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THE QUATERNARY SEDIMENTS OF THE SHETLAND PLATFORM AND ADJACENT CONTINENTAL SHELF MARGIN.

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Submitted for the degree of Ph D.

University of Keele.

1987.

VOLUME .2. DIAGRAMS AND APPENDICES.

BOREHOLE SUMMARY LOG: KEY.

LITHOLOGY


CLAY


BIOCLASTICS


SAND


LAMINATION


CLASTICS –
Varying sizes


BEDROCK

UNIT NUMBER


UNIT X


UNIT 3


UNIT -1


UNIT 4


UNIT 0


UNIT 5


UNIT 1

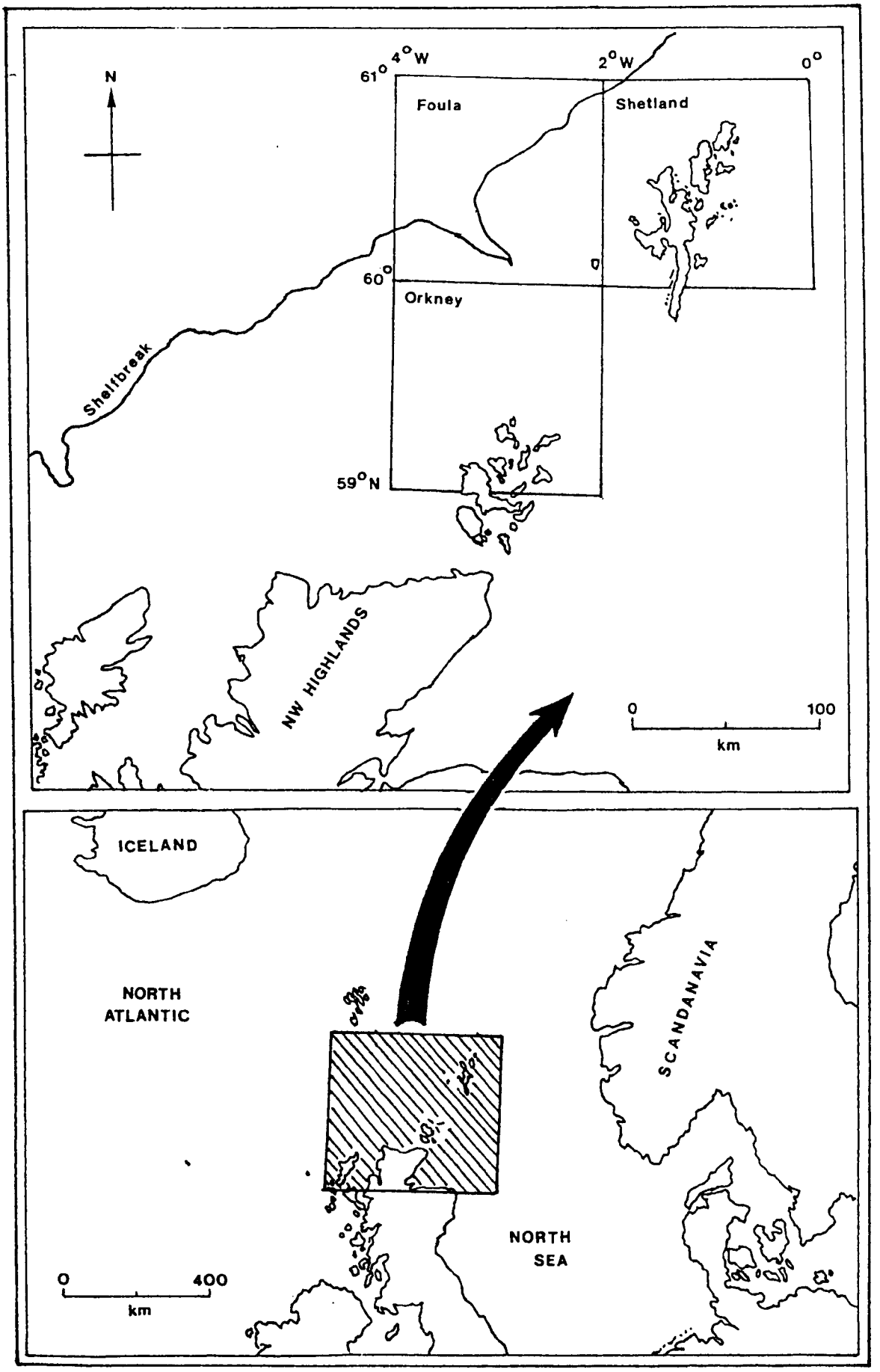


UNIT T

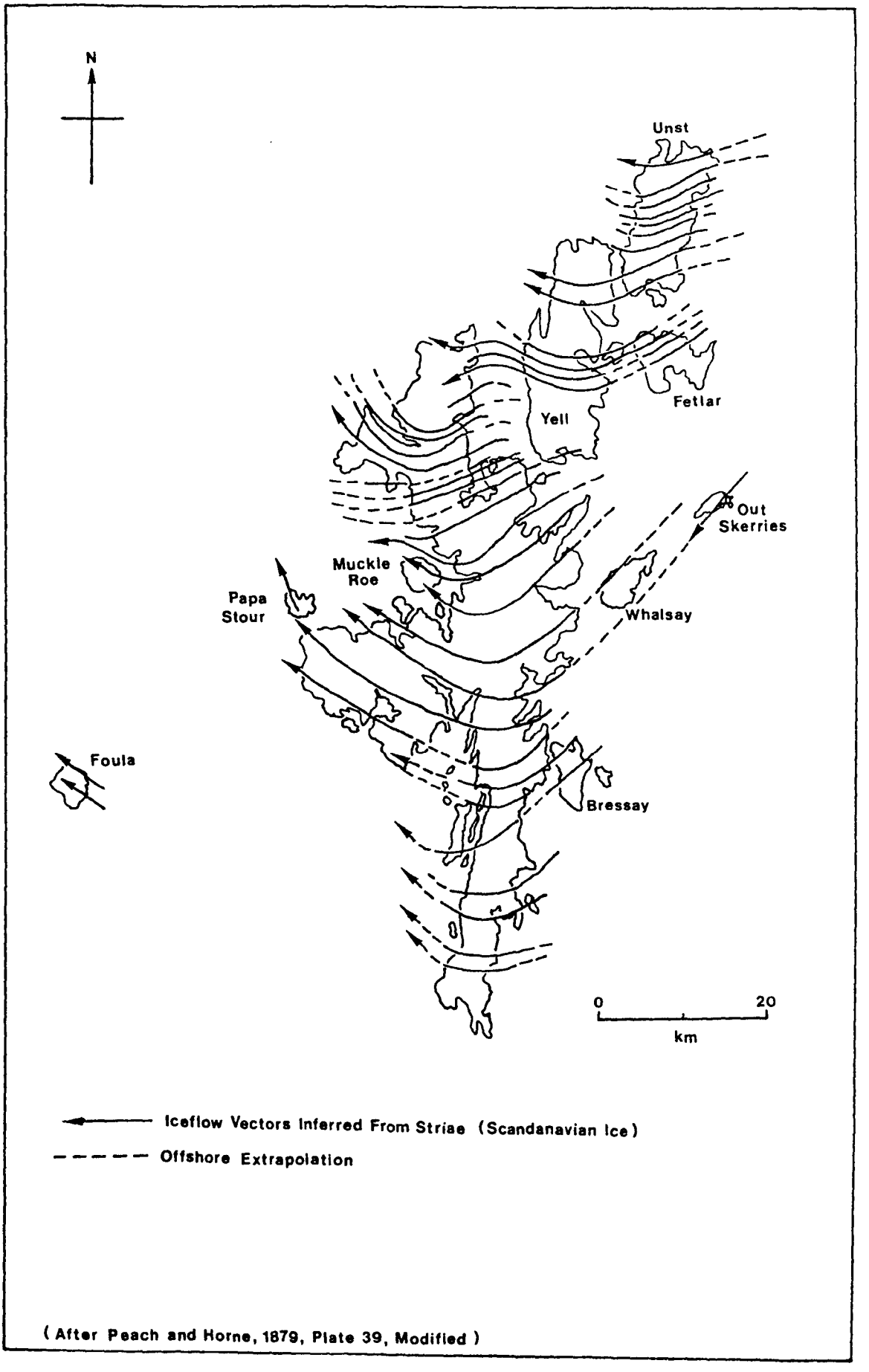

UNIT 2


ROCKHEAD

P.1. PRESENT STUDY AREA.

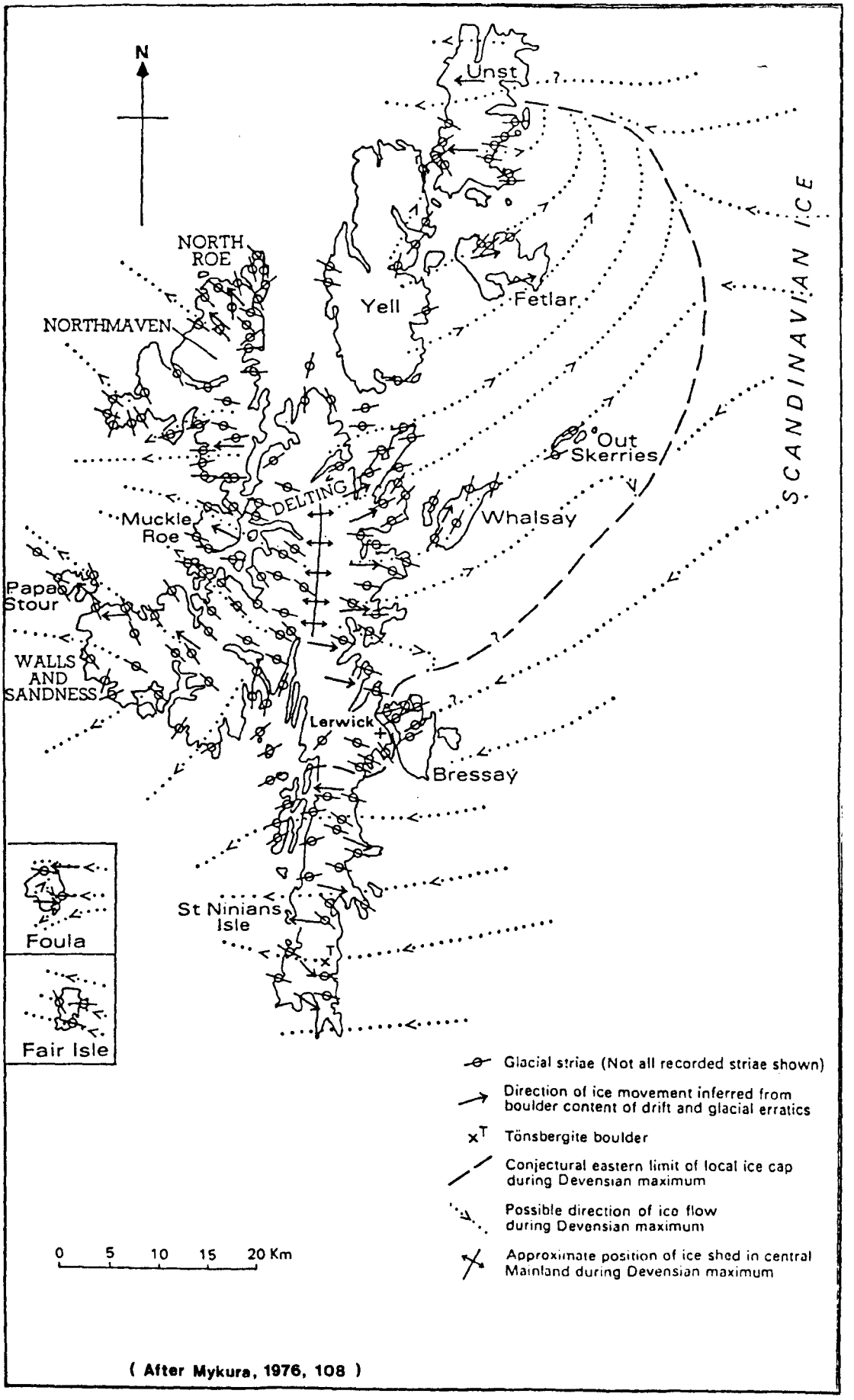


1.1.1. PEACH AND HORNE'S MAIN GLACIATION.



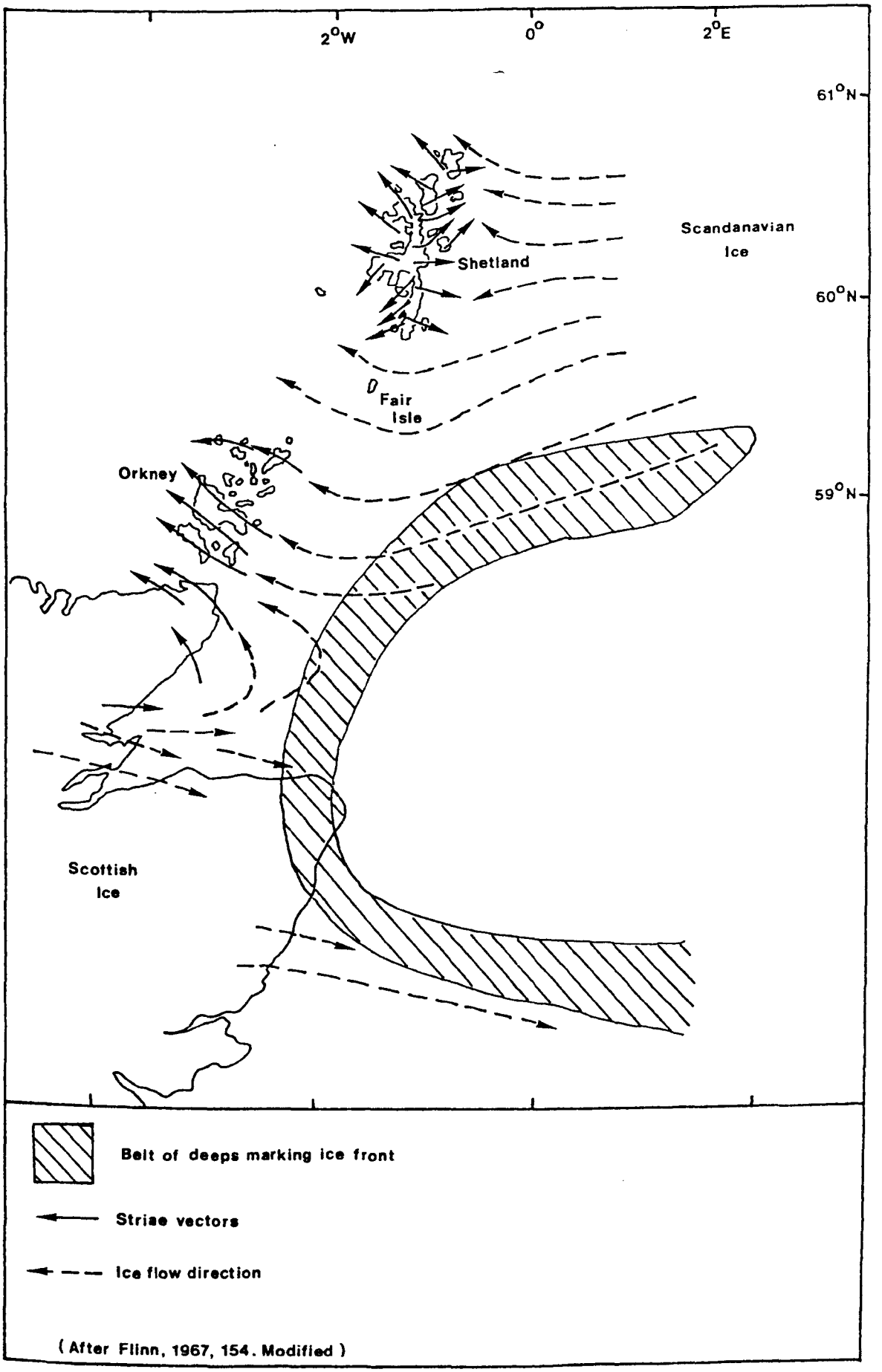
(After Peach and Horne, 1879, Plate 39, Modified)

1.1.2. MYKURA'S RECONSTRUCTION.



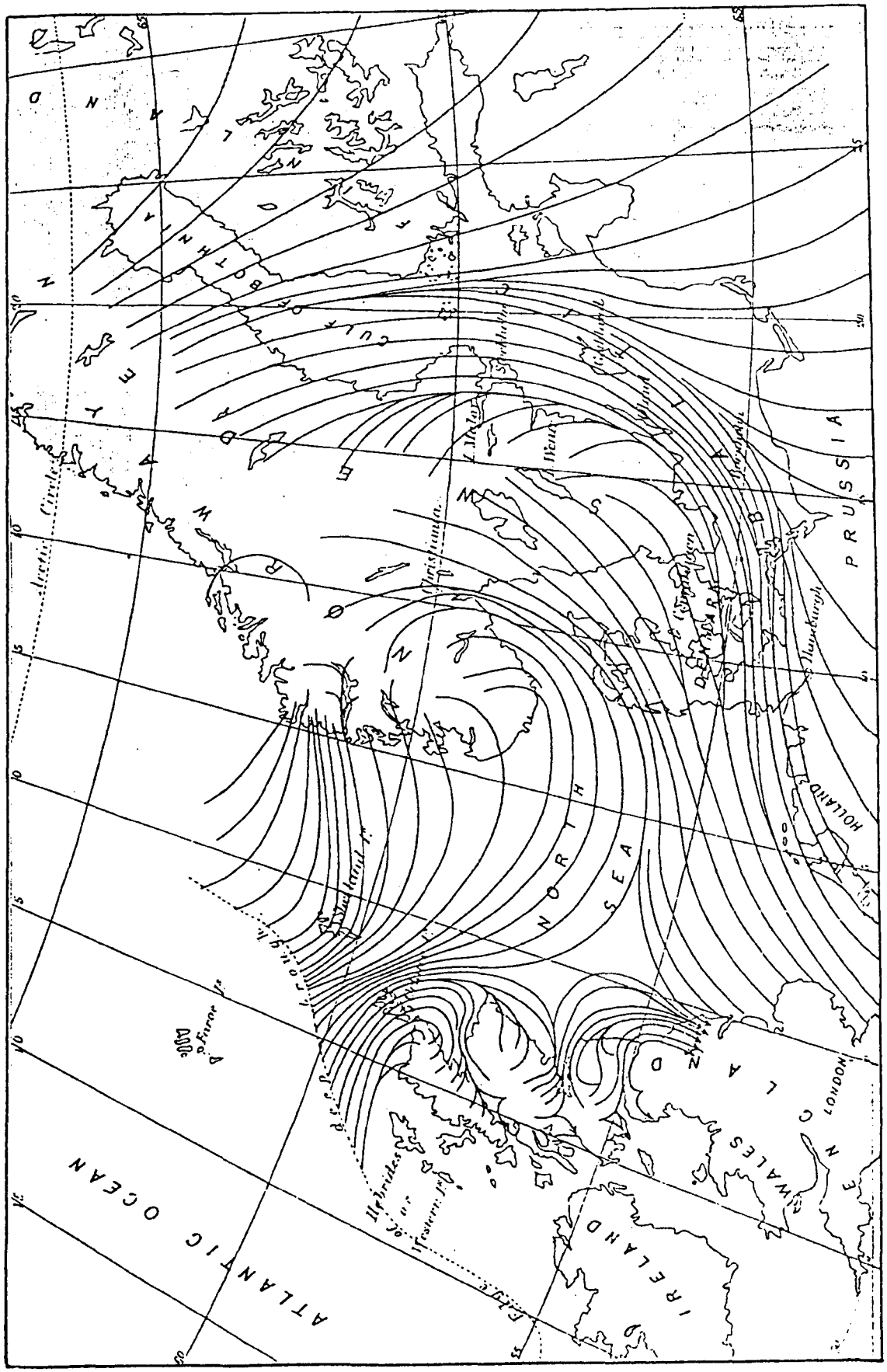
(After Mykura, 1976, 108)

1.1.3. FLINN'S ICE SHEET RECONSTRUCTIONS.



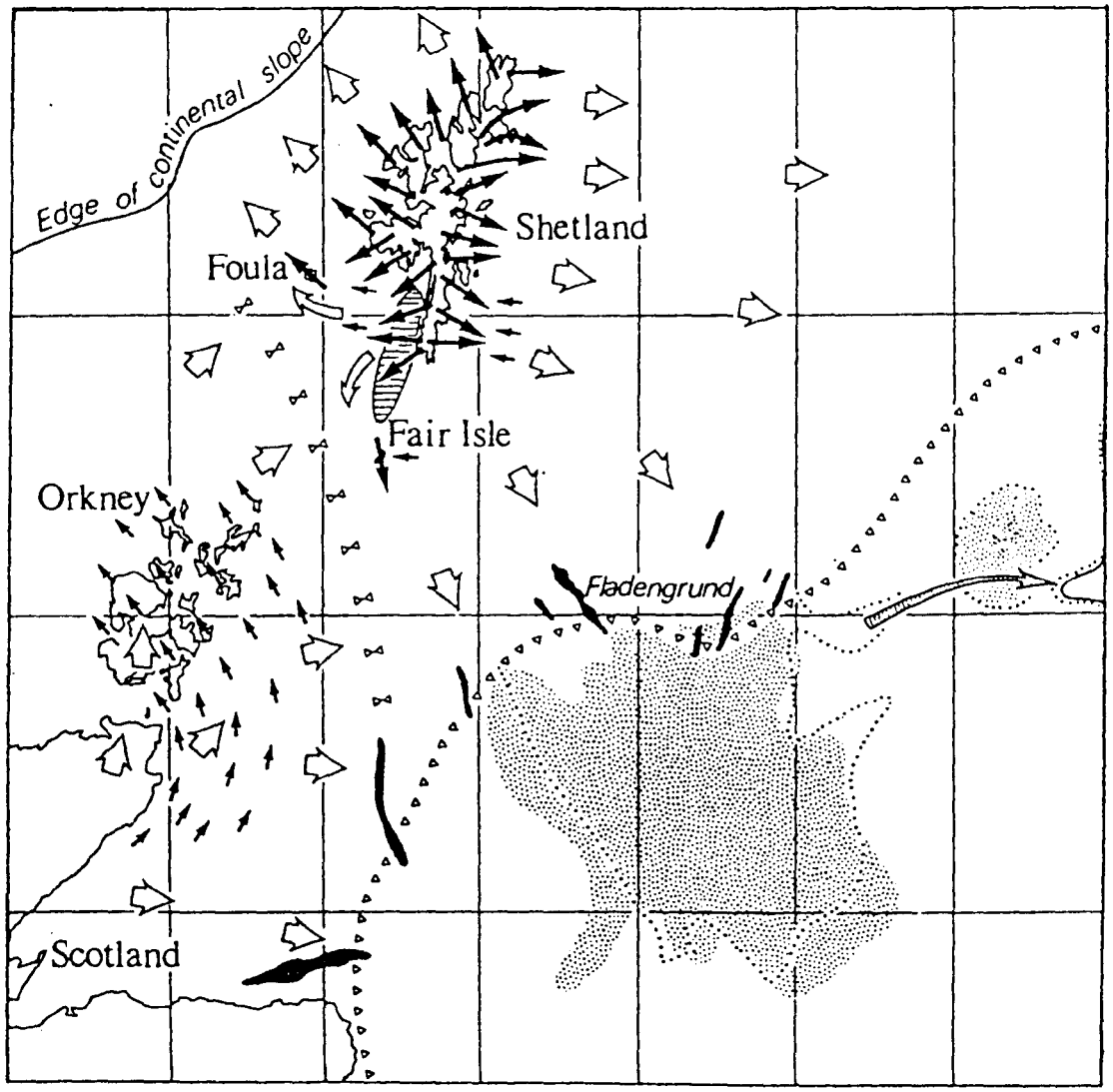
(After Flinn, 1967, 154. Modified)

1.1.4. PEACH AND HORNE'S ICE SHEET FLOW VECTORS.



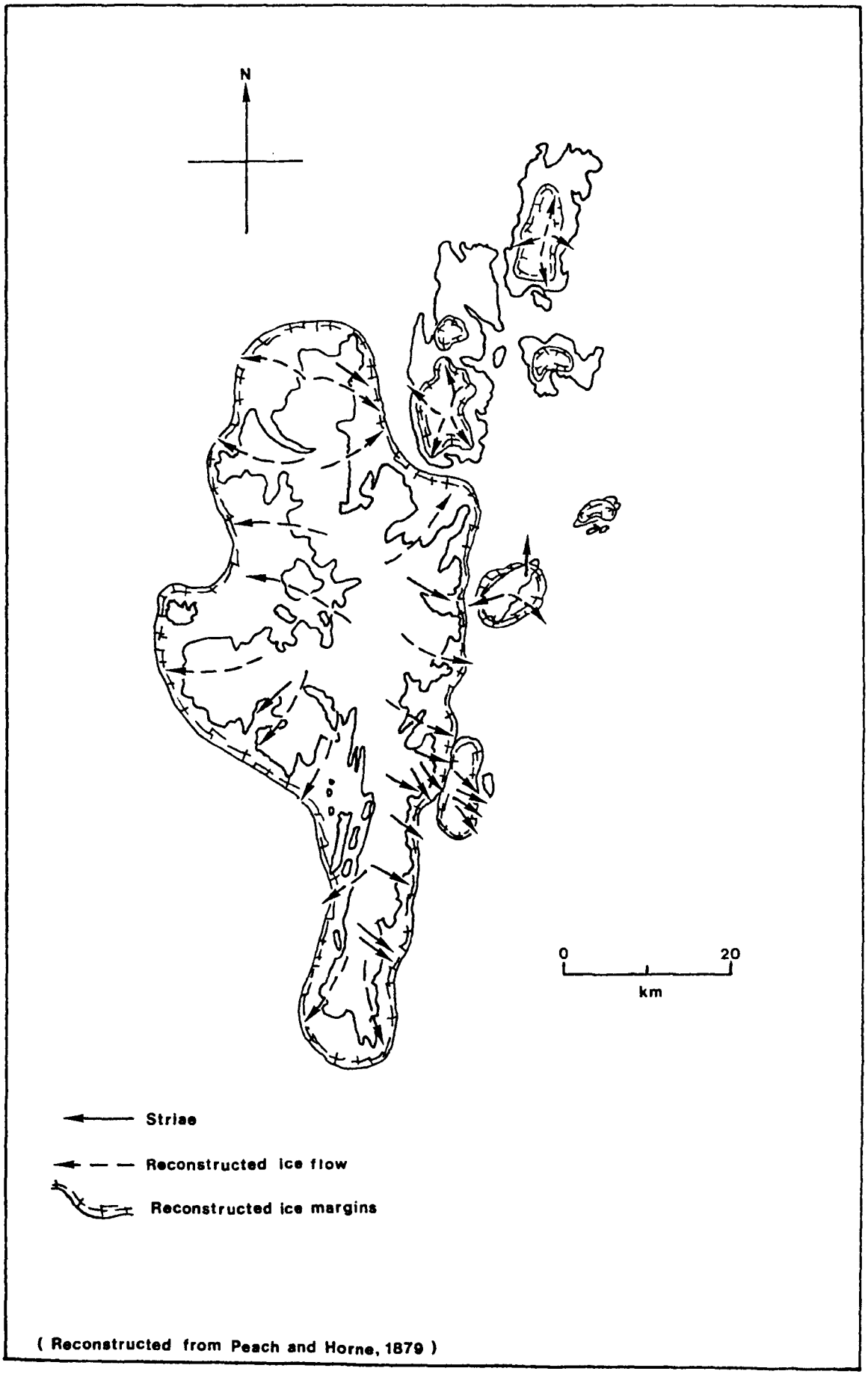
(After Peach and Horne, 1880, Plate 27)

1.1.5. FLINN'S LATER ICE MASS RECONSTRUCTIONS.



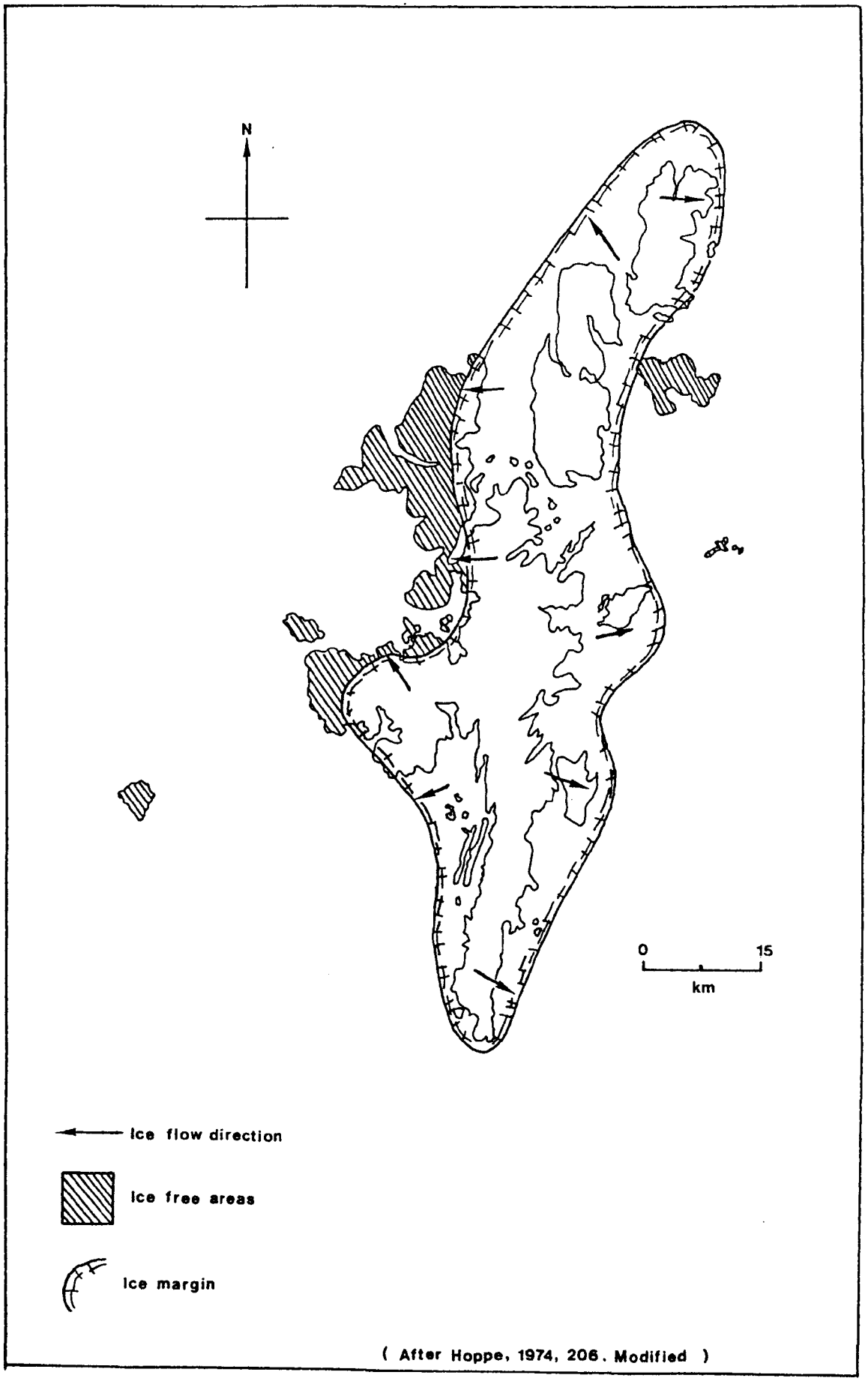
(After Flinn, 1978, fig.5.)

1.1.6. RECONSTRUCTION OF PEACH AND HORNE'S LATER GLACIATION.



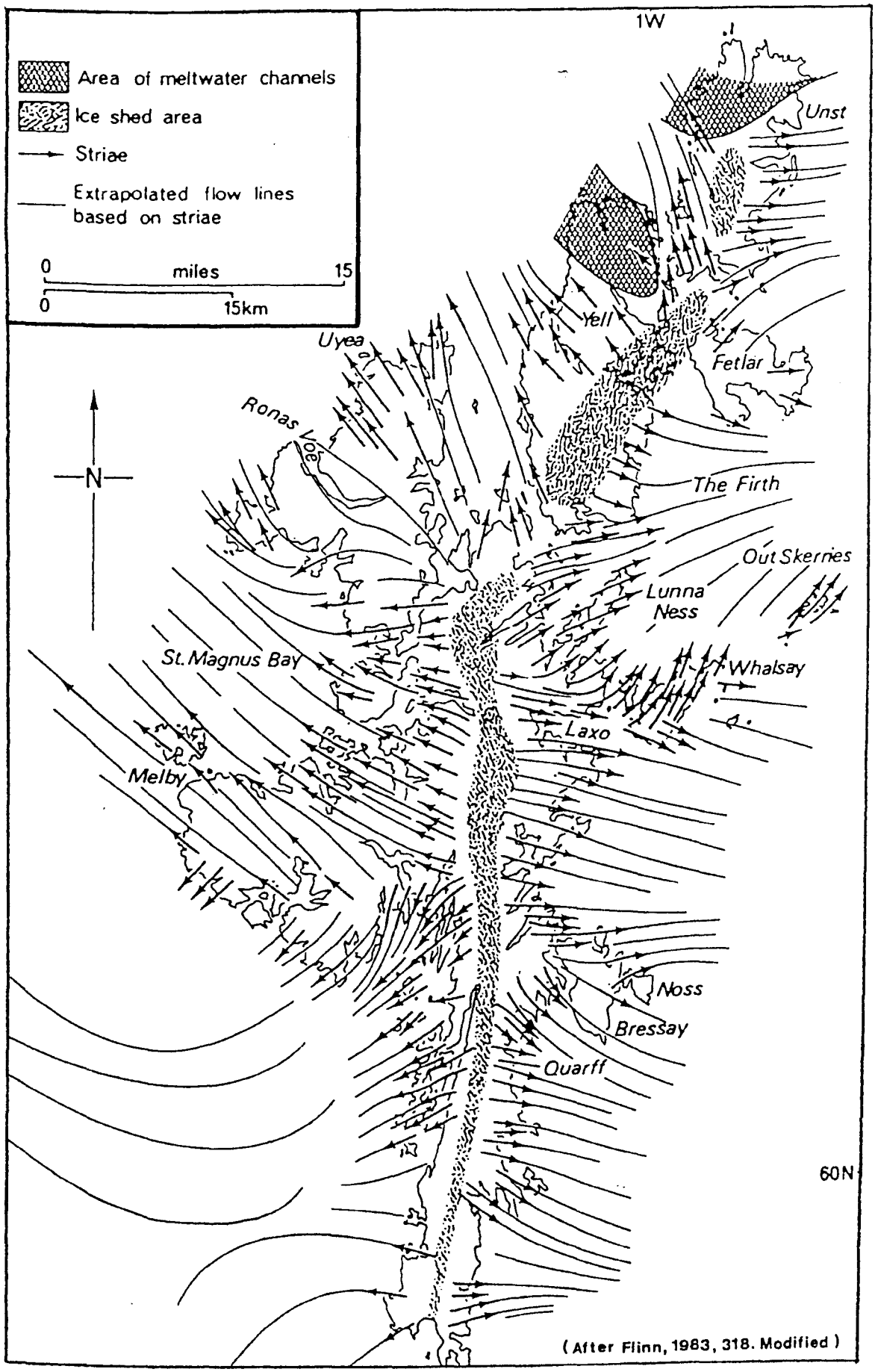
(Reconstructed from Peach and Horne, 1879)

1.1.7. HOPPE'S LOCAL ICE CAP.

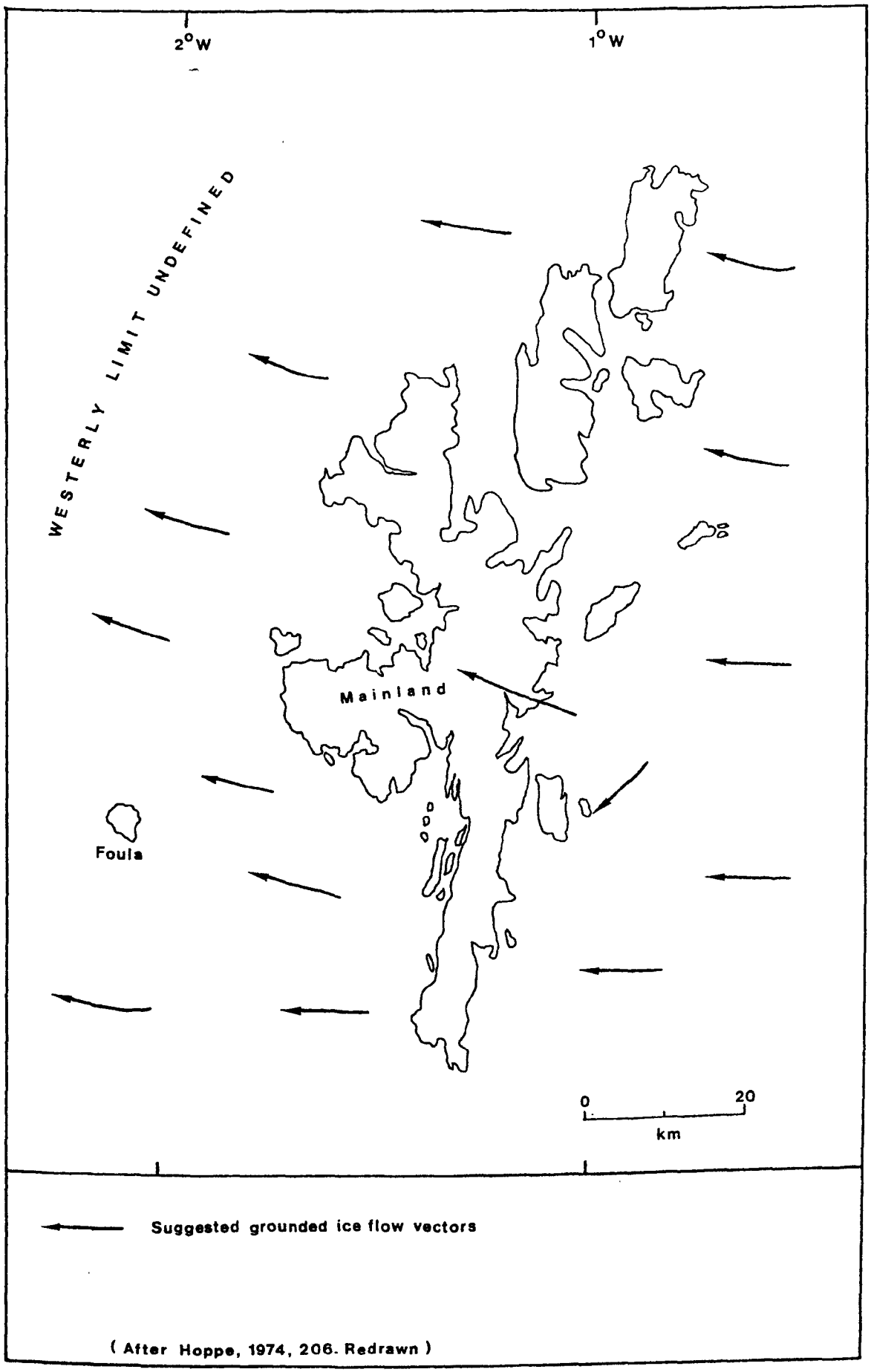


(After Hoppe, 1974, 206. Modified)

1.1.8. FLINN'S SHETLAND ICE CAP.

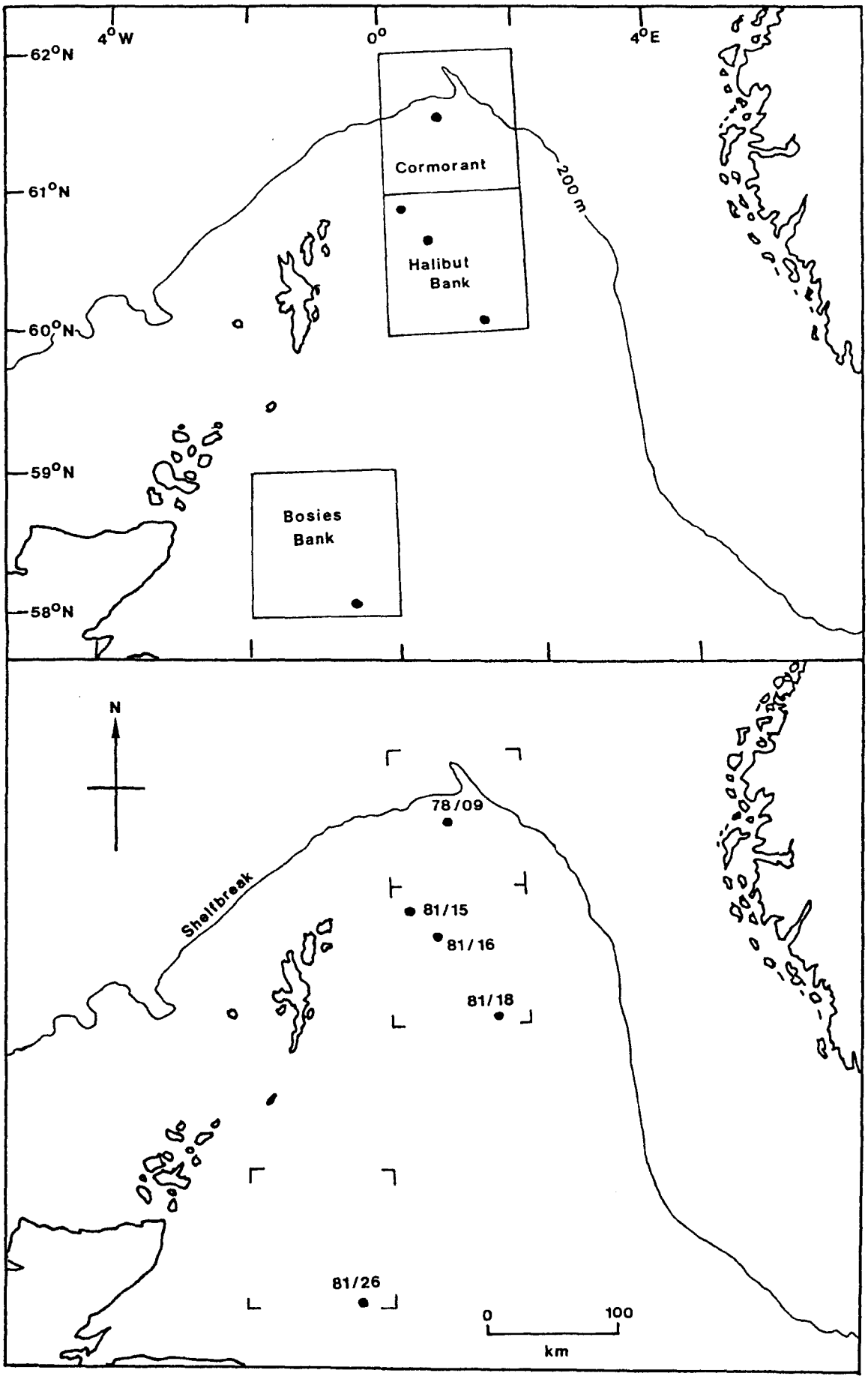


1.1.9. HOPPE'S SCANDANAVIAN ICE FLOW.



(After Hoppe, 1974, 206. Redrawn)

1.4.1. NORTH SEA BOREHOLE SITES.



2.1.1. BOREHOLE LOCATIONS.

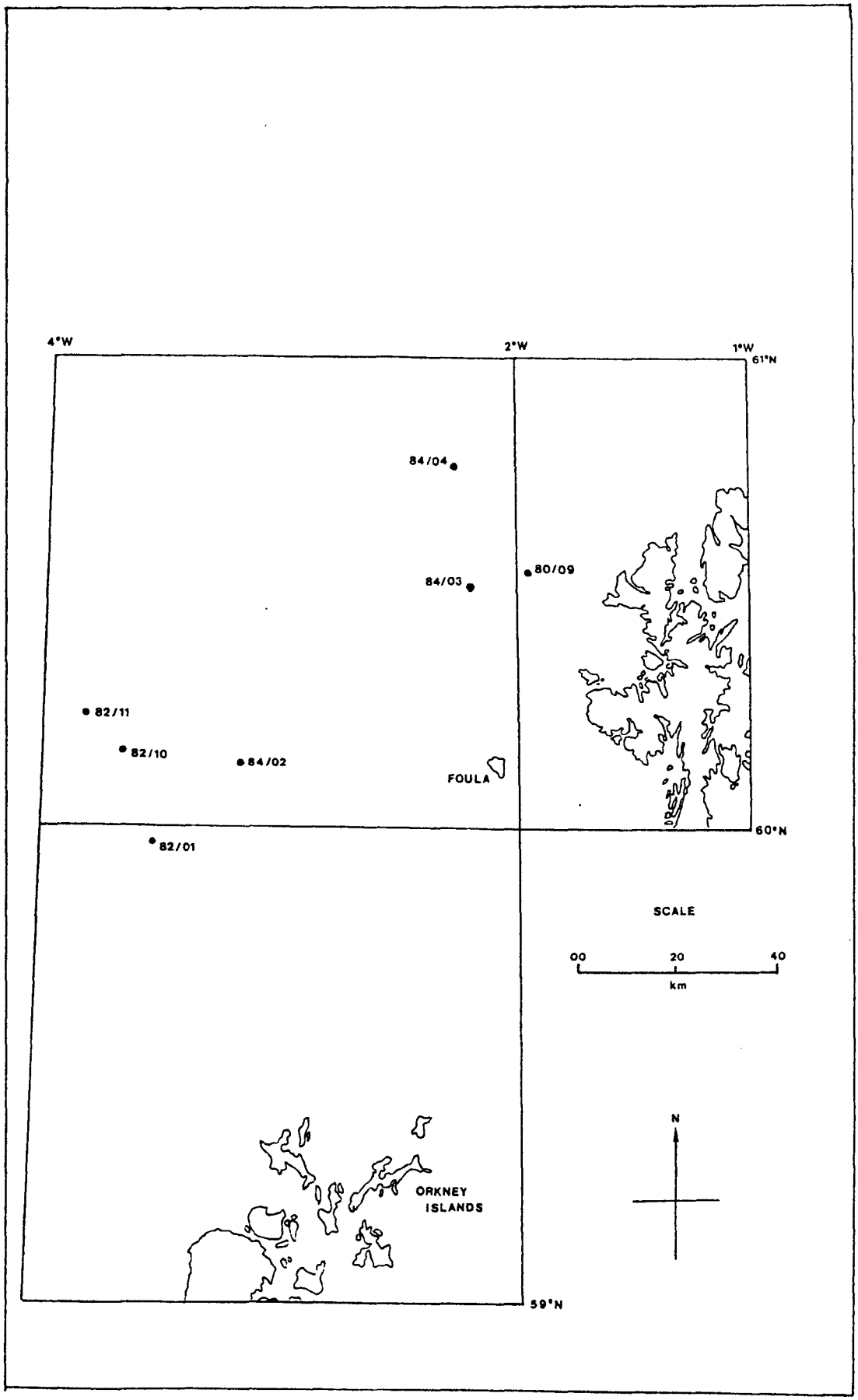
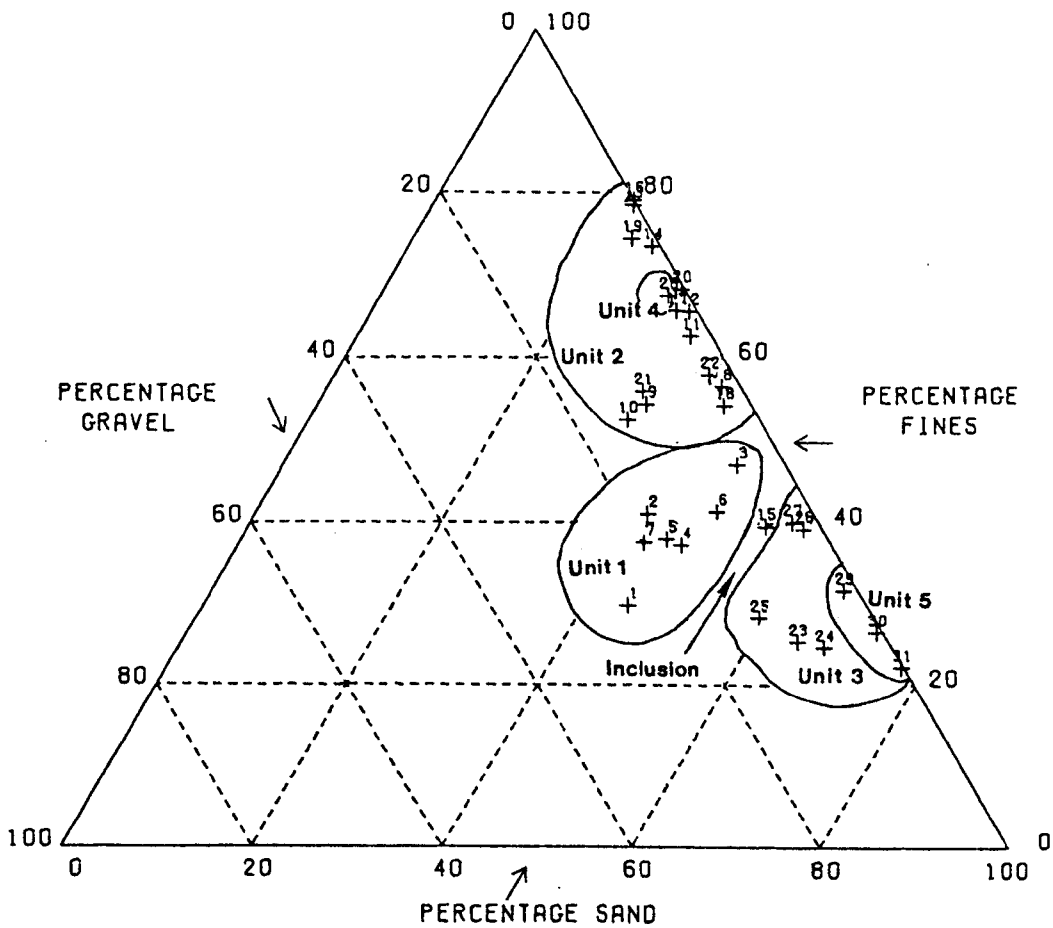


FIG 2.2.1. TOTAL COMPOSITION PLOT.

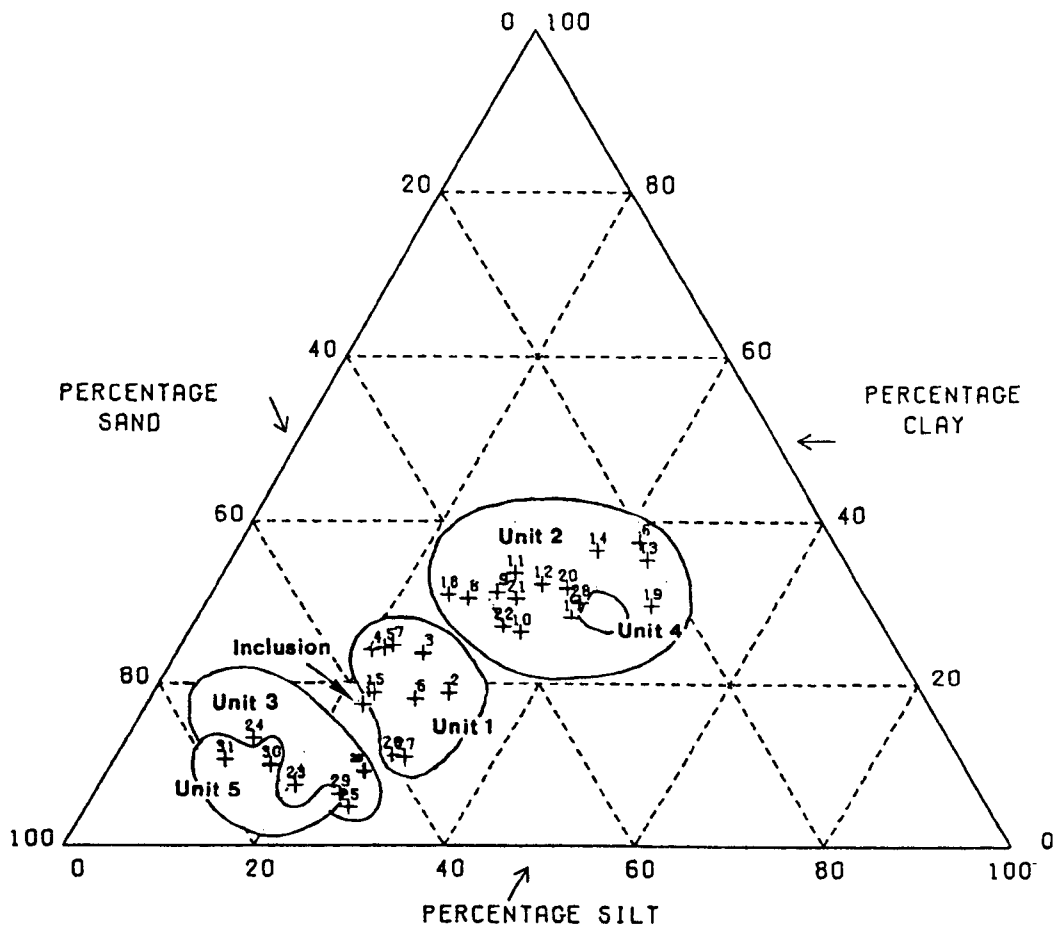


SAMPLE DEPTHS.

1) 3.75M. 2) 7.80M. 3) 13.70M. 4) 17.90M. 5) 18.50M.
6) 23.00M. 7) 23.40M. 8) 27.20M. 9) 27.54M. 10) 27.85M.
11) 31.70M. 12) 31.85M. 13) 32.00M. 14) 32.80M. 15) 32.80M.
16) 32.90M. 17) 37.30M. 18) 37.70M. 19) 40.90M. 20) 41.50M.
21) 42.40M. 22) 46.65M. 23) 49.35M. 24) 52.20M. 25) 60.35M.
26) 78.70M. 27) 87.90M. 28) 97.40M. 29) 99.70M. 30)103.30M.
31)104.30M.

SITE FIX: 60 10 00N 03 40 01W. SOILS LAB. UNIVERSITY OF KEELE

FIG 2.2.2. MATRIX COMPOSITION PLOT.



SAMPLE DEPTHS.

1) 3.75M. 2) 7.80M. 3) 13.70M. 4) 17.90M. 5) 18.50M.
6) 23.00M. 7) 23.40M. 8) 27.20M. 9) 27.54M. 10) 27.85M.
11) 31.70M. 12) 31.85M. 13) 32.00M. 14) 32.80M. 15) 32.80M.
16) 32.90M. 17) 37.30M. 18) 37.70M. 19) 40.90M. 20) 41.50M.
21) 42.40M. 22) 46.65M. 23) 49.35M. 24) 52.20M. 25) 60.35M.
26) 78.70M. 27) 87.90M. 28) 97.40M. 29) 99.70M. 30)103.30M.
31)104.30M.

SITE FIX: 60 10 00N 03 40 01W. SOILS LAB. UNIVERSITY OF KEELE

FIG 2.2.3. CLAY MINERALOGY:UNIT .1.

KEY

Bio - Biotite, cal - Calcite, chl - Chlorite,

fsp - Feldspars : Na- Sodium, Ca- Calcium, K- Potassium,

hal - Halite, Ill - Illite, Qz - Quartz, Sm - Smectite,

Sm-C - Chlorite-smectite, Sm-M - Mica-smectite,

? - Tentative identification.

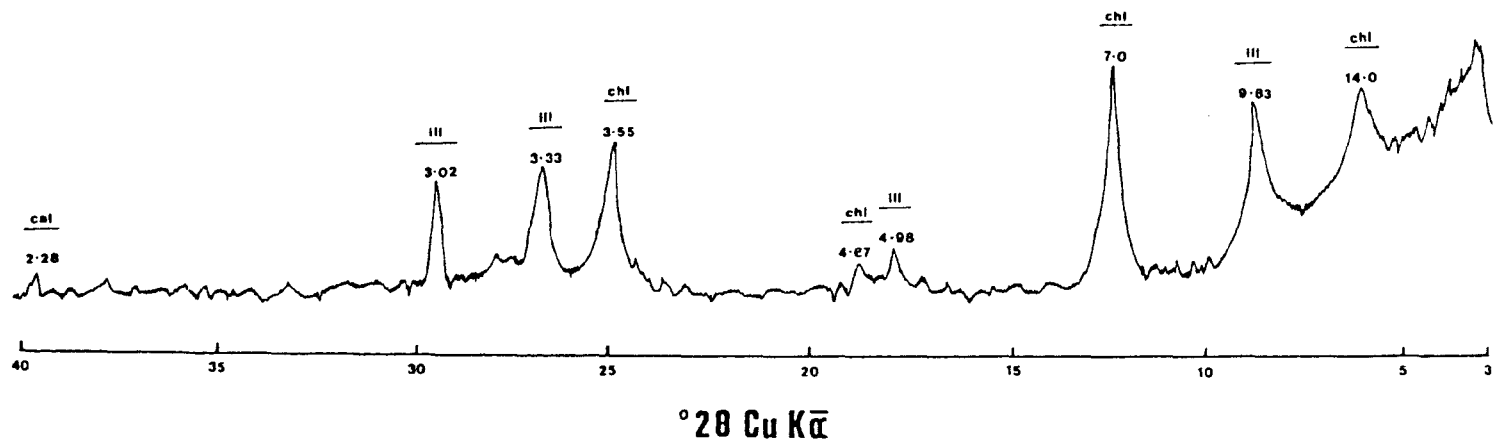


FIG 2.2.4. CLAY MINERALOGY : UNIT .2.

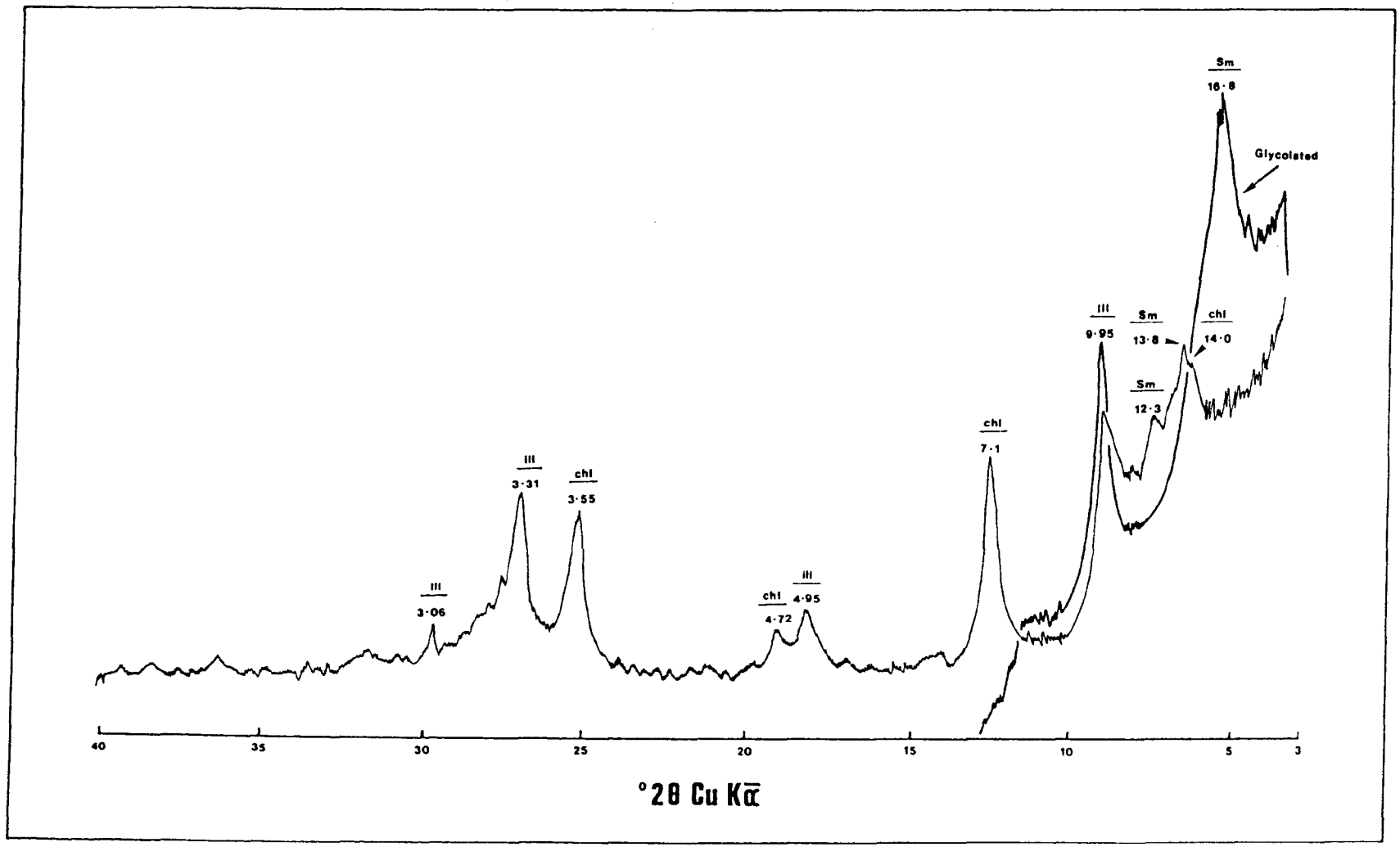
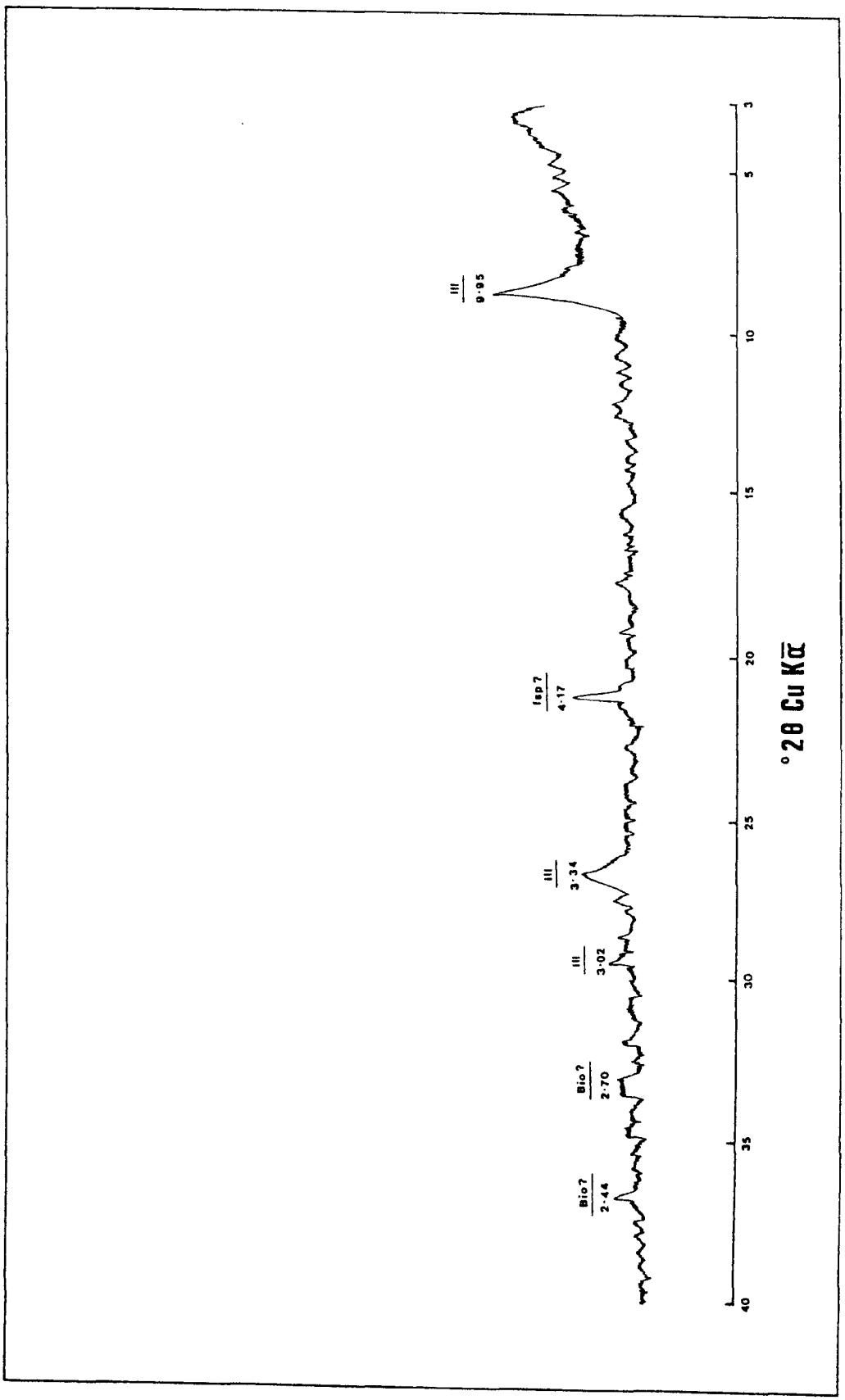


FIG 2.2.5. CLAY MINERALOGY : UNIT .5.



2.2.6. BOREHOLE SUMMARY LOG: BOREHOLE 82/10.

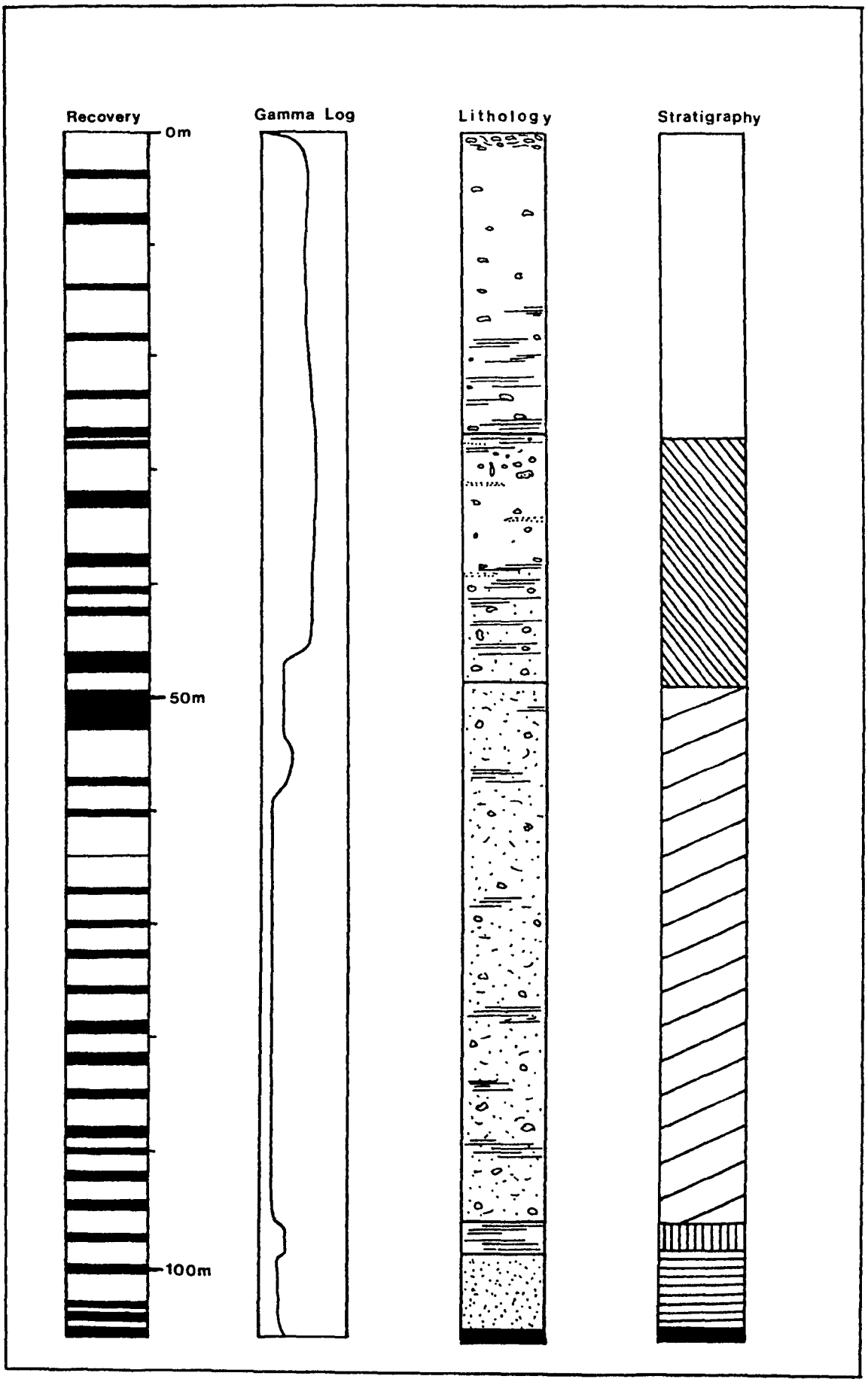
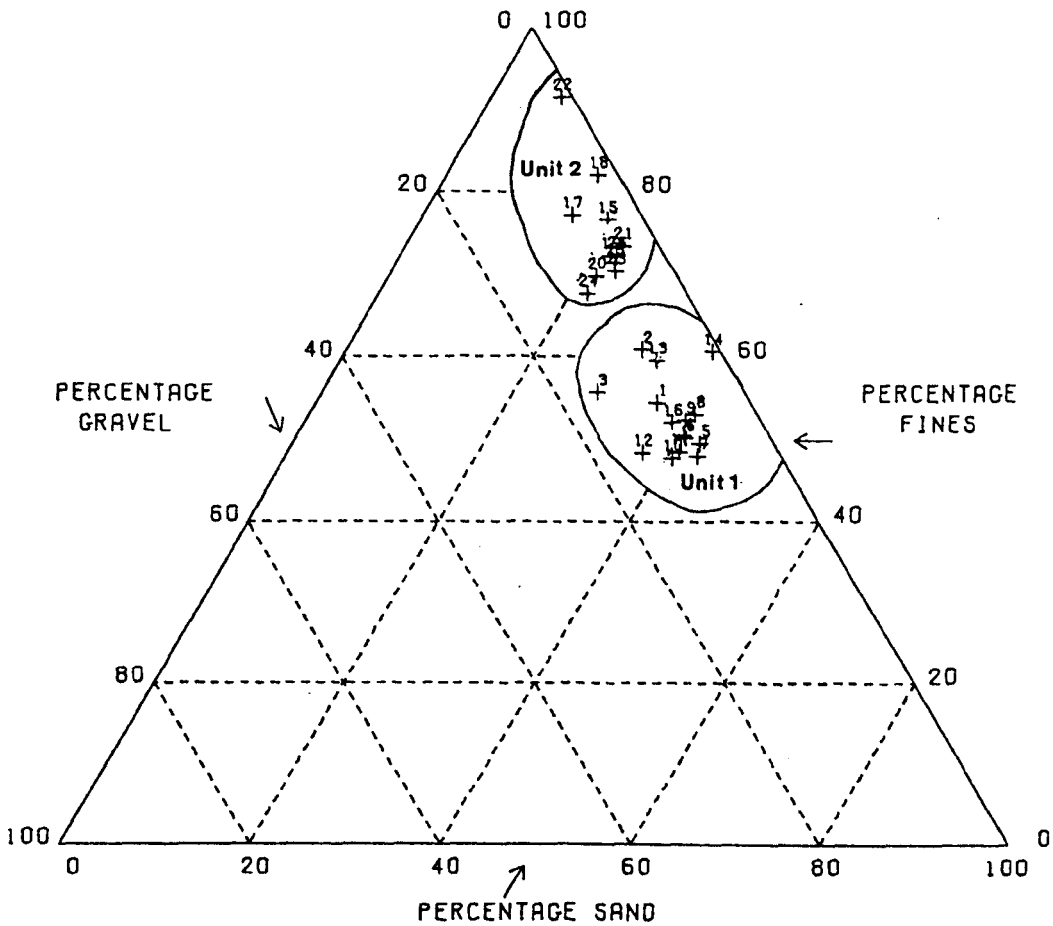


FIG 2.3.1. TOTAL COMPOSITION PLOT.

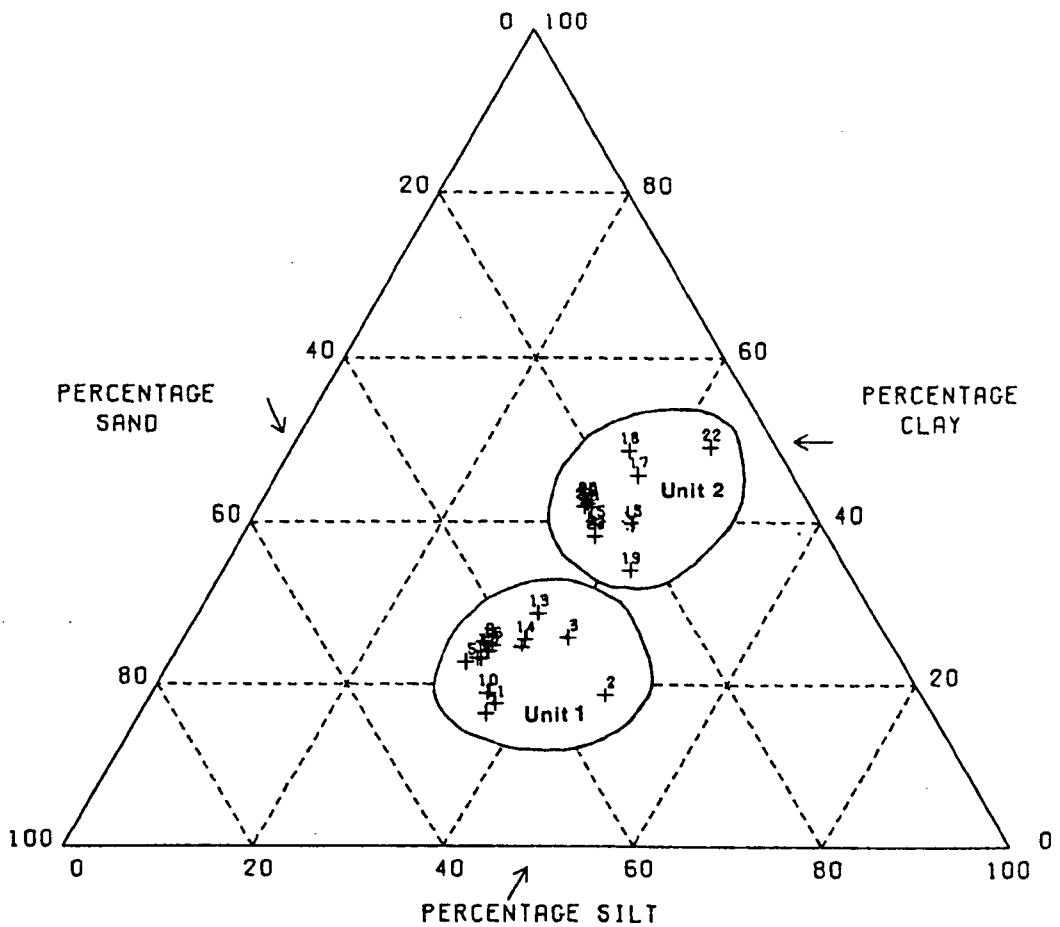


SAMPLE DEPTHS.

1) .40M. 2) .90M. 3) 5.00M. 4) 11.40M. 5) 15.00M.
6) 21.50M. 7) 26.25M. 8) 26.80M. 9) 35.40M. 10) 36.70M.
11) 44.20M. 12) 47.35M. 13) 48.10M. 14) 48.80M. 15) 49.45M.
16) 58.40M. 17) 58.95M. 18) 60.15M. 19) 60.60M. 20) 60.85M.
21) 61.75M. 22) 62.80M. 23) 63.80M. 24) 64.80M. 25) 65.80M.
26) 69.80M.

SITE FIX: SS 55 18N 03 31 14M. SOILS LAB. UNIVERSITY OF KEELE

FIG 2.3.2. MATRIX COMPOSITION PLOT.



SAMPLE DEPTHS.

1) .40M. 2) .90M. 3) 5.00M. 4) 11.40M. 5) 15.00M.
6) 21.50M. 7) 26.25M. 8) 26.80M. 9) 35.40M. 10) 36.70M.
11) 44.20M. 12) 47.35M. 13) 48.10M. 14) 48.80M. 15) 49.45M.
16) 58.40M. 17) 58.95M. 18) 60.15M. 19) 60.60M. 20) 60.85M.
21) 61.75M. 22) 62.80M. 23) 63.80M. 24) 64.80M. 25) 65.80M.
26) 69.80M.

SITE FIX: 59 55 18N 03 31 14W. SOILS LAB. UNIVERSITY OF KEELE

FIG 2.3.3. CLAY MINERALOGY : UNIT .1.

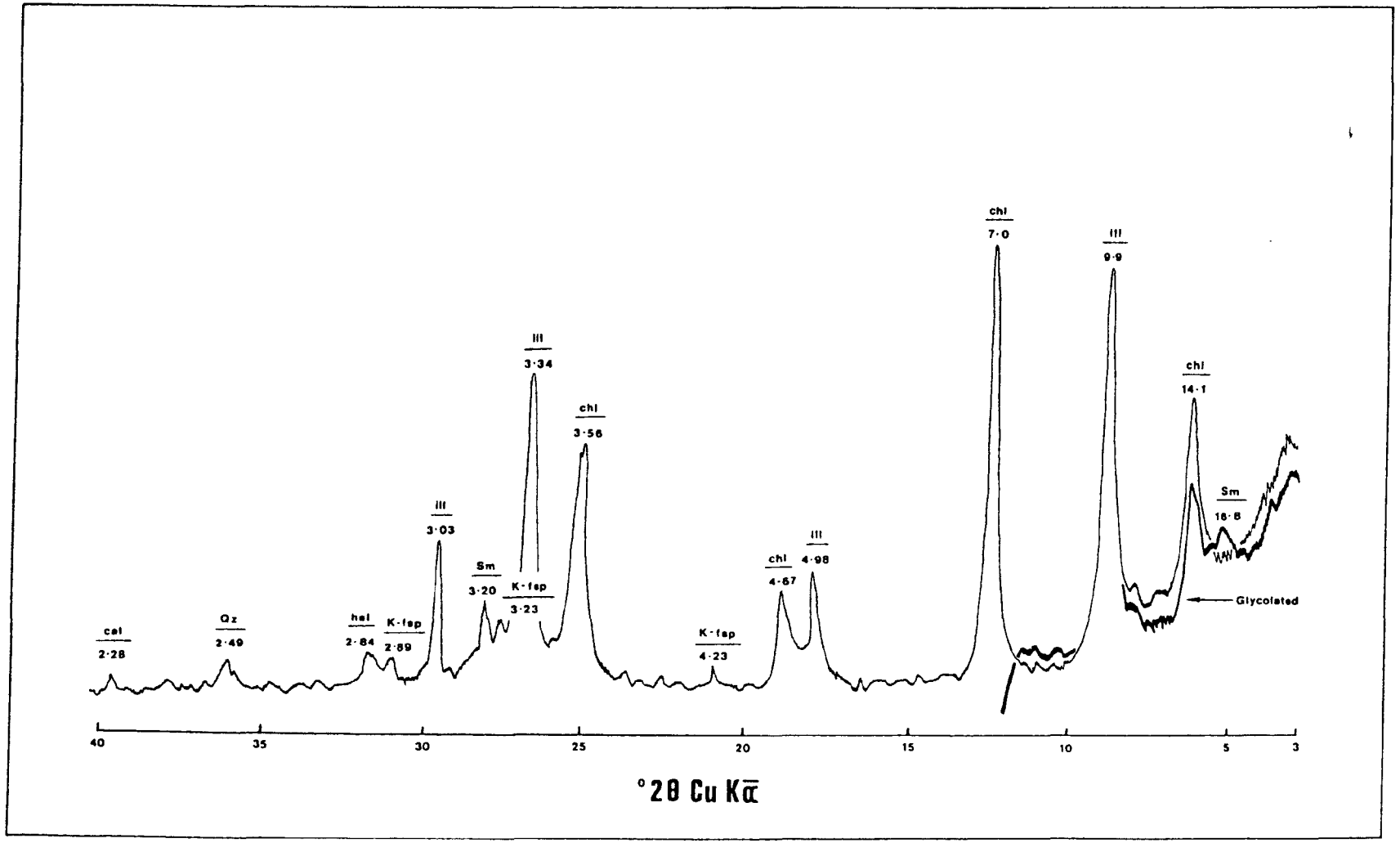


FIG 2.3.4. CLAY MINERALOGY : UNIT .1.

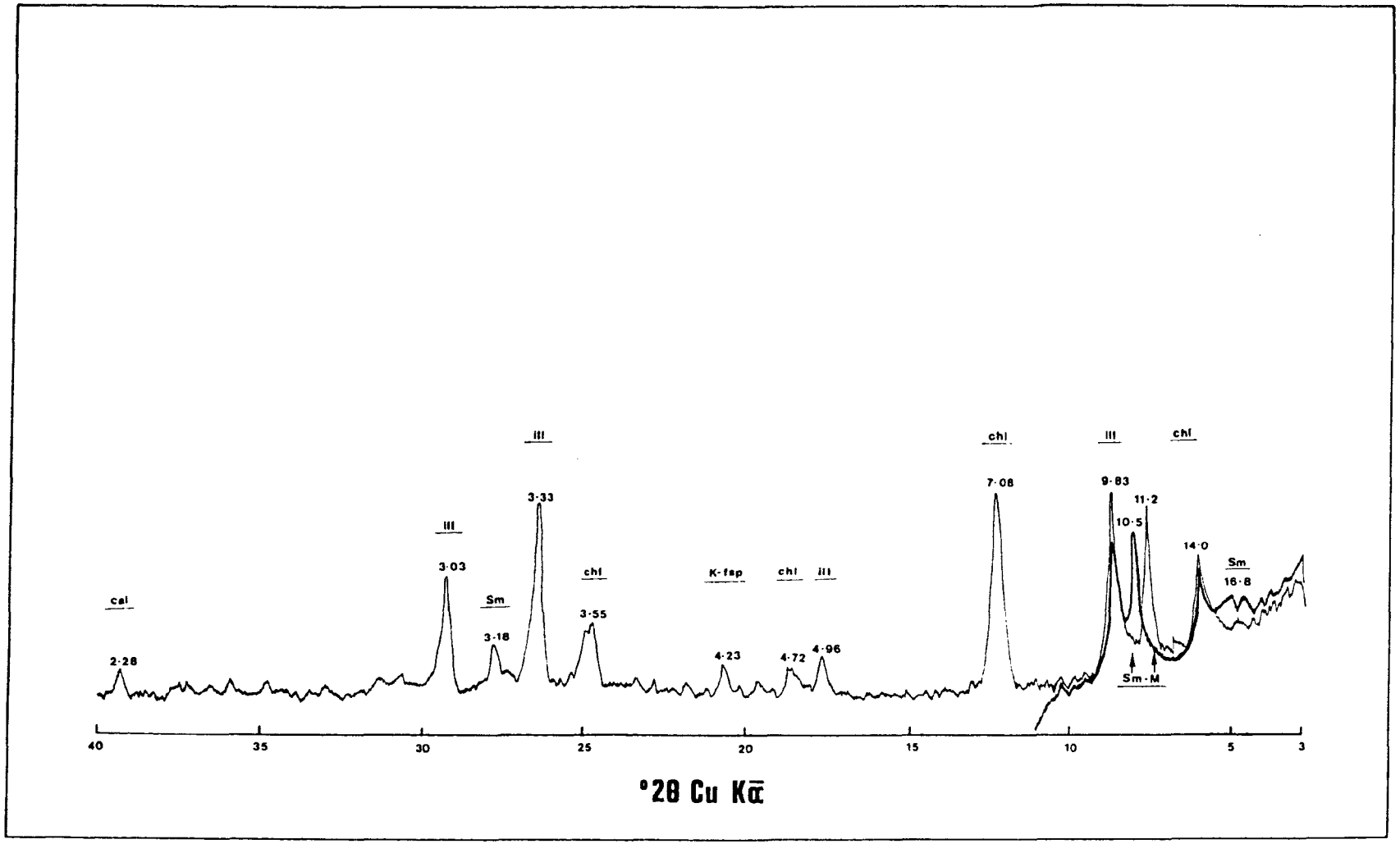
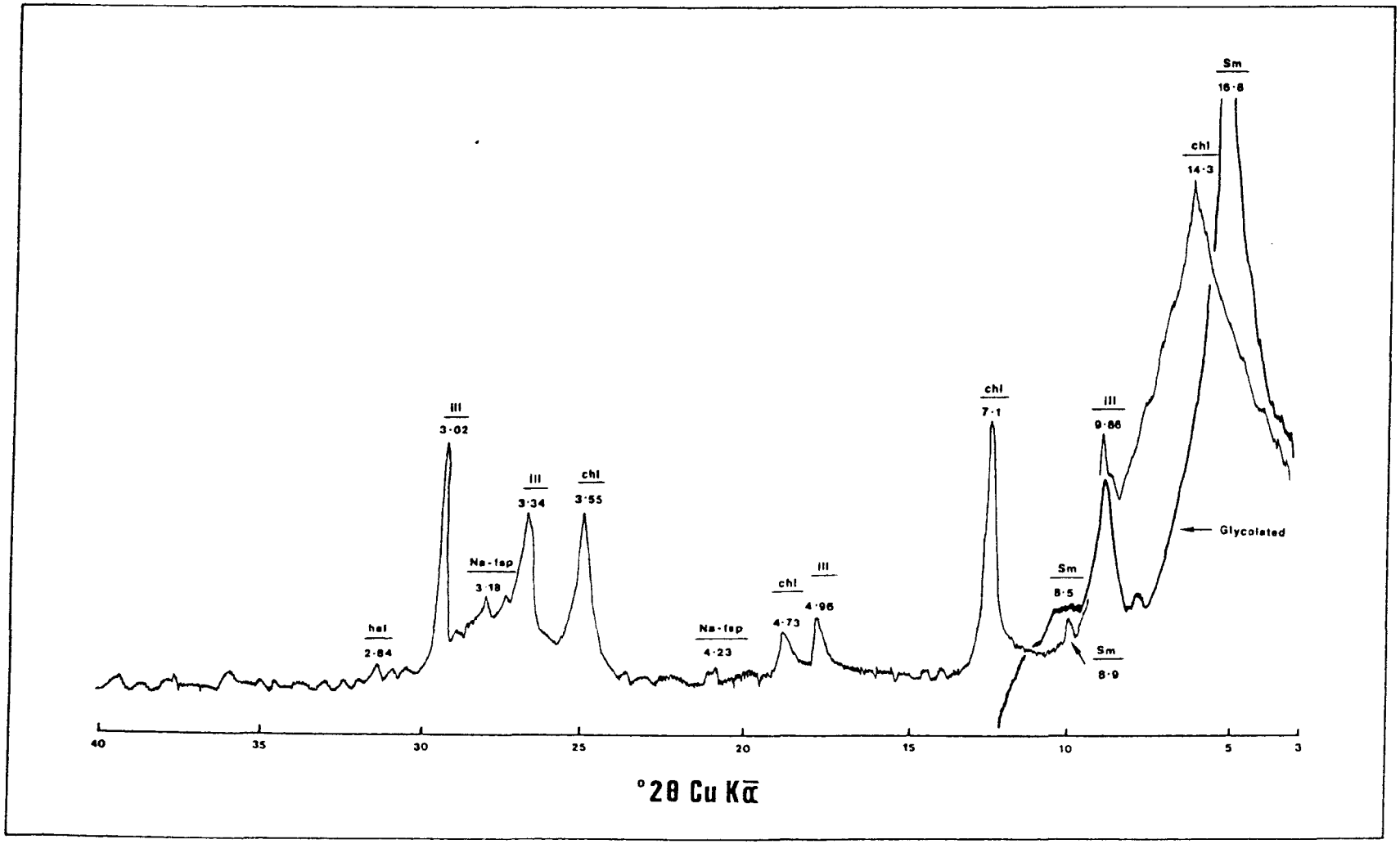


FIG 2.3.5. CLAY MINERALOGY : UNIT .2.



2.3.6. BOREHOLE SUMMARY LOG: BOREHOLE 82/01.

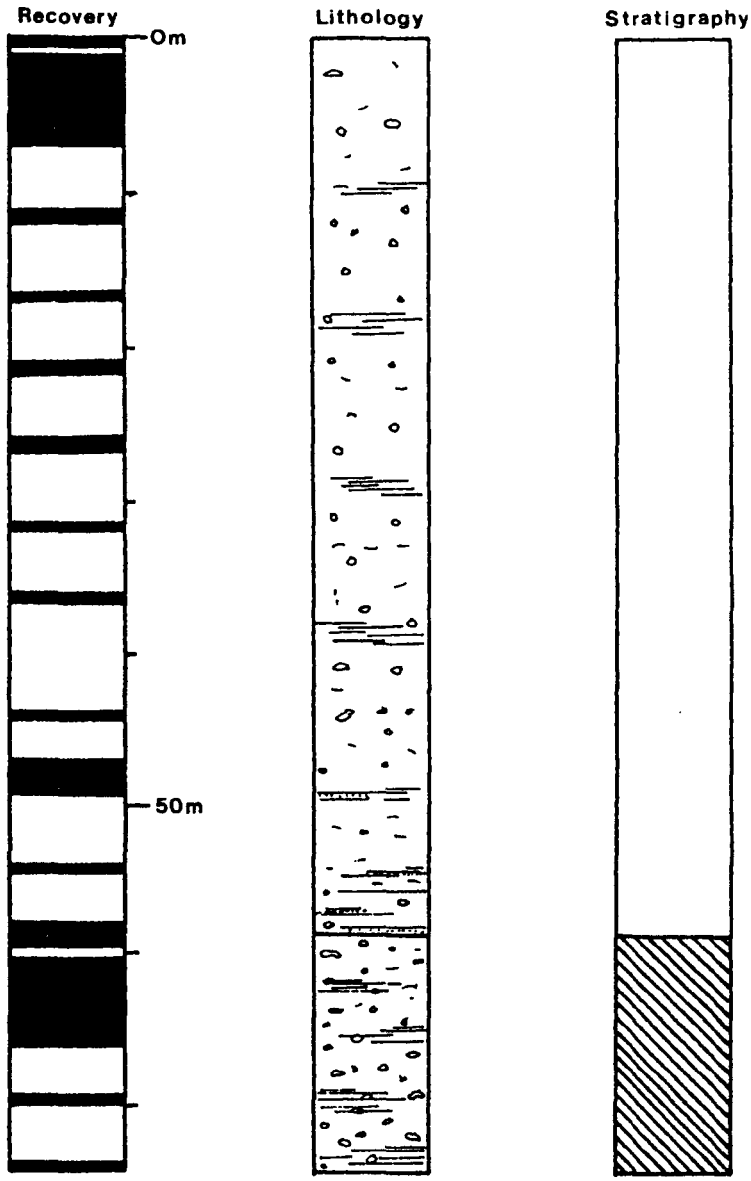
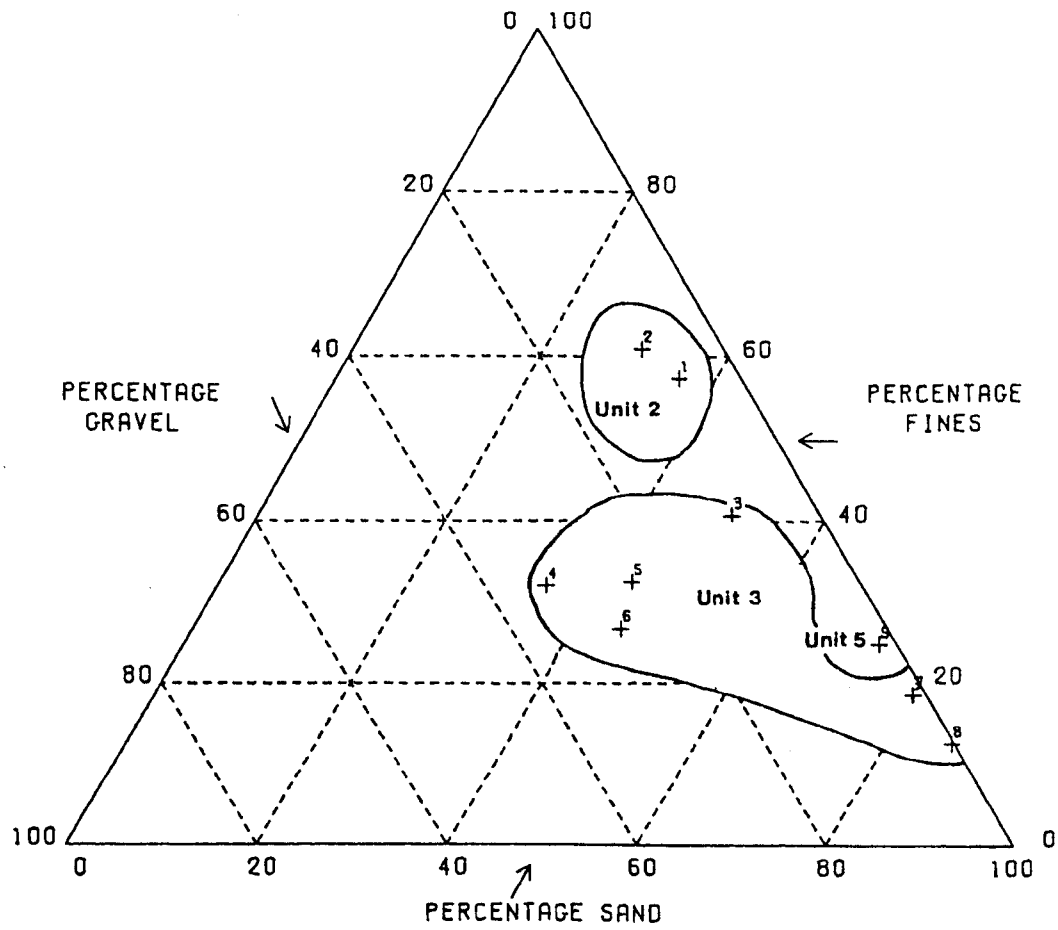


FIG 2.4.1. TOTAL COMPOSITION PLOT.



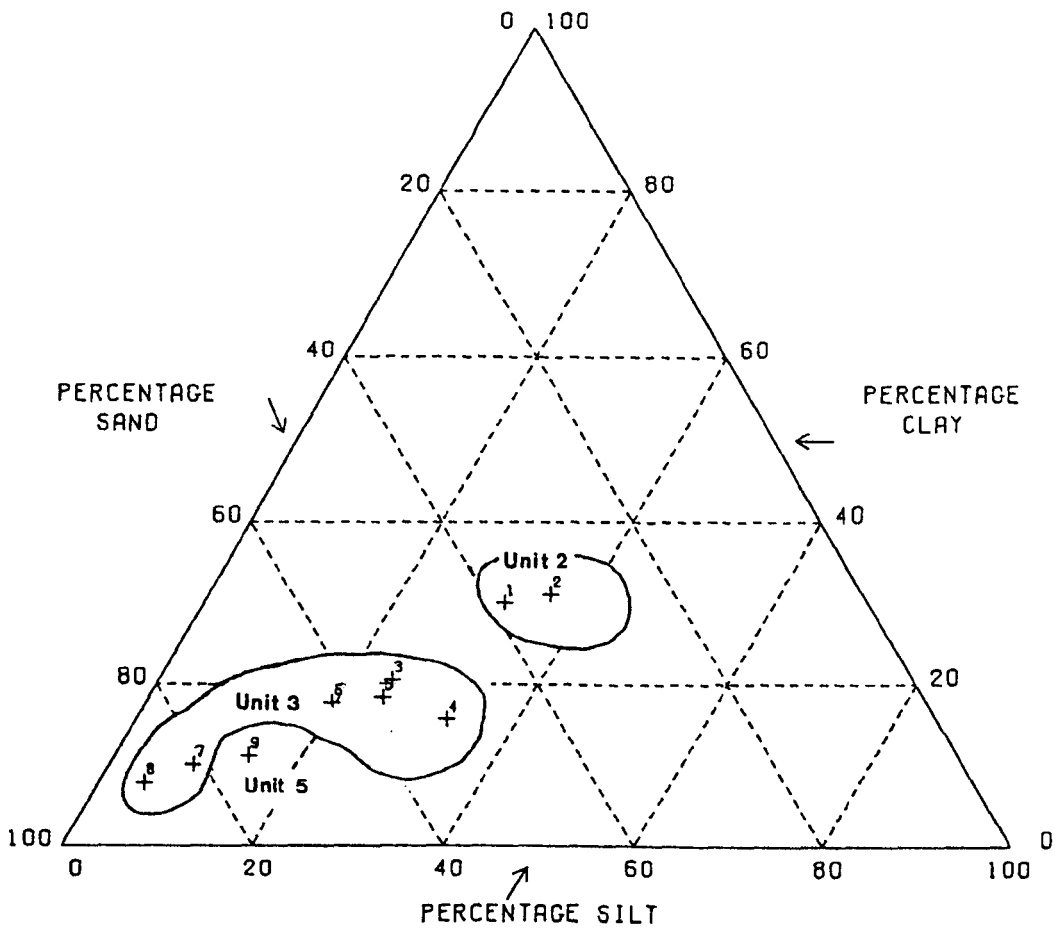
SAMPLE DEPTHS.

1) 3.80M. 2) 5.15M. 3) 5.50M. 4) 7.40M. 5) 8.20M.
6) 9.20M. 7) 10.60M. 8) 15.50M. 9) 33.10M.

SITE FIX: 50 08 48N 03 10 06W.

SOILS LAB. UNIVERSITY OF KEELE

FIG 2.4.2. MATRIX COMPOSITION PLOT.



SAMPLE DEPTHS.

1) 3.80M. 2) 5.15M. 3) 5.50M. 4) 7.40M. 5) 8.20M.
6) 9.20M. 7) 10.60M. 8) 15.50M. 9) 33.10M.

SITE FIX: 60 08 48N 03 10 06W. SOILS LAB. UNIVERSITY OF KEELE

FIG 2.4.3. CLAY MINERALOGY : UNIT .2.

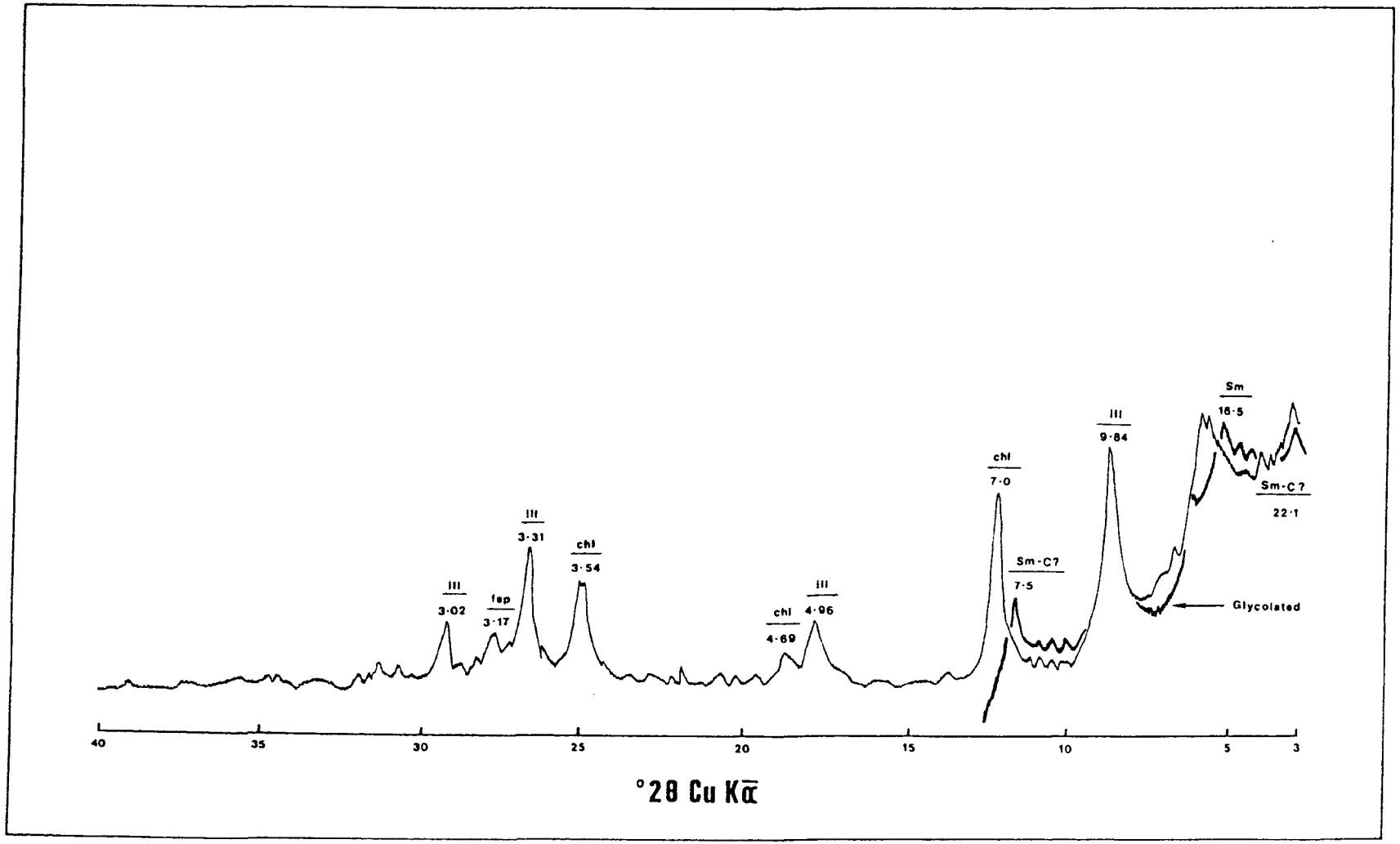


FIG 2.4.4. CLAY MINERALOGY : UNIT 5.

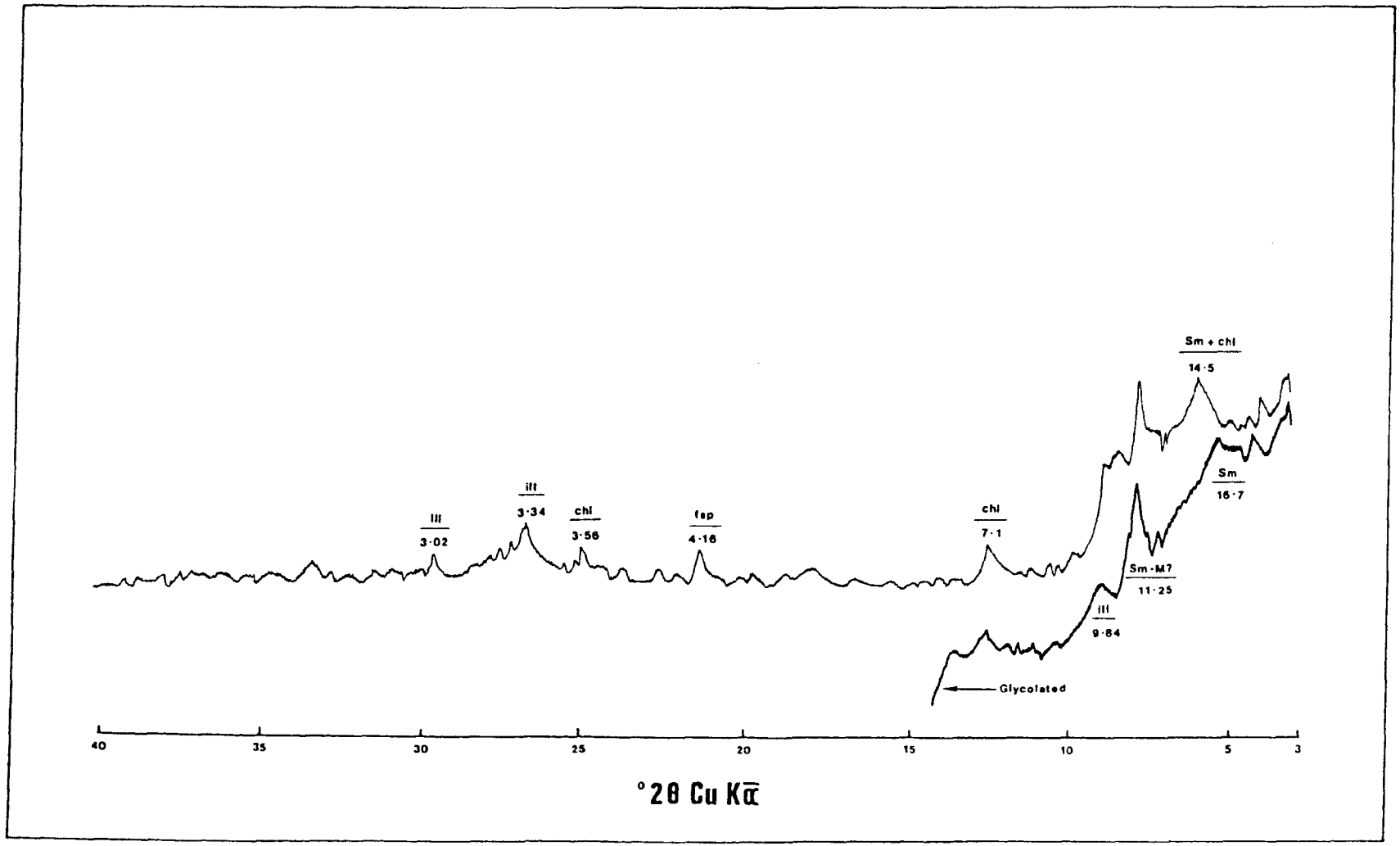
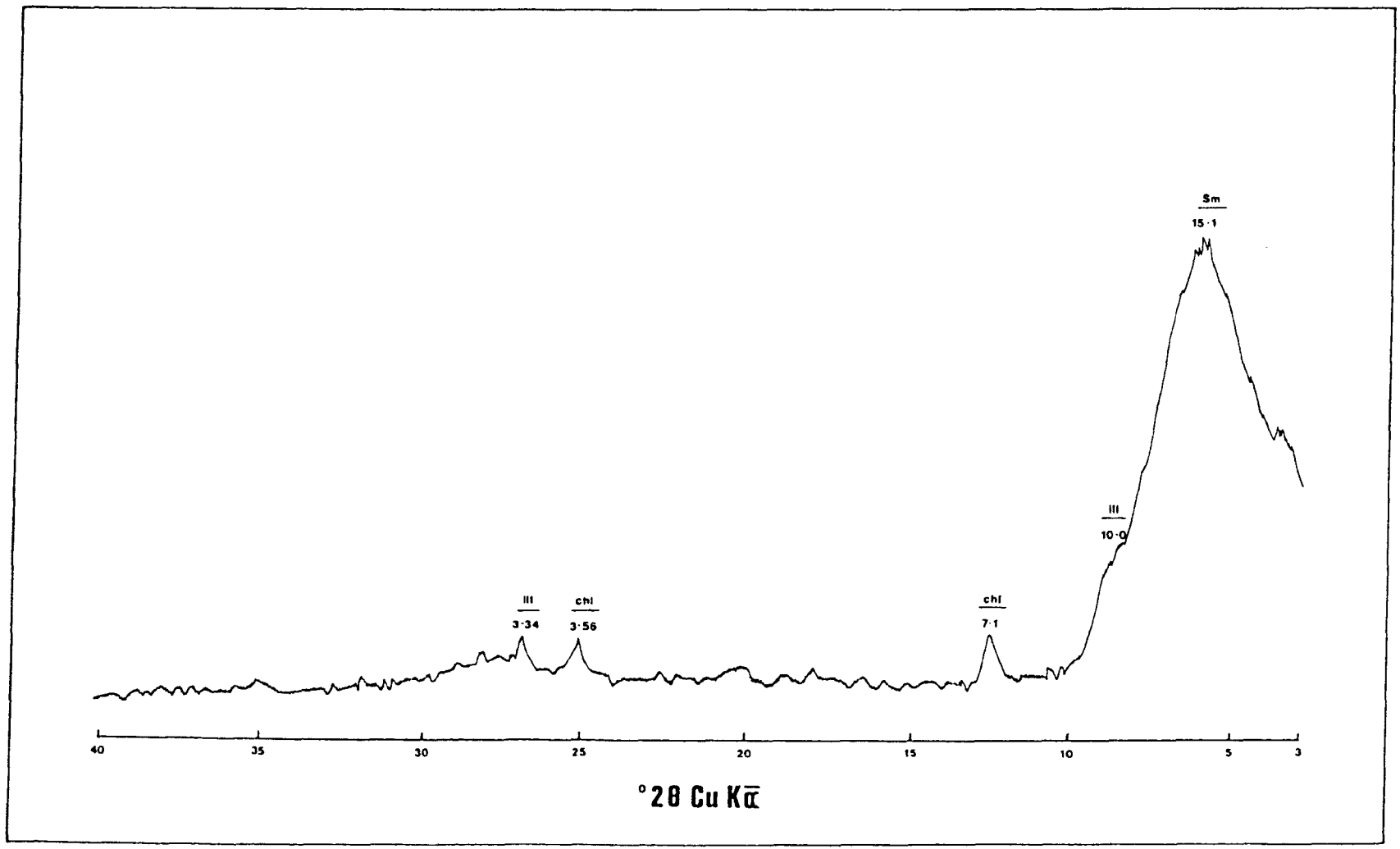


FIG 2.4.5. CLAY MINERALOGY : UNIT .5.



2.4.6. BOREHOLE SUMMARY LOG: BOREHOLE 84/02.

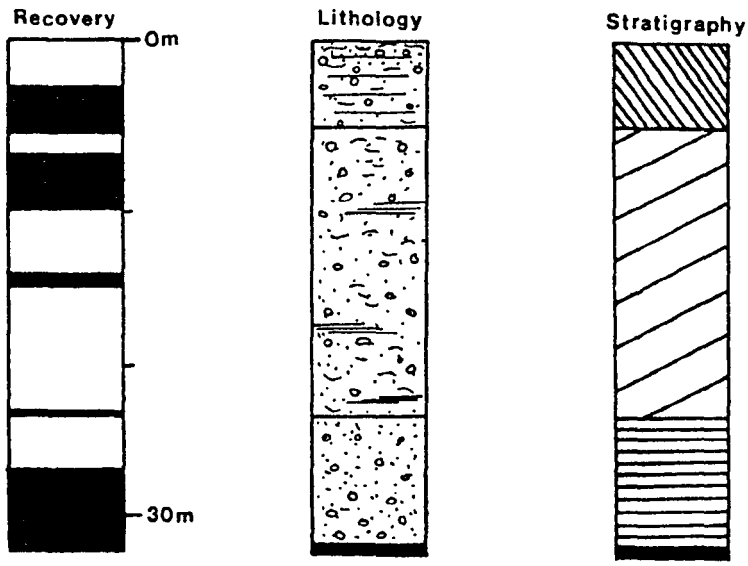
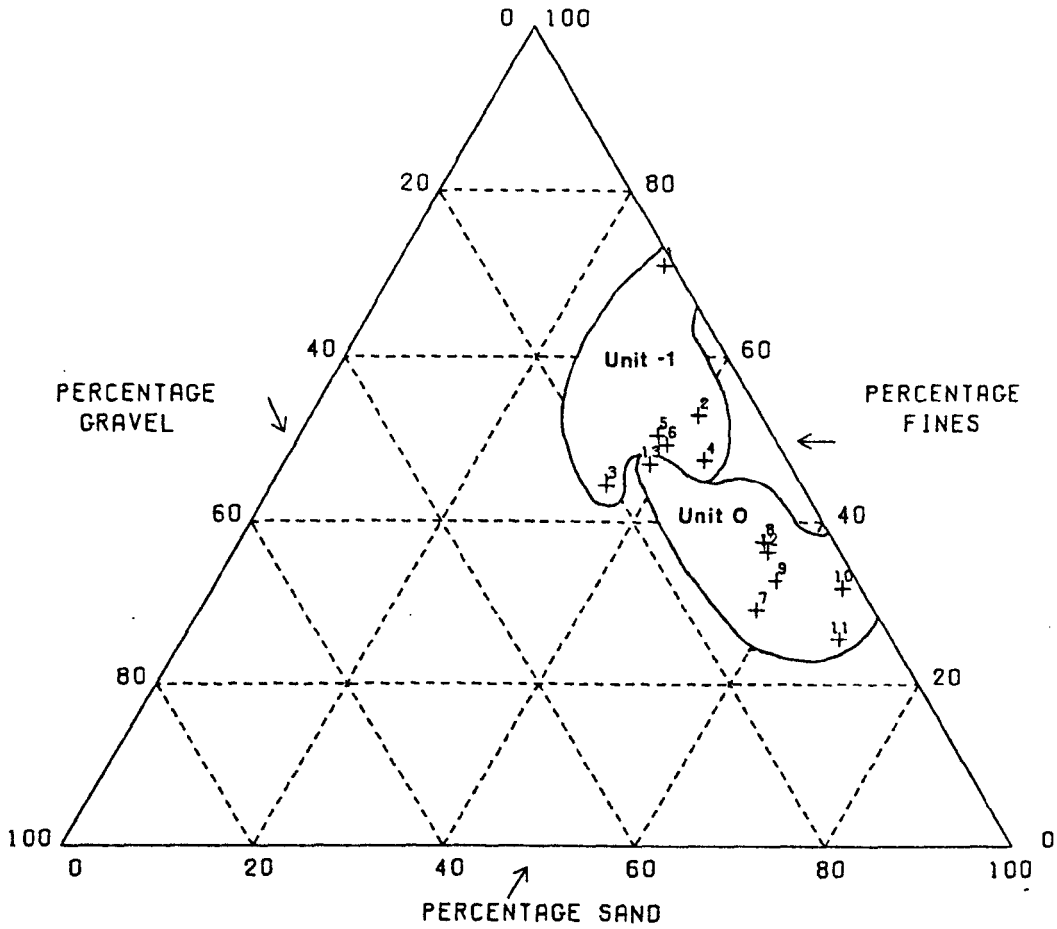


FIG 2.5.1. TOTAL COMPOSITION PLOT.



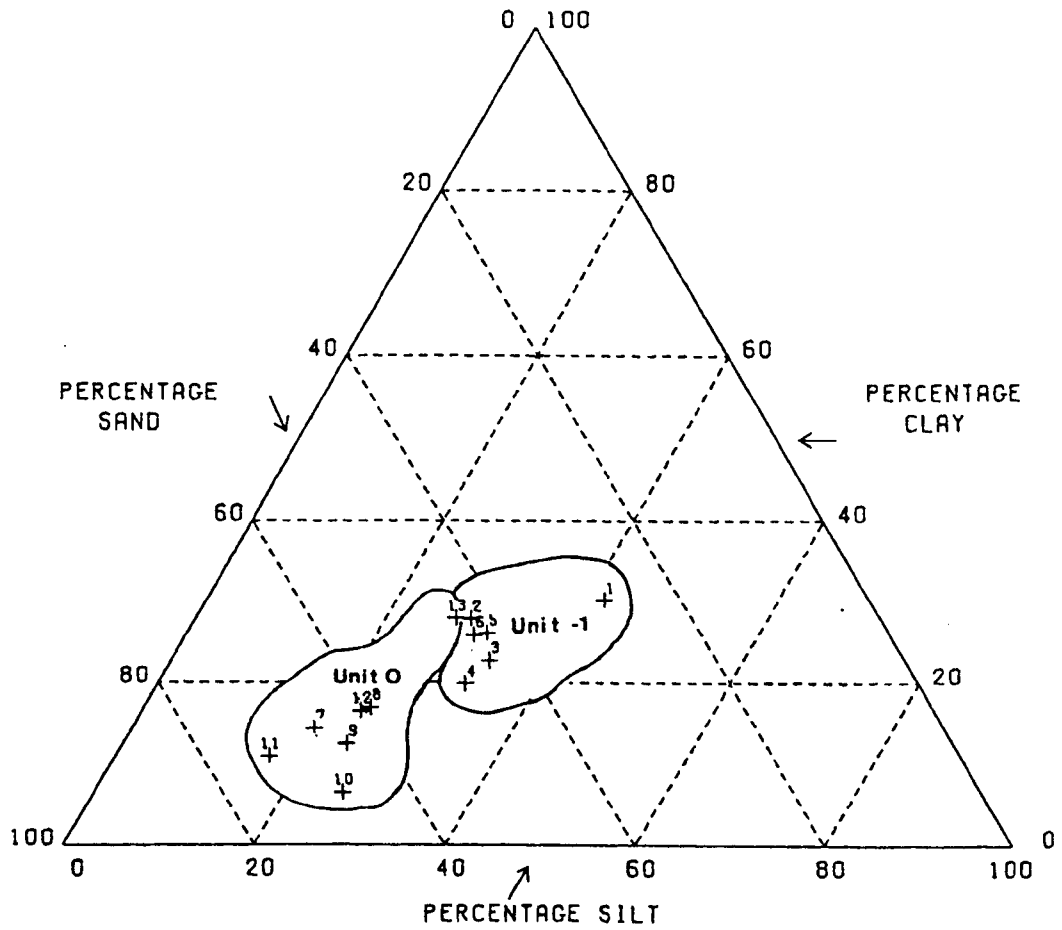
SAMPLE DEPTHS.

1) 2.80M. 2) 3.80M. 3) 6.70M. 4) 9.50M. 5) 15.00M.
6) 22.30M. 7) 25.05M. 8) 27.40M. 9) 29.30M. 10) 29.50M.
11) 30.30M. 12) 33.20M. 13) 46.00M.

SITE FIX: 60 15 06N 03 52 16W.

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FIG 2.5.2. MATRIX COMPOSITION PLOT.



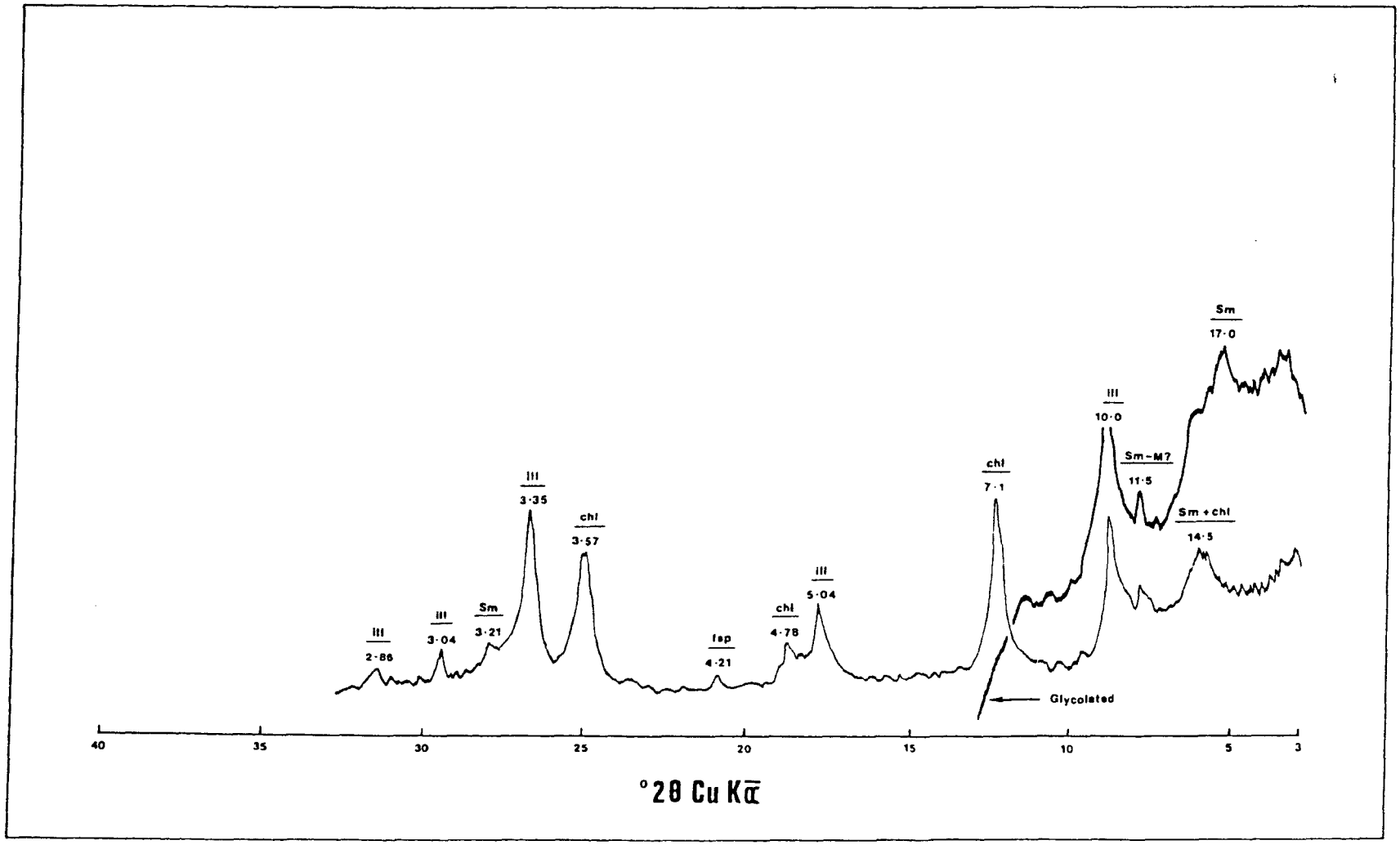
SAMPLE DEPTHS.

1) 2.80M. 2) 3.80M. 3) 6.70M. 4) 9.50M. 5) 15.00M.
6) 22.30M. 7) 25.05M. 8) 27.40M. 9) 29.30M. 10) 29.50M.
11) 30.30M. 12) 33.20M. 13) 46.00M.

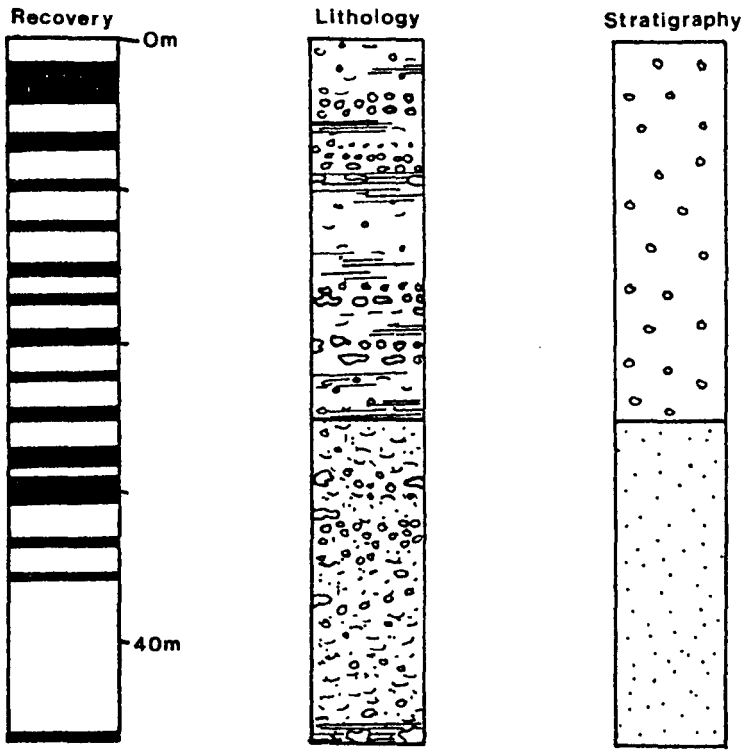
SITE FIX: 60 15 06N 03 52 16W.

SOILS LAB. UNIVERSITY OF KEELE

FIG 2.5.3. CLAY MINERALOGY : UNIT .0.



2.5.4. BOREHOLE SUMMARY LOG: BOREHOLE 82/11.



2.6.1. BOREHOLE SUMMARY LOG: BOREHOLE 84/04.

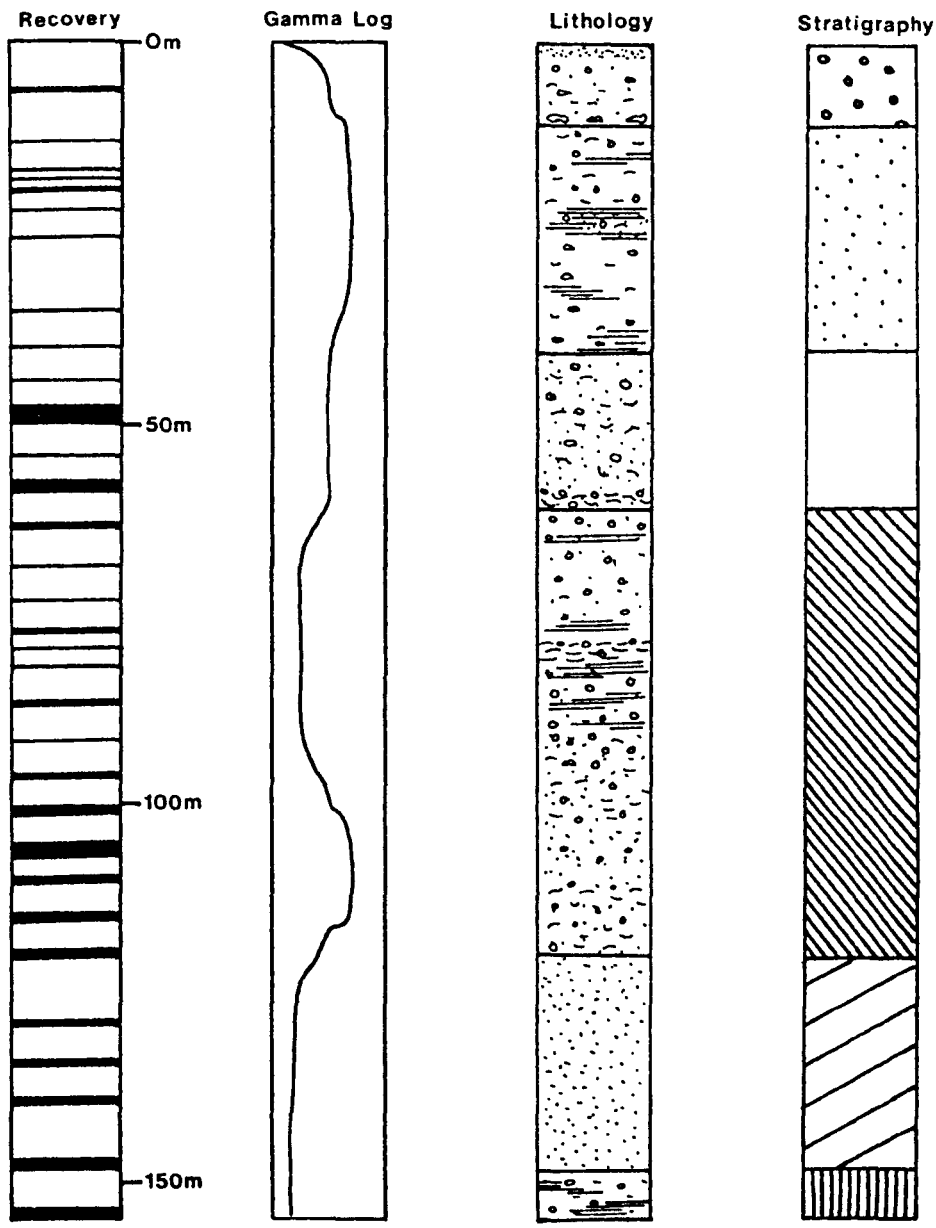
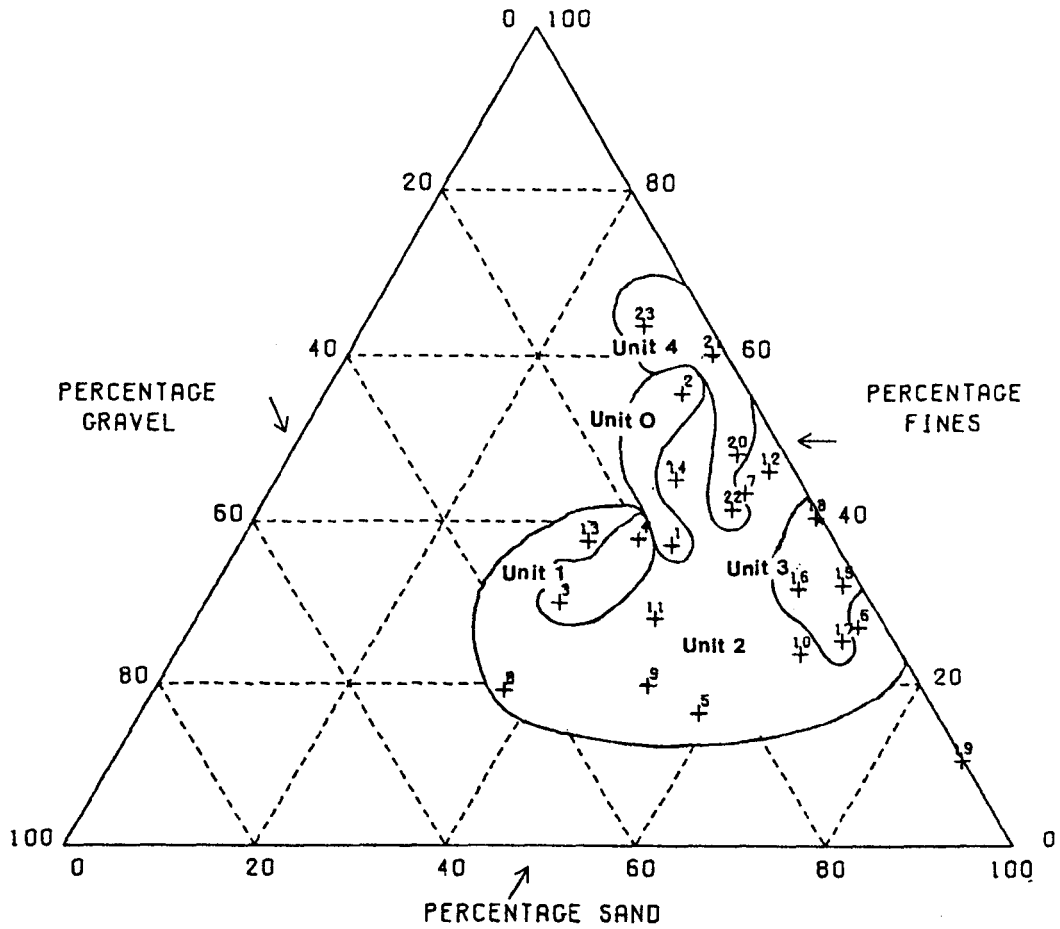


FIG 2.6.2. TOTAL COMPOSITION PLOT.

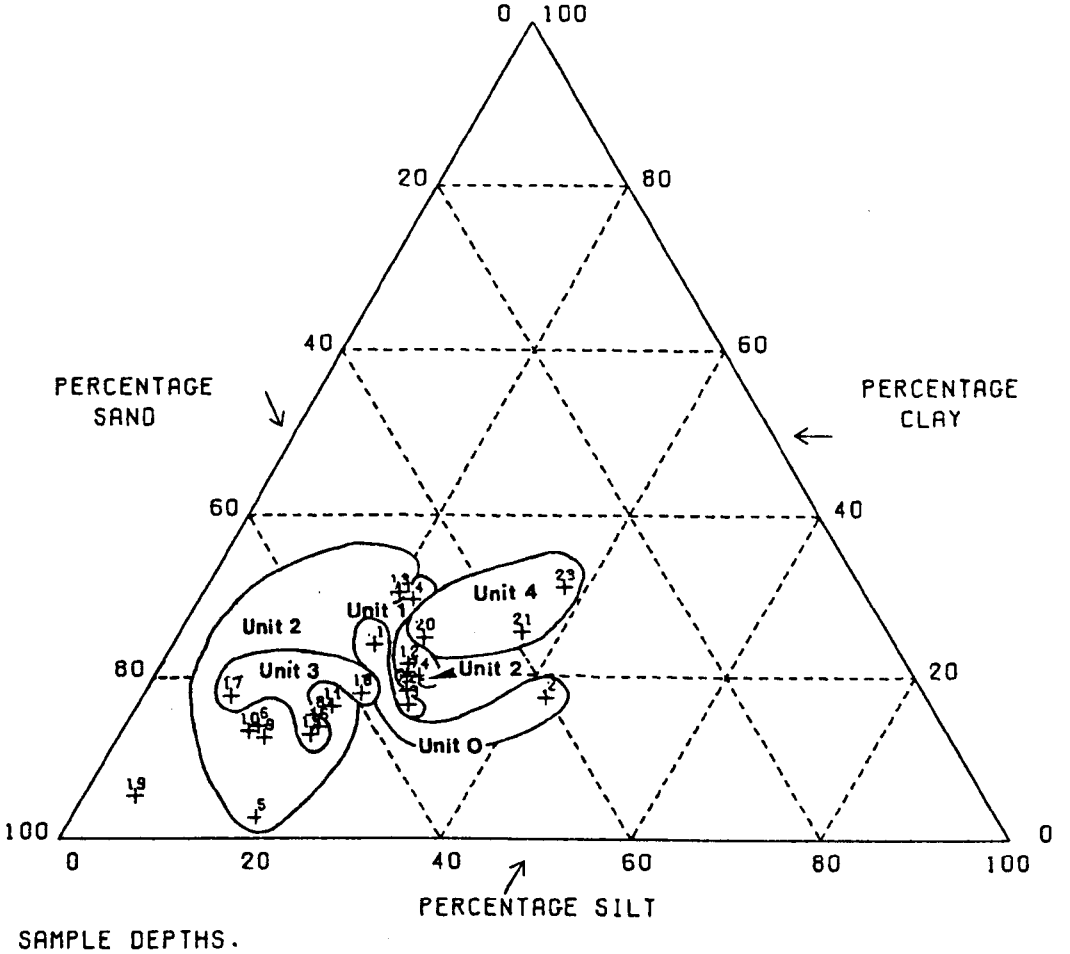


SAMPLE DEPTHS.

1) 13.20M. 2) 21.70M. 3) 54.10M. 4) 58.80M. 5) 63.40M.
6) 63.90M. 7) 68.80M. 8) 77.90M. 9) 86.75M. 10) 91.90M.
11) 96.80M. 12)101.00M. 13)107.75M. 14)115.80M. 15)120.90M.
16)129.60M. 17)134.75M. 18)139.90M. 19)148.20M. 20)148.50M.
21)148.70M. 22)154.00M. 23)154.00M.

SITE FIX: 60 45 03N 02 16 21W. SOILS LAB. UNIVERSITY OF KEELE

FIG 2.6.3. MATRIX COMPOSITION PLOT.



SAMPLE DEPTHS.

1) 13.20M. 2) 21.70M. 3) 54.10M. 4) 58.80M. 5) 63.40M.
6) 63.90M. 7) 68.80M. 8) 77.90M. 9) 86.75M. 10) 91.90M.
11) 96.80M. 12)101.00M. 13)107.75M. 14)115.80M. 15)120.90M.
16)129.60M. 17)134.75M. 18)139.90M. 19)148.20M. 20)148.50M.
21)148.70M. 22)154.00M. 23)154.00M.

SITE FIX: 60 45 03N 02 16 21W. SOILS LAB. UNIVERSITY OF KEELE

FIG 2.6.4. CLAY MINERALOGY : UNIT .2.

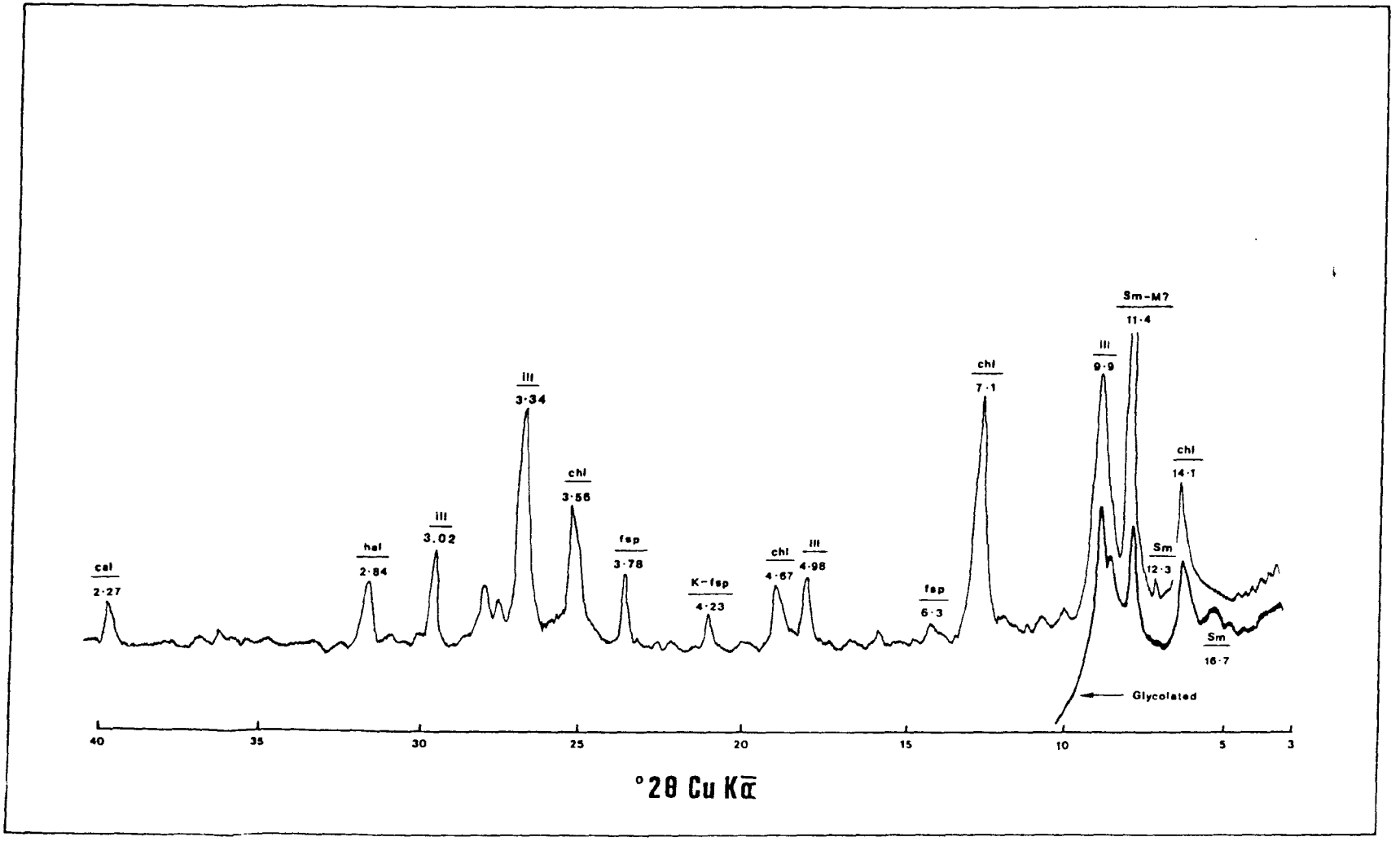


FIG 2.6.5. CLAY MINERALOGY : UNIT .2.

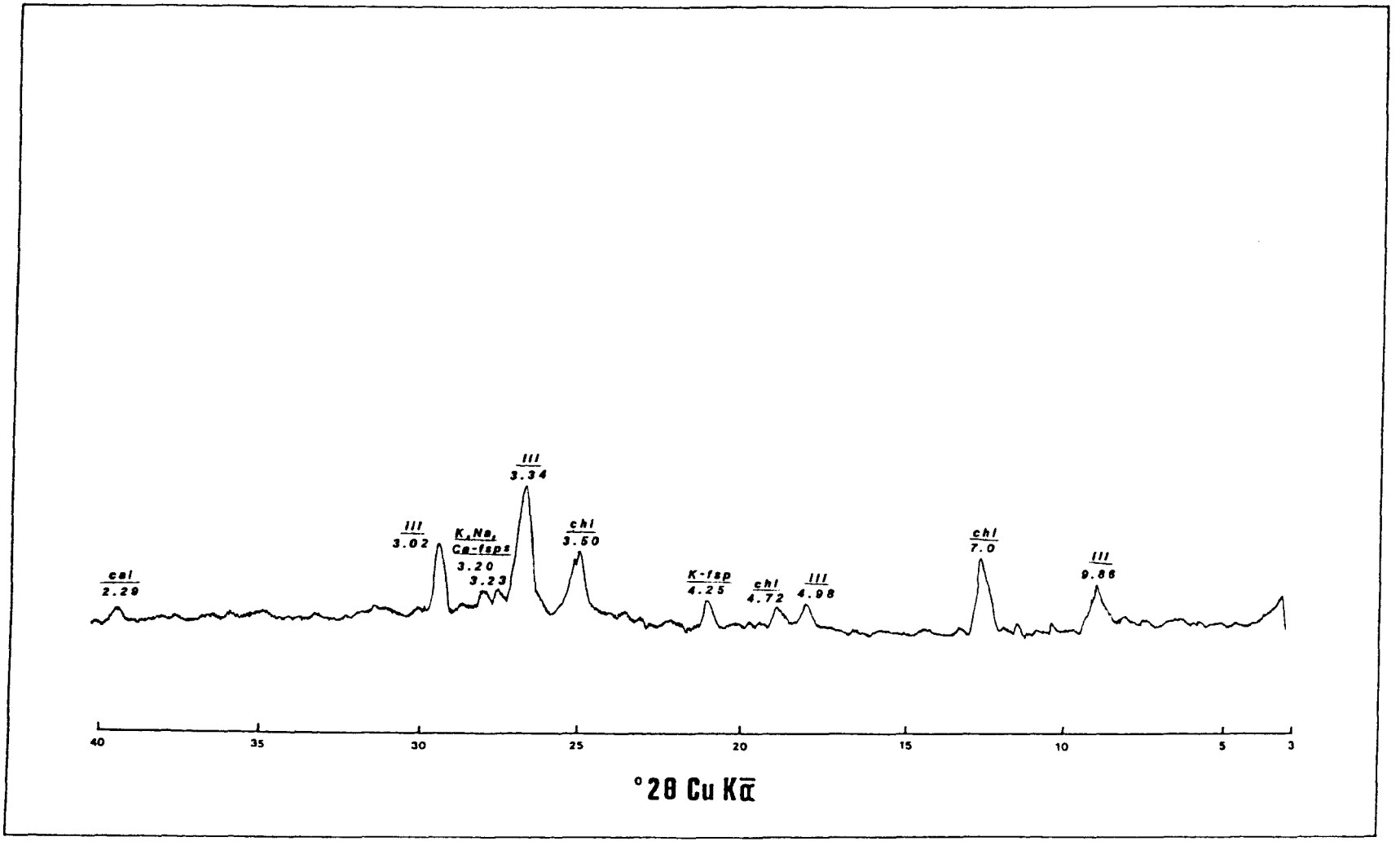
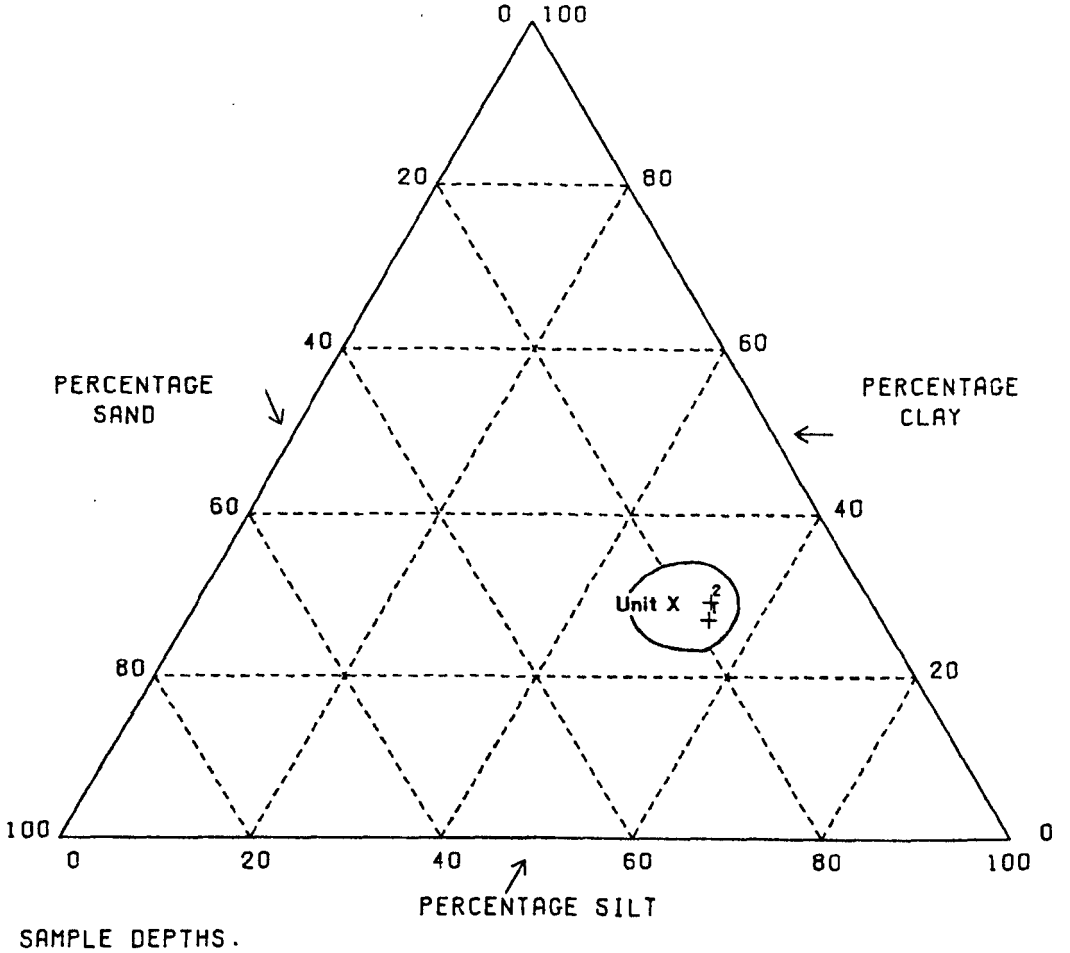


FIG 2.7.1. MATRIX COMPOSITION PLOT.



SAMPLE DEPTHS.

1) 7.00M. 2) 9.00M.

SITE FIX: 60 29 58N 02 12 11W.

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2.7.2. BOREHOLE SUMMARY LOG: BOREHOLE 84/03.

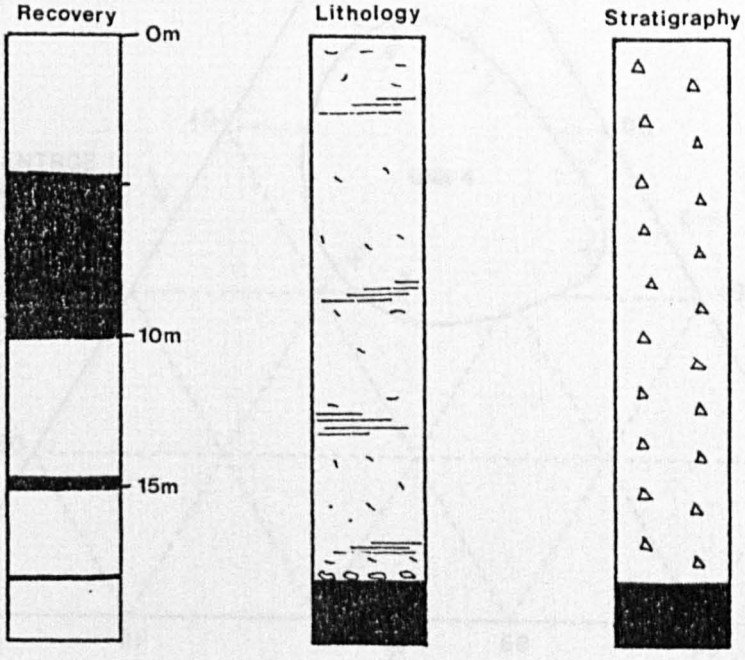
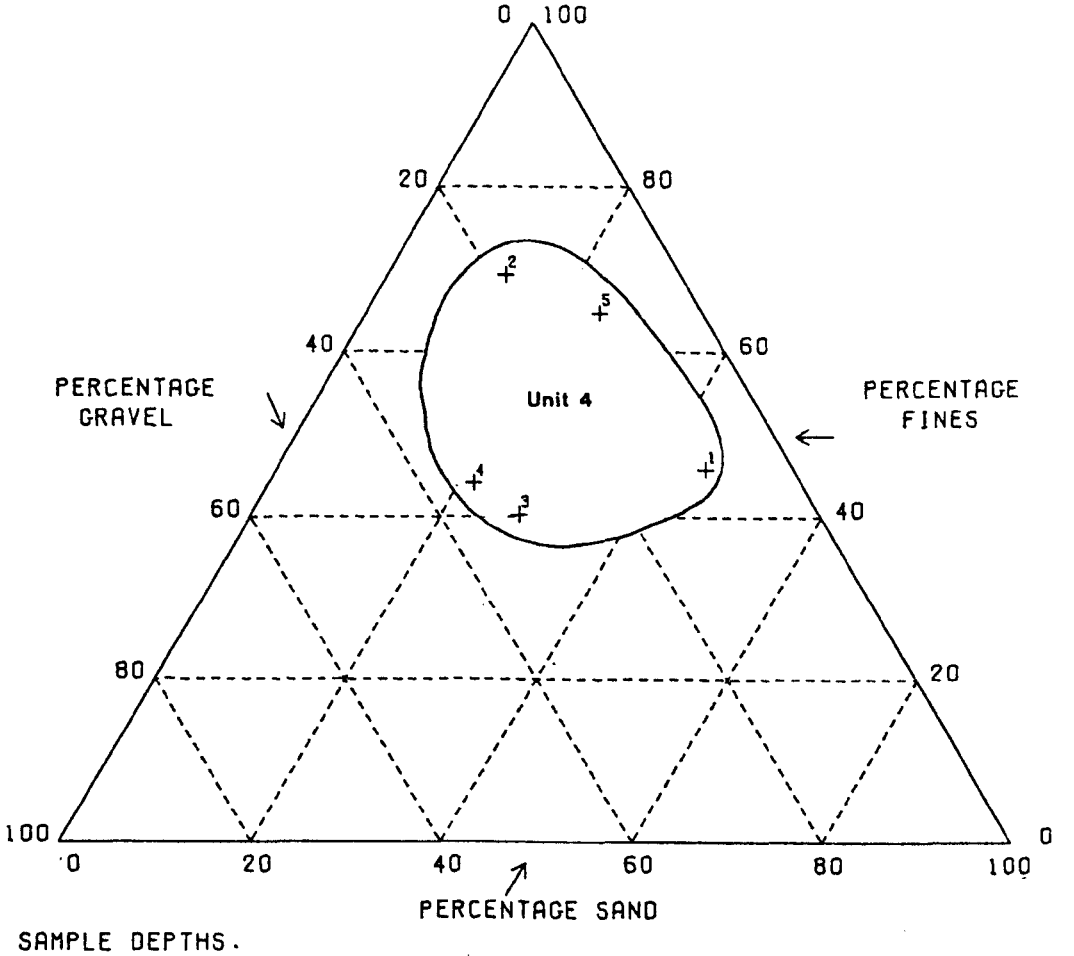


FIG 2.8.1. TOTAL COMPOSITION PLOT.



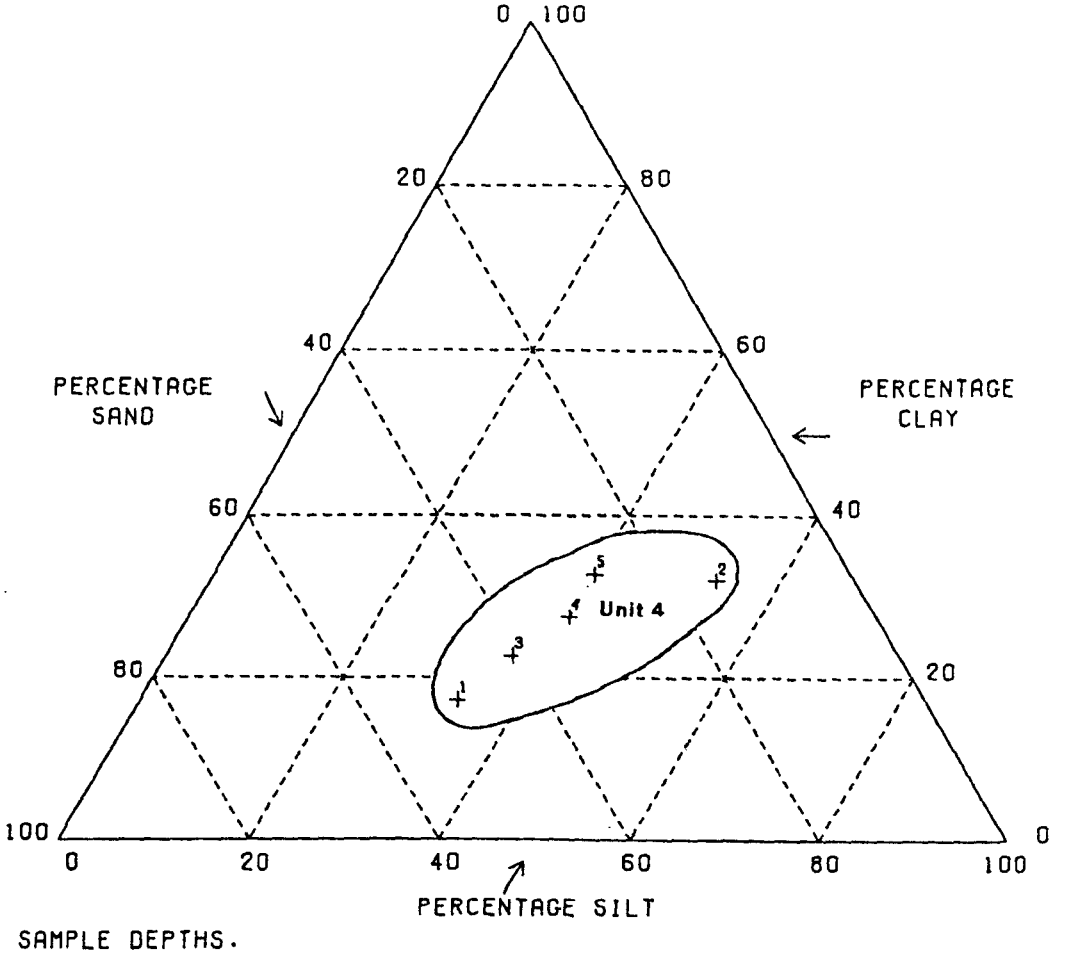
SAMPLE DEPTHS.

1) 8.40M. 2) 18.85M. 3) 21.00M. 4) 21.50M. 5) 27.70M.

SITE FIX: 60 32 00N 01 55 50W.

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FIG 2.8.2. MATRIX COMPOSITION PLOT.



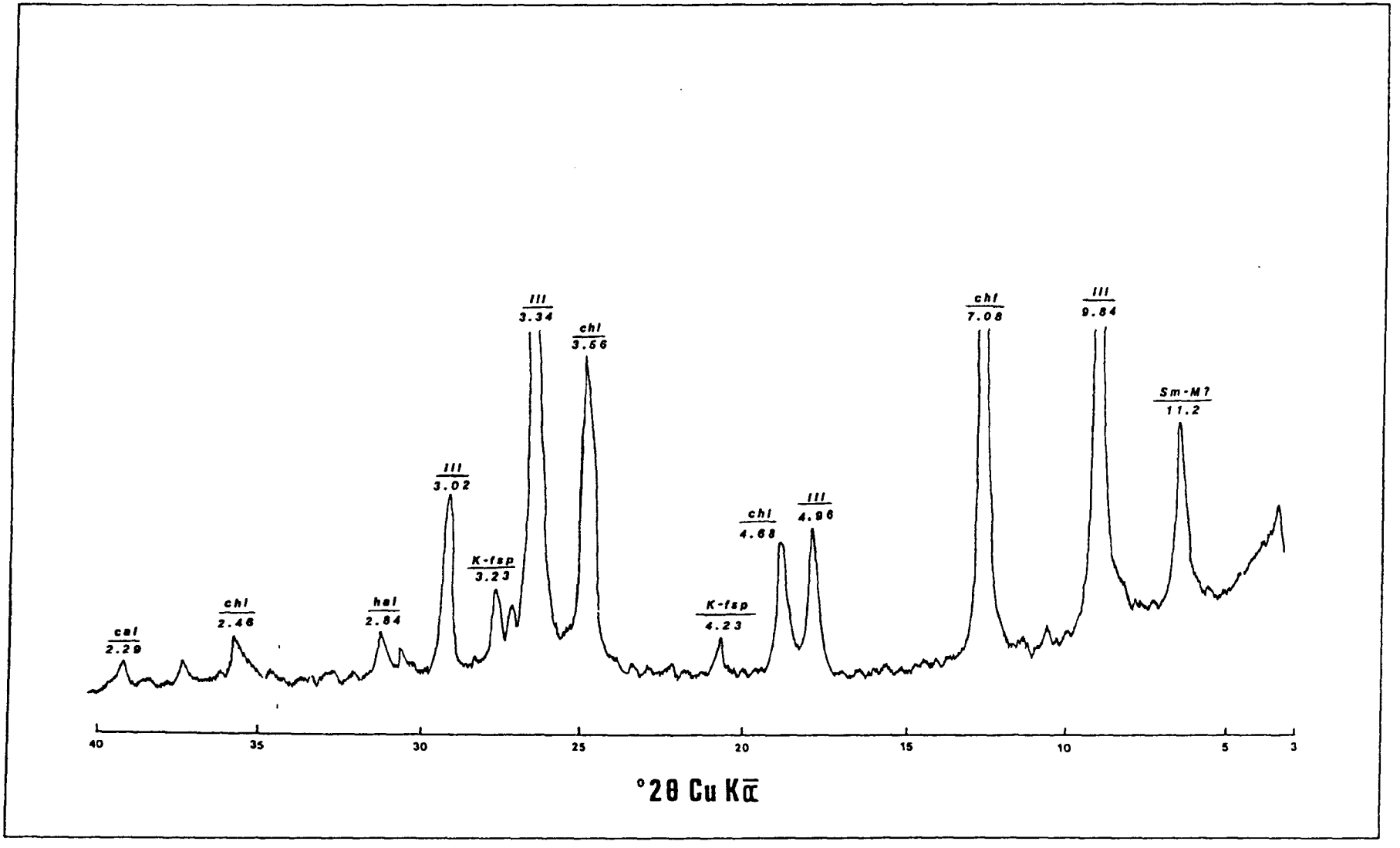
SAMPLE DEPTHS.

1) 8.40M. 2) 18.85M. 3) 21.00M. 4) 21.50M. 5) 27.70M.

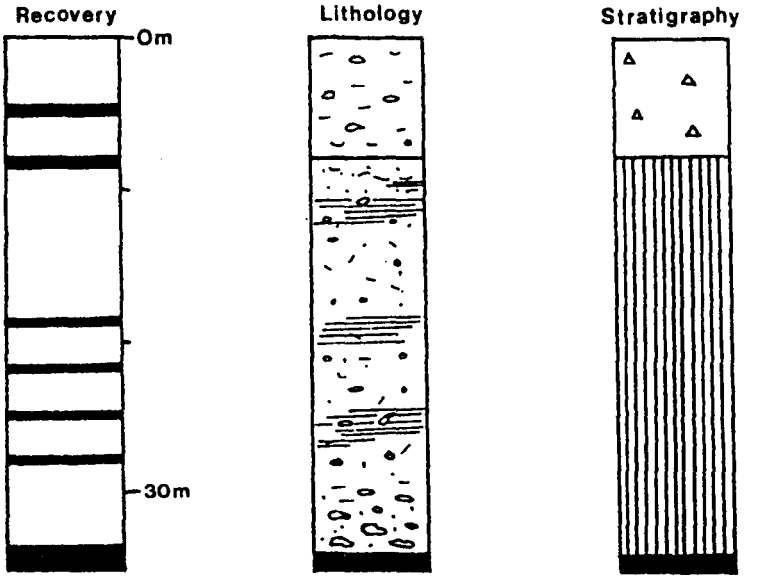
SITE FIX: 60 32 00N 01 55 50W.

SOILS LAB. UNIVERSITY OF KEELE

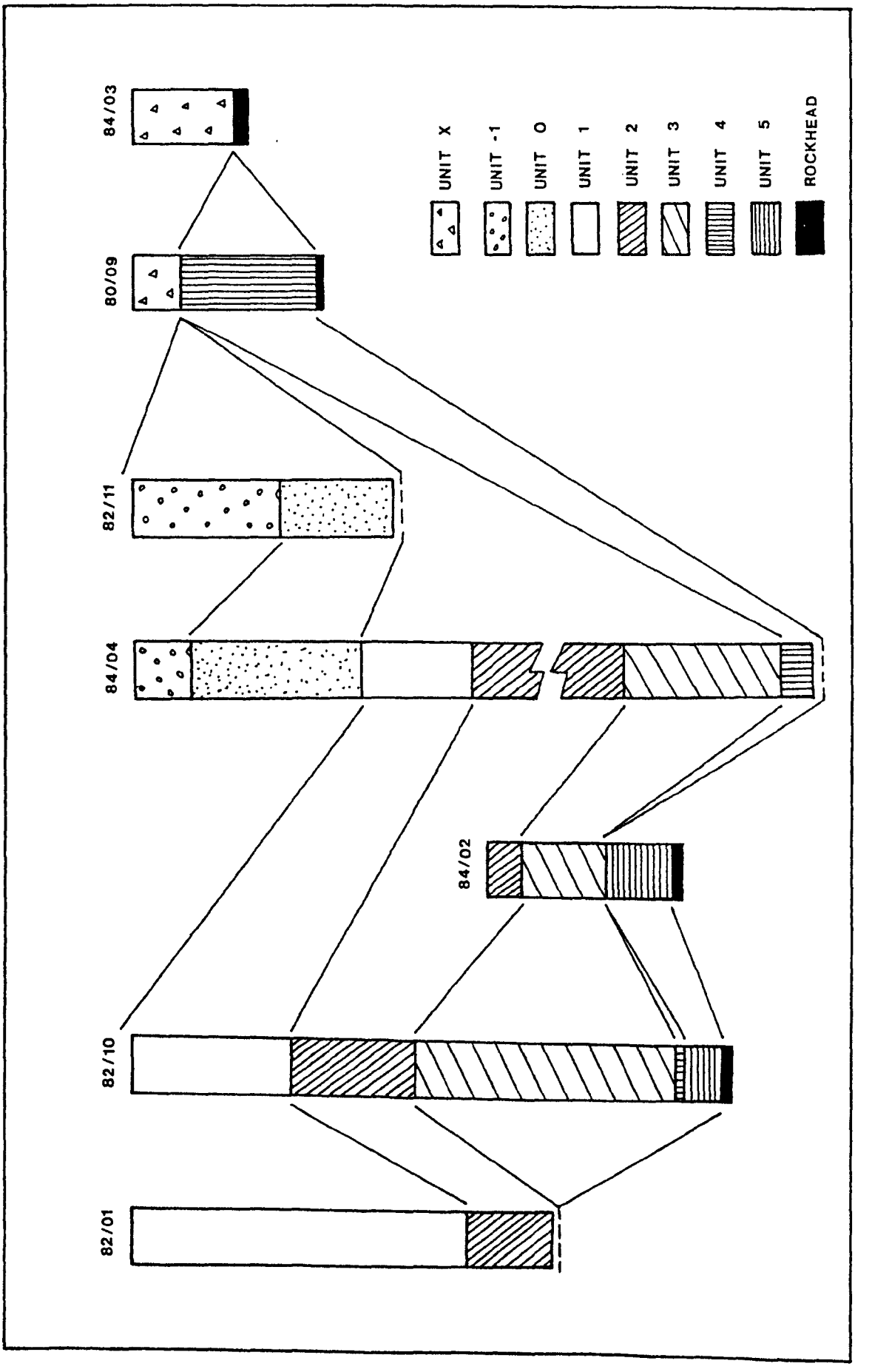
FIG 2.8.3. CLAY MINERALOGY : UNIT .4.



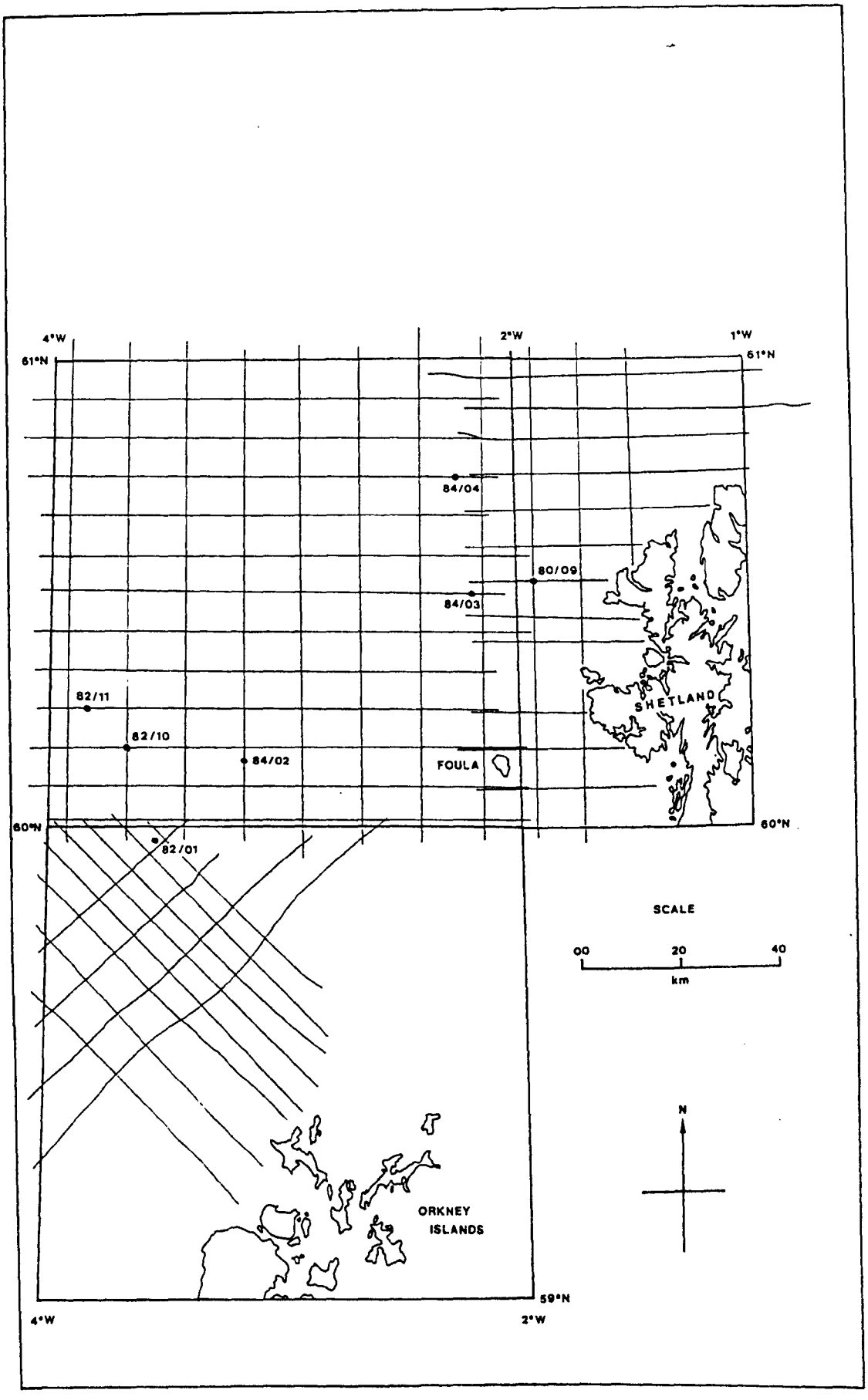
2.8.4. BOREHOLE SUMMARY LOG: BOREHOLE 80/09.



2.9.1. BOREHOLE ANALYSIS: UNIT CORRELATION.



3.1. SEISMIC TRAVERSE LINES ANALYSED IN THIS STUDY.



61°N 4°W — 3°W — 2°W — 61°N 1°W

KEY

61 LINE NUMBERS

80/09 BOREHOLE SITES

a,b,c,v,x See main text

TRAVERSE LINES CROSS POINTS

UNIT .X.
UNIT .-2.
UNIT .-1.
UNIT .0.
UNIT .1.
UNIT .2.
UNIT .3.
UNIT .4.
TERTIARY } UNIT .5.
BASEMENT }

REFLECTORS.

—— POSITIVE

— — TENTATIVE

---- POSSIBLE

SCALE

0 m
200
400

0 10 20
kms

1:250,000

37 36 38 43 44 45 39 61 40 41 54 53

22 35 23 34 24 33 25 32 26 27 17

84/04 84/03 80/09 82/11 82/10

SHETLAND

FOULA

60°N 1°W

FIGURE 3.2A SEISMIC SURVEY: EAST-WEST LINE INTERPRETATIONS.

(BGS SURVEY PROJECTS: 77/07 &79/14).

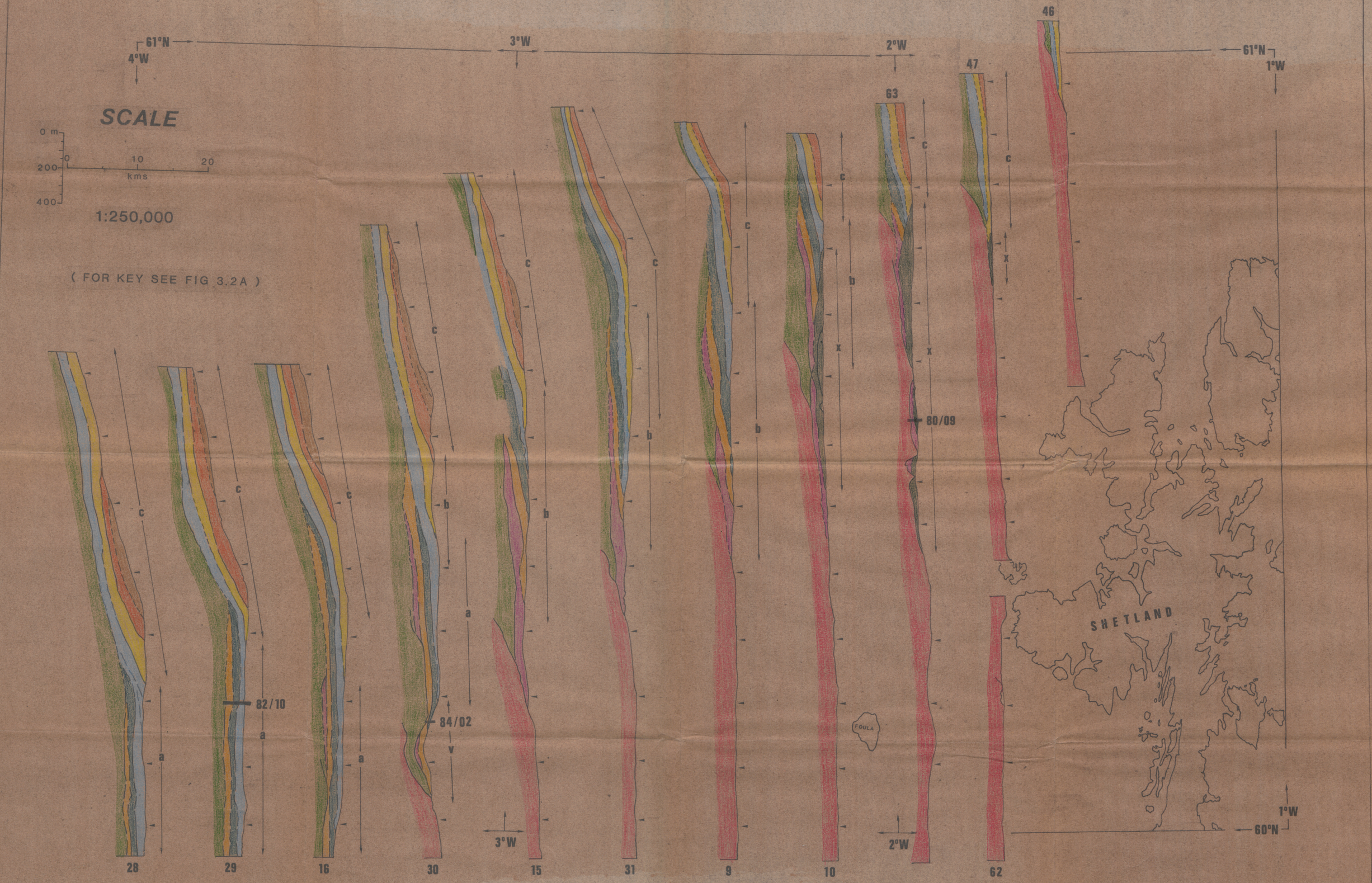


FIGURE 3.2B SEISMIC SURVEY: NORTH-SOUTH LINE INTERPRETATIONS.

(BGS SURVEY PROJECTS: 77/07 & 79/14).

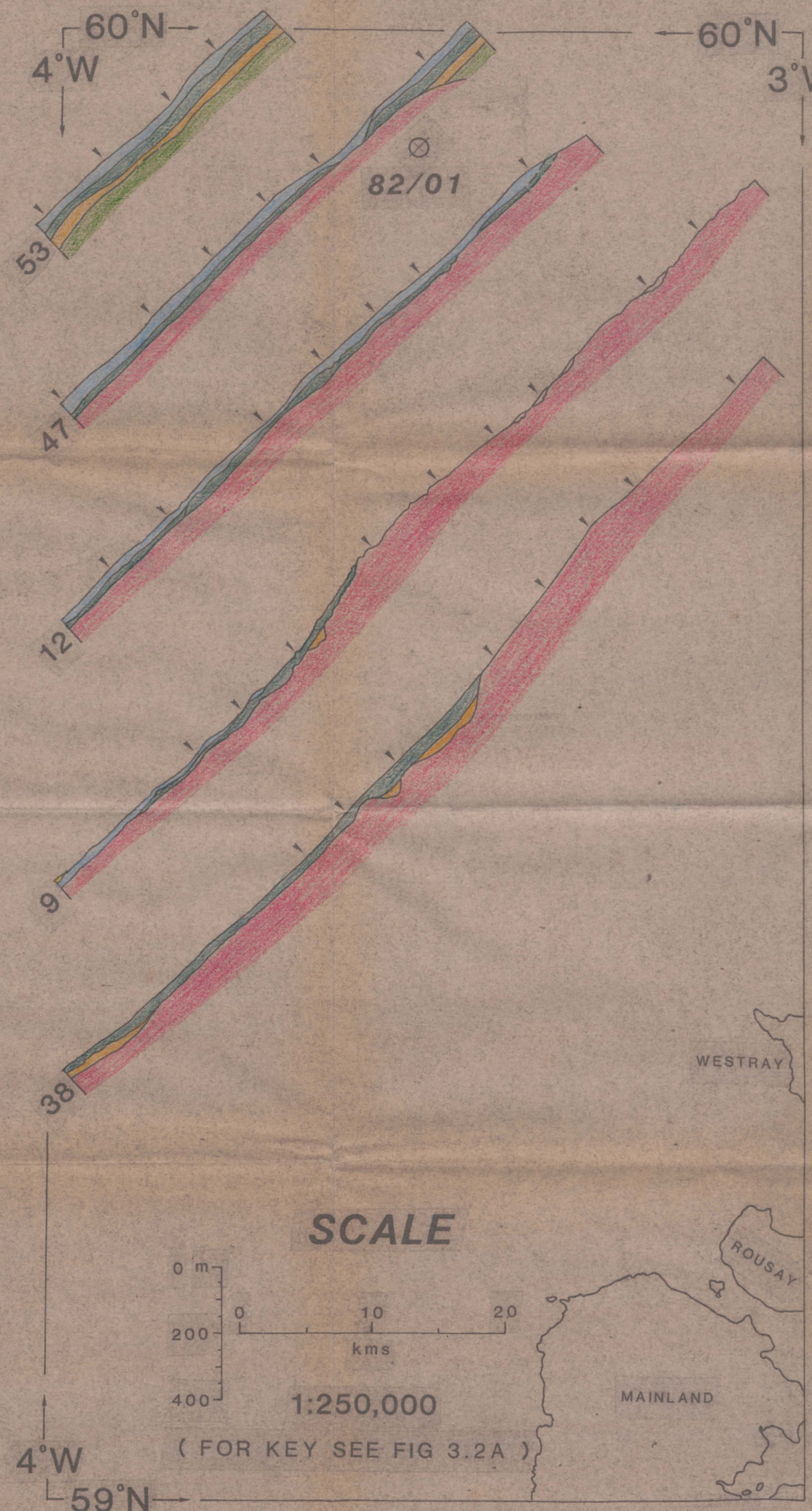


FIGURE 3.3A

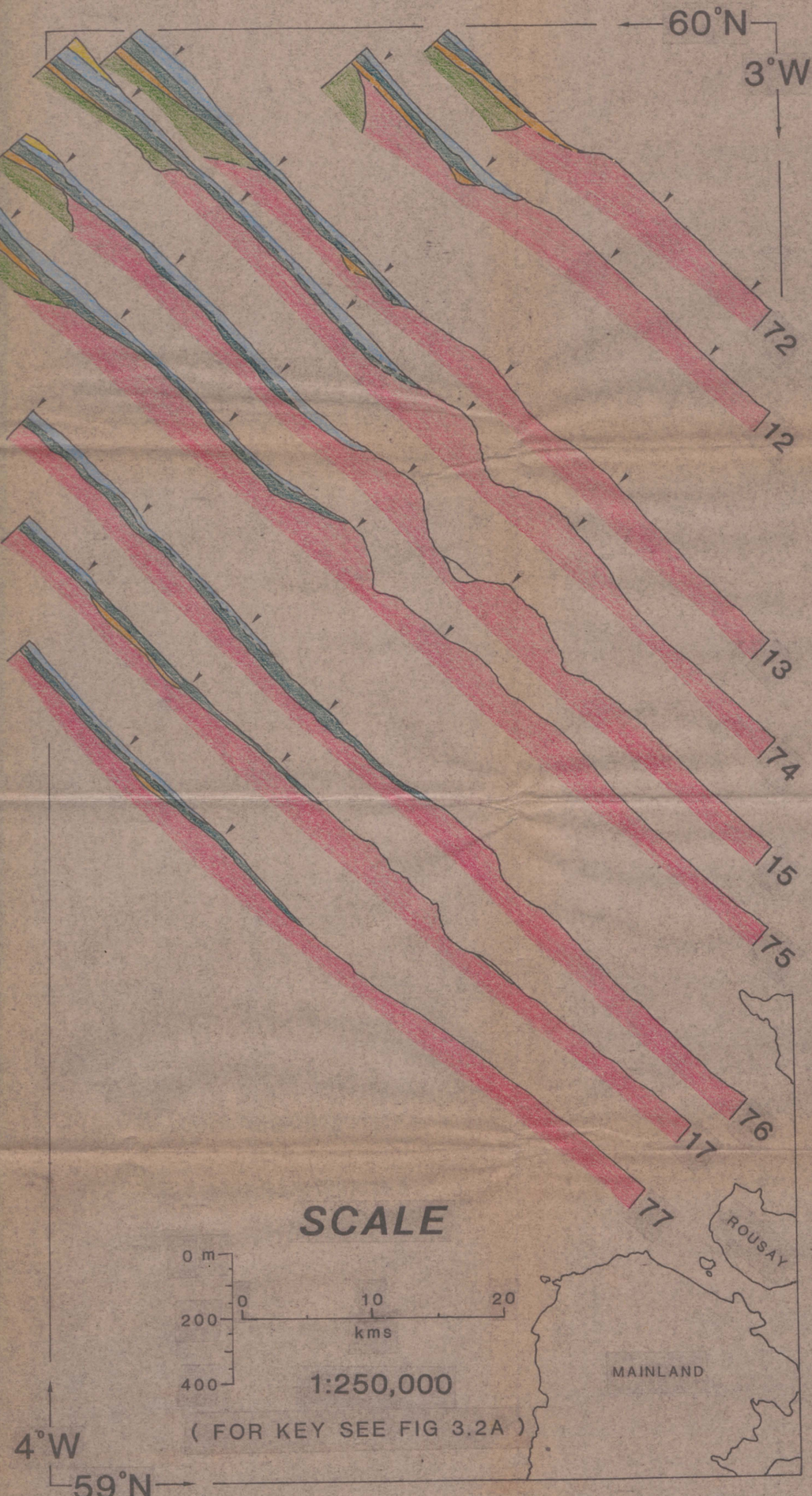
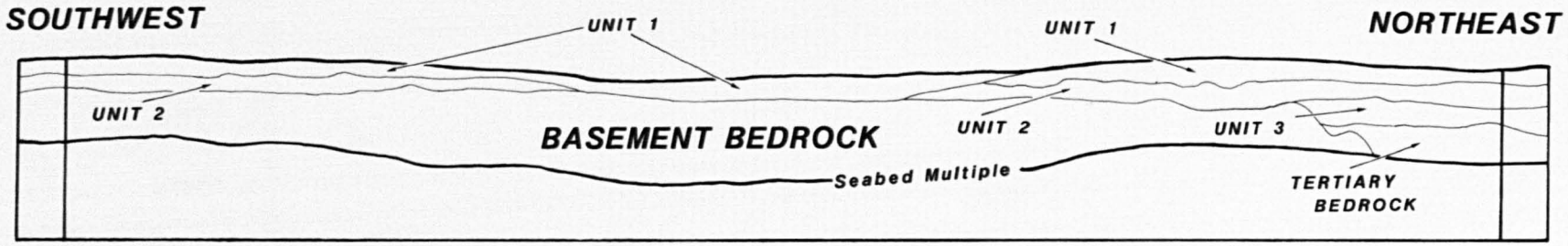


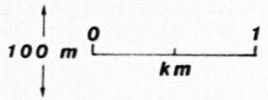
FIGURE 3.3B

SEISMIC SURVEY: WEST ORKNEY LINE INTERPRETATIONS.

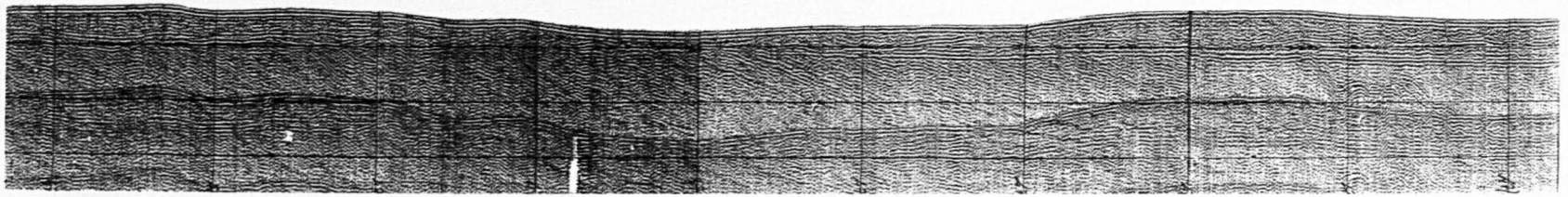
BGS SURVEY PROJECTS: 74/04 & 71/05.

FIG 3.4. SEISMIC STRUCTURE NORTH OF BOREHOLE 82/01.





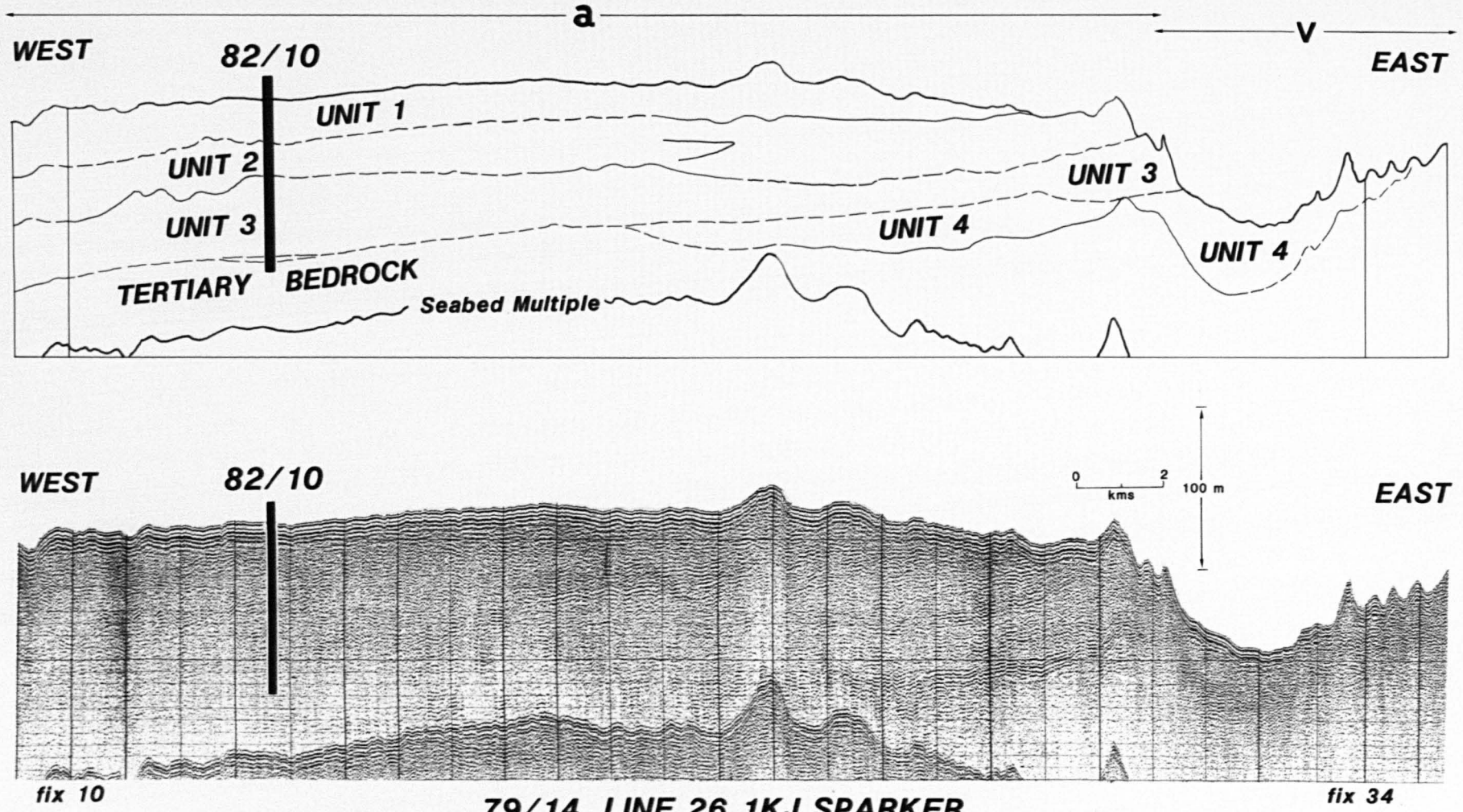
SOUTHWEST NORTHEAST



fix 27 — 74/04 LINE 47 1 KJ SPARKER — fix 36

For location see fig 3.3a.

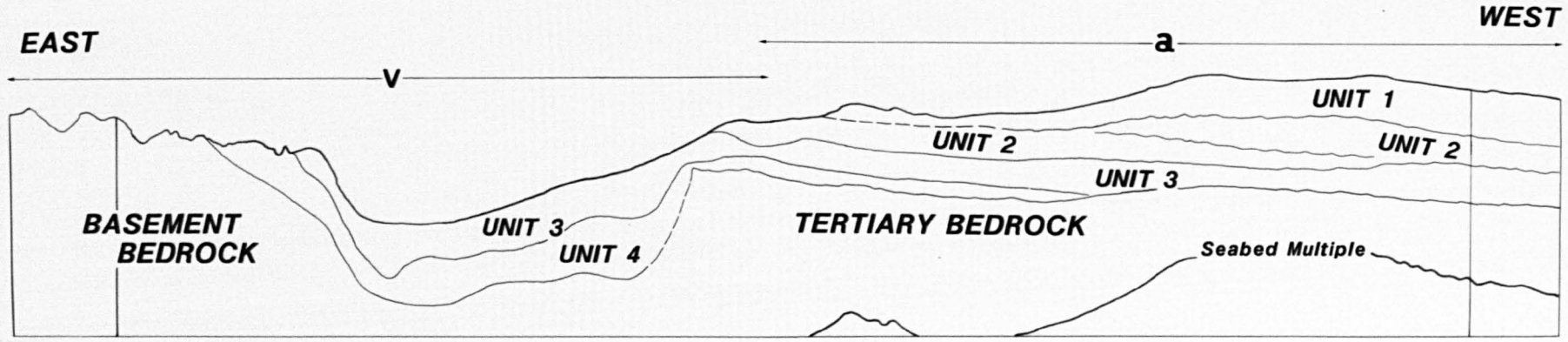
FIG 3.5. SITE LOCATION: BOREHOLE 82/10.

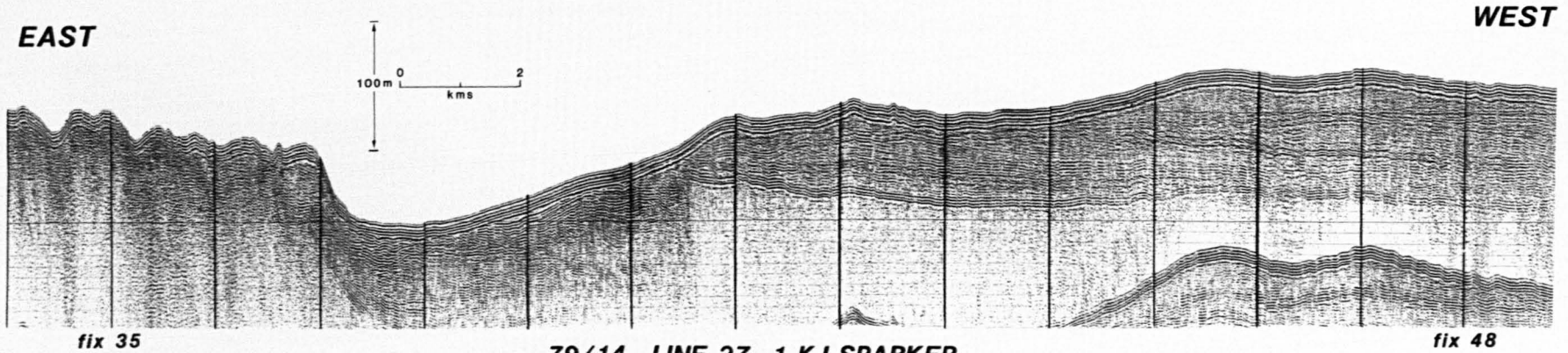


79/14 LINE 26 1KJ SPARKER

For location see Fig 3.2a.

FIG 3.6. REFLECTOR GEOMETRY IN AREAS MARKED 'A'.

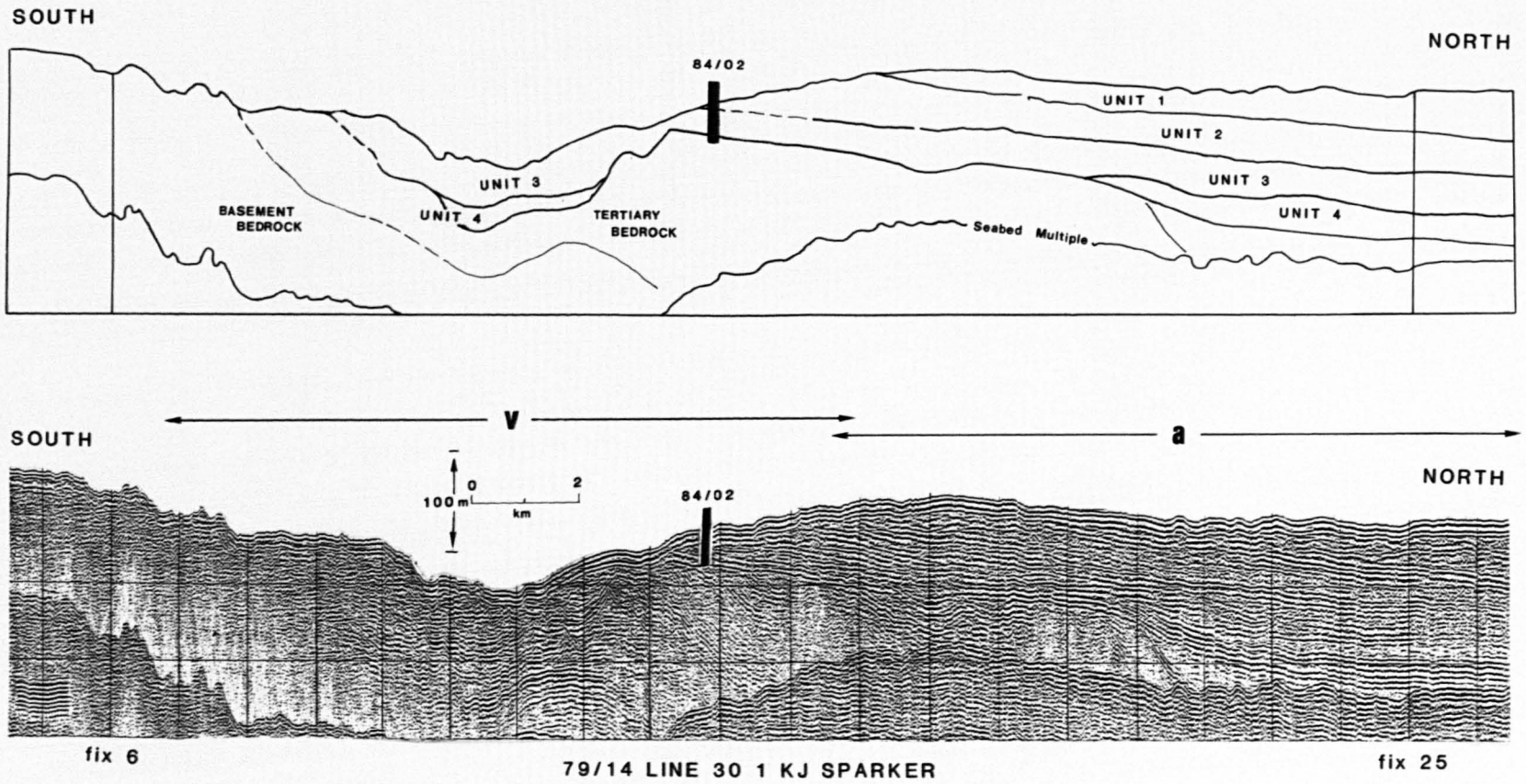




79/14 LINE 27 1 KJ SPARKER

For location see fig 3.2A.

FIG 3.7 SITE LOCATION: BOREHOLE 84/02



For location see fig 3.2b

3.8. REFLECTION GEOMETRY ACROSS THE SHELFBREAK.

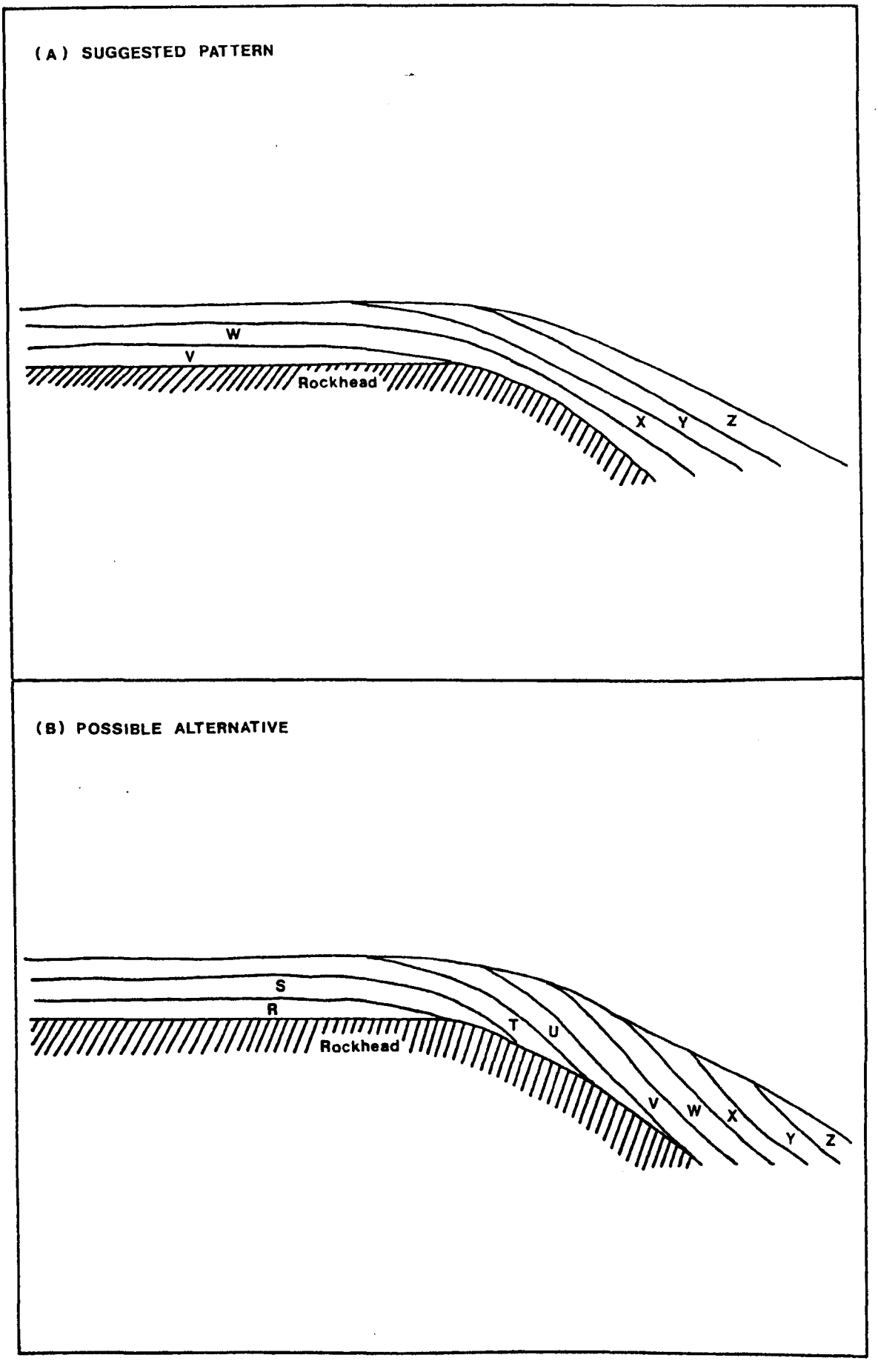
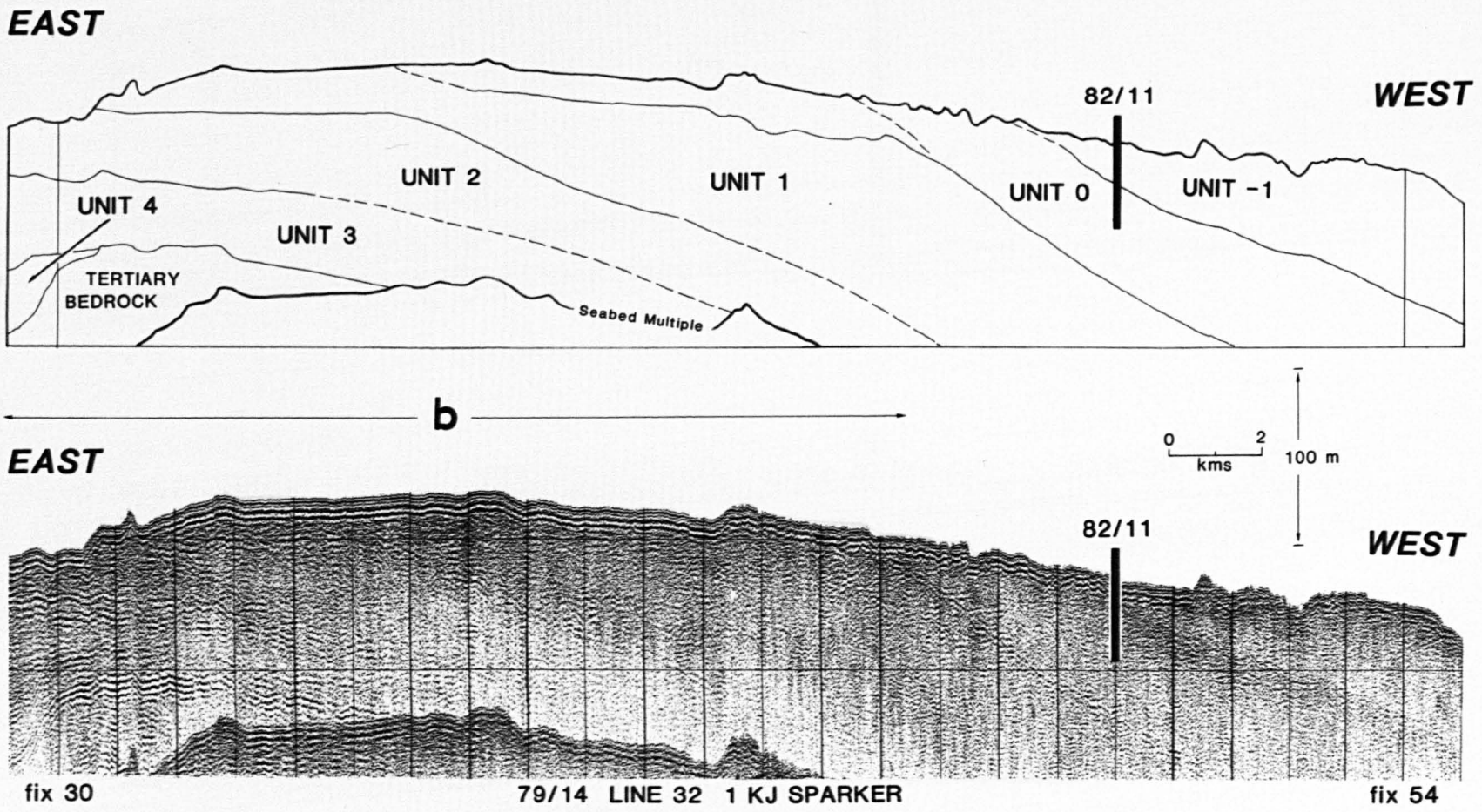
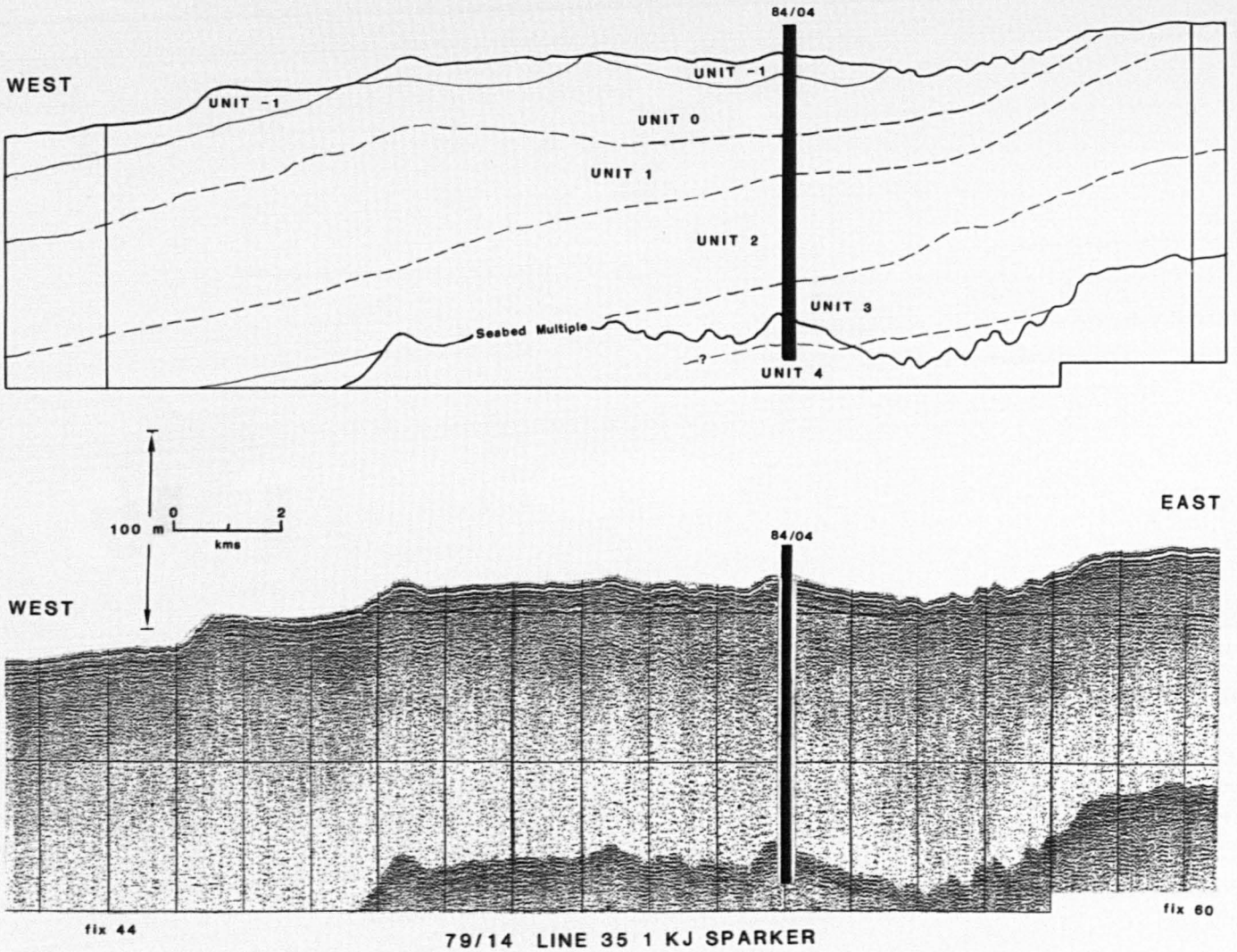


FIG 3.9 SITE LOCATION: BOREHOLE 82/11.



For location see fig 3.2a

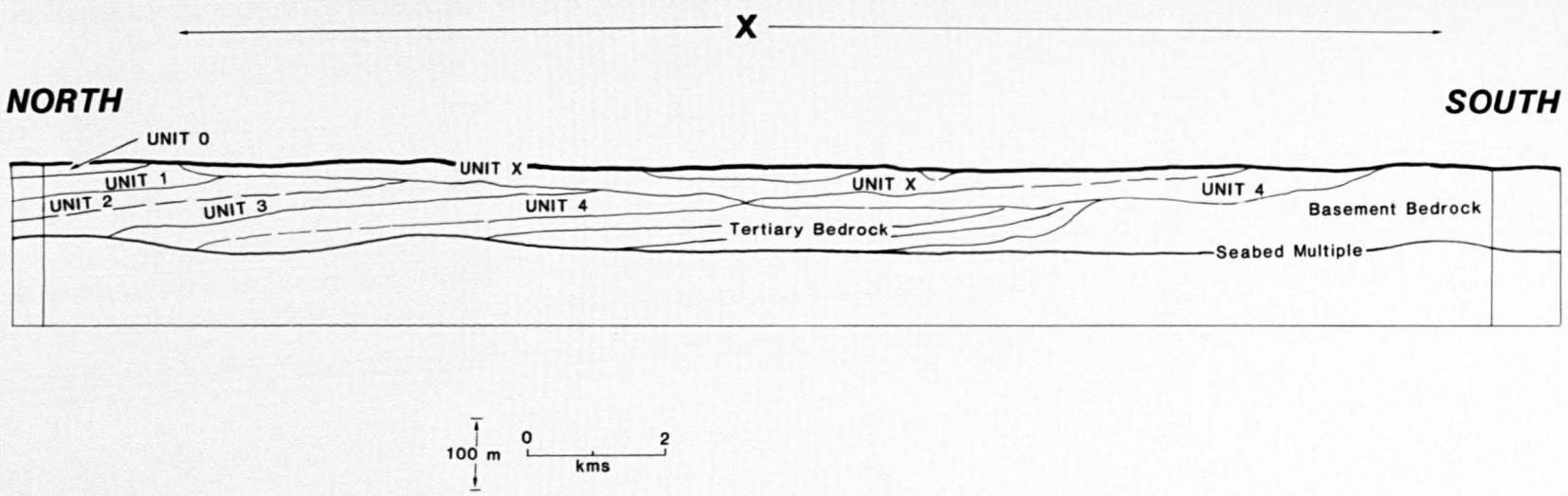
FIG 3.10 SITE LOCATION: BOREHOLE 84/04



79/14 LINE 35 1 KJ SPARKER

For location see fig 3.2a

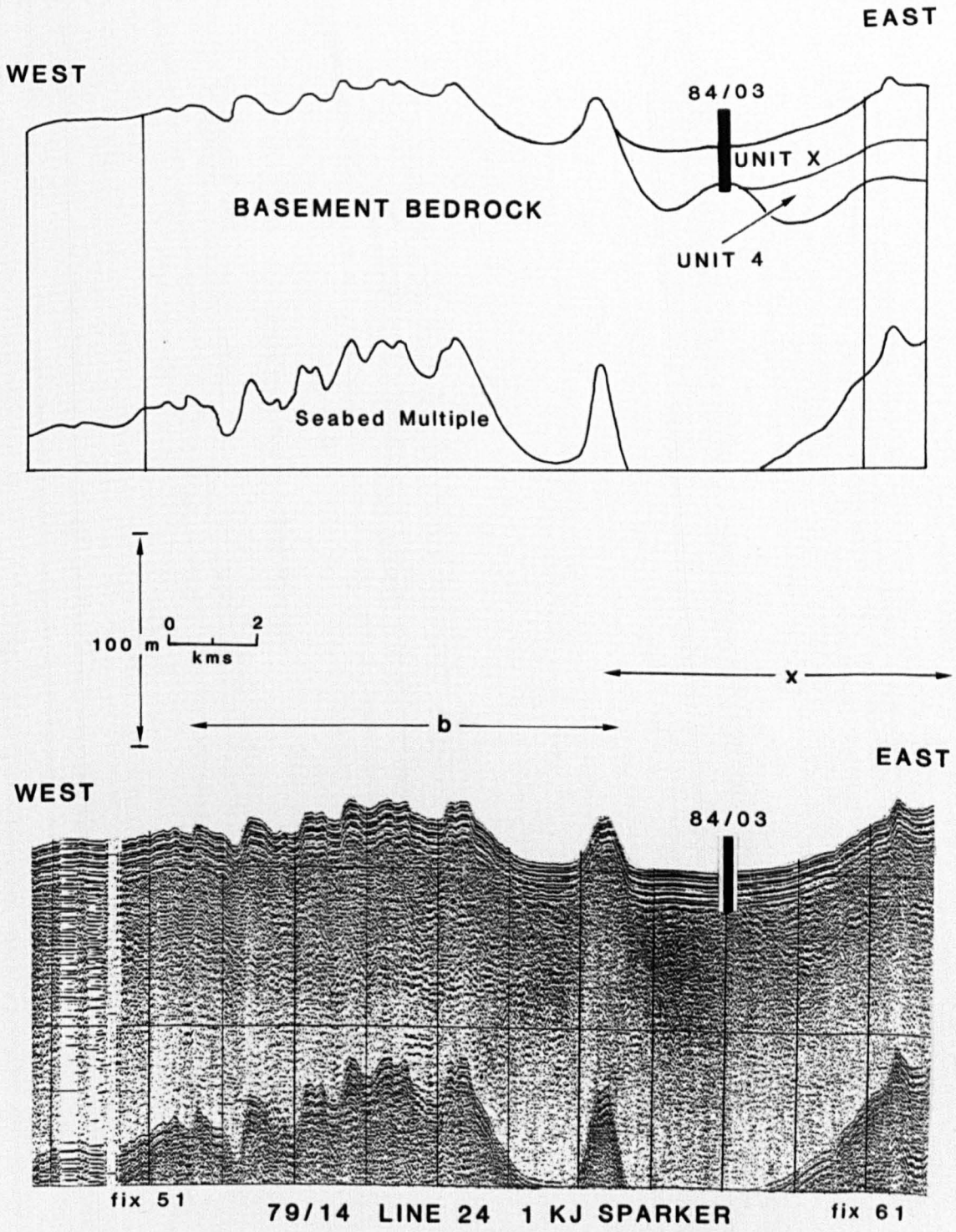
FIG 3.11. SEISMIC STRUCTURE WEST OF ST. MAGNUS BAY



79/14 LINE 10 1 KJ SPARKER

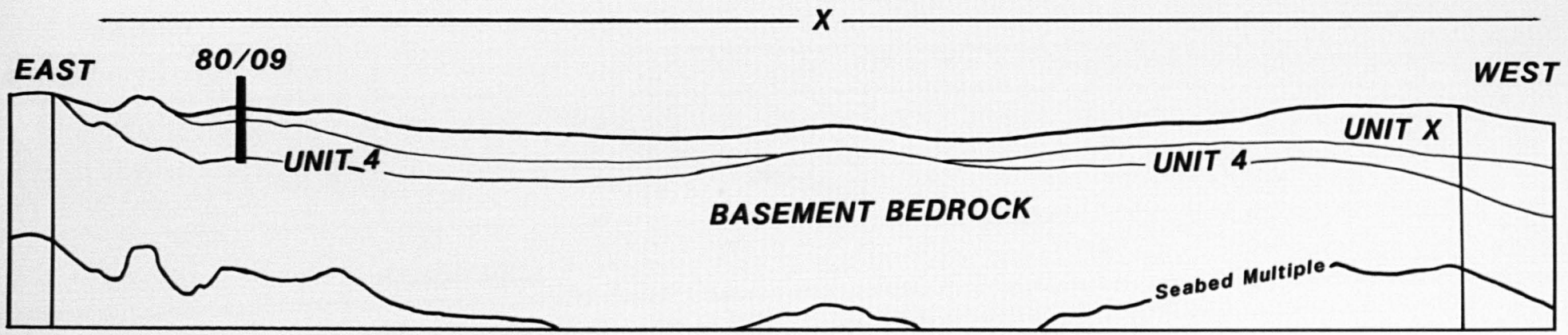
For location see fig 3.2b.

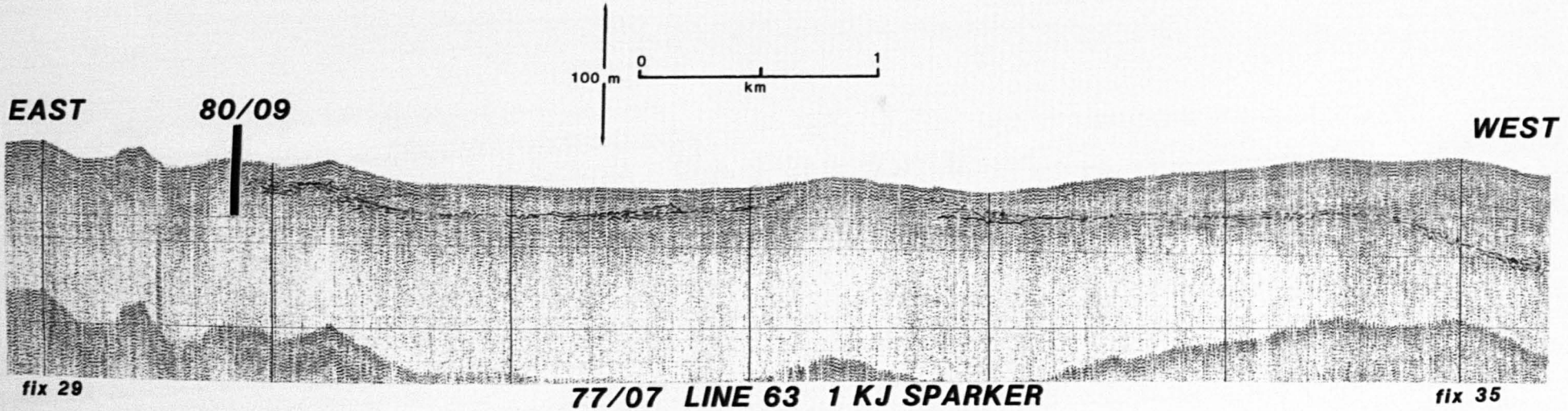
FIG 3.12. SITE LOCATION BOREHOLE 84/03.



For location see fig 3.2a.

FIG 3.13 SITE LOCATION: BOREHOLE 80/09.

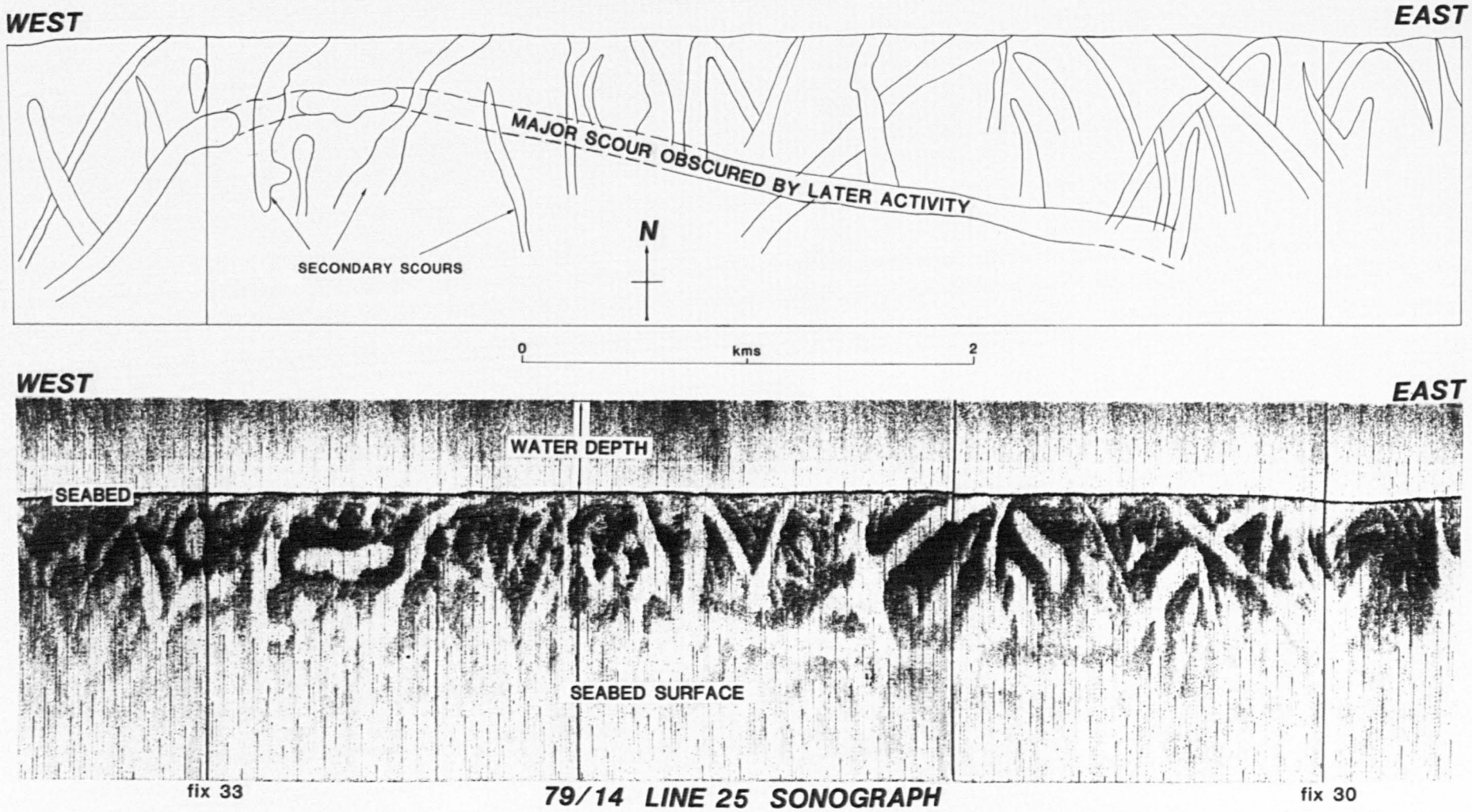




77/07 LINE 63 1 KJ SPARKER

For location see fig 3.2a

FIG 3.14. EXAMPLE OF ICEBERG SCOUR PATTERNS.



79/14 LINE 25 SONOGRAPH

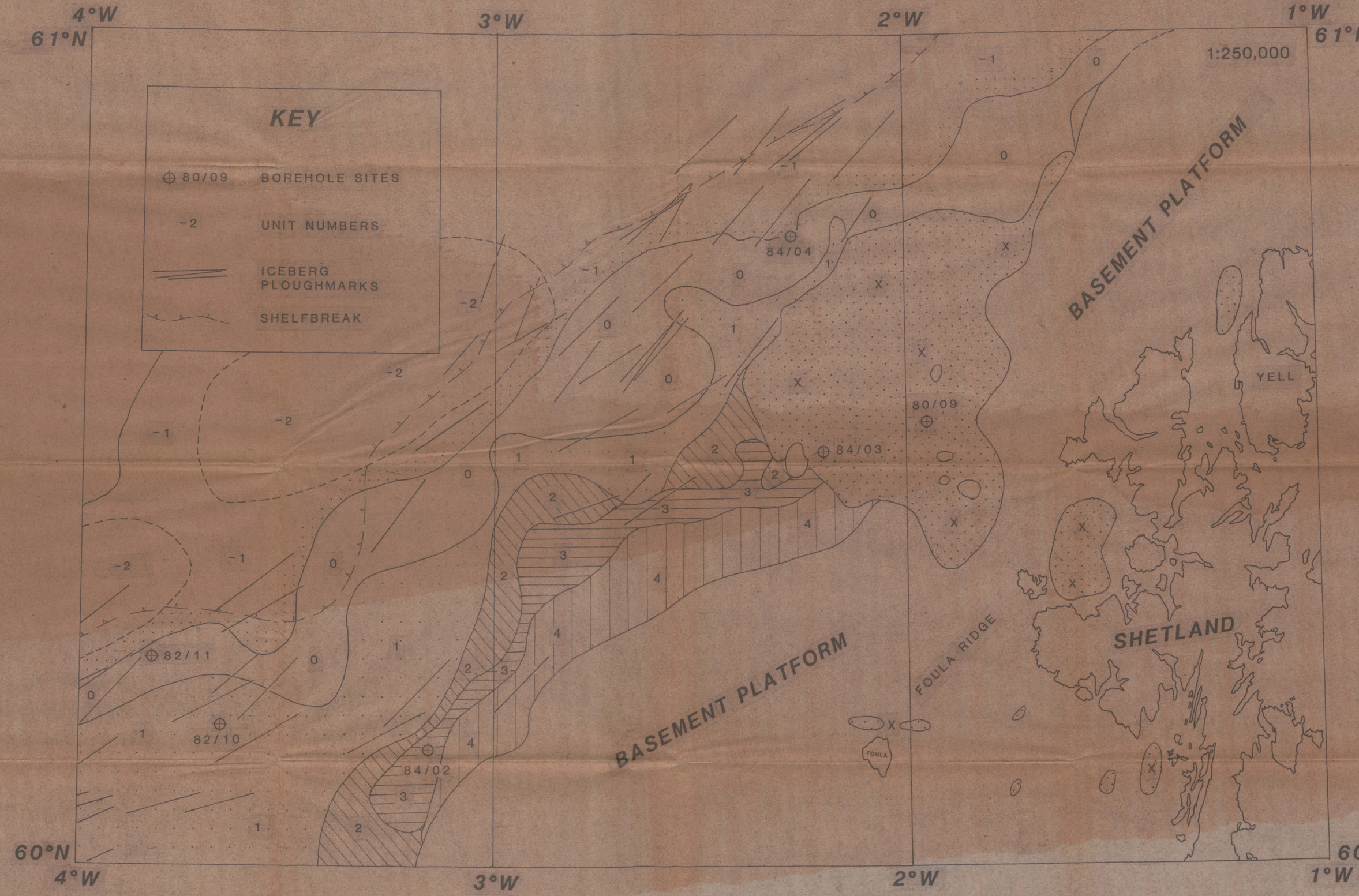


FIGURE 3.15 SEABED FEATURES AND UNIT OUTCROP PATTERNS.

DEPTH INDETERMINATE
BEYOND THIS POINT

4°W

2°W

61°N

1°W

60°N

4°W

59.5°N

ORKNEY-SHETLAND PLATFORM

FOULA RIDGE

FOULA

WEST SHETLAND PLATFORM

ST. MAGNUS BAY BASIN

YELL

MAINLAND

WEST FAIR ISLE BASIN

2°W

1°W

60°N

59.5°N

WESTRAY

MAINLAND

ROUSAY

N

SCALE

0 10 20
kms

ALL DEPTHS IN METRES

1:250,000

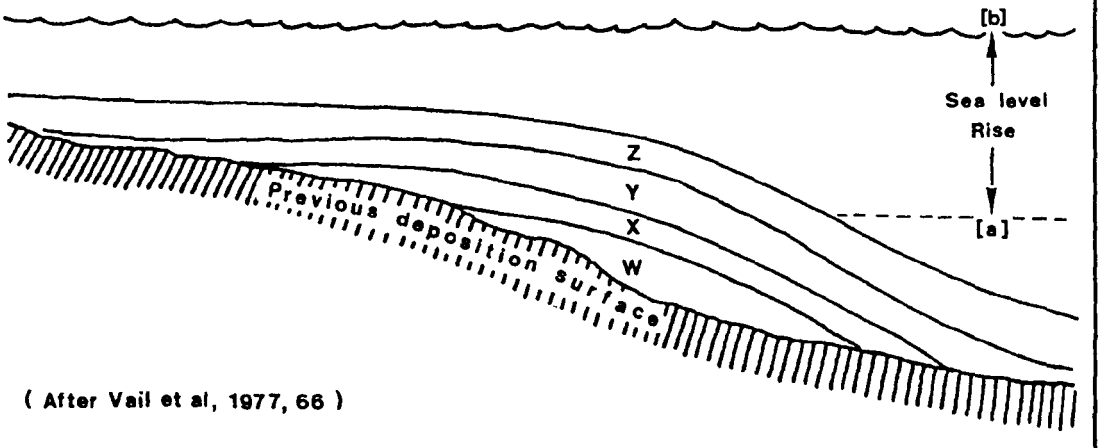
Based on data from present study plus a synthesis of published and unpublished maps produced by D.Evans and J.Cheshet, Marine Geology Unit, British Geological Survey.

FIGURE 3.16 QUATERNARY ISOPACHS.



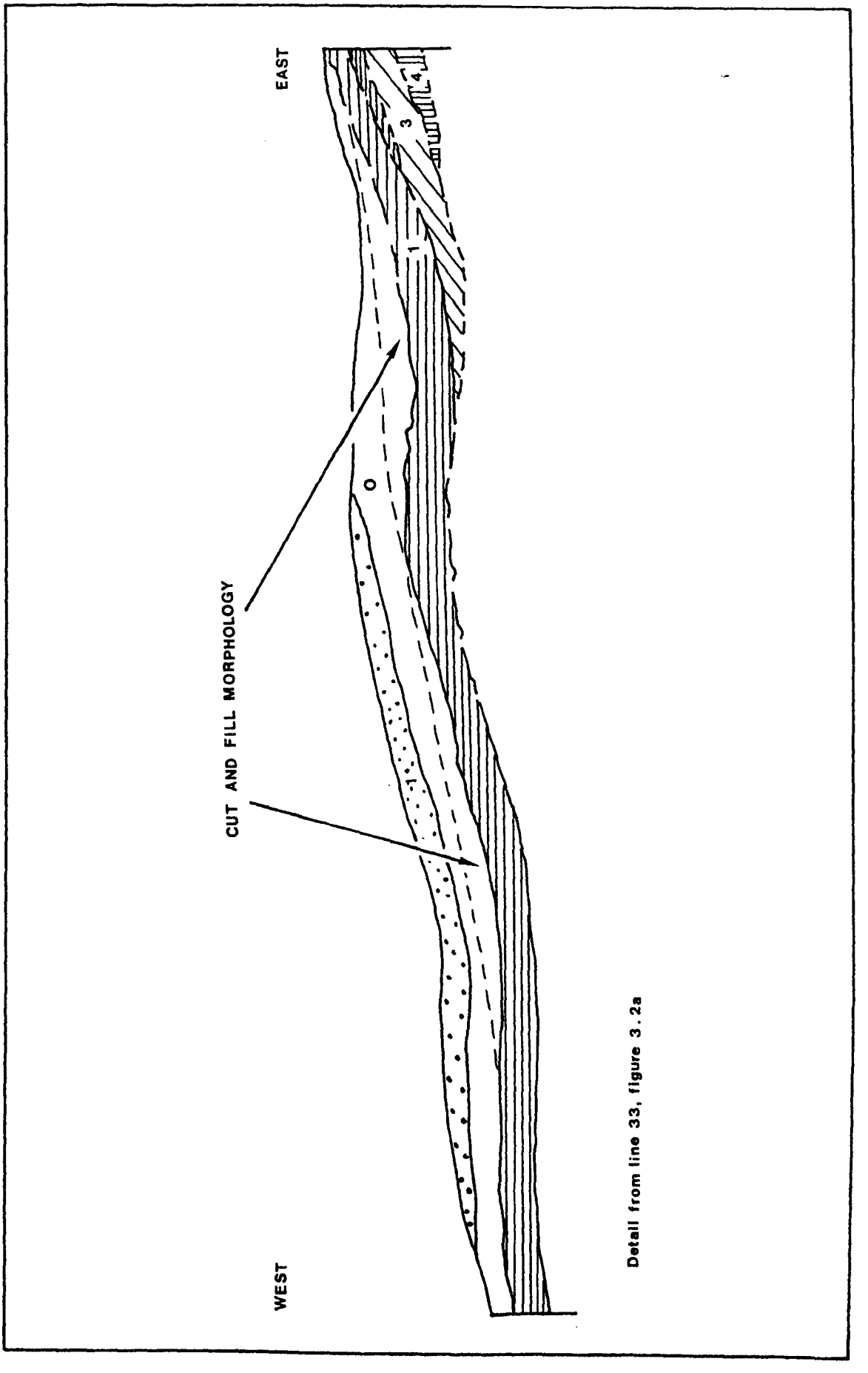
FIGURE 3.17 STUDY AREA BATHYMETRY.

3.18. DEPOSITIONAL UNIT ONLAP.

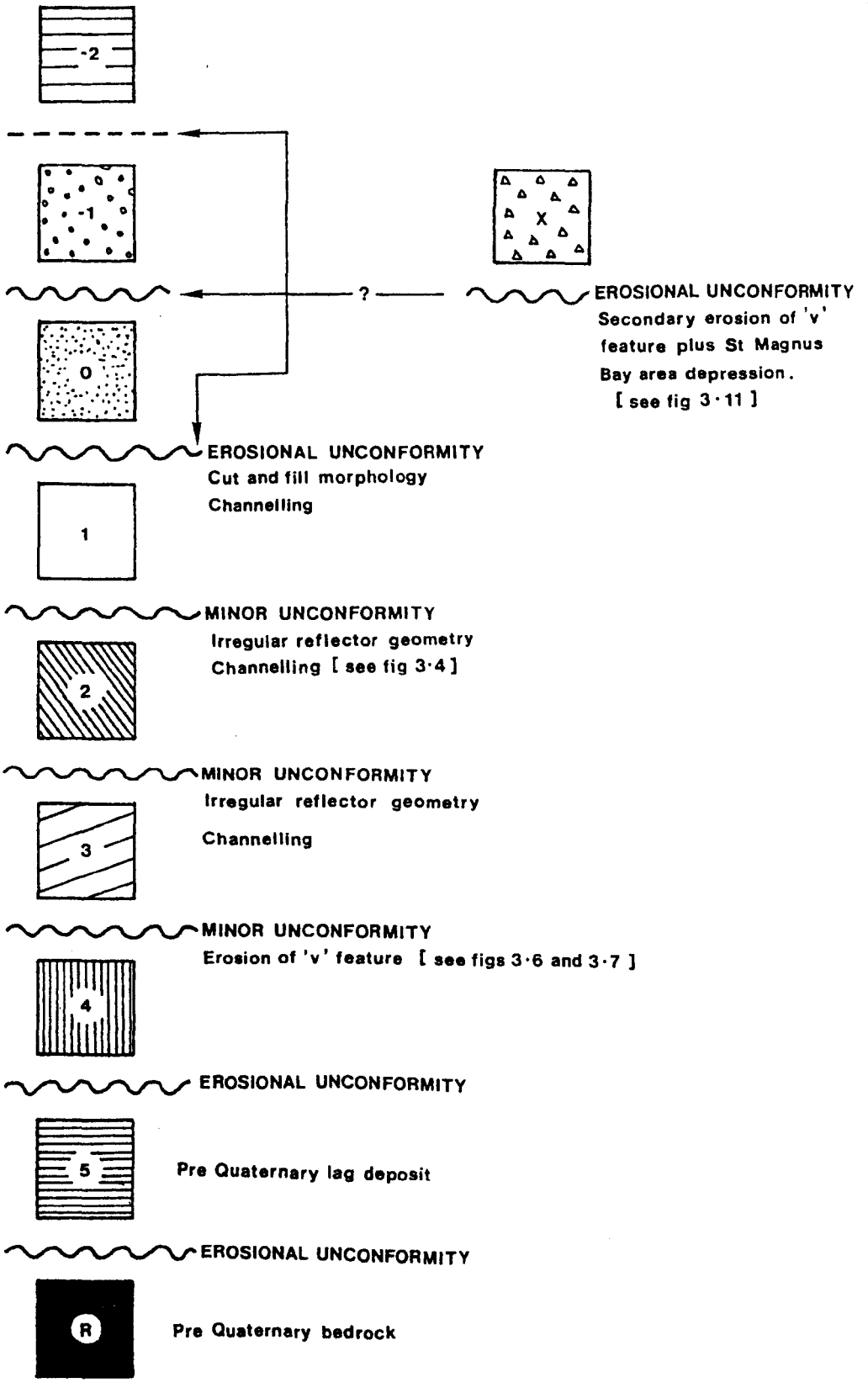


(After Vail et al, 1977, 66)

3.19. CUT-AND-FILL DEPOSITIONAL MORPHOLOGY.



3.20. CHRONOSTRATIGRAPHIC UNIT ASSOCIATIONS.



4.2.1. SEDIMENT DEFINITION PROCEDURE.

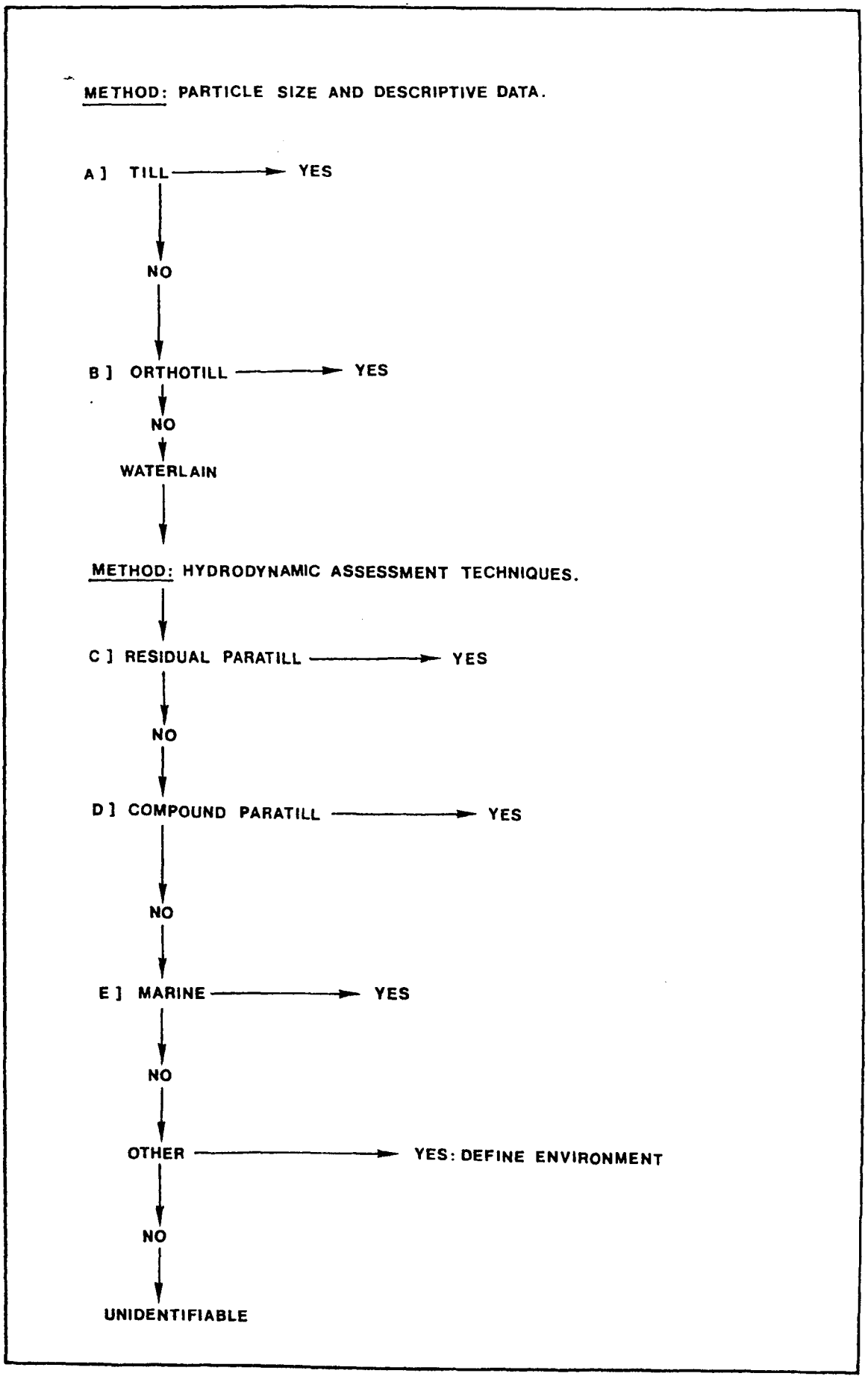


FIG 4.2.2. FACIES SUCCESSION MODEL.

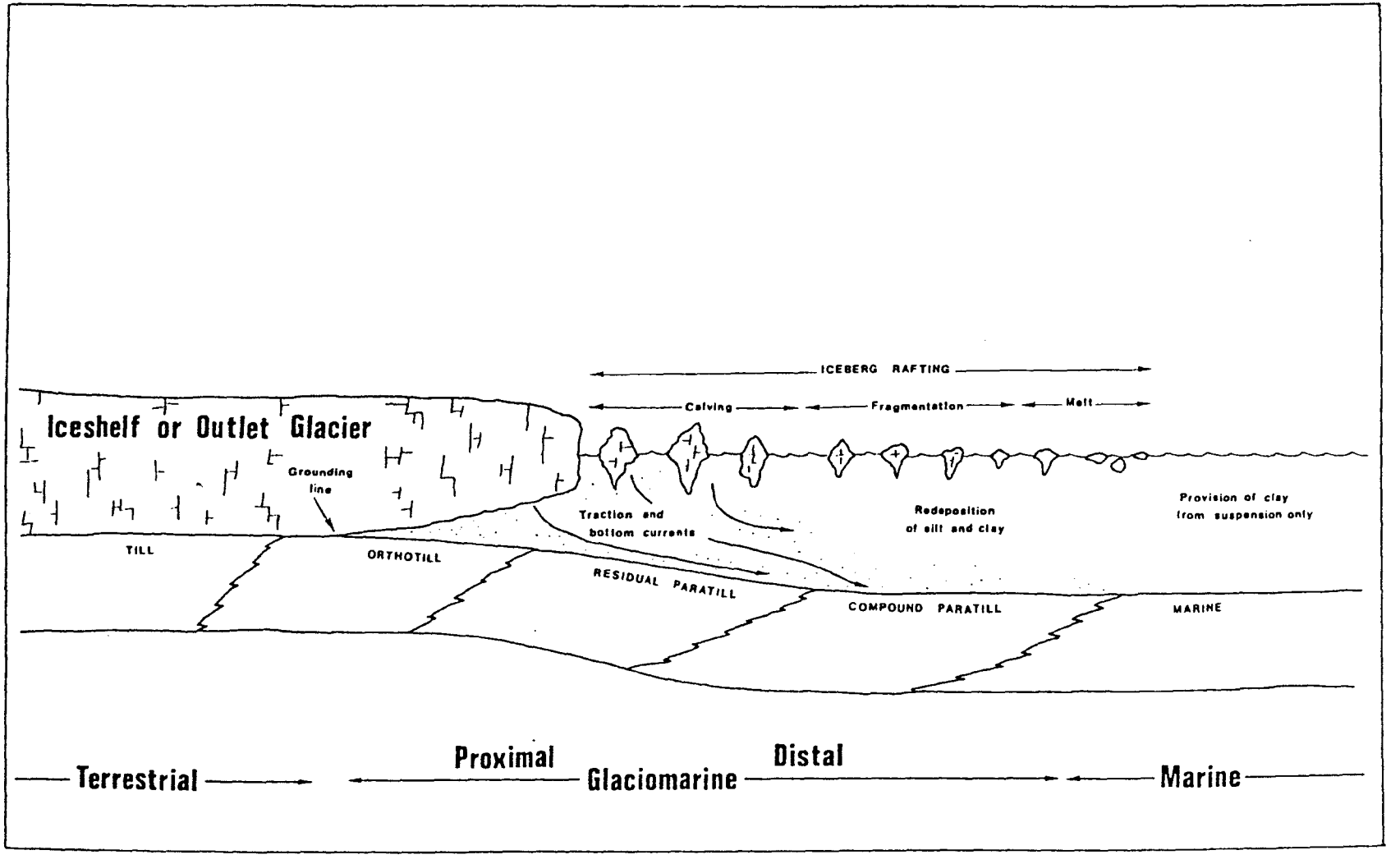
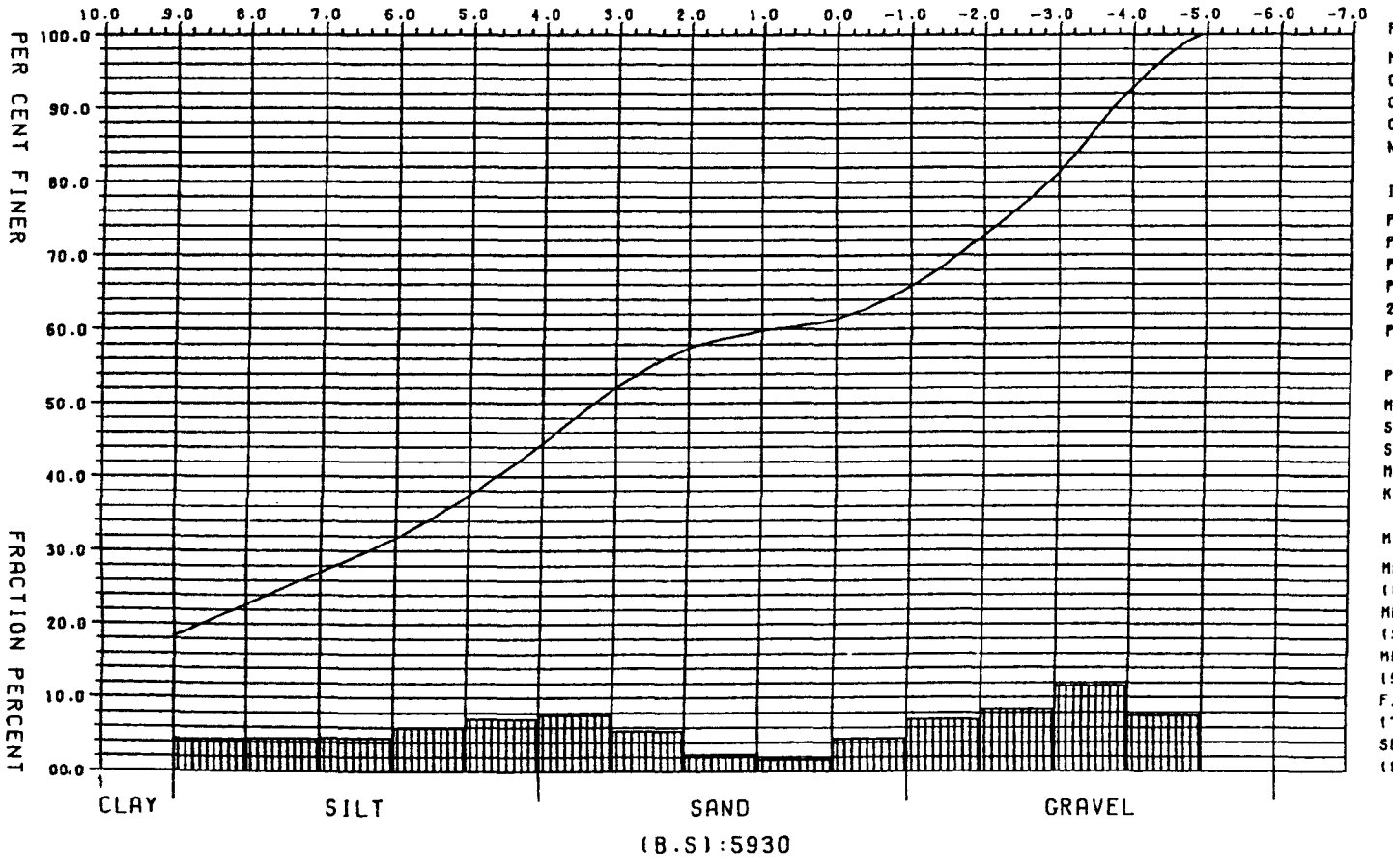


FIG 4.3.1. UNIT .4. (BH 80/09).

DEPTH: 21.50M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 3.20
GRAPHIC STANDARD DEVIATION = 5.79
GRAPHIC SKEWNESS = .05
GRAPHIC KURTOSIS = .72
NORMALISED KURTOSIS = .42

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 3.25
PHI (ARITHMETIC) MEAN DIAMETER = 3.17
PHI DEVIATION MEASURE = 6.43
PHI SKEWNESS MEASURE = -.01
2ND PHI SKEWNESS MEASURE = .14
PHI KURTOSIS MEASURE = .32

PHI MOMENT STATISTICS.

MEAN SIZE = .99
STANDARD DEVIATION = 3.80
SKEWNESS (THIRD MOMENT) = .36
MEAN CUBED DEVIATION = 19.91
KURTOSIS (FOURTH MOMENT) = 2.04

MC CAMMON'S STATISTICS.

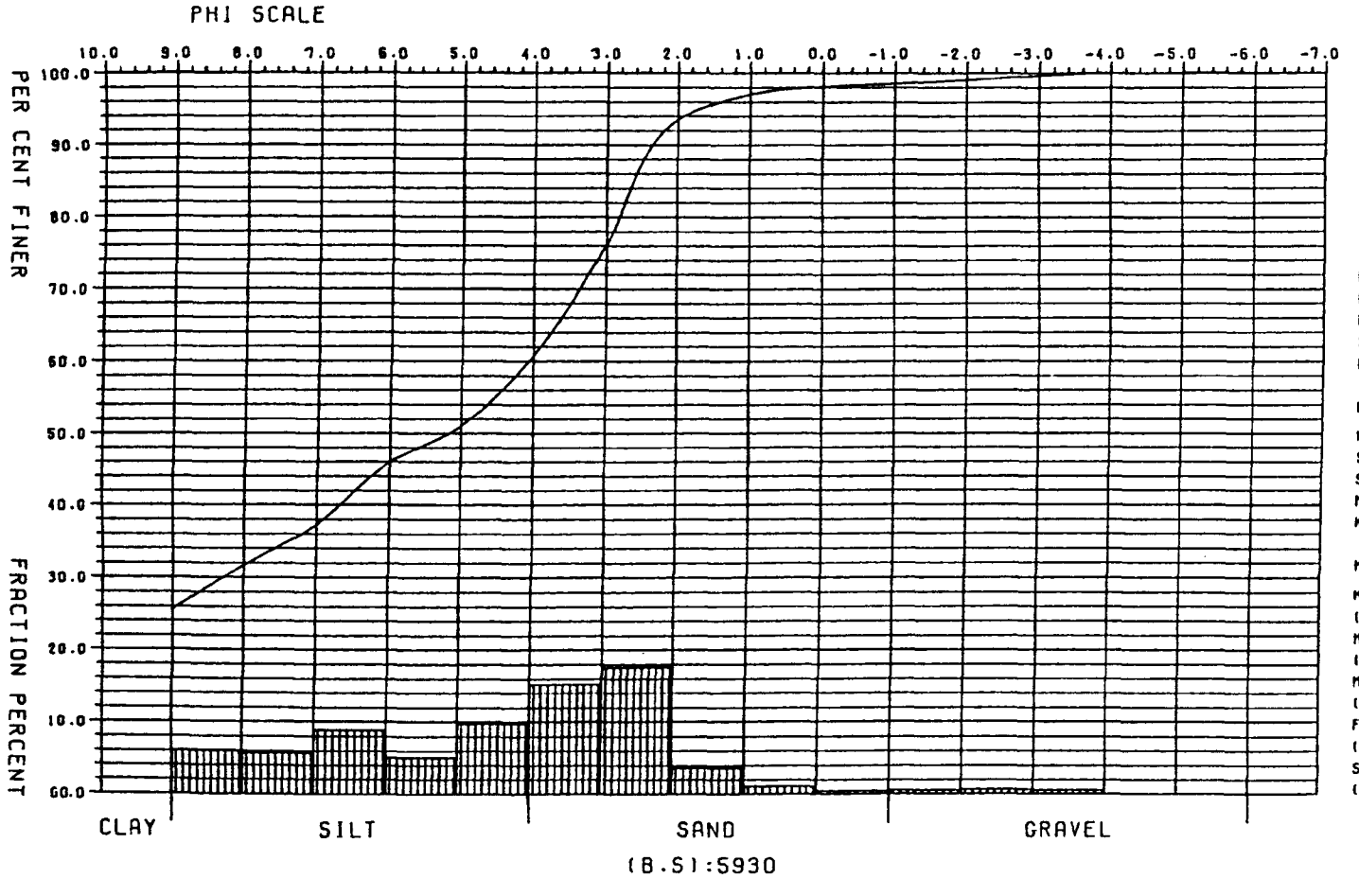
MEAN SIZE = 2.98
(88 PER CENT EFFICIENCY)
MEAN SIZE = 3.17
(93 PER CENT EFFICIENCY)
MEAN SIZE = 3.08
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 5.59
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 5.69
(87 PER CENT EFFICIENCY)

SITE FIX: 50 32 00N 01 55 50W.

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FIG 4.3.2. UNIT .4. (BH 84/04).

DEPTH: 148.70M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 6.18
GRAPHIC STANDARD DEVIATION = 3.82
GRAPHIC SKEWNESS = .37
GRAPHIC KURTOSIS = .78
NORMALISED KURTOSIS = .44

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 5.16
PHI (ARITHMETIC) MEAN DIAMETER = 6.69
PHI DEVIATION MEASURE = 4.16
PHI SKEWNESS MEASURE = .37
2ND PHI SKEWNESS MEASURE = .51
PHI KURTOSIS MEASURE = .38

PHI MOMENT STATISTICS.

MEAN SIZE = 3.20
STANDARD DEVIATION = 2.23
SKEWNESS (THIRD MOMENT) = 1.22
MEAN CUBED DEVIATION = 13.54
KURTOSIS (FOURTH MOMENT) = 4.00

MC CAMMON'S STATISTICS.

MEAN SIZE = 5.99
(88 PER CENT EFFICIENCY)
MEAN SIZE = 6.25
(93 PER CENT EFFICIENCY)
MEAN SIZE = 6.19
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.72
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.76
(87 PER CENT EFFICIENCY)

SITE FIX: 60 45 03N 02 16 21W.

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FIG 4.3.3. UNIT .4. (BH 80/09).

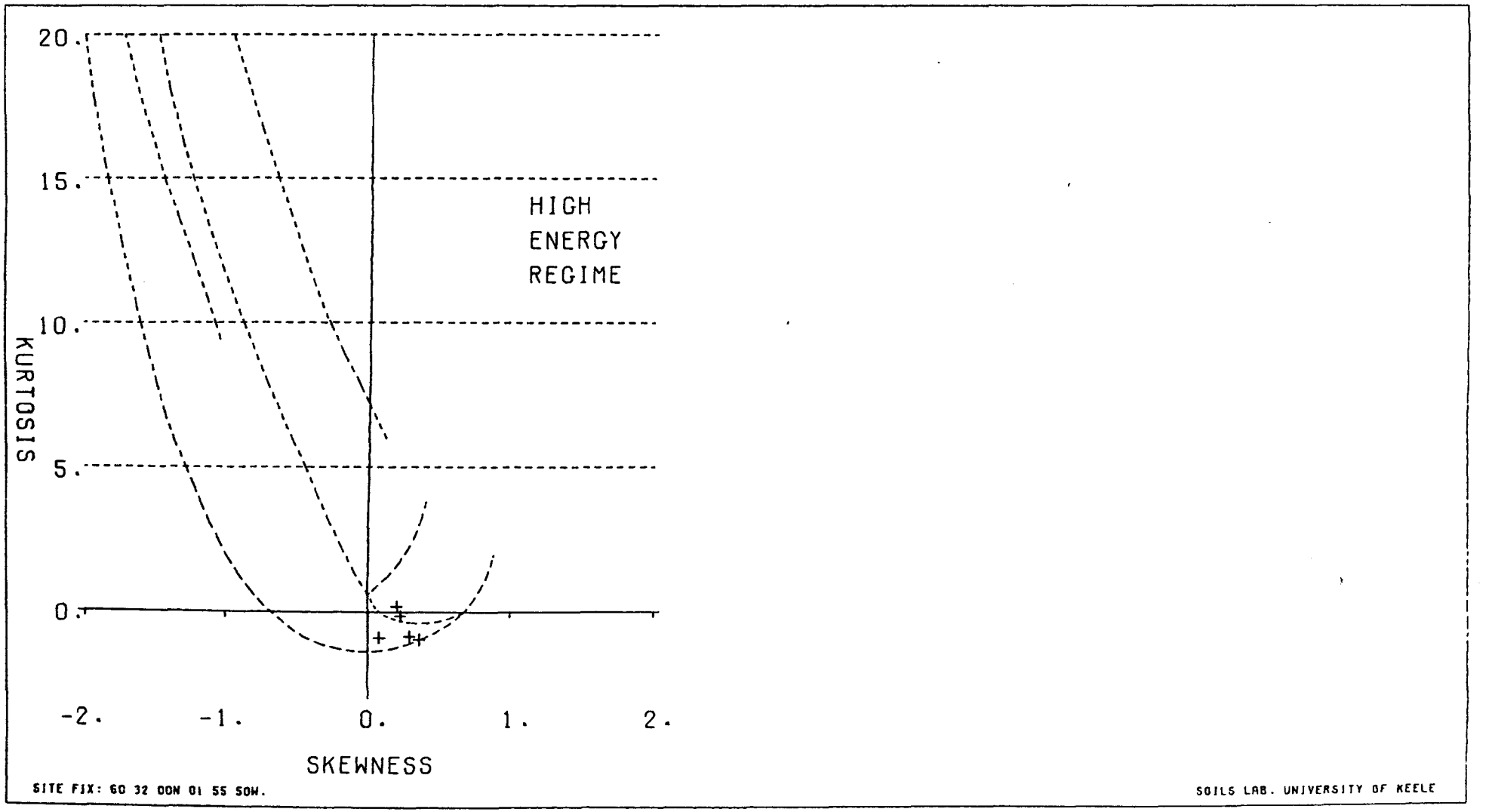


FIG 4.3.4. UNIT .4. (SECOND SUBGROUP).

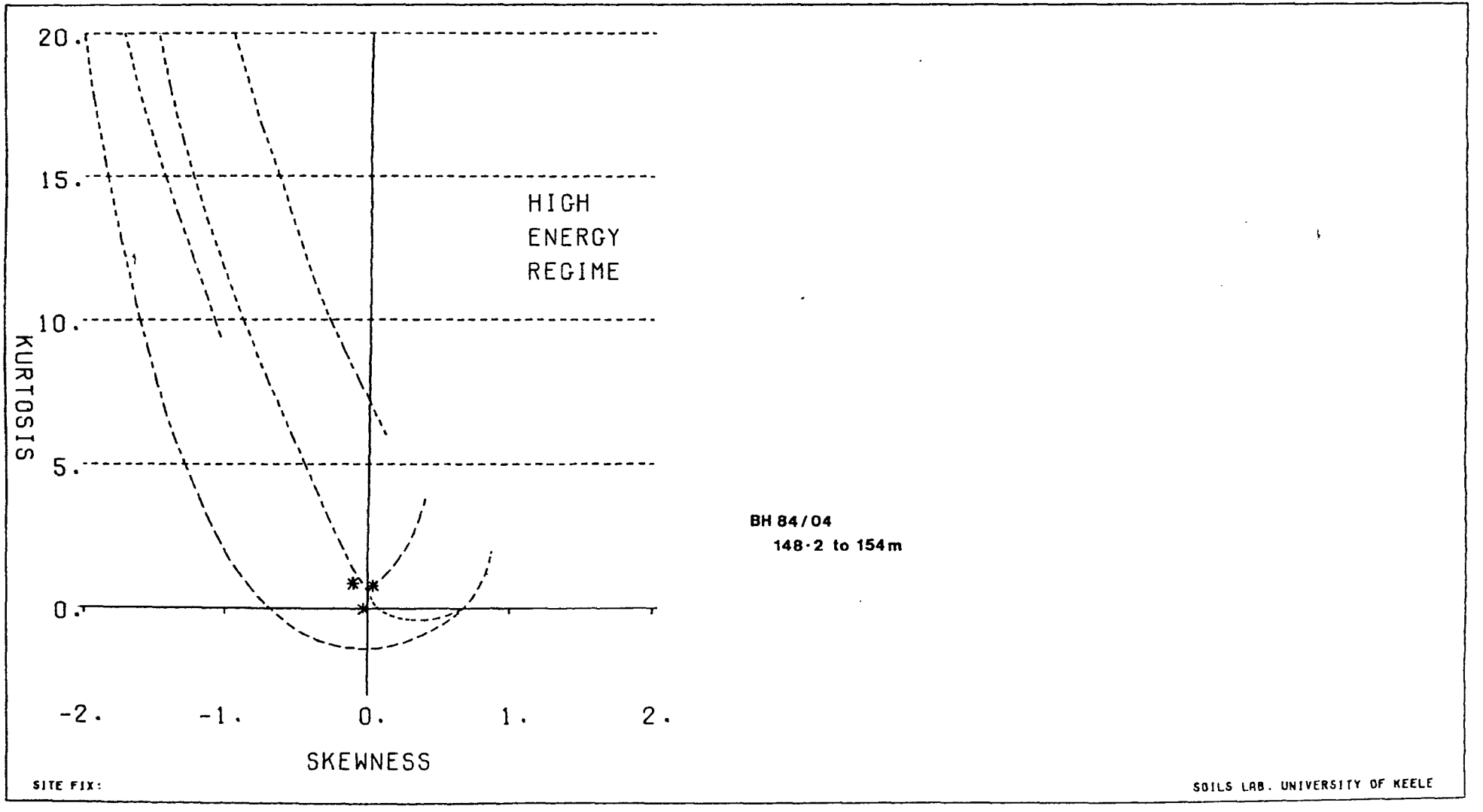


FIG 4.3.5. UNIT .4. (SECOND SUBGROUP).

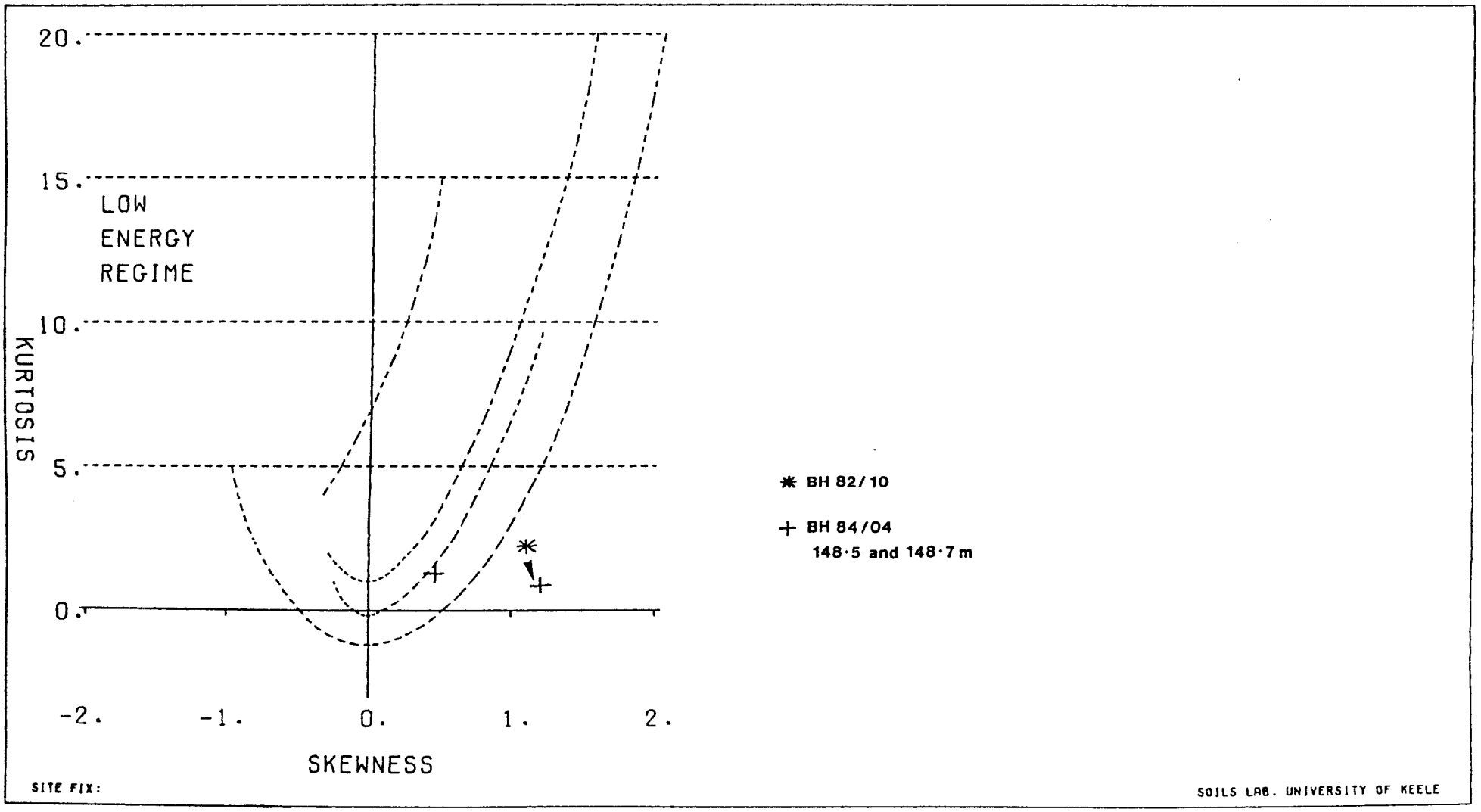


FIG 4.3.6. UNIT .4. SEDIMENTS.

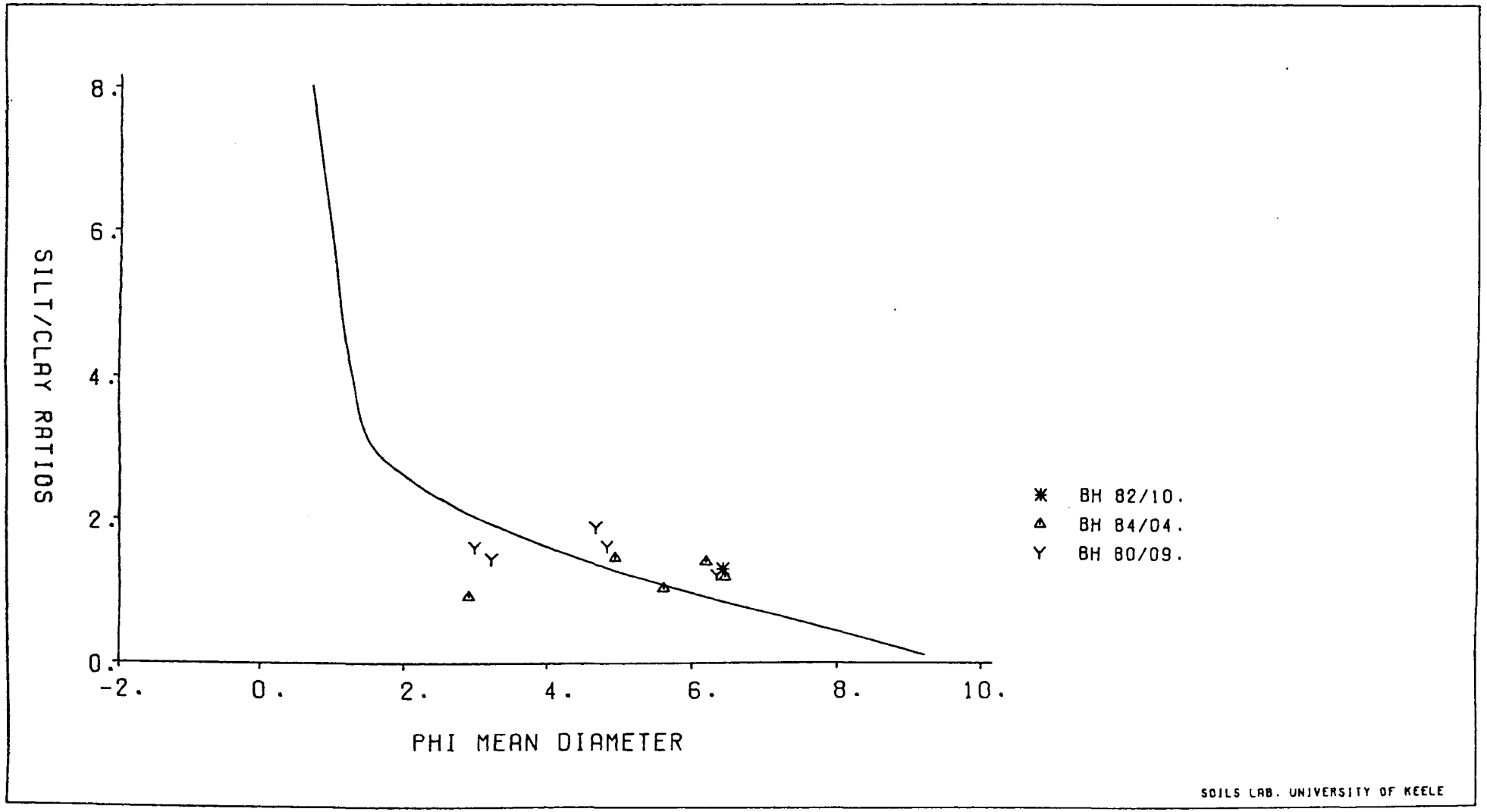
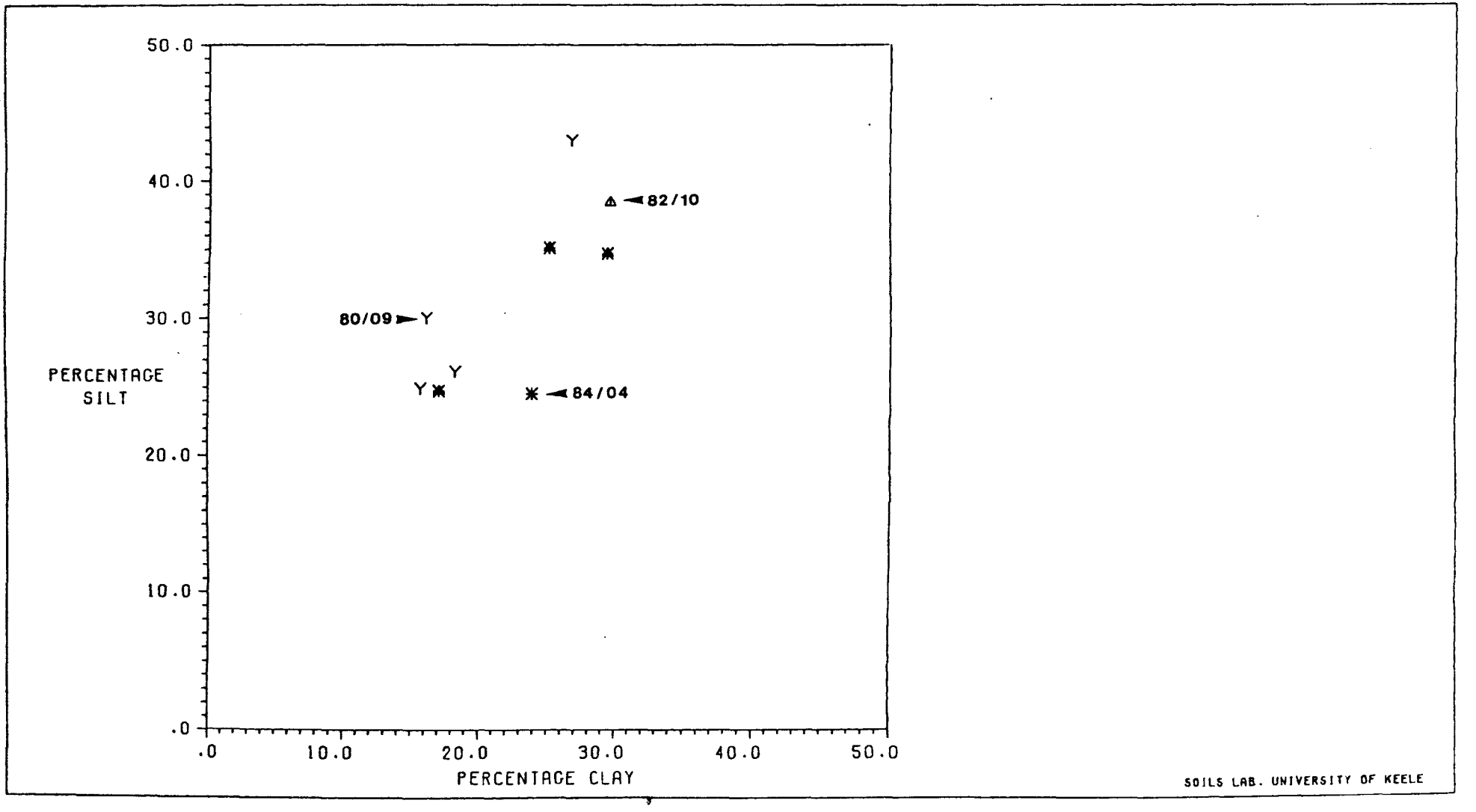


FIG 4.3.7. UNIT .4. SILT:CLAY PLOT.



4.3.8. FACIES SUCCESSION : UNIT 4.

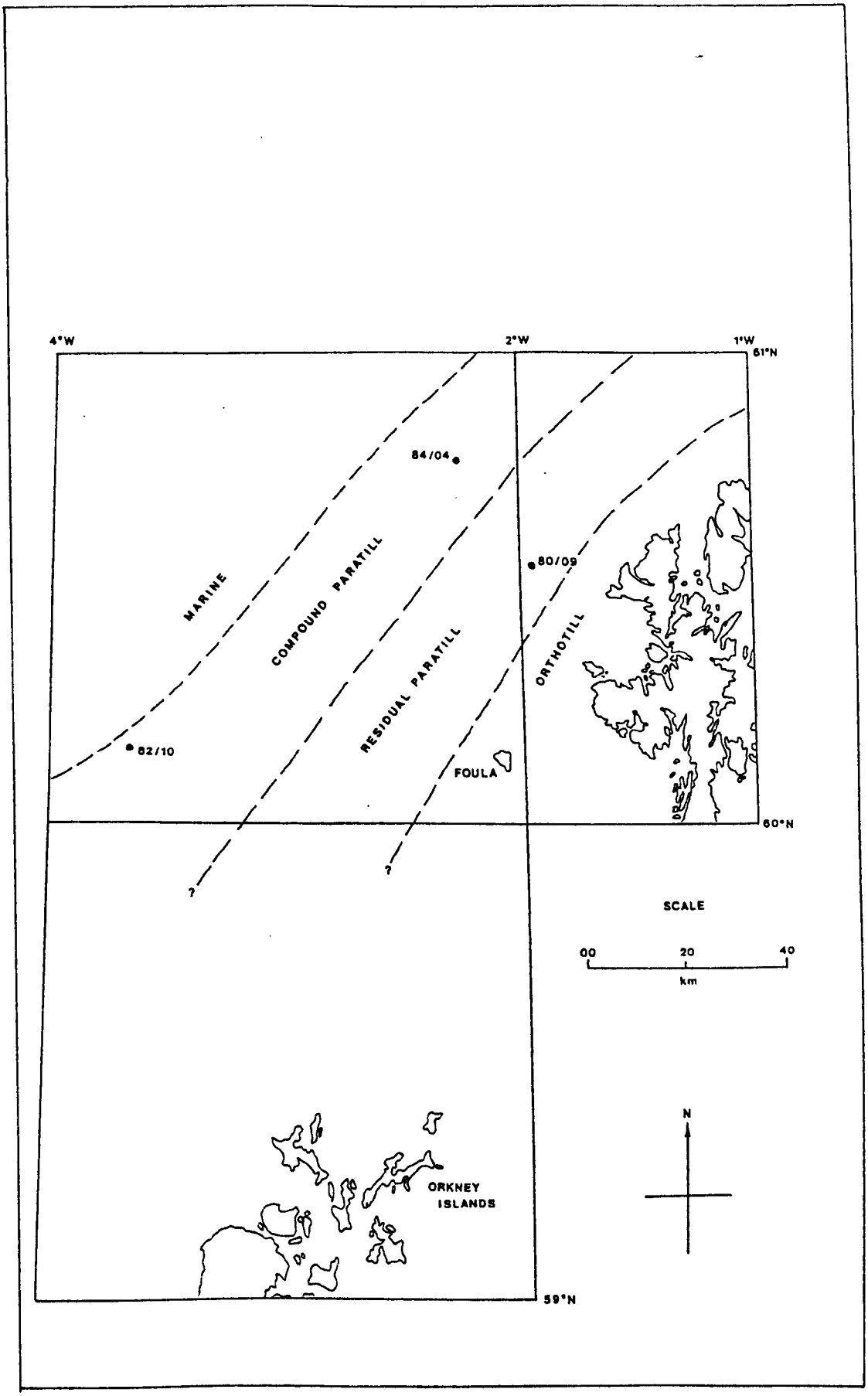
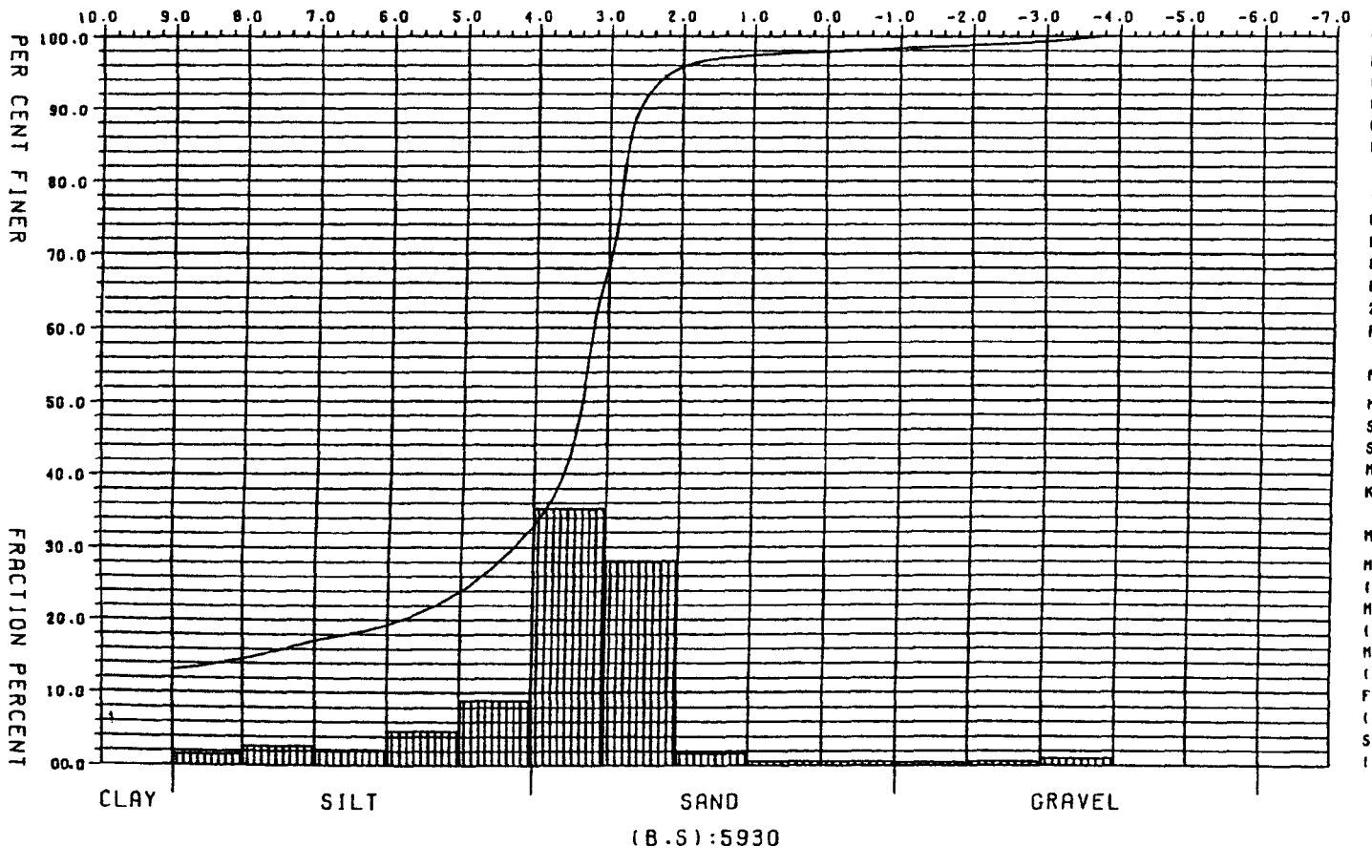


FIG 4.4.1. UNIT .3. (BH 84/04).

DEPTH: 120.90M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 4.43
GRAPHIC STANDARD DEVIATION = 2.76
GRAPHIC SKEWNESS = .63
GRAPHIC KURTOSIS = 1.94
NORMALISED KURTOSIS = .66

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 3.50
PHI (ARITHMETIC) MEAN DIAMETER = 4.90
PHI DEVIATION MEASURE = 2.49
PHI SKEWNESS MEASURE = .56
2ND PHI SKEWNESS MEASURE = 1.42
PHI KURTOSIS MEASURE = 1.02

PHI MOMENT STATISTICS.

MEAN SIZE = 3.01
STANDARD DEVIATION = 1.62
SKEWNESS (THIRD MOMENT) = .64
MEAN CUBED DEVIATION = 2.69
KURTOSIS (FOURTH MOMENT) = 7.76

MC CAMMON'S STATISTICS.

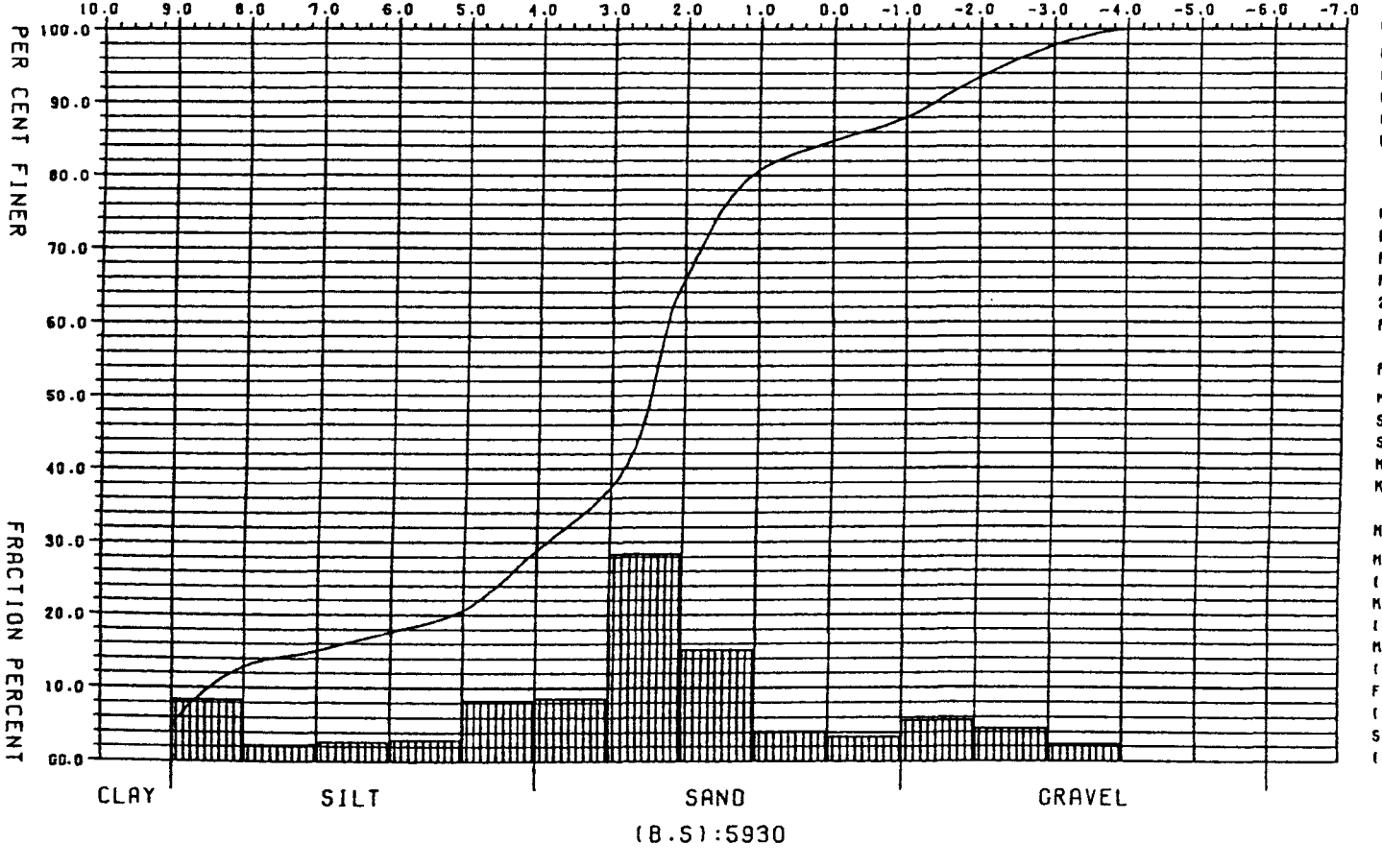
MEAN SIZE = 3.95
(88 PER CENT EFFICIENCY)
MEAN SIZE = 4.64
(93 PER CENT EFFICIENCY)
MEAN SIZE = 4.58
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 2.86
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 2.65
(87 PER CENT EFFICIENCY)

SITE FIX: 60 45 03N 02 16 21W.

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FIG 4.4.2. UNIT .3. (BH 82/10).

DEPTH: 60.35M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 3.08
GRAPHIC STANDARD DEVIATION = 3.33
GRAPHIC SKEWNESS = .19
GRAPHIC KURTOSIS = 1.51
NORMALISED KURTOSIS = .60

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 2.54
PHI (ARITHMETIC) MEAN DIAMETER = 3.35
PHI DEVIATION MEASURE = 3.23
PHI SKEWNESS MEASURE = .25
2ND PHI SKEWNESS MEASURE = .23
PHI KURTOSIS MEASURE = .75

PHI MOMENT STATISTICS.

MEAN SIZE = 2.53
STANDARD DEVIATION = 2.83
SKEWNESS (THIRD MOMENT) = .34
MEAN CUBED DEVIATION = 7.79
KURTOSIS (FOURTH MOMENT) = 3.18

MC CAMMON'S STATISTICS.

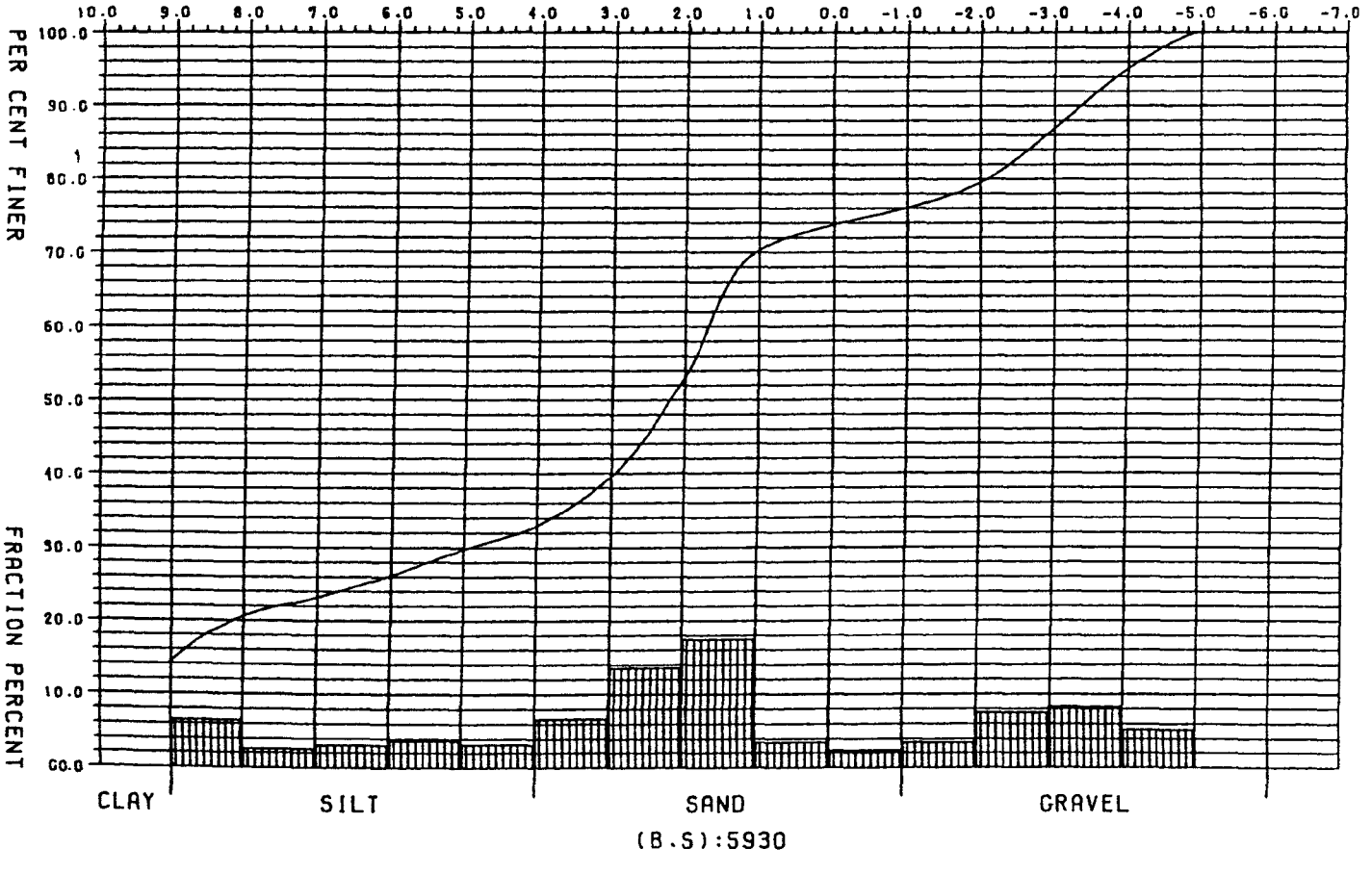
MEAN SIZE = 2.91
(88 PER CENT EFFICIENCY)
MEAN SIZE = 3.25
(93 PER CENT EFFICIENCY)
MEAN SIZE = 2.95
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.41
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.09
(87 PER CENT EFFICIENCY)

SITE FIX: 60 10 00N 03 40 01W.

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FIG 4.4.3. UNIT .3. (BH 84/02).

DEPTH: 8.20M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 2.76
GRAPHIC STANDARD DEVIATION = 5.30
GRAPHIC SKEWNESS = .19
GRAPHIC KURTOSIS = .96
NORMALISED KURTOSIS = .49

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 2.21
PHI (ARITHMETIC) MEAN DIAMETER = 3.03
PHI DEVIATION MEASURE = 5.67
PHI SKEWNESS MEASURE = .15
2ND PHI SKEWNESS MEASURE = .33
PHI KURTOSIS MEASURE = .43

PHI MOMENT STATISTICS.

MEAN SIZE = 1.35
STANDARD DEVIATION = 3.40
SKEWNESS (THIRD MOMENT) = .33
MEAN CUBED DEVIATION = 13.09
KURTOSIS (FOURTH MOMENT) = 2.71

MC CAMMON'S STATISTICS.

MEAN SIZE = 2.13
(88 PER CENT EFFICIENCY)
MEAN SIZE = 3.15
(93 PER CENT EFFICIENCY)
MEAN SIZE = 2.94
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 5.16
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.90
(87 PER CENT EFFICIENCY)

SITE FIX: 60 08 48N 03 10 06W.

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FIG 4.4.4. HIGH ENERGY SAMPLES.

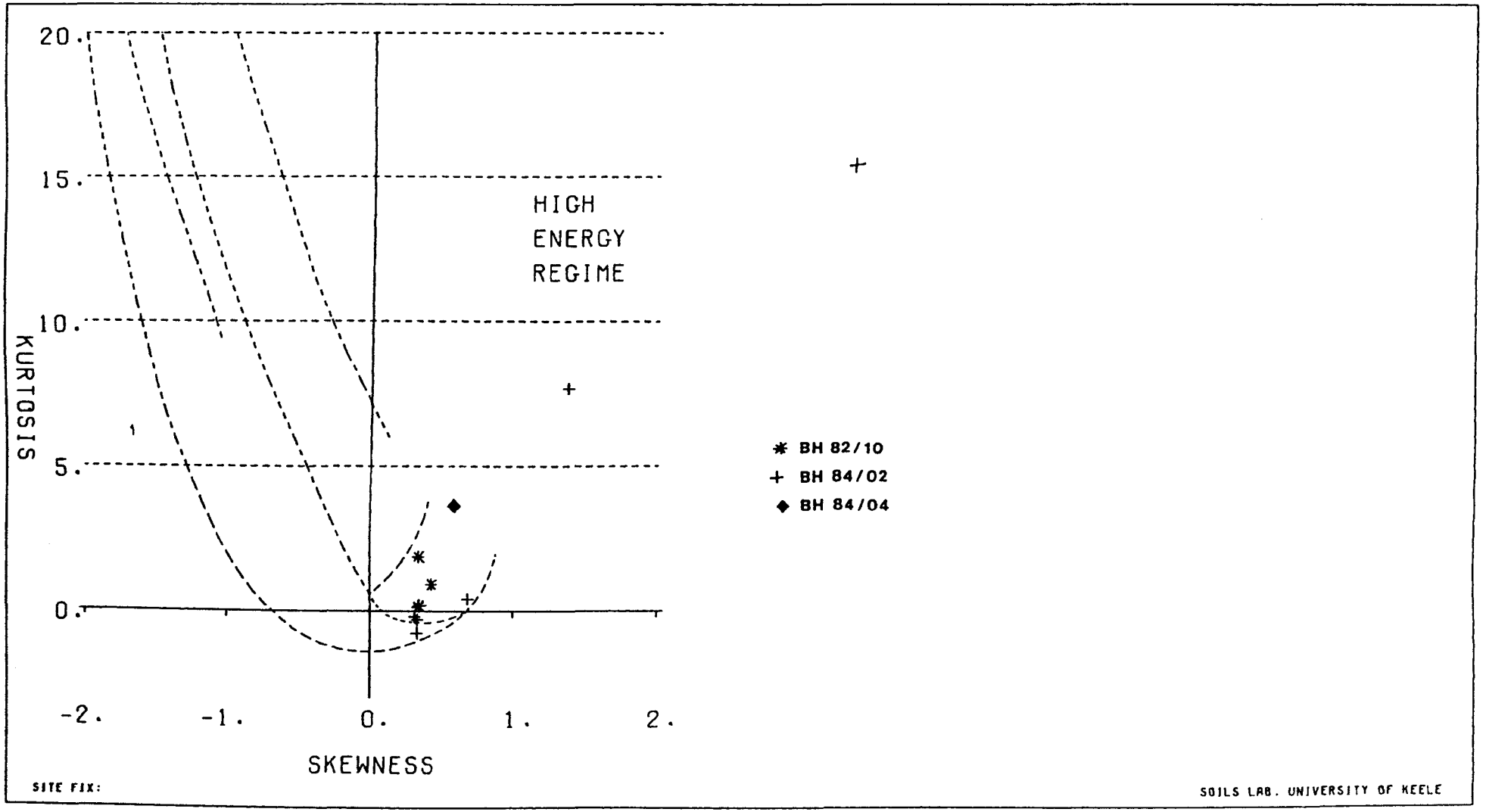


FIG 4.4.5. UNIT 3 (FIRST SUBGROUP).

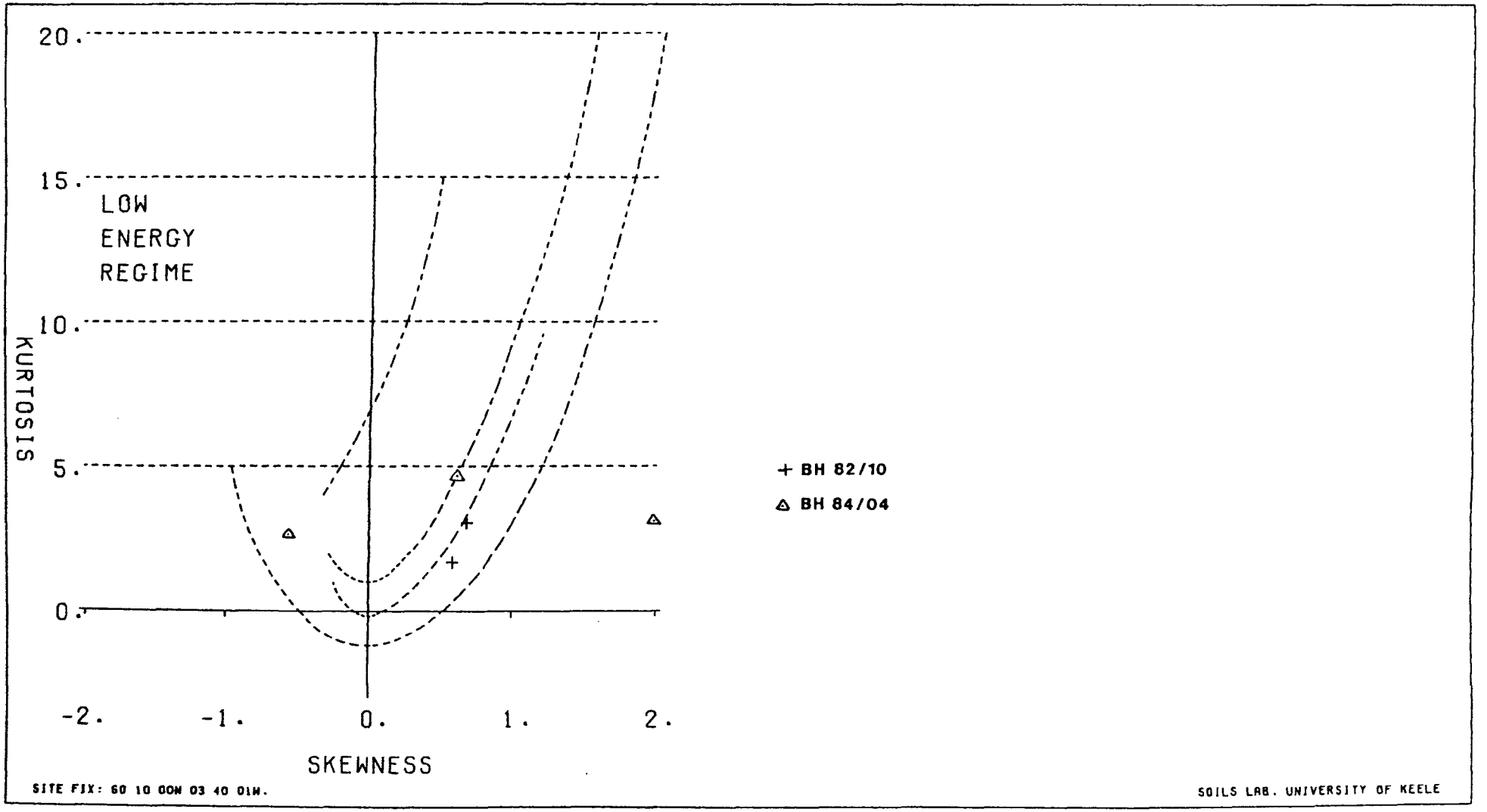


FIG 4.4.6. UNIT .3. SEDIMENTS.

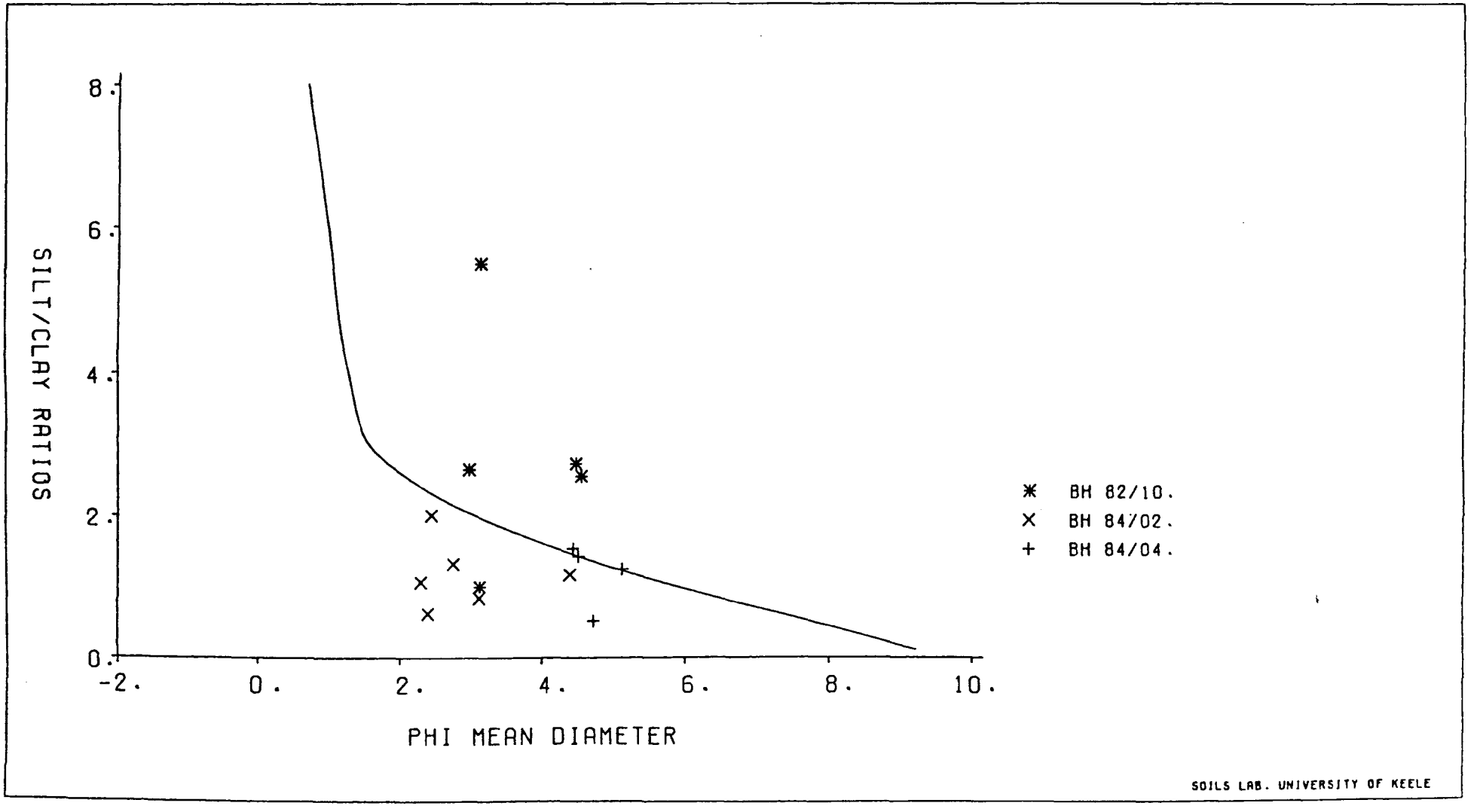


FIG 4.4.7. UNIT .3. SILT:CLAY PLOT .

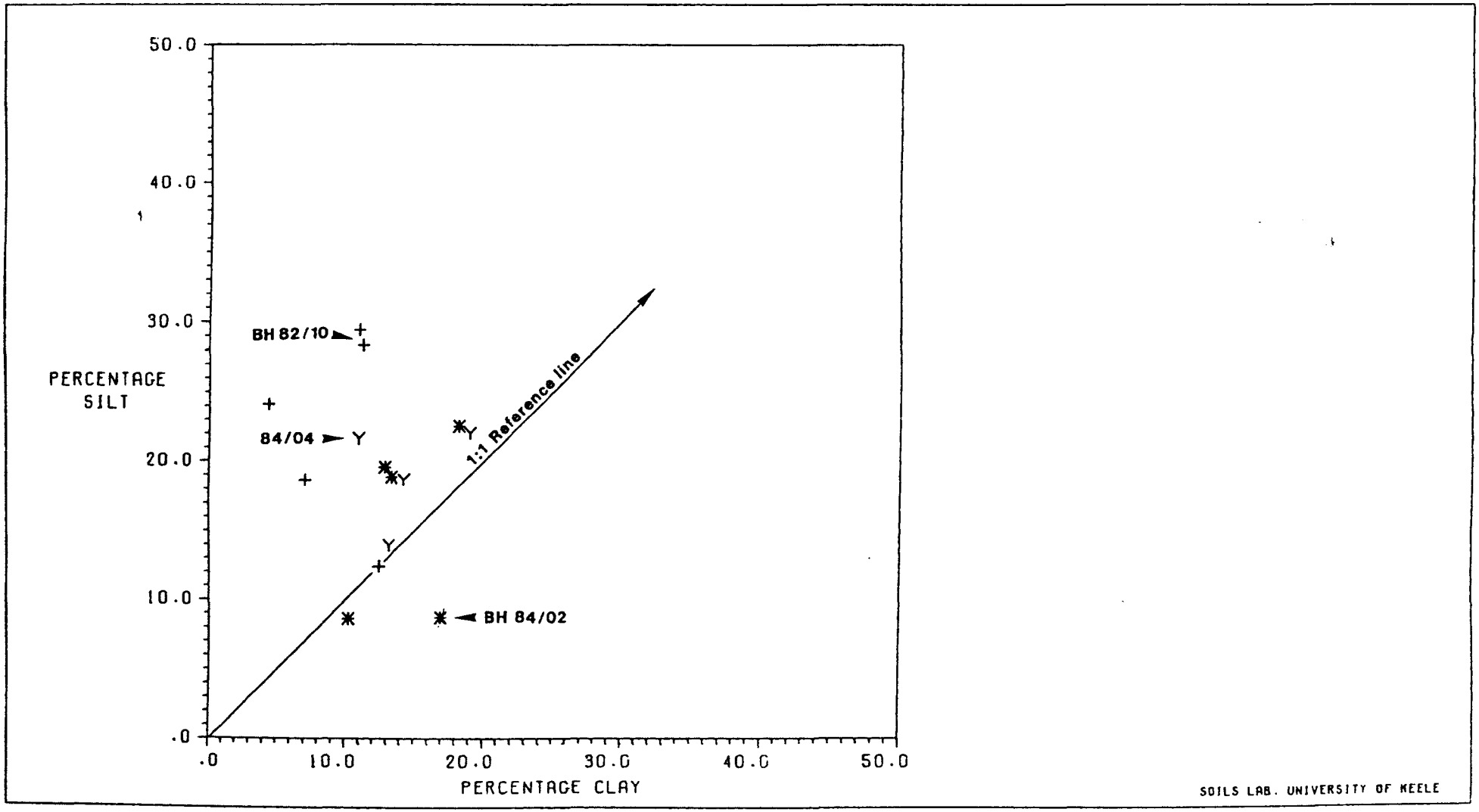
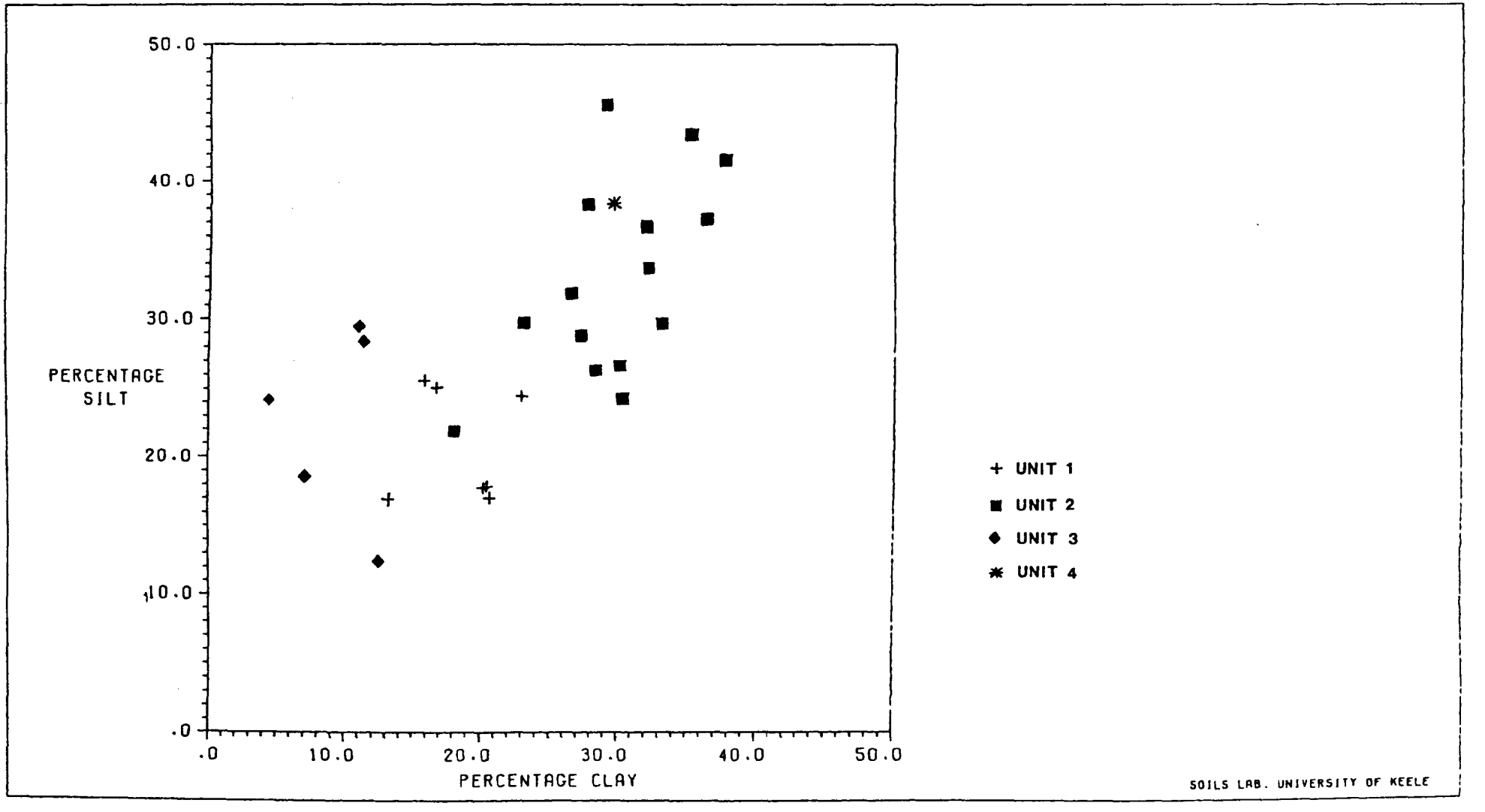


FIG 4.4.8. SILT:CLAY PLOT. (82/10).



4.4.9. FACIES SUCCESSION : UNIT 3.

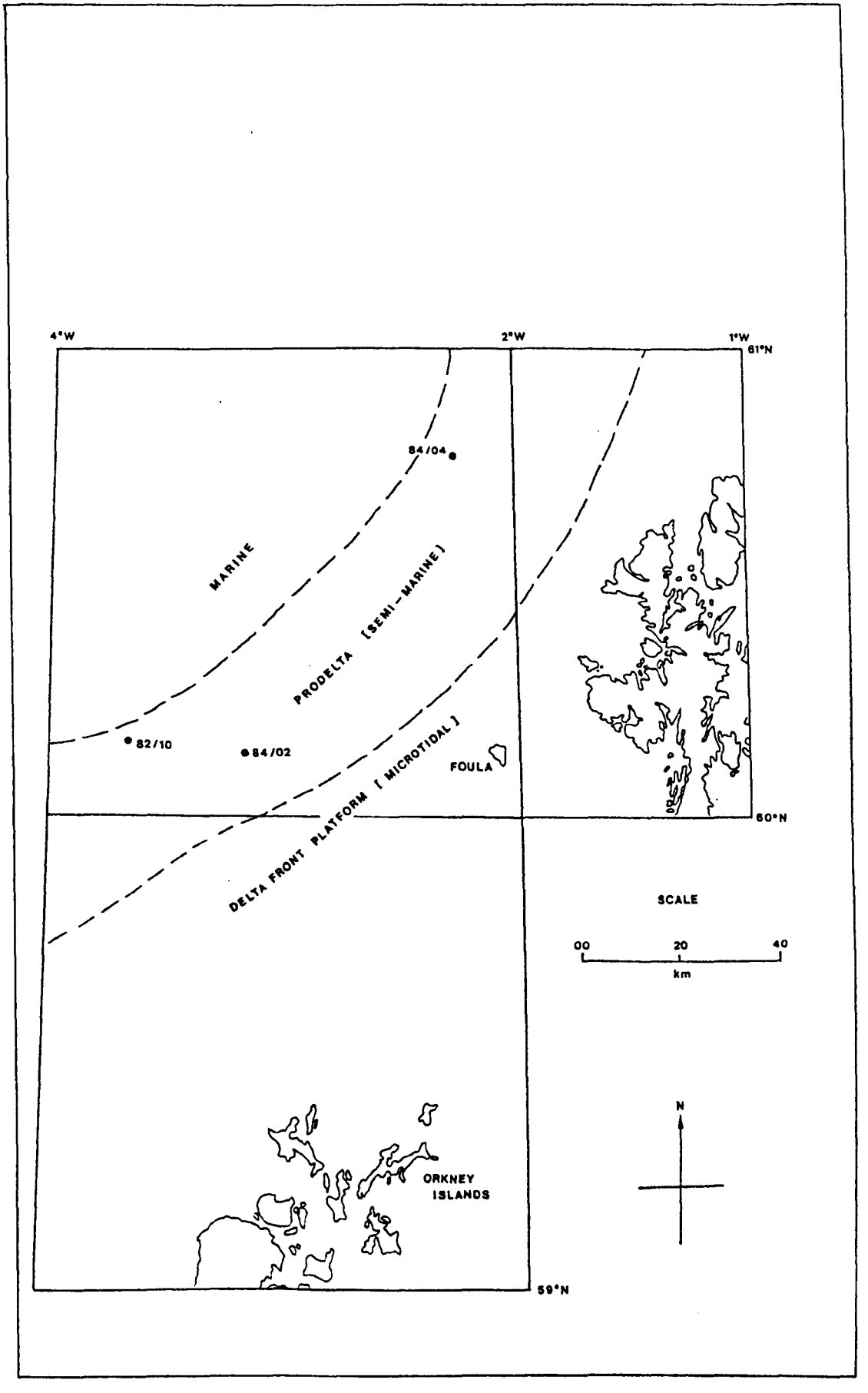
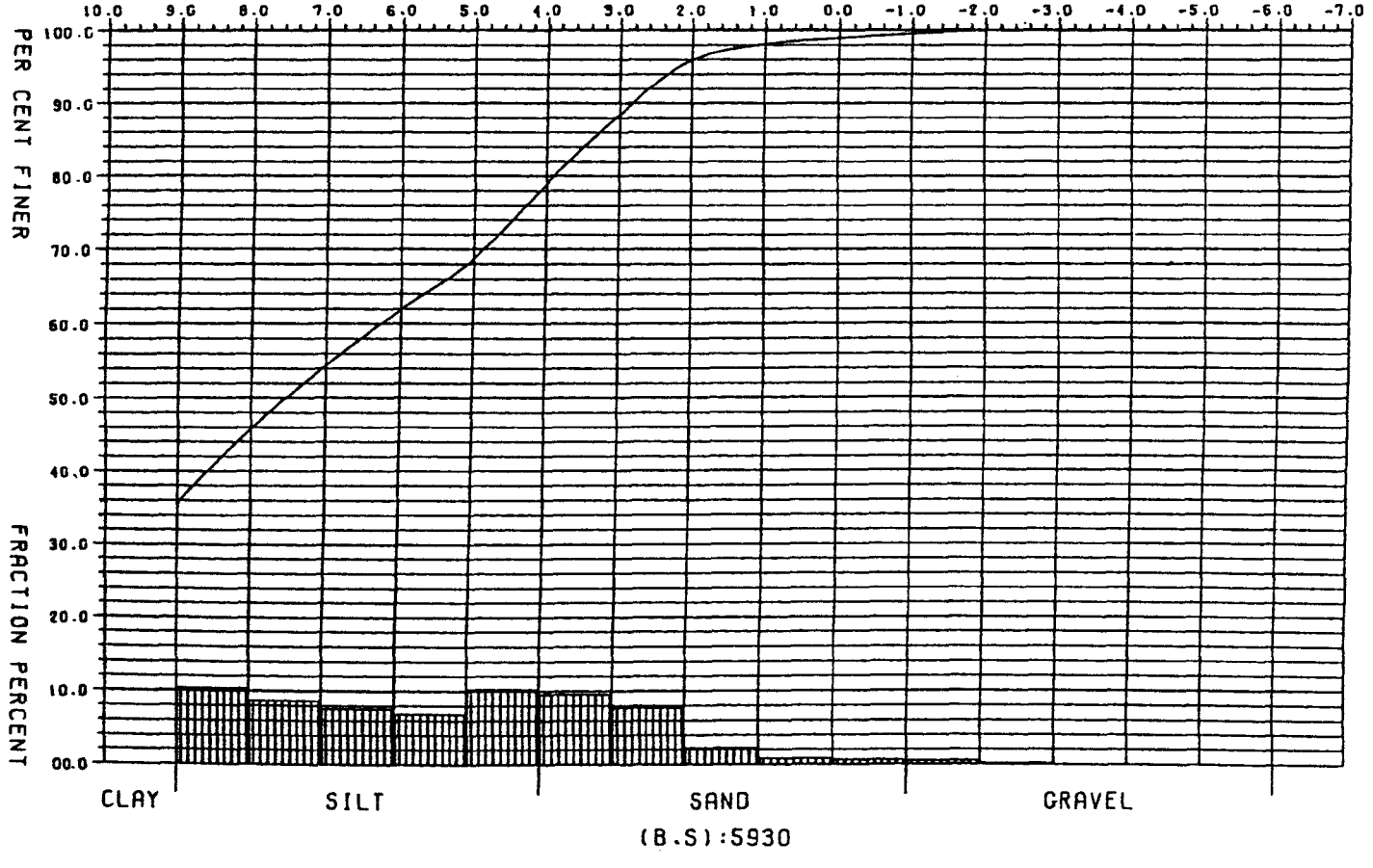


FIG 4.5.1. UNIT .2. (BH 82/10).

DEPTH: 32.00M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 7.55
GRAPHIC STANDARD DEVIATION = 3.77
GRAPHIC SKEWNESS = .03
GRAPHIC KURTOSIS = .75
NORMALISED KURTOSIS = .43

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 7.49
PHI (ARITHMETIC) MEAN DIAMETER = 7.59
PHI DEVIATION MEASURE = 4.15
PHI SKEWNESS MEASURE = .02
2ND PHI SKEWNESS MEASURE = .05
PHI KURTOSIS MEASURE = .35

PHI MOMENT STATISTICS.

MEAN SIZE = 3.39
STANDARD DEVIATION = 2.40
SKEWNESS (THIRD MOMENT) = 1.54
MEAN CUBED DEVIATION = 21.25
KURTOSIS (FOURTH MOMENT) = 3.32

MC CAMMON'S STATISTICS.

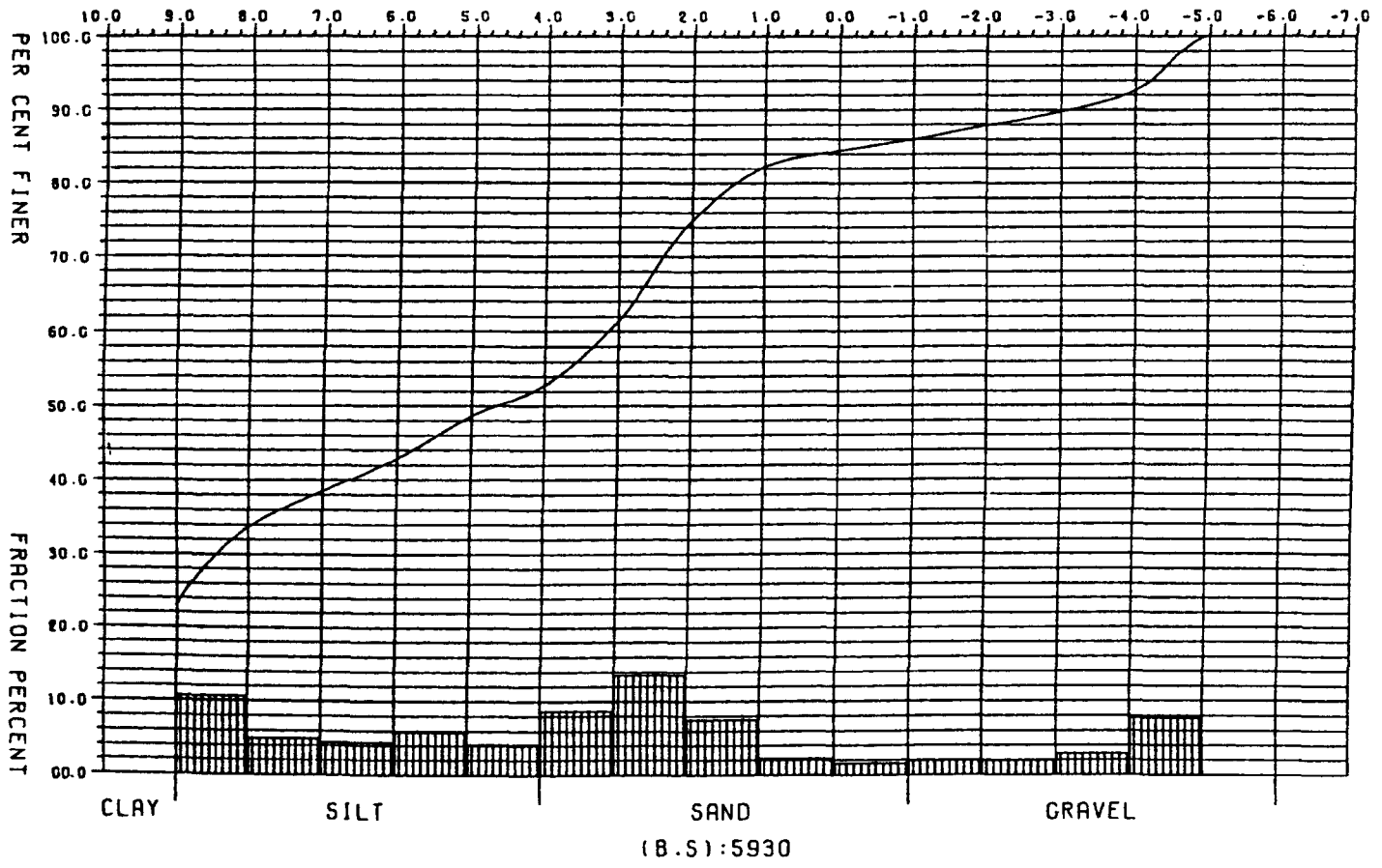
MEAN SIZE = 7.51
(88 PER CENT EFFICIENCY)
MEAN SIZE = 7.60
(93 PER CENT EFFICIENCY)
MEAN SIZE = 7.49
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.65
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.69
(87 PER CENT EFFICIENCY)

SITE FIX: 60 10 00N 03 40 01W.

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FIG 4.5.2. UNIT .2. (BH 82/10).

DEPTH: 27.85M.



SAMPLE.STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 5.09
GRAPHIC STANDARD DEVIATION = 5.20
GRAPHIC SKEWNESS = .05
GRAPHIC KURTOSIS = 1.03
NORMALISED KURTOSIS = .51

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 4.63
PHI (ARITHMETIC) MEAN DIAMETER = 5.31
PHI DEVIATION MEASURE = 5.18
PHI SKEWNESS MEASURE = .13
2ND PHI SKEWNESS MEASURE = -.07
PHI KURTOSIS MEASURE = .67

PHI MOMENT STATISTICS.

MEAN SIZE = 2.29
STANDARD DEVIATION = 3.54
SKEWNESS (THIRD MOMENT) = .12
MEAN CUBED DEVIATION = 5.09
KURTOSIS (FOURTH MOMENT) = 2.70

MC CAMMON'S STATISTICS.

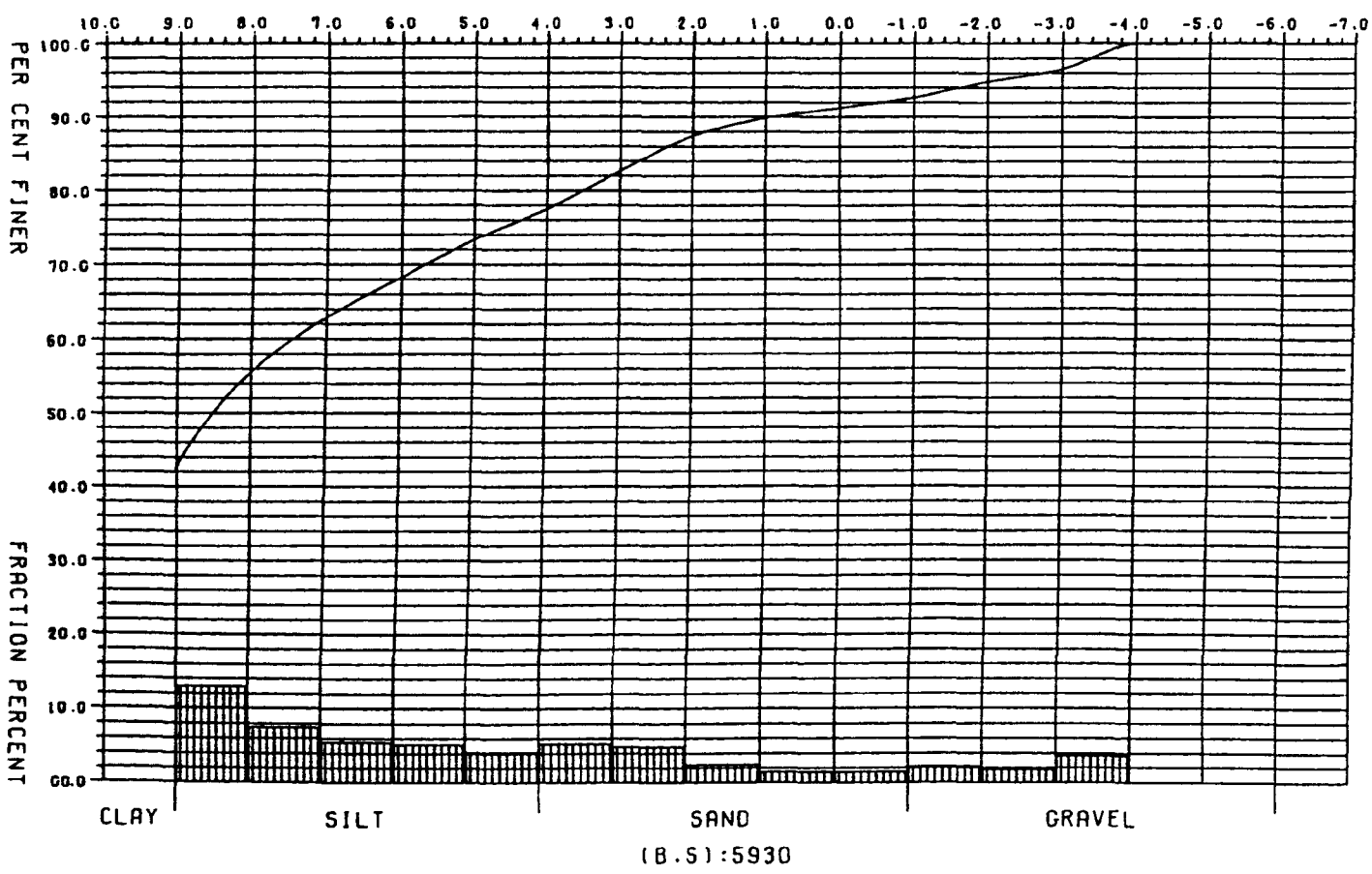
MEAN SIZE = 5.18
(66 PER CENT EFFICIENCY)
MEAN SIZE = 5.33
(93 PER CENT EFFICIENCY)
MEAN SIZE = 4.93
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 5.26
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.89
(87 PER CENT EFFICIENCY)

SITE FIX: 60 10 00N 03 40 01W.

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FIG 4.5.3. UNIT .2. (BH 82/01).

DEPTH: 58.95M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 7.74
GRAPHIC STANDARD DEVIATION = 4.72
GRAPHIC SKEWNESS = -.29
GRAPHIC KURTOSIS = .98
NORMALISED KURTOSIS = .50

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 8.41
PHI (ARITHMETIC) MEAN DIAMETER = 7.40
PHI DEVIATION MEASURE = 4.71
PHI SKEWNESS MEASURE = -.21
2ND PHI SKEWNESS MEASURE = -.59
PHI KURTOSIS MEASURE = .65

PHI MOMENT STATISTICS.

MEAN SIZE = 2.60
STANDARD DEVIATION = 3.17
SKEWNESS (THIRD MOMENT) = .85
MEAN CUBED DEVIATION = 27.32
KURTOSIS (FOURTH MOMENT) = 2.80

MC CAMMON'S STATISTICS.

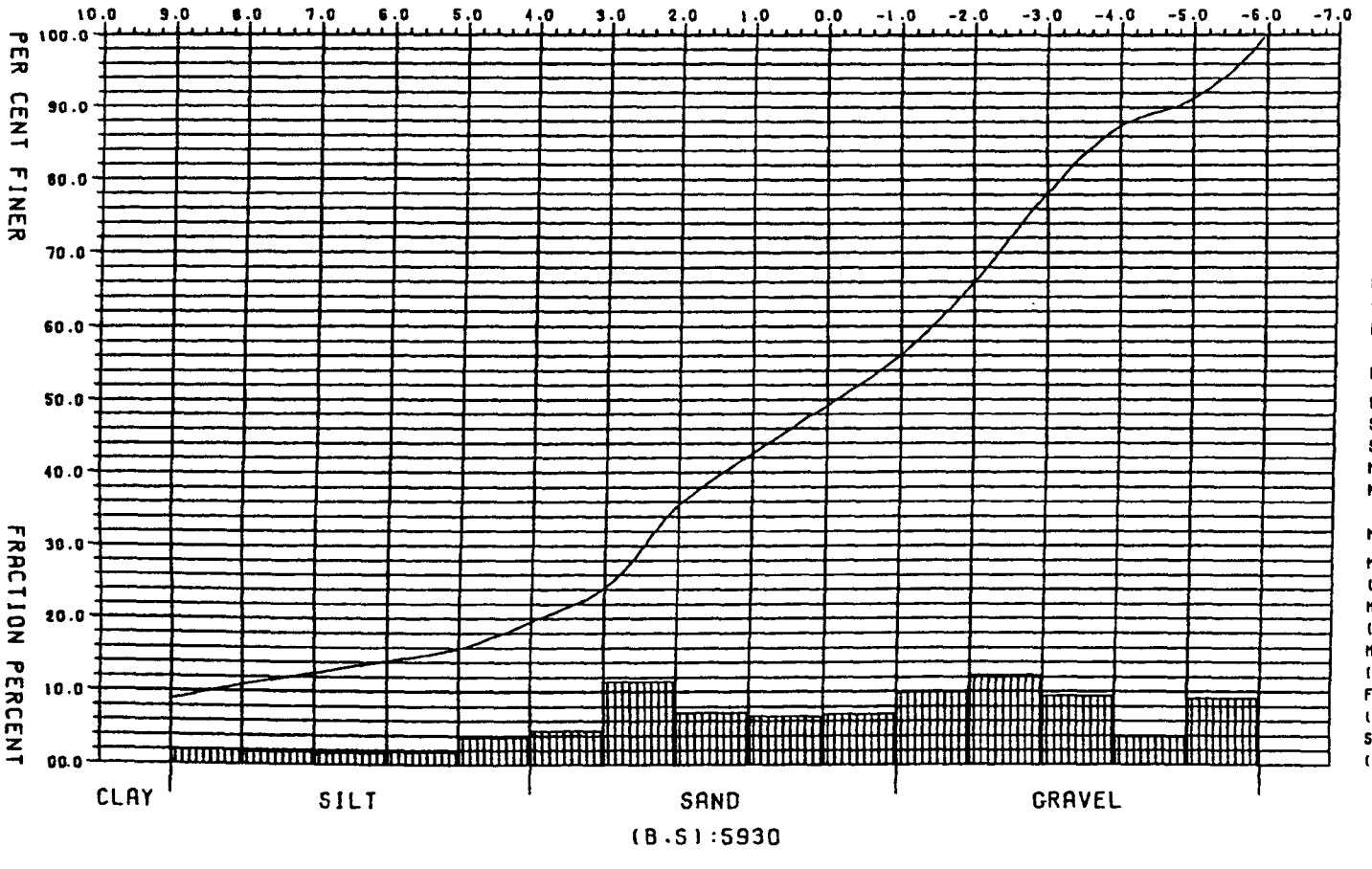
MEAN SIZE = 7.64
(88 PER CENT EFFICIENCY)
MEAN SIZE = 7.96
(93 PER CENT EFFICIENCY)
MEAN SIZE = 7.48
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 4.69
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.41
(87 PER CENT EFFICIENCY)

SITE FIX: 59 55 18N 03 31 14W.

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FIG 4.5.4. FIRST SUBSET (84/04).

DEPTH: 77.90M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = .37
GRAPHIC STANDARD DEVIATION = 4.65
GRAPHIC SKEWNESS = .27
GRAPHIC KURTOSIS = 1.20
NORMALISED KURTOSIS = .54

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = -.14
PHI (ARITHMETIC) MEAN DIAMETER = .63
PHI DEVIATION MEASURE = 4.29
PHI SKEWNESS MEASURE = .18
2ND PHI SKEWNESS MEASURE = .70
PHI KURTOSIS MEASURE = .93

PHI MOMENT STATISTICS.

MEAN SIZE = -.23
STANDARD DEVIATION = 3.37
SKEWNESS (THIRD MOMENT) = .45
MEAN CUBED DEVIATION = 17.34
KURTOSIS (FOURTH MOMENT) = 2.78

MC CAMMON'S STATISTICS.

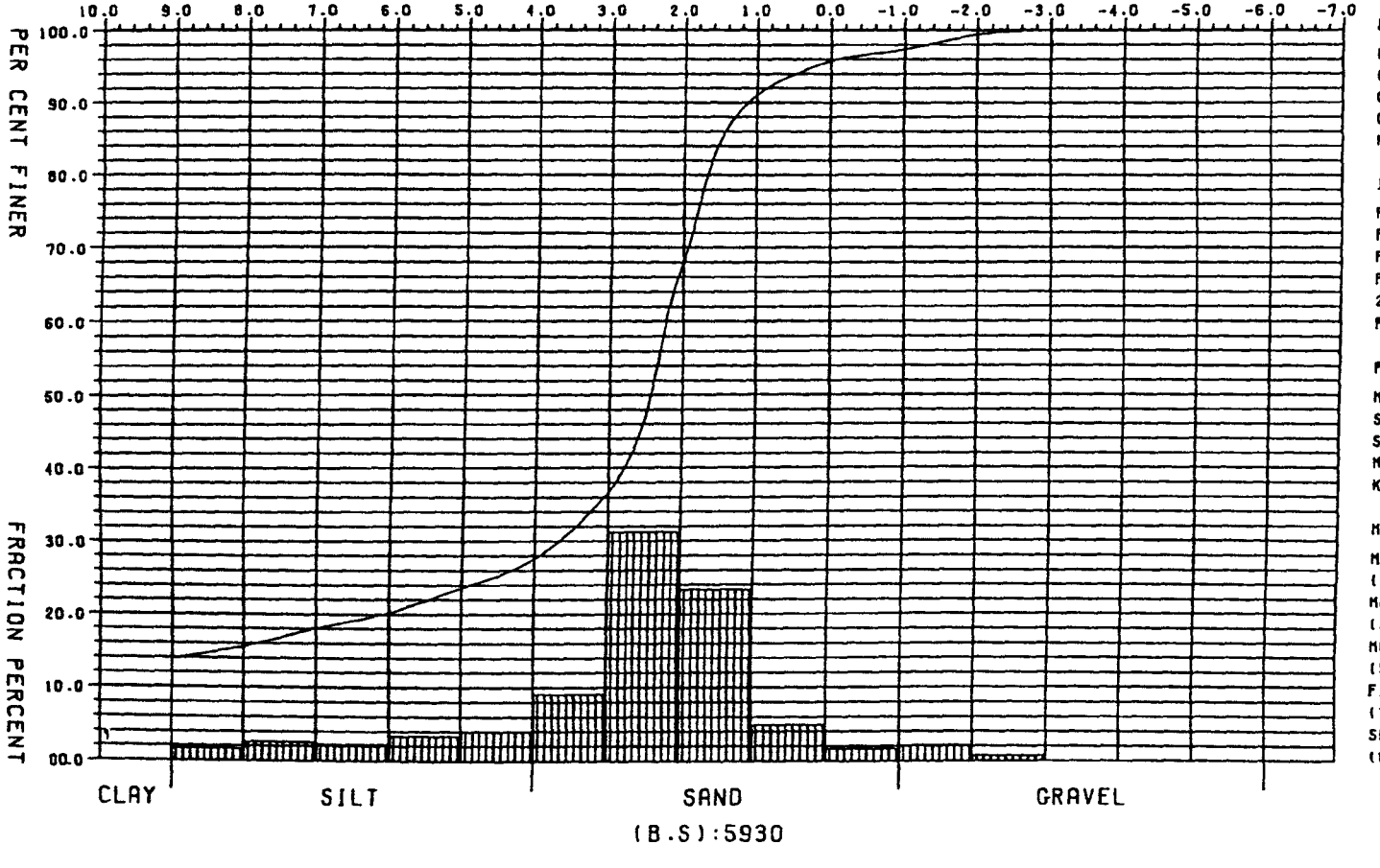
MEAN SIZE = .17
(88 PER CENT EFFICIENCY)
MEAN SIZE = .91
(93 PER CENT EFFICIENCY)
MEAN SIZE = .73
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 4.77
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.61
(87 PER CENT EFFICIENCY)

SITE FIX: 60 45 03N 02 16 21W.

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FIG 4.5.5. SECOND SUBSET (84/04).

DEPTH: 63.90M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 3.87
GRAPHIC STANDARD DEVIATION = 3.44
GRAPHIC SKEWNESS = .60
GRAPHIC KURTOSIS = 1.70
NORMALISED KURTOSIS = .63

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 2.56
PHI (ARITHMETIC) MEAN DIAMETER = 4.53
PHI DEVIATION MEASURE = 3.23
PHI SKEWNESS MEASURE = .61
2ND PHI SKEWNESS MEASURE = 1.11
PHI KURTOSIS MEASURE = .87

PHI MOMENT STATISTICS.

MEAN SIZE = 2.23
STANDARD DEVIATION = 1.81
SKEWNESS (THIRD MOMENT) = 1.44
MEAN CUBED DEVIATION = 8.57
KURTOSIS (FOURTH MOMENT) = 6.06

MC CAMMON'S STATISTICS.

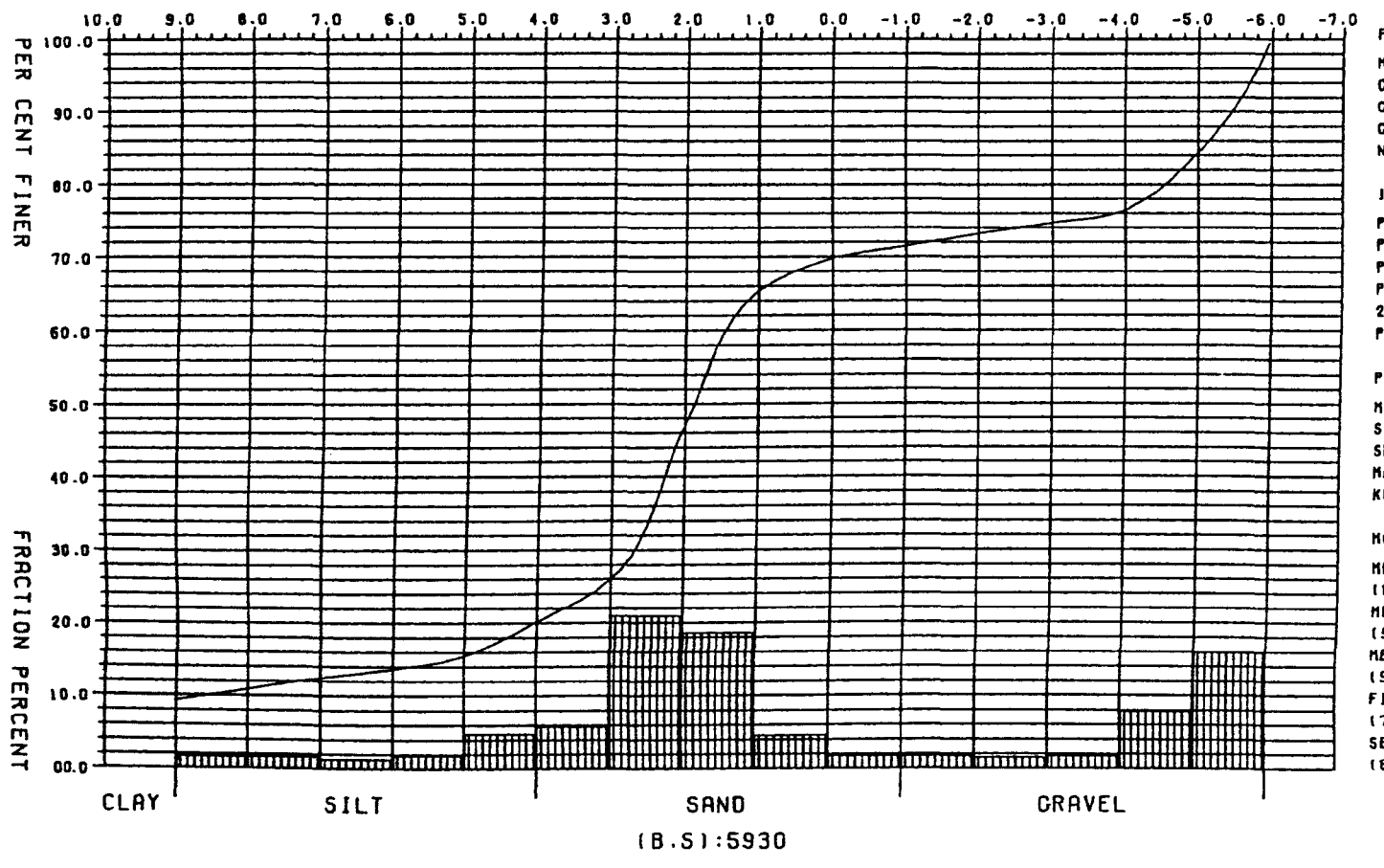
MEAN SIZE = 3.36
(88 PER CENT EFFICIENCY)
MEAN SIZE = 3.96
(93 PER CENT EFFICIENCY)
MEAN SIZE = 3.84
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.53
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.22
(87 PER CENT EFFICIENCY)

SITE FIX: 60 45 03N 02 16 21W.

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FIG 4.5.6. THIRD SUBSET (84/04).

DEPTH: 86.75M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = .56
GRAPHIC STANDARD DEVIATION = 5.03
GRAPHIC SKEWNESS = -.13
GRAPHIC KURTOSIS = 1.09
NORMALISED KURTOSIS = .52

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 1.82
PHI (ARITHMETIC) MEAN DIAMETER = -.07
PHI DEVIATION MEASURE = 4.92
PHI SKEWNESS MEASURE = -.38
2ND PHI SKEWNESS MEASURE = .20
PHI KURTOSIS MEASURE = .72

PHI MOMENT STATISTICS.

MEAN SIZE = .31
STANDARD DEVIATION = 3.62
SKEWNESS (THIRD MOMENT) = -.28
MEAN CUBED DEVIATION = -13.39
KURTOSIS (FOURTH MOMENT) = 2.32

MC CAMMON'S STATISTICS.

MEAN SIZE = .45
(88 PER CENT EFFICIENCY)
MEAN SIZE = 1.56
(93 PER CENT EFFICIENCY)
MEAN SIZE = 1.28
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 5.03
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.74
(87 PER CENT EFFICIENCY)

SITE FIX: 60 45 03N 02 16 21W.

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FIG 4.5.7. FIRST SUBGROUP.

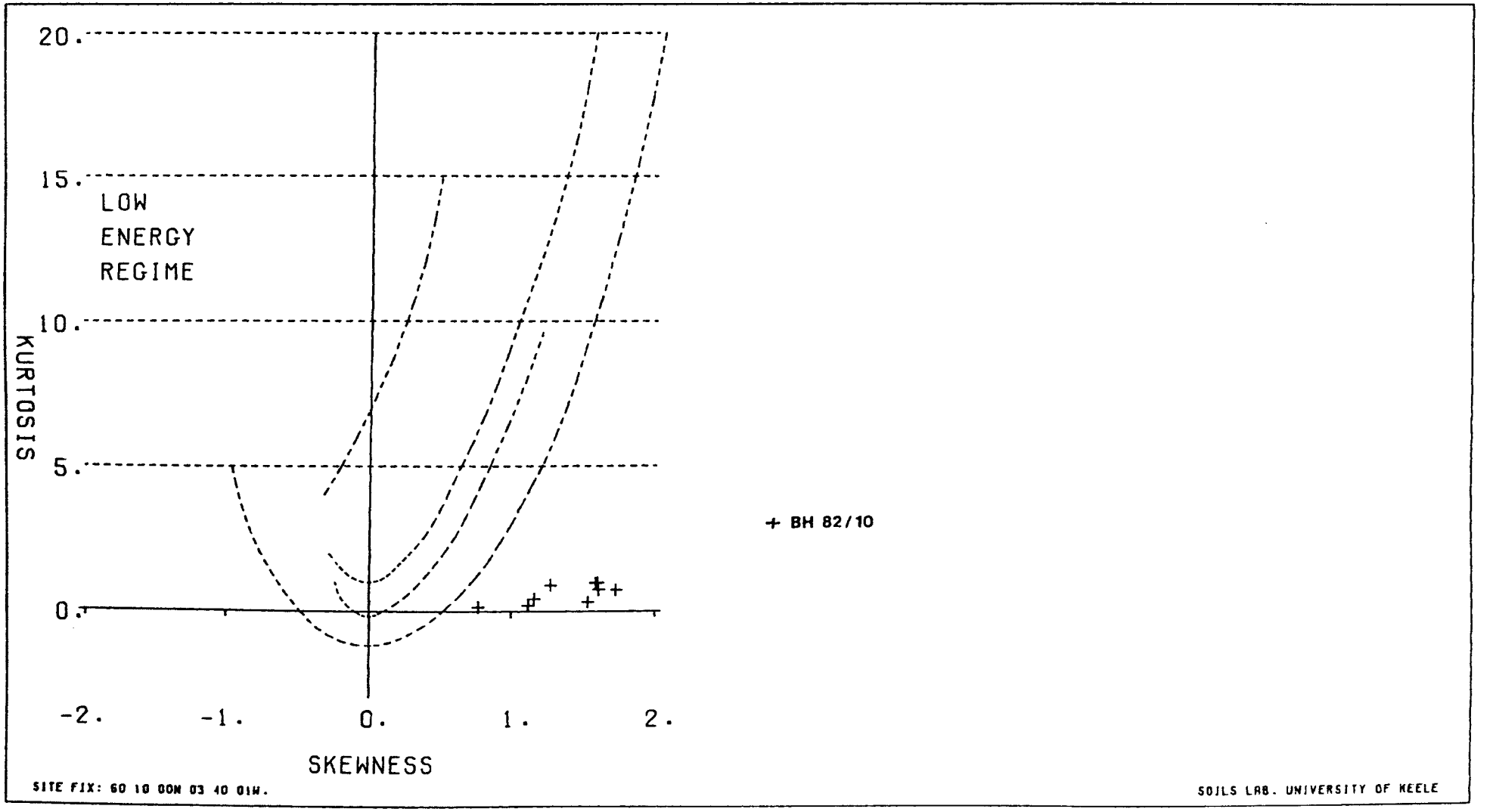


FIG 4.5.8. FIRST SUBGROUP.

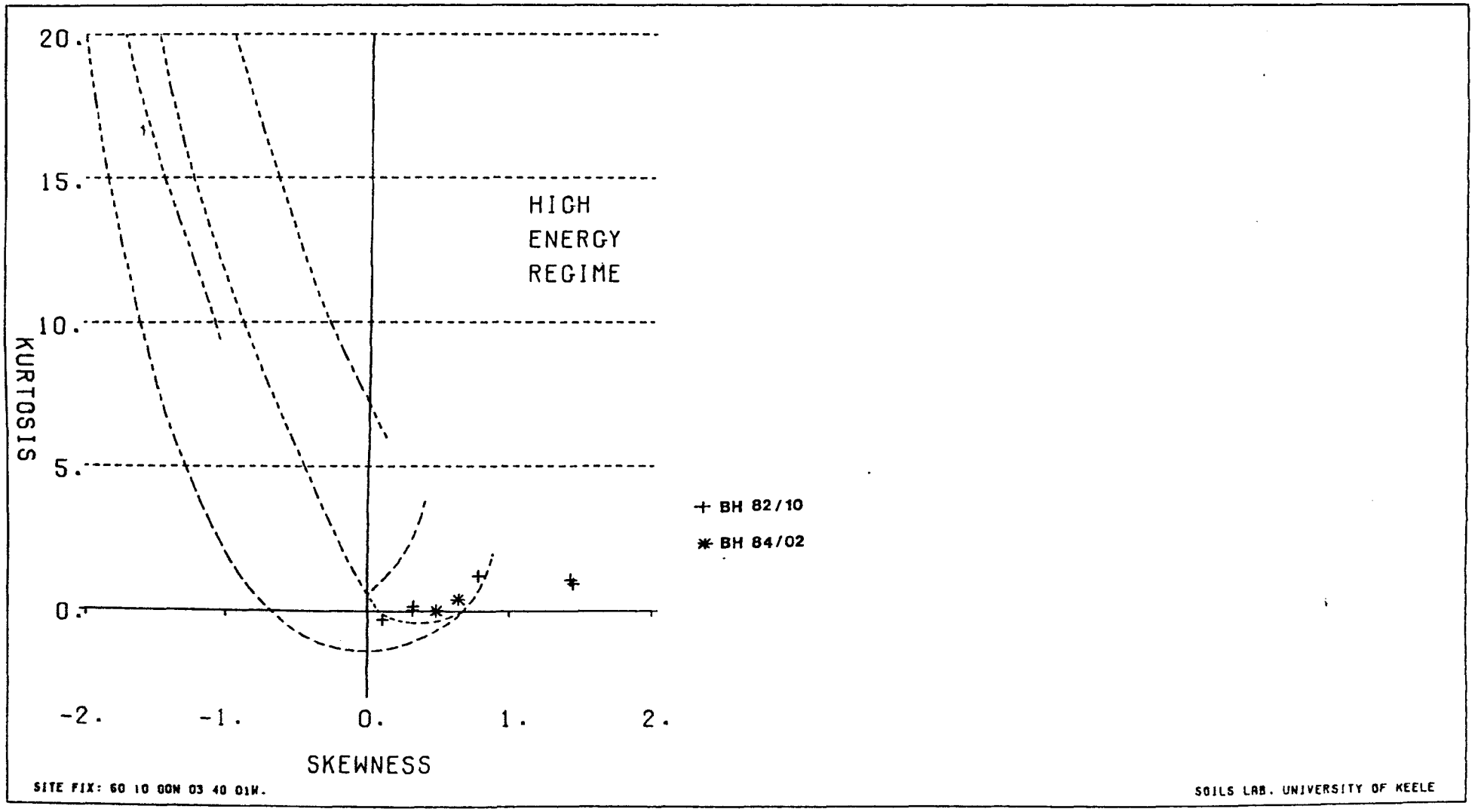


FIG 4.5.9. UNIT.2. (BH 82/01).

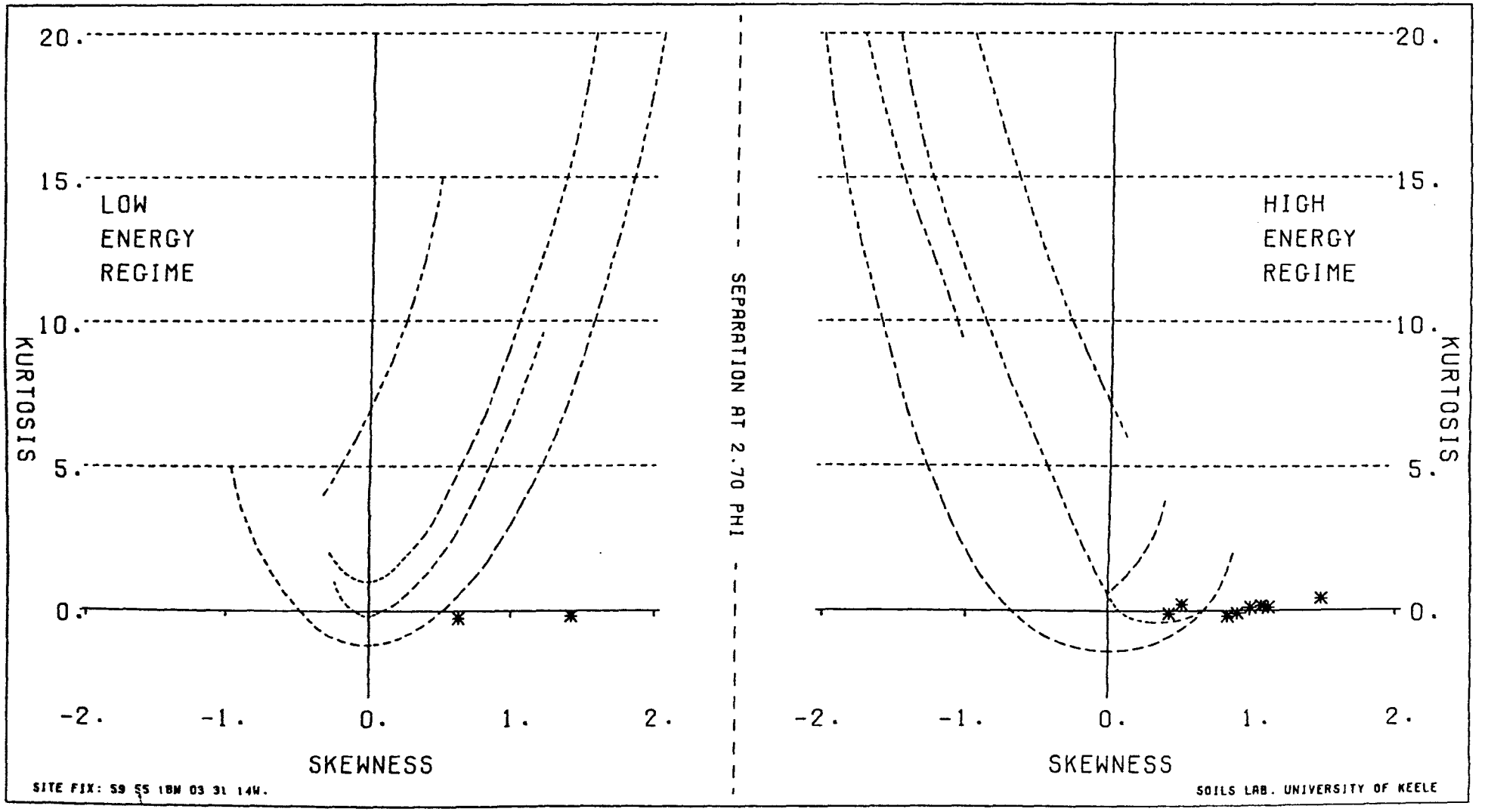
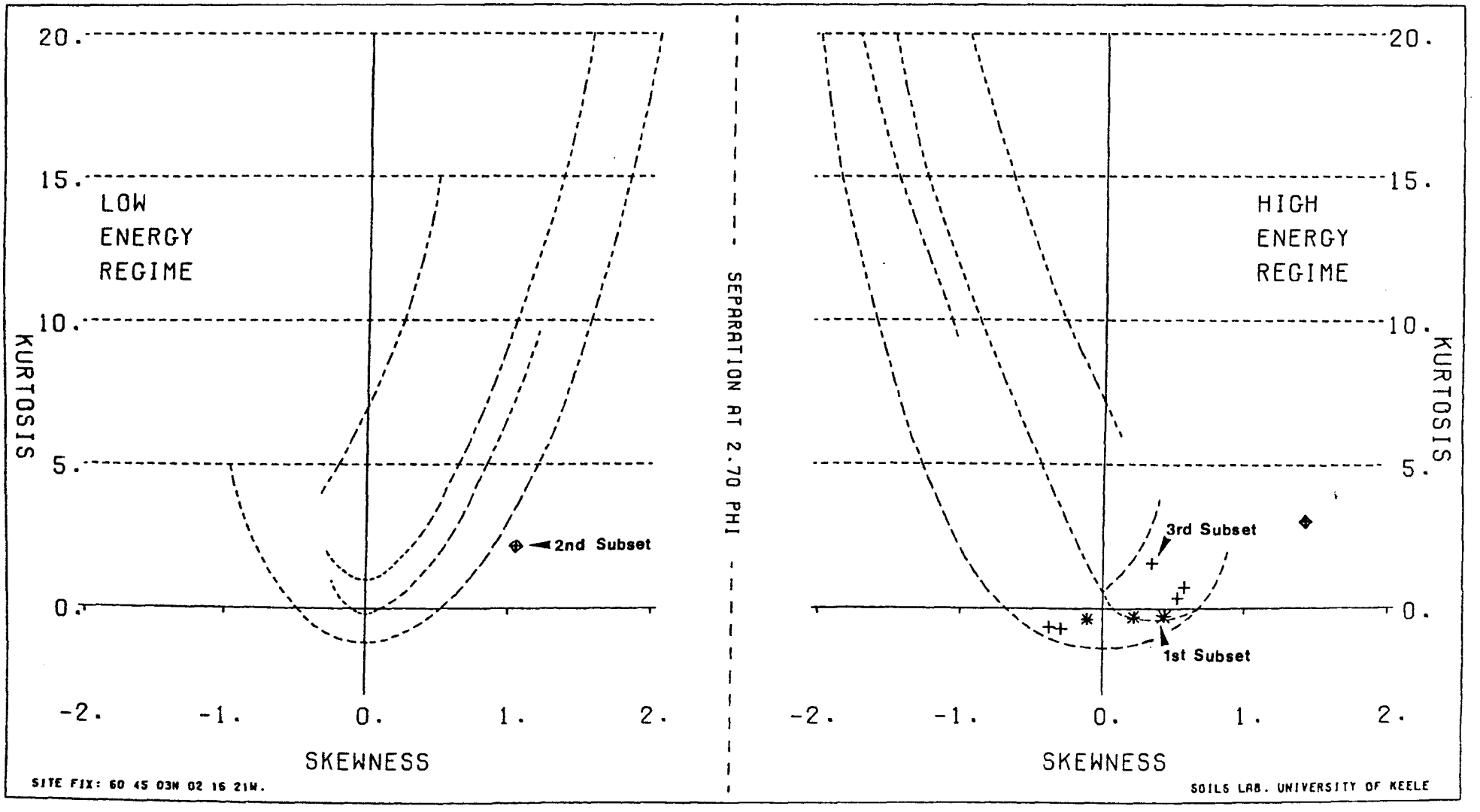


FIG 4.5.10. UNIT .2. (BH 84/04).



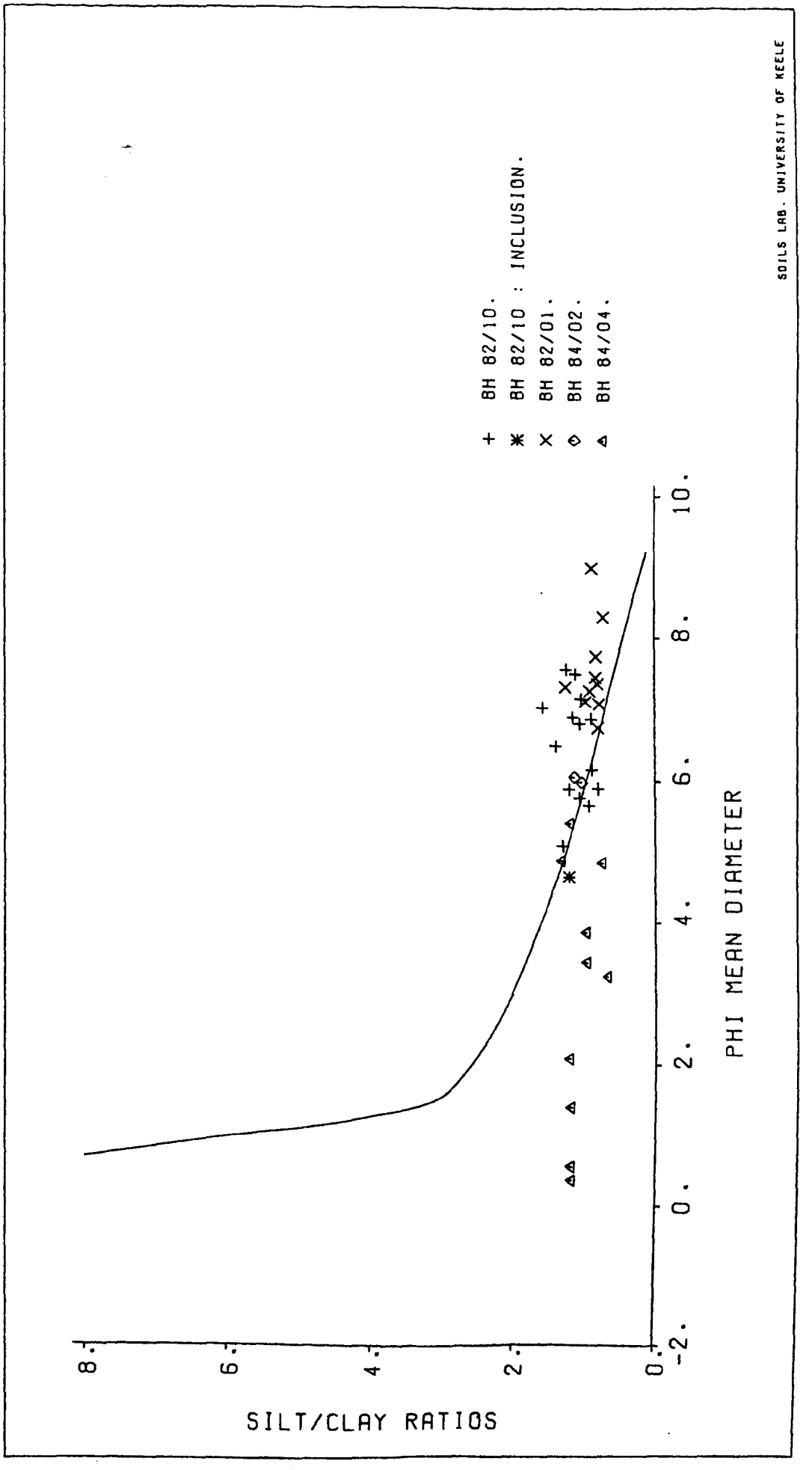


FIG 4.5.11. UNIT .2. SEDIMENTS.

4.5.12. FACIES SUCCESSION : UNIT 2.

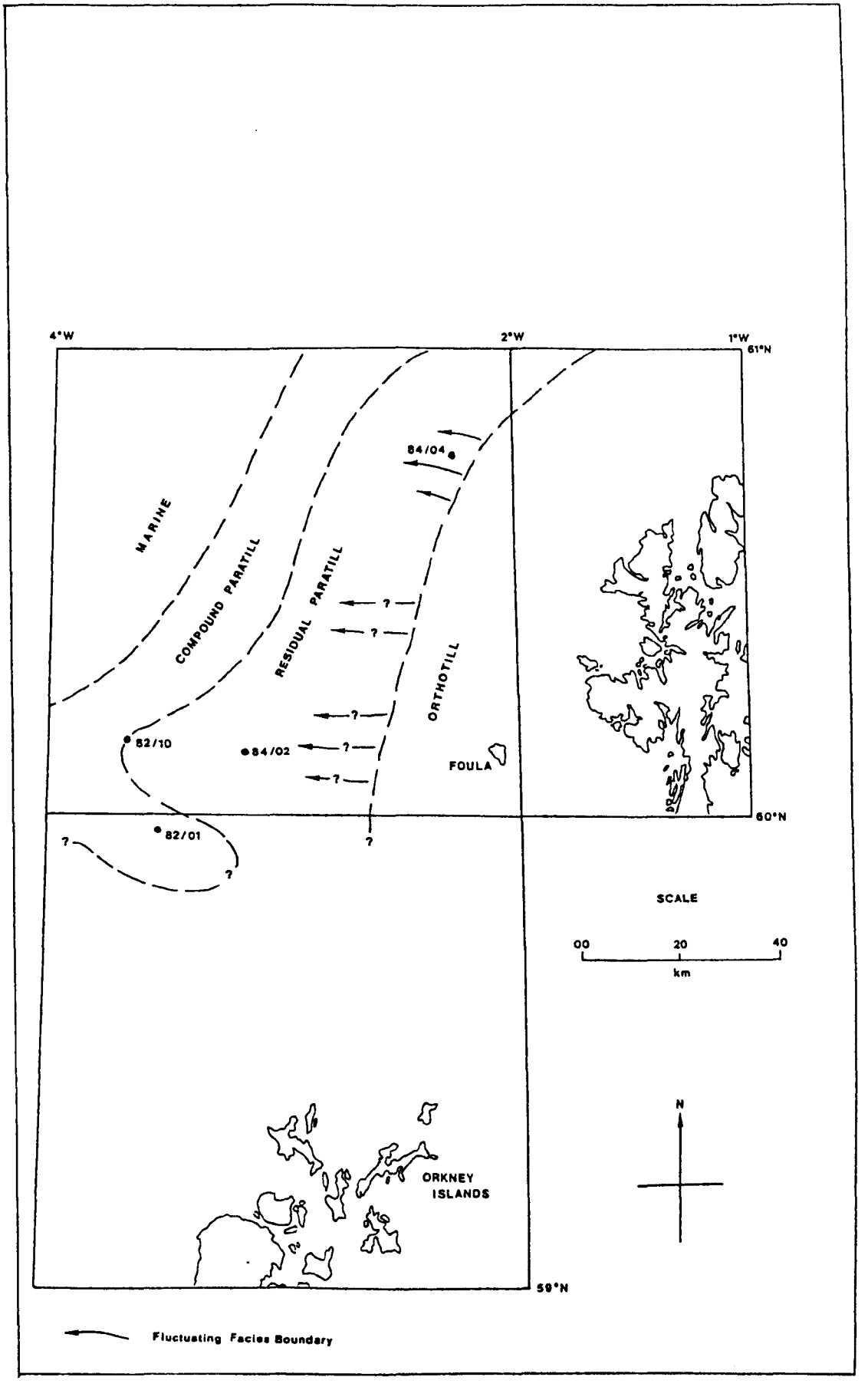
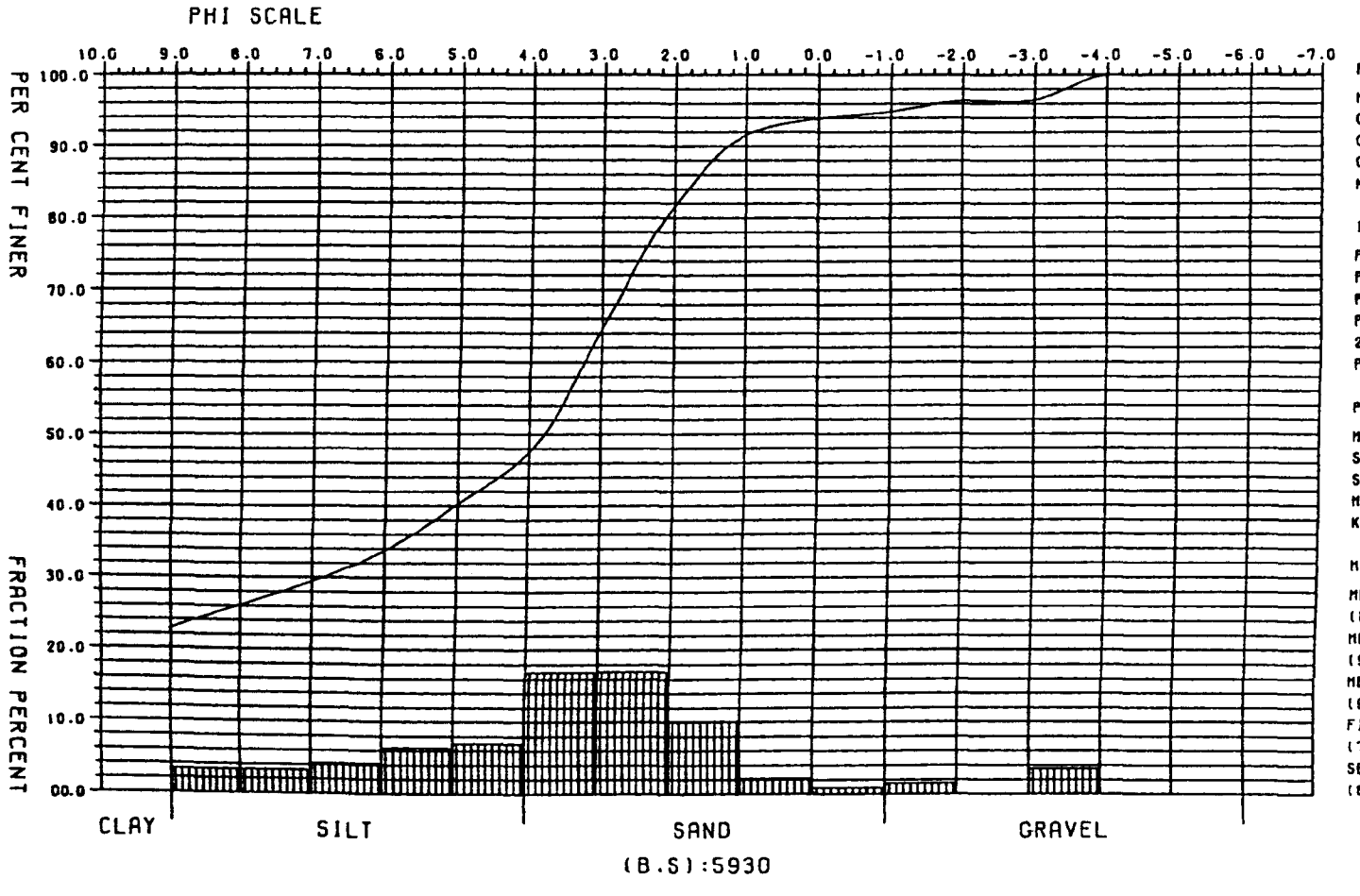


FIG 4.6.1. UNIT .1. (BH 82/10).

DEPTH: 13.70M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 5.35
GRAPHIC STANDARD DEVIATION = 4.31
GRAPHIC SKEWNESS = .41
GRAPHIC KURTOSIS = .97
NORMALISED KURTOSIS = .49

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 3.84
PHI (ARITHMETIC) MEAN DIAMETER = 6.11
PHI DEVIATION MEASURE = 4.37
PHI SKEWNESS MEASURE = .52
2ND PHI SKEWNESS MEASURE = .47
PHI KURTOSIS MEASURE = .60

PHI MOMENT STATISTICS.

MEAN SIZE = 2.52
STANDARD DEVIATION = 2.36
SKEWNESS (THIRD MOMENT) = .52
MEAN CUBED DEVIATION = 6.87
KURTOSIS (FOURTH MOMENT) = 4.29

MC CAMMON'S STATISTICS.

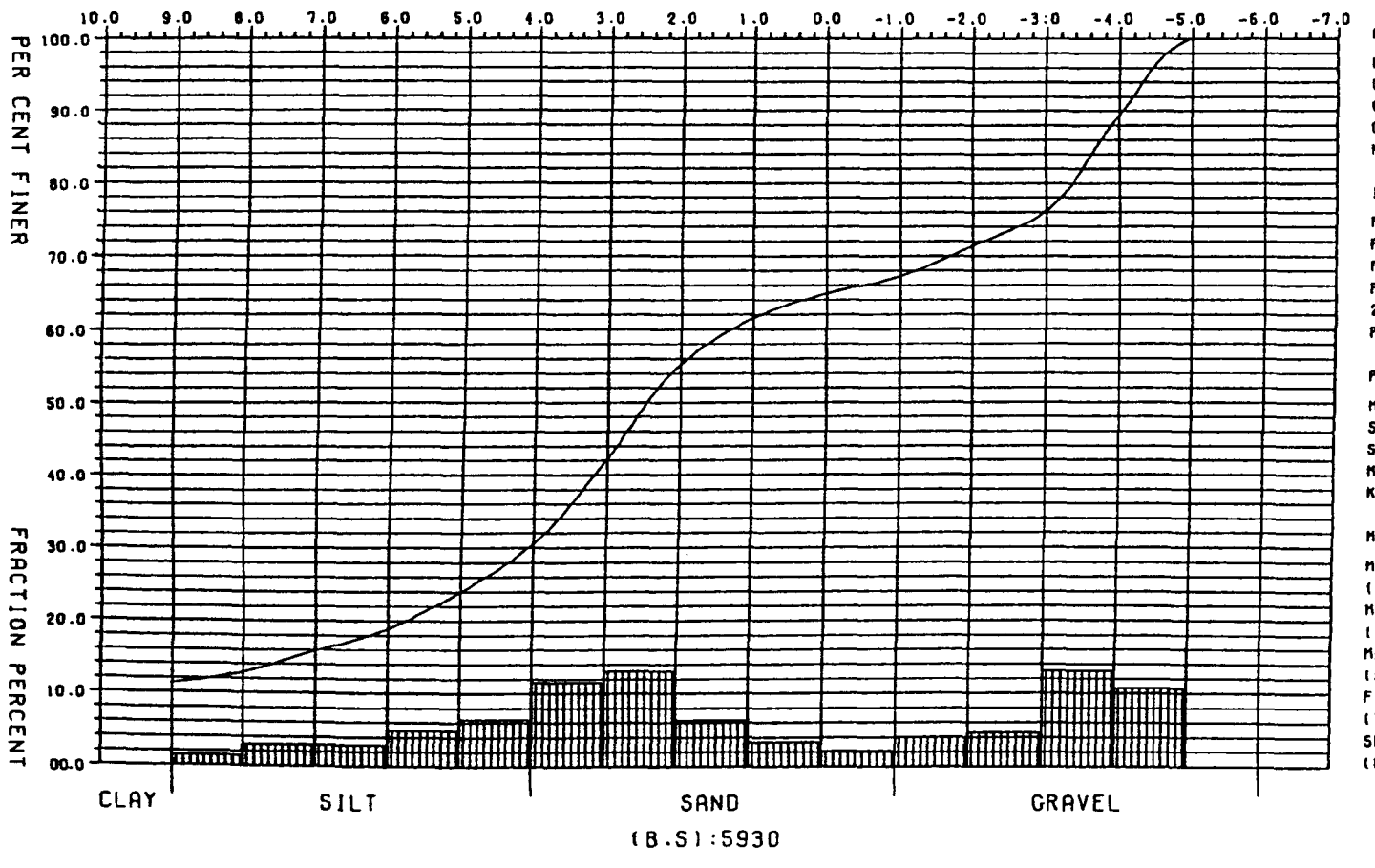
MEAN SIZE = 5.17
(88 PER CENT EFFICIENCY)
MEAN SIZE = 5.35
(93 PER CENT EFFICIENCY)
MEAN SIZE = 5.14
(87 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 4.27
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.22
(87 PER CENT EFFICIENCY)

SITE FIX: 60 10 00N 03 40 01W.

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FIG 4.6.2. UNIT .1. (BH 84/04).

DEPTH: 54.10M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 1.90
GRAPHIC STANDARD DEVIATION = 5.11
GRAPHIC SKEWNESS = .01
GRAPHIC KURTOSIS = .88
NORMALISED KURTOSIS = .47

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 2.39
PHI (ARITHMETIC) MEAN DIAMETER = 1.66
PHI DEVIATION MEASURE = 5.27
PHI SKEWNESS MEASURE = -.14
2ND PHI SKEWNESS MEASURE = .24
PHI KURTOSIS MEASURE = .55

PHI MOMENT STATISTICS.

MEAN SIZE = .83
STANDARD DEVIATION = 3.56
SKEWNESS (THIRD MOMENT) = .07
MEAN CUBED DEVIATION = 3.08
KURTOSIS (FOURTH MOMENT) = 2.02

MC CAMMON'S STATISTICS.

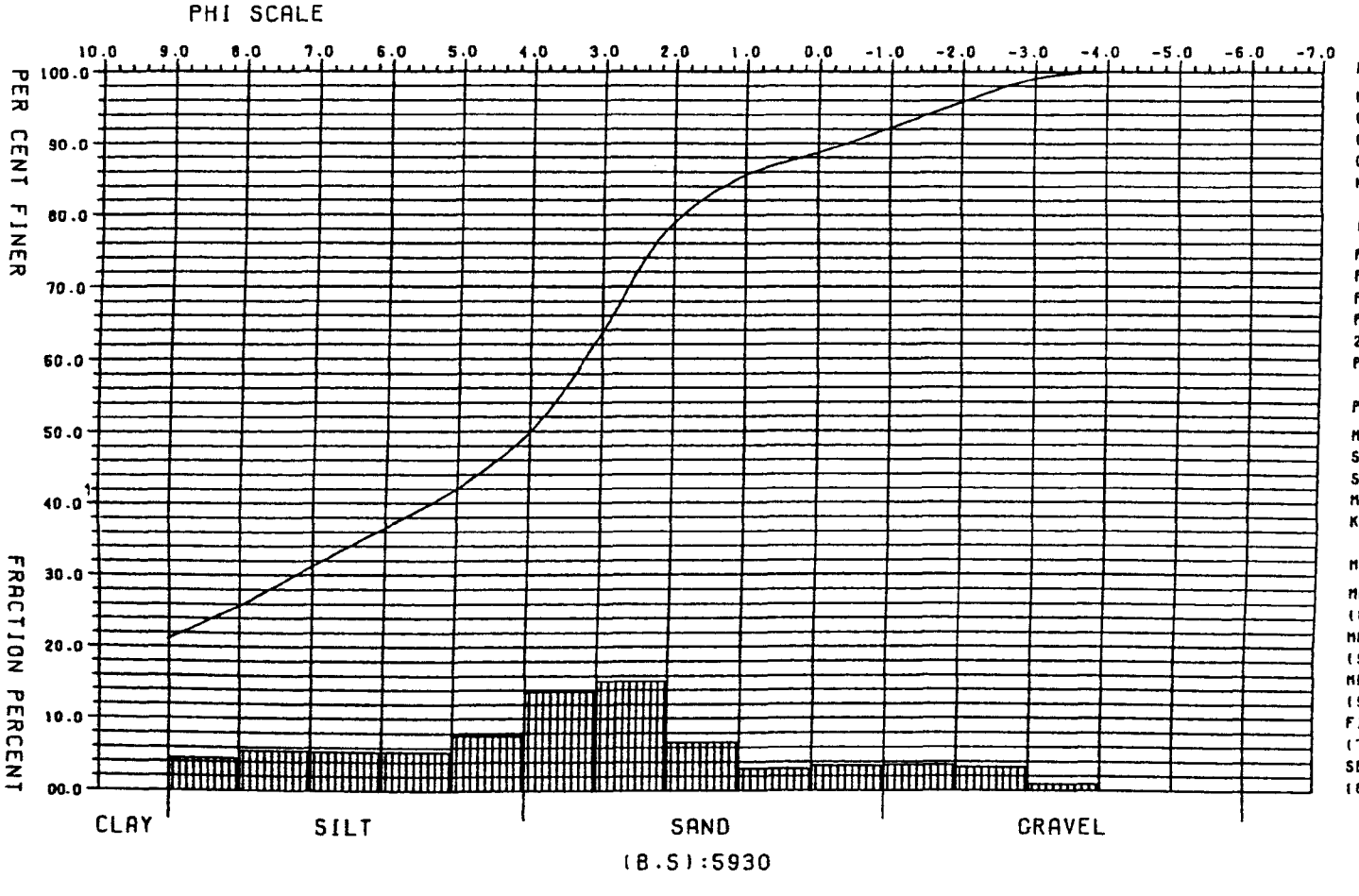
MEAN SIZE = 1.61
(88 PER CENT EFFICIENCY)
MEAN SIZE = 2.13
(93 PER CENT EFFICIENCY)
MEAN SIZE = 2.12
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 5.05
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.99
(87 PER CENT EFFICIENCY)

SITE FIX: 60 45 03N 02 16 21W.

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FIG 4.6.3. UNIT .1. (BH 82/01).

DEPTH: 15.00M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 5.13
GRAPHIC STANDARD DEVIATION = 4.46
GRAPHIC SKEWNESS = .30
GRAPHIC KURTOSIS = 1.02
NORMALISED KURTOSIS = .50

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 3.97
PHI (ARITHMETIC) MEAN DIAMETER = 5.71
PHI DEVIATION MEASURE = 4.49
PHI SKEWNESS MEASURE = .39
2ND PHI SKEWNESS MEASURE = .34
PHI KURTOSIS MEASURE = .63

PHI MOMENT STATISTICS.

MEAN SIZE = 2.58
STANDARD DEVIATION = 2.64
SKEWNESS (THIRD MOMENT) = .58
MEAN CUBED DEVIATION = 10.66
KURTOSIS (FOURTH MOMENT) = 3.19

MC CAMMON'S STATISTICS.

MEAN SIZE = 5.01
(88 PER CENT EFFICIENCY)
MEAN SIZE = 5.29
(93 PER CENT EFFICIENCY)
MEAN SIZE = 5.03
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 4.44
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.21
(87 PER CENT EFFICIENCY)

SITE FIX: 59 55 18N 03 31 14W.

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FIG 4.6.4. UNIT .1. (82/10 & 84/04).

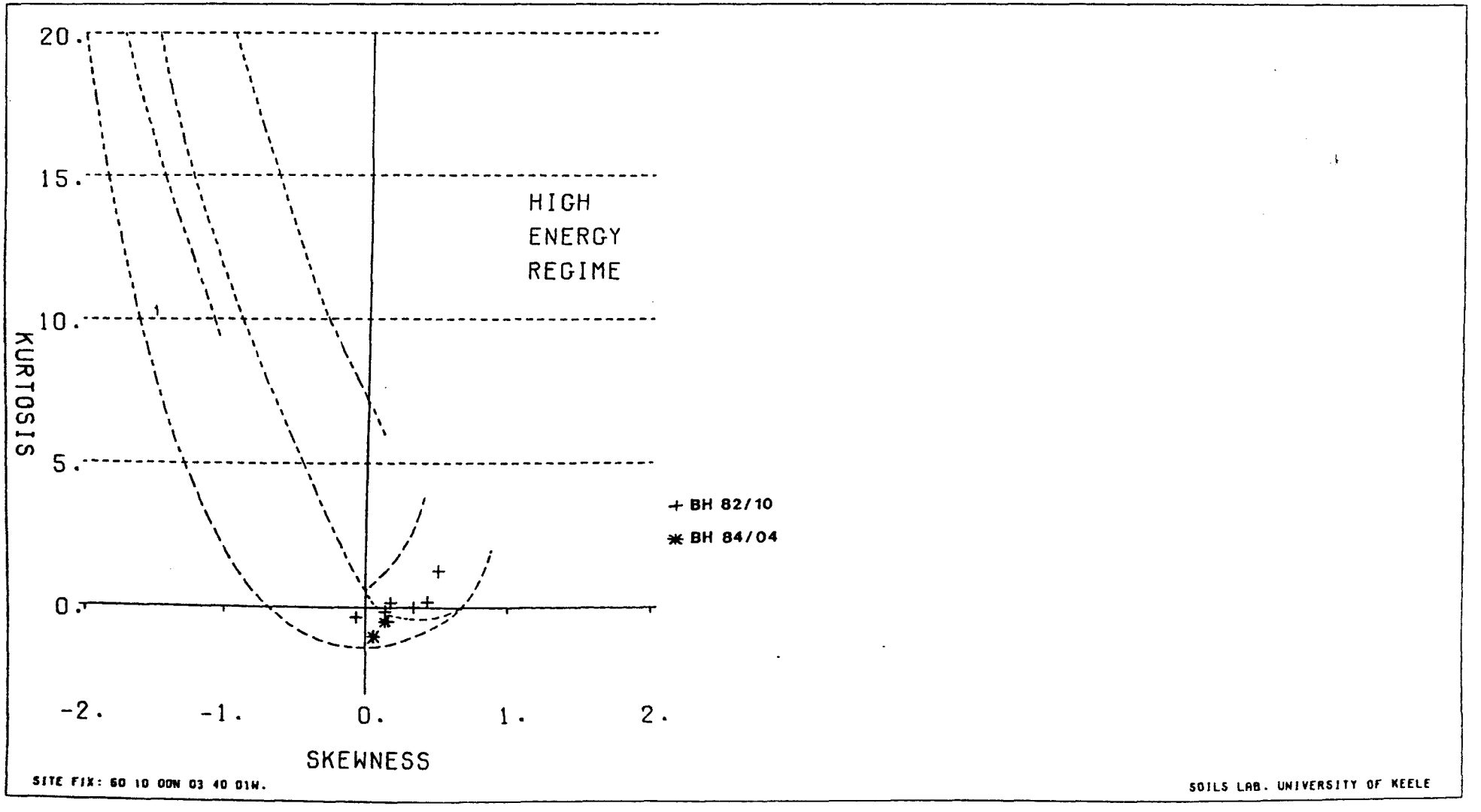


FIG 4.6.5. UNIT .1. (BH 82/01).

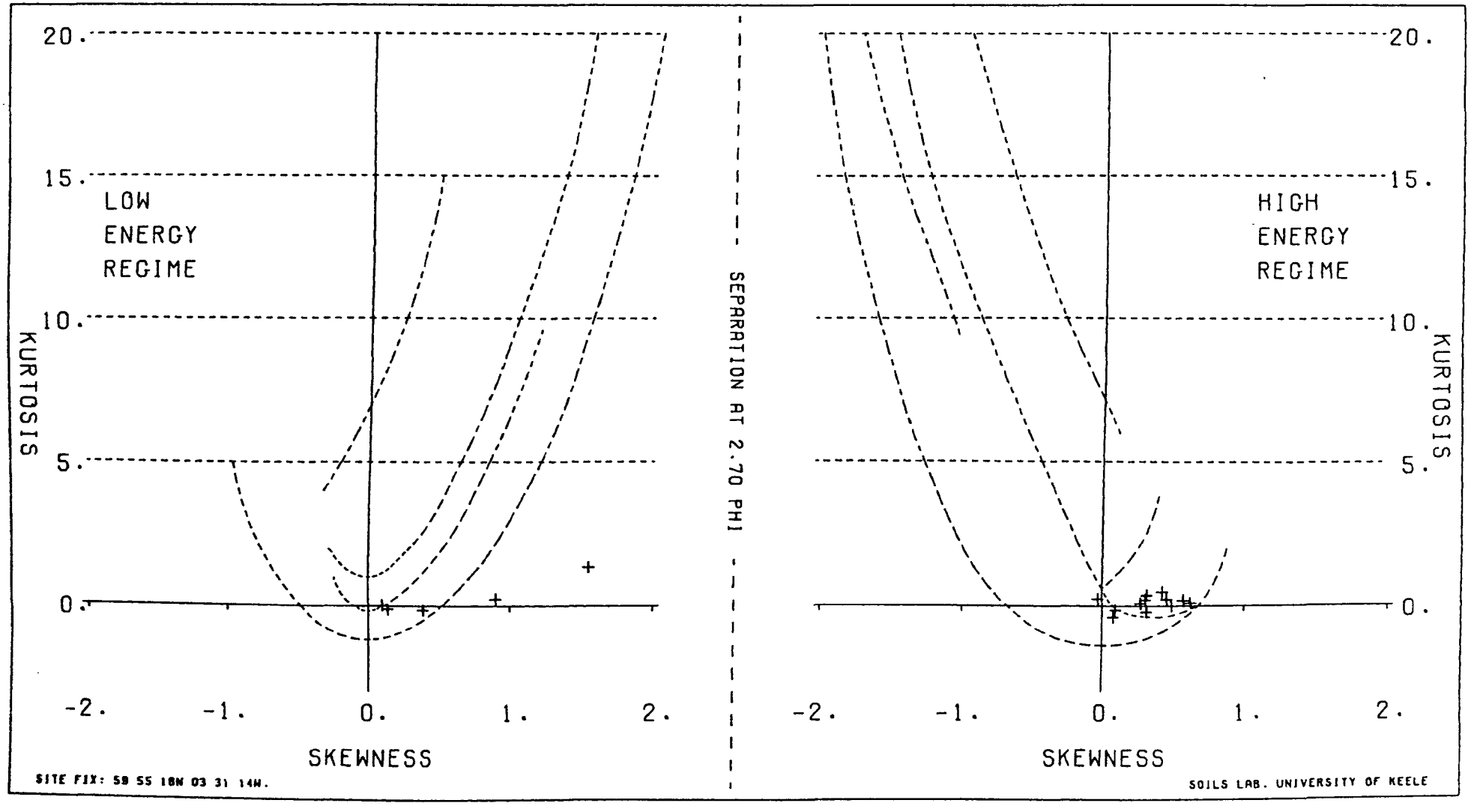
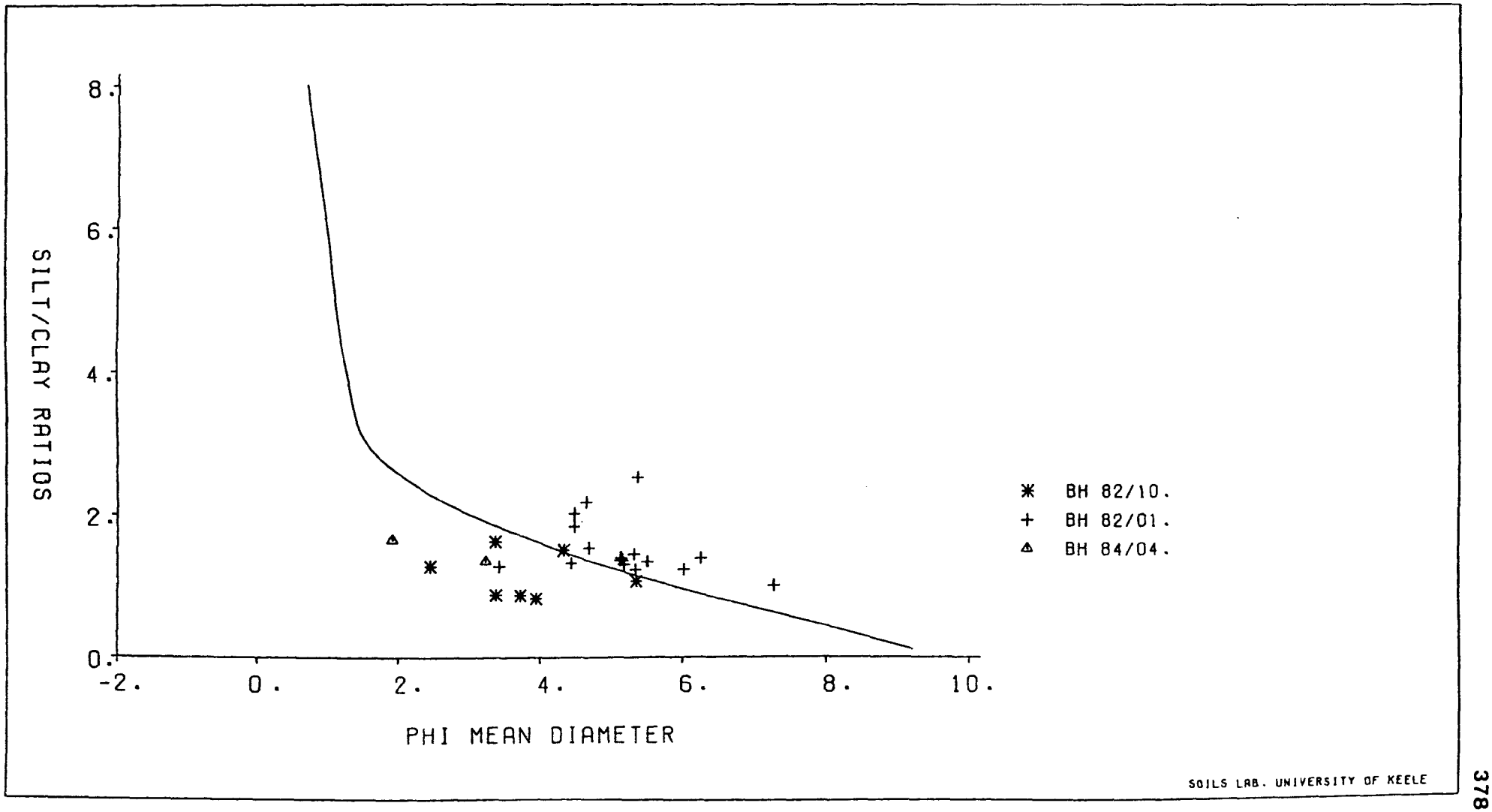


FIG 4.6.6. UNIT .1. SEDIMENTS.



4.6.7. FACIES SUCCESSION : UNIT 1.

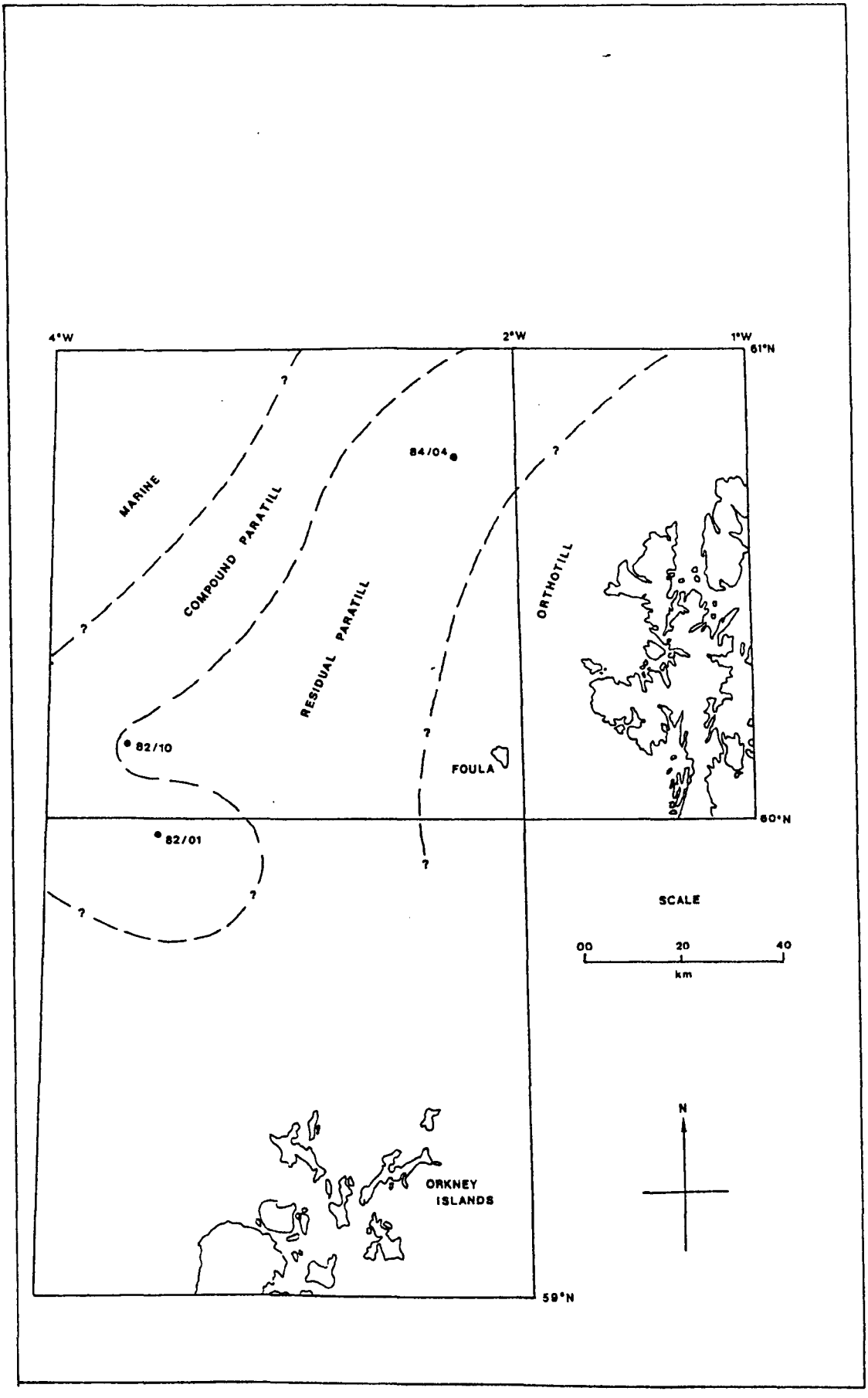
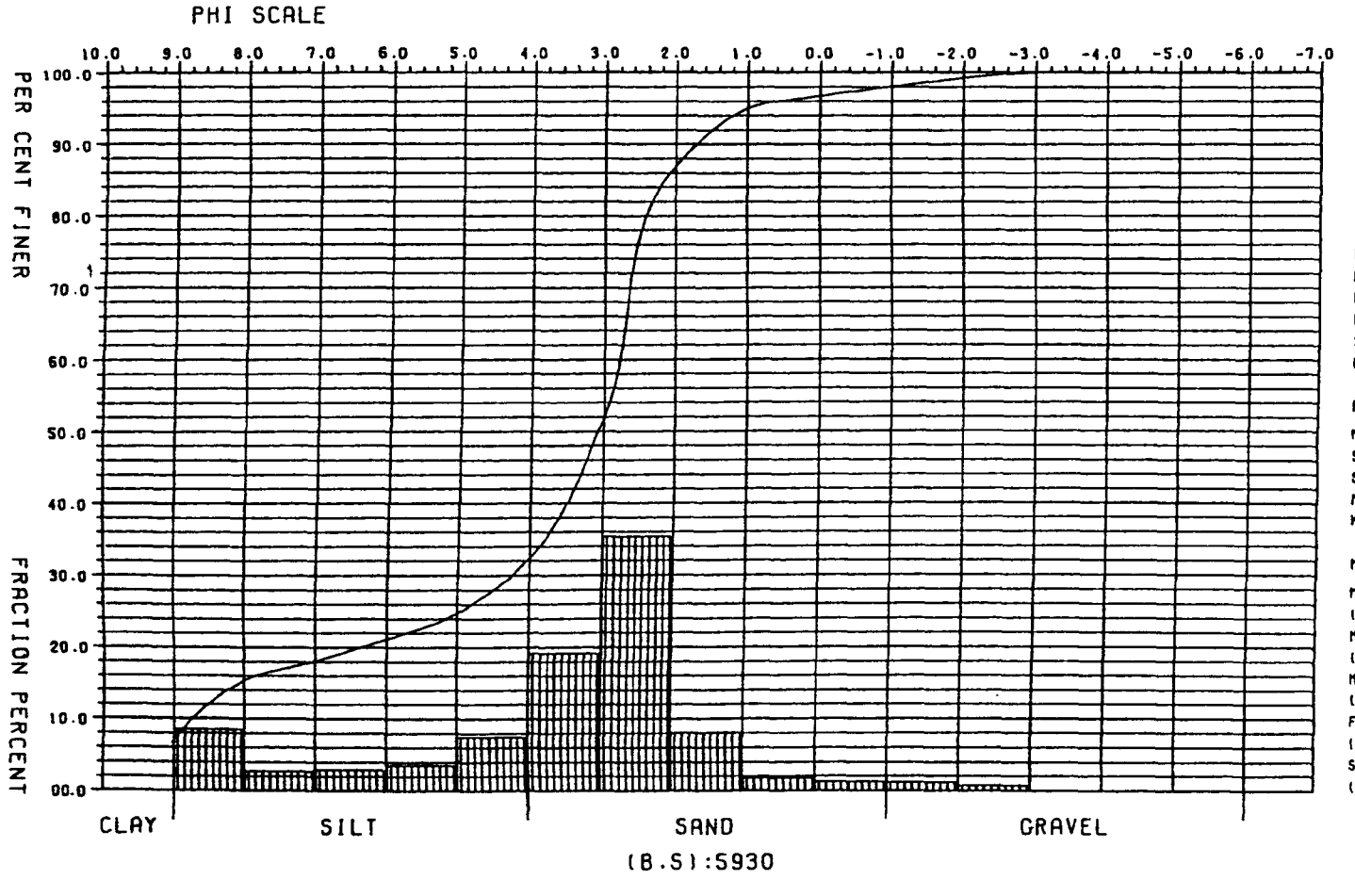


FIG 4.7.1. UNIT .0. (BH 82/11).

DEPTH: 29.50M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 4.29
GRAPHIC STANDARD DEVIATION = 2.81
GRAPHIC SKEWNESS = .60
GRAPHIC KURTOSIS = 1.45
NORMALISED KURTOSIS = .59

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 3.07
PHI (ARITHMETIC) MEAN DIAMETER = 4.90
PHI DEVIATION MEASURE = 2.82
PHI SKEWNESS MEASURE = .65
2ND PHI SKEWNESS MEASURE = .89
PHI KURTOSIS MEASURE = .64

PHI MOMENT STATISTICS.

MEAN SIZE = 3.32
STANDARD DEVIATION = 2.19
SKEWNESS (THIRD MOMENT) = 1.03
MEAN CUBED DEVIATION = 10.78
KURTOSIS (FOURTH MOMENT) = 4.18

MC CAMMON'S STATISTICS.

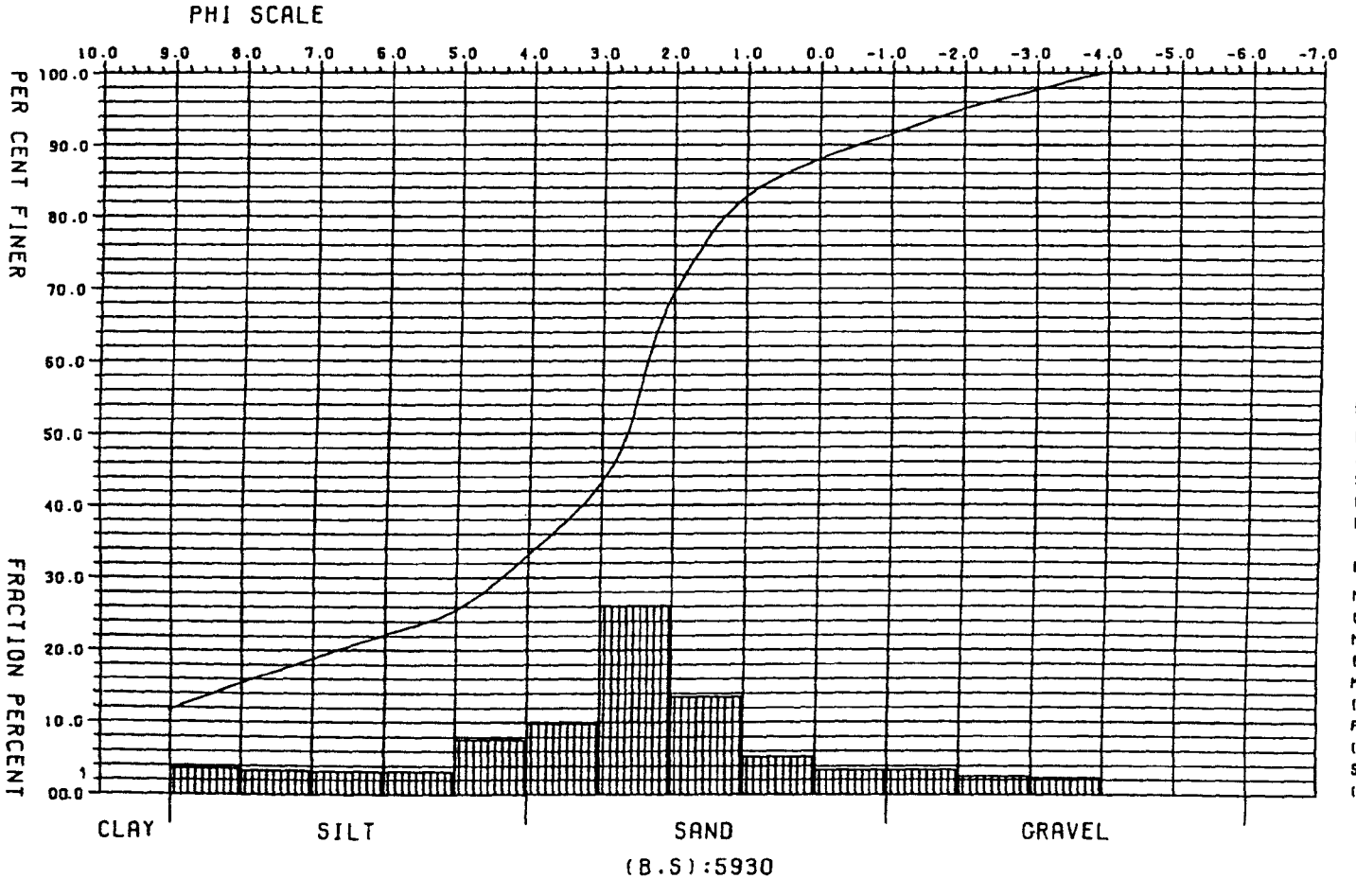
MEAN SIZE = 3.86
(88 PER CENT EFFICIENCY)
MEAN SIZE = 4.09
(93 PER CENT EFFICIENCY)
MEAN SIZE = 4.12
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 2.82
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 2.69
(87 PER CENT EFFICIENCY)

SITE FIX: 60 15 06N 03 52 16W.

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FIG 4.7.2. UNIT .0. (BH 82/11).

DEPTH: 29.30M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 3.77
GRAPHIC STANDARD DEVIATION = 3.87
GRAPHIC SKEWNESS = .38
GRAPHIC KURTOSIS = 1.60
NORMALISED KURTOSIS = .62

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 2.73
PHI (ARITHMETIC) MEAN DIAMETER = 4.29
PHI DEVIATION MEASURE = 3.53
PHI SKEWNESS MEASURE = .44
2ND PHI SKEWNESS MEASURE = .62
PHI KURTOSIS MEASURE = .96

PHI MOMENT STATISTICS.

MEAN SIZE = 2.32
STANDARD DEVIATION = 2.49
SKEWNESS (THIRD MOMENT) = .46
MEAN CUBED DEVIATION = 7.07
KURTOSIS (FOURTH MOMENT) = 3.76

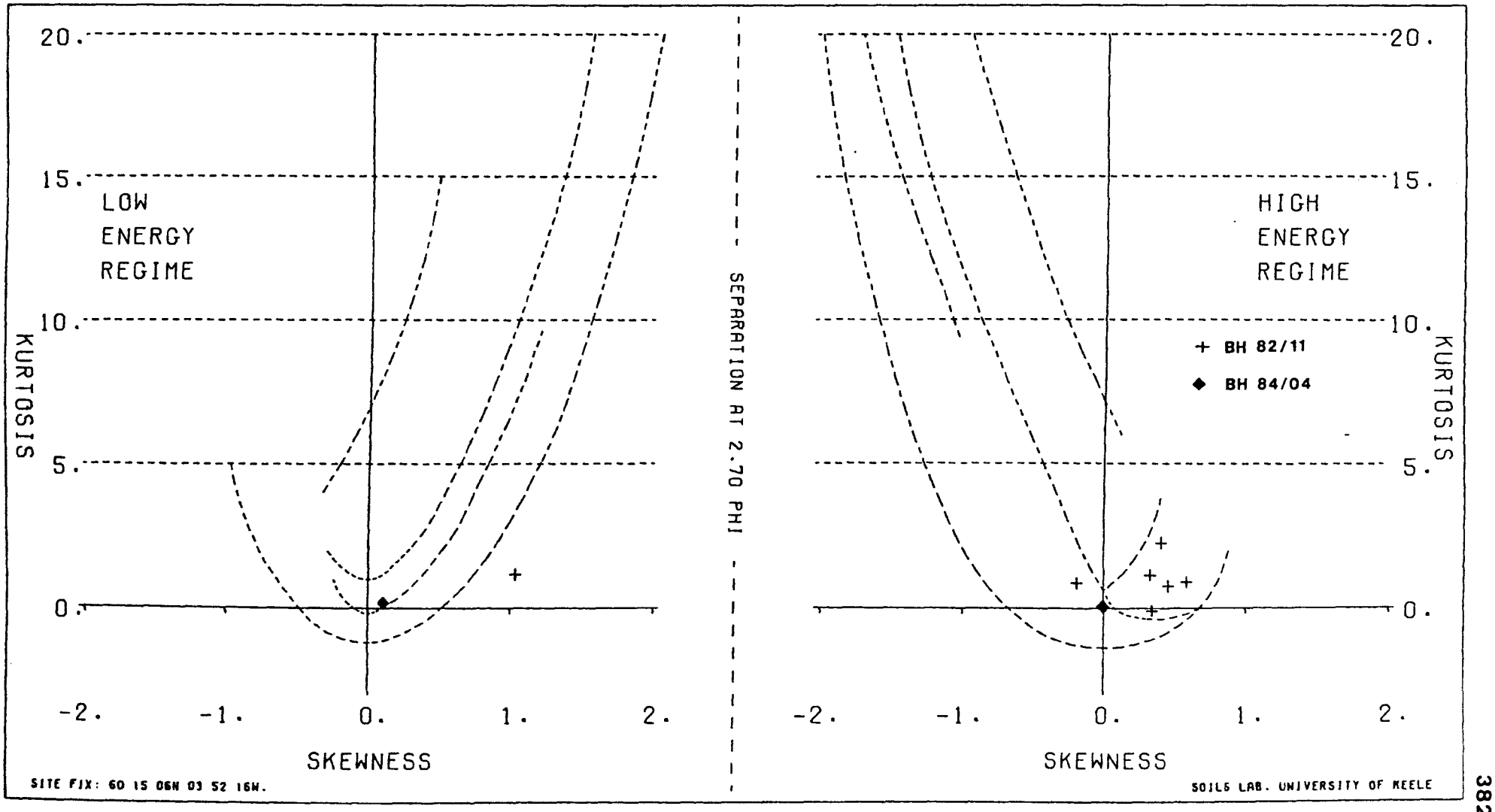
MC CAMMON'S STATISTICS.

MEAN SIZE = 3.52
(88 PER CENT EFFICIENCY)
MEAN SIZE = 3.87
(93 PER CENT EFFICIENCY)
MEAN SIZE = 3.67
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.96
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.58
(87 PER CENT EFFICIENCY)

SITE FIX: 60 15 06N 03 52 16W.

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FIG 4.7.3. UNIT .O. SEDIMENTS.



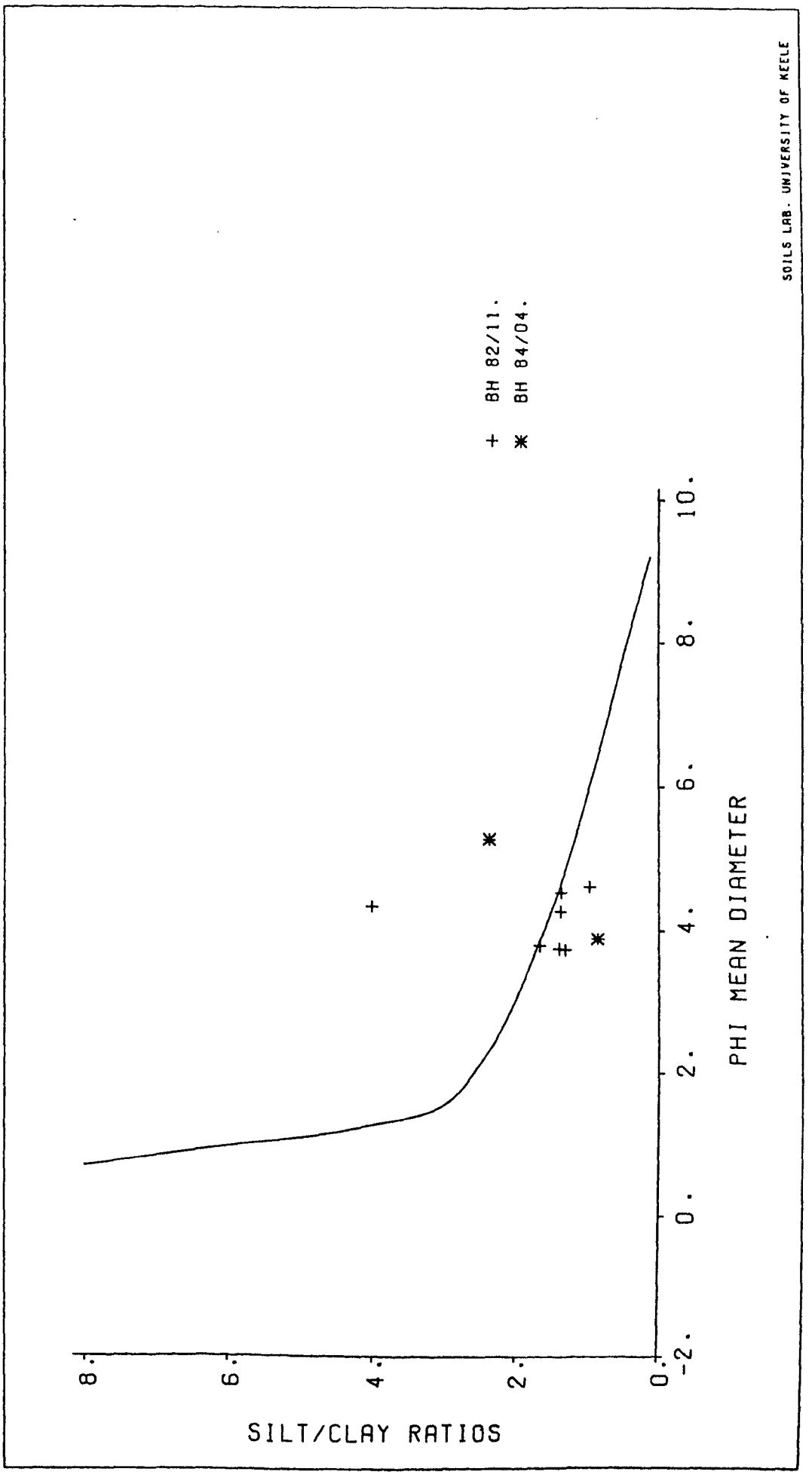
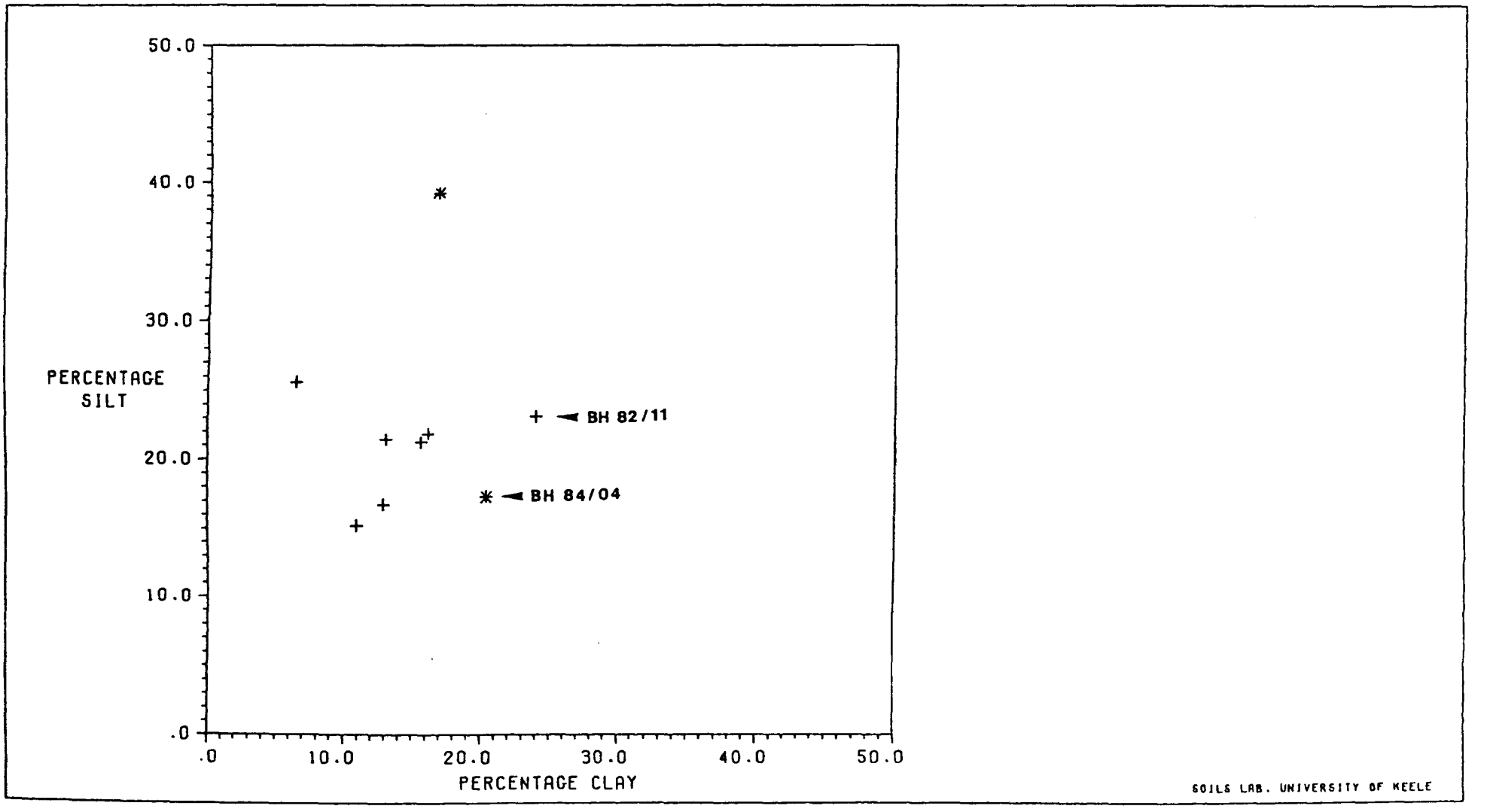


FIG 4.7.4. UNIT .O. SEDIMENTS.

FIG 4.7.5. UNIT .O. SILT:CLAY PLOT.



4.7.6. FACIES SUCCESSION : UNIT O.

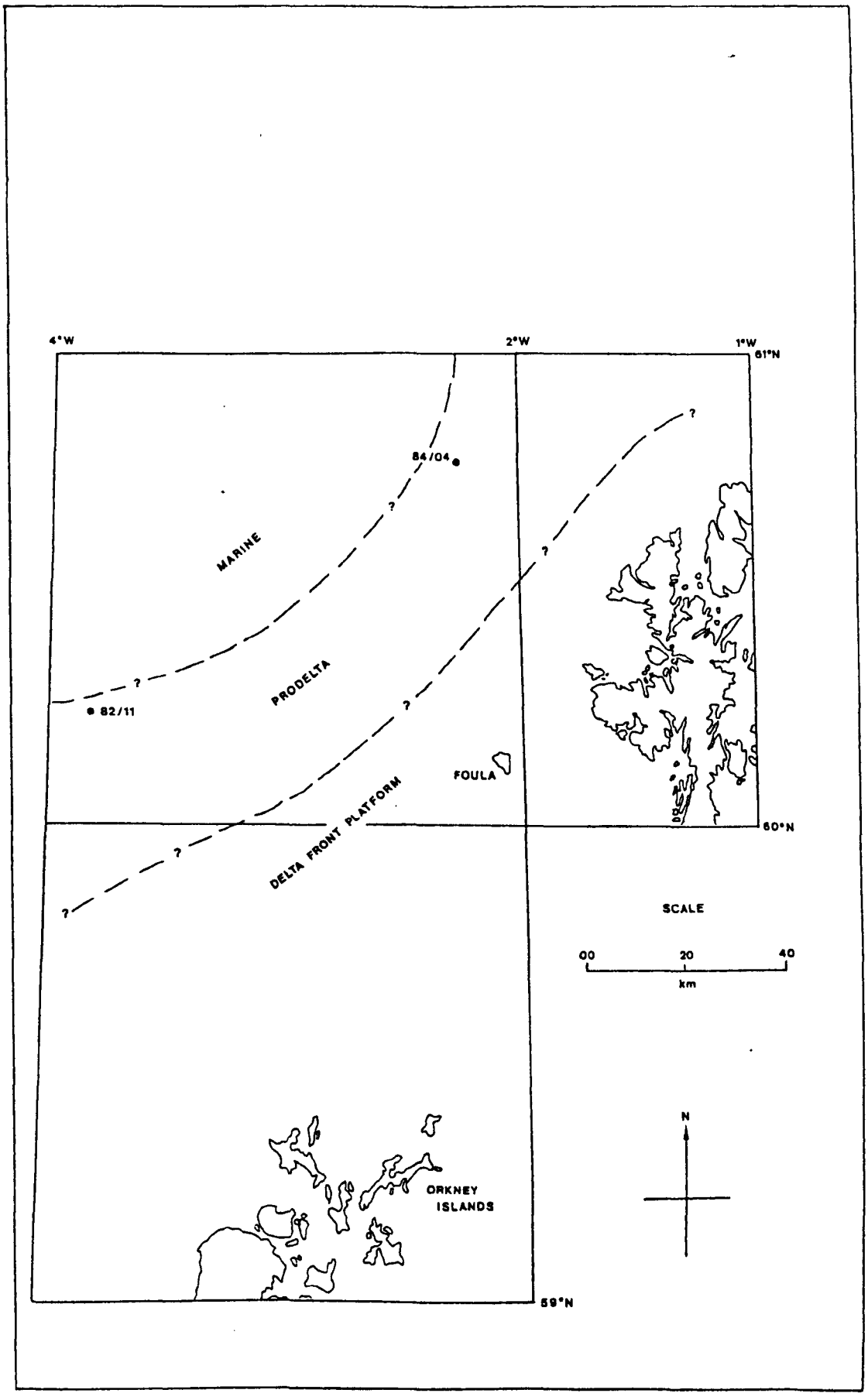
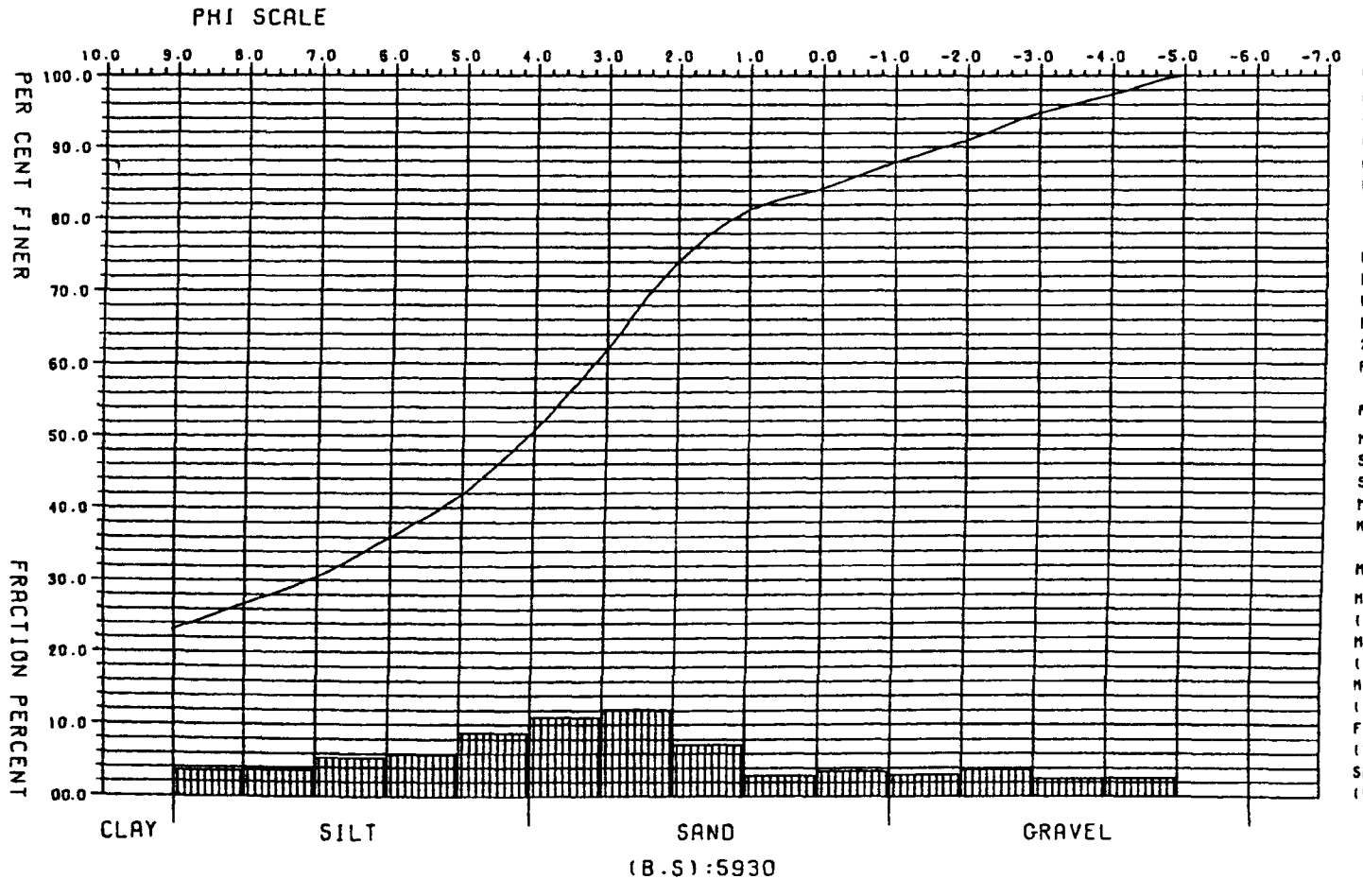


FIG 4.8.1. UNIT .-1. (BH 82/11).

DEPTH: 15.00M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 4.89
GRAPHIC STANDARD DEVIATION = 5.05
GRAPHIC SKEWNESS = .17
GRAPHIC KURTOSIS = .99
NORMALISED KURTOSIS = .50

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 4.07
PHI (ARITHMETIC) MEAN DIAMETER = 5.30
PHI DEVIATION MEASURE = 5.24
PHI SKEWNESS MEASURE = .24
2ND PHI SKEWNESS MEASURE = .16
PHI KURTOSIS MEASURE = .53

PHI MOMENT STATISTICS.

MEAN SIZE = 2.11
STANDARD DEVIATION = 2.93
SKEWNESS (THIRD MOMENT) = .21
MEAN CUBED DEVIATION = 5.34
KURTOSIS (FOURTH MOMENT) = 3.05

MC CAMMON'S STATISTICS.

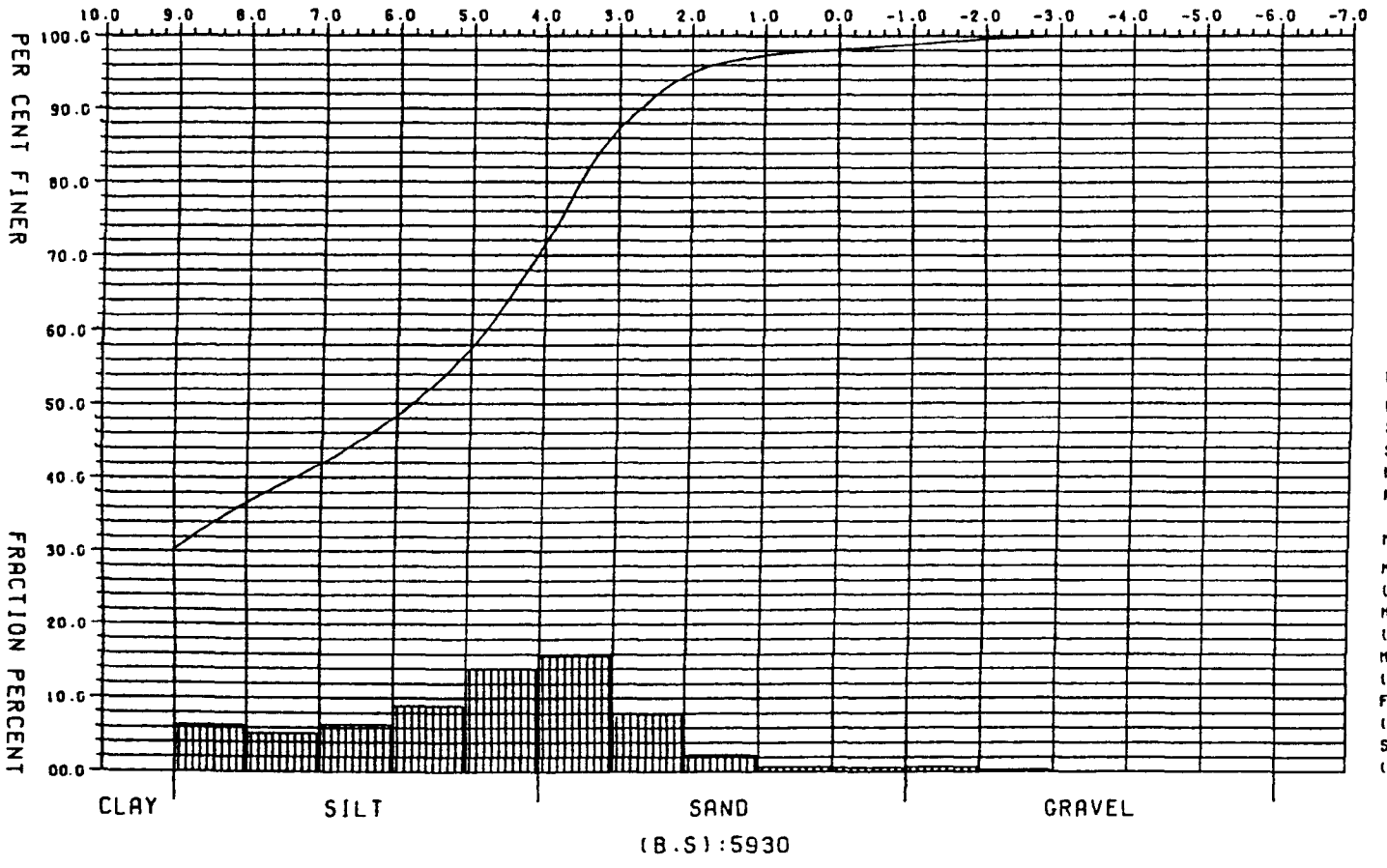
MEAN SIZE = 4.97
(86 PER CENT EFFICIENCY)
MEAN SIZE = 5.02
(93 PER CENT EFFICIENCY)
MEAN SIZE = 4.78
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 5.00
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.68
(87 PER CENT EFFICIENCY)

SITE FIX: 60 15 06N 03 52 16W.

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FIG 4.8.2. UNIT .-1. (BH 82/11).

DEPTH: 2.80M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 6.78
GRAPHIC STANDARD DEVIATION = 3.74
GRAPHIC SKEWNESS = .34
GRAPHIC KURTOSIS = .75
NORMALISED KURTOSIS = .43

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 5.80
PHI (ARITHMETIC) MEAN DIAMETER = 7.27
PHI DEVIATION MEASURE = 4.08
PHI SKEWNESS MEASURE = .36
2ND PHI SKEWNESS MEASURE = .43
PHI KURTOSIS MEASURE = .38

PHI MOMENT STATISTICS.

MEAN SIZE = 3.25
STANDARD DEVIATION = 2.16
SKEWNESS (THIRD MOMENT) = 1.44
MEAN CUBED DEVIATION = 14.52
KURTOSIS (FOURTH MOMENT) = 3.95

MC CAMMON'S STATISTICS.

MEAN SIZE = 6.64
(88 PER CENT EFFICIENCY)
MEAN SIZE = 6.67
(93 PER CENT EFFICIENCY)
MEAN SIZE = 6.78
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.63
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.71
(87 PER CENT EFFICIENCY)

SITE FIX: 60 15 06N 03 52 16W.

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FIG 4.8.3. UNIT .-1. (BH 82/11).

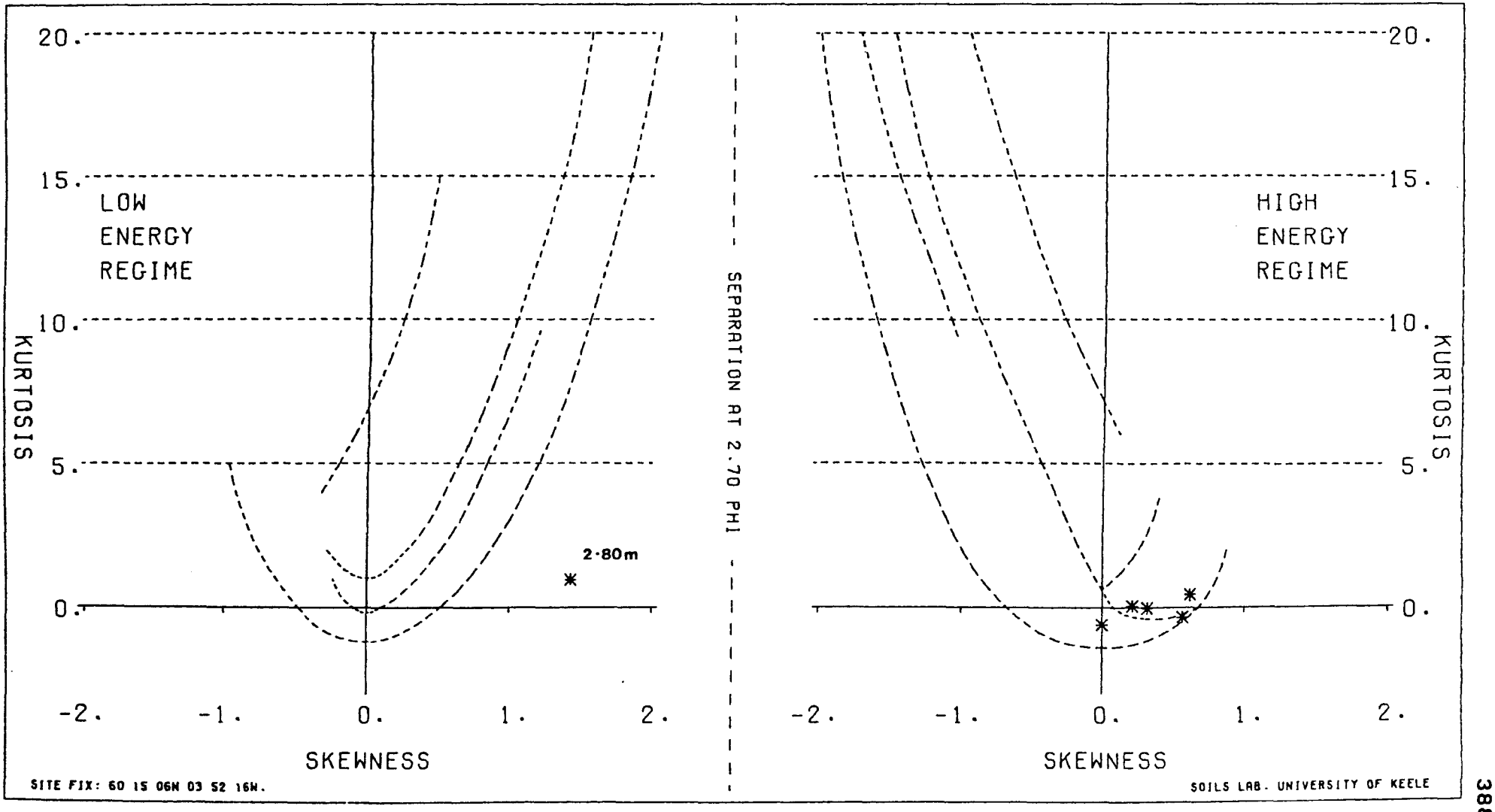
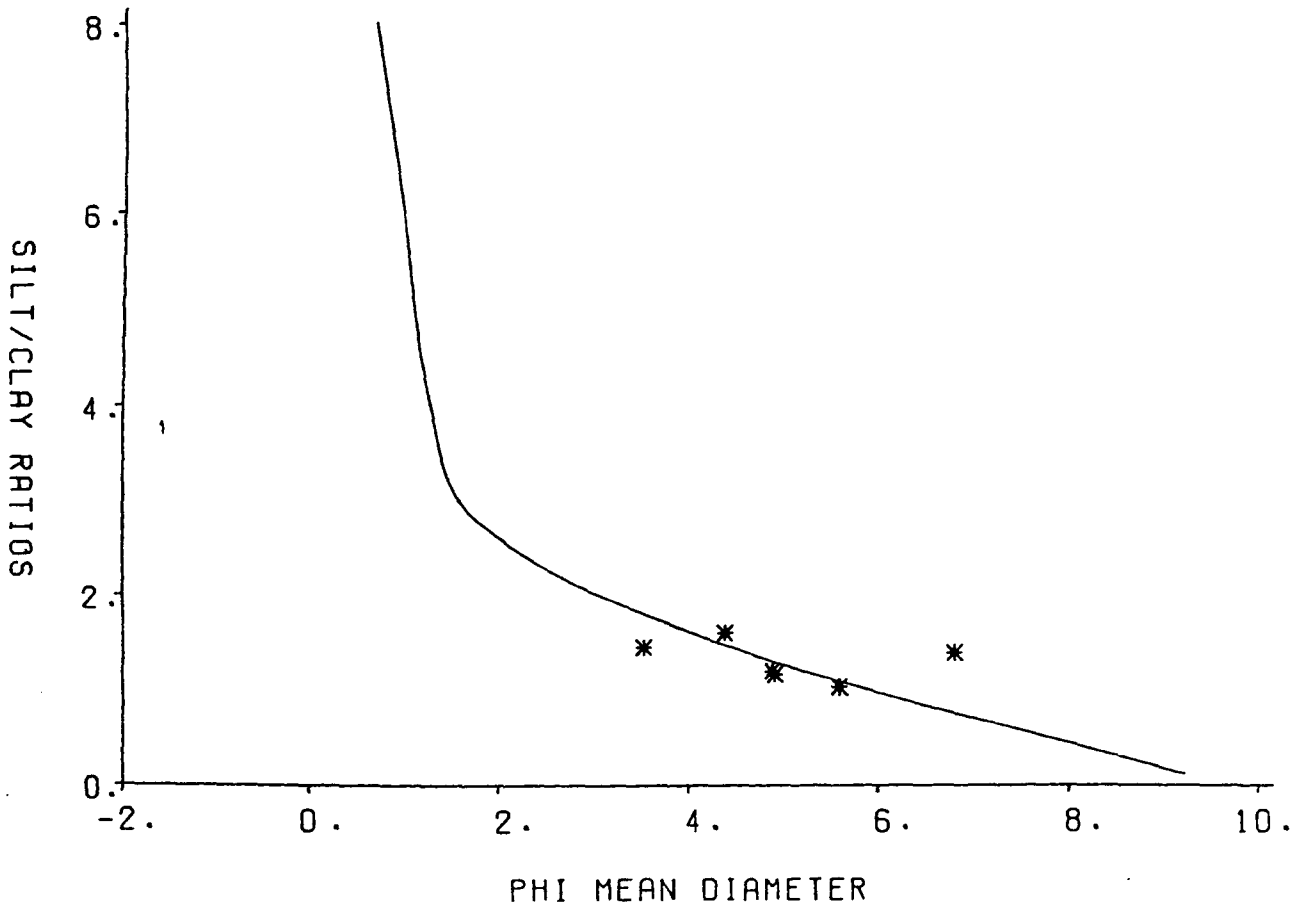


FIG 4.8.4. UNIT .-1. SEDIMENTS.



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4.8.5. FACIES SUCCESSION : UNIT -1.

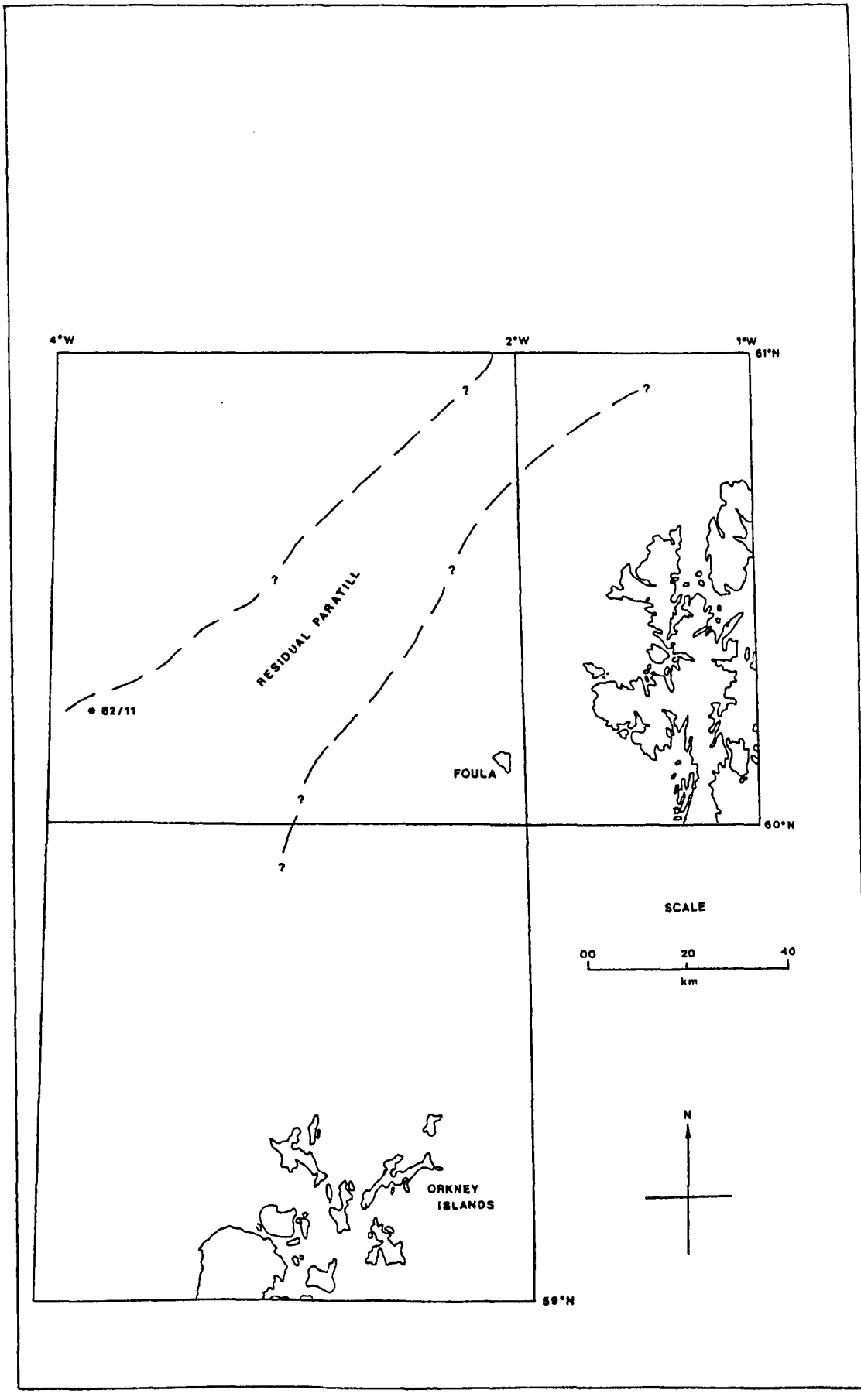
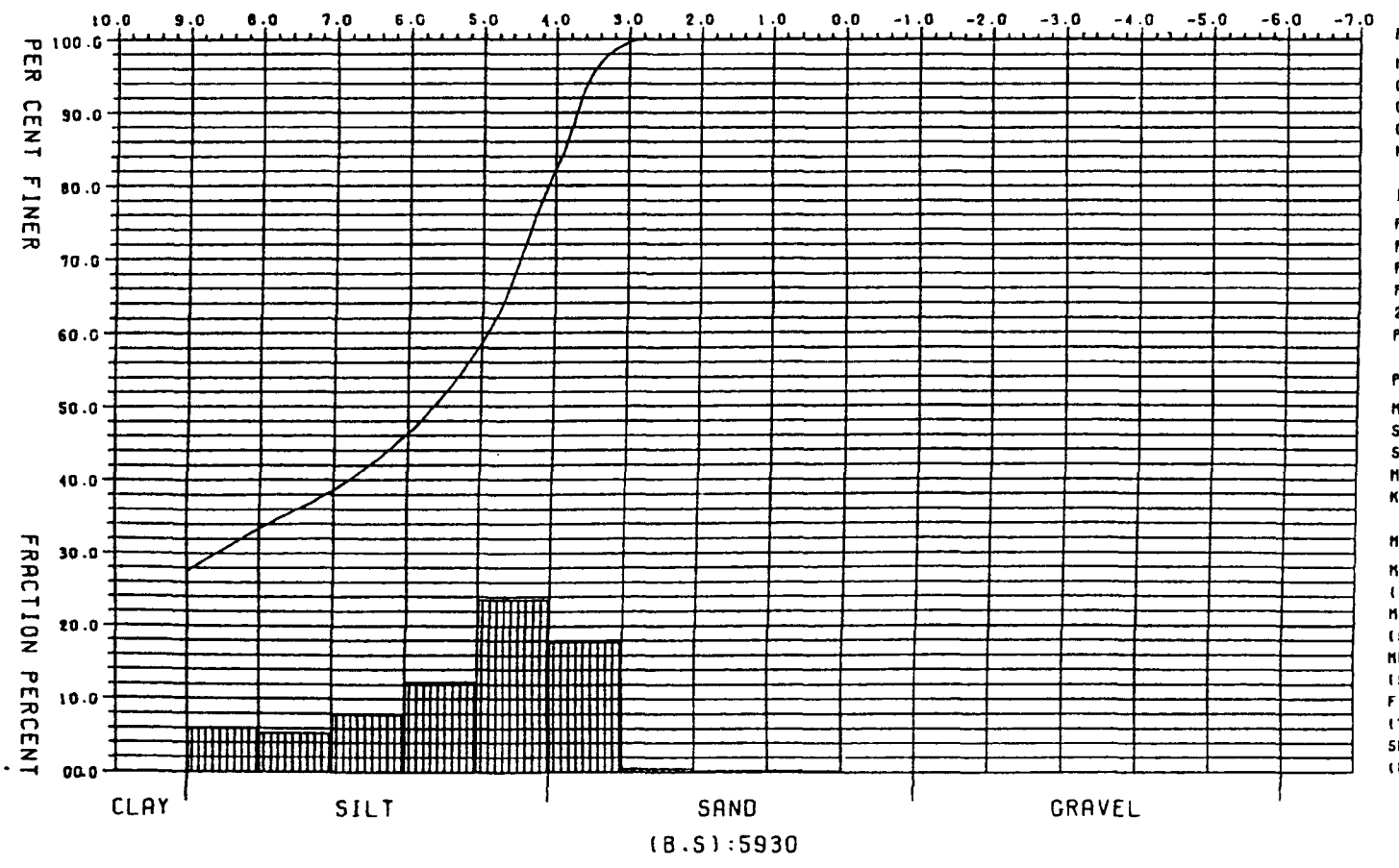


FIG 4.9.1. UNIT .X. (BH 84/03).

DEPTH: 7.00M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 6.87
GRAPHIC STANDARD DEVIATION = 3.29
GRAPHIC SKEWNESS = .50
GRAPHIC KURTOSIS = .79
NORMALISED KURTOSIS = .44

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 5.67
PHI (ARITHMETIC) MEAN DIAMETER = 7.46
PHI DEVIATION MEASURE = 3.59
PHI SKEWNESS MEASURE = .50
2ND PHI SKEWNESS MEASURE = .69
PHI KURTOSIS MEASURE = .37

PHI MOMENT STATISTICS.

MEAN SIZE = 3.75
STANDARD DEVIATION = 1.78
SKEWNESS (THIRD MOMENT) = 2.00
MEAN CUBED DEVIATION = 11.34
KURTOSIS (FOURTH MOMENT) = 4.55

MC CAMMON'S STATISTICS.

MEAN SIZE = 6.69
(88 PER CENT EFFICIENCY)
MEAN SIZE = 6.93
(93 PER CENT EFFICIENCY)
MEAN SIZE = 6.88
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.20
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.18
(87 PER CENT EFFICIENCY)

SITE FIX: 60 29 58N 02 12 11W.

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FIG 4.9.2. UNIT .X. (BH 84/03).

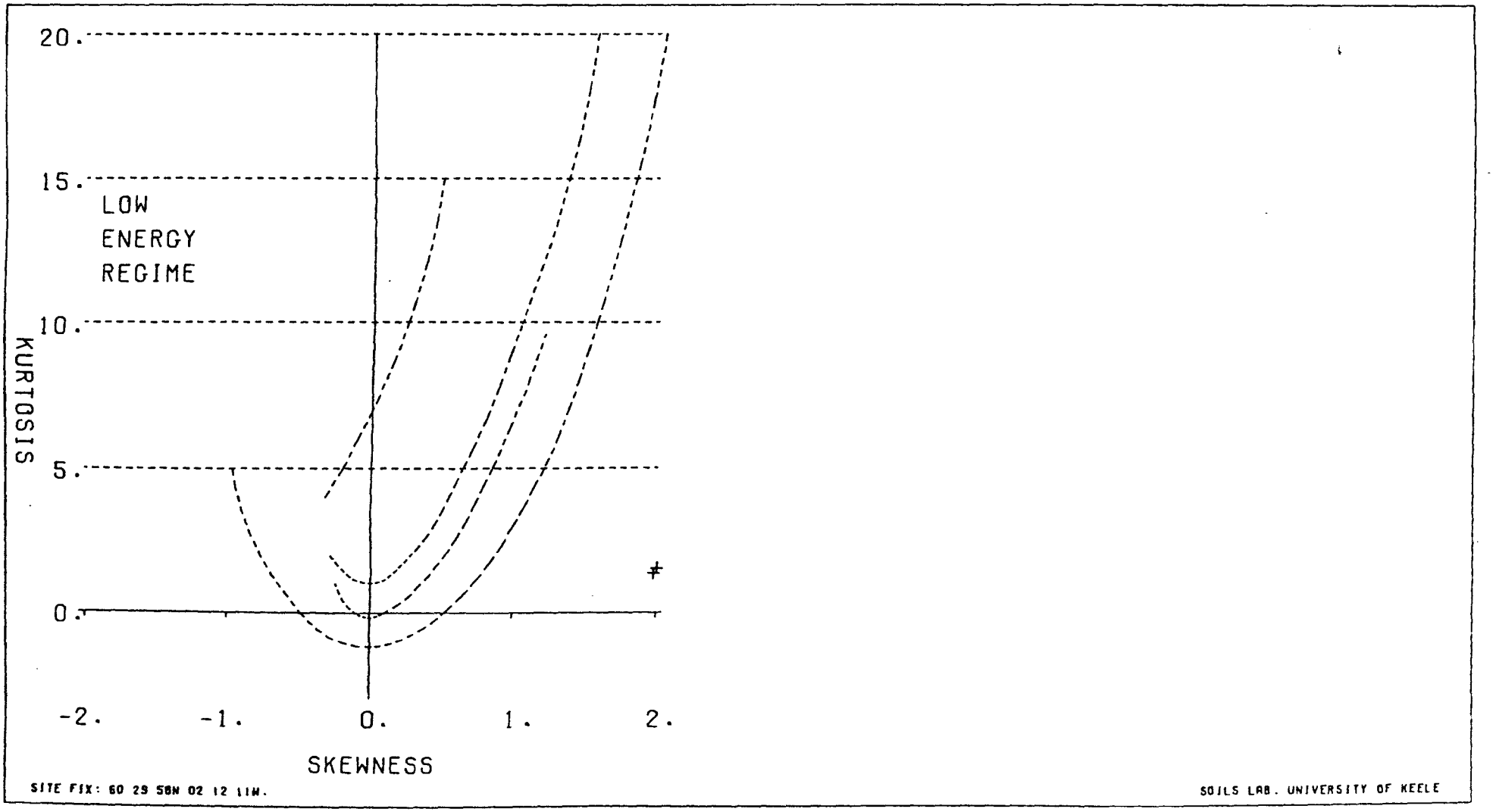
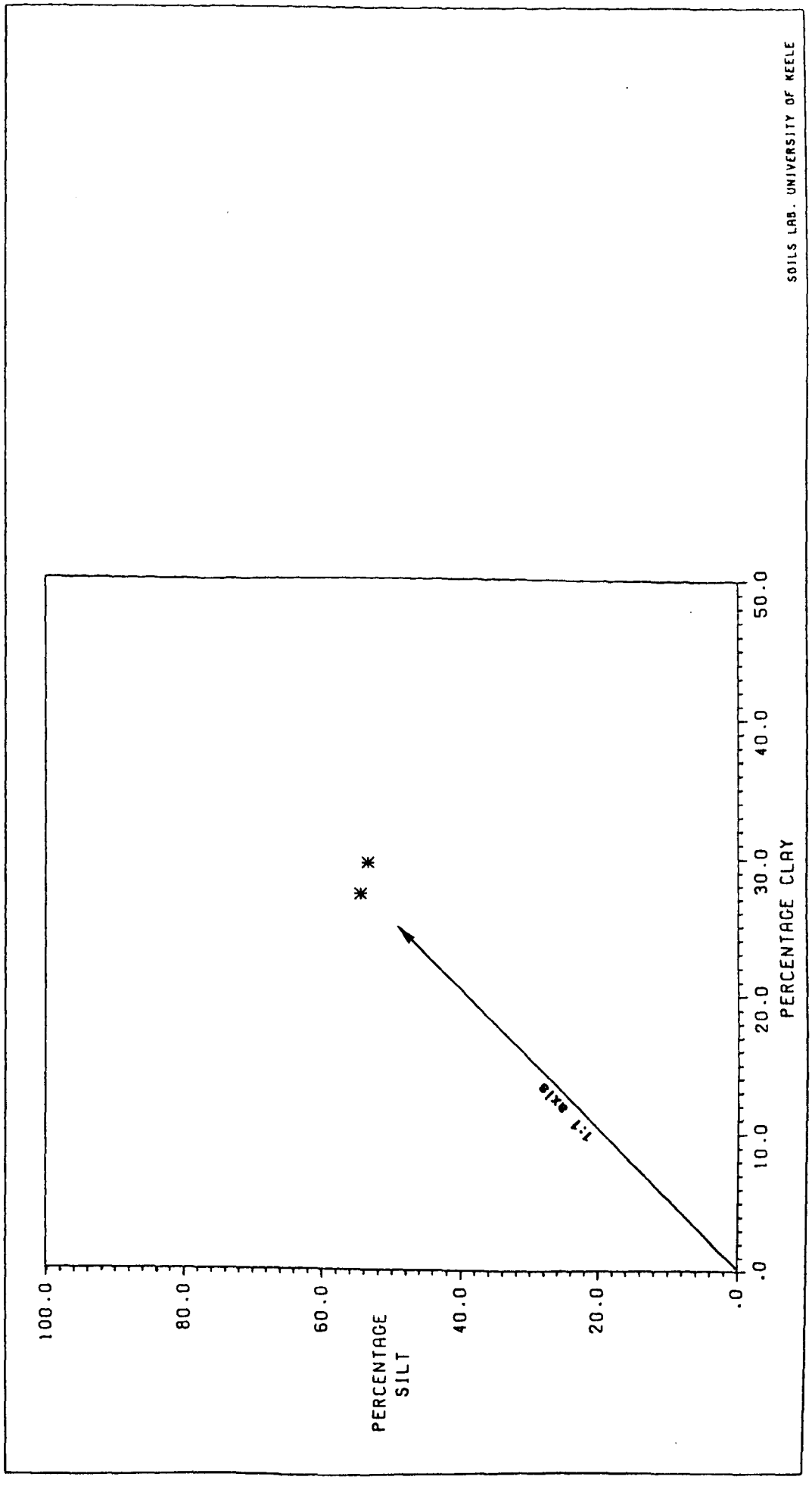


FIG 4.9.3. UNIT .X. SILT:CLAY PLOT.



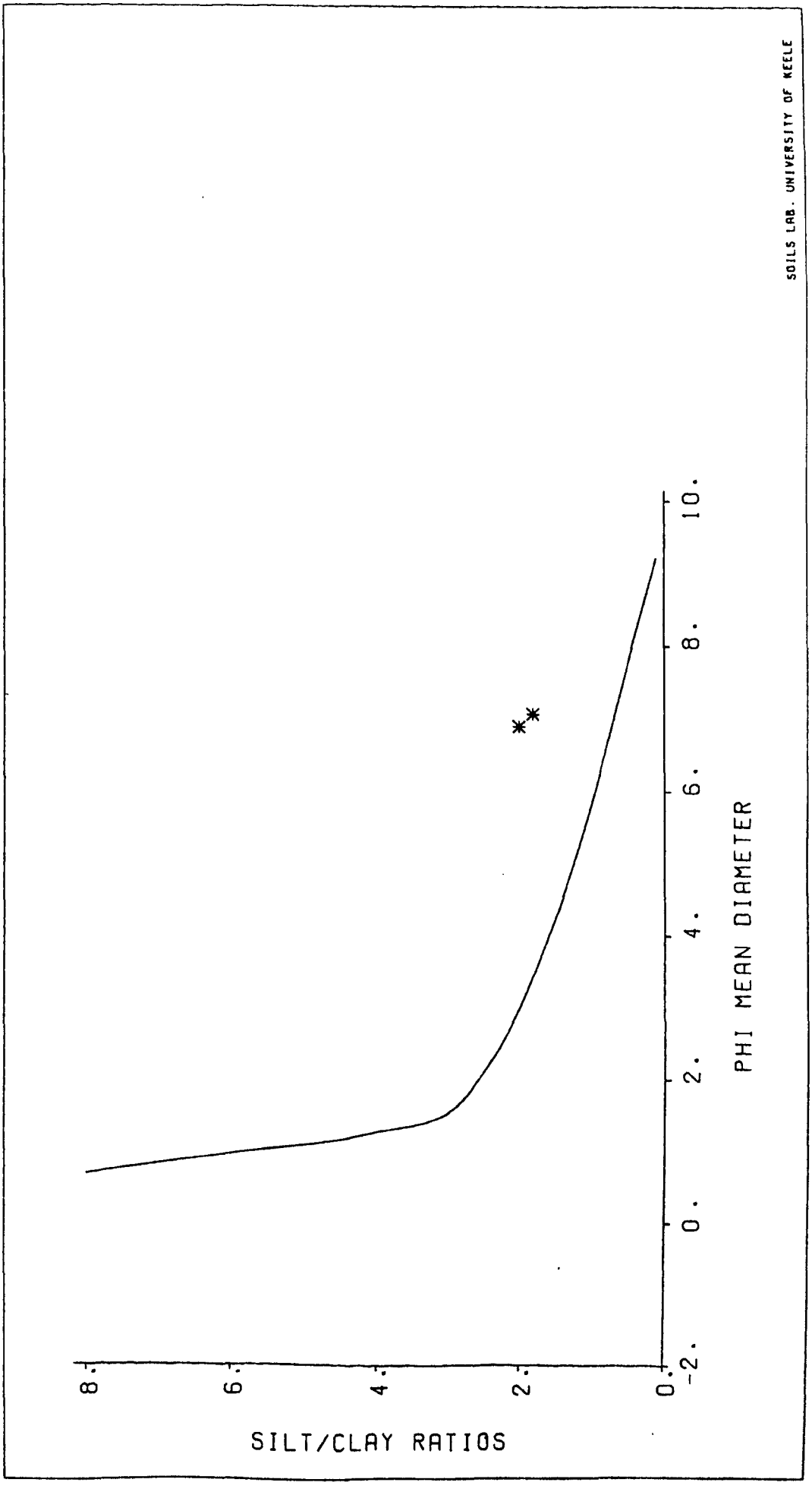
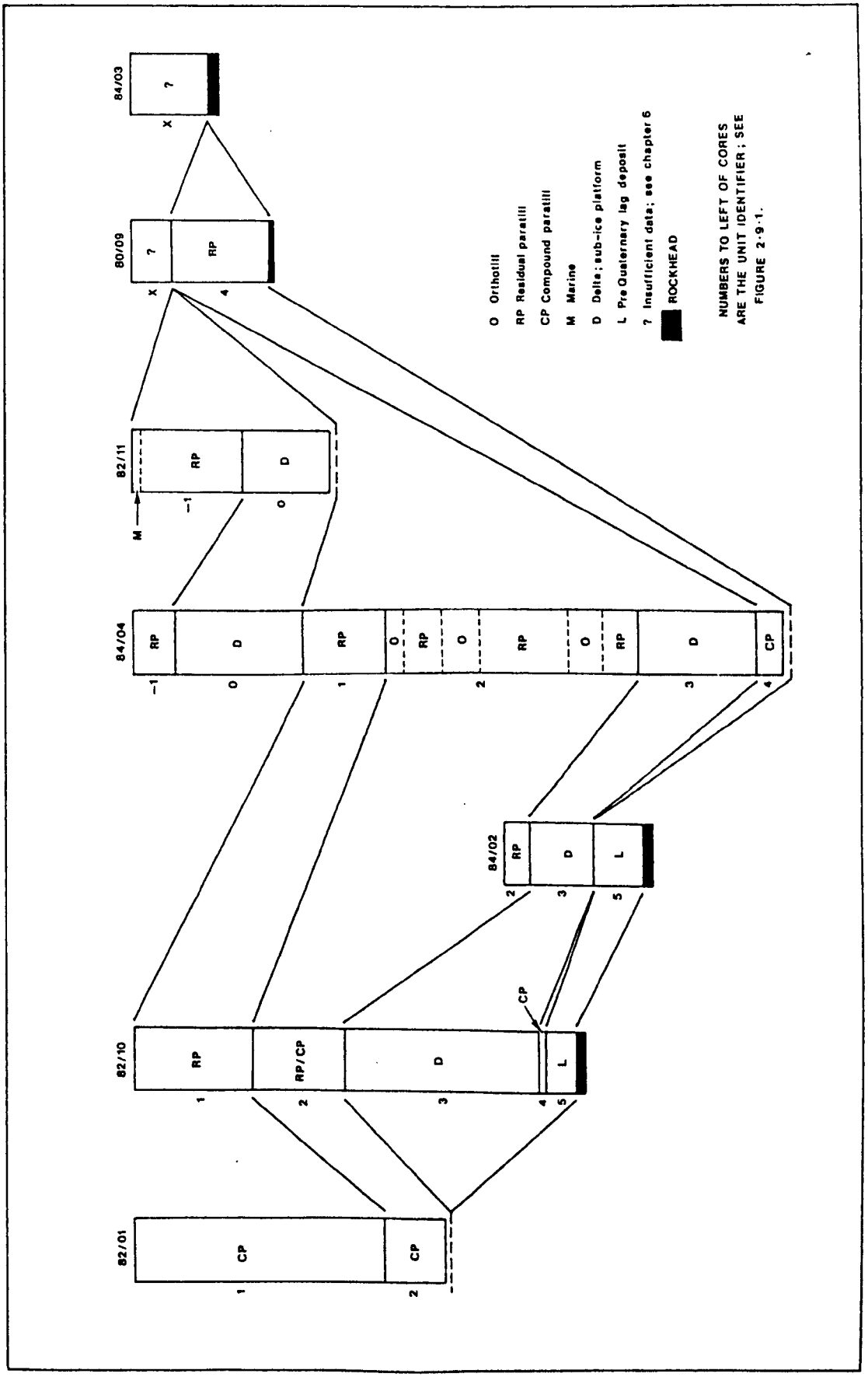
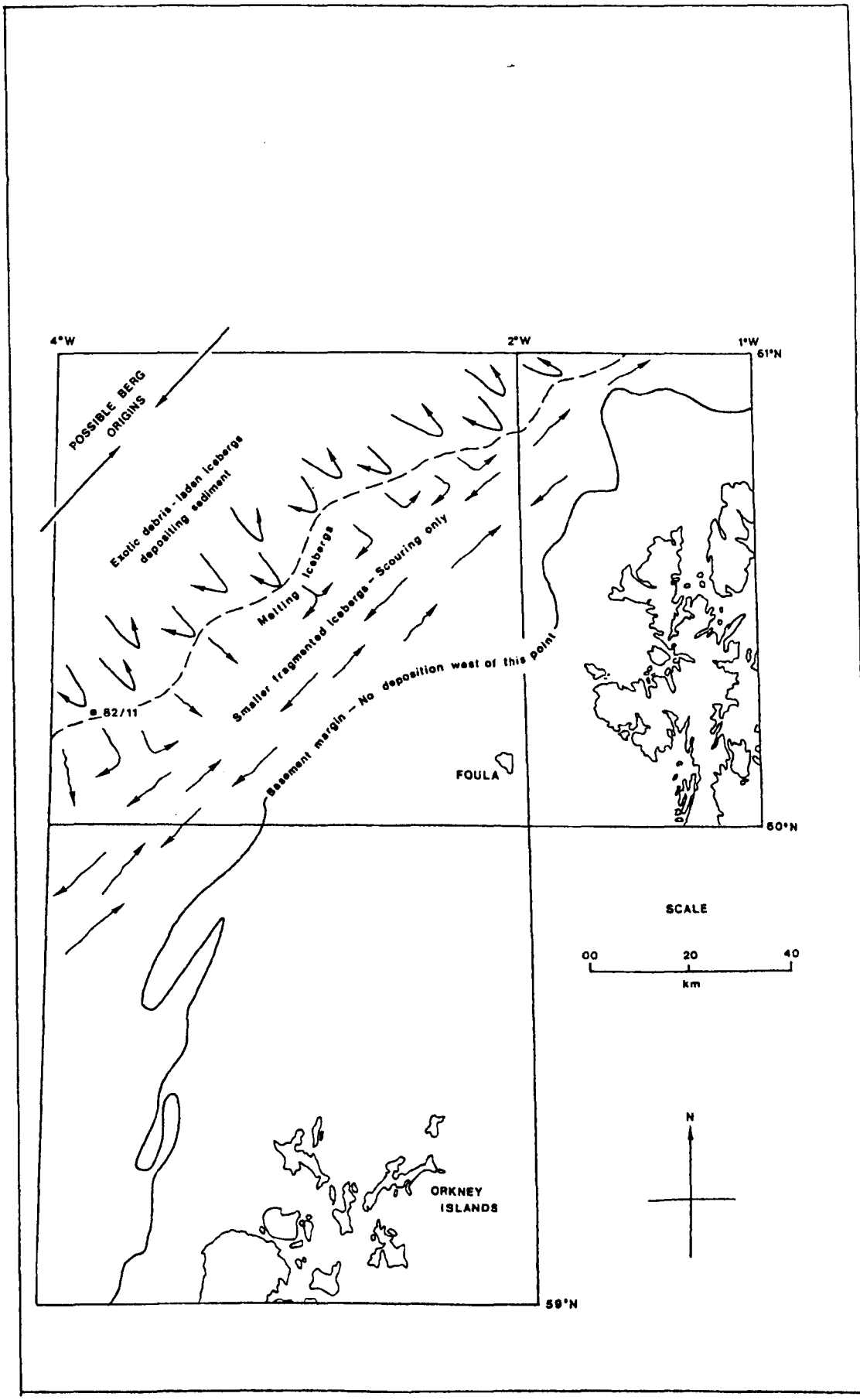


FIG 4.9.4. UNIT .X. SEDIMENTS.

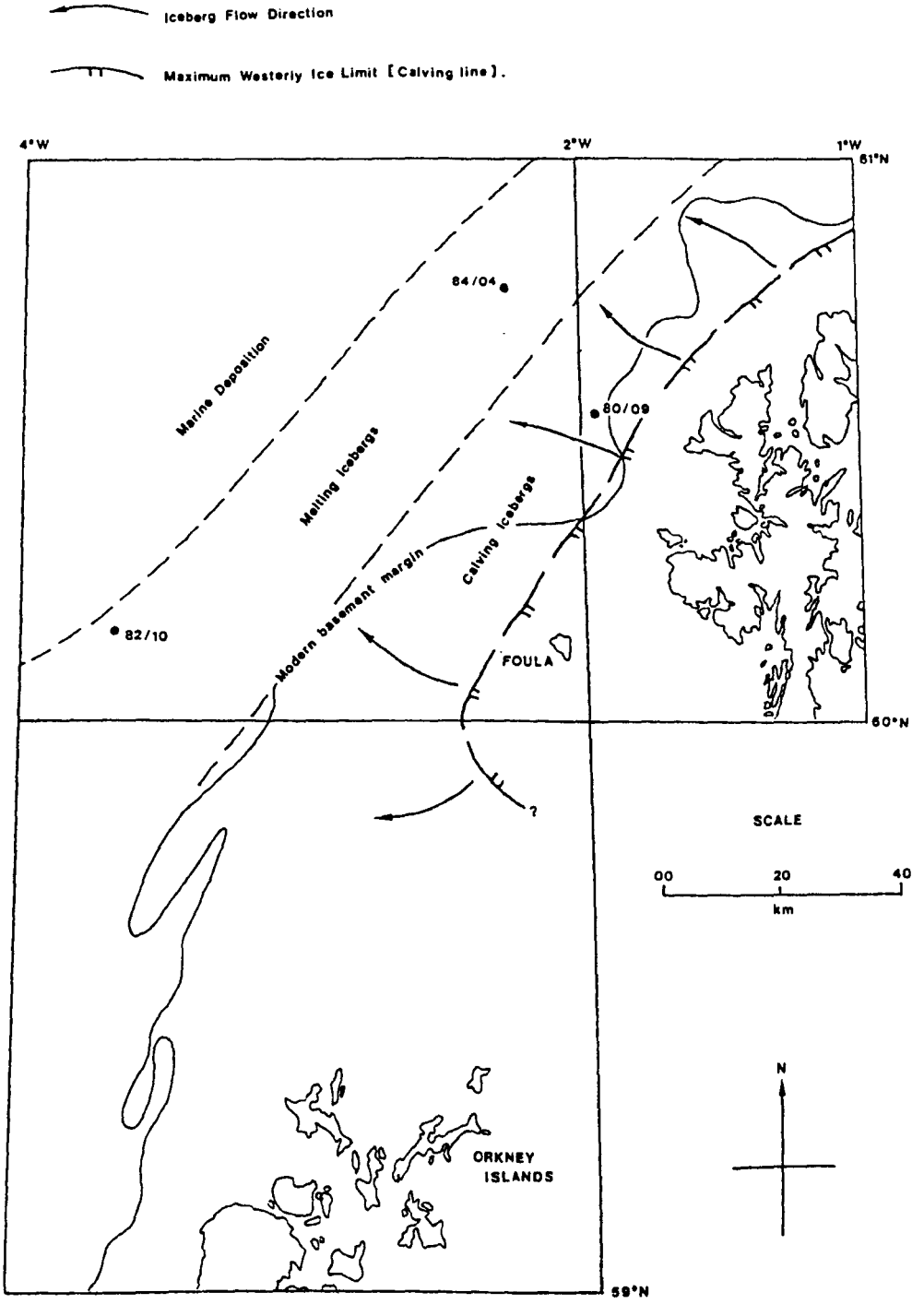
4.11.1. UNIT FACIES INTERPRETATION.



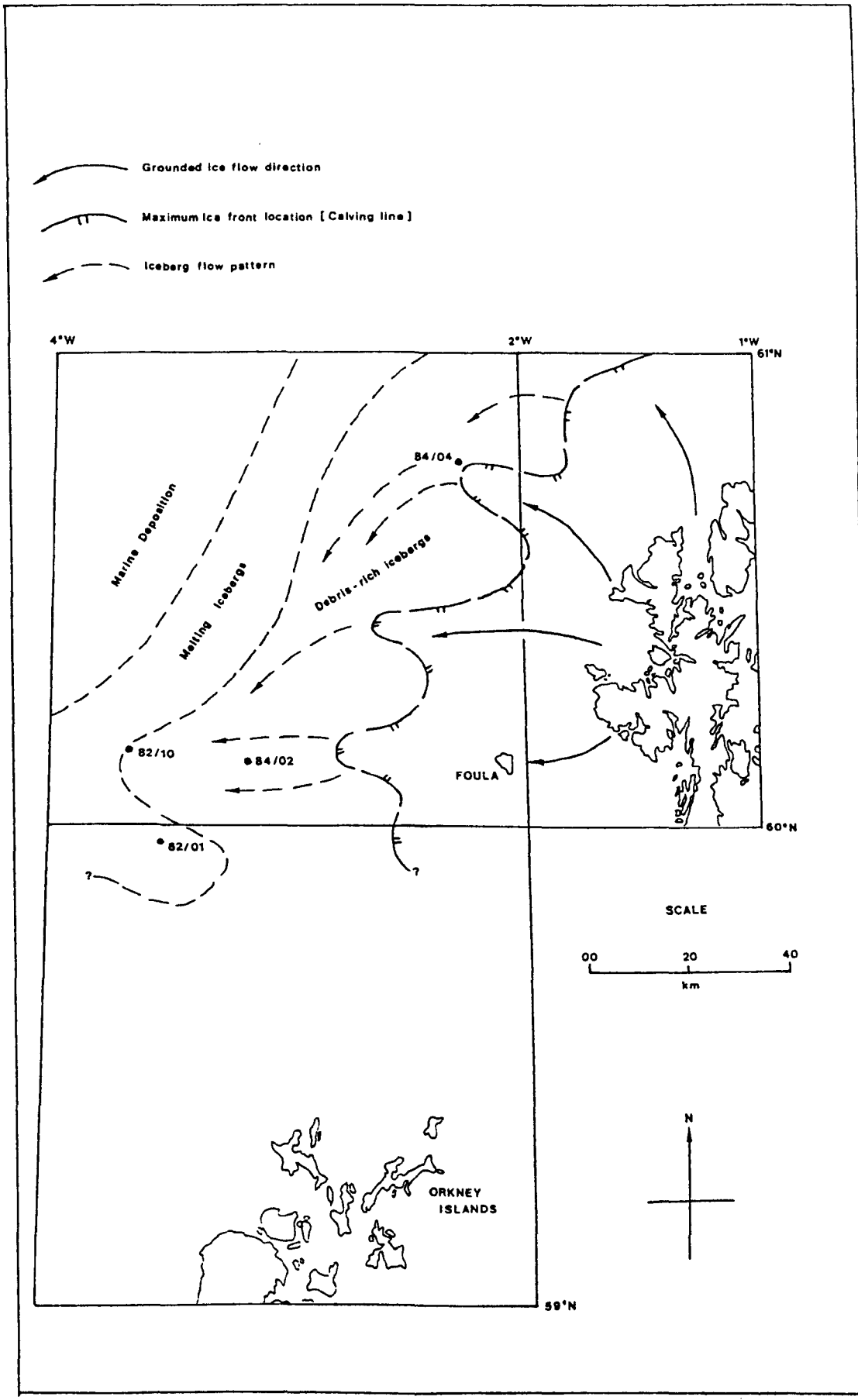
5.3.1. DEPOSITIONAL ENVIRONMENT: UNIT .-1.



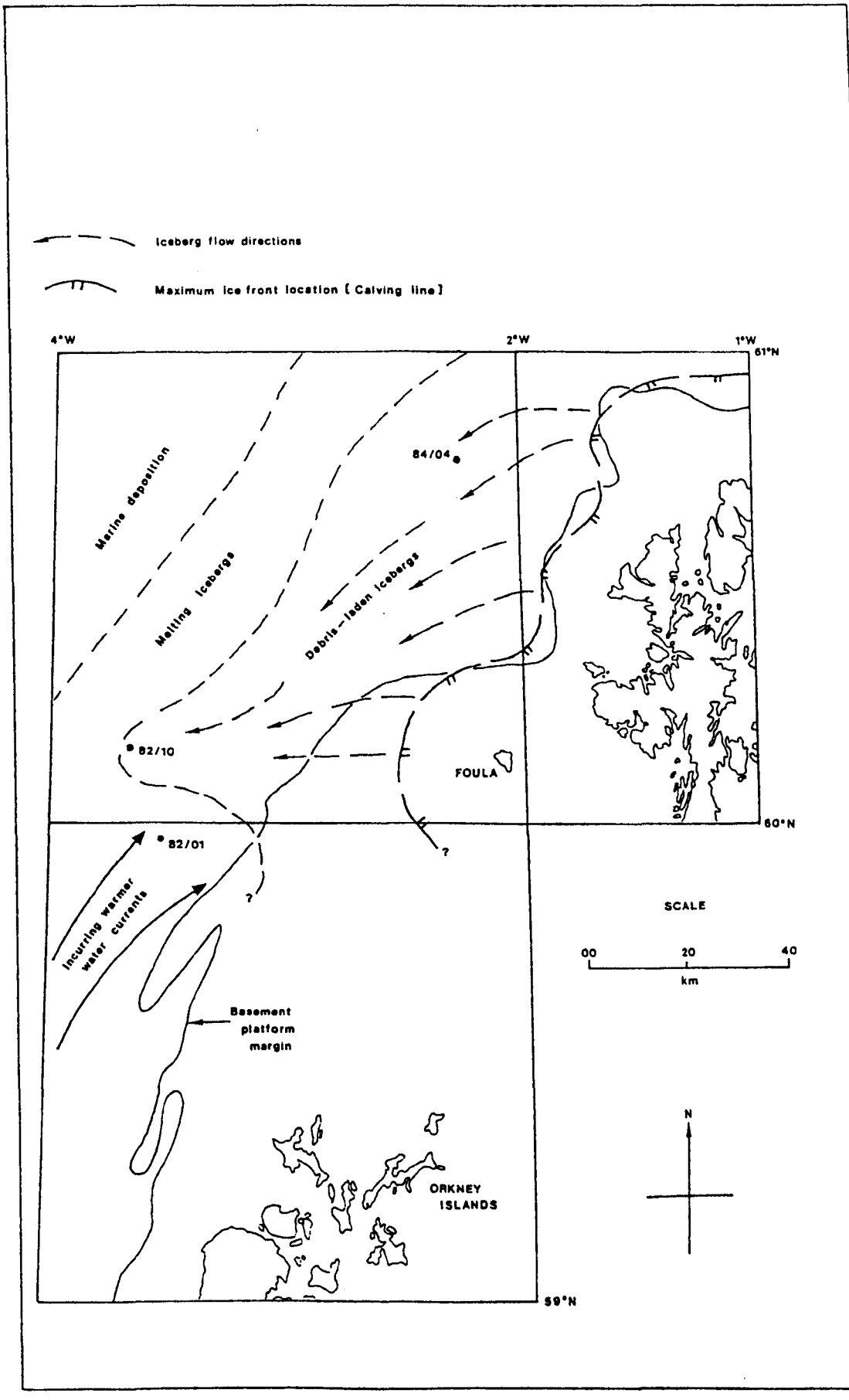
5.3.2. DEPOSITIONAL ENVIRONMENT: UNIT .4.



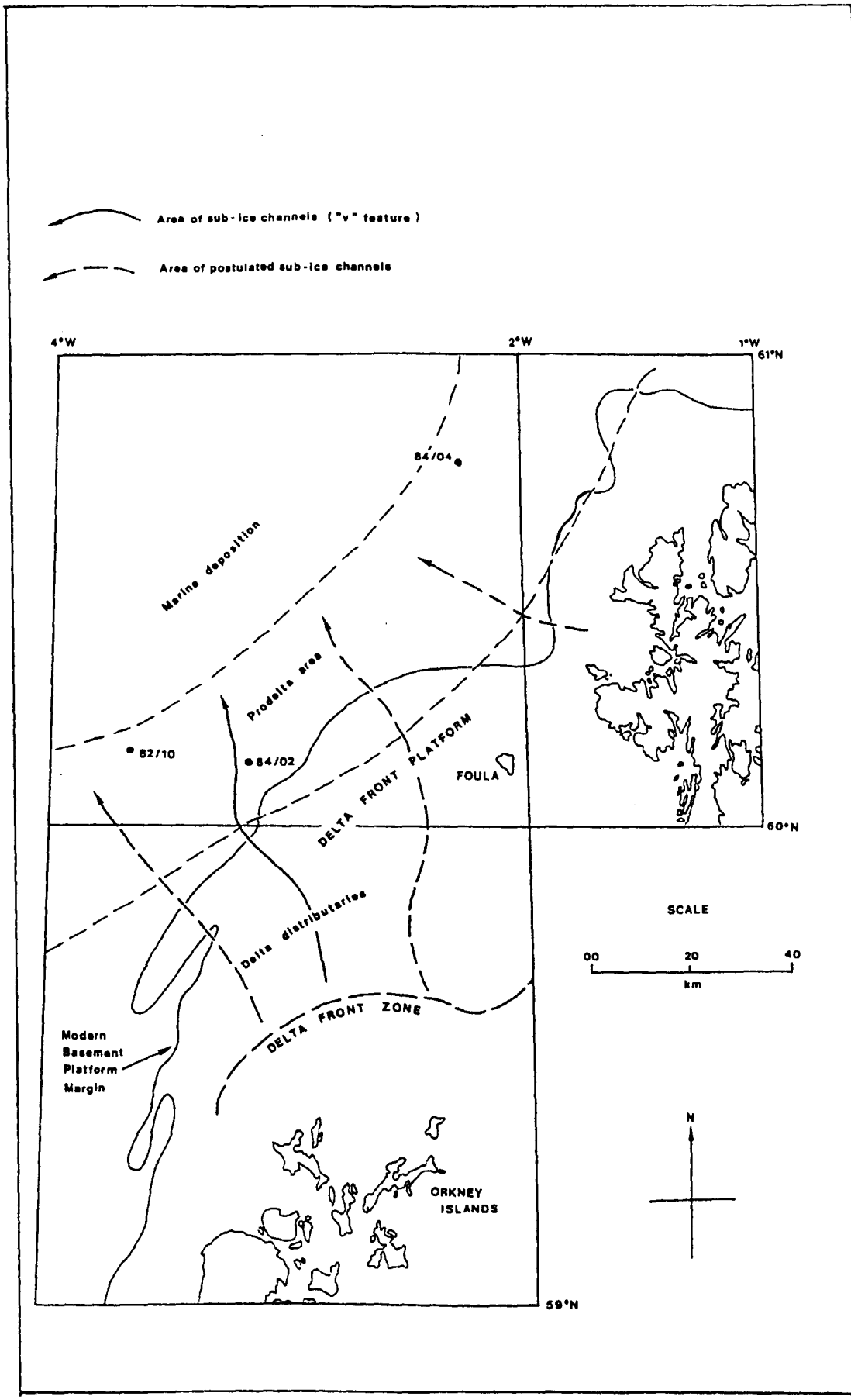
5.3.3. DEPOSITIONAL ENVIRONMENT: UNIT .2.



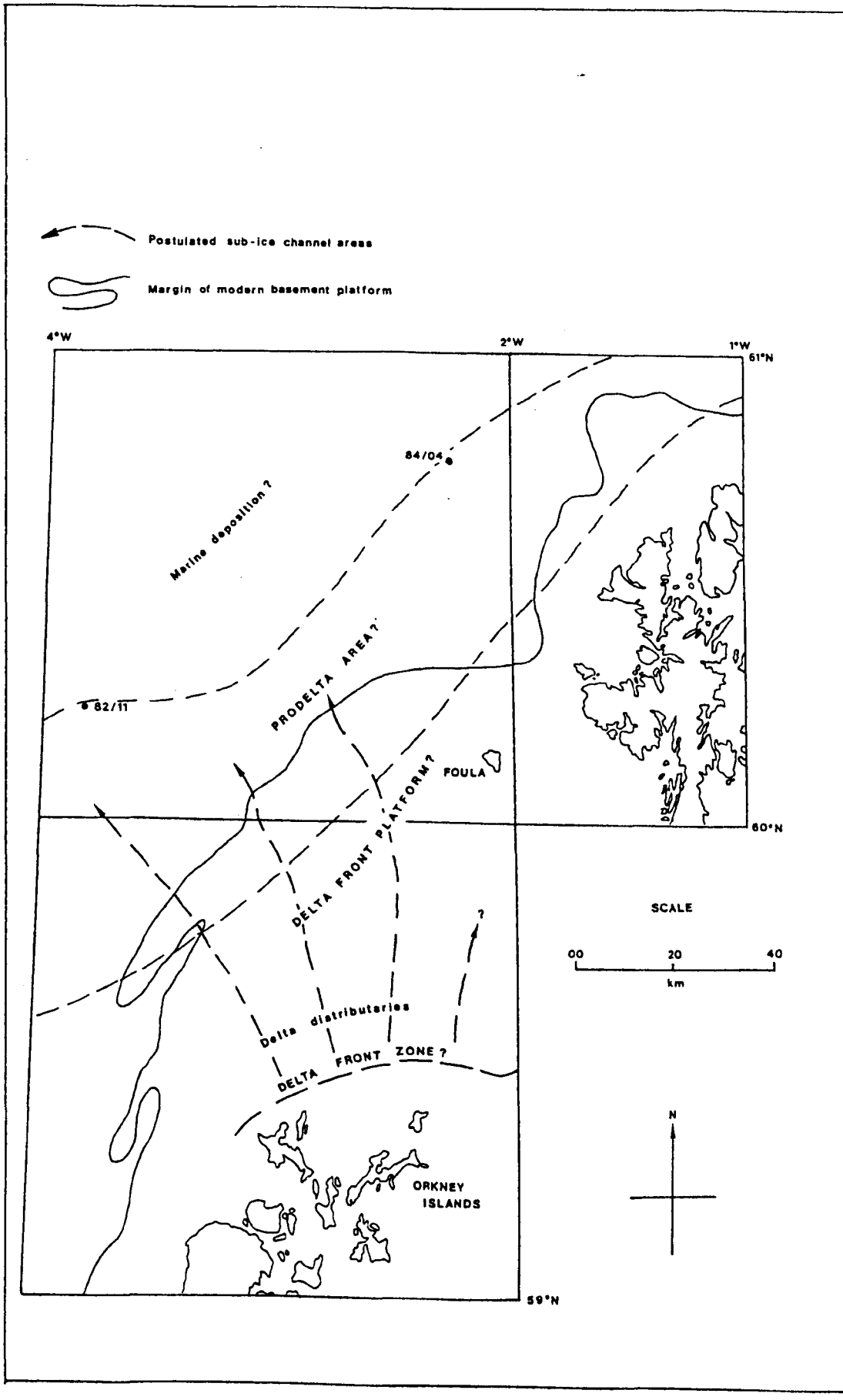
5.3.4. DEPOSITIONAL ENVIRONMENT: UNIT .1.



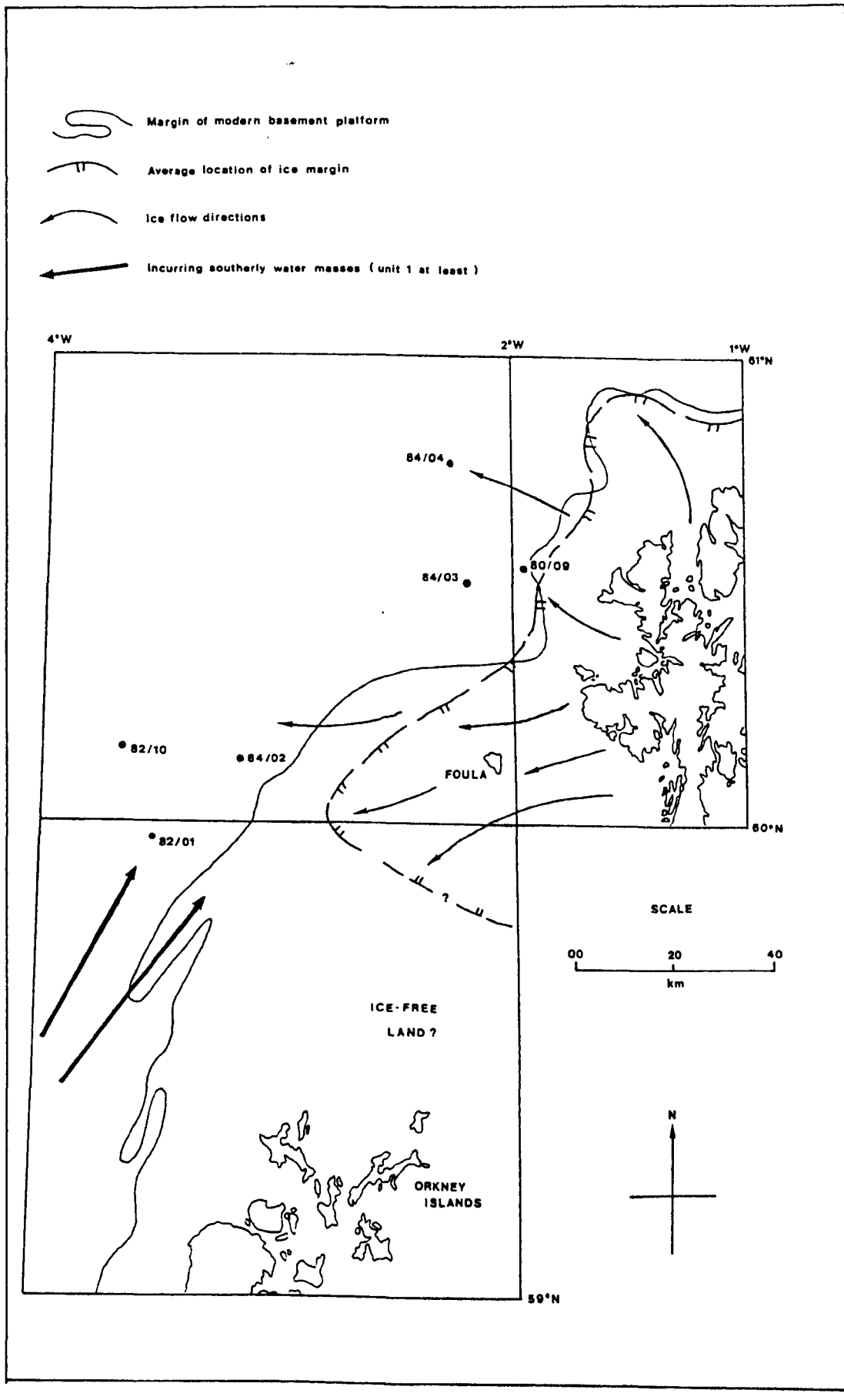
5.3.5. DEPOSITIONAL ENVIRONMENT: UNIT .3.



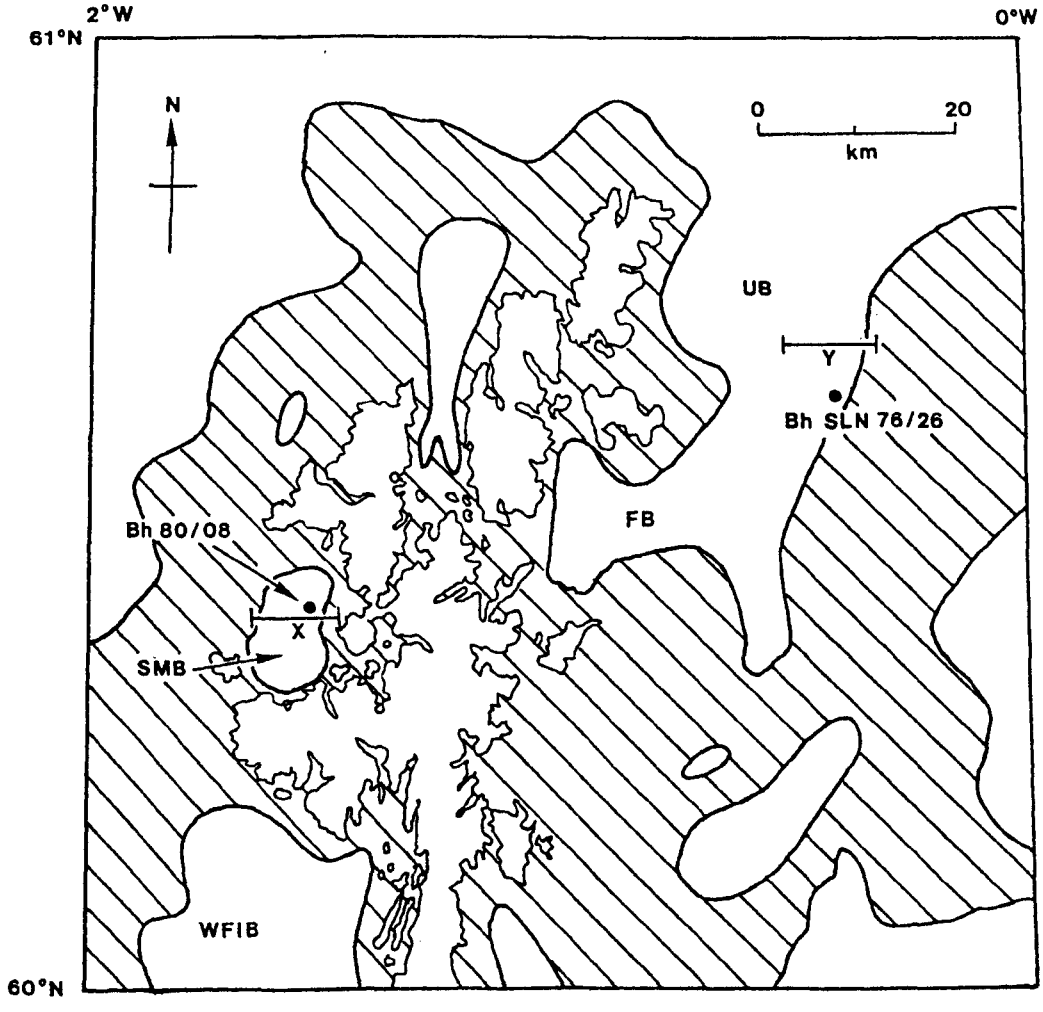
5.3.6. DEPOSITIONAL ENVIRONMENT: UNIT .0.



5.4.1. AVERAGE DEPOSITIONAL SETTING: UNITS 4, 2 AND 1.



6.1.1. INSHORE BOREHOLE LOCATIONS.



X Section in figure 6·2·1

Y Section in figure 6·3·1

● Borehole Sites

Basement Outcrops

WFIB West Fair Isle Basin

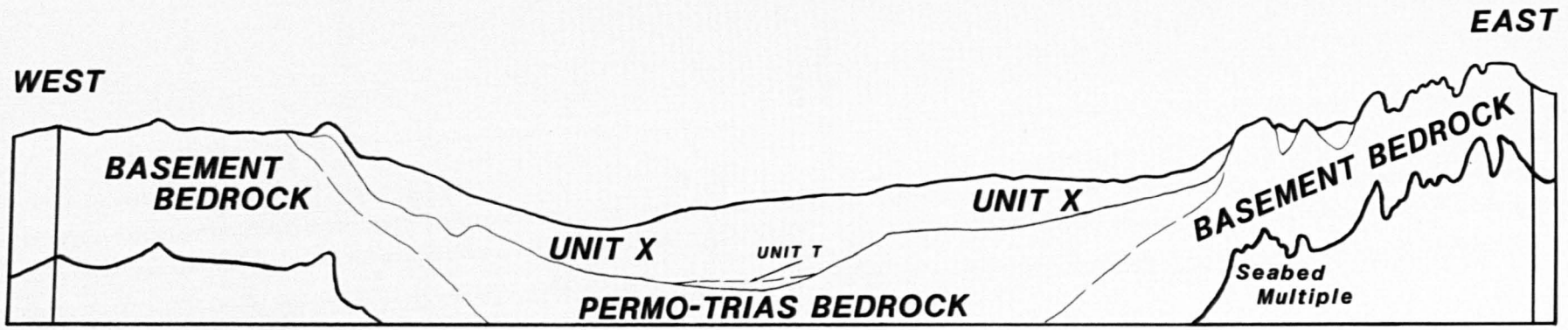
SMB St. Magnus Bay Basin

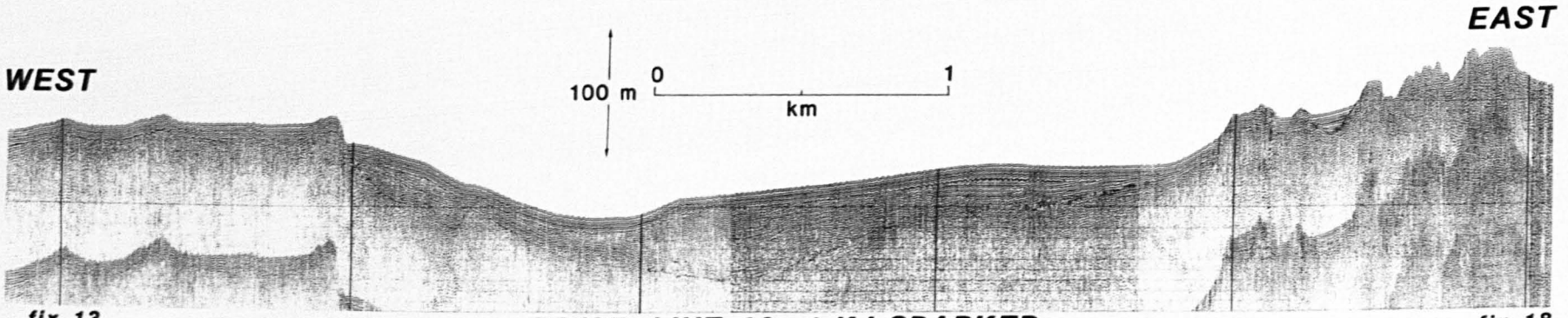
FB Fetlar Basin

UB Unst Basin

(Based on Chesher, 1984, modified)

FIG 6.2.1. SEISMIC STRUCTURE: ST. MAGNUS BAY.

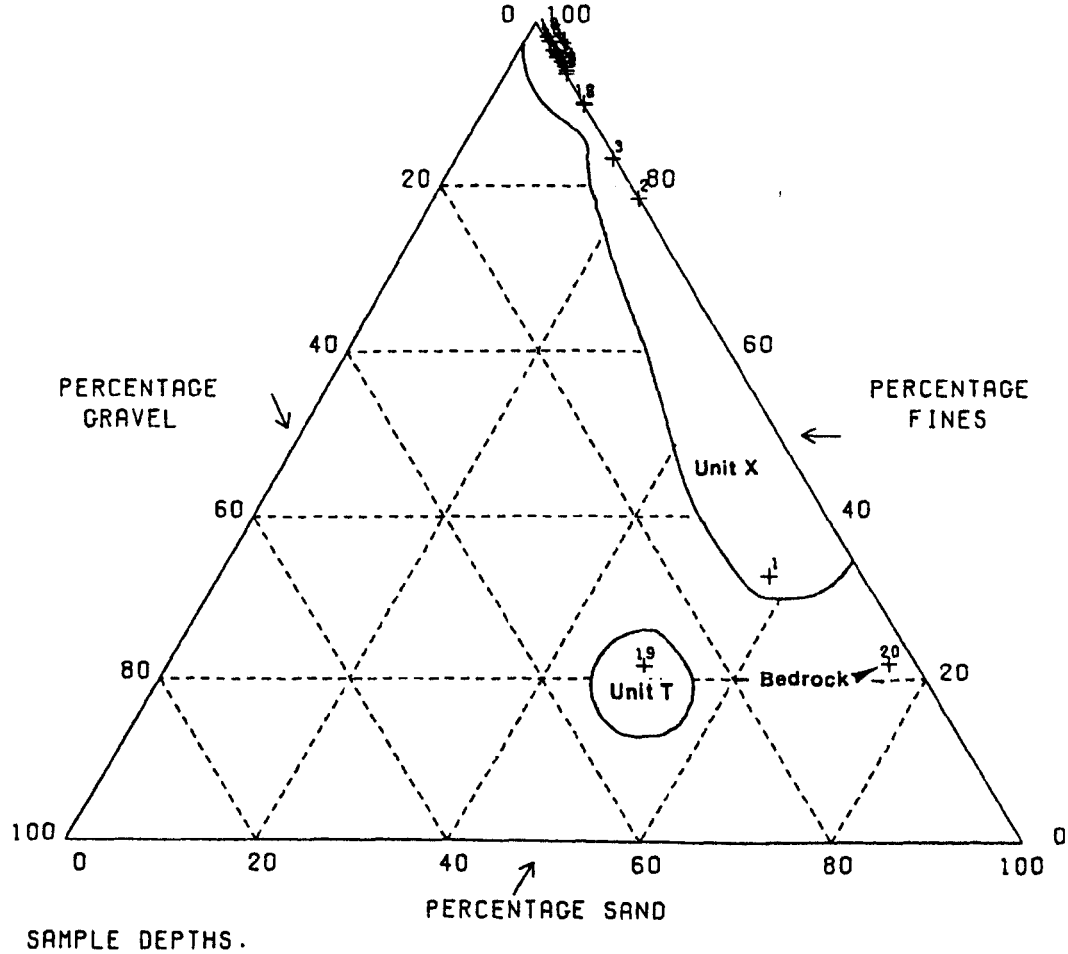




77/07 LINE 40 1 KJ SPARKER

For location see fig 3.2a.

FIG 6.2.2. TOTAL COMPOSITION PLOT.

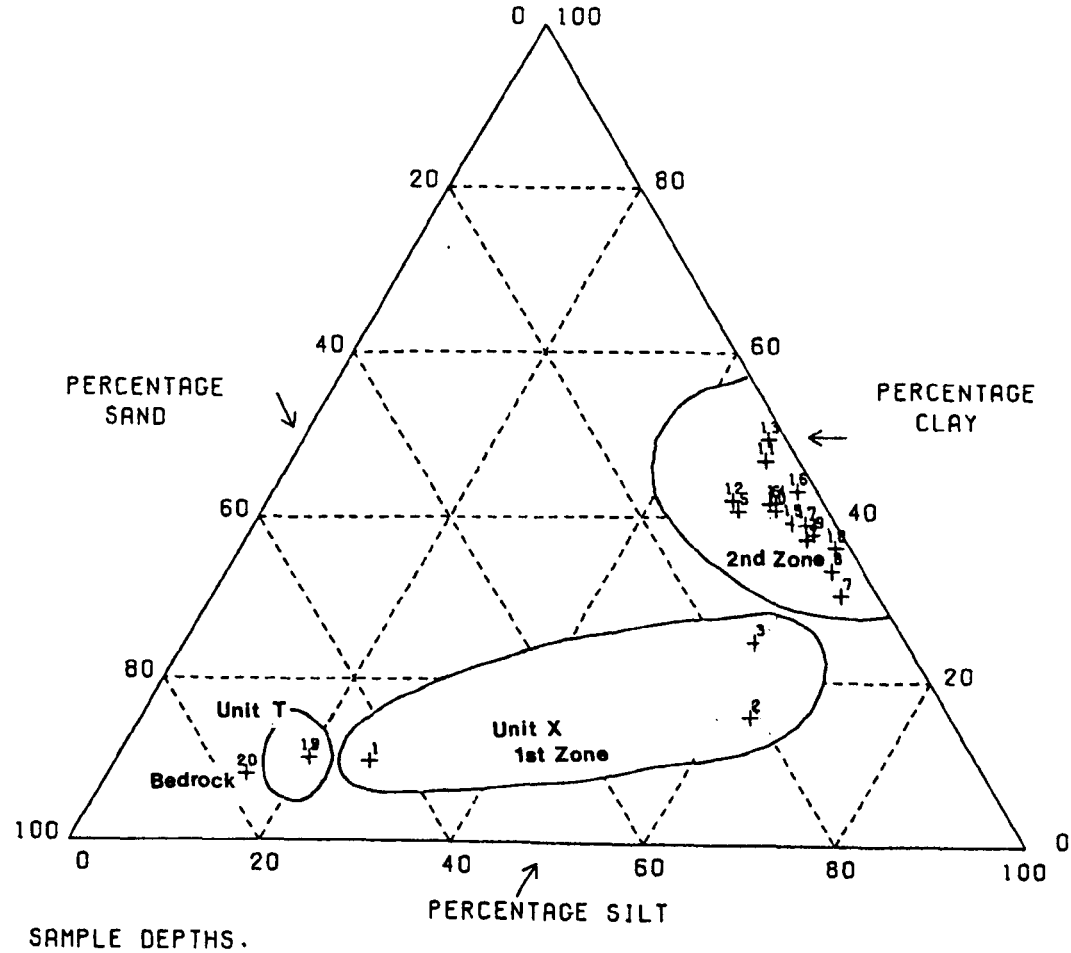


SAMPLE DEPTHS.

1) 2.00M.	2) 2.40M.	3) 3.60M.	4) 4.60M.	5) 5.00M.
6) 7.00M.	7) 9.90M.	8) 11.40M.	9) 12.70M.	10) 13.50M.
11) 15.70M.	12) 16.50M.	13) 17.40M.	14) 18.20M.	15) 19.30M.
16) 23.20M.	17) 24.50M.	18) 24.80M.	19) 29.75M.	20) 34.64M.

SITE FIX: 60 22 50N 01 35 00W. SOILS LAB. UNIVERSITY OF KEELE

FIG 6.2.3. MATRIX COMPOSITION PLOT. -



SAMPLE DEPTHS.

1) 2.00M. 2) 2.40M. 3) 3.60M. 4) 4.60M. 5) 5.00M.
6) 7.00M. 7) 9.90M. 8) 11.40M. 9) 12.70M. 10) 13.50M.
11) 15.70M. 12) 16.50M. 13) 17.40M. 14) 18.20M. 15) 19.30M.
16) 23.20M. 17) 24.50M. 18) 24.80M. 19) 29.75M. 20) 34.64M.

SITE FIX: 60 22 50N 01 35 00W.

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FIG 6.2.4. CLAY MINERALOGY : UNIT .X.

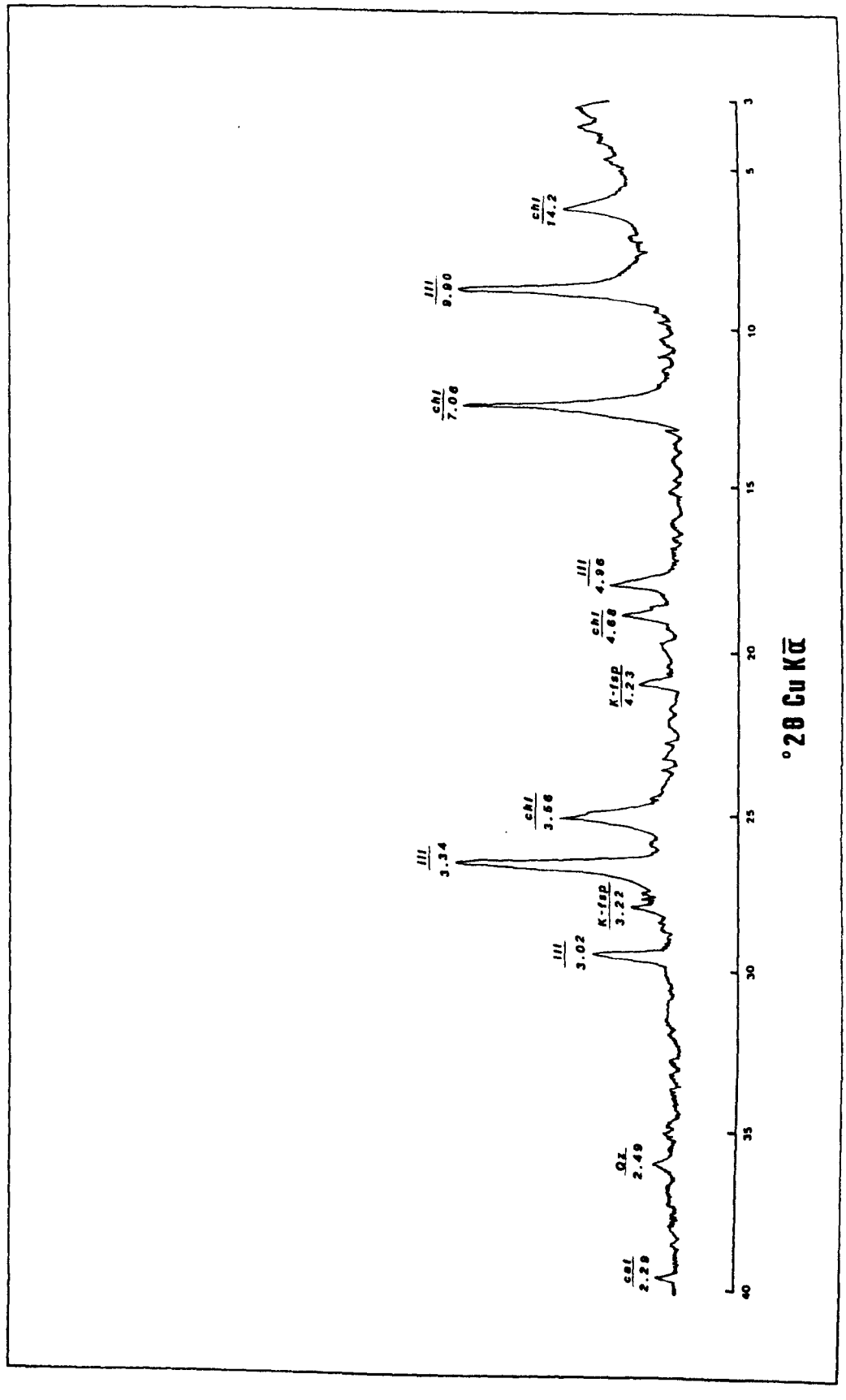


FIG 6.2.5. CLAY MINERALOGY : UNIT .X.

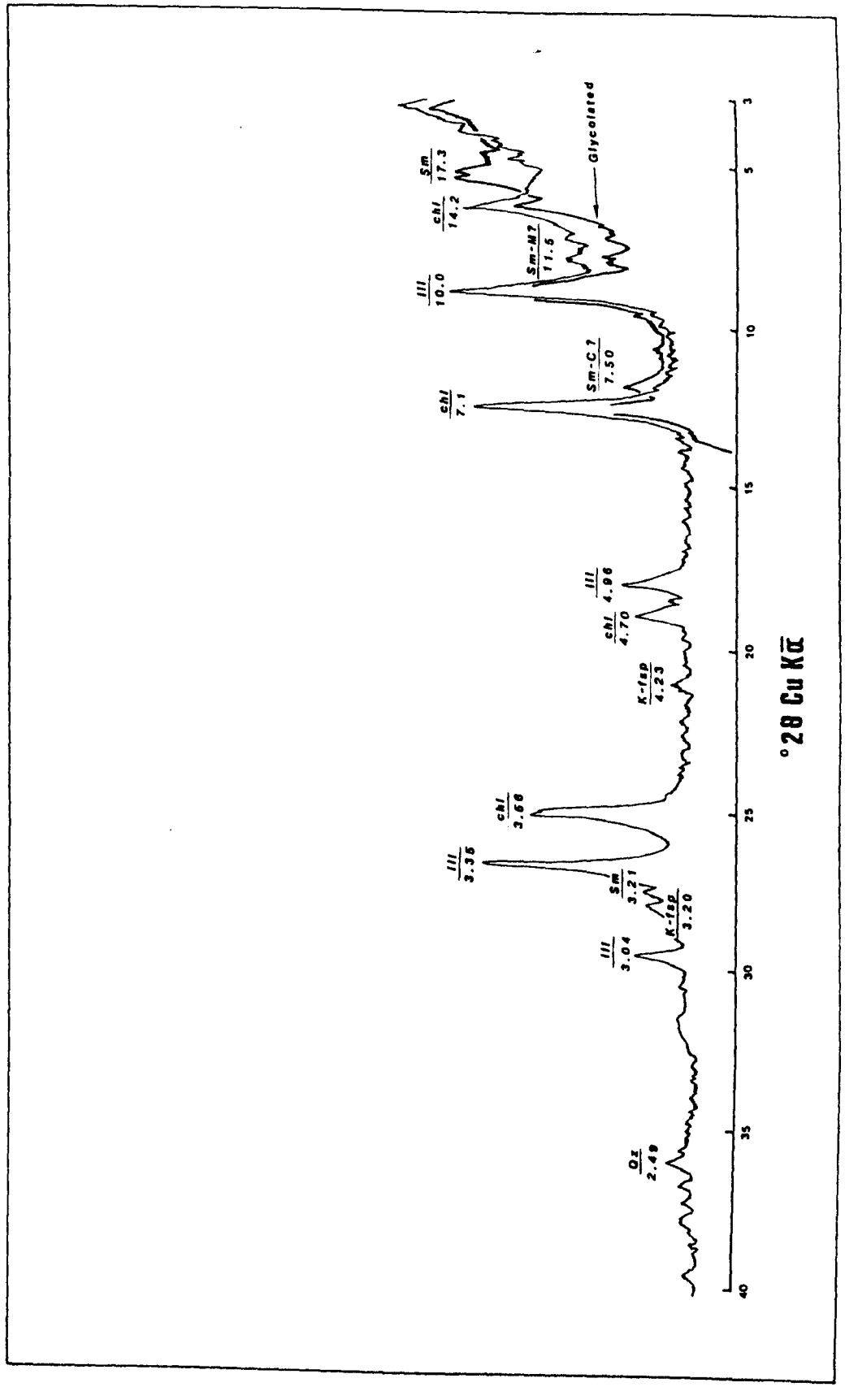
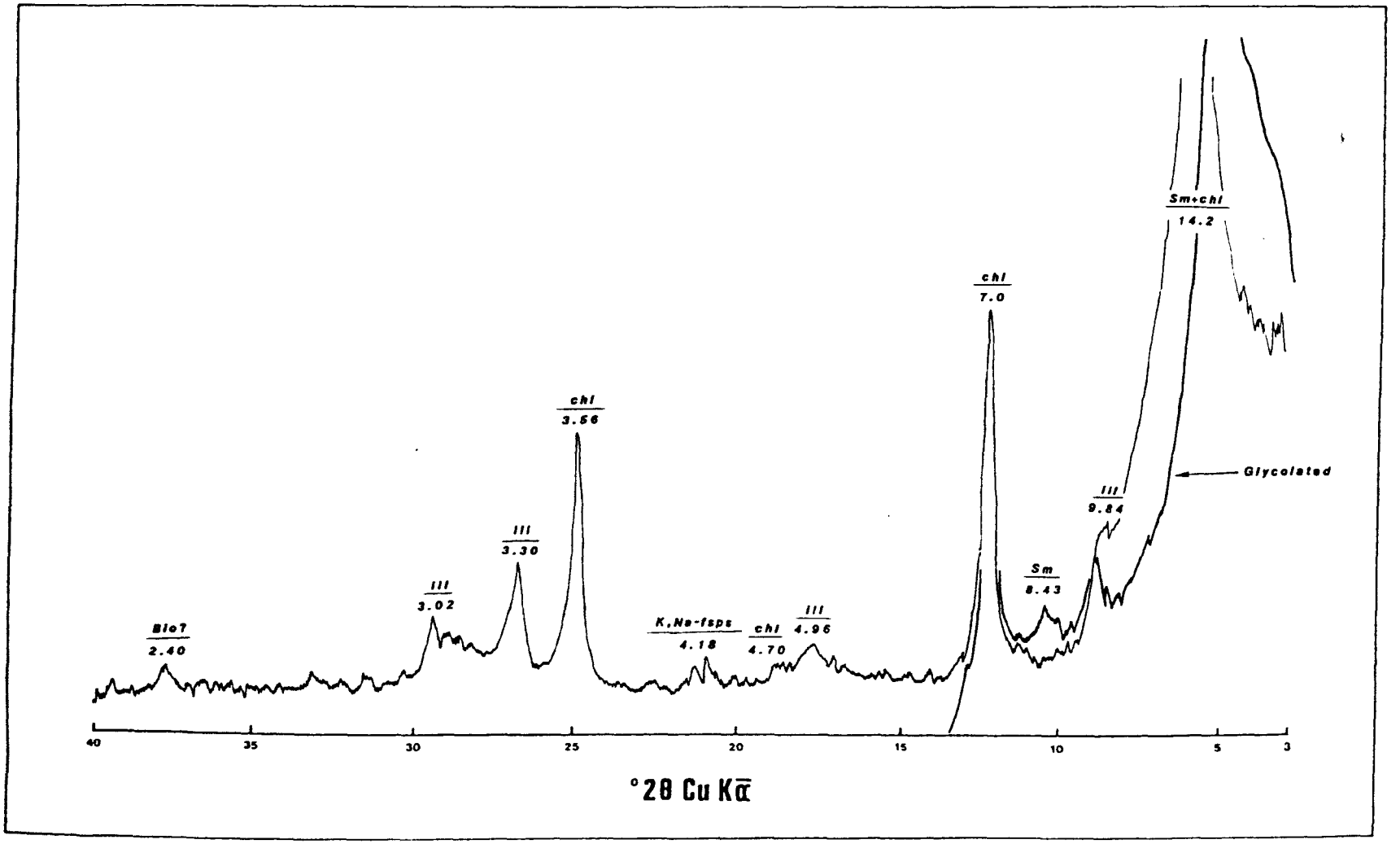


FIG 6.2.6. CLAY MINERALOGY : UNIT .T.



6.2.7. BOREHOLE SUMMARY LOG: BOREHOLE 80/08.

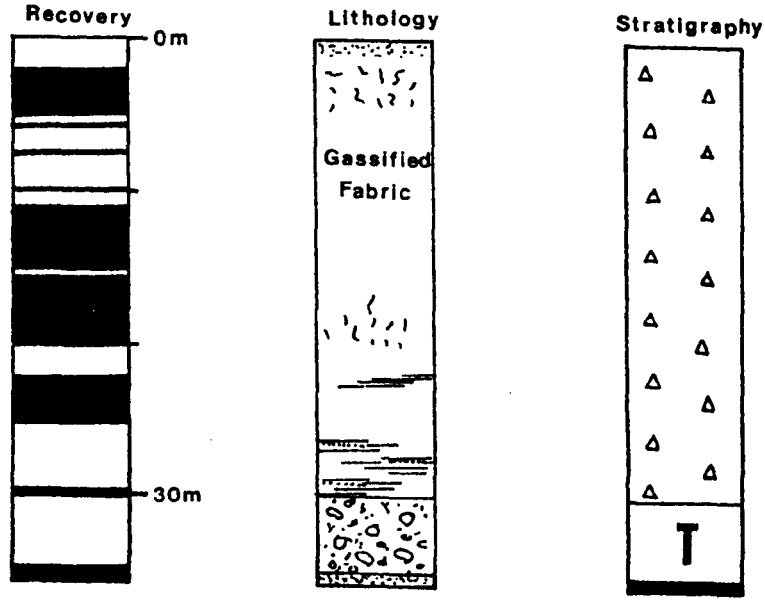
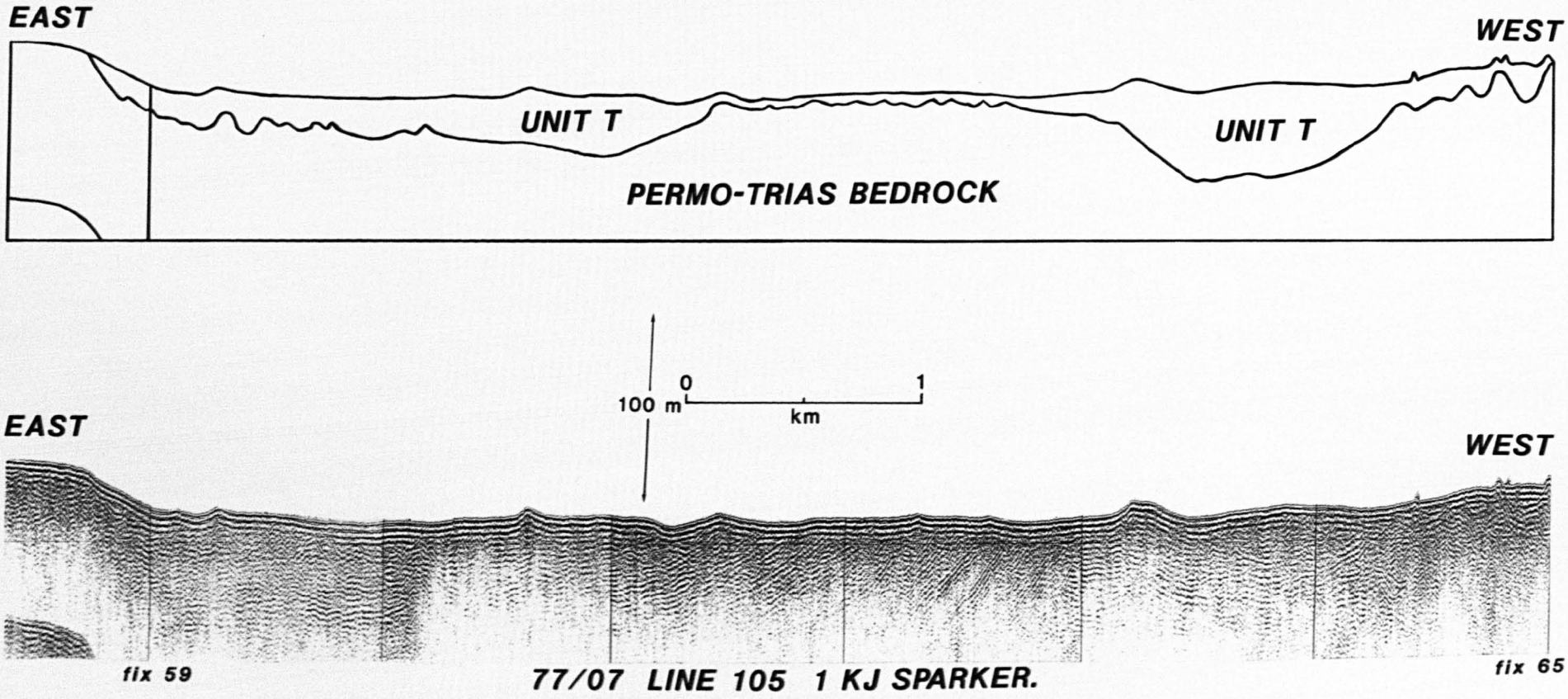


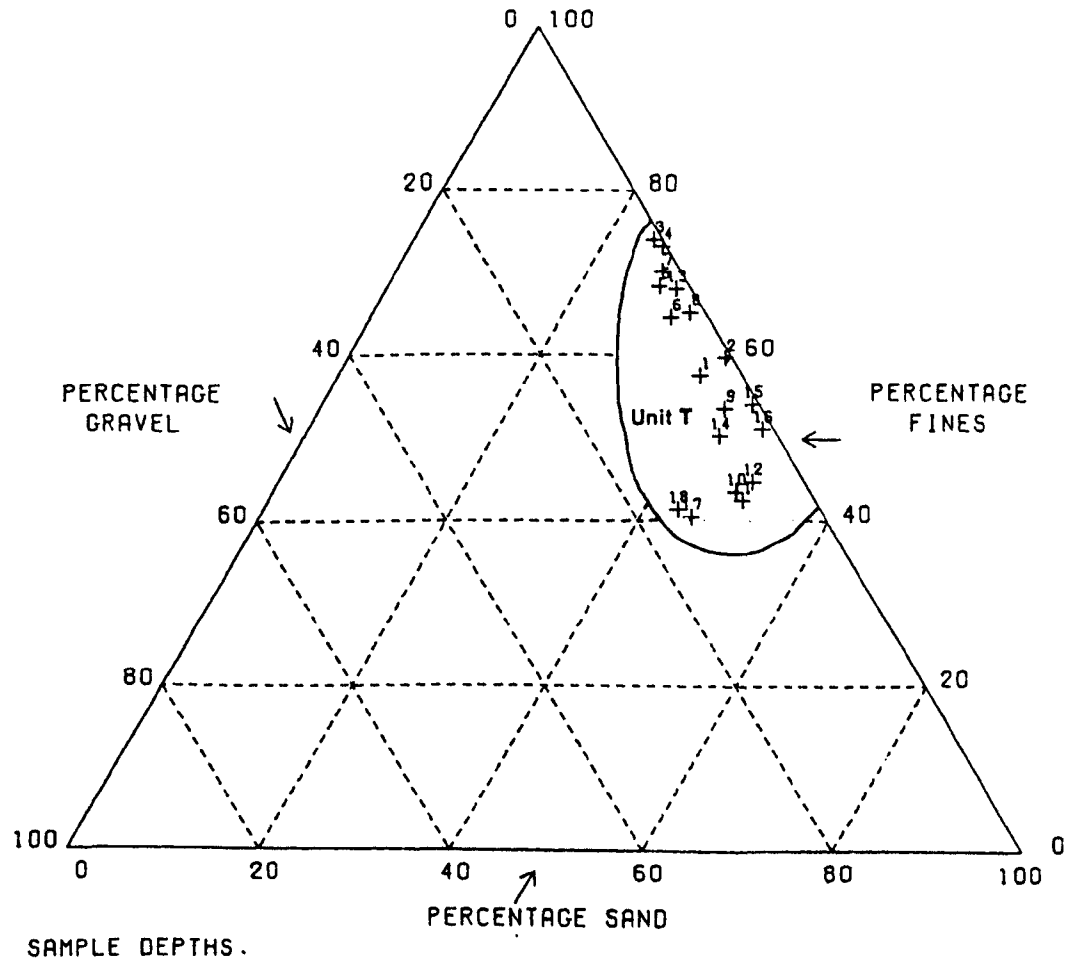
FIG 6.3.1. SEISMIC STRUCTURE: EAST SHETLAND PLATFORM.



77/07 LINE 105 1 KJ SPARKER.

For location see fig 6.1.1.

FIG 6.3.2. TOTAL COMPOSITION PLOT.

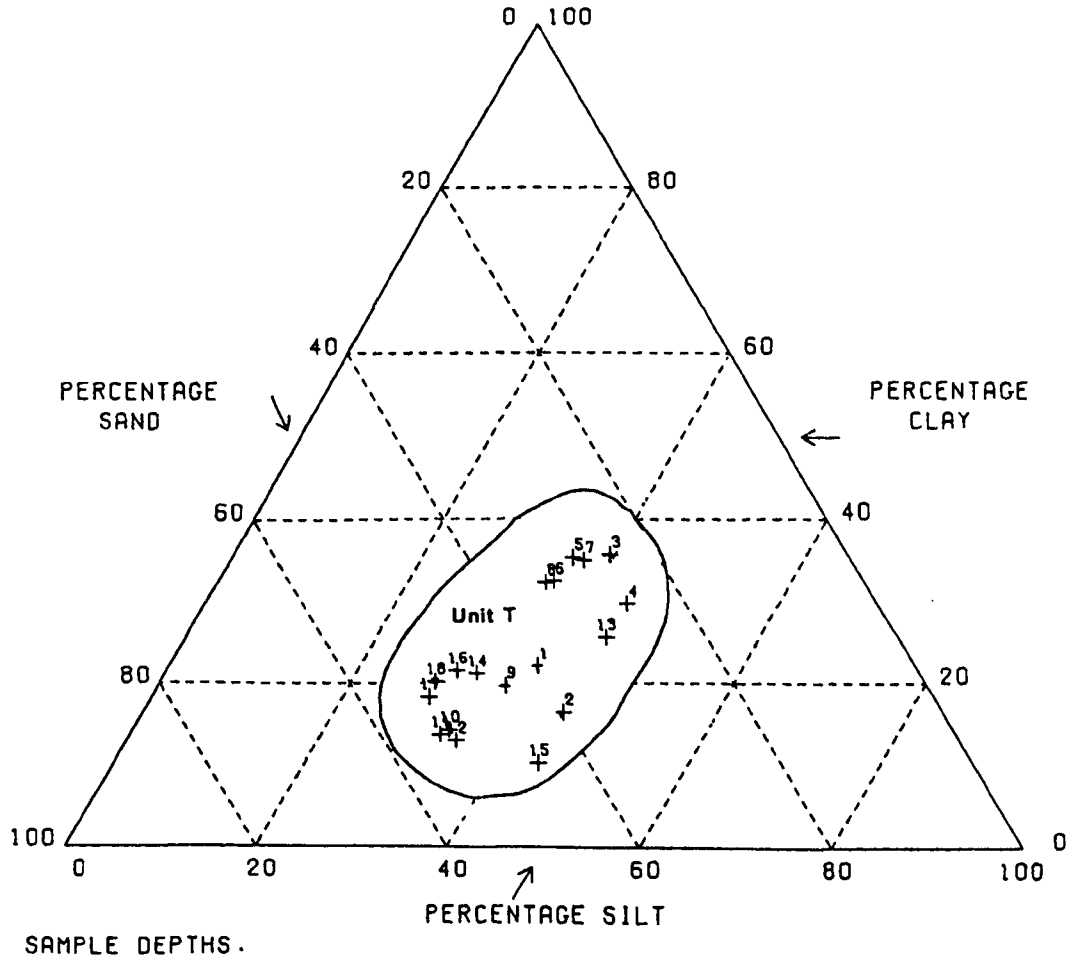


SAMPLE DEPTHS.

1) 6.40M. 2) 9.90M. 3) 10.70M. 4) 11.50M. 5) 13.30M.
6) 20.50M. 7) 29.10M. 8) 29.60M. 9) 33.30M. 10) 33.90M.
11) 34.20M. 12) 34.30M. 13) 34.80M. 14) 39.80M. 15) 40.90M.
16) 42.00M. 17) 46.80M. 18) 54.40M.

SITE FIX: 60 37 96N 00 24 00W. SOILS LAB. UNIVERSITY OF KEELE

FIG 6.3.3. MATRIX COMPOSITION PLOT.



SAMPLE DEPTHS.

1) 6.40M. 2) 9.90M. 3) 10.70M. 4) 11.50M. 5) 13.30M.
6) 20.50M. 7) 29.10M. 8) 29.60M. 9) 33.30M. 10) 33.90M.
11) 34.20M. 12) 34.30M. 13) 34.80M. 14) 39.80M. 15) 40.90M.
16) 42.00M. 17) 46.80M. 18) 54.40M.

SITE FIX: 60 37 96N 00 24 00W. SOILS LAB. UNIVERSITY OF KEELE

FIG 6.3.4. CLAY MINERALOGY : UNIT .T.

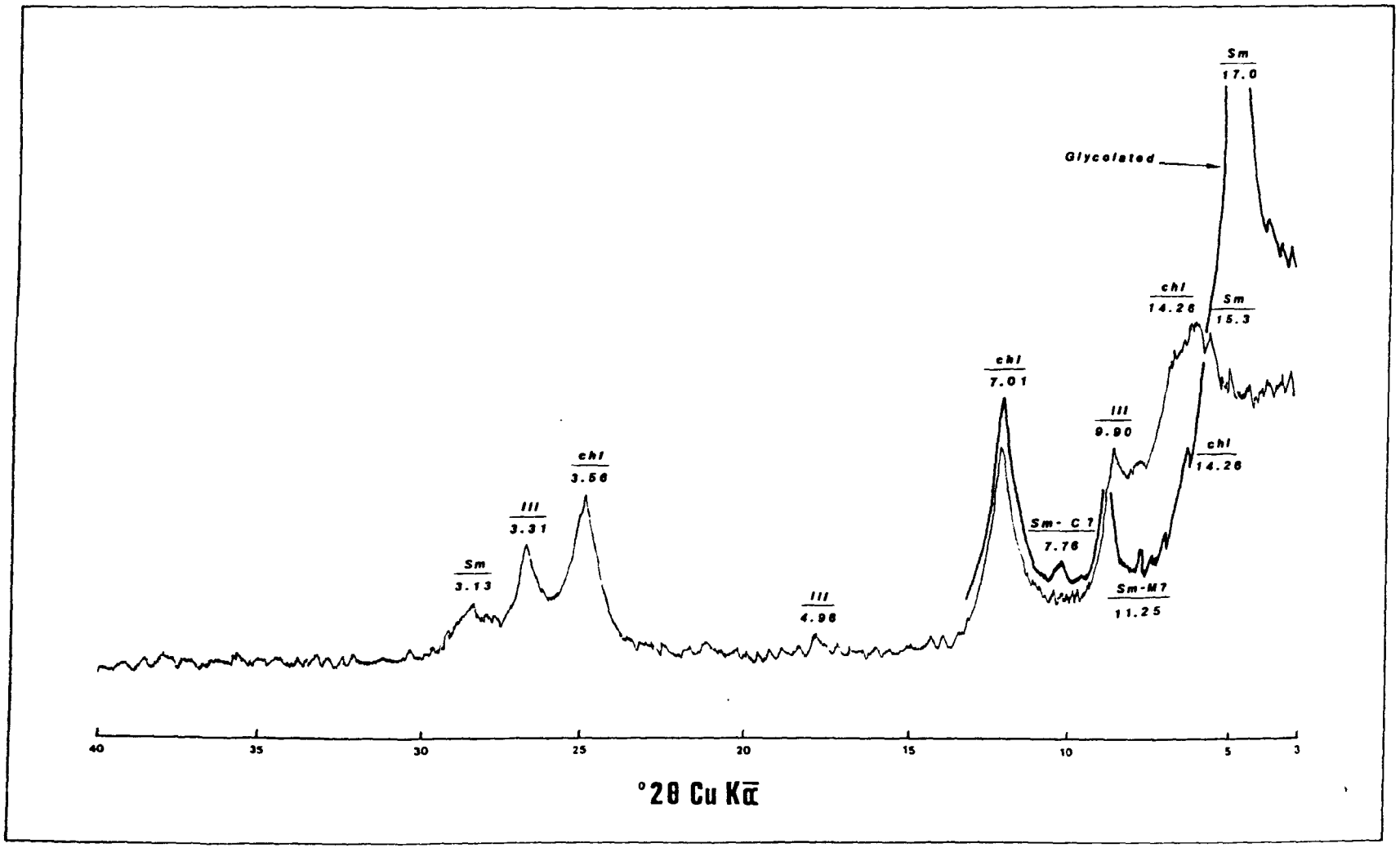
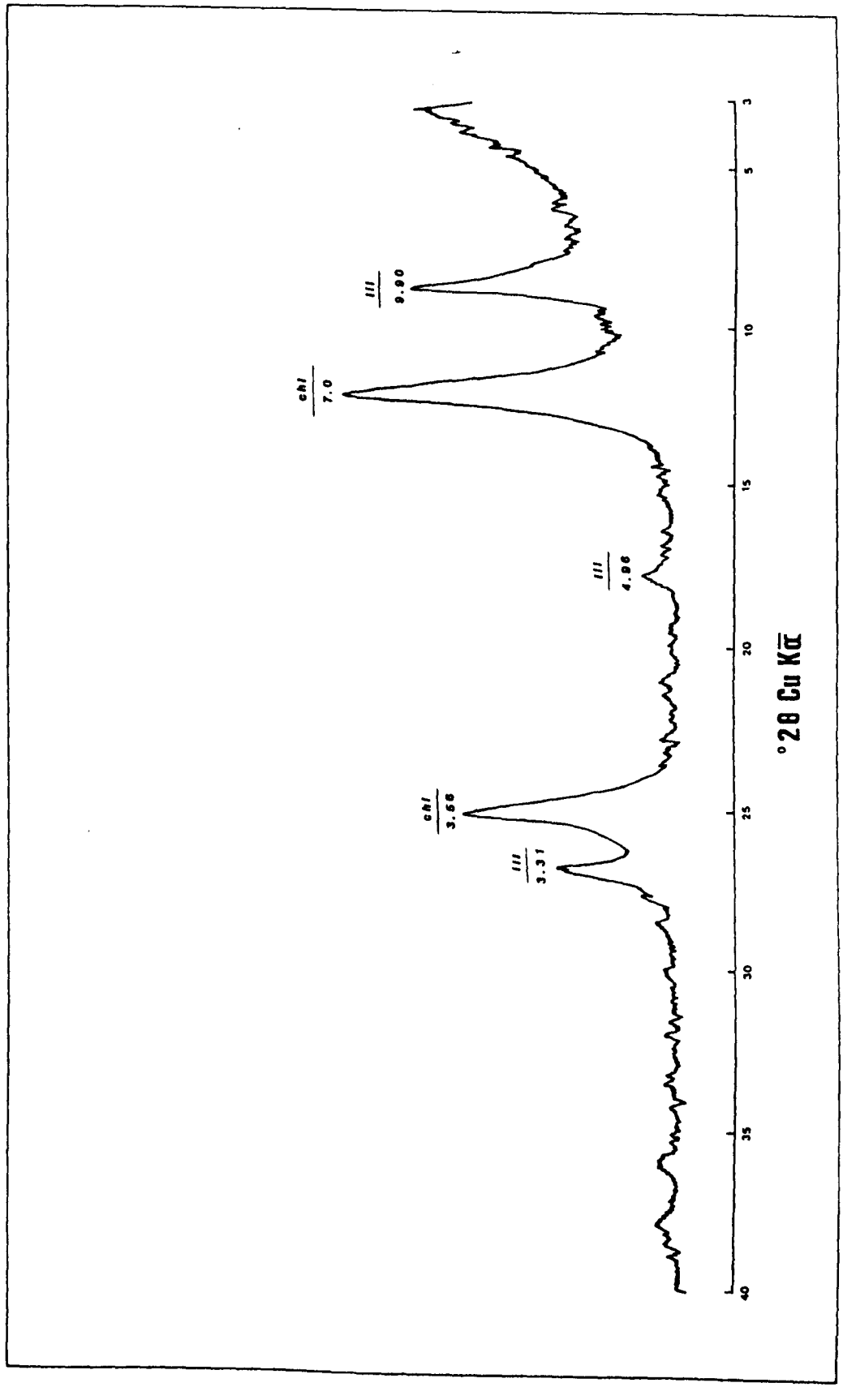


FIG 6.3.5. CLAY MINERALOGY : UNIT .T.



6.3.6. BOREHOLE SUMMARY LOG: BOREHOLE SLN 76/26.

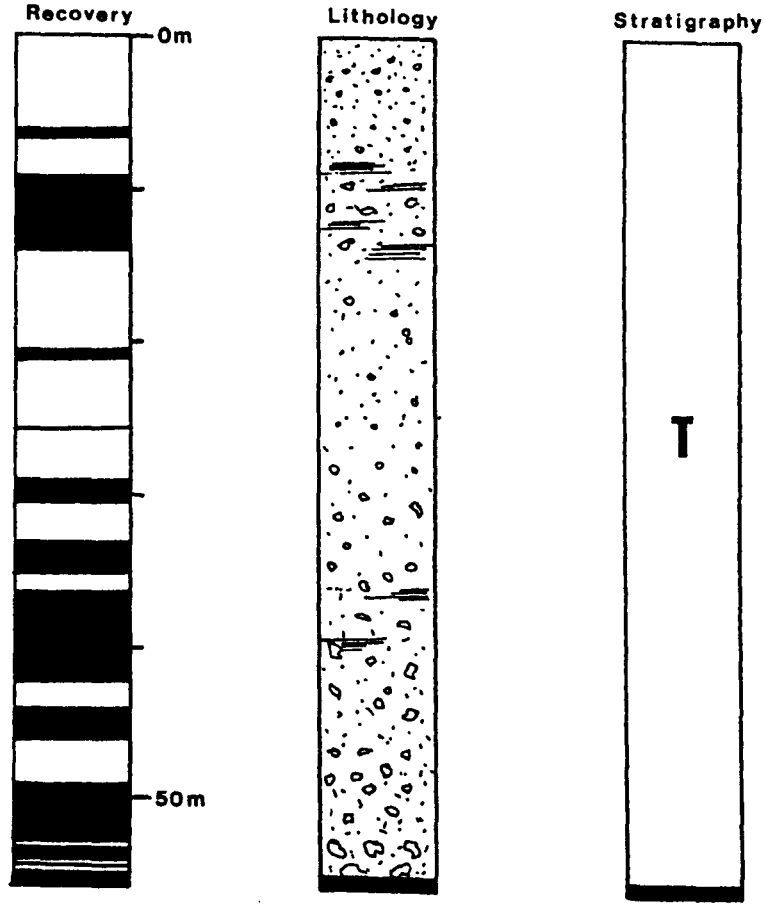
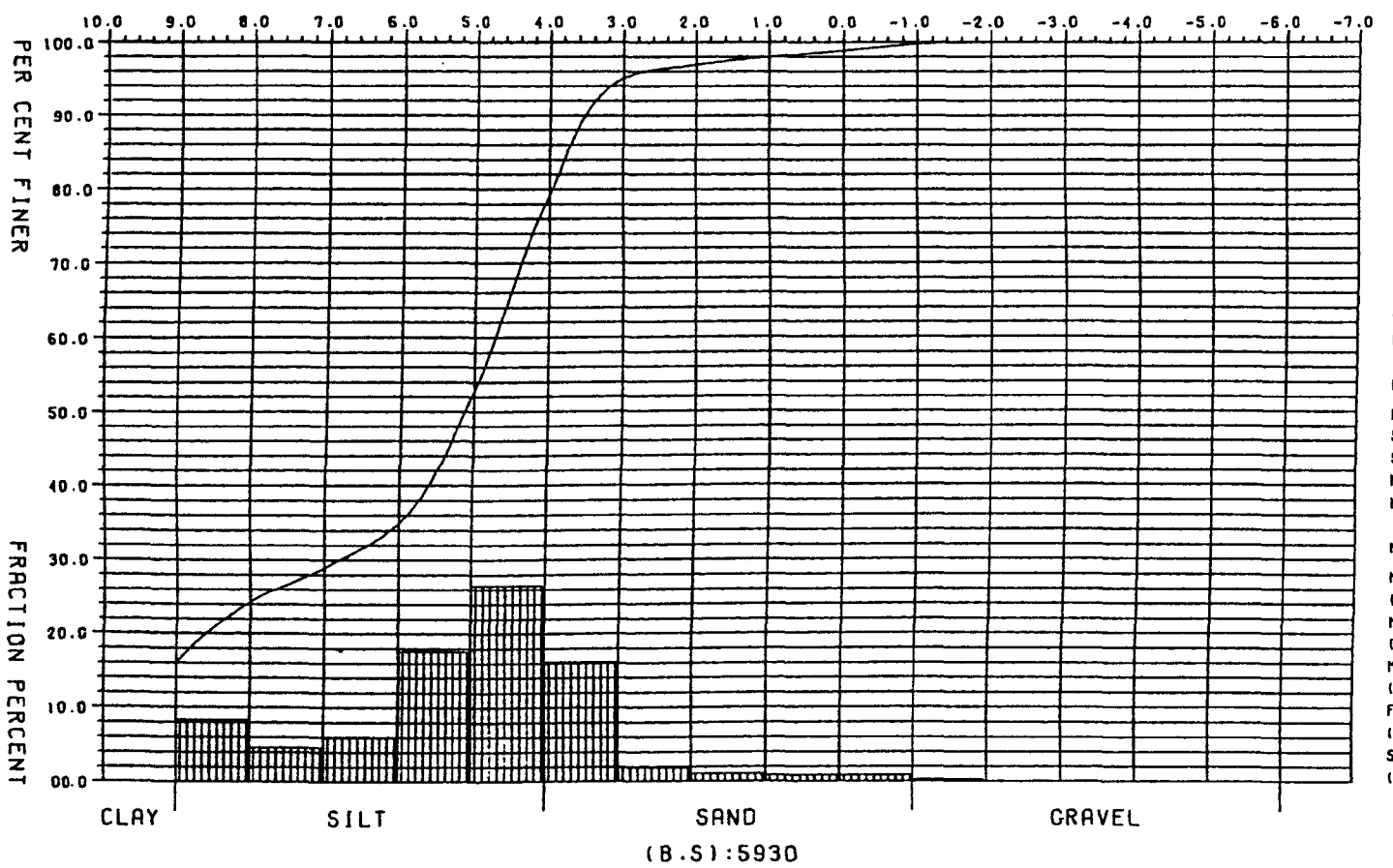


FIG 6.4.1. UNIT .X. (BH 80/08).

DEPTH: 2.40M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 5.92
GRAPHIC STANDARD DEVIATION = 2.76
GRAPHIC SKEWNESS = .50
GRAPHIC KURTOSIS = 1.06
NORMALISED KURTOSIS = .51

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 5.12
PHI (ARITHMETIC) MEAN DIAMETER = 6.32
PHI DEVIATION MEASURE = 2.65
PHI SKEWNESS MEASURE = .45
2ND PHI SKEWNESS MEASURE = .96
PHI KURTOSIS MEASURE = .79

PHI MOMENT STATISTICS.

MEAN SIZE = 4.22
STANDARD DEVIATION = 1.81
SKEWNESS (THIRD MOMENT) = 1.16
MEAN CUBED DEVIATION = 6.65
KURTOSIS (FOURTH MOMENT) = 4.24

MC CAMMON'S STATISTICS.

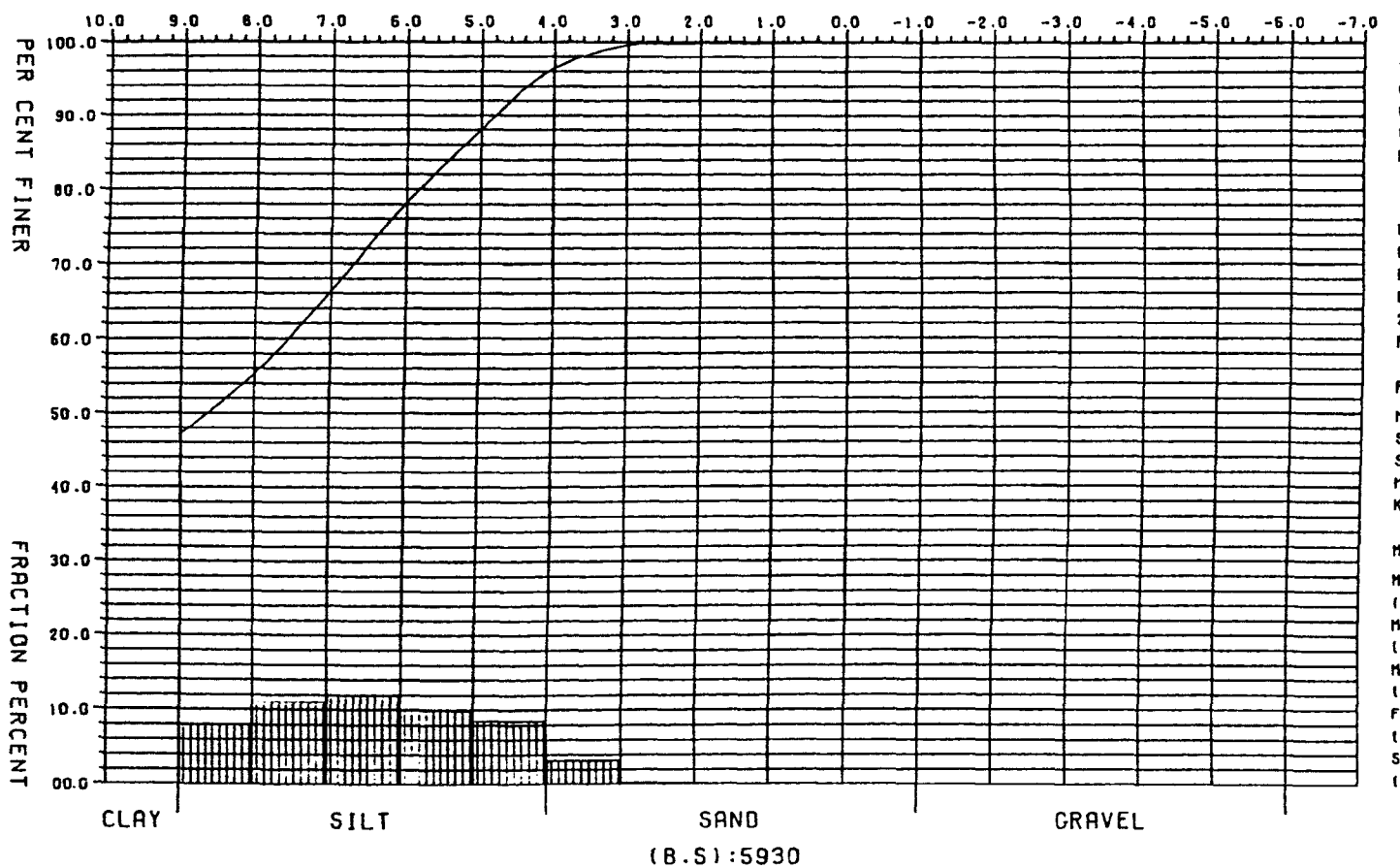
MEAN SIZE = 5.85
(88 PER CENT EFFICIENCY)
MEAN SIZE = 6.14
(93 PER CENT EFFICIENCY)
MEAN SIZE = 6.10
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 2.60
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 2.80
(87 PER CENT EFFICIENCY)

SITE FIX: 60 22 50N 01 35 00W.

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FIG 6.4.2. UNIT .X. (BH 80/08).

DEPTH: 15.70M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 8.78
GRAPHIC STANDARD DEVIATION = 3.14
GRAPHIC SKEWNESS = .05
GRAPHIC KURTOSIS = .75
NORMALISED KURTOSIS = .43

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 8.64
PHI (ARITHMETIC) MEAN DIAMETER = 8.64
PHI DEVIATION MEASURE = 3.46
PHI SKEWNESS MEASURE = .06
2ND PHI SKEWNESS MEASURE = .05
PHI KURTOSIS MEASURE = .35

PHI MOMENT STATISTICS.

MEAN SIZE = 3.32
STANDARD DEVIATION = 2.43
SKEWNESS (THIRD MOMENT) = 1.66
MEAN CUBED DEVIATION = 24.08
KURTOSIS (FOURTH MOMENT) = 3.06

MC CAMMON'S STATISTICS.

MEAN SIZE = 8.77
(66 PER CENT EFFICIENCY)
MEAN SIZE = 8.67
(93 PER CENT EFFICIENCY)
MEAN SIZE = 8.75
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.04
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.05
(87 PER CENT EFFICIENCY)

SITE FIX: 60 22.50N 01 35.00W.

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FIG 6.4.3. HIGH ENERGY SAMPLES.

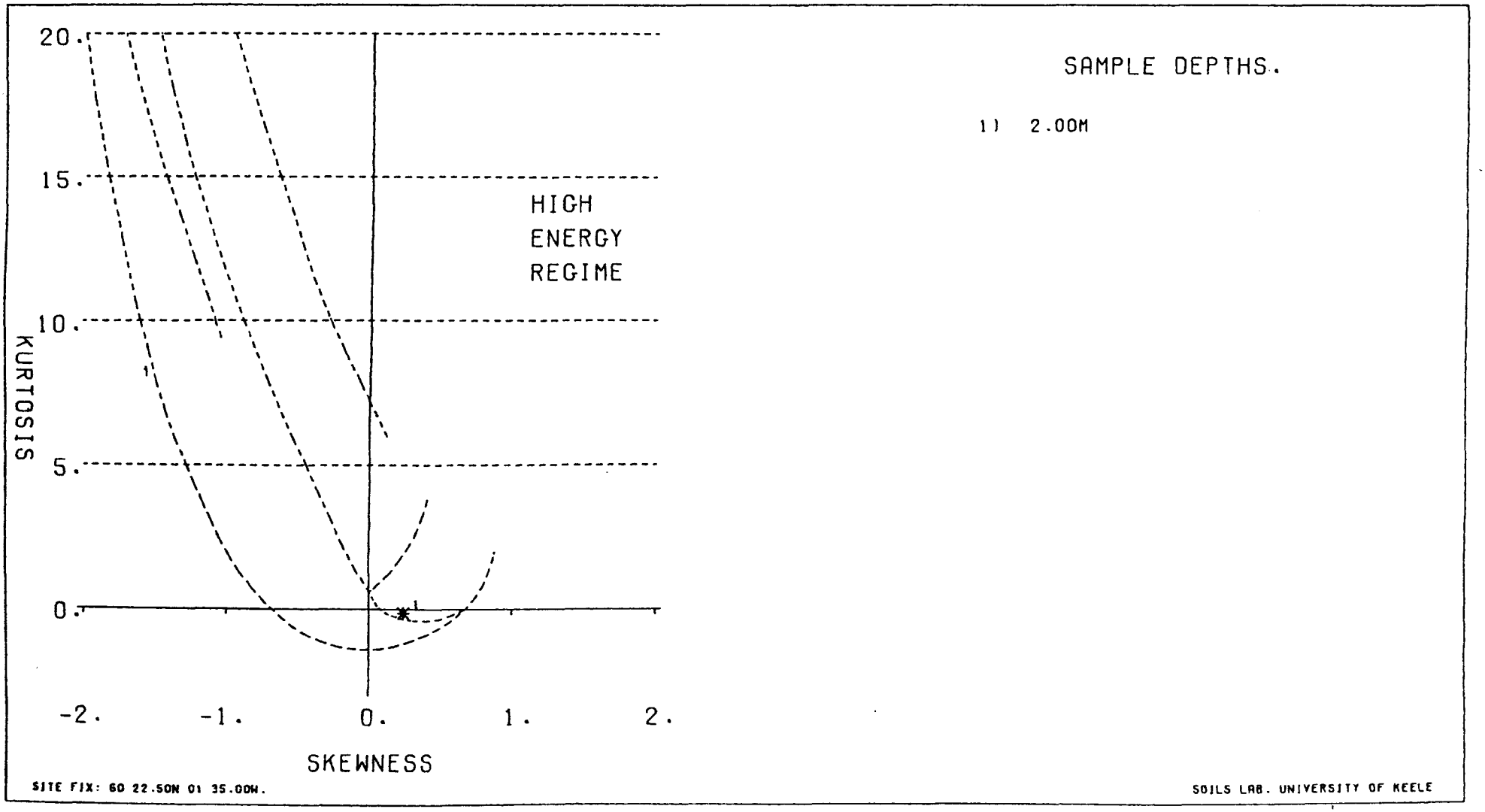


FIG 6.4.4. LOW ENERGY SAMPLES.

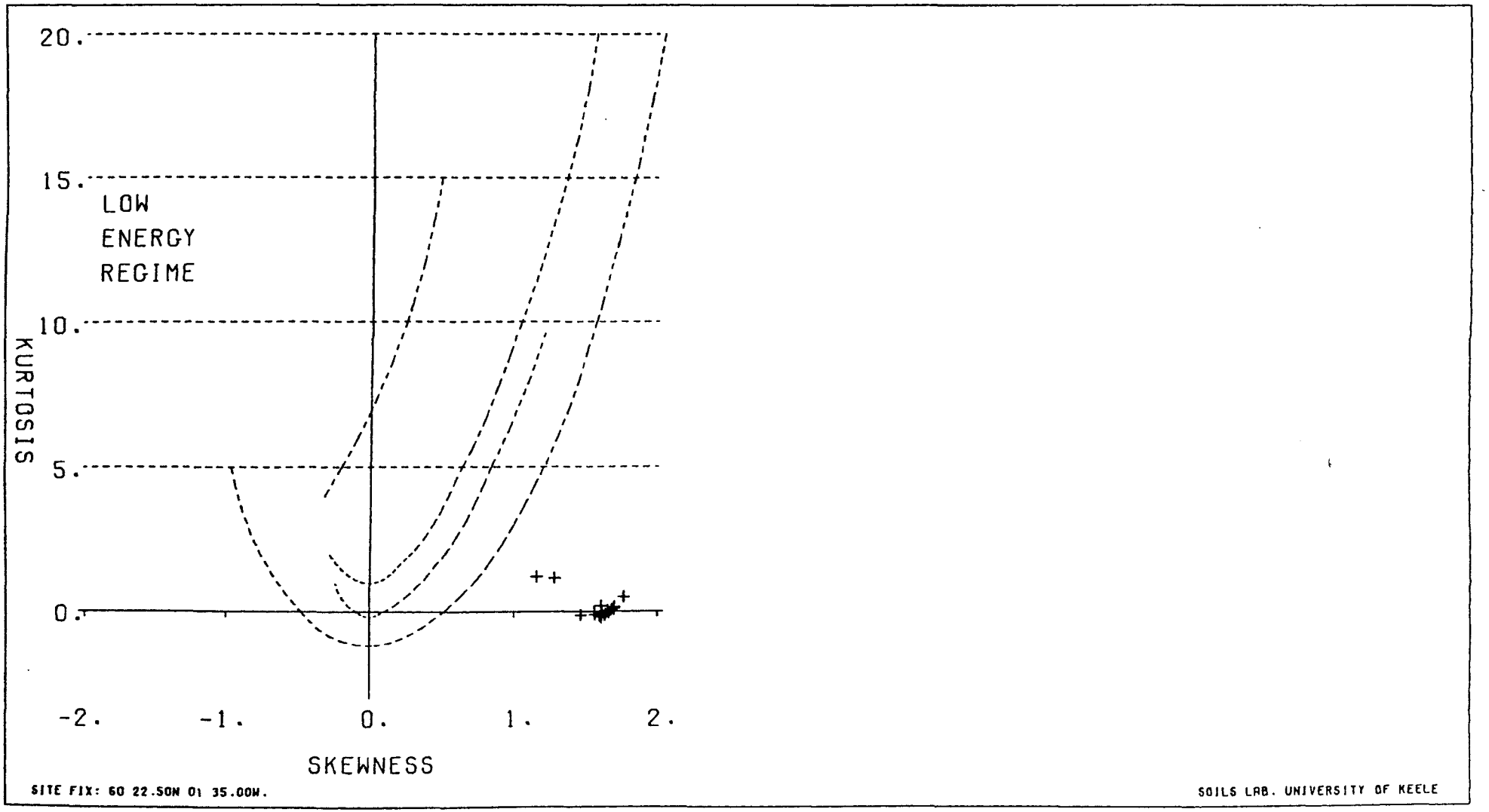


FIG 6.4.5. UNIT .X. SEDIMENTS.

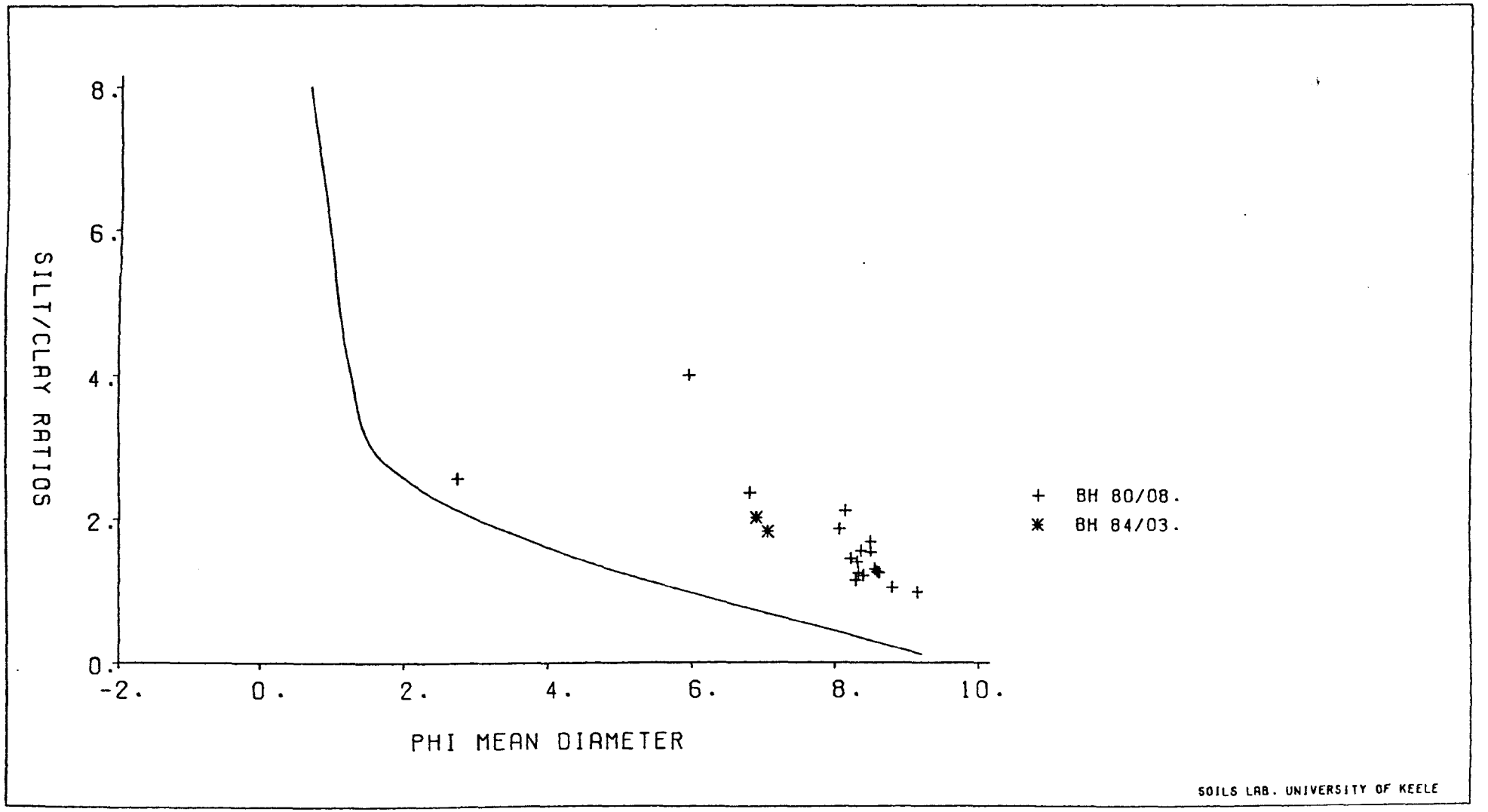


FIG 6.4.6. SILT:CLAY PLOT.

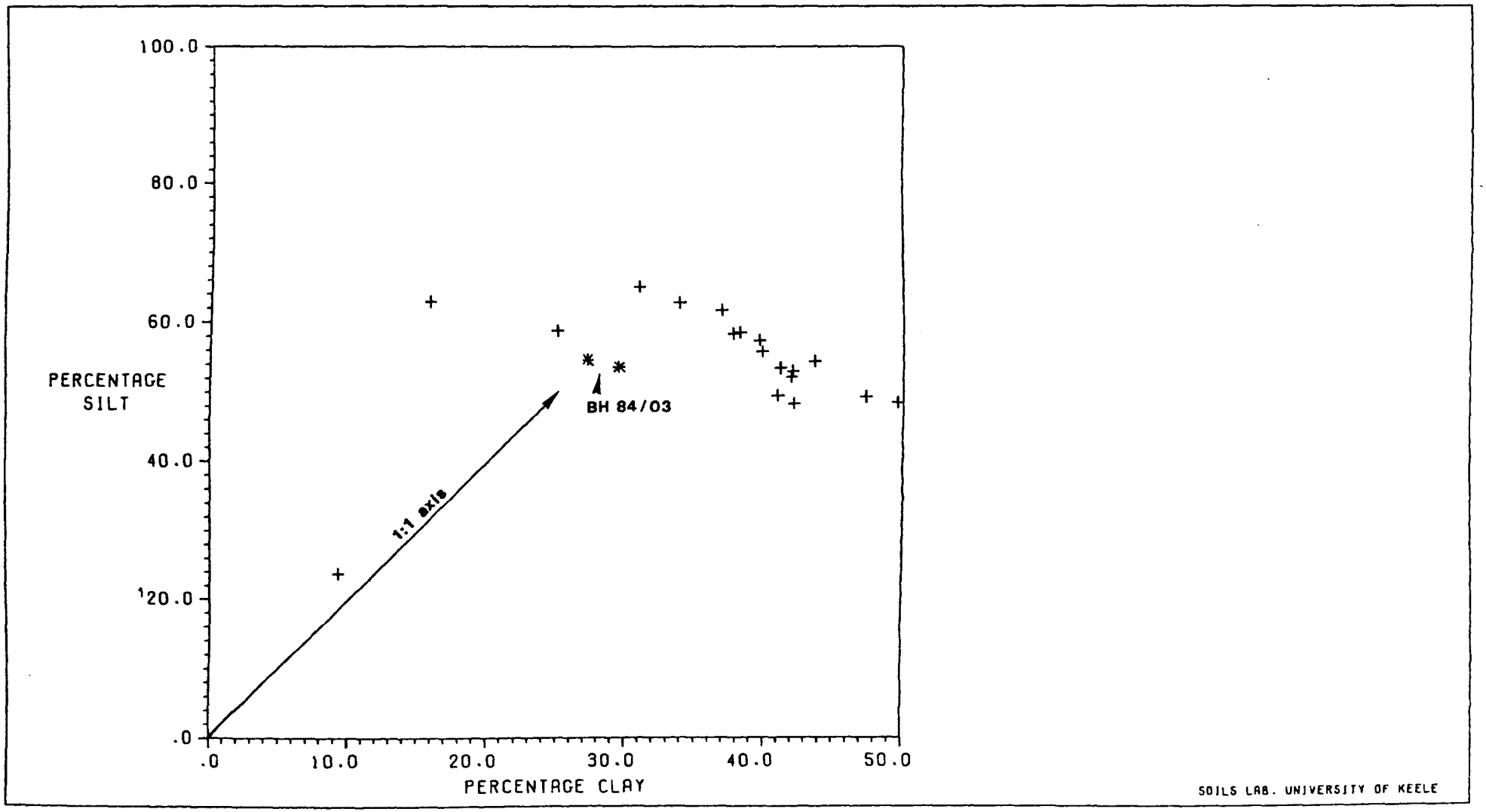
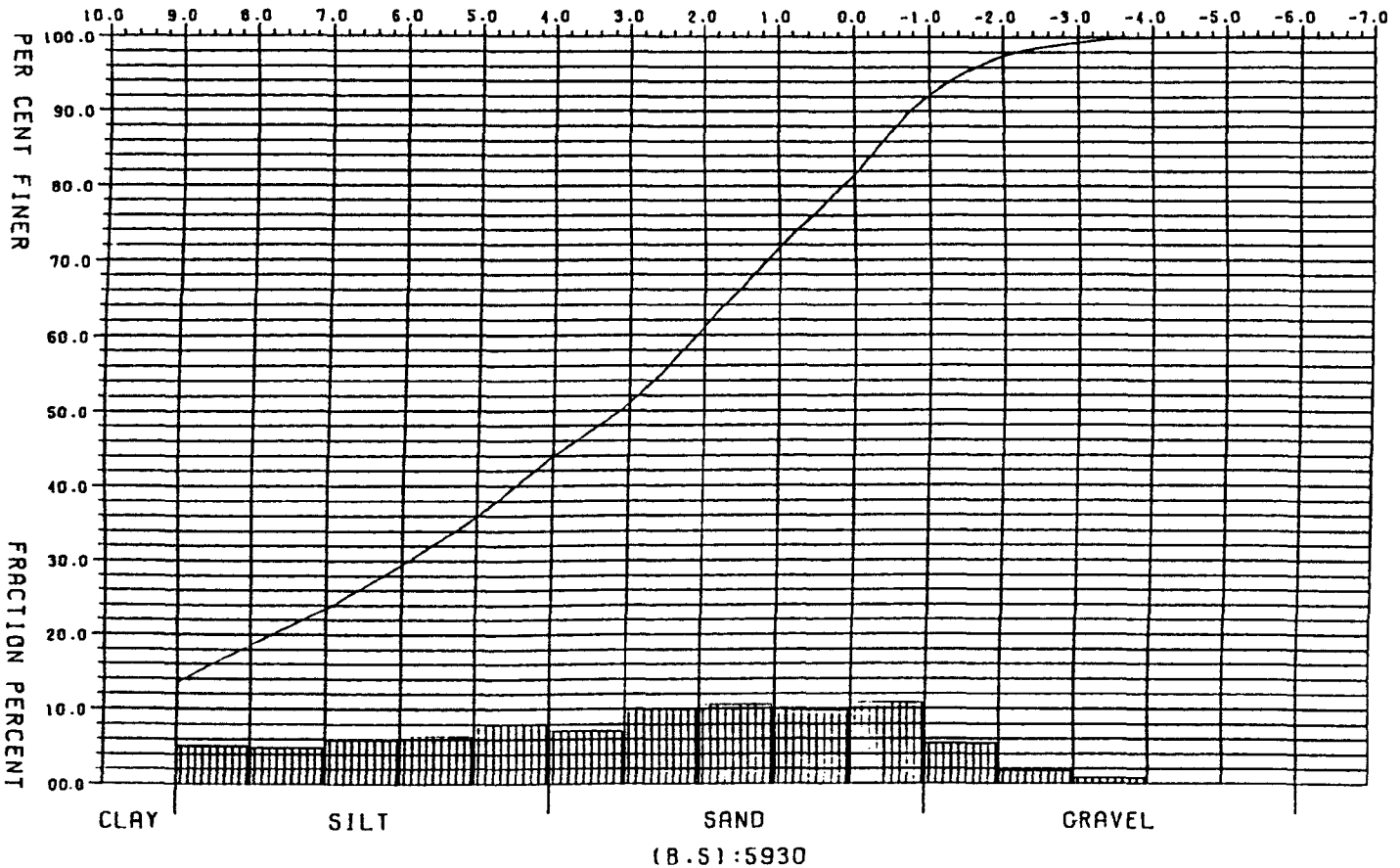


FIG 6.5.1 UNIT .T. (SLN 76/26).

DEPTH: 33.90M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 3.78
GRAPHIC STANDARD DEVIATION = 4.26
GRAPHIC SKEWNESS = .27
GRAPHIC KURTOSIS = .92
NORMALISED KURTOSIS = .48

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 3.11
PHI (ARITHMETIC) MEAN DIAMETER = 4.12
PHI DEVIATION MEASURE = 4.37
PHI SKEWNESS MEASURE = .23
2ND PHI SKEWNESS MEASURE = .50
PHI KURTOSIS MEASURE = .56

PHI MOMENT STATISTICS.

MEAN SIZE = 2.39
STANDARD DEVIATION = 2.85
SKEWNESS (THIRD MOMENT) = .64
MEAN CUBED DEVIATION = 14.66
KURTOSIS (FOURTH MOMENT) = 2.59

MC CAMMON'S STATISTICS.

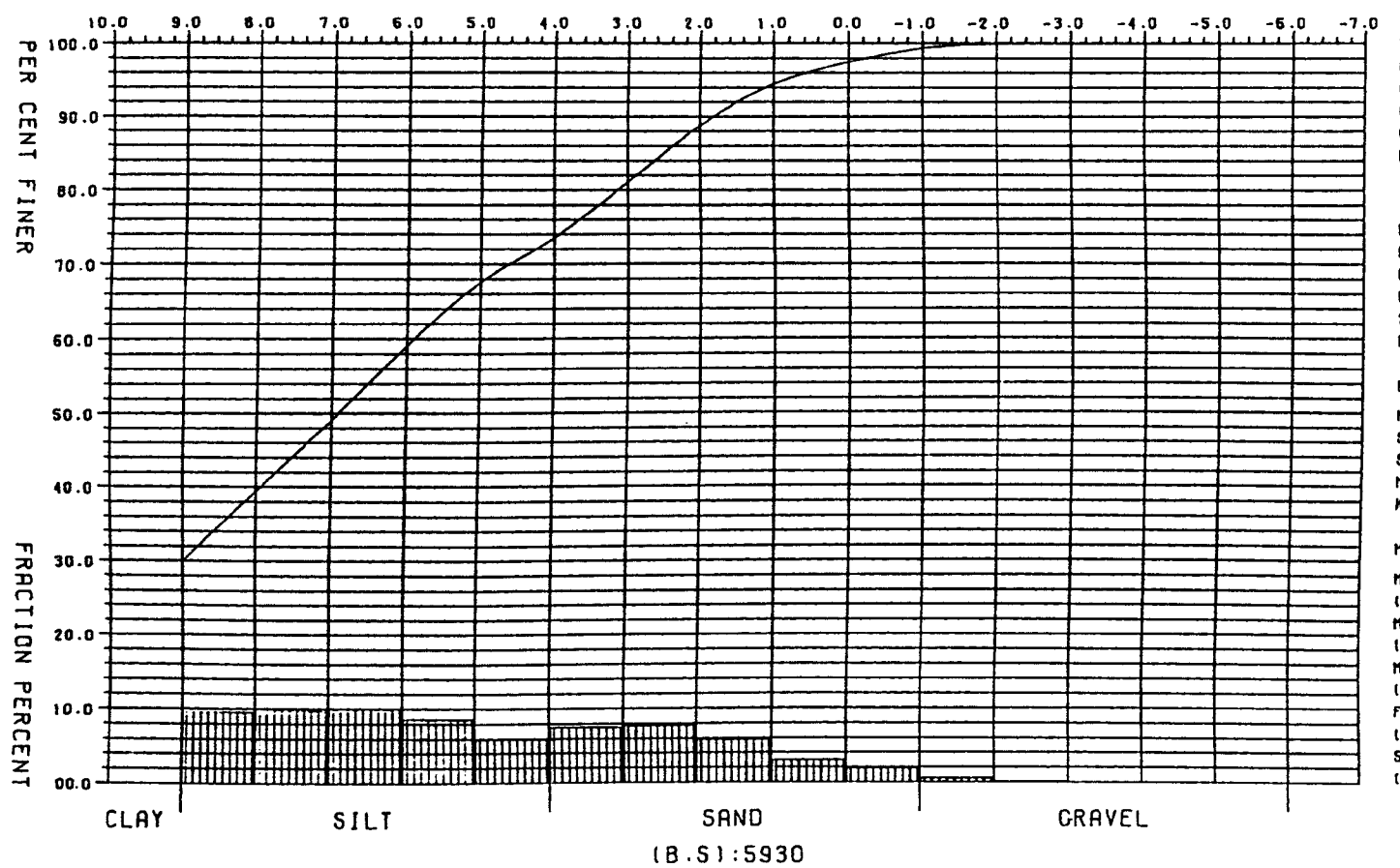
MEAN SIZE = 3.64
(88 PER CENT EFFICIENCY)
MEAN SIZE = 4.01
(93 PER CENT EFFICIENCY)
MEAN SIZE = 3.94
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 4.21
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 4.15
(87 PER CENT EFFICIENCY)

SITE FIX: 60 37 96N 00 24 00W.

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FIG 6.5.2 UNIT .T. (SLN 76/26).

DEPTH: 11.50M.



SAMPLE STATISTICS

FOLK AND WARD STATISTICS.

MEAN SIZE = 6.93
GRAPHIC STANDARD DEVIATION = 4.05
GRAPHIC SKEWNESS = .01
GRAPHIC KURTOSIS = .84
NORMALISED KURTOSIS = .46

INMAN'S STATISTICS.

PHI MEDIAN DIAMETER = 6.89
PHI (ARITHMETIC) MEAN DIAMETER = 6.95
PHI DEVIATION MEASURE = 4.35
PHI SKEWNESS MEASURE = .01
2ND PHI SKEWNESS MEASURE = .02
PHI KURTOSIS MEASURE = .42

PHI MOMENT STATISTICS.

MEAN SIZE = 3.46
STANDARD DEVIATION = 2.53
SKEWNESS (THIRD MOMENT) = 1.16
MEAN CUBED DEVIATION = 18.77
KURTOSIS (FOURTH MOMENT) = 2.70

MC CAMMON'S STATISTICS.

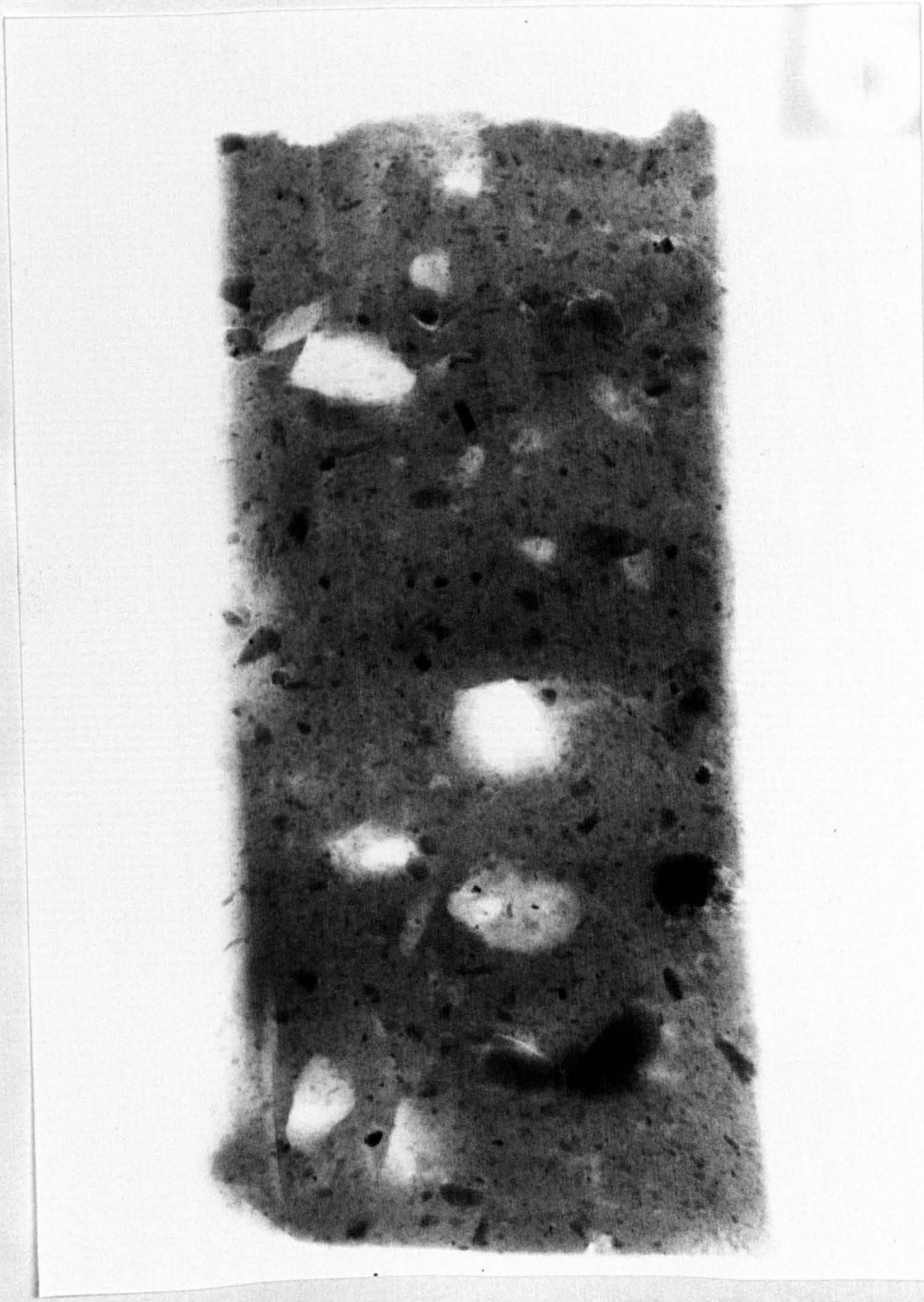
MEAN SIZE = 6.88
(88 PER CENT EFFICIENCY)
MEAN SIZE = 7.04
(93 PER CENT EFFICIENCY)
MEAN SIZE = 6.90
(97 PER CENT EFFICIENCY)
FIRST SORTING MEASURE = 3.96
(79 PER CENT EFFICIENCY)
SECOND SORTING MEASURE = 3.86
(87 PER CENT EFFICIENCY)

SITE FIX: 60 37 96N 00 24 00W.

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PLATE 2.2.1.

BOREHOLE 82/10. UNIT .1. 23.0 to 23.2 metres.



Darker zones represent small clastic and bioclastic fragments. Note absence of preferred orientation. White patches are areas where large clasts lay in this matrix (**Magnification 1x life**).

PLATE 2.2.2.

BOREHOLE 82/10. UNIT .2. 41.1 to 41.20 metres.



Note the colour difference between the matrix and the sand layer towards the top of the section, and the lower sand layer associated with a similarly coloured clast. Note also how this lower layer cuts across the matrix lamination unevenly, but does not disrupt it. **(Magnification 1x life).**

PLATE 2.2.3.

BOREHOLE 82/10. UNIT .2. 32.5 to 32.8 metres.



Sulphide bands are darker areas possibly indicating drill-induced disturbance. Note intercalated sand layers near base of section. (Magnification 0.54x life).

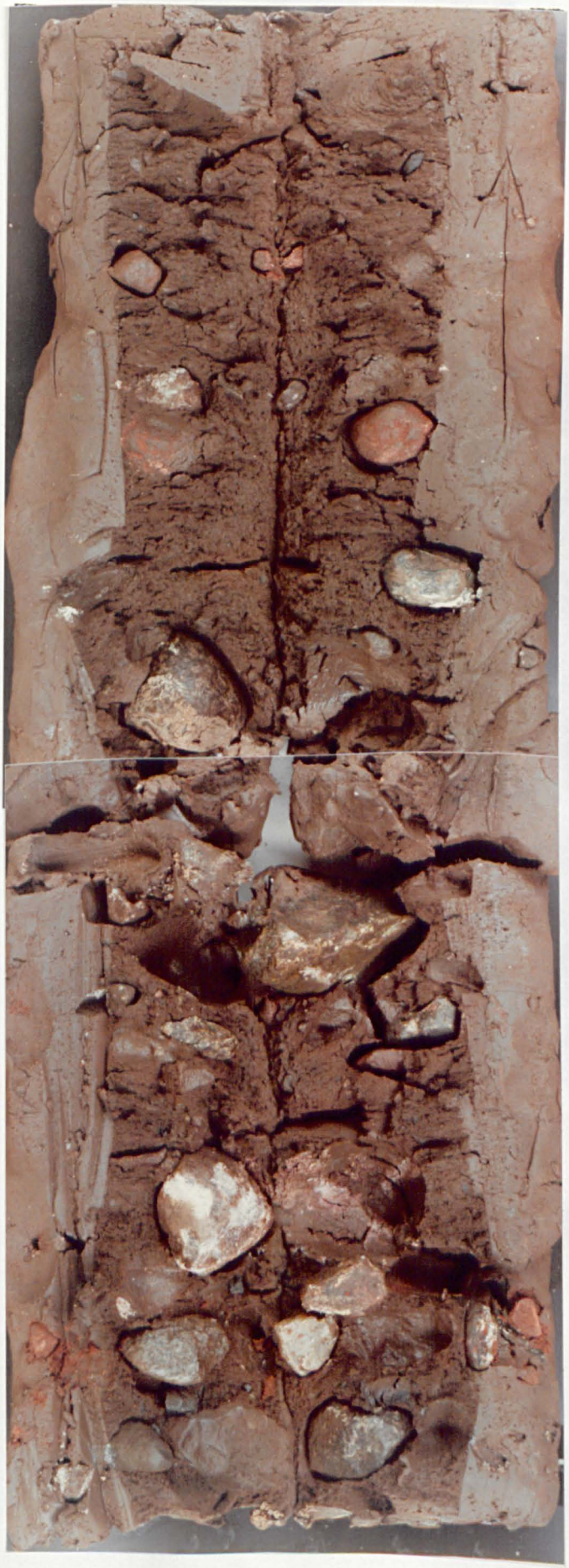


PLATE 2.2.4.

BOREHOLE 82/10. UNIT .2.

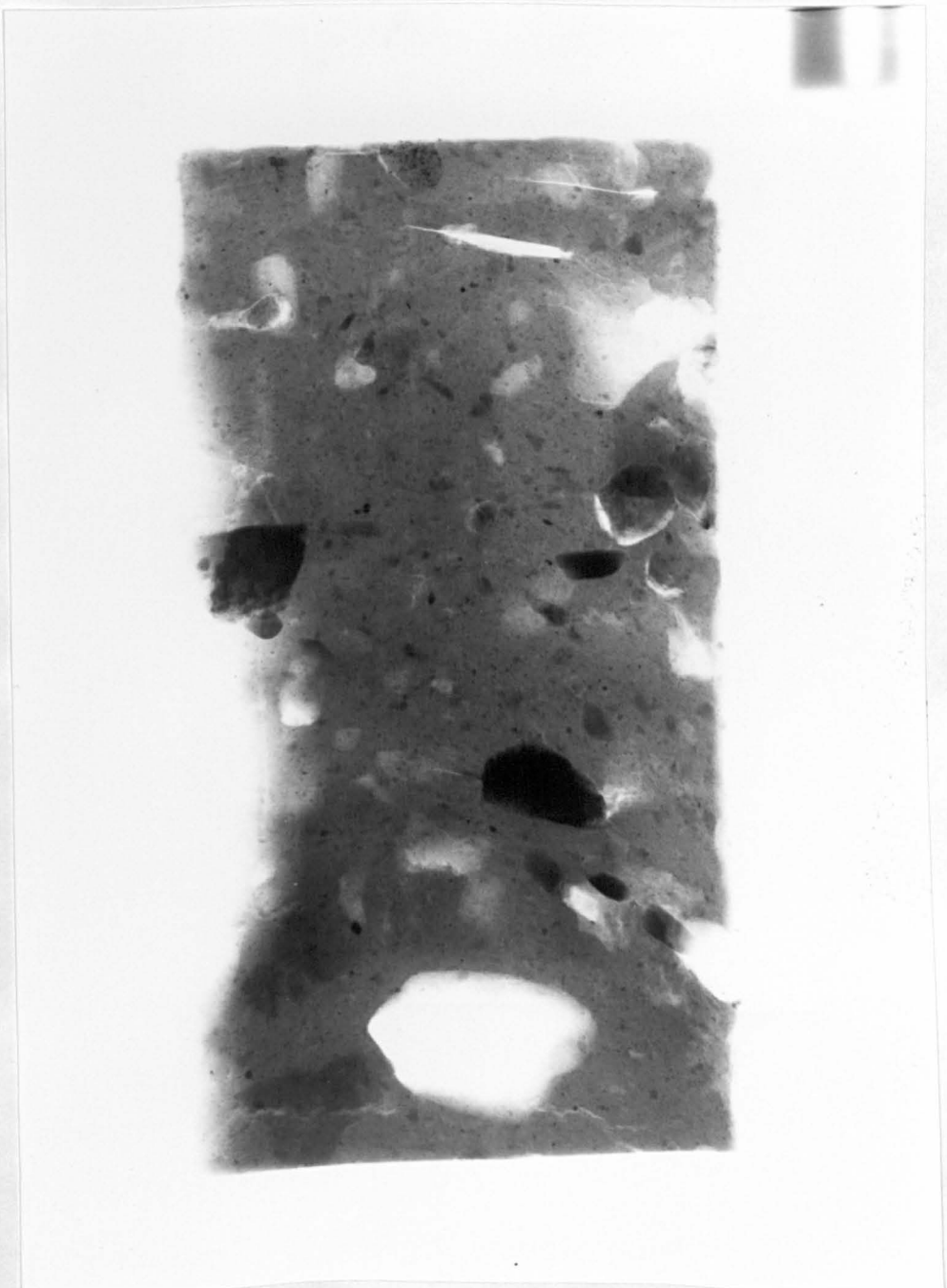
27.54 to 28.00 metres.

Note the increase in clast content down core.

(Magnification 0.57x life)

PLATE 2.2.5.

BOREHOLE 82/10. UNIT.2. 27.54 to 27.70 metres.



X-ray of section of core in the upper right half of plate 2.2.4. No evidence of discing features, cutting perpendicularly across the core, can be seen to indicate drill damage. (Magnification 1x life).

PLATE 2.2.6.

BOREHOLE 82/10. UNIT .2. 31.6 to 31.7 metres.



Note the downwarping of the sand layers and the rhythmic sulphide bands close to the clast margins. (Magnification 1.63x life).

PLATE 2.2.7.

BOREHOLE 82/10. UNIT .2. 32.8 to 32.90 metres.



Sediment inclusion. Note massive structure and colour compared to the surrounding matrix. Note also the abundance of clastic fragments in the material. **(Magnification 1.3x life).**

PLATE 2.2.8.

BOREHOLE 82/10. UNIT .2. 32.8 to 32.9 metres.



Left half of the inclusion shown in plate 2.2.7. Note the depression of lamination on the underside of the inclusion and laminae penetration on the left hand side. (Magnification 1.44x life).

PLATE 2.2.9.

BOREHOLE 82/10. UNIT .3. 52.2 to 52.35 metres.



Note the bioclastic fragments lying perpendicular to the core axis, in an otherwise apparently massive sandy matrix. This represents a rare example of an undisturbed fabric in this unit. (**Magnification 1.63x life**).

PLATE 2.2.10.

BOREHOLE 82/10. UNIT .4. 97.0 to 97.3 metres.



Note darker red and black bands (often sandy) cutting irregularly across the core. Note also the small and sparse nature of the clastic component. Bioclastic fragments occur to the top right. (Magnification 0.43x life).

PLATE 2.2.11.

BOREHOLE 82/10. UNIT .4. 97.3 to 97.5 metres.



Note the reddish and brown sand-rich bands due to drilling disturbance. Note also the small clastic and bioclastic fragments, and the clear lamination, towards the top of the core. (Magnification 0.52x life).

PLATE 2.2.12.

BOREHOLE 82/10. UNIT .5. 105.3 to 105.5 metres.



Rhythmic lighter green layers represent washing in of fines from the adjacent, darker, areas under drilling, or, the washing out of the fine content altogether from the darker regions. Note bioclastic fragment to upper left. **(Magnification 0.65x life).**

PLATE 2.3.1.

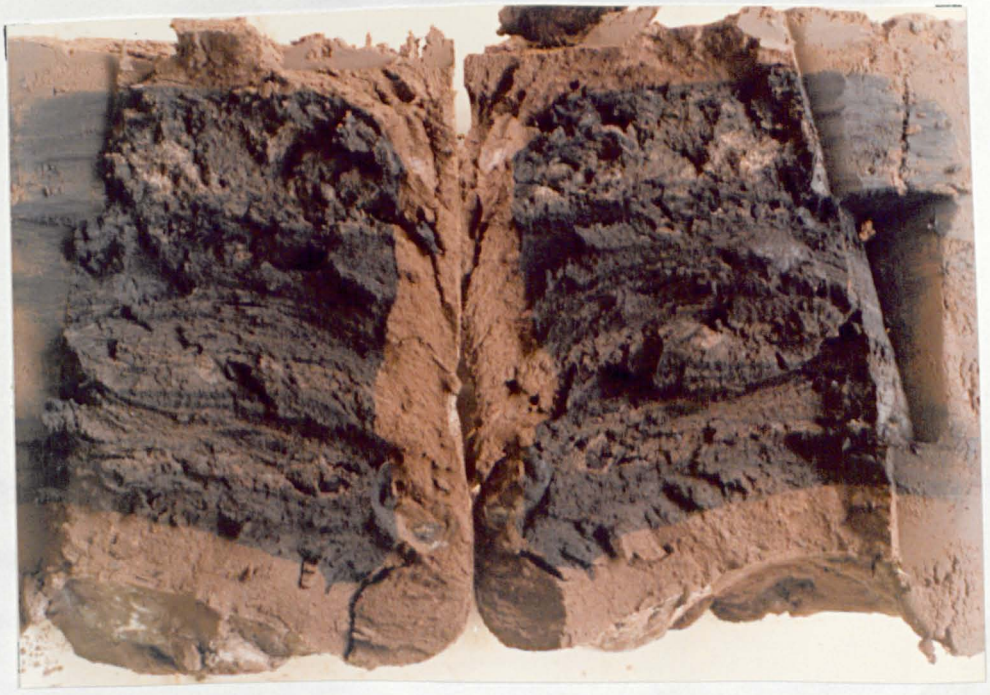
BOREHOLE 82/01. UNIT .1.

A)



13.45 to 13.60 metres. Typical grey matrix of unit .1. Note the "rust" red oxidized colour of the core periphery. **(Magnification 0.65x life).**

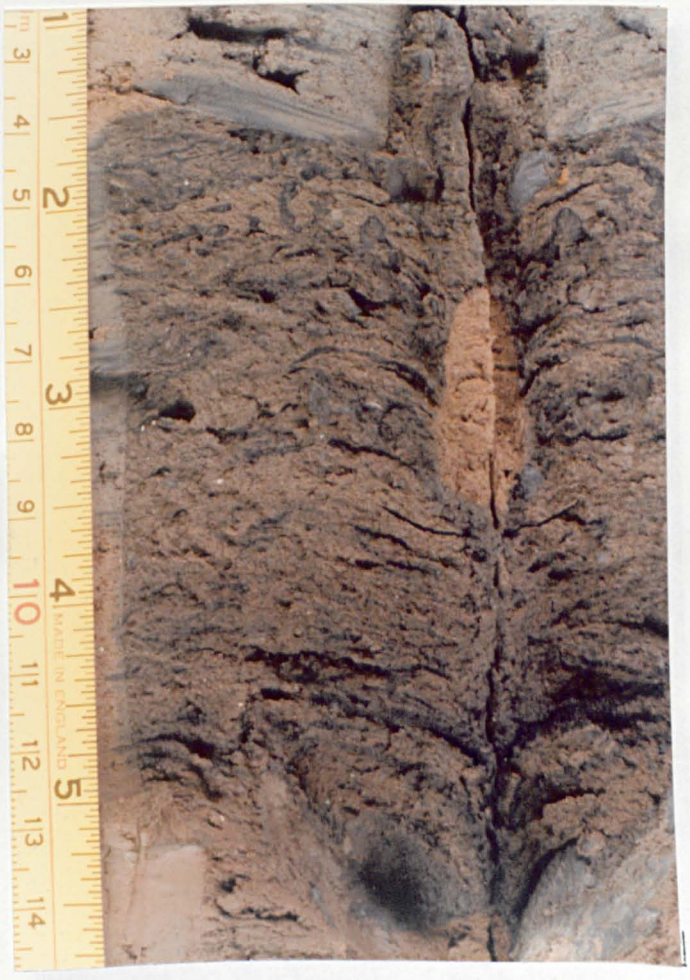
B)



13.9 to 14.0 metres. Sulphide banding in unit .1. Note fineness of bands and close proximity to each other.**(Magnification 1.04x life).**

PLATE 2.3.2.

BOREHOLE 82/01. UNIT .1. 48.6 to 48.75 metres.



Note the distorted and discontinuous sulphide bands in the upper half of the core. Note also the "smudges" to the right of the 5 cm mark on the scale. **(Magnification 0.87x life).**

PLATE 2.3.3.

BOREHOLE 82/01. UNIT .1. 48.95 to 49.05 metres.



Note sulphide "blotches" in the centre of the section. (Magnification 1x life).

PLATE 2.3.4.

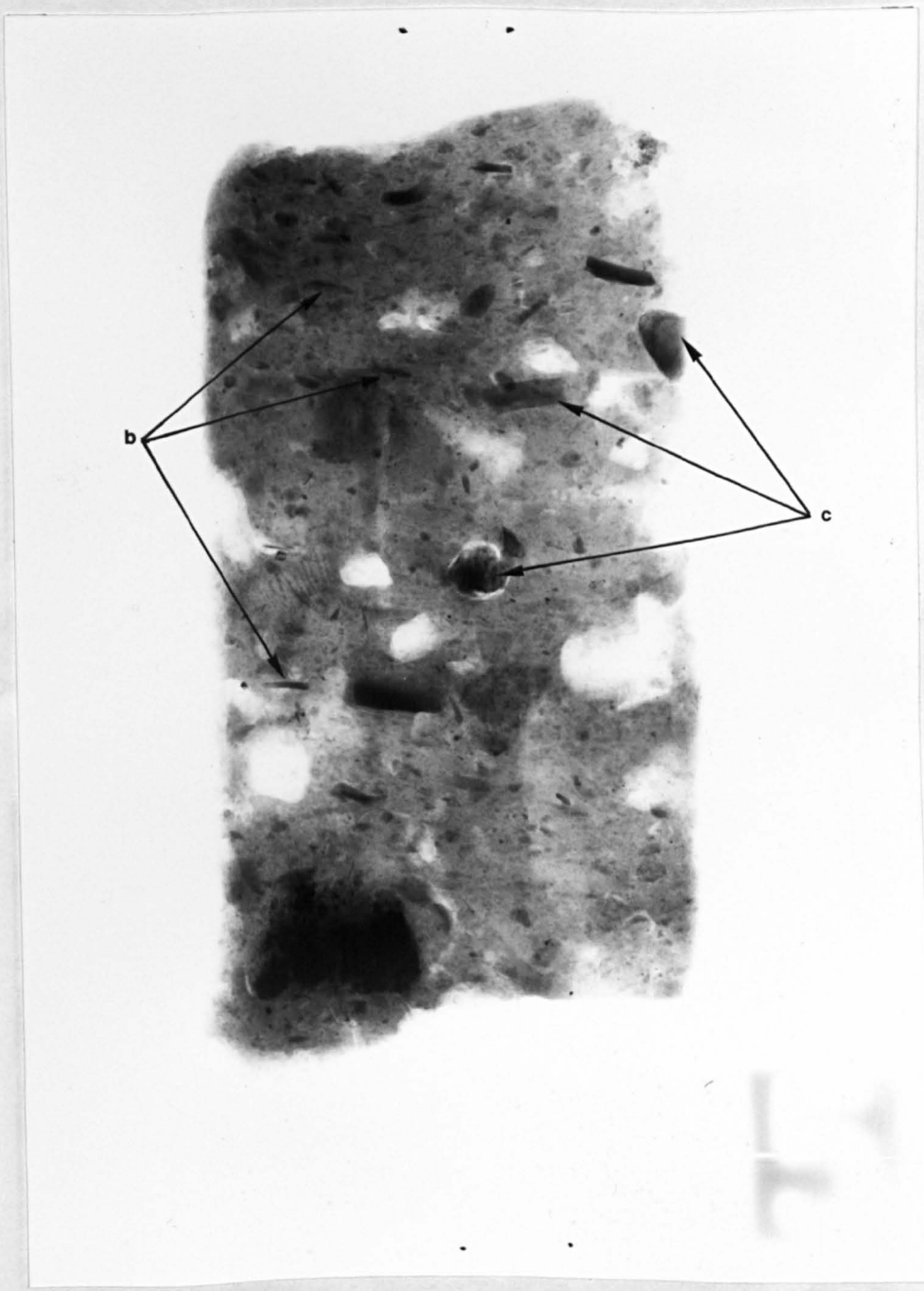
BOREHOLE 82/01. UNIT .1. 49.3 to 49.4 metres.



Note the absence of concentrated sulphide banding, and the reddish sand layers to the left of the 6 cm mark on the scale. Large shear to the left of the 7 cm mark is probably a result of drill disturbance. (Magnification 1x life).

PLATE 2.3.5.

BOREHOLE 82/01. UNIT .1. 36.7 to 36.8 metres.



Note the profusion of small clastic (c) and bioclastic (b) fragments. (**Magnification 1x life**).

PLATE 2.3.6.

BOREHOLE 82/01. UNIT .2.

A)



58.9 to 58.95 metres. Note two halves of grey clast in bottom of frame showing how friable this material is. **(Magnification 1.08x life).**

B)



Note the lamination apparent in the grey clast on the right, perpendicular to the matrix lamination. **(Magnification 2x life).**

PLATE 2.3.7.

BOREHOLE 82/01. UNIT .2. 60.15 to 60.35 metres.



Note profusion of light grey clasts within the matrix, and the similar clour of the matrix at certain levels. (Magnification 0.54x life).

PLATE 2.3.8.

BOREHOLE 82/01. UNIT .2. 61.9 to 61.95 metres.



Note grey clast, subrounded in form, with slight striation on the surface indicating it has undergone attrition. Note also the profusion of smaller rock fragments. (**Magnification 1.86x life**).

PLATE 2.3.9.

BOREHOLE 82/01. UNIT .2. 62.75 to 62.95 metres.



Note the greyish tone to the matrix below the 7 cm mark on the scale. This zone is dominated by the grey clastic material. **(Magnification 0.59x life).**

PLATE 2.5.1.

BOREHOLE 82/11. UNIT .-1. 9.70 to 9.75 metres.



Note the alignment of elongated clasts perpendicular to the core axis towards the top of the section. (Magnification 0.52x life).

PLATE 2.5.2.

BOREHOLE 82/11. UNIT .-1. 9.9 to 10.0 metres.



Obliquely dipping clastic fragments. Note also the irregularly orientated bioclastic fragments. (**Magnification 1.3x life**).

PLATE 2.5.3.

BOREHOLE 82/11. UNIT .-1. 6.70 to 6.90 metres.



Note the increase in large clastic fragments towards the base of the section. (Magnification 0.52x life).

PLATE 2.5.4.

BOREHOLE 82/11. UNIT .O. 25.05 to 25.25 metres.



Massive matrix in this unit. Note the large subrounded clast fragment in the centre right and the mass of bioclastic material which shows up as white streaks. (**Magnification 0.52x life**).

PLATE 2.5.5.

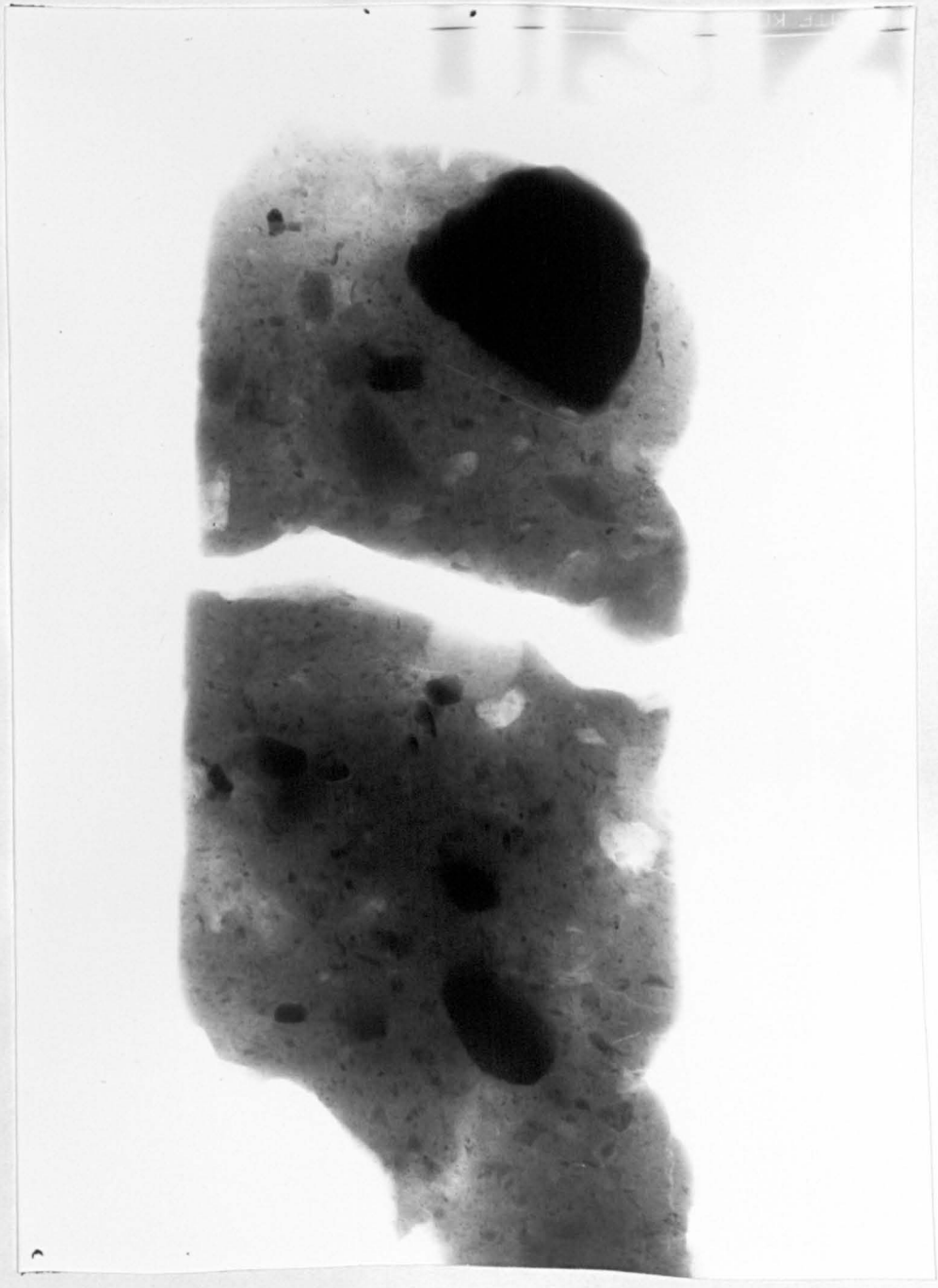
BOREHOLE 82/11. UNIT .O. 29.45 to 29.55 metres.



Note massive matrix plus the mass of bioclastic fragments. (Magnification 1.37x life).

PLATE 2.6.1.

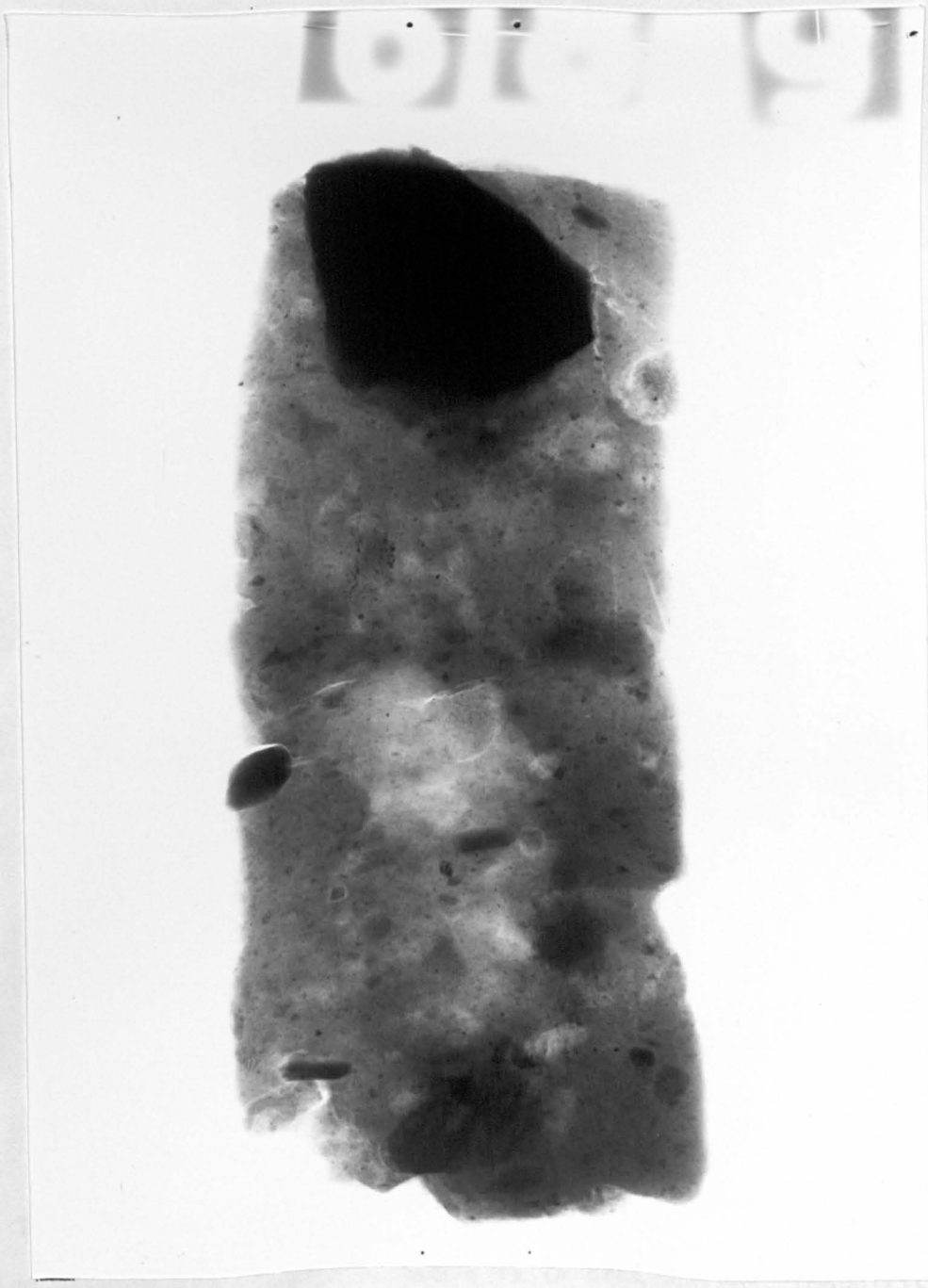
BOREHOLE 84/04. UNIT .O. 13.2 to 13.4 metres.



Note the varying alignment of the clastic material, and the smaller bioclastic fragments. (Magnification 1x life).

PLATE 2.6.2.

BOREHOLE 84/04. UNIT .2. 68.8 to 69.0 metres.



Note large clast at the top of the section and the tendency for elongated fragments to align perpendicular to the core axis. (Magnification 1x life).

PLATE 2.6.3.

BOREHOLE 84/04. UNIT .2. 77.9 to 78.0 metres.



Note the profusion of clastic debris and the absence of any preferred orientation between the fragments. Scale is in centimetres. **(Magnification 0.4x life).**

PLATE 2.6.4.

BOREHOLE 84/04. UNIT .2. 101 to 101.3 metres.



Note paucity of clastic debris compared to some of the sections illustrated earlier. (Magnification 1x life).

PLATE 2.6.5.

BOREHOLE 84/04. UNIT .3.

A)



129.6 to 129.7 metres. Massive structure characteristic of this unit. (Magnification 1.73x life).

B)



139.9 to 140.0 metres. Note absence of lamination and paucity of clastic and bioclastic fragments. (Magnification 1x life).

PLATE 2.6.6.

BOREHOLE 84/04. UNIT .4. 154 metres (pilot).



Lamination in sediment at base of the recovered borehole. Note the very small size of the clastic debris. (**Magnification 2.17x life**).

PLATE 2.6.7.

BOREHOLE 84/04. UNIT .4. 148.7 to 148.85 metres.



X-ray of undisturbed section. Note small size of the clastic material and the absence of any preferred orientation. (Magnification 1x life).

PLATE 2.6.8.

BOREHOLE 84/04. UNIT .4. 148.5 to 148.7 metres.



Drill damage structures. Note "stacking" at top, followed by a sand-rich layer. Underneath this is colour banding, vertical and horizontal to the core axis. (Magnification 1.24x life).

PLATE 6.2.1.

BOREHOLE 80/08. UNIT .X. 2.20 to 2.40 metres.



Massive grey matrix at top of unit. Note fine bioclastic material. (Magnification 0.64x life).

PLATE 6.2.2.

BOREHOLE 80/08. UNIT .X. 4.50 to 4.60 metres.



Note blackened core interior due to sulphide staining and the oxidation of the core periphery to an olive/brown colour. (Magnification 1.59x life).

PLATE 6.2.3.

BOREHOLE 80/08. UNIT .X. 4.85 to 4.95 metres.



Note blocky structure and rust coloured streaks with the odd blackened sulphide zone. (Magnification 1.41x life).

PLATE 6.2.4.

BOREHOLE 80/08. UNIT .X. 9.90 to 9.96 metres.



"Gassified" fabric in matrix. Note "rust" coloured areas, and the profusion of void spaces. (**Magnification 2.12x life**).

PLATE 6.2.5.

BOREHOLE 80/08. UNIT .X. 11.40 to 11.60 metres.



Sulphide blackening of gassified fabric. Other areas have probably oxidized after recovery. (Magnification 0.5x life).

PLATE 6.2.6.

BOREHOLE 80/08. UNIT .X. 24.80 to 25.00 metres.



Laminated matrix; note reddy-brown colour compared to overlying sections. (**Magnification 0.55x life**).

PLATE 6.3.1.

BOREHOLE SLN 76/26. UNIT .T. 20.50 to 20.80 metres.



Laminated matrix. Note distorted and weathered schistose debris at base of section, and profusion of smaller clastic debris at higher levels. **(Magnification 0.64x life)**

PLATE 6.3.2.

BOREHOLE SLN 76/26. UNIT .T. 33.30 to 33.50 metres.



Massive matrix with profusion of small clastic debris. Note weathered and split clast towards the top of the section, and stained zone around weathered schist clast at bottom right (this clast is shown enlarged in plate 6.3.3.). **(Magnification 0.55x life)**

PLATE 6.3.3.

BOREHOLE SLN 76/26. UNIT .T. 33.40 to 33.50 metres.



Weathered schistose clast at base of plate 6.3.2. Note cracks in clast and "chloritic" colour produced by weathering. **(Magnification 1.27x life)**

PLATE 6.3.4.

BOREHOLE SLN 76/26. UNIT .T. 33.85 to 34.00 metres.



Weathered "regolith" material composed of basement lithologies.

(Magnification 0.56x life)

PLATE 6.3.5.

BOREHOLE SLN 76/26. UNIT .T. 34.40 to 34.50 metres.



Close up of weathered regolith (from top left of section in plate 6.3.6.). Note profusion of small fragments. Pinks/browns are rotted feldspars; greens are chlorite. (**Magnification 1.27x life**)

PLATE 6.3.6.

BOREHOLE SLN 76/26. UNIT .T. 34.40 to 34.60 metres.



Typical regolith zone with interbedded sandy layer at base of section (lower left of this section is reproduced in plate 6.3.7.).
(Magnification 0.64x life)

PLATE 6.3.7.

BOREHOLE SLN 76/26. UNIT .T. 34.50 to 34.60 metres.



Core section from base of plate 6.3.6. Note sandy zone composed of fine granular material similar to the coarser regolith zone overlying it. Note also rotted schistose clast at base of section. (Magnification 1.27x life).

PLATE 6.3.8.

BOREHOLE SLN 76/26. UNIT .T. 54.15 to 54.25 metres.



Zone of intense staining produced by weathering. This type of feature dominates the matrix just above the transition to bedrock. **(Magnification 1.06x life)**

TABLE 4.2.1. SEDIMENT TYPE CHARACTERISTICS

FEATURES	Till	Orthotill	PARATILLS		Marine
			Residual	Compound	
STRATIFICATION	Unstratified Massive	Unstratified Massive	Crude or absent stratification Laminated	Crude to well stratified Laminated	Well stratified Finely laminated
TEXTURE	Homogeneous	Homogeneous	Heterogeneous	Heterogeneous	Homogeneous
MATRIX	Unsorted Polymodal Overconsolidated Coarse skewed	Poorly sorted No pronounced fine mode Till lenses due to mudflows Coarse skewed	Badly sorted sand and gravel Winnowed fine content Loosely compacted Coarse skewed	Sorted sand and fine fractions Bimodal; pronounced silt mode Ice-rafted mode varying, depending upon location. Finer skewed	Very well sorted Predominantly fine grained Fine skewed
CLASTICS	No pebble fabric Angular clasts	No pebble fabric Angular clasts	Crude / no clast alignment parallel to bedding. Vertically-standing elongated clasts. Slightly rounded clasts	Elongated clasts parallel bedding. Penetration / deformation of laminae by clastic debris. Vertically-standing elongated clasts. Medially rounded clasts	No clastic material
MICROFOSSILS	NO SPECIES – UNLESS REWORKED		Abundant, low diversity faunas Arenaceous species	Marine assemblages with varying abundance / diversity Few arenaceous species	Marine assemblages ONLY
ENVIRONMENT	Grounded ice deposits Terrestrial	Grounding line deposits	Deposition from floating ice in a high energy marine setting	Deposition from floating ice in a low energy marine setting	Open marine deposits

TABLE 4.3.1. FORAMINIFERAL ANALYSIS : UNIT .4.

BENTHONIC FORAMINIFERA: UNIT .4.		
SPECIES	*BH 84/04*	*BH 82/10*
	149.00m.	*97.25m.*
Cibicides Lobatulus	-	-
Elphidium Clavatum	*54.0%*	*67.2%*
Cassidulina Laevigata	*38.0%*	*25.9%*
Cassidulina Reniforme	-	*1.7%*
Protelphidium Orbiculare	*0.7%*	-
Bucella Frigida	*0.7%*	*0.3%*
Elphidium Subarcticum	*0.7%*	*1.0%*
Nonion Barleeanum	*0.7%*	*0.3%*
Islandiella Helenae	*0.3%*	-
Total Count	*300*	*290*
Faunal Diversity (95%)	*3*	*4*

(Extracted from Gregory, 1983b & 1985).

TABLE 4.4.1. FORAMINIFERAL ANALYSIS : UNIT .3.

BENTHONIC FORAMINIFERA : UNIT .3.										
SPECIES	BOREHOLE 84/04			BOREHOLE 82/10						
	121.0m.	129.0m.	135.0m.	79.1m.	82.0m.	85.0m.	88.5m.	90.0m.	92.5m.	95.0m.
Cassidulina Reniforme	25.0%	26.7%	0.4%	46.4%	-	11.3%	60.8%	10.0%	37.0%	12.2%
Cibicides Lobatulus	1.0%	4.0%	26.6%	3.0%	11.2%	56.3%	13.0%	7.3%	19.0%	23.5%
Elphidium Clavatum	64.0%	64.4%	38.3%	44.4%	63.8%	6.1%	19.9%	50.0%	22.0%	22.4%
Bulimina Marginata	0.7%	-	-	-	-	0.3%	-	-	-	1.0%
Elphidium Subarcticum	0.7%	-	0.4%	0.3%	5.9%	4.1%	1.3%	2.1%	1.0%	0.7%
Islandiella Islandica	1.3%	-	-	-	-	2.0%	0.3%	0.6%	0.3%	-
Islandiella Umbata	2.3%	-	-	-	-	9.2%	0.3%	-	0.7%	1.7%
Trifarina Angulosa	1.3%	0.3%	31.9%	-	9.0%	4.8%	1.0%	0.6%	10.0%	30.6%
Protelphidium Orbiculare	2.0%	1.0%	-	3.0%	2.7%	2.0%	1.3%	13.6%	2.7%	3.4%
Bucella Frigida	-	1.3%	0.4%	0.3%	-	-	0.7%	0.3%	1.0%	-
Quinque. Serulunum	0.3%	0.4%	0.4%	0.3%	5.9%	0.3%	1.0%	0.3%	2.0%	0.7%
Total Count	300	303	282	304	188	293	301	330	300	294
Faunal Diversity (95%)	6	3	3	4	5	8	4	6	11	4

(After Gregory, 1983b & 1985).

TABLE 4.4.2. DINOFLAGELLATE ANALYSIS : UNIT .3.

DINOFLAGELLATE CYSTS: UNIT .3.			
SPECIES	*BH 84/04*	*BH 82/10*	
	(CSC 6277)	*(CSC 5884)*	*(CSC 5885)*
Bitectatodinium Tepikiense	*41.1%*	*54.6%*	*32.3%*
Operculodinium Centrocarpum	*19.2%*	*18.2%*	*43.0%*
Spiniferites spp. indet.	*12.3%*	*9.1%*	*15.1%*
Protoperidinium spp. indet.	*11.0%*	*6.8%*	-
Spiniferites Ramosus	*8.2%*	-	*3.2%*
Achomosphaera Andalousiense	*4.1%*	*6.8%*	-
Protoperidinium Subinerme	*2.7%*	-	*1.1%*
Spiniferites Mirabilis	*1.4%*	-	-
Total Count	*73*	*44*	*93*

(Extracted form Harland, 1983b & 1985a).

TABLE 4.5.1. FORAMINIFERAL ANALYSIS : UNIT .2.

BENTHONIC FORAMINIFERA : UNIT .2.														
SPECIES	BOREHOLE 84/04										BOREHOLE 82/10		BOREHOLE 82/01	
	64.0m	69.0m	72.0m	78.0m	82.0m	87.5 - 96.9m	101.5m	106.0m	111.0m	116.0m	31.8m	37.85m	59.0m	60.4m
Cassidulina Reniforme	29.6%	27.8%	33.9%	14.3%	39.5%		20.0%	15.6%	9.0%	6.1%	47.0%	66.6%	5.0%	21.3%
Cibicides Lobatulus	3.7%	2.1%	-	17.9%	9.3%		6.7%	0.7%	3.0%	0.3%	-	-	10.0%	3.3%
Elphidium Clavatum	30.2%	63.6%	60.0%	42.9%	39.5%		61.9%	74.8%	79.8%	86.0%	49.0%	16.7%	37.5%	42.6%
Bulimina Marginata	-	-	-	-	-		5.4%	-	-	-	-	-	-	1.6%
Islandiella Helenae	-	-	0.6%	-	-		-	-	-	0.3%	1.3%	-	-	3.3%
Islandiella Islandica	2.7%	1.1%	1.2%	3.6%	4.7%		-	-	-	1.0%	1.0%	16.7%	10.0%	1.6%
Protelphidium Orbiculare	5.3%	3.2%	3.0%	10.7%	4.7%		1.0%	2.8%	4.9%	1.4%	-	-	10.0%	6.6%
Elphidium Subarcticum	0.5%	-	-	-	-		-	0.7%	1.5%	2.7%	0.3%	-	-	-
Trifarina Angulosa	0.5%	-	-	-	-		1.3%	-	-	-	-	-	-	3.3%
Quinque. Senuluvum	-	-	-	-	-		0.6%	0.3%	-	0.3%	0.3%	-	-	-
Bucella Frigida	-	-	-	-	2.3%		0.3%	1.8%	0.4%	0.7%	-	-	2.5%	-
Cassidulina Laevigata	-	-	-	-	-		-	-	-	-	-	-	10.0%	-
NO SPECIES														
Total Count	189	187	165	28	43		315	282	267	293	300	6	40	61
Faunal Diversity (95%)	5	4	3	6	5		5	4	4	4	4	2	10	13

(After Gregory, 1983a, 1983b & 1985).

TABLE 4.6.1. FORAMINIFERAL ANALYSIS : UNIT .1.

BENTHONIC FORAMINIFERA : UNIT .1.											
SPECIES	BOREHOLE 84/04		BOREHOLE 82/10				BOREHOLE 82/01				
	50.0m	59.0m	3.75m	4.75m	13.7m	18.25m	44.4m	47.0m	48.0m	49.1m	58.4m
Cassidulina Reniforme	51.3%	26.8%	47.8%	2.3%	15.0%	44.4%	31.9%	33.6%	37.0%	48.4%	28.8%
Cibicides Lobatulus	5.9%	1.0%	4.7%	35.9%	0.3%	11.1%	6.0%	4.3%	3.3%	0.7%	10.8%
Elphidium Clavatum	35.5%	61.0%	43.7%	45.8%	79.0%	26.7%	47.8%	47.4%	53.0%	43.4%	40.5%
Bulimina Marginata	0.3%	-	-	-	-	-	1.0%	-	-	0.3%	1.0%
Islandiella Helenae	1.0%	-	1.4%	0.7%	0.7%	-	1.7%	1.0%	1.3%	-	3.3%
Islandiella Islandica	1.0%	5.7%	-	13.0%	-	4.4%	2.3%	1.3%	0.3%	-	1.8%
Protelphidium Orbiculare	1.0%	1.6%	1.0%	-	1.3%	8.9%	2.3%	2.0%	-	-	1.5%
Total Count	304	123	295	301	300	45	301	304	300	304	333
Faunal Diversity (95%)	4	4	3	3	6	5	9	10	4	3	12

(Extracted from Gregory, 1983a, 1983b & 1985).

TABLE 4.7.1. FORAMINIFERAL ANALYSIS : UNIT .O.

BENTHONIC FORAMINIFERA: UNIT .O.				
SPECIES	*BOREHOLE 84/04*			
	17.0m.	*21.7m.*	*26.0m.*	*40.0m.*
Cassidulina Reniforme	27.9%	38.4%	41.6%	63.0%
Cibicides Lobatulus	4.0%	-	2.0%	4.3%
Elphidium Clavatum	45.0%	45.4%	50.5%	22.0%
Cassidulina Laevigata	-	-	-	-
Protelphidium Orbiculare	6.3%	1.7%	1.3%	1.7%
Nonion Barleeanum	-	1.3%	0.3%	-
Trifarina Angulosa	3.3%	3.4%	2.4%	2.3%
Bulimina Marginata	5.3%	3.0%	1.3%	2.0%
Islandiella Helenae	2.7%	1.7%	2.7%	3.3%
Islandiella Islandica	2.3%	1.0%	0.7%	0.3%
Total Count	301	297	297	300
Faunal Diversity (95%)	8	8	5	5

(Extracted from Gregory, 1985).

TABLE 4.8.1. DINOFLAGELLATE ANALYSIS : UNIT .-1.

DINOFLAGELLATE CYSTS: UNIT .-1.				
SPECIES	*BOREHOLE 82/11.*			
	1.90m.	*2.90m.*	*10.0m.*	*12.4m.*
Bitectatodinium Tepikiense	*50.9%*	*63.3%*	*88.9%*	*87.6%*
Spiniferites spp. indet.	*23.7%*	*23.3%*	*5.9%*	*4.2%*
Operculodinium Centrocarpum	*20.3%*	*10.0%*	*5.2%*	*8.4%*
Spiniferites Mirabilis	*1.7%*	-	-	-
Protoperidinium Leonis	*1.7%*	-	-	-
Achomosphaera Andalousiense	-	*3.3%*	-	-
Total Count	*59*	*30*	*135*	*24*
BGS CSC Numbers	*5892*	*5893*	*5896*	*5897*

(Extracted from Harland, 1983d).

TABLE 7.4.1. DEPOSITIONAL CHRONOLOGY.

CHRONOLOGY				MICROPAL'	SEDIMENTATION RATES			UNIT	
	DATE (BP) [1]	PERIOD			CUMULATIVE DEPOSITIONAL TIMESPAN (YEARS BP)	ESTIMATED DEPOSITIONAL PERIOD (YEARS)	ESTIMATED UNIT SEDIMENTATION RATE (per 1000 years)		
	10,000	HOLOCENE		NO RECOVERY	10,000	10,000	5 metres (5 metres)	-2	(X)
UPPER PLEISTOCENE	26,000	WEICHSELIAN	LATE	[2]	25,000	15,000	4 metres	-1	
				Interstadial Foraminiferal Assemblage	40,000	15,000	4 metres	0	
	50 to 60,000		MIDDLE		55,000	15,000	2 to 4 metres	1	(T)
			EARLY		65,000	10,000	3 to 4 metres	2	
	125 to 128,000	EEMIAN		Upper Pleistocene Foram and Dinoflagellate Assemblages	115,000	50,000	1 metre	3	
		SAALIAN		Ameliorative Interglacial ? Foraminiferal Assemblage	125,000+	10,000	4 metres	4	(T)

[1] Chronology after Stoker et al., 1985.

[2] This appears to support Harland's (1983d) correlation between 82/11, and Formation 2. of Binns et al., (1974).

APPENDIXES

LABORATORY TECHNIQUE APPENDIX.

The laboratory techniques used during the core analysis for the present study are detailed in sequence in this appendix, from core subsampling to detailed methods carried out on specific fractions of the samples taken.

1.1. CORE SUBSAMPLING AND DESCRIPTION.

As detailed in section 2.1.1. of the main text, as far as possible core samples were taken from what appeared to be undamaged borehole sections. Samples taken were from 5 to 25 centimetres in length, dependent upon the physical properties of the sediment at that point, to achieve a representative section.

Samples were taken by carefully splitting the core across its diameter and peeling it open to preserve as much of the internal structure as possible. From one half of the core the sample was taken, leaving the other half with the BGS as a reference section. This reference section was used as the basis for an overall core description relating to the entire recovered section. This description was combined with the details from laboratory analysis to produce the core descriptions given in chapters two and six.

During the visual description of the core, immediatley after splitting, a note was also taken of colour variations between any notable features using standard Munsell soil colour charts. In all cases this was completed under identical artificial lighting to maintain consistency. Munsell colour values are also quoted in the

core descriptions in chapters two and six.

Where possible, either before or after subsampling, important details of the split core were photographed. Standard colour film, ranging between 100 and 400 ASA was used, with either daylight balanced artificial lights or fluorescent tubes with a filter to correct the colour balance to normal daylight. A standard 35 mm SLR was used, with extension bellows for extreme close-ups. The magnification factor on the resulting prints was estimated by measuring the long axis of the print in the camera viewfinder prior to exposure. This distance was then related to the long axis size of the final print to determine the actual level of magnification. Magnification factors relative to life are given with all the colour plates presented in the present study.

1.2. LABORATORY ANALYSIS.

X-RAY SECTIONS.

Where possible, prior to detailed sedimentological analysis, samples were prepared and x-rayed. This was achieved by cutting down the outer surface of the sample to produce a section of uniform thickness parallel with the core diameter. The thickness of these sections varied according to the physical characteristics of the sediment, ranging between 13 and 17 millimetres. The finer-grained samples generally produced the thinner sections. If the sample cracked during this process it was not x-rayed as this would produce seconday details on the exposure not endemic to the original

sedimentary structure.

After the sample sections were cut to thickness, an average measurement of this thickness was assessed using calipers, to calculate the required exposure time. Samples were then placed in a Fraxitron X-Ray machine, on top of shielded Kodak Industrex-C film. Exposure periods ranged between 0.50 and 0.70 minutes.

After exposure the film was developed in the standard way and monochromatic contact prints made of the negatives. These prints are reproduced in the present study, and all are consequently at a scale of 1x life.

DRYING.

After any x-ray analysis was completed the samples were dried in a fan-assisted oven to remove all the remaining moisture.

Samples were then broken down in a mortar and pestle taking care, wherever possible, to preserve intact fragile constituents such as bioclastic debris or weathered clasts before disaggregation.

PARTICLE SIZE ANALYSIS.

SIEVING.

From the dried component of each sample a gross subsample of between 100 and 300 grammes was extracted. The size of this sample varied according to the constituents of the core. Where large amounts

of clastic debris were present a larger subsample was taken to ensure that it was representative of that sample as a whole. With more fine grained sediments, a much smaller quantity could be taken as representative.

These subsamples were placed in marked plastic beakers and mixed with water. Hydrogen peroxide was then added to each subsample to digest any remnant organic matter. Subsamples were then regularly stirred over 2 to 3 days until any reaction ceased, indicating that all organic material had been oxidized.

Once this was achieved approximately 50 to 70 millilitres of Sodium pyrophosphate solution was added as a dispersant (75 grammes of Na-pyrophosphate granules dissolved in 1 litre of water). This solution was thoroughly stirred and left, with further periods of stirring, for at least 24 hours to enable the dispersant to penetrate.

Dispersed subsamples were then wet-sieved through standard BS phi-graded sieves. Sizes ranged from -4 to 0 phi at the coarse end, down to 5 phi at the fine end. Subsamples were sieved for a total of 12 minutes with a constant flow of water equivalent to 2 litres per minute.

After sieving, the individual sieves were removed and stacked in sequence in a fan-assisted oven. They were then dried at 60 degrees centigrade (to prevent heat distortion of the finer sieves) until all the constituents were dry.

The sieve stacks were then replaced on the sieve shaker for a further five minutes to loosen any material caught in the sieve

meshes and to enable any remaining fine material to pass through the respective sieves.

Individual phi components were then removed from their respective sieves and placed in marked weighing boats of known weight. These were then reweighed to calculate the individual sample weight in each phi interval.

Finally weights were related back to the weight of the initial subsample to express them as a percentage of the overall sample. These percentages were subtracted from 100%, set at the phi size above that containing the coarsest material analysed. These figures were then used to produce the upper end of the particle size curves used in the present study.

PIPETTING.

From the disaggregated bulk sample, a further sample of 10 grammes was extracted by sieving through a 2 millimetre (-1 phi) sieve and extracting from the finer residue.

This material was placed in a glass beaker to which was added approximately 50 millilitres of distilled water and 2 millilitres of hydrogen peroxide. This solution was stirred regularly for the next two to three days until any signs of a reaction had ceased, indicating that all the organic matter had been oxidized.

To this solution was then added 10 millilitres of sodium pyrophosphate solution. This solution was mixed thoroughly and left for 24 hours for the dispersant to penetrate. At the end of this period the contents of the beakers were agitated and then placed in

an ultrasonic bath for 2 minutes to ensure that all the particles had been separated.

This solution was then transferred immediatley to the cylinder of an Andreasen pipette apparatus, which was filled up with distilled water to the 10 centimetre level on the cylinder. The head of the apparatus was then reinserted. The entire apparatus was then placed in a water bath, to a level covering the 10 centimetre mark on the cylinder, at a constant 24 degrees centigrade, for the temperature in the cylinders to equalize to that of the bath. Thirty minutes was a sufficient period of time for this to occur.

Once the contents of the cylinder had reached 24 degrees centigrade, analysis was initiated by removing the cylinder and shaking it end over end for 90 seconds to ensure that all of the material that had settled out was resuspended.

Simultaneously, the cylinder was then placed in the water bath and a stop watch started. At the following set times 10 millilitre subsamples were withdrawn and placed in marked glass beakers of known weight.

4 phi		24 seconds
5 phi	01 minute	38 seconds
6 phi	06 minutes	17 seconds
7 phi	24 minutes	06 seconds
8 phi	1 hour 31 minutes	00 seconds
9 phi	5 hours 31 minutes	00 seconds

With the increasing time periods it was possible to stagger sampling and run up to 4 samples in any one six hour period.

After sampling the individual subsamples were placed in an oven at 105 degrees centigrade to evaporate off all of the moisture. When this had occurred the beakers were placed in a desiccator containing hygroscopic silica gel to cool down. Sample beakers were then removed from the desiccator and immediatley reweighed.

CALCULATIONS:- The weight percentage finer at each phi sampling interval was calculated using the following equation :-

$$\% \text{ Finer} = \frac{W2 - W1 - CF}{Dv} \times M$$

Where:-

W1 = Weight of sample beaker

W2 = Weight of beaker + dry sample

M = Percentage of overall sample finer than -1 phi

CF = Correction factor for dispersant, calculated as;

$$\frac{\text{Dried weight of 10 ml sample of dispersant}}{\text{Volume of pipette to 10 cm mark} \div 10}$$

Dv = Divisor for individual pipette cylinders, calculated as;

$$\frac{1}{\text{Volume of pipette to 10 cm mark}}$$

On completion of the 9 phi sample for any given pipette run, a futher sample of 150 to 200 millilitres was extracted for XRD analysis (see below).

The percentage finer figures for the pipette analysis were then added to those of the sieving analysis to complete the overall particle size curves for each subsample. The two overlapping sampling points, at 4 and 5 phi, were both plotted and a best fit line drawn

between them. In good samples the variations at this overlap point bentween sieving and pipetting was usually less than 2%. If great variation was noted at this point, however, where possible both analyses were re-run.

ORGANIC CONTENT.

Samples for organic content analysis were taken in the same way as those for pipetting, and standard 2 gramme samples were used throughout, extracted from the fine fraction passing through a 2 millimetre (-1 phi) sieve.

Apart from this the method and calculation of results used was as specified in BS 1377 (1975, 46 - 47) in the section on soil chemical tests (Test 8 - Determination of the Organic Matter Content). The details are consequently not reproduced here.

CLAY MINERALOGY.

PREPARATION.

Each sample, was extracted after the completion of the pipette analysis. A further 150 to 200 millilitres of solution was withdrawn after the 9 phi sample was taken.

This solution was placed in a plastic test tube and centrifuged at 4500 rpm for 10 minutes to settle out the clay particles. The supernatant liquid was then syphoned off. The test tube was then refilled with solution and this procedure repeated until all the

sample had been centrifuged.

The test tube was then filled with distilled water and placed in an ultrasonic bath for 10 minutes to resuspend the clay particles. It was then returned to the centrifuge for a further 10 minutes at 4500 rpm. This procedure was repeated twice more on each sample to wash off any remaining concentrations of dispersant or hydrogen peroxide.

After the final rinse the concentrated clay particles were mixed into a slurry and smeared across a glass microscope slide. This slurry was then left to dry (see Carroll, 1970b, 57).

EXPOSURE.

Glass slides were exposed in a standard dfiffractometer (Phillips) using Cu-K-alpha radiation and an exposure run of 2 to 40 degrees.

After initial exposure selected samples, showing marked changes in any core, were placed in a desiccator containing ethylene glycol for 24 hours to enable a re-run to define mixed-layered clays. Glycolated runs were terminated at approximately 10 degrees.

Interpretation of dry and glycolated traces indicated that the clay mineralogy was not diverse enough to aid in unit definition and environmental interpretation. For this reason the running of further XRD traces, after heating, was considered to be unwarranted.

D-spacings were identified using standard conversion tables cited in the literature (Carroll, 1970b; Brindley & Brown, 1980) and are, consequently, not discussed in further detail here.

CARBONATE CONTENT.

The percentage carbonate content was calculated using a standard Chittick apparatus and accompanying conversion/calibration charts. Samples from the dried material for sieving analysis was resieved through a 3.75 phi sieve and a 1.70 gramme sample of the fine residue extracted. This material was placed in a conical flask and connected to the Chittick apparatus.

Before the reaction was started the ambient room temperature and barometric pressure were noted. Barometric pressure (in millibars) was converted to millimetres of mercury.

To begin the reaction, 25 cubic centimetres of 6M HCl acid was introduced into the conical flask. A stopwatch was simultaneously started. The sample flask was then agitated for 30 seconds and the resulting volume of carbon dioxide produced at that time read off.

The reaction was then left to continue until it had ceased, and no evidence of further carbon dioxide production could be seen. Final readings were then taken of the volume of carbon dioxide produced, and the room temperature (in degrees centigrade) and barometric pressure (converted to millimetres of mercury).

CALCULATION.

The first and second carbon dioxide readings were multiplied by constants, cross-referenced from tables relating to the temperature and pressure at the time of the respective readings.

The first corrected reading then had 4% of the second reading extracted from it. The resultant value was compared to charts, supplied with the apparatus, to determine the percentage of calcite in the sample.

The subtraction of this corrected first value from the second calculated reading then gave a figure for comparison with the supplied charts to determine the percentage of dolomite in the sample.

Adding both of these values together, therefore, gave the overall percentage of carbonates in each sample analysed.

STATISTICAL APPENDIX.

There are a great variety of techniques available for the interpretation of particle size data. The intention in this study was in no way to consider them all critically, but simply to use a range of these methods, where necessary, to illustrate important facets of the sediments being analysed. In the following appendix the ideas (and modifications) behind these techniques will be discussed, together with the way in which they were employed in the main part of the thesis.

APPENDIX 2.1.

GRAPHIC OR MOMENT ?

There are, at present, a number of approaches to the analysis of particle size data, in statistical terms. For over twenty years there has been an ongoing debate as to whether graphic or central moment measures are the more acceptable descriptors of particle size distributions. The efficacy of these main approaches will be considered briefly here, to show how the statistical measures used in the present study were chosen.

The basic division between graphic statistics and moment measures dates back to the studies of Folk and Ward (1957) and Friedman (1967) respectively. Various accounts of the relative merits and

disadvantages of these methods have appeared ever since. The aim in the present study was to assess which of these two approaches would most accurately represent the sediments under analysis, as a basis for genetic interpretation. No mention will be made of the differences from normal statistical measures, as a result of using weight instead of number frequency data, and using phi-class intervals instead of individual particle diameter, as these problems apply equally to all the techniques mentioned.

The graphic measures of mean, median, standard deviation (sorting), skewness and kurtosis are based on the deviation of percentiles from particle size curves. Various formulae have been suggested, notably by Folk & Ward (op. cit.), Inman (1952) and McCammon (1962). Advantages have been seen in all these methods. Davis and Ehrlich (1970, 3544) considered Inman's formulae preferable to those of Folk & Ward, in terms of uniformity of response to a range of particle size distributions. This was especially true for non-normal distributions, as his statistical measures were independent of functional form (Jones ,1970, 1208). Folk & Ward's (op. cit.) measures, by contrast, showed a closer correspondence to central moment measures (Davis & Ehrlich, op. cit.), and employed more percentiles than the Inman method. They were also mutually independent, meaning that they could theoretically be applied to both normal and non-normal distributions (Sahu, 1964, 77). In his review, McCammon (op. cit.) took this process a step farther, to employ far more percentiles, thereby increasing the descriptive efficiency of the graphic measures of mean size and standard deviation.

The major problem with graphic statistics is the interpolation between percentiles or class intervals (curve construction), plus the extrapolation of the tails of the distribution, to enable the estimation of the 5th and 95th percentiles. Curve production obviously represents a qualitative judgement of the shape of the distribution,

and this is one example of the problems in grouping data into classes through the use of the laboratory techniques described in appendix .1. Errors of this kind are inevitable, because the continuous distribution function of any given sample can never be accurately known (Swan et al., 1979, 489). Swan et al. (1978, 869) also make the point that computer interpolation often assumes a linear relationship between points, which consequently presumes a centre of gravity at the mid-point of the class interval. This is unlikely to occur in reality (Folk, 1966, 79). However, linear interpolation was used in the computer program written to calculate graphic statistics for the present study (see appendix 2.1a). The reading-off of percentiles from gaussian plots, by contrast, assumes a gaussian distribution. As an example of the attendant error in using either approach, Swan et al. (ibid., 870) showed that standard deviation was always greater for a known distribution when using a linear instead of a gaussian distribution.

Percentile measures are only estimators of true population parameters, because the data are grouped. It has been noted that decreasing the size of the class intervals and, therefore, the subjective interpolation between known points, despite decreasing the error in estimating any given percentile, does not necessarily produce a marked increase in efficiency (ibid., 872). For this reason, the use of whole-phi class intervals during laboratory analysis was maintained in the present study. Even with multiple analyses of samples, several constructed particle size curves showed minor inflections at this scale. These inflections are particularly damaging when using graphic statistics to estimate population parameters. It was concluded, therefore, that sampling at quarter-phi or half-phi intervals was likely to increase the time required for analysis, without necessarily improving the accuracy of graphic statistics.

The other major problem in using graphic measures appears when

particle size distributions have a significant fine content, which cannot be directly analysed using presently available sedimentological techniques. Extrapolation of the "tail" is therefore necessary, to at least the 5th and 95th percentile levels. The most commonly used technique is that suggested by Folk and Ward (1957, 13), whereby the last known value at 9 phi is extrapolated linearly to zero at 14 phi. Other techniques have been suggested. Swan et al. (ibid., 868) used a gaussian extrapolation to 99.99% at 14 phi, but as they point out :-

" ... this, like all other extrapolation techniques, is totally arbitrary and does not take into account the character of individual samples. No extrapolation technique can be considered a substitute for an adequate size analysis or proper sampling procedures."

(ibid., 868-9)

For this reason the method of Folk and Ward was used in the present study, and is incorporated in the computer program given in appendix 2.1a. Even if incorrect, the widespread use of this method to date means that the present study at least maintains comparability with a long-standing inaccuracy. It was decided that the complexity of modifying the computer program to produce gaussian tail extrapolations was unwarranted in the light of the interpretational weight that was ultimately put on the statistics (in effect they were included for comparative purposes for future works). The use of a linear extrapolation also maintains internal consistency with the percentile estimation procedure in the program.

Perhaps as a result of the inherent inaccuracy of extrapolation, several authors have noted problems with the use of graphic statistics. Most seem to agree that for near-normal samples the graphic statistics, principally the mean and standard deviation, do approach the sample population parameters (Davis & Ehrlich, 1970, 353;

& 3540). However, Swan et al. (1978, 875) noted that with any significant deviations from normality the skewness and kurtosis measures respond erratically. As these statistics are the measures of departures from normality, graphic measures overall would seem to be rather inefficient descriptive statistics for particle size weight-frequency distributions, and several authors have indicated that they should be used with discretion for highly skewed samples with significant tails above/below the 16th/84th percentiles.

Many of the same criticisms can be levelled at central moment statistics. Jones (1970, 1211) for example, illustrated errors due to grouping, truncation and simple random sampling. The truncation errors become significant when the tails make up as little as 1% of the total sample. Folk (1966, 79) made a similar criticism because moment measures employ the entire population distribution, unlike percentile measures. Koldijk (1968, 59) also noted that second moment (standard deviation) measures give a false impression of reality in multi-modal samples. These criticisms may stem, in part, from the implicit assumptions made in using moment measures for weight-frequency distributions. Although such measures are logically acceptable, there is little evidence to suggest that weight-frequency distributions will behave in a similar manner to the mathematical distributions on which moments are based, apart from the apparent adherence of the former to log-normality (Davis & Ehrlich, op. cit., 3538).

Other authors have suggested that these criticisms may be over emphasized. Swan et al., (1979, 491), for example, showed that in practice moment measures calculated from grouped data do approximate ungrouped values, implying that grouping-induced errors may be insignificant. They also illustrated that reducing sieve intervals did not always improve the accuracy of moment estimation. With respect to truncation errors, however, significant departures were noted if a 9

phi cut-off was employed, though a 12 phi cut-off did not seem to seriously affect the results. Surprisingly, it was also found that using linear or probability redistributions below 9 phi did not produce greater accuracy than simply using the 9 phi cut-off. It was concluded that redistribution was only permissible where the fine fraction was almost certain to follow a known distribution. As was stated above, this is effectively impossible in most operational situations. For this reason the statistics calculated in the computer program (appendix 2.1a) used the 9 phi cut-off value, and the slight accompanying loss in accuracy was accepted.

In general terms, it is apparent that both graphic and moment measures have their advantages and their drawbacks. The best approach would be to evaluate the response of both to known model, or actual environmental, conditions (Davis & Ehrlich, op. cit., 3540). In the present study, where statistical values were employed, it was decided to place more emphasis on the moment measures. Swan et al. (1978; 1979), for example, concluded that truncated and grouped moment measures were more likely to approximate true sample and population weight-frequency distributions than any of the other presently available statistical measures, particularly if the most sensitive parameters (skewness and kurtosis) are to be used. In the following sections of theis appendix, therefore, moment measures will be used for the statistical values needed in the techniques. Graphic measures are included for comparative purposes alone.

APPENDIX 2.1A.

Computer program .PSD500

(Fortran 77) Used to calculate statistics.

```
C*****************************************************************

C    A PROGRAMME DESIGNED TO CALCULATE A VARIETY OF SEDIMENTARY
C    DESCRIPTIVE STATISTICS FROM RAW PARTICLE SIZE (PHI) DATA,
C    AND PRODUCE THIS DATA AS PARTICLE SIZE CUMULATIVE CURVES.

C    WRITTEN BY D.N.COCKCROFT, SOILS RESEARCH LABORATORY,
C    UNIVERSITY OF KEELE:DECEMBER 1984.
C    BASED ON AN ORIGINAL PLOTTING PROGRAMME BY M.J.EDGE, DEPT.
C    OF ENGINEERING,UNIVERSITY OF OXFORD:JUNE 1984.

C*****************************************************************


      REAL
DATA(50,16),POS(16),CUM(21),COORD(16,2),DEPTH(50),Q(21),A(16)
      REAL LDEP(11),LAB(22),PER(21),MEAN,KURT,NORK,SORT,SKEW,PMD,IPD
      REAL
OSKE,TSKE,PKUR,FMEA,FSTD,FSKE,FCUB,FKUR,M,P,RR(16),V(16),S,R
      REAL DD,MM(16),NN(16),D(16),FF(16),C(16),GRA(16),IPSD,HIST(16)
      REAL MCMO,MCMT,MCMA,MCSO,MCST
      INTEGER LOC(5),BORING(10),X,E,F,G,H,T,FFF,GG,B,HH,ZZZ,TT
      DATA LDEP/0.0,10.,20.,30.,40.,50.,60.,70.,80.,90.,100./
      DATA LAB/-7.,-6.,-5.,-4.,-3.,-2.,-1.,0.0,1.,2.,3.,4.,
     15.,6.,7.,8.,9.,10.,11.,12.,13.,14./
      DATA PER/97.,95.,90.,85.,84.,80.,75.,70.,65.,55.,50.,45.,
     235.,30.,25.,20.,16.,15.,10.,5.,3./
      DATA GRA/205.,195.,185.,175.,165.,155.,145.,135.,125.,115.,
     1105.,95.,85.,75.,65.,55./

      READ(5,98)N
   98 FORMAT(I2)
      READ(5,99)(LOC(S) ,S=1,5),(BORING(S) ,S=1,10)
   99 FORMAT(5A4,10A4)
      WRITE(2,96)LOC
   96 FORMAT(5A4)
      WRITE(2,95)BORING
   95 FORMAT(10A4)
      DO 10 K=1,N
      READ(5,97)DEPTH(K)
   97 FORMAT(F6.2)
      READ(5,100) (DATA(K,J) ,J=1,16)
  100 FORMAT(16(F4.1,1X))
   10 CONTINUE
      ZZZ=0
  109 FFF=0
      WRITE(2,110)
  110 FORMAT(5X,36HWHICH SAMPLE DO YOU WISH TO ANALYSE,//)
      DO 112 P=1,N
      X=P
      WRITE(2,111)X,DEPTH(P)
  111 FORMAT(I2,5X,F6.2)
  112 CONTINUE
      WRITE(2,113)
  113 FORMAT(5X,47HPLEASE MAKE YOUR CHOICE: SELECT THE SAMPLE NO.:,//)
      READ(1,114)B
  114 FORMAT(I2)

      WRITE(2,21)
   21 FORMAT(5X,49HWHICH TYPE OF TAIL EXTRAPOLATION DO YOU REQUIRE:-,)
```

```
      WRITE(2,22)
   22 FORMAT(5X,47H1.  LINEAR (FOLK AND WARD'S 1957) EXTRAPOLATION.,)
      WRITE(2,23)
   23 FORMAT(3X,29HOR,2.  GAUSSIAN EXTRAPOLATION.,/)
   24 WRITE(2,25)
   25 FORMAT(15X,24HPLEASE SELECT .1.  OR .2.,/)
      READ(1,26)E
   26 FORMAT(I1)
      IF(E.LT.1.OR.E.GT.2.)GOTO24
      IF(E.EQ.1)GOTO31
      IF(E.EQ.2)GOTO41

C FOLK AND WARD'S LINEAR EXTRAPOLATION.

   31 CUM(1)=100.-DATA(B,1)
      DO 8 J=2,16
      K=J-1
      CUM(J)=CUM(K)-DATA(B,J)
    8 CONTINUE
      CUM(17)=(CUM(16)*0.8)
      CUM(18)=(CUM(16)*0.6)
      CUM(19)=(CUM(16)*0.4)
      CUM(20)=(CUM(16)*0.2)
      CUM(21)=0.0
      GOTO119

C GAUSSIAN EXTRAPOLATION OF THE TAIL.
   41 CONTINUE


  119 WRITE(2,120)
  120 FORMAT(5X,34HDO YOU REQUIRE PLOT OR STATISTICS ,)
   80 WRITE(2,121)
  121 FORMAT(5X,16HPLEASE SELECT:-,)
      WRITE(2,122)
  122 FORMAT(5X,25H1.  PARTICLE SIZE PLOT,OR,,)
      WRITE(2,123)
  123 FORMAT(5X,28H2.  PARTICLE SIZE STATISTICS.,/)
      READ(1,124)F
  124 FORMAT(I1)
      IF(F.LT.1.OR.F.GT.2)GOTO80
      GOTO(130,150)F


  130 WRITE(2,131)
  131 FORMAT(5X,42HDO YOU REQUIRE STATISTICS WITH YOUR PLOT.,)
  132 WRITE(2,133)
  133 FORMAT(5X,32HPLEASE ANSWER YES (1) OR NO (2).,/)
      READ(1,134)GG
  134 FORMAT(I1)
      IF(GG.LT.1.OR.GG.GT.2)GOTO132
      IF(GG.EQ.2)GOTO208
  135 WRITE(2,136)
  136 FORMAT(5X,35HPLEASE SELECT FROM THE FOLLOWING:-,)
      WRITE(2,137)
  137 FORMAT(10X,28H1.  FOLK AND WARD STATISTICS.,)
      WRITE(2,138)
  138 FORMAT(10X,22H2.  INMAN°S STATISTICS.,)
      WRITE(2,139)
  139 FORMAT(10X,28H3.  FRIEDMAN MOMENT MEASURES.,)
```

```
      WRITE(2,140)
  140 FORMAT(10X,19H4.  BOTH .1.  AND .2.,)
      WRITE(2,141)
  141 FORMAT(10X,19H5.  BOTH .1.  AND .3.,)
      WRITE(2,142)
  142 FORMAT(10X,19H6.  BOTH .2.  AND .3.,)
      WRITE(2,143)
  143 FORMAT(10X,18H7.  ALL THREE SETS.,)
      WRITE(2,200)
  200 FORMAT(10X,25H8.  McCAMMON'S STATISTICS.,)
      WRITE(2,201)
  201 FORMAT(10X,19H9.  BOTH .1.  AND .8.,)
      WRITE(2,202)
  202 FORMAT(9X,20H10.  BOTH .2.  AND .8.,)
      WRITE(2,203)
  203 FORMAT(9X,20H11.  BOTH .3.  AND .8.,)
      WRITE(2,204)
  204 FORMAT(9X,20H12.  .1., .2.  AND .8.,)
      WRITE(2,205)
  205 FORMAT(9X,20H13.  .1., .3.  AND .8.,)
      WRITE(2,206)
  206 FORMAT(9X,20H14.  .2., .3.  AND .8.,)
      WRITE(2,207)
  207 FORMAT(9X,18H15.  ALL FOUR SETS.,/)
      READ(1,144)FFF
  144 FORMAT(I2)
      IF(FFF.LT.1.OR.FFF.GT.15)GOTO135

  208 WRITE(2,145)
  145 FORMAT(5X,45HDO YOU REQUIRE BRITISH STANDARD :5930 (1981) ,)
      WRITE(2,146)
  146 FORMAT(5X,37HSEDIMENT NOMENCLATURE WITH YOUR PLOT.,/)
  147 WRITE(2,148)
  148 FORMAT(5X,32HPLEASE ANSWER YES (1) OR NO (2).,/)
      READ(1,149)HH
  149 FORMAT(I1)
      IF(HH.LT.1.OR.HH.GT.2)GOTO147
      WRITE(2,170)
  170 FORMAT(5X,42HDO YOU REQUIRE A HISTOGRAM WITH YOUR PLOT.,/)
  169 WRITE(2,171)
  171 FORMAT(5X,32HPLEASE ANSWER YES (1) OR NO (2).,/)
      READ(1,172)TT
  172 FORMAT(I1)
      IF(TT.LT.1.OR.TT.GT.2)GOTO169
      IF(GG.EQ.2)GOTO50
      GOTO150

C PARTICLE SIZE STATISTICS ROUTINES.

  150 L=1
      DO 3 J=1,21
      IF(CUM(J).GT.PER(L)) GOTO3
      K=J
    5 R=(CUM(J-1))-CUM(J)
      DIF=(CUM(J-1))-PER(L)
      COR=(DIF/R)
      Q(22-L)=LAB(K)+COR
      L=L+1
      IF(L.EQ.22)GOTO4
      IF(CUM(J).LE.PER(L))GOTO5
```

```
      GOTO 3
    4 J=21
    3 CONTINUE
      IF(GG.EQ.1)GOTO152
      GOTO159
  152 IF(FFF.EQ.2.OR.FFF.EQ.6)GOTO370
      IF(FFF.EQ.10.OR.FFF.EQ.14)GOTO370
      IF(FFF.EQ.3.OR.FFF.EQ.11)GOTO500
      IF(FFF.EQ.1.OR.FFF.EQ.4.OR.FFF.EQ.9)GOTO320
      IF(FFF.EQ.5.OR.FFF.EQ.7.OR.FFF.EQ.12)GOTO320
      IF(FFF.EQ.13.OR.FFF.EQ.15)GOTO320
      IF(FFF.EQ.8)GOTO400
  159 WRITE(2,160)
  160 FORMAT(5X,33HWHICH STATISTICS DO YOU REQUIRE ,)
      WRITE(2,161)
  161 FORMAT(15X,26H1.  GRAPHIC STATISTICS, OR,,)
      WRITE(2,162)
  162 FORMAT(15X,19H2.  MOMENT MEASURES.)
  167 WRITE(2,163)
  163 FORMAT(5X,24HPLEASE SELECT .1.  OR .2.,/)
      READ(1,164)G
  164 FORMAT(I1)
      IF(G.LT.1.OR.G.GT.2)GOTO167
      GOTO(300,500)G


C CALCULATION OF GRAPHIC STATISTICS.

  300 WRITE(2,303)
  303 FORMAT(5X,36HYOU HAVE A CHOICE OF THE FOLLOWING:-,/)
      WRITE(2,304)
  304 FORMAT(10X,37H1.  FOLK AND WARD'S (1957) STATISTICS.,)
      WRITE(2,305)
  305 FORMAT(10X,29H2.  INMAN'S (1952) STATISTICS.,)
      WRITE(2,309)
  309 FORMAT(10X,32H3.  McCAMMON°S (1962) STATISTICS.,/)
  306 WRITE(2,307)
  307 FORMAT(5X,29HPLEASE SELECT .1., .2.  OR .3.,/)
      READ(1,308)H
  308 FORMAT(I1)
      IF(H.LT.1.OR.H.GT.3)GOTO306
      WRITE(2,209)Q(11)
  209 FORMAT(5X,16HSAMPLE MEDIAN = ,F5.2,5H PHI.,///)
      GOTO(320,370,400)H

C FOLK AND WARD'S (1957) GRAPHIC STATISTICS.

  320 MEAN=((Q(5)+Q(11)+Q(17))/3.0)
      SORT=((Q(5)-Q(17))/4)+((Q(2)-Q(20))/6.6)
      SKEW=(((Q(17)+Q(5))-2*Q(11))/(2*(Q(5)-Q(17))))+(((Q(20)+Q(2))
     1-(2*Q(11)))/(2*(Q(2)-Q(20))))
      KURT=(Q(2)-Q(20))/(2.44*(Q(7)-Q(15)))
      NORK=KURT/(KURT+1)

      IF(FFF.EQ.1)GOTO 50
      IF(FFF.EQ.4.OR.FFF.EQ.12)GOTO370
      IF(FFF.EQ.5.OR.FFF.EQ.13)GOTO500
      IF(FFF.EQ.9)GOTO400
      IF(FFF.EQ.7.OR.FFF.EQ.15)GOTO370
      WRITE(2,326)
```

```
326 FORMAT(5X,42HFOLK AND WARD°S (1957) GRAPHIC STATISTICS.,/)
     WRITE(2,327)MEAN
327 FORMAT(10X,12HMEAN SIZE = ,F5.2,4HPHI.,)
     WRITE(2,328)SORT
328 FORMAT(10X,39HINCLUSIVE GRAPHIC STANDARD DEVIATION = ,F5.2,)
     WRITE(2,329)SKEW
329 FORMAT(10X,29HINCLUSIVE GRAPHIC SKEWNESS = ,F5.2,)
     WRITE(2,330)KURT
330 FORMAT(10X,19HGRAPHIC KURTOSIS = ,F5.2,)
     IF(KURT.GT.1.OR.KURT.LT.1)WRITE(2,331)NORK
331 FORMAT(10X,30HNORMALISED GRAPHIC KURTOSIS = ,F5.2,)
     WRITE(2,332)
332 FORMAT(5X,34HALL VALUES EXPRESSED IN PHI UNITS.,/)

     WRITE(2,333)
333 FORMAT(15X,9HCOMMENTS.,/)
     IF(SORT.LE.0.35)WRITE(2,334)
334 FORMAT(5X,27HSAMPLE = VERY WELL SORTED.,)
     IF(SORT.GT.0.35.AND.SORT.LE.0.50)WRITE(2,335)
335 FORMAT(5X,21HSAMPLE = WELL SORTED.,)
     IF(SORT.GT.0.50.AND.SORT.LE.1.00)WRITE(2,336)
336 FORMAT(5X,27HSAMPLE = MODERATELY SORTED.,)
     IF(SORT.GT.1.00.AND.SORT.LE.2.00)WRITE(2,337)
337 FORMAT(5X,23HSAMPLE = POORLY SORTED.,)
     IF(SORT.GT.2.00.AND.SORT.LE.4.00)WRITE(2,338)
338 FORMAT(5X,28HSAMPLE = VERY POORLY SORTED.,)
     IF(SORT.GT.4.00)WRITE(2,339)
339 FORMAT(5X,33HSAMPLE = EXTREMELY POORLY SORTED.,)

     IF(SKEW.GT.0.0)WRITE(2,340)
340 FORMAT(5X,31HSKEWNESS SHOWS "TAIL" OF FINES.,)
     IF(SKEW.LT.0.0)WRITE(2,341)
341 FORMAT(5X,35HSKEWNESS SHOWS COARSE GRAIN "TAIL".,)
     IF(SKEW.GE.-1.00.AND.SKEW.LT.-0.30)WRITE(2,342)
342 FORMAT(5X,31HSAMPLE IS VERY NEGATIVE SKEWED.,)
     IF(SKEW.GE.-0.30.AND.SKEW.LT.-0.10)WRITE(2,343)
343 FORMAT(5X,26HSAMPLE IS NEGATIVE SKEWED.,)
     IF(SKEW.GE.-0.10.AND.SKEW.LT.0.10)WRITE(2,344)
344 FORMAT(5X,29HSAMPLE IS NEARLY SYMMETRICAL.,)
     IF(SKEW.GE.0.10.AND.SKEW.LT.0.30)WRITE(2,345)
345 FORMAT(5X,26HSAMPLE IS POSITIVE SKEWED.,)
     IF(SKEW.GE.0.30.AND.SKEW.LE.1.00)WRITE(2,346)
346 FORMAT(5X,31HSAMPLE IS VERY POSITIVE SKEWED.,)

     IF(KURT.LT.0.67)WRITE(2,347)
347 FORMAT(5X,27HSAMPLE IS VERY PLATYKURTIC.,)
     IF(KURT.GE.0.67.AND.KURT.LT.0.90)WRITE(2,348)
348 FORMAT(5X,22HSAMPLE IS PLATYKURTIC.,)
     IF(KURT.GE.0.90.AND.KURT.LT.1.00)WRITE(2,349)
     IF(KURT.GT.1.00.AND.KURT.LT.1.11)WRITE(2,349)
349 FORMAT(5X,21HSAMPLE IS MESOKURTIC.,)
     IF(KURT.EQ.1.00)WRITE(2,350)
350 FORMAT(5X,31HSAMPLE IS NORMALLY DISTRIBUTED.,)
     IF(KURT.GE.1.11.AND.KURT.LT.1.50)WRITE(2,351)
351 FORMAT(5X,22HSAMPLE IS LEPTOKURTIC.,)
     IF(KURT.GE.1.50.AND.KURT.LT.3.00)WRITE(2,352)
352 FORMAT(5X,27HSAMPLE IS VERY LEPTOKURTIC.,)
     IF(KURT.GE.3.00)WRITE(2,353)
353 FORMAT(5X,32HSAMPLE IS EXTREMELY LEPTOKURTIC.,)
```

```
      IF(NORK.EQ.0.50)WRITE(2,354)
 354 FORMAT(5X,50HNORMALISED KURTOSIS INDICATES NORMAL
DISTRIBUTION.,)
      GOTO600


C CALCULATION OF INMAN'S (1952) GRAPHIC STATISTICS.

 370 PMD=Q(11)
      IPD=(Q(5)+Q(17))*0.5
      IPSD=(Q(5)-Q(17))*0.5
      OSKE=((IPD-PMD)/IPSD)
      TSKE=((0.5*(Q(2)+Q(20)))-Q(11))/IPSD
      PKUR=((0.5*(Q(2)-Q(20)))-IPSD)/IPSD

      IF(FFF.EQ.2) GOTO50
      IF(FFF.EQ.4) GOTO50
      IF(FFF.EQ.6.OR.FFF.EQ.7)GOTO500
      IF(FFF.EQ.14.OR.FFF.EQ.15)GOTO500
      IF(FFF.EQ.10)GOTO400
      IF(FFF.EQ.12)GOTO400
      WRITE(2,377)
 377 FORMAT(5X,34HINMAN°S (1952) GRAPHIC STATISTICS.,/)
      WRITE(2,378)
 378 FORMAT(5X,17HCENTRAL TENDENCY.)
      WRITE(2,379)PMD
 379 FORMAT(10X,22HPHI MEDIAN DIAMETER = ,F5.2,)
      WRITE(2,380)IPD
 380 FORMAT(10X,33HPHI (ARITHMETIC) MEAN DIAMETER = ,F5.2,)
      WRITE(2,381)
 381 FORMAT(5X,21HDISPERSION (SORTING).)
      WRITE(2,382)IPSD
 382 FORMAT(10X,24HPHI DEVIATION MEASURE = ,F5.2,)
      WRITE(2,383)
 383 FORMAT(5X,9HSKEWNESS.)
      WRITE(2,384)OSKE
 384 FORMAT(10X,23HPHI SKEWNESS MEASURE = ,F5.2,)
      WRITE(2,385)TSKE
 385 FORMAT(10X,27H2ND PHI SKEWNESS MEASURE = ,F5.2,)
      WRITE(2,386)
 386 FORMAT(5X,22HKURTOSIS (PEAKEDNESS).)
      WRITE(2,387)PKUR
 387 FORMAT(10X,23HPHI KURTOSIS MEASURE = ,F5.2,/)

      WRITE(2,388)
 388 FORMAT(15X,9HCOMMENTS.,/)
      IF(PMD.EQ.IPD)WRITE(2,389)
 389 FORMAT(10X,44HMEAN = PHI MEDIAN; SYMMETRICAL DISTRIBUTION.,)
      IF(PMD.NE.IPD)WRITE(2,390)
 390 FORMAT(10X,30HSAMPLE DISTRIBUTION IS SKEWED.,)
      IF(OSKE.LT.PMD.AND.OSKE.LT.0.0)WRITE(2,391)
 391 FORMAT(10X,46HDISTRIBUTION SKEWED TOWARDS COARSER DIAMETERS.,)
      IF(OSKE.GT.PMD.AND.OSKE.GT.0.0)WRITE(2,392)
 392 FORMAT(10X,44HDISTRIBUTION SKEWED TOWARDS FINER DIAMETERS.,)
      IF(PKUR.EQ.0.65)WRITE(2,393)
 393 FORMAT(10X,43HPHI KURTOSIS INDICATES NORMAL DISTRIBUTION.,)
      IF(PKUR.GT.0.65)WRITE(2,394)
 394 FORMAT(10X,35HSAMPLE DISTRIBUTION IS PLATYKURTIC.,)
      IF(PKUR.LT.0.65)WRITE(2,395)
 395 FORMAT(10X,35HSAMPLE DISTRIBUTION IS LEPTOKURTIC.,)
```

```
      GOTO600

C CALCULATION OF PHI ARITHMETIC MOMENT MEASURES.

 500 DO 501 J=1,16
      K=J+1
      M=(LAB(K)-0.5)
      D(J)=(M*DATA(B,J))
 501 CONTINUE
      A(2)=D(1)+D(2)
      DO 502 J=3,16
      A(J)=A(J-1)+D(J)
 502 CONTINUE
      FMEA=(A(16)*0.01)
      DO 520 J=1,16
      K=J+1
      P=((LAB(K)-0.5)-FMEA)**2
      RR(J)=(P*DATA(B,J))
 520 CONTINUE
      V(2)=RR(1)+RR(2)
      DO 522 J=3,16
      V(J)=V(J-1)+RR(J)
 522 CONTINUE
      FSTD=0.1*(SQRT (V(16)))
      DO 530 J=1,16
      K=J+1
      S=((LAB(K)-0.5)-FMEA)**3
      FF(J)=(S*DATA(B,J))
 530 CONTINUE
      C(2)=FF(1)+FF(2)
      DO 532 J=3,16
      C(J)=C(J-1)+FF(J)
 532 CONTINUE

      FSKE=0.01*(FSTD**(-3))*C(16)
      FCUB=0.01*C(16)

      DO 540 J=1,16
      K=J+1
      DD=((LAB(K)-0.5)-FMEA)**4
      MM(J)=(DD*DATA(B,J))
 540 CONTINUE
      NN(2)=MM(1)+MM(2)
      DO 542 J=3,16
      NN(J)=NN(J-1)+MM(J)
 542 CONTINUE
      FKUR=0.01*(FSTD**(-4))*NN(16)

      IF(FFF.EQ.3)GOTO 50
      IF(FFF.EQ.5)GOTO 50
      IF(FFF.EQ.6)GOTO 50
      IF(FFF.EQ.7)GOTO 50
      IF(FFF.EQ.11)GOTO400
      IF(FFF.EQ.13)GOTO400
      IF(FFF.EQ.14)GOTO400
      IF(FFF.EQ.15)GOTO400
```

```
      WRITE(2,560)
  560 FORMAT(5X,35HPHI MOMENT (FRIEDMAN°S) STATISTICS.,/)
      WRITE(2,561)FMEA
  561 FORMAT(10X,12HMEAN SIZE = ,F5.2,)
      WRITE(2,562)FSTD
  562 FORMAT(10X,21HSTANDARD DEVIATION = ,F5.2,)
      WRITE(2,563)FSKE
  563 FORMAT(10X,26HSKEWNESS (THIRD MOMENT) = ,F5.2,)
      WRITE(2,564)FCUB
  564 FORMAT(10X,23HMEAN CUBED DEVIATION = ,F7.2,)
      WRITE(2,565)FKUR
  565 FORMAT(10X,27HKURTOSIS (FOURTH MOMENT) = ,F5.2,)
      WRITE(2,566)
  566 FORMAT(10X,34HALL VALUES EXPRESSED IN PHI UNITS.,)
      GOTO600


C MC CAMMON°S ( 1962 ) STATISTICS.

  400 MCMO=(Q(16)+Q(11)+Q(6))/3.
      MCMT=(Q(18)+Q(14)+Q(11)+Q(8)+Q(3))/5.
      MCMA=(Q(2)+Q(4)+Q(7)+Q(9)+Q(10)+Q(12)+Q(13)
     1+Q(15)+Q(18)+Q(20))/10.
      MCSO=(Q(4)+Q(2)-Q(20)-Q(18))/5.4
      MCST=(Q(8)+Q(6)+Q(3)+Q(1)-Q(21)-Q(18)-Q(16)-Q(14))/9.1


      IF(FFF.GE.8)GOTO50

      WRITE(2,405)
  405 FORMAT(5X,29HMcCAMMON°S (1962) STATISTICS.,/)
      WRITE(2,406)MCMO
  406 FORMAT(10X,12HMEAN SIZE = ,F5.2,)
      WRITE(2,407)
  407 FORMAT(10X,23H88 PER CENT EFFICIENCY.,/)
      WRITE(2,408)MCMT
  408 FORMAT(10X,12HMEAN SIZE = ,F5.2,)
      WRITE(2,409)
  409 FORMAT(10X,23H93 PER CENT EFFICIENCY.,/)
      WRITE(2,410)MCMA
  410 FORMAT(10X,12HMEAN SIZE = ,F5.2,)
      WRITE(2,411)
  411 FORMAT(10X,23H97 PER CENT EFFICIENCY.,/)
      WRITE(2,412)MCSO
  412 FORMAT(10X,24HFIRST SORTING MEASURE = ,F5.2,)
      WRITE(2,413)
  413 FORMAT(10X,23H79 PER CENT EFFICIENCY.,/)
      WRITE(2,414)MCST
  414 FORMAT(10X,25HSECOND SORTING MEASURE = ,F5.2,)
      WRITE(2,415)
  415 FORMAT(10X,23H87 PER CENT EFFICIENCY.,/)
      GOTO600


C PARTICLE SIZE GRAPH PLOT COMMANDS.

   50 DO 30 J=1,16
      COORD(J,1)=200.-CUM(J)
      COORD(J,2)=GRA(J)
   30 CONTINUE
```

```
      IF(TT.NE.1)GOTO39
      DO 37 J=1,16
      IF (DATA(B,J).EQ.00.0)GOTO37
      HIST(J)=200.-DATA(B,J)
   37 CONTINUE
   39 IF(ZZZ.EQ.1)GOTO810
      CALL DEVBEG
      GOTO811
  810 CALL PICCLE
  811 CALL WINDO2(0.,260.,0.,300.)
      CALL MOVTO2(0.,0.)
      CALL A4
      CALL BOX(80.,20.,219.,276.)
      CALL BOX(100.,45.,200.,215.)
      CALL BOX(65.,35.,77.,145.)
      CALL BOX(65.,170.,77.,225.)
      CALL GRID(200.,45.,215.,10,100.,1,1)
      CALL GRID(200.,45.,100.,17,170.,2,1)
      CALL GRID(200.,45.,215.,50,100.,1,1)
      CALL MOVTO2(0.,0.)
      CALL CHAHAR(4,1)
      CALL TITLE(BORING,73.,37.)
      CALL CHAHAR(4,1)
      CALL MOVTO2(73.,175.)
      CALL CHAHOL(8HDEPTH:*.)
      CALL MOVTO2(73.,201.)
      IF (DEPTH(B).EQ.000.00)GOTO1000
      CALL CHAFIX(DEPTH(B),6,2)
      CALL CHAHOL(4HM.*.)
      GOTO 1100 1000 CALL CHAHOL(8HSEABED*.) 1100 CALL MOVTO2(0.,0.)
      CALL CHAHAR(2,1)
      CALL UNI(217.,230.)
      CALL MOVTO2(217.,23.)
      CALL CHAHAR(2,1)
      CALL CHAHOL(11HSITE FIX:*.)
      CALL CHAHAR(2,1)
      CALL TITL2(LOC,217.,37.)
      CALL CHAHAR(2,1)
      CALL ANNO1(200.,45.,100.,10,100,1,2,LDEP)
      CALL ANNO(100.,215.,170.,17,170,2,2,LAB)
      CALL CHAHAR(2,1)
      CALL MOVTO2(98.,143.)
      CALL CHAHOL(3H0*.)
      CALL MOVTO2(201.,38.)
      CALL CHAHOL(4H00*.)
      CALL CHAHAR(3,0)
      IF(TT.NE.1)GOTO1200
      CALL MOVTO2(168.,32.)
      CALL CHAHOL(18HFRACTION PERCENT*.)
      CALL MOVTO2(100.,32.)
      CALL CHAHOL(16HPER CENT FINER*.)
      GOTO1250 1200 CALL MOVTO2(136.,32.)
      CALL CHAHOL(16HPER CENT FINER*.) 1250 CALL CHAHAR(3,1)
      CALL MOVTO2(93.,57.)
      CALL CHAHOL(11HPHI SCALE*.)
      IF(HH.EQ.2)GOTO90
      CALL MOVTO2(200.,55.)
      CALL LINTO2(204.,55.)
      CALL MOVTO2(200.,105.)
      CALL LINTO2(204.,105.)
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      CALL MOVTO2(200.,155.)
      CALL LINTO2(204.,155.)
      CALL MOVTO2(200.,205.)
      CALL LINTO2(204.,205.)
      CALL CHAHAR(3,1)
      CALL MOVTO2(206.,76.)
      CALL CHAHOL(6HSILT*.)
      CALL MOVTO2(206.,45.)
      CALL CHAHOL(6HCLAY*.)
      CALL MOVTO2(206.,126.)
      CALL CHAHOL(6HSAND*.)
      CALL MOVTO2(206.,174.)
      CALL CHAHOL(8HGRAVEL*.)
      CALL MOVTO2(211.,119.)
      CALL CHAHOL(12H(B.S):5930*.)
   90 CALL PENSEL(2,0.2,2)
      CALL WINDO2(100.,200.,45.,215.)
      CALL AXIPOS(0.,0.)
      CALL MOVTO2(COORD(1,1),COORD(1,2))
      CALL CURTO2(COORD(1,1),COORD(1,2),16,0,0)
      IF(TT.NE.1)GOTO179
      CALL PENSEL(2,0.4,2)
      Y=214.9
      DO 176 J=1,16
      IF(HIST(J).EQ.00.0)GOTO175
      CALL MOVTO2(200.,Y)
      CALL LINTO2(HIST(J),Y)
      CALL LINTO2(HIST(J),Y-9.6)
      CALL LINTO2(200.,Y-9.6)
      CALL GRID(HIST(J),Y-10.,200.,10,10.,2,2)
  175 Y=Y-10.
  176 CONTINUE
      CALL PENEND(2,0.4,2)
  179 CALL WINDO2(0.,260.,0.,300.)


      CALL PENSEL(1,0.2,2)
      IF(GG.EQ.2)GOTO599
      CALL CHAHAR(3,1)
      CALL MOVTO2(93.,228.)
      CALL CHAHOL(19HSAMPLE STATISTICS*.)
      X=100.
      Y=220.
      IF(FFF.EQ.1.OR.FFF.EQ.4)GOTO51
      IF(FFF.EQ.5.OR.FFF.EQ.7)GOTO51
      IF(FFF.EQ.9.OR.FFF.EQ.12)GOTO51
      IF(FFF.EQ.13.OR.FFF.EQ.15)GOTO51
      IF(FFF.EQ.8)GOTO900
      IF(FFF.EQ.10.OR.FFF.EQ.14)GOTO62
      IF(FFF.EQ.2.OR.FFF.EQ.6)GOTO52
      IF(FFF.EQ.3.OR.FFF.EQ.11)GOTO54

   51 CALL CHAHAR(2,1)
      CALL MOVTO2(X+0.,Y+0.)
      CALL CHAHOL(27HFOLK AND WARD STATISTICS.*.)
      CALL MOVTO2(X+4.,Y)
      CALL CHAHOL(14HMEAN SIZE = *.)
      CALL MOVTO2(X+4.,Y+16.)
      CALL CHAFIX(MEAN,5,2)
      CALL MOVTO2(X+7.,Y)
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      CALL CHAHOL(31HGRAPHIC STANDARD DEVIATION = *.)
      CALL MOVTO2(X+7.,Y+40.)
      CALL CHAFIX (SORT,5,2)
      CALL MOVTO2(X+10.,Y)
      CALL CHAHOL(21HGRAPHIC SKEWNESS = *.)
      CALL MOVTO2(X+10.,Y+25.)
      CALL CHAFIX(SKEW,5,2)
      CALL MOVTO2(X+13.,Y)
      CALL CHAHOL(21HGRAPHIC KURTOSIS = *.)
      CALL MOVTO2(X+13.,Y+25.)
      CALL CHAFIX(KURT,5,2)
      CALL MOVTO2(X+16.,Y)
      CALL CHAHOL(24HNORMALISED KURTOSIS = *.)
      CALL MOVTO2(X+16.,Y+29.)
      CALL CHAFIX(NORK,5,2)
      IF(FFF.EQ.1)GOTO599
      IF(FFF.EQ.5)GOTO54
      IF(FFF.EQ.9)GOTO901
      IF(FFF.EQ.13)GOTO802
      IF(FFF.EQ.12)GOTO72
      IF(FFF.EQ.15)GOTO72


   52 IF(FFF.EQ.2.OR.FFF.EQ.6)GOTO62
      IF(FFF.EQ.4.OR.FFF.EQ.7)GOTO72
   62 X=100.
      Y=220.
      GOTO82
   72 X=122.
      Y=220.
   82 CALL CHAHAR(2,1)
      CALL MOVTO2(X+0.,Y+0.)
      CALL CHAHOL(21HINMAN°S STATISTICS.*.)
      CALL MOVTO2(X+4.,Y)
      CALL CHAHOL(24HPHI MEDIAN DIAMETER = *.)
      CALL MOVTO2(X+4.,Y+31.)
      CALL CHAFIX(PMD,5,2)
      CALL MOVTO2(X+7.,Y)
      CALL CHAHOL(35HPHI (ARITHMETIC) MEAN DIAMETER = *.)
      CALL MOVTO2(X+7.,Y+46.)
      CALL CHAFIX(IPD,5,2)
      CALL MOVTO2(X+10.,Y)
      CALL CHAHOL(26HPHI DEVIATION MEASURE = *.)
      CALL MOVTO2(X+10.,Y+34.)
      CALL CHAFIX(IPSD,5,2)
      CALL MOVTO2(X+13.,Y)
      CALL CHAHOL(25HPHI SKEWNESS MEASURE = *.)
      CALL MOVTO2(X+13.,Y+30.)
      CALL CHAFIX(OSKE,5,2)
      CALL MOVTO2(X+16.,Y)
      CALL CHAHOL(29H2ND PHI SKEWNESS MEASURE = *.)
      CALL MOVTO2(X+16.,Y+36.)
      CALL CHAFIX(TSKE,5,2)
      CALL MOVTO2(X+19.,Y)
      CALL CHAHOL(25HPHI KURTOSIS MEASURE = *.)
      CALL MOVTO2(X+19.,Y+31.)
      CALL CHAFIX(PKUR,5,2)
      IF(FFF.EQ.7.OR.FFF.EQ.6)GOTO54
      IF(FFF.EQ.10)GOTO902
      IF(FFF.EQ.12)GOTO904
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```
      IF(FFF.EQ.14)GOTO803
      IF(FFF.EQ.15)GOTO804
      GOTO599


 54 IF(FFF.EQ.3)GOTO809
      IF(FFF.EQ.5)GOTO802
      IF(FFF.EQ.6)GOTO803
      IF(FFF.EQ.7)GOTO804
      IF(FFF.EQ.11)GOTO802
809 X=100.
      GOTO805
802 X=122.
      GOTO805
803 X=125.
      GOTO805
804 X=147.
805 Y=220.
      CALL CHAHAR(2,1)
      CALL MOVTO2(X+0.,Y+0.)
      CALL CHAHOL(24HPHI MOMENT STATISTICS.*.)
      CALL MOVTO2(X+4.,Y)
      CALL CHAHOL(14HMEAN SIZE = *.)
      CALL MOVTO2(X+4.,Y+16.)
      CALL CHAFIX(FMEA,5,2)
      CALL MOVTO2(X+7.,Y)
      CALL CHAHOL(23HSTANDARD DEVIATION = *.)
      CALL MOVTO2(X+7.,Y+28.)
      CALL CHAFIX(FSTD,5,2)
      CALL MOVTO2(X+10.,Y)
      CALL CHAHOL(28HSKEWNESS (THIRD MOMENT) = *.)
      CALL MOVTO2(X+10.,Y+35.)
      CALL CHAFIX(FSKE,5,2)
      CALL MOVTO2(X+13.,Y)
      CALL CHAHOL(25HMEAN CUBED DEVIATION = *.)
      CALL MOVTO2(X+13.,Y+32.)
      CALL CHAFIX(FCUB,7,2)
      CALL MOVTO2(X+16.,Y)
      CALL CHAHOL(29HKURTOSIS (FOURTH MOMENT) = *.)
      CALL MOVTO2(X+16.,Y+38.)
      CALL CHAFIX(FKUR,5,2)

      IF(FFF.EQ.3.OR.FFF.EQ.5)GOTO599
      IF(FFF.EQ.6.OR.FFF.EQ.7)GOTO599


 56 IF(FFF.EQ.11)GOTO901
      IF(FFF.EQ.13)GOTO903
      IF(FFF.EQ.12.OR.FFF.EQ.14)GOTO904
      IF(FFF.EQ.15)GOTO905
900 X=100.
      GOTO906
901 X=122.
      GOTO906
902 X=125.
      GOTO906
903 X=144.
      GOTO906
904 X=147.
      GOTO906
```

```
905 X=169.
906 Y=220.
     CALL CHAHAR(2,1)
     CALL MOVTO2(X+0.,Y+0.)
     CALL CHAHOL(25HMC CAMMON°S STATISTICS.*.)
     CALL MOVTO2(X+4.,Y+0.)
     CALL CHAHOL(14HMEAN SIZE = *.)
     CALL MOVTO2(X+4.,Y+16.)
     CALL CHAFIX(MCMO,5,2)
     CALL MOVTO2(X+7.,Y)
     CALL CHAHOL(26H(88 PER CENT EFFICIENCY)*.)
     CALL MOVTO2(X+10.,Y)
     CALL CHAHOL(14HMEAN SIZE = *.)
     CALL MOVTO2(X+10.,Y+16.)
     CALL CHAFIX(MCMT,5,2)
     CALL MOVTO2(X+13.,Y)
     CALL CHAHOL(26H(93 PER CENT EFFICIENCY)*.)
     CALL MOVTO2(X+16.,Y)
     CALL CHAHOL(14HMEAN SIZE = *.)
     CALL MOVTO2(X+16.,Y+16.)
     CALL CHAFIX(MCMA,5,2)
     CALL MOVTO2(X+19.,Y)
     CALL CHAHOL(26H(97 PER CENT EFFICIENCY)*.)
     CALL MOVTO2(X+22.,Y)
     CALL CHAHOL(26HFIRST SORTING MEASURE = *.)
     CALL MOVTO2(X+22.,Y+32.)
     CALL CHAFIX(MCSO,5,2)
     CALL MOVTO2(X+25.,Y)
     CALL CHAHOL(26H(79 PER CENT EFFICIENCY)*.)
     CALL MOVTO2(X+28.,Y)
     CALL CHAHOL(27HSECOND SORTING MEASURE = *.)
     CALL MOVTO2(X+28.,Y+34.)
     CALL CHAFIX(MCST,5,2)
     CALL MOVTO2(X+31.,Y)
     CALL CHAHOL(26H(87 PER CENT EFFICIENCY)*.)
     GOTO 599
599 ZZZ=1
     CALL CHASWI(0)
600 WRITE(2,601)
601 FORMAT(5X,37HDO YOU REQUIRE ANY FURTHER ANALYSES ,)
602 WRITE(2,603)
603 FORMAT(5X,31HPLEASE ANSWER YES(1), OR NO(2).,/)
     READ(1,604)T
604 FORMAT(I1)
     IF(T.LT.1.OR.T.GT.2)GOTO602
     IF(T.EQ.1)GOTO109
     CALL DEVEND
     STOP
     END


C SUBROUTINE TO DELIMIT THE BOUNDARIES OF AN A4 PAGE   ON THE
PLOTTING PAPER.    N.B.  THE ORIGIN IS (30.,0.).

      SUBROUTINE A4
      CALL MOVTO2(30.,296.)
      CALL LINTO2(32.,296.)
      CALL MOVTO2(236.,296.)
      CALL LINTO2(239.,296.)
      CALL LINTO2(239.,293.)
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      CALL MOVTO2(239.,150.)
      CALL LINTO2(239.,146.)
      CALL MOVTO2(239.,3.)
      CALL LINTO2(239.,0.)
      CALL LINTO2(236.,0.)
      CALL MOVTO2(33.,0.)
      CALL LINTO2(30.,0.)
      CALL LINTO2(30.,3.)
      CALL MOVTO2(30.,146.)
      CALL LINTO2(30.,150.)
      CALL MOVTO2(30.,293.)
      CALL LINTO2(30.,296.)
      CALL MOVTO2(42.5,108.5)
      CALL SYMBOL(3)
      CALL MOVTO2(42.5,187.5)
      CALL SYMBOL(3)
      RETURN
      END

      SUBROUTINE GRID(X,Y,Z,INT,ALEN,ID,EE)
      REAL X,Y,Z,ALEN,POS(60)
      INTEGER INT,ID,EE

      C=ALEN/FLOAT(INT)
      IF(EE.EQ.2)GOTO5
      IF(INT.LE.20)CALL PENSEL(1,0.5,2)
      IF(INT.GT.20)CALL PENSEL(1,0.1,2)
      GOTO6
    5 CALL PENSEL(2,0.4,2)
    6 IF(ID.EQ.2)GOTO2
      DO 1 P=1,INT
      X=X-C
      POS(P)=X
      CALL MOVTO2(POS(P),Y)
      CALL LINTO2(POS(P),Z)
    1 CONTINUE
      GOTO4
    2 DO 3 P=1,INT
      Y=Y+C
      POS(P)=Y
      CALL MOVTO2(X,POS(P))
      CALL LINTO2(Z,POS(P))
    3 CONTINUE
    4 CONTINUE
      RETURN
      END



      SUBROUTINE TITLE(BORI,X,Y)
      DIMENSION BORI(10)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAARR(BORI,10,4)
      CALL CHASWI(0)
      RETURN
      END

      SUBROUTINE TITL2(LOC,X,Y)
```

```
      DIMENSION LOC(5)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAARR(LOC,5,4)
      CALL CHASWI(0)
      RETURN
      END

C PRINTS THE SOILS LABORATORY ID, WHERE REQUIRED.

      SUBROUTINE UNI(X,Y)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAHOL(32HSOILS LAB.  UNIVERSITY OF KEELE*.)
      CALL CHASWI(0)
      RETURN
      END


C DRAWS AN ENCLOSED BOX OF SPECIFIED DIMENSIONS.

      SUBROUTINE BOX(A,B,C,D)
      REAL A,B,C,D
      CALL WINDO2(0.,300.,0.,320.)
      CALL SHIFT2(0.,0.)
      CALL MOVTO2(A,B)
      CALL LINTO2(A,D)
      CALL LINTO2(C,D)
      CALL LINTO2(C,B)
      CALL LINTO2(A,B)
      RETURN
      END


C DRAWS 2 AXES FROM AND TO SPECIFIED POSITIONS.

      SUBROUTINE AXI(X,Y,Z,W)
      REAL X,Y,Z,W
      CALL MOVTO2(X,Y)
      CALL LINTO2(X,W)
      CALL LINTO2(Z,W)
      RETURN
      END

C MOVES THE PLOTTING PEN TO THE SPECIFIED ORIGIN   OF THE PARAMETERS
TO BE PLOTTED.

      SUBROUTINE AXIPOS(XAXI,YAXI)
      REAL XAXI,YAXI
      CALL MOVTO2(XAXI,YAXI)
      CALL SHIFT2(XAXI,YAXI)
      RETURN
      END


C DASHES AND SCALES BOTH THE HORIZONTAL AND VERTICAL AXES   FOR A
PLOT DRAWN WHERE THE X AXIS IS PARALLEL TO THE   HORIZONTAL.

      SUBROUTINE ANNO(X,Y,ALEN,INT,MAX,ID,INN,LAB)
      DIMENSION AINT(150), DASH(200)
```

```
      REAL X,Y,ALEN,LAB(12)
      INTEGER INT,MAX,ID,INN

      C=ALEN/FLOAT(INT)
      DO 10 K=1,INT
      AINT(K)=C*K
   10 CONTINUE
      D=FLOAT(MAX/INN)
      EE=ALEN/D
      LL=IFIX(D)
      DO 7 KK=1,LL
      DASH(KK)=EE*FLOAT(KK)
    7 CONTINUE
      IF(ID.EQ.1)GOTO25
      YY=Y
      DO 8 MM=1,LL
      YYY=YY-DASH(MM)
      CALL MOVTO2(X-0.8,YYY)
      CALL LINTO2(X,YYY)
    8 CONTINUE
      XPO=X-2.0
      CALL MOVTO2(XPO,Y-5.0)
      CALL CHAFIX(LAB(1),5,1)
      CALL MOVTO2(X-1.5,Y)
      CALL LINTO2(X,Y)
      M=2
      DO 20 L=1,INT
      YO=Y-AINT(L)
      CALL MOVTO2(XPO,YO-5.0)
      CALL CHAFIX(LAB(M),5,1)
      CALL MOVTO2(X-1.5,YO)
      CALL LINTO2(X,YO)
      M=M+1
   20 CONTINUE
      GOTO30
   25 XX=X
      DO 9 II=1,LL
      XXX=XX-DASH(II)
      CALL MOVTO2(XXX,Y+0.8)
      CALL LINTO2(XXX,Y)
    9 CONTINUE
      YPO=Y+2.5
      CALL MOVTO2(X-7.0,YPO)
      CALL CHAFIX(LAB(M),5,1)
      CALL MOVTO2(X,Y+1.5)
      CALL LINTO2(X,Y)
      M=2
      DO 30 L=1,INT
      XO=X+AINT(L)
      CALL MOVTO2(XO-7.0,YPO)
      CALL CHAFIX(LAB(M),5,1)
      CALL MOVTO2(XO,Y+1.5)
      CALL LINTO2(XO,Y)
      M=M+1
   30 CONTINUE
      RETURN
      END

C DASHES AND SCALES BOTH THE HORIZONTAL AND VERTICAL AXES   FOR A
PLOT WHERE THE X AXIS IS NORMAL TO THE   HORIZONTAL.
```

```
      SUBROUTINE ANNO1(X,Y,ALEN,INT,MAX,ID,INN,LAB)
      DIMENSION AINT(150),DASH(200)
      REAL X,Y,ALEN,LAB(20)
      INTEGER INT,MAX,INN,ID

      C=ALEN/FLOAT(INT)
      DO 10 K=1,INT
      AINT(K)=C*K
   10 CONTINUE
      D=FLOAT(MAX/INN)
      EE=ALEN/D
      LL=IFIX(D)
      DO 7 KK=1,LL
      DASH(KK)=EE*FLOAT(KK)
    7 CONTINUE
      IF(ID.EQ.1)GOTO25
      YY=Y
      DO 8 MM=1,LL
      YYY=YY+DASH(MM)
      CALL MOVTO2(X+0.8,YYY)
      CALL LINTO2(X,YYY)
    8 CONTINUE
      XPO=X-2.0
      CALL MOVTO2(XPO,Y-4.0)
      CALL CHAFIX(LAB(1),5,1)
      CALL MOVTO2(X+1.5,Y)
      CALL LINTO2(X,Y)
      M=2
      DO 20 L=1,INT
      YO=Y+AINT(L)
      CALL MOVTO2(XPO,YO-7.0)
      CALL CHAFIX(LAB(M),5,1)
      CALL MOVTO2(X+1.5,YO)
      CALL LINTO2(X,YO)
      M=M+1
   20 CONTINUE
      GOTO30
   25 XX=X
      DO 9 II=1,LL
      XXX=XX-DASH(II)
      CALL MOVTO2(XXX,Y-0.8)
      CALL LINTO2(XXX,Y)
    9 CONTINUE
      YPO=Y-9.0
      CALL MOVTO2(X+1.0,YPO)
      CALL CHAFIX(LAB(1),5,1)
      CALL MOVTO2(X,Y-1.5)
      CALL LINTO2(X,Y)
      M=2
      DO 30 L=1,INT
      XO=X-AINT(L)
      CALL MOVTO2(XO+1.0,YPO)
      CALL CHAFIX(LAB(M),5,1)
      CALL MOVTO2(XO,Y-1.5)
      CALL LINTO2(XO,Y)
      M=M+1
   30 CONTINUE
      RETURN
      END
```

APPENDIX 2.2

ENERGY REGIME ANALYSIS.

Descriptive statistics have been used in the past to characterize different sediments. Their use to illustrate the origin and history of these sediments has been more limited. This is partly the result of the fact that different particle size distributions can produce similar particle size statistics, so no particular group of parameters is indicative of a unique genetic origin. Moreover, sediments of varied origins can produce similar particle size distributions. In effect, therefore, a given particle size curve is not indicative of a unique sediment either. As Sly et al. (1982, 71) noted :-

"... there does not appear to be a uniform model within which the full spectrum of erosional and depositional sediments can be placed, and which allows for both characterization of particle size and formative origin."

In an attempt to obviate this problem Sly, and various co-workers, introduced a new, non-dimensional method of plotting and interpreting moment measures (Sly, 1977, 77). The moment measures used are similar to those of Friedman (1967), except that the kurtosis value is reduced by 3 to produce a zero value for skewness and kurtosis with a perfectly normal distribution. To achieve this in the present study a computer program was written to calculate the statistics and produce the required graphical output in the manner proposed by these authors (Sly et al., 1982, fig .10.). The computer

program is given in appendix 2.2a.

The method is based on the assumption that moment measures represent the mixing of end-member, particle size, populations in the gravel, sand, silt and clay ranges. Several authors have illustrated the use of this assumption. Damiani and Thomas (1974) showed that sediment statistics from the Bay of Quinte, Lake Ontario, could be accounted for by the mixing of sand and clay end-members in varying proportions. A similar conclusion was reached for all the surficial sediments of Lake Ontario by Thomas et al. (1972, 76). The mixing of these end-members in varying amounts produces variations in the value of skewness and kurtosis, although it has been suggested that kurtosis is not environmentally sensitive under certain hydraulic conditions (Koldijk, 1968, 65). By selecting unimodal sediment samples, Sly et al. (1983) found that they plotted along a narrow curve, bordering more bimodal samples, on skewness:kurtosis plots. They concluded that these samples represented sediments whose particle size characteristics approached equilibrium with the prevailing hydraulic conditions at the time of deposition. It was also shown that unimodal samples from a range of lacustrine, fluvial and marine environments plotted along the same "boundary" curve (ibid., fig.11.). In this way any sediment which had undergone hydraulic transport could, therefore, be compared with any other on the basis of environmental hydrodynamics. The interpretation of these skewness:kurtosis plots is consequently based on the assumption that the size distribution of the sediment actually reflects the fluidity of the transportational/depositional medium, and the avialable energy, at the depositional site (Sahu, 1964, 73).

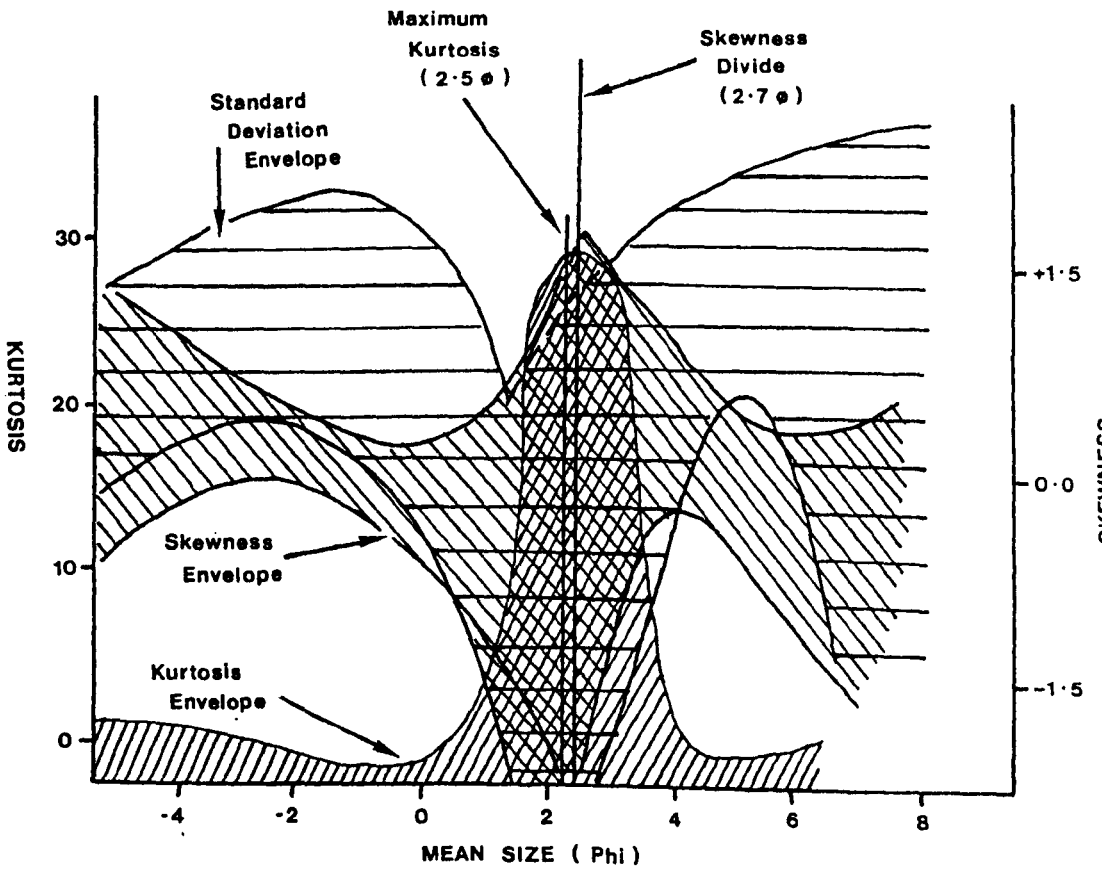
This kind of technique has certain advantages for the present study. Using this kind of plot only requires a primary assessment that a sample has undergone waterborne transport, without needing a more exact determination of its depositional history and previous transport

conditions. The element of subjectivity in analysis is consequently reduced.

Plots of skewness or kurtosis against phi mean diameter show marked changes in the zone covered by the sand end-member. Kurtosis envelopes show a maximum (leptokurticity) whilst skewness shows a sign change (see fig 2.2.1.). Standard deviation envelopes also show a minimum in this region, but are not used in the present study, because it has been suggested that this parameter is insensitive to sample distributions which depart from normality, or have non-normally distributed end-member populations (Damiani & Thomas, 1974; Thomas et al., 1972, 76). It was also noted that the area of these changes coincided with Hjulstrom's (1939) zone of minimum erosional velocity. This transition, around a value of 2.7 phi, was therefore interpreted as indicative of a change from a high energy (erosive and transportational) regime with sediments being deposited under conditions of incipient hydraulic motion, to a low energy (depositional) regime characterized by sedimentation from hydraulic suspension. This high/low energy division is used on the plots in the present study.

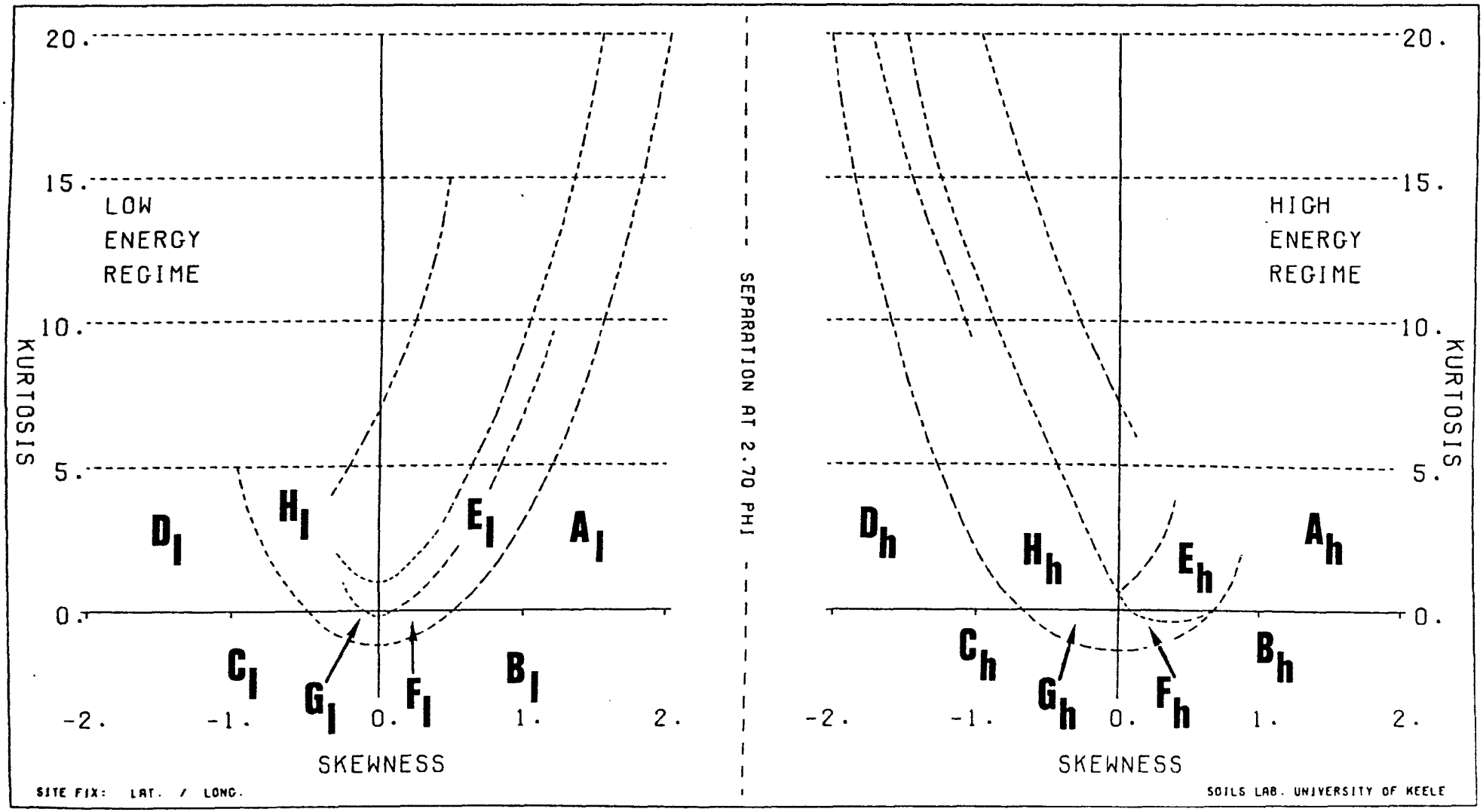
Once this basic division has been made, the areas around the boudary curves can be further subdivided. Outside the outer boundary curve are zones A to D, running in a clockwise direction. These zones represent a progression through decreasing energy levels (see fig 2.2.2.). On high energy regime plots, this takes the form of a change from gravels (A), to sandy gravels (B & C) and finally sands (D). On the low energy regime plots a similar progression runs from sands (A) to fine clays (D). Inside the outer boundary curve, zones E to H reflect this trend but are representative of more bimodal samples with "anomalously" large amounts of a coarser component as might be found, for example, in ice rafted sediments. Further zones are defined in the literature mentioned above, but they are not employed in the present

2.2.1. GRAIN SIZE PARAMETERS.



[After Sly et al., 1983, Modified.]

FIG. 2.2.2 PLOT SUBZONES.



study and are not discussed further here.

The interpretation of the sediments in these zones is based on their plotted distance from the outer boundary curve. Sediments very close to, or on, this curve are close to hydrodynamic equilibrium and will have sorting characteristics contolled by environmental hydrodynamics. Sediments plotting farther away from this curve have skewness and kurtosis values which reflect a modification of the sorting of a sediment by factors other than the hydraulic regime, for example, source and supply, reworking, mixing and velocity fluctuations. This creates a more bi- or multi-modal distribution corresponding with the central zones of the graph.

In the present study, the suggestions of Sly et al. (1983, 220) were followed with regard to the interpretation of samples (see chapters 4 and 6 in the main text). Units were not characterized, or interpreted in terms of the plotted position of any one sample, but on the "average" zonal pattern of all the samples analysed from any given unit. In this way any localised anomalies could be withheld from the overall assessment of a unit, and a generalised idea of "hydraulic climate" could be inferred for use in the determination of genetic origin (ibid., 232).

RESULTS.

The plotted position of samples in the units defined in chapters 2 and 6 show a more complicated pattern than that presented by the authors quoted earlier. Units are rarely distinctly separated on plots, and most plot in approximately similar locations. It was also found that individual units did not always plot exclusively on high or low energy regime graphs, within, or between borehole sites. In part, this may be a function of polygenetic origins for the sediments being analysed. Glaciomarine deposits, for example, are particularly likely

to preserve some characteristics of both glacial and marine sediments. In this instance the plotted positions of samples could give a misleading impression of hydraulic conditions unless this factor is taken into account. A significant number of the samples in the present study also plotted outside the outer boundary curve indicating the presence of coarse debris. This was generally taken to be indicative of the ice rafting of gravel and coarse sand to more distal locations. No actual assessment of the hydrodynamic velocity prevalent at the time of deposition was made for any of the units, because virtually none of the samples plotted on the boundary curve. The possibility of polygenetic origin, or partial reworking, meant that the few that did could not be categorically attributed to the phase of deposition that had left them in their present form. The problem of partial recovery under drilling (see chapter 2.1.) also increased the probability that sediments did not accurately represent hydrodynamic conditions at the time of deposition.

One major technique that was used is worthy of note here as it has not been previously discussed. The facies model presented in chapter 4 (see section 4.2.2.) for the interpretation of the sediments analysed in the present study, provided for the differentiation of residual and compound paratills (see table 4.2.1. and fig 4.2.2.). When all other factors were taken into account, it was found that residual paratills were almost exclusively restricted to high energy regime plots. This was thought to be indicative of the current activity (bottom and traction) associated with this zone, as high energy regime samples are deposited under conditions of incipient hydraulic motion (see above). On the other hand, compound paratills are attributed to zones beyond the influence of these currents, where deposition comes from floating ice, or hydraulic suspension, alone. Hence the low energy regime signature for these sediments. This separation between high and low energy was

incorporated into the criteria used to differentiated between these two types of glaciomarine deposit. The use of "high" and "low" energy conditions in the criteria in table 4.2.1. therefore refers directly to the plots of energy regime. The division of high energy (residual) glaciomarine and low energy (compound) glaciomarine deposits may have wider application beyond the present study for these reasons.

APPENDIX 2.2A.

Computer Program .SLY1 (Fortran 77).

Used to produce high:low energy regime plots.

```
C*****************************************************************
C
C     A PROGRAMME DESIGNED TO PRODUCE PLOTS OF PARTICLE SIZE
C     PHI MOMENT STATISTICS IN THE FORM OF HYDRODYNAMIC
C     REGIME CONDITION PLOTS; AFTER THE METHOD PROPOSED BY
C     SLY, P.G. ET ALIA (1983).
C
C     OUTPUT FORMAT IS COMPATABLE WITH A GINO N1051 PLOTTER.
C     INPUT FILES AS FOR PSD50 STREAM PROGRAMS.
C
C     WRITTEN BY D.N.  COCKCROFT, DEPARTMENT OF GEOGRAPHY,
C     UNIVERSITY OF KEELE: MAY 1985.
C
C*****************************************************************

      REAL LOCURA(10,2),LOCURB(7,2),LOCURC(5,2),LOCURD(7,2)
      REAL HICURA(10,2),HICURB(8,2),HICURC(5,2),HICURD(4,2),HICURE(3,2)
      REAL HICURF(10,2),HICURG(8,2),HICURH(5,2),HICURI(4,2),HICURJ(3,2)
      REAL DEPTH(50),DATA(50,16),LAB(22),D(16),E,A(16),FMEA(50),FSKE(50)
      REAL FKUR(50),FCUB(50),FSTD(50),PP,RR(16),V(16),S,FF(16),C(16)
      REAL DD,CC(16),NN(16),COORY(50),COORX(50),PLOTY(50),PLOTX(50)
      REAL F,R,X,Y,SKEW(5),KURT(4)
      INTEGER LOC(5),BORING(10),N,K,L,J,ZZZ,Q,M,KK,LL,MM,BB,P,T,EMAX

      DATA LAB/-7.,-6.,-5.,-4.,-3.,-2.,-1.,0.0,1.,2.,3.,4.,5.,6.,
     17.,8.,9.,10.,11.,12.,13.,14./
      DATA LOCURA/85.,110.,135.,160.,185.,188.,191.,188.,185.,160.,
     1135.,130.,123.,114.,97.,93.,84.,75.,72.,60./
      DATA LOCURB/85.,110.,135.,160.,175.,180.,175.,123.,118.,110.,
     1100.,91.,84.,77./
      DATA LOCURC/110.,135.,150.,160.,165.,96.,90.,84.,79.,76./
      DATA LOCURD/137.,160.,175.,185.,186.,185.,180.,114.,105.,97.,
     186.5,84.,81.5,78./
      DATA HICURA/85.,110.,135.,160.,185.,189.5,192.,189.5,185.,
     1175.,163.,167.,173.,181.,196.,202.,213.,224.,230.,235./
      DATA HICURB/85.,110.,135.,160.,182.,185.,187.,185.,176.,
     1182.,191.,202.,213.,215.,221.,230./
      DATA HICURC/85.,110.,135.,149.,155.,189.,197.,206.,213.,216./
      DATA HICURD/85.,110.,135.,138.,170.,177.,186.,187./
      DATA HICURE/166.,174.,182.,223.,220.,213./
      DATA HICURF/85.,110.,135.,160.,185.,189.5,192.,189.5,185.,
     1175.,34.,38.,44.,52.,67.,73.,83.,94.,101.,106./
      DATA HICURG/85.,110.,135.,160.,182.,185.,187.,185.,47.,
     153.,62.,73.,84.,86.,92.,101./
      DATA HICURH/85.,110.,135.,149.,155.,60.,68.,77.,84.,87./
      DATA HICURI/85.,110.,135.,138.,41.,48.,57.,58./
      DATA HICURJ/166.,174.,182.,94.,91.,84./
      DATA SKEW/-2.,-1.,0.,1.,2./
      DATA KURT/20.,15.,10.,05./



      READ(5,10)N
   10 FORMAT(I2)
      READ(5,11)(LOC(S) ,S=1,5),(BORING(S) ,S=1,10)
   11 FORMAT(5A4,10A4)
      WRITE(2,12)LOC
   12 FORMAT(5A4)
```

```
    WRITE(2,13)BORING
13 FORMAT(10A4)
    DO 14 K=1,N
    READ(5,15)DEPTH(K)
15 FORMAT(F6.2)
    READ(5,16)(DATA(K,J) ,J=1,16)
16 FORMAT(16(F4.1,1X))
14 CONTINUE
    WRITE(2,17)
17 FORMAT(1X,///)
    ZZZ=0

19 WRITE(2,20)
20 FORMAT(10X,34HWHICH TYPE OF PLOT DO YOU REQUIRE,)
    WRITE(2,21)
21 FORMAT(10X,36HYOU HAVE A CHOICE OF THE FOLLOWING:-/)
    WRITE(2,22)
22 FORMAT(5X,44H1.  DUAL PLOT OF HIGH AND LOW ENERGY REGIMES./)
    WRITE(2,23)
23 FORMAT(5X,37H2.  PLOT OF LOW ENERGY REGIME SAMPLES./)
    WRITE(2,24)
24 FORMAT(5X,38H3.  PLOT OF HIGH ENERGY REGIME SAMPLES.//)
27 WRITE(2,25)
25 FORMAT(10X,29HPLEASE SELECT .1., .2.  OR .3./)
    READ(1,26)Q
26 FORMAT(I1)
    IF(Q.LT.1.OR.Q.GT.3)GOTO27

    IF(Q.EQ.1)GOTO39
    WRITE(2,30)
30 FORMAT(2X,42HDO YOU WISH TO IDENTIFY THE SAMPLE DEPTHS./)
33 WRITE(2,31)
31 FORMAT(2X,31HPLEASE ANSWER YES(1) OR NO (2)./)
    READ(1,32)M
32 FORMAT(I1)
    IF(M.LT.1.OR.M.GT.2)GOTO33
    GOTO40


39 M=2
40 WRITE(2,41)
41 FORMAT(2X,40HYOU HAVE THE FOLLOWING CHOICE OF SYMBOLS,/)
    WRITE(2,42)
42 FORMAT(10X,23H1.  AN UPRIGHT TRIANGLE,/)
    WRITE(2,43)
43 FORMAT(10X,24H2.  AN INVERTED TRIANGLE,/)
    WRITE(2,44)
44 FORMAT(10X,18H3.  A PLUS(+) SIGN,/)
    WRITE(2,45)
45 FORMAT(10X,14H4.  A CROSS(X),/)
    WRITE(2,46)
46 FORMAT(10X,12H5.  A SQUARE,/)
    WRITE(2,47)
47 FORMAT(10X,13H6.  A DIAMOND,/)
    WRITE(2,48)
48 FORMAT(10X,13H7.  A HEXAGON,/)
    WRITE(2,49)
49 FORMAT(10X,18H8.  AN ASTERISK(*),/)
    WRITE(2,50)
50 FORMAT(10X,29H9.  A DOT OF SPECIFIED RADIUS,/)
```

```
 54 WRITE(2,51)
 51 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 9,/)
    READ(1,52)KK
 52 FORMAT(I1)
    IF(KK.LT.1.OR.KK.GT.9)GOTO54
    IF(KK.EQ.9)GOTO53
    IF(KK.GE.1.AND.KK.LE.8) LL=0
    GOTO60
 53 WRITE(2,55)
 55 FORMAT(5X,43HPLEASE SPECIFY THE RADIUS OF THE DOT IN MM,/)
 57 READ(1,56)LL
 56 FORMAT(I1)


 60 WRITE(2,61)
 61 FORMAT(5X,40HYOU HAVE THE FOLLOWING CHOICE OF COLOURS,/)
    WRITE(2,62)
 62 FORMAT(10X,9H1.  BLACK,/)
    WRITE(2,63)
 63 FORMAT(10X,7H2.  RED,/)
    WRITE(2,64)
 64 FORMAT(10X,8H3.  BLUE,/)
    WRITE(2,65)
 65 FORMAT(10X,9H4.  GREEN,/)
    WRITE(2,66)
 66 FORMAT(5X,16HFOR YOUR SYMBOLS,)
 69 WRITE(2,67)
 67 FORMAT(5X,39HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 4.,/)
    READ(1,68)MM
 68 FORMAT(I1)
    IF(MM.LT.1.OR.MM.GT.4)GOTO69
    IF(MM.EQ.3) MM=7
    IF(MM.EQ.4) MM=5


    DO 1000 BB=1,N
    DO 501 J=1,16
    K=J+1
    E=(LAB(K)-0.5)
    D(J)=(E*DATA(BB,J))
501 CONTINUE
    A(2)=D(1)+D(2)
    DO 502 J=3,16
    A(J)=A(J-1)+D(J)
502 CONTINUE
    FMEA(BB)=(A(16)*0.01)
    DO 520 J=1,16
    K=J+1
    PP=((LAB(K)-0.5)-FMEA(BB))**2
    RR(J)=(PP*DATA(BB,J))
520 CONTINUE
    V(2)=RR(1)+RR(2)
    DO 522 J=3,16
    V(J)=V(J-1)+RR(J)
522 CONTINUE
    FSTD(BB)=0.1*(SQRT(V(16)))
    DO 530 J=1,16
    K=J+1
    S=((LAB(K)-0.5)-FMEA(BB))**3
    FF(J)=(S*DATA(BB,J))
```

```
530 CONTINUE
     C(2)=FF(1)+FF(2)
     DO 532 J=3,16
     C(J)=C(J-1)+FF(J)
532 CONTINUE
     FSKE(BB)=0.01*((FSTD(BB))**(-3))*C(16)
     DO 540 J=1,16
     K=J+1
     DD=((LAB(K)-0.5)-FMEA(BB))**4
     CC(J)=(DD*DATA(BB,J))
540 CONTINUE
     NN(2)=CC(1)+CC(2)
     DO 542 J=3,16
     NN(J)=NN(J-1)+CC(J)
542 CONTINUE
     FKUR(BB)=0.01*((FSTD(BB))**(-4))*NN(16)

     FKUR(BB)=FKUR(BB)*5.0
     FSKE(BB)=FSKE(BB)*25.0

     COORY(BB)=FSKE(BB)
     COORX(BB)=FKUR(BB) 1000 CONTINUE


     IF(Q.EQ.1)GOTO600
     IF(Q.EQ.2)GOTO627
     IF(Q.EQ.3)GOTO625

600 DO 601 J=1,N
     IF(FMEA(J).LE.2.70)GOTO602
     COORY(J)=COORY(J)+84.
     COORX(J)=200.-COORX(J)
     GOTO601
602 COORY(J)=COORY(J)+213.
     COORX(J)=200.-COORX(J)
601 CONTINUE
     EMAX=N
     GOTO700


627 P=1
     DO 628 J=1,N
     IF(FMEA(J).LE.2.70)GOTO628
     COORY(P)=COORY(J)+84.
     COORX(P)=200.-COORX(J)
     P=P+1
628 CONTINUE
     EMAX=P-1
     GOTO700

625 P=1
     DO 626 J=1,N
     IF(FMEA(J).GT.2.70)GOTO626
     COORY(P)=COORY(J)+84.
     COORX(P)=200.-COORX(J)
     P=P+1
626 CONTINUE
     EMAX=P-1
```

```
700 DO 701 J=1,N
     PLOTY(J)=COORY(J)
     PLOTX(J)=COORX(J)
701 CONTINUE

C PLOTTING ROUTINES FOLLOW HERE


801 IF(ZZZ.EQ.1)GOTO810
     CALL DEVBEG
     GOTO811
810 CALL PICCLE
811 CALL WINDO2(0.,260.,0.,300.)
     CALL MOVTO2(0.,0.)
     CALL A4
     CALL BOX(80.,20.,219.,276.)
     CALL BOX(66.,35.,73.,155.)
     CALL CHAHAR(4,1)
     CALL TITLE(BORING,71.,39.)
     CALL CHAHAR(2,1)
     CALL UNI(217.,229.)
     CALL CHAHAR(2,1)
     CALL MOVTO2(217.,25.)
     CALL CHAHOL(11HSITE FIX:*.)
     CALL CHAHAR(2,1)
     CALL TITL2(LOC,217.,39.)

     IF(M.EQ.2)GOTO820
     CALL MOVTO2(92.,205.)
     CALL CHAHAR(4,1)
     CALL CHAHOL(16HSAMPLE DEPTHS.*.)
     CALL CHAHAR(3,1)
     F=102.
     R=188.
     L=1
     DO 821 P=1,N
     IF(Q.EQ.2.AND.FMEA(P).LE.2.70)GOTO821
     IF(Q.EQ.3.AND.FMEA(P).GT.2.70)GOTO821
     CALL MOVTO2(F,R)
     CALL CHAINT(L,2)
     CALL CHAHOL(3H)*.)
     CALL MOVTO2(F,R+7.)
     CALL CHAFIX(DEPTH(P),6,2)
     CALL CHAHOL(3HM*.)
     R=R+28.
     IF(L.EQ.3)GOTO822
     IF(L.EQ.6)GOTO822
     IF(L.EQ.9)GOTO822
     IF(L.EQ.12)GOTO822
     IF(L.EQ.15)GOTO822
     IF(L.EQ.18)GOTO822
     IF(L.EQ.21)GOTO822
     IF(L.EQ.25)GOTO822
     IF(L.EQ.28)GOTO822
     IF(L.EQ.30)GOTO822
     IF(L.EQ.33)GOTO822
     IF(L.EQ.36)GOTO822
     IF(L.EQ.39)GOTO822
     IF(L.EQ.42)GOTO822
     IF(L.EQ.45)GOTO822
```

```
      IF(L.EQ.48)GOTO822
      GOTO823
822 F=F+5.
      R=188.
823 L=L+1
821 CONTINUE

820 CALL MOVTO2(185.,33.)
      CALL LINTO2(185.,135.)
      CALL MOVTO2(85.,84.)
      CALL LINTO2(200.,84.)
      X=85.
      Y=34.
      CALL CHAHAR(4,1)
      DO 830 J=1,4
      CALL MOVTO2(X,Y)
      CALL DASHED(1,2.0,1.0,0.0)
      CALL LINBY2(0.0,100.0)
      CALL MOVTO2(X+2.,Y-8.)
      CALL CHAFIX(KURT(J),3,0)
      X=X+25.
830 CONTINUE
      CALL MOVTO2(187.,29.)
      CALL CHAHOL(4H0.*.)
      CALL DASHED(0,0.0,0.0,0.0)


      X=185.
      Y=34.
      CALL CHAHAR(4,1)
      DO 832 J=1,5
      CALL MOVTO2(X,Y)
      CALL LINTO2(X+1.,Y+0.)
      CALL MOVTO2(X+20.,Y-4.)
      CALL CHAFIX(SKEW(J),3,0)
      Y=Y+25.
832 CONTINUE
      CALL CHAHAR(4,1)
      CALL MOVTO2(213.,74.)
      CALL CHAHOL(10HSKEWNESS*.)
      CALL MOVTO2(205.,83.)
      CALL CHAHOL(3H0*.)
      CALL CHAHAR(4,0)
      CALL MOVTO2(138.,22.)
      CALL CHAHOL(10HKURTOSIS*.)

      IF(Q.EQ.3)GOTO850

      CALL CHAHAR(4,1)
      CALL MOVTO2(116.,37.)
      CALL CHAHOL(5HLOW*.)
      CALL MOVTO2(122.,37.)
      CALL CHAHOL(8HENERGY*.)
      CALL MOVTO2(128.,37.)
      CALL CHAHOL(8HREGIME*.)
      CALL DASHED(1,2.0,1.0,0.0)

      CALL MOVTO2(85.,135.)
      CALL CURTO2(LOCURA(1,1),LOCURA(1,2),10,0,0)
      CALL MOVTO2(85.,123.)
```

```
      CALL CURTO2(LOCURB(1,1),LOCURB(1,2),7,0,0)
      CALL MOVTO2(110.,96.)
      CALL CURTO2(LOCURC(1,1),LOCURC(1,2),5,0,0)
      CALL MOVTO2(137.,113.)
      CALL CURTO2(LOCURD(1,1),LOCURD(1,2),7,0,0)
      CALL DASHED(0,0.0,0.0,0.0)
      IF(Q.EQ.2)GOTO900
      CALL MOVTO2(85.,213.)
      CALL LINTO2(200.,213.)
      CALL MOVTO2(185.,162.)
      CALL LINTO2(185.,264.)
      X=85.
      Y=162.
      CALL CHAHAR(4,1)
      DO 834 J=1,4
      CALL MOVTO2(X,Y)
      CALL DASHED(1,2.0,1.0,0.0)
      CALL LINBY2(0.0,100.0)
      CALL MOVTO2(X+2.,Y+101.)
      CALL CHAFIX(KURT(J),3,0)
      X=X+25.
834 CONTINUE
      CALL MOVTO2(187.,266.)
      CALL CHAHOL(4H0.*.)
      CALL DASHED(0,0.0,0.0,0.0)
      CALL CHAHAR(4,1)
      X=185.
      Y=163.
      DO 836 J=1,5
      CALL MOVTO2(X,Y)
      CALL LINTO2(X+1.,Y+0.)
      CALL MOVTO2(X+20.,Y-4.)
      CALL CHAFIX(SKEW(J),3,0)
      Y=Y+25.
836 CONTINUE
      CALL MOVTO2(213.,203.)
      CALL CHAHOL(10HSKEWNESS*.)
      CALL MOVTO2(205.,212.)
      CALL CHAHOL(3H0*.)
      CALL CHAHAR(4,0)
      CALL MOVTO2(138.,271.)
      CALL CHAHOL(10HKURTOSIS*.)

      CALL CHAHAR(4,1)
      CALL MOVTO2(116.,240.)
      CALL CHAHOL(6HHIGH*.)
      CALL MOVTO2(122.,240.)
      CALL CHAHOL(8HENERGY*.)
      CALL MOVTO2(128.,240.)
      CALL CHAHOL(8HREGIME*.)
      CALL DASHED(1,2.0,1.0,0.0)

      CALL MOVTO2(85.,163.)
      CALL CURTO2(HICURA(1,1),HICURA(1,2),10,0,0)
      CALL MOVTO2(85.,176.)
      CALL CURTO2(HICURB(1,1),HICURB(1,2),8,0,0)
      CALL MOVTO2(85.,189.)
      CALL CURTO2(HICURC(1,1),HICURC(1,2),5,0,0)
      CALL MOVTO2(85.,170.)
      CALL CURTO2(HICURD(1,1),HICURD(1,2),4,0,0)
```

```
      CALL MOVTO2(166.,223.)
      CALL CURTO2(HICURE(1,1),HICURE(1,2),3,0,0)
      CALL DASHED(0,0.0,0.0,0.0)

      GOTO 900
850 CALL CHAHAR(4,1)
      CALL MOVTO2(116.,112.)
      CALL CHAHOL(6HHIGH*.)
      CALL MOVTO2(122.,112.)
      CALL CHAHOL(8HENERGY*.)
      CALL MOVTO2(128.,112.)
      CALL CHAHOL(8HREGIME*.)

      CALL DASHED(1,2.0,1.0,0.0)
      CALL MOVTO2(85.,35.)
      CALL CURTO2(HICURF(1,1),HICURF(1,2),10,0,0)
      CALL MOVTO2(85.,48.)
      CALL CURTO2(HICURG(1,1),HICURG(1,2),8,0,0)
      CALL MOVTO2(85.,61.)
      CALL CURTO2(HICURH(1,1),HICURH(1,2),5,0,0)
      CALL MOVTO2(85.,42.)
      CALL CURTO2(HICURI(1,1),HICURI(1,2),4,0,0)
      CALL MOVTO2(166.,195.)
      CALL CURTO2(HICURJ(1,1),HICURJ(1,2),3,0,0)
      CALL DASHED(0,0.0,0.0,0.0)


900 IF(Q.EQ.2.OR.Q.EQ.3)GOTO902
      CALL CHAHAR(3,0)
      CALL MOVTO2(127.,147.)
      CALL CHAHOL(24HSEPARATION AT 2.70 PHI*.)
      CALL MOVTO2(177.,148.)
      CALL DASHED(1,4.0,2.0,0.0)
      CALL LINBY2(40.,0.)
      CALL MOVTO2(82.,148.)
      CALL LINBY2(40.,0.)
      CALL DASHED(0,0.0,0.0,0.0)
      CALL WINDO2(80.,205.,20.,276.)
      GOTO905
902 CALL WINDO2(80.,205.,20.,145.)
905 CALL PLOT(PLOTX,PLOTY,EMAX,KK,LL,MM)
      IF(M.EQ.1)CALL NUMBER(PLOTX,PLOTY,EMAX)
      ZZZ=1
      CALL CHASWI(0)
      WRITE(2,400)
400 FORMAT(5X,37HDO YOU REQUIRE ANY FURTHER ANALYSES ,)
401 WRITE(2,402)
402 FORMAT(5X,31HPLEASE ANSWER YES(1), OR NO(2).,/)
      READ(1,403)T
403 FORMAT(I1)
      IF(T.LT.1.OR.T.GT.2)GOTO401
      IF(T.EQ.1)GOTO19
      IF(T.EQ.2)CALL DEVEND
      STOP
      END


C SUBROUTINES SHOULD FOLLOW ON FROM HERE
```

```
      SUBROUTINE A4
      CALL MOVTO2(30.,296.)
      CALL LINTO2(32.,296.)
      CALL MOVTO2(236.,296.)
      CALL LINTO2(239.,296.)
      CALL LINTO2(239.,293.)
      CALL MOVTO2(239.,150.)
      CALL LINTO2(239.,146.)
      CALL MOVTO2(239.,3.)
      CALL LINTO2(239.,0.)
      CALL LINTO2(236.,0.)
      CALL MOVTO2(33.,0.)
      CALL LINTO2(30.,0.)
      CALL LINTO2(30.,3.)
      CALL MOVTO2(30.,146.)
      CALL LINTO2(30.,150.)
      CALL MOVTO2(30.,293.)
      CALL LINTO2(30.,296.)
      CALL MOVTO2(42.5,108.5)
      CALL SYMBOL(3)
      CALL MOVTO2(42.5,187.5)
      CALL SYMBOL(3)
      RETURN
      END


      SUBROUTINE TITLE(BORI,X,Y)
      DIMENSION BORI(10)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAARR(BORI,10,4)
      CALL CHASWI(0)
      RETURN
      END


      SUBROUTINE TITL2(LOC,X,Y)
      DIMENSION LOC(5)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAARR(LOC,5,4)
      CALL CHASWI(0)
      RETURN
      END


      SUBROUTINE UNI(X,Y)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAHOL(32HSOILS LAB.  UNIVERSITY OF KEELE*.)
      CALL CHASWI(0)
      RETURN
      END
```

```
      SUBROUTINE BOX(A,B,C,D)
      REAL A,B,C,D
      CALL SHIFT2(0.,0.)
      CALL MOVTO2(A,B)
      CALL LINTO2(A,D)
      CALL LINTO2(C,D)
      CALL LINTO2(C,B)
      CALL LINTO2(A,B)
      RETURN
      END



      SUBROUTINE PLOT(X,Y,N,KK,LL,MM)
      REAL X(50),Y(50)
      INTEGER N,KK,LL,MM
      CALL PENSEL(MM,0.2,2)
      CALL CHAHAR(3,1)
      DO 14 P=1,N
      CALL MOVTO2(X(P),Y(P))
      IF(KK.EQ.09)GOTO13
      CALL SYMBOL(KK)
      GOTO14
   13 CALL DOT(LL)
   14 CONTINUE
      RETURN
      END



      SUBROUTINE NUMBER(X,Y,N)
      REAL X(50),Y(50)
      INTEGER N,M
      M=1
      CALL PENSEL(1,0.2,3)
      DO 6 P=1,N
      CALL MOVTO2(X(P)-1.,Y(P)+0.5)
      CALL CHAHAR(2,1)
      CALL CHAINT(M,2)
      M=M+1
    6 CONTINUE
      CALL PENEND(1,0.2,3)
      CALL CHASWI(0)
      RETURN
      END
```

APPENDIX 2.3.

SILT:CLAY RATIO PLOTS.

Whilst working on energy regime plots Sly et al. (1983, 231) suggested that fractional ratios could be used in a similar way to the moment statistics. This suggestion followed on logically from an earlier study by Pelletier (1973), in which he used silt:clay ratios to define a series of low energy regimes similar to those of later authors (discussed here in appendix 2.2). This earlier technique was also employed in the present study . There are, however, more preconditions to its use, and to fulfil these operational criteria it had to be assumed that :-

i) The nature, composition and provision of material for sedimentation remained fairly constant through time, and throughout the study area, for each unit analysed.

ii) Energy availability was constant in time and space in respect of any given bathymetric zone, that is, where and when a given depth of water occurred, conditions would be similar to those for that water depth at some earlier, and any later, period at any location where these conditions might be replicated.

The technique was primarily employed in the present study to gain a comparative idea of seawater depth, and distance from the shoreline, during the deposition of any given unit.

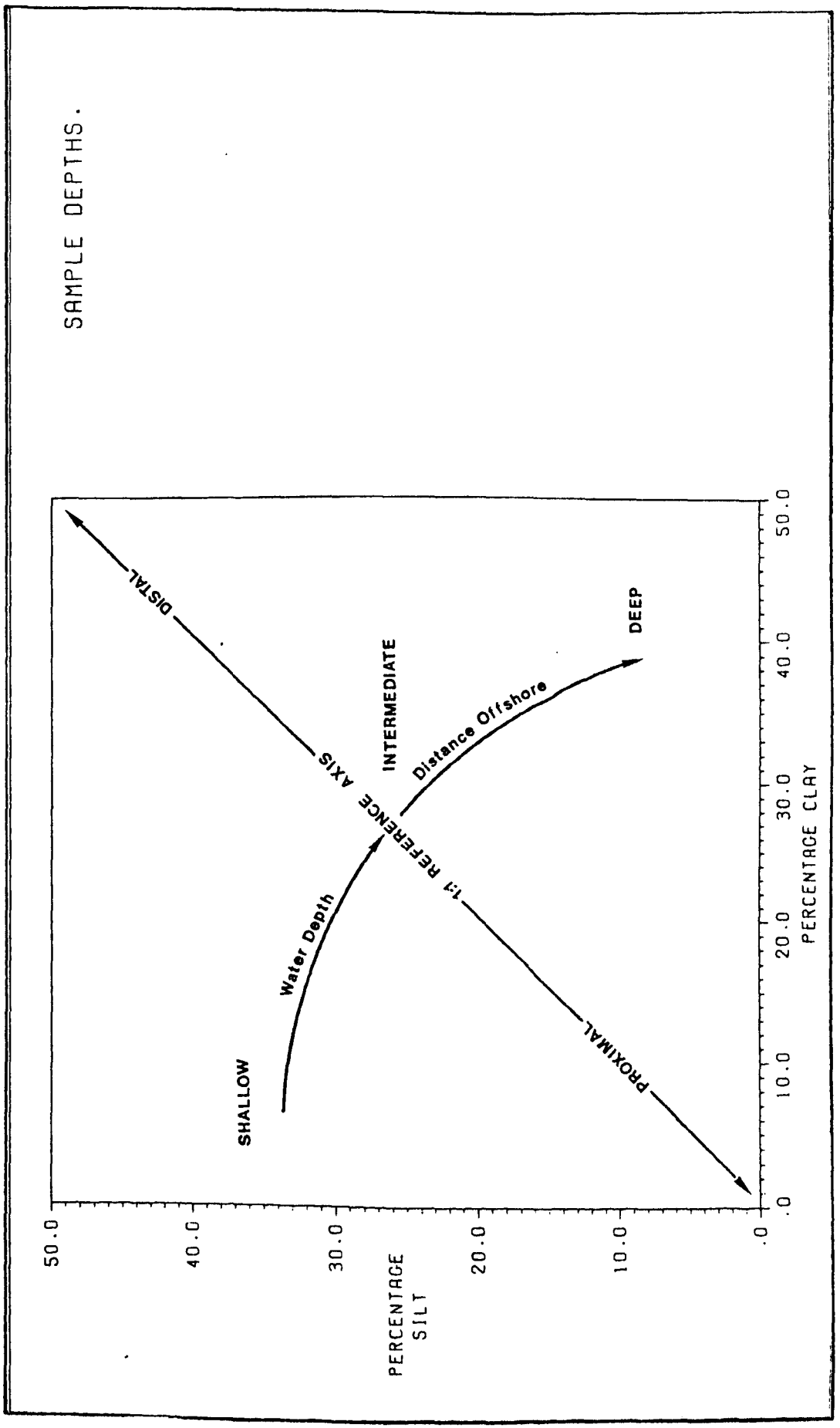
The method of plotting and interpretation is based on that of Pelletier (ibid.), with one important difference. Silt and clay

fractions in the present study are defined according to British Standard 5930 (1981). As such, the silt-clay transition point is placed at 9 phi, as opposed to the 8 phi used in the original study (ibid., fig 2.2.). Silt:clay ratios were calculated from a recalculated sample fine content of 100 %, using the computer program given in appendix 2.3a. This program also plotted the data against phi mean diameter in the manner illustrated by Pelletier (ibid.). Silt:clay ratios exceeding a value of 8.00 were plotted at this level to facilitate easy plotting, as the theoretical limit of ratios is infinity. Moreover, Pelletier stated that the gradient of the asymptotic line above 8.00 was fairly constant, so this appeared to make the most sensible cut-off level.

INTERPRETATION.

Scatter plots from individual units of raw silt:clay percentages (not recalculated to 100%) show the progressive sorting changes between different bathymetric environments, produced by sea level and shore proximity changes. Raw percentages will, generally, be higher in deeper water and at greater distances from the shoreline because of the selective settling out of coarser material closer to land (if no other processes such as current activity or ice rafting are involved). On this basis Pelletier (1973) identified three arbitrary bathymetric zones according to the general grouping of sample points on these plots. The tendency appears to be for the shallowest water sediments (from nearest the shoreline) to plot above a 1:1 axis (see fig 2.3.1.), on the silt side of the graph. There is then a clockwise progression with sediments from intermediate water depths plotting around the 1:1 axis, and deep water sediments (farthest from the shoreline) below the 1:1 axis on the clay side (see fig 2.3.1.). Overall the increasing water depth and distance offshore function

2.3.1. SILT : CLAY PLOTS.



represents a decrease in transportational hydraulic velocity, so the relative position at which a unit plots can, therefore, give some impression of the bathymetric conditions at the time the unit was deposited. The sediments from inshore areas on these plots also tend to cluster closest to the origin. The computer program written to produce these plots is given in appendix 2.3b. Although Pelletier gave specific water depths for his arbitrary zones, they were not used in the present study. The differences in source material, sediment supply and physiographic conditions means the relationship between sediment characteristics and water depth will be completely different in the present study. The same will be true for distance offshore. The bathymetric zones used in the present study are, therefore, comparative measures only and direct depth comparisons cannot be made.

A similar association can be seen on the plots of silt:clay ratio against phi mean diameter. In this instance increasing distance offshore is associated with lower silt:clay ratios and high phi mean diameters. The nearshore deposits, therefore, tend to plot to the left of these diagrams and show the highest silt:clay ratios, whilst more distal sediments plot increasingly farther to the right. Pelletier (ibid.) indicated that this relationship was asymptotic. He also suggested that the coarser sediments were more dispersed around the reference line than finer samples. Ultimately, it would appear that material undergoing transport will tend towards a clay end-member with a silt:clay ratio of zero (ibid., 11). In the same way as raw silt clay plots, therefore, these plots would give an impression of relative distance from the shoreline for each of the units identified in the present study, from which an assessment of formative origin could be made.

APPENDIX 2.3A.

Computer program .PELLET (Fortran 77)

Used to produce silt:clay ratio plots

in the manner described by Pelletier (1973).

```
C*************************************************************************
C
C     A PROGRAMME DESIGNED TO PRODUCE SILT/CLAY RATIO PLOTS
C     FROM RAW SEDIMENTOLOGICAL DATA USING THE METHOD
C     PROPOSED BY B.  R.  PELLETIER (1973).
C
C     WRITTEN BY D.  N.  COCKCROFT, DEPARTMENT OF GEOGRAPHY,
C     UNIVERSITY OF KEELE: SEPTEMBER 1985.
C
C     OUTPUT GRAPHICS ARE PRODUCED ON A FORTRAN-77 GINO
C     GRAPHICS N1051 PLOTTER.
C
C*************************************************************************


      INTEGER ISAMPL(10),CONECT,N,Q,M,KK,KKK,LL,MM,J,P,L
      REAL FILE1(10),DEPTH(50),SILT(50),CLAY(50),MEAN(50),FINE(50)
      REAL SIPE(50),CLPE(50),RATI(50),COORX(50),COORY(50),PHME(7)
      REAL ASCURV(9,2),X,Y,RANO(5),D,V,F,R

      DATA ASCURV/192.5,188.5,182.,174.,162.,158.,143.,119.,94.,
     1180.,165.,140.,115.,90.,85.,80.,76.5,73./
      DATA RANO/0.,2.,4.,6.,8./
      DATA PHME/-2.,0.,2.,4.,6.,8.,10./



      KKK=0
      L=0
      B=0
  100 WRITE(2,11)
   11 FORMAT(//5X,41HTHIS PROGRAMME WILL CO-PLOT SILT AND CLAY,)
      WRITE(2,12)
   12 FORMAT(5X,37HPARAMETERS ACCORDING TO THE METHOD OF,)
      WRITE(2,13)
   13 FORMAT(5X,23HB.  R.  PELLETIER (1973).//)
   14 WRITE(2,15)
   15 FORMAT(5X,40HPLEASE SPECIFY THE SEDIMENTARY DATA FILE,/)
      READ(1,16)FILE1
   16 FORMAT(10A4)
      IERR=CONECT(FILE1,5)
      IF(IERR.EQ.0)GOTO90
      WRITE(2,17)IERR
   17 FORMAT(I1)
      GOTO14
   90 READ(5,101)(ISAMPL(S) ,S=1,10)
  101 FORMAT(10A4)
      READ(5,102)N
  102 FORMAT(I2)
      DO 104 P=1,N
      READ(5,103)DEPTH(P),SILT(P),CLAY(P),MEAN(P)
  103 FORMAT(F6.2,11X,F4.1,1X,F4.1,6X,F4.1)
  104 CONTINUE
      DO 8 P=1,N
      WRITE(2,9)(DEPTH(P),SILT(P),CLAY(P),MEAN(P))
    9 FORMAT(F6.2,2X,F4.1,1X,F4.1,1X,F4.1)
    8 CONTINUE
```

```
      DO 119 P=1,N
      FINE(P)=SILT(P)+CLAY(P)
      SIPE(P)=(SILT(P)/FINE(P))*100.
      CLPE(P)=(CLAY(P)/FINE(P))*100.
      RATI(P)=(SIPE(P)/CLPE(P))
  119 CONTINUE

      DO 105 P=1,N
      RATI(P)=RATI(P)*12.5
      MEAN(P)=MEAN(P)*12.5
  105 CONTINUE
      IF(KKK.EQ.3.AND.M.EQ.1)GOTO39
      IF(KKK.EQ.3.AND.M.NE.1)GOTO29
      WRITE(2,106)
  106 FORMAT(1H ///)

  108 WRITE(2,110)
  110 FORMAT(5X,33HWHICH TYPE OF PLOT DO YOU REQUIRE,)
  109 WRITE(2,111)
  111 FORMAT(5X,22HPLEASE SELECT EITHER:-/)
      WRITE(2,112)
  112 FORMAT(10X,35H1.  PLOT OF ASYMPTOTIC RELATIONSHIP./)
      WRITE(2,113)
  113 FORMAT(10X,34H2.  PLOT OF ARBITRARY ENERGY ZONES./)
      READ(1,114)Q
  114 FORMAT(I1)
      IF(Q.LT.1.OR.Q.GT.2)GOTO109


   29 WRITE(2,30)
   30 FORMAT(2X,42HDO YOU WISH TO IDENTIFY THE SAMPLE DEPTHS./)
   33 WRITE(2,31)
   31 FORMAT(2X,31HPLEASE ANSWER YES(1) OR NO (2)./)
      READ(1,32)M
   32 FORMAT(I1)
      IF(M.LT.1.OR.M.GT.2)GOTO33
      GOTO40


   39 M=2
   40 WRITE(2,41)
   41 FORMAT(2X,40HYOU HAVE THE FOLLOWING CHOICE OF SYMBOLS,/)
      WRITE(2,42)
   42 FORMAT(10X,23H1.  AN UPRIGHT TRIANGLE,/)
      WRITE(2,43)
   43 FORMAT(10X,24H2.  AN INVERTED TRIANGLE,/)
      WRITE(2,44)
   44 FORMAT(10X,18H3.  A PLUS(+) SIGN,/)
      WRITE(2,45)
   45 FORMAT(10X,14H4.  A CROSS(X),/)
      WRITE(2,46)
   46 FORMAT(10X,12H5.  A SQUARE,/)
      WRITE(2,47)
   47 FORMAT(10X,13H6.  A DIAMOND,/)
      WRITE(2,48)
   48 FORMAT(10X,13H7.  A HEXAGON,/)
      WRITE(2,49)
   49 FORMAT(10X,18H8.  AN ASTERISK(*),/)
      WRITE(2,50)
   50 FORMAT(10X,29H9.  A DOT OF SPECIFIED RADIUS,/)
```

```
54 WRITE(2,51)
51 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 9,/)
    READ(1,52)KK
52 FORMAT(I1)
    IF(KK.LT.1.OR.KK.GT.9)GOTO54
    IF(KK.EQ.9)GOTO53
    IF(KK.GE.1.AND.KK.LE.8) LL=0
    GOTO60
53 WRITE(2,55)
55 FORMAT(5X,43HPLEASE SPECIFY THE RADIUS OF THE DOT IN MM,/)
57 READ(1,56)LL
56 FORMAT(I1)


60 WRITE(2,61)
61 FORMAT(5X,40HYOU HAVE THE FOLLOWING CHOICE OF COLOURS,/)
    WRITE(2,62)
62 FORMAT(10X,9H1.  BLACK,/)
    WRITE(2,63)
63 FORMAT(10X,7H2.  RED,/)
    WRITE(2,64)
64 FORMAT(10X,8H3.  BLUE,/)
    WRITE(2,65)
65 FORMAT(10X,9H4.  GREEN,/)
    WRITE(2,66)
66 FORMAT(5X,16HFOR YOUR SYMBOLS,)
69 WRITE(2,67)
67 FORMAT(5X,39HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 4.,/)
    READ(1,68)MM
68 FORMAT(I1)
    IF(MM.LT.1.OR.MM.GT.4)GOTO69
    IF(MM.EQ.3) MM=7
    IF(MM.EQ.4) MM=5


    DO 200 J=1,N
    IF(RATI(J).GT.100.)GOTO201
    COORX(J)=194.-RATI(J)
    GOTO200
201 COORX(J)=94.
200 CONTINUE

    DO 205 J=1,N
    COORY(J)=(MEAN(J)+65.)
205 CONTINUE
    DO 207 P=1,N
    WRITE(2,206)(DEPTH(P),COORX(P),COORY(P))
206 FORMAT(F6.2,2X,F5.1,1X,F5.1)
207 CONTINUE



350 IF(KKK.EQ.0)CALL DEVBEG
    IF(KKK.EQ.1.OR.KKK.EQ.2)GOTO351
    IF(KKK.EQ.3)GOTO503
 351 CALL WINDO2(0.,260.,0.,300.)
    CALL MOVTO2(0.,0.)
    CALL A4
    CALL BOX(80.,20.,219.,276.)
    CALL BOX(66.,35.,73.,155.)
```

```
      CALL CHAHAR(4,1)
      CALL TITLE(ISAMPL,71.,39.)
      CALL CHAHAR(2,1)
      CALL UNI(217.,229.)
      CALL CHAHAR(4,1)

      IF(Q.EQ.2)GOTO498
      CALL MOVTO2(92.,40.)
      CALL LINTO2(194.,40.)
      CALL LINTO2(194.,192.)
      CALL MOVTO2(192.5,180.)
      CALL CURTO2(ASCURV(1,1),ASCURV(1,2),9,0,0)
      GOTO499
498 CALL BOX(92.,40.,194.,192.)
499 X=194.
      Y=40.
      DO 500 J=1,5
      CALL MOVTO2(X,Y)
      CALL LINTO2(X+0.,Y-1.)
      CALL MOVTO2(X+2.,Y-8.)
      CALL CHAFIX(RANO(J),3,0)
      X=X-25.
500 CONTINUE

      CALL MOVTO2(196.,35.)
      CALL CHAHOL(3H0*.)
      X=194.
      Y=40.
      DO 501 J=1,7
      CALL MOVTO2(X,Y)
      CALL LINTO2(X+1.,Y+0.)
      CALL MOVTO2(X+6.,Y-3.)
      CALL CHAFIX(PHME(J),3,0)
      Y=Y+25.
501 CONTINUE
      CALL MOVTO2(200.,64.)
      CALL CHAHOL(3H0*.)
      CALL MOVTO2(209.,92.)
      CALL CHAHOL(19HPHI MEAN DIAMETER*.)
      CALL CHAHAR(4,0)
      CALL MOVTO2(123.,25.)
      CALL CHAHOL(18HSILT/CLAY RATIOS*.)
 503 IF(M.EQ.2)GOTO900
      IF(KKK.EQ.1.OR.KKK.EQ.2)L=0
      IF(L.GE.1)GOTO900
      CALL MOVTO2(92.,205.)
      CALL CHAHAR(4,1)
      CALL CHAHOL(16HSAMPLE DEPTHS.*.)
      CALL CHAHAR(3,1)
      F=102.
      R=188.
      L=1
      DO 821 P=1,N
      CALL MOVTO2(F,R)
      CALL CHAINT(L,2)
      CALL CHAHOL(3H)*.)
      CALL MOVTO2(F,R+7.)
      CALL CHAFIX(DEPTH(P),6,2)
      CALL CHAHOL(3HM*.)
      R=R+28.
```

```
      IF(L.EQ.3)GOTO822
      IF(L.EQ.6)GOTO822
      IF(L.EQ.9)GOTO822
      IF(L.EQ.12)GOTO822
      IF(L.EQ.15)GOTO822
      IF(L.EQ.18)GOTO822
      IF(L.EQ.21)GOTO822
      IF(L.EQ.24)GOTO822
      IF(L.EQ.27)GOTO822
      IF(L.EQ.30)GOTO822
      IF(L.EQ.33)GOTO822
      IF(L.EQ.36)GOTO822
      IF(L.EQ.39)GOTO822
      IF(L.EQ.42)GOTO822
      IF(L.EQ.45)GOTO822
      IF(L.EQ.48)GOTO822
      GOTO823
822   F=F+5.
      R=188.
823   L=L+1
821   CONTINUE

900   CALL WINDO2(80.,196.,35.,195.)
      CALL PLOT(COORX,COORY,N,KK,LL,MM)
      IF(M.EQ.1)CALL NUMBER(COORX,COORY,N)
      IF(KKK.NE.3)GOTO905
      CALL WINDO2(0.,260.,0.,300.)
      D=200.
      IF(B.GE.1)GOTO904
      V=165.
904   CALL MOVTO2(V,D)
      CALL PENSEL(MM,0.2,2)
      CALL SYMBOL(KK)
      CALL MOVTO2(V+1.,D+5.)
      CALL PENSEL(1,0.2,2)
      CALL CHAHAR(3,1)
      CALL TITLE(ISAMPL,V+1.,D+5.)
      V=V+5.
      B=B+1
905   CALL CHASWI(0)

 71   WRITE(2,700)
700   FORMAT(//2X,15HDO YOU WISH TO:,/)
      WRITE(2,701)
701   FORMAT(5X,38H1.  PRODUCE ANOTHER PLOT FROM THE SAME,)
      WRITE(2,702)
702   FORMAT(9X,12HDATA SOURCE.,/)
      WRITE(2,703)
703   FORMAT(5X,41H2.  PRODUCE ANOTHER PLOT FROM A DIFFERENT,)
      WRITE(2,704)
704   FORMAT(9X,12HDATA SOURCE.,/)
      WRITE(2,705)
705   FORMAT(5X,36H3.  PLOT MORE DATA ON THE SAME GRAPH,)
      WRITE(2,706)
706   FORMAT(9X,29HFROM A DIFFERENT DATA SOURCE.,/)
      WRITE(2,707)
707   FORMAT(5X,20H4.  FINISH PLOTTING.,/)
      WRITE(2,708)
708   FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 4,/)
      READ(1,709)KKK
```

```
 709 FORMAT(I1)
     IF(KKK.LT.1.OR.KKK.GT.4)GOTO71
     IF(KKK.EQ.1.OR.KKK.EQ.2)CALL PICCLE
     IF(KKK.EQ.1)GOTO108
     IF(KKK.EQ.2.OR.KKK.EQ.3)GOTO14
     IF(KKK.EQ.4) CALL DEVEND
     STOP
     END


C SUBROUTINES FOLLOW ON HERE



     SUBROUTINE A4
     CALL MOVTO2(30.,296.)
     CALL LINTO2(32.,296.)
     CALL MOVTO2(236.,296.)
     CALL LINTO2(239.,296.)
     CALL LINTO2(239.,293.)
     CALL MOVTO2(239.,150.)
     CALL LINTO2(239.,146.)
     CALL MOVTO2(239.,3.)
     CALL LINTO2(239.,0.)
     CALL LINTO2(236.,0.)
     CALL MOVTO2(33.,0.)
     CALL LINTO2(30.,0.)
     CALL LINTO2(30.,3.)
     CALL MOVTO2(30.,146.)
     CALL LINTO2(30.,150.)
     CALL MOVTO2(30.,293.)
     CALL LINTO2(30.,296.)
     CALL MOVTO2(42.5,108.5)
     CALL SYMBOL(3)
     CALL MOVTO2(42.5,187.5)
     CALL SYMBOL(3)
     RETURN
     END



     SUBROUTINE TITLE(BORI,X,Y)
     DIMENSION BORI(10)
     REAL X,Y
     CALL MOVTO2(X,Y)
     CALL CHAARR(BORI,10,4)
     CALL CHASWI(0)
     RETURN
     END



     SUBROUTINE TITL2(LOC,X,Y)
     DIMENSION LOC(5)
     REAL X,Y
     CALL MOVTO2(X,Y)
     CALL CHAARR(LOC,5,4)
     CALL CHASWI(0)
```

```
      RETURN
      END


      SUBROUTINE UNI(X,Y)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAHOL(32HSOILS LAB.  UNIVERSITY OF KEELE*.)
      CALL CHASWI(0)
      RETURN
      END


      SUBROUTINE BOX(A,B,C,D)
      REAL A,B,C,D
      CALL SHIFT2(0.,0.)
      CALL MOVTO2(A,B)
      CALL LINTO2(A,D)
      CALL LINTO2(C,D)
      CALL LINTO2(C,B)
      CALL LINTO2(A,B)
      RETURN
      END


      SUBROUTINE PLOT(X,Y,N,KK,LL,MM)
      REAL X(50),Y(50)
      INTEGER N,KK,LL,MM
      CALL PENSEL(MM,0.2,2)
      CALL CHAHAR(3,1)
      DO 14 P=1,N
      CALL MOVTO2(X(P),Y(P))
      IF(KK.EQ.09)GOTO13
      CALL SYMBOL(KK)
      GOTO14
   13 CALL DOT(LL)
   14 CONTINUE
      RETURN
      END


      SUBROUTINE NUMBER(X,Y,N)
      REAL X(50),Y(50)
      INTEGER N,M
      M=1
      CALL PENSEL(1,0.2,3)
      DO 6 P=1,N
      CALL MOVTO2(X(P)-1.,Y(P)+0.5)
      CALL CHAHAR(2,1)
      CALL CHAINT(M,2)
      M=M+1
    6 CONTINUE
      CALL PENEND(1,0.2,3)
      CALL CHASWI(0)
      RETURN
      END
```

APPENDIX 2.3B.

Computer program .SEDPLOT (Fortran 77)

Used to plot a variety of sedimentological parameters against each other and against depth.

```
**********************************************************************

  A PROGRAMME DESIGNED TO CO-PLOT A VARIETY OF SEDIMENTARY AND
  GEOTECHNICAL PARAMETERS WITH GINO GRAPHICAL OUTPUT.

   WRITTEN BY M.J.  EDGE AND C.T.  FOSTER, SOILS RESEARCH LAB.,
   UNIVERSITY OF KEELE: AUGUST 1983.

   EXTENDED AND MODIFIED BY D.N.  COCKCROFT, SOILS RESEARCH
   LABORATORY, UNIVERSITY OF KEELE: FEBRUARY 1985.

**********************************************************************


      REAL DEPTH(50),GRAVEL(50),SAND(50),SILT(50),CLAY(50)
      REAL MEDIAN(50),MEAN(50),SORT(50),SKEW(50),KURT(50)
      REAL PLOTX(50),PLOTY(50),LABEL(11),LDEP(11),HMAX,VMAX
      REAL DEP(11),SO(11),SK(11),KU(11),KR(11),SP(11),FILE1(10)
      REAL FILE2(10),GDEP(50),NMC(50),BD(50),DD(50),OCR(50)
      REAL SD(50),BUNIT(50),DUNIT(50),SUNIT(50),POR(50)
      REAL VR(50),SR(50),PL(50),LLT(50),PI(50),LI(50),ACT(50)
      INTEGER CPT(50),TX(50),PPT(50),TOB(50),EOB(50),P,DDD
      REAL CT(50),CP(50),TXPP(50),CPO(50),TXPO(50),PPO(50)
      REAL PLOTZ(50,2),PLOTW(50,2),Q,R,S,CALC(50),DOLO(50)
      INTEGER E,F,C,D,EMAX,ISAMPL(10),CONECT,ISAM(10)
      DATA DEP/0.,1.,2.,3.,4.,5.,6.,7.,8.,9.,10./
      DATA SO/2.5,3.0,3.5,4.0,4.5,5.0,5.5,6.5,0.,0.,0./
      DATA SK/-0.3,-0.1,0.1,0.3,0.5,0.7,0.,0.,0.,0.,0./
      DATA KU/0.6,0.8,1.0,1.2,1.4,1.6,0.,0.,0.,0.,0./
      DATA KR/0.5,1.5,2.5,3.5,4.5,5.5,0.,0.,0.,0.,0./
      DATA SP/1.5,2.5,3.5,4.5,5.5,6.5,0.,0.,0.,0.,0./


C READS IN: SOURCE DATA FILES   SAMPLE IDENTITY (ISAMPL)   NO.  OF
DATA OBSERVATIONS (N)   SEDIMENTARY AND GEOTECHNICAL PARAMETERS

      KKK=0
  100 WRITE(2,11)
   11 FORMAT(//5X,40HTHIS PROGRAMME WILL CO-PLOT A VARIETY OF,)
      WRITE(2,12)
   12 FORMAT(5X,39HSEDIMENTARY AND GEOTECHNICAL PARAMETERS,//)
    8 WRITE(2,13)
   13 FORMAT(5X,40HPLEASE SPECIFY THE SEDIMENTARY DATA FILE,/)
      READ(1,14)FILE1
   14 FORMAT(10A4)
      IERR=CONECT(FILE1,5)
      IF (IERR.EQ.0) GO TO 50
      WRITE(2,16)IERR
   16 FORMAT(I1)
      GO TO 8
   50 WRITE(2,18)
   18 FORMAT(5X,41HPLEASE SPECIFY THE GEOTECHNICAL DATA FILE,/)
      READ(1,19)FILE2
   19 FORMAT(10A4)
      IERR=CONECT(FILE2,3)
      IF (IERR.EQ.0) GO TO 17
      WRITE(2,20)IERR
   20 FORMAT(I1)
      GO TO 50
   17 READ(5,101)(ISAMPL(S) ,S=1,10)
```

```
 101 FORMAT(10A4)
      READ(5,102)N
 102 FORMAT(I2)
      DO 1 P=1,N
      READ(5,103)DEPTH(P),GRAVEL(P),SAND(P),SILT(P),CLAY(P),
     1MEDIAN(P),MEAN(P),SORT(P),SKEW(P),KURT(P),CALC(P),DOLO(P)
 103 FORMAT(F6.2,1X,F4.1,1X,F4.1,1X,F4.1,1X,F4.1,1X,F4.2,1X,
     1F4.2,1X,F4.2,1X,F5.2,1X,F4.2,2X,F5.2,1X,F5.2)


C MULTIPLIES CERTAIN ARRAYS BY SPECIFIED FACTORS TO   FACILITATE
SCALING AND PLOTTING.

      MEDIAN(P)=MEDIAN(P)*10.
      MEAN(P)=MEAN(P)*10.
      SORT(P)=SORT(P)*10.
      SKEW(P)=SKEW(P)*100.
      KURT(P)=KURT(P)*100.
      CALC(P)=CALC(P)*10.
      DOLO(P)=DOLO(P)*10.
   1 CONTINUE

      READ(3,800)(ISAM(S) ,S=1,10)
 800 FORMAT(10A4)
      READ(3,801)E
 801 FORMAT(I2,///////)
      DO 802 P=1,E
      READ(3,803)GDEP(P),NMC(P),BD(P),DD(P),SD(P),BUNIT(P),DUNIT(P),
     1SUNIT(P)
 803 FORMAT(F6.2,1X,F4.1,3X,F4.2,2X,F4.2,2X,F4.2,3X,F5.2,
     12X,F5.2,2X,F5.2)
 802 CONTINUE

      READ(3,820)
 820 FORMAT(//////)
      DO 808 P=1,E
      READ(3,809)POR(P),VR(P),SR(P)
 809 FORMAT(15X,F5.3,1X,F5.3,2X,F5.1)
 808 CONTINUE

      READ(3,821)
 821 FORMAT(//////)
      DO 804 P=1,E
      READ(3,805)PL(P),LLT(P),PI(P),LI(P)
 805 FORMAT(16X,F4.1,5X,F4.1,17X,F4.1,6X,F5.2)
 804 CONTINUE

      READ(3,822)
 822 FORMAT(////////)
      DO 806 P=1,E
      READ(3,807)CPT(P),TX(P),PPT(P),OCR(P),TOB(P),EOB(P),CT(P),CP(P),
     1TXPP(P),CPO(P),TXPO(P),PPO(P)
 807 FORMAT(8X,I3,2X,I3,2X,I3,2X,F4.1,2X,I4,1X,I4,3X,
     1F4.2,3X,F4.2,3X,F4.2,3X,F4.2,3X,F4.2,3X,F4.2)
  53 FORMAT(I3)
 806 CONTINUE

      DO 1000 P=1,E
      DO 1001 PP=1,N
      IF (GDEP(P).EQ.DEPTH(PP)) ACT(P)=PI(P)/CLAY(PP)
```

```
1001 CONTINUE
1000 CONTINUE

     DO 811 P=1,E
     BD(P)=BD(P)*10.
     DD(P)=DD(P)*10.
     SD(P)=SD(P)*10.
     POR(P)=POR(P)*100.
     VR(P)=VR(P)*100.
     LI(P)=LI(P)*100.
     OCR(P)=OCR(P)*10.
     CT(P)=CT(P)*100.
     CP(P)=CP(P)*100.
     TXPP(P)=TXPP(P)*100.
     CPO(P)=CPO(P)*100.
     TXPO(P)=TXPO(P)*100.
     PPO(P)=PPO(P)*100.
     ACT(P)=ACT(P)*100.
 811 CONTINUE
     IF (KKK.EQ.4) GO TO 124

C SELECTION OF THE TYPE OF PLOT REQUIRED AND THE   PARAMETERS TO BE
PLOTTED.

  99 WRITE(2,104)
 104 FORMAT(///3H ,27HYOU HAVE A CHOICE OF PLOTS://)
     WRITE(2,105)
 105 FORMAT(10X,35H1.  PLOT OF VARIABLE X AGAINST DEPTH,//)
     WRITE(2,106)
 106 FORMAT(10X,36H2.  CO-PLOT OF PARAMETERS X AGAINST Y,//)
     GO TO 301
   2 WRITE(2,300)
 300 FORMAT(5X,37HYOUR CHOICE SHOULD BE BETWEEN 1 AND 2,/)
 301 WRITE(2,107)
 107 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 OR 2,//)
     READ(1,108)M
 108 FORMAT(I1)
  52 IF (M.LT.1.OR.M.GT.2) GO TO 2
     IF (M.EQ.1) GOTO 109
     IF (M.EQ.2) GOTO 302
 109 WRITE(2,110)
 110 FORMAT(/48HWHICH VARIABLE DO YOU WISH TO PLOT AGAINST DEPTH,/)
     GOTO 3
 302 WRITE(2,303)
 303 FORMAT(/33HYOU MAY PLOT VARIABLE X AGAINST Y,/)
     CONTINUE
   3 WRITE(2,111)
 111 FORMAT(2X,12H01.  % GRAVEL,11X,16H13.  SAT.  DENSITY,9X,
    115H25.  C.P.T.  DATA,)
     WRITE(2,112)
 112 FORMAT(2X,10H02.  % SAND,13X,16H14.  BULK UNIT W.,9X,
    117H26.  TRIAXIAL DATA,)
     WRITE(2,113)
 113 FORMAT(2X,10H03.  % SILT,13X,15H15.  DRY UNIT W.,10X,
    120H27.  POCKET PEN.  DATA,)
     WRITE(2,114)
 114 FORMAT(2X,10H04.  % CLAY,13X,16H16.  SAT.  UNIT W.,9X,
    112H28.  OCR DATA,)
     WRITE(2,115)
 115 FORMAT(2X,15H05.  MEDIAN G.S.,8X,12H17.  POROSITY,13X,
```

```
     120H29.  CPT/TRIAX.  RATIO,)
      WRITE(2,116)
 116 FORMAT(2X,13H06.  MEAN G.S.,10X,15H18.  VOIDS RATIO,10X,
     117H30.  CPT/PP.  RATIO,)
      WRITE(2,117)
 117 FORMAT(2X,11H07.  SORTING,12X,15H19.  DEGREE SAT.,10X,
     120H31.  TRIAX./PP.  RATIO,)
      WRITE(2,118)
 118 FORMAT(2X,12H08.  SKEWNESS,11X,17H20.  PLASTIC LIMIT,8X,
     117H32.  CPT/Po.  RATIO,)
      WRITE(2,119)
 119 FORMAT(2X,12H09.  KURTOSIS,11X,16H21.  LIQUID LIMIT,9X,
     119H33.  TRIAX/Po.  RATIO,)
      WRITE(2,850)
 850 FORMAT(2X,14H10.  % MOISTURE,9X,17H22.  PLASTIC INDEX,8X,
     117H34.  PP./Po.  RATIO,)
      WRITE(2,851)
 851 FORMAT(2X,16H11.  BULK DENSITY,7X,16H23.  LIQUID INDEX,9X,
     110H35.  T.O.B.,)
      WRITE(2,852)
 852 FORMAT(2X,15H12.  DRY DENSITY,8X,12H24.  ACTIVITY,13X,
     110H36.  E.O.B.,)
      WRITE(2,853)
 853 FORMAT(2X,13H37.  % CALCITE,10X,14H38.  % DOLOMITE,
     111X,16H39.  % CARBONATES,)
      GO TO 120
   4 WRITE(2,304)
 304 FORMAT(5X,39HYOUR CHOICE SHOULD BE BETWEEN 01 AND 39,/)
      IF (L.GE.01.AND.L.LE.39) GO TO 308
 120 IF (M.EQ.1) GOTO 121
      IF (M.EQ.2) GOTO 305
 121 IF (M.EQ.1) L=0
      WRITE(2,122)
 122 FORMAT(5X,40HPLEASE MAKE YOUR CHOICE:SELECT 01 TO 39,)
      READ(1,123)J
 123 FORMAT(I2)
      IF (J.LT.01.OR.J.GT.39) GO TO 4
      GO TO 124
 305 WRITE(2,306)
 306 FORMAT(2X,45HCHOOSE (01 TO 39) THE VARIABLE ON THE X AXIS:,)
      READ(1,307)L
 307 FORMAT(I2)
      IF (L.LT.01.OR.L.GT.39) GOTO 4
 308 WRITE(2,309)
 309 FORMAT(2X,45HCHOOSE (01 TO 39) THE VARIABLE ON THE Y AXIS:,)
      READ(1,310)J
 310 FORMAT(I2)
      IF (J.LT.01.OR.J.GT.39) GOTO 4
      CONTINUE


C PLACES THE CHOSEN PARAMETERS INTO TWO ARRAYS: PLOTX, PLOTY.

C PLOTX CONTAINS THE HORIZONTAL (X) AXIS CO-ORDINATES   PLOTY
CONTAINS THE VERTICAL (Y) AXIS CO-ORDINATES

C REGARDLESS OF THE ORIENTATION OF THE PLOTS ON THE PAPER.

 124 IF (M.EQ.1) GO TO 856
      IF (M.EQ.2) GO TO 857
```

```
856 IF (J.GE.01.AND.J.LE.09) GO TO 860
     IF (J.GE.10.AND.J.LE.36) GO TO 861
     IF (J.GE.37.AND.J.LE.39) GO TO 860

860 DO 36 P=1,N
     PLOTY(P)=0.0-DEPTH(P)
     IF (J.EQ.01) PLOTX(P)=GRAVEL(P)
     IF (J.EQ.02) PLOTX(P)=SAND(P)
     IF (J.EQ.03) PLOTX(P)=SILT(P)
     IF (J.EQ.04) PLOTX(P)=CLAY(P)
     IF (J.EQ.05) PLOTX(P)=MEDIAN(P)
     IF (J.EQ.06) PLOTX(P)=MEAN(P)
     IF (J.EQ.07) PLOTX(P)=SORT(P)
     IF (J.EQ.08) PLOTX(P)=SKEW(P)
     IF (J.EQ.09) PLOTX(P)=KURT(P)
     IF (J.EQ.37) PLOTX(P)=CALC(P)
     IF (J.EQ.38) PLOTX(P)=DOLO(P)
     IF (J.EQ.39) PLOTX(P)=(CALC(P)+DOLO(P))
 36 CONTINUE
     GO TO 30

861 DO 37 P=1,E
     PLOTY(P)=0.0-GDEP(P)
     IF (J.EQ.10) PLOTX(P)=NMC(P)
     IF (J.EQ.11) PLOTX(P)=BD(P)
     IF (J.EQ.12) PLOTX(P)=DD(P)
     IF (J.EQ.13) PLOTX(P)=SD(P)
     IF (J.EQ.14) PLOTX(P)=BUNIT(P)
     IF (J.EQ.15) PLOTX(P)=DUNIT(P)
     IF (J.EQ.16) PLOTX(P)=SUNIT(P)
     IF (J.EQ.17) PLOTX(P)=POR(P)
     IF (J.EQ.18) PLOTX(P)=VR(P)
     IF (J.EQ.19) PLOTX(P)=SR(P)
     IF (J.EQ.20) PLOTX(P)=PL(P)
     IF (J.EQ.21) PLOTX(P)=LLT(P)
     IF (J.EQ.22) PLOTX(P)=PI(P)
     IF (J.EQ.23) PLOTX(P)=LI(P)
     IF (J.EQ.24) PLOTX(P)=ACT(P)
     IF (J.EQ.25) PLOTX(P)=FLOAT(CPT(P))
     IF (J.EQ.26) PLOTX(P)=FLOAT(TX(P))
     IF (J.EQ.27) PLOTX(P)=FLOAT(PPT(P))
     IF (J.EQ.28) PLOTX(P)=OCR(P)
     IF (J.EQ.29) PLOTX(P)=CT(P)
     IF (J.EQ.30) PLOTX(P)=CP(P)
     IF (J.EQ.31) PLOTX(P)=TXPP(P)
     IF (J.EQ.32) PLOTX(P)=CPO(P)
     IF (J.EQ.33) PLOTX(P)=TXPO(P)
     IF (J.EQ.34) PLOTX(P)=PPO(P)
     IF (J.EQ.35) PLOTX(P)=FLOAT(TOB(P))
     IF (J.EQ.36) PLOTX(P)=FLOAT(EOB(P))
 37 CONTINUE
     GO TO 30

857 IF (J.GE.01.AND.J.LE.09) GO TO 862
     IF (J.GE.10.AND.J.LE.36) GO TO 863
     IF (J.GE.37.AND.J.LE.39) GOTO862

862 DO 31 P=1,N
     IF (J.EQ.01) PLOTW(P,2)=GRAVEL(P)
     IF (J.EQ.02) PLOTW(P,2)=SAND(P)
```

```
      IF (J.EQ.03) PLOTW(P,2)=SILT(P)
      IF (J.EQ.04) PLOTW(P,2)=CLAY(P)
      IF (J.EQ.05) PLOTW(P,2)=MEDIAN(P)
      IF (J.EQ.06) PLOTW(P,2)=MEAN(P)
      IF (J.EQ.07) PLOTW(P,2)=SORT(P)
      IF (J.EQ.08) PLOTW(P,2)=SKEW(P)
      IF (J.EQ.09) PLOTW(P,2)=KURT(P)
      IF (J.EQ.37) PLOTW(P,2)=CALC(P)
      IF (J.EQ.38) PLOTW(P,2)=DOLO(P)
      IF (J.EQ.39) PLOTW(P,2)=(CALC(P)+DOLO(P))
      PLOTW(P,1)=DEPTH(P)
   31 CONTINUE
      GO TO 858

  863 DO 33 P=1,E
      IF (J.EQ.10) PLOTW(P,2)=NMC(P)
      IF (J.EQ.11) PLOTW(P,2)=BD(P)
      IF (J.EQ.12) PLOTW(P,2)=DD(P)
      IF (J.EQ.13) PLOTW(P,2)=SD(P)
      IF (J.EQ.14) PLOTW(P,2)=BUNIT(P)
      IF (J.EQ.15) PLOTW(P,2)=DUNIT(P)
      IF (J.EQ.16) PLOTW(P,2)=SUNIT(P)
      IF (J.EQ.17) PLOTW(P,2)=POR(P)
      IF (J.EQ.18) PLOTW(P,2)=VR(P)
      IF (J.EQ.19) PLOTW(P,2)=SR(P)
      IF (J.EQ.20) PLOTW(P,2)=PL(P)
      IF (J.EQ.21) PLOTW(P,2)=LLT(P)
      IF (J.EQ.22) PLOTW(P,2)=PI(P)
      IF (J.EQ.23) PLOTW(P,2)=LI(P)
      IF (J.EQ.24) PLOTW(P,2)=ACT(P)
      IF (J.EQ.25) PLOTW(P,2)=FLOAT(CPT(P))
      IF (J.EQ.26) PLOTW(P,2)=FLOAT(TX(P))
      IF (J.EQ.27) PLOTW(P,2)=FLOAT(PPT(P))
      IF (J.EQ.28) PLOTW(P,2)=OCR(P)
      IF (J.EQ.29) PLOTW(P,2)=CT(P)
      IF (J.EQ.30) PLOTW(P,2)=CP(P)
      IF (J.EQ.31) PLOTW(P,2)=TXPP(P)
      IF (J.EQ.32) PLOTW(P,2)=CPO(P)
      IF (J.EQ.33) PLOTW(P,2)=TXPO(P)
      IF (J.EQ.34) PLOTW(P,2)=PPO(P)
      IF (J.EQ.35) PLOTW(P,2)=FLOAT(TOB(P))
      IF (J.EQ.36) PLOTW(P,2)=FLOAT(EOB(P))
      PLOTW(P,1)=GDEP(P)
   33 CONTINUE
      GO TO 858

  858 IF (L.GE.01.AND.L.LE.09) GO TO 864
      IF (L.GE.10.AND.L.LE.36) GO TO 865
      IF (L.GE.37.AND.L.LE.39) GOTO864

  864 DO 32 P=1,N
      IF (L.EQ.01) PLOTZ(P,2)=GRAVEL(P)
      IF (L.EQ.02) PLOTZ(P,2)=SAND(P)
      IF (L.EQ.03) PLOTZ(P,2)=SILT(P)
      IF (L.EQ.04) PLOTZ(P,2)=CLAY(P)
      IF (L.EQ.05) PLOTZ(P,2)=MEDIAN(P)
      IF (L.EQ.06) PLOTZ(P,2)=MEAN(P)
      IF (L.EQ.07) PLOTZ(P,2)=SORT(P)
      IF (L.EQ.08) PLOTZ(P,2)=SKEW(P)
      IF (L.EQ.09) PLOTZ(P,2)=KURT(P)
```

```
      IF (L.EQ.37) PLOTZ(P,2)=CALC(P)
      IF (L.EQ.38) PLOTZ(P,2)=DOLO(P)
      IF (L.EQ.39) PLOTZ(P,2)=(CALC(P)+DOLO(P))
      PLOTZ(P,1)=DEPTH(P)
   32 CONTINUE
      GO TO 859

  865 DO 34 P=1,E
      IF (L.EQ.10) PLOTZ(P,2)=NMC(P)
      IF (L.EQ.11) PLOTZ(P,2)=BD(P)
      IF (L.EQ.12) PLOTZ(P,2)=DD(P)
      IF (L.EQ.13) PLOTZ(P,2)=SD(P)
      IF (L.EQ.14) PLOTZ(P,2)=BUNIT(P)
      IF (L.EQ.15) PLOTZ(P,2)=DUNIT(P)
      IF (L.EQ.16) PLOTZ(P,2)=SUNIT(P)
      IF (L.EQ.17) PLOTZ(P,2)=POR(P)
      IF (L.EQ.18) PLOTZ(P,2)=VR(P)
      IF (L.EQ.19) PLOTZ(P,2)=SR(P)
      IF (L.EQ.20) PLOTZ(P,2)=PL(P)
      IF (L.EQ.21) PLOTZ(P,2)=LLT(P)
      IF (L.EQ.22) PLOTZ(P,2)=PI(P)
      IF (L.EQ.23) PLOTZ(P,2)=LI(P)
      IF (L.EQ.24) PLOTZ(P,2)=ACT(P)
      IF (L.EQ.25) PLOTZ(P,2)=FLOAT(CPT(P))
      IF (L.EQ.26) PLOTZ(P,2)=FLOAT(TX(P))
      IF (L.EQ.27) PLOTZ(P,2)=FLOAT(PPT(P))
      IF (L.EQ.28) PLOTZ(P,2)=OCR(P)
      IF (L.EQ.29) PLOTZ(P,2)=CT(P)
      IF (L.EQ.30) PLOTZ(P,2)=CP(P)
      IF (L.EQ.31) PLOTZ(P,2)=TXPP(P)
      IF (L.EQ.32) PLOTZ(P,2)=CPO(P)
      IF (L.EQ.33) PLOTZ(P,2)=TXPO(P)
      IF (L.EQ.34) PLOTZ(P,2)=PPO(P)
      IF (L.EQ.35) PLOTZ(P,2)=FLOAT(TOB(P))
      IF (L.EQ.36) PLOTZ(P,2)=FLOAT(EOB(P))
      PLOTZ(P,1)=GDEP(P)

   34 CONTINUE
      GO TO 859

  859 IF (J.GE.01.AND.J.LE.09) F=N
      IF (J.GE.10.AND.J.LE.36) F=E
      IF (J.GE.37.AND.J.LE.39) F=N
      IF (L.GE.01.AND.L.LE.09) C=N
      IF (L.GE.10.AND.L.LE.36) C=E
      IF (L.GE.37.AND.L.LE.39) C=N


      IF(C.EQ.F) D=C
      DDD=0
      DO 1200 P=1,D
      IF(PLOTZ(P,1).EQ.PLOTW(P,1)) DDD=DDD+1
  1200 CONTINUE
      IF(DDD.NE.D)GOTO1210
      DO 1205 P=1,D
      PLOTY(P)=PLOTZ(P,2)
      PLOTX(P)=PLOTW(P,2) 1205 CONTINUE
      GOTO1220 1210 D=1
      DO 60 P=1,C
      DO 70 PP=1,F
```

```
      IF (PLOTZ(P,1).EQ.PLOTW(PP,1)) PLOTY(D)=PLOTZ(P,2)
      IF (PLOTZ(P,1).EQ.PLOTW(PP,1)) PLOTX(D)=PLOTW(PP,2)
      IF (PLOTZ(P,1).EQ.PLOTW(PP,1)) D=D+1
   70 CONTINUE
   60 CONTINUE

 1220 DO 71 P=1,D
      PLOTX(P)=PLOTX(P)*(-1)
   71 CONTINUE
      IF (KKK.EQ.4) GO TO 1002

   30 IF (M.EQ.1.AND.J.GE.01.AND.J.LE.09) GO TO 41
      IF (M.EQ.1.AND.J.GE.37.AND.J.LE.39) GOTO41
      IF (M.EQ.1.AND.J.GE.10.AND.J.LE.36) GO TO 42
      IF (M.EQ.2) GO TO 43

   41 EMAX=N
      GO TO 44
   42 EMAX=E
      GO TO 44
   43 EMAX=D
      WRITE(2,617)EMAX
  617 FORMAT(7HEMAX = ,I2)
      GO TO 44
   44 DO 73 P=1,EMAX
      IF (P.GT.1.AND.M.EQ.1) GO TO 72
      IF (P.GT.1.AND.M.EQ.2) GO TO 74
      HMAX=PLOTX(1)
      VMAX=PLOTY(1)
      GO TO 73
   72 IF (HMAX.LE.PLOTX(P)) HMAX=PLOTX(P)
      IF (VMAX.GE.PLOTY(P)) VMAX=PLOTY(P)
      GO TO 73
   74 IF (HMAX.GE.PLOTX(P)) HMAX=PLOTX(P)
      IF (VMAX.LE.PLOTY(P)) VMAX=PLOTY(P)
      GO TO 73
   73 CONTINUE

      IF (M.EQ.1) VMAX=VMAX*(-1)
      IF (M.EQ.2) HMAX=HMAX*(-1)



C PLACES THE ANNOTATION OF THE AXES INTO TWO ARRAYS: LDEP, LABEL.

C LDEP PLACES THE SCALE ALONG THE HORIZONTAL (X) AXIS   LABEL PLACES
THE SCALE ALONG THE VERTICAL (Y) AXIS

C AGAIN REGARDLESS OF PLOT ORIENTATION ON THE PAPER.

      DO 6 K=1,11
      IF (M.EQ.2) GOTO 127
      IF (VMAX.LE.10.31) LDEP(K)=DEP(K)
      IF (VMAX.GT.10.31.AND.VMAX.LE.20.0) LDEP(K)=DEP(K)*2.
      IF (VMAX.GT.20.0.AND.VMAX.LE.50.0) LDEP(K)=DEP(K)*5.
      IF (VMAX.GT.50.0.AND.VMAX.LE.105.0) LDEP(K)=DEP(K)*10.
      IF (VMAX.GT.105.0.AND.VMAX.LE.230.0) LDEP(K)=DEP(K)*20.
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127 IF(J.EQ.28.AND.HMAX.LE.100.) LABEL(K)=DEP(K)*2.
     IF (J.EQ.28.AND.HMAX.GT.100.) LABEL(K)=DEP(K)*4.
     IF (J.EQ.28.AND.HMAX.GT.200.)LABEL(K)=DEP(K)*20.0
     IF (J.GE.1.AND.J.LE.04.AND.HMAX.LE.50.) LABEL(K)=DEP(K)*10.
     IF (J.GE.1.AND.J.LE.04.AND.HMAX.GT.50.) LABEL(K)=DEP(K)*20.
     IF (J.EQ.5.OR.J.EQ.6) LABEL(K)=DEP(K)*2.
     IF (J.EQ.7.AND.HMAX.LE.50.) LABEL(K)=SO(K)
     IF (J.EQ.7.AND.HMAX.GT.50.) LABEL(K)=SP(K)
     IF (J.EQ.8) LABEL(K)=SK(K)
     IF (J.EQ.9.AND.HMAX.LE.160.) LABEL(K)=KU(K)
     IF (J.EQ.9.AND.HMAX.GT.160.) LABEL(K)=KR(K)
     IF (J.EQ.10) LABEL(K)=DEP(K)*10.
     IF (J.EQ.11.OR.J.EQ.13) LABEL(K)=(DEP(K)/5.)+1.5
     IF (J.EQ.12) LABEL(K)=(DEP(K)/5.)+1.1
     IF (J.EQ.14.OR.J.EQ.16) LABEL(K)=(DEP(K)*2.)+15.
     IF (J.EQ.15) LABEL(K)=(DEP(K)*2.)+11.
     IF (J.EQ.17) LABEL(K)=DEP(K)/5.
     IF (J.EQ.18) LABEL(K)=KU(K)-0.4
     IF (J.EQ.19) LABEL(K)=(DEP(K)*10.)+75.
     IF (J.GE.20.AND.J.LE.22) LABEL(K)=DEP(K)*10.
     IF (J.EQ.23) LABEL(K)=(SK(K)*2.)-0.4
     IF (J.GE.25.AND.J.LE.27) LABEL(K)=DEP(K)*100.
     IF (J.EQ.24.OR.(J.GE.29.AND.J.LE.31)) LABEL(K)=DEP(K)/2.5
     IF (J.GE.32.AND.J.LE.34) LABEL(K)=DEP(K)
     IF (J.GE.35.AND.J.LE.36.AND.HMAX.LE.250.) LABEL(K)=DEP(K)*50.
     IF (J.GE.35.AND.J.LE.36.AND.HMAX.GT.250.AND.HMAX.LE.500.)
    1LABEL(K)=DEP(K)*100.
     IF (J.GE.35.AND.J.LE.36.AND.HMAX.GT.500.AND.HMAX.LE.1000.)
    1LABEL(K)=DEP(K)*200.
     IF (J.GE.35.AND.J.LE.36.AND.HMAX.GT.1000.) LABEL(K)=DEP(K)*400.
     IF (J.EQ.37.OR.J.EQ.38.AND.HMAX.LE.100.) LABEL(K)=DEP(K)*2.
     IF (J.EQ.37.OR.J.EQ.38.AND.HMAX.GT.100.) LABEL(K)=DEP(K)*4.
     IF (J.EQ.39.AND.HMAX.LE.100.) LABEL(K)=DEP(K)*2.
     IF (J.EQ.39.AND.HMAX.GT.100.) LABEL(K)=DEP(K)*5.
     IF (M.EQ.1) GOTO 6
     IF (L.EQ.28.AND.HMAX.LE.10.) LDEP(K)=DEP(K)*2.
     IF (L.EQ.28.AND.HMAX.GT.10.) LDEP(K)=DEP(K)*4.
     IF (L.GE.1.AND.L.LE.04.AND.VMAX.LE.50.) LDEP(K)=DEP(K)*10.
     IF (L.GE.1.AND.L.LE.04.AND.VMAX.GT.50.) LDEP(K)=DEP(K)*20.
     IF (L.EQ.5.OR.L.EQ.6) LDEP(K)=DEP(K)*2.
     IF (L.EQ.7.AND.VMAX.LE.50.) LDEP(K)=SO(K)
     IF (L.EQ.7.AND.VMAX.GT.50.) LDEP(K)=SP(K)
     IF (L.EQ.8) LDEP(K)=SK(K)
     IF (L.EQ.9.AND.VMAX.LE.160.) LDEP(K)=KU(K)
     IF (L.EQ.9.AND.VMAX.GT.160.) LDEP(K)=KR(K)
     IF (L.EQ.10) LDEP(K)=DEP(K)*10.
     IF (L.EQ.11.OR.L.EQ.13) LDEP(K)=(DEP(K)/5.)+1.5
     IF (L.EQ.12) LDEP(K)=(DEP(K)/5.)+1.1
     IF (L.EQ.14.OR.L.EQ.16) LDEP(K)=(DEP(K)*2.)+15.
     IF (L.EQ.15) LDEP(K)=(DEP(K)*2.)+11.
     IF (L.EQ.17) LDEP(K)=DEP(K)/5.
     IF (L.EQ.18) LDEP(K)=KU(K)-0.4
     IF (L.EQ.19) LDEP(K)=(DEP(K)*10.)+75.
     IF (L.GE.20.AND.L.LE.22) LDEP(K)=DEP(K)*10.
     IF (L.EQ.23) LDEP(K)=(SK(K)*2.)-0.4
     IF (L.GE.25.AND.L.LE.27) LDEP(K)=DEP(K)*100.
     IF (L.EQ.24.OR.(L.GE.29.AND.L.LE.31)) LDEP(K)=DEP(K)/2.5
     IF (L.GE.32.AND.L.LE.34) LDEP(K)=DEP(K)
     IF (L.GE.35.AND.L.LE.36.AND.VMAX.LE.250.) LDEP(K)=DEP(K)*50.
     IF (L.GE.35.AND.L.LE.36.AND.VMAX.GT.250.AND.HMAX.LE.500.)
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     1LDEP(K)=DEP(K)*100.
      IF (L.GE.35.AND.L.LE.36.AND.VMAX.GT.500.AND.VMAX.LE.1000.)
     1LDEP(K)=DEP(K)*200.
      IF (L.GE.35.AND.L.LE.36.AND.VMAX.GT.1000.) LDEP(K)=DEP(K)*400.
      IF (L.EQ.37.OR.L.EQ.38.AND.VMAX.LE.100.) LDEP(K)=DEP(K)*2.
      IF (L.EQ.37.OR.L.EQ.38.AND.VMAX.GT.100.) LDEP(K)=DEP(K)*4.
      IF (L.EQ.39.AND.VMAX.LE.100.) LDEP(K)=DEP(K)*2.
      IF (L.EQ.39.AND.VMAX.GT.100.) LDEP(K)=DEP(K)*5.
    6 CONTINUE


C SELECTION OF THE METHOD OF PLOTTING (LINES AND/OR SYMBOLS)

 1002 WRITE(2,128)
  128 FORMAT(2X,20HDO YOU WISH TO PLOT:,/)
      WRITE(2,129)
  129 FORMAT(5X,39H1.  WITH A STRAIGHT LINE BETWEEN POINTS,/)
      WRITE(2,130)
  130 FORMAT(5X,16H2.  WITH SYMBOLS,/)
      WRITE(2,131)
  131 FORMAT(5X,42H3.  WITH SYMBOLS JOINED BY A STRAIGHT LINE,//)
  311 WRITE(2,132)
  132 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 3,//)
      READ(1,133)JJ
  133 FORMAT(I1)
      IF (JJ.LT.1.OR.JJ.GT.3) GO TO 311
      IF (JJ.EQ.1) KK=0
      IF (JJ.EQ.1) GO TO 134
      IF (JJ.EQ.3) GO TO 404
      IF (JJ.EQ.2.AND.M.EQ.1)GO TO 404
      WRITE(2,400)
  400 FORMAT(2X,39HDO YOU WISH TO IDENTIFY THE DATA POINTS,/)
      WRITE(2,401)
  401 FORMAT(5X,27HIF YES TYPE 1; IF NO TYPE 2,/)
      READ(1,402)JJJ
  402 FORMAT(I1)
      IF (JJJ.EQ.1) JJ=4
  404 WRITE(2,312)
  312 FORMAT(2X,40HYOU HAVE THE FOLLOWING CHOICE OF SYMBOLS,/)
      WRITE(2,313)
  313 FORMAT(10X,23H1.  AN UPRIGHT TRIANGLE,/)
      WRITE(2,314)
  314 FORMAT(10X,24H2.  AN INVERTED TRIANGLE,/)
      WRITE(2,315)
  315 FORMAT(10X,18H3.  A PLUS(+) SIGN,/)
      WRITE(2,316)
  316 FORMAT(10X,14H4.  A CROSS(X),/)
      WRITE(2,317)
  317 FORMAT(10X,12H5.  A SQUARE,/)
      WRITE(2,318)
  318 FORMAT(10X,13H6.  A DIAMOND,/)
      WRITE(2,319)
  319 FORMAT(10X,13H7.  A HEXAGON,/)
      WRITE(2,320)
  320 FORMAT(10X,18H8.  AN ASTERISK(*),/)
      WRITE(2,321)
  321 FORMAT(10X,29H9.  A DOT OF SPECIFIED RADIUS,/)
      WRITE(2,322)
  322 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 9,/)
      READ(1,323)KK
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 323 FORMAT(I1)
      IF (KK.EQ.9) GO TO 324
      IF (KK.GE.1.AND.KK.LE.8) LL=0
      GOTO 134
 324 WRITE(2,325)
 325 FORMAT(5X,43HPLEASE SPECIFY THE RADIUS OF THE DOT IN MM,/)
      READ(1,326)LL
 326 FORMAT(I1)


C SELECTION OF THE COLOUR(S) OF THE LINE AND/OR SYMBOLS.

 134 WRITE(2,135)
 135 FORMAT(5X,40HYOU HAVE THE FOLLOWING CHOICE OF COLOURS,/)
      WRITE(2,136)
 136 FORMAT(10X,9H1.  BLACK,/)
      WRITE(2,137)
 137 FORMAT(10X,7H2.  RED,/)
      WRITE(2,138)
 138 FORMAT(10X,8H3.  BLUE,/)
      WRITE(2,139)
 139 FORMAT(10X,9H4.  GREEN,/)
      IF (JJ.EQ.1.OR.JJ.EQ.2.OR.JJ.EQ.4) GO TO 140
      IF (JJ.EQ.3) GO TO 144
 140 WRITE(2,141)
 141 FORMAT(5X,21HFOR YOUR LINE/SYMBOLS,)
      WRITE(2,142)
 142 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 4,/)
      READ(1,143)MM
 143 FORMAT(I1)
      IF (MM.LT.1.OR.MM.GT.4) GOTO 140
      IF (JJ.EQ.1.OR.JJ.EQ.2.OR.JJ.EQ.4) NN=0
      GOTO 7
 144 WRITE(2,145)
 145 FORMAT(5X,47HCHOOSE THE COLOUR OF THE SYMBOLS: SELECT 1 TO 4,/)
      READ(1,146)MM
 146 FORMAT(I1)
      IF (MM.LT.1.OR.MM.GT.4) GO TO 144
 147 WRITE(2,148)
 148 FORMAT(5X,51HPLEASE CHOOSE THE COLOUR OF THE LINE: SELECT 1 TO
4,)
      READ(1,149)NN
 149 FORMAT(I1)
      IF (NN.LT.1.OR.NN.GT.4) GO TO 147
   7 CONTINUE
      IF (MM.EQ.3) MM=7
      IF (NN.EQ.3) NN=7
      IF (MM.EQ.4) MM=5
      IF (NN.EQ.4) NN=5



      IF (KKK.EQ.0) CALL DEVBEG
      IF (M.EQ.2) GO TO 90

C PLOT OF VARIABLE X AGAINST DEPTH.

C SIZE OF BOXES, POSITION OF AXES, SCALING FACTORS AND   LABEL
INTERVALS ARE ALL SPECIFIED HERE WHILST USING   COMMON SUBROUTINES.
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      IF (KKK.EQ.3.OR.KKK.EQ.4) GO TO 82
      CALL BOX(80.,20.,219.,260.)
      CALL BOX(80.,265.,219.,276.)
      CALL AXI(105.,35.,205.,235.)
      IF (J.EQ.08) CALL AXI(135.,235.,135.,35.)
      IF (J.EQ.09.AND.HMAX.LE.160.) CALL AXI(145.,235.,145.,35.)
      IF(J.EQ.09.AND.HMAX.GT.160.) CALL AXI(115.,235.,115.,35.)
      IF (J.EQ.19.OR.J.EQ.23) CALL AXI(155.,235.,155.,35.)
      IF (J.GE.29.AND.J.LE.31) CALL AXI(155.,235.,155.,35.)
      IF (J.EQ.28.AND.HMAX.LE.10.) CALL AXI(115.,235.,115.,35.)
      IF (J.EQ.28.AND.HMAX.GT.10.) CALL AXI(110.,235.,110.,35.)
      IF (J.GE.32.AND.J.LE.34) CALL AXI(125.,235.,125.,35.)
      CALL CHAHAR(4,0)
      CALL TITLE(ISAMPL,100.,269.)
      CALL CHAHAR(2,0)
      CALL UNI(172.,22.)
      CALL CHAHAR(3,0)
      CALL ANNO(105.,235.,200.,10,100,2,2,LDEP)
      CALL ANNO(105.,235.,100.,5,100,1,2,LABEL)
      CALL NAME(J,L,M,126.,245.,90.,126.)
   82 CALL WINDO2(102.,205.,22.,238.)
      IF (J.EQ.07.AND.HMAX.LE.50.) CALL AXIPOS(5.,235.)
      IF (J.EQ.07.AND.HMAX.GT.50.) CALL AXIPOS(75.,235.)
      IF (J.EQ.08) CALL AXIPOS(135.,235.)
      IF (J.EQ.09.AND.HMAX.LE.160.) CALL AXIPOS(45.,235.)
      IF (J.EQ.09.AND.HMAX.GT.160.) CALL AXIPOS(95.,235.)
      IF (J.GE.01.AND.J.LE.06) CALL AXIPOS(105.,235.)
      IF (J.EQ.10.OR.J.EQ.17.) CALL AXIPOS(105.,235.)
      IF (J.GE.20.AND.J.LE.22) CALL AXIPOS(105.,235.)
      IF (J.GE.24.AND.J.LE.36) CALL AXIPOS(105.,235.)
      IF (J.GE.37.AND.J.LE.39) CALL AXIPOS(105.,235.)
      IF (J.EQ.11.OR.J.EQ.13.OR.J.EQ.14) CALL AXIPOS(-45.,235.)
      IF (J.EQ.16.OR.J.EQ.19) CALL AXIPOS(-45.,235.)
      IF (J.EQ.12.OR.J.EQ.15) CALL AXIPOS(-5.,235.)
      IF (J.EQ.18) CALL AXIPOS(85.,235.)
      IF (J.EQ.23) CALL AXIPOS(155.,235.)
      CALL CALIB(J,L,M,HMAX,VMAX,A,B)
      CALL PLOT(PLOTX,PLOTY,EMAX,J,L,JJ,KK,LL,MM,NN)
      CALL TRANSF(2)
      GOTO 91


C CO-PLOT OF VARIABLES X AGAINST Y.

C SIZE OF BOXES, POSITION OF AXES, SCALING FACTORS AND   LABEL
INTERVALS ARE ALL SPECIFIED HERE WHILST USING   COMMON SUBROUTINES.

   90 IF (KKK.EQ.3.OR.KKK.EQ.4) GO TO 83
      CALL BOX(80.,20.,219.,276.)
      CALL BOX(87.,56.,207.,176.)
      CALL BOX(66.,35.,73.,155.)
      IF (J.EQ.08) CALL AXI(171.,56.,171.,176.)
      IF (J.EQ.09.AND.HMAX.LE.160.) CALL AXI(159.,56.,159.,176.)
      IF (J.EQ.09.AND.HMAX.GT.160.) CALL AXI(195.,56.,195.,176.)
      IF (L.EQ.08) CALL AXI(207.,92.,87.,92.)
      IF (L.EQ.09.AND.VMAX.LE.160.) CALL AXI(207.,104.,87.,104.)
      IF (L.EQ.09.AND.VMAX.GT.160.) CALL AXI(207.,68.,87.,68.)
      IF (J.EQ.19.OR.J.EQ.23) CALL AXI(147.,56.,147.,176.)
      IF (J.GE.29.AND.J.LE.31) CALL AXI(147.,56.,147.,176.)
      IF (L.EQ.19.OR.L.EQ.23) CALL AXI(207.,116.,87.,116.)
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      IF (L.GE.29.AND.L.LE.31) CALL AXI(207.,116.,87.,116.)
      IF (J.GE.32.AND.J.LE.34) CALL AXI(183.,56.,183.,176.)
      IF (L.GE.32.AND.L.LE.34) CALL AXI(207.,80.,87.,80.)
      IF (J.EQ.28.AND.HMAX.LE.10.) CALL AXI(195.,56.,195.,176.)
      IF (J.EQ.28.AND.HMAX.GT.10.) CALL AXI(201.,56.,201.,176.)
      IF (L.EQ.28.AND.VMAX.LE.10.) CALL AXI(207.,68.,87.,68.)
      IF (L.EQ.28.AND.VMAX.GT.10.) CALL AXI(207.,62.,87.,62.)
      CALL CHAHAR(4,1)
      CALL TITLE(ISAMPL,71.,39.)
      CALL CHAHAR(2,1)
      CALL UNI(217.,229.)
      CALL CHAHAR(3,1)
      CALL ANNO1(207.,56.,120.,5,100,2,2,LDEP)
      CALL ANNO1(207.,56.,120.,5,100,1,2,LABEL)
      CALL NAME(J,L,M,147.,25.,216.5,87.)
      IF(JJ.EQ.4)GOTO87
      GOTO83
87    CALL MOVTO2(92.,205.)
      CALL CHAHAR(4,1)
      CALL CHAHOL(16HSAMPLE DEPTHS.*.)
      CALL CHAHAR(3,1)
      Q=102.
      R=188.
      DO 89 P=1,N
      CALL MOVTO2(Q,R)
      CALL CHAINT(P,2)
      CALL CHAHOL(3H)*.)
      CALL MOVTO2(Q,R+7.)
      CALL CHAFIX(DEPTH(P),6,2)
      CALL CHAHOL(3Hm*.)
      R=R+28.
      IF(P.EQ.3)GOTO85
      IF(P.EQ.6)GOTO85
      IF(P.EQ.9)GOTO85
      IF(P.EQ.12)GOTO85
      IF(P.EQ.15)GOTO85
      IF(P.EQ.18)GOTO85
      IF(P.EQ.21)GOTO85
      IF(P.EQ.24)GOTO85
      IF(P.EQ.27)GOTO85
      IF(P.EQ.30)GOTO85
      IF(P.EQ.33)GOTO85
      IF(P.EQ.36)GOTO85
      IF(P.EQ.39)GOTO85
      IF(P.EQ.42)GOTO85
      IF(P.EQ.45)GOTO85
      IF(P.EQ.48)GOTO85
      GOTO89
85    Q=Q+5.
      R=188.
89    CONTINUE
83    CALL WINDO2(84.,210.,53.,179.)
      IF (J.GE.01.AND.J.LE.06) X=207.
      IF (L.GE.01.AND.L.LE.06) Y=56.
      IF (J.EQ.07.AND.HMAX.LE.50.) X=327.
      IF (J.EQ.07.AND.HMAX.GT.50.) X=243.
      IF (L.EQ.07.AND.VMAX.LE.50.) Y=-64.
      IF (L.EQ.07.AND.VMAX.GT.50.) Y=20.
      IF (J.EQ.08) X=171.
      IF (L.EQ.08) Y=92.
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      IF (J.EQ.09.AND.HMAX.LE.160.) X=279.
      IF (J.EQ.09.AND.HMAX.GT.160.) X=219.
      IF (L.EQ.09.AND.VMAX.LE.160.) Y=-16.
      IF (L.EQ.09.AND.VMAX.GT.160.) Y=44.
      IF (J.EQ.10.OR.J.EQ.17) X=207.
      IF (L.EQ.10.OR.L.EQ.17) Y=56.
      IF (J.EQ.11.OR.J.EQ.13.OR.J.EQ.14) X=387.
      IF (L.EQ.11.OR.L.EQ.13.OR.L.EQ.14) Y=-124.
      IF (J.EQ.12.OR.J.EQ.15) X=339.
      IF (L.EQ.12.OR.L.EQ.15) Y=-76.
      IF (J.EQ.16.OR.J.EQ.19) X=387.
      IF (L.EQ.16.OR.L.EQ.19) Y=-124.
      IF (J.EQ.18) X=231.
      IF (L.EQ.18) Y=32.
      IF (J.GE.20.AND.J.LE.22) X=207.
      IF (L.GE.20.AND.L.LE.22) Y=56.
      IF (J.EQ.23) X=147.
      IF (L.EQ.23) Y=116.
      IF (J.GE.24.AND.J.LE.36) X=207.
      IF (L.GE.24.AND.L.LE.36) Y=56.
      IF (J.GE.37.AND.J.LE.39) X=207.
      IF (L.GE.37.AND.L.LE.39) Y=56.
      CALL AXIPOS(X,Y)
      CALL CALIB(J,L,M,HMAX,VMAX,A,B)
      CALL PLOT(PLOTX,PLOTY,EMAX,J,L,JJ,KK,LL,MM,NN)
      IF (JJ.EQ.4) CALL NUMBER(PLOTX,PLOTY,EMAX,A,B,J,L)
      CALL TRANSF(2)

 91 WRITE(2,500)
500 FORMAT(//2X,15HDO YOU WISH TO:,/)
      WRITE(2,501)
501 FORMAT(5X,38H1.  PRODUCE ANOTHER PLOT FROM THE SAME,)
      WRITE(2,502)
502 FORMAT(9X,12HDATA SOURCE.,/)
      WRITE(2,503)
503 FORMAT(5X,41H2.  PRODUCE ANOTHER PLOT FROM A DIFFERENT,)
      WRITE(2,504)
504 FORMAT(9X,12HDATA SOURCE.,/)
      WRITE(2,505)
505 FORMAT(5X,36H3.  PLOT MORE DATA ON THE SAME GRAPH,)
      WRITE(2,506)
506 FORMAT(9X,26HFROM THE SAME DATA SOURCE.,/)
      WRITE(2,507)
507 FORMAT(5X,36H4.  PLOT MORE DATA ON THE SAME GRAPH,)
      WRITE(2,508)
508 FORMAT(9X,29HFROM A DIFFERENT DATA SOURCE.,/)
      WRITE(2,509)
509 FORMAT(5X,20H5.  FINISH PLOTTING.,/)
      WRITE(2,510)
510 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 5,/)
      READ(1,511)KKK
511 FORMAT(I1)
      IF (KKK.EQ.1.OR.KKK.EQ.2) CALL PICCLE
      IF (KKK.EQ.1) GO TO 99
      IF (KKK.EQ.3) GO TO 52
      IF (KKK.EQ.2.OR.KKK.EQ.4) GO TO 8
      IF (KKK.EQ.5) CALL DEVEND
      STOP
      END
```

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C SUBROUTINE TO DELIMIT THE BOUNDARIES OF AN A4 PAGE   ON THE
PLOTTING PAPER.    N.B.  THE ORIGIN IS (30.,0.)

      SUBROUTINE A4
      CALL MOVTO2(30.,296.)
      CALL LINTO2(32.,296.)
      CALL MOVTO2(236.,296.)
      CALL LINTO2(239.,296.)
      CALL LINTO2(239.,293.)
      CALL MOVTO2(239.,150.)
      CALL LINTO2(239.,146.)
      CALL MOVTO2(239.,3.)
      CALL LINTO2(239.,0.)
      CALL LINTO2(236.,0.)
      CALL MOVTO2(33.,0.)
      CALL LINTO2(30.,0.)
      CALL LINTO2(30.,3.)
      CALL MOVTO2(30.,146.)
      CALL LINTO2(30.,150.)
      CALL MOVTO2(30.,293.)
      CALL LINTO2(30.,296.)
      CALL MOVTO2(42.5,108.5)
      CALL SYMBOL(3)
      CALL MOVTO2(42.5,187.5)
      CALL SYMBOL(3)
      RETURN
      END


C PRINTS THE TITLE OF THE PLOT IN ANY SPECIFIED POSITION.

      SUBROUTINE TITLE(ISAM,X,Y)
      DIMENSION ISAM(10)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAARR(ISAM,10,4)
      CALL CHASWI(0)
      RETURN
      END


C PRINTS THE SOILS LAB.  ID.  IN ANY SPECIFIED POSITION.

      SUBROUTINE UNI(X,Y)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAHOL(32HSOILS LAB.  UNIVERSITY OF KEELE*.)
      CALL CHASWI(0)
      RETURN
      END


C DRAWS A BOX OF ANY SPECIFIED DIMENSIONS INCLUDING C A4
DELIMITATION.

      SUBROUTINE BOX(A,B,C,D)
      REAL A,B,C,D
      CALL WINDO2(0.,260.,0.,300.)
      CALL SHIFT2(0.,0.)
      CALL A4
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      CALL MOVTO2(A,B)
      CALL LINTO2(A,D)
      CALL LINTO2(C,D)
      CALL LINTO2(C,B)
      CALL LINTO2(A,B)
      RETURN
      END


C DRAWS TWO AXES FROM AND TO SPECIFIED POSITIONS.

      SUBROUTINE AXI(X,Y,Z,W)
      REAL X,Y,Z,W
      CALL MOVTO2(X,Y)
      CALL LINTO2(X,W)
      CALL LINTO2(Z,W)
      RETURN
      END


C PRINTS THE NAMES OF THE PARAMETERS PLOTTED ALONG THE   HORIZONTAL
AND VERTICAL AXES IN ANY SPECIFIED POSITIONS.

      SUBROUTINE NAME(J,L,M,X,Y,Z,W)
      INTEGER J,L,M
      REAL X,Y,Z,W

      IF (M.EQ.1) GO TO 8
      IF (M.EQ.2) GO TO 11

    8 IF (J.EQ.19.OR.J.EQ.28.OR.J.EQ.30) X=X+5.
      IF (J.EQ.34.OR.J.EQ.35) X=X+5.
      IF (J.EQ.16.OR.J.EQ.27.OR.J.EQ.29.OR.J.EQ.33) X=X+7.
      IF (J.EQ.07.OR.J.GE.10.AND.J.LE.15.OR.J.EQ.26) X=X+9.
      IF (J.EQ.01.OR.J.EQ.05.OR.J.GE.20.AND.J.LE.22) X=X+12.
      IF (J.GE.02.AND.J.LE.04.OR.J.EQ.06.OR.J.EQ.18) X=X+14.
      IF (J.EQ.23.OR.J.EQ.25) X=X+14.
      IF (J.EQ.17.OR.J.EQ.24) X=X+16.
      IF (J.EQ.08.OR.J.EQ.09) X=X+21.
      IF (J.EQ.37.OR.J.EQ.38) X=X+9.
      IF (J.EQ.39) X=X+7.
      GOTO 7

    7 CALL MOVTO2(X,Y)
      IF (M.EQ.1) CALL CHAHAR(3,0)
      IF (M.EQ.2) CALL CHAHAR(3,1)

      IF (M.EQ.2) GO TO 11

      IF (J.EQ.01) CALL CHAHOL(19HPERCENTAGE GRAVEL*.)
      IF (J.EQ.02) CALL CHAHOL(17HPERCENTAGE SAND*.)
      IF (J.EQ.03) CALL CHAHOL(17HPERCENTAGE SILT*.)
      IF (J.EQ.04) CALL CHAHOL(17HPERCENTAGE CLAY*.)
      IF (J.EQ.05) CALL CHAHOL(19HMEDIAN GRAIN SIZE*.)
      IF (J.EQ.06) CALL CHAHOL(17HMEAN GRAIN SIZE*.)
      IF (J.EQ.07) CALL CHAHOL(21HSORTING COEFFICIENT*.)
      IF (J.EQ.08) CALL CHAHOL(10HSKEWNESS*.)
      IF (J.EQ.09) CALL CHAHOL(10HKURTOSIS*.)
      IF (J.EQ.10) CALL CHAHOL(22HMOISTURE CONTENT (%)*.)
      IF (J.EQ.11) CALL CHAHOL(21HWET DENSITY (g/cm3)*.)
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      IF (J.EQ.12) CALL CHAHOL(21HDRY DENSITY (g/cm3)*.)
      IF (J.EQ.13) CALL CHAHOL(22HSAT.  DENSITY (g/cm3)*.)
      IF (J.EQ.14) CALL CHAHOL(22HWET UNIT WT.  (kN/m3)*.)
      IF (J.EQ.15) CALL CHAHOL(22HDRY UNIT WT.  (kN/m3)*.)
      IF (J.EQ.16) CALL CHAHOL(23HSAT.  UNIT WT.  (kN/m3)*.)
      IF (J.EQ.17) CALL CHAHOL(14HPOROSITY (n)*.)
      IF (J.EQ.18) CALL CHAHOL(17HVOIDS RATIO (e)*.)
      IF (J.EQ.19) CALL CHAHOL(26HDEGREE OF SATURATION (%)*.)
      IF (J.EQ.20) CALL CHAHOL(19HPLASTIC LIMIT (%)*.)
      IF (J.EQ.21) CALL CHAHOL(18HLIQUID LIMIT (%)*.)
      IF (J.EQ.22) CALL CHAHOL(18HPLASTICITY INDEX*.)
      IF (J.EQ.23) CALL CHAHOL(17HLIQUIDITY INDEX*.)
      IF (J.EQ.24) CALL CHAHOL(15HCLAY ACTIVITY*.)
      IF (J.EQ.25) CALL CHAHOL(17HSu: CPT (kN/m2)*.)
      IF (J.EQ.26) CALL CHAHOL(22HSu: TRIAXIAL (kN/m2)*.)
      IF (J.EQ.27) CALL CHAHOL(24HSu: PCKT.  PEN.  (kN/m2)*.)
      IF (J.EQ.28) CALL CHAHOL(25HOVERCONSOLIDATION RATIO*.)
      IF (J.EQ.29) CALL CHAHOL(24HSu: CPT/TRIAXIAL RATIO*.)
      IF (J.EQ.30) CALL CHAHOL(26HSu: CPT/PCKT.  PEN.  RATIO*.)
      IF (J.EQ.31) CALL CHAHOL(31HSu: TRIAXIAL/PCKT.  PEN.  RATIO*.)
      IF (J.EQ.32) CALL CHAHOL(19HSu (CPT)/Po RATIO*.)
      IF (J.EQ.33) CALL CHAHOL(24HSu (TRIAXIAL)/Po RATIO*.)
      IF (J.EQ.34) CALL CHAHOL(26HSu (PCKT.  PEN.)/Po RATIO*.)
      IF (J.EQ.35) CALL CHAHOL(26HTOTAL OVERBURDEN (kN/m2)*.)
      IF (J.EQ.36) CALL CHAHOL(30HEFFECTIVE OVERBURDEN (kN/m2)*.)
      IF (J.EQ.37) CALL CHAHOL(20HPERCENTAGE CALCITE*.)
      IF (J.EQ.38) CALL CHAHOL(21HPERCENTAGE DOLOMITE*.)
      IF (J.EQ.39) CALL CHAHOL(23HPERCENTAGE CARBONATES*.)

      IF (M.EQ.1) GO TO 13

   11 IF (J.GE.01.AND.J.LE.04) GO TO 1
      IF (J.EQ.05.OR.J.EQ.06) GO TO 2
      IF (J.EQ.07) GO TO 3
      IF (J.EQ.08.OR.J.EQ.09) GO TO 4
      IF (J.EQ.10) GO TO 5
      IF (J.GE.11.AND.J.LE.13) GO TO 20
      IF (J.GE.14.AND.J.LE.16) GO TO 21
      IF (J.EQ.17) GO TO 22
      IF (J.EQ.18) GO TO 23
      IF (J.EQ.19) GO TO 24
      IF (J.EQ.20.OR.J.EQ.21) GO TO 25
      IF (J.EQ.22.OR.J.EQ.23) GO TO 26
      IF (J.EQ.24) GO TO 27
      IF (J.GE.25.AND.J.LE.27) GO TO 28
      IF (J.EQ.28) GO TO 29
      IF (J.GE.29.AND.J.LE.34) GO TO 30
      IF (J.EQ.35.OR.J.EQ.36) GO TO 31
      IF (J.GE.37.AND.J.LE.39) GOTO32

    1 CALL MOVTO2(X-1.0,Y+3.0)
      CALL CHAHOL(12HPERCENTAGE*.)
      CALL MOVTO2(X+3.0,Y+7.0)
      IF (J.EQ.01) CALL CHAHOL(8HGRAVEL*.)
      IF (J.EQ.02) CALL CHAHOL(8H SAND *.)
      IF (J.EQ.03) CALL CHAHOL(8H SILT *.)
      IF (J.EQ.04) CALL CHAHOL(8H CLAY *.)
      GO TO 12
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 2 CALL MOVTO2(X-1.0,Y+7.0)
   IF (J.EQ.05) CALL CHAHOL(8HMEDIAN*.)
   IF (J.EQ.06) CALL CHAHOL(8H MEAN *.)
   CALL MOVTO2(X+3.0,Y+3.0)
   CALL CHAHOL(12HGRAIN SIZE*.)
   GO TO 12

 3 CALL MOVTO2(X-1.0,Y+6.0)
   CALL CHAHOL(9HSORTING*.)
   CALL MOVTO2(X+3.0,Y+2.0)
   CALL CHAHOL(13HCOEFFICIENT*.)
   GO TO 12

 4 CALL MOVTO2(X,Y)
   IF (J.EQ.8) CALL CHAHOL(10HSKEWNESS*.)
   IF (J.EQ.9) CALL CHAHOL(10HKURTOSIS*.)
   GO TO 12

 5 CALL MOVTO2(X-3.0,Y+5.0)
   CALL CHAHOL(10HMOISTURE*.)
   CALL MOVTO2(X+1.0,Y+6.0)
   CALL CHAHOL(9HCONTENT*.)
   CALL MOVTO2(X+5.0,Y+10.0)
   CALL CHAHOL(5H(%)*.)
   GO TO 12

20 CALL MOVTO2(X-1.0,Y+1.0)
   IF (J.EQ.11) CALL CHAHOL(13HWET DENSITY*.)
   IF (J.EQ.12) CALL CHAHOL(13HDRY DENSITY*.)
   IF (J.EQ.13) CALL CHAHOL(14HSAT.  DENSITY*.)
   CALL MOVTO2(X+3.0,Y+6.0)
   CALL CHAHOL(9H(G/CM3)*.)
   GO TO 12

21 CALL MOVTO2(X-1.0,Y)
   IF (J.EQ.14) CALL CHAHOL(14HWET UNIT WT.*.)
   IF (J.EQ.15) CALL CHAHOL(14HDRY UNIT WT.*.)
   IF (J.EQ.16) CALL CHAHOL(15HSAT.  UNIT WT.*.)
   CALL MOVTO2(X+3.0,Y+6.0)
   CALL CHAHOL(9H(KN/M3)*.)
   GO TO 12

22 CALL MOVTO2(X-1.0,Y+5.0)
   CALL CHAHOL(10HPOROSITY*.)
   CALL MOVTO2(X+3.0,Y+10.)
   CALL CHAHOL(5H(N)*.)
   GO TO 12

23 CALL MOVTO2(X-1.0,Y+2.0)
   CALL CHAHOL(13HVOIDS RATIO*.)
   CALL MOVTO2(X+3.0,Y+10.0)
   CALL CHAHOL(5H(E)*.)
   GO TO 12

24 CALL MOVTO2(X-3.0,Y+4.0)
   CALL CHAHOL(11HDEGREE OF*.)
   CALL MOVTO2(X+1.0,Y+3.0)
   CALL CHAHOL(12HSATURATION*.)
   CALL MOVTO2(X+5.0,Y+10.0)
   CALL CHAHOL(5H(%)*.)
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      GO TO 12

   25 CALL MOVTO2(X-3.0,Y+6.0)
      IF (J.EQ.20) CALL CHAHOL(9HPLASTIC*.)
      IF (J.EQ.21) CALL CHAHOL(8HLIQUID*.)
      CALL MOVTO2(X+1.0,Y+8.0)
      CALL CHAHOL(7HLIMIT*.)
      CALL MOVTO2(X+5.0,Y+10.0)
      CALL CHAHOL(5H(%)*.)
      GO TO 12

   26 CALL MOVTO2(X-1.0,Y+3.0)
      IF (J.EQ.22) CALL CHAHOL(12HPLASTICITY*.)
      IF (J.EQ.23) CALL CHAHOL(11HLIQUIDITY*.)
      CALL MOVTO2(X+3.0,Y+8.0)
      CALL CHAHOL(7HINDEX*.)
      GO TO 12

   27 CALL MOVTO2(X-1.0,Y+9.0)
      CALL CHAHOL(6HCLAY*.)
      CALL MOVTO2(X+3.0,Y+5.0)
      CALL CHAHOL(10HACTIVITY*.)
      GO TO 12

   28 CALL MOVTO2(X-3.0,Y+10.0)
      CALL CHAHOL(5HSU:*.)
      IF (J.EQ.25) CALL MOVTO2(X+1.0,Y+10.0)
      IF (J.EQ.25) CALL CHAHOL(5HCPT*.)
      IF (J.EQ.26) CALL MOVTO2(X+1.0,Y+5.0)
      IF (J.EQ.26) CALL CHAHOL(10HTRIAXIAL*.)
      IF (J.EQ.27) CALL MOVTO2(X+1.0,Y+3.0)
      IF (J.EQ.27) CALL CHAHOL(12HPCKT.  PEN.*.)
      CALL MOVTO2(X+5.0,Y+6.0)
      CALL CHAHOL(9H(KN/M2)*.)
      GO TO 12

   29 CALL MOVTO2(X+1.0,Y+10.0)
      CALL CHAHOL(5HOCR*.)
      GO TO 12

   30 CALL MOVTO2(X-3.0,Y+10.0)
      CALL CHAHOL(5HSU:*.)
      IF (J.EQ.29) CALL MOVTO2(X+1.0,Y+1.0)
      IF (J.EQ.29) CALL CHAHOL(14HCPT/TRIAXIAL*.)
      IF (J.EQ.30.OR.J.EQ.33) CALL MOVTO2(X+1.0,Y+2.0)
      IF (J.EQ.30) CALL CHAHOL(13HCPT/P.  PEN.*.)
      IF (J.EQ.33) CALL CHAHOL(13HTRIAXIAL/PO*.)
      IF (J.EQ.31) CALL MOVTO2(X+1.0,Y)
      IF (J.EQ.32) CALL MOVTO2(X+1.0,Y+7.0)
      IF (J.EQ.34) CALL MOVTO2(X+1.0,Y+3.0)
      IF (J.EQ.31) CALL CHAHOL(15HTRIAX/P.  PEN.*.)
      IF (J.EQ.32) CALL CHAHOL(8HCPT/PO*.)
      IF (J.EQ.34) CALL CHAHOL(12HP.  PEN./PO*.)
      CALL MOVTO2(X+5.0,Y+8.0)
      CALL CHAHOL(7HRATIO*.)
      GO TO 12

   31 IF (J.EQ.36) CALL MOVTO2(X-3.0,Y+4.0)
      IF (J.EQ.35) CALL MOVTO2(X-3.0,Y+8.0)
      IF (J.EQ.36) CALL CHAHOL(11HEFFECTIVE*.)
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      IF (J.EQ.35) CALL CHAHOL(7HTOTAL*.)
      CALL MOVTO2(X+1.0,Y+3.0)
      CALL CHAHOL(12HOVERBURDEN*.)
      CALL MOVTO2(X+5.0,Y+6.0)
      CALL CHAHOL(9H(KN/M2)*.)
      GO TO 12

   32 CALL MOVTO2(X-1.,Y+3.)
      CALL CHAHOL(12HPERCENTAGE*.)
      IF(J.EQ.37) CALL MOVTO2(X+3.,Y+7.)
      IF(J.EQ.37) CALL CHAHOL(9HCALCITE*.)
      IF(J.EQ.38) CALL MOVTO2(X+3.,Y+6.)
      IF(J.EQ.38) CALL CHAHOL(10HDOLOMITE*.)
      IF(J.EQ.39) CALL MOVTO2(X+3.,Y+0.)
      IF(J.EQ.39) CALL CHAHOL(12HCARBONATES*.)
      GOTO12

   12 IF (L.EQ.19.OR.L.EQ.28.OR.L.EQ.30) W=W+5.
      IF (L.EQ.34.OR.L.EQ.35) W=W+5.
      IF (L.EQ.16.OR.L.EQ.27.OR.L.EQ.29.OR.L.EQ.33) W=W+7.
      IF (L.EQ.07.OR.L.GE.10.AND.L.LE.15.OR.L.EQ.26) W=W+9.
      IF (L.EQ.01.OR.L.EQ.05.OR.L.GE.20.AND.L.LE.22) W=W+12.
      IF (L.GE.02.AND.L.LE.04.OR.L.EQ.06.OR.L.EQ.18) W=W+14.
      IF (L.EQ.23.OR.L.EQ.25) W=W+14.
      IF (L.EQ.17.OR.L.EQ.24) W=W+16.
      IF (L.EQ.08.OR.L.EQ.09) W=W+21.
      IF (L.EQ.37.OR.L.EQ.38) W=W+9.
      IF (L.EQ.39) W=W+7.

      CALL MOVTO2(Z,W)
      IF (L.EQ.01) CALL CHAHOL(19HPERCENTAGE GRAVEL*.)
      IF (L.EQ.02) CALL CHAHOL(17HPERCENTAGE SAND*.)
      IF (L.EQ.03) CALL CHAHOL(17HPERCENTAGE SILT*.)
      IF (L.EQ.04) CALL CHAHOL(17HPERCENTAGE CLAY*.)
      IF (L.EQ.05) CALL CHAHOL(19HMEDIAN GRAIN SIZE*.)
      IF (L.EQ.06) CALL CHAHOL(17HMEAN GRAIN SIZE*.)
      IF (L.EQ.07) CALL CHAHOL(21HSORTING COEFFICIENT*.)
      IF (L.EQ.08) CALL CHAHOL(10HSKEWNESS*.)
      IF (L.EQ.09) CALL CHAHOL(10HKURTOSIS*.)
      IF (L.EQ.10) CALL CHAHOL(22HMOISTURE CONTENT (%)*.)
      IF (L.EQ.11) CALL CHAHOL(21HWET DENSITY (g/cm3)*.)
      IF (L.EQ.12) CALL CHAHOL(21HDRY DENSITY (g/cm3)*.)
      IF (L.EQ.13) CALL CHAHOL(22HSAT.  DENSITY (g/cm3)*.)
      IF (L.EQ.14) CALL CHAHOL(22HWET UNIT WT.  (kN/m3)*.)
      IF (L.EQ.15) CALL CHAHOL(22HDRY UNIT WT.  (kN/m3)*.)
      IF (L.EQ.16) CALL CHAHOL(23HSAT.  UNIT WT.  (kN/m3)*.)
      IF (L.EQ.17) CALL CHAHOL(14HPOROSITY (n)*.)
      IF (L.EQ.18) CALL CHAHOL(17HVOIDS RATIO (e)*.)
      IF (L.EQ.19) CALL CHAHOL(26HDEGREE OF SATURATION (%)*.)
      IF (L.EQ.20) CALL CHAHOL(19HPLASTIC LIMIT (%)*.)
      IF (L.EQ.21) CALL CHAHOL(18HLIQUID LIMIT (%)*.)
      IF (L.EQ.22) CALL CHAHOL(18HPLASTICITY INDEX*.)
      IF (L.EQ.23) CALL CHAHOL(17HLIQUIDITY INDEX*.)
      IF (L.EQ.24) CALL CHAHOL(15HCLAY ACTIVITY*.)
      IF (L.EQ.25) CALL CHAHOL(17HSu: CPT (kN/m2)*.)
      IF (L.EQ.26) CALL CHAHOL(22HSu: TRIAXIAL (kN/m2)*.)
      IF (L.EQ.27) CALL CHAHOL(24HSu: PCKT.  PEN.  (kN/m2)*.)
      IF (L.EQ.28) CALL CHAHOL(25HOVERCONSOLIDATION RATIO*.)
      IF (L.EQ.29) CALL CHAHOL(24HSu: CPT/TRIAXIAL RATIO*.)
      IF (L.EQ.30) CALL CHAHOL(26HSu: CPT/PCKT.  PEN.  RATIO*.)
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      IF (L.EQ.31) CALL CHAHOL(31HSu: TRIAXIAL/PCKT.  PEN.  RATIO*.)
      IF (L.EQ.32) CALL CHAHOL(19HSu (CPT)/Po RATIO*.)
      IF (L.EQ.33) CALL CHAHOL(24HSu (TRIAXIAL)/Po RATIO*.)
      IF (L.EQ.34) CALL CHAHOL(26HSu (PCKT.  PEN.)/Po RATIO*.)
      IF (L.EQ.35) CALL CHAHOL(26HTOTAL OVERBURDEN (kN/m2)*.)
      IF (L.EQ.36) CALL CHAHOL(30HEFFECTIVE OVERBURDEN (kN/m2)*.)
      IF (L.EQ.37) CALL CHAHOL(20HPERCENTAGE CALCITE*.)
      IF (L.EQ.38) CALL CHAHOL(21HPERCENTAGE DOLOMITE*.)
      IF (L.EQ.39) CALL CHAHOL(23HPERCENTAGE CARBONATES*.)
      CALL CHASWI(0)
      GO TO 6

   13 CALL CHAHAR(3,1)
      CALL MOVTO2(Z,W-11.)
      CALL CHAHOL(22HSUB-BOTTOM DEPTH (M)*.)
      CALL CHASWI(0)
    6 CONTINUE
      RETURN
      END


C DASHES AND SCALES BOTH THE HORIZONTAL AND VERTICAL AXES   FOR A
PLOT DRAWN WHERE THE X AXIS IS PARALLEL TO THE   HORIZONTAL.

      SUBROUTINE ANNO(X,Y,ALEN,INT,MAX,ID,INN,LAB)
      DIMENSION AINT(150),DASH(200)
      REAL X,Y,ALEN,LAB(12)
      INTEGER INT,MAX,INN,ID C
      C=ALEN/FLOAT(INT)
      DO 10 K=1,INT
      AINT(K)=C*K
   10 CONTINUE
      D=FLOAT(MAX/INN)
      EE=ALEN/D
      LL=IFIX(D)
      DO 7 KK=1,LL
      DASH(KK)=EE*FLOAT(KK)
    7 CONTINUE
      IF (ID.EQ.1)GO TO 25
      YY=Y
      DO 8 MM=1,LL
      YYY=YY-DASH(MM)
      CALL MOVTO2(X-0.8,YYY)
      CALL LINTO2(X,YYY)
    8 CONTINUE
      XPO=X-12.0
      CALL MOVTO2(XPO,Y-1)
      CALL CHAFIX(LAB(1),5,1)
      CALL MOVTO2(X-1.5,Y)
      CALL LINTO2(X,Y)
      M=2
      DO 20 L=1,INT
      YO=Y-AINT(L)
      CALL MOVTO2(XPO,YO-1)
      CALL CHAFIX(LAB(M),5,1)
      CALL MOVTO2(X-1.5,YO)
      CALL LINTO2(X,YO)
      M=M+1
   20 CONTINUE
      GO TO 30
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 25 XX=X
    DO 9 II=1,LL
    XXX=XX+DASH(II)
    CALL MOVTO2(XXX,Y+0.8)
    CALL LINTO2(XXX,Y)
  9 CONTINUE

    YPO=Y+2.5
    CALL MOVTO2(X-9.0,YPO)
    CALL CHAFIX(LAB(1),6,1)
    CALL MOVTO2(X,Y+1.5)
    CALL LINTO2(X,Y)
    M=2
    DO 30 L=1,INT
    XO=X+AINT(L)
    CALL MOVTO2(XO-9.0,YPO)
    CALL CHAFIX(LAB(M),6,1)
    CALL MOVTO2(XO,Y+1.5)
    CALL LINTO2(XO,Y)
    M=M+1
 30 CONTINUE
    RETURN
    END


C MOVES THE PLOTTING PEN TO THE SPECIFIED ORIGIN   OF THE PARAMETERS
TO BE PLOTTED.

      SUBROUTINE AXIPOS(XAXI,YAXI)
      REAL XAXI, YAXI
      CALL MOVTO2(XAXI,YAXI)
      CALL SHIFT2(XAXI,YAXI)
      RETURN
      END


C DASHES AND SCALES BOTH THE HORIZONTAL AND VERTICAL AXES   FOR A
PLOT DRAWN WHERE THE X AXIS IS NORMAL TO THE   HORIZONTAL.

      SUBROUTINE ANNO1(X,Y,ALEN,INT,MAX,ID,INN,LAB)
      DIMENSION AINT(150),DASH(200)
      REAL X,Y,ALEN,LAB(12)
      INTEGER INT,MAX,INN,ID

      C=ALEN/FLOAT(INT)
      DO 10 K=1,INT
      AINT(K)=C*K
 10 CONTINUE
      D=FLOAT(MAX/INN)
      EE=ALEN/D
      LL=IFIX(D)
      DO 7 KK=1,LL
      DASH(KK)=EE*FLOAT(KK)
  7 CONTINUE
      IF (ID.EQ.1) GO TO 25
      YY=Y
      DO 8 MM=1,LL
      YYY=YY+DASH(MM)
      CALL MOVTO2(X+0.8,YYY)
      CALL LINTO2(X,YYY)
```

```
 8 CONTINUE
    XPO=X+5.0
    CALL MOVTO2(XPO,Y-10.0)
    CALL CHAFIX(LAB(1),6,1)
    CALL MOVTO2(X+1.5,Y)
    CALL LINTO2(X,Y)
    M=2
    DO 20 L=1,INT
    YO=Y+AINT(L)
    CALL MOVTO2(XPO,YO-10.0)
    CALL CHAFIX(LAB(M),6,1)
    CALL MOVTO2(X+1.5,YO)
    CALL LINTO2(X,YO)
    M=M+1
20 CONTINUE
    GO TO 30
25 XX=X
    DO 9 II=1,LL
    XXX=XX-DASH(II)
    CALL MOVTO2(XXX,Y-0.8)
    CALL LINTO2(XXX,Y)
 9 CONTINUE

    YPO=Y-15.0
    CALL MOVTO2(X+1.0,YPO)
    CALL CHAFIX(LAB(1),6,1)
    CALL MOVTO2(X,Y-1.5)
    CALL LINTO2(X,Y)
    M=2
    DO 30 L=1,INT
    XO=X-AINT(L)
    CALL MOVTO2(XO+1.0,YPO)
    CALL CHAFIX(LAB(M),6,1)
    CALL MOVTO2(XO,Y-1.5)
    CALL LINTO2(XO,Y)
    M=M+1
30 CONTINUE
    RETURN
    END


C THIS PLOTS THE DATA POINTS AS EITHER A LINE OR AS SYMBOLS   WITH
THE CHOICE OF COLOUR(S) AS SPECIFIED IN THE MAIN   PROGRAMME.

      SUBROUTINE PLOT(X,Y,N,J,L,JJ,KK,LL,MM,NN)
      REAL X(50),Y(50)
      INTEGER N,J,L,JJ,KK,LL,MM,NN

      IF (L.EQ.0) GO TO 1
      IF (L.NE.0) GO TO 20

 1 CALL MOVTO2(X(1),Y(1))
      IF (J.GE.10.AND.J.LE.21) GO TO 2
      IF (J.GE.23.AND.J.LE.36) GO TO 2
      IF (JJ.EQ.1) GO TO 11
      IF (JJ.GE.2.AND.JJ.LE.4) GO TO 12

11 IF (JJ.EQ.1) CALL PENSEL(MM,0.2,2)
      IF (JJ.EQ.3) CALL PENSEL(NN,0.2,2)
      IF (JJ.EQ.3) CALL MOVTO2(X(1),Y(1))
```

```
      CALL POLTO2(X,Y,N)
      IF (JJ.EQ.1) CALL PENEND(MM,0.2,2)
      IF (JJ.EQ.3) CALL PENEND(NN,0.2,2)
      GO TO 10

   12 CALL PENSEL(MM,0.2,2)
      DO 14 P=1,N
      IF (JJ.EQ.2.OR.JJ.EQ.4) CALL CHAHAR(3,1)
      IF (JJ.EQ.3) CALL CHAHAR(3,0)
      CALL MOVTO2(X(P),Y(P))
      IF (KK.EQ.09) GO TO 13
      CALL SYMBOL(KK)
      GO TO 14
   13 CALL DOT(LL)
   14 CONTINUE
      CALL PENEND(MM,0.2,2)
      IF (JJ.EQ.3) GO TO 11
      GO TO 10

    2 DO 5 P=1,N
      CALL MOVTO2(X(P),Y(P))
      PP=P
      P=N
    5 CONTINUE
      IF (JJ.EQ.1) GO TO 6
      IF (JJ.GE.2.AND.JJ.LE.4) GO TO 8

    6 IF (JJ.EQ.1) CALL PENSEL(MM,0.2,2)
      IF (JJ.EQ.3) CALL PENSEL(NN,0.2,2)
      P=PP+1
      DO 7 III=P,N
      IF (X(III).EQ.0) GO TO 7
      CALL LINTO2(X(III),Y(III))
    7 CONTINUE
      IF (JJ.EQ.1) CALL PENEND(MM,0.2,2)
      IF (JJ.EQ.3) CALL PENEND(NN,0.2,2)
      GO TO 10

    8 CALL PENSEL(MM,0.2,2)
      DO 9 II=PP,N
      IF (X(II).EQ.0) GO TO 9
      IF (X(II).NE.0) CALL MOVTO2(X(II),Y(II))
      IF (JJ.EQ.2.OR.JJ.EQ.4) CALL CHAHAR(3,1)
      IF (JJ.EQ.3) CALL CHAHAR(3,0)
      IF (KK.EQ.09) GO TO 15
      CALL SYMBOL(KK)
      GO TO 9
   15 CALL DOT(LL)
    9 CONTINUE
      CALL PENEND(MM,0.2,2)
      IF (JJ.EQ.3) GO TO 6
      GO TO 10


   20 CALL PENSEL(MM,0.2,2)
      DO 21 P=1,N
      CALL MOVTO2(X(P),Y(P))
      IF (KK.EQ.09) GO TO 22
      CALL SYMBOL(KK)
      GO TO 21
```

```
 22 CALL DOT(LL)
 21 CONTINUE
      CALL PENEND(MM,0.2,2)
      GO TO 10

 10 CONTINUE
      RETURN
      END


C THIS CHOOSES VARIABLE SCALES ACCORDING TO THE MAXIMUM   VALUES OF
THE PARAMETERS TO BE PLOTTED.

      SUBROUTINE CALIB(J,L,M,H,V,A,B)
      REAL H,V,A,B
      INTEGER J,L,M

      IF (M.EQ.1) GO TO 1
      IF (M.EQ.2) GO TO 2

    1 IF (J.EQ.28.AND.H.LE.100.) A=1.
      IF (J.EQ.28.AND.H.GT.100.) A=0.5
      IF (J.EQ.28.AND.H.GT.200.) A=0.1
      IF (J.GE.01.AND.J.LE.04.AND.H.LE.50.) A=2.
      IF (J.GE.01.AND.J.LE.04.AND.H.GT.50.) A=1.
      IF (J.EQ.5.OR.J.EQ.6.OR.J.EQ.8) A=1.
      IF (J.EQ.7.AND.H.LE.50.) A=4.
      IF (J.EQ.7.AND.H.GT.50.) A=2.
      IF (J.EQ.9.AND.H.LE.160.) A=1.
      IF (J.EQ.9.AND.H.GT.160.) A=0.2
      IF (J.EQ.10.OR.J.GE.19.AND.J.LE.22) A=2.
      IF (J.GE.11.AND.J.LE.16) A=10.
      IF (J.EQ.17.OR.J.EQ.18) A=1.
      IF (J.EQ.23.OR.J.EQ.24) A=0.5
      IF (J.GE.25.AND.J.LE.27) A=0.2
      IF (J.GE.29.AND.J.LE.31) A=1.
      IF (J.GE.32.AND.J.LE.34) A=0.2
      IF ((J.EQ.35.OR.J.EQ.36).AND.H.LE.250.) A=0.4
      IF ((J.EQ.35.OR.J.EQ.36).AND.H.GT.250.AND.H.LE.500.) A=0.2
      IF ((J.EQ.35.OR.J.EQ.36).AND.H.GT.500.AND.H.LE.1000.) A=0.1
      IF ((J.EQ.35.OR.J.EQ.36).AND.H.GT.1000.AND.H.LE.2000.) A=0.05
      IF ((J.GE.37.AND.J.LE.39).AND.H.LE.100.) A=1.
      IF ((J.EQ.37.OR.J.EQ.38).AND.H.GT.100.) A=0.5
      IF (J.EQ.39.AND.H.GT.100.) A=0.4

      IF (V.LE.10.31) B=20.
      IF (V.GT.10.31.AND.V.LE.20.) B=10.
      IF (V.GT.20.AND.V.LE.50.) B=4.
      IF (V.GT.50.AND.V.LE.105.) B=2.
      IF (V.GT.105.AND.V.LE.230.0) B=1.

      GO TO 10

    2 IF (J.EQ.28.AND.H.LE.100.) A=1.2
      IF (J.EQ.28.AND.H.GT.100.) A=0.6
      IF (J.EQ.28.AND.H.GT.200.) A=0.12
      IF (J.GE.1.AND.J.LE.04.AND.H.LE.50.) A=2.4
      IF (J.GE.1.AND.J.LE.04.AND.H.GT.50.) A=1.2
      IF (J.EQ.5.OR.J.EQ.6.OR.J.EQ.8) A=1.2
      IF (J.EQ.7.AND.H.LE.50.) A=4.8
```

```
      IF (J.EQ.7.AND.H.GT.50.) A=2.4
      IF (J.EQ.9.AND.H.LE.160.) A=1.2
      IF (J.EQ.9.AND.H.GT.160.) A=0.24
      IF ((J.EQ.10.OR.J.GE.19).AND.J.LE.22) A=2.4
      IF (J.GE.11.AND.J.LE.16) A=12.
      IF (J.EQ.17.OR.J.EQ.18) A=1.2
      IF (J.EQ.23.OR.J.EQ.24) A=0.6
      IF (J.GE.25.AND.J.LE.27) A=0.24
      IF (J.GE.29.AND.J.LE.31) A=0.6
      IF (J.GE.32.AND.J.LE.34) A=0.24
      IF ((J.EQ.35.OR.J.EQ.36).AND.H.LE.250.) A=0.48
      IF ((J.EQ.35.OR.J.EQ.36).AND.H.GT.250.AND.H.LE.500.) A=0.24
      IF ((J.EQ.35.OR.J.EQ.36).AND.H.GT.500.AND.H.LE.1000.) A=0.12
      IF ((J.EQ.35.OR.J.EQ.36).AND.H.GT.1000.AND.H.LE.2000.) A=0.06
      IF ((J.GE.37.AND.J.LE.39).AND.H.LE.100.) A=1.2
      IF ((J.EQ.37.OR.J.EQ.38).AND.H.GT.100.) A=0.6
      IF (J.EQ.39.AND.H.GT.100.) A=0.48

      IF (L.EQ.28.AND.V.LE.100.) B=1.2
      IF (L.EQ.28.AND.V.GT.100.) B=0.6
      IF (L.EQ.28.AND.H.GT.200.0) B=0.12
      IF (L.GE.1.AND.L.LE.04.AND.V.LE.50.) B=2.4
      IF (L.GE.1.AND.L.LE.04.AND.V.GT.50.) B=1.2
      IF (L.EQ.5.OR.L.EQ.6.OR.L.EQ.8) B=1.2
      IF (L.EQ.7.AND.V.LE.50.) B=4.8
      IF (L.EQ.7.AND.V.GT.50.) B=1.2
      IF (L.EQ.9.AND.V.LE.160.) B=1.2
      IF (L.EQ.9.AND.V.GT.160.) B=0.24
      IF (L.EQ.10.OR.L.GE.19.AND.L.LE.22) B=2.4
      IF (L.GE.11.AND.L.LE.16) B=12.
      IF (L.EQ.17.OR.L.EQ.18) B=1.2
      IF (L.EQ.23.OR.L.EQ.24) B=0.6
      IF (L.GE.25.AND.L.LE.27) B=0.24
      IF (L.GE.29.AND.L.LE.31) B=0.6
      IF (L.GE.32.AND.L.LE.34) B=0.24
      IF (L.EQ.35.OR.L.EQ.36.AND.V.LE.250.) B=0.48
      IF (L.EQ.35.OR.L.EQ.36.AND.V.GT.250.AND.V.LE.500.) B=0.24
      IF (L.EQ.35.OR.L.EQ.36.AND.V.GT.500.AND.V.LE.1000.) B=0.12
      IF (L.EQ.35.OR.L.EQ.36.AND.V.GT.1000.AND.V.LE.2000.) B=0.06
      IF ((L.GE.37.AND.L.LE.39).AND.V.LE.100.) B=1.2
      IF ((L.EQ.37.OR.L.EQ.38).AND.V.GT.100.) B=0.6
      IF (L.EQ.39.AND.V.GT.100.) B=0.48

      GO TO 10

   10 CALL SCALE2(A,B)
      RETURN
      END


C PRINTS THE SAMPLE NUMBER AGAINST THE SYMBOL CHOSEN (AT A   SET
DISTANCE AWAY) ON A CO-PLOT.

      SUBROUTINE NUMBER(X,Y,N,A,B,J,L)
      REAL X(50),Y(50),A,B
      INTEGER N,J,L

      M=1
      CALL PENSEL(1,0.2,3)
      DO 6 P=1,N
```

```
      CALL MOVTO2(X(P)-(1.0/A),Y(P)+(1.0/B))
      CALL CHAHAR(2,1)
      CALL CHAINT(M,2)
      M=M+1
    6 CONTINUE
      CALL PENEND(1,0.2,3)
      CALL CHASWI(0)
      RETURN
      END
```

APPENDIX 2.4.

PARTICLE SIZE (TERNARY) COMPOSITION PLOTS.

Two main types of sample composition plot was used in the present study (see chapters 2 and 6). Both are based on ternary plots, with individual sample points plotted at the intersecting point representing the proportions of three constituent end-member particle size populations. The variant of the computer program used to produce these plots is given in appendix 2.4a.

Divisions of the particle size distribution are based on British Standard 5930 (1981). In the first case plots of (total) "overall" particle size composition were used. These were constructed from three constituent proportions of gravel, sand and fines (silt + clay : often identified as "mud" in the literature). The particle size cut-off values for these paramters were, respectively, above -1 phi, -1 phi to 4 phi, and below 4 phi. The second type of plot used removed the coarse gravel component to leave the finer "matrix" material in the sediment. The relative proportions were first recalculated to 100 %, and then split into constituent end-member populations of sand (-1 to 4 phi), silt (4 to 9 phi) and clay (below 9 phi). A third plot was available, combining the sand and gravel into a "coarse" fraction, but this plot was not used in the present study.

Once points were plotted on these graphs, the grouping of sample points was used as one of the criteria in defining unit boundaries. Grouping of a number of successive samples (by depth), within any zone of a ternary plot, is indicative of a similar particle size

distribution. This similarity, therefore, indicated a physical similarity between those samples. In genetic terms, this was taken to mean that they were deposited under approximately similar environmental conditions. Changes between two depths, to a new zone, would indicate the transition from one unit to the next. Such divisions were particularly notable for borehole 82/10 (see figs 2.2.1. & 2.2.2., chapter two).

Drill-damaged samples were not included on these plots because their signatures had been modified and were no longer representative of the sediment as it had originally been deposited.

APPENDIX 2.4A.

Computer program .T4000 (Fortran 77)

Used to produce ternary plots of sample composition

for "total" and "matrix" components.

```
C*********************************************************************
C
C  A FORTRAN-77 PROGRAMME DESIGNED TO CALCULATE FOUR SEDIMENTARY
C  PARAMETERS RELATED TO THE BRITISH STANDARD (1981) B.S.  5930
C  NOMENCLATURE, AND PRODUCE THIS DATA AS A RANGE OF TERNARY
C  PLOTS USING A GINO-GRAPHICS(N1051) PLOTTER.  (MULTI-COLOURED)
C
C     WRITTEN BY D.N.  COCKCROFT, SOILS RESEARCH LABORATORY,
C     UNIVERSITY OF KEELE: JANUARY 1985.
C     BASED ON AN ORIGINAL TERNARY PLOT ROUTINE WRITTEN BY
C     M.J.  EDGE & C.T.  FOSTER, SOILS RESEARCH LABORATORY,
C     UNIVERSITY OF KEELE: JUNE 1984.
C
C*********************************************************************


      REAL GRAVEL(50),SAND(50),SILT(50),CLAY(50),X(50),Y(50),C,D
      REAL A(50),B(50),W,S,Z,R,CUM(50,16),DATA(50,16),DEPTH(50)
      INTEGER LAB(6),K,P,BORING(10),LOC(5),J,N,L,M,ZZZ,T
      DATA LAB/0,20,40,60,80,100/

      ZZZ=0
  200 WRITE(2,30)
   30 FORMAT(5X,38HDO YOU REQUIRE .1.SAND,SILT,CLAY PLOT,)
      WRITE(2,31)
   31 FORMAT(17X,29HOR .2.GRAVEL,SAND,FINES PLOT.,)
      WRITE(2,32)
   32 FORMAT(17X,28HOR .3.COARSE,SILT,CLAY PLOT.,/)
   29 WRITE(2,33)
   33 FORMAT(5X,23HPLEASE SELECT 1,2 OR 3.,/)
      READ(1,35)L
   35 FORMAT(I1)
      IF (L.LT.1.OR.L.GT.3)GOTO29
      IF(ZZZ.EQ.1)GOTO105

      READ(5,98)N
   98 FORMAT(I2)
      READ(5,99)(LOC(S) ,S=1,5),(BORING(S) ,S=1,10)
   99 FORMAT(5A4,10A4)
      WRITE(2,96)LOC
   96 FORMAT(5A4)
      WRITE(2,97)BORING
   97 FORMAT(10A4)
      DO 95 P=1,N
      READ(5,100)DEPTH(P)
  100 FORMAT(F6.2)
      READ(5,101)(DATA(P,J) ,J=1,16)
  101 FORMAT(16(F4.1,1X))
   95 CONTINUE

      DO 102 P=1,N
      CUM(P,1)=100.-DATA(P,1)
      DO 103 J=2,16
      K=J-1
      CUM(P,J)=CUM(P,K)-DATA(P,J)
  103 CONTINUE
  102 CONTINUE

      DO 104 P=1,N
      GRAVEL(P)=100.-CUM(P,6)
```

```
      SAND(P)=CUM(P,6)-CUM(P,11)
      SILT(P)=CUM(P,11)-CUM(P,16)
      CLAY(P)=CUM(P,16)
  104 CONTINUE
  105 GOTO(50,60,70)L


C VALUES FOR SAND,SILT,CLAY,PLOT: EQUATED UP TO 100 PERCENT.
   50 DO 3 P=1,N
      A(P)=CLAY(P)*100/(100-GRAVEL(P))
      B(P)=SILT(P)*100/(100-GRAVEL(P))
    3 CONTINUE
      GOTO80


C VALUES FOR GRAVEL PLOT AS INPUT FILE:FINES=CLAY+SILT.
   60 DO 4 P=1,N
      A(P)=CLAY(P)+SILT(P)
      B(P)=SAND(P)
    4 CONTINUE
      GOTO80


C VALUES FOR COARSE PLOT AS INPUT FILE:COARSE=GRAVEL +SAND
   70 DO 8 P=1,N
      A(P)=CLAY(P)
      B(P)=SILT(P)
    8 CONTINUE


   80 DO 2 P=1,N
      X(P)=85+(B(P)*1.25)+(0.63*A(P))
      Y(P)=92.+(1.08*A(P))
    2 CONTINUE


      JJ=2
  404 WRITE(2,312)
  312 FORMAT(2X,40HYOU HAVE THE FOLLOWING CHOICE OF SYMBOLS,/)
      WRITE(2,313)
  313 FORMAT(10X,23H1.  AN UPRIGHT TRIANGLE,/)
      WRITE(2,314)
  314 FORMAT(10X,24H2.  AN INVERTED TRIANGLE,/)
      WRITE(2,315)
  315 FORMAT(10X,18H3.  A PLUS(+) SIGN,/)
      WRITE(2,316)
  316 FORMAT(10X,14H4.  A CROSS(X),/)
      WRITE(2,317)
  317 FORMAT(10X,12H5.  A SQUARE,/)
      WRITE(2,318)
  318 FORMAT(10X,13H6.  A DIAMOND,/)
      WRITE(2,319)
  319 FORMAT(10X,13H7.  A HEXAGON,/)
      WRITE(2,320)
  320 FORMAT(10X,18H8.  AN ASTERISK(*),/)
      WRITE(2,321)
  321 FORMAT(10X,29H9.  A DOT OF SPECIFIED RADIUS,/)
      WRITE(2,322)
  322 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 9,/)
      READ(1,323)KK
```

```
 323 FORMAT(I1)
      IF (KK.EQ.9) GO TO 324
      IF (KK.GE.1.AND.KK.LE.8) LL=0
      GOTO 134
 324 WRITE(2,325)
 325 FORMAT(5X,43HPLEASE SPECIFY THE RADIUS OF THE DOT IN MM,/)
      READ(1,326)LL
 326 FORMAT(I1)


C SELECTION OF THE COLOUR(S) OF THE LINE AND/OR SYMBOLS.

 134 WRITE(2,135)
 135 FORMAT(5X,40HYOU HAVE THE FOLLOWING CHOICE OF COLOURS,/)
      WRITE(2,136)
 136 FORMAT(10X,9H1.  BLACK,/)
      WRITE(2,137)
 137 FORMAT(10X,7H2.  RED,/)
      WRITE(2,138)
 138 FORMAT(10X,8H3.  BLUE,/)
      WRITE(2,139)
 139 FORMAT(10X,9H4.  GREEN,/)
      IF (JJ.EQ.1.OR.JJ.EQ.2.OR.JJ.EQ.4) GO TO 140
      IF (JJ.EQ.3) GO TO 144
 140 WRITE(2,141)
 141 FORMAT(5X,21HFOR YOUR LINE/SYMBOLS,)
      WRITE(2,142)
 142 FORMAT(5X,38HPLEASE MAKE YOUR CHOICE: SELECT 1 TO 4,/)
      READ(1,143)MM
 143 FORMAT(I1)
      IF (MM.LT.1.OR.MM.GT.4) GOTO 140
      IF (JJ.EQ.1.OR.JJ.EQ.2.OR.JJ.EQ.4) NN=0
      GOTO 7
 144 WRITE(2,145)
 145 FORMAT(5X,47HCHOOSE THE COLOUR OF THE SYMBOLS: SELECT 1 TO 4,/)
      READ(1,146)MM
 146 FORMAT(I1)
      IF (MM.LT.1.OR.MM.GT.4) GO TO 144
 147 WRITE(2,148)
 148 FORMAT(5X,51HPLEASE CHOOSE THE COLOUR OF THE LINE: SELECT 1 TO
4,)
      READ(1,149)NN
 149 FORMAT(I1)
      IF (NN.LT.1.OR.NN.GT.4) GO TO 147
   7 CONTINUE
      IF (MM.EQ.3) MM=7
      IF (NN.EQ.3) NN=7
      IF (MM.EQ.4) MM=5
      IF (NN.EQ.4) NN=5

 153 WRITE(2,150)
 150 FORMAT(2X,38HDO YOU WISH TO NUMBER THE DATA POINTS.,)
      WRITE(2,151)
 151 FORMAT(2X,30HPLEASE ANSWER YES(1) OR NO(2).,/)
      READ(1,152)M
 152 FORMAT(I1)
      IF(M.LT.1.OR.M.GT.2)GOTO153
```

```
      IF(ZZZ.EQ.1)GOTO810
      CALL DEVBEG
      GOTO811
  810 CALL PICCLE
  811 CALL WINDO2(0.,260.,0.,300.)
      CALL MOVTO2(0.,0.)
      CALL A4
      CALL CHAHAR(3,0)
      CALL MOVTO2(85.,151.)
      CALL CHAHOL(12HPERCENTAGE*.)
      CALL MOVTO2(191.,151.)
      CALL CHAHOL(12HPERCENTAGE*.)
      CALL MOVTO2(132.5,82.)
      CALL CHAHOL(12HPERCENTAGE*.)
      IF(L.EQ.1)CALL MOVTO2(90.,147.)
      IF(L.EQ.1)CALL CHAHOL(6HSAND*.)
      IF(L.EQ.2.OR.L.EQ.3)CALL MOVTO2(88.,147.)
      IF(L.EQ.2)CALL CHAHOL(8HGRAVEL*.)
      IF(L.EQ.3)CALL CHAHOL(8HCOARSE*.)
      CALL MOVTO2(196.,147.)
      IF(L.EQ.1.OR.L.EQ.3)CALL CHAHOL(6HCLAY*.)
      IF(L.EQ.2)CALL CHAHOL(7HFINES*.)
      CALL MOVTO2(155.5,82.)
      IF(L.EQ.1.OR.L.EQ.3)CALL CHAHOL(6HSILT*.)
      IF(L.EQ.2)CALL CHAHOL(6HSAND*.)


      CALL MOVTO2(85.,92.)
      CALL LINTO2(147.5,200.)
      CALL LINTO2(210.,92.)
      CALL LINTO2(85.,92.)
      CALL DASHED(1,2.0,1.0,0.0)
      CALL MOVTO2(135.,178.4)
      CALL LINTO2(160.,178.4)
      CALL LINTO2(110.,92.)
      CALL LINTO2(97.5,113.6)
      CALL LINTO2(197.5,113.6)
      CALL LINTO2(185.,92.)
      CALL LINTO2(135.,178.4)
      CALL MOVTO2(122.5,156.8)
      CALL LINTO2(172.5,156.8)
      CALL LINTO2(135.,92.)
      CALL LINTO2(110.,135.2)
      CALL LINTO2(185.,135.2)
      CALL LINTO2(160.,92.)
      CALL LINTO2(122.5,156.8)
      CALL DASHED(0,0.0,0.0,0.0)

      W=200.
      Z=147.5
      S=1.5
      R=0.0
      DO 5 L=1, 6
      CALL MOVTO2((Z+S),W)
      CALL CHAINT(LAB(7-L),3)
      CALL MOVTO2((Z-S)-7.0,W)
      CALL CHAINT(LAB(0+L),3)
      CALL MOVTO2((R+82.),88.)
      CALL CHAINT(LAB(0+L),3)
      IF(L.EQ.1)S=0.0
```

```
      R=R+25.
      S=S+12.5
      W=W-21.6
    5 CONTINUE

      CALL PENSEL(MM,0.2,2)
      CALL MOVTO2(X(1),Y(1))
      IF(KK.EQ.09)GOTO13
      CALL SYMBOL(KK)
      IF(M.EQ.1)GOTO12
      GOTO14
   13 CALL DOT(LL)
      IF(M.EQ.1)GOTO12
      GOTO14
   12 CALL MOVTO2(((X(1))-1),((Y(1))+1))
      CALL CHAHAR(2,0)
      CALL CHAINT(1,2)
   14 DO 6 J=2,N
      CALL MOVTO2(X(J),Y(J))
      CALL CHAHAR(3,0)
      IF(KK.EQ.09)GOTO15
      CALL SYMBOL(KK)
      IF(M.EQ.1)GOTO9
      GOTO6
   15 CALL DOT(LL)
      IF(M.EQ.1)GOTO9
      GOTO6
    9 CALL MOVTO2(((X(J))-1),((Y(J))+1))
      CALL CHAHAR(2,0)
      CALL CHAINT(J,2)
    6 CONTINUE


      CALL ARROW
      CALL CHAHAR(4,0)
      CALL TITLE(BORING,80.,264.)
      CALL MOVTO2(83.,27.)
      CALL CHAHAR(2,0)
      CALL CHAHOL(11HSITE FIX:*.)
      CALL CHAHAR(2,0)
      CALL TITL2(LOC,97.,27.)
      CALL CHAHAR(2,0)
      CALL UNI(173.,27.)
      CALL BOX(75.,25.,220.,257.)
      CALL BOX(75.,260.,220.,272.)
      IF(M.EQ.2)GOTO21
      CALL MOVTO2(80.,78.)
      CALL CHAHAR(3,0)
      CALL CHAHOL(16HSAMPLE DEPTHS.*.)
      C=84.
      D=70.
      DO 20 P=1,N
      CALL MOVTO2(C,D)
      CALL CHAINT(P,3)
      CALL CHAHOL(3H)*.)
      CALL MOVTO2(C+8.,D)
      CALL CHAFIX(DEPTH(P),6,2)
      CALL CHAHOL(4HM.*.)
      C=C+25.
      IF(P.EQ.5)GOTO19
```

```
      IF(P.EQ.10)GOTO19
      IF(P.EQ.15)GOTO19
      IF(P.EQ.20)GOTO19
      IF(P.EQ.25)GOTO19
      IF(P.EQ.30)GOTO19
      IF(P.EQ.35)GOTO19
      IF(P.EQ.40)GOTO19
      IF(P.EQ.45)GOTO19
      GOTO20
   19 C=84.
      D=D-5.
   20 CONTINUE
   21 ZZZ=1
      CALL CHASWI(0)
  600 WRITE(2,601)
  601 FORMAT(5X,37HDO YOU REQUIRE ANY FURTHER ANALYSES ,)
  602 WRITE(2,603)
  603 FORMAT(5X,31HPLEASE ANSWER YES(1), OR NO(2).,/)
      READ(1,604)T
  604 FORMAT(I1)
      IF(T.LT.1.OR.T.GT.2)GOTO602
      IF(T.EQ.1)GOTO200
      IF(T.EQ.2)CALL DEVEND
      STOP
      END
```

C SUBROUTINE TO DELIMIT THE BOUNDARIES OF AN A4 PAGE PERPENDICULAR TO THE PLOTTING PAPER. N.B. THE ORIGIN IS (30.,0.)

```
      SUBROUTINE A4
      CALL MOVTO2(30.,297.)
      CALL LINTO2(33.,297.)
      CALL MOVTO2(237.,297.)
      CALL LINTO2(240.,297.)
      CALL LINTO2(240.,294.)
      CALL MOVTO2(240.,151.)
      CALL LINTO2(240.,147.)
      CALL MOVTO2(240.,3.)
      CALL LINTO2(240.,0.)
      CALL LINTO2(237.,0.)
      CALL MOVTO2(33.,0.)
      CALL LINTO2(30.,0.)
      CALL LINTO2(30.,3.)
      CALL MOVTO2(30.,147.)
      CALL LINTO2(30.,151.)
      CALL MOVTO2(30.,294.)
      CALL LINTO2(30.,297.)
      CALL MOVTO2(42.5,108.)
      CALL SYMBOL(3)
      CALL MOVTO2(42.5,189.)
      CALL SYMBOL(3)
      RETURN
      END
```

```
C SUBROUTINE B41 TO DRAW A4 PAGE (ORIGIN 0.,0.)   NORMAL TO THE PAPER
ORIENTATION.

      SUBROUTINE B41
      CALL MOVTO2(0.,210.)
      CALL LINTO2(3.,210.)
      CALL MOVTO2(294.,210.)
      CALL LINTO2(297.,210.)
      CALL LINTO2(297.,207.)
      CALL MOVTO2(297.,107.)
      CALL LINTO2(297.,103.)
      CALL MOVTO2(297.,3.)
      CALL LINTO2(297.,0.)
      CALL LINTO2(294.,0.)
      CALL MOVTO2(3.,0.)
      CALL LINTO2(0.,0.)
      CALL LINTO2(0.,3.)
      CALL MOVTO2(0.,103.)
      CALL LINTO2(0.,107.)
      CALL MOVTO2(0.,207.)
      CALL LINTO2(0.,210.)
      CALL MOVTO2(108.5,12.5)
      CALL SYMBOL(3)
      CALL MOVTO2(188.5,12.5)
      CALL SYMBOL(3)
      RETURN
      END


C ARROWS FOR TERNARY DIAGRAMS TO SHOW AXIAL TRENDS.

      SUBROUTINE ARROW
      CALL MOVTO2(186.75,146.)
      CALL LINTO2(181.75,146.)
      CALL MOVTO2(183.5,147.)
      CALL LINTO2(181.75,146.)
      CALL LINTO2(183.5,145.)
      CALL MOVTO2(143.5,85.1)
      CALL LINTO2(146.,89.4)
      CALL MOVTO2(146.,87.4)
      CALL LINTO2(146.,89.4)
      CALL LINTO2(144.2,88.4)
      CALL MOVTO2(112.5,151.5)
      CALL LINTO2(114.5,147.)
      CALL MOVTO2(114.8,149.)
      CALL LINTO2(114.5,147.)
      CALL LINTO2(113.,148.)
      RETURN
      END


C PRINTS THE TITLE OF THE PLOT IN ANY SPECIFIED POSITION.

      SUBROUTINE TITLE(BORI,X,Y)
      DIMENSION BORI(10)
      REAL X,Y
```

```
      CALL MOVTO2(X,Y)
      CALL CHAARR(BORI,10,4)
      CALL CHASWI(0)
      RETURN
      END

      SUBROUTINE TITL2(LOC,X,Y)
      DIMENSION LOC(5)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAARR(LOC,5,4)
      CALL CHASWI(0)
      RETURN
      END


C PRINTS THE SOILS LAB.  ID.  IN ANY SPECIFIED POSITION.

      SUBROUTINE UNI(X,Y)
      REAL X,Y
      CALL MOVTO2(X,Y)
      CALL CHAHOL(32HSOILS LAB.  UNIVERSITY OF KEELE*.)
      CALL CHASWI(0)
      RETURN
      END


C DRAWS A BOX OF ANY SPECIFIED DIMENSIONS INCLUDING   A4 DELIMITATION.

      SUBROUTINE BOX(A,B,C,D)
      REAL A,B,C,D
      CALL WINDO2(0.,260.,0.,300.)
      CALL SHIFT2(0.,0.)
      CALL MOVTO2(A,B)
      CALL LINTO2(A,D)
      CALL LINTO2(C,D)
      CALL LINTO2(C,B)
      CALL LINTO2(A,B)
      RETURN
      END



C MOVES THE PLOTTING PEN TO THE SPECIFIED ORIGIN   OF THE PARAMETERS TO BE
PLOTTED.

      SUBROUTINE AXIPOS(XAXI,YAXI)
      REAL XAXI, YAXI
      CALL MOVTO2(XAXI,YAXI)
      CALL SHIFT2(XAXI,YAXI)
      RETURN
      END



C THIS PLOTS THE DATA POINTS AS EITHER A LINE OR AS SYMBOLS   WITH THE
CHOICE OF COLOUR(S) AS SPECIFIED IN THE MAIN   PROGRAMME.
```

```
      SUBROUTINE PLOT(X,Y,N,J,K,L,M,NN)
      REAL X(50),Y(50)
      INTEGER N,J,K,L,M,NN

      CALL MOVTO2(X(1),Y(1))
      IF (J.EQ.1) GO TO 1
      IF (J.GE.2.AND.J.LE.4) GO TO 2

    1 IF (J.EQ.1) CALL PENSEL(M,0.2,2)
      IF (J.EQ.3) CALL PENSEL(NN,0.2,2)
      IF (J.EQ.3) CALL MOVTO2(X(1),Y(1))
      CALL POLTO2(X,Y,N)
      IF (J.EQ.1) CALL PENEND(M,0.2,2)
      IF (J.EQ.3) CALL PENEND(NN,0.2,2)
      GO TO 10

    2 CALL PENSEL(M,0.2,2)
      DO 7 P=1,N
      IF (J.EQ.2.OR.J.EQ.4) CALL CHAHAR(3,1)
      IF (J.EQ.3) CALL CHAHAR(3,0)
      CALL MOVTO2(X(P),Y(P))
      IF (K.EQ.9) GO TO 3
      CALL SYMBOL(K)
      GO TO 7
    3 CALL DOT(L)
    7 CONTINUE
      CALL PENEND(M,0.2,2)
      IF (J.EQ.3) GO TO 1
      GO TO 10

   10 CONTINUE
      RETURN
      END


C PRINTS THE SAMPLE NUMBER AGAINST THE SYMBOL CHOSEN (AT A   SET DISTANCE
AWAY) ON A CO-PLOT.

      SUBROUTINE NUMBER(X,Y,N,H,V,J,L,SC,A,B)
      REAL X(50),Y(50),H,V,SC(10),A,B
      INTEGER J,L,N

      M=1
      CALL PENSEL(1,0.2,3)
      DO 6 P=1,N
      CALL MOVTO2(X(P)-(1.0/A),Y(P)+(1.0/B))
      CALL CHAHAR(1,1)
      CALL CHAINT(M,2)
      M=M+1
    6 CONTINUE
      CALL PENEND(1,0.2,3)
      CALL CHASWI(0)
      RETURN
      END
```

APPENDIX 2.5.

MANIPULATION OF MICROPALAEONTOLOGICAL DATA.

SAMPLING.

All of the micropalaeontological evidence utilized in the present study was collected by the Marine Geology Unit of the British Geological Survey, during borehole drilling operations. Half- to full-core transverse sections were cut through boreholes at varying intervals. Samples taken were approximately 1 cm thick. The outer rim of the core was removed to reduce the possibility of down-core contamination in the samples analysed. The remainder was placed in a sealed plastic bag and labelled with a unique (CSC) number. These samples were then sent to BGS Keyworth for analysis.

Samples were fractionated using standard techniques. Faunas were then divided. The dinoflagellate cyst analysis was carried out by R Harland, and the benthonic foraminiferal analysis by D Gregory, both of the Micropalaeontology Unit. Results are reproduced here with the permission of the BGS.

BENTHONIC FORAMINIFERA.

Counts were carried out on 300 individuals wherever possible. When assemblages were too poor to enable this, all identifiable specimens were counted. In these circumstances only those assemblages approaching, or exceeding, the 300 individual mark could be regarded

as having any statistical reliability (Lord, 1980, 104). Results were provided as tables of raw counts by species for the Marine Geology Unit, together with a preliminary assessment of the environmental conditions which these species indicated. Few of the samples were large enough to warrant any conjecture of this kind.

In the present study, these counts were recalculated as percentages of the total, for each sample (CSC) depth. In the tables given in chapter four, only the major species present are reproduced from these counts, as they were considered to be more indicative of environmental conditions than "odd" occurrences of other species.

The 95% diversity values quoted in these tables were calculated according to the method of Walton (1964), and defined as :-

"... the number of ranked species of a counted or estimated foraminiferal population whose cumulative percentage constitutes 95% of the total population."

(Walton, ibid., 213).

The ratio was calculated by ranking, and then summing, the percentages for individual species until 95% was equalled or exceeded. This value gave an impression of the total species diversity, without taking into account the occurrence of rare species.

As these counts were not carried out specifically for the present study, it had to be assumed that the sample density and the possibility of reworking had been taken into account during analysis. The problems of taxonomic comparability, and species misidentification, were also assumed to be minimal. As all the benthonic foraminiferal assemblages quoted in the present study were calculated by one operator, it could be assumed that any error that did occur would be consistent within the entire set of samples.

DINOFLAGELLATE CYSTS.

Dinoflagellate assemblages were invariably much poorer than the foraminiferal ones. In many cases the number of recorded individuals was too small to warrant any comment. In all cases a population of 300 specimens was never reached. Results are generally only given for assemblages exceeding 40 individuals. Even this number means the results from cyst analysis are less reliable than those from benthonic foraminifera.

Results are quoted using the same sample (CSC) numbers relating to the foraminiferal assemblages, as both originate from the same core subsample. Figures are given as recalculated percentages of the total sample, with the number of individuals (n) counted, as they appeared in the Marine Geology Unit reports used in the present study.

Comments provided on these small populations are, consequently, highly subjective, with respect to any palaeoclimatic inference that might be drawn from them. Slightly more weight is placed on actual occurrence in the present study, when an assessment of the age of units is attempted in chapter seven. In many cases, comments given on dinoflagellate assemblages in fact relate more to age than to environmental conditions at the time of deposition.