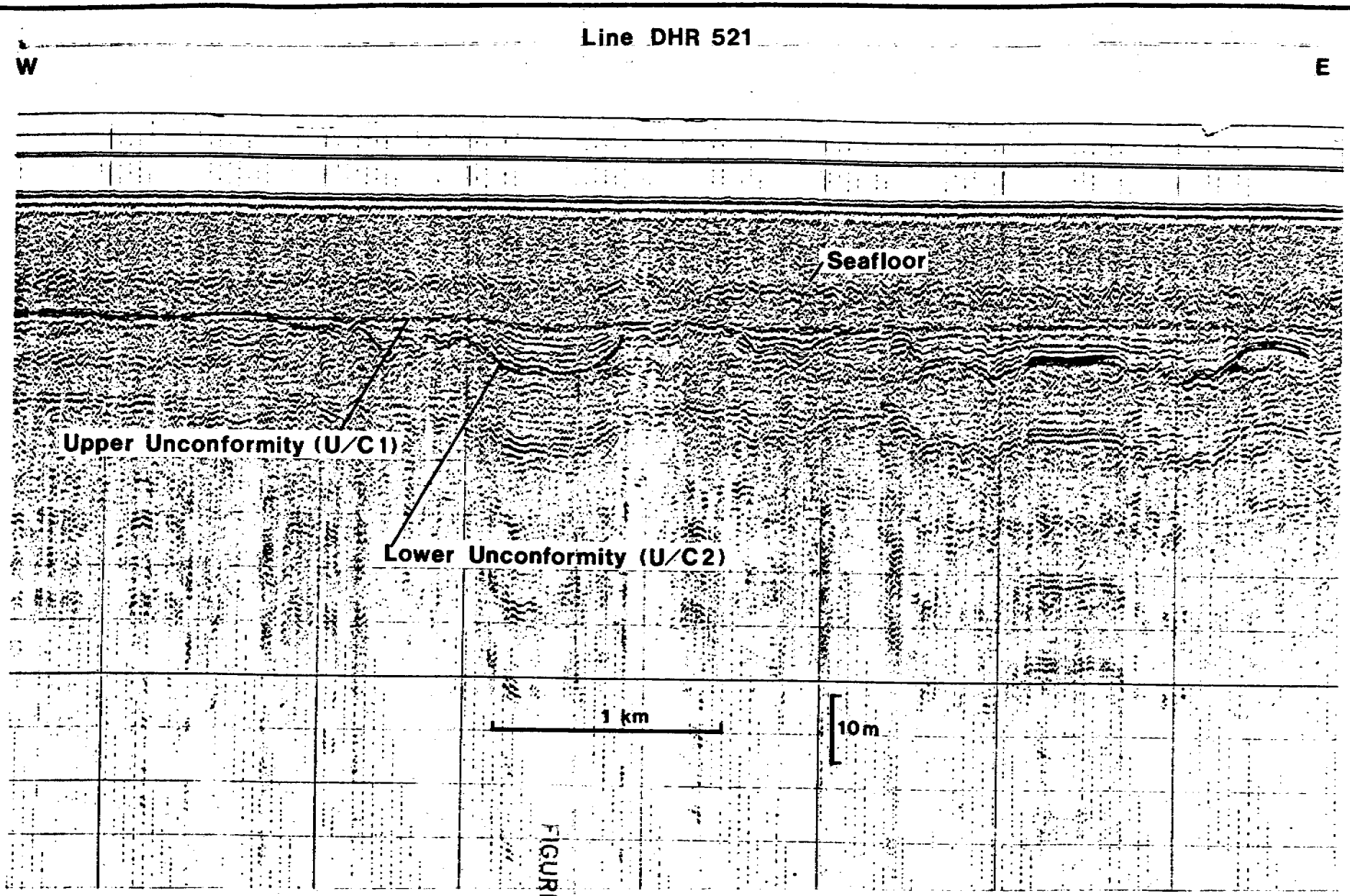


FIGURE 4

Section of east - west boomer line DHR80-521 located along the north edge of the Isserk Site. The relief displayed on the lower unconformity can only be approximated with the wide line spacing of the survey coverage.

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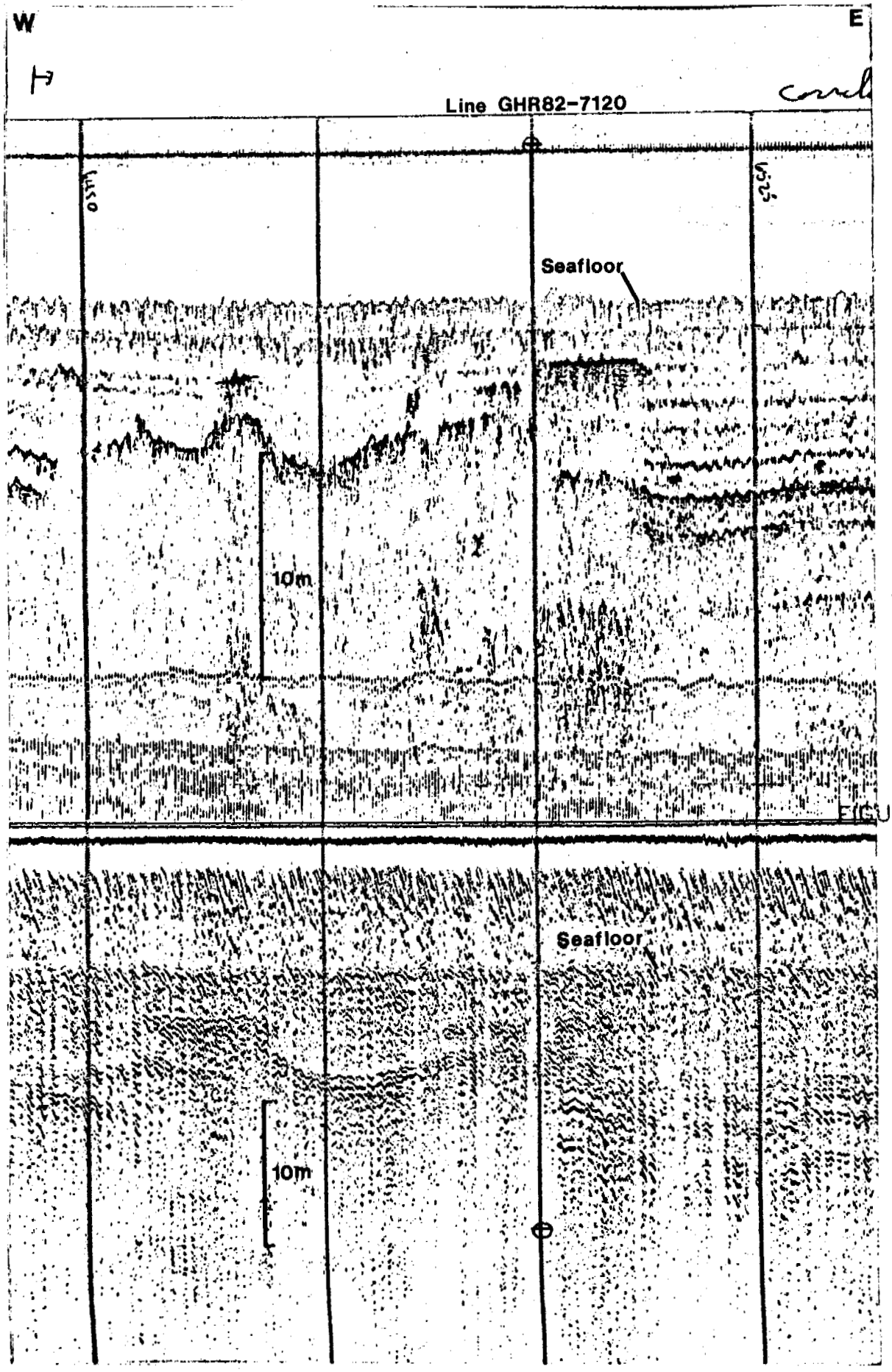
FIGURE 4



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Section of seismic line GHR82-7120. This record is typical of the data collected in 1982 over the Isserk Site. Note the low quality of the boomer data and the discrepancy in scale between the two displays.

FIGURE 5

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 Isserk 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.

Ninety-nine boreholes were identified within the Isserk Borrow Block (EBA, 1988a). The distribution of the boreholes within the Isserk Borrow Block is displayed on the track plot in Figure 3 and Enclosure 1. The map shows that the boreholes are concentrated in closely spaced sets rather than spread in a uniform distribution over the borrow blocks. The distribution reflects the normal objective of the borehole programs to determine suitable borrow material in proximity to preselected oil exploration targets. While a more uniform distribution would be of greater benefit to this program by providing ground truth for a wider range of seismically defined units, the concentration in specific areas is useful for determining the local variability of seismic units.

A serious shortcoming of the data set is that very few of the boreholes lie directly on or near the profile tracks. In some cases this is because the original seismic records were not found in the data search. This is the case, for instance, in the Issungnak O-61 wellsite area located on the northern edge of the Isserk block. It is known that a closely spaced suite of seismic data was collected over this site on behalf of ESSO Resources Ltd. The data, however, was not recovered. In other cases the boreholes were apparently drilled without seismic confirmation. The suite of boreholes that were taken over the main Isserk block fall into this category. The result of these

factors is that of the 99 boreholes located within the Isserk Block, only 22 lie within 250 meters of a seismic line.

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. 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. IT 78 - 10

Area Abbreviation Year Drilled - Borehole No.
(eg Itoyuk) (eg. 1978) - (eg. 10)

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 Isserk data base.

TABLE 2 BLOCK NAMES AND ABBREVIATIONS, ISSERK BORROW BLOCK

BOREHOLE SITE	ABBREVIATION(s)
Isserk	IB,IN,B15
Itoyuk	IT
Issungnak or Issungnak South	IS
Regional Drilling Programs	H,53-,70-

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 Isserk Borrow Block is moderate to sparse in relation to the overall size of the region. The boreholes tend to be clustered into 4 main groups which were drilled for exploration island sites and a more regional area associated with previous work on the core area of the borrow prospect itself.

5 DETAILED GEOLOGICAL DESCRIPTION: ISSERK BORROW BLOCK

Throughout this section of the report the discussion and interpretation is restricted to the region of the Isserk Borrow Block. It is aimed primarily at the surficial physiography and shallow sedimentary section for the sole purpose of granular resource borrow evaluation. 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 not to be interpreted as time stratigraphic interpretations which would be the norm for geological interpretation procedures.

5.1 Previous Work

The Isserk Borrow prospect has seen considerable work and study by the offshore operators and the government since approximately 1980. During 1980 Geoterrex/DOME first conducted five geophysical survey lines and 12 coreholes over the site. Musellec et al. (1980) reported an area of 13.4 sq. km. and a potential sand reserve estimate of 75.43 m^3 X 10^6 from the analysis of these data. Through 1981 and 1982 additional surveys and boreholes were completed on the prospect though EOR was unable to secure detailed reports on these programs.

O'Connor (1982), in a regional assessment of Borrow sites, reported the average D_{50} of the sands from the Isserk area to be approximately 200 um and that it outcrops directly at the seabed suggesting that hopper trailer dredges could be used for development though possibly constrained by bathymetry (minimum depth limitations).

O'Connor (1983), in a regional gravel assessment report, indicated that over 40 km of seismic data had been obtained at the site with 25 boreholes and 21 grab samples, and that during 1981 Dome had briefly carried out production dredging, and during 1982 Gulf had conducted some test dredging over the site. He estimated that 50 m^3 X 10^6 of granular material was present at the site with sand comprising approximately 80% of the volume. Of the remaining 10 m^3 X 10^6 of gravel, only 2 m^3 X 10^6 could be considered "proven" and that only 35 m^3 X 10^6 of the entire reserve could be considered "proven". Figure 6 is an example grain size curve for samples of coarse granular materials from the Isserk site (reproduced from O'Connor, 1983)

which demonstrates that the gravel tends to be very sandy and that the largest gravel materials noted were less that 20 mm in diameter. From the test dredging conducted by GULF in 1982, the mean D_{50} of material recovered was about 230 um, and only 2 of the 151 samples tested contained granular material with D_{90} in the gravel range (greater than 5 mm). His conclusion from this study was that the Isserk site was primarily a source of sand borrow material.

Olynyk and Quinn (1985) produced a compilation report on the Isserk Borrow site for GULF. Within this report they mapped the deposits and reported a small lens of gravel (1.2m thick) which appeared to be in the middle of the deposit. They were unable to fully map the outline of this lens due to the data coverage available. They reported the finding of some large gravel pieces (in one case, an 80 mm diameter cobble) and suggested a previous high-energy (beach) environment of deposition, or less-likely, an ice-rafted depositional scenario. Their study did not update volume estimates for the site although it did suggest a southward and eastward extension of the main body of fine sands.

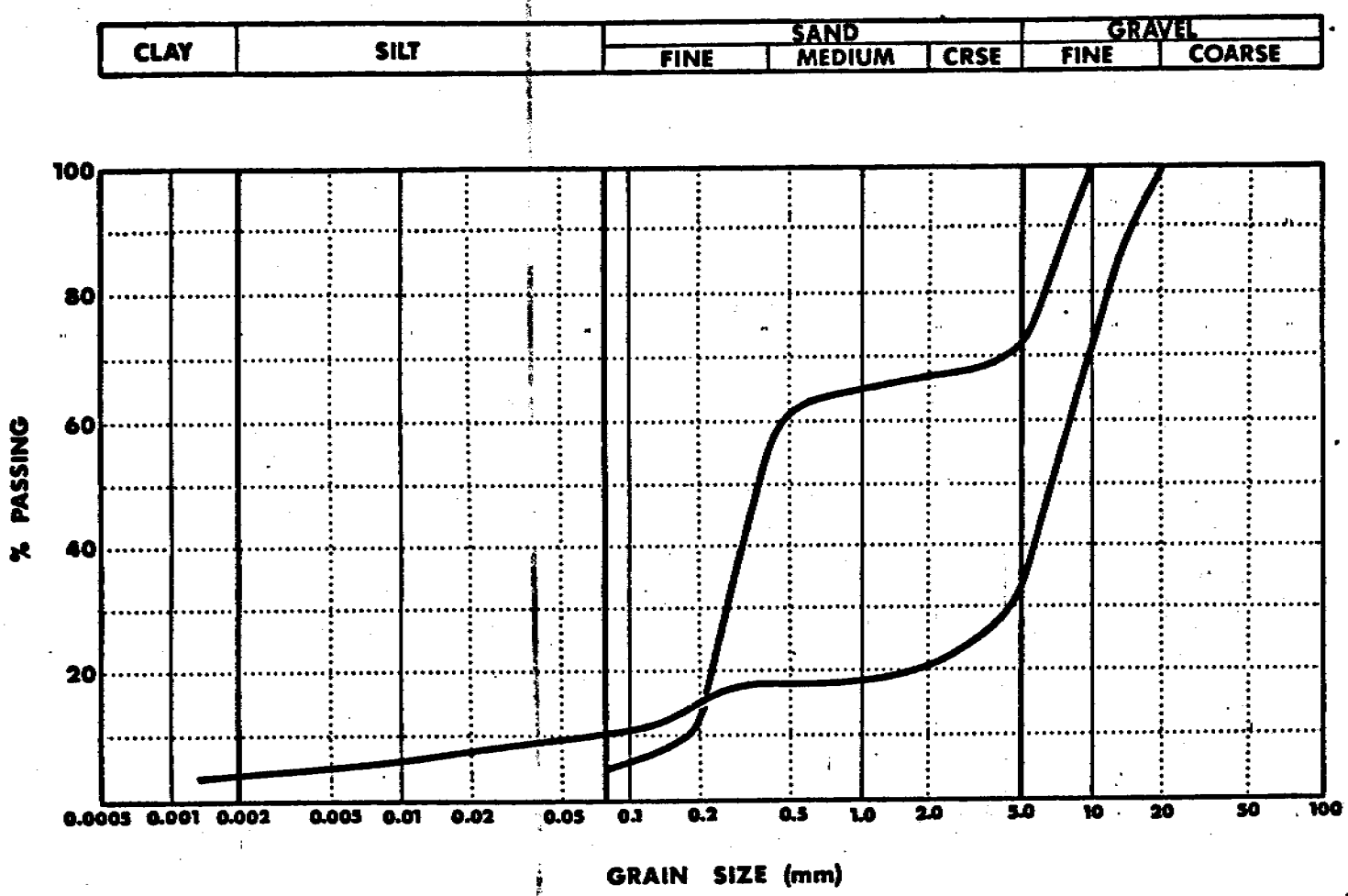

FIGURE6

Examples of Coarse Granular Material from Isserk

M.J. O'CONNOR & ASSOCIATES LTD.	
JOB NO.: 10-176	DATE: 83/03/31
DRAWN BY: JFT	DWG. NO.: 5.4

5.2 Bathymetry

The bathymetry of the site is presented in Figure 7 and Enclosure 2. This bathymetry is developed from a recontouring of Canadian Hydrographic field sheets WA 10077 and WA 10086, surveyed in 1969 and 1971, respectively. The original field sheets were displayed at 1:100,000 scale and line spacing varies from about 800 to 1500 meters over the area. Navigation for the surveys was by Decca Lamda and soundings are reduced to chart datum. Much of this area has been resurveyed by the Canadian Hydrographic Service in recent years and it is anticipated that a recontouring of this new and more accurate data will modify the shape and detail of the contours to some degree.

The contours describe a gently dipping plain that slopes to the north over the southern half of the site and to the north-northeast over the northern half of the site. The seafloor is slightly raised along a north-south axis through the west-center of the site and again along a northwest-southeast axis near the southeast corner. These rises are separate from each other, and are possible expressions of different geologic features.

Water depths over the site vary from a minimum of eight meters in the southeast corner to a maximum of 24 meters in the northeast corner. The slope of the surface to the north is uninterrupted.

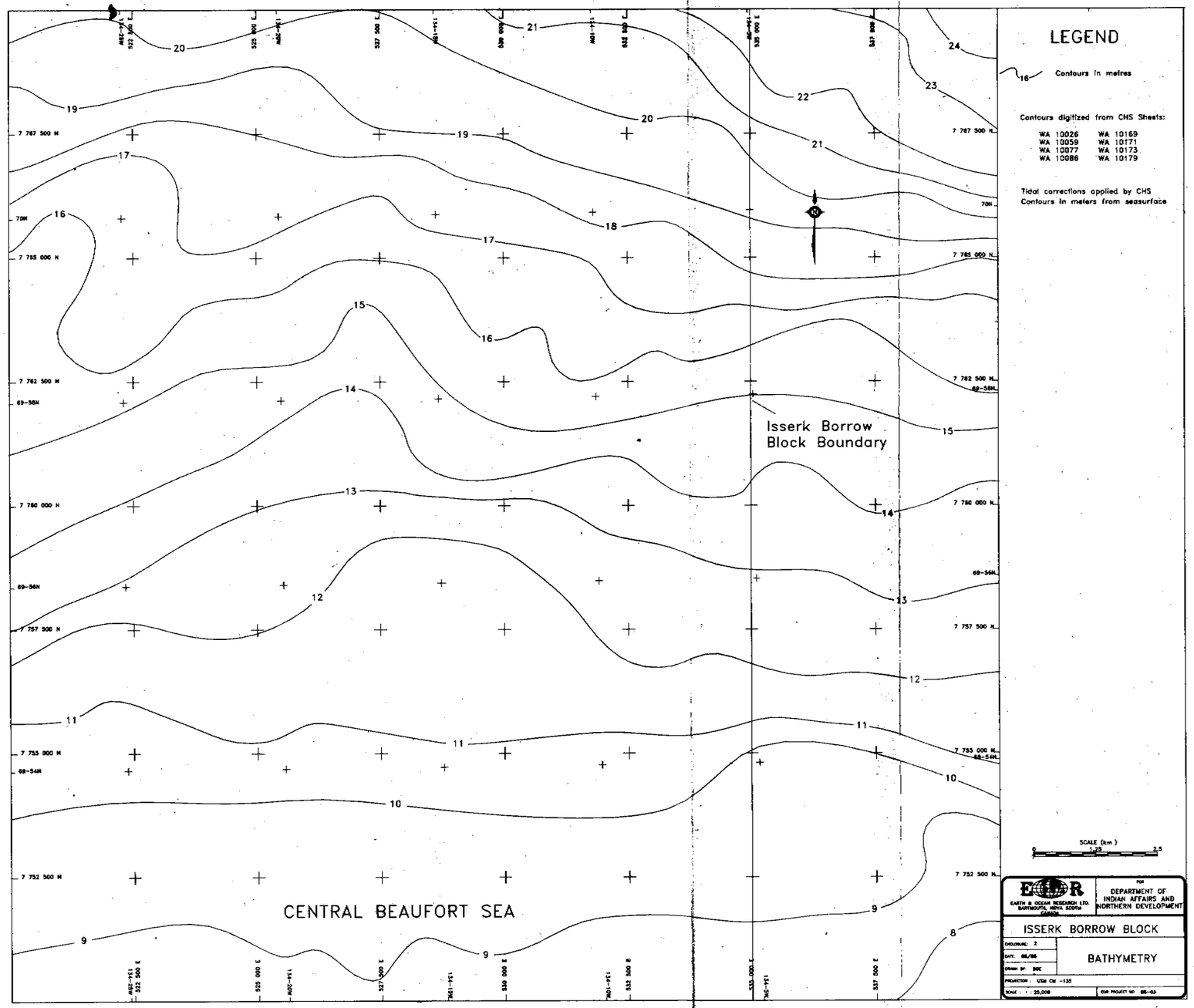
LEGEND
16 Contours in metres
Contours digitized from CHS Sheets:
WA 10026 WA 10169
WA 10059 WA 10171
WA 10077 WA 10173
WA 10086 WA 10179
Tidal corrections applied by CHS
Contours in meters from seasurface
Isserk Borrow Block Boundary
CENTRAL BEAUFORT SEA
SCALE (km)
0 1.25 2.5
EGR
EARTH & OCEAN RESEARCH LTD. DARTMOUTH, NOVA SCOTIA CANADA
FOR DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT
ISSERK BORROW BLOCK
BATHYMETRY
EGR PROJECT NO 88-03

FIGURE 7

5.3 Surficial Cover

The surficial cover over the Unit C sand material is displayed in Figure 8 and Enclosure 3. The cover is defined directly from borehole information and by inference from the seismic data. The surficial cover consists of coarse material, which occupies roughly the central and west central part of the block and extends to the southeast to the southern border of the site. It is bordered to the north, west, east and south by fine material. Sample data from the boreholes is available for the coarse material located in the central portion of the deposit. Within this area, the coarse material is predominantly composed of poorly graded fine sands to silty sands. The sands are non cohesive, olive brown to dark brown. Occasional gravel clasts from 15 to 25 mm in diameter occur throughout the deposit. The gravel clasts, where described, are polished and sub-rounded. The gravel content increases in pockets located along the southwest edge of the coarse deposit where it is equally dominant with the sand. These deposits are noted as being "gap graded" with the gravels being fine textured and the sands being poorly sorted fine to medium textured.

There are no boreholes within the portion of the coarse zone that extends from the central deposit to the southeast and beyond the southern boundary to the south. Seismic evidence suggests that this zone is composed of a combination of two geologic units. The younger unit is an extension of the central deposit and it is inferred that the texture of this extension will be similar to that of the central zone, i.e., generally poorly sorted silty sands with some gravel. The unit is defined by the transition of the surface character on the microprofiler and boomer records from an irregular microrelief to a featureless microrelief. Figure 9, a portion of profile GHR 82-7122 shows this transition. A slight doming of the seafloor is associated with this change in seismic signature.

The older unit extends from the south and is in contact with the younger in the south-central area. Textural information is not available for the deposit within the site although recent testing of the unit immediately to the south of the block reveals coarse sand and gravel at the seafloor (S.Blasco, pers comm.). The boundary of the deposit as outlined on the map, is defined as that area where Unit C rises to within two meters of the seafloor. The seismic data available are not of a sufficient resolution to measure the depth of the unit within this value and there may be areas within this boundary that are very close to the seafloor. The microprofiler data do not show the smooth seafloor trace characteristic of sand size sediments at the seafloor across this zone and the deposit may be covered by a thin soft veneer.

The fine material surrounding the coarse deposit consists 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.

While clay samples from throughout the area share this general variability, those of the Issungnak O-61 group of boreholes (IS78- series) at the northern boundary of the block are more consistently of high plasticity. Those of the Itoyuk I-27 (IT81- series), to the east, Isserk B-15 (B-15- series), to the south, and Issungnak South (S81-series) to the west are virtually all low plastic clays. This suggests that the Issungnak O-61 surficial clays are a different body than the clays to the south, a suggestion that is tentatively supported by the seismic data. A somewhat arbitrary boundary has been drawn across the northern end of the survey site to note this change in stratigraphic units.

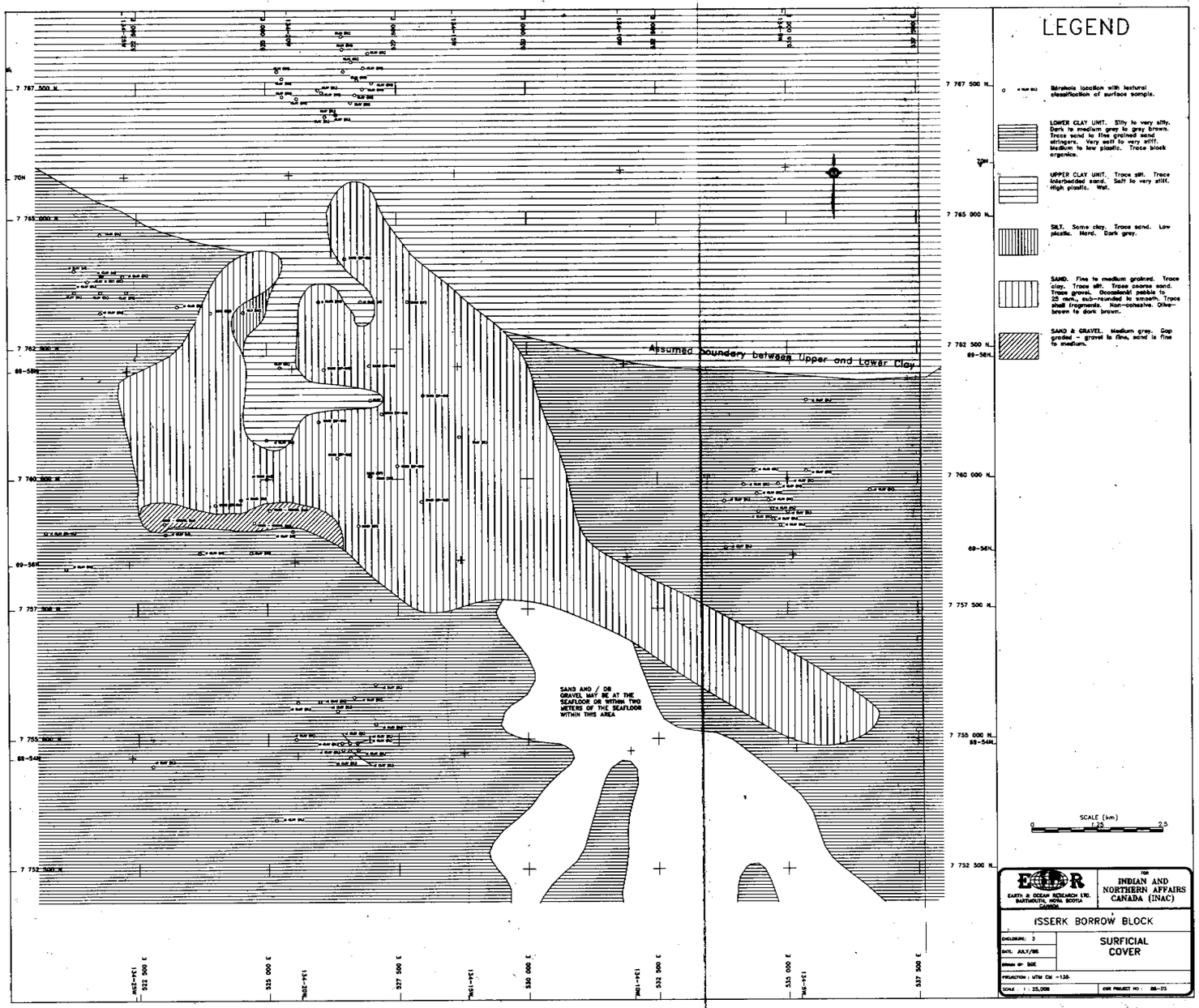
LEGEND
Borehole location with textural classification of surface sample.
LOWER CLAY UNIT. Silty to very silty. Dark to medium grey to grey brown. Trace sand to fine grained sand stringers. Very soft to very stiff. Medium to low plastic. Trace black organics.
UPPER CLAY UNIT. Trace silt. Trace interbedded sand. Soft to very stiff. High plastic. Wet.
SILT. Some clay. Trace sand. Low plastic. Hard. Dark grey.
SAND. Fine to medium grained. Trace clay. Trace silt. Trace coarse sand. Trace gravel. Occasional pebble to 25 mm, sub-rounded to smooth. Trace shell fragments. Non-cohesive. Olive-brown to dark brown.
SAND & GRAVEL. Medium grey. Gap graded - gravel is fine, sand is fine to medium.
Assumed boundary between Upper and Lower Clay
SAND AND / OR GRAVEL MAY BE AT THE SEAFLOOR OR WITHIN TWO METERS OF THE SEAFLOOR WITHIN THIS AREA
7 767 500 N
7 765 000 N
7 762 500 N
7 760 000 N
7 757 500 N
7 755 000 N
7 752 500 N
69-58N
70M
522 500 E
525 000 E
527 500 E
530 000 E
532 500 E
535 000 E
537 500 E
SCALE (km)
0 1.25 2.5
EDGER
EARTH & OCEAN RESEARCH LTD. DARTMOUTH, NOVA SCOTIA CANADA
FOR INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ISSERK BORROW BLOCK
ENCLOSURE: 3
DATE: JULY/95
SURFICIAL COVER
DRAWN BY: SOE
PROJECTION : UTM CM = 135-
SCALE : 1 : 25,000
EOR PROJECT NO : 86-175

FIGURE 8

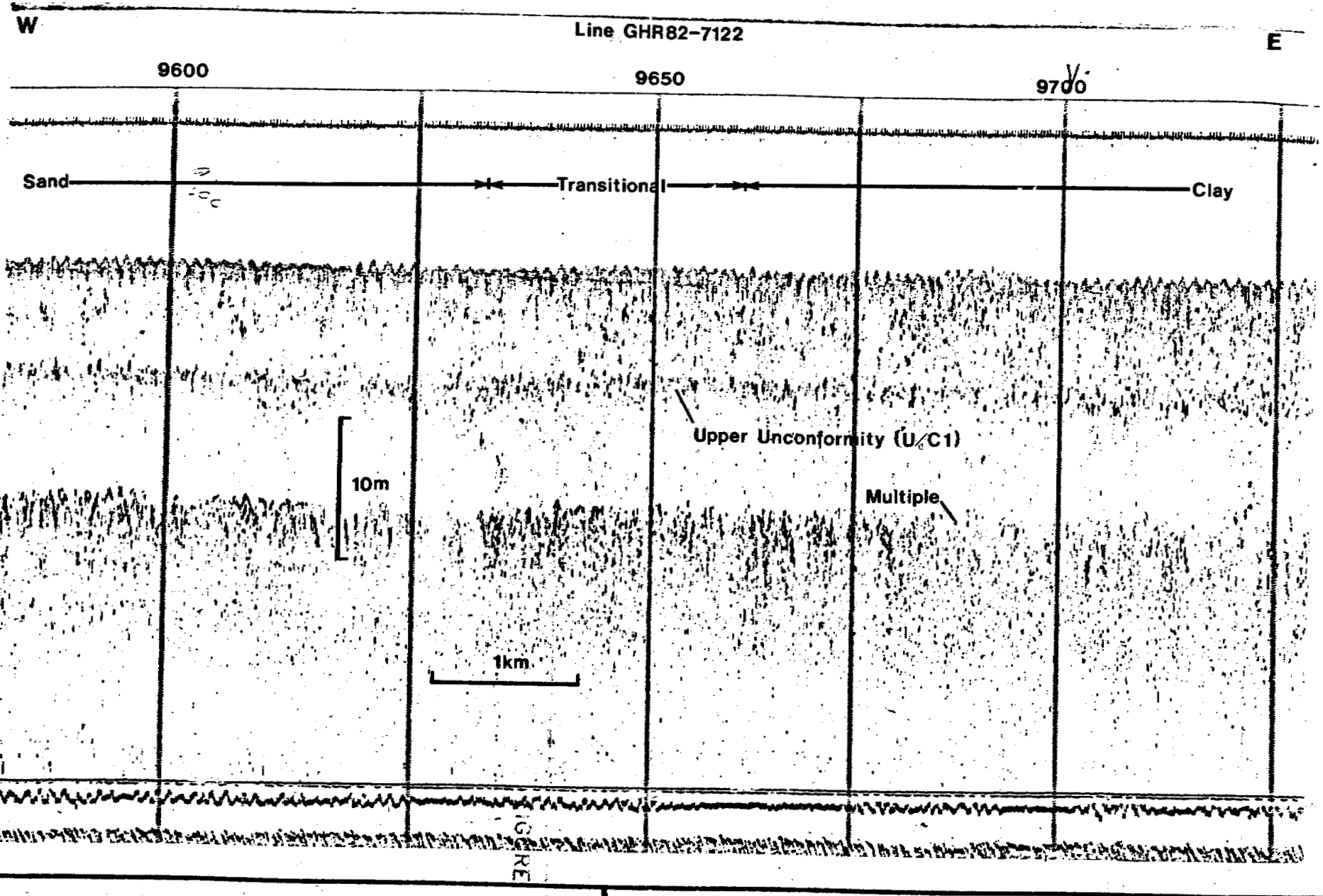

FIGURE 9

Section of east - west microprofiler line GHR82-7122 located in the southeast sector of the Isserk Site. The change in the character of the seafloor trace across the sand/clay boundary is illustrated.

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EOR

5.4 Sub-Surface Geology

The sub-surface geology within the site can be described within the framework of O'Connor's stratigraphic model for the Beaufort shelf. Units A, B, and C are identified and facies within these units discerned. The near surface litho-stratigraphy and structure are complex and distinct changes in seismic character are observed vertically and horizontally along individual seismic profiles. Continuity in the seismic data is generally poor, and the ability to confidently follow seismic horizons from line to line is low. While varying in detail, the boreholes present a more consistent picture of the general stratigraphy.

Three borehole transects have been constructed; a north-south transect, an east-west transect, and a southwest-northeast transect. These are presented as Figures 10, 11, and 12. The orientations are approximate and the transects do not form straight lines as they are determined by the distribution of the boreholes. The geographic positions correlating to these transects has been shown on the seismic track plot and borehole map of Figure 3, Enclosure 1.

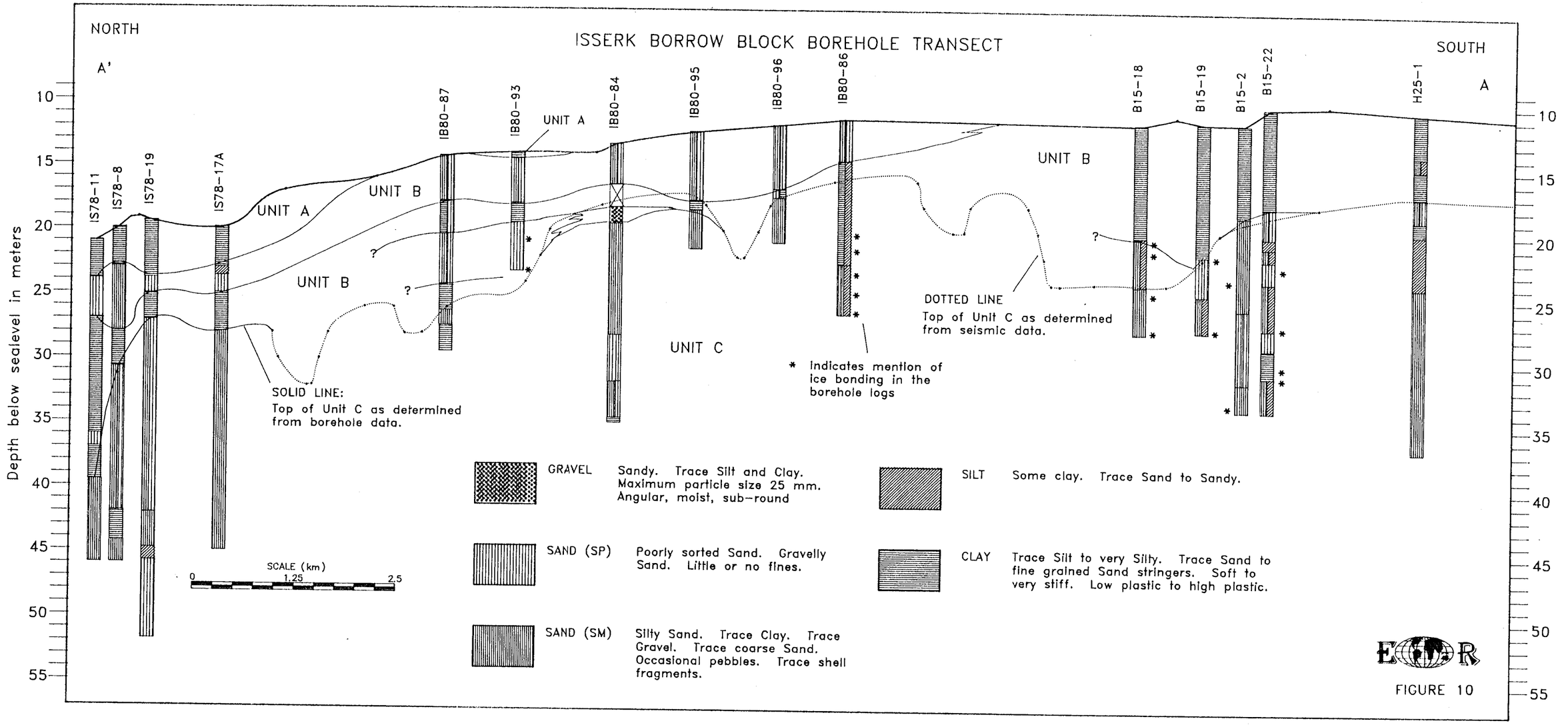
NORTH
A'
ISSERK BORROW BLOCK BOREHOLE TRANSECT
SOUTH
A
Depth below sealevel in meters
IS78-11
IS78-8
IS78-19
IS78-17A
IB80-87
IB80-93
IB80-84
IB80-95
IB80-96
IB80-86
B15-18
B15-19
B15-2
B15-22
H25-1
UNIT A
UNIT B
UNIT B
UNIT B
UNIT C
SOLID LINE:
Top of Unit C as determined from borehole data.
DOTTED LINE
Top of Unit C as determined from seismic data.
* Indicates mention of ice bonding in the borehole logs
SCALE (km)
0
1.25
2.5
GRAVEL
Sandy. Trace Silt and Clay. Maximum particle size 25 mm. Angular, moist, sub-round
SAND (SP)
Poorly sorted Sand. Gravelly Sand. Little or no fines.
SAND (SM)
Silty Sand. Trace Clay. Trace Gravel. Trace coarse Sand. Occasional pebbles. Trace shell fragments.
SILT
Some clay. Trace Sand to Sandy.
CLAY
Trace Silt to very Silty. Trace Sand to fine grained Sand stringers. Soft to very stiff. Low plastic to high plastic.
10
15
20
25
30
35
40
45
50
55

FIGURE 10

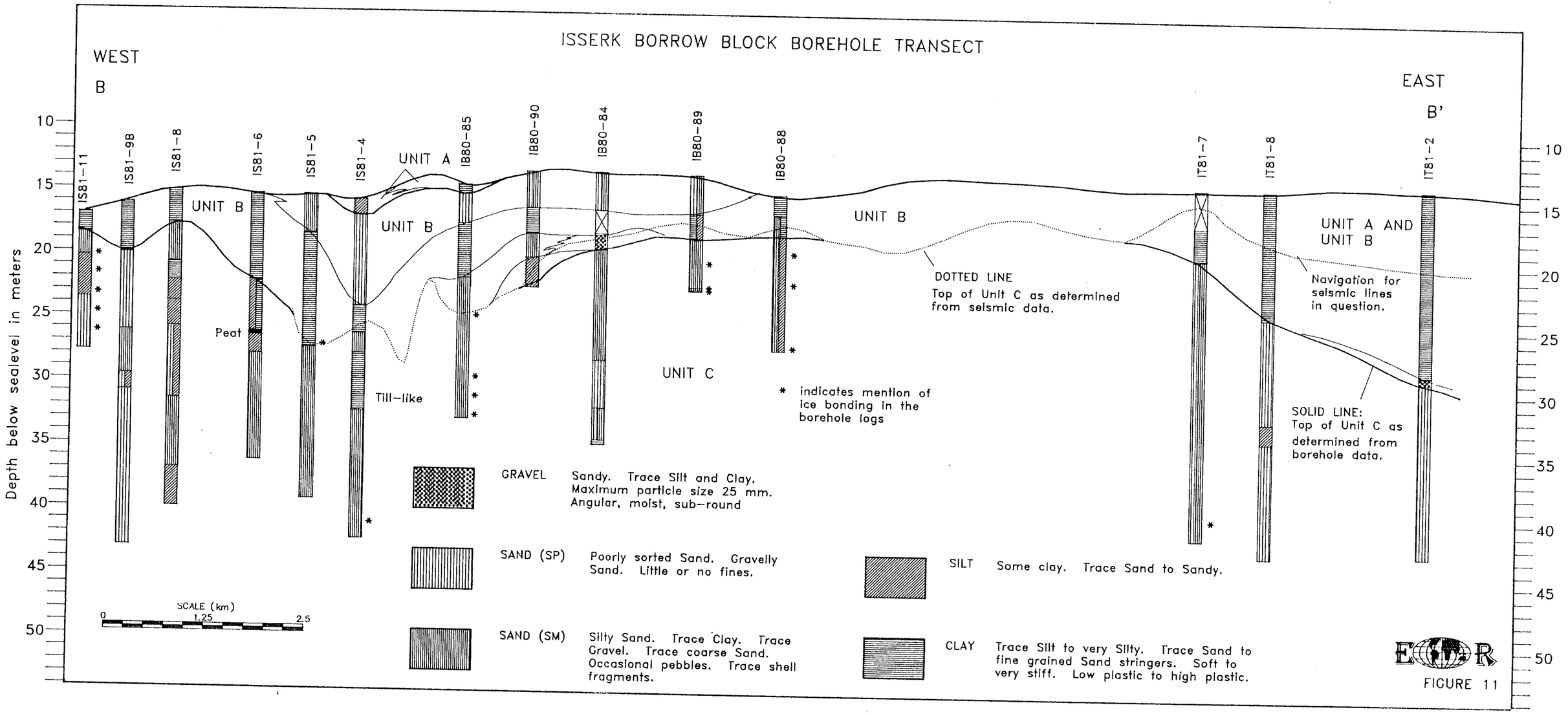
ISSERK BORROW BLOCK BOREHOLE TRANSECT
WEST
B
EAST
B'
IS81-11
IS81-9B
IS81-8
IS81-6
IS81-5
IS81-4
IB80-85
IB80-90
IB80-84
IB80-89
IB80-88
IT81-7
IT81-8
IT81-2
UNIT A
UNIT B
UNIT B
UNIT B
UNIT A AND UNIT B
Peat
Till-like
UNIT C
DOTTED LINE
Top of Unit C as determined from seismic data.
Navigation for seismic lines in question.
SOLID LINE:
Top of Unit C as determined from borehole data.
* indicates mention of ice bonding in the borehole logs
Depth below sealevel in meters
10
15
20
25
30
35
40
45
50
SCALE (km)
0
1.25
2.5
GRAVEL
Sandy. Trace Silt and Clay. Maximum particle size 25 mm. Angular, moist, sub-round
SAND (SP)
Poorly sorted Sand. Gravelly Sand. Little or no fines.
SAND (SM)
Silty Sand. Trace Clay. Trace Gravel. Trace coarse Sand. Occasional pebbles. Trace shell fragments.
SILT
Some clay. Trace Sand to Sandy.
CLAY
Trace Silt to very Silty. Trace Sand to fine grained Sand stringers. Soft to very stiff. Low plastic to high plastic.
E R

FIGURE 11

ISSERK BORROW BLOCK BOREHOLE TRANSECT

SOUTHWEST

NORTHEAST

C

C'

Depth below sealevel in meters

10
15
20
25
30
35
40
45
50
55

UNIT B

UNIT C

UNIT B

UNIT B

?

?

SOLID LINE:
Top of Unit C as determined by borehole data.

DOTTED LINE
Top of Unit C as determined from seismic data.

* indicates mention of ice bonding in the borehole logs

SCALE (km)
0 1.25 2.5

GRAVEL — Sandy. Trace Silt and Clay. Maximum particle size 25 mm. Angular, moist, sub-round

SAND (SP) — Poorly sorted Sand. Gravelly Sand. Little or no fines.

SAND (SM) — Silty Sand. Trace Clay. Trace Gravel. Trace coarse Sand. Occasional pebbles. Trace shell fragments.

SILT — Some clay. Trace Sand to Sandy.

CLAY — Trace Silt to very Silty. Trace Sand to fine grained Sand stringers. Soft to very stiff. Low plastic to high plastic.

EDR

FIGURE 12

5.4.1 Lower Unconformity

The lowest regionally persistent horizon is a composite of a younger and an older erosion surface, the equivalents of U/C1 and U/C2 respectively in O'Connor's (1982) model. The character of each in the borrow block area is distinctive and they are distinguishable one from the other where data quality permits.

The older unconformity forms a highly incised, irregular surface. The surface has been removed by the subsequent erosion episode (U/C1) over the crest of the site and to the east as the Kugmallit Channel is approached. The profiles of Figure 11 shows the irregular lower surface descending to the east and west from a central high. The extreme irregularity of the horizon suggests an old subaerial erosion surface that has not been affected by the transgression.

The structure map presented in Figure 13 and Enclosure 4 describes the shape of the upper surface of Unit C. Where the younger erosion surface has excavated to the top of Unit C, it forms a smooth, featureless plain. The remnant areas that were not affected by this erosion episode display a highly dissected pattern. The surface descends to the north, east and west from an irregular crest that extends from the southeast edge of the site through approximately the site center and beyond the site boundary to the northwest. The surface descends from a high of ten meters near the southern border, where it lies at or near the seafloor, to 34 meters at the northwest edge of the survey coverage. As the surface descends, there is progressively less planation by the later erosion episode, with the result that the map displays an increasingly more complex topography to the north.

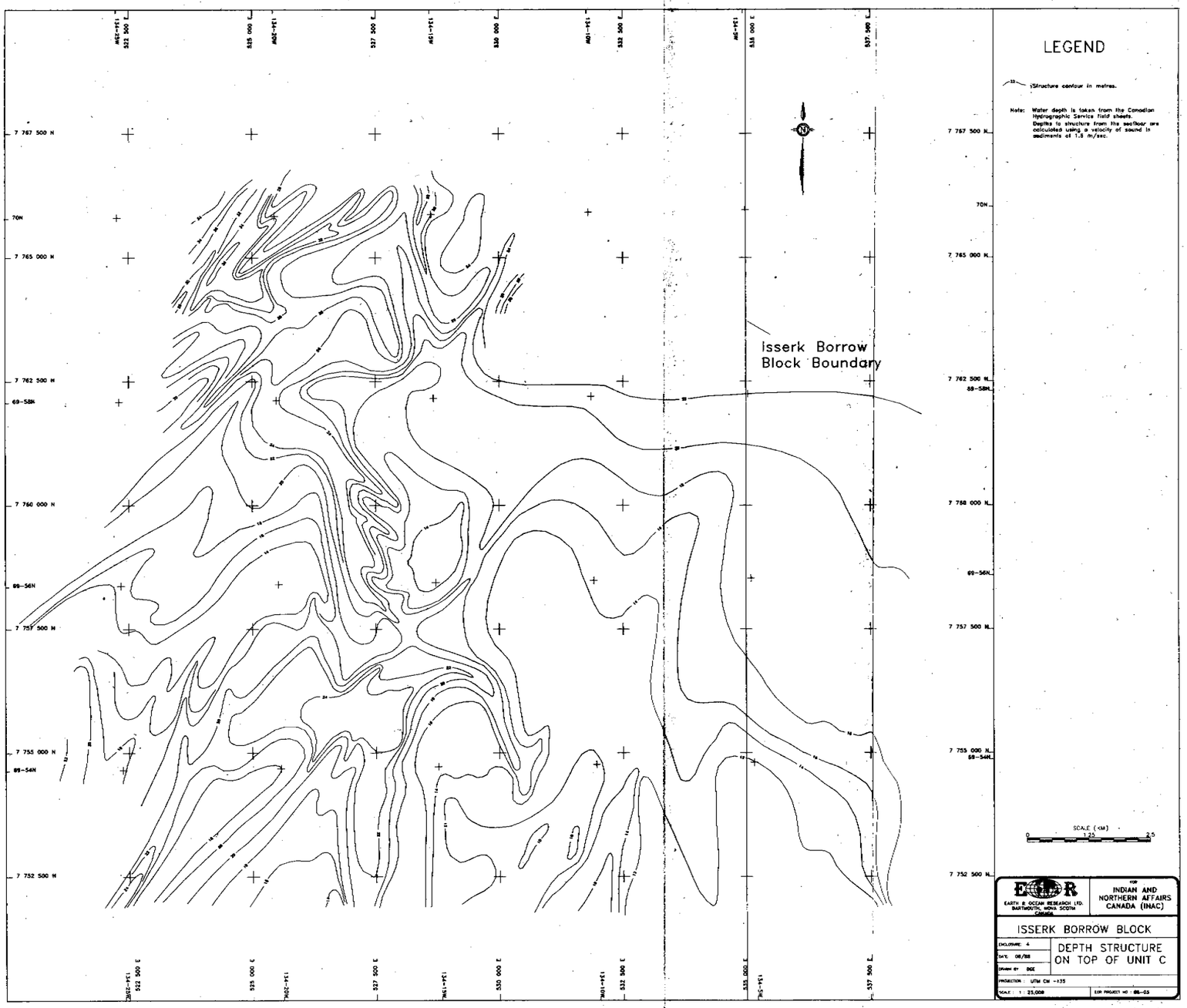
LEGEND
Structure contour in metres.
Note: Water depth is taken from the Canadian Hydrographic Service field sheets.
Depths to structure from the seafloor are calculated using a velocity of sound in sediments of 1.8 m/sec.
Isserk Borrow Block Boundary
7 767 500 N
70N
7 765 000 N
7 762 500 N
69-58N
7 760 000 N
69-56N
7 757 500 N
7 755 000 N
69-54N
7 752 500 N
7 788 000 N
7 785 000 N
7 782 500 N
7 757 500 N
7 753 000 N
522 500 E
525 000 E
527 500 E
530 000 E
532 500 E
535 000 E
537 500 E
SCALE (KM)
0 1.25 2.5
EARTH & OCEAN RESEARCH LTD. DARTMOUTH, NOVA SCOTIA CANADA
FOR INDIAN AND NORTHERN AFFAIRS CANADA (INAC)
ISSERK BORROW BLOCK
ENCLOSURE 4
DATE 08/88
DRAWN BY BGE
DEPTH STRUCTURE ON TOP OF UNIT C
PROJECTION : UTM CM -135
SCALE : 1 : 25,000
EOR PROJECT NO : 88-03

FIGURE 13

5.4.2 Unit C

The stratigraphic unit underlying this unconformity surface is correlated on position and character to Unit C of O'Connor's (1980) model. Within the Isserk area, this represents the deepest unit consistently identifiable on the seismic records. The seismic character of the internal structures of this unit is highly variable although seismic continuity and amplitude are uniformly low throughout. Where reflectors are observed they are of short length and of variable dip. Crosscutting relationships, and steeply dipping foresets ending in small channels are observed. Elsewhere the depositional patterns are not as well developed or preserved. Large areas occur where there are no reflectors within this unit. This may be due to the uniformity of the material within these areas.

As mentioned above, reflectors suggestive of infilled channels and channel cut and fill occur within the sequence. Figure 14, from the boomer profile GHR81-69, illustrates cut and fill activity. In general, the reflectors do not provide continuous patterns and suggest a depositional environment that was highly variable both laterally and vertically over short distances.

There are also changes in the seismic character associated with the crest of the unit where it approaches the surface beneath the Akpak Plateau. In these areas, which are restricted to the southern part of the site, the subsurface return becomes particularly broken up, with very few coherent returns, and noise bursts that may represent increased backscatter from coarse material near or at the surface. Figure 15, again from the boomer profile GHR81-69 displays this character. Note the narrow, closely spaced, "V" shaped reflectors that may represent narrow trenches or perhaps noise bursts. The occurence of coarser, more resistant material over the crest of the unit may be responsible for the ridge morphology in this area.

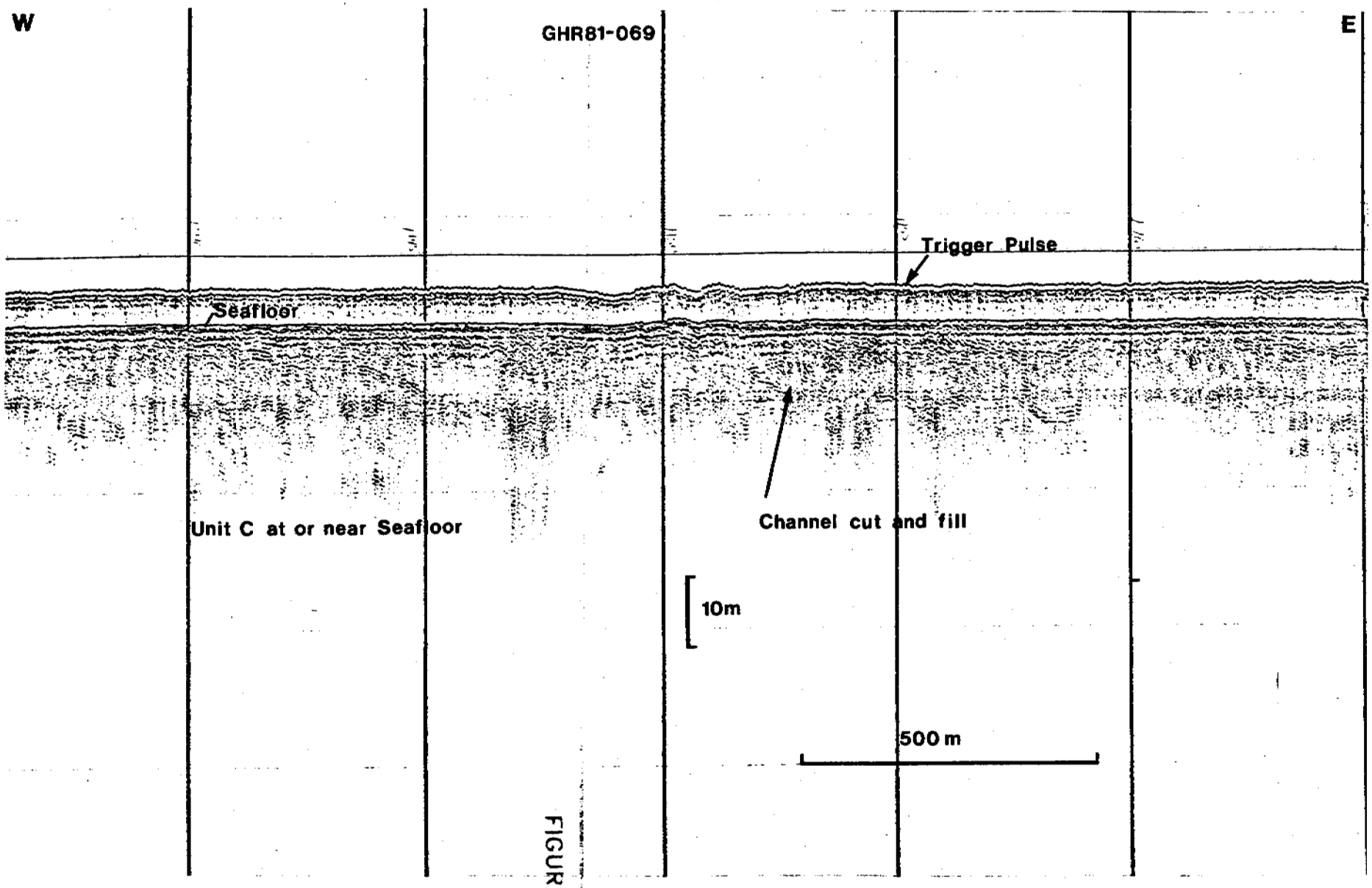

FIGURE 14

FIGURE 14

Section of east - west boomer line GHR81-069 located on the southern edge of the Isserk Site. Short, irregularly dipping reflectors and noise bursts indicate channel cut and fill and variable but generally coarse material.

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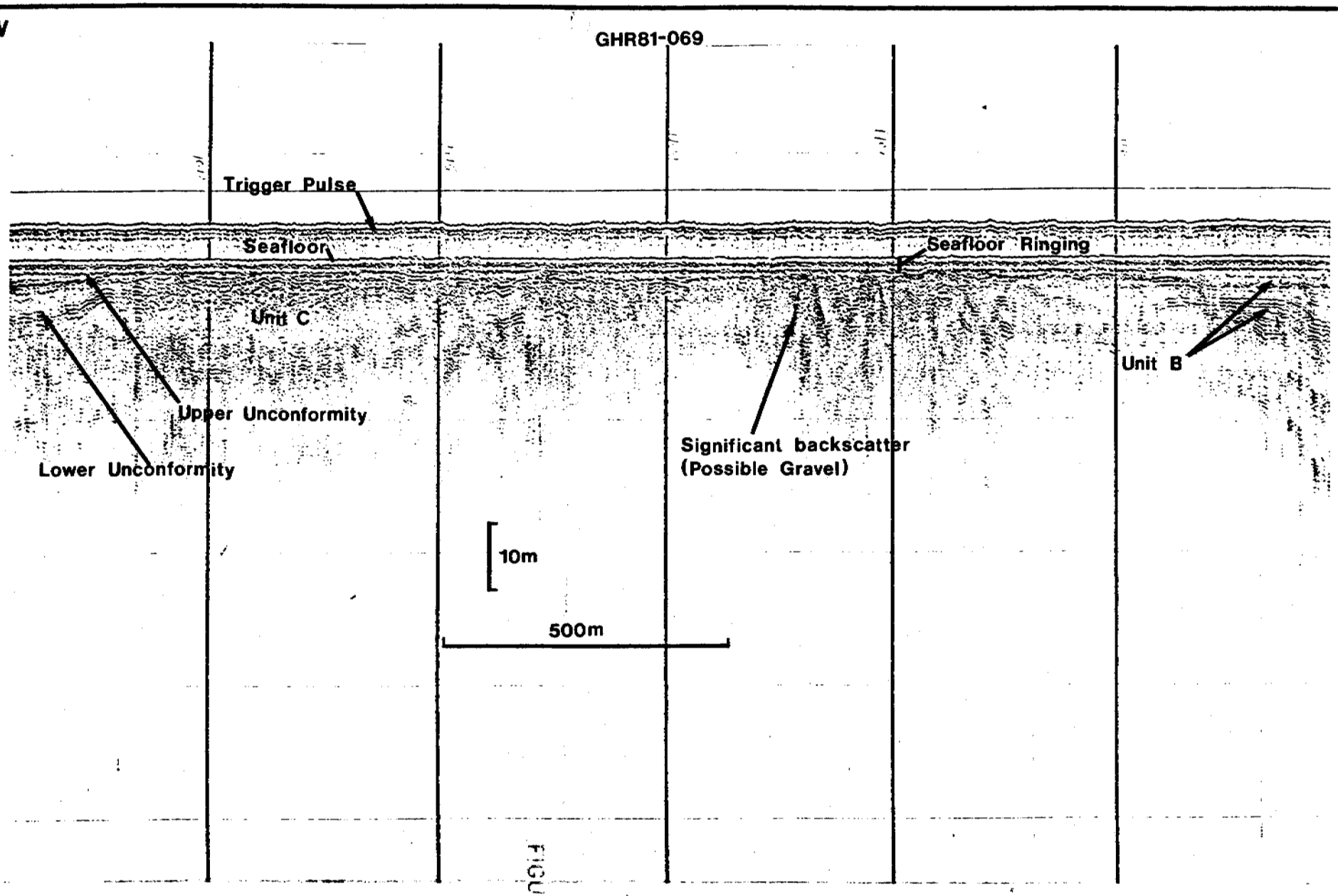

FIGURE 15

Section of east - west boomer line GHR81-069 located on the south edge of the Isserk Site. Unit C lies at or near the seafloor across this area and is truncated by the Upper Unconformity. Irregular noise patterns at or just below this surface indicate possible gravels.

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A particular section suggests a migrating dune or bar system. An example of this feature is presented in Figure 16. This is a portion of boomer profile GHR81-062A, and is located on the east flank of the Akpak Plateau in the east-central part of the block area. The feature is described in greater detail below in order to gain further insight into the potential composition and variability of Unit C.

Three buried mounds are visible. The central mound is the best preserved and consists of a series of closely spaced foresets which become younger and higher to the east (right) and whose distal ends form the bottomsets of a small depression. The bottomsets infill the depression and overstep the easternmost of the mounds. This mound displays a few eastward dipping foresets but is generally devoid of internal reflectors. To the west (left) the stoss side of the central mound forms one flank of a larger basin, the other flank of which is formed by the westernmost mound. As with the central mound, this mound is also composed of steeply dipping, eastward facing foresets. The foresets, however have been truncated upsection and the mound appears to be significantly eroded. The foresets grade distally into very faint bottomsets which underlie the western flank of the central mound, establishing the western mound as the older.

The intervening basins are infilled with conformable, closely spaced, continuous reflectors. The amplitude of these reflectors is higher than the amplitude of the foresets within the mounds, suggesting a greater variability in texture of the beds. The infill of the eastern basin is co-eval with the development of the central mound, while the infill of the western basin onlaps the central and western mound. It is therefore younger than both. The onlap on both flanks of this latter basin indicates that the infill does not form a part of the lower depositional cycle on which it rests, but rather represents a later depositional environment during which provenance was from the north or (more likely) the south. The entire sequence is bounded upsection by a distinct change in seismic character that represents an abrupt transition to another depositional environment. While truncation of reflectors is not unequivically evident along this boundary in this figure, it is apparent elsewhere, and the boundary represents either a hiatus or later period of erosion over this site.

The pattern evident in this example is consistent with an interpretation of a shallow submarine bar or subaerial dune system that was migrating to the east and subsequently buried. At any time during the formation of this system, erosion, hiatus, and deposition were occuring simultaneously over short

horizontal distances and new bars/dunes were being constructed as old features were destroyed or overstepped.

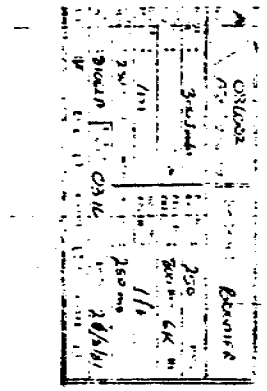
This morphology has implications that bear on the texture and distribution of material. Bars and dunes are formed of predominantly sand size material through saltation and traction load. As the features migrate (in this case eastward), coarser material is left as lag material on the stoss side, while finer material is deposited in front of the advancing face. If subaerial, the low lying area in front of the dune may be lagoonal or salt marsh. If submarine, this area will be an area of reduced flow. Each of these environments will promote the accumulation of fine organic material and inorganic silts and clays. Within Figure 17, therefore, it is expected that the mounds will consist predominantly of fine to medium sands which will fine to eastward. Gravel and coarse sand may be expected as scattered lag horizons flooring the system. Fine sands, silts, and organic silts and clays will be interleaved within the small basins.

This represents a particular environment of local extent observed within the sequence identified as Unit C. It is a good example in that it provides information on texture, (predominantly sand); on provenance, (eastward to westward), on depositional environment, (subaerial to sublittoral), on depositional mode, (traction and saltation), and lateral variability in texture (moderate to high). The extent to which this model is applicable to the rest of Unit C over the Isserk Block is uncertain as line spacing is limited and subsequent erosion may well have erased the key morphologic forms over much of the area.

W

Line GHR81-062A

E



10m

500m

Trigger Pulse

Seafloor

Upper Unconformity

Lower Unconformity

Unit A or A and B – Marine Clays

Truncated Foresets – Uniform Sand

Unit B – Channel Infill – Interbedded Silts, Clays, and Sands

Overstepped Bottomsets – Interbedded Silts, Fine Sands, possible Peat Beds

FIGURE 16

Section of east - west boomer line GHR81-062A located on the eastern edge of the Isserk Site. A complex sequence of seismic patterns has been preserved that indicate depositional environments that evolve from possibly subaerial to shallow marine.

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EOR

The assessment of the textural makeup of Unit C as deduced from the seismic data is corroborated and extended downsection by the borehole data. In the Isserk area, Unit C is seen to consist predominantly of dense to very dense, silty sand. The sand contains occasional traces of silt and gravel, as well as lenses of gravel, silt, and organics. Referring to the borehole profiles in Figures 10, 11, and 12, it can be seen that while thick deposits of sand are dominant and common to all boreholes below the unconformity, there is considerable variability in texture, with silt and clay deposits scattered throughout. It is also observed that there is considerable vertical and horizontal variability even between closely spaced boreholes. The lack of continuity of textural units between boreholes combined with the lack of continuity in the seismic data preclude detailed facies mapping.

5.4.3 Unit B

Unit B unconformably overlies Unit C throughout the survey area. An unconformity (U/C1) separates the unit into two subunits and several facies are observed within each subunit. The unconformity (U/C1)forms a smooth, regular surface that domes over the Akpak Plateau. Where it encounters Unit C it has truncated this unit and forms the distinctive planar erosional surface described above in the description of Unit C. Elsewhere the surface is not as well developed, and in some basinal areas may represent a hiatus within the deposition of Unit B as there is no evidence of erosion.

The subunit that underlies this unconformity occurs as stratified infill within the channels and depressions formed on Unit C. The seismic signature suggests that this infill is predominantly fine grained and the boreholes support this assessment. The boreholes also show coarser sand units sandwiched between the clay units and occasional gravel layers at the base of the clay strata. Thin gravel deposits overlie Unit C sands in borehole IB80-84, located on the crest of the plateau, and in borehole IT81-2, located on the flank of the plateau where it descends into the Kugmallit Channel. Sand deposits located downsection to the north of borehole IB80-84 in boreholes IB80-87 and 93 may be distal facies of this gravel and are so depicted on borehole transect A-A'. These deposits may be the result of lateral reworking of Unit C into conformable basal facies during initial transgression.

The upper subunit of Unit B is laid conformably on the transgression unconformity. From borehole and seismic evidence, this subunit is seen to consist of a sand facies and a clay facies. The upper subunit, either the sand facies or the clay

facies, extends upwards to the seafloor over much of the area. The sand facies occupies the central part of the Isserk site and constitutes the granular resource identified for the area from past work. The clay facies lies at the seafloor to the east, west, and south of the sand. It is possibly interrupted in the southwest by the exposure at the seafloor of Unit C, as depicted on the map of surficial cover.

In contrast to the cut and fill structures noted in Unit C, and the infill character of the lower subunit of unit B, the upper subunit displays either no bedding or faint horizontal bedding. While the surface of the sand facies is seismically distinctive where it rests on the seafloor, the lower boundary does not constitute a consistent reflector and the base of the deposit cannot be mapped seismically. Similarly, the lateral edges can only be defined where the deposit rests on the seafloor and the stratigraphic relationship of the deposit to the surrounding clays cannot be determined from the seismic data available.

Borehole data, however, reveal that the surficial sand deposit is a lens shaped body that varies from 1.5 to 4.5 meters thickness. The maximum thickness occurs along a north-south axis that extends through the center of the deposit. The clay facies underlies the sand and isolates this body from the underlying coarse deposits of Units C and the underlying Unit B materials. Possible exceptions to this are noted in boreholes IB80-84 and IB80-96. In borehole IB80-84, as can be observed on the borehole transects, there is an area of no data between the upper sand and the lower gravel. The log notes "No sample - fines washing out" and it is reasonable to assume that this signifies a fine non-cohesive sand or possibly silt deposit rather than a continuation of the coarse material. In borehole IB80-96, the upper sand is separated from the lower sand by a 0.5 meter thick sand and clay deposit.

The boreholes also indicate that the upper sand does not extend beyond its surficial expression for any appreciable distance to the southwest, or west. As is seen from the borehole transects B-B', and C-C', possibly equivalent sand bodies do not occur within the boreholes immediately beyond the surficial sand cover in these directions.

To the south, there is no equivalent sand body in the Isserk B-15 series boreholes. A three km gap in the borehole spacing exists between the main Isserk (IB80-series) boreholes and the Isserk B-15 boreholes, and the boundary could be anywhere within this gap.

To the east borehole IB80-88 shows a clay unit on the surface over a thin clay-and-sand unit over a thick silt-and-

sand unit. While the thick unit is almost surely Unit C, the thin clay and sand unit may be either Unit C or a buried portion of the upper sand deposit. If the latter, then there is no constraint on the extent of the upper sand unit until the Itiyok boreholes (IT81- series) are encountered, a distance of five km. In the transect, the surface clay has been correlated with the older clay unit, thereby strictly limiting the extent of the surface sand. The alternate interpretation may be equally viable.

The separation of the upper sand from the lower sand by the clay layer indicates that the source for the upper sand is not the sand body directly beneath it. The location of the upper sand over the crest of the coarse textured Unit C does suggest, however, that this older ridge is the ultimate source. The connection between the two bodies may lie in the southeast quadrant of the site, which has not been sampled by boreholes but which seismics indicate is floored by Unit C strata.

5.4.4 Unit A

There is evidence to suggest that Unit B is buried by a more recent fine grained deposit over the northern part of the site. As noted in the discussion of surficial cover, the clays occuring on the surface in the Issungnak O-61 boreholes are slightly, but consistently, different from those of the other borehole sets. It is also noted in profile DHR80-540B, a north-south line that extends out of the survey area to the north, that a reflector overlying the transgressive unconformity rises from the north to meet the seafloor near the southern end of the line (see track plot for line location). This line is of poor quality and is not reproducible. Based on these observations the upper sand in the Issungnak O-61 (IS81- series) boreholes is correlated with the upper sand on surface at the main Isserk site. This places the surficial clay at the Issungnak site stratigraphically higher than the Unit B sands and clays. The evidence is tenuous, and the lack of borehole control between the Isserk boreholes and the Issungnak boreholes will allow other correlations.

5.4.5 Ice Bonding

Ice bonding within the sediments is an observed phenomenon within the survey block. Ice bonding can seriously degrade seismic data, either by masking data beneath ice bonded sediments, or by producing spurious acoustic reflectors that are not related to the actual structure of the sediment column. Of the 99 boreholes recorded within the survey area, 42 record ice or ice bonding from at least one level within the core. This may, in fact, underrepresent the case, as discussed by O'Connor in his report on frozen subseabottom sediments (O'Connor, 1984).

The ice bonding is prevalent in the central, west, and south sectors of the block. These areas are sampled by the Isserk B-15 borehole set (prefix B-15, IN- 70-,53-), the 1980 Isserk Borrow area borehole set (prefix IB80-), and the Issungnak South borehole data set (prefix IS81-). No ice bonding is recorded for the northern sector sampled by the Issungnak O-61 boreholes (prefix IS78-), or for the western sector sampled by the Itoyok boreholes (prefix IT81-).

Within the areas where ice bonding is recorded, the phenomenon is common. Ice bonding is noted in 20 of the 25 Isserk B-15 boreholes, 7 of the 16 Isserk 1980 boreholes, and 11 of the 14 Issungnak South boreholes. Six (6) of the 9 Isserk 1980 boreholes that do not record ice bonding are shorter than 10 meters however and may not be representative. For this same

reason the Isserk boreholes prefixed by IB78- are not considered representative, with the exception of IB78-1, as they are less than 6 meters in length. It is noteable that IB78-1, which is 24 meters long, does record frozen material.

Ice bonded sediments are recorded from a minimum of 3 meters depth but are not common within 7 meters of the seafloor. Thereafter, to the depth of penetration of the boreholes, ice bonding is common. Identification of bonding is, with few exceptions, restricted to sand or sandy units. O'Connor notes, however, that this may be a bias introduced by drilling and sampling methods and that improved methods demonstrate that ice bonding occurs in all three of the major sediment types and that in the Canadian Beaufort Sea clayey soils account for slightly more of the observed ground ice than sandy and silty soils (O'Connor, 1984).

5.5 Depositional Summary

Predominantly fine to medium sand was deposited as Unit C through channel cut and fill processes in a locally variable but generally moderate to high energy fluvial or glacio-fluvial environment. Potentially coarser and more resistant material was deposited as a linear body that extended from the southeast corner of the site through the site center. Subsequent to this deposition the surface of the unit was downcut under subaerial conditions to form a highly irregular topography of small channels and mounds. The more resistant body was downcut to a lesser extent and formed the positive core for the plateau in this area. During this period, material was moved downslope via the gullies and also on the interfluves via dune formation. On the eastern flank of the plateau, leading down into the Kugmallit Channel, coarse material was aggraded into dune-like bedforms that indicate sediment movement to the east into the channel.

The sculpting of the highly incised topography was followed by a marine transgression that initiated the deposition of Unit B. Preservation of much of the subaerially constructed topography on Unit C suggests that the initial transgression across this area was rapid. Predominantly fine material was deposited in the depressions on Unit C. As the sealevel rose, planation of the raised part of Unit C occurred and produced local lag gravel deposits that remained in contact with the source material. A distal sand facies spread out over the clays deposited on Unit C in the basinal areas. This was followed by a period of shallow marine deposition of fine material. A short second regression was followed by a slower transgressive rise in relative sealevel, during which time the raised portions of Unit C and the previously deposited Unit B strata were reduced by

wave base planation to a smooth surface. The elevated section of Unit C to the south and the previously reworked Unit B sands and gravels provided the source material for a thin coarse grained deposit centered over the crest of the site. Fine grained clays were deposited coevally away from the crest of Unit C.

With continued transgression, the wave base moved away to the south and the construction of the sand body ceased. The upper sand body was buried by marine clays in the deeper water area to the north. With continued shoreline retreat, this process may be ongoing. At present, however, most of the Isserk Block area is floored by old sediments laid down during the most recent transgression.

6 GRANULAR RESOURCE - ISSERK BORROW BLOCK

6.1 Extent of Deposits

The granular resources of the Isserk Borrow Block are located in two geologic deposits of different age, distribution, and depositional mode. The upper deposit represents a reworked deposit associated with Unit B, while the lower deposit consists the Unit C basal material. The distribution of the surficial prospect material is displayed as Figure 17 and Enclosure 5 and the distribution of the lower prospect is shown in Figure 18 and Enclosure 6. These maps incorporate divisions of the reserve into Proven, Prospective and Probable zones. 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. 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. 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.

Within the Isserk Borrow Block area measurements of overburden and resource thicknesses were made for each borehole. This provides information which is of value both to the engineer concerned with borrow resource, and to the geologist interested in establishing relationships between the boreholes. These analysis have revealed that there are two distinct bodies of sand flooring the Isserk block, with the lower sand being ubiquitous and the upper sand being of local extent.

Because of the applicability of this two resource model, the boreholes have been coded and are described in terms of a first encountered coarse unit and a second encountered coarse unit. The detailed description of this coding along with a tabular summary of all boreholes within the block are given in Appendix 3. This allowed spatial display of these data on the map sheets and subsequent contouring and definition of the two prospect areas. From observation it is apparent that where there is only one sand unit present and the borehole longer than about

10 meters, the sand unit present is the older of the two. The only instance where this may not apply is borehole IB80-84 near the center of the Isserk block where the upper and lower sands may be in contact with each other.

6.1.1 Upper Surficial Prospect

The main body of the deposit is roughly triangular in shape and located in the west-central part of the block (Figure 17). A narrow, linear, "tail" extends from the southeast edge of the main deposit to near the southeast corner of the block area.

The spatial distribution of this deposit is defined on the basis of borehole control and the seafloor character of the boomer and profiler records. Coarse material on the seafloor, as identified in the boreholes, is associated with a distinct change in character on the seismic records. In this regard the microprofiler records are more useful than the boomer records.

The microprofiler records are characterized by a lessening or absence of sub bottom reflectors and an even unscoured seafloor surface. The return signal from the seafloor is short and well defined. The first primary multiple is prominent, indicating a significant percentage of the pulse is reflected back from the seafloor rather than transmitted through.

The boomer records share these characteristics with the profiler records but to a lesser effect. This is primarily due to the higher power and lower frequency of the system which make the signal less sensitive to changes in texture.

While the map in Figure 17 displays the areal distribution of the deposit for the proven, probable and prospective zones, contours indicating the thickness of the deposit are only provided for the proven zone. The thicknesses are derived soley from the borehole logs as the base of the deposit was not observed on the geophysical data.

Twenty five boreholes have been drilled within the boundaries of this zone. Borehole penetration varies from 4.5 meters to 21.4 meters with 17 boreholes less than 10 meters long. The majority of the boreholes encounter sand at the seafloor and silty or clayey deposits at from 1.25 to 3 meters below seafloor. Two boreholes, IB80-84 and IB80-96 record sand from the seafloor to their depth of penetration. Borehole IB80-84 was drilled to a depth of 21.4 meters, and borehole IB80-96 to a depth of 9.1 meters. Three boreholes record a veneer of clay atop the surficial sands. The veneer varies from 0.2 meters to 0.6 meters. The boreholes, IB80-95, IB80-93, and IB78-5 are located in proximity to each other and the clay

deposit may form a continuous veneer along the western side and northern tip of the zone.

The Proven resource is primarily based on the borehole information and occupies the central part of the deposit with the displayed boundaries defined by both borehole and seismic data. Within this zone there is a very high confidence that useable granular material occurs. Based on the borehole data, this zone has been further subdivided into zones dredgeable by hopper dredge only and by both hopper and stationary dredge methods. These subdivisions are shown by the heavy dash-dotted line subdivisions within the proven area. The position of these lines has been made using the Dredgeability assessments and the Development Concerns assessment of each of the boreholes and using a simple rule of equidistance between the boreholes within the proven reserve area. Based on these subdivisions two small regions associated with boreholes IB80-96 and IB80-84 are defined which are catagorized as dredgeable with either hopper or stationary dredge. It is assumed that below the approximate 4 m level in each of these regions one would be mining the lower sand resource as opposed to the upper reworked Unit B materials.

The Probable resource boundaries are based on seismic and limited borehole information. This area is seen to rim the proven region with a tail defined which extends approximately 8 km off toward the southeast from the main body of the deposit. This tail region is defined exclusively with the seismic data.

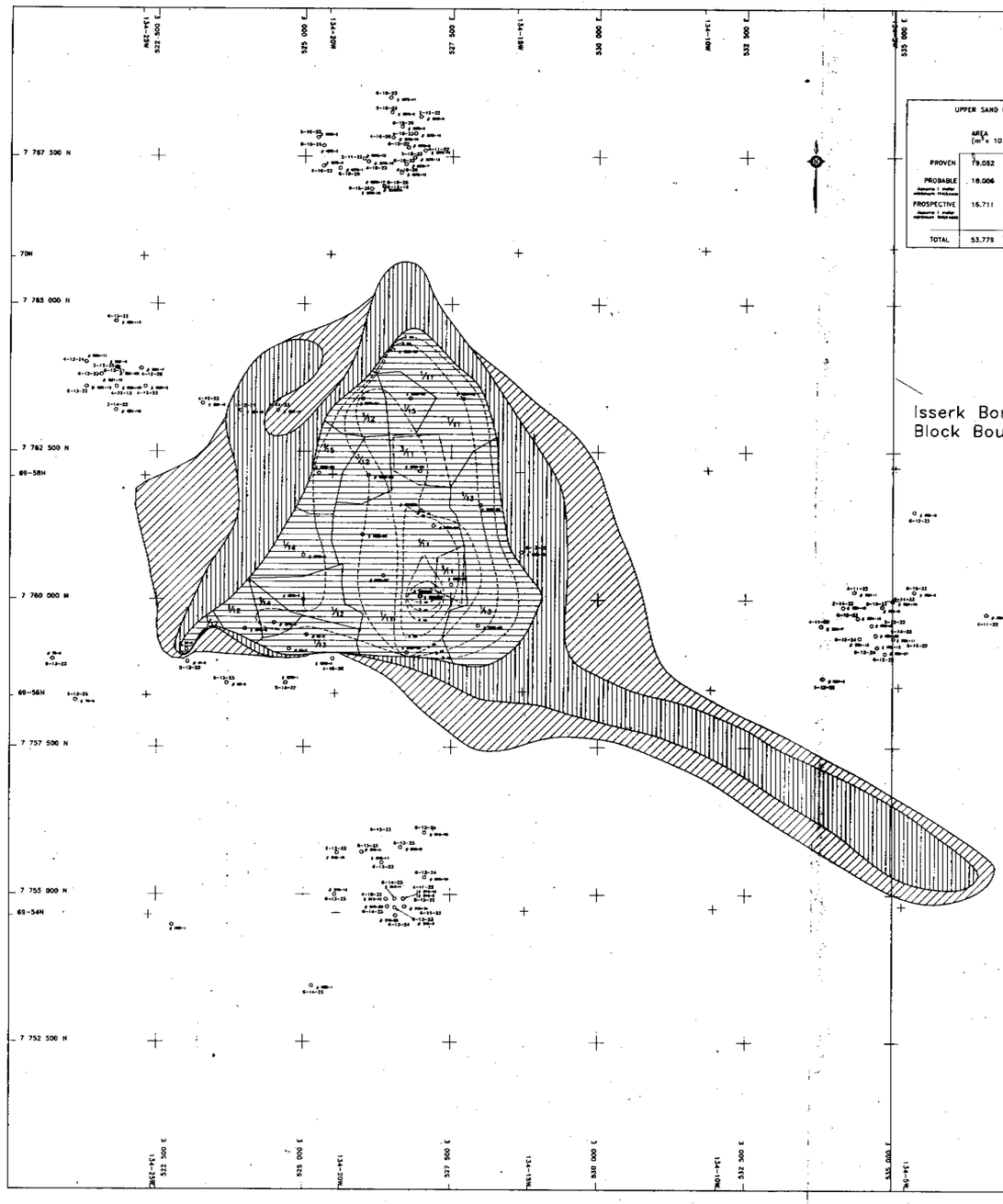
The Prospective region is defined entirely on the seismic data set and is based on bottom character return along with faintly defined internal reflections seen within the data. It may represent an extension of reworked Unit B materials, however borehole information would be required to confirm this.

6.1.2 Lower Basal Prospect

The Lower Basal Prospect represents a region where the unconformity surface representing the top of Unit C comes to within 3 m of the seabed. The 3 m limit has been taken as the practical limit of overburden stripping when a Stationary Suction dredge is utilized. This region is located in the southeastern corner of the prospect area and is highly irregular in shape (Figure 18).

This region is defined almost entirely from mapping of the seismic data and is only confirmed by boreholes in the extreme northwestern tip of the area. Because of this lack of borehole confirmation the entire prospect is considered to be Prospective only at this time. Although some limited quality information is available, the boreholes indicate this lower unit to be highly

variable in nature and considerable confirmation drilling will be necessary to confirm this region as a viable resource.



UPPER SAND UNIT GRANULAR RESOURCE

	AREA ($m^2 \times 10^6$)	VOLUME ($m^3 \times 10^6$)
PROVEN	19.052	45.03
PROBABLE (assume 1 meter minimum thickness)	18.006	18.01
PROSPECTIVE (assume 1 meter minimum thickness)	16.711	16.71
TOTAL	53.778	79.75

LEGEND

- Outline of deposit as interpreted from seismic and borehole data
- Thickness contours in meters
- Borrow prospect zones based on dredgeability
- Borrow prospect zones based on development concerns
- H20-1 Borehole location and identification
- Proven Resource
- Probable Resource
- Prospective Resource

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
< 0.5 m of overburden
> 20 m of recoverable sand

4 Too much overburden for either type of dredge

5 Gradation too fine for suitable fill performance

6 Both overburden and fines content precludes 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 to deposit
12 Poor to unsuitable quality (fines > 12%)
13 Permafrost will be encountered by dredge
14 Material is marginally too fine
D90 between 90 and 150 u
fines content between 12% and 15%
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 Complexly stratified or very thick Unit B
24 Complexly stratified sand strata (Unit C?)
25 Permafrost noted on BH logs
26 Double clay layer
27 Overburden (Unit A & B) exceed 15 m -channel fill
28 BH too short for full interpretation

Borehole description developed by Neil MacLeod of EBA Engineering Consultants Ltd. Calgary, ALTA.

SCALE (km)
0 1.25 2.5

EDGER
EARTH & OCEAN RESEARCH LTD.
DARTMOUTH, NOVA SCOTIA CANADA

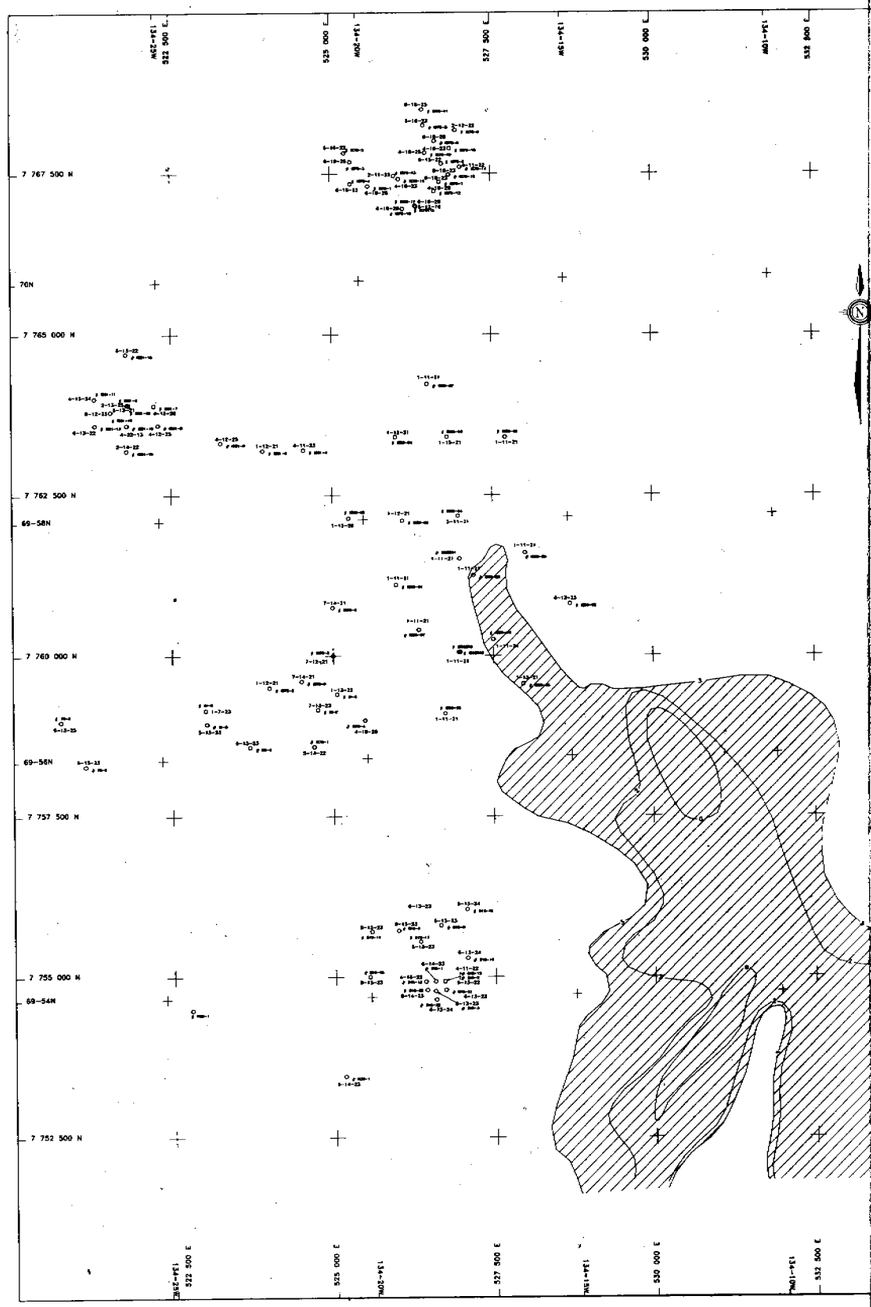
FOR INDIAN AND NORTHERN AFFAIRS CANADA (INAC)

ISSERK BORROW BLOCK

ENCLOSURE: 5
DATE: 08/88
DRAWN BY: BDC
PROJECTION: UTM CM -135
SCALE: 1 : 25,000
EOR PROJECT NO 88-03

GRANULAR RESOURCES UPPER SAND UNIT

FIGURE 17



GRANULAR RESOURCE - LOWER SAND UNIT	AREA ($m \times 10^8$)	VOLUME ($m \times 10^9$)
Assume 1 meter	40.840	40.840
Assume 5 meters	-	204.20
Assume 10 meters	-	408.00
Assume 20 meters	-	816.00

Isserk Borrow Block Boundary

LEGEND

PROSPECTIVE RESOURCE. Resource is defined as that portion of Unit C that lies within three meters of the seafloor.

Borehole Location and Identification

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
< 0.5 m of overburden
> 20 m of recoverable sand

4 Too much overburden for either type of dredge

5 Gradation too fine for suitable EIH 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 to deposit
12 Poor to unsuitable quality (fines > 12%)
13 Permafrost will be encountered by dredge
14 Material is marginally too fine
D90 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 EIH
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 Complexly stratified or very thick Unit B
24 Complexly stratified sand strata (Unit C?)
25 Permafrost noted on BH logs
26 Double clay layer
27 Overburden (Unit A & B) exceed 15 m - channel fill
28 BH too short for full interpretation

Borehole description developed by Niall MacLeod of EBA Engineering Consultants Ltd. Calgary, ALTA.

SCALE (km)
0 1.25 2.5

EDGER
EARTH & OCEAN RESEARCH LTD.
DARTMOUTH, NOVA SCOTIA CANADA

PREPARED FOR INDIAN AND NORTHERN AFFAIRS CANADA (INAC)

ISSERK BORROW BLOCK

ENCLOSURE: 5
DATE: DEC/88
DRAWN BY: BGE
PROJECTION: UTM CM -135
SCALE: 1 : 25,000
EDR PROJECT NO: 88-03

GRANULAR RESOURCE LOWER SAND UNIT

FIGURE 18

6.2 Granular Resource Volume Estimates

Table 3 summarizes the estimates of proven, probable and prospective volume of granular resource for the two prospect areas defined in this report. The methods of volume calculation vary slightly for the two prospects in that the upper sand is assumed to represent a body which is exposed at the seafloor and no stripping is required, thus mining is limited to the thickness of the resource. In this case a minimum thickness of one metre is required and volumes are calculated based on the area between the contours times the average thickness assuming a linear proportion distribution between the contour lines (ie. area = 10 m^2, between the 2 and 3 m contours: therefore volume = 10 m^2 X 2.5 m = 25 m^3). For this upper material the total volume is taken as the sum of the volumes between all thickness contour lines. The total probable and total prospective resources incorporate the volumes of the higher probability materials.

Within the lower sand body volumes are calculated based on an assumed thickness of the resource material which reflects the assumed maximum depth of dredging capabilities. Since detailed evaluations of the depth of the resource are not possible at this time these values are taken as estimations only.

TABLE 3 GRANULAR RESOURCE VOLUME ESTIMATES - ISSERK BORROW BLOCK

Upper Sand Unit Exposed at the Seafloor

Unit Thickness (m)		Area (m^2 *10^6)	Volume (m^3 *10^6)
PROVEN RESOURCE			
> 1 < 2		4.483	6.73
> 2 < 3		4.964	12.41
> 3 < 4		5.534	19.37
> 4 < 5		2.896	13.03
> 5 < 6		1.185	6.52
TOTAL PROVEN RESOURCE:		**19.062**	**45.03**
PROBABLE RESOURCE			
Assume 1 meter minimum		18.006	18.01
	TOTAL RESOURCE	37.068	63.04
PROSPECTIVE RESOURCE			
Assume 1 meter minimum		16.711	16.71
	TOTAL RESOURCE	53.779	79.75

Lower Sand Unit

PROSPECTIVE ONLY - Portion of Unit C covered by three meters of overburden or less

Unit Thickness (m)	Area (m^2 *10^6)	Volume (m^3 *10^6)
Assume 1 meter	40.840	40.84
Assume 5 meters	40.840	204.20
Assume 10 meters	40.840	408.00
Assume 20 meters	40.840	816.00

7 CONCLUSIONS

The Isserk Borrow Block of the south central Beaufort Sea covers an area of 400 square kilometres and contains significant amounts of proven, probable, and prospective granular resource materials. Through the integration of geophysical, geotechnical, and geological data collected over the past 15 years from both industry and government operators, two main deposits were identified. These deposits occur as fine to medium grained sand bodies that lie within a complex sequence of glacio-fluvial, fluvial, and transgressive marine type sediments that form a northwest - southeast trending ridge across the Akpat Plateau.

The first deposit (Upper Sand Unit) is a localized shallow sand body which lies in the central portion of the Isserk Borrow Block. Its triangular shape covers an area of approximately 53 million square metres. Borehole and seismic data indicate an estimated 19 million cubic metres of proven, 63 million cubic metres of probable, and up to 80 million cubic metres of prospective granular resource materials. The proven resource estimate is based primarily on borehole information and subdivided according to dredging and development concerns.

The second deposit (Lower Sand Unit) is a near surface exposure of Unit C which lies in the southeast quadrant of the study area. Its estimated 800 million cubic metres of prospective granular resources is based on limited seismic information only, and requires considerable future ground truthing. Of this 800 million it is likely that only 100 to 300 million might actually be recoverable when permafrost bonding and resource quality are fully considered and delineated.

It is conceivable that the Lower Sand Unit extends beneath the Upper Sand Unit to the northwest, separated, however, by a clay layer of variable thickness. The actual extent and quality of this deposit can only be determined through further investigation.

8 RECOMMENDATIONS

The results of this program have outlined two granular resource deposits in the Isserk Borrow Block. The compilation and interpretation of the data used in this study identified certain limitations and deficiencies to which the following recommendations are addressed.

1 Due to the poor borehole coverage in the probable and prospective areas of both deposits it is recommended that several boreholes be drilled on an interim basis in order to gain a better appreciation of the variability and quality of granular resources in these areas.

At least 6 holes should be drilled in the probable and prospective areas surrounding the proven area of the Upper Sand deposit. Four of these holes would be located in the areas immediately east and west of the central proven zone, while the other two holes would be located immediately north and south of the main deposit.

At least 2 boreholes should be drilled within the Lower Sand deposit, preferably one within the 0 metre overburden in the southwest portion of the deposit, and one in the southeast portion.

At least 2 boreholes should be drilled along the linear 'tail' extending to the southeast of the central proven area of the upper sand deposit. One hole would be located so as to penetrate the 0 metre overburden area of the Lower Sand deposit in order to unravel the relationship between the two deposits in this area. The other hole would be located closer to the southeast end of the extension.

2 Due to the poor coverage and low quality of the geophysical data used in this study, it is recommended that the area be resurveyed covering both deposits. It is important for this program to concentrate on achieving high resolution and good penetration so that regional stratigraphic correlations and internal facies variations may be more accurately defined. This will enable a better

understanding of the stratigraphic relationship between the two deposits, as well as internal facies variations and differences that contribute to resource quality.

Priority may be given to the Lower Sand Unit since there is very little seismic coverage of this area. It is recommended that survey lines be completed in an east - west direction on a grid of approximately 1 km line spacing, with north - south directed lines be completed with a 2 km line spacing.

For the Upper Sand Unit it is recommended that survey lines be completed in an east - west and north - south direction of approximately 2 km line spacing in both directions. Eastern lines should extend into the area of the Lower Sand Unit for better correlation of the two sand bodies at depth.

The geophysical program should consist of 3.5 kHz profiler, a Boomer system (the IKB Seistec - line and cone - limited aperture reciever is strongly recommended with the boomer source), and a deeper penetration small airgun system as the subbottom profiling tools. These data should be complemented by a sidescan sonar and a precision fathometer to assess water depths, seabed texture, and seabed features. It is recommended that navigation systems be of comparable quality to those employed during collection of the industry data sets. A broader weather window can be obtained through the use of some form of active heave compensation system. This will allow much more comprehensive lithologic and stratigraphic interpretation of these data such as is only presently obtained during the occasional ideal, calm survey day. These systems are presently not commercially available and some development work may be necessary.

3 A geotechnical investigation should be carried out pending results of the recommended geophysical program. At least 60 boreholes are required to more accurately define the probable and prospective potential in the two deposits, and to clarify the nature and extent of the fine interlayer between the two sand bodies. Exact borehole locations would honor questionable areas resulting from any modifications to the interpretation of the deposits presented in this report.

4 Following the recommended geophysical and geotechnical programs, a synthesis and evaluation of the data would be required to update and revise the extent and quality of the granular resources in the area. The recommended follow up programs may expose variations within the region which the present data set may not allow, therefore a closer examination of more localized areas would be required. This may be especially true for the Lower Sand deposit and the linear 'tail' extending from the proven area of the Upper Sand deposit.

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APPENDICES

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.

YEAR	CLIENT	CONTRACTOR	SURVEY TITLE	LINE COVERAGE	LINES LISTING
1984	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
1985	ESSO	McGREGOR GEOSCIENCES 85-45.4	ARNAK K-06 C.O.G.L.A 9426 J1-3E	57 Km, 15 LINES, 4 CORES (AR85SD1, AR85SD	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

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LISTING OF GEOPHYSICAL SURVEYS WITHIN THE ISSERK-ERKSAK

BORROW BLOCK AREAS

COMPILED BY McELHANNEY GEOSURVEYS LTD.

YEAR	CLIENT	CONTRACTOR	SURVEY TITLE	LINE COVERAGE	LINES LISTING
1982	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
1982	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 FG,PINGO SEARCH P30,P32,P28,P39,P28,TIE LINESB99KUD,KUD044,CORGAS,DENNY,P23WAM,WAMB99,B99,S#1,IRKTIM
1983	ESSO	GEOTERREX 93-41	NIPTERK L-19	82 Km., 19 LINES, 3 CORES (82-N-1, 83-NH	85118 - 85134, 85136, 85088
1983	ESSO	GEOTERREX 93-41	REGIONAL LINES 1983	100 Km, 6 LINES	85-088, 85158, 85159, 83-01, 83-02, 83-03
1983	ESSO	GEOTERREX 93-41	KAUBVIK I-43	83 Km, 18 LINES, ONE (1) CORE (83-KHS-SO	85072 - 85 089
1983	ESSO	GEOTERREX 93-41	AMERK O-9	74 Km, 16 LINES, 4 CORES (82-A-1,82-A-2,	85054,85056 - 85060,85062 - 85071
1983	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
1983	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.

YEAR	CLIENT	CONTRACTOR	SURVEY TITLE	LINE COVERAGE	LINES LISTING
1974	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
1978	DOME	FAIRFIELD AQUATRONICS	UKALERK C-50	35 Km,11 LINES	42,32,22,12,2,31,21,11,1,33,34
1978	DOME	GSI	REGIONAL LINES 1978	360Km,2 LINES	DHR-78-1,2
1980	DOME	GEOTERREX	TINGMIARK & UKALERK BORROW STUDY	7 LINES	DHR80-527,601,609,521E,610,605,525C
1980	DOME	GEOMARINE	SOUTH KAGLULIK BORROW STUDY	N/A	DHR80-820,821,823,825,827,829
1980	DOME	GEOTERREX	ISSERK BORROW STUDY	5 LINES	DHR80-310,311,312,515B,309
1980	GULF	GEOTERREX	REGIONAL LINES 1980	50 Km,2 LINES	LINES 10, 20
1980	DOME	GEOTERREX	UVILUK BORROW STUDY	8 LINES	DHR80-503,556A,506,643,647,651,527,653
1980	GULF	GEOTERREX	AKPAK	36 Km,14 LINES	302,307,312,317,322,780,805,830,855,880, 905,930,955,980
1980	GULF	GEOTERREX	NORTH ISSUNGNAK WELLSITE	36 Km,14 LINES	199,204,209,214,219,500,525,550,575,600, 625,650,675,700
1981	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.

YEAR	CLIENT	CONTRACTOR	SURVEY TITLE	LINE COVERAGE	LINES LISTING
1981	DOME	GEOTERREX	KOGYUK	260.6Km, 40 LINES	GHR81-302 TO GHR81-332,GHR81-078,045,311,046,043,047, 075,018,089
1981	DOME	GEOTERREX	NERLERK RIDGE BORROW SITE	24Km,11 LINES	DHR81-140-1 TO DHR81-140-9,DHR81-140-2A,3A
1981	GULF	M.J. O'CONNOR & ASSOCIATES	REGIONAL BORROW INVESTIGATION 1981	2200 Km,	81-092--099, 81-0001--0014, 81-0001--089 (NOT CONTINUOUS)
1981	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
1981	DOME	GEOMARINE	UVILIK P-66	440.25Km	DHR81-140-1 TO DHR81-140-70, DHR81--140-115,119,131,135,139,147
1981	GULF	GEOTERREX	KOGYUK AREA	235 Km,32 LINES	GHR-81-301...GHR-81-332
1981	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
1981	GULF	GEOTERREX	SOUTH KOAKOAK 1981	31 Km,10 LINES	GHR-81-0004,025,0005,051,350,821,0002,80 1,806,811
1982	DOME	GEOTERREX	REGIONAL LINES 1982	226.6KM	DHR82-02 TO DHR82-09
1982	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-81-001B			L/F/C	L/F/C	L
GHR-81-0005B			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-81-0002	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
82-01	L		L/F/C	L	L
82-02	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
85-999		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
DHR-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-80-556A			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-80-521C			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-80-532	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-81-305A			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 ISSERK 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 Isserk Borrow Block by EBA Engineering Consultants Ltd. in their report entitled "Compilation of Borehole Logs for the Isserk Borrow Block Beaufort Sea" (EBA 1988a). Within this compilation, a total of 99 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 1988a ISSERK GEOTECHNICAL BOREHOLE DATA BASE. (Definition of Table 1A-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

HEADING	EXPLANATION

A cont'd

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.

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

HEADING		EXPLANATION
B cont'd	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 dredge.
	14 -	The material is marginally too fine. D90 lies between 90 and 150 microns. Fines content lies between 12 and 18%.
	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?).

HEADING	EXPLANATION
25 -	Permafrost noted on the borehole logs.
26 -	Double clay layer.
27 -	Overburden (Unit A & B) exceed 15 metres and is possible channel fill.
28 -	The borehole is too short for adequate interpretation.

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

HEADING	EXPLANATION

inserted, therefore, that summarizes the core below this level.

The codes with 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 occurence of the borehole.
C - Sandy units and silty and clayey units lie below the second occurrence of coarse material.

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 ISSERK BORROW BLOCK

BH	WD(M)	LTH(M)	A	B	C	1a	1b	2a	2b	3	ICE	NORTH	EAST	ZONE	LATITUDE	LONGITUDE
Note: Underlined boreholes contain dredgeable resource.																
53-5	13.4	11.3	6	13	23	7.0	4.3	0.0	0.0	E	T	7758580	522915	8	69.935169	-134.40156
53-6	13.0	19.9	6	13	23	15.8	4.1	0.0	0.0	E	T	7758580	523695	8	69.935099	-134.38119
70-3	13.6	20.0	6	13	23	5.3	2.2	12.5	7.5	E	T	7758980	520735	8	69.938938	-134.45839
70-6	13.3	14.3	6	13	23	14.3	0.0	0.0	0.0	E	T	7758285	521125	8	69.932675	-134.44837
B15-1	11.1	24.5	6	14	23	9.3	1.8	13.5	11.0	E	F	7754927	526563	8	69.902068	-134.30738
B15-2	11.4	22.3	6	13	22	7.2	15.1	0.0	0.0	E	T	7754929	526708	8	69.902071	-134.30360
B15-3	10.8	10.7	6	14	23	9.0	1.7	0.0	0.0	E	F	7754778	526562	8	69.900732	-134.30745
B15-12	11.4	22.3	4	11	22	9.5	12.8	0.0	0.0	E	F	7754929	526708	8	69.902071	-134.30360
B15-13	11.4	10.0	4	18	22	10.0	0.0	0.0	0.0	E	F	7754925	526415	8	69.902065	-134.31124
B15-15	11.4	18.6	6	13	23	18.6	0.0	0.0	0.0	E	T	7755000	525540	8	69.902825	-134.33403
B15-16	12.0	23.7	6	13	23	16.3	7.4	0.0	0.0	E	T	7755705	525580	8	69.909142	-134.33278
B15-17	11.4	25.3	6	13	23	17.7	6.9	25.0	0.3	E	T	7755545	526340	8	69.907632	-134.31301
B15-18	11.4	16.2	6	13	24	12.6	3.6	0.0	0.0	E	T	7756050	527060	8	69.912086	-134.29408
B15-19	11.3	16.2	6	13	24	10.2	3.3	0.0	0.0	N	T	7755290	527065	8	69.905271	-134.29418
B15-20	11.0	13.7	6	13	23	11.2	2.5	0.0	0.0	E	T	7754795	526435	8	69.900898	-134.31075
B15-21	11.1	18.5	6	13	23	11.2	2.8	15.2	3.3	E	T	7754795	526725	8	69.900868	-134.30319
B15-22	10.1	23.5	6	13	24	7.7	2.3	11.8	1.6	C	T	7754645	526575	8	69.899538	-134.30715
B15-A	11.9	20.1	6	13	23	20.1	0.0	0.0	0.0	E	T	7755720	526000	8	69.909235	-134.32183
B15-B	11.8	12.9	6	13	23	11.0	1.5	0.0	0.0	N	T	7755800	526655	8	69.909886	-134.30472
H20-1	10.1	26.0	6	13	23	18.6	7.4	0.0	0.0	E	T	7754485	522770	8	69.898463	-134.40638
H25-1	10.5	26.3	6	14	23	6.5	2.0	13.5	12.8	E	F	7753450	525150	8	69.888965	-134.34463
IB78-1	12.7	24.0	5	14	22	3.6	16.0	0.0	0.0	N	T	7758585	524695	8	69.935051	-134.35507
IB78-2	14.0	5.0	1	12	21	0.0	1.5	0.0	0.0	N	F	7759503	523998	8	69.943347	-134.37303
IB78-3	14.0	5.0	7	12	21	0.0	1.5	0.0	0.0	N	F	7760000	524998	8	69.947709	-134.34676
IB78-4	13.5	5.5	4	18	28	5.5	0.0	0.0	0.0	E	F	7758993	525496	8	69.938632	-134.33404
IB78-5	14.5	4.5	7	14	21	0.2	1.5	0.0	0.0	N	F	7760748	524995	8	69.954416	-134.34663
IB78-6	13.5	5.5	7	14	21	0.0	2.0	0.0	0.0	N	F	7759602	524499	8	69.944188	-134.35991
IB80-84	13.4	21.4	3	11	21	0.0	21.0	0.0	0.0	N	F	7762173	526966	8	69.966997	-134.29468
IB80-85	14.3	18.3	1	15	26	0.6	2.4	7.3	11.0	E	T	7762139	525256	8	69.966863	-134.33942
IB80-86	11.3	15.2	1	13	21	0.0	3.4	11.2	4.0	E	T	7759559	527962	8	69.943454	-134.26946
IB80-87	14.3	15.2	1	11	21	0.0	3.6	6.1	3.9	N	F	7764226	526502	8	69.985452	-134.30621
IB80-88	14.9	12.2	6	13	23	12.2	0.0	0.0	0.0	E	T	7760801	528700	8	69.954509	-134.24978
IB80-89	13.4	9.1	1	11	21	0.0	3.0	5.0	3.8	N	T	7761599	528001	8	69.961741	-134.26780
IB80-90	13.4	9.1	1	12	21	0.0	3.0	4.9	1.8	N	F	7762101	526099	8	69.966439	-134.31738
IB80-91	13.1	9.7	1	11	21	0.0	3.0	0.0	0.0	N	F	7761101	525997	8	69.957483	-134.32034
IB80-92	14.0	9.1	1	11	21	0.0	3.0	6.2	2.9	E	T	7763398	527701	8	69.977903	-134.27508
IB80-93	0.0	0.0	1	15	21	0.4	3.6	5.4	3.7	E	T	7763402	526802	8	69.978033	-134.29860

TABLE 3A-2 cont'd BOREHOLES WITHIN THE ISSERK BORROW BLOCK

BH	WD(M)	LTH(M)	A	B	C	1a	1b	2a	2b	3	ICE	NORTH	EAST	ZONE	LATITUDE	LONGITUDE
Note: Underlined boreholes contain dredgeable resource.																
IB80-94	15.2	9.1	1	12	21	0.0	4.2	5.5	3.6	E	F	7763400	526000	8	69.978097	-134.31959
IB80-95	0.0	0.0	1	11	21	0.0	5.5	6.1	3.0	E	F	7761250	527200	8	69.958696	-134.28885
IB80-96	11.9	9.1	1	11	21	0.0	4.8	5.5	3.6	E	F	7760250	527500	8	69.949699	-134.28131
IB80-97	12.5	9.1	1	11	21	0.0	3.4	0.0	0.0	N	T	7760401	526351	8	69.951171	-134.31129
IB80-98	12.2	9.1	1	11	21	0.0	4.8	6.7	2.4	E	F	7759099	526751	8	69.939456	-134.30123
IB82801	18.3	6.7	1	11	21	0.2	3.9	0.0	0.0	N	F	7761510	526983	8	69.961050	-134.29444
IB82802	12.2	11.0	1	11	21	0.0	1.0	2.5	1.7	C	F	7760053	526986	8	69.947986	-134.29480
IB82803	11.6	9.8	1	11	21	0.0	1.9	0.0	0.0	N	F	7760054	526966	8	69.947997	-134.29533
IN-C	13.4	13.7	1	7	23	0.0	1.2	11.2	2.5	E	T	7759150	523010	8	69.940271	-134.39893
IN-D	12.9	19.1	5	13	23	3.6	1.5	15.1	4.0	E	T	7758940	523030	8	69.938386	-134.39846
IN-F	12.8	16.8	7	13	23	0.0	1.2	6.5	4.5	C	T	7759160	524755	8	69.940201	-134.35335
IN-G	12.7	16.9	1	13	22	0.0	1.5	5.6	11.3	E	T	7759400	525055	8	69.942324	-134.34544
IS78-1	18.0	28.0	6	16	26	5.0	2.2	11.2	16.8	E	F	7767303	525599	8	70.013132	-134.32896
IS78-2	20.0	26.0	6	16	23	4.0	2.2	10.2	15.8	E	F	7767821	525222	8	70.017813	-134.33869
IS78-3	20.0	26.0	6	16	26	3.3	3.0	12.2	13.8	E	F	7767683	525319	8	70.016566	-134.3361
IS78-4	18.8	27.2	6	16	23	4.0	3.5	11.0	16.2	E	F	7767341	525318	8	70.013500	-134.33631
IS78-5	19.5	26.5	6	15	22	3.5	23.0	0.0	0.0	E	F	7767652	526750	8	70.016145	-134.29869
IS78-6	19.5	32.5	6	16	26	5.5	3.2	10.0	19.5	C	F	7768004	526642	8	70.019312	-134.30141
IS78-7	20.0	26.0	6	16	23	3.0	5.0	10.0	16.0	E	F	7767371	526713	8	70.013629	-134.29974
IS78-8	20.0	26.0	5	16	23	3.0	5.0	10.7	11.3	C	F	7768247	526469	8	70.021509	-134.30587
IS78-9	20.2	25.8	2	12	22	3.5	22.3	0.0	0.0	E	F	7768171	526961	8	70.020777	-134.29300
IS78-10	20.0	26.0	4	16	23	5.0	21.0	0.0	0.0	E	F	7767889	526872	8	70.018257	-134.29542
IS78-11	21.0	25.0	6	16	23	3.0	3.0	18.5	6.5	E	F	7768496	526449	8	70.023743	-134.30632
IS78-12	20.0	26.0	4	16	26	4.0	7.5	10.0	16.0	E	F	7767225	526631	8	70.012329	-134.30193
IS78-13	20.0	14.0	2	11	22	2.4	11.6	0.0	0.0	E	F	7767465	526004	8	70.014544	-134.31830
IS78-14	20.0	26.0	4	11	22	4.0	22.0	0.0	0.0	E	F	7767601	527034	8	70.015658	-134.29126
IS78-15	20.0	26.0	5	16	23	14.0	8.2	24.0	2.0	E	F	7767482	526857	8	70.014610	-134.29593
IS78-16	20.5	25.5	4	16	23	3.0	5.5	13.2	12.3	E	F	7767416	526077	8	70.014097	-134.31640
IS78-17	20.0	14.0	6	16	26	4.2	2.8	9.0	5.0	E	F	7767000	526338	8	70.010341	-134.30968
IS7817A	20.0	26.0	6	12	26	3.7	1.3	8.0	18.0	E	F	7766987	526349	8	70.010223	-134.30940
IS78-18	21.0	13.0	6	16	26	2.0	3.0	10.0	3.0	E	F	7766953	526139	8	70.009940	-134.31491
IS78-19	19.5	32.5	4	16	26	4.5	1.2	7.7	24.8	E	F	7767821	526493	8	70.017687	-134.30537
IS81-4	15.5	26.6	4	11	23	1.3	7.0	16.5	10.1	E	T	7763203	524553	8	69.976471	-134.35751
IS81-5	15.2	23.8	1	12	21	0.0	3.0	12.0	11.8	E	T	7763194	523918	8	69.976449	-134.37413
IS81-6	15.2	20.8	4	12	23	12.5	8.3	0.0	0.0	E	F	7763315	523270	8	69.977593	-134.39105
IS81-7	16.2	10.6	4	12	26	7.0	2.3	0.0	0.0	N	F	7763903	522228	8	69.982957	-134.41817
IS81-8	14.9	24.7	4	12	23	2.5	3.0	16.3	5.0	N	F	7763596	522298	8	69.980198	-134.41641

TABLE 3A-2 cont'd BOREHOLES WITHIN THE ISSERK BORROW BLOCK

BH	WD(M)	LTH(M)	A	B	C	1a	1b	2a	2b	3	ICE	NORTH	EAST	ZONE	LATITUDE	LONGITUDE
Note: Underlined boreholes contain dredgeable resource.																
IS81-9	16.2	29.5	2	13	22	2.4	19.6	0.0	0.0	N	T	7763917	521812	8	69.983117	-134.42905
IS81-9B	15.9	29.8	6	13	22	4.0	9.5	14.6	12.1	E	T	7763912	521837	8	69.983071	-134.42840
IS81-10	16.5	20.4	4	13	22	4.0	16.4	0.0	0.0	E	T	7763594	521807	8	69.980222	-134.42926
IS81-11	16.8	10.7	4	13	24	1.5	1.3	6.6	4.1	E	T	7764010	521296	8	69.983994	-134.44254
IS81-13	16.2	11.5	6	13	22	5.2	6.3	0.0	0.0	E	T	7763594	521300	8	69.980264	-134.44253
IS81-15	16.2	24.1	6	13	22	11.5	9.5	0.0	0.0	N	T	7764703	521797	8	69.990166	-134.42925
IS81-16	17.0	22.6	2	13	22	3.2	19.4	0.0	0.0	E	T	7763802	521552	8	69.982108	-134.43589
IS81-18	15.2	28.4	2	14	22	3.7	24.7	0.0	0.0	E	T	7763198	521801	8	69.976671	-134.42952
IT81-1	14.3	30.8	4	11	22	6.0	16.5	23.5	7.3	E	F	7760141	534353	8	69.947907	-134.10228
IT81-2	14.3	27.8	4	11	22	13.7	14.1	0.0	0.0	E	F	7759766	536595	8	69.944240	-134.04386
IT81-10	14.6	27.7	6	14	23	12.5	15.2	0.0	0.0	E	F	7759987	535002	8	69.946440	-134.08538
IT81-11	13.7	13.7	6	12	22	7.3	6.4	0.0	0.0	E	F	7759352	535012	8	69.940746	-134.08537
IT81-12	13.7	32.0	6	12	24	5.3	10.3	20.0	2.7	E	F	7759208	534735	8	69.939492	-134.09266
IT81-13	14.3	28.4	6	12	24	6.7	21.7	0.0	0.0	E	F	7759357	534443	8	69.940866	-134.10023
IT81-16	14.0	31.7	6	12	23	7.5	1.5	13.0	12.6	C	F	7759700	534413	8	69.943945	-134.10088
IT81-19	14.0	25.6	2	14	22	2.3	23.3	0.0	0.0	E	F	7759879	534164	8	69.945583	-134.10732
IT81-20	14.0	31.7	6	14	22	8.5	23.2	0.0	0.0	E	F	7759409	534711	8	69.941297	-134.09321
IT81-21	13.7	29.0	6	12	22	5.5	23.5	0.0	0.0	E	F	7759096	534869	8	69.938469	-134.08921

LEGEND

- # IB78-2 — Borehole location and ID
- 1275 GHR-81-62 1295 — Seismic track; Event Number; Line Number
- A' # 70-6 — Borehole transect with borehole location and ID (see Figures 11, 12, and 13)

Isserk Borrow Block Boundary

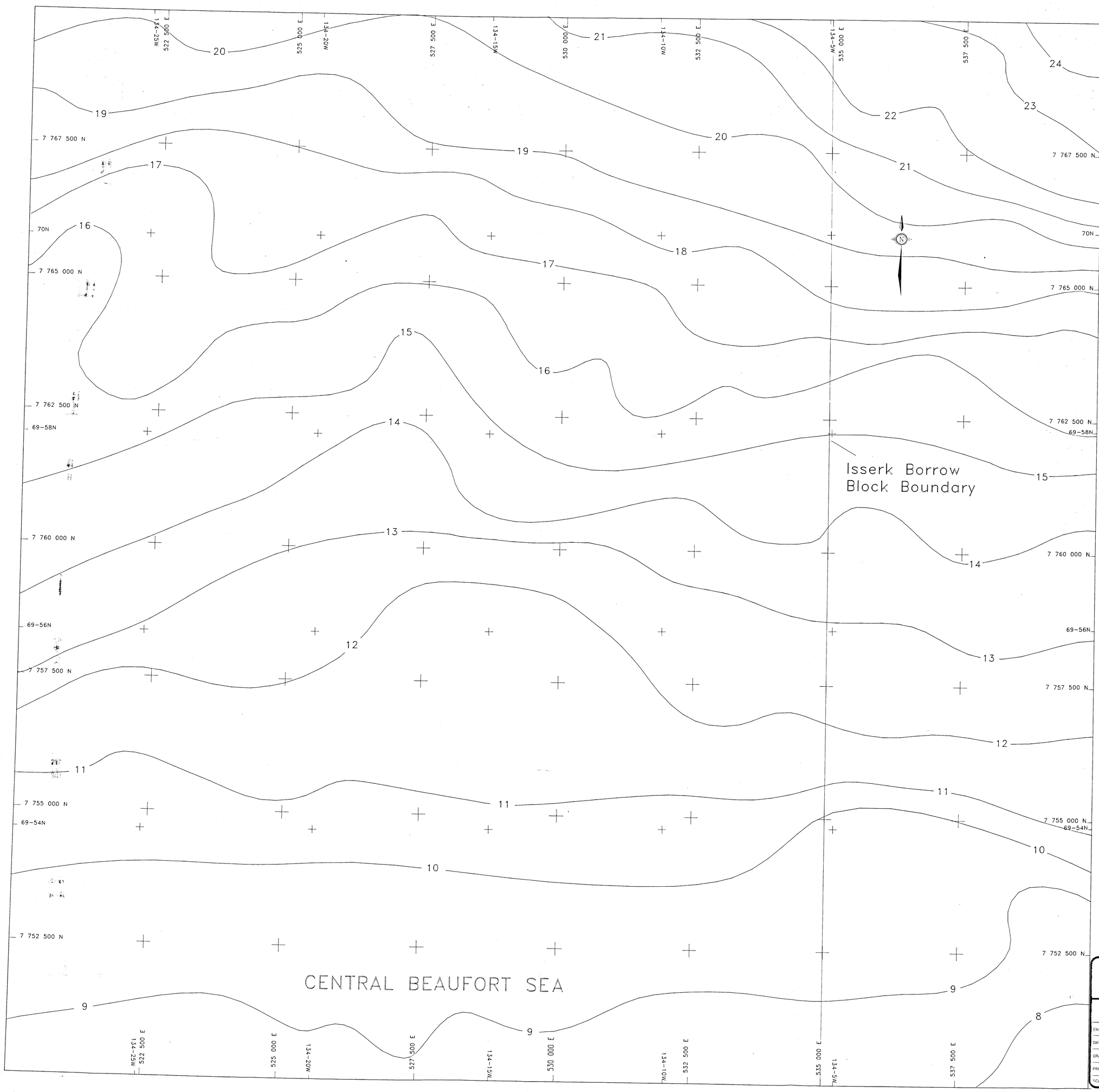
SCALE (km) 0 1.25 2.5

EOR EARTH & OCEAN RESEARCH LTD. DARTMOUTH, NOVA SCOTIA CANADA	FOR INDIAN AND NORTHERN AFFAIRS CANADA (INAC)

ISSERK BORROW BLOCK

BOREHOLE AND SEISMIC COVERAGE

ENCLOSURE: 1
DATE: JULY/88
DRAWN BY: BGE
PROJECTION : UTM CM -135
SCALE : 1 : 25,000
EOR PROJECT NO : 88-03



LEGEND

16 Contours in metres

Contours digitized from CHS Sheets:

WA 10026	WA 10169
WA 10059	WA 10171
WA 10077	WA 10173
WA 10086	WA 10179

Tidal corrections applied by CHS
Contours in meters from seasurface

SCALE (km)
0 1.25 2.5

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CANADA

FOR
DEPARTMENT OF
INDIAN AFFAIRS AND
NORTHERN DEVELOPMENT

ISSERK BORROW BLOCK

BATHYMETRY

ENCLOSURE: 2
DATE: 08/88
DRAWN BY: BGE
PROJECTION : UTM CM -135
SCALE : 1 : 25,000
EOR PROJECT NO : 88-03

LEGEND

- ○ sl CLAY (CL) — Borehole location with textural classification of surface sample.
- LOWER CLAY UNIT. Silty to very silty. Dark to medium grey to grey brown. Trace sand to fine grained sand stringers. Very soft to very stiff. Medium to low plastic. Trace black organics.
- UPPER CLAY UNIT. Trace silt. Trace interbedded sand. Soft to very stiff. High plastic. Wet.
- SILT. Some clay. Trace sand. Low plastic. Hard. Dark grey.
- SAND. Fine to medium grained. Trace clay. Trace silt. Trace coarse sand. Trace gravel. Occasional pebble to 25 mm., sub-rounded to smooth. Trace shell fragments. Non-cohesive. Olive-brown to dark brown.
- SAND & GRAVEL. Medium grey. Gap graded - gravel is fine, sand is fine to medium.

Assumed boundary between Upper and Lower Clay

SAND AND / OR GRAVEL MAY BE AT THE SEAFLOOR OR WITHIN TWO METERS OF THE SEAFLOOR WITHIN THIS AREA

SCALE (km)
0 1.25 2.5

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FOR
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ISSERK BORROW BLOCK

ENCLOSURE: 3
DATE: JULY/88
DRAWN BY: BGE
PROJECTION : UTM CM -135
SCALE : 1 : 25,000
EOR PROJECT NO : 88-03

SURFICIAL COVER

522 500 E
134-25W
525 000 E
134-20W
527 500 E
134-15W
530 000 E
134-10W
532 500 E
134-5W
535 000 E
537 500 E

7 767 500 N
70N
7 765 000 N
7 762 500 N
69-58N
7 760 000 N
69-56N
7 757 500 N
7 755 000 N
69-54N
7 752 500 N

Isserk Borrow
Block Boundary

LEGEND

22 — Structure contour in metres.

Note: Water depth is taken from the Canadian Hydrographic Service field sheets.
Depths to structure from the seafloor are calculated using a velocity of sound in sediments of 1.6 m/sec.

SCALE (KM)
0 1.25 2.5

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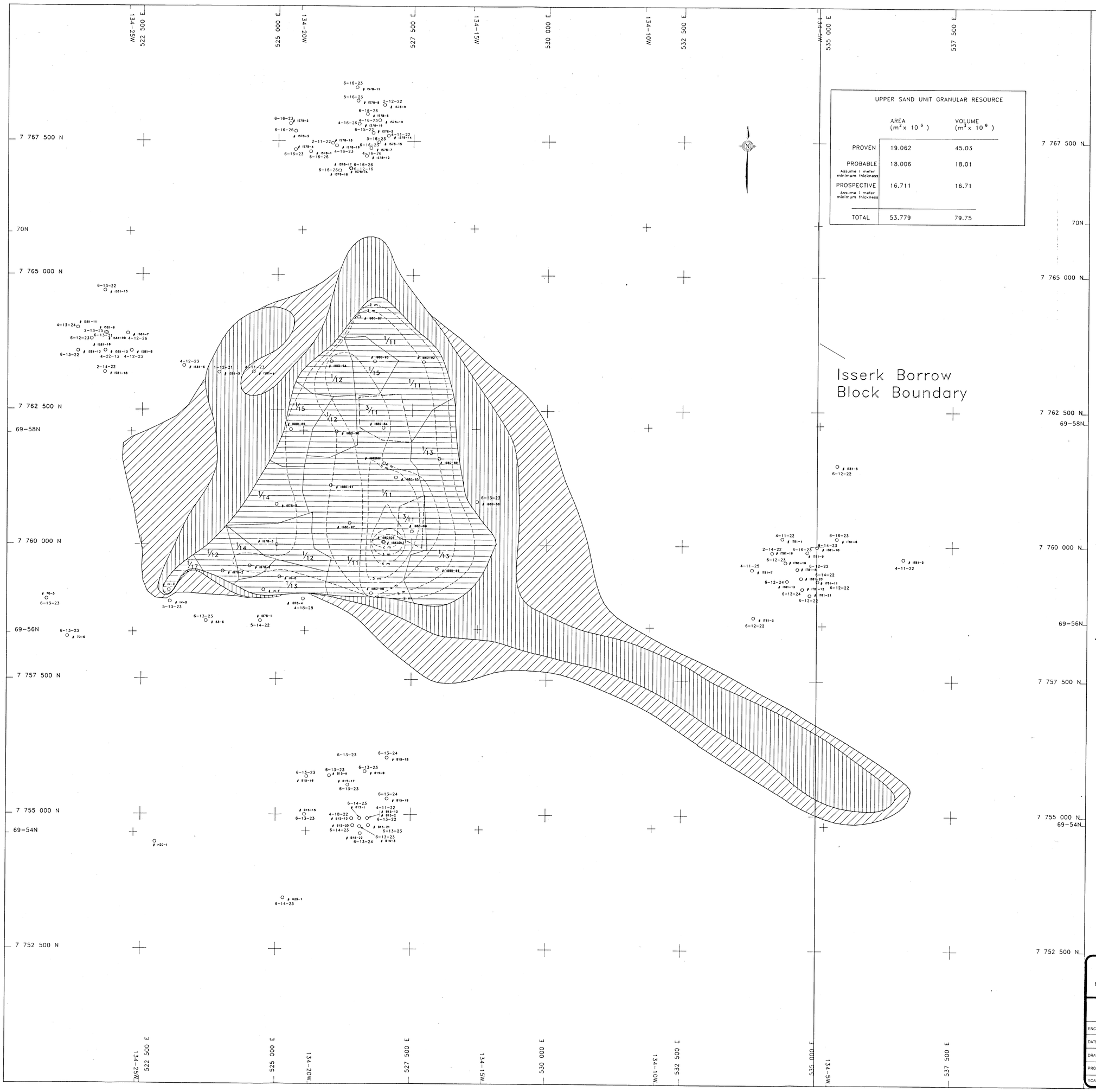
ISSERK BORROW BLOCK

ENCLOSURE: 4
DATE: 08/88
DRAWN BY: BGE

DEPTH STRUCTURE ON TOP OF UNIT C

PROJECTION : UTM CM -135
SCALE : 1 : 25,000
EOR PROJECT NO : 88-03



UPPER SAND UNIT GRANULAR RESOURCE

	AREA ($m^2 \times 10^6$)	VOLUME ($m^3 \times 10^6$)
PROVEN	19.062	45.03
PROBABLE Assume 1 meter minimum thickness	18.006	18.01
PROSPECTIVE Assume 1 meter minimum thickness	16.711	16.71
TOTAL	53.779	79.75

LEGEND

- Outline of deposit as interpreted from seismic and borehole data
- Thickness contours in meters
- Borrow prospect zones based on dredgeability
- Borrow prospect zones based on development concerns
- # H20-1 Borehole location and identification
- Proven Resource
- Probable Resource
- Prospective Resource

4-11-22 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
< 0.5 m of overburden
> 20 m of recoverable sand

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

4-11-22

DEVELOPMENT CONCERNS CODE

11 Good quality to deposit
12 Poor to unsuitable quality (fines > 12%)
13 Permafrost will be encountered by dredge
14 Material is marginally too fine
D90 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

4-11-22

STRATIGRAPHIC CLASSIFICATION

21 Granular sediments at or very near (<0.5 m) seabed
22 Simple stratigraphy of clay +/- some Unit B overlying sand
23 Complexly stratified or very thick Unit B
24 Complexly stratified sand strata (Unit C?)
25 Permafrost noted on BH logs
26 Double clay layer
27 Overburden (Unit A & B) exceed 15 m -channel fill
28 BH too short for full interpretation

Borehole description developed by
Neil MacLeod of
EBA Engineering Consultants Ltd.
Calgary, ALTA.

SCALE (km)
0 1.25 2.5

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ISSERK BORROW BLOCK

ENCLOSURE: 5
DATE: 08/88
DRAWN BY: BGE

GRANULAR RESOURCES
UPPER SAND UNIT

PROJECTION : UTM CM -135
SCALE : 1 : 25,000
EOR PROJECT NO : 88-03

GRANULAR RESOURCE – LOWER SAND UNIT	AREA ($m \times 10^2$)	VOLUME ($m \times 10^3$)
Assume 1 meter	40.840	40.840
Assume 5 meters	"	204.20
Assume 10 meters	"	408.00
Assume 20 meters	"	816.00

LEGEND

PROSPECTIVE RESOURCE.
Resource is defined as that portion of Unit C that lies within three meters of the seafloor.

IT81-2 — Borehole Location and Identification

4-11-22 — 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
< 0.5 m of overburden
> 20 m of recoverable sand

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

4-11-22 — DEVELOPMENT CONCERNS CODE

11 Good quality to deposit
12 Poor to unsuitable quality (fines > 12%)
13 Permafrost will be encountered by dredge
14 Material is marginally too fine
D90 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

4-11-22 — STRATIGRAPHIC CLASSIFICATION

21 Granular sediments at or very near (<0.5 m) seabed
22 Simple stratigraphy of clay +/- some Unit B overlying sand
23 Complexly stratified or very thick Unit B
24 Complexly stratified sand strata (Unit C?)
25 Permafrost noted on BH logs
26 Double clay layer
27 Overburden (Unit A & B) exceed 15 m –channel fill
28 BH too short for full interpretation

Isserk Borrow Block Boundary

Borehole description developed by
Neil MacLeod of
EBA Engineering Consultants Ltd.
Calgary, ALTA.

SCALE (km)
0 1.25 2.5

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CANADA

FOR
INDIAN AND NORTHERN AFFAIRS CANADA (INAC)

ISSERK BORROW BLOCK

GRANULAR RESOURCE
LOWER SAND UNIT

ENCLOSURE: 6
DATE: 08/88
DRAWN BY: BGE
PROJECTION : UTM CM –135
SCALE : 1 : 25,000
EOR PROJECT NO : 88-03