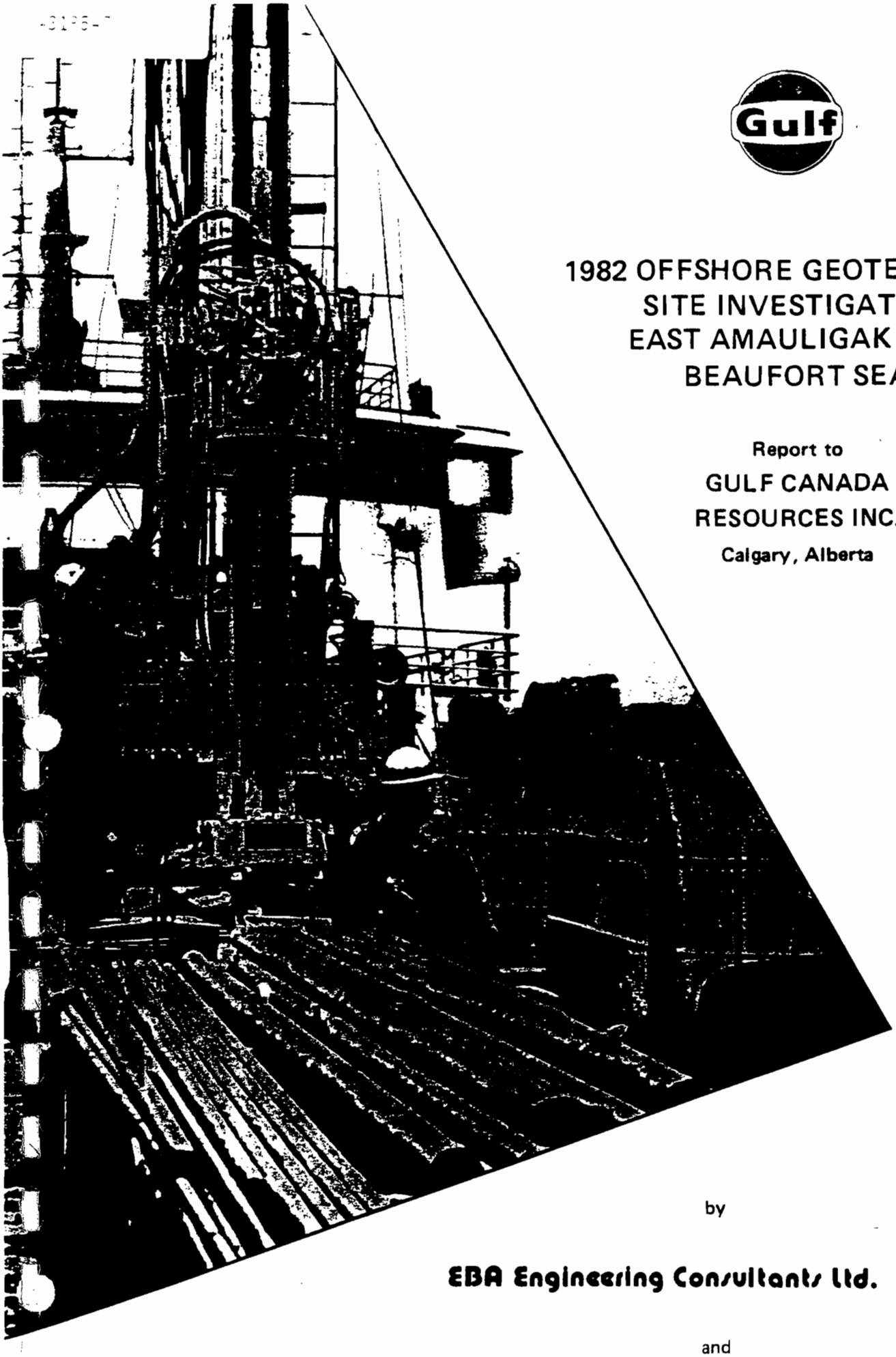

1982 OFFSHORE GEOTECHNICAL SITE INVESTIGATION EAST AMAULIGAK SITE BEAUFORT SEA

Report to

GULF CANADA RESOURCES INC.

Calgary, Alberta

by

EBA Engineering Consultants Ltd.

and

McClelland engineers, inc.

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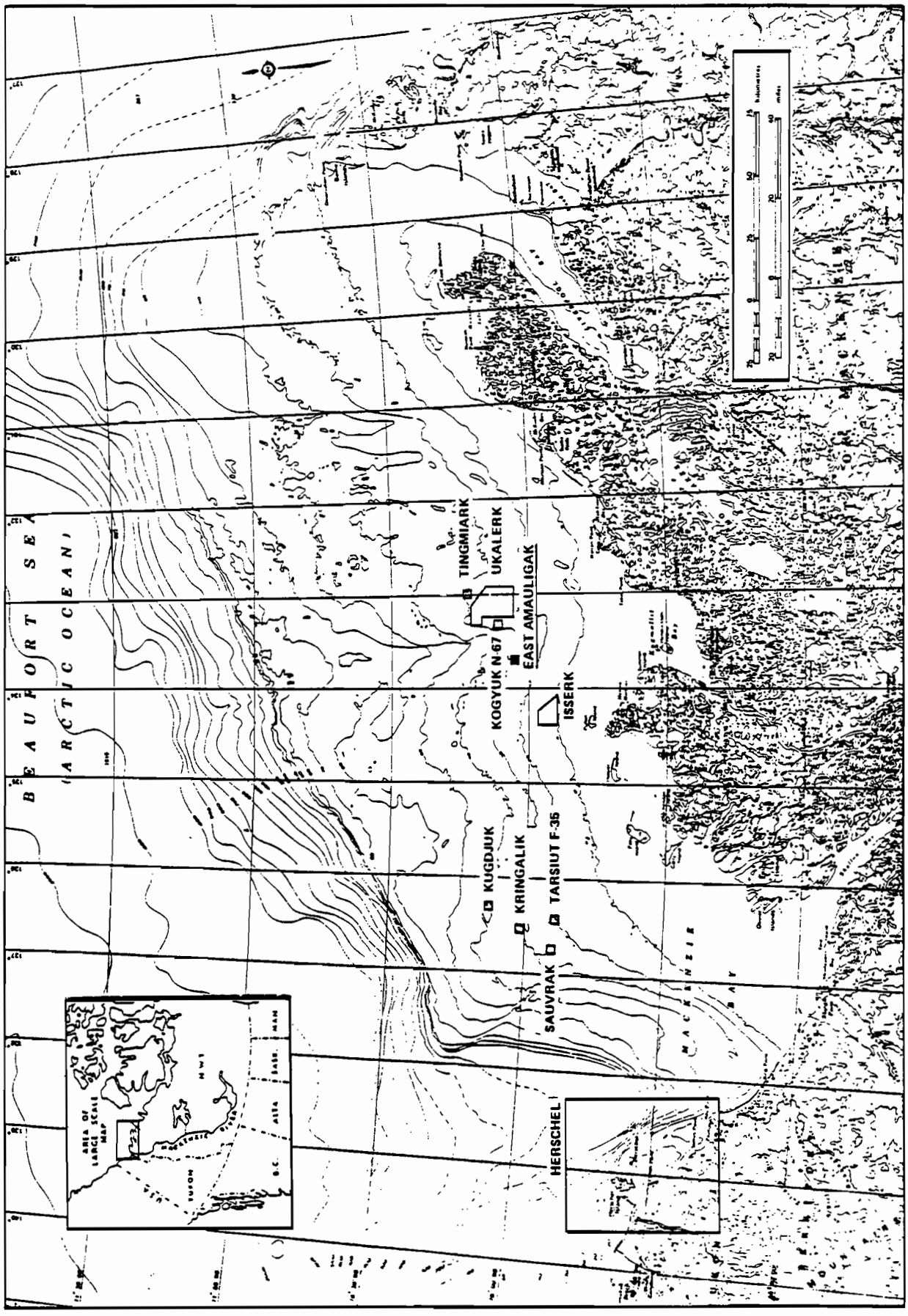

FIGURE 1 GENERAL LOCATION MAP

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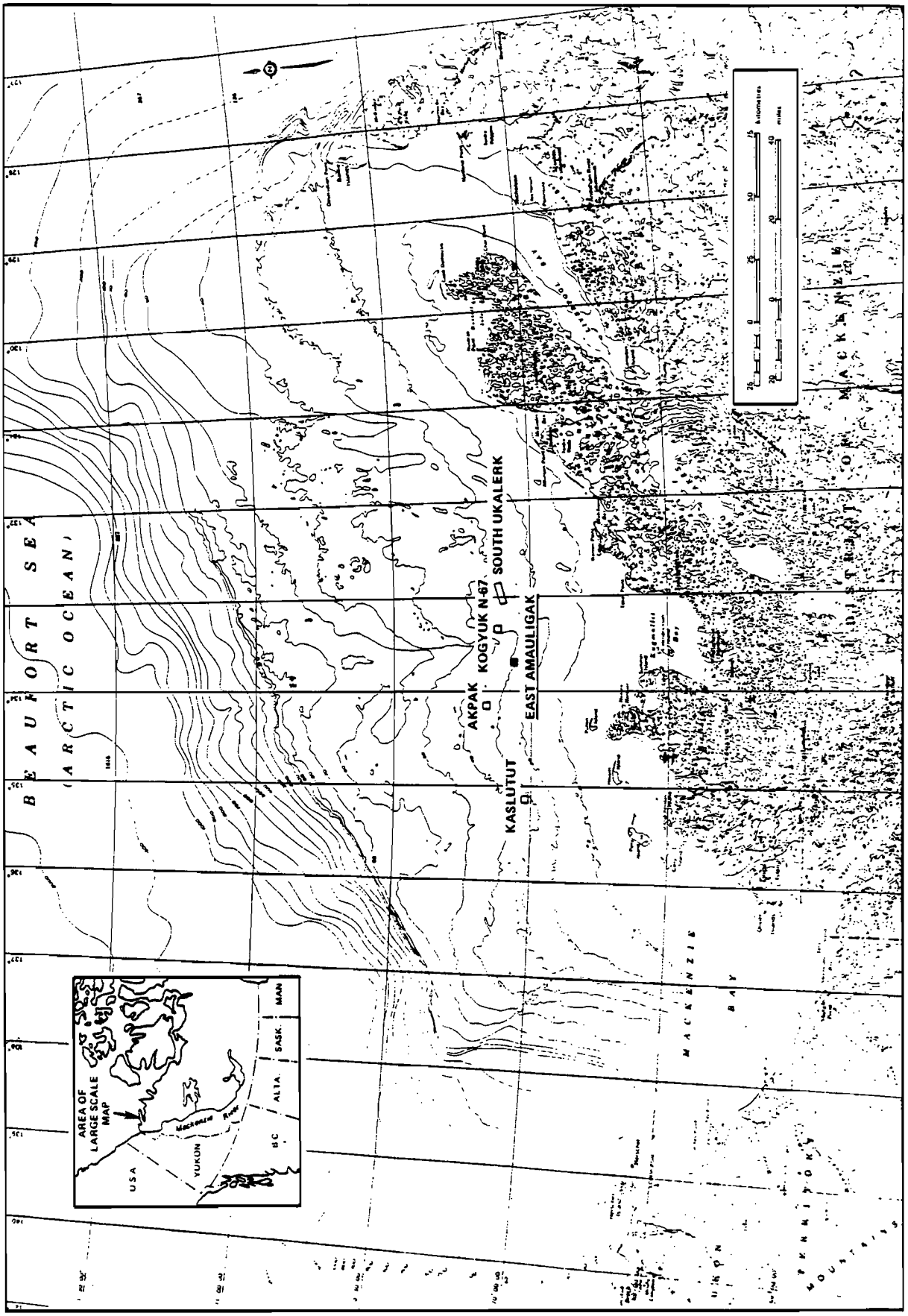


FIGURE 1 GENERAL LOCATION MAP

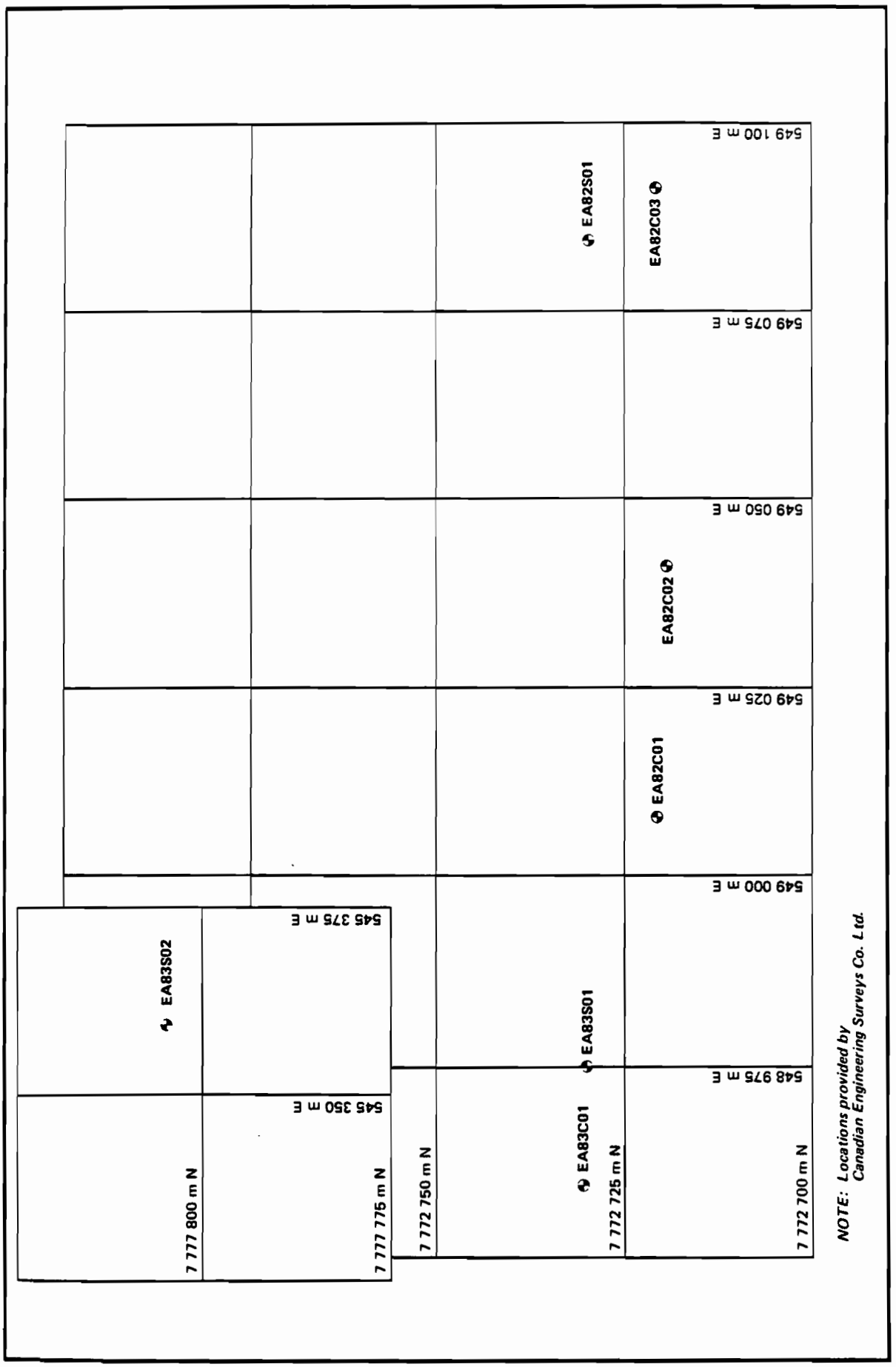


FIGURE 2 TESTHOLE LOCATION MAP
EAST AMAULIGAK AREA

TABLE 1 BOREHOLE/PROBEHOLE LOCATIONS

BOREHOLE/PROBEHOLE	UTM COORDINATES (ZONE 8)		GEOGRAPHIC COORDINATES Latitude	Longitude	DATE	SEABED PENETRATION (metres)
EA82S01	7 772 730N	549 085E	70°03'30.2"	133°42'37.6"	82-09-05	11.1
EA82C01	7 772 720N	549 019E	70°03'30.0"	133°42'43.9"	83-09-04	30.7
EA82C02	7 772 720N	549 040E	70°03'30.0"	113°42'41.9"	82-09-05	24.0
EA82C03	7 772 720N	549 090E	70°03'29.9"	133°42'37.2"	82-09-05	25.7
EA83S01	7 772 730N	548 975E	70°03'29.6"	133°42'13.5"	83-07-16	23.0
EA83C01	7 772 730N	548 955E	70°03'30.3	133'42'49.5"	83-07-16	12.0
EA83S02	7 777 810N	545 345E	70°03'35.1"	133'48'29.7"	83-07-17	9.5

Note: 1. All coordinates supplied by CES.

2. EA82/83 denotes a borehole/probehole at the East Amauligak site drilled/tested in 1982/83. "S" refers to "sampled", "C" refers to "static cone". The number following the latter designation is the borehole/probehole number.

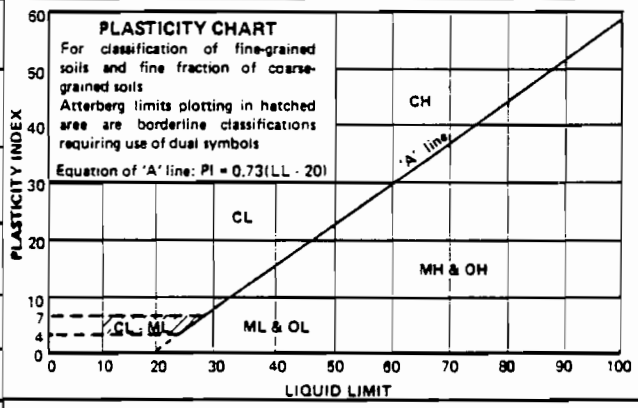
APPENDIX A

BOREHOLE LOGS

UNIFIED SOIL CLASSIFICATION†

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below 'A' line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand clay mixtures	Atterberg limits plot above 'A' line and plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly-graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures	Atterberg limits plot below 'A' line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above 'A' line and plasticity index greater than 7	
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
			CH	Inorganic clay of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity		
HIGHLY ORGANIC SOILS			PT	Peat, muck and other highly organic soils		

Classification on basis of percentage of fines
Less than 5% pass No. 200 sieve: GW, GP, SW, SP
More than 12% pass No. 200 sieve: GM, GC, SM, SC
5% to 12% pass No. 200 sieve: Borderline classification requiring use of dual symbols



*Based on the material passing the 3 in. (75 mm) sieve
†ASTM Designation D 2487, for identification procedure see D 2488

GROUND ICE DESCRIPTION

ICE NOT VISIBLE

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
N	Nf	Poorly-bonded or friable	
	Nbn	No excess ice, well-bonded	
	Nbe	Excess ice, well-bonded	

VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
V	Vx	Individual ice crystals or inclusions	
	Vc	Ice coatings on particles	
	Vr	Random or irregularly oriented ice formations	
	Vs	Stratified or distinctly oriented ice formations	

VISIBLE ICE GREATER THAN 50% BY VOLUME

ICE	ICE + Soil Type	Ice with soil inclusions	
	ICE	Ice without soil inclusions (greater than 25 mm (1 in.) thick)	

NOTE:

1. *Dual symbols are used to indicate borderline or mixed ice classifications*
2. *Visual estimates of ice contents indicated on borehole logs ± 5%*
3. *This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes*

LEGEND

Soil Ice

SYSTEM INTERNATIONAL UNITS

QUANTITY	NAME	SYMBOL	EXPRESSED IN TERMS OF OTHER SI UNITS	EXPRESSED IN TERMS OF BASE AND SUPPLEMENTARY UNITS
SI UNITS				
length	metre	m		
mass	kilogram	kg		
time	second	s		
electric current	ampere	A		
thermodynamic temperature	kelvin	K		
amount of substance	mole	mol		
luminous intensity	candela	cd		
SI SUPPLEMENTARY UNITS				
plane angle	radian	rad		
solid angle	steradian	sr		
EXAMPLES OF SI DERIVED UNITS WITH SPECIAL NAMES				
frequency	hertz	Hz	1/s	s^{-1}
force	newton	N	$m \cdot kg/s^2$	$m \cdot kg \cdot s^{-2}$
pressure, stress	pascal	Pa	N/m^2	$m^{-1} \cdot kg \cdot s^{-2}$
energy, work, quantity of heat	joule	J	$N \cdot m$	$m^2 \cdot kg \cdot s^{-2}$
power, radiant flux	watt	W	J/s	$m^2 \cdot kg \cdot s^{-3}$
EXAMPLES OF SI DERIVED UNITS WITHOUT SPECIAL NAMES				
velocity - linear	metre per second		m/s	$m \cdot s^{-1}$
- angular	(radian per second)		rad/s	$rad \cdot s^{-1}$
acceleration - linear	(metre per second) per second		m/s^2	$m \cdot s^{-2}$
- angular	(radian per second) per second		rad/s^2	$rad \cdot s^{-2}$
concentration (of amount of substance)	mole per cubic metre		mol/m^3	$mol \cdot m^{-3}$
dynamic viscosity	pascal second		$Pa \cdot s$	$m^{-1} \cdot kg \cdot s^{-1}$
moment of force	newton metre		$N \cdot m$	$m^2 \cdot kg \cdot s^{-2}$
surface tension	newton per metre		N/m	$kg \cdot s^{-2}$
heat flux density, irradiance	watt per square metre		W/m^2	$kg \cdot s^{-3}$
heat capacity, entropy	joule per kelvin		J/K	$m^2 \cdot s^{-2} \cdot K^{-1}$
specific heat capacity, specific entropy	joule per kilogram kelvin		$J/(kg \cdot K)$	$m^2 \cdot s^{-2} \cdot K^{-1}$
specific energy	joule per kilogram		J/kg	$m^2 \cdot s^{-2}$
thermal conductivity	watt per metre kelvin		$W/(m \cdot K)$	$m \cdot kg \cdot s^{-3} \cdot K^{-1}$

OTHER UNITS PERMITTED FOR USE WITH SI

QUANTITY	NAME	SYMBOL	DEFINITION
time	minute	min	1 min = 60 s
	hour	h	1 h = 3,600 s
	day	d	1 d = 86,400 s
	year	a	
plane angle	degree	°	$1° = (\pi/180)$ rad
	minute	′	$1′ = (\pi/10{,}800)$ rad
	second	″	$1″ = (\pi/648{,}000)$ rad
area	hectare	ha	1 ha = 10,000 m^2
volume	litre	L	1,000 L = 1 m^3
temperature	degree Celsius	°C	0° C = 273.15° K
			temperature interval 1 C° = 1 K°
mass	tonne	t	1 t = 1,000 kg = 1 Mg

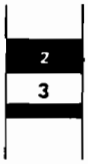
MULTIPLYING FACTOR	PREFIX	SYMBOL	MULTIPLYING FACTOR	PREFIX	SYMBOL
$1{,}000{,}000{,}000{,}000{,}000{,}000 = 10^{18}$	exa	E	$0.1 = 10^{-1}$	deci*	d
$1{,}000{,}000{,}000{,}000{,}000 = 10^{15}$	peta	P	$0.01 = 10^{-2}$	centi*	c
$1{,}000{,}000{,}000{,}000 = 10^{12}$	tetra	T	$0.001 = 10^{-3}$	milli	m
$1{,}000{,}000{,}000 = 10^{9}$	giga	G	$0.000{,}001 = 10^{-6}$	micro	-
$1{,}000{,}000 = 10^{6}$	mega	M	$0.000{,}000{,}001 = 10^{-9}$	nano	n
$1{,}000 = 10^{3}$	kilo	k	$0.000{,}000{,}000{,}001 = 10^{-12}$	pico	p
$100 = 10^{2}$	hecto*	h	$0.000{,}000{,}000{,}000{,}001 = 10^{-15}$	femto	f
$10 = 10^{1}$	deca*	da	$0.000{,}000{,}000{,}000{,}000{,}001 = 10^{-18}$	atto	a

* to be avoided where possible

SYMBOLS AND ABBREVIATIONS USED ON BOREHOLE LOGS

SOIL SAMPLE

- represented by sample identification number which increase sequentially from the top of the hole; thickness of block is equivalent to sample recovery



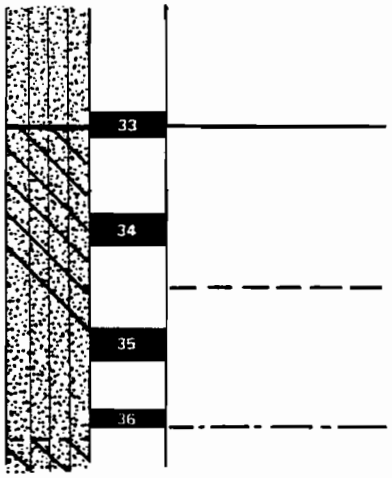
SOIL BOUNDARIES

- have been indicated using the following system

- stratum boundary observed within sample

- stratum boundary assumed to occur within ± 0.5m of the marked level and is probably gradational between the two samples

- stratum boundary assumed to occur within ± 1.0m of the marked level



- stratum boundary notation for both depth below seabed (41.5 metres) and elevation below sealevel (uncorrected for tides) (-64.6 metres El.)

41.5 (-64.6 El.)

SOIL DESCRIPTION

UNIFIED SOIL CLASSIFICATION — USC

- determined in accordance with chart on following page

TEXTURAL DESCRIPTION

- determined in accordance with attached sheet and used to augment Unified Soil Classification

Special terms used include:

e.g. - "becoming trace of/with some CLAY" indicating an overall change in a feature of the stratum not sufficient to change the total description

- "trace of/with some CLAY" indicating small feature displayed in that sample only

MUNSELL COLOUR DESIGNATION

- describing wet grey soil, e.g. (5Y 4/2)

- describing dry grey soil, e.g. (10YR 6/1)

GROUND ICE DESCRIPTION

- determined in accordance with chart on following page; extra effort has been made to better describe the degree and extent of soil bonding and also a value of core temperature (°C) at that level

- see also definition of terms in text

e.g. FROZEN - 2.3
- Nf - Nbn
- poorly to slightly bonded
SAND: Nbn - 2.8
CLAY: not frozen

TEST RESULTS

- see legend at bottom of borehole log

CONSISTENCY

Fine-Grained Soils

Major portion passing No. 200 Sieve. Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silt. Consistency is rated according to shear strength, as indicated by penetrometer readings or vane shear readings.

Descriptive Term	Unconfined Compressive Strength kPa	Equivalent Blows per Foot (N)
Very Soft	less than 25	0 - 2
Soft	25 to 50	2 - 4
Firm	50 to 100	4 - 8
Stiff	100 to 200	8 - 16
Very Stiff	200 to 400	15 - 50
Hard	400 and higher	>50

Coarse-Grained Soils

Major portion retained in No. 200 Sieve. Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

Descriptive Term	Relative Density	Equivalent Blows per foot (N)
Very Loose	0 - 20%	0 - 4
Loose	20 - 40%	4 - 10
Compact or Medium	40 - 75%	10 - 30
Dense	75 - 90%	30 - 50
Very Dense	90 - 100%	50 +

The number of blows (N) on a 2" O.D. split spoon sampler by a 140 lbs. weight falling 30" required to drive the sample a distance of 1' (in accordance with ASTM D1586).

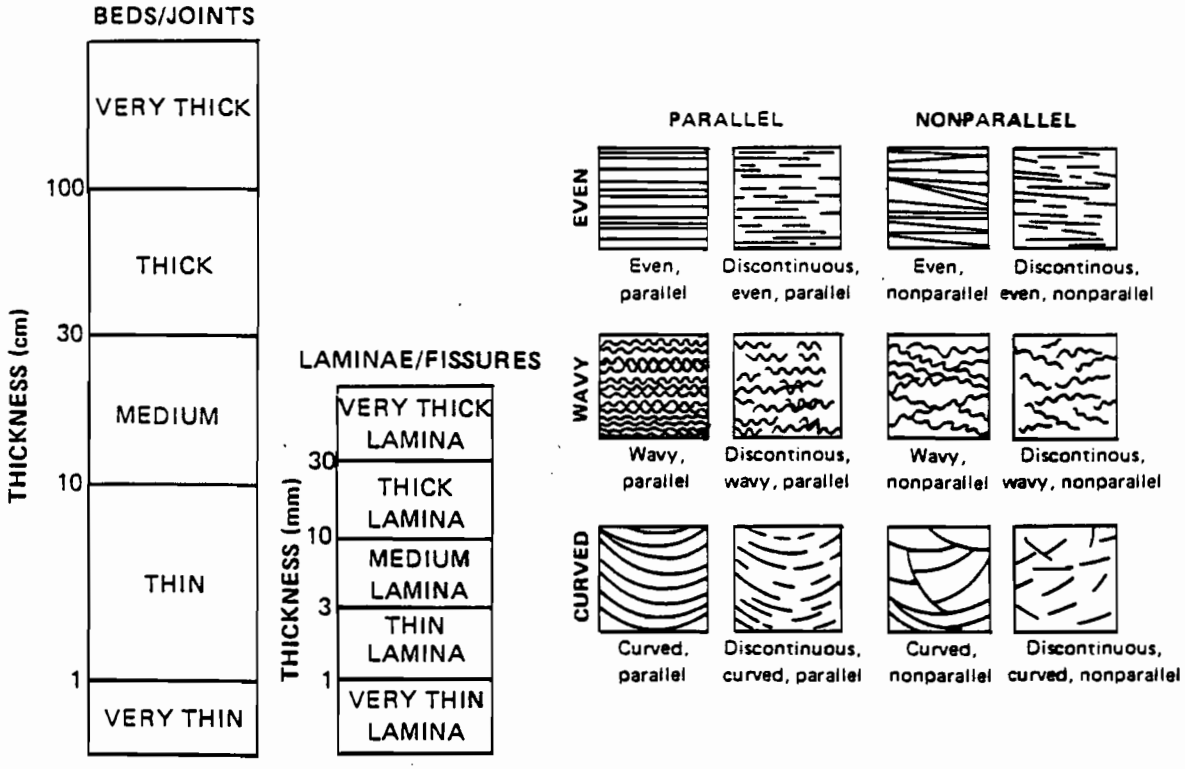
PLASTICITY

Low - Liquid limit less than 50
High - Liquid limit greater than 50

DESCRIPTION OF SEDIMENTARY STRUCTURES

BEDS SEDIMENTATION UNITS DEPOSITED UNDER ESSENTIALLY CONSTANT PHYSICAL CONDITIONS, SEPARATED BY BEDDING PLANES WHICH ARE RECOGNIZABLE BY TEXTURAL OR COMPOSITIONAL CHANGES RESULTING FROM PERIODS OF NON-DEPOSITION OR EROSION, OR ABRUPT CHANGES IN DEPOSITIONAL CONDITIONS. BEDS MAY BE INTERNALLY HOMOGENEOUS, OR COMPOSED OF SMALLER UNITS-LAMINAE

LAMINAE THE SMALLEST MEGASCOPIC LAYERS IN A SEDIMENTARY SEQUENCE, REPRESENTING MINOR FLUCTUATIONS IN PHYSICAL CONDITIONS DURING THE DEPOSITION OF BEDS. LAMINAE ARE RELATIVELY UNIFORM IN TEXTURE AND COMPOSITION AND GENERALLY LACK MEGASCOPIC INTERNAL LAYERING.

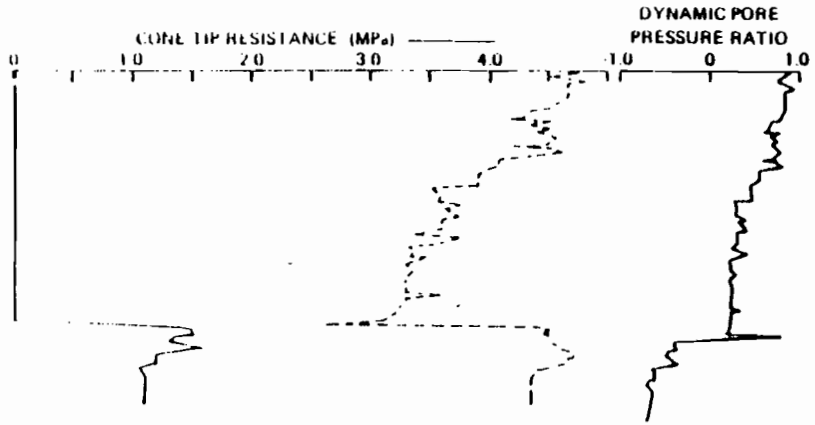


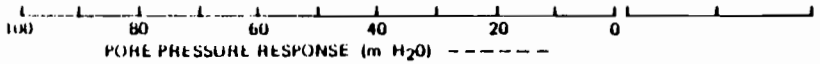
e.g. Thick bed
Thickly spaced joint

e.g. Thin lamina
Thinly spaced fissures

(After Campbell, 1967)

(Modified after Ingram, 1954 and Campbell, 1967)





Geosystems

CONE PENETRATION TEST DATA

PENETRATION TEST

LOCATION: EAST AMAULIGAK
UTM COORDINATES: 7 772 730 m N ; 548 975 m E
TIME: 1630 hrs.
WATER DEPTH: 36.6 m

DEPTH BELOW SEABED (metres)

SYM.	No.	SOIL DESCRIPTION	GROUND ICE
	1	CLAY (CL) - with some silt, becoming trace of silt, homogenous, with black organic specks, low plasticity, soft, dark grey	NOT FROZEN
	2		
	3	*Gas noted in drilling mud prior to sampling*	
	4	9.4 m (-46.0 m El.)	
	5	SAND (SP) - fine-grained with some medium grained and trace of silt, dense to very dense (estimated), olive brown.	
	6		
	7		
		END OF BOREHOLE 23.0 m (-59.6 m El.)	
		NOTE: Ships movement causes early termination of borehole.	

BULK DENSITY ($Mg\,m^{-3}$) ▲
1.4 1.6 1.8 2.0
PLASTIC LIMIT — WATER CONTENT (%) — LIQUID LIMIT
20 40 60 80

UNDRAINED SHEAR STRENGTH (kiloPascals)
50 100 150

SPECIALIZED TESTS
G

JOB No.: 101 - 3862
DRILLING COMPLETED: 83-07-16
BOREHOLE DEPTH: 23.0 m
DRILLING RIG: Simco 5000/MV Broderick
LOG COMPILED BY: JPR

LEGEND

SOIL SYMBOLS: SAND, SILT, CLAY

SHEAR STRENGTH
+ Torvane
x Min. Vane
□ Pilcon Vane
● Unconfined Compr.
▲ UU Triaxial
■ CU Triaxial

TEST IDENTIFICATION
C - Consolidation
TS - Thaw Strain
DS - Direct Shear
T - Triaxial Shear
S - P.W. Salinity
X - X-Ray Diffr.

BOREHOLE NUMBER EA 83 S01

PAGE 1OF 1

BOREHOLE LOG AND LABORATORY TEST RESULTS

APPENDIX B

CLASSIFICATION

SUMMARY OF TEST RESULTS

Borehole Number / Sample Number	Sample Type	Depth (metres) *Sample Photographed	Unified Soil Classification	Ground Ice Description (%)	Temp. (°C)	Moisture Content (%)	Frozen Moisture Content (%)	Bulk Density (Mgm^{-3})	ATTERBERG LIMITS: Liquid Limit (%)	ATTERBERG LIMITS: Plastic Limit (%)	GRAIN SIZE DISTRIBUTION: Clay (%)	Silt (%)	Sand (%)	Gravel (%)	D_{50} (μm)	SHEAR STRENGTH: Test	Shear Strength (kPa)	Failure Strain (%)	Consistency	CONSOLIDATION CHARACTERISTICS: P_o (kPa)	P_c (kPa)	C_c	TEST RESULTS TABULATED SEPARATELY
EA83-01																							
1	T	0.0 - 0.91			-0.9	45										PV	26						
2	B	3.05 - 3.66			1.8	45			50	28	48	51	1			PV	16						
3	T	6.10 - 6.70			-0.3	40										PV	16						
3	G	6.10 - 6.70																					G
4	B	9.14 - 9.42	SP-SM			20						6	94		200								
5	B	12.19 - 12.95	SP-SM			24						9	91		210								
6	B	15.24 - 16.00				26						25	75		120								
7	B	18.24 - 18.74				20						16	84		150								
EA83-02																							
1	T	0.00 - 0.81				45										PV	28						
2	T	3.10 - 3.40				47										PV	22						
3	T	5.54 - 5.99				45										PV	19						
4	T	7.06 - 7.82			-0.7	49										PV	18						
5	T	8.60 - 9.35			-0.2	18										PV	96						

LEGEND AND NOTES

- B - Bag Sample
- G - Gas Sample
- L - Liner Sample
- P - Piston Sample
- NR - No Recovery
- NS - No Sample Remaining
- PF - Permafrost Sample
- PW - Porewater Sample
- T - Sample Stored in Tube
- W - Waxed Sample
- RC - Radiocarbon Sample
- MV - Minivane
- FC - Fall Cone
- TV - Torvane
- PV - Pilcon Vane
- RV - Remote Vane
- UU - Unconsolidated Undrained Triaxial
- UUp - UU Triaxial with Pore Pressure Measurements
- CU - Consolidated Undrained Triaxial
- CUp - CU Triaxial with Pore Pressure Measurements
- CD - Consolidated Drained Triaxial
- O - Organic Content
- S - Salinity
- TS - Thaw Strain
- SG - Specific Gravity

Project Number: 101-3862

Reviewed By: _____ P.Eng.

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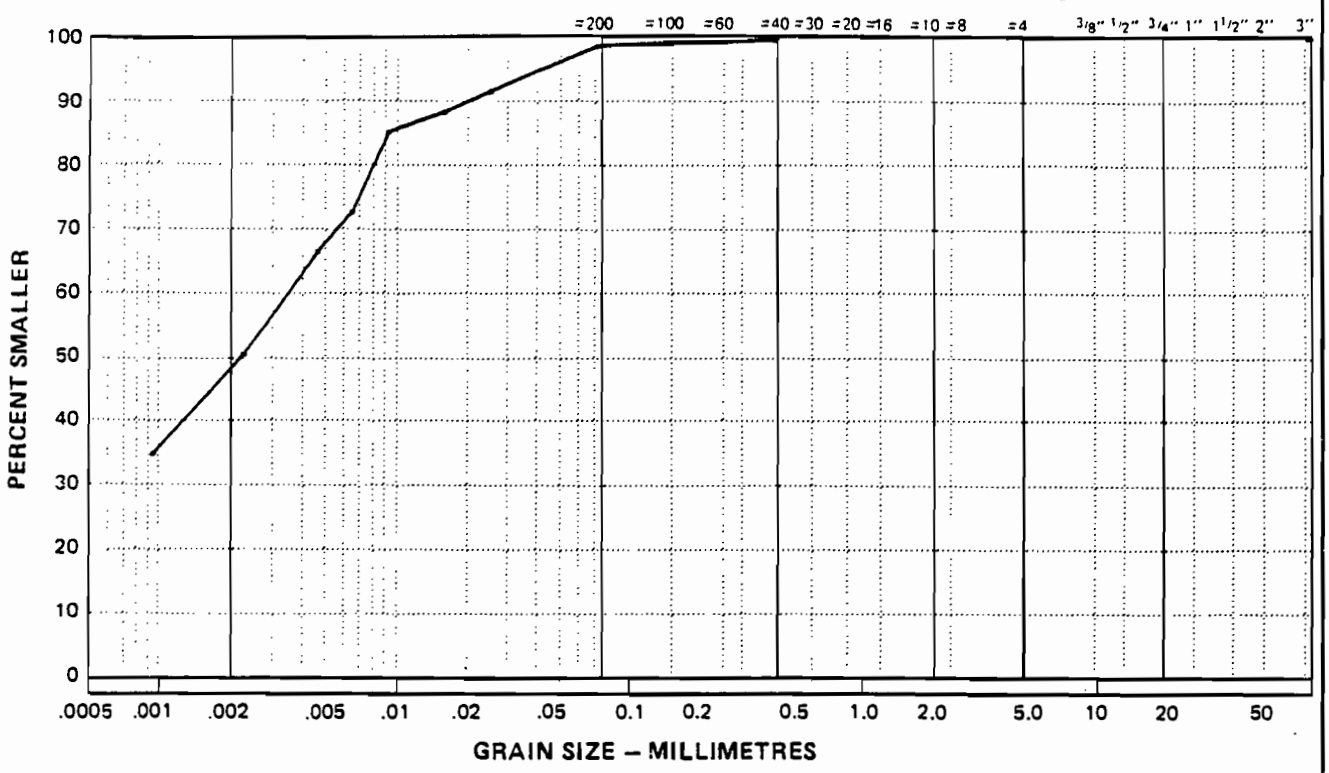
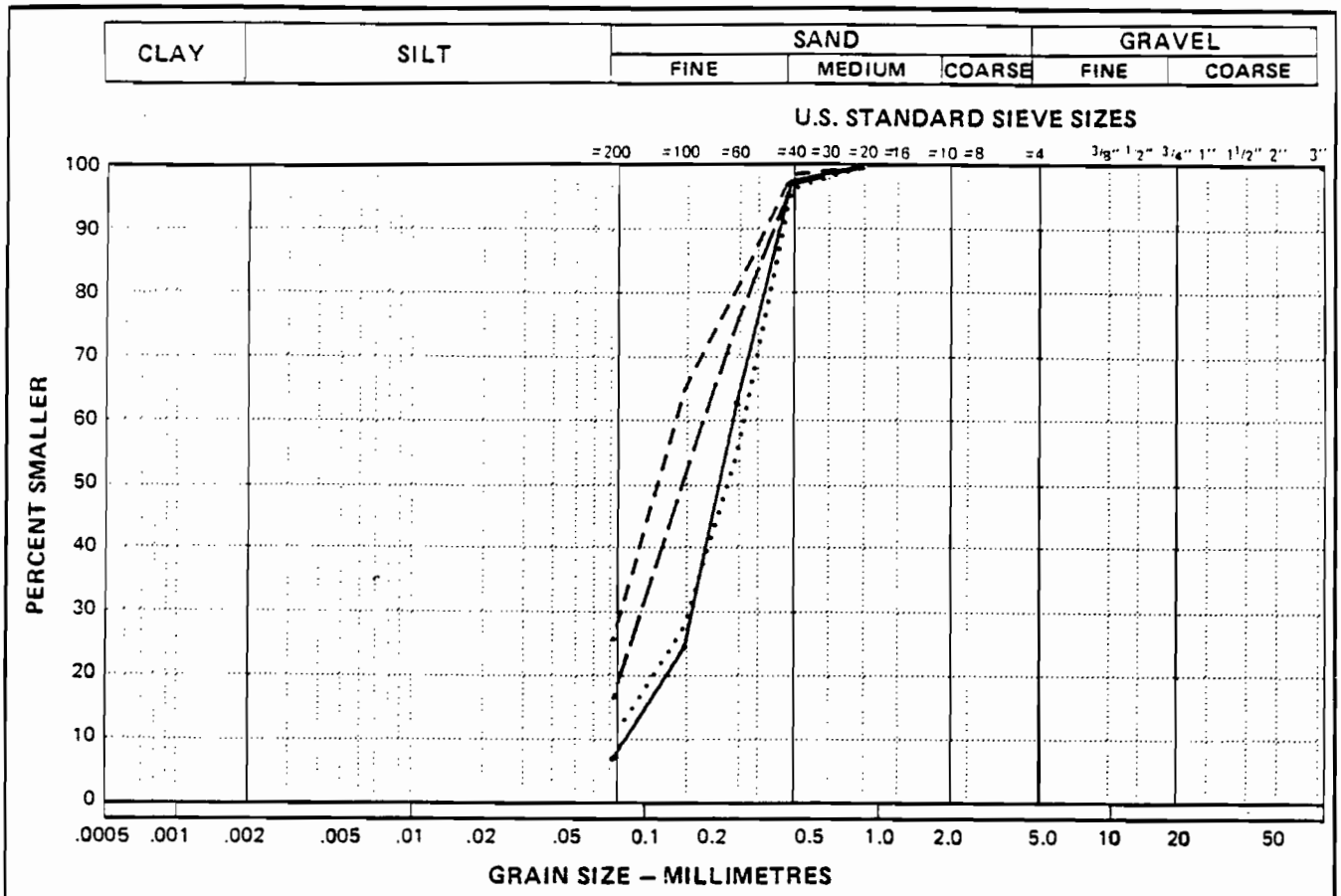
PARTICLE - SIZE ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
_____	EA83S01	3.05 - 3.66	47.7	51.5	.8	0.0	-	-	

JOB NO. 101 -3862 DATE 83-09-28

PARTICLE - SIZE ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
———	EA83S01	9.14 - 9.42	-	6.2	93.8	0.0	2.8	1.3	SP-SM
. . . . .	EA83S01	12.20 - 13.00	-	9.3	90.7	0.0	3.5	1.2	SP-SM
— — —	EA83S01	15.20 - 16.00	-	25.0	75.0	0.0	-	-	
—— ——	EA83S01	18.30 - 18.70	-	15.7	84.3	0.0	-	-	

JOB NO. 101 -3862 DATE

APPENDIX C

IN SITU TESTING

APPENDIX C
GLOSSARY OF EQUATIONS USED IN CONE PENETRATION TEST INTERPRETATION

C.1 Undrained Shear Strength

$$q_c = N_c C_u + \sigma$$

where: q_c = instantaneous cone tip resistance (MPa)

C_u = undrained shear strength of the material (MPa)

N_c = a cone bearing capacity factor based on site-specific correlation between the cone and an in situ measurement of undrained shear strength, usually a vane shear apparatus.

and, σ = a representation of total vertical in situ stress (MPa). This factor, for ease of calculation has been calculated by

$$\sigma = \gamma z$$

where: γ = 18 KN/m^3 (estimated "average" density for overlying soil)

and, z = depth of data point below seabed (m)

N.B. the effect of the overlying water column is ignored as the cone tip resistance is zeroed at seabed. This analysis will be ignored if the soil is likely to drain upon shear. The soil is classified in two ways for this purpose; if a mantle sleeve friction value is available, a friction ratio is calculated and compared with the instaneous point resistance by the method suggested by Schmertmann (1977). Values falling outside those suggested for

pure clays are ignored. If pore pressure values are available soils exhibiting marked dilatent behavior are ignored for calculation purposes. As no concensus of opinion exists at present in the literature for a suitable classification system, pore pressure values less than 20% of hydrostatic pressure at the level in question are ignored.

C.2 Dynamic Pore Pressure Ratio

$$DPPR = \frac{U - p_o}{q_c - \sigma_v}$$

where: DPPR = dynamic pore pressure ratio (after Jefferies and Funegard, 1983)

U = pore pressure measured by cone tip (mH_2O)

q_c = instantaneous cone tip resistance (MPa)

p_o = hydrostatic pore pressure calculated at that level (MPa)

$$p_o = \gamma_w (z_w + z)$$

where: γ_w = density of water (9.81 KN/m^3)

z_w = depth of water at the site (metres)

and, z = depth below seabed (metres)

and, σ_v = the total vertical in situ stress (MPa). This factor, for ease of calculation, has been calculated by

$$\sigma_v = \gamma z + z_w \gamma_w$$

where: γ = 18 KN/m^3 = estimated "average" density for overlying soil

and, z, z_w and γ_w are as above.

C.3 Relative Density

The relative density of the soil is calculated from an algorithm based on the data provided by Baldi et al (1979). Two solutions exist for the calculation of relative density. Thus, initially, the calculation uses the formula:

$$\text{Relative Density} = \frac{20q_c + 24\sigma'^{2}_v - 54\sigma'_v + 71}{0.1\sigma'_v 2 + 1.9\sigma_v + 2.025}$$

where: q_c = instantaneous cone tip resistance (MPa)

and, σ'_v = effective vertical stress at that level, calculated from: $\sigma'_v = \gamma' z$

where: γ' = 10 KN/m^3 ("effective" density of overlying soil)

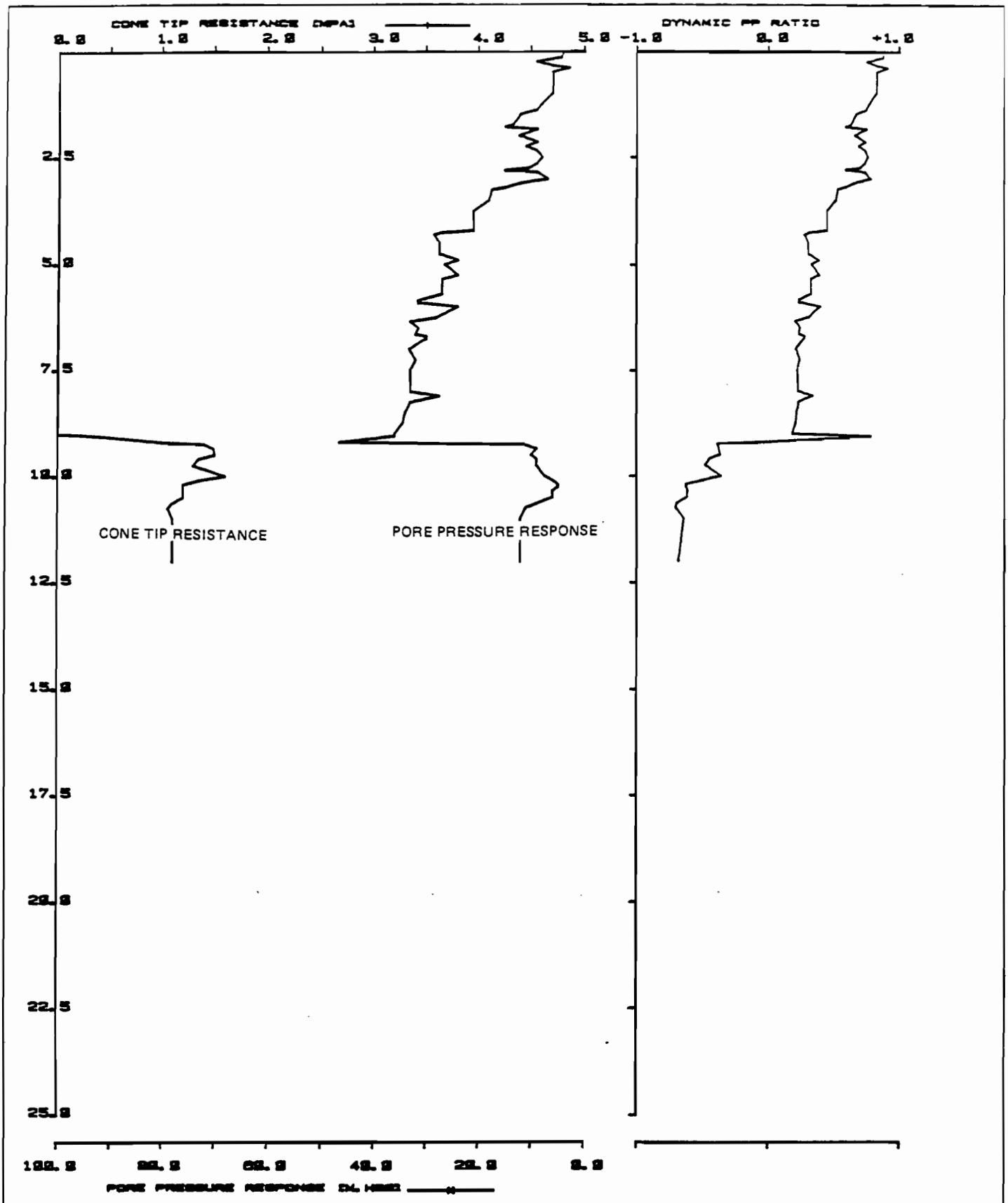
and, z = depth below seabed of that level (metres)

If this value of relative density is greater than 65% the parameter is recalculated using:

$$\text{Relative Density} = \frac{20q_c - 244\,\sigma'^{2}_{v} + 590\,\sigma'_{v} + 94}{11\,\sigma'_{v} - 3.6\,\sigma'^{2}_{v} + 2.6}$$

This analysis will be ignored if the soil is not sand. The soil is classified in two ways for this purpose; if a mantle sleeve friction value is available, a friction ratio is calculated and compared with the instananeous point resistance by the method suggested by Schmertmann (1977). Values falling outside those for SP sands are ignored. If pore pressure values are available, soils exhibiting dilatency are ignored.

In addition to the above, in line with the Baldi analysis, values are ignored when the effective vertical stress exceeds 200 kPa.



WATER DEPTH: 20.0

ALL DEPTHS IN METRES

BULK DENSITY (KN/M3): 18.0

NC: 9.0

CONE PENETRATION TEST ANALYSIS

TITLE: GULF CONE EA-83-C01

FIGURE: C-1

APPENDIX D

SUBCONSULTANTS REPORT

PROJECT NO. 83-0148-4-1005

SEPTEMBER 23, 1983

EBA ENGINEERING CONSULTANTS LTD.
HYDROCARBON GAS AND CARBONATE ANALYSES
ON SOILS FROM AKPAK, EAST AMAULIGAK,
KASLUTUT AND SOUTH UKALERK.

CHEMEX LABS (ALBERTA) LTD.
8764 - 50 AVENUE
EDMONTON, ALBERTA T6E 5K8
(403) 465-9877

ANALYTICAL METHODS

HYDROCARBON GAS ANALYSES

Sediment samples for hydrocarbon gas analysis were sealed in cans in a brine solution at the drill site. Two sizes of cans were used; the larger size contained 100cc of sediment and the smaller 50cc of sediment. In the laboratory, a volume of brine equivalent to the sediment volume was removed and replaced with helium. The cans were then mechanically agitated for one hour to displace the hydrocarbon gases into the head space. The head space gas was analyzed for methane, ethane, propane, ethylene and propylene. Results are reported as gas volume hydrocarbon component per 10^6 volumes of wet sediment (ppm vol/vol). This method of reporting is the same as that used in past reports.

CARBONATE

Moisture content was determined by drying at 105°C; the samples were then digested for 24 hours in hydrochloric acid, - solution was back titrated with sodium hydroxide. Three samples were analyzed in duplicate. Single determinations were performed on the remainder of the samples since check samples were within acceptable limits of reproducibility.

RESULTS

CARBONATE ANALYSES

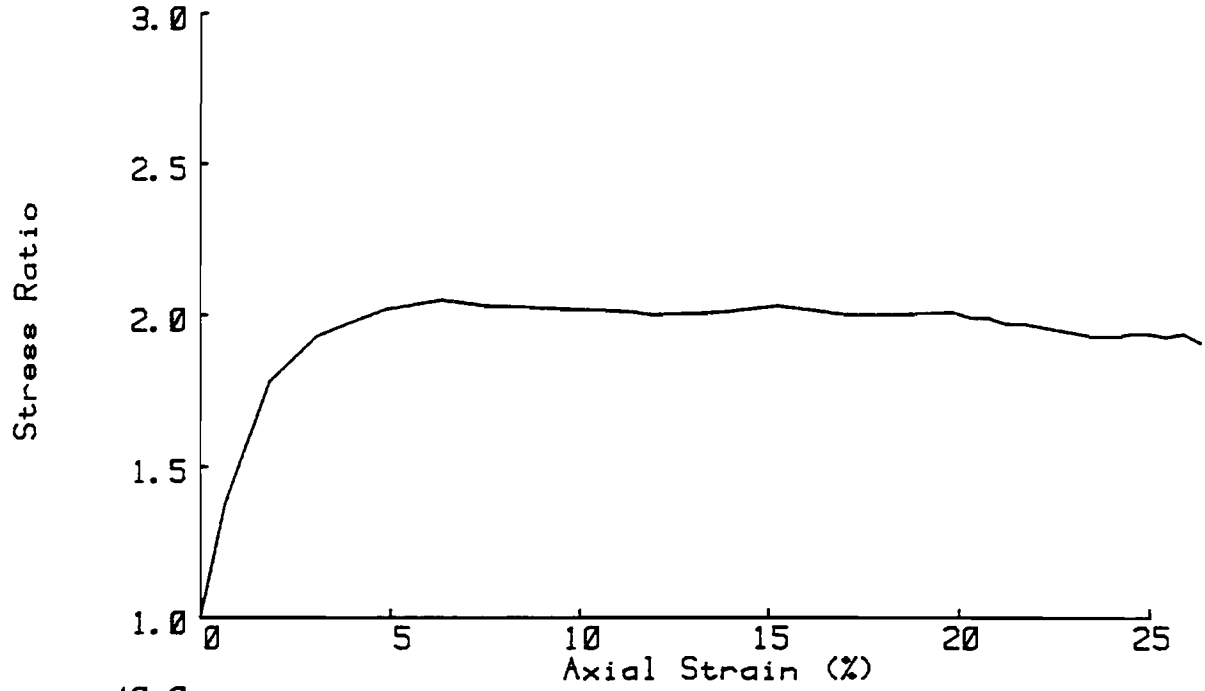
NAME	SAMPLE #	INTERVAL (m)	MOISTURE (MASS FRAC)	CARBONATE (MASS FRAC) WET BASIS
AKPAK (AK83 SO2)	2B	1.0 - 1.50	.1500	.0321
	4	3.35- 3.70	.1610	.0301
	6	6.4 - 6.80	.1996	.0428
	8	12.5 -13.0	.2406	.0393
	10	19.2 -19.55	.1797	.0274
	13	27.74-27.90	.1585	.0322
	17	39.9 -40.4	.2011	.0351
SOUTH UKALERK (SU83 SO1)	2	1.19- 1.49	.1896	.0641
	5B	10.64-10.84	.2013	.0540
	10	25.59-25.88	.2004	.0319
	16	34.62-34.82	.1698	.0290
SOUTH UKALERK (SU83 SO2)	4	5.4 - 5.7	.1795	.0490
	8	17.6 -17.9	.2103	.0640
	13	32.8 -33.0	.1994	.0261

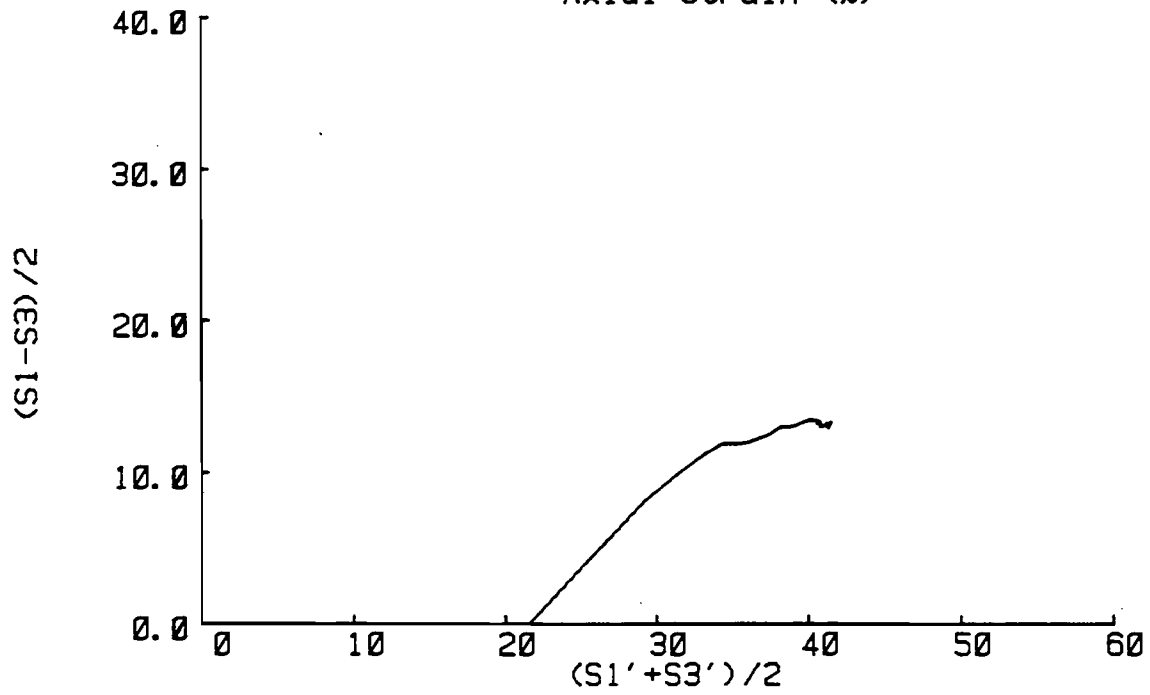
RESULTS

HYDROCARBON ANALYSES

NAME	SAMPLE #	INTERVAL (m)	CONCENTRATIONS (ppm) METHANE	ETHANE	PROPANE	ETHYLENE	PRO-PYLENE
AKPAK (AK83-S02)	S-18B	43.6 -44.0	387	3.2	N.D.*	0.60	N.D.
	S-20B	49.99-50.21	422,100	6.8	N.D.	0.57	N.D.
EAST AMAULIGAK (EA83-S01)	3	6.10-6.71	2,337	N.D.	N.D.	N.D.	N.D.
KASLUTUT (KT83 S01)	2C	2.41- 3.06	110	N.D.	N.D.	N.D.	N.D.
	14B	35.94-36.31	48,880	2.6	N.D.	N.D.	N.D.
	18B	49.05-49.70	119	N.D.	N.D.	N.D.	N.D.
KASLUTUT (KT83 S02)	7C	9.75-10.55	110	N.D.	N.D.	N.D.	N.D.
	14B	21.95-22.45	375	N.D.	N.D.	N.D.	N.D.
SOUTH UKALERK (SU83 S01)	14B	37.77-38.17	896	3.1	N.D.	0.53	N.D.
	23C	54.43-55.02	890	N.D.	N.D.	N.D.	N.D.
	29C	58.00-58.25	126,970	6.7	N.D.	N.D.	N.D.
SOUTH UKALERK (SU83 S02)	20C	54.13-54.93	397	N.D.	N.D.	N.D.	N.D.
	21C	57.17-57.60	4,650	1.28	N.D.	N.D.	N.D.

Test no.	σ'_{3c} (kPa)	Dry dens. (Mg/cu. m)
4	21.4	1.19





UNCONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE WATER PRESSURE MEASUREMENTS

FIGURE
D. 12

APPENDIX E

Consolidation Test Results

TABLE 1 BOREHOLE AND PROBEHOLE LOCATION

BOREHOLE OR PROBEHOLE	UTM COORDINATES (ZONE 8)		GEOGRAPHIC COORDINATES		DATE	SEABED PENETRATION
			LATITUDE	LONGITUDE	(completed)	(metres)
AD84CIØ1,Ø2*	N 7 775 062	E 545 062	70° 04' 48"	133° 48' 53"	84-09-28	9.0
AD84SIØ1	N 7 775 062	E 545 065	70° 04' 48"	133° 48' 53"	84-09-29	16.5
AD84CIØ3,3B*	N 7 774 562	E 544 712	70° 04' 32"	133° 49' 27"	84-09-29	25.6
AD84CIØ4	N 7 774 808	E 544 717	70° 04' 40"	133° 49' 26"	84-09-30	17.6
AD84CIØ5	N 7 774 819	E 544 960	70° 04' 40"	133° 49' 03"	84-09-30	16.4
AD84SIØ5	N 7 774 810	E 544 954	70° 04' 40"	133° 49' 04"	84-09-30	17.7
AD84CIØ6	N 7 774 562	E 544 962	70° 04' 32"	133° 49' 04"	84-09-30	12.5
AD84CIØ7	N 7 775 062	E 544 712	70° 04' 48"	133° 49' 26"	84-10-01	10.3
AD84CIØ8	N 7 775 307	E 544 710	70° 04' 56"	133° 49' 26"	84-10-01	7.8
AD84CIØ9	N 7 775 308	E 544 960	70° 04' 56"	133° 49' 02"	84-10-01	6.9
AD84CIØ10,10B	N 7 775 054	E 544 903	70° 04' 47"	133° 49' 08"	84-10-01	16.8
AD84CIØ11	N 7 774 830	E 545 450	70° 04' 40"	133° 48' 17"	84-10-02	8.3
AD84CIØ12	N 7 774 812	E 545 212	70° 04' 39"	133° 48' 39"	84-10-02	8.5
AD84CIØ13	N 7 775 062	E 545 212	70° 04' 48"	133° 48' 39"	84-10-02	8.6
AD84CIØ14	N 7 775 061	E 545 454	70° 04' 47"	133° 48' 16"	84-10-02	9.1
AM84CIØ1,1B*	N 7 774 948	E 545 332	70° 04' 44"	133° 48' 28"	84-10-02	12.1
AM84CIØ2,2B*	N 7 774 948	E 545 568	70° 04' 44"	133° 48' 06"	84-10-03	23.7
AM84CIØ3,3B*	N 7 774 875	E 545 405	70° 04' 41"	133° 48' 21"	84-10-02	33.3
AM84CIØ4	N 7 774 872	E 545 493	70° 04' 41"	133° 48' 13"	84-10-03	9.3
AM84SIØ5	N 7 774 830	E 545 450	70° 04' 40"	133° 48' 17"	84-10-02	15.5
AM84CIØ6	N 7 774 784	E 545 404	70° 04' 38"	133° 48' 21"	84-10-03	8.7
AM84CIØ7,7B*	N 7 774 781	E 545 496	70° 04' 38"	133° 48' 13"	84-10-03	30.5
AM84CIØ8,8B*	N 7 774 712	E 545 332	70° 04' 36"	133° 48' 28"	84-10-04	32.8

NOTE: 1. All coordinates supplied by C.E.S.
2. "AD84" or "AM84" denotes a borehole or probehole at the AMAULIGAK I-65 site, drilled or tested in 1984. "SI" refers to "sample investigation", "CI" refers to "static cone investigation". The number following the latter designation is the borehole or probehole number.
* Probehole was predrilled through the upper clay and casing was set for continuation of CPT into sand.