



Golder Associates

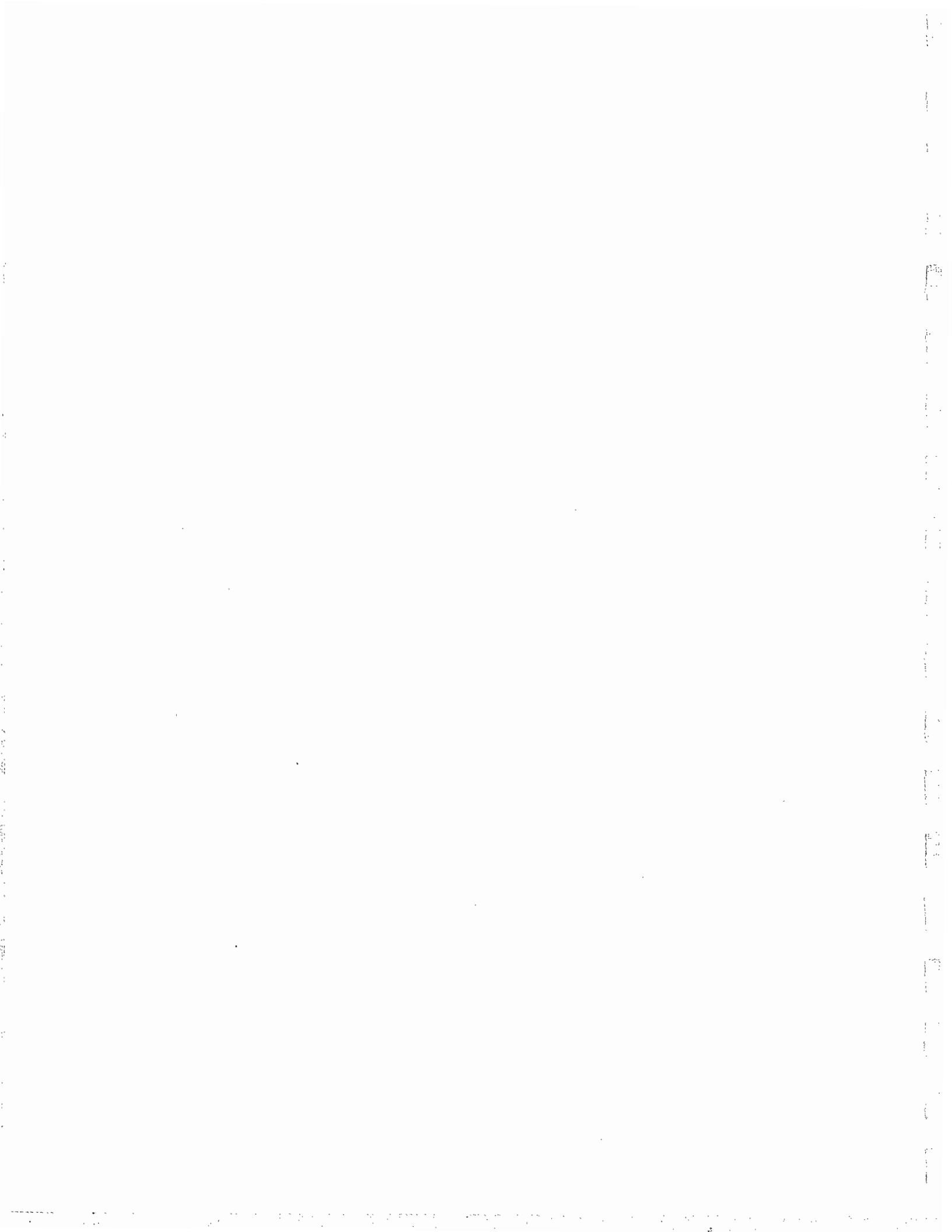
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

Report to
GULF CANADA RESOURCES INC.
on
BEAUFORT SEA GEOTECHNICAL INVESTIGATION - 1981
KOGYUK

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812-2102

February, 1982



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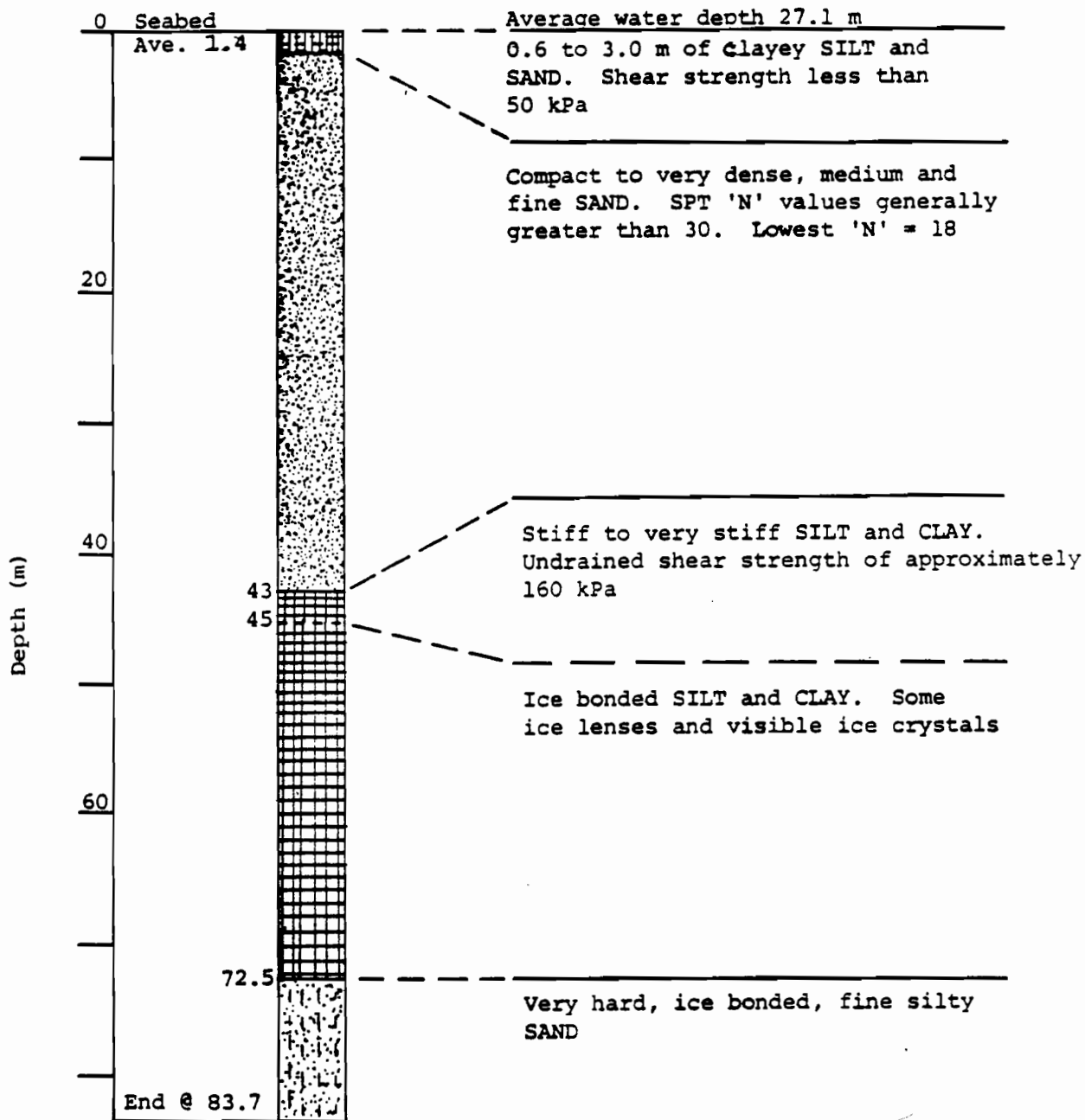
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KOGYUK : SUMMARY LOG

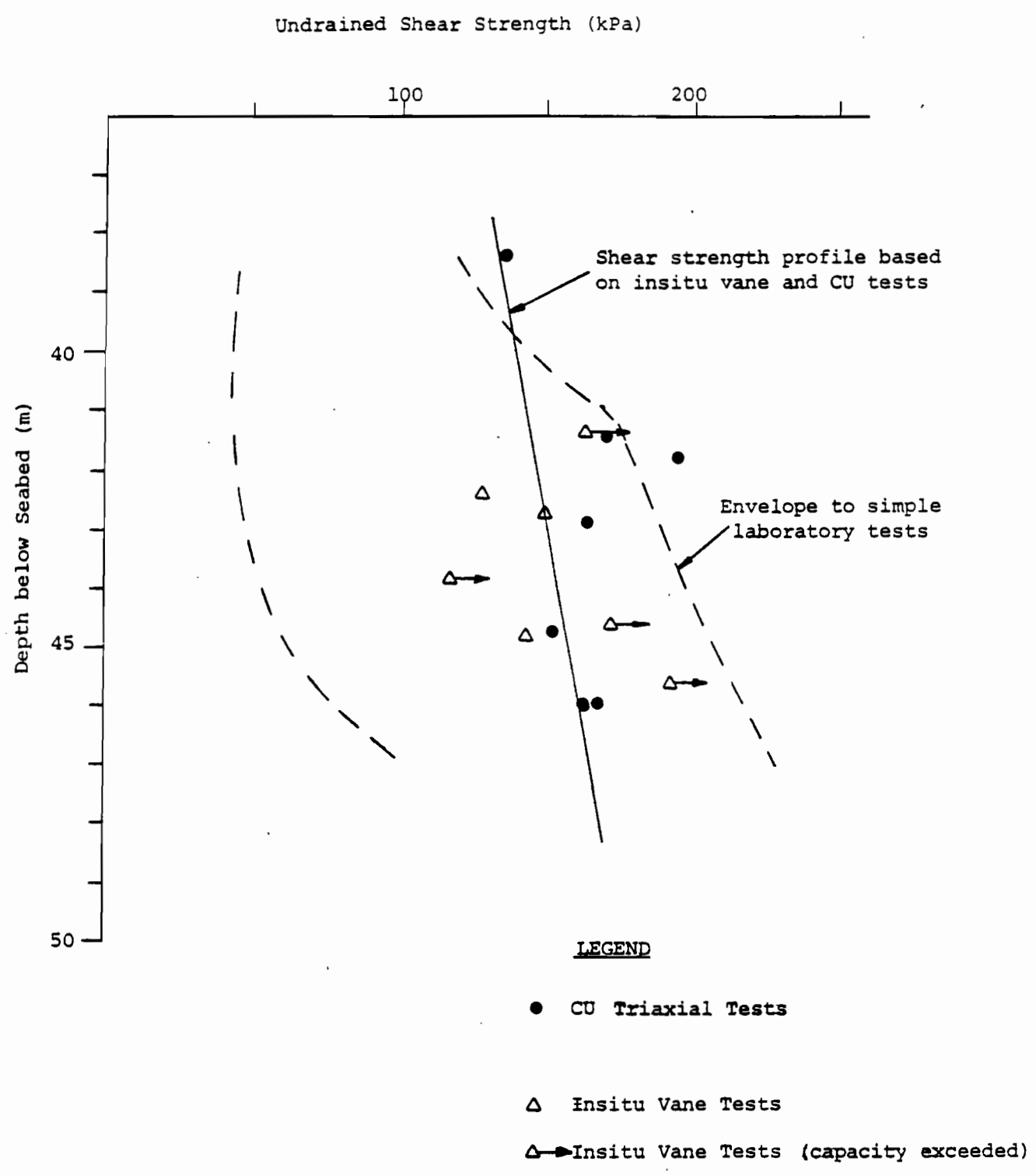
Figure 1



Project No. 812-2102, Drawn SP, Reviewed Date 10-12-01

COMPARISON OF SHEAR STRENGTH MEASUREMENTS

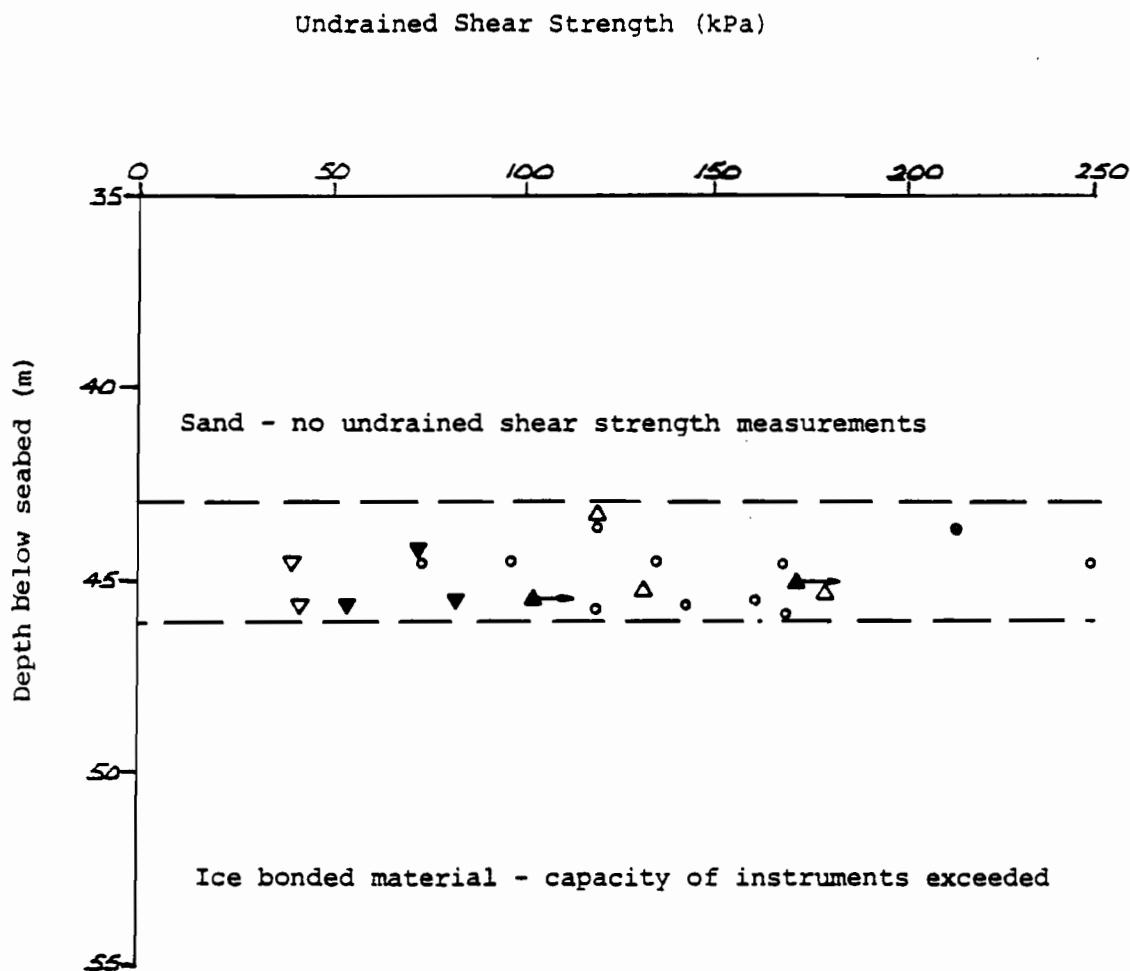
Figure 2



Project No. 02-2/02
Drawn S.A.
Reviewed
Date 1/1/02

KOGYUK - UNDRAINED SHEAR STRENGTH

Figure 3



LEGEND

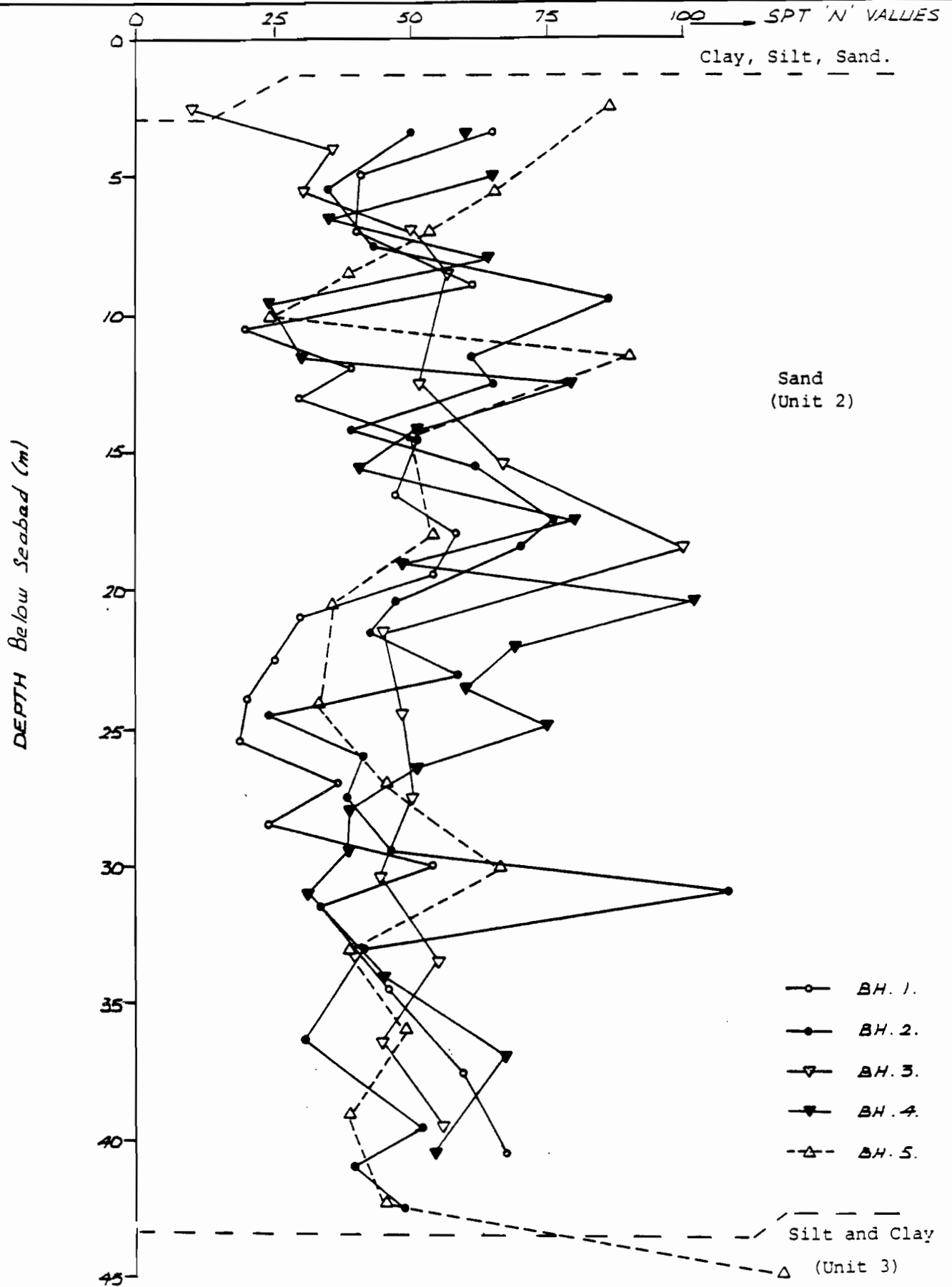
- CU Triaxial Test
- ▲ Insitu Vane Tests (capacity exceeded)
- Fall Cone
- ▼ Unconfined Compression
- ▲ Laboratory Vane
- ▼ Pocket Penetrometer

Based on CU triaxial and insitu vane tests, average undrained shear strength for design is approximately 160 kPa.

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KOBYUK SPT 'N' VALUES, UNIT 2

Figure 4



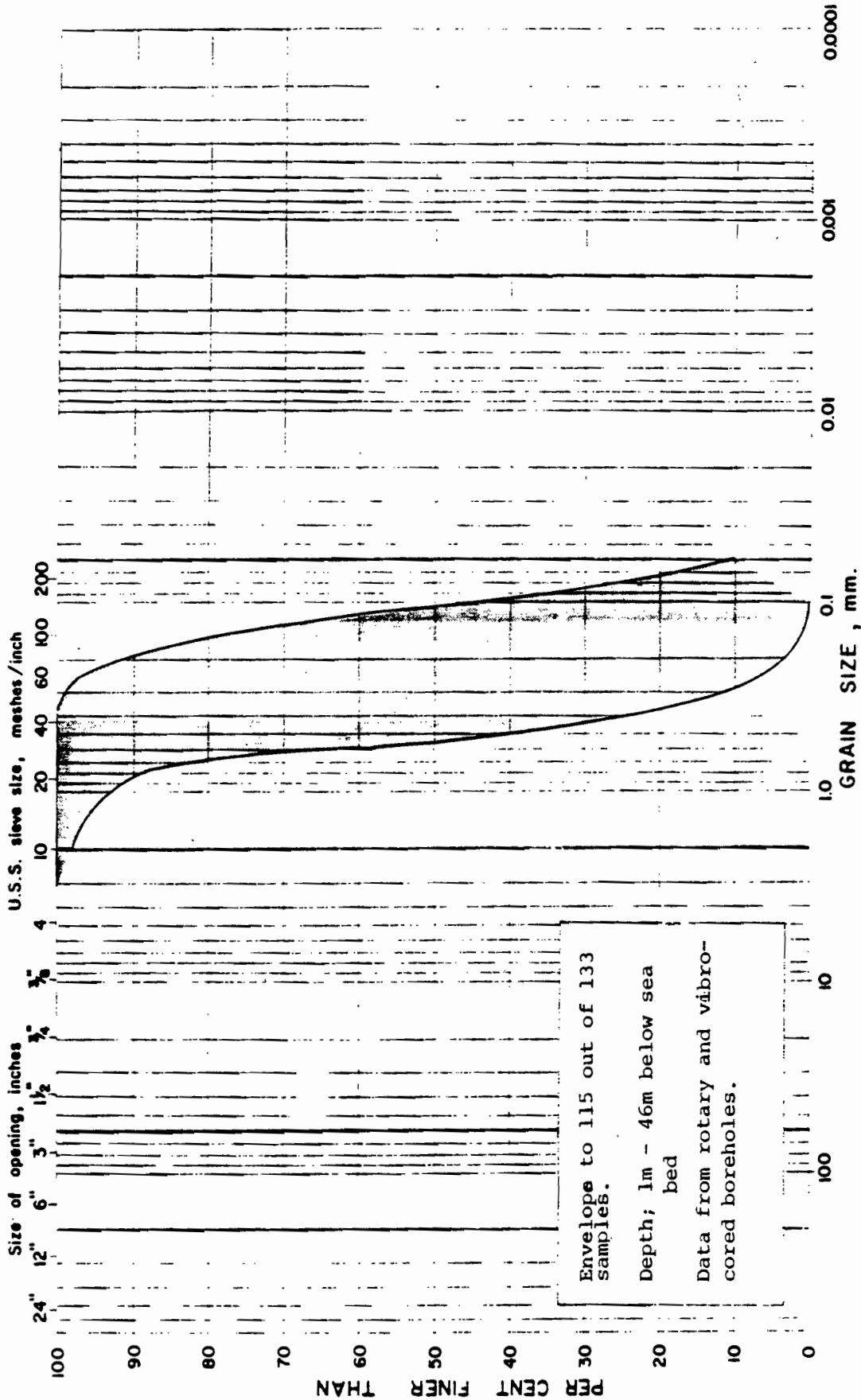
Project No. 812-2102 Drawn CP Reviewed Date 8-12-81

GRAIN SIZE DISTRIBUTION

KOGYUK SUMMARY GRADING CURVE ENVELOPE

Figure 5

M.I.T. GRAIN SIZE SCALE



BOULDER SIZE	COBBLE SIZE	GRAVEL SIZE			SAND SIZE			SILT SIZE		CLAY SIZE
		coarse	medium	fine	coarse	medium	fine	fine grained		

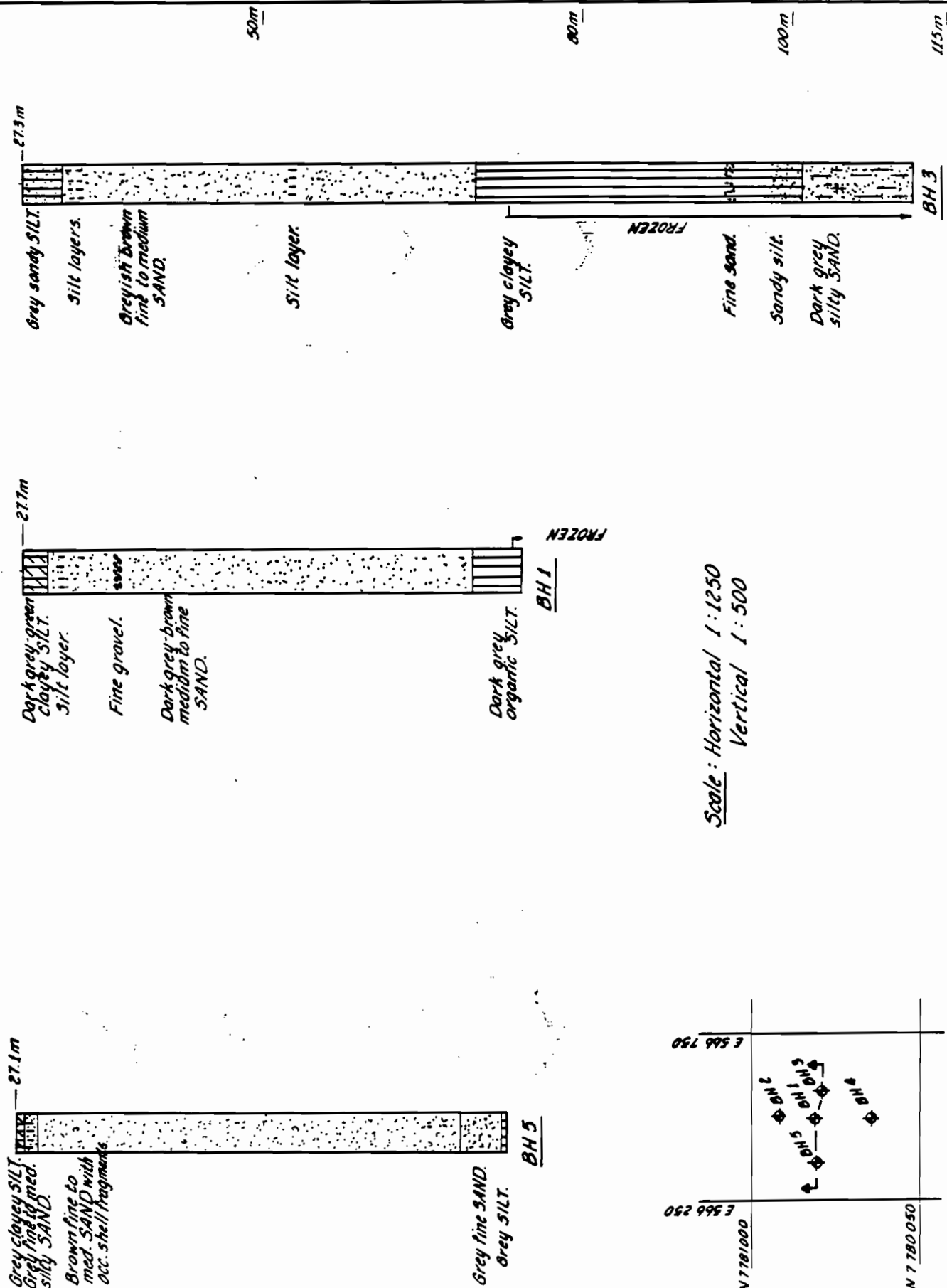
Project No. 812-2.102. Drawn GB. Reviewed. Date Dec '81

GEOLOGICAL SECTION THROUGH KOGYUK

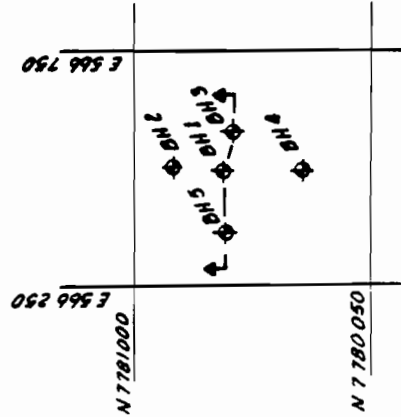
Figure 6

PROJECT NO. 812-2102 DRAWN BYD REVIEWED DATE Dec '81

METRES BELOW SEA LEVEL 25m

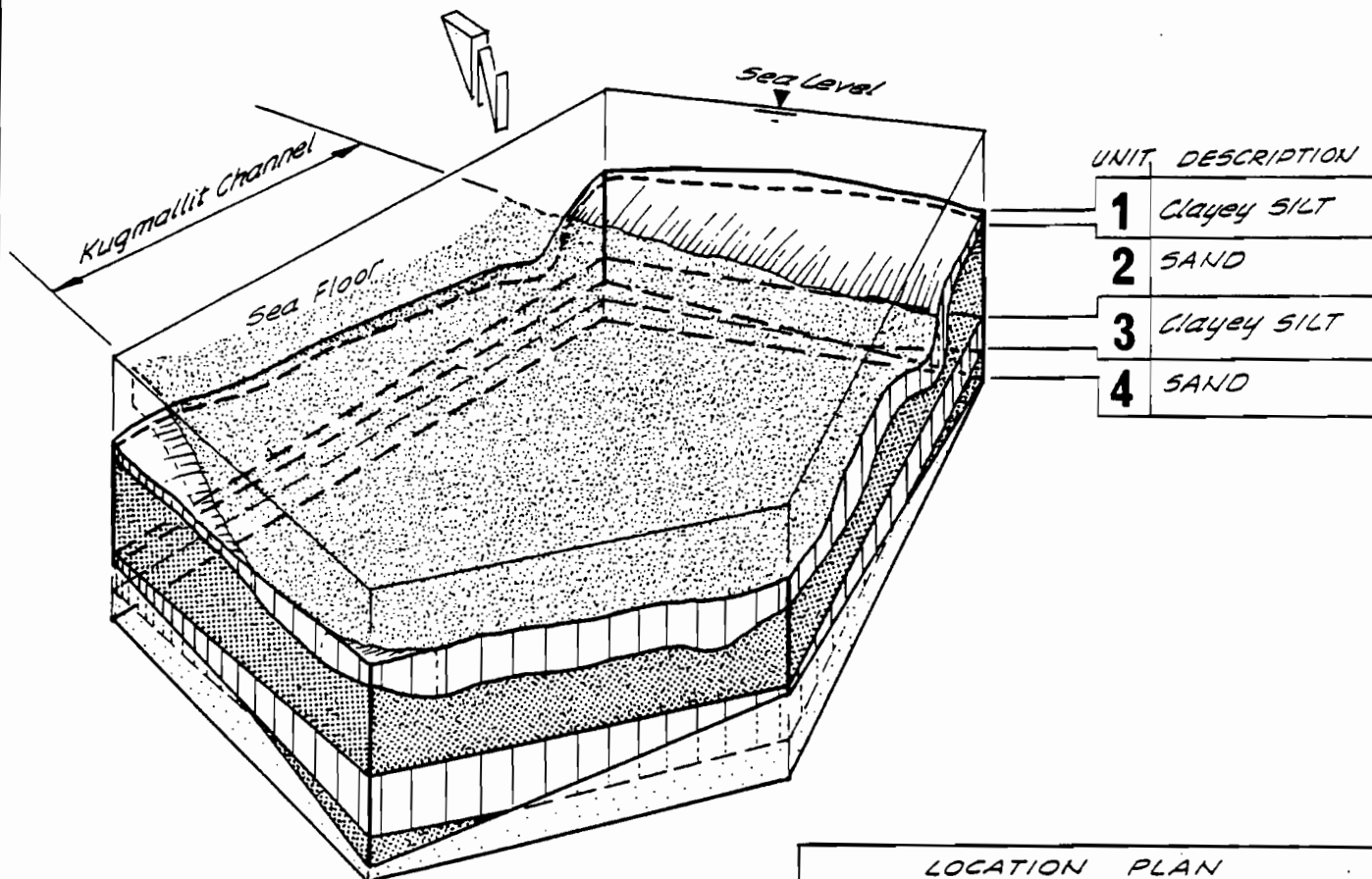


Scale: Horizontal 1:1250
Vertical 1:500

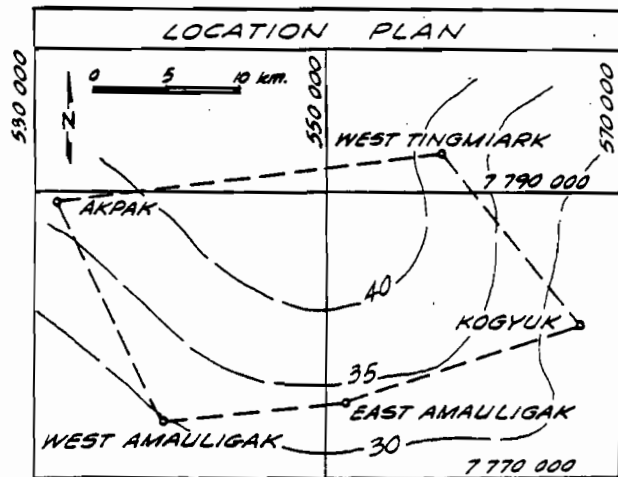


REGIONAL GEOLOGY IN EAST OF PROJECT AREA.

Figure 7



Schematic only - Not to Scale



NOTE: Bathymetry Approximate

PROJECT NO. B/2-2102... DRAWN BY... REVIEWED... DATE Feb '82

TABLE 1 KOGYUK TRIAXIAL TESTS

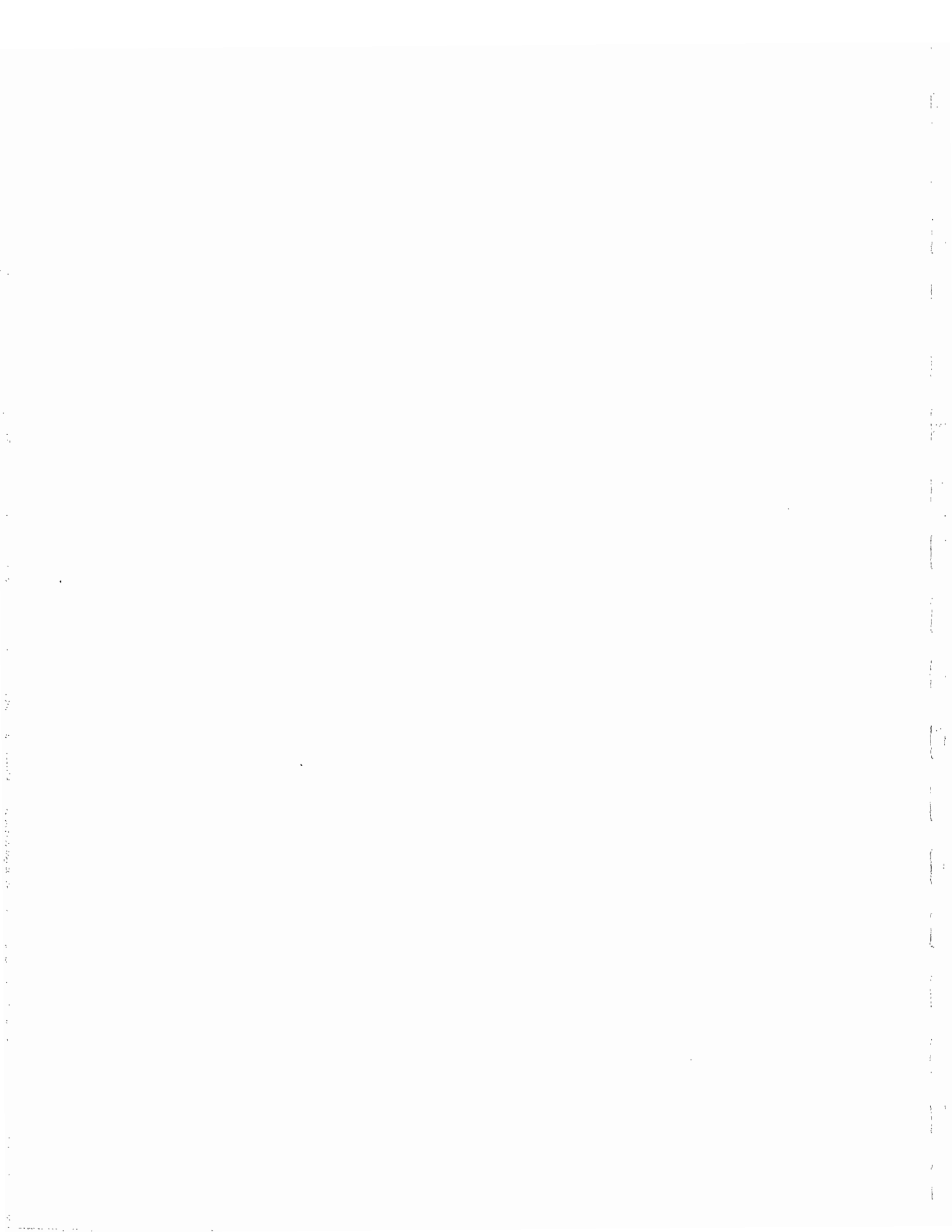
Borehole No.	Sample No.	Depth (m)	Type of Test	Cell Pressure kPa	Back Pressure kPa	Ratio* $\sigma'3 / \sigma'v$	Rate of Strain %/Hr	Failure			Comments
								Deviator Stress (kPa)	Strain %	Pore Pressure (kPa)	
2	26	44.3-44.5	unconfined	0	-	-	4.2	82	2.2	-	partially frozen sample
4	25	43.6-44.2	CU	690	262	1.01	3.7	486	10.1	-	
4	26	45.1-45.9	unconfined	0	-	-	3.7	85	3.6	-	

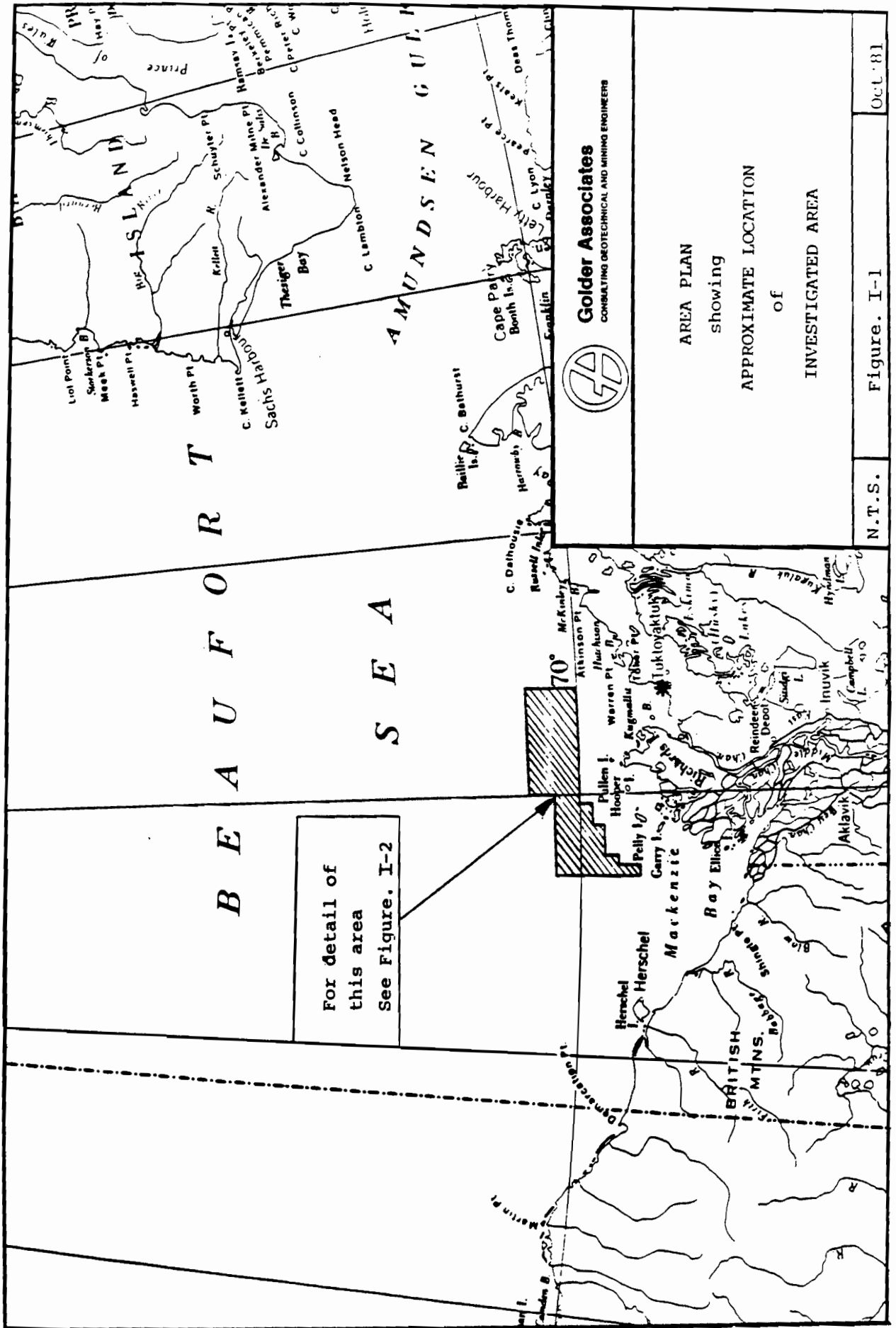
* $\sigma'3$ = Effective cell pressure at start of test

$\sigma'v$ = Vertical effective overburden pressure in-situ

APPENDIX I

Plans of Investigated Area





For detail of
this area
See Figure. I-2



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AREA PLAN
showing
APPROXIMATE LOCATION
of
INVESTIGATED AREA

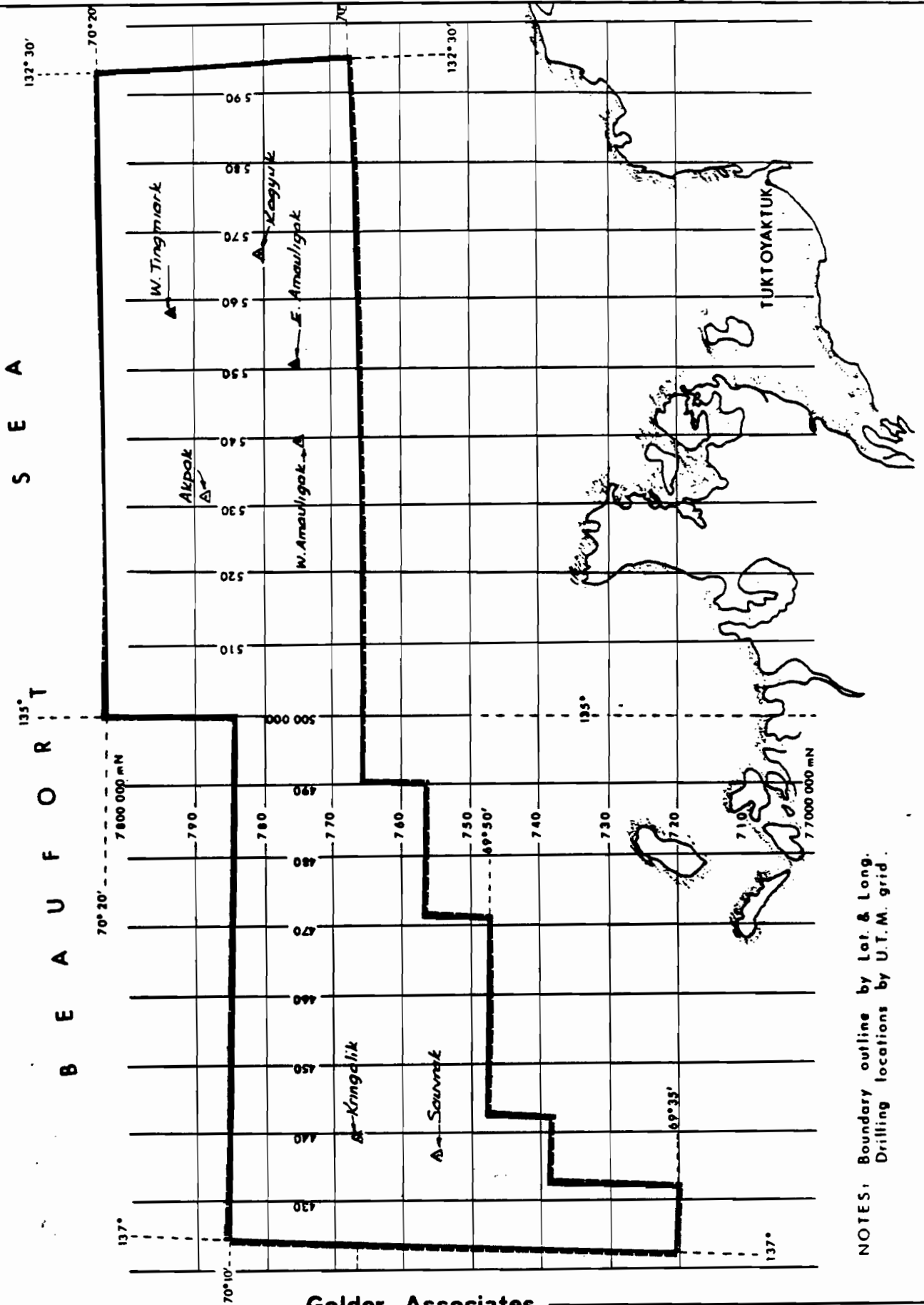
N.T.S.

Figure. I-1

Oct. 81

AREA PLAN SHOWING APPROXIMATE LOCATIONS
OF INVESTIGATED SITES

Figure I-2



NOTES: Boundary outline by Lat. & Long.
Drilling locations by U.T.M. grid.

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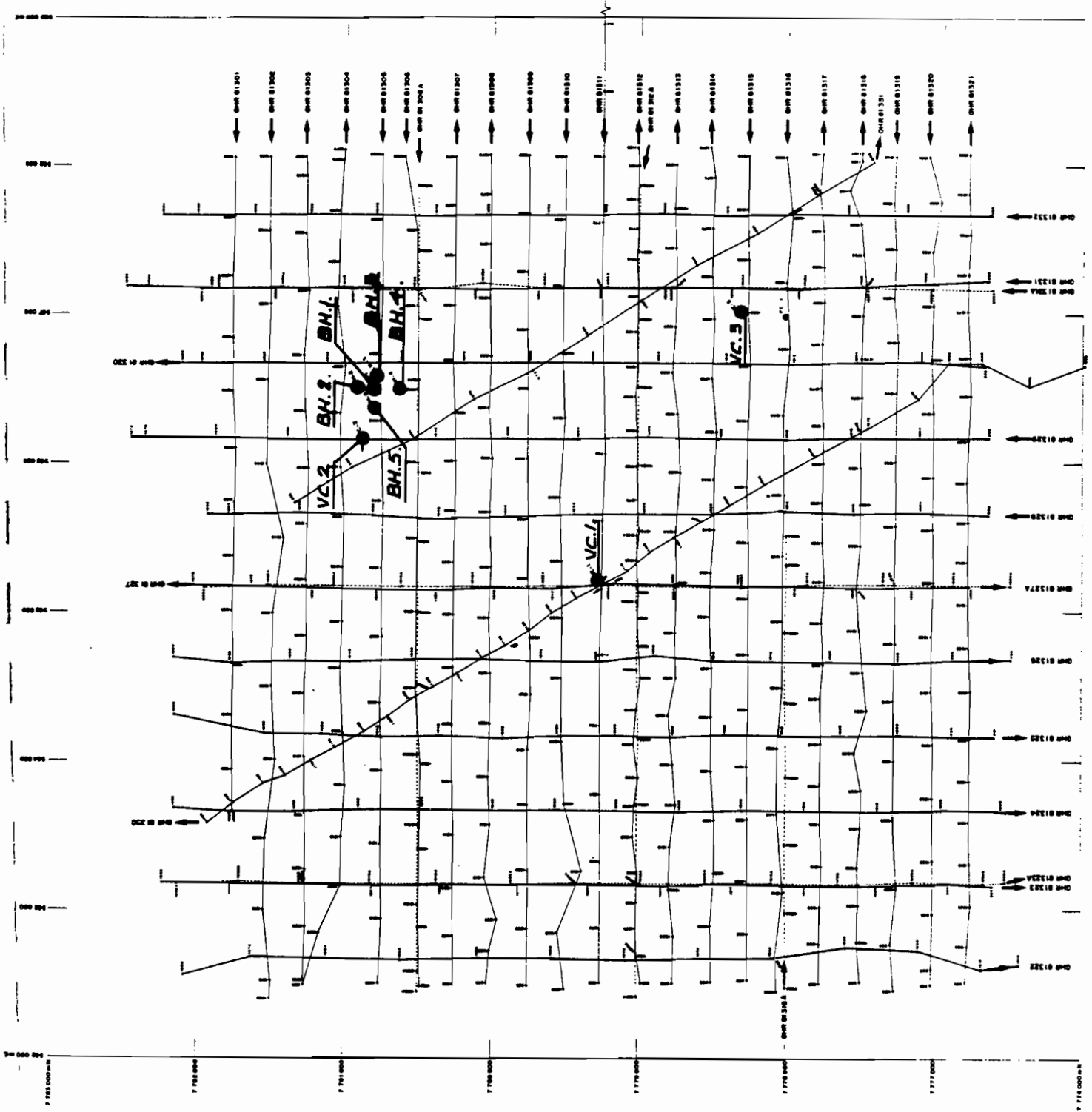
APPENDIX II

Borehole Location Plan

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KOBYUK : BOREHOLE LOCATIONS

Figure. II - 1

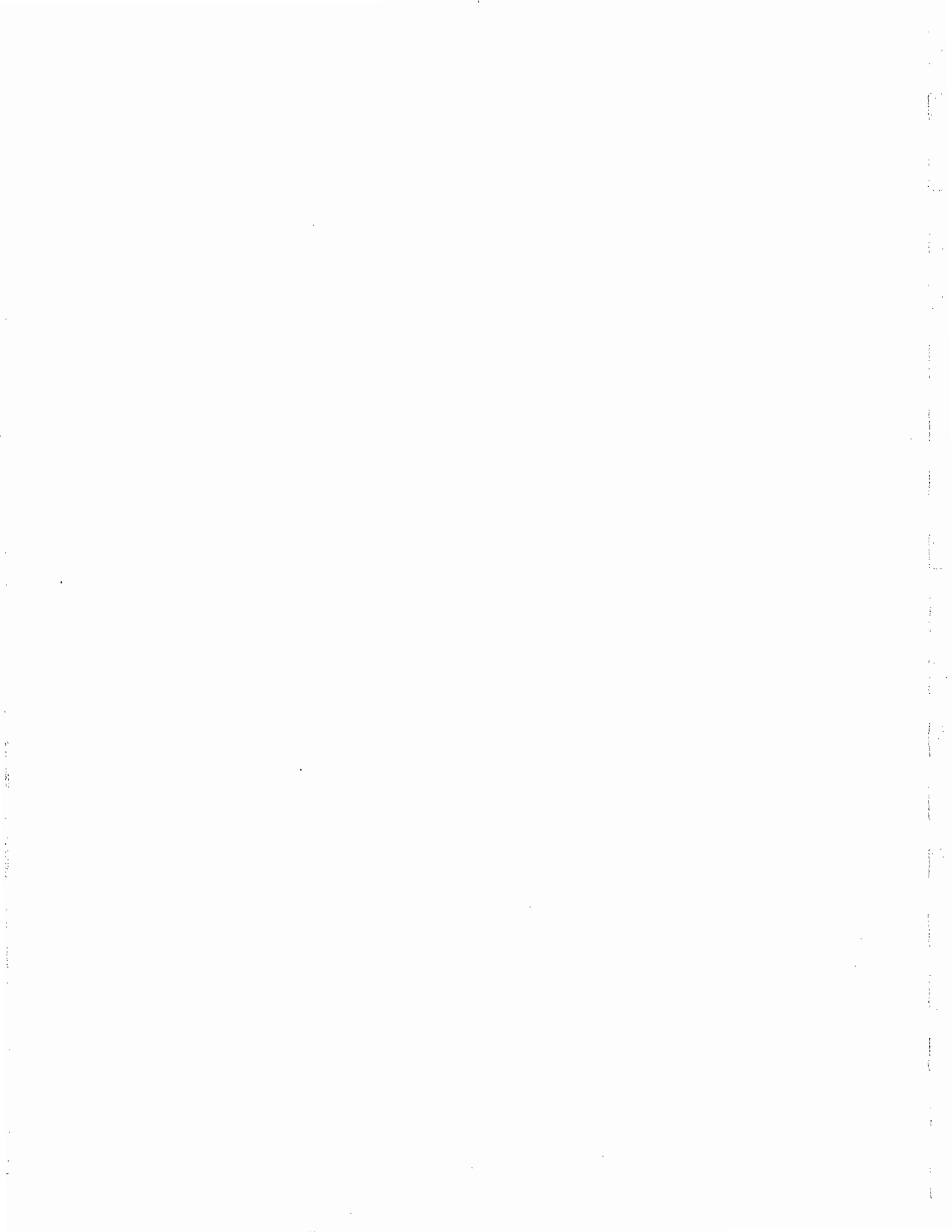


APPENDIX III

Borehole Logs, Borrow Search

Note:

1. The borrow search drilling was not supervised by Golder Associates, and therefore the soil classification system may not be consistent with the Golder Associates system on the next page.
2. Vibrocored samples are highly disturbed and therefore soil consistencies and densities on the vibrocore borehole logs may not be representative.



LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
DS Denison type sample
FS foil sample
RC rock core
ST slotted tube
TO thin-walled, open
TP thin-walled, piston
WS wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 63.5 kg hammer dropped 760mm required to drive a 50mm diameter, 60 degree cone 0.3 m, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 63.5 kg hammer dropped 760 mm required to drive a 50mm drive open sampler

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

NOTES:

¹Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

²Undrained triaxial tests in which pore pressures are measured are shown as \bar{Q} or \bar{R} .

III. SOIL DESCRIPTION

(a) Cohesionless Soils

<i>Relative Density</i>	<i>N, blows/0.3 m</i>
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

<i>Consistency</i>	<i>c_u, kPa</i>
Very soft	Less than 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	over 200

IV. SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH combined analysis, sieve and hydrometer¹
Q undrained triaxial²
R consolidated undrained triaxial²
S drained triaxial
U unconfined compression
V field vane test
F fall cone
L lab vane
P pocket penetrometer

SOIL CLASSIFICATION SYSTEM

GRAIN SIZE SCALE: M.I.T. STANDARD

BOULDERS	Large than 200 mm
COBBLES	60 mm to 200 mm
GRAVEL	2 mm to 60 mm
SAND	0.06 mm to 2 mm
SILT	0.002 to 0.06 mm
CLAY	Smaller than 0.002 mm

COMPOSITION:

"and"	36 to 50%
"y" or "ey"	21 to 35%
"some"	11 to 20%
"trace"	0 to 10%

EXAMPLE:

Gravel 70% Sand 22%
Pass #200 Sieve 8%
Sandy Gravel, Trace of Silt

EXCEPTION:

Silt 70% Clay 30%
And plots above 'A' line
Silty clay not clayey silt

RECORD OF BOREHOLE VC 01

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 779 272 E 565 215 DATUM: Sea floor
 BOREHOLE TYPE: Sonic. DIAMETER: 10.16cm BORING DATE: August 11, 1981 WATER DEPTH: 30 m.

DEPTH. 1:50(m)	SOIL DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	WATER CONTENT PERCENT				ADDITIONAL LAB. TESTING	
				W _p	W	W _L	W _U		
	Sea Floor								
0.0	Stiff dark olive grey CLAY, mottled with black clay				-----				
0.9	Dark olive to black silty CLAY, mixed with some fine sand								
1.5	Soft, very dark grey, highly disturbed, silty CLAY, with fine and medium sand		4					M	
2.0									
2.3	Loose medium to fine SAND		5					M	
3.0	Black sandy SILT, liquefied								
3.6	Dense light brown medium SAND, trace of silt		6					M	
4.0									
				7					M
				8					M
				9					M
6.0									
8.0									
8.5	Very stiff black CLAY, some SAND		10					M	
9.1	Light brown medium SAND, mostly disturbed, trace of silt		11					M	

10.0 End of Borehole
 PROJECT No. 812-2102

Golder Associates

BORE HOLE No VC 01
 SHEET 1 OF 1

RECORD OF BOREHOLE VC 02

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 780 882 E 566 159 DATUM: Sea floor
 BOREHOLE TYPE: Sonic. DIAMETER: 10.16cm BORING DATE: August 11, 1981 WATER DEPTH: 28 m.

DEPTH. 1:50(m)	SOIL DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	WATER CONTENT PERCENT				ADDITIONAL LAB TESTING
				W _p	W	W	W _L	
	Sea Floor							
0.0	Dark olive grey silty CLAY organic							
0.4	Dark greyish brown medium to coarse SAND, trace of silt		2					M
			3					M
2.0			4					M
2.3	Dark greyish brown, fine to medium SAND, some silt		5a					M
2.9	Dark greyish brown to olive brown medium SAND, trace of silt							
4.0			5b					M
5.0	Dark greyish brown coarse to medium SAND, trace of silt		6					M
			7					M
6.0	Clayey, silty, fine to medium SAND, graded		8					M
				9				
6.8	End of Borehole							

RECORD OF BOREHOLE VC 03

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk

LOCATION CO-ORDS: N 7 778 323 E 567 010

DATUM: Sea floor

BOREHOLE TYPE: Sonic.

DIAMETER: 10.16cm

BORING DATE: August 12, 1981

WATER DEPTH: 24 m.

DEPTH. 1:50(m)	SOIL DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	WATER CONTENT PERCENT				ADDITIONAL LAB TESTING
				W _p	W	W _L	L	
				20	40	60	80	
	Sea Floor							
0.0	Dark olive grey clayey SAND							
0.3	Very dense dark to very dark grey medium SAND with some silt and clay		1					M
			2					M
1.2	Very dense medium SAND							
1.9	Medium SAND with layers of organic silt		3					M
2.2	Olive grey to black, medium SAND		4					M
			5					M
3.0	Olive grey, medium SAND, clean							
3.7	Dark olive grey, medium SAND		6					M
4.0			7					M
4.1	Dark greyish brown, medium SAND, trace of silt		8					M
			9					M
6.0			10					M
6.8	Dense, very dark greyish brown fine to medium silty SAND		11					M
7.2	Dense, very dark greyish brown medium to fine SAND a trace to some silt		12					M
7.6			13					M
8.0								
			14					M
10.0	see next sheet							

APPENDIX IV

Laboratory Tests, Borrow Search

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GRAIN SIZE DISTRIBUTION

Table: IV - 1

BOREHOLE VC - 01

BOREHOLE TYPE: Sonic

SITE NAME: Kogyuk

Depth		Sample No.	Gravel	Sand			Fines	Silt			Clay
From	To			C	M	F		C	M	F	
1.5	2.4	4	0	2	39	17	42				
2.4	3.0	5	0	0	52	33	15				
3.6	4.9	6	0	3	71	18	8				
4.9	6.4	7	0	0	82	13	5				
6.4	6.7	8	0	0	74	16	10				
6.7	8.2	9	0	1	79	13	7				
8.5	9.1	10	0	0	12	6	82				
9.1	10.0	11	0	2	78	13	7				

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GRAIN SIZE DISTRIBUTION

Table: IV - 2

BOREHOLE VC - 02

BOREHOLE TYPE: Sonic

SITE NAME: Kogyuk

Depth		Sample No.	Gravel	Sand			Fines	Silt			Clay
From	To			C	M	F		C	M	F	
0.5	1.2	2	0	13	80	3	4				
1.2	1.5	3	0	39	52	3	6				
1.5	2.3	4	1	33	62	2	2				
2.3	3.1	5A	0	0	59	27	14				
3.1	5.0	5B	0	3	68	22	7				
5.0	5.8	6	0	20	73	4	3				
5.8	6.1	7	2	9	65	10	14				
6.1	6.4	8	0	1	39	33	27				
6.4	6.9	9	0	1	64	17	18				

Project No. 812-2102

GRAIN SIZE DISTRIBUTION

Table: IV - 3

BOREHOLE VC - 03

BOREHOLE TYPE: Sonic

SITE NAME: Kogyuk

Depth		Sample No.	Gravel	Sand			Fines	Silt			Clay
From	To			—	C	M		F	—	C	
0.5	0.6	1	0	3	69	9	19				
1.4	1.55	2	0	2	80	8	10				
2.1	2.25	3	0	5	83	7	5				
2.7	2.85	4	0	7	80	6	7				
3.1	3.25	5	0	2	88	9	1				
4.0	4.15	6	0	2	90	6	2				
4.3	4.45	7	0	4	80	5	11				
4.9	5.05	8	0	2	88	7	3				
5.9	6.05	9	0	2	88	8.5	1.5				
7.0	7.15	10	0	2	40	52	6				
7.2	7.35	11	2	4	74	12	8				
7.5	7.65	12	0	2	66	26	6				
8.7	8.85	13	0	0.5	51.5	35	13				
10.1	10.4	14	0	1	49	35	15				
11.6	12.2	15	0	1	61	25	13				
12.8	13.1	16	0	4	80	12	4				
15.2	15.9	17	0	0	23	56	21				

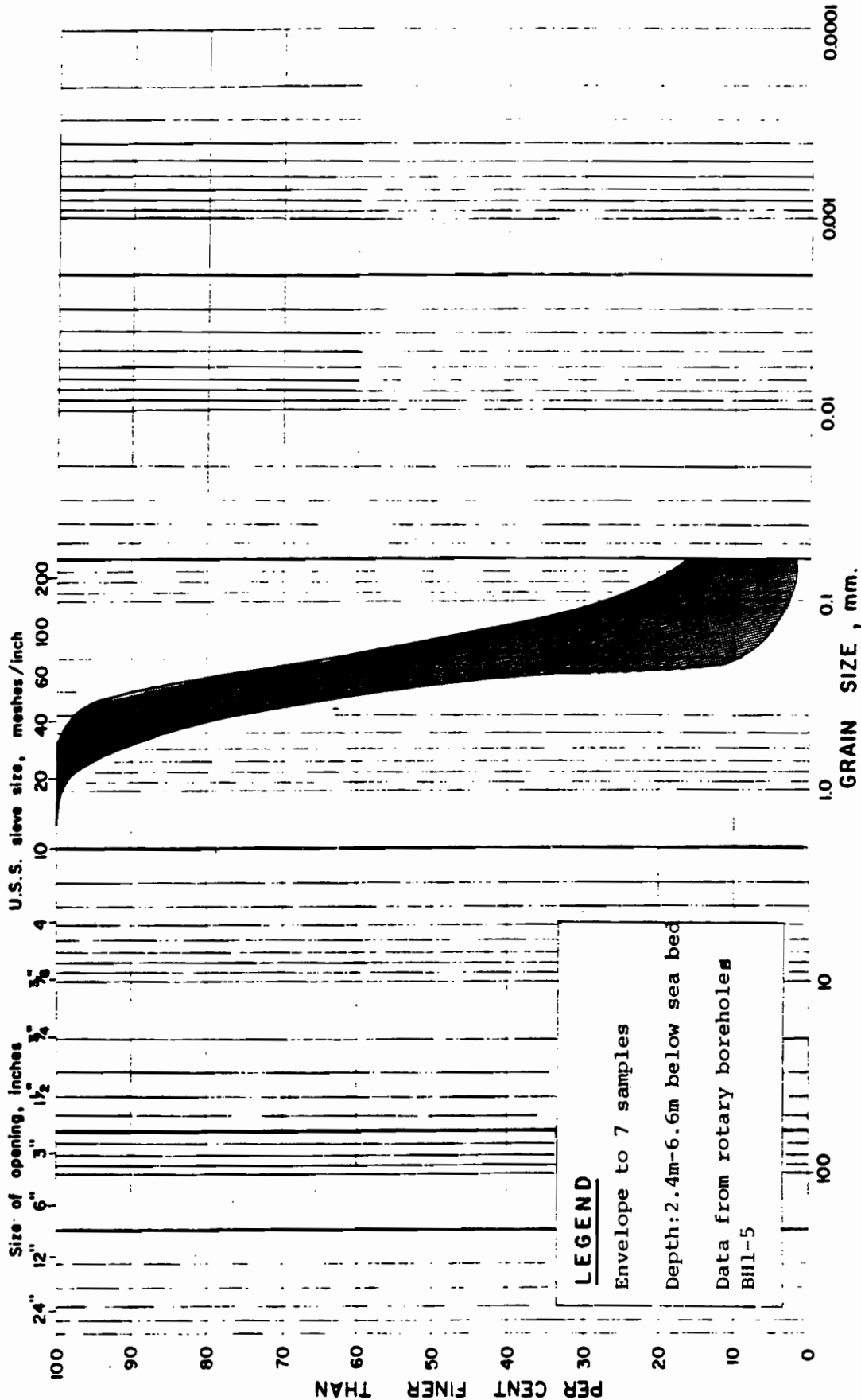
Project No. 812-2102

GRAIN SIZE DISTRIBUTION

Figure IV.1

KOGYUK MAC SITE - GRADING CURVE ENVELOPE from 2.4m-6.6m

M.I.T. GRAIN SIZE SCALE



BOULDER SIZE	COBBLE SIZE	GRAVEL SIZE	SAND SIZE	SILT SIZE	CLAY SIZE
		coarse medium fine	coarse medium fine	fine grained	

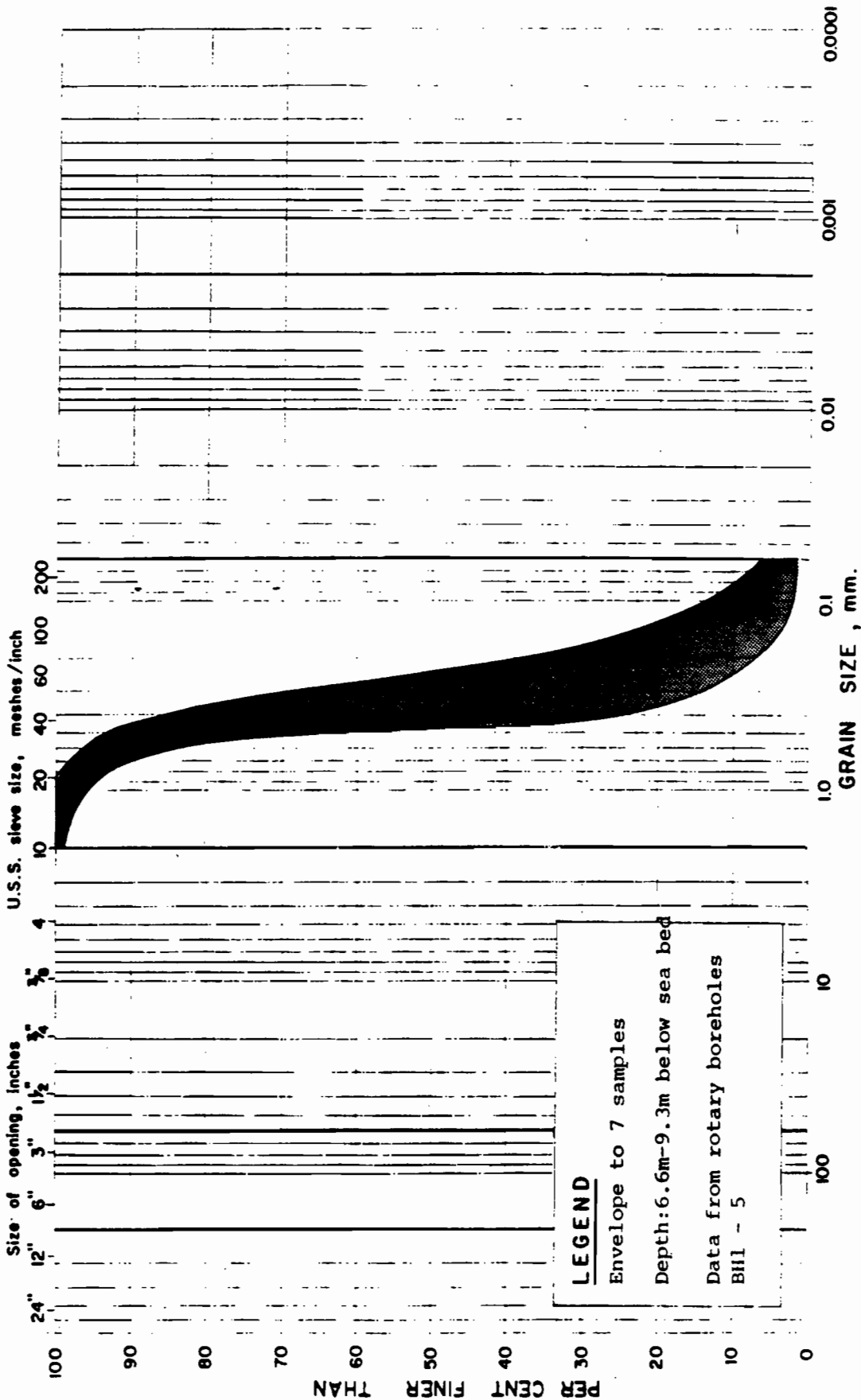
Project No. 812-3102 Drawn G.P.G. Reviewed Date Jan '82

GRAIN SIZE DISTRIBUTION

KOGYUK MAC SITE - GRADING CURVE ENVELOPE from 6.6m - 9.3m

Figure IV.2

M.I.T. GRAIN SIZE SCALE

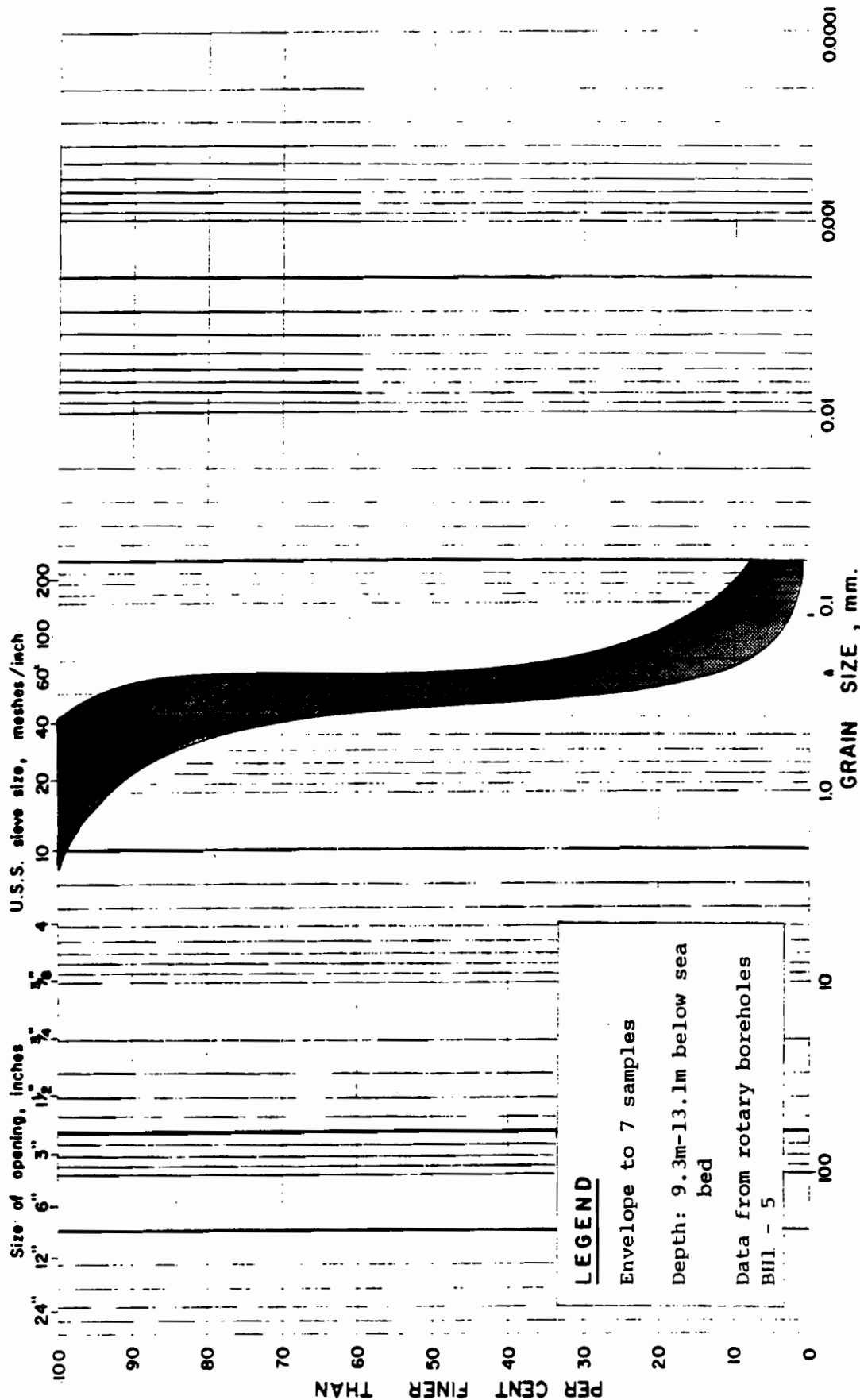


GRAIN SIZE DISTRIBUTION

Figure IV.3

KOGYUK MAC SITE - GRADING CURVE ENVELOPE from 9.3m - 13.1m

M.I.T. GRAIN SIZE SCALE



BOULDER SIZE	GRAVEL SIZE	SAND SIZE			SILT SIZE		CLAY SIZE
	coarse medium fine	coarse medium fine	coarse medium fine	coarse medium fine	fine grained		

LEGEND
 Envelope to 7 samples
 Depth: 9.3m-13.1m below sea bed
 Data from rotary boreholes BH11 - 5

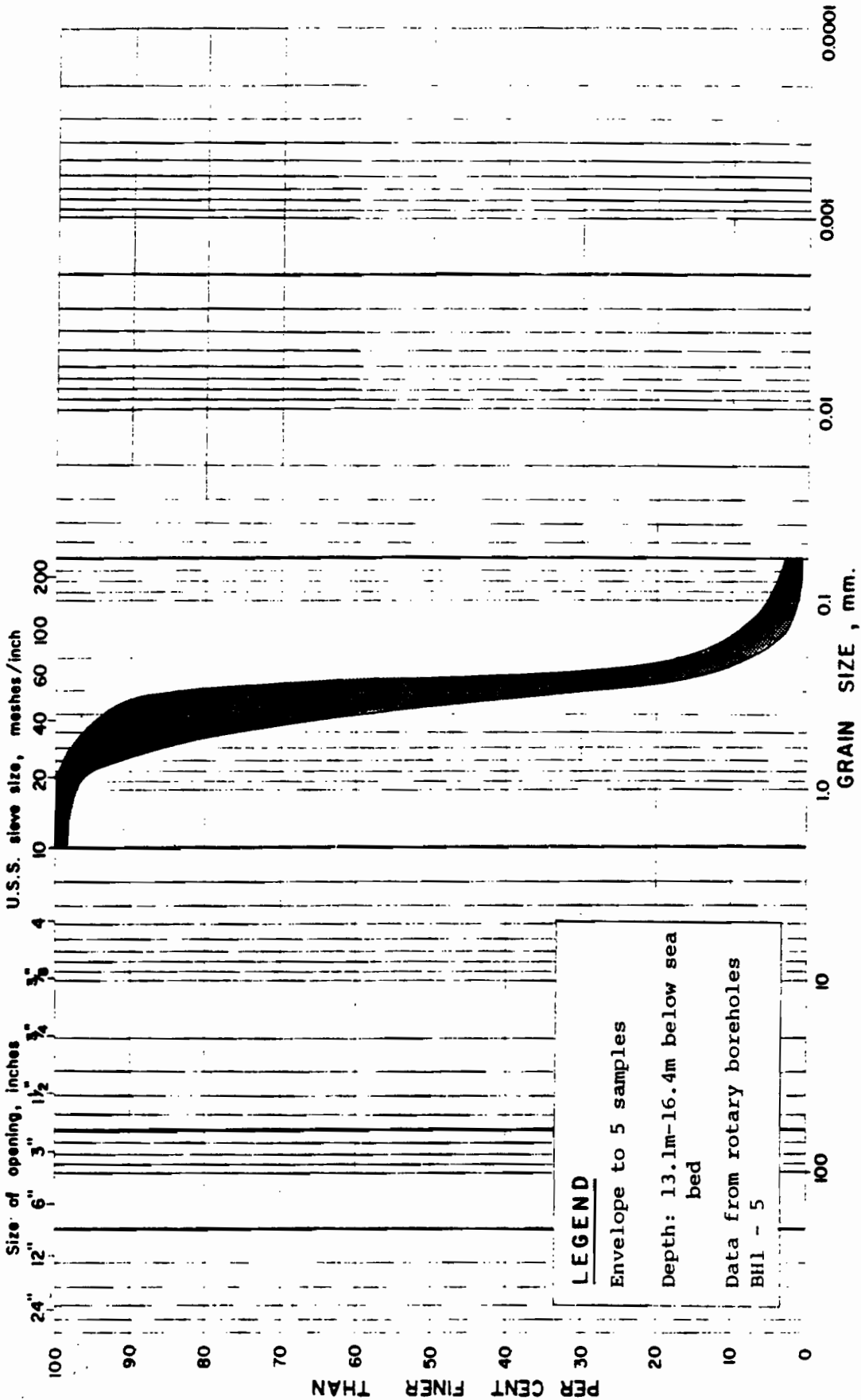
Project No. 012-2102 Drawn 6.1.85 Reviewed Date Jan '82

GRAIN SIZE DISTRIBUTION

KOGYUK MAC SITE - GRADING CURVE ENVELOPE from 13.1m - 16.4m

Figure 10.4

M.I.T. GRAIN SIZE SCALE



LEGEND
 Envelope to 5 samples
 Depth: 13.1m-16.4m below sea bed
 Data from rotary boreholes
 BH1 - 5

BOULDER SIZE		GRAVEL SIZE		SAND SIZE		SILT SIZE		CLAY SIZE
	coarse	medium	fine	coarse	medium	fine	coarse	medium

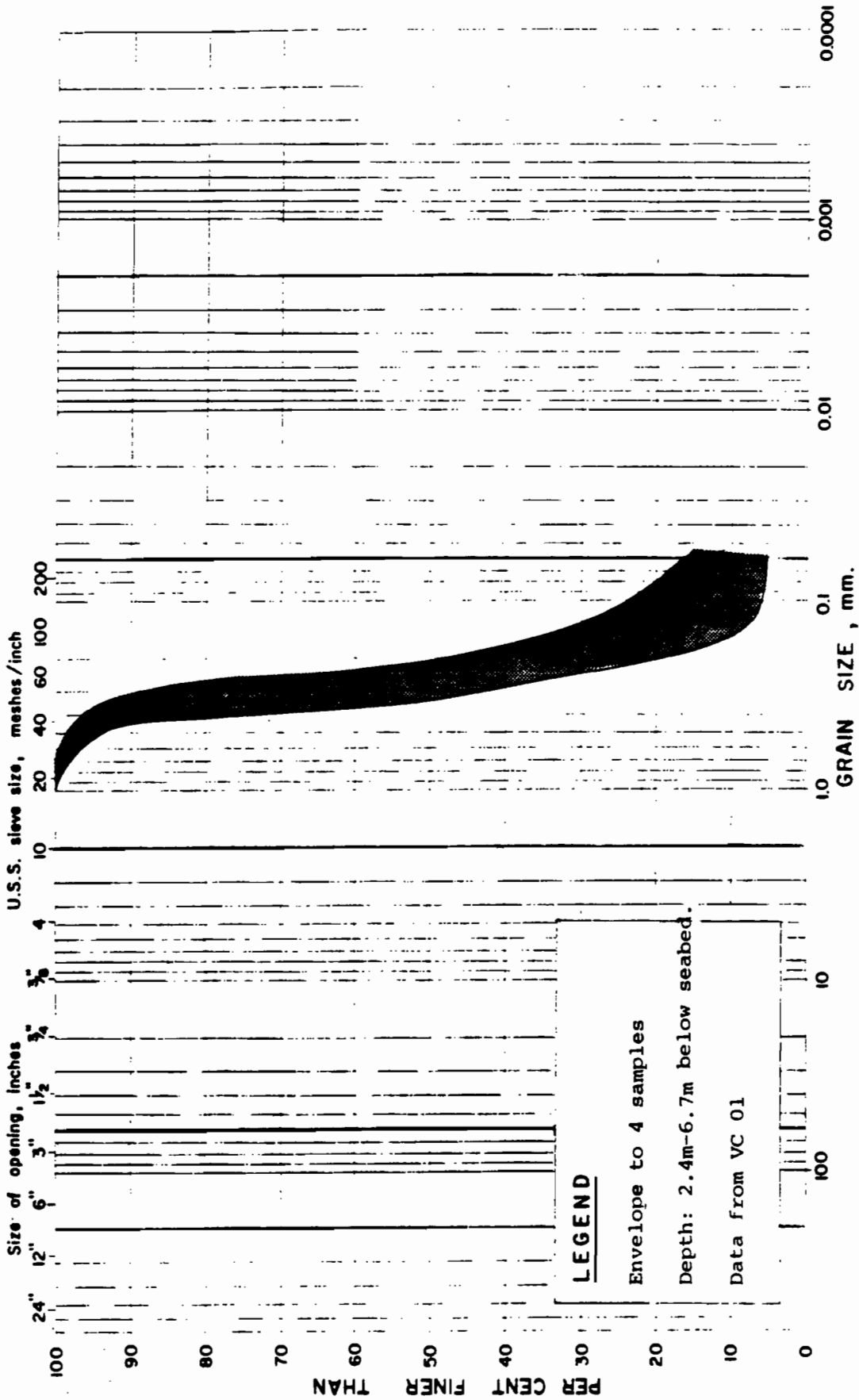
Project No. 812-2102 Drawn G.M.B Revised Date Jan '82

GRAIN SIZE DISTRIBUTION

Figure 10.5

KOBYUK - GRADING CURVE ENVELOPE, VC-01 from 2.4m-6.7m

M.I.T. GRAIN SIZE SCALE



BOULDER SIZE	COBBLE SIZE	GRAVEL SIZE			SAND SIZE			SILT SIZE		CLAY SIZE
		coarse	medium	fine	coarse	medium	fine	coarse	fine grained	

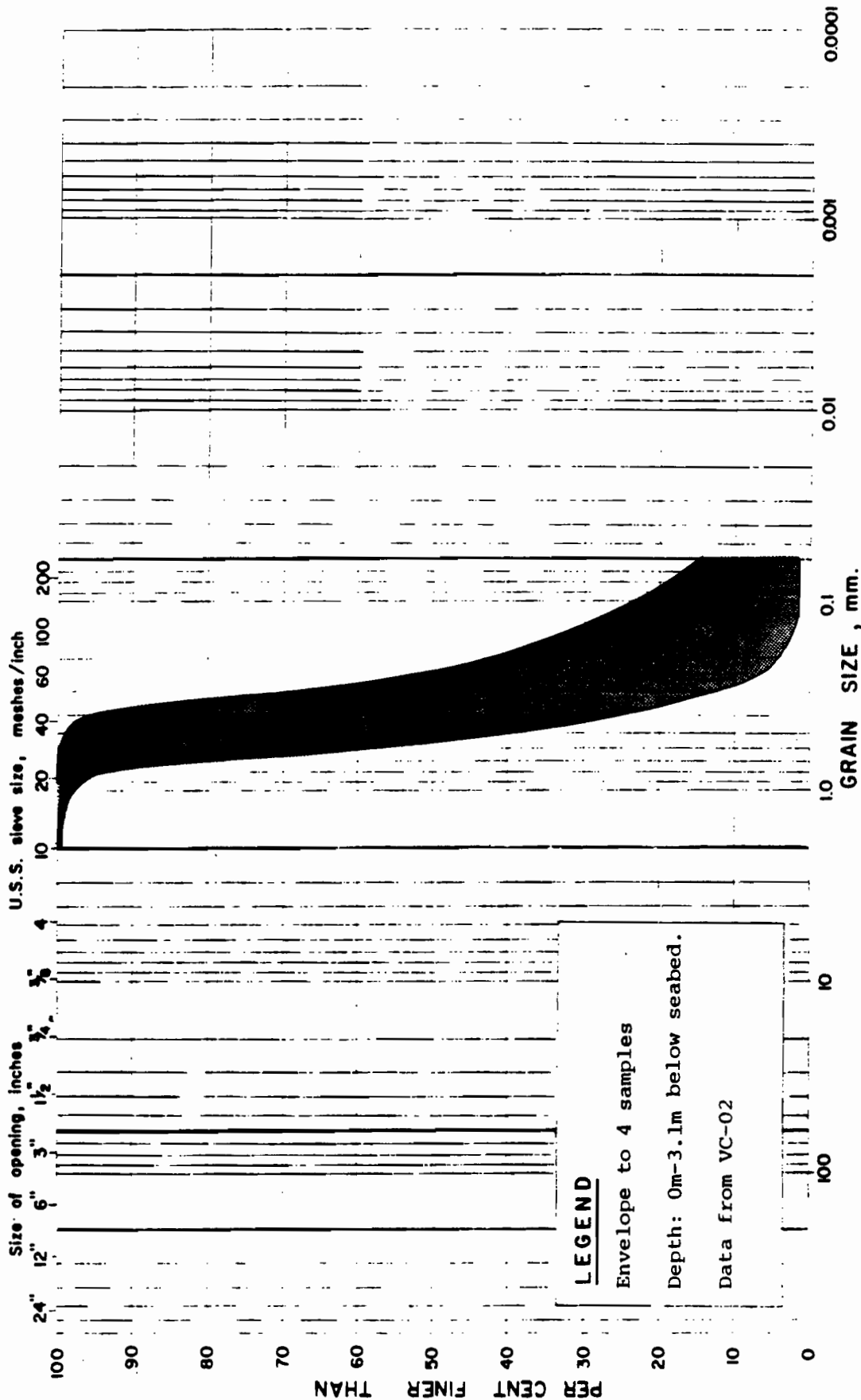
Project No. 812-2102 Drawn G.P.B. Reviewed Date JAN '82

GRAIN SIZE DISTRIBUTION

Figure IV.7

KOGYUK - GRADING CURVE ENVELOPE, VC-02 from 0m-3.1m

M.I.T. GRAIN SIZE SCALE



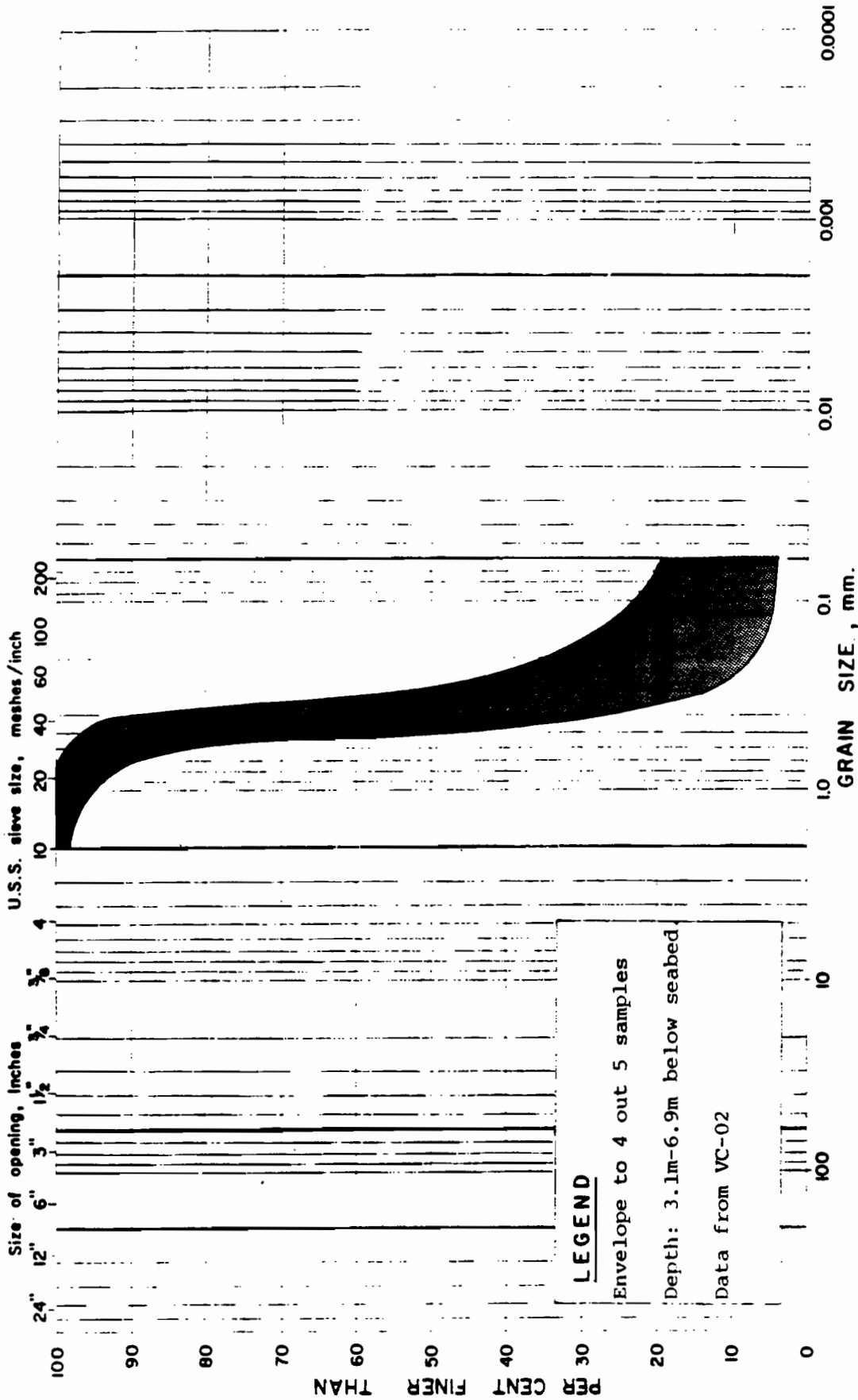
BOULDER SIZE	GRAVEL SIZE			SAND SIZE		CLAY SIZE	
	coarse	medium	fine	coarse	medium	fine	fine grained

GRAIN SIZE DISTRIBUTION

KOGYUK - GRADING CURVE ENVELOPE, VC-02 from 3.1m-6.9m

Figure IV.6

M.I.T. GRAIN SIZE SCALE



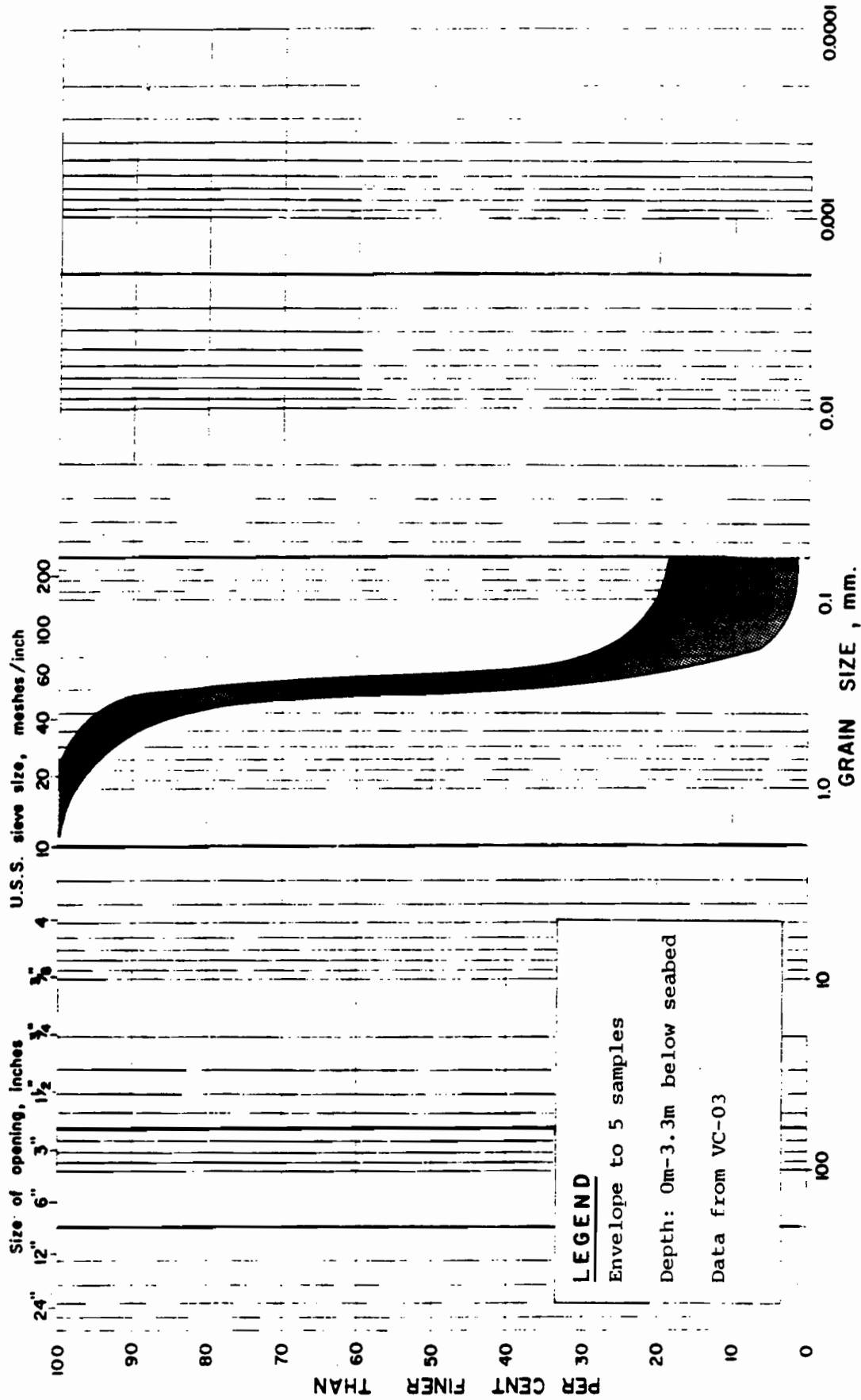
Project No. 812-2102 Drawn: JAB Reviewed: Date: Jan '72

GRAIN SIZE DISTRIBUTION

Figure IV.9

KOGYUK - GRADING CURVE ENVELOPE, VC-03 from 0m-3.3m

M.I.T. GRAIN SIZE SCALE



BOULDER SIZE	COBBLE SIZE	GRAVEL SIZE	SAND SIZE	SILT SIZE	CLAY SIZE
	coarse medium fine	coarse medium fine	coarse medium fine	fine grained	

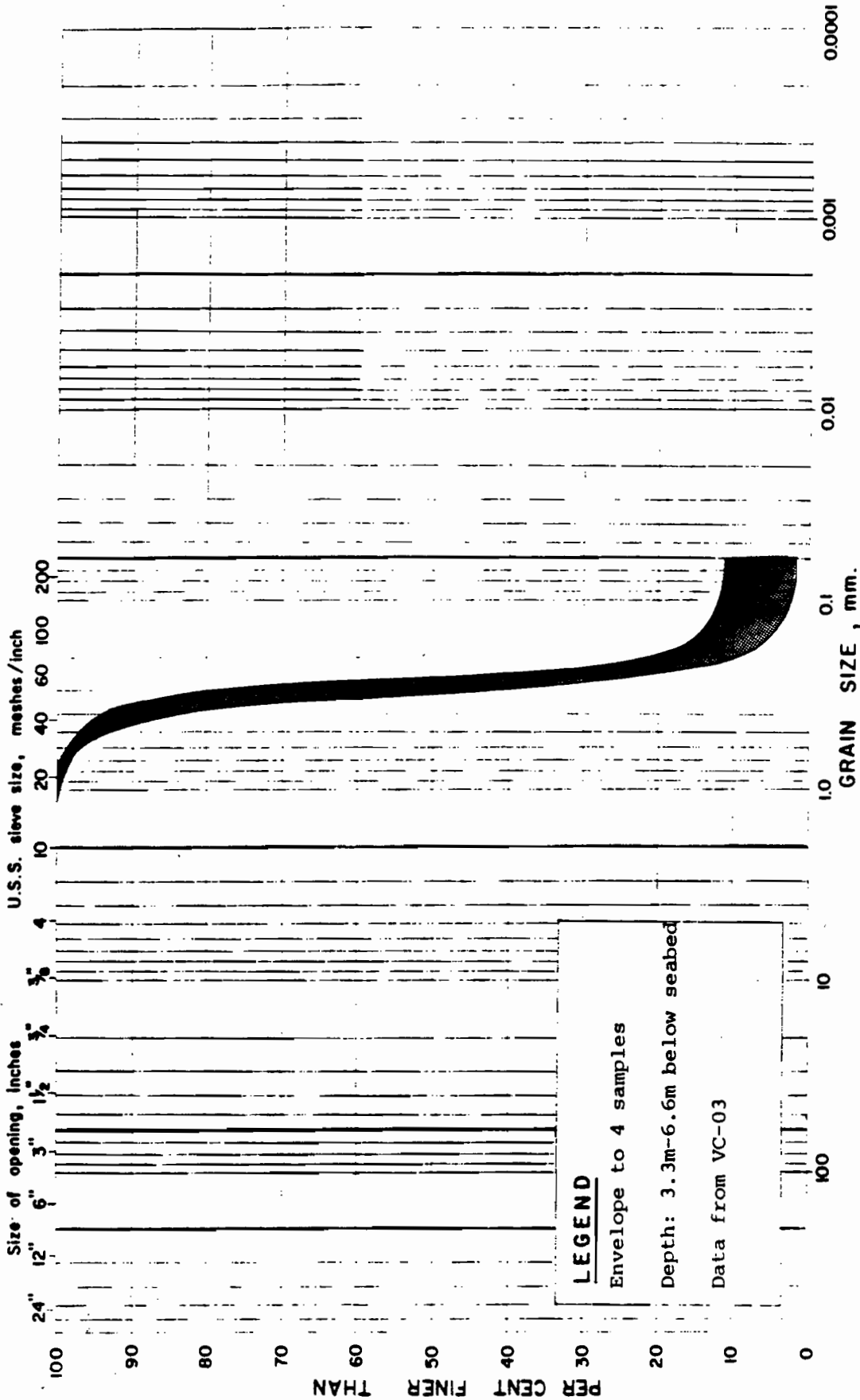
Project No. 8/1-2/02 Drawn G.A.B. Revised Date Jan '82

GRAIN SIZE DISTRIBUTION

Figure IV.10

KOGYUK - GRADING CURVE ENVELOPE, VC-03 from 3.3m-6.6m

M.I.T. GRAIN SIZE SCALE



LEGEND

Envelope to 4 samples

Depth: 3.3m-6.6m below seabed

Data from VC-03

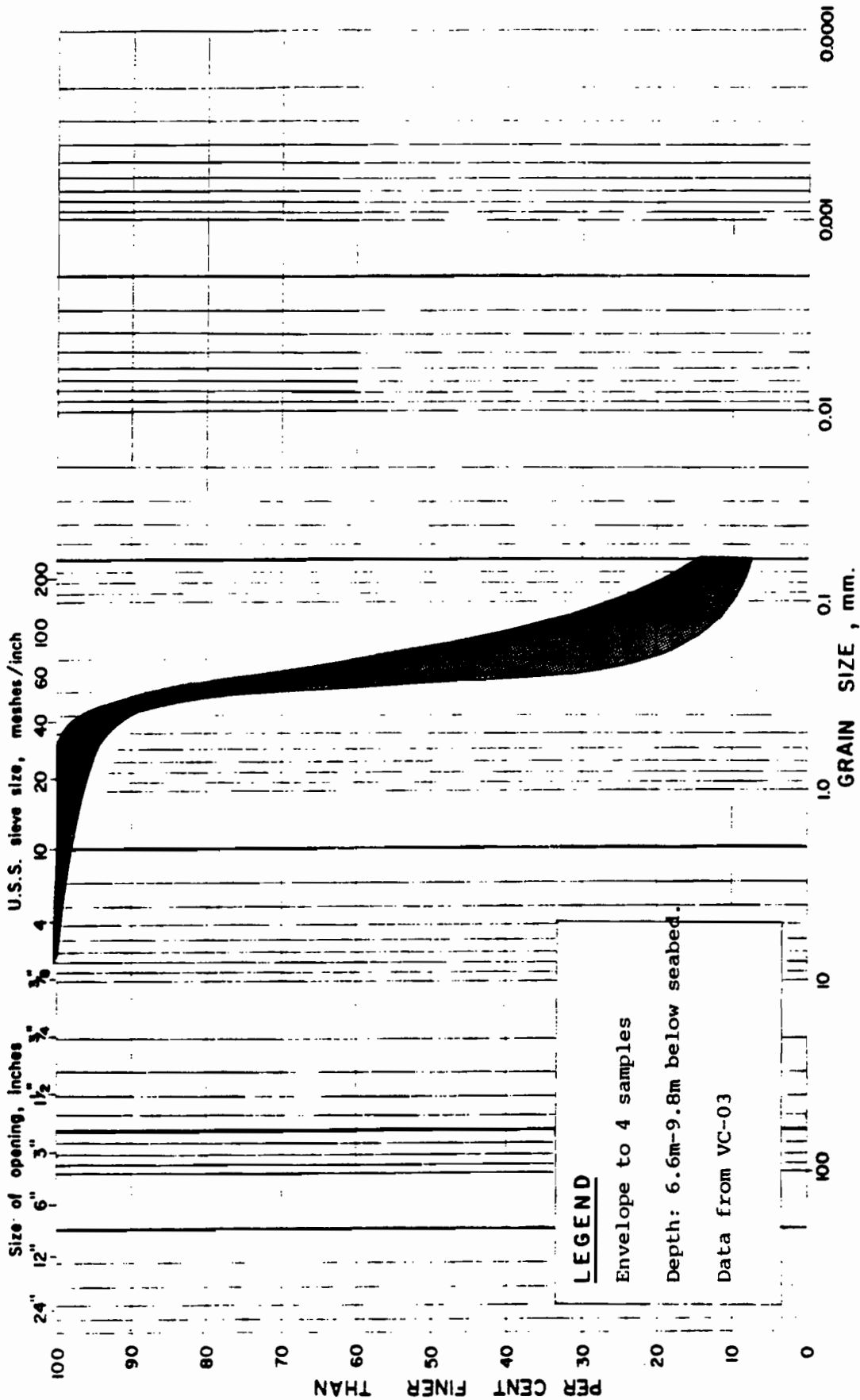
BOULDER SIZE	COBBLE SIZE	coarse	medium	fine	SILT SIZE	CLAY SIZE
		GRAVEL SIZE				
		coarse	medium	fine		
		SAND SIZE				

GRAIN SIZE DISTRIBUTION

Figure IV.11

KOGYUK - GRADING CURVE ENVELOPE, VC-03 from 6.6m-9.8m

M.I.T. GRAIN SIZE SCALE



LEGEND
 Envelope to 4 samples
 Depth: 6.6m-9.8m below seabed.
 Data from VC-03

BOULDER SIZE	GRAVEL SIZE		SAND SIZE		SILT SIZE		CLAY SIZE	
	coarse	medium	fine	coarse	medium	fine	coarse	medium

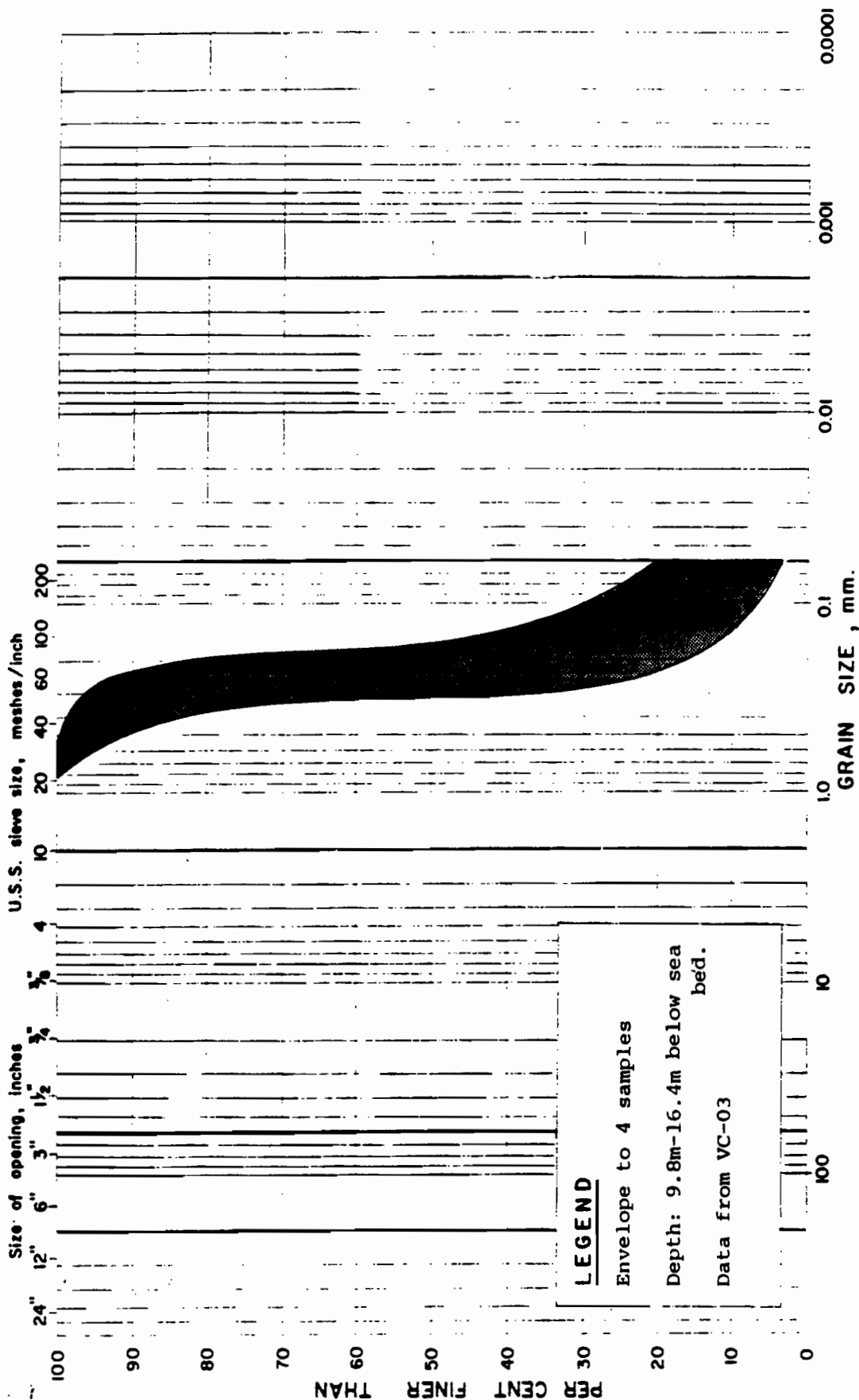
Project No. 811-2102 Drawn by: [Signature] Reviewed: [Signature] Date: Jan '82

GRAIN SIZE DISTRIBUTION

Figure IV.12

KOGYUK - GRADING CURVE ENVELOPE, VC-03 from 9.8m-16.4m

M.I.T. GRAIN SIZE SCALE



LEGEND

Envelope to 4 samples

Depth: 9.8m-16.4m below sea bed.

Data from VC-03

BOULDER SIZE	GRAVEL SIZE	SAND SIZE	SILT SIZE	CLAY SIZE
coarse	medium	fine	coarse	fine
coarse	medium	fine	coarse	fine

Project No. 812-2102 Drawn G.P.B. Reviewed Date Jan '82



APPENDIX V

Borehole Logs, Foundation Investigation

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
DS Denison type sample
FS foil sample
RC rock core
ST slotted tube
TO thin-walled, open
TP thin-walled, piston
WS wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 63.5 kg hammer dropped 760mm required to drive a 50mm diameter, 60 degree cone 0.3 m, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 63.5 kg hammer dropped 760 mm required to drive a 50mm drive open sampler

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

NOTES:

¹Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

²Undrained triaxial tests in which pore pressures are measured are shown as *Q* or *R*.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Relative Density	<i>N</i> , blows/0.3 m
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	<i>c_u</i> , kPa
Very soft	Less than 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	over 200

IV. SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH combined analysis, sieve and hydrometer¹
Q undrained triaxial²
R consolidated undrained triaxial²
S drained triaxial
U unconfined compression
V field vane test
F fall cone
L lab vane
P pocket penetrometer

SOIL CLASSIFICATION SYSTEM

GRAIN SIZE SCALE: M.I.T. STANDARD

BOULDERS	Large than 200 mm
COBBLES	60 mm to 200 mm
GRAVEL	2 mm to 60 mm
SAND	0.06 mm to 2 mm
SILT	0.002 to 0.06 mm
CLAY	Smaller than 0.002 mm

COMPOSITION:

"and"	36 to 50%
"y" or "ey"	21 to 35%
"some"	11 to 20%
"trace"	0 to 10%

EXAMPLE:

Gravel 70% Sand 22%
Pass #200 Sieve 8%
Sandy Gravel, Trace of Silt

EXCEPTION:

Silt 70% Clay 30%
And plots above 'A' line
Silty clay not clayey silt

Summary of Ground Ice Descriptive System
(After Pihlainen and Johnston 1963, Linell and Kaplar 1966)

A. ICE NOT VISIBLE^(a)

Group Symbol	Subgroup		Field Identification
	Description	Symbol	
N	Poorly bonded or friable	Nf	To determine presence of excess ice, use procedure under note ^(b) and hand magnifying lens as necessary. For soils not fully saturated, estimate degree of ice saturation: medium, low. Note presence of crystals or of ice coatings around larger particles.
	No excess ice	Nbn	
	Well-bonded Excess ice	Nb Nbe	

B. VISIBLE ICE—LESS THAN 1 INCH THICK^(a)

Group Symbol	Subgroup		Field Identification															
	Description	Symbol																
V	Individual ice crystals or inclusions	Vx	For ice phase, record the following when applicable: <table border="0"> <tr> <td>Location</td> <td>Size</td> </tr> <tr> <td>Orientation</td> <td>Shape</td> </tr> <tr> <td>Thickness</td> <td>Pattern of arrangement</td> </tr> <tr> <td>Length</td> <td></td> </tr> <tr> <td>Spacing</td> <td></td> </tr> <tr> <td>Hardness</td> <td rowspan="2">} per Group C</td> </tr> <tr> <td>Structure</td> </tr> <tr> <td>Colour</td> <td></td> </tr> </table>	Location	Size	Orientation	Shape	Thickness	Pattern of arrangement	Length		Spacing		Hardness	} per Group C	Structure	Colour	
	Location	Size																
	Orientation	Shape																
	Thickness	Pattern of arrangement																
Length																		
Spacing																		
Hardness	} per Group C																	
Structure																		
Colour																		
Ice coatings on particles	Vc																	
Random or irregularly oriented ice formations	Vr																	
Stratified or distinctly oriented ice formations	Vs																	

C. VISIBLE ICE—GREATER THAN 1 INCH THICK

Group Symbol	Subgroup		Field Identification																								
	Description	Symbol																									
ICE	Ice with soil inclusions	ICE + soil type	Designate material as ICE ^(c) and use descriptive terms as follows, usually one item from each group, when applicable: <table border="0"> <tr> <td><i>Hardness</i></td> <td><i>Structure</i>^(d)</td> </tr> <tr> <td>HARD</td> <td>CLEAR</td> </tr> <tr> <td>SOFT</td> <td>CLOUDY</td> </tr> <tr> <td>(of mass, not individual crystals)</td> <td>POROUS</td> </tr> <tr> <td></td> <td>CANDLED</td> </tr> <tr> <td></td> <td>GRANULAR</td> </tr> <tr> <td></td> <td>STRATIFIED</td> </tr> <tr> <td><i>Colour</i></td> <td><i>Admixtures</i></td> </tr> <tr> <td>(Examples):</td> <td>(Examples):</td> </tr> <tr> <td>COLOURLESS</td> <td>CONTAINS</td> </tr> <tr> <td>GRAY</td> <td>FEW THIN</td> </tr> <tr> <td>BLUE</td> <td>SILT INCLUSIONS</td> </tr> </table>	<i>Hardness</i>	<i>Structure</i> ^(d)	HARD	CLEAR	SOFT	CLOUDY	(of mass, not individual crystals)	POROUS		CANDLED		GRANULAR		STRATIFIED	<i>Colour</i>	<i>Admixtures</i>	(Examples):	(Examples):	COLOURLESS	CONTAINS	GRAY	FEW THIN	BLUE	SILT INCLUSIONS
	<i>Hardness</i>	<i>Structure</i> ^(d)																									
HARD	CLEAR																										
SOFT	CLOUDY																										
(of mass, not individual crystals)	POROUS																										
	CANDLED																										
	GRANULAR																										
	STRATIFIED																										
<i>Colour</i>	<i>Admixtures</i>																										
(Examples):	(Examples):																										
COLOURLESS	CONTAINS																										
GRAY	FEW THIN																										
BLUE	SILT INCLUSIONS																										
Ice without soil inclusions	ICE																										

- (a) Frozen soils in the N group may, on close examination, indicate presence of ice within the voids of the material by crystalline reflections or by a sheen on fractured or trimmed surfaces. The impression received by the unaided eye, however, is that none of the frozen water occupies space in excess of the original voids in the soil. The opposite is true of frozen soils in the V group.
- (b) When visual methods are inadequate, a simple field test to aid evaluation of volume of excess ice can be made by placing some frozen soil in a small jar, allowing it to melt, and observing the quantity of supernatant water as a percentage of total volume.
- (c) Where special forms of ice such as hoarfrost can be distinguished, more explicit description should be given.
- (d) Observer should be careful to avoid being misled by surface scratches or frost coating on the ice.

RECORD OF BOREHOLE BH 1

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 780 799 E 566 495 DATUM: See floor
 BOREHOLE TYPE: Rotary DIAMETER: 10.16 cm BORING DATE: August 18, 1981 WATER DEPTH: 27.7 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPo		'N' VALUE Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	
0.0	Firm to stiff, dark grey/ green clayey SILT, with trace of medium and fine SAND Dense, dark grey-brown medium to fine SAND with trace of silt and coarse SAND Silty layers about 5 mm thick @ 3.0-3.3 m Borehole lost @ 6.2 m due to movement of ship Trace of fine gravel @ 8.4-8.9 m	1	TO			L 45 F 49	20	20	60	
2.0		2	AS				40	40	60	M
		3	DO				60	60	60	M
		4	DO				40	40	60	M
6.2		5	DO				40	40	60	M
		6	DO				60	60	60	M
10.0		7	DO				20	20	60	M

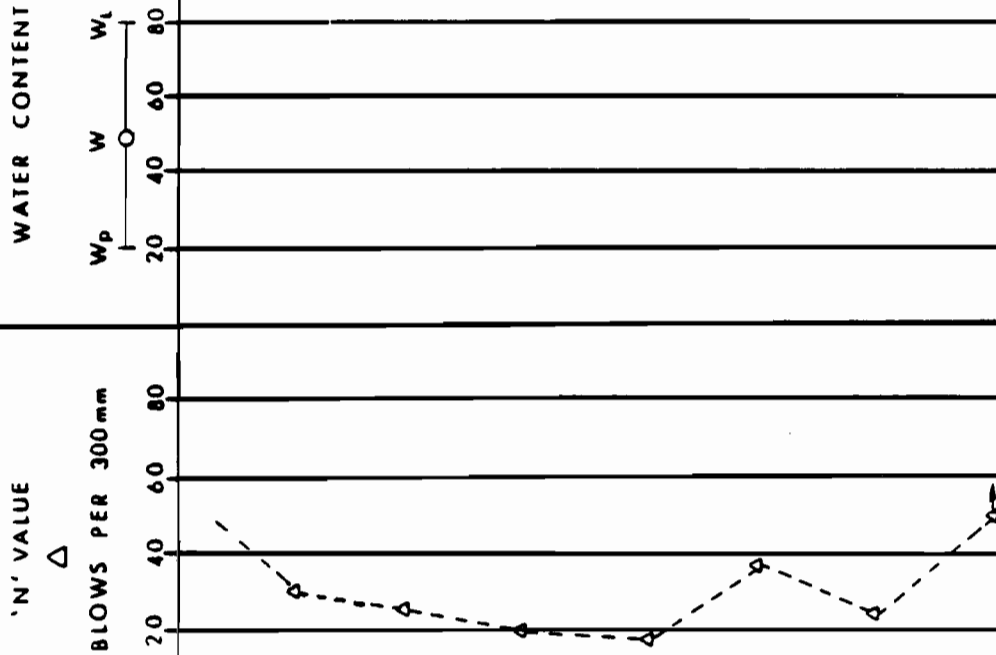
RECORD OF BOREHOLE BH 1

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 780 799 E 566 495 DATUM: See floor

BOREHOLE TYPE: Rotary DIAMETER: 10.16 cm BORING DATE: August 18, 1981 WATER DEPTH: 27.7 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE Δ BLOWS PER 300mm	WATER CONTENT				ADDITIONAL LAB TESTING		
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	W _L			
20.0	Dense, dark grey-brown medium to fine SAND with trace of silt and coarse SAND	14	DO										
		15	DO										
		16	DO										M
		17	DO										M
		18	DO										M
		19	DO										
30.0		20	DO										N=50 for 250mm



RECORD OF BOREHOLE BH 1

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 799 E 566 495 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16 cm **BORING DATE:** August 18, 1981 **WATER DEPTH:** 27.7 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE BLOWS PER 300mm △	WATER CONTENT				ADDITIONAL LAB TESTING	
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	O		Wl
100												
30.0	Dense, dark grey-brown medium to fine SAND with trace of silt and coarse SAND Odd pieces of shells @ 31.2 m	21	DO			35						M
31.2						45						M
40.0		as above	23	DO			55					

RECORD OF BOREHOLE BH 1

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 780 799 E 566 495 DATUM: Sea floor
 BOREHOLE TYPE: Rotary DIAMETER: 10.16 cm BORING DATE: August 18, 1981 WATER DEPTH: 27.7 m

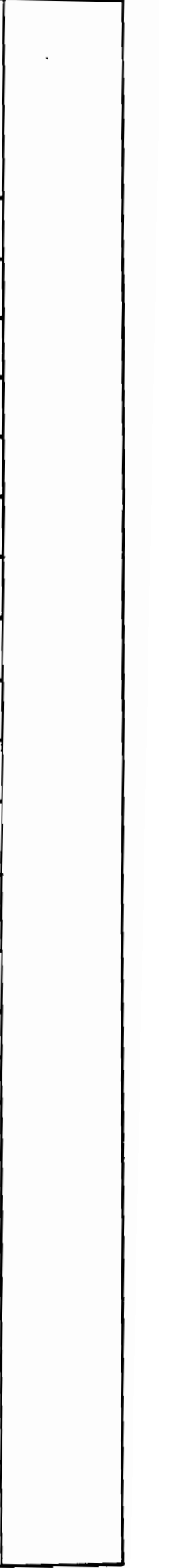
DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE Δ BLOWS PER 300 mm	WATER CONTENT Wp W Wl	ADDITIONAL LAB TESTING
		No.	Type	Temp °C	in Situ			
1-100								
40.0	Dense, dark grey-brown medium to fine SAND with trace of silt and coarse SAND	24	DO			60		N=60 for 250 mm M
41.8	Stiff to very stiff dark grey SILT with some clay and black organic layers Thinly bedded with frequent SILT partings	25	DO			25		II
46.2	Ice bonded, fine ice crystals	26	TO	-2.2				γ = 18.8 kN/m ³ C
46.5	End of Borehole							

RECORD OF BOREHOLE BH 2

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 908 E 566 505 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16cm **BORING DATE:** September 15, 1981 **WATER DEPTH:** 26.5 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No. Type	Temp °C	in Situ	in Lab		Wp	W	Wl	
0	Soft clayey SILT, and SAND, trace fine gravel, becoming stiffer with depth Grey silty fine SAND, trace of clay Compact to dense brown medium and fine SAND, trace of silt	1				46	20	20	80	MII
3.0						14				M
3.7						13				M
						4				M
						28				M
10.0		5	DO	0.0						M

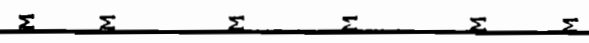


RECORD OF BOREHOLE BH 2

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 780 908 E 566 505 DATUM: Sea floor
 BOREHOLE TYPE: Rotary DIAMETER: 10.16cm BORING DATE: September 5, 1981 WATER DEPTH: 26.5 m

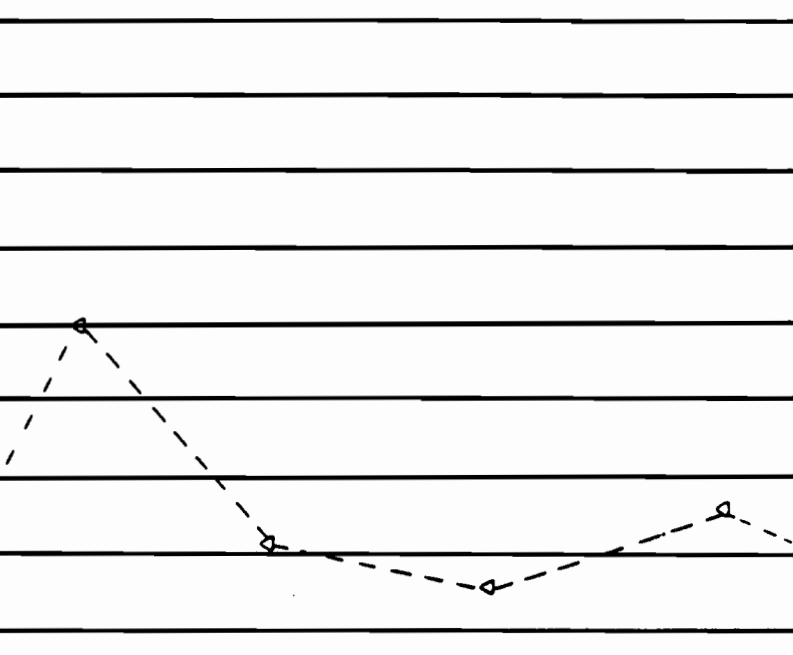
DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE BLOWS PER 300mm △	WATER CONTENT			ADDITIONAL LAB TESTING		
		No.	Type	Temp °C	in Situ		in Lab	Wp	W		W _L	
10.0	Compact to dense brown medium and fine SAND, trace of silt occasional shell fragments @ 17.0-17.5 m occasional fine shell fragments @ 18.3-18.8 m	6	DO	-1.1								
		7	DO									
		8	DO									
		9	DO									
		10	DO	-1.7								
		11	DO	-1.7								
20.0												



RECORD OF BOREHOLE BH 2
UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk
LOCATION CO-ORDS: N 7 780 908 E 566 505 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16cm **BORING DATE:** September 5, 1981 **WATER DEPTH:** 26.5 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPo		'N' VALUE △ BLOWS PER 300mm	WATER CONTENT				ADDITIONAL LAB TESTING		
		No.	Type	Temp °C	in Situ		in Lab	W _p	W	W _L			
30.0	Dense, brown medium and fine SAND	19	DO	-2.2								M	
		20	DO	-2.2									M
		21	DO										M
		22	DO										M
40.0													

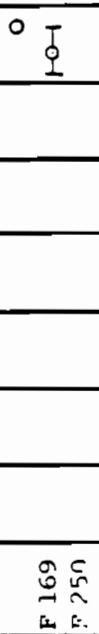
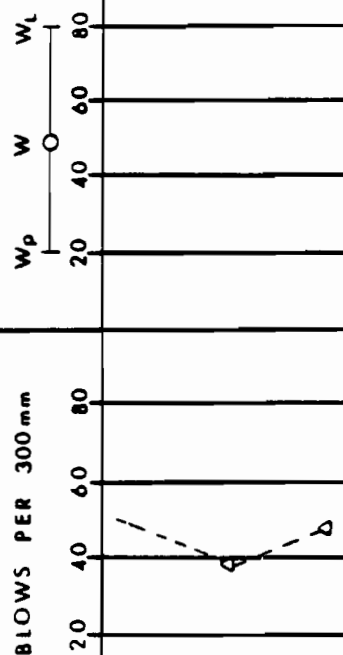


RECORD OF BOREHOLE BH 2

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 908 E 566 505 **DATUM:** Sea floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16 cm **BORING DATE:** September 5, 1981 **WATER DEPTH:** 26.5 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE △	WATER CONTENT			ADDITIONAL LAB TESTING
		No. Type	Temp °C	in Situ	in Lab		Wp	W	Wl	
1.100										
40.0	Dense, grey fine to medium SAND	23	DO 0.0							M
43.0	Stiff grey SILT with some clay	24	DO							M
44.0	visible fine ice crystals	25	TO							H, U
44.8	End of Borehole	26	TO -1.7							σ = 19.6 kN/m ³



RECORD OF BOREHOLE BH 3

UTM GRID ZONE 8 WAD 72

SITE NAME: Koqyuk LOCATION CO-ORDS: N 7 780 798 E 566 596 DATUM: See floor
 BOREHOLE TYPE: Rotary DIAMETER: 10.16 cm BORING DATE: October 8, 1981 WATER DEPTH: 27.3 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE BLOWS PER 300mm Δ	WATER CONTENT				ADDITIONAL LAB TESTING	
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	W _L		
0												
3.0	Very loose to compact, grey, SAND and SILT with trace of clay Dense greyish brown, medium and fine SAND, with trace of silt in upper 3 m, some layering evident	1	TO	-0.8			20	40	60	80	M, H	
		2	DO			20	40	60	80		M	
		3	DO	1.6		20	40	60	80		M	
		4	DO	-0.4		20	40	60	80		M	
		5	DO	0.5		20	40	60	80		M	
		6	DO	0.6		20	40	60	80			

10.0

RECORD OF BOREHOLE BH 3

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 798 E 566 596 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16cm **BORING DATE:** October 8, 1981 **WATER DEPTH:** 27.3 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE Δ BLOWS PER 300mm	WATER CONTENT			ADDITIONAL LAB TESTING
		No	Type	in Situ	in Lab		Wp	W	Wl	
10.0	Dense greyish brown, medium and fine SAND	7	DO			50	20	40	80	M
15.0		8	DO	0.8		50	20	40	80	50 blows for 225 mm
20.0		9	DO	0.3		50	20	40	80	M 50 blows for 150 mm

RECORD OF BOREHOLE BH 3

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 798 E 566 596 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16 cm **BORING DATE:** October 8, 1981 **WATER DEPTH:** 27.3 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	
1.100										
20.0										
	25 mm seam of silt with organic inclusions	10	DO	0.9		45	20	45	65	
										M
	Dense greyish brown, medium and fine SAND	11	DO	1.1		45	20	45	65	
30.0		12	DO	0.6		45	20	45	65	

RECORD OF BOREHOLE BH 3

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 798 E 566 596 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16 cm **BORING DATE:** October 8, 1981 **WATER DEPTH:** 27.3 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE △ BLOWS PER 300 mm	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	in Situ	in Lab		Wp	W	Wl	
30.0	Dense greyish brown, medium and fine SAND.	13	DO	1.0		45	20	45	80	M
		14	DO	1.6		55	20	45	80	50 blows for 250 mm
		15	DO	0.2		45	20	45	80	M
40.0			16	DO	0.5		55	20	45	80

RECORD OF BOREHOLE BH 3
UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 798 E 566 596 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10-16cm **BORING DATE:** October 8, 1981 **WATER DEPTH:** 27.3 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPo		'N' VALUE Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	
40.0	Dense greyish brown medium and fine SAND	17	DO	0.6						
45.0	Stiff to very stiff, layered grey to black SILT and CLAY with some organics									
		18	TO	-0.8	V 171	F 97 L 72 P 120				
50.0	Hard grey ice bonded SILT, with trace to some clay, some ice lensing, with white residue along ice planes	19	TO	-1.7		F 120 L 83 P 132				H
		20	TO	-1.6		L 123				

RECORD OF BOREHOLE BH 3

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 798 E 566 596 **DATUM:** Sea floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16 cm **BORING DATE:** October 8, 1981 **WATER DEPTH:** 27.3 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPo		'N' VALUE BLOWS PER 300mm Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	
50.0	as above	21	TO	-2.0		L > 125 F > 250 P 180	20	40	80	
53.0	Hard grey ice bonded clayey SILT, with horizon- tal to steeply sloped ice lensing, up to 7 mm thick	22	TO	-1.7		L > 125 F > 250 P > 215	20	40	80	
60.0		23	TO	-1.7		L > 125 F > 250 P > 215	20	40	80	

RECORD OF BOREHOLE BH 3

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 780 798 E 566 596 DATUM: See floor
 BOREHOLE TYPE: Rotary DIAMETER: 10.16cm BORING DATE: October 8, 1981 WATER DEPTH: 27.3 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE Δ BLOWS PER 300mm	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	
1:100										
60.0	Hard grey ice bonded clayey SILT with horizontal to steeply sloped ice lensing	24	TO	-1.8		L > 125 F > 250 P > 215	30	45	65	H
65.8		25	TO	-1.9		L > 125	25	40	60	
70.0		Bedding at 30° to horizon- tal, with many thin organic layers @ 65.2 to 65.8 m Bedding at top of sample is twisted, occasional thin layers of sand	26	TO	-1.7			20	35	55

RECORD OF BOREHOLE BH 3

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 780 798 E 566 596 DATUM: See floor
 BOREHOLE TYPE: Rotary DIAMETER: 10.16cm BORING DATE: October 8, 1981 WATER DEPTH: 27.3 m

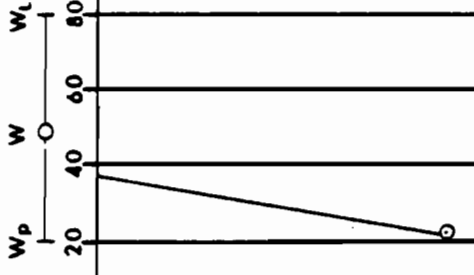
DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH		'N' VALUE BLOWS PER 300mm Δ	WATER CONTENT				ADDITIONAL LAB TESTING
		No.	Temp °C	in Situ	in lab		W _p	W	W _L		
70.0	Some fine sand lenses below 70 m, typically 12 mm thick	26					20	40	40	80	
72.5		Very hard ice bonded fine grey silty SAND, with occasional layers (12 mm typically) of clayey silt.	27	-1.5				20	40	40	80
80.0			28	-1.5				20	40	40	80

RECORD OF BOREHOLE BH 3

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 798 E 566 596 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16cm **BORING DATE:** October 8, 1981 **WATER DEPTH:** 27.3 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No. Type	Temp °C	in Situ	in Lab		W _p	W	W _L	
1.100										
80.0	Very hard ice bonded fine grey silty SAND, with occasional layers (12mm typically) of clayey silt									
83.7	End of Borehole	29	DO	-1.1						100 blows for 75 mm



RECORD OF BOREHOLE BH 4

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 630 E 566 497 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16 cm **BORING DATE:** September 8, 1981 **WATER DEPTH:** 27.7 m

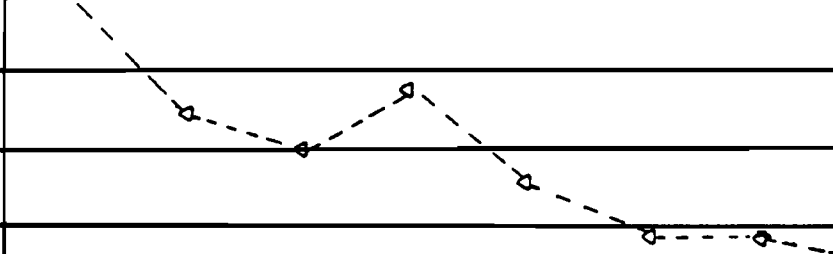
DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE BLOWS PER 300mm Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No. Type	Temp °C	in Situ	in Lab		W_p	W	W_L	
0	Very soft clayey SILT to silty CLAY									
1.2	Compact grey, silty, fine to medium SAND	1	TO							
2.0	Compact to dense brown medium and fine SAND, with a trace of silt	2	DO							M
		3	DO							M
6.4	Occasional thin layers of grey silty fine SAND	4	DO	0.6						M
		5	DO							M
10.0		6	DO	0.6						M

RECORD OF BOREHOLE BH 4

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk LOCATION CO-ORDS: N 7 780 630 E 566 497 DATUM: See floor
 BOREHOLE TYPE: Rotary DIAMETER: 10.16cm BORING DATE: September 8, 1981 WATER DEPTH: 27.7 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH		'N' VALUE BLOWS PER 300mm Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No. Type	Temp °C	in Situ	in Lab		Wp	W	Wl	
1.100										
20.0	Compact to dense brown medium and fine SAND, trace of silt	13	DO 0.6							N=102 M
		14	DO 0.6							M
		15	DO 0.0							M
		16	DO 1.1							M
		17	DO 1.1							IM
		18	DO 0.0							M
		19	DO 0.6							M
30.0										

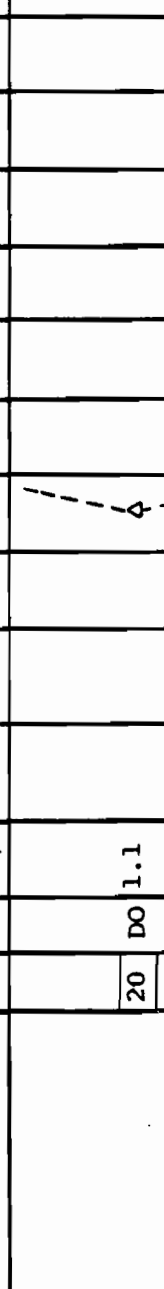


RECORD OF BOREHOLE BH 4

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 630 E 566 497 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16 cm **BORING DATE:** September 8, 1981 **WATER DEPTH:** 27.7 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE △ BLOWS PER 300 mm	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	in Situ	in Lab		Temp °C	W _p	W	
100										
30.0	Dense to very dense brown medium and fine SAND, trace of silt	20	DO	1.1		30				
35.0						45				M
40.0			22	DO	1.1		65			



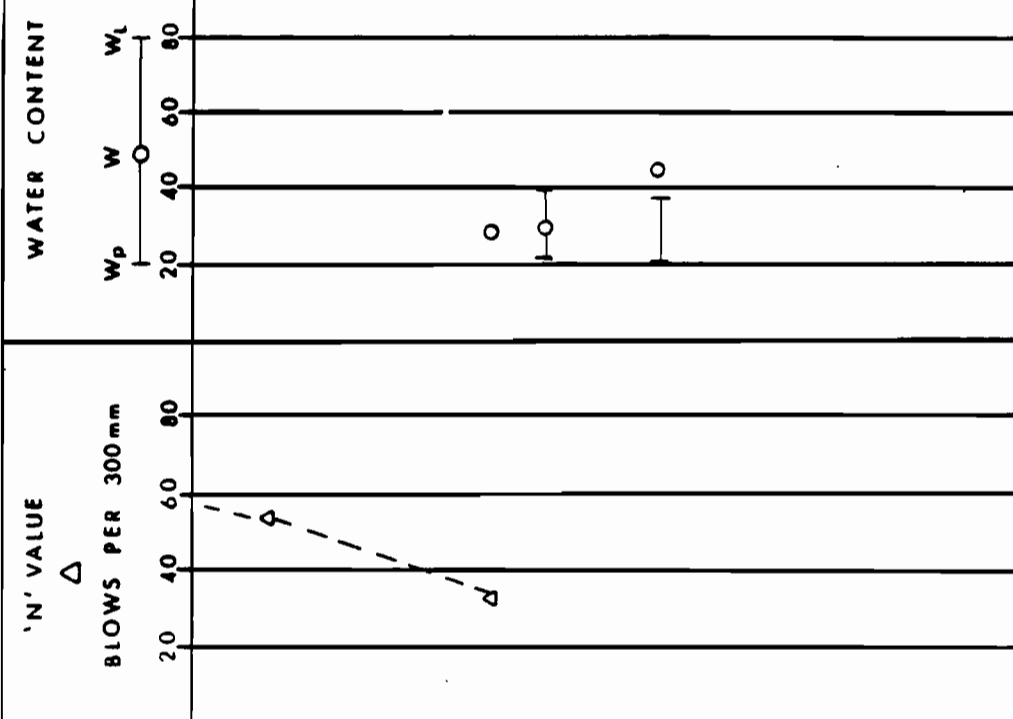
RECORD OF BOREHOLE BH 4

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 630 E 566 497 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16cm **BORING DATE:** September 8, 1981 **WATER DEPTH:** 27.7 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	
40.0	Dense to very dense brown medium and fine SAND, trace of silt	23	DO							
42.7		24	DO	0.6						
		25	TO	0.6	V>100					
45.1	Thin horizontal ice lenses	26	TO	0.0						
45.9	End of Borehole									

$R_c = 19.1 \text{ kN/m}^3$
 $U, U_c = 19.2 \text{ kN/m}^3$

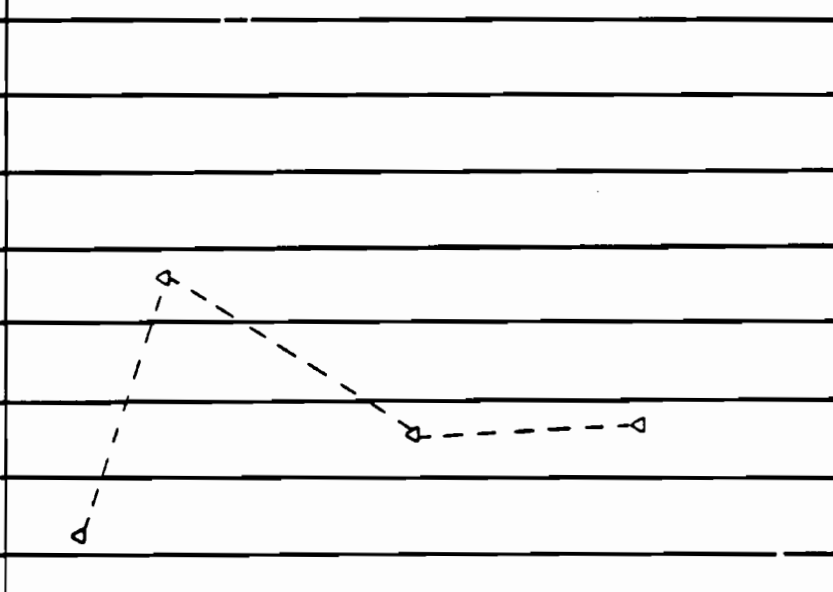


RECORD OF BOREHOLE BH 5

UTM GRID ZONE 8 WAD 72

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 799 , E 566 358 **DATUM:** See floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16cm **BORING DATE:** September 11, 1981 **WATER DEPTH:** 27.1 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPa		'N' VALUE BLOWS PER 300mm △	WATER CONTENT				ADDITIONAL LAB TESTING		
		No. Type	Temp °C	in Situ	in Lab		Wp	W	W _L	W _L			
1.100													
10.0	Compact to very dense brown medium and fine SAND	6	DO			25						M	
		7	DO 0			85							M
		8	DO 1.1			50							M
		9	DO 0.6			50							M
20.0													

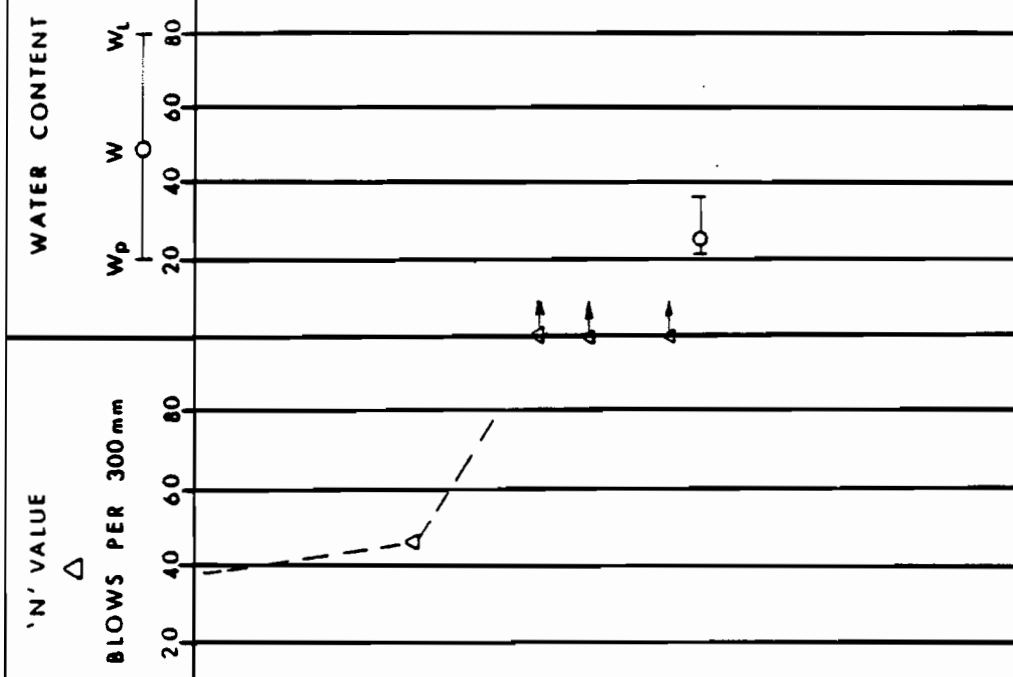


RECORD OF BOREHOLE BH 5

UTM GRID **ZONE 8 WAD 72**

SITE NAME: Kogyuk **LOCATION CO-ORDS:** N 7 780 799 E 566 358 **DATUM:** Sea floor
BOREHOLE TYPE: Rotary **DIAMETER:** 10.16cm **BORING DATE:** September 11, 1981 **WATER DEPTH:** 27.1 m

DEPTH (m)	SOIL DESCRIPTION	SAMPLE		SHEAR STRENGTH kPo		'N' VALUE BLOWS PER 300mm Δ	WATER CONTENT			ADDITIONAL LAB TESTING
		No.	Type	Temp °C	in Situ		in Lab	Wp	W	
1.100										
40.0	Compact to very dense brown medium and fine SAND									
41.4	Dense to very dense dark grey uniform fine SAND	17	DO							M
		18	DO	1.1						N > 100
		19	DO	1.1						M > 100
45.8	Very stiff light & dark grey mottled SILT	20	DO	1.1						M > 100
46.2	End of Borehole	21	TO	0.6						N > 100



APPENDIX VI

Laboratory Tests, Foundation Investigation

THE UNIVERSITY OF CHICAGO

KOGYUK BH1: LABORATORY TEST RESULTS

BOREHOLE TYPE: Rotary

DATUM: Sea Floor

Sample Number	Depth(m)		W _n %	W _L %	W _P %	Plasticity Index	Unit Weight (kN/m ³)	Grain Size Analysis
	From	To						
1	0.9	1.8	19.4	33	13	20		
2	2.4	3.1						
3	3.1	3.4						
4	4.6	5.0						
5	6.9	7.3						
6	8.4	8.8						
7	9.9	10.4						
8	11.4	11.9						
9	13.0	13.4						
10	14.5	14.9						
11	16.0	16.5						
12	17.5	18.0						
13	19.1	19.5						
14	20.6	21.0						
15	22.1	22.6						
16	23.6	24.1						
17	25.2	25.6						
18	26.7	27.1						
19	28.2	28.7						
20	29.7	30.2						
21	31.2	31.7						
22	34.3	34.8						
23	37.3	37.8						
24	39.9	40.4						
25	43.1	43.6	28.9	40	23	17		x
26	45.7	46.5	30.0	39	27	12	18.8	

GRAIN SIZE DISTRIBUTION

Table 1.0

BOREHOLE 1

BOREHOLE TYPE: Rotary

SITE NAME: Kogyuk

Depth		Sample No.	Gravel	Sand			Fines	Silt			Clay
From	To			C	M	F		C	M	F	
3.0	3.4	3	—	2	60	19	19				
4.6	5.0	4		4	66	24	6				
6.9	7.3	5		6	86	6	2				
8.4	8.8	6	2	7	85	5	1				
9.9	10.4	7		2	63	26	9				
13.0	13.4	9		4	85	10	1				
16.0	16.5	11		1	78	19	2				
19.1	19.5	13		1	84	14	1				
22.1	22.6	15		1	86	12	1				
25.1	25.6	17			77	21	2				
28.2	28.7	19			74	25	1				
31.2	31.7	21		1	90	9					
34.3	34.7	22		3	85	11	1				
37.3	37.8	23			76	22	2				
39.9	40.4	24		1	82	16	1				
43.1	43.6	25					100	4	32	29	35

Project no. 812-2102

KOGYUK BH2: LABORATORY TEST RESULTS

BOREHOLE TYPE: Rotary

DATUM: Sea Floor

Sample Number	Depth(m)		W _n %	W _L %	W _P %	Plasticity Index	Unit Weight (kN/m ³)	Grain Size Analyses
	From	To						
1	1.5	- 2.1	21.2					x
2	3.4	- 3.8						x
3	5.2	- 5.6						x
4	7.0	- 7.5						x
5	9.3	- 9.8						x
6A	11.0	- 11.4						x
6B	11.0	- 11.4						x
7	12.2	- 12.7						x
8	13.9	- 14.3						x
9	15.4	- 15.9						x
10	17.1	- 17.5						x
11	18.3	- 18.8						x
12	20.0	- 20.4						x
13	21.3	- 21.8						x
14	22.9	- 23.3						x
15	24.4	- 24.8						x
16	25.9	- 26.4						x
17	27.4	- 27.9						x
18	29.0	- 29.4						x
19	30.5	- 30.9						x
20	32.9	- 33.4						x
21	36.0	- 36.4						x
22	39.0	- 39.5						x
23	40.7	- 41.2						x
24	42.1	- 42.5						x
25	43.6	- 43.9						x
26	44.2	- 44.8	28.0	34	23	11	19.4	x

GRAIN SIZE DISTRIBUTION

Table: VI. 4

BOREHOLE 2

BOREHOLE TYPE: Rotary

SITE NAME: Kogyuk

Depth		Sample No.	Gravel	Sand			Fines	Silt			Clay
From	To			C	M	F		C	M	F	
1.5	2.1	1		6	48	8	38	1	2	7	28
3.4	3.8	2			66	24	10				
5.2	5.6	3		2	59	33	6				
7.0	7.5	4		1	91	6	2				
9.3	9.8	5		5	88	5	2				
11.0	11.4	6A	2	14	74	8	2				
11.0	11.4	6B		6	87	6	1				
12.2	12.6	7		3	82	13	2				
13.9	14.3	8		2	82	14	2				
15.4	52	9		2	80	15	3				
17.1	17.5	10		6	79	13	2				
18.3	18.7	11		4	85	9	2				
20.0	20.4	12		2	90	6	2				
21.3	21.8	13		1	19	73	7				
22.9	23.4	14			30	56	14				
24.4	24.9	15		2	78	18	2				
25.9	26.4	16		1	78	17	4				
27.4	27.9	17			75	21	4				
29.0	29.5	18		1	82	14	3				
30.5	30.9	19		1	85	11	3				
32.9	33.4	20		1	83	13	3				
36.0	36.5	21	1	4	85	8	2				
39.0	39.5	22		5	85	8	2				
40.7	41.2	23		1	81	15	3				
42.1	42.6	24		3	86	9	2				
44.2	44.8	26				2	98	10	50	18	20

PROJECT NO. 812-2102

KOGYUK BH3: LABORATORY TEST RESULTS

BOREHOLE TYPE: Rotary

DATUM: Sea Floor

Sample Number	Depth(m)		W _n %	W _L %	W _p %	Plasticity Index	Unit Weight (kN/m ³)	Grain Size Analyses
	From	To						
1	0.6	- 1.2	26.9					x
2	2.4	- 2.9						
3	3.7	- 4.1	20.4					x
4	5.2	- 5.6	21.0					x
5	6.7	- 7.2	21.0					x
6	8.2	- 8.7						
7	11.9	- 12.3	21.0					x
8	14.9	- 15.4						
9	18.0	- 18.4	21.3					x
10	21.0	- 21.5						
11	24.1	- 24.5	25.7					x
12	27.1	- 27.6						
13	30.2	- 30.6	23.7					x
14	33.2	- 33.7						
15	36.3	- 36.7	23.8					x
16	39.3	- 39.8						
17	42.4	- 42.8	30.9	39	26	13		
18	43.9	- 44.5	31.1	37	25	12		
19	45.1	- 45.7	29.0	60	28	32		x
20	48.2	- 48.8	28.1	36	25	11		
21	51.5	- 52.1	23.0	39	23	16		
22	54.6	- 55.2	21.6					
23	57.6	- 58.2	28.9	49	28	21		
24	60.7	- 61.3	27.6	50	29	21		x
25	65.2	- 65.7	28.3	46	23	23		
26	69.8	- 70.3	21.4					
27	74.4	- 74.8	31.8					
28	78.9	- 79.4	39.4					
29	83.5	- 83.7	22.9					

GRAIN SIZE DISTRIBUTION

Table: VI. 6

BOREHOLE 3

BOREHOLE TYPE: Rotary

SITE NAME: Kogyuk

Depth		Sample No.	Gravel	Sand			Fines	Silt			Clay
From	To			C	M	F		C	M	F	
0.6	1.2	1A	—	3	44	10	43				
0.6	1.2	1B		6	42	15	37	2	2	8	25
3.7	4.1	3		1	49	40	10				
5.2	5.6	4		1	37	47	15				
6.7	7.2	5		8	84	6	2				
11.9	12.3	7	1	11	83	5					
18.0	18.4	9		6	86	7	1				
24.1	24.5	11		9	78	11	2				
30.2	30.6	13		6	90	3	1				
36.3	36.7	15		10	84	5	1				
45.1	45.7	19					100	1	36	31	32
60.7	61.3	24				1	99	2	8	32	57

PROJECT NO. 812-2102

KOGYUK BH4: LABORATORY TEST RESULTS

BOREHOLE TYPE: Rotary

DATUM: Sea Floor

Sample Number	Depth(m)		W _n %	W _L %	W _p %	Plasticity Index	Unit Weight (kN/m ³)	Grain Size Analyses
	From	To						
1	1.5	- 2.1						
2	3.2	- 3.7						x
3	4.7	- 5.2						x
4	6.4	- 6.9						x
5	7.9	- 8.4						x
6	9.5	- 10.1						x
7	11.0	- 11.6						x
8	12.3	- 12.8						x
9	13.9	- 14.3						x
10	15.6	- 15.9						
11	16.9	- 17.4						x
12	18.4	- 18.9						x
13	20.1	- 20.6						x
14	21.5	- 22.0						x
15	22.4	- 23.5						x
16	24.5	- 25.0						x
17	26.1	- 26.5						x
18	27.6	- 28.0						x
19	29.1	- 29.6						
20	30.6	- 31.1						
21	33.7	- 34.1						x
22	36.7	- 37.2						x
23	39.9	- 40.4						
24	43.0	- 43.4	29.8					
25	43.6	- 44.2	35.3	39	22	17		
26	45.1	- 45.9	44.9	34	21	13	18.9,19.1	x

GRAIN SIZE DISTRIBUTION

Table VI. 8

BOREHOLE 4

BOREHOLE TYPE: Rotary

SITE NAME: Kogyuk

Depth		Sample No.	Gravel	Sand			Fines	Silt			Clay
From	To			C	M	F		C	M	F	
3.2	3.7	2	—	2	59	30	9				
4.7	5.2	3		2	63	29	6				
6.4	6.9	4		6	60	26	8				
7.9	8.4	5	1	6	86	5	2				
9.4	9.9	6		2	69	20	9				
11.0	11.5	7		10	74	12	4				
12.3	12.8	8		7	84	7	2				
13.9	14.4	9		17	75	7	1				
16.9	17.4	11		2	69	26	3				
18.4	18.9	12		1	69	26	3				
20.1	20.6	13		3	83	13	1				
21.5	21.9	14		1	71	24	4				
22.4	23.5	15		1	49	47	3				
24.5	25.0	16		2	87	8	3				
26.1	26.5	17		1	75	18	6				
27.6	28.0	18		3	74	18	5				
33.7	34.1	21		2	88	8	2				
36.7	37.2	22		6	84	8	2				
45.1	45.9	26				1	99	9	45	22	23

PROJECT NO. 812-2102

KOGYUK BH5: LABORATORY TEST RESULTS

BOREHOLE TYPE: Rotary

DATUM: Sea Floor

Sample Number	Depth(m)		W _n %	W _L %	W _p %	Plasticity Index	Unit Weight (kN/m ³)	Grain Size Analyses
	From	To						
1	1.2	- 1.5	15.1					x
2	2.3	- 2.7						x
3	5.3	- 5.8						x
4	6.7	- 7.2						x
5	8.2	- 8.7						x
6	9.9	- 10.4						x
7	11.3	- 11.7						x
8	14.3	- 14.8						x
9	17.4	- 17.8						x
10	20.4	- 20.9						x
11	23.5	- 23.9						x
12	26.5	- 27.0						x
13	29.6	- 30.2						x
14	32.6	- 33.1						x
15	35.7	- 36.1						x
16	38.9	- 39.3						x
17	41.9	- 42.4						x
18	43.4	- 43.8						x
19	44.4	- 44.7						x
20	45.3	- 45.6						x
21	45.7	- 46.2	24.2	36	22	14		

GRAIN SIZE DISTRIBUTION

Table VI. 10

BOREHOLE 5

BOREHOLE TYPE: Rotary

SITE NAME: Kogyuk

Depth		Sample No.	Gravel	Sand			Fines	Silt			Clay
From	To			C	M	F		C	M	F	
1.2	1.5	1	—	4	72	6	18				
2.3	2.7	2		9	81	8	2				
5.3	5.8	3		2	58	34	6				
6.7	7.2	4		2	56	36	6				
8.2	8.7	5		5	67	24	4				
9.9	10.4	6		3	74	14	19				
11.3	11.7	7			67	30	3				
14.3	14.8	8		2	86	9	3				
17.4	17.8	9		3	88	7	2				
20.4	20.9	10		2	83	12	3				
23.5	23.9	11		4	82	12	2				
26.5	27.0	12		3	71	20	6				
29.6	30.2	13		2	74	18	6				
32.6	33.1	14		3	81	13	3				
35.7	36.1	15		8	84	7	1				
38.9	39.3	16		3	84	12	1				
41.9	42.4	17		1	85	13	1				
43.4	43.8	18			54	43	3				
44.3	44.7	19		1	61	35	3				
45.3	45.6	20			30	67	3				

PROJECT NO. 812-2102



UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

Figure VI. 1

Site. Kogyuk

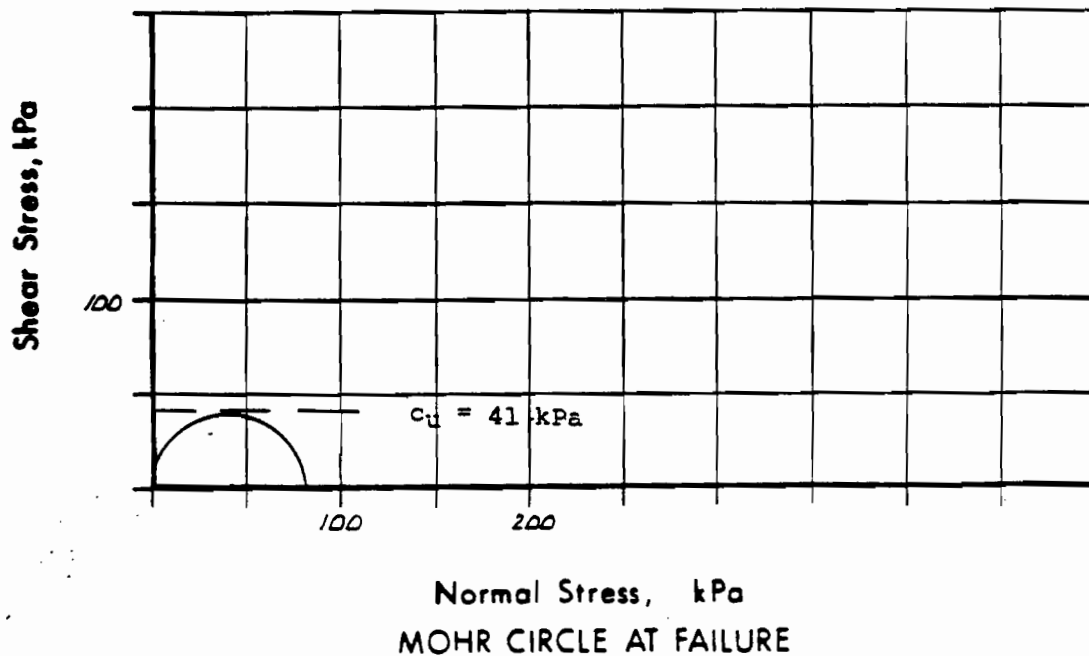
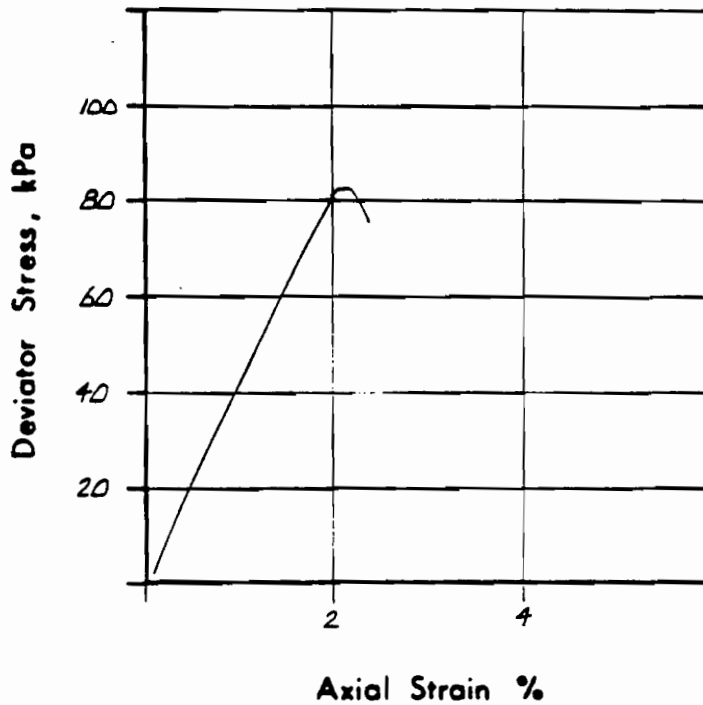
Borehole No. 2

Sample No. 26

Depth 44.3 - 44.5

Partially frozen sample at Start of test.

SUMMARY	
Cell Pressure kPa	Unconfined
Rate of Strain % per hour	4.2
Deviator stress at failure: kPa	82
% Strain at failure	2.2





CONSOLIDATED UNDRAINED TRIAXIAL TEST

Figure VI. 2

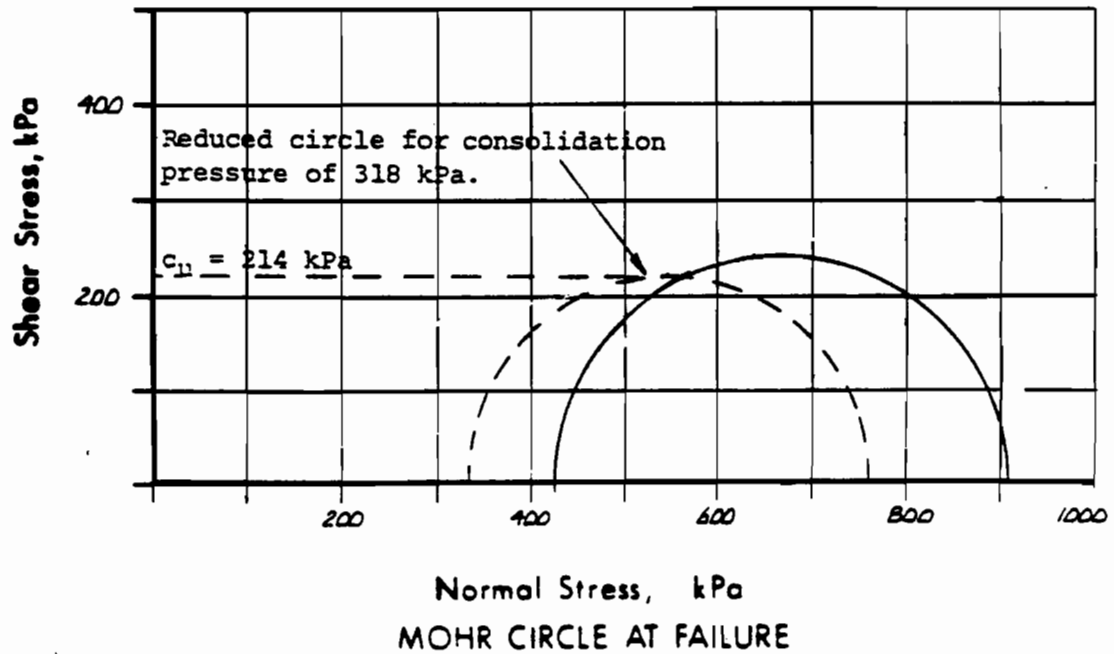
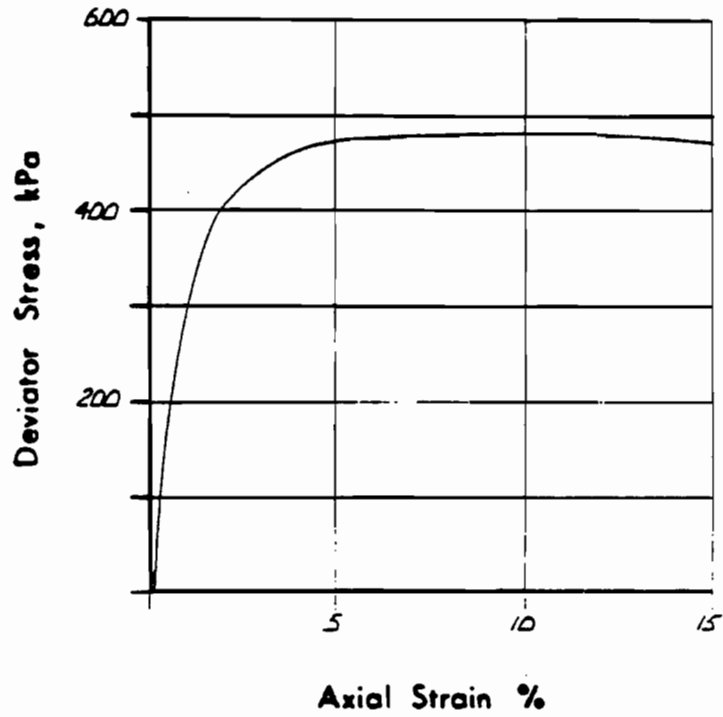
Site. Kogyuk

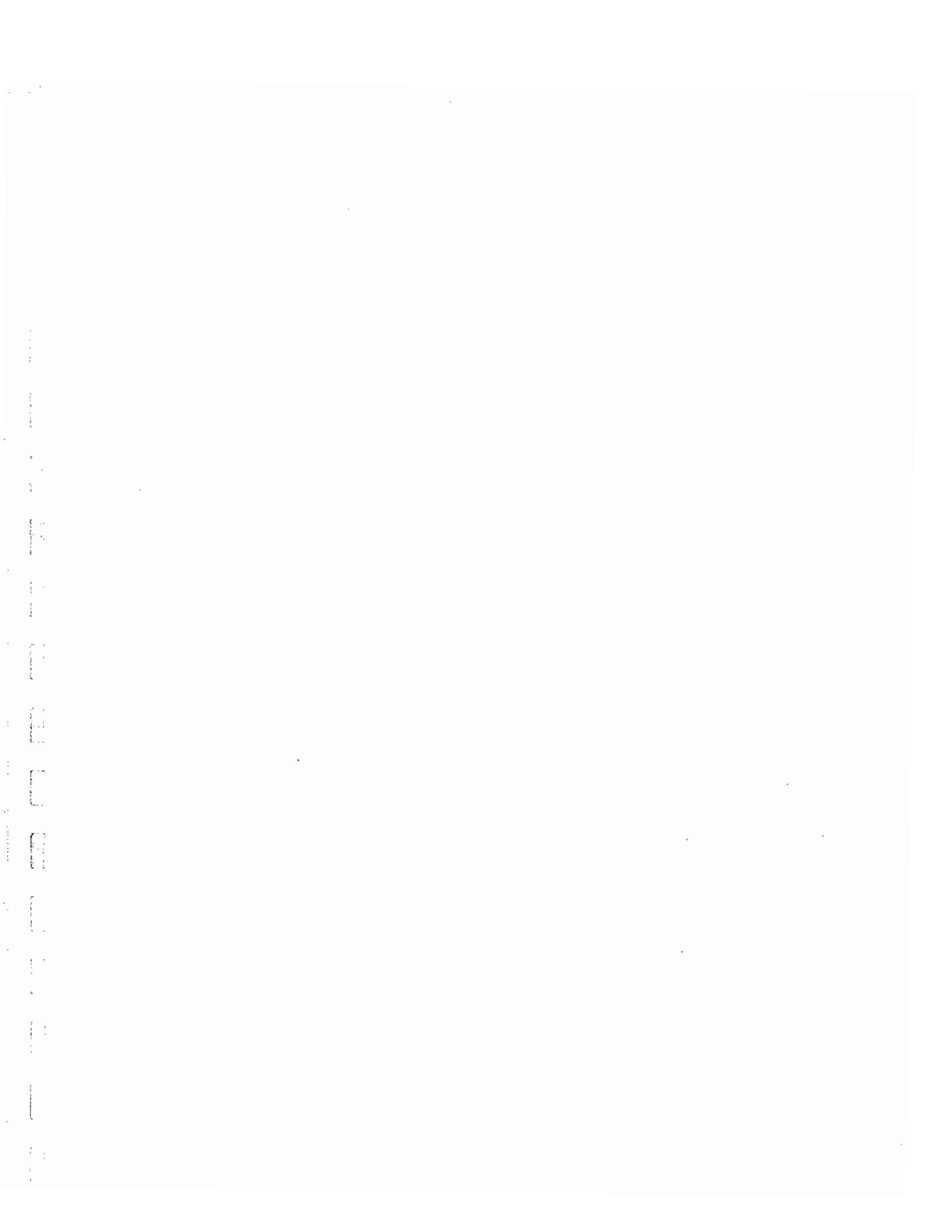
Borehole No. 4

Sample No. 25

Depth 43.6 - 44.2 m

Test No.	1
Cell Pressure kPa	690
Back Pressure kPa	262
Rate of Strain % per hour	3.8
Deviator Stress at failure: kPa	486
% Strain at failure	10.1
Pore Pressure at failure: kPa	-







UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

Figure. VI. 3

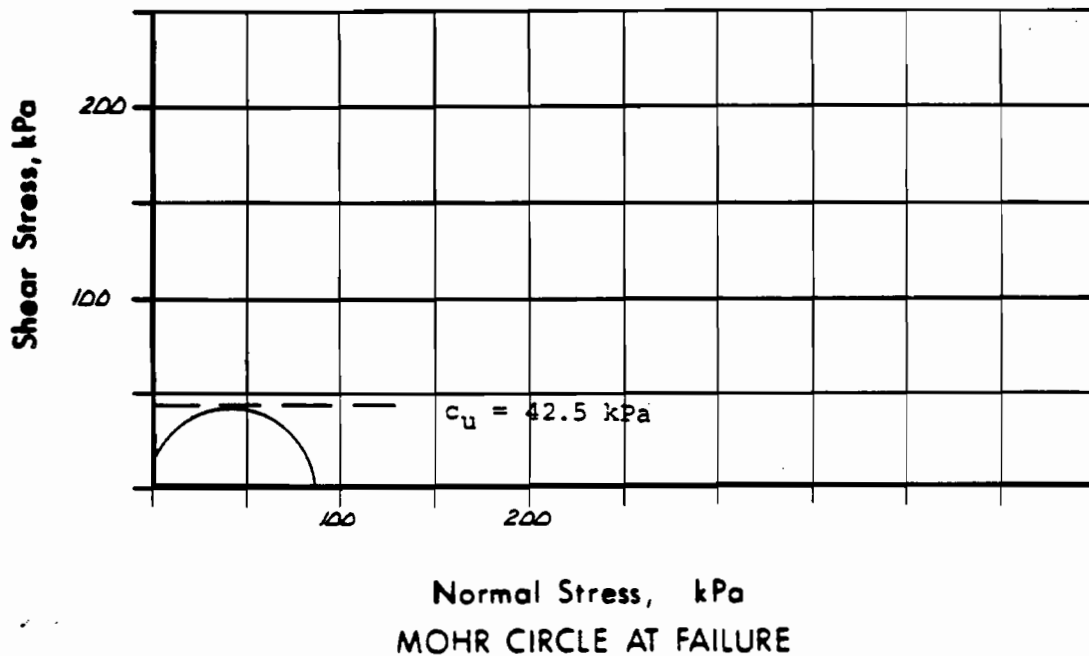
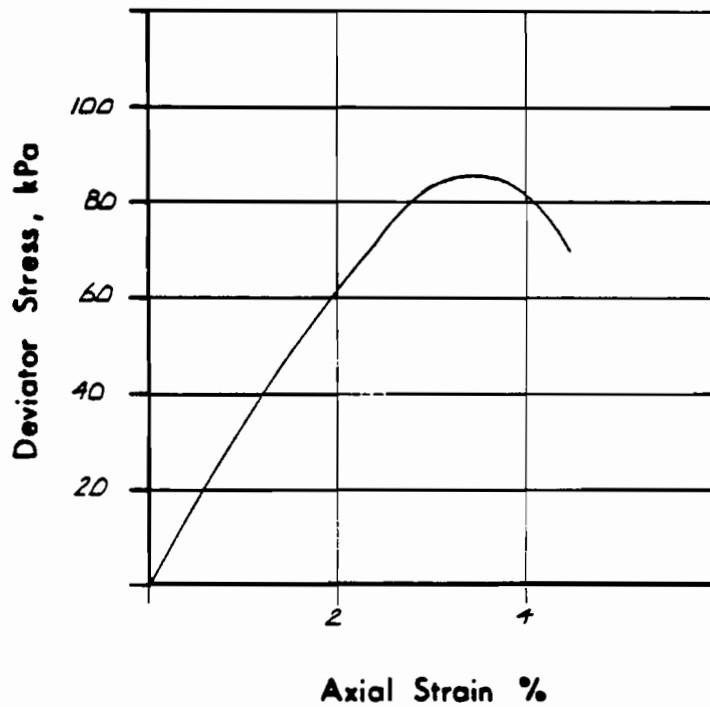
Site. Kogyuk

Borehole No. 4

Sample No. 26

Depth 45.1 - 45.9 m

SUMMARY	
Cell Pressure kPa	Unconfined
Rate of Strain % per hour	3.7
Deviator stress at failure: kPa	85
% Strain at failure	3.6

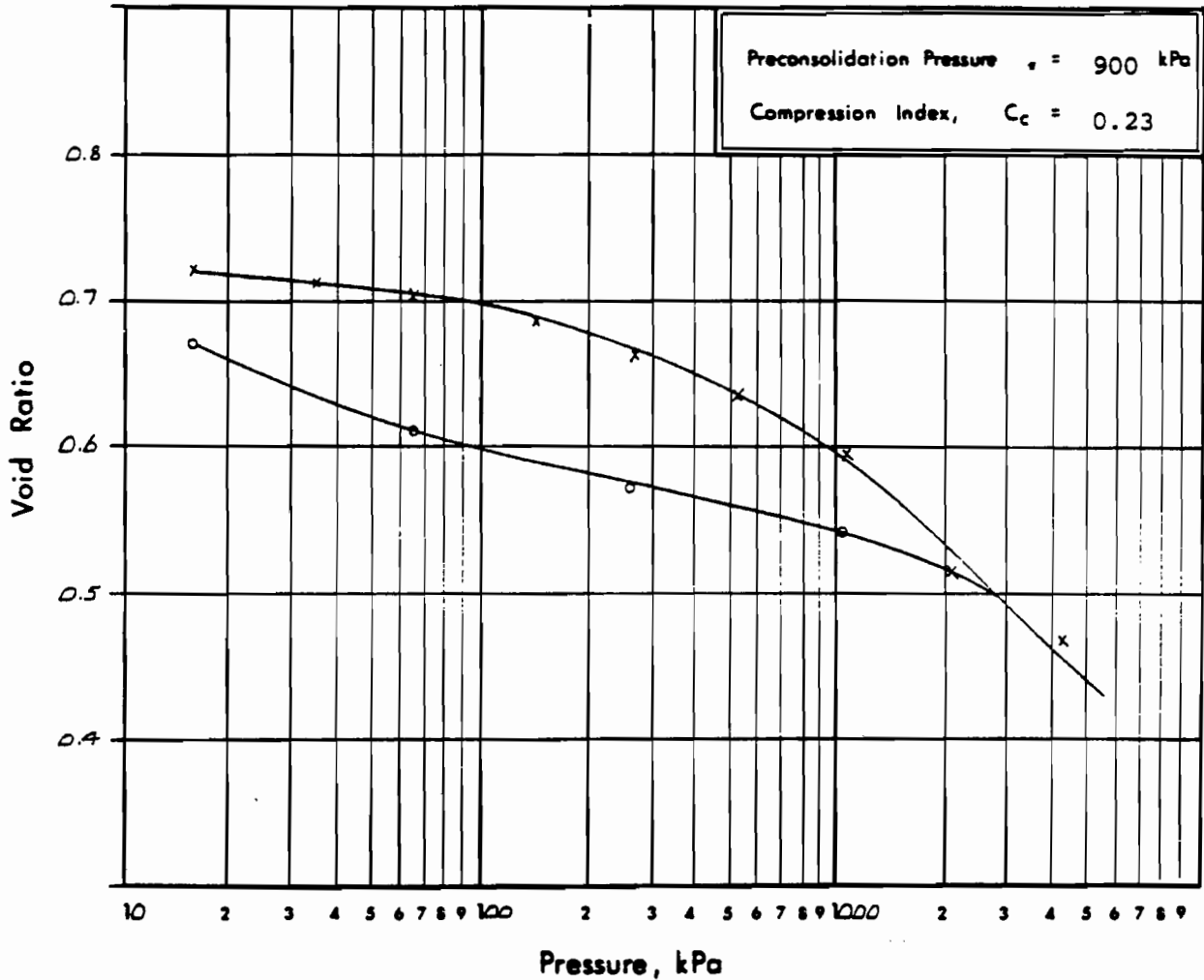




CONSOLIDATION TEST

Figure. VI. 4

Site. Kogyuk Borehole No. 1
Sample No. 26 Depth. 45.7 - 46.5 m



PRESSURE kPa	VOID RATIO	m_v kPa^{-1}	c_v cm^2/sec	k cm/sec
8.3	0.751	1.0×10^{-3}	1.1×10^{-2}	8.0×10^{-7}
16.6	0.721	2.0×10^{-3}	1.9×10^{-2}	3.8×10^{-6}
34.2	0.711	3.48×10^{-4}	1.6×10^{-2}	5.3×10^{-7}
66.6	0.701	1.84×10^{-4}	9.6×10^{-3}	1.7×10^{-7}
133.2	0.685	1.35×10^{-4}	6.9×10^{-3}	9.1×10^{-8}
266.4	0.664	9.34×10^{-5}	1.5×10^{-2}	1.4×10^{-7}
532.9	0.638	5.92×10^{-5}	1.2×10^{-2}	6.7×10^{-8}
1065.7	0.596	4.87×10^{-5}	8.4×10^{-3}	4.0×10^{-8}
2131.5	0.514	4.82×10^{-5}	7.1×10^{-3}	3.4×10^{-8}
4263.0	0.471	1.32×10^{-5}	1.6×10^{-3}	2.0×10^{-9}

