The structure and petrology of the volcanic rocks of Eigg, muck and Canna, N. W. Scotland

Allwright, E. A.

THE STRUCTURE AND PETROLOGY OF THE VOLCANIC ROCKS OF EIGG, MUCK AND CANNA, N. W. SCOTLAND

(2 Volumes)

by

E. A. ALLWRIGHT, B.Sc. (Sheffield)

VOLUME 2

(FIGURES. TABLES AND APPENDICES)

A thesis submitted for the Degree of Master of Science in the Department of Geological Sciences at the University of Durham.

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Figure 1.1

Topographical features of the Isle of Eigg

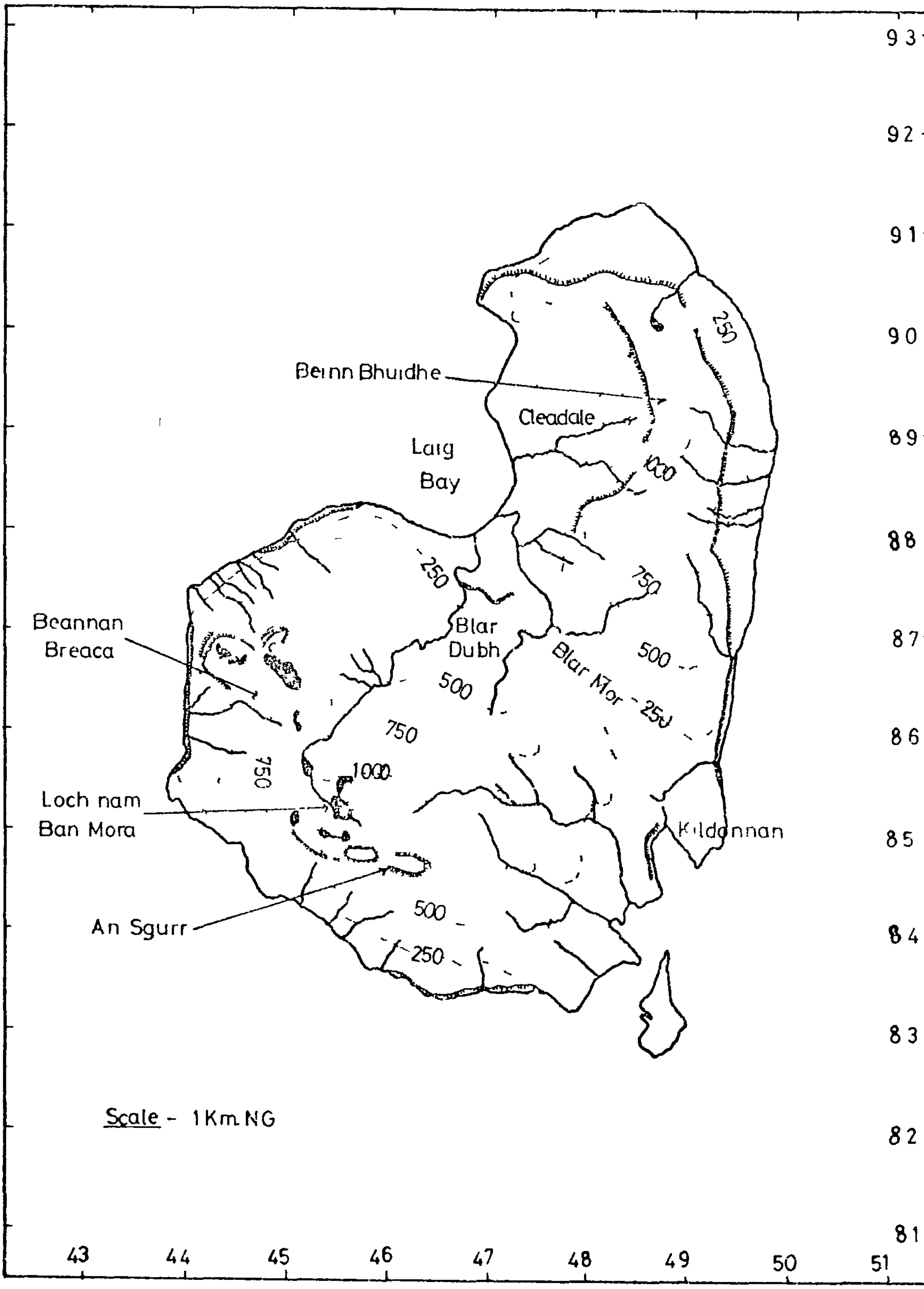

93
92
91
90
89
88
87
86
85
84
83
82
81
43
44
45
46
47
48
49
50
51
Beinn Bhuidhe
Cleadale
Laig
Bay
250
1000
750
500
Blar
Dubh
Blar Mor
Beannan
Breaca
Loch nam
Ban Mora
An Sgurr
Kildonnan
Scale - 1Km NG

Figure 11

Figure 1.2 Topographical features of the Isle of Muck

Figure 1.3 Topographical features of the Isle of Canna

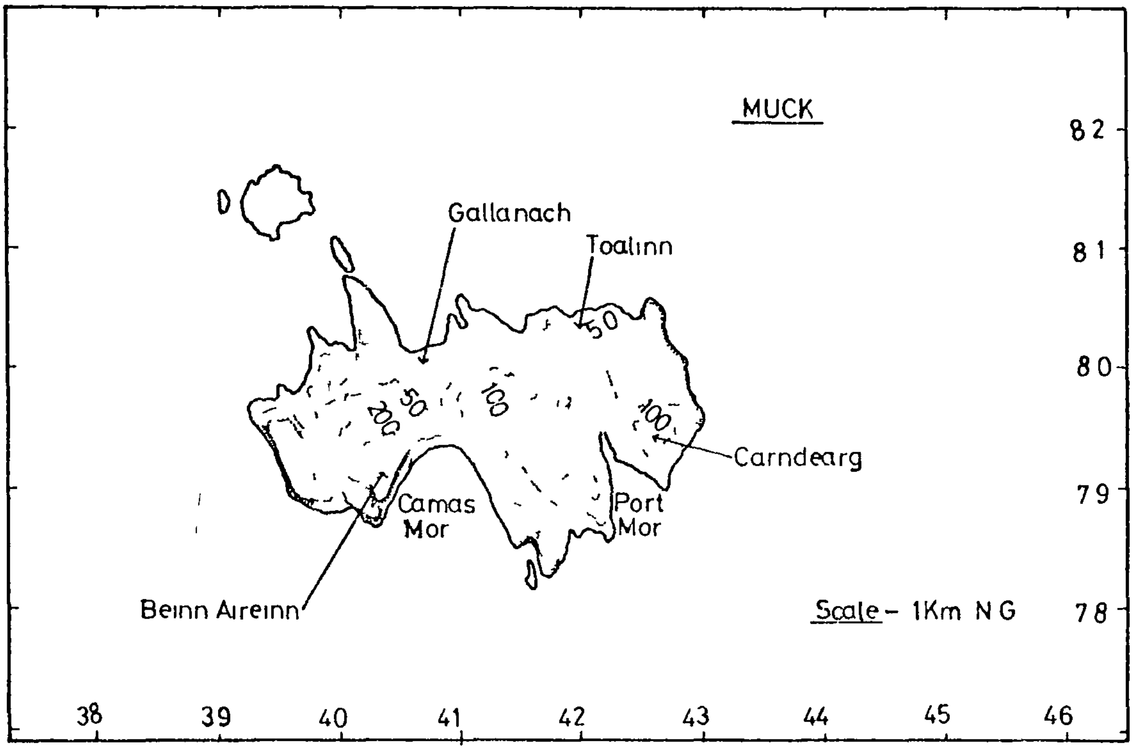


Figure 1 2

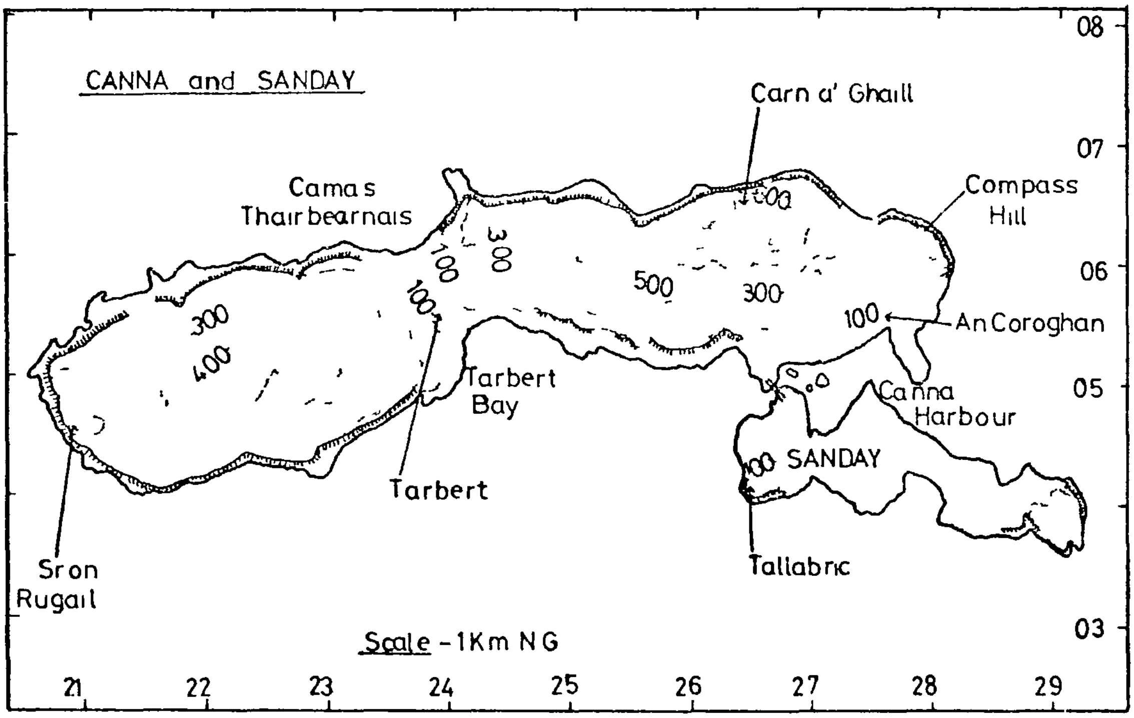


Figure 1 3

Figure 1.4 Eigg from Muck, showing how the pitchstone ridge dominates southwest Eigg.

Figure 1.5 Cleadale cliffs and Laig Bay, Eigg.

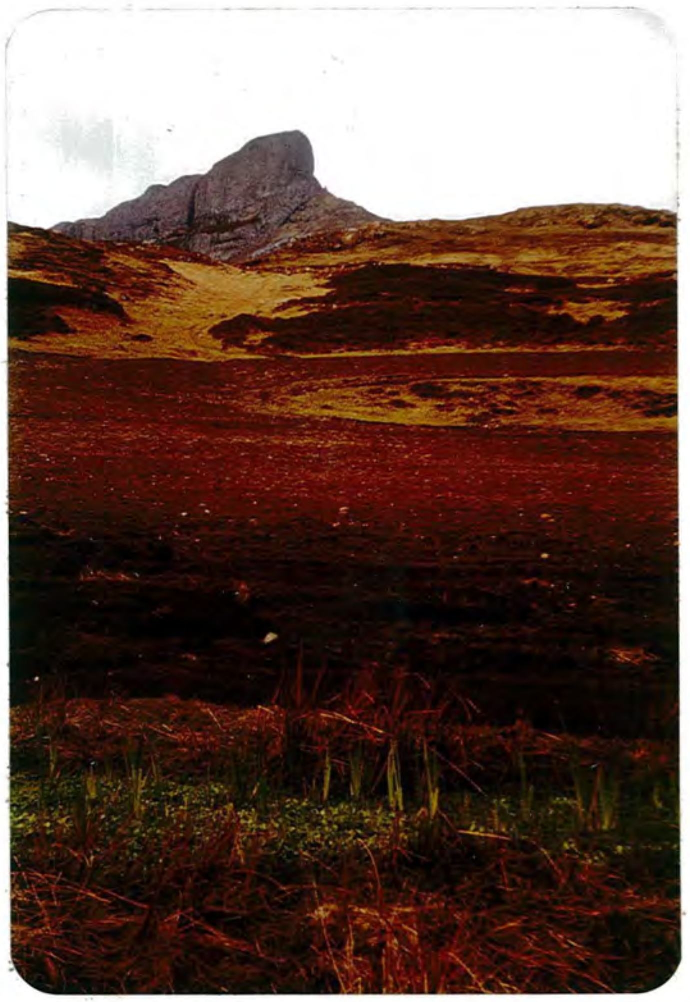
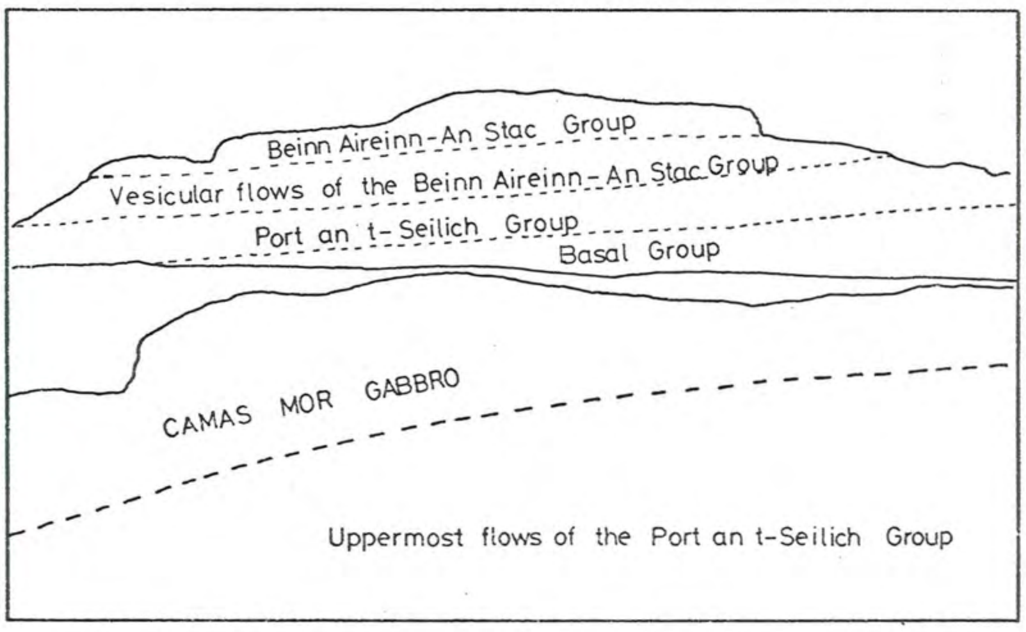


Figure 1.6 Central Eigg showing the type of vegetation.

(Note how the Sgurr ridge dominates the landscape)

Figure 1.7 Muck: Beinn Aireinn and the cliffs of An Stac - looking across Camas Mor from near Fionn-aird

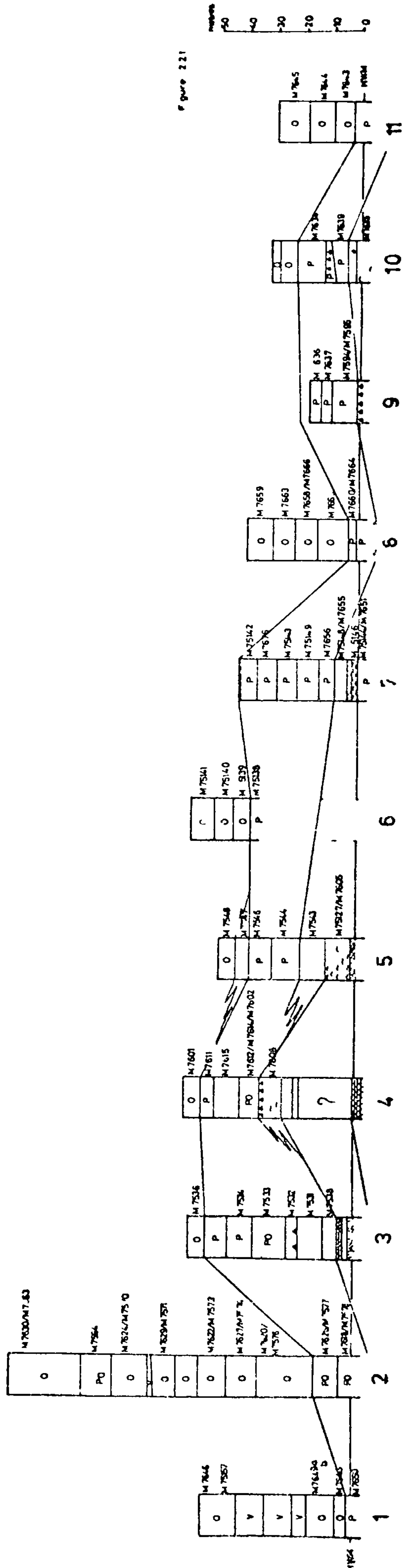


See chapter 2 for details of statigraphy

Figure 1.8: Eastern Canna: Panorama taken from Sanday

Figure 2.2.1

Muck. sequences examined



Key to symbols used in stratigraphical sequences

Cl	Columnar flow
	Aphyric flow
O	Olivine phyric flow
P	Plagioclase phyric flow
P(r)	Flow with rare plagioclase phenocrysts
(pr)	Plagioclase-rich flow (SE Muck only)
PO	Plagioclase and olivine phyric flow
OC	Olivine and clinopyroxene phyric flow
cpx	Clinopyroxene phyric flow
POC	Plagioclase, olivine and clinopyroxene phyric flow
	Platey basalt (Canna), Grey rock (Eigg)
	Glomerophyric flow (Canna)
~ ~ ~	Differentiated flow
V V V V	Vesicular flow
A A A A A	Amygdaloidal flow
	Shale with carbonaceous streaks (Canna)
	Fine grained sediment (Canna)
	Fine grained sediment/red bed (Muck)
	Conglomerate
	Fine grained conglomeratic sediment
	Breccia/agglomerate
X X X X	Grulin felsite, Eigg
	Mesozoic sediments
VVV	Vesicular flow top
	Erosional surface
???	Sequence unknown
unex	Unexposed ground

Figure 2.2.3

South-east Muck. Extent of the flows

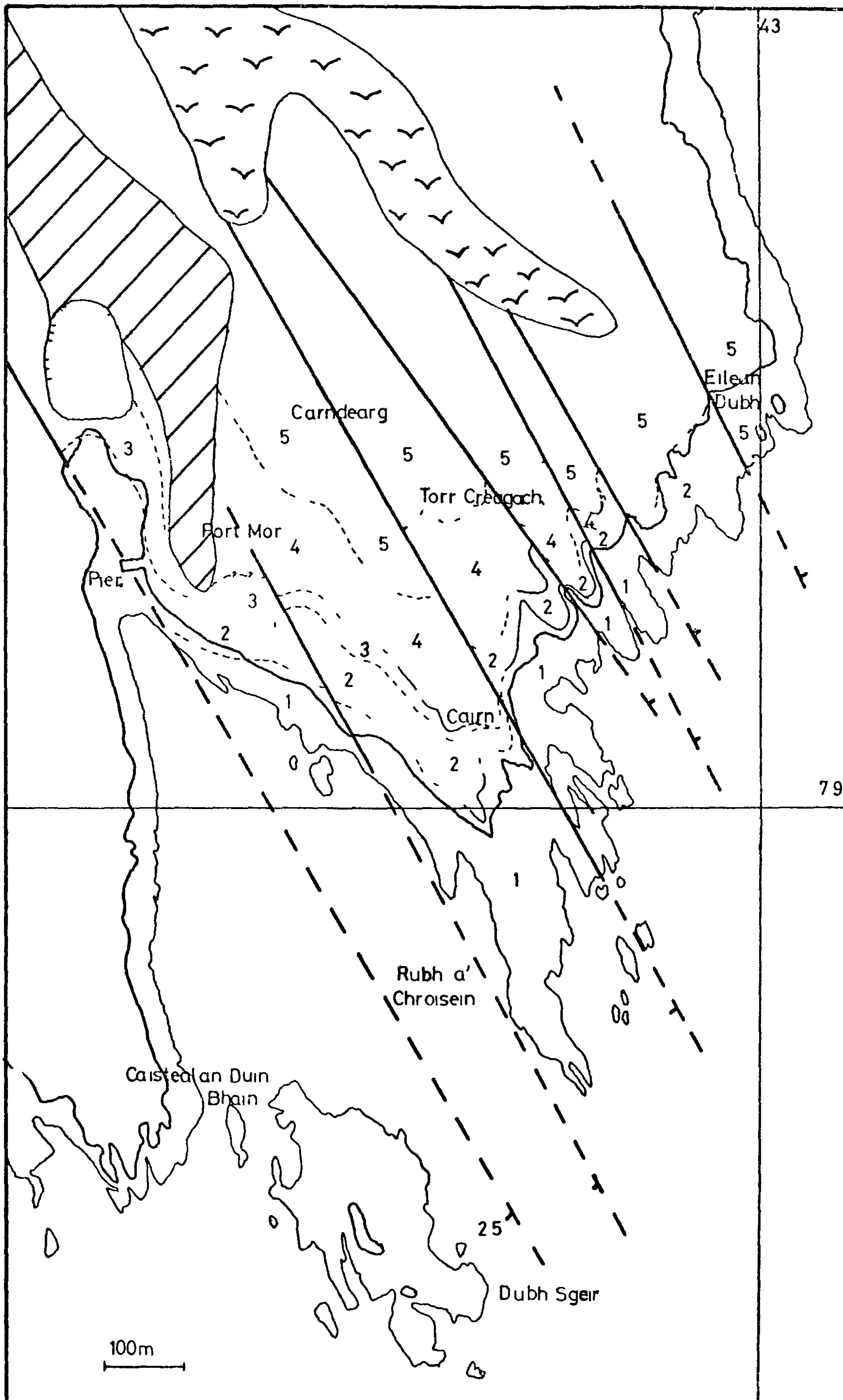

43
79
Carndearg
Torr Creagach
Port Mor
Pier
Cairn
Eilean Dubh
Rubh a' Chroisein
Caisteal an Duin Bhain
Dubh Sgeir
25
100m

Figure 223

Figure 2.2.4

South-east Muck   Sequences examined

Figure 224

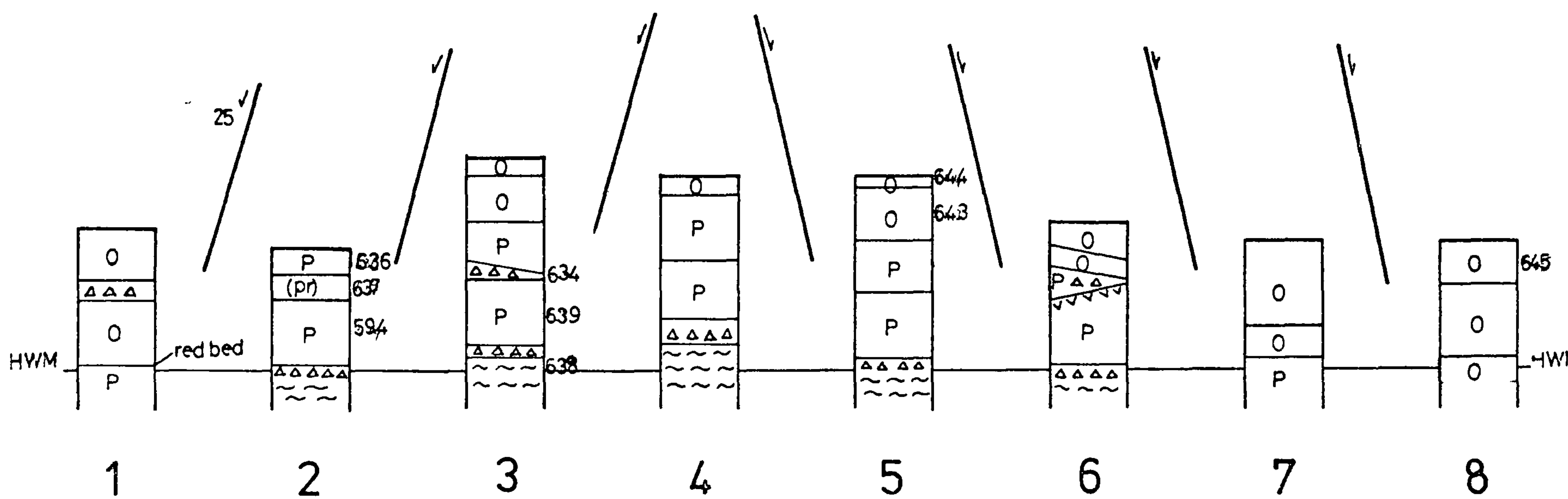
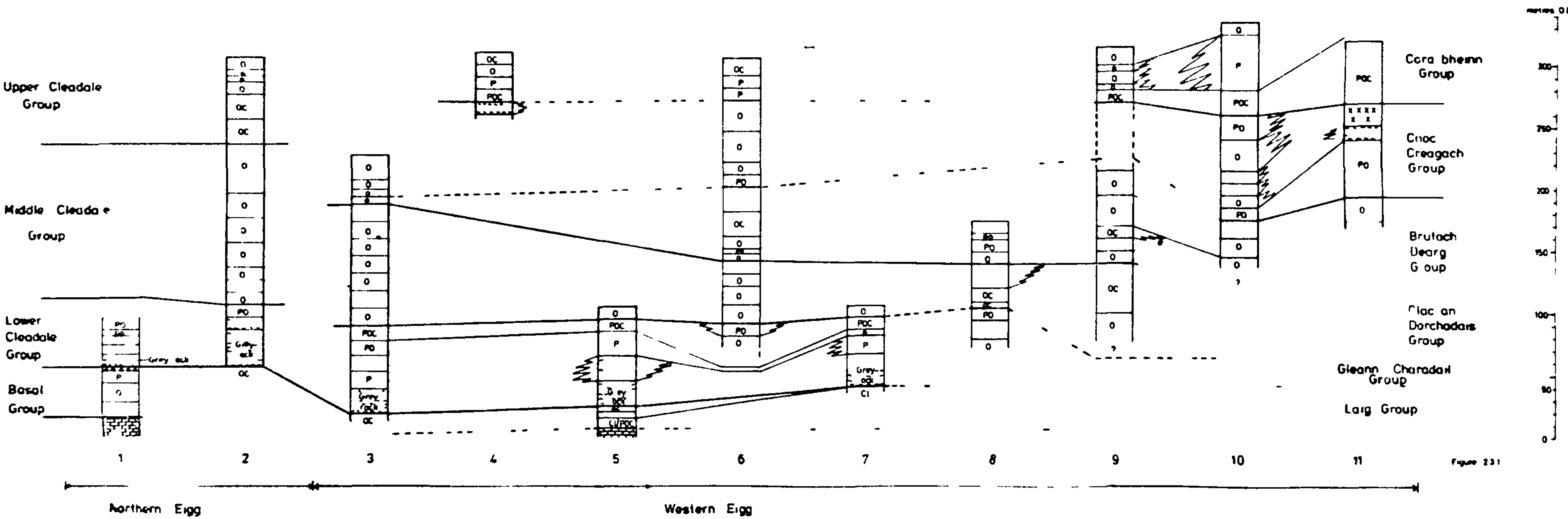

25
HWM
red bed
O
P
(pr)
636
637
594
634
639
638
644
643
645
1
2
3
4
5
6
7
8

Figure 2.3.1

Sigg Sequences examined showing correlations.

See Figure 2.2.1 for Key to symbols.



Upper Cleadale Group
Middle Cleadale Group
Lower Cleadale Group
Basal Group
Cora bheinn Group
Cnoc Creagach Group
Brutach Dearg Group
Clac an Dorchadais Group
Gleann Charadail Group
Laig Group
metres O.D.
1
2
3
4
5
6
7
8
9
10
11
Northern Eigg
Western Eigg

Figure 2.3.3: Eigg: Cleadale cliffs

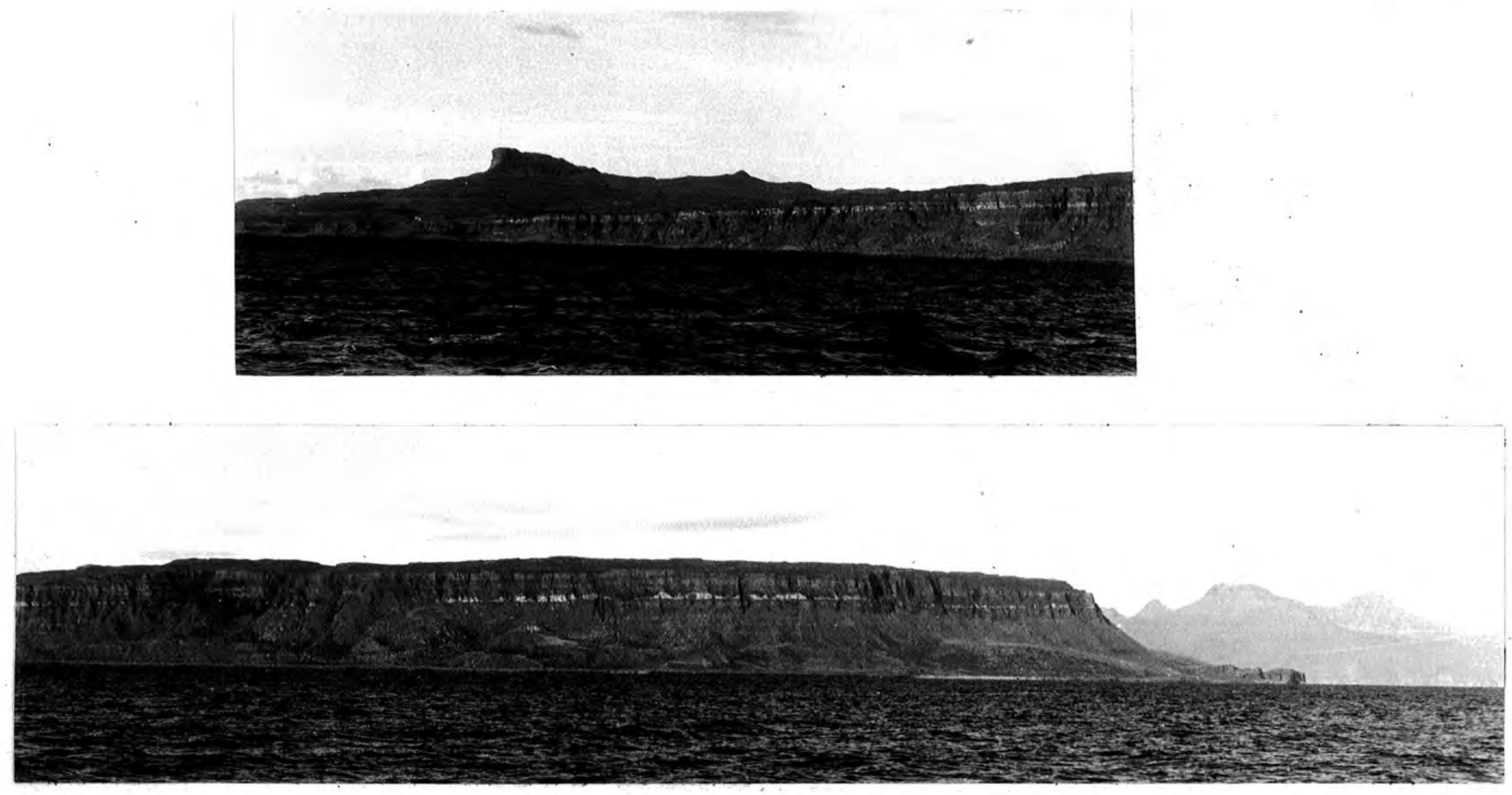


Figure 2.3.4: East coast cliffs of Eigg

Figure 2.3.5

Sketch of the east coast cliffs, Eigg
(c. 49408737)

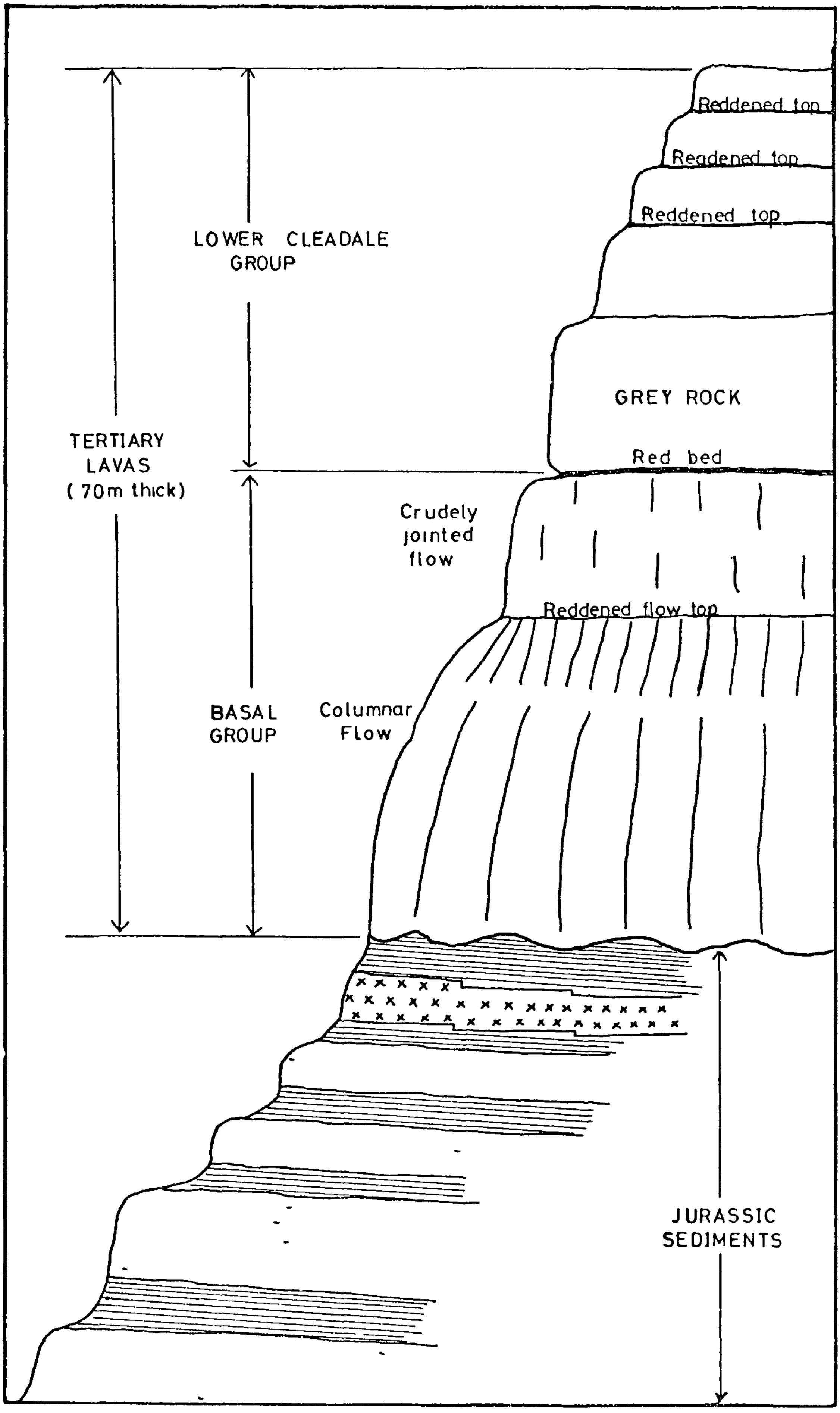
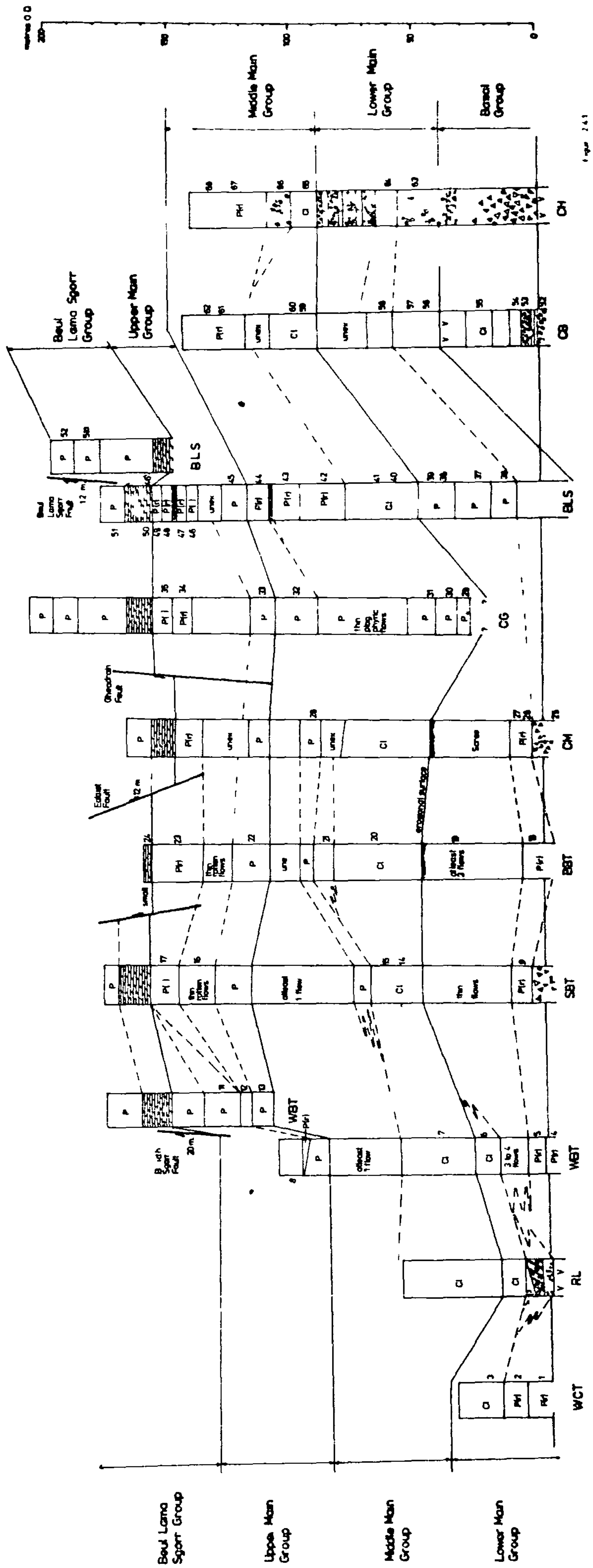

Reddened top
Readened top
Reddened top
LOWER CLEADALE GROUP
GREY ROCK
Red bed
TERTIARY LAVAS (70m thick)
Crudely jointed flow
Reddened flow top
BASAL GROUP
Columnar Flow
JURASSIC SEDIMENTS

Figure 235

Figure 2.4.1

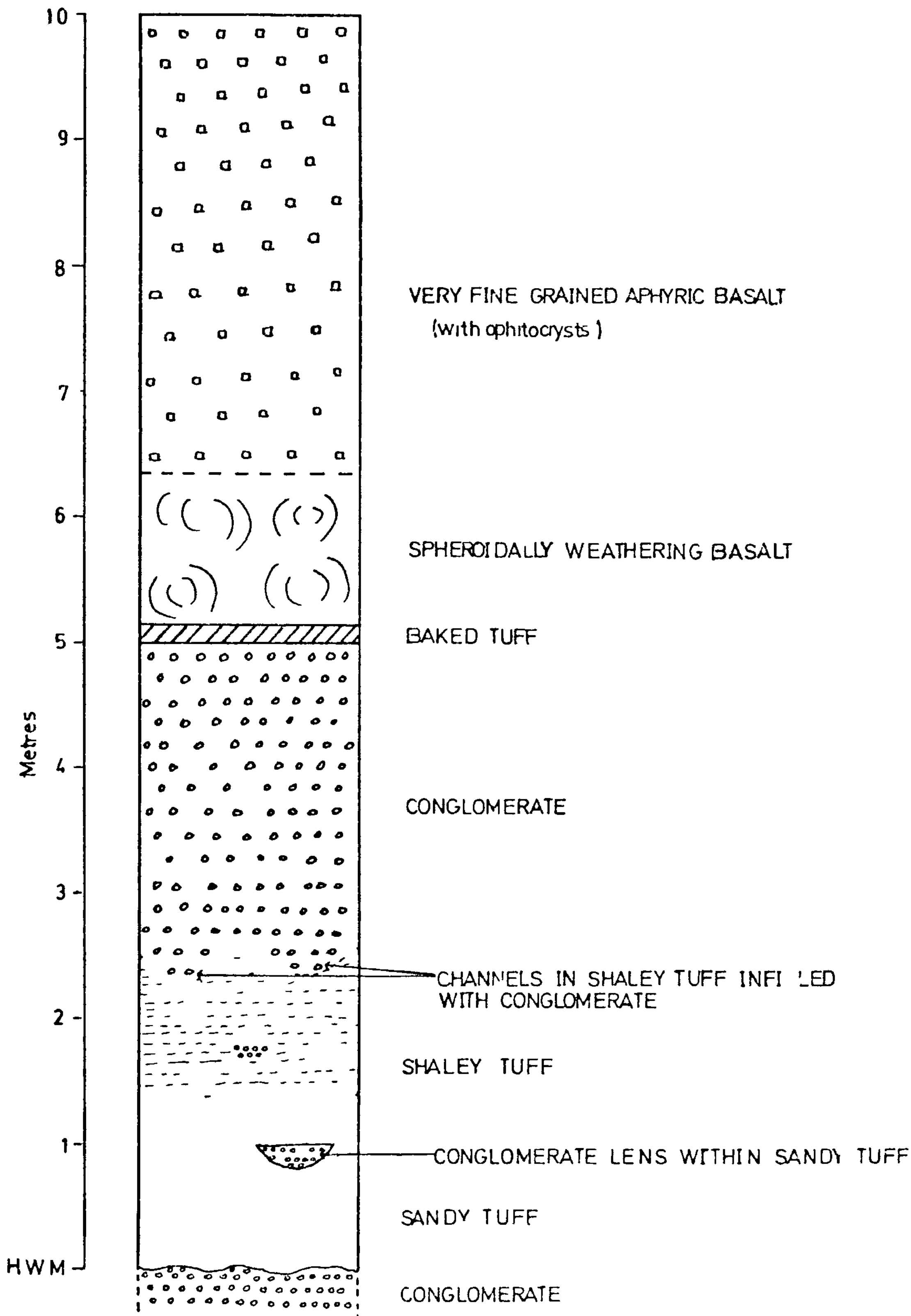
Eastern Canna Sequences examined showing correlations.

Key as for Figure 2.2.1



Beul Lama Sgorr Group
Upper Main Group
Middle Main Group
Lower Main Group
Basal Group
WCT
RL
WBT
SBT
BBT
CM
CG
BLS
CB
CH
erosional surface

Figure 2.4.3 Sequence just east of The Square (27130522)



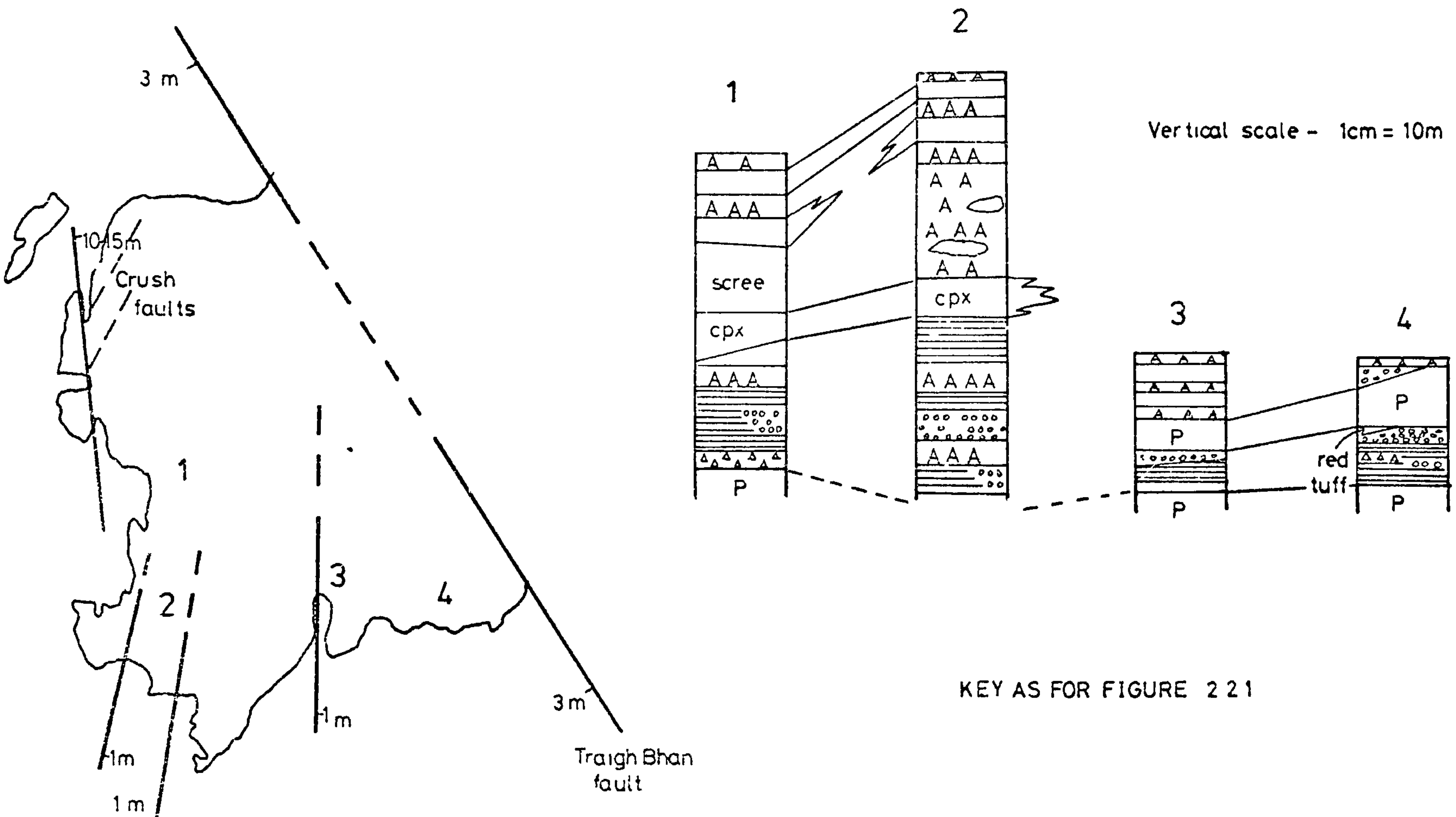


Figure 2.4.4 Sanday sequences collected from Tallabric block

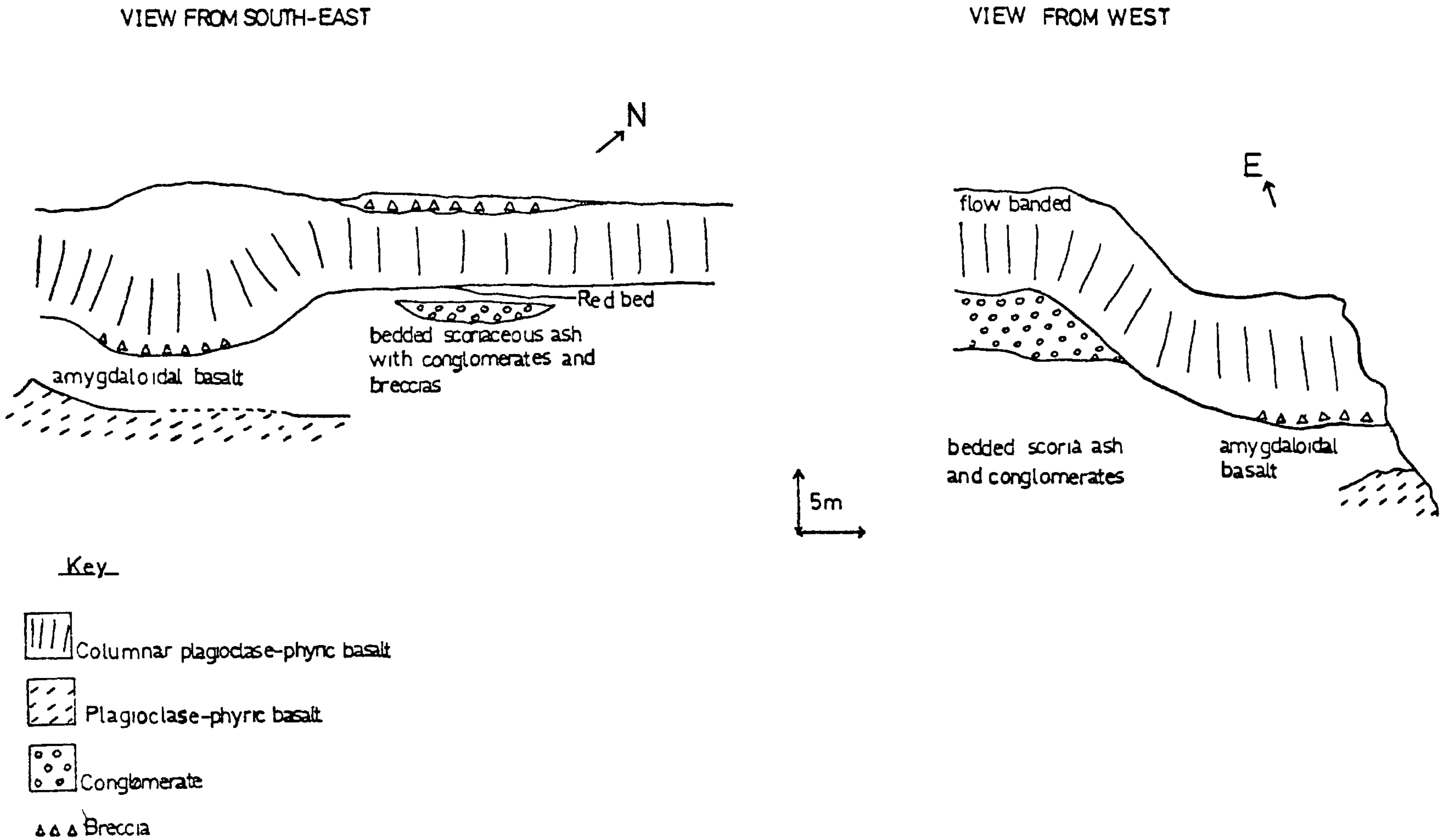


Figure 2.4.5 Sanday, sketch of flows, east of Tallabric (26800410)

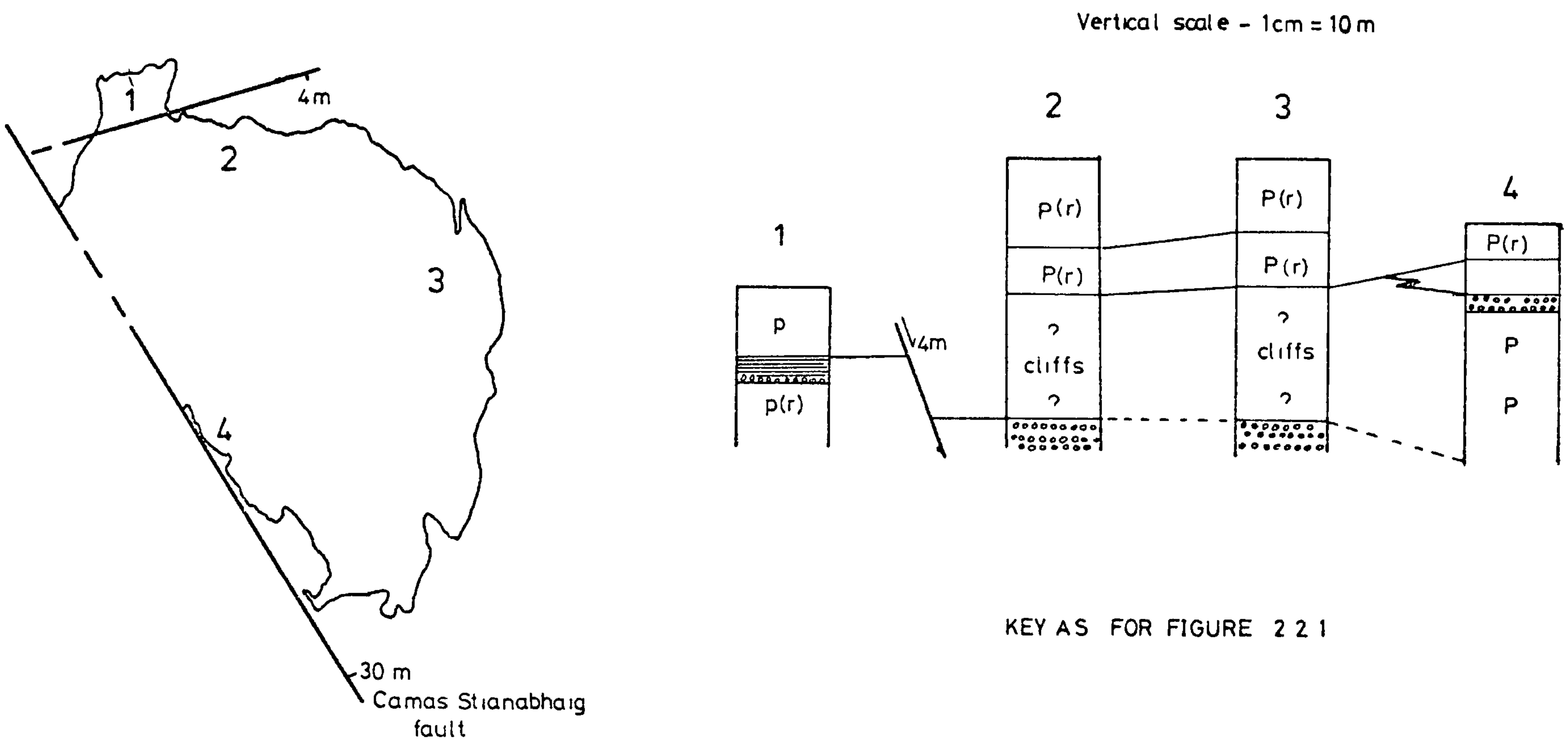
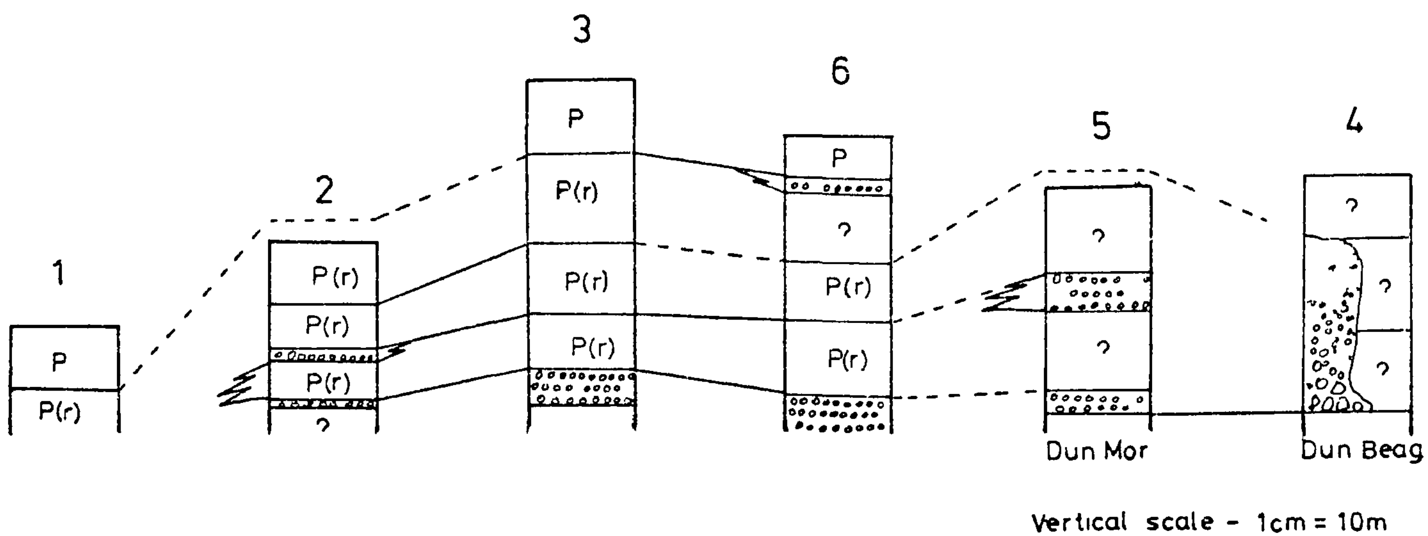


Figure 2 4 6 Sanday sequences collected from Eastern block

Figure 2 4 7

Sanday sequences collected from East Central block



KEY AS FOR FIGURE 221

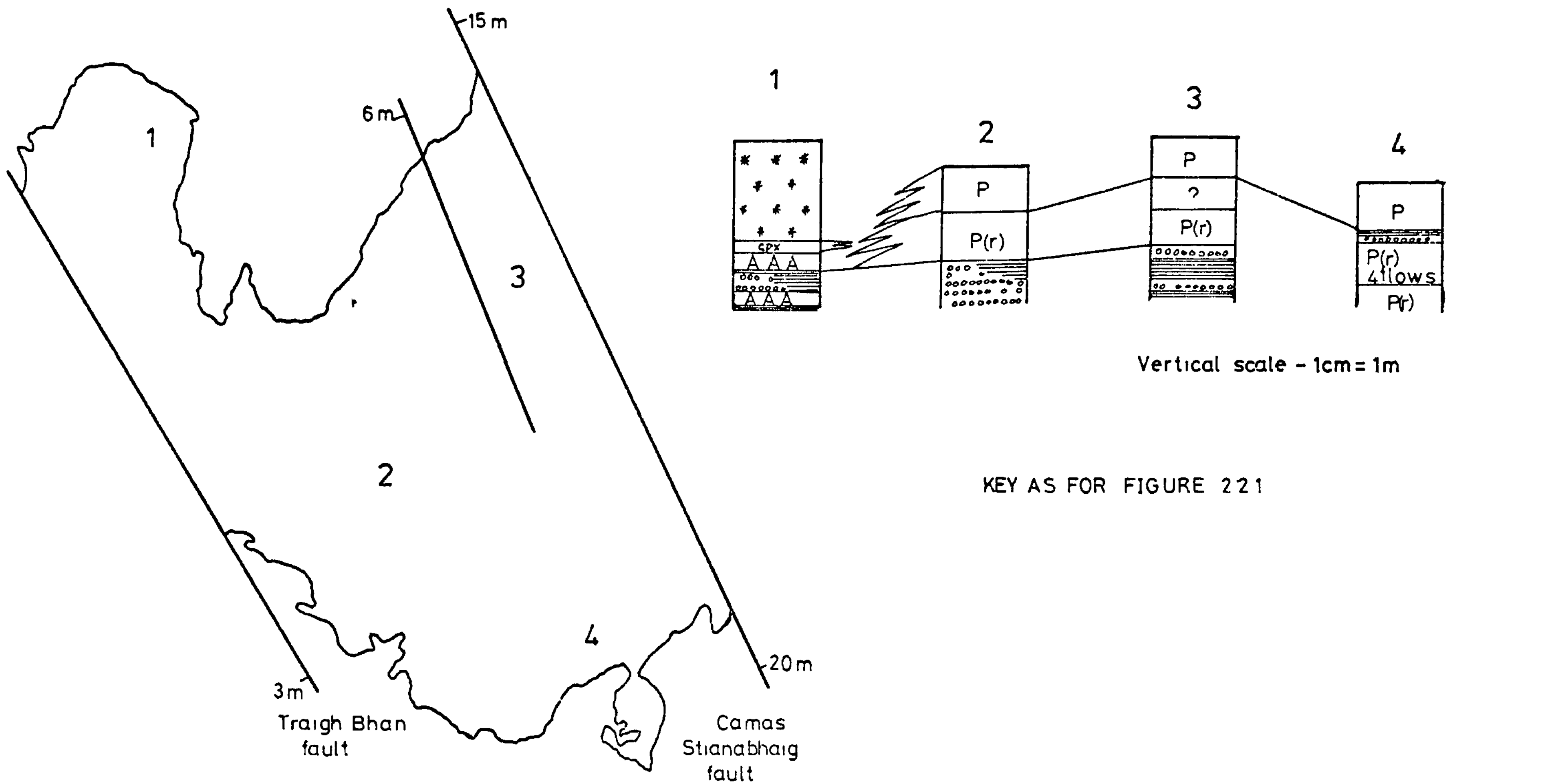


Figure 2.4.8. Sanday sequences collected from West Central block

Figure 2.4.9 Sanday channel-infill deposit, Cnoc Ghreannabric (27470690)

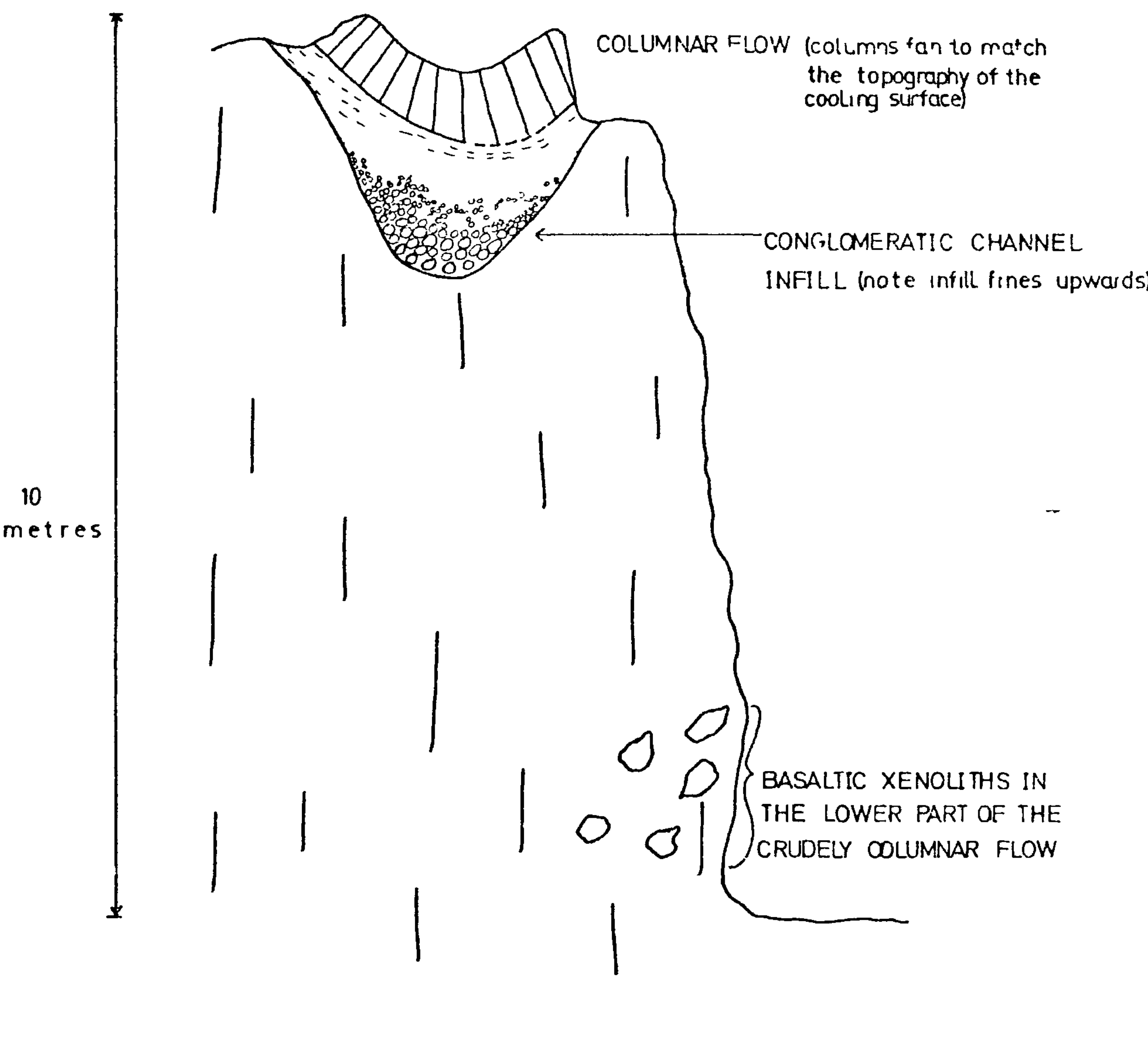


Figure 2.4.10

Sanday Summary of correlations.

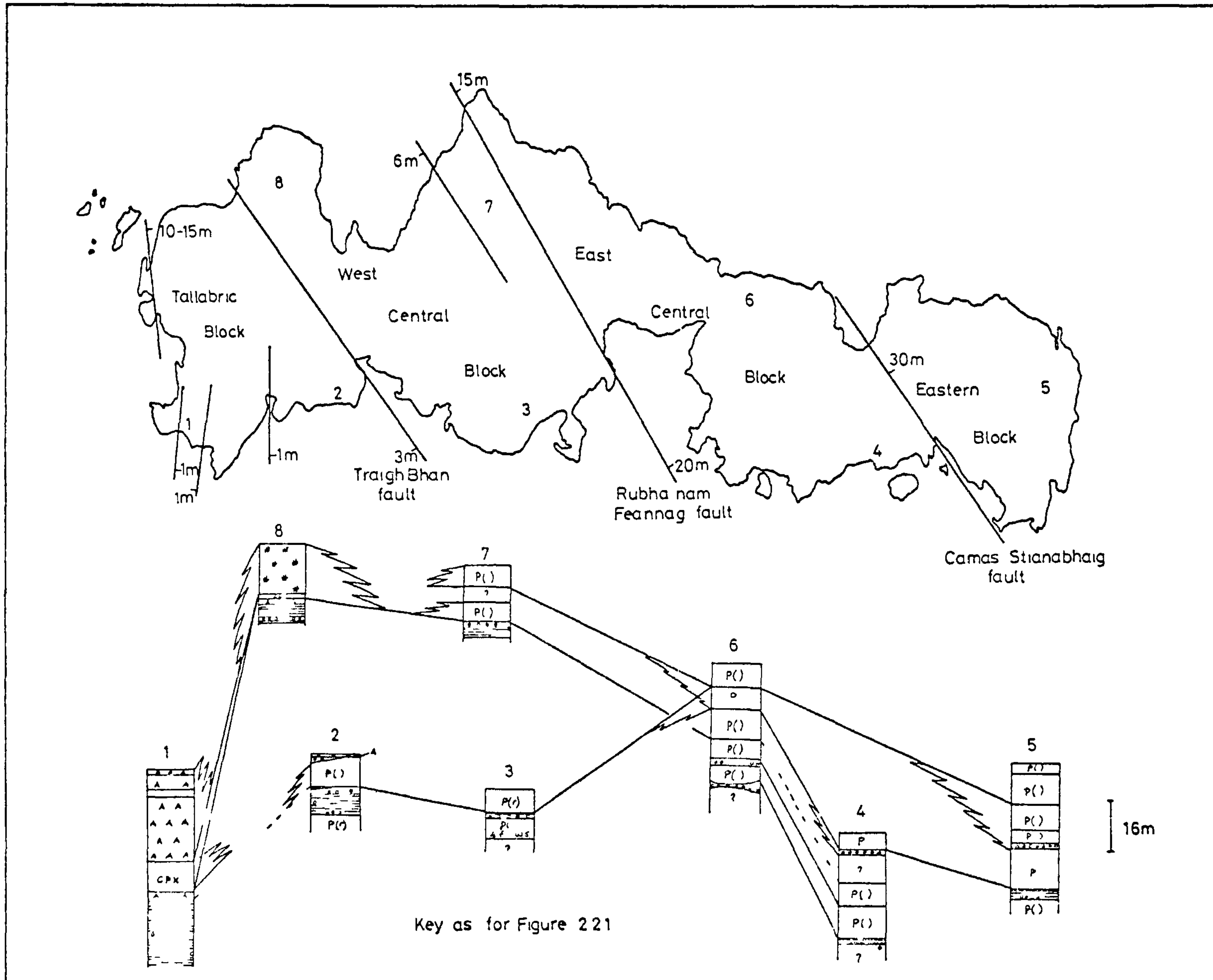

15m
6m
8
7
10-15m
West
East
Tallabric
Block
Central
Central
6
Block
Block
Block
30m
Eastern
5
2
3
1
Block
4
-1m
-1m
3m
Traigh Bhan
fault
20m
Rubha nam
Feannag fault
1m
Camas Stianabhaig
fault
16m
Key as for Figure 2.21

Figure 2.4.10

Figure 2.4.11

Canna Harbour outcrops of flows and conglomerates

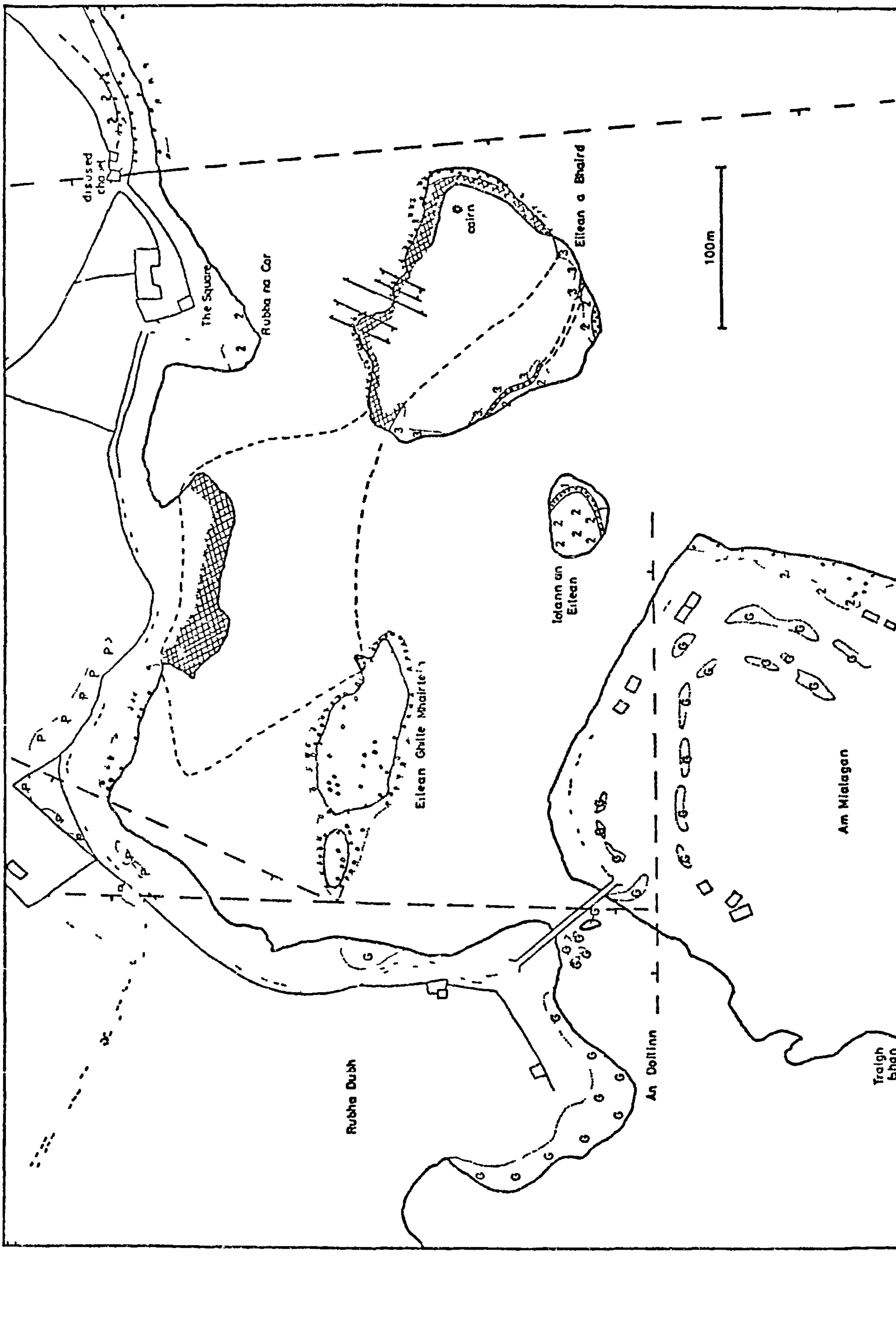

disused chapel
The Square
Rubha na Car
cairn
Eilean a Bhaird
100m
Iolann an Eilean
Eilean Ghille Mhairtein
Am Mialagan
An Doilinn
Rubha Dubh
Traigh bhan

Figure 2.4.11

Figure 2.4.12

Canna Harbour sequences examined

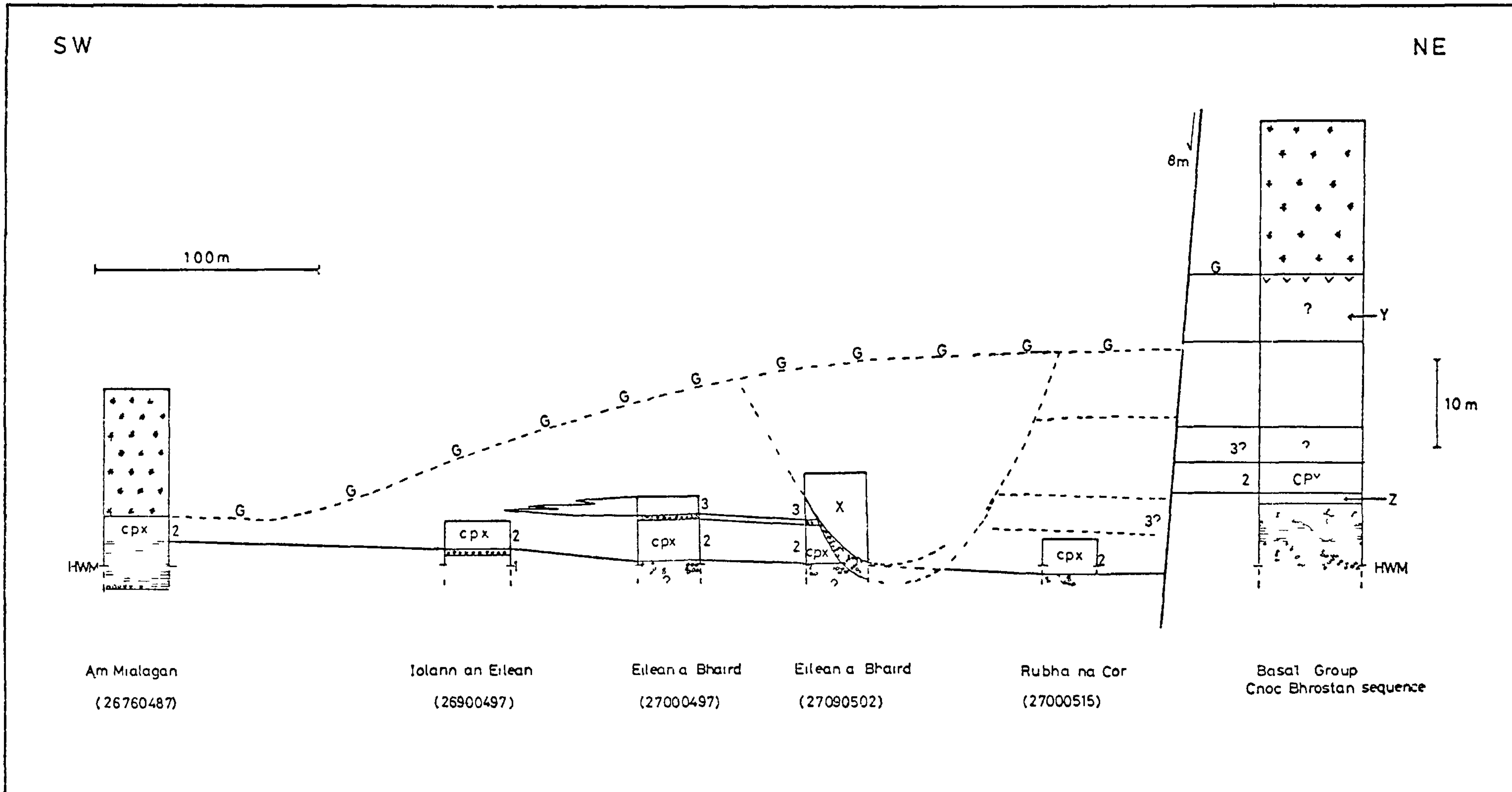
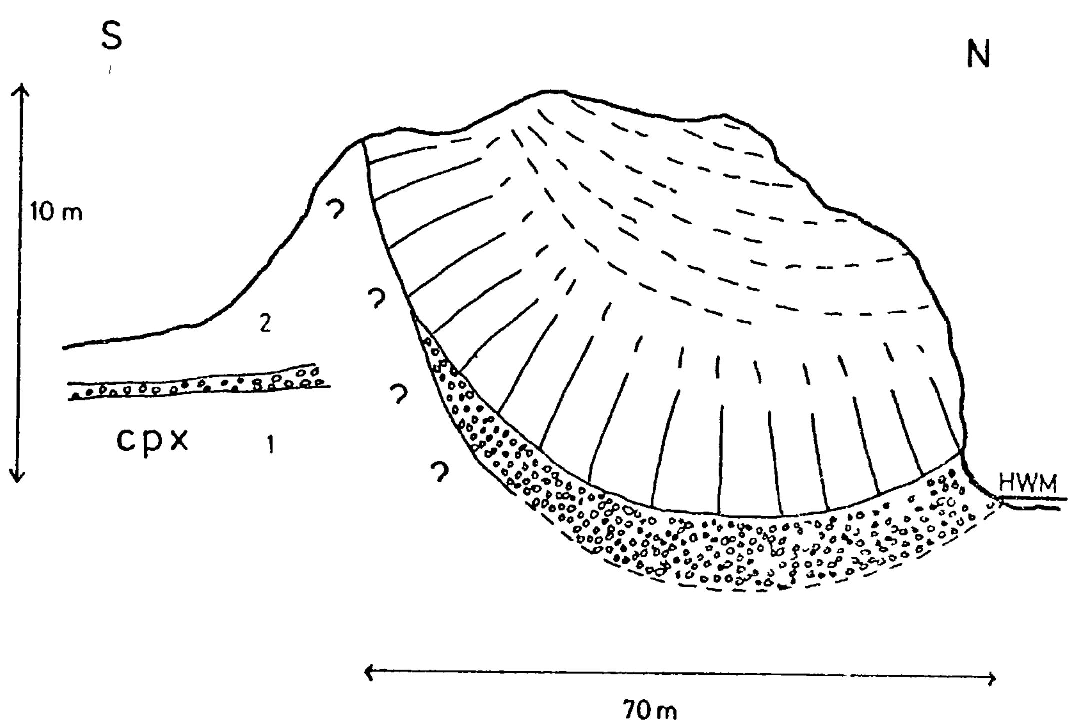

SW
NE
100m
10 m
8m
G
cpx
X
CPx
Y
Z
HWM
Am Mialagan
(26760487)
Iolann an Eilean
(26900497)
Eilean a Bhaird
(27000497)
Eilean a Bhaird
(27090502)
Rubha na Cor
(27000515)
Basal Group
Cnoc Bhrostan sequence

Figure 2.412

Figure 2 4 13 Canna Harbour Eilean a' Bhaird from the east



KEY

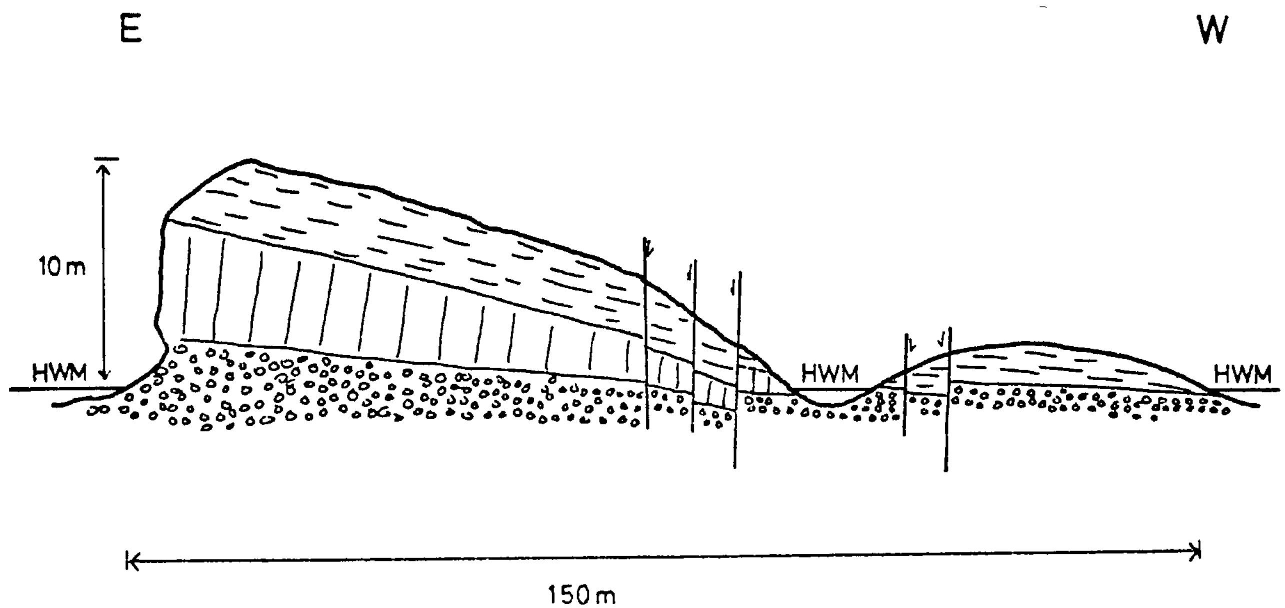
CPX Flow 1, very fine grained with ophitocrysts of clinopyroxene

2 Flow 2, fine grained aphyric lava

Conglomerate

Upper part of valley-infill flow (horizontal jointing)

Lower part of valley-infill flow (columnar jointing)



KEY AS FOR FIGURE 2.4.13

Figure 2.4.14 Canna Harbour Eilean a' Bhaird from the north

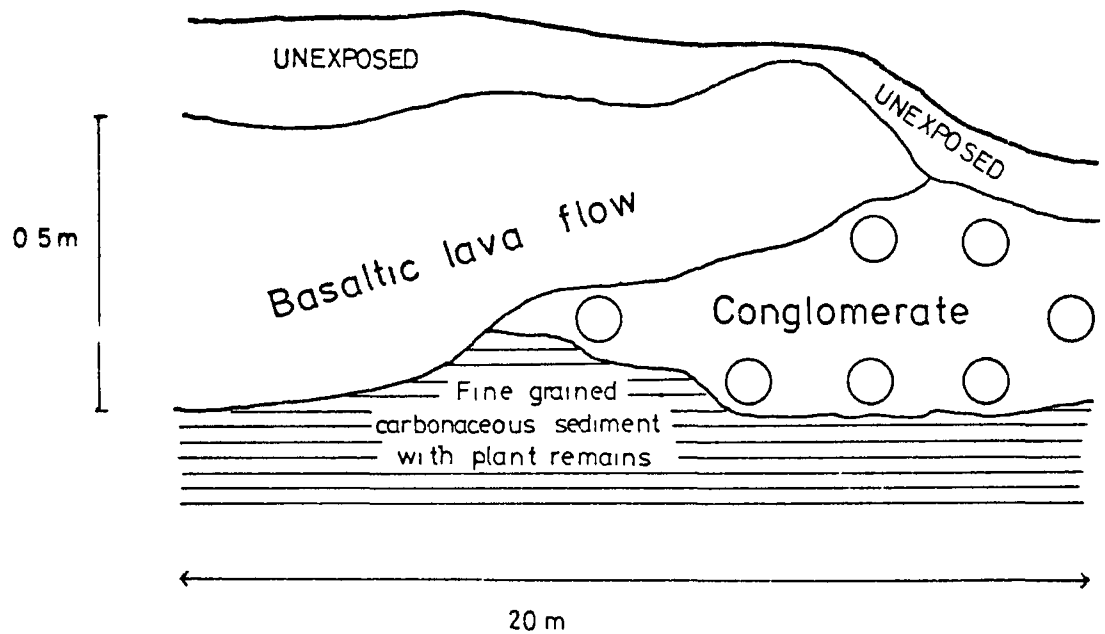
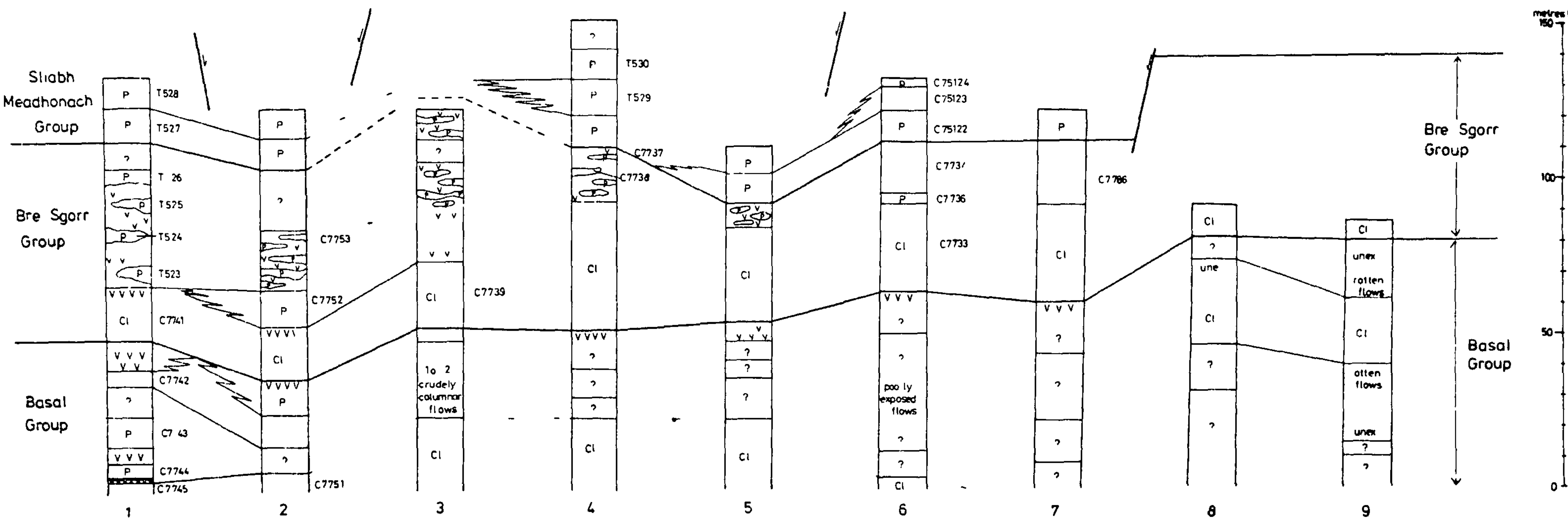


Figure 2 4 15 Canna Harbour foreshore near Canna House (27420542)

Figure 2.4.16

Western Canna Sequences examined showing correlations



Sliabh Meadhonach Group
Bre Sgorr Group
Basal Group
Bre Sgorr Group
Basal Group
metres O.D.
150
100
50
0
T528
T527
T525
T524
T523
C7741
C7742
C7744
C7745
C7753
C7752
C7751
C7739
1 to 2 crudely columnar flows
T530
T529
C7737
C7738
C75124
C75123
C75122
C7736
C7733
C7786
unex
rotten flows
une
poorly exposed flows
1
2
3
4
5
6
7
8
9

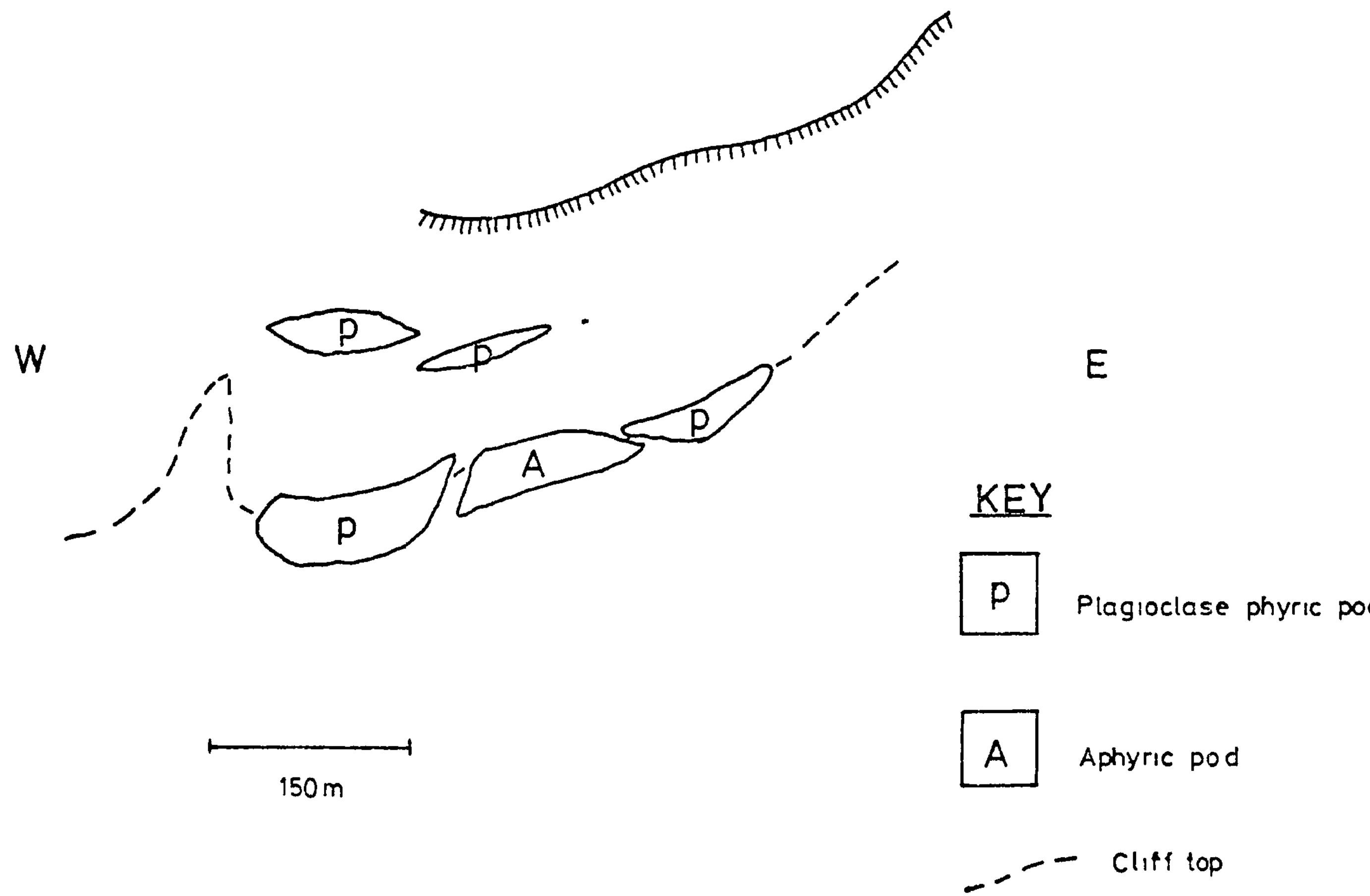


Figure 2 4 17 Western Canna cliff top near Iola Sgorr (21800415)

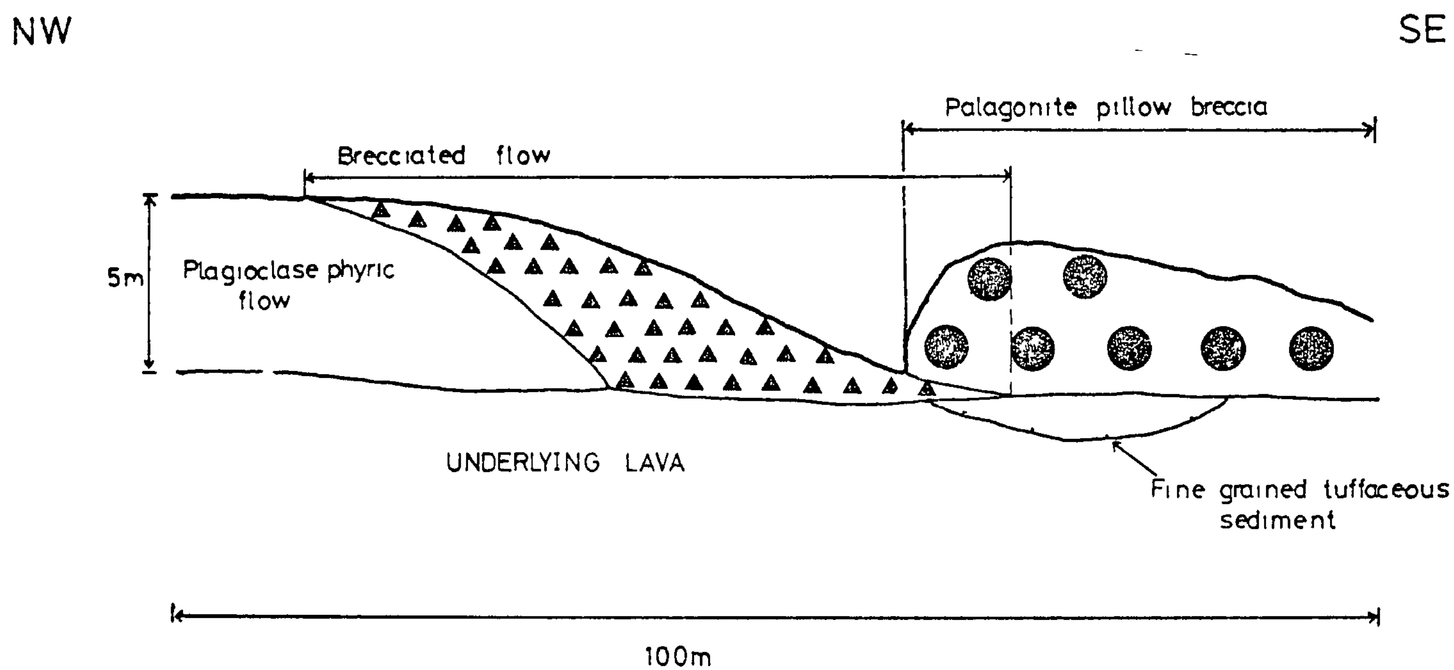


Figure 2.4.18 Western Canna flow passing into palagonite pillow breccia, foreshore near Bre Sgorr (21250400)

Figure 2.4.19

Correlations between Eastern and Western Canna sequences

For key to sequences see Figures 2.4.1, 2.4.2 and 2.4.16.

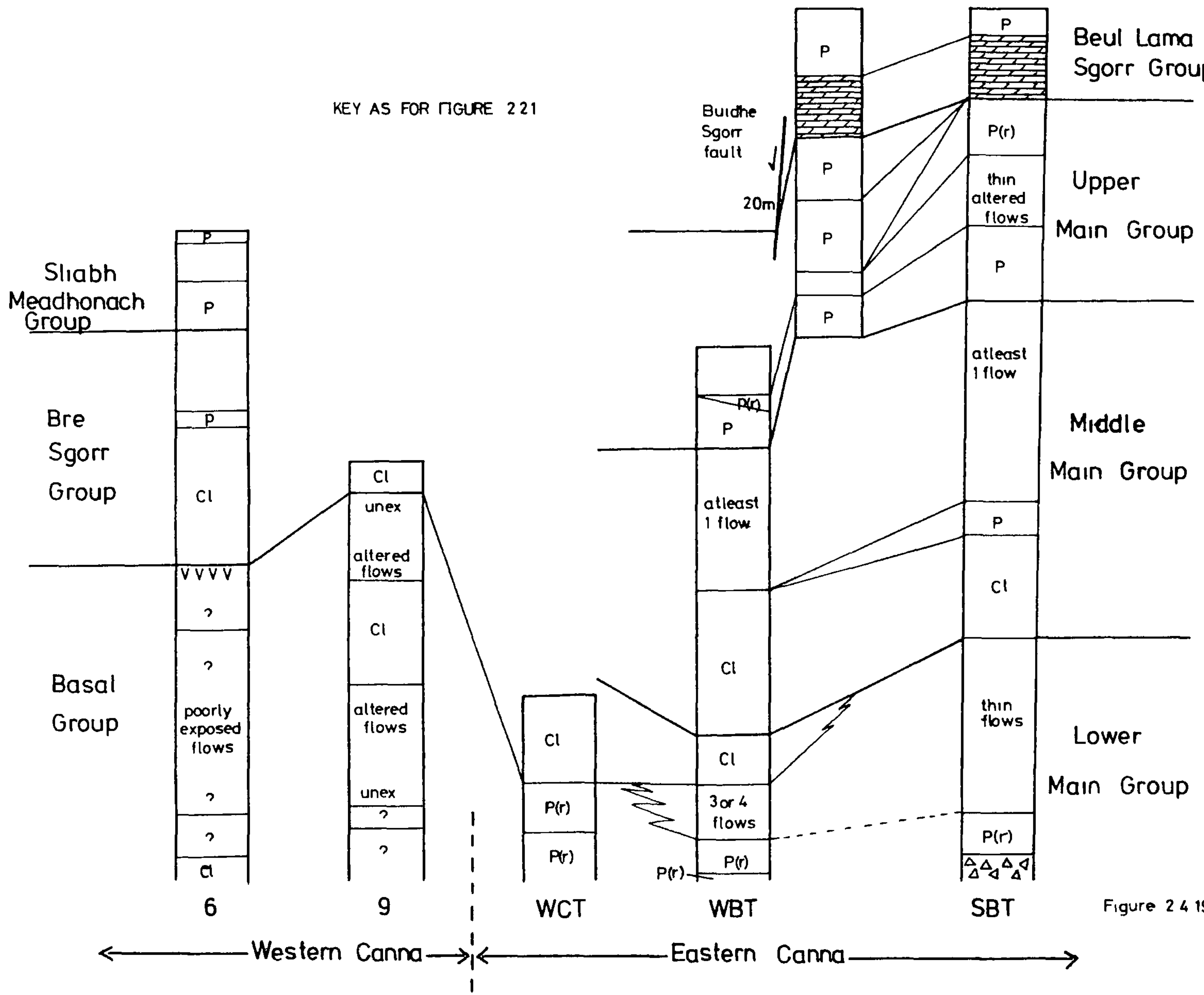

KEY AS FOR FIGURE 2 21
Beul Lama Sgorr Group
Upper Main Group
Middle Main Group
Lower Main Group
Sliabh Meadhonach Group
Bre Sgorr Group
Basal Group
Buidhe Sgorr fault
20m
P
P(r)
Cl
unex
altered flows
poorly exposed flows
thin altered flows
atleast 1 flow
thin flows
3 or 4 flows
VVVV
?
6
9
WCT
WBT
SBT
Western Canna
Eastern Canna

Figure 2 4 19

Figure 2.5.1

Geology of the Sea of the Hebrides near Eigg, Muck and Canna.

Figure 2.5.1

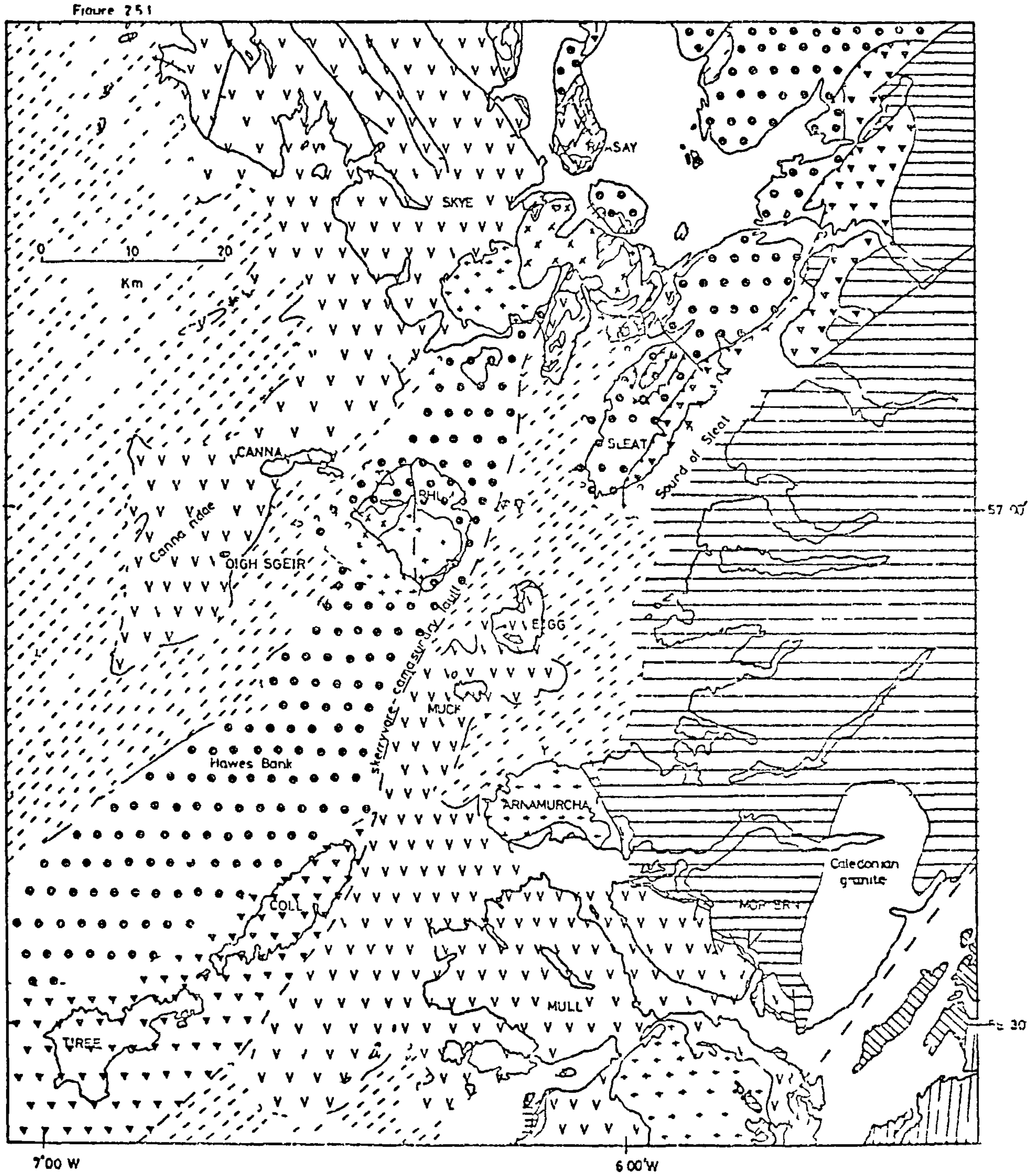

SKYE
SLEAT
Sound of Sleat
CANNA
OIGH SGEIR
EIGG
MUCK
Hawes Bank
COLL
TIREE
MULL
Caledonian granite
0
10
20
Km
57 00'
7°00 W
6 00'W

Figure 3.1a Contorted flow banding, basaltic flow, Eigg

Figure 3.1b Contorted flow banding, basaltic flow, Eigg

Figure 3.2a Columnar jointing, cliffs of south Sanday.

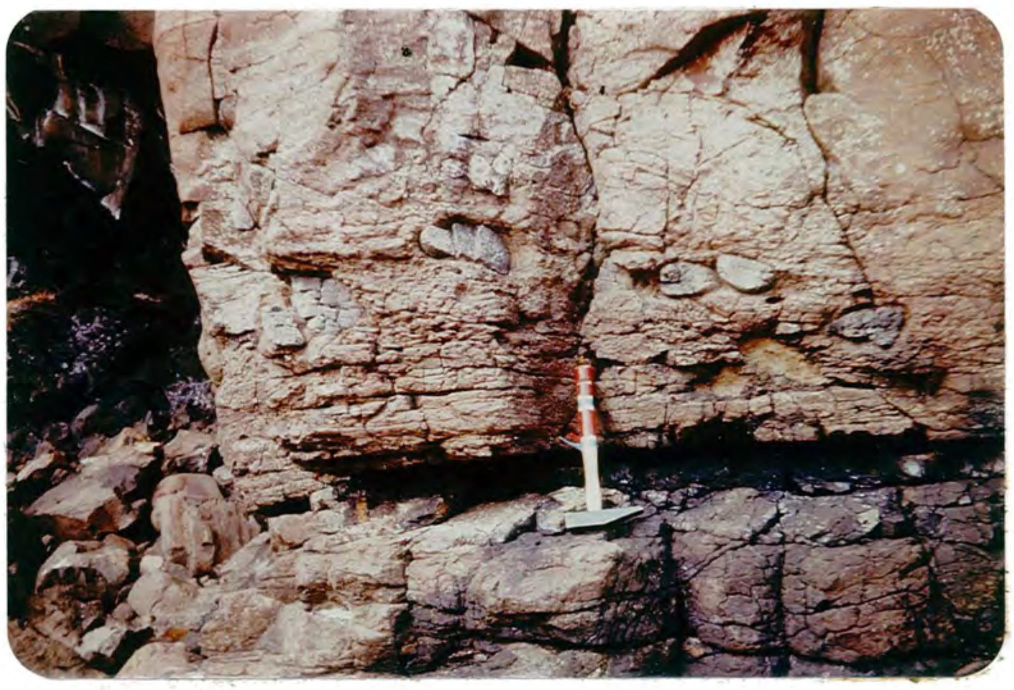


Figure 3.2b Xenoliths in basaltic flow, cliffs of south Sanday.

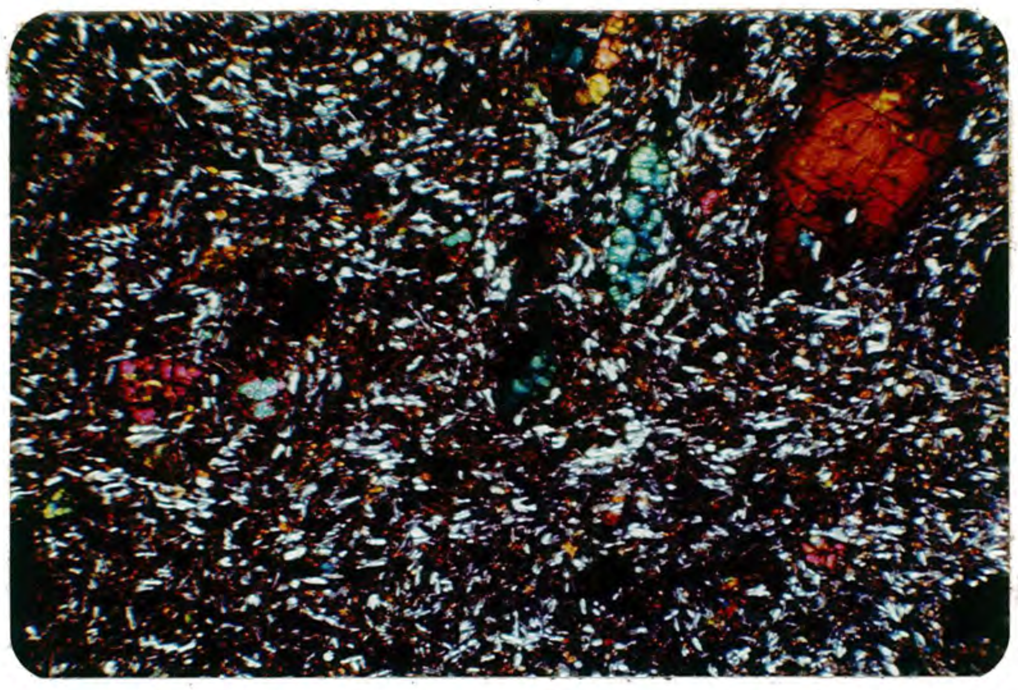


Figure 3.3a Olivine phyric basalt, Muck (M7570)

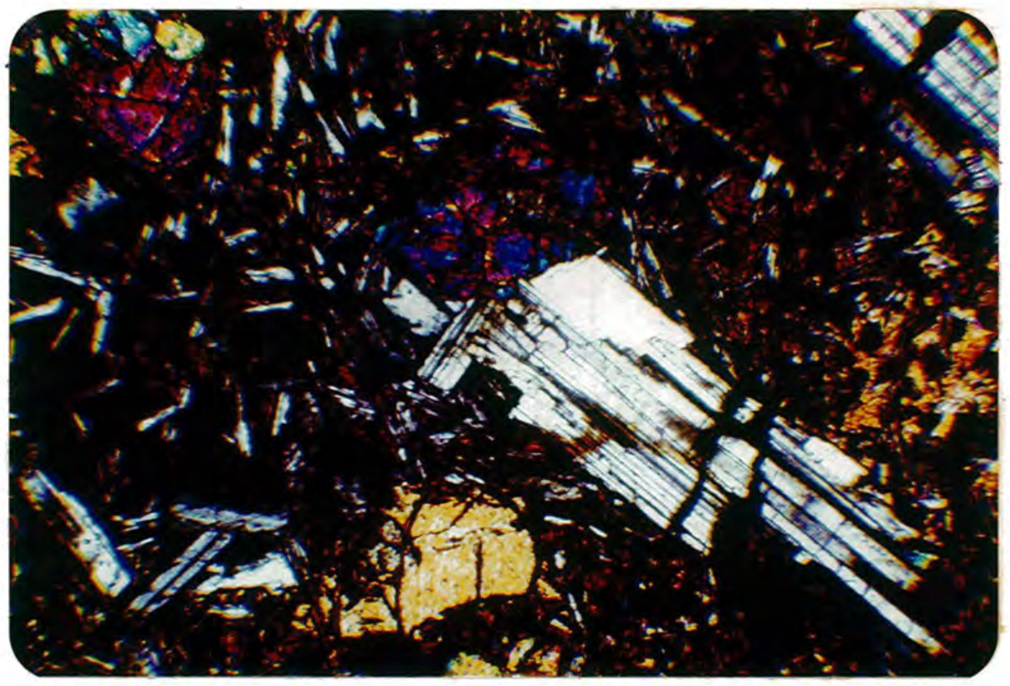


Figure 3.3b Olivine and plagioclase phyric basalt, Muck (M7578)

Figure 4 1 Sketch of MD17 (42437918)

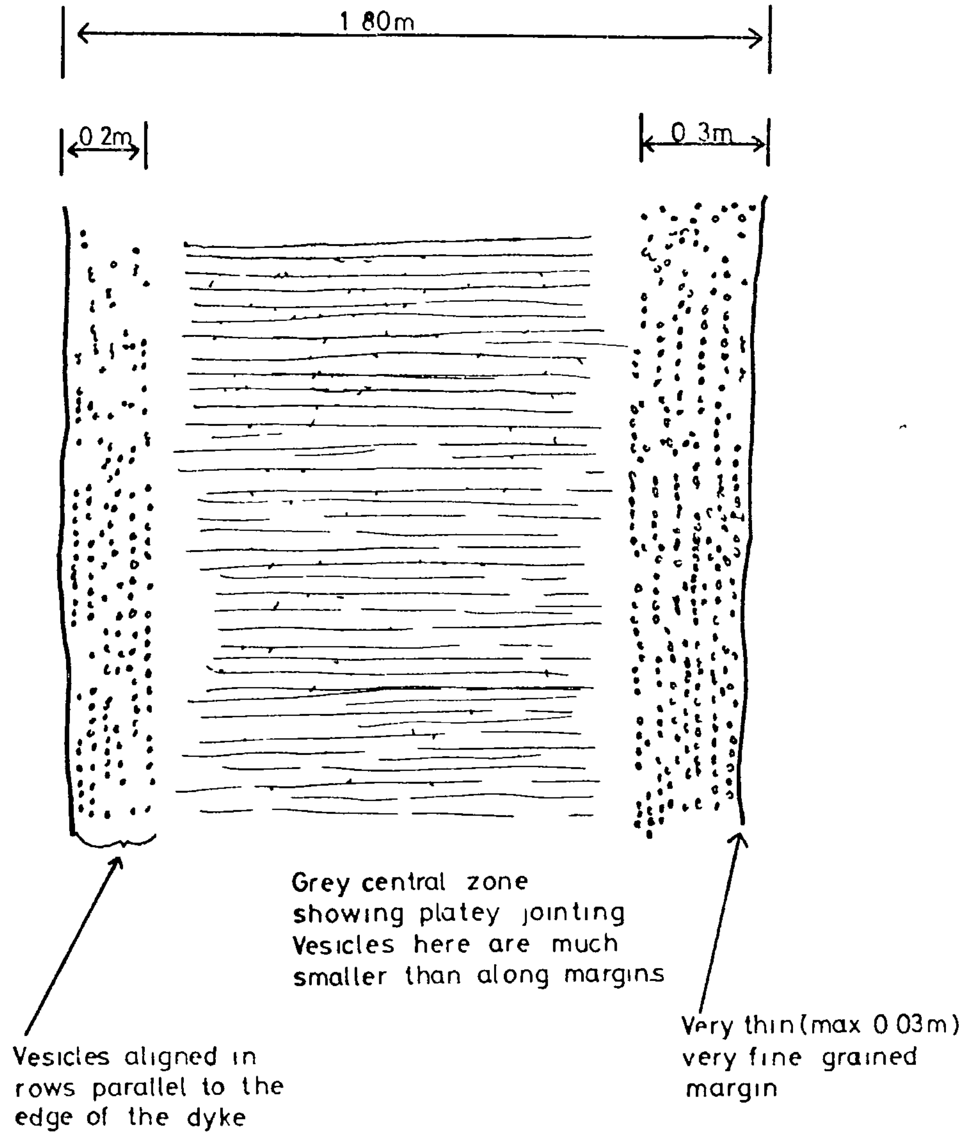
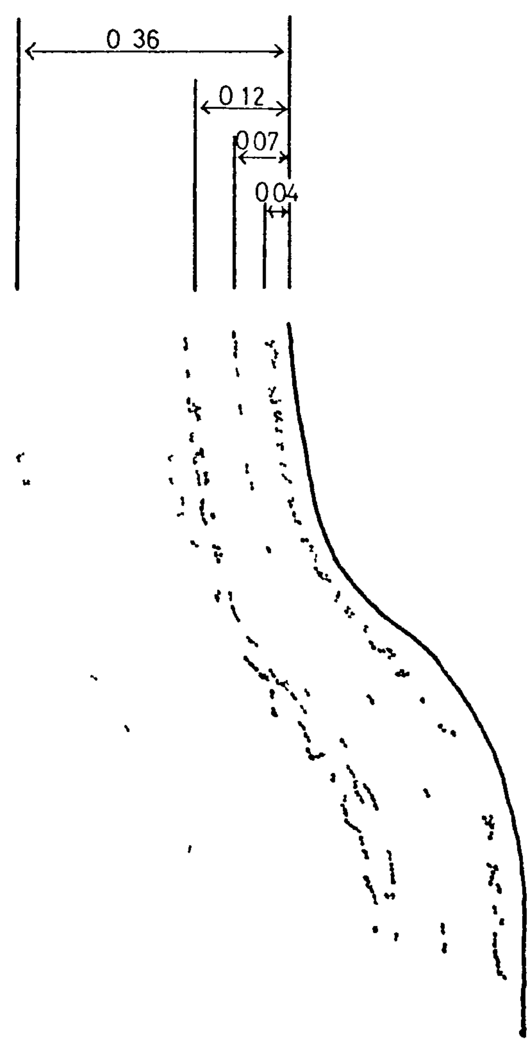
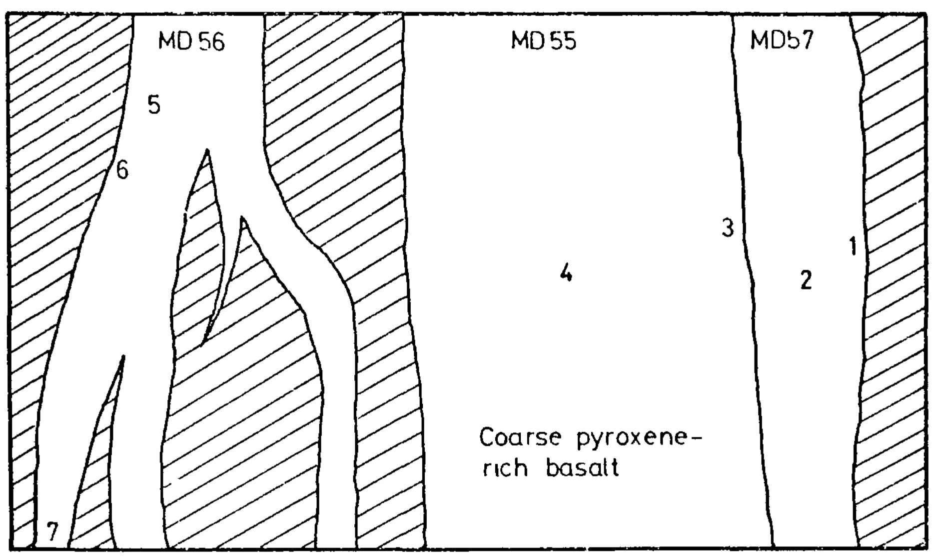


Figure 4 2 Marginal part of MD18 (42697908) showing lines of vesicles parallel with margin of dyke



Note - Thicknesses shown are in metres

Figure 4 3 Sketch of dyke complex near Rubh' Leam na Laraich, Muck (39227970)



Scale - 1 2000

Sample localities

1 MD57B

2 MD57A

3 MD55A

4 MD55B

5 MD56C

6 MD56B

7 MD56A

KEY

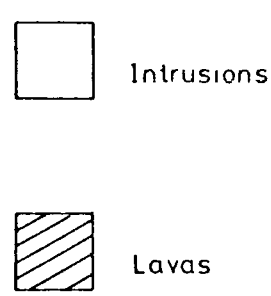


Figure 4 4 Dyke (MD 37) showing side-stepping (42877928)

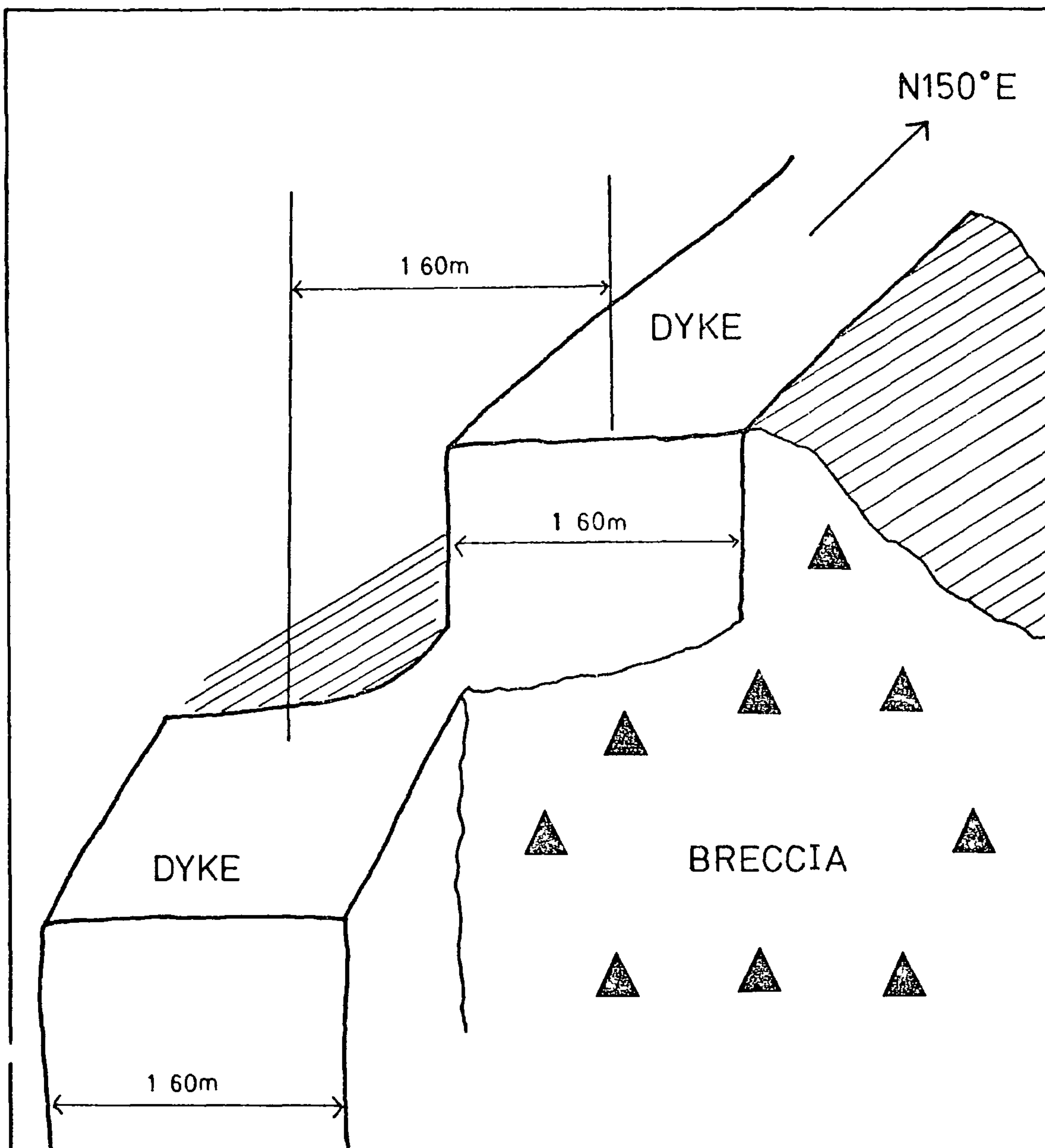


Figure 4.5 Dyke dying out downwards, S E Muck.
(42827932)

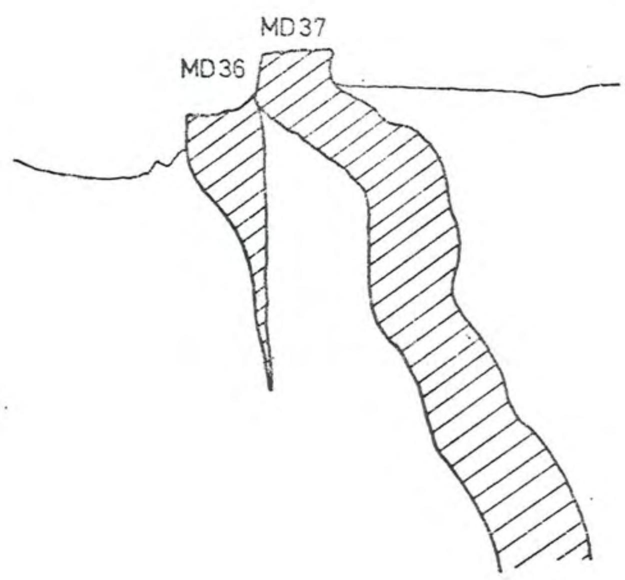
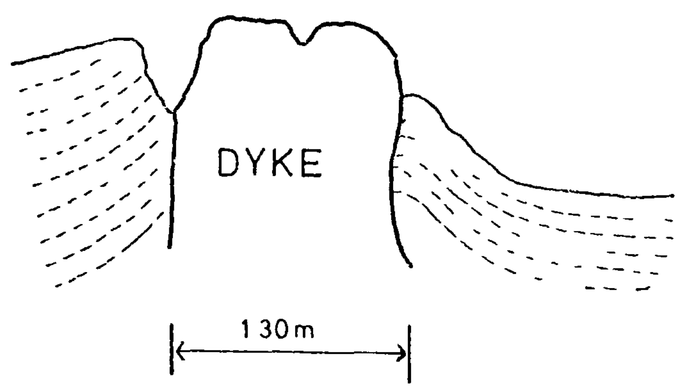


Figure 4.6 Dyke/country rock relationships, Camas Mor, Muck (c 40737935)

a) Sketch of MD122 showing updoming of sediments



b) Cross section showing thermal metamorphism

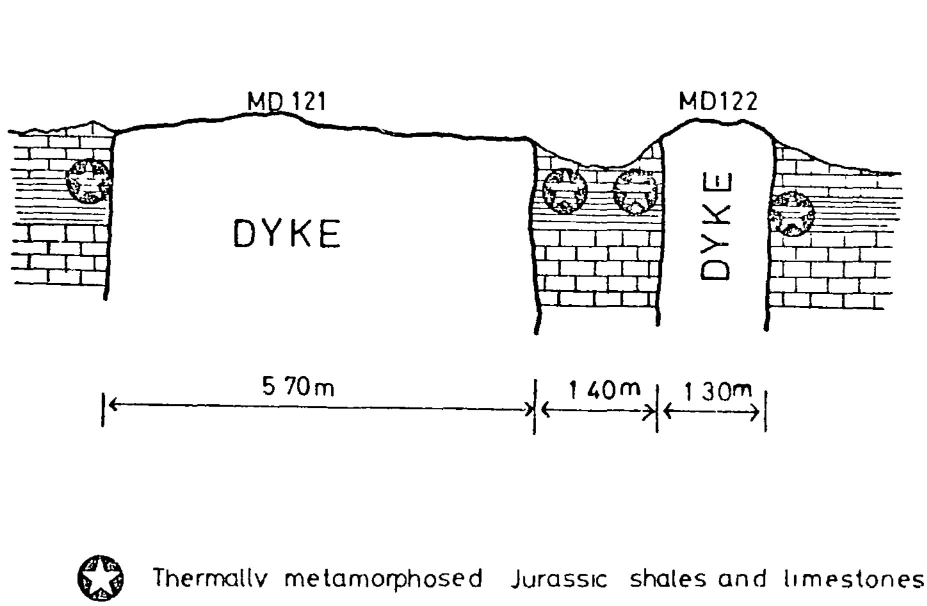


Figure 4.7 Dyke passing into a sill, Laig Bay, Eigg
(E7404- c 46928925)

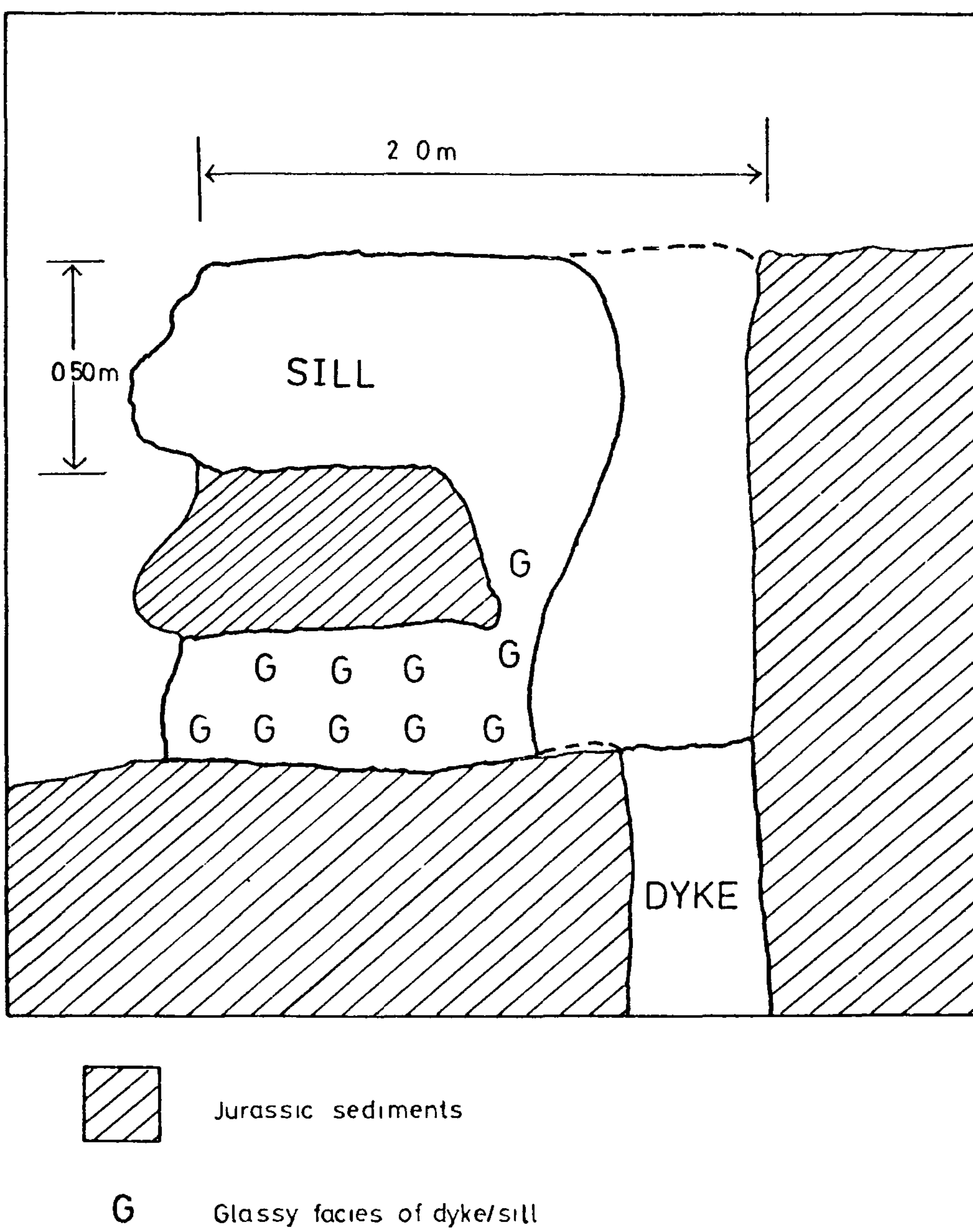
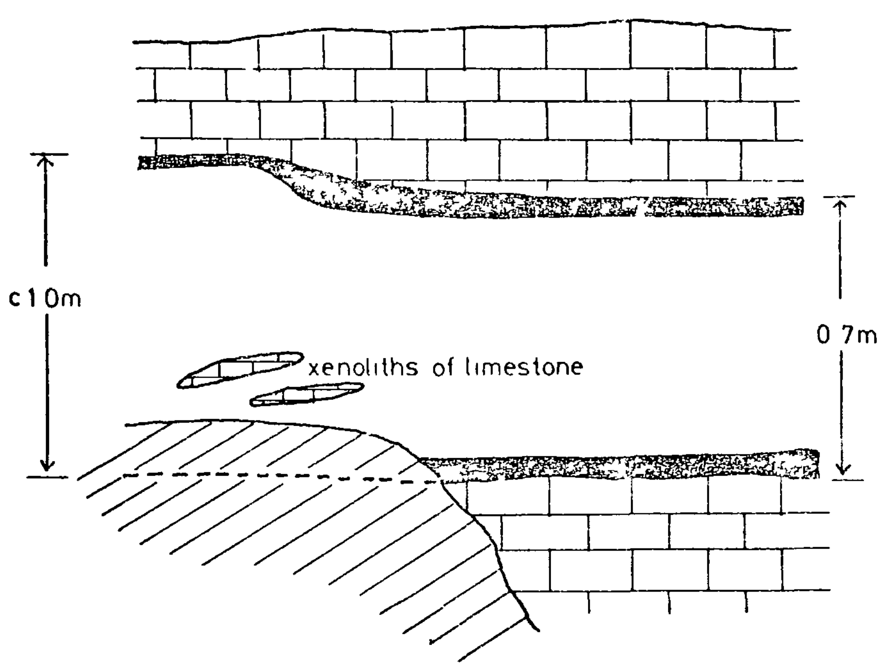


Figure 4 8 Sill intruding Jurassic sediments, Laig Bay, Eigg (E7401- c 47248851)



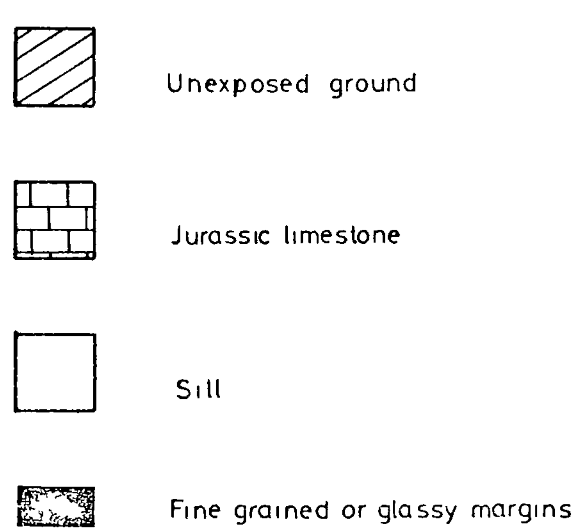


Figure 4.9

Location and trend of the dykes of Muck

Note - The numbers shown on this diagram are the sample numbers used in this thesis except that the preceding 'MD' is omitted.

(There is one exception to the above - M7606)

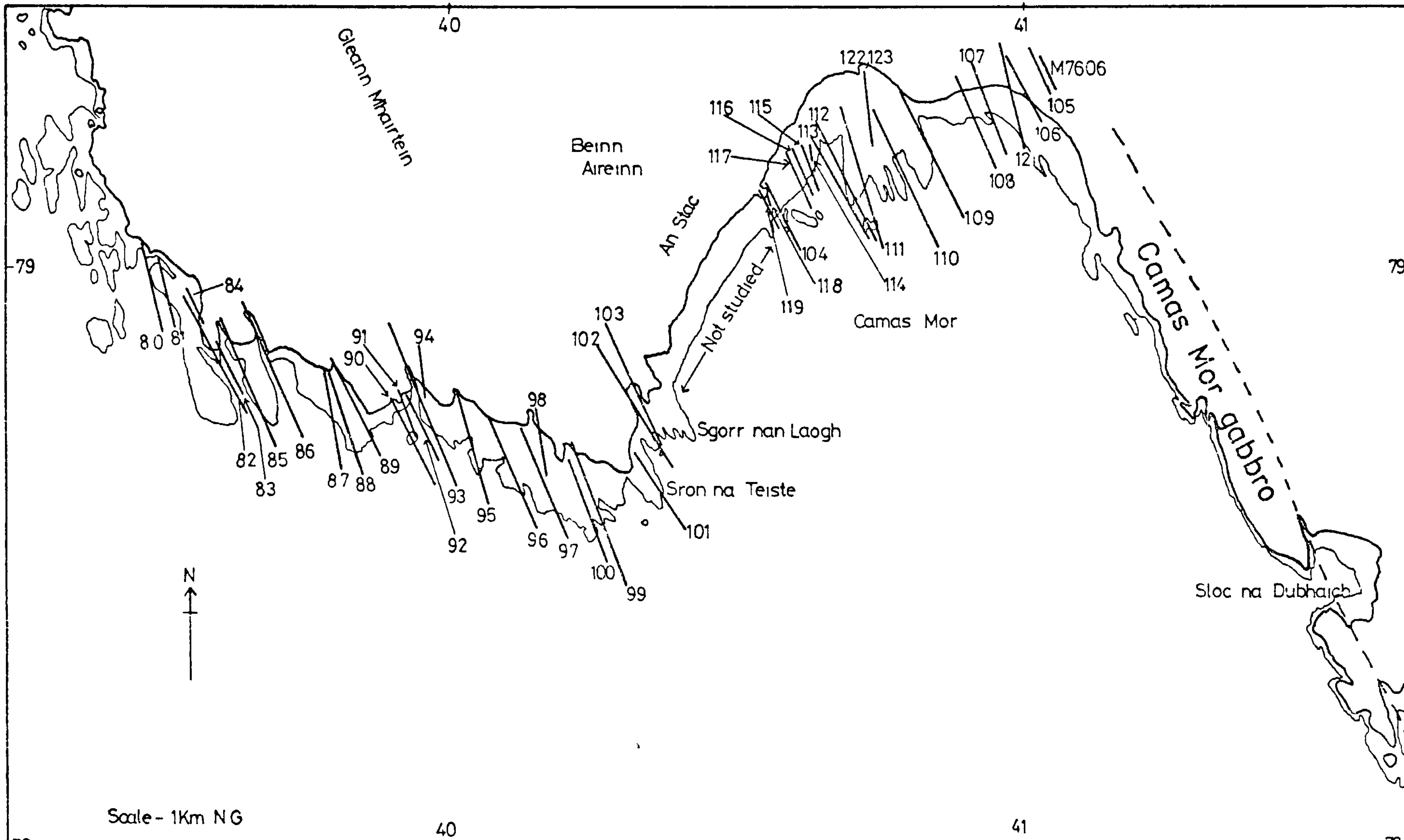


Figure 4.9a Southwest Muck - location and trend of dykes

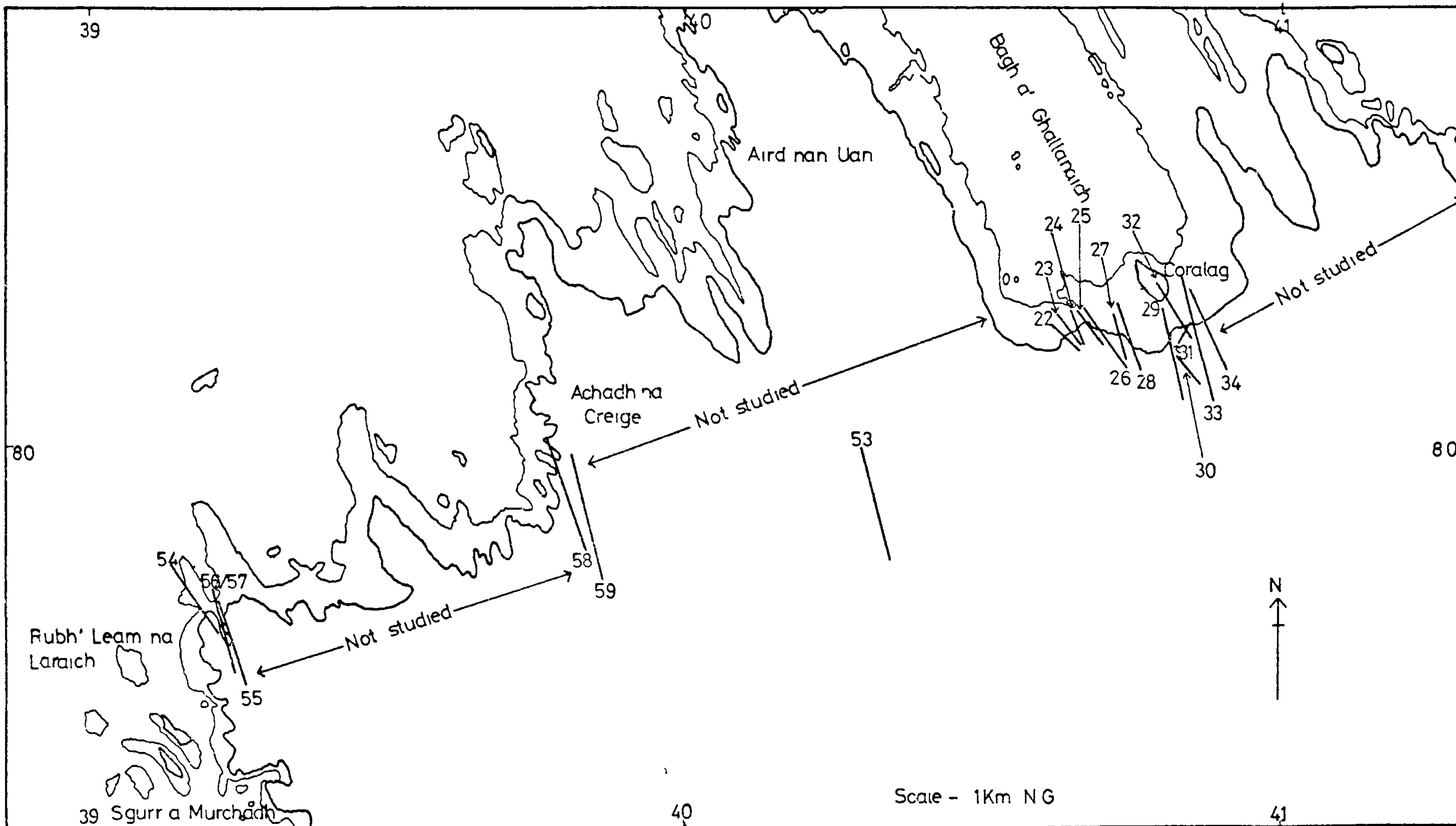


Figure 4 9b Northwest Muck- location and trend of dykes

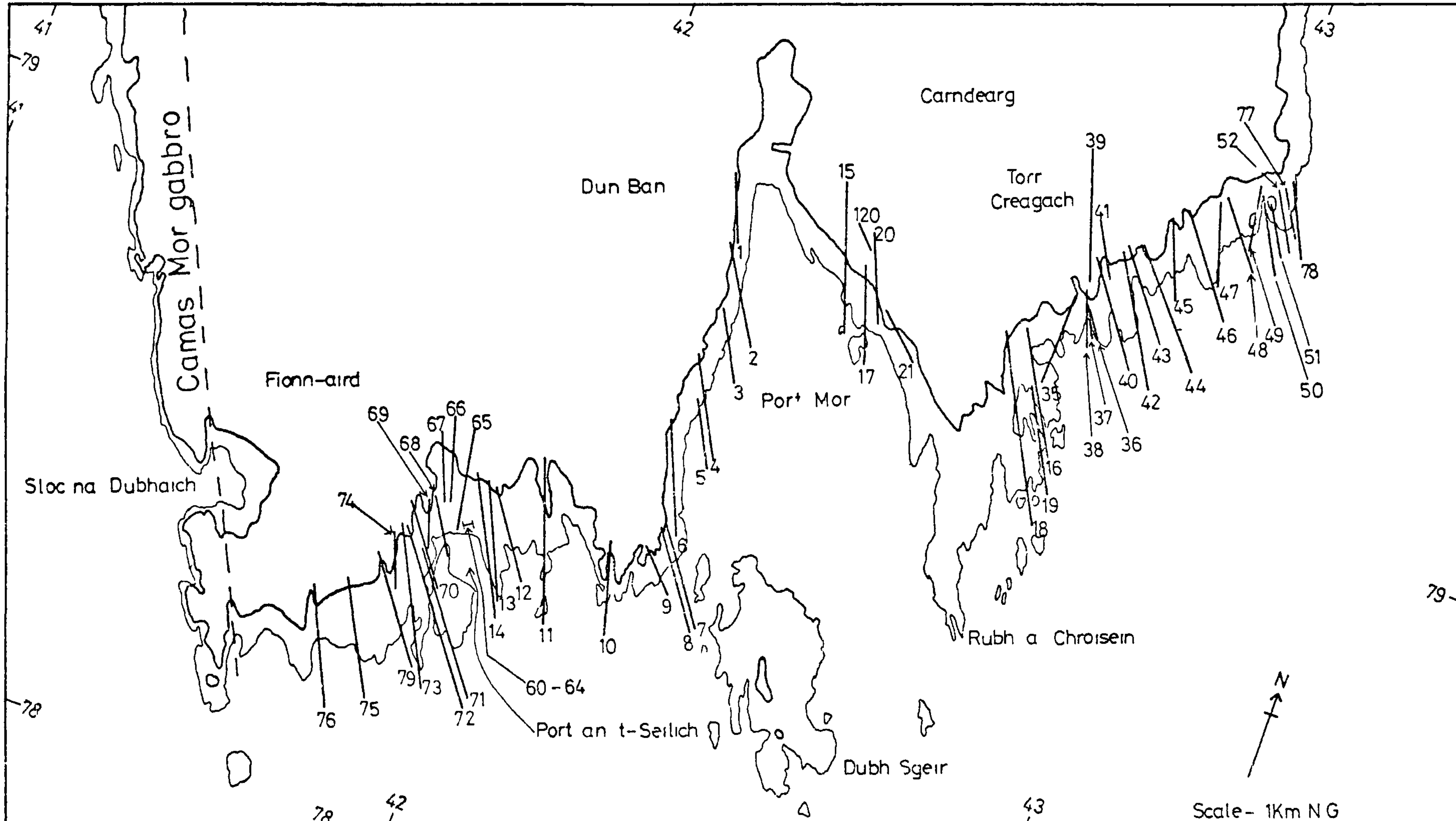


Figure 4.9c Southeast Muck - location and trend of dykes

Figure 4.10

Rose diagrams of dykes outcropping along the south coast of Muck.

Note Rose diagrams drawn to the scale of 1 cm representing 1 dyke.

Dykes grouped in 5 degree sectors by trend for these diagrams.

Figure 4 10a Dykes west of Camas Mor beach

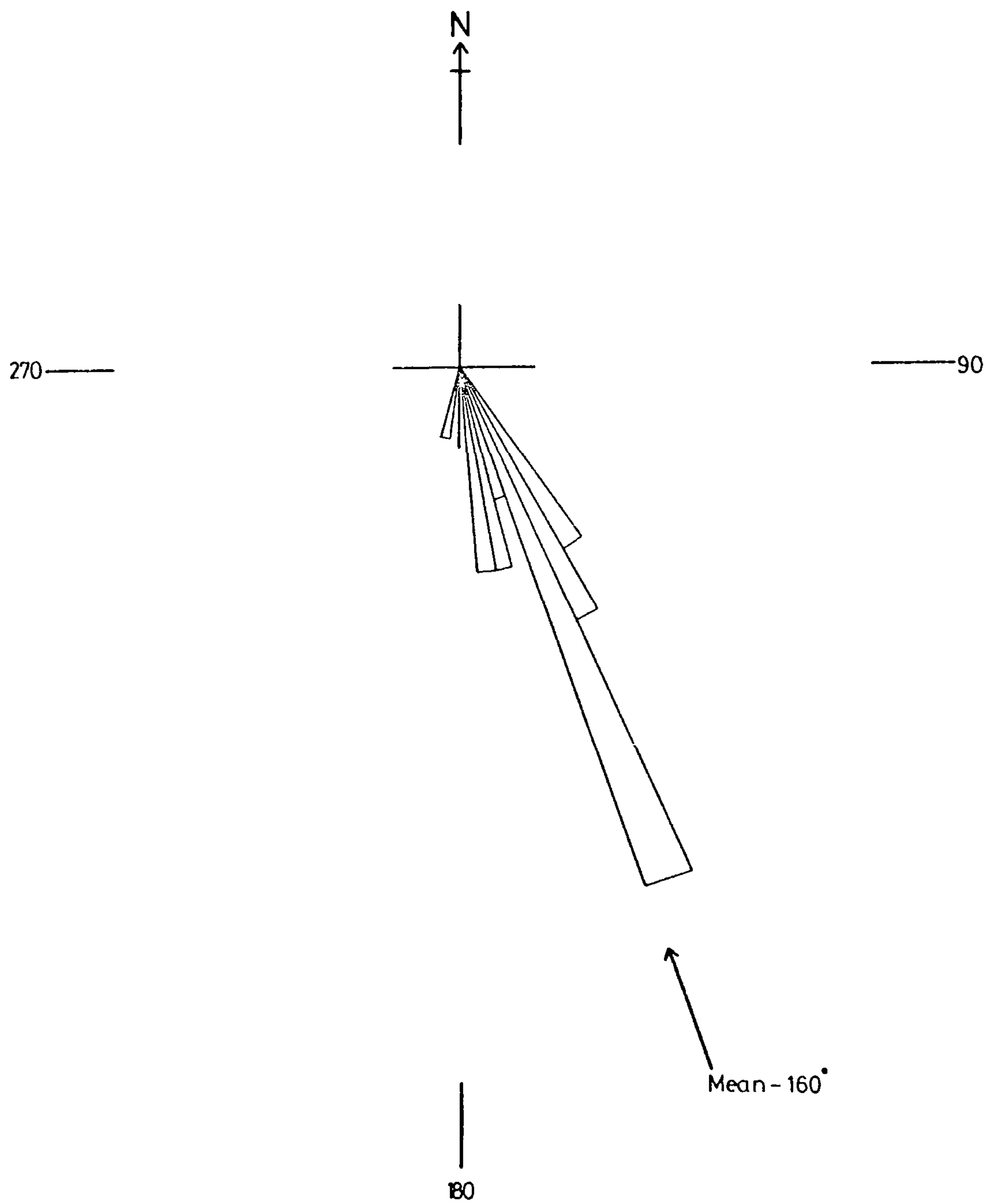


Figure 4.10b Dykes east of Camas Mor beach - west of Camas Mor gabbro

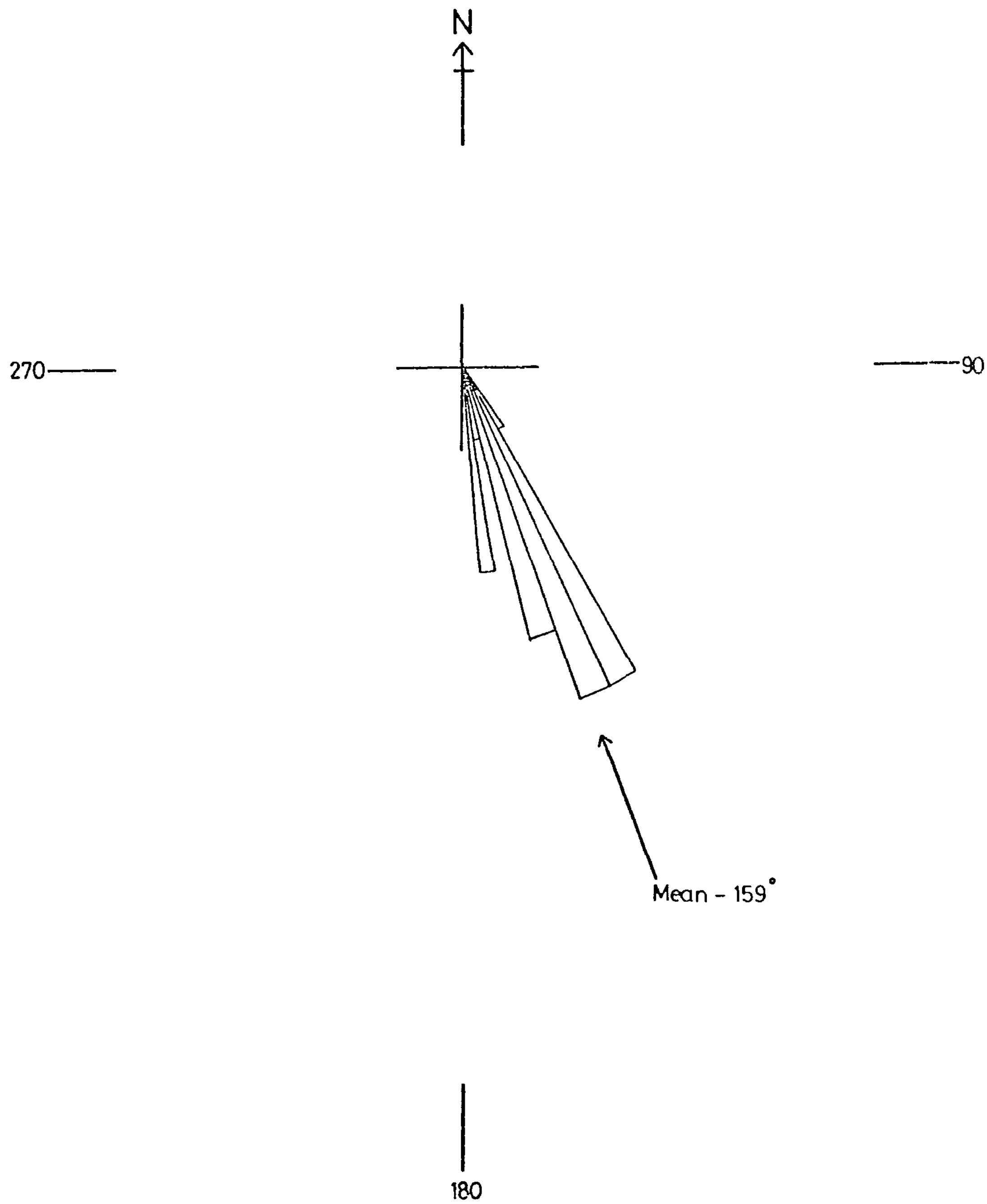


Figure 4.10c Dykes east of Camas Mor gabbro - west of Port Mor

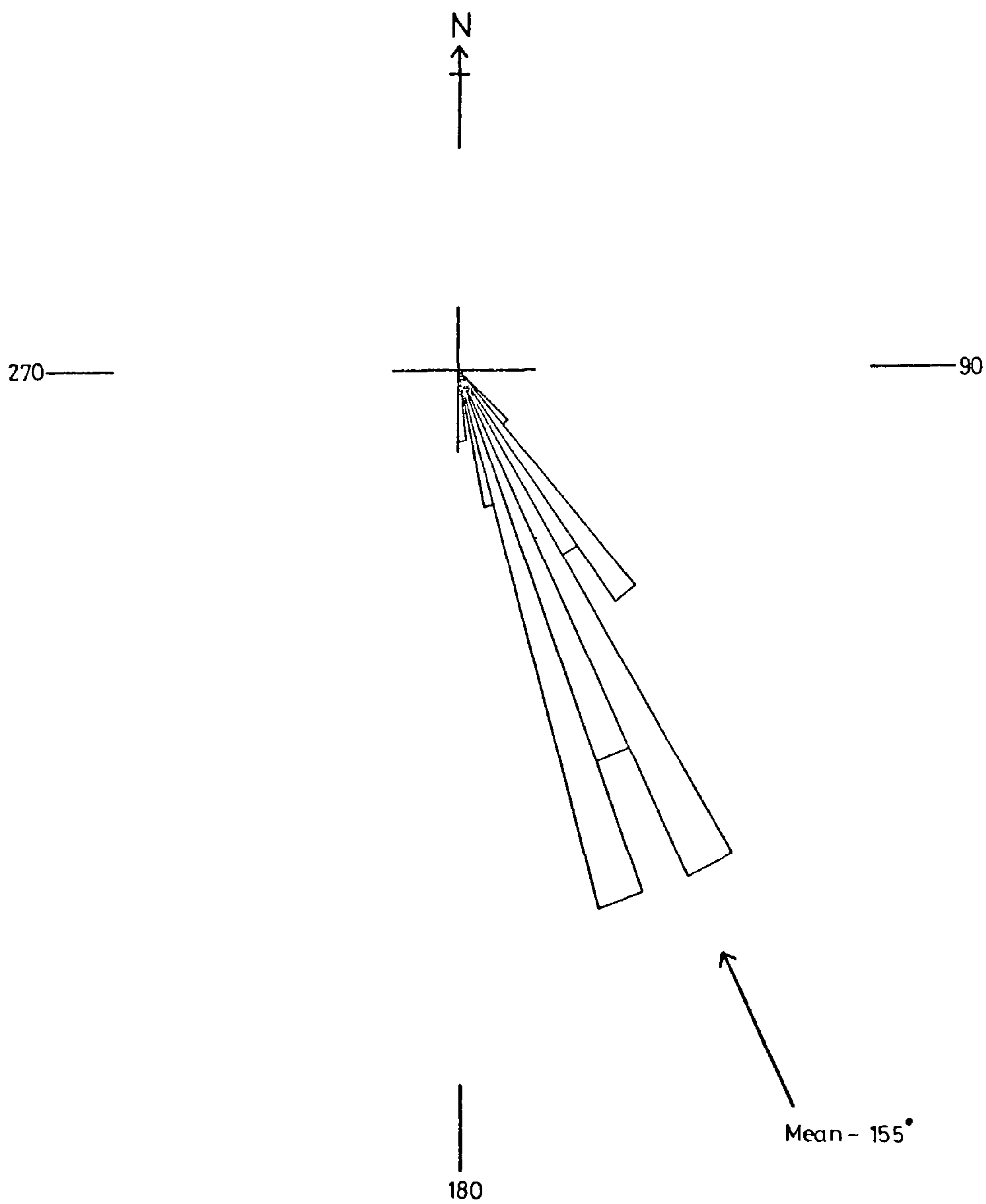


Figure 4 10d Dykes east of Port Mor

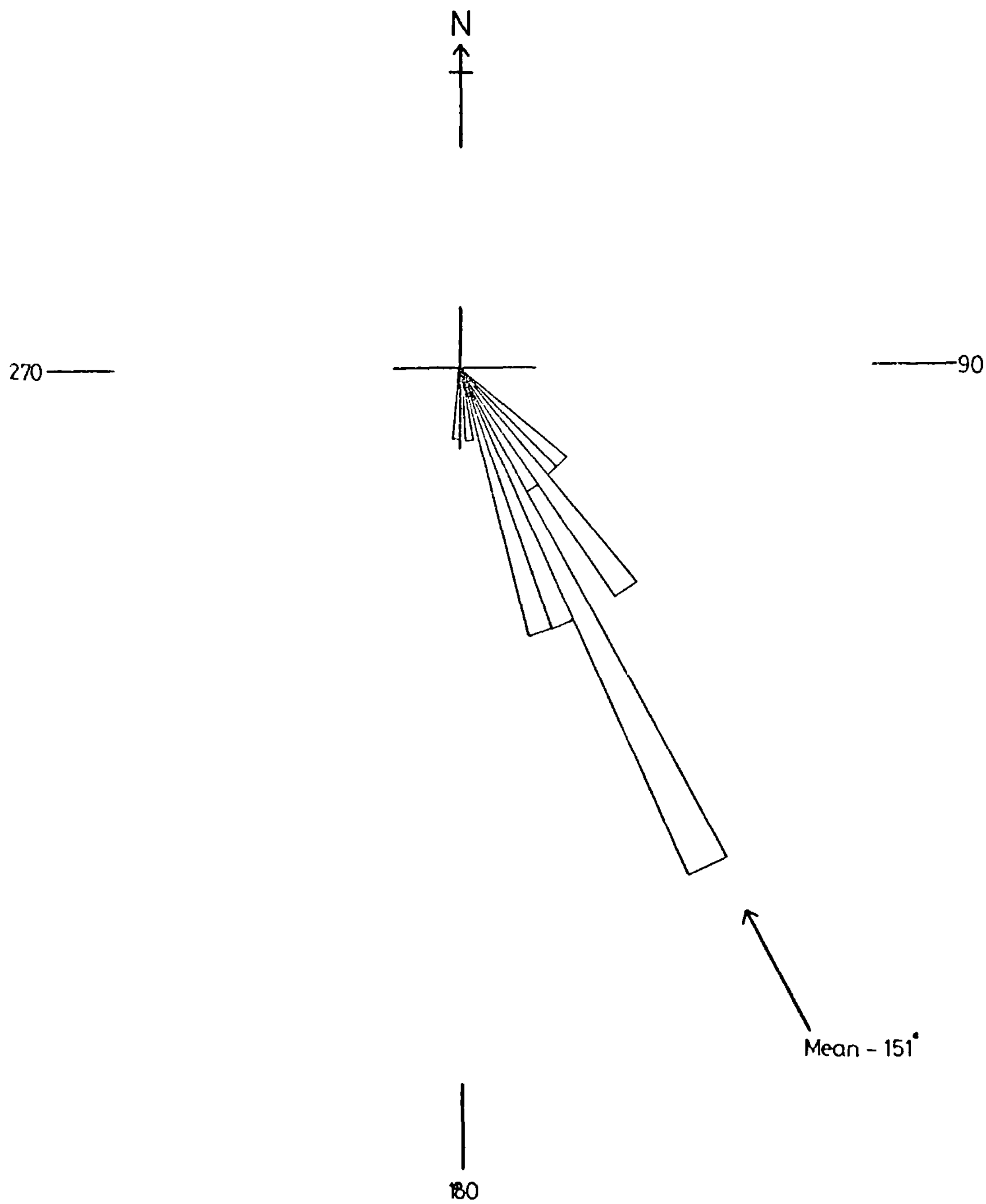
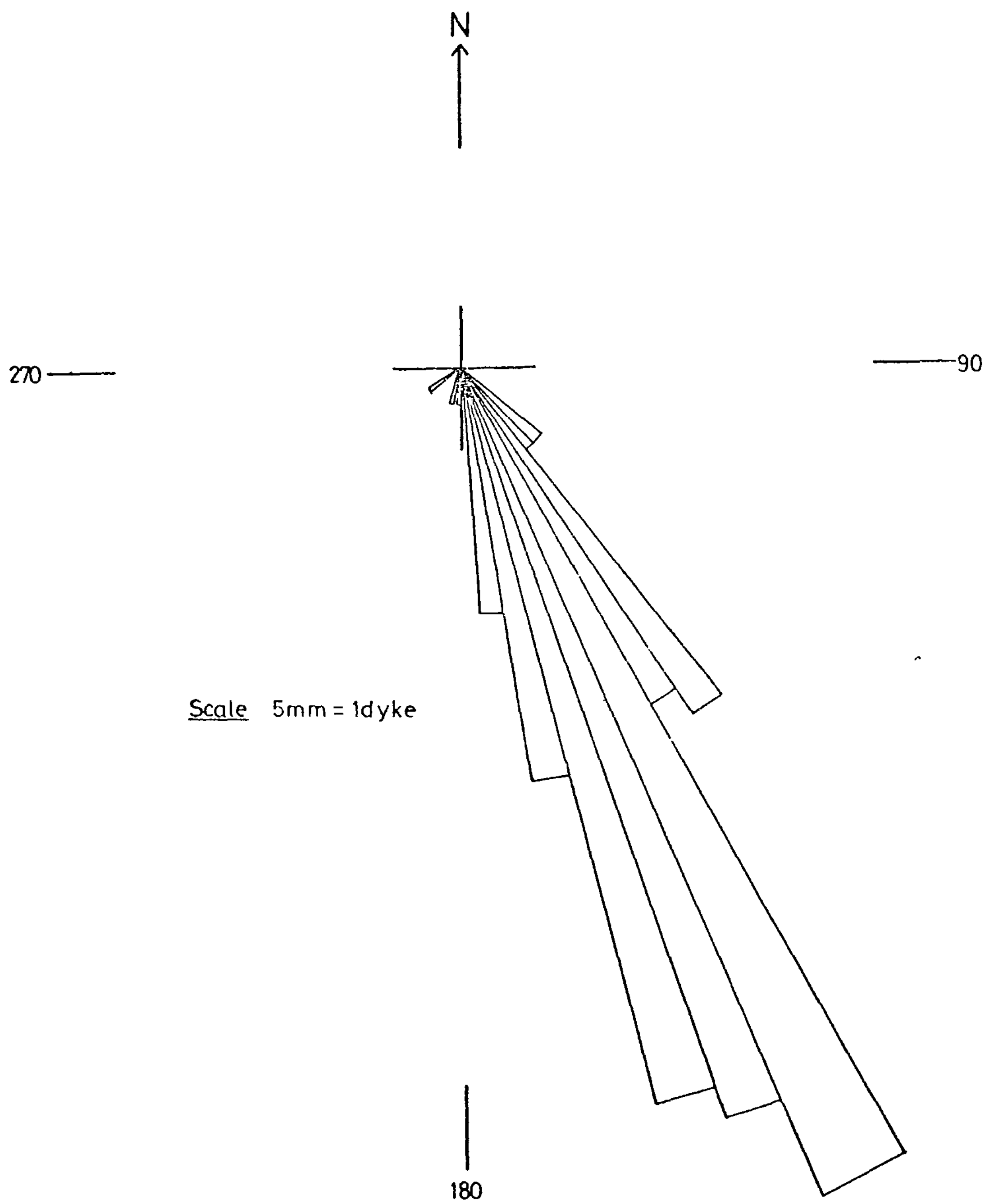
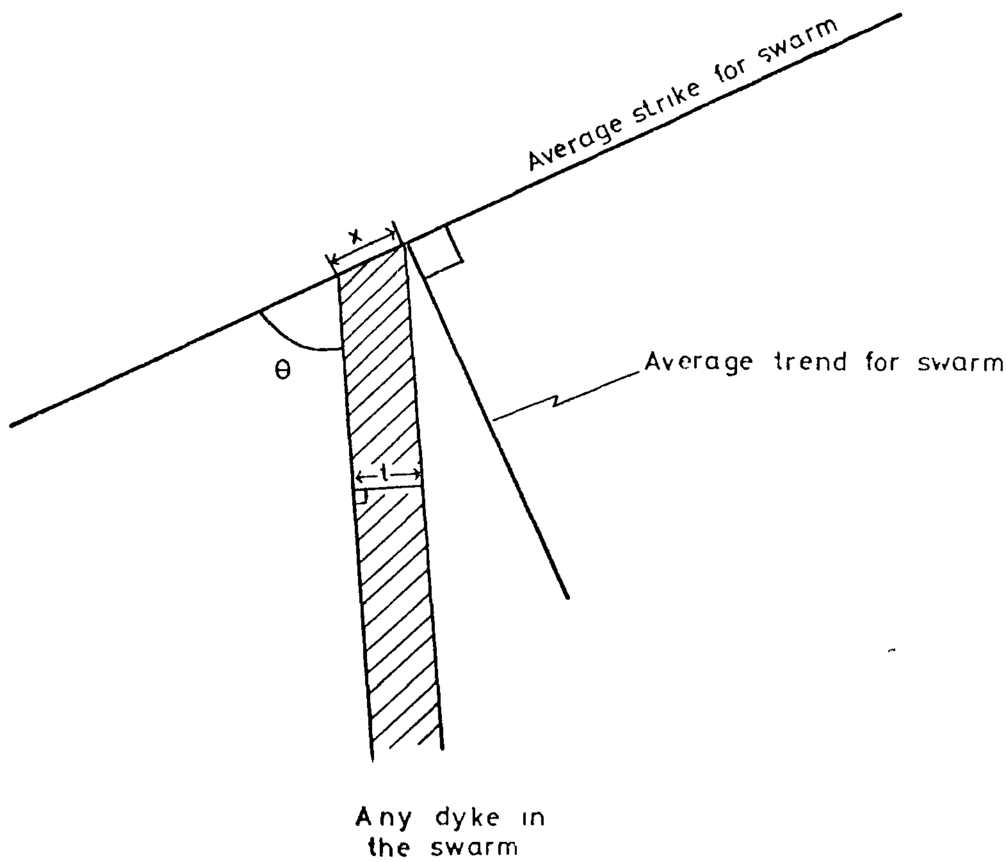


Figure 4 11 Rose diagram of all the dykes of Muck



Note Dykes plotted in groups of 5 degrees of trend

Figure 4.12 Extension caused by a dyke along the average strike direction for the swarm



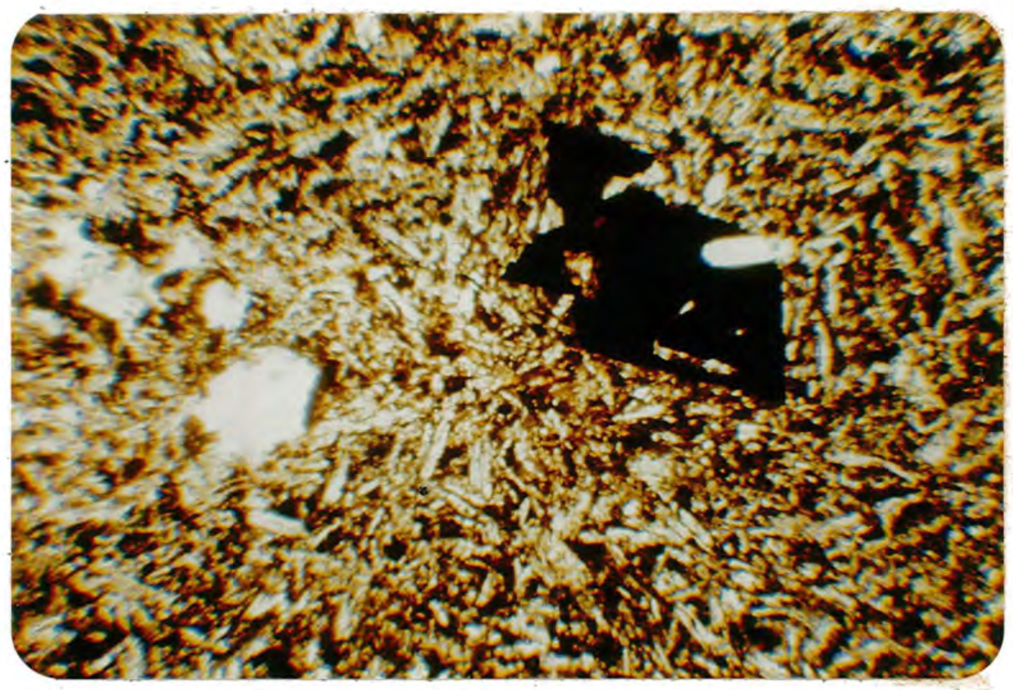
t measured thickness of dyke

x extension caused by dyke along average strike for swarm

θ angle between trend of dyke and average strike for swarm

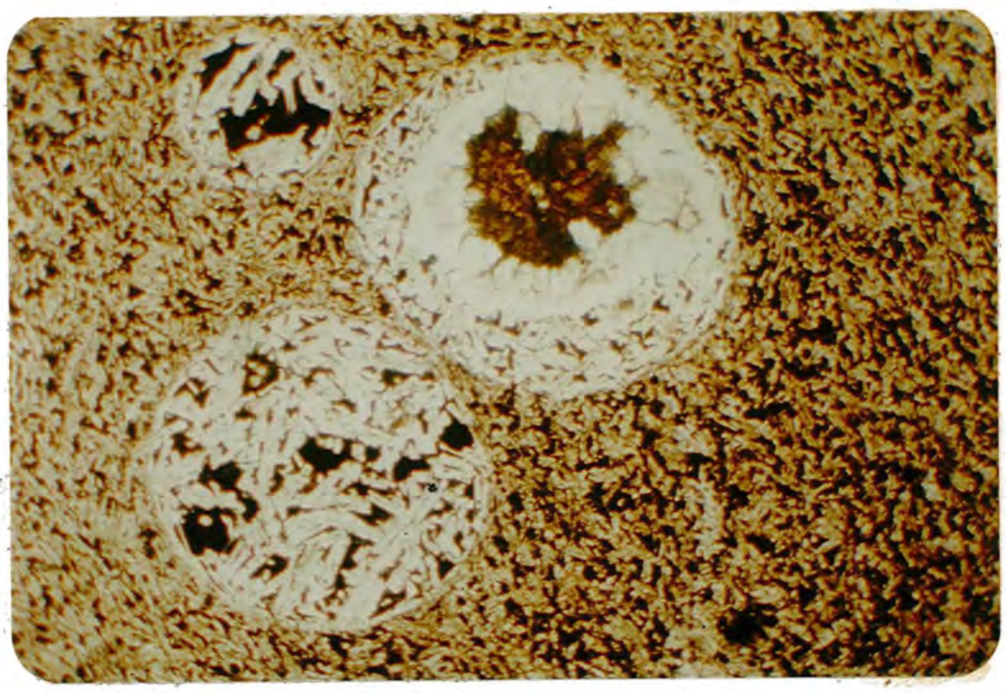
$$x = \frac{t}{\sin\theta}$$

Figure 5.1 Opaque phyric dyke from Muck (MD99)



Chemically and petrographically this sample is a mugearite.

Figure 5.2 Mugearitic dyke from Muck (MD108)



The coarse grained, circular inclusions are of plagioclase and an amphibole.

Note how the matrix appears to 'flow' around the inclusion situated at the lower left of the photograph.

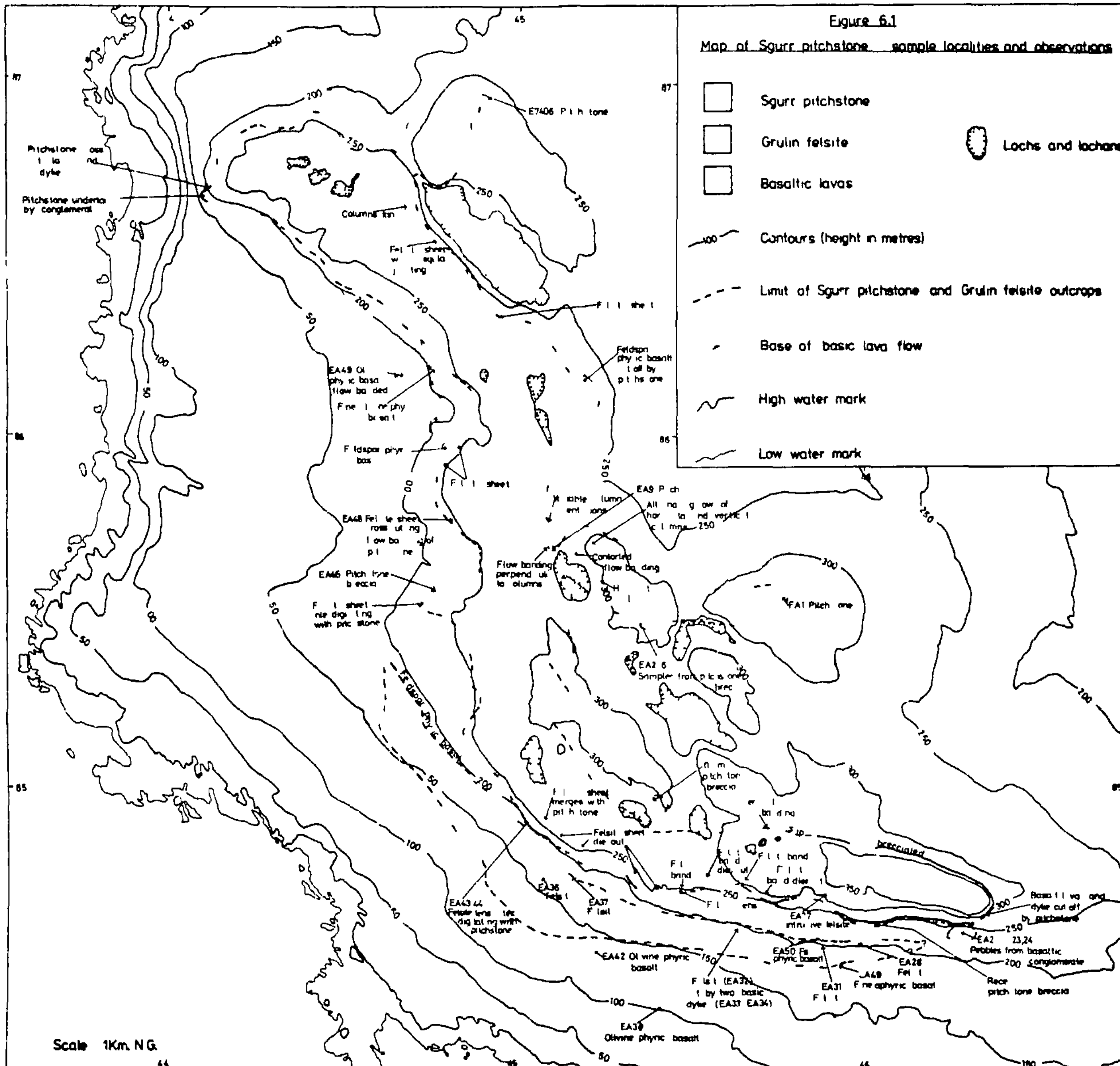


Figure 6.1

Map of Sgurr pitchstone sample localities and observations

Figure 6.2 Sgurr pitchstone cross cutting lavas near The Nose. (46368470)

Figure 6.3 South face of An Sgurr pitchstone ridge.

Figure 6.4 Dykes truncated by Sgurr pitchstone

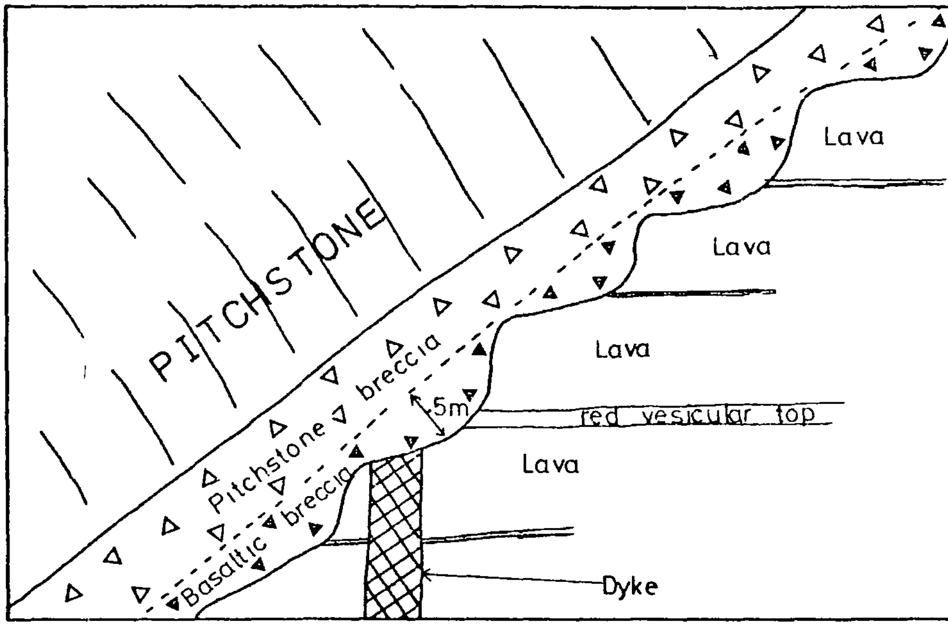


Figure 6.4a Near The Nose (46368465)

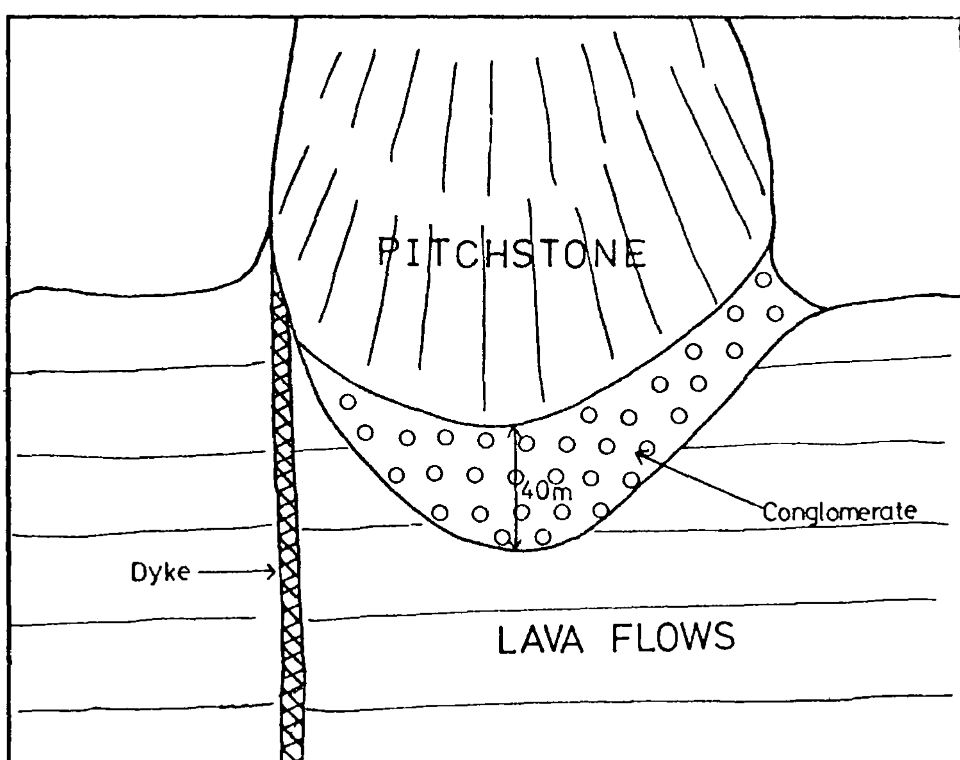
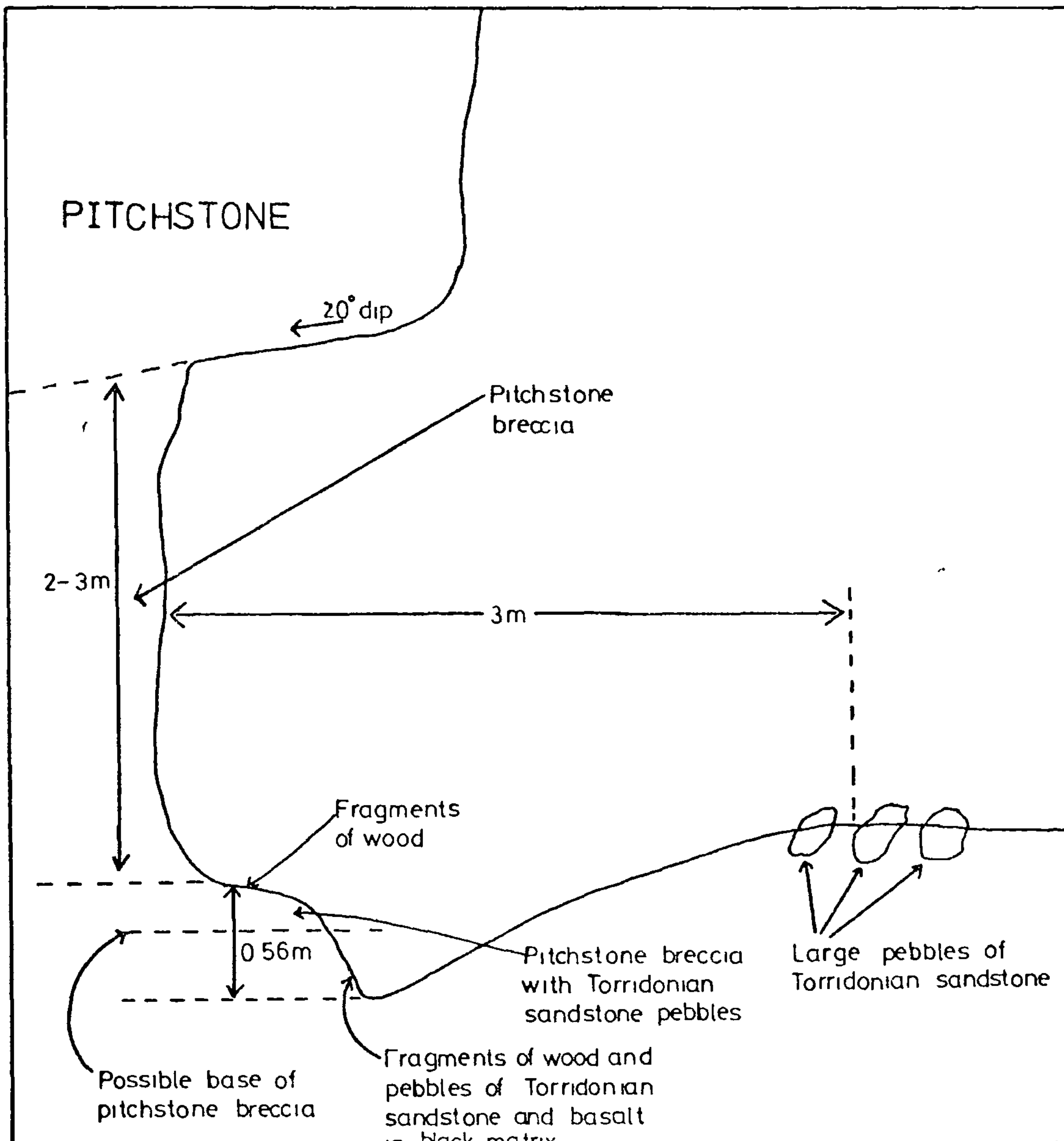


Figure 6.4b Near Bidein Boidheach (44098670)

Figure 6 6 Plan of trench excavated in recess below pitchstone, west of Botterill's Crack (46068462)



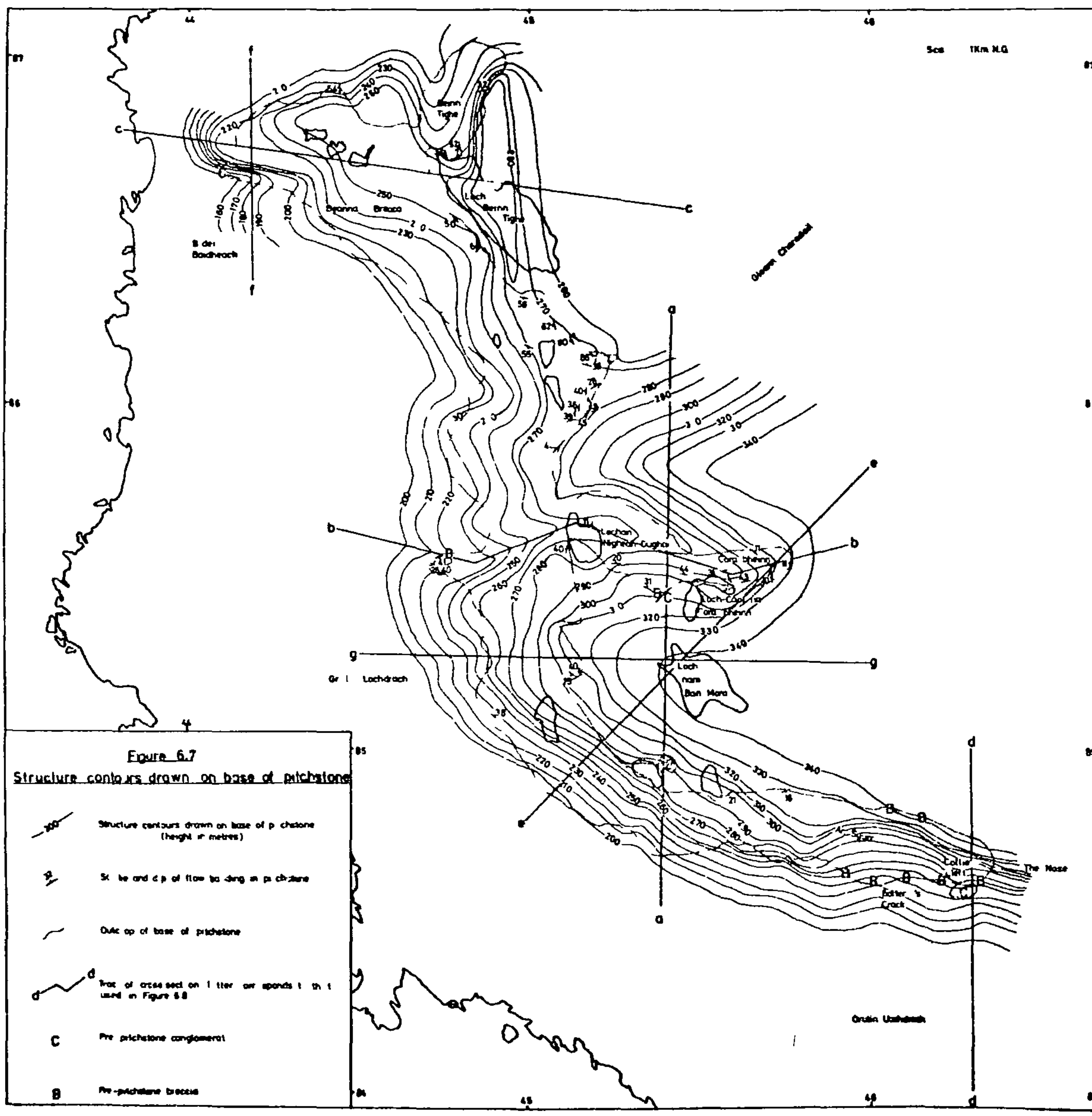


Figure 6.7
Structure contours drawn on base of pitchstone

Figure 6.8

Cross sections across Sgurr pitchstone using structure contours

(For key - see Figure 6.8g)

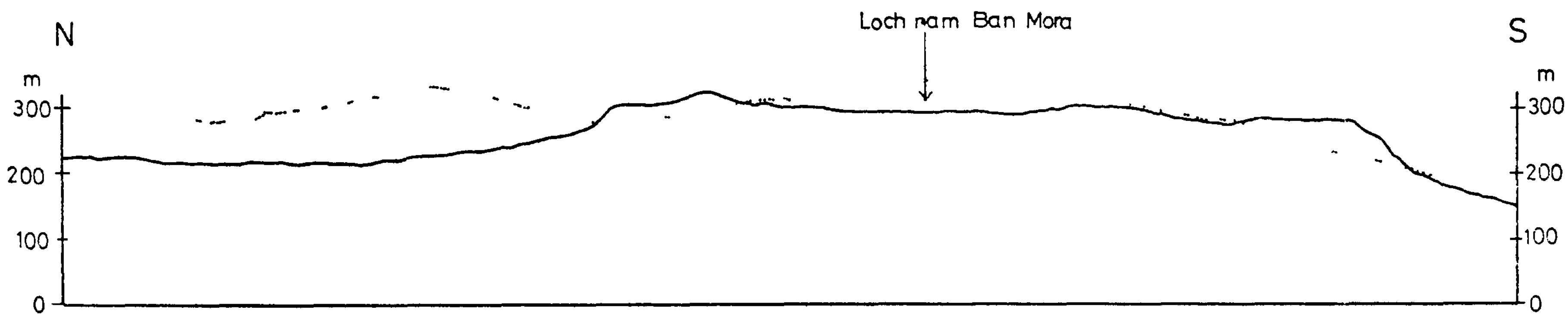


Figure 6 8a

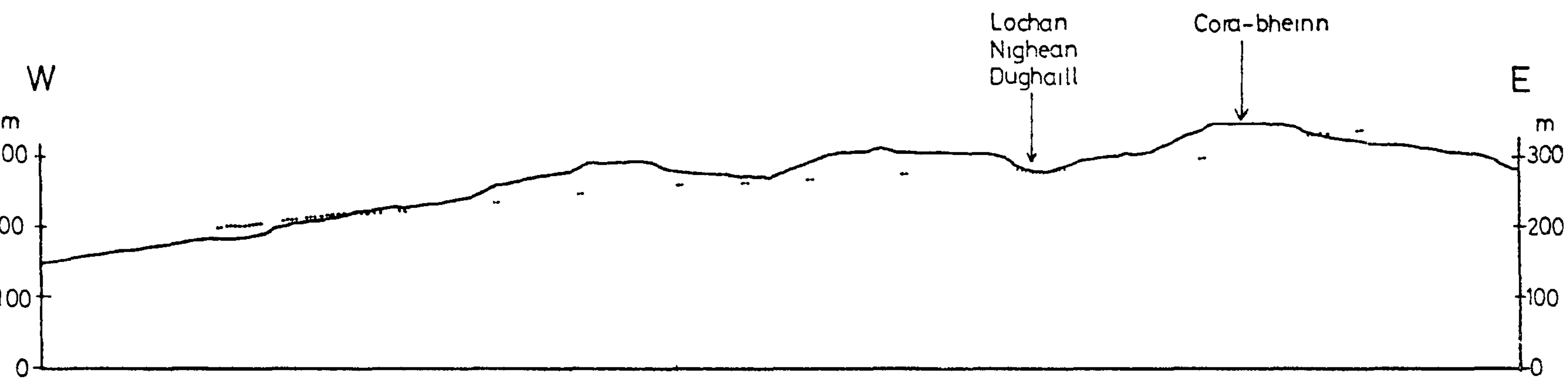


Figure 6 8b

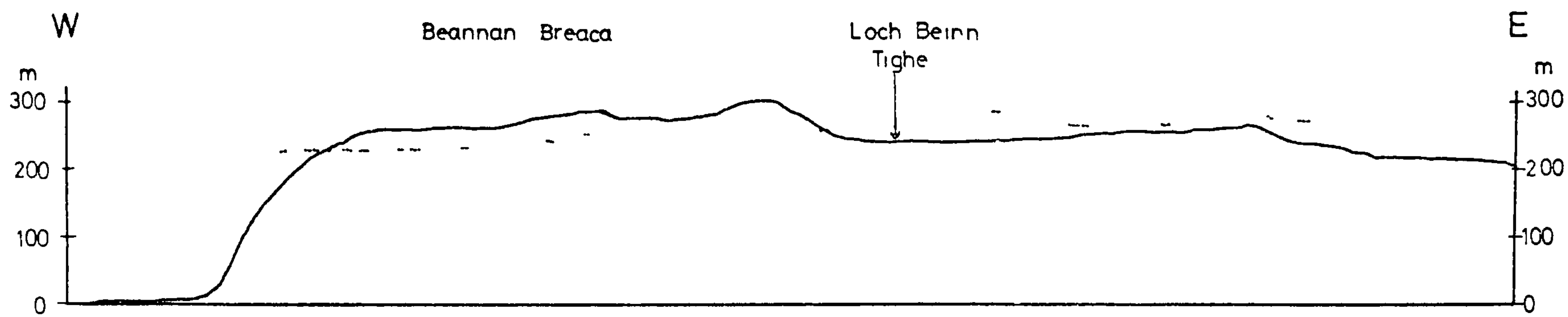


Figure 6 8c

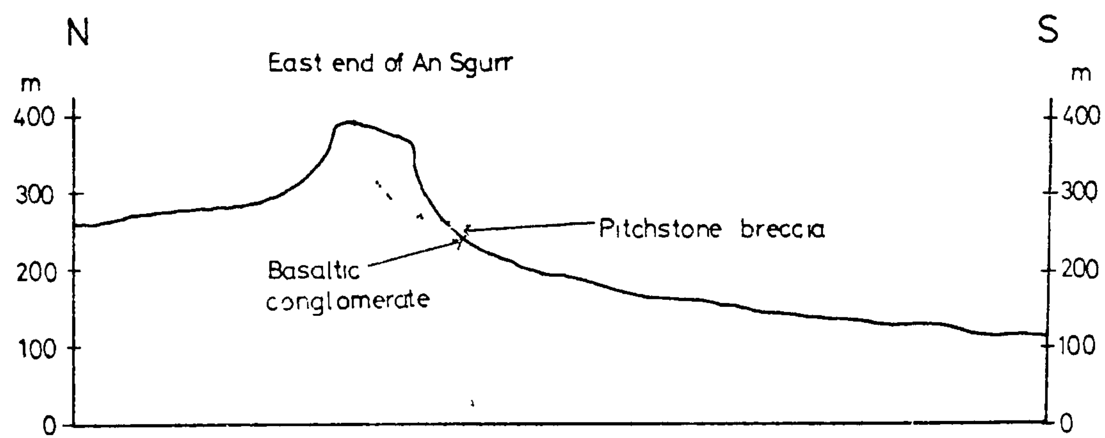


Figure 6 8d

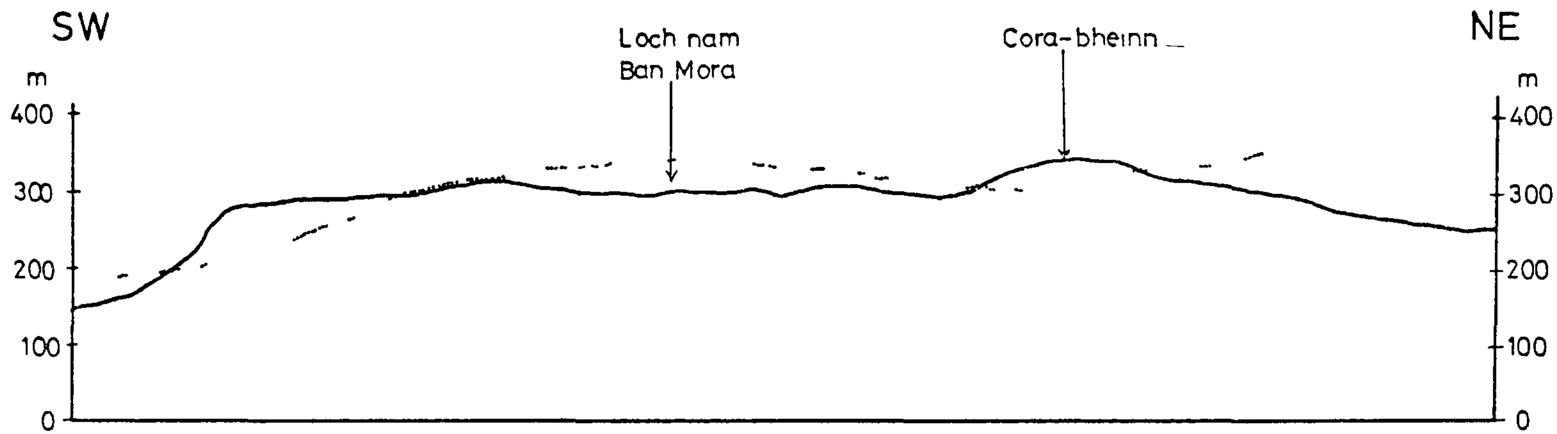


Figure 6 8e

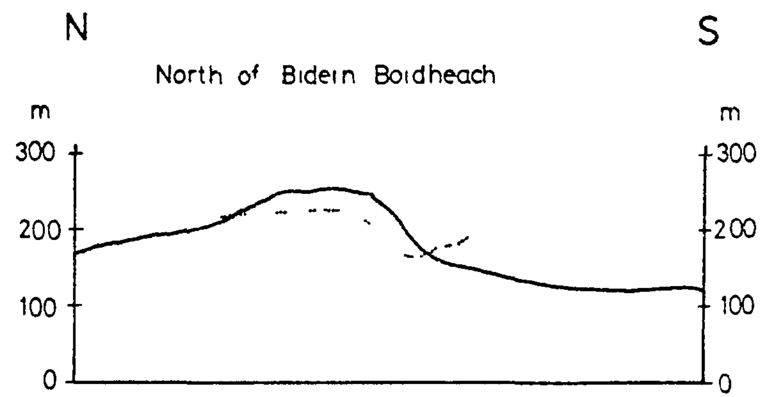


Figure 6 8f

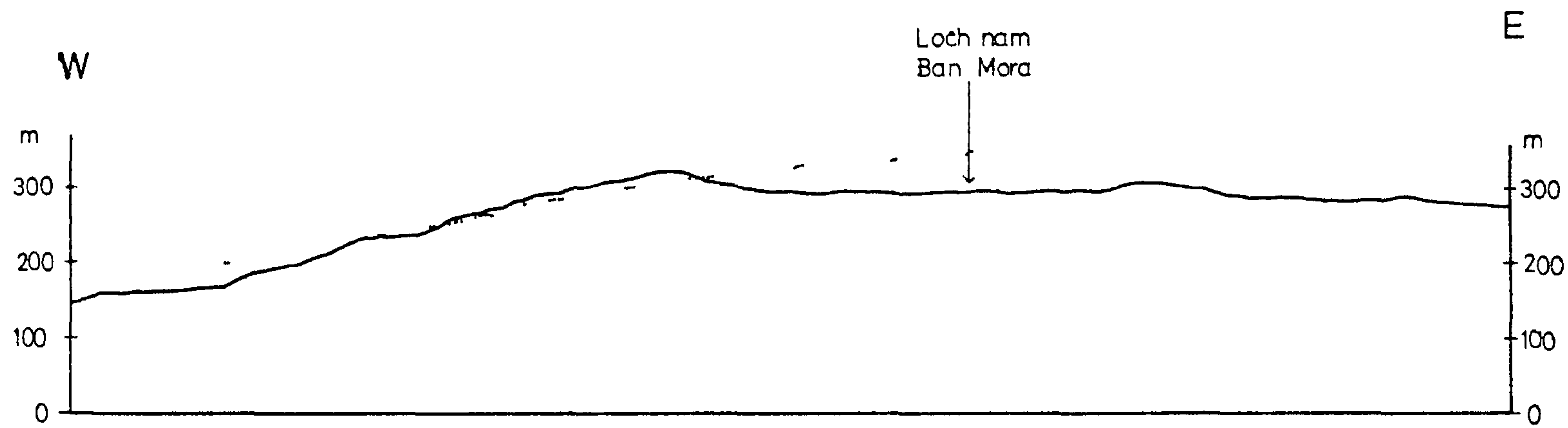


Figure 6 8g

KEY TO FIGURE 6.8

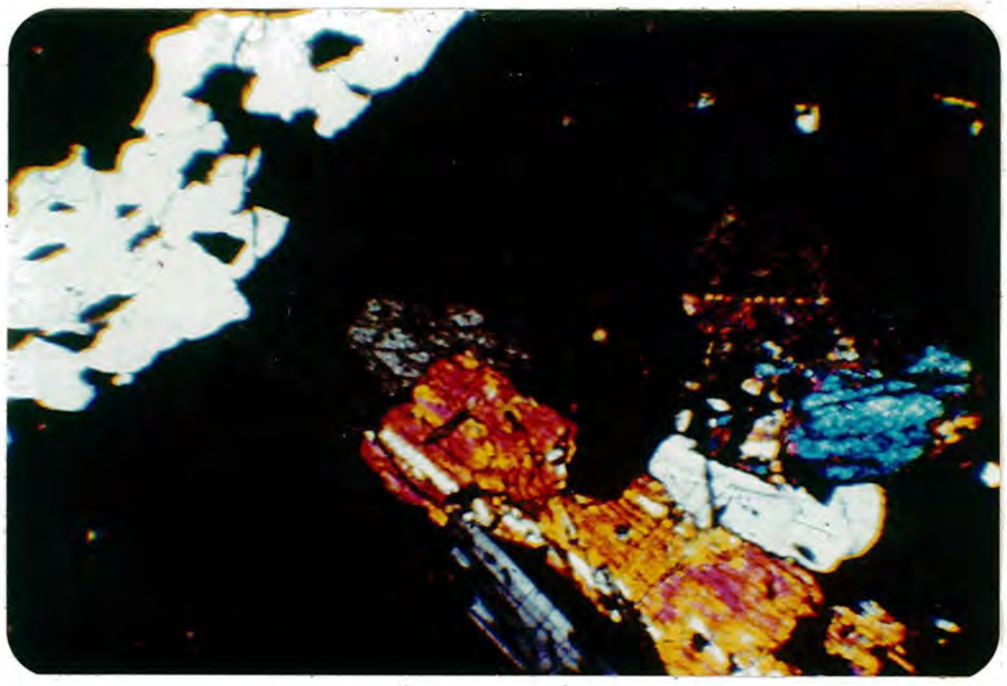
Base of pitchstone as indicated by structure contours (equivalent to pre-pitchstone topography)

Present day topography

Horizontal scale - as for Figure 6.7

Location of cross sections are shown on Figure 6.7

Figure 7.2 Sgurr pitchstone (E7406)
(crossed polars)



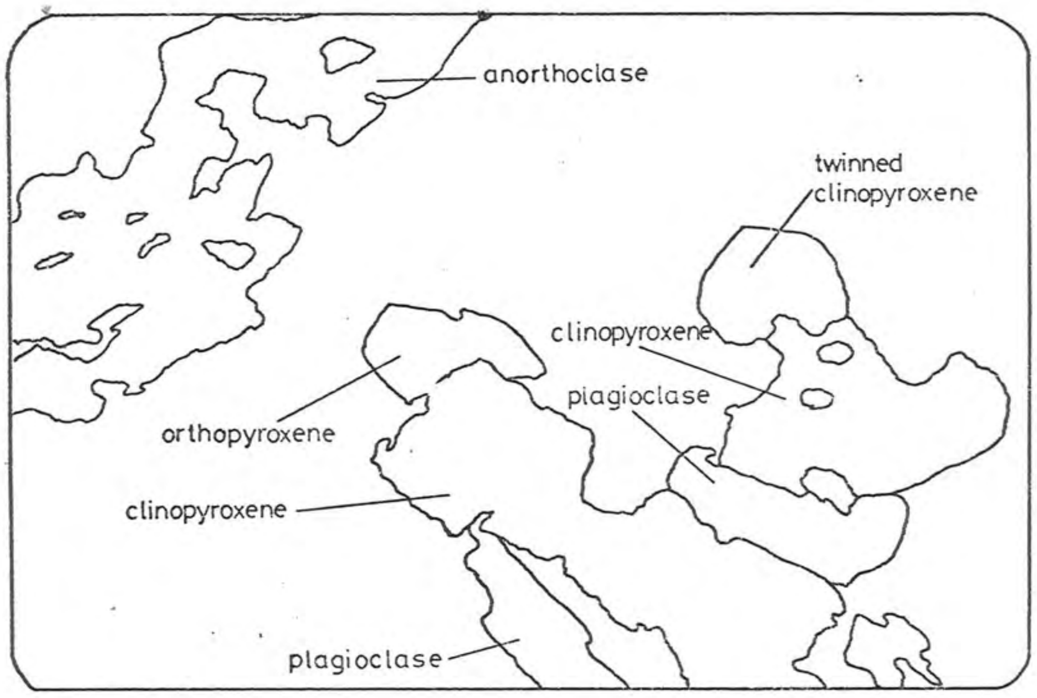
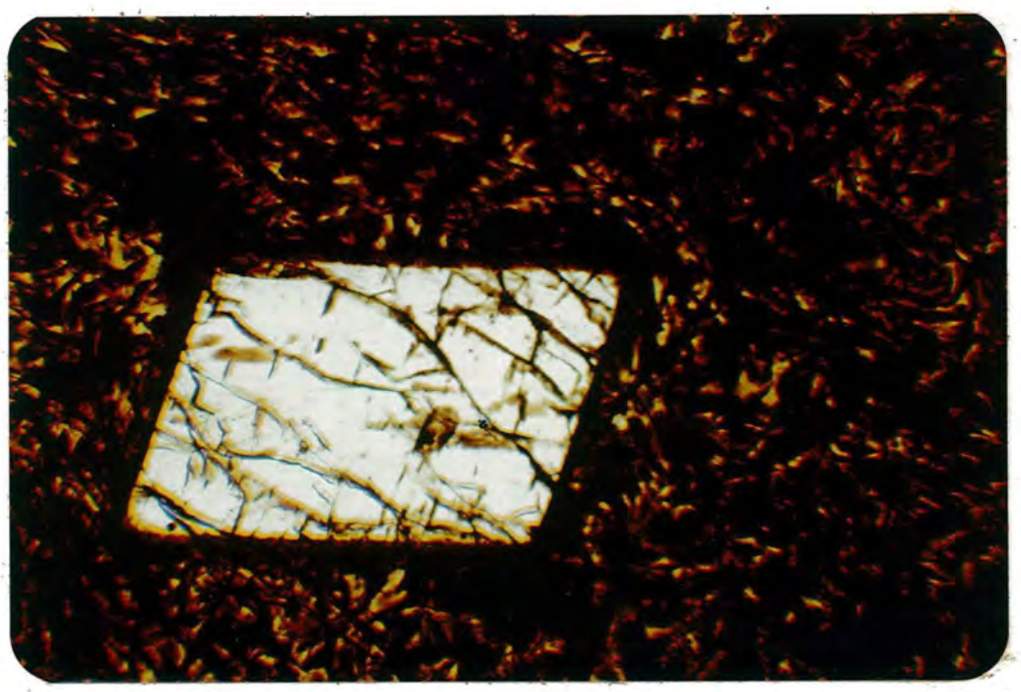


Figure 7.3 Eastern pitchstone dyke, Rudh' an Tancaird

(E7454 - plane polarised light)



Note:- sanidine phenocryst in yellowish glass crystallites preferentially growing on corners of phenocryst rather than along the side.

Figure 7.4 Sgorr Sgaileach felsite (E7423)
(crossed polars)

Note:- rounded and slightly corroded quartz grains
anorthoclase phenocryst partially altered
to calcite
felsitic texture of matrix

Figure 8.1 Main red bed of Muck in gully between Sron na Teiste and Sgorr nan Laogh (40327887)

Figure 8.2 Main red bed of Muck showing inclusions of altered vesicular basalt (41987861)

Figure 8 3 Possible volcanic bomb in red bed, Camas Mor, Muck (40877931)

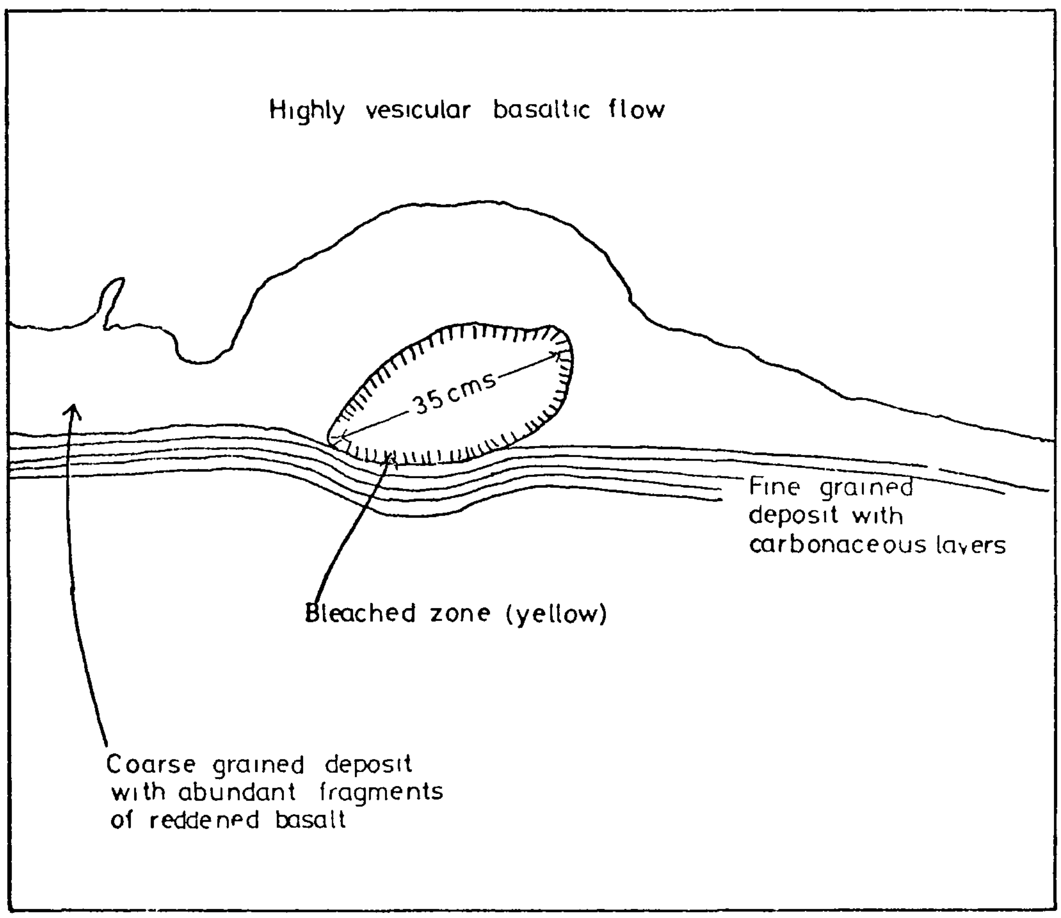


Figure 8.4 Red bed north of the Manse, Eigg (48188525)

Figure 8.5

Sketch of the cliffs above Garbh Asgarnish (28170613)

(Thicknesses after Harker 1908)

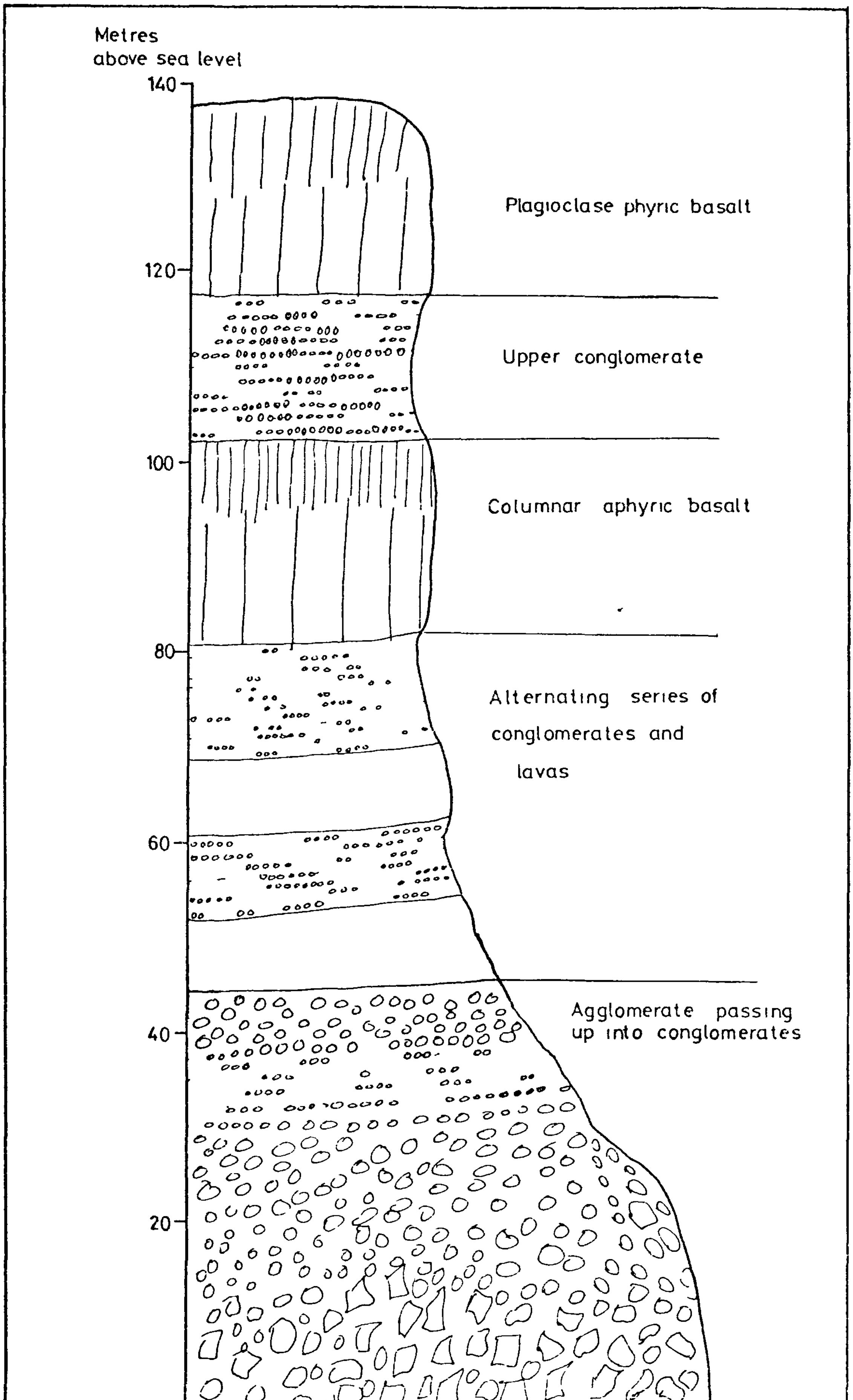
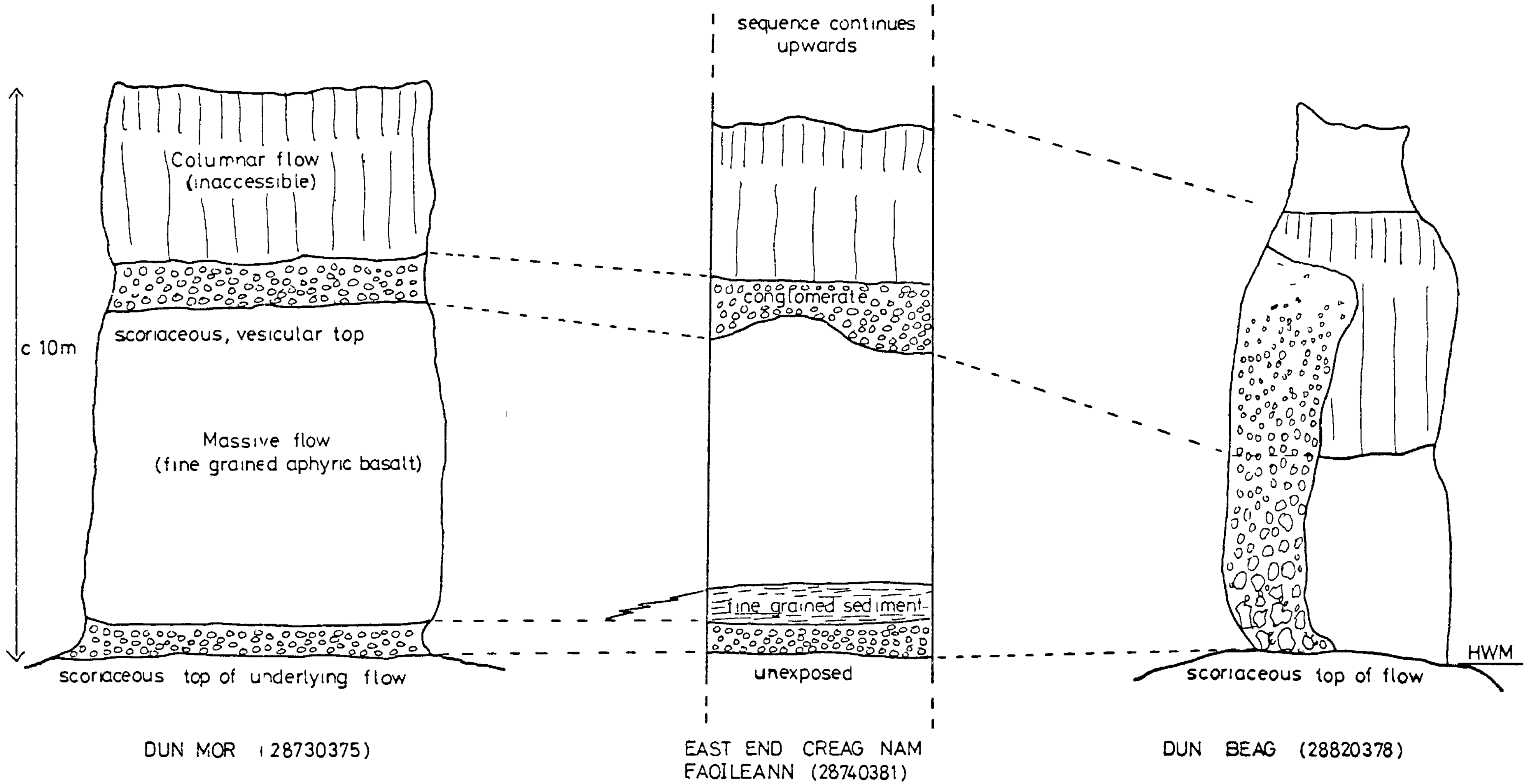

Metres
above sea level
140
120
100
80
60
40
20
Plagioclase phyric basalt
Upper conglomerate
Columnar aphyric basalt
Alternating series of
conglomerates and
lavas
Agglomerate passing
up into conglomerates

Figure 8 5

Figure 8.6

Diagrammatic sketch of Dun Beag, Dun Mor and the cliffs of Creag nam Faoileann to the north.

Figure 8 6



sequence continues upwards
Columnar flow (inaccessible)
c 10m
scoriaceous, vesicular top
Massive flow (fine grained aphyric basalt)
scoriaceous top of underlying flow
conglomerate
fine grained sediment
unexposed
HWM
scoriaceous top of flow
DUN MOR (28730375)
EAST END CREAG NAM FAOILEANN (28740381)
DUN BEAG (28820378)

Figure 8.7 Dun Beag, Sanday showing also the geology of north west Rhum.

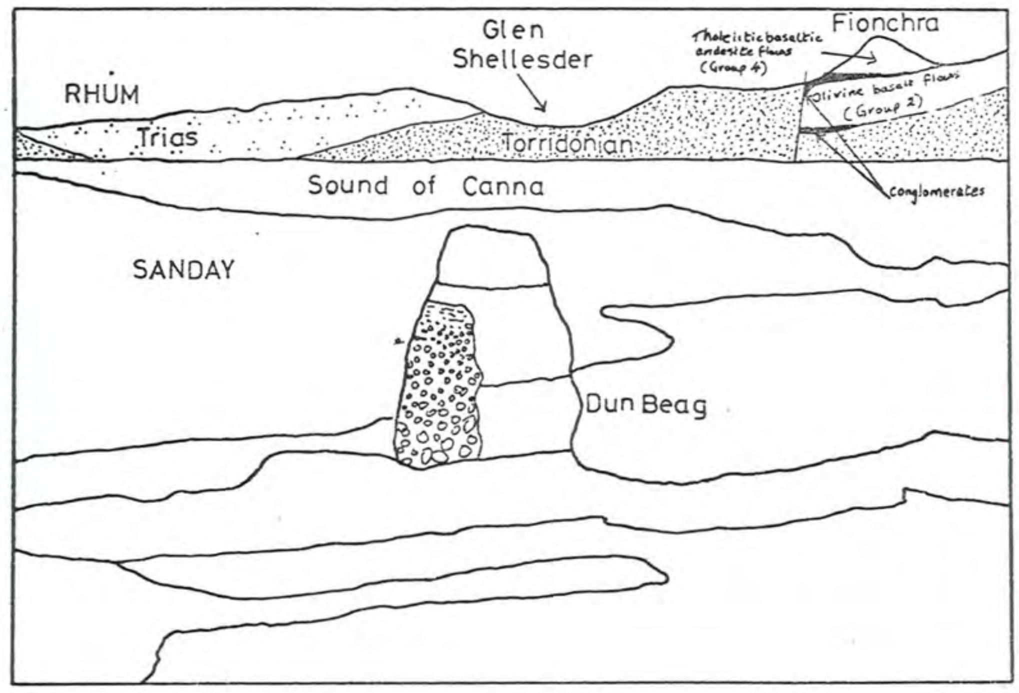
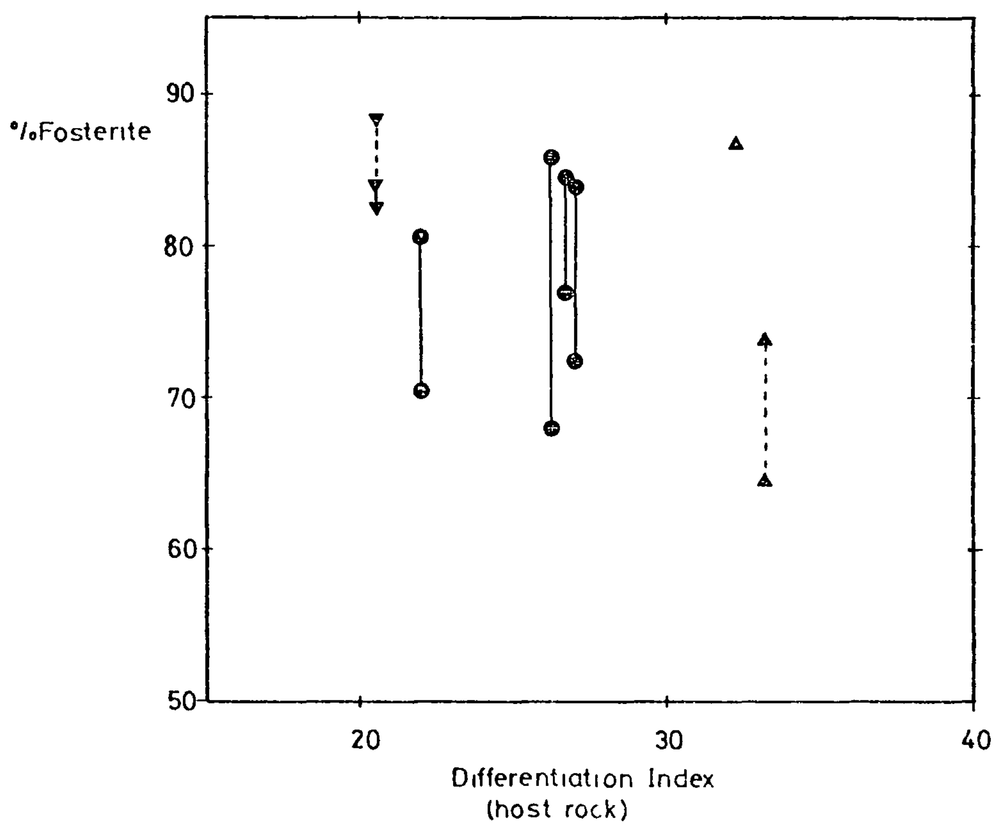


Figure 9.1 Variation in fosterite content of olivines with Thorton Tuttle differentiation index



KEY

▲ Intrusives Eigg

▼ Intrusives Muck

● Extrusives (Eigg only)

●——● Core/margin analyses of crystal

▲- - -▲ Co-existing olivines

NB Only the author's data has been plotted

Figure 9.2 Olivines - NiO content plotted against fosterite content

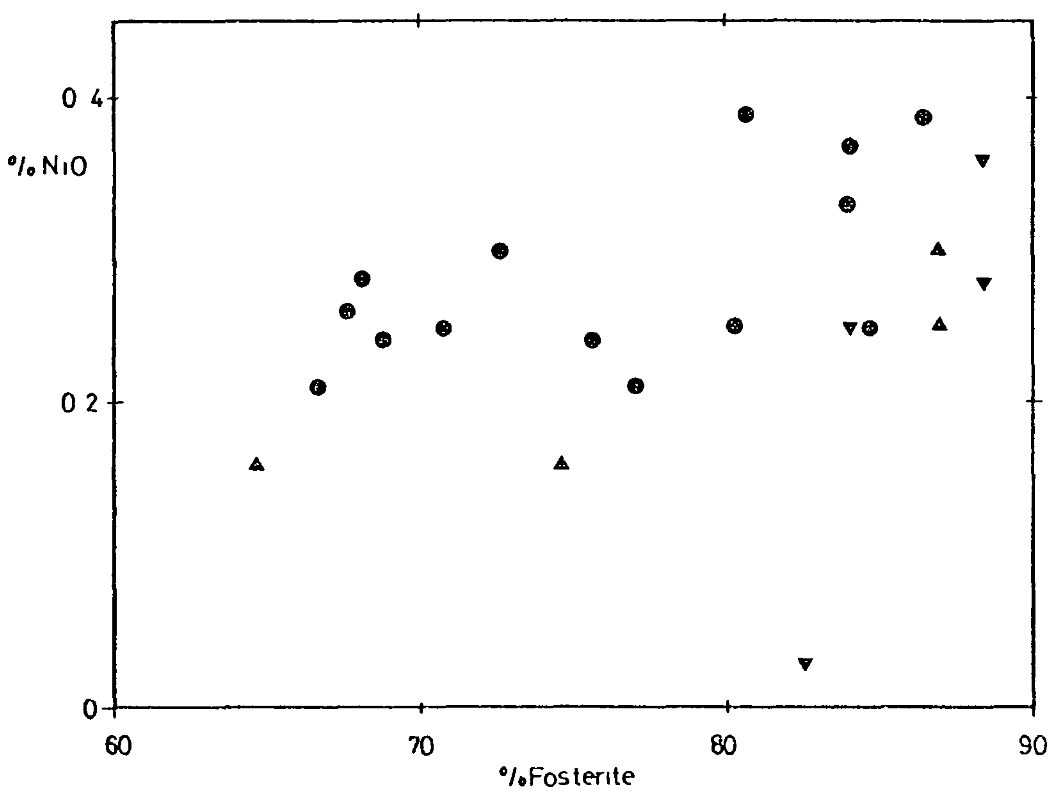
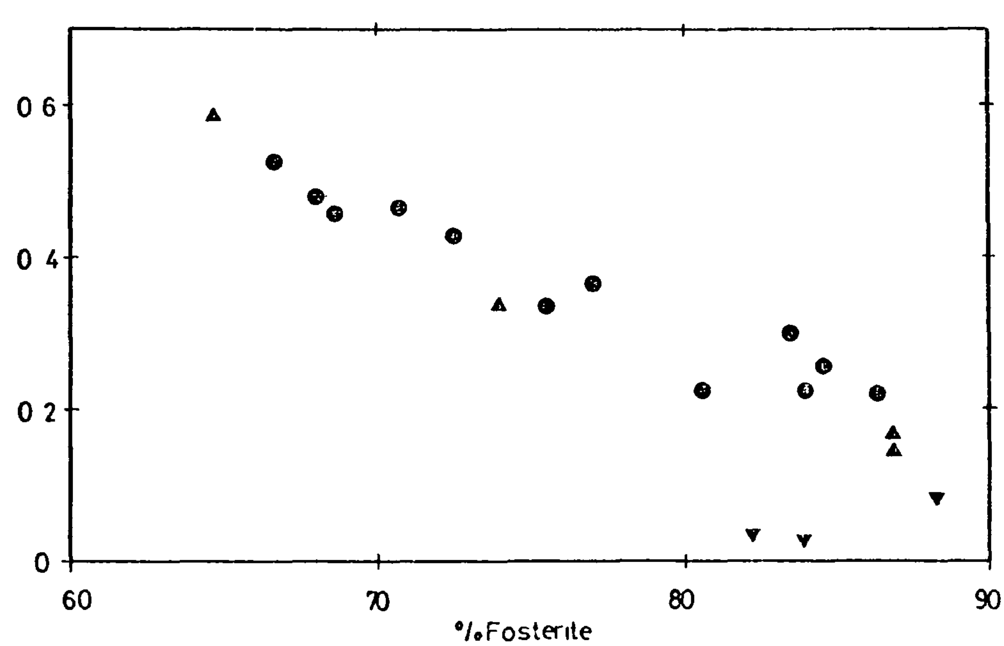


Figure 9 3 Olivines - MnO content plotted against fosterite content



KEY AS FOR FIGURE 9 1

Figure 9.4

Pyroxenes from basic rocks of Eigg and Muck in pyroxene quadrilateral.

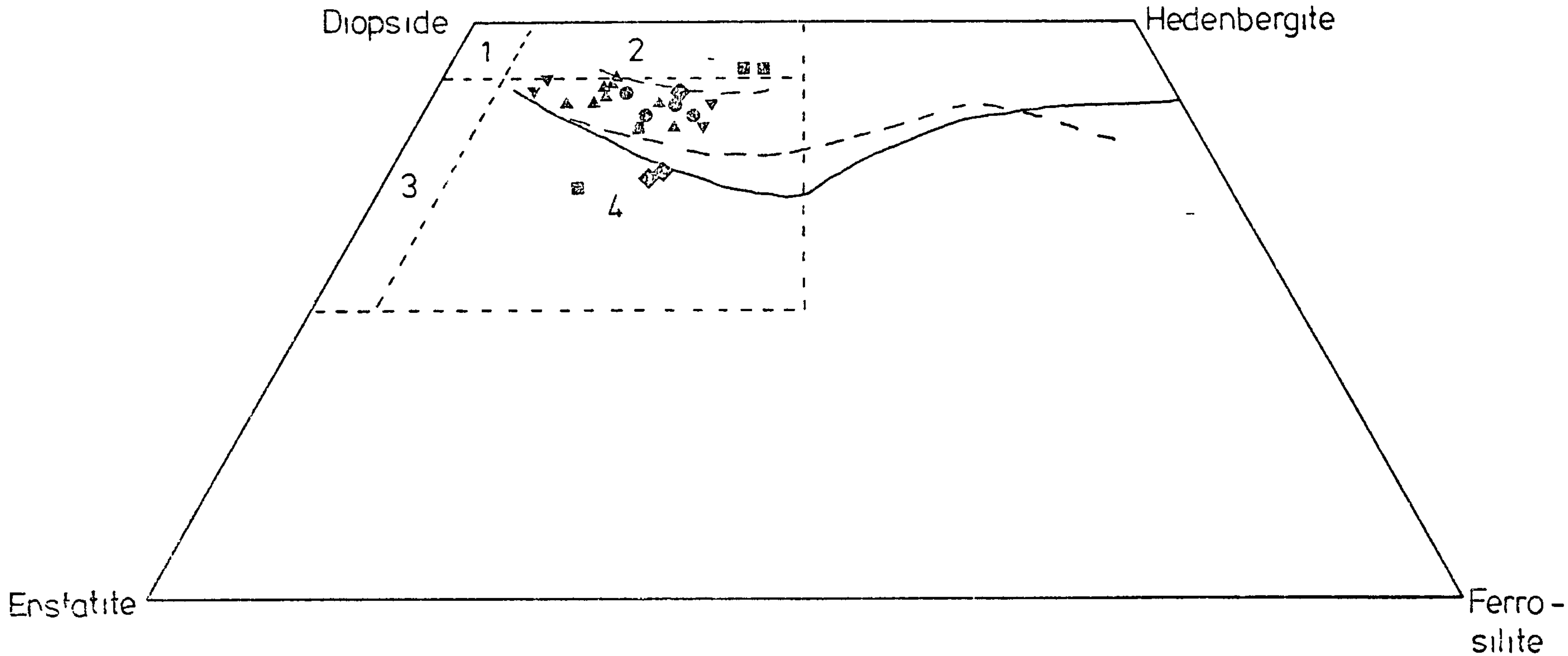


Figure 9.4 Pyroxenes from basic rocks of Eigg and Muck in pyroxene quadrilateral

Figure 9.5

Pyroxenes from acid rocks of Eigg in pyroxene quadrilateral.

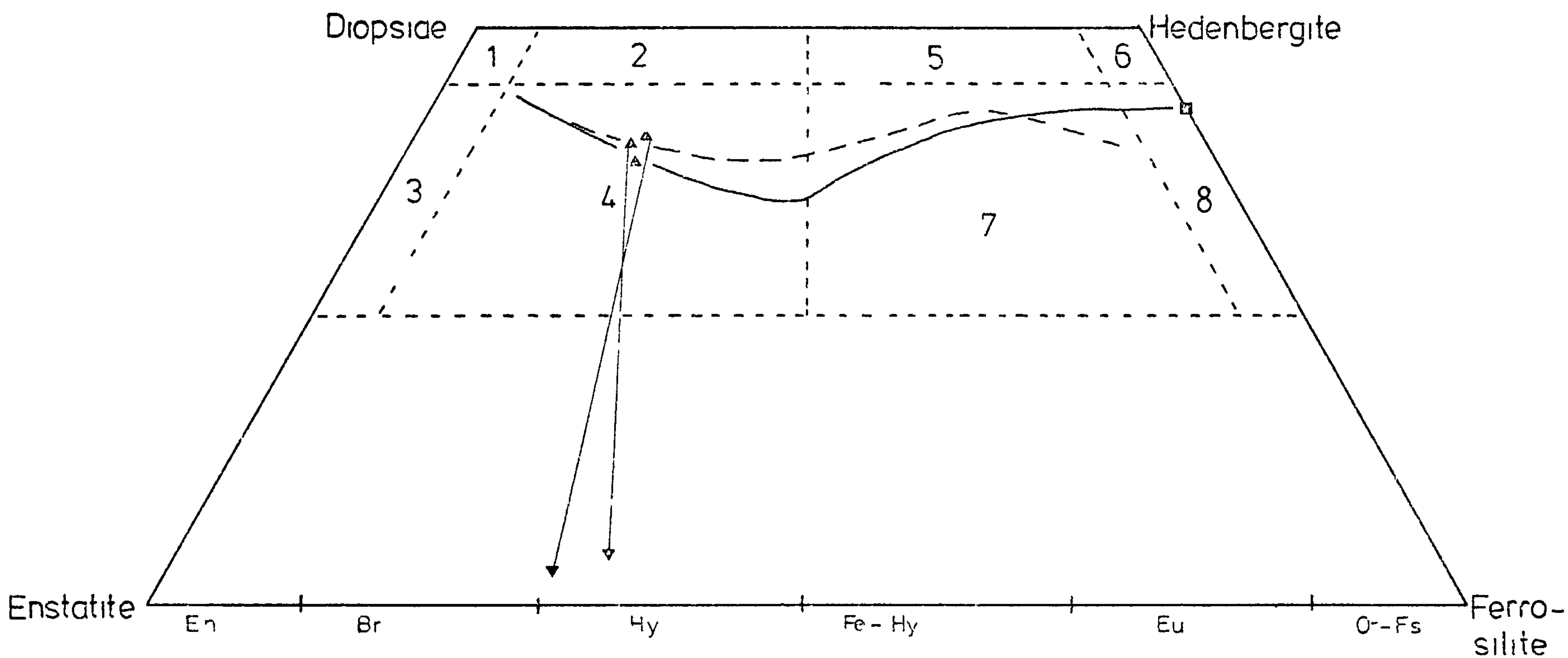


Figure 9.5 Pyroxenes from acid rocks of Eigg in pyroxene quadrilateral

Figure 9.6

Nomenclature of the feldspars from the acid rocks of Eigg.

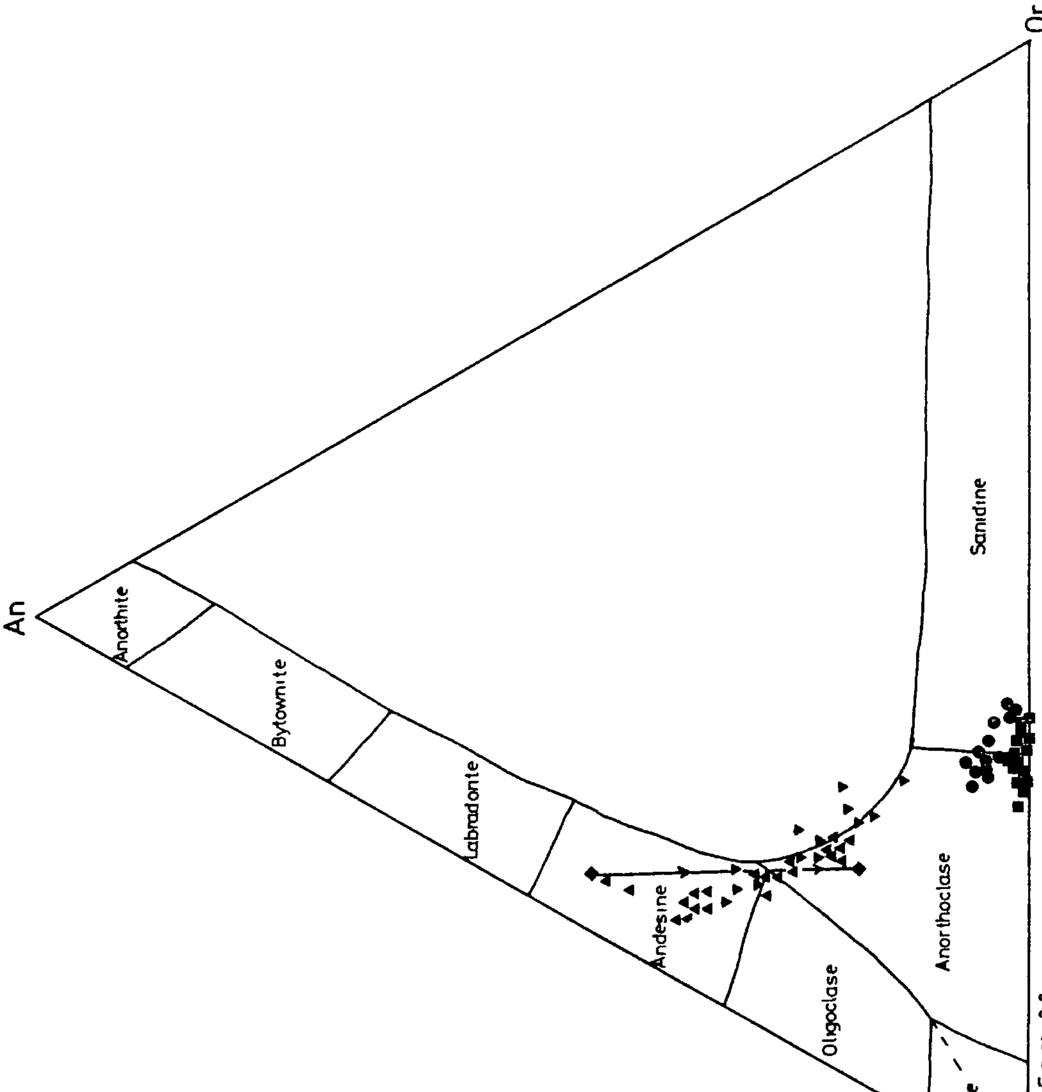

An
Or
Ab
Anorthite
Bytownite
Labradorite
Andesine
Oligoclase
Albite
Anorthoclase
Sanidine

Figure 9 6

Figure 9.7

Alkali feldspars from acid rocks of Eigg plotted on Anorthite - Albite - Orthoclase diagram.

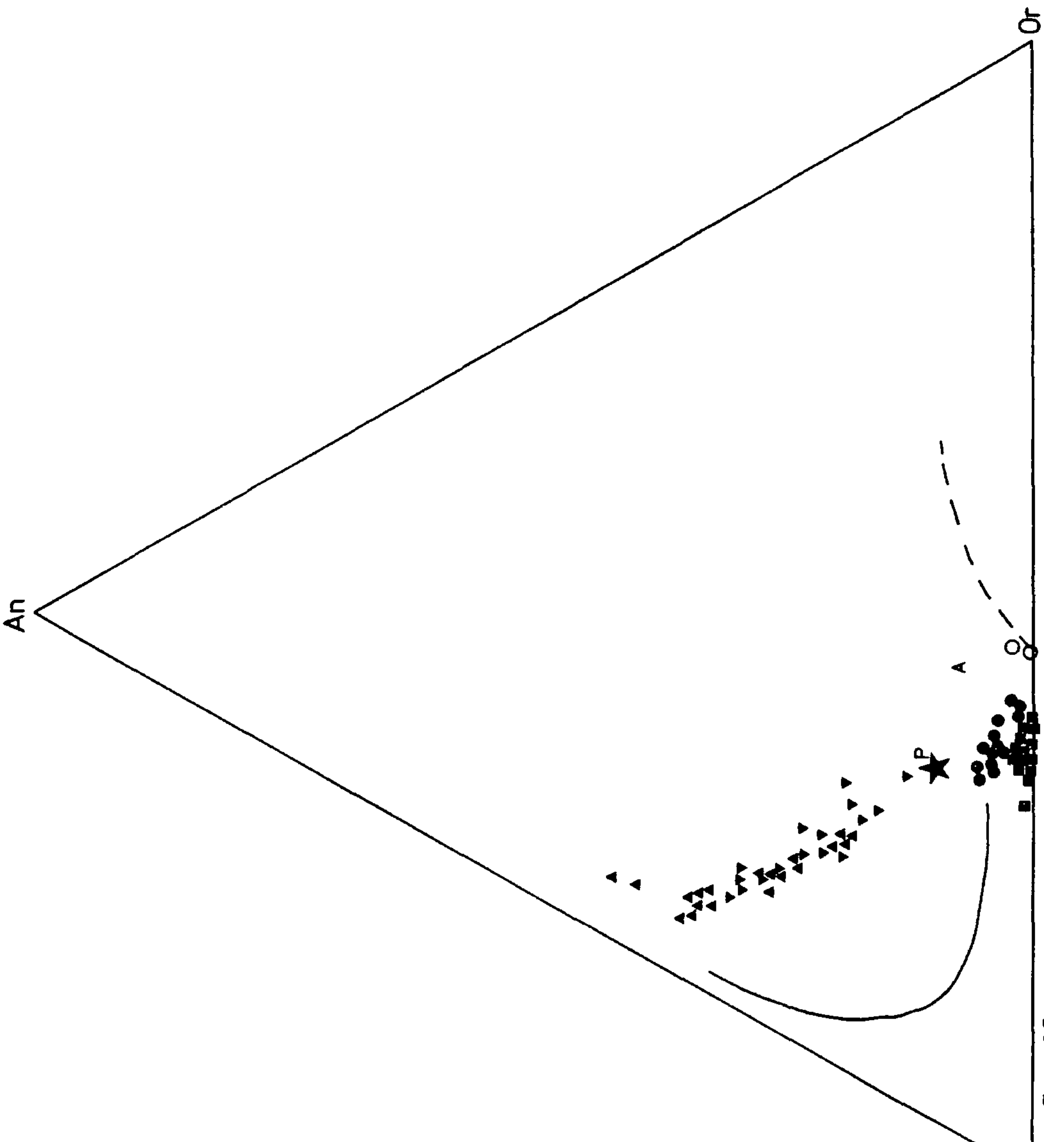


Figure 97

Figure 10 1 Histogram of initial analyses totals

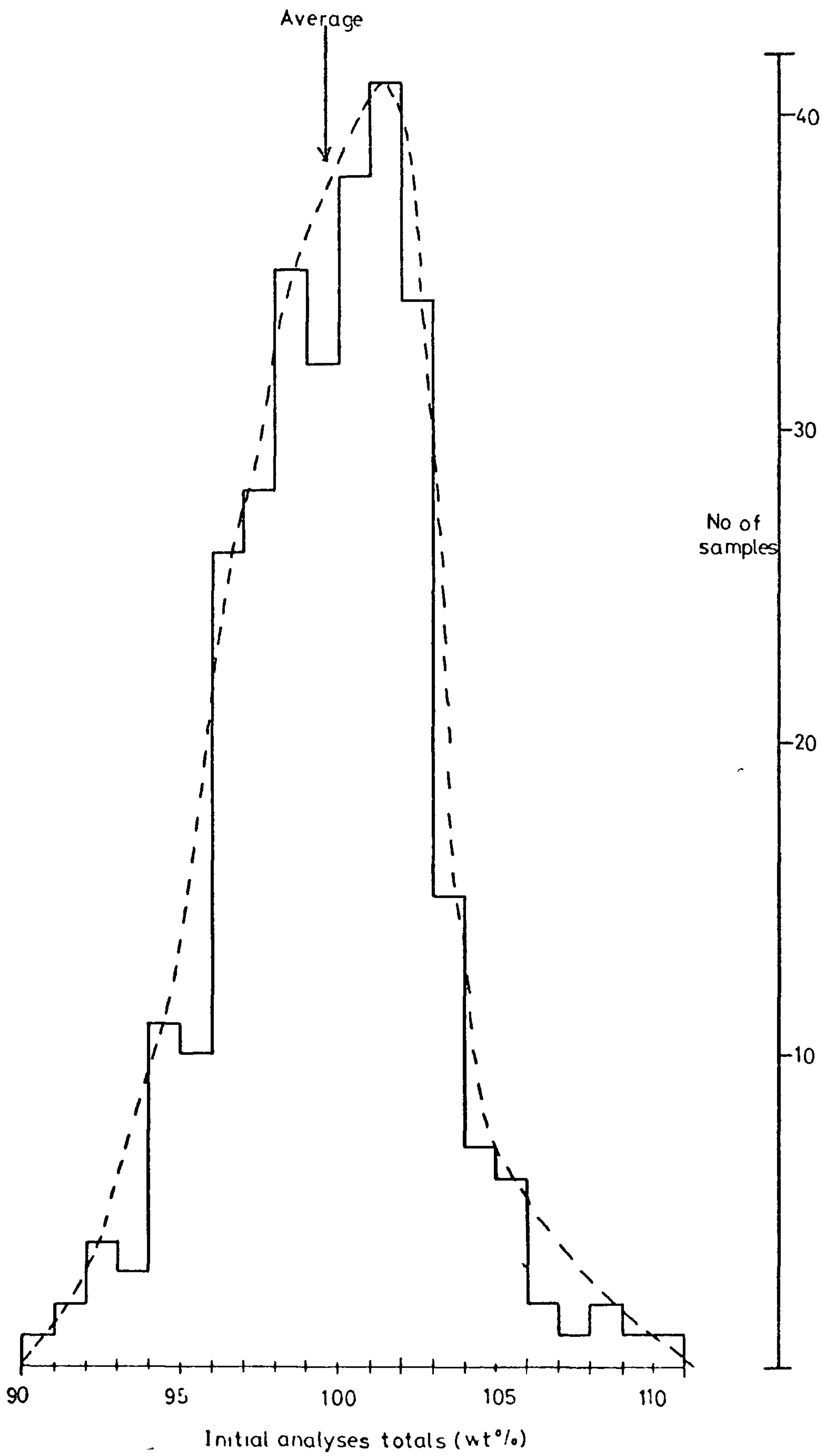
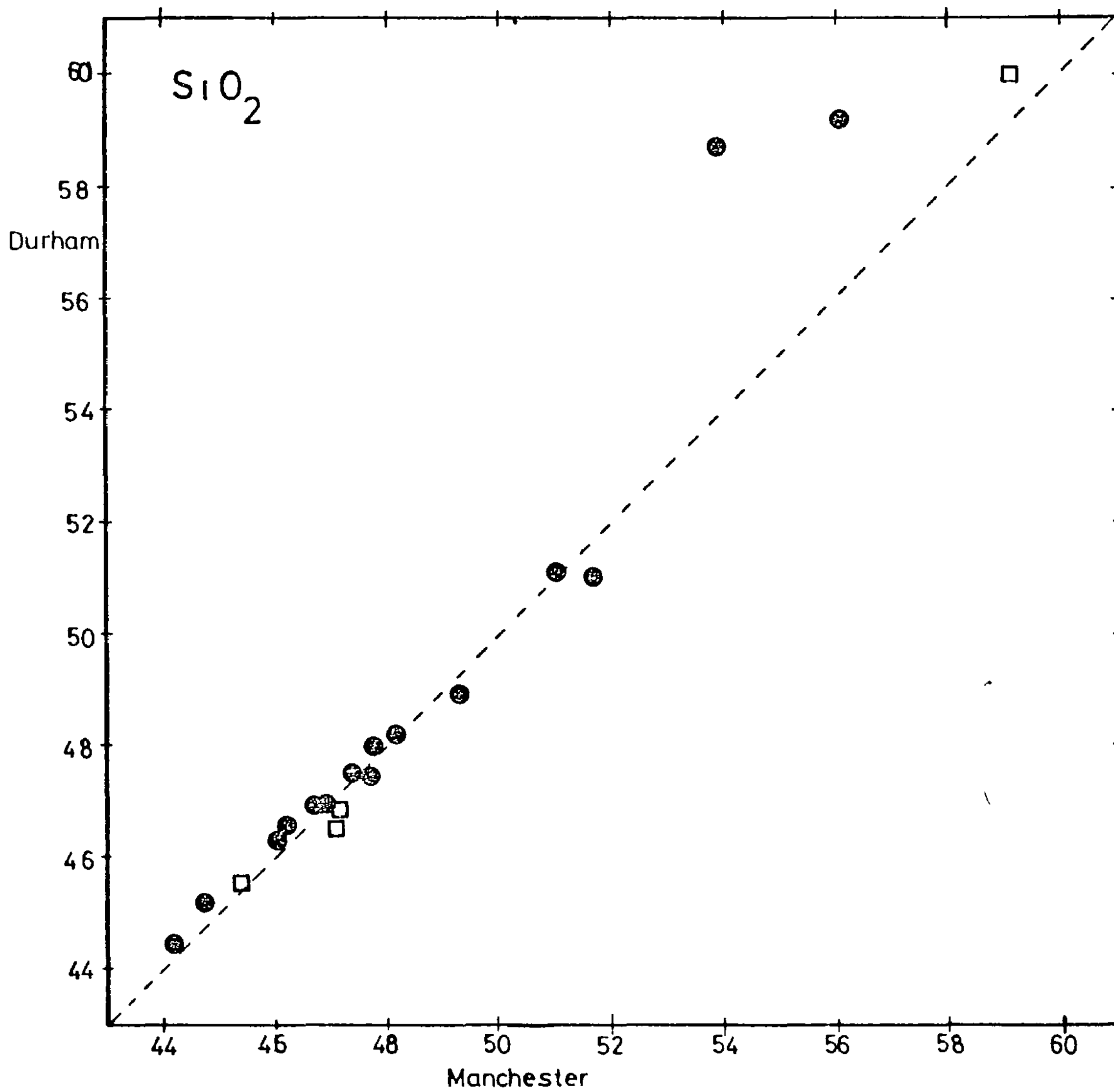


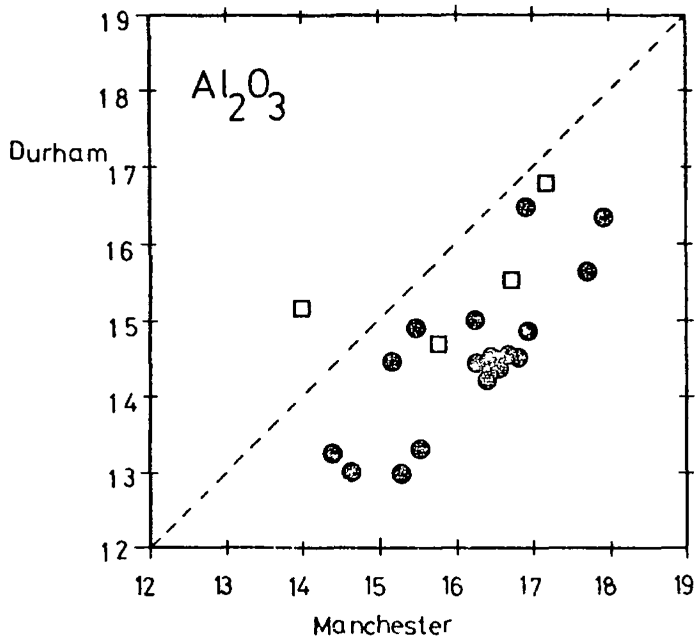
Figure 10.2

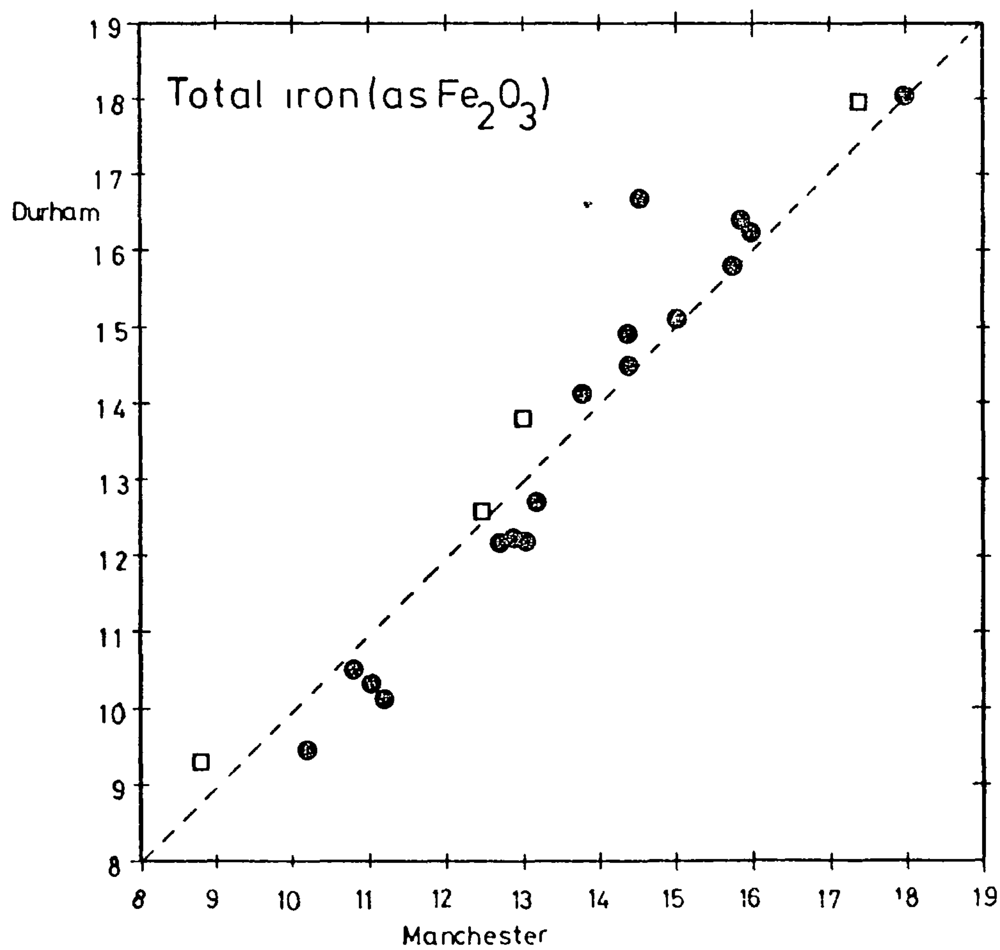
Comparison of analyses of Rhum and Skye lavas done at Manchester and Durham.

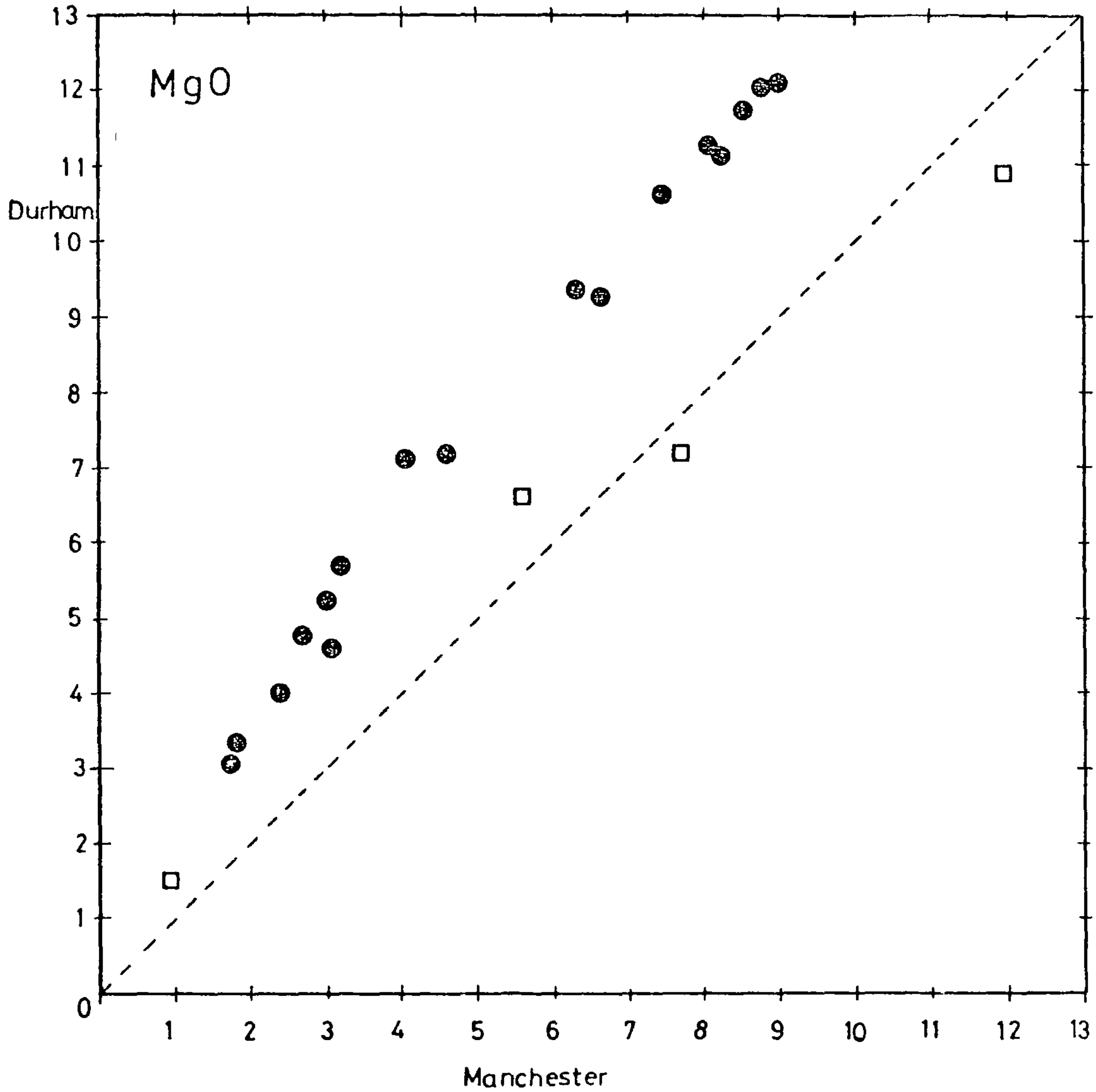
● Rhum analyses (X-ray fluorescence, Manchester)

□ Skye analyses (wet chemical, Manchester)

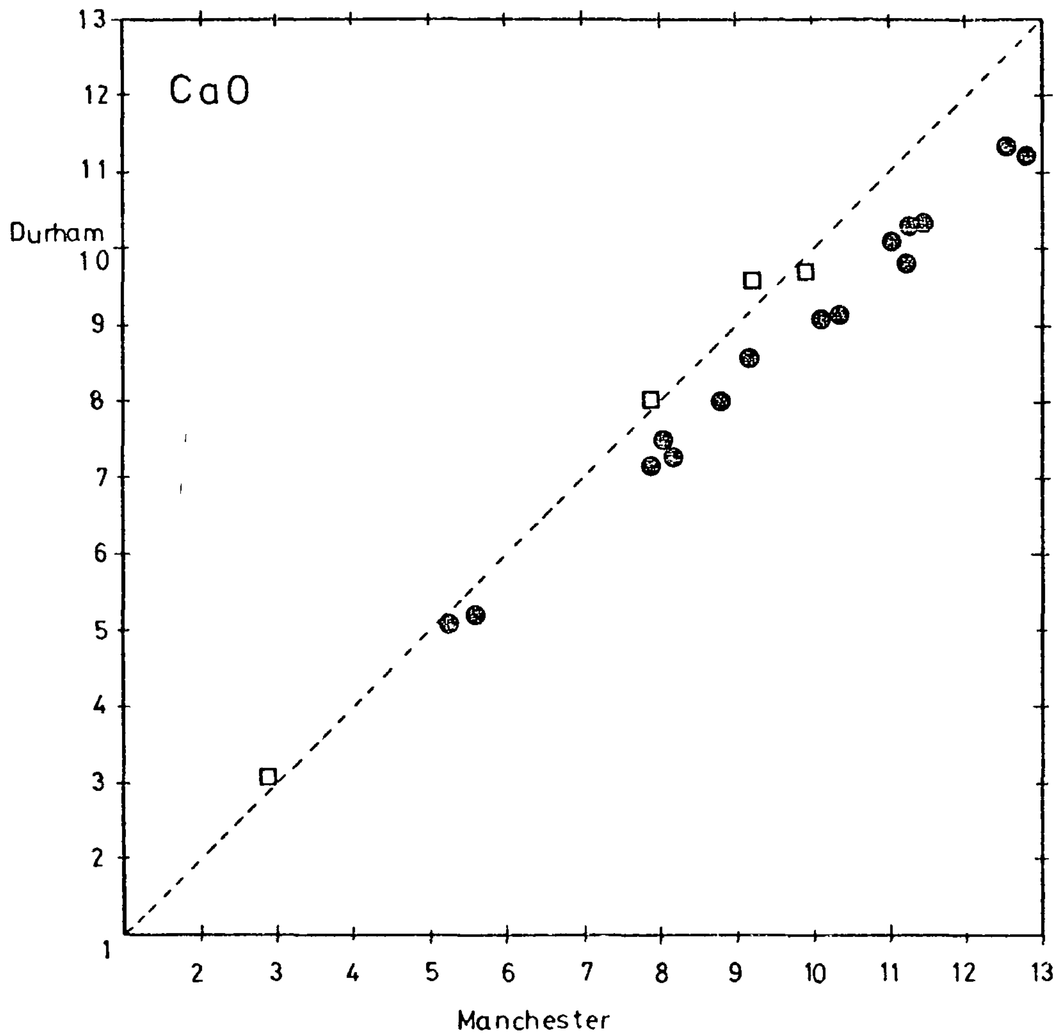

SiO2
Durham
60
58
56
54
52
50
48
46
44
44
46
48
50
52
54
56
58
60
Manchester

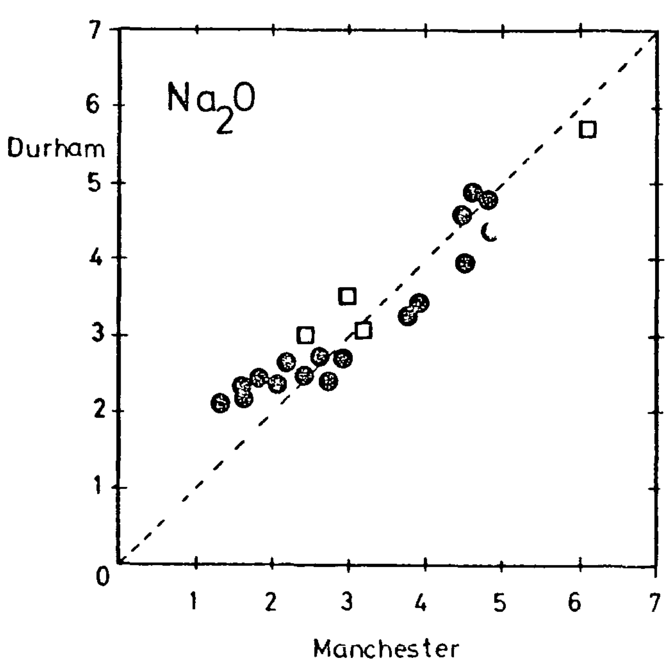

Al2O3
Durham
Manchester
12
13
14
15
16
17
18
19

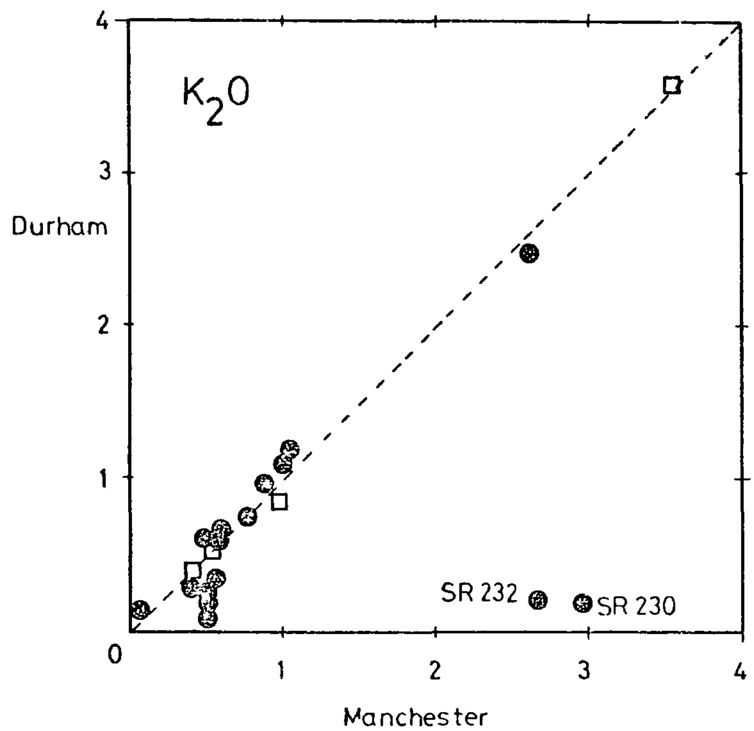

Total iron (as Fe2O3)
Durham
Manchester
8
9
10
11
12
13
14
15
16
17
18
19

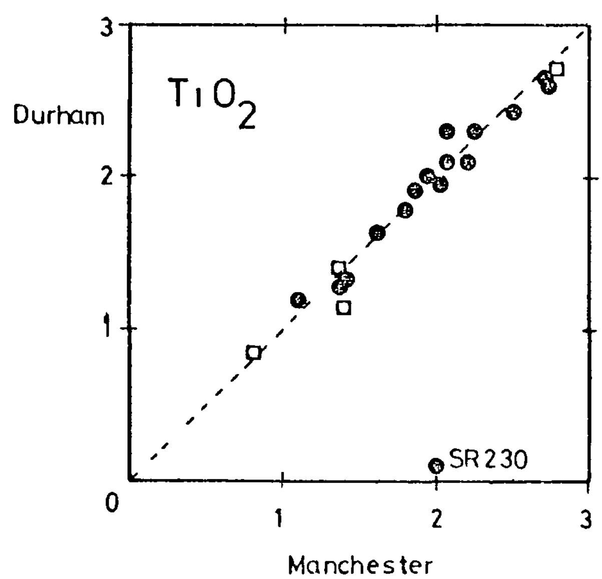


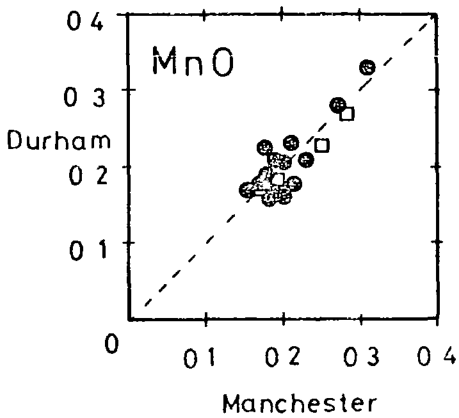
MgO
Durham
Manchester
0
1
2
3
4
5
6
7
8
9
10
11
12
13


CaO
Durham
Manchester
1
2
3
4
5
6
7
8
9
10
11
12
13


Na_2O
Durham
Manchester
0
1
2
3
4
5
6
7


K2O
Durham
Manchester
SR 232
SR 230
0
1
2
3
4


TiO2
Durham
Manchester
SR 230
0
1
2
3


MnO
Durham
Manchester
0
0 1
0 2
0 3
0 4

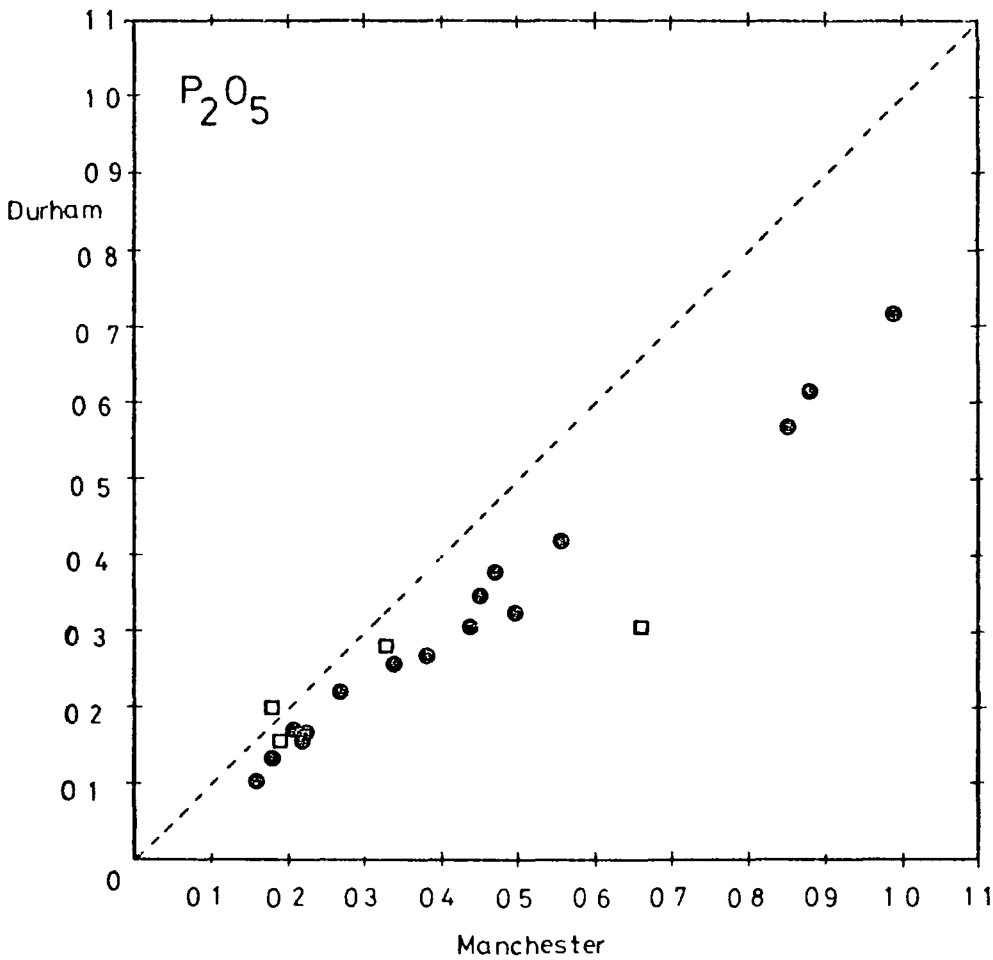

P_2O_5
Durham
Manchester
0
0 1
0 2
0 3
0 4
0 5
0 6
0 7
0 8
0 9
1 0
1 1

Figure 10.3

Total alkalis versus silica diagram for all samples

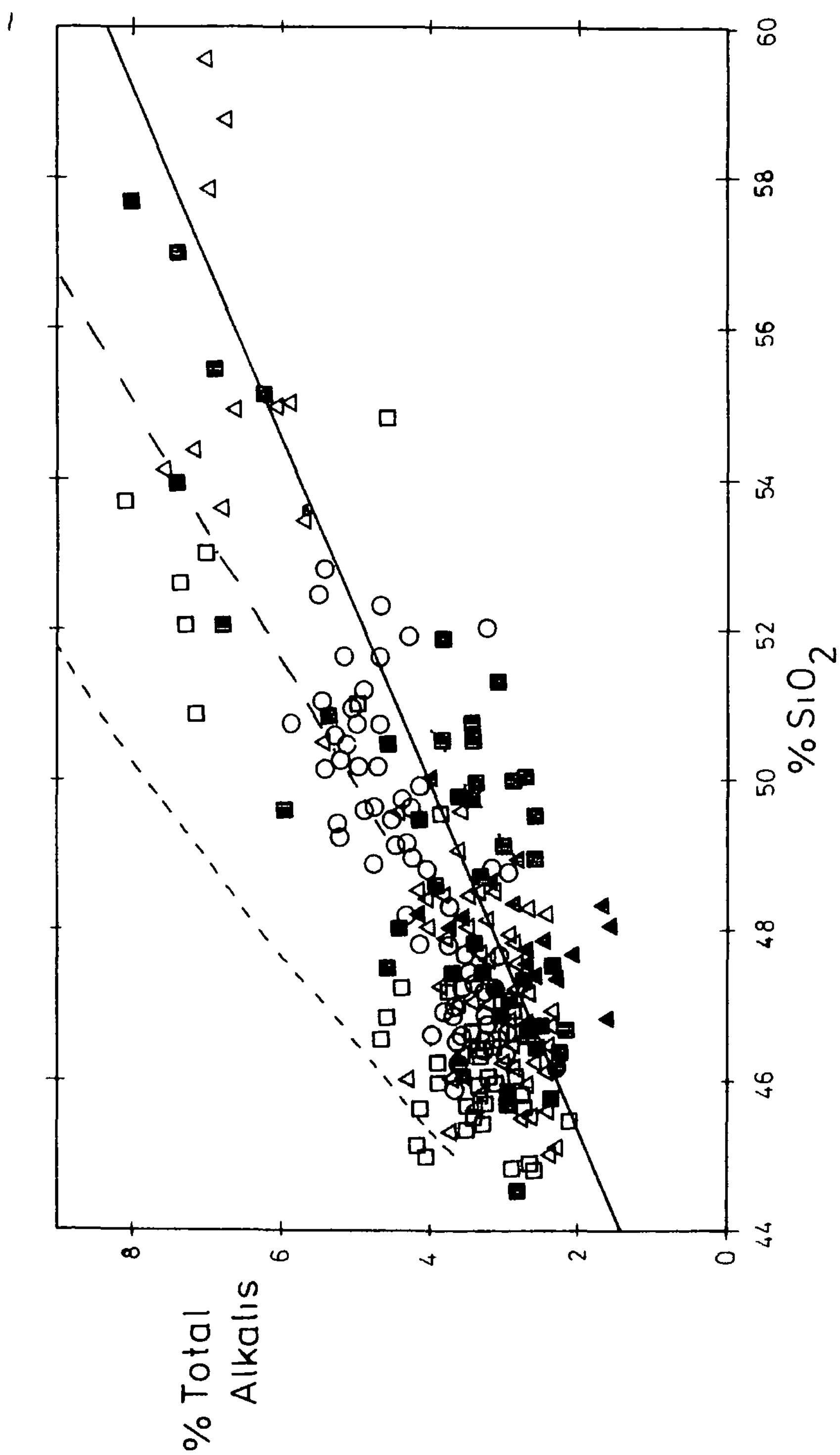
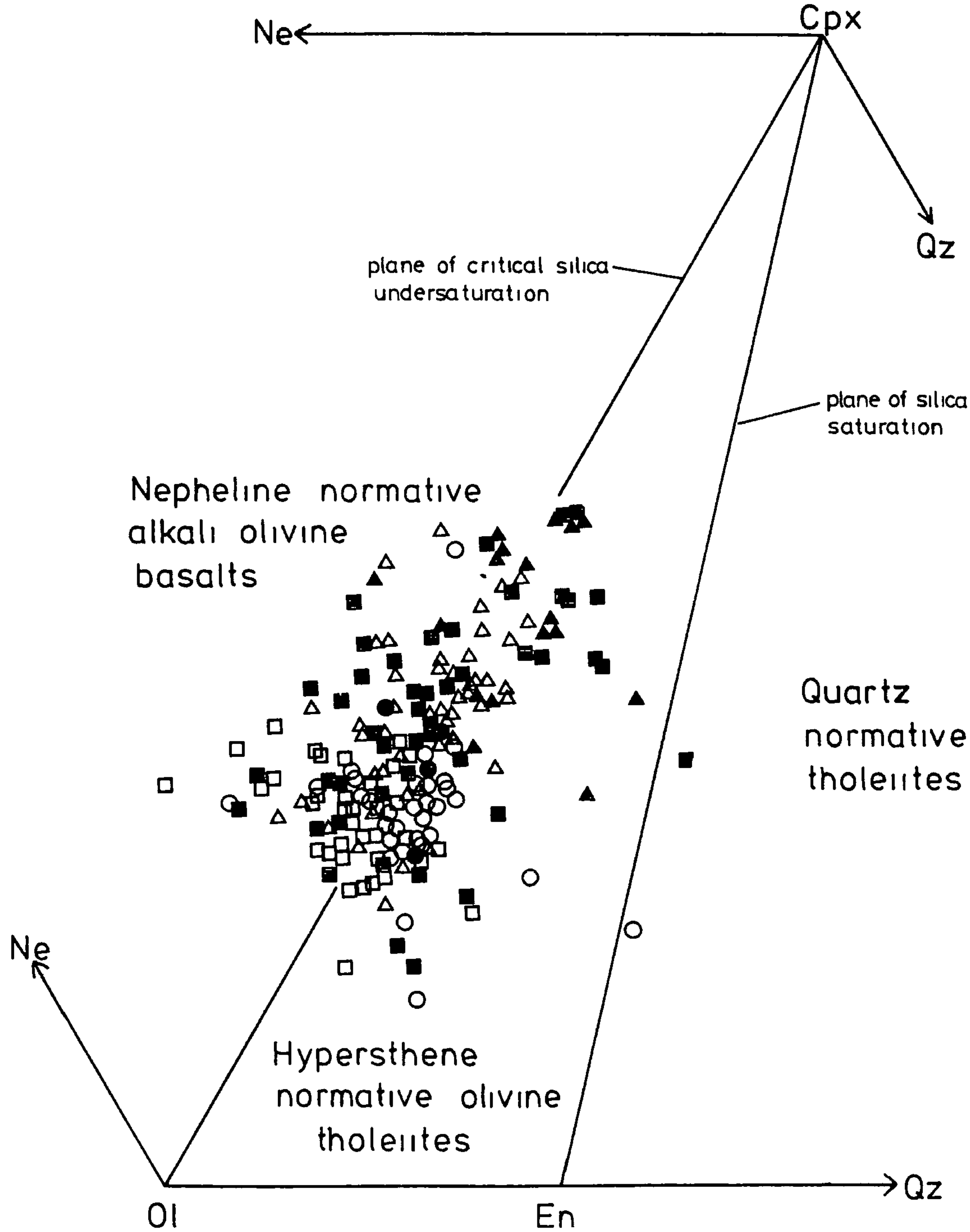

% Total Alkalis
0
2
4
6
8
% SiO_2
44
46
48
50
52
54
56
58
60

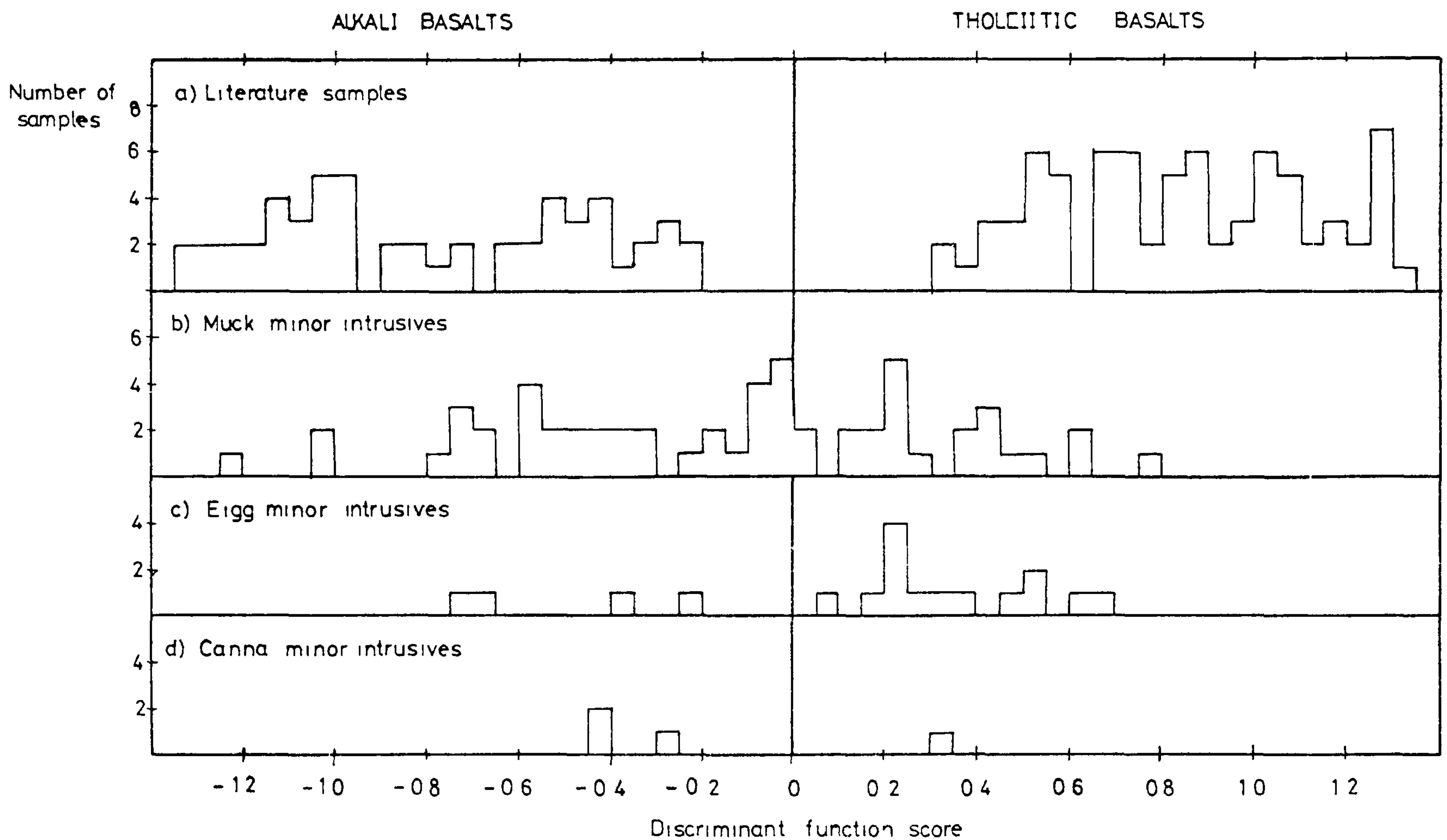
Figure 10.4 All basalts plotted in plagioclase projection of plagioclase-olivine-clinopyroxene-nepheline/quartz system



SYMBOLS AS FOR FIGURE 10.3

Figure 10.5

Results of the discriminant analysis method.


ALKALI BASALTS
THOLEIITIC BASALTS
Number of samples
a) Literature samples
b) Muck minor intrusives
c) Eigg minor intrusives
d) Canna minor intrusives
8
6
4
2
-1.2
-1.0
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1.0
1.2
Discriminant function score

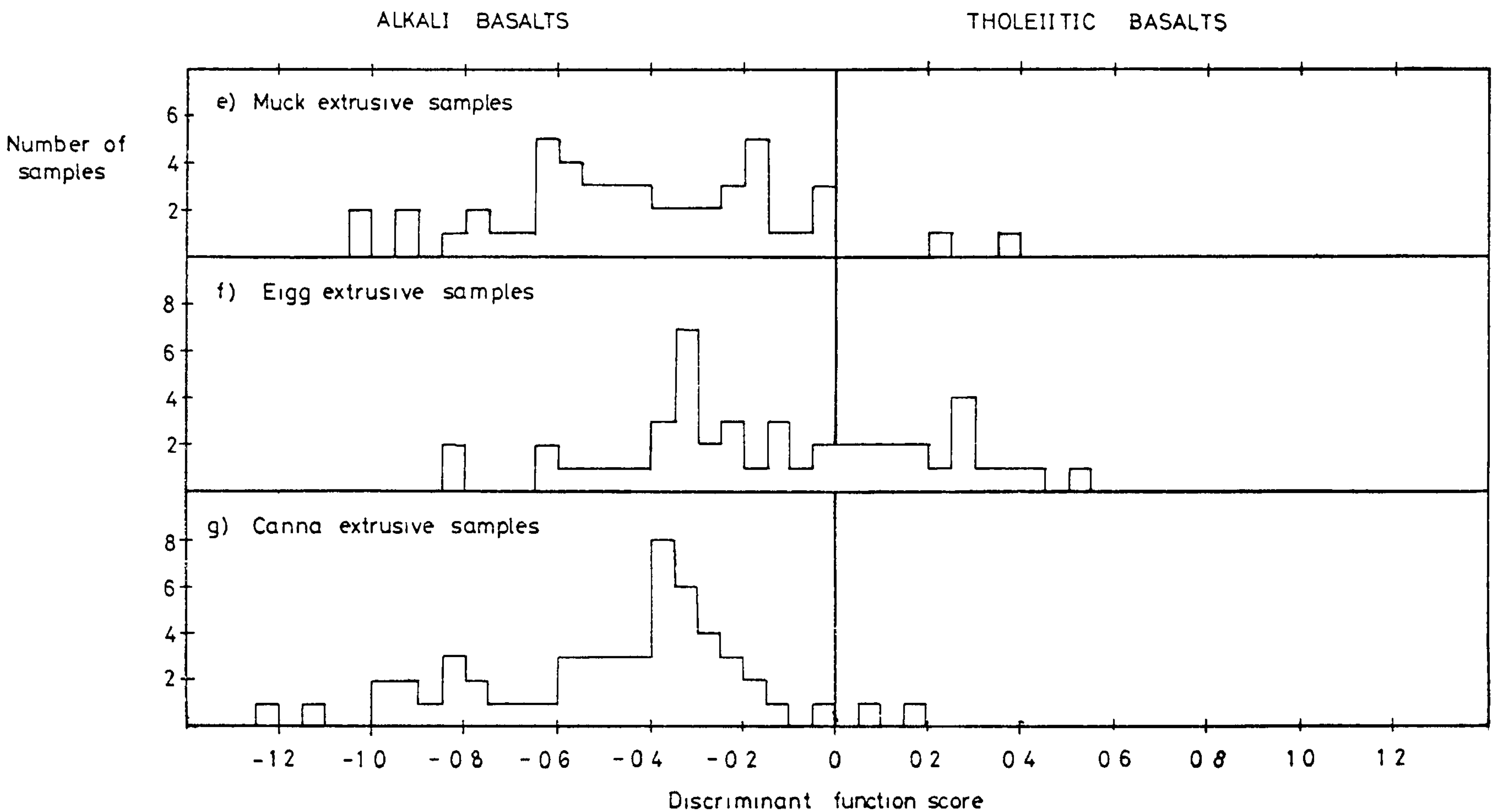
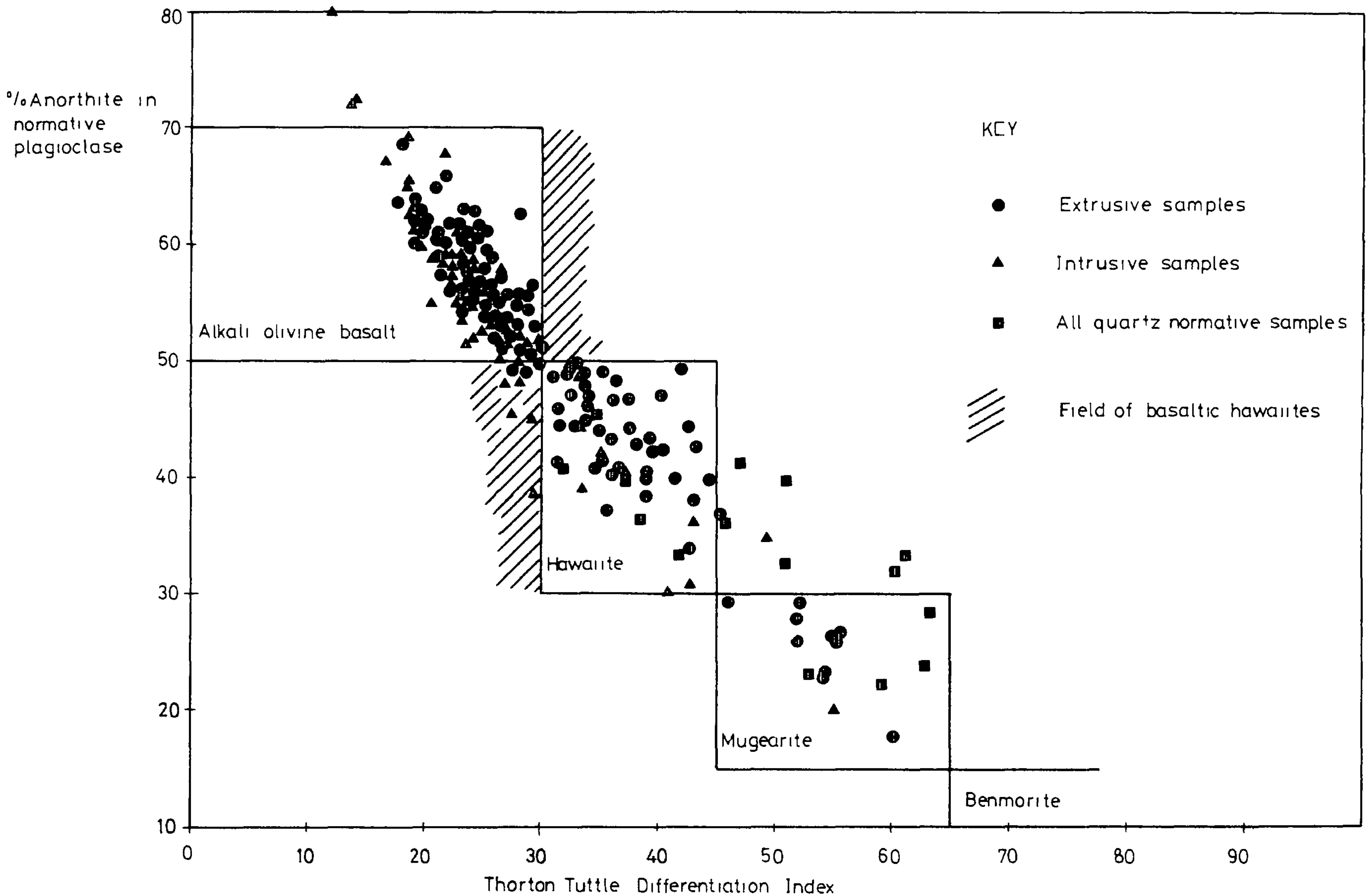

ALKALI BASALTS
THOLEIITIC BASALTS
Number of samples
e) Muck extrusive samples
f) Eigg extrusive samples
g) Canna extrusive samples
6
4
2
8
6
4
2
8
6
4
2
-1 2
-1 0
- 0 8
- 0 6
- 0 4
- 0 2
0
0 2
0 4
0 6
0 8
1 0
1 2
Discriminant function score

Figure 10.6

Plot of Differentiation index against % Anorthite in the normative plagioclase for all samples.



°/o Anorthite in normative plagioclase
80
70
60
50
40
30
20
10
Alkali olivine basalt
Hawaiite
Mugearite
Benmorite
KEY
Extrusive samples
Intrusive samples
All quartz normative samples
Field of basaltic hawaiites
0
10
20
30
40
50
60
70
80
90
Thorton Tuttle Differentiation Index

Figure 10.7

Selected Harker diagrams for all fresh extrusive samples

(Major elements)

Figure 10 7a

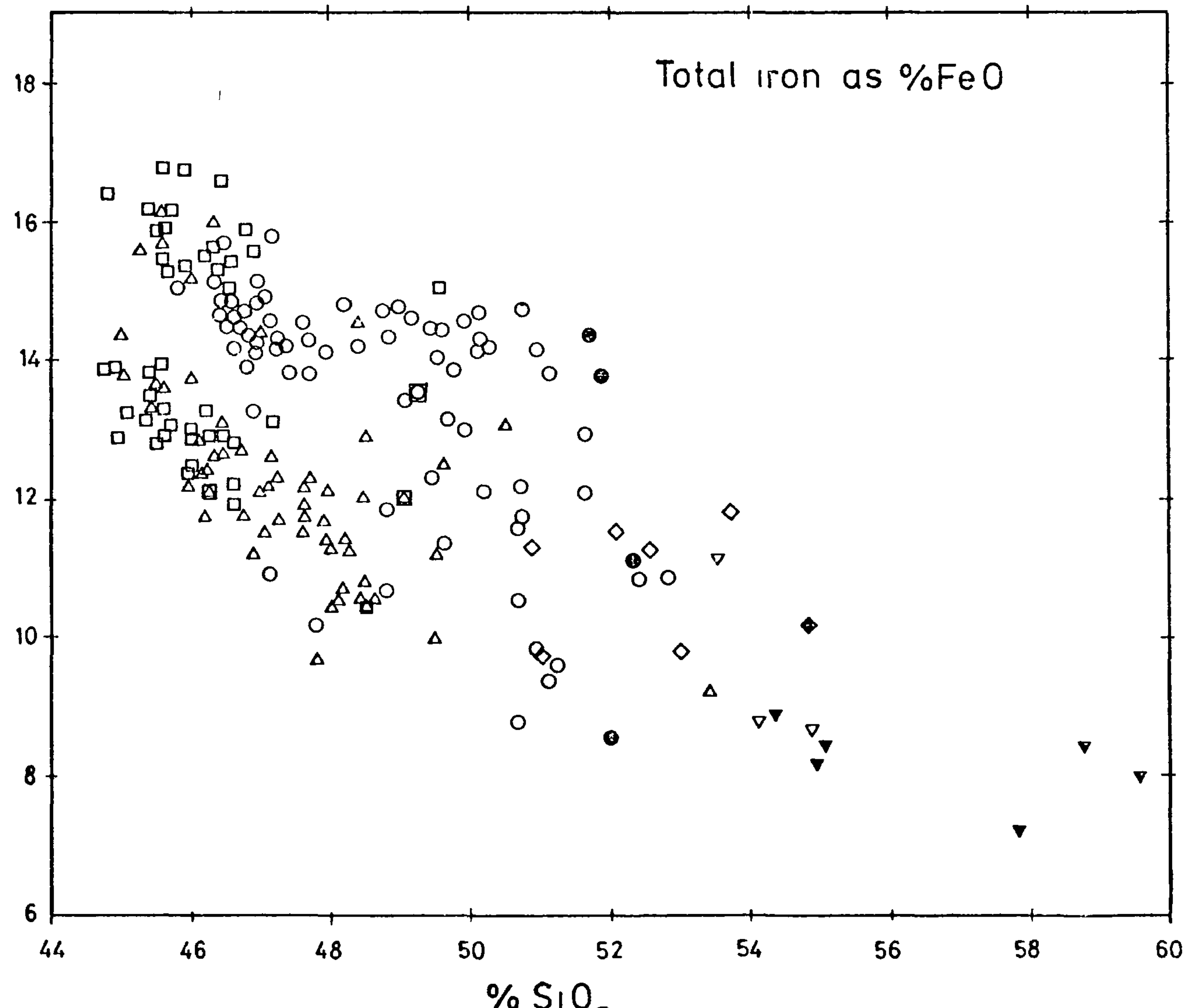


Figure 10 7b

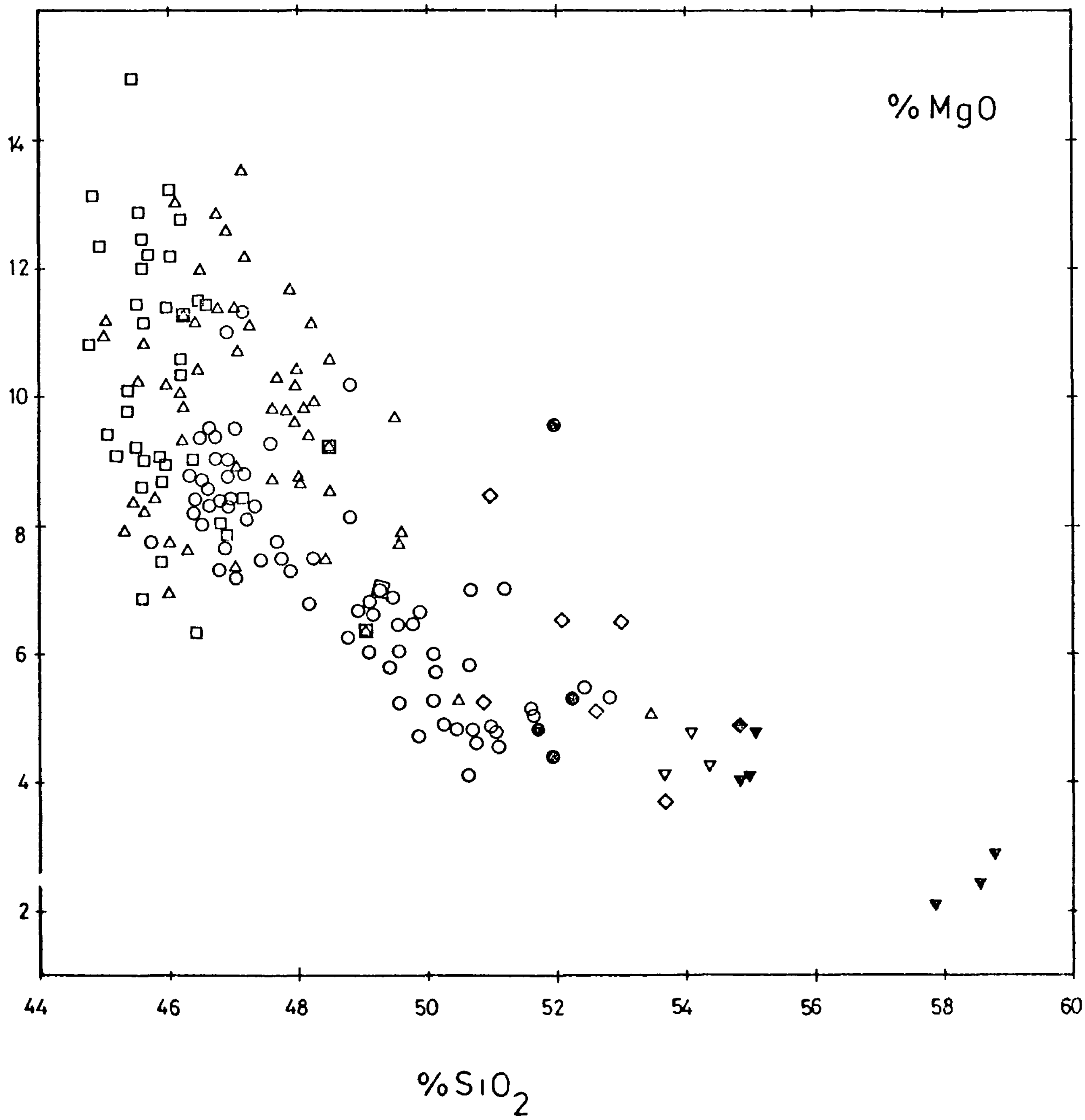


Figure 10 7c

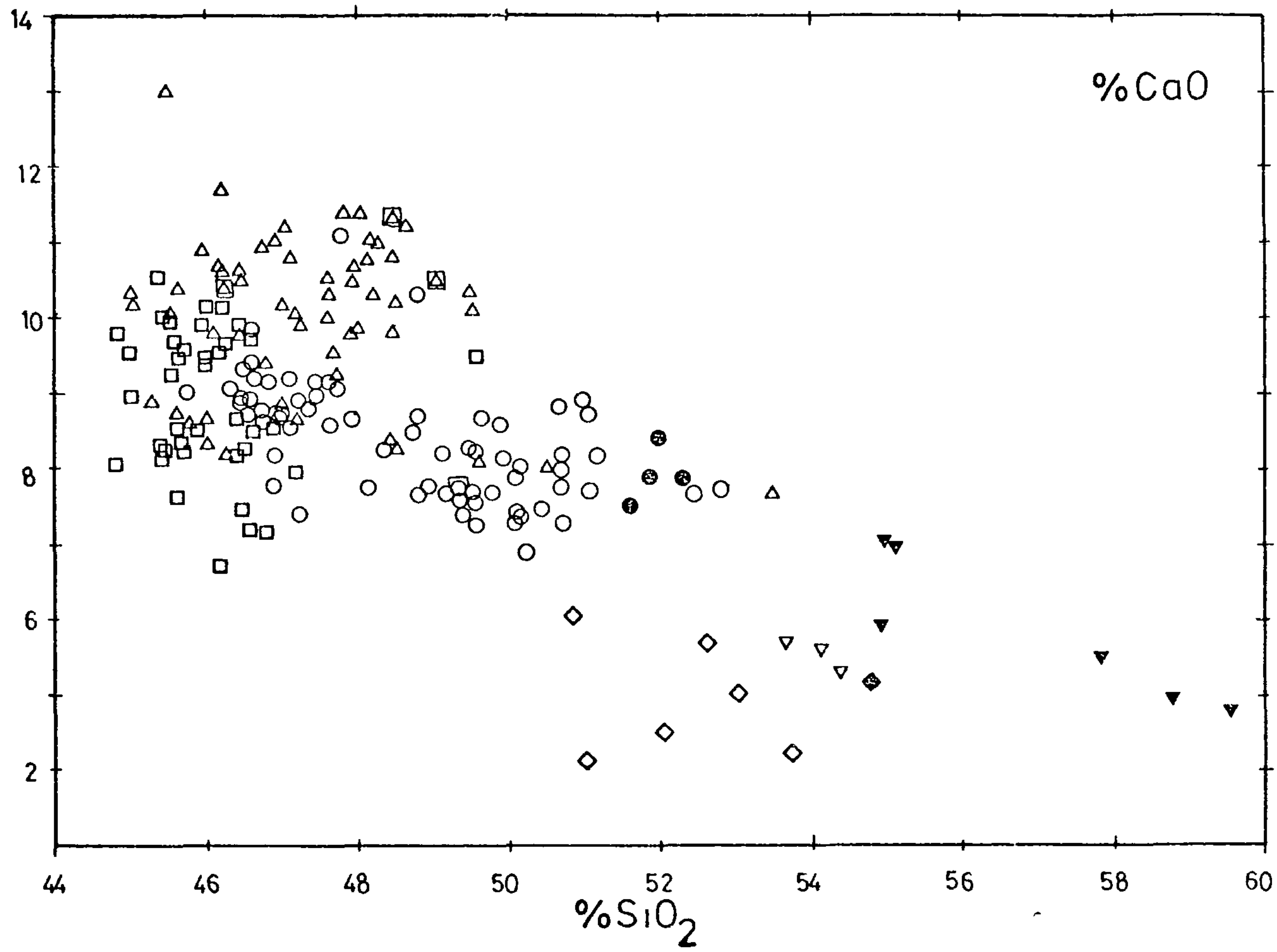


Figure 10 7d

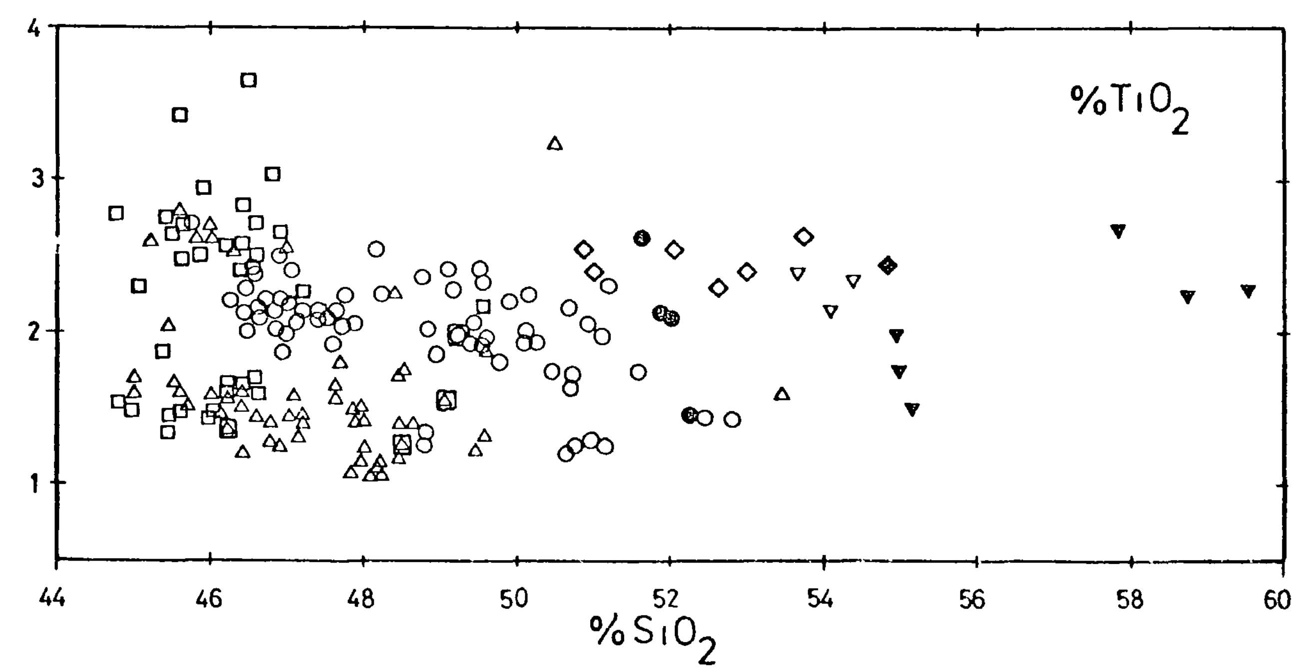


Figure 10 7e

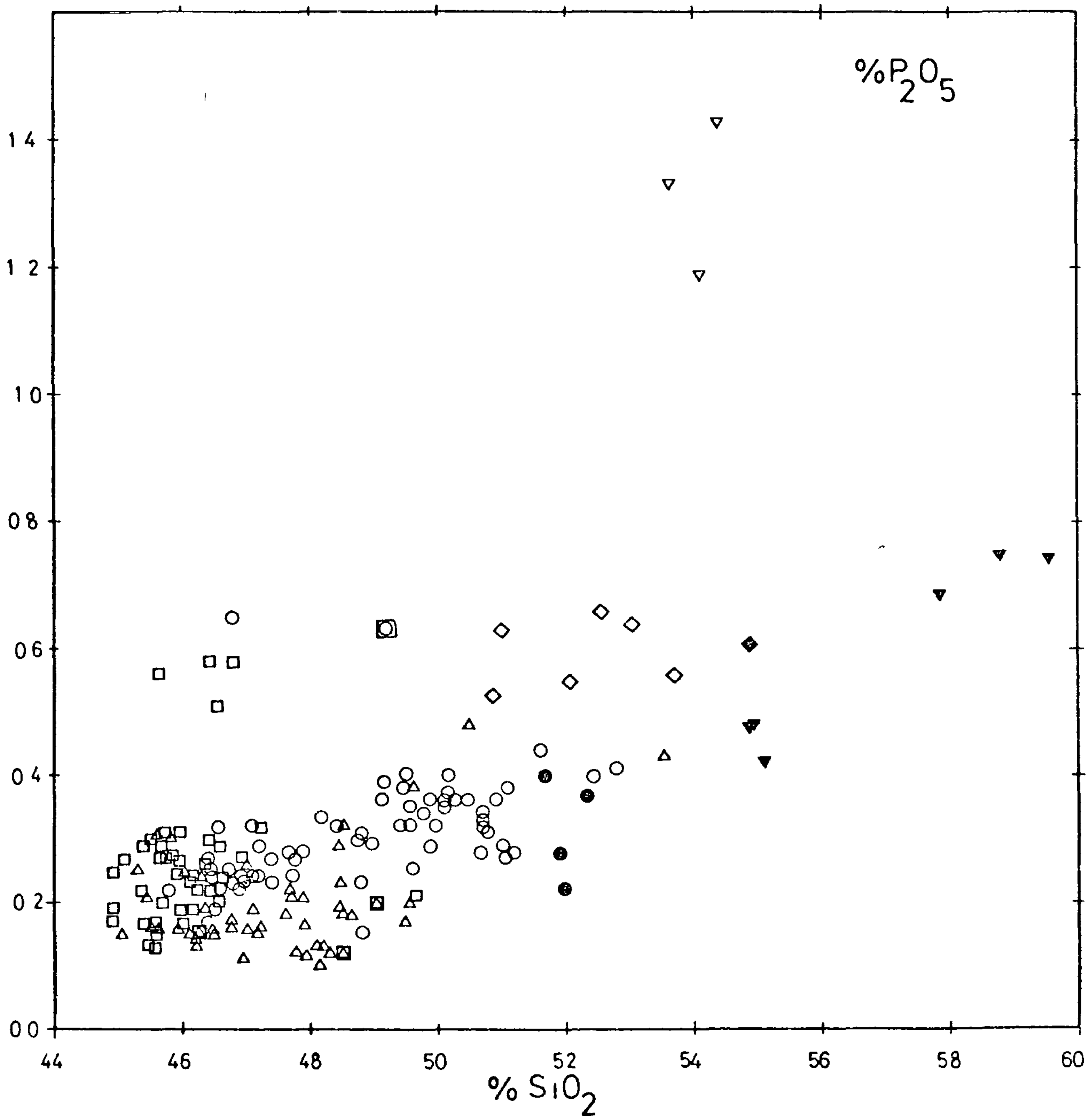


Figure 10.8

Selected Harker diagrams for the aphyric and sparsely porphyritic extrusive samples (Major elements).

Figure 10 8a

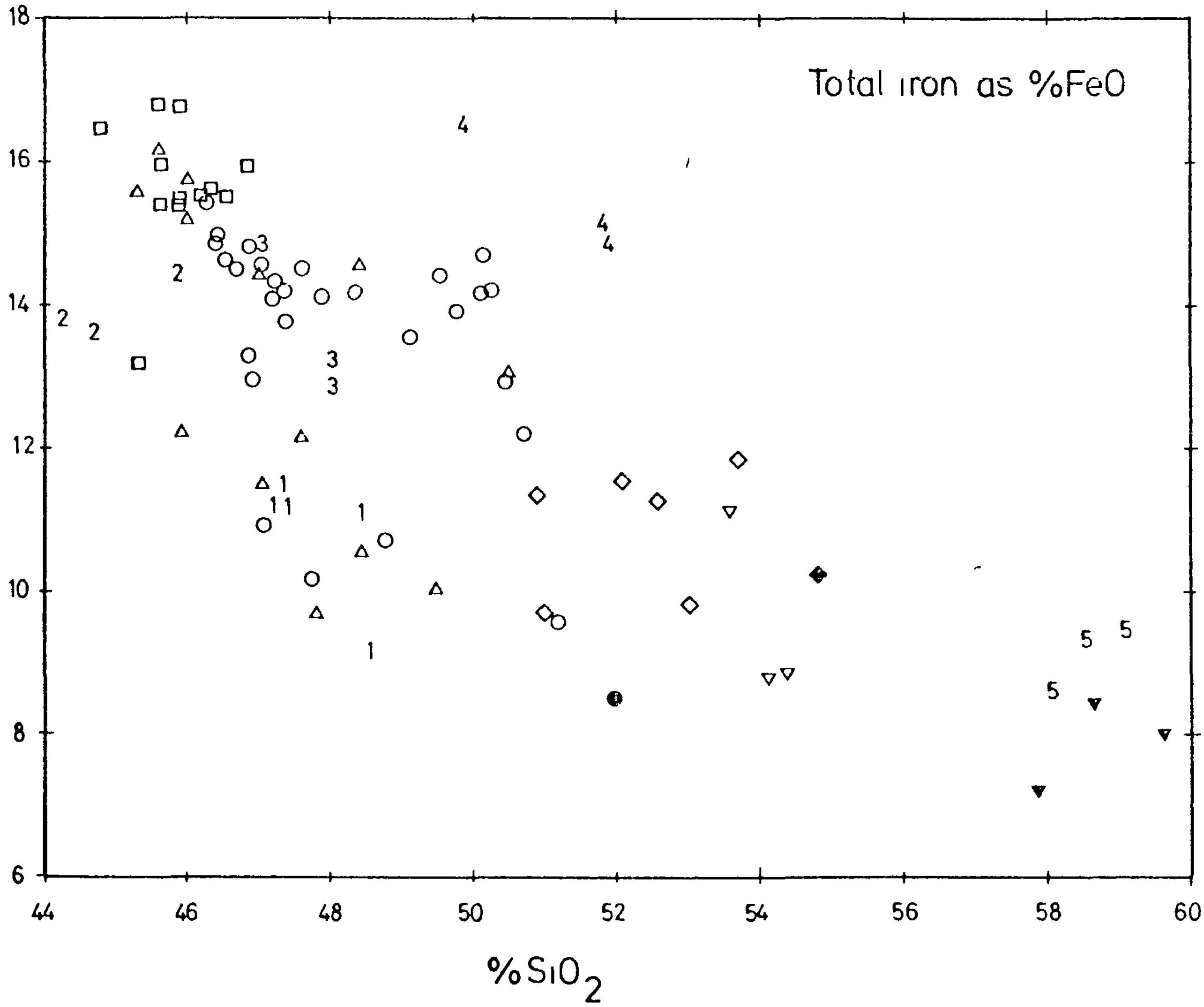


Figure 10 8b

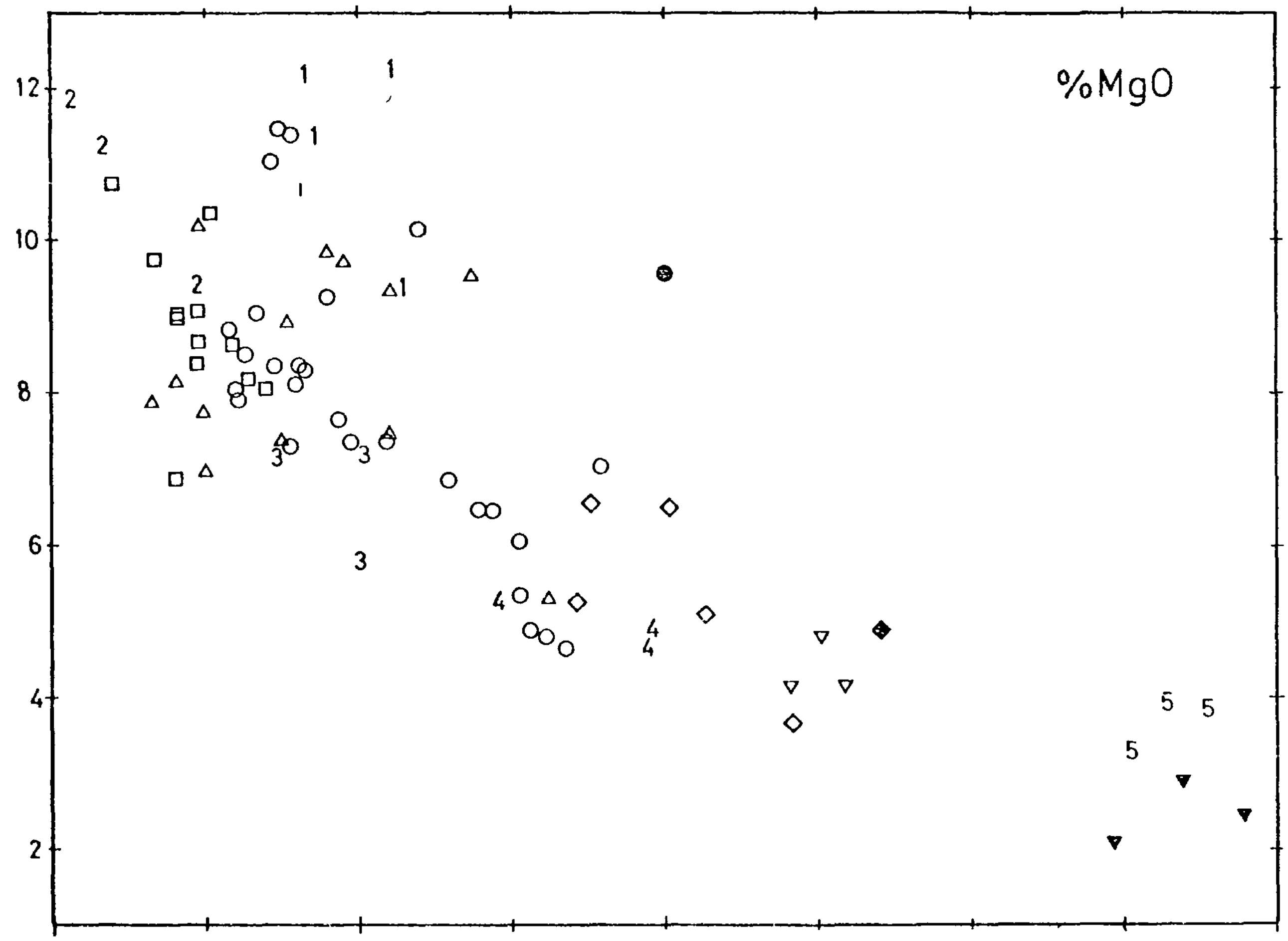


Figure 10 8c

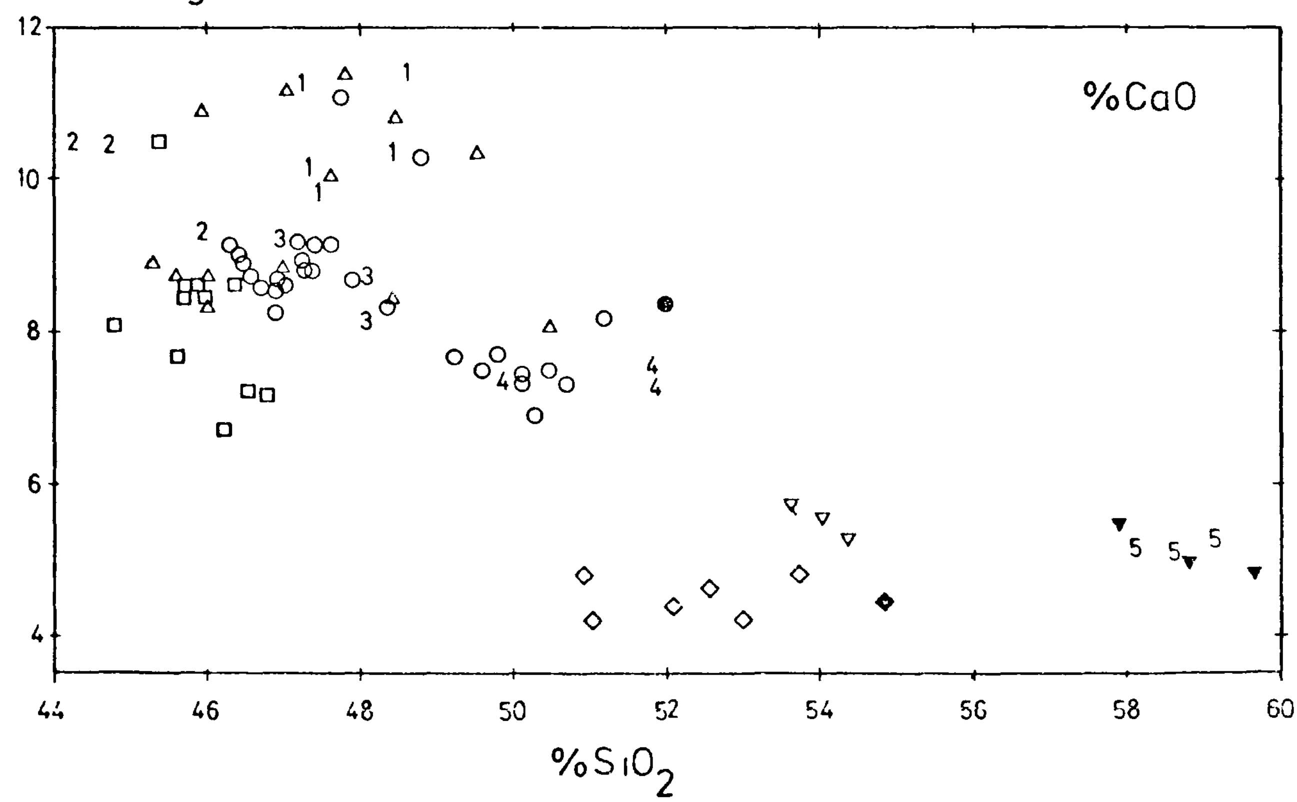


Figure 10 8d

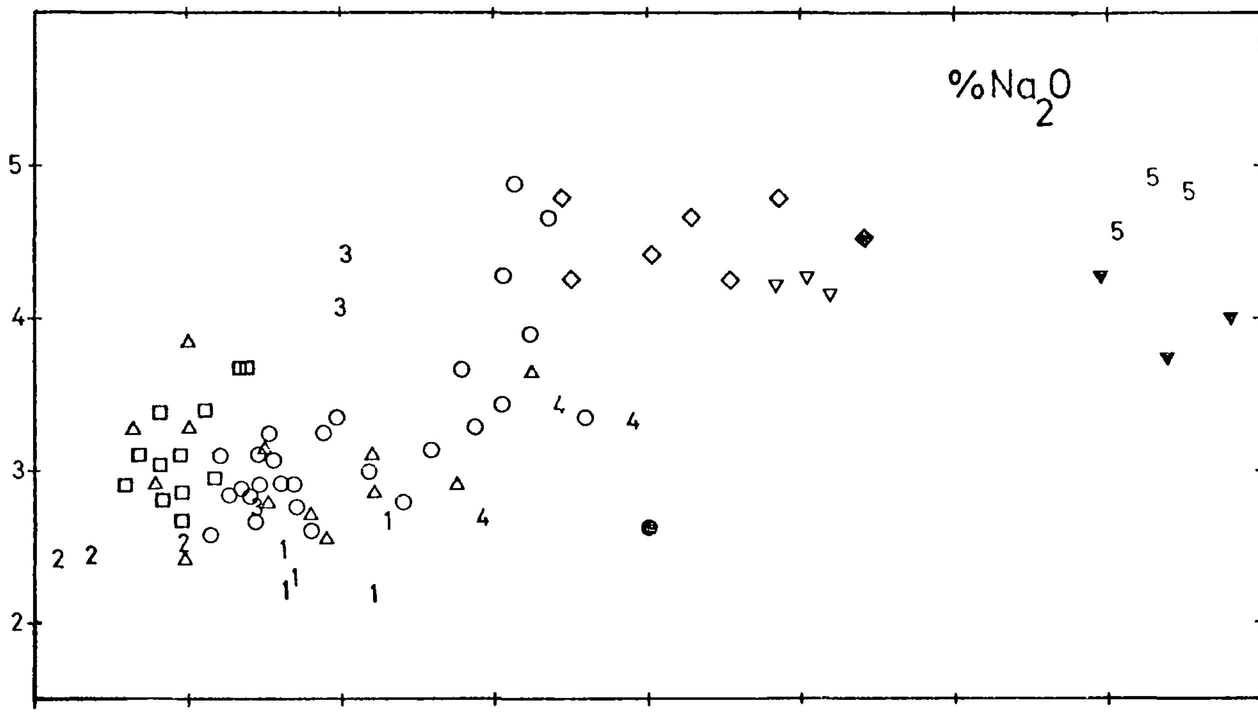


Figure 10 8e

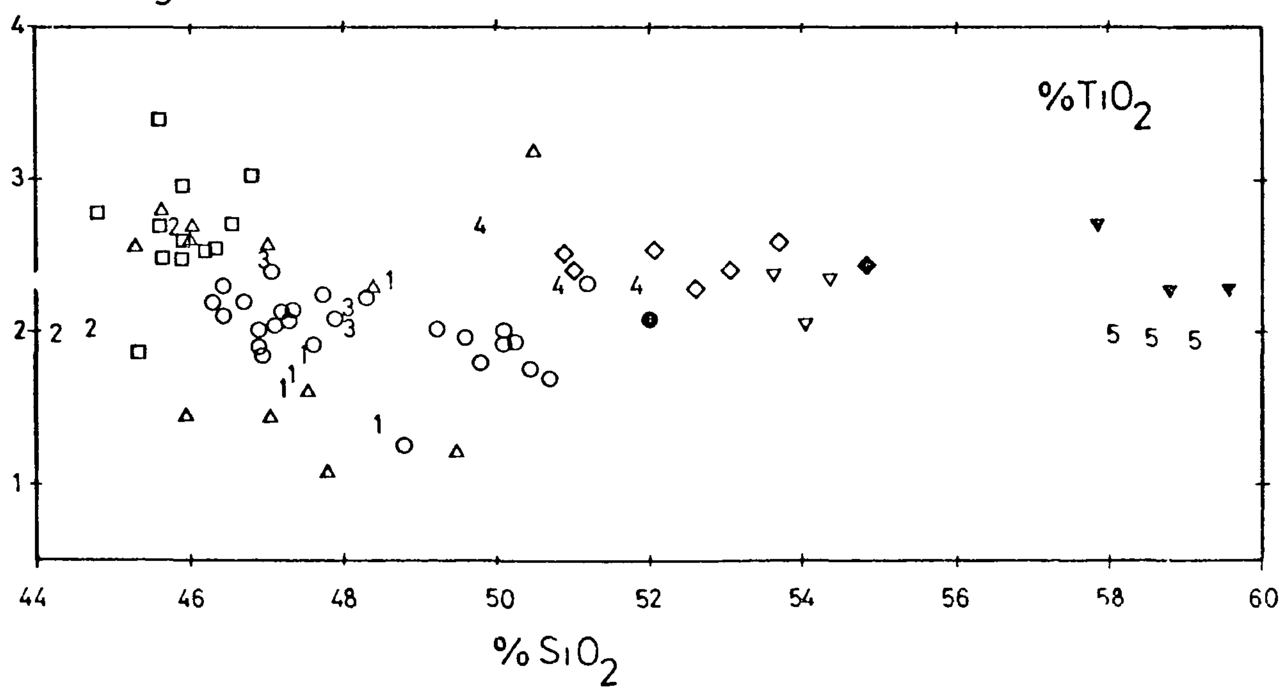


Figure 10 8f

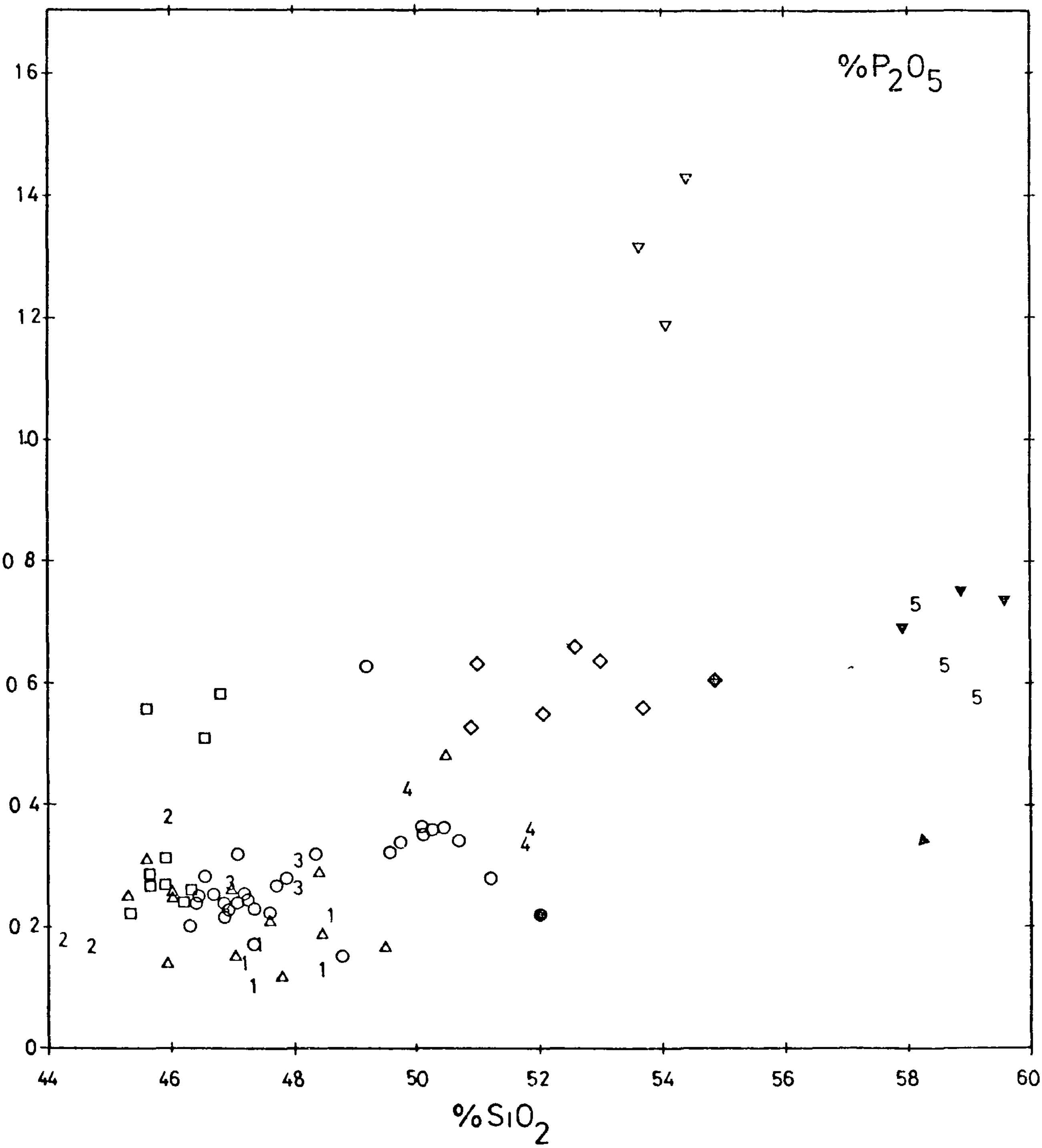


Figure 10.9

Selected Harker diagrams for all fresh intrusive samples.

(Major elements)

Figure 10 9a

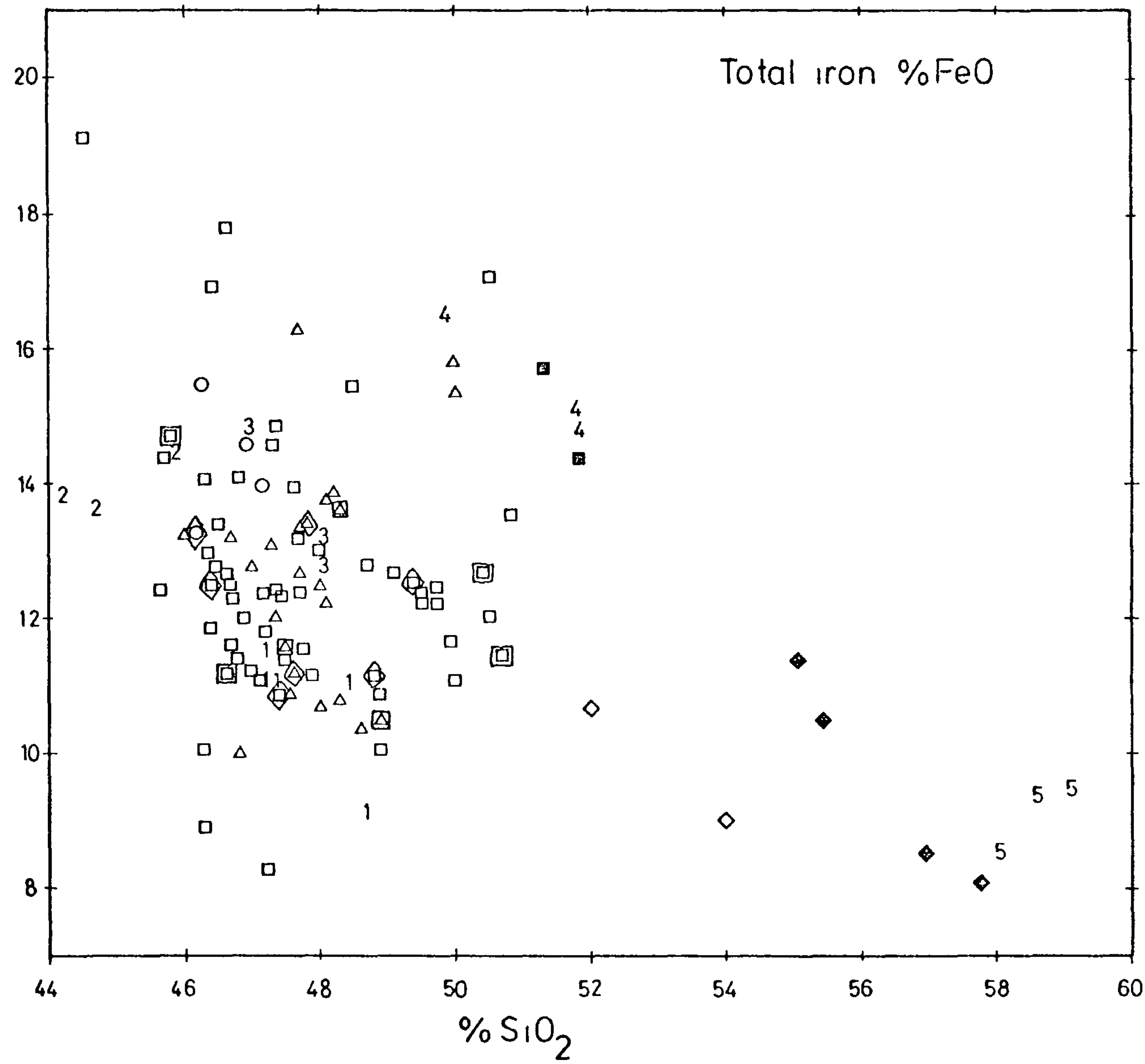


Figure 10 9b

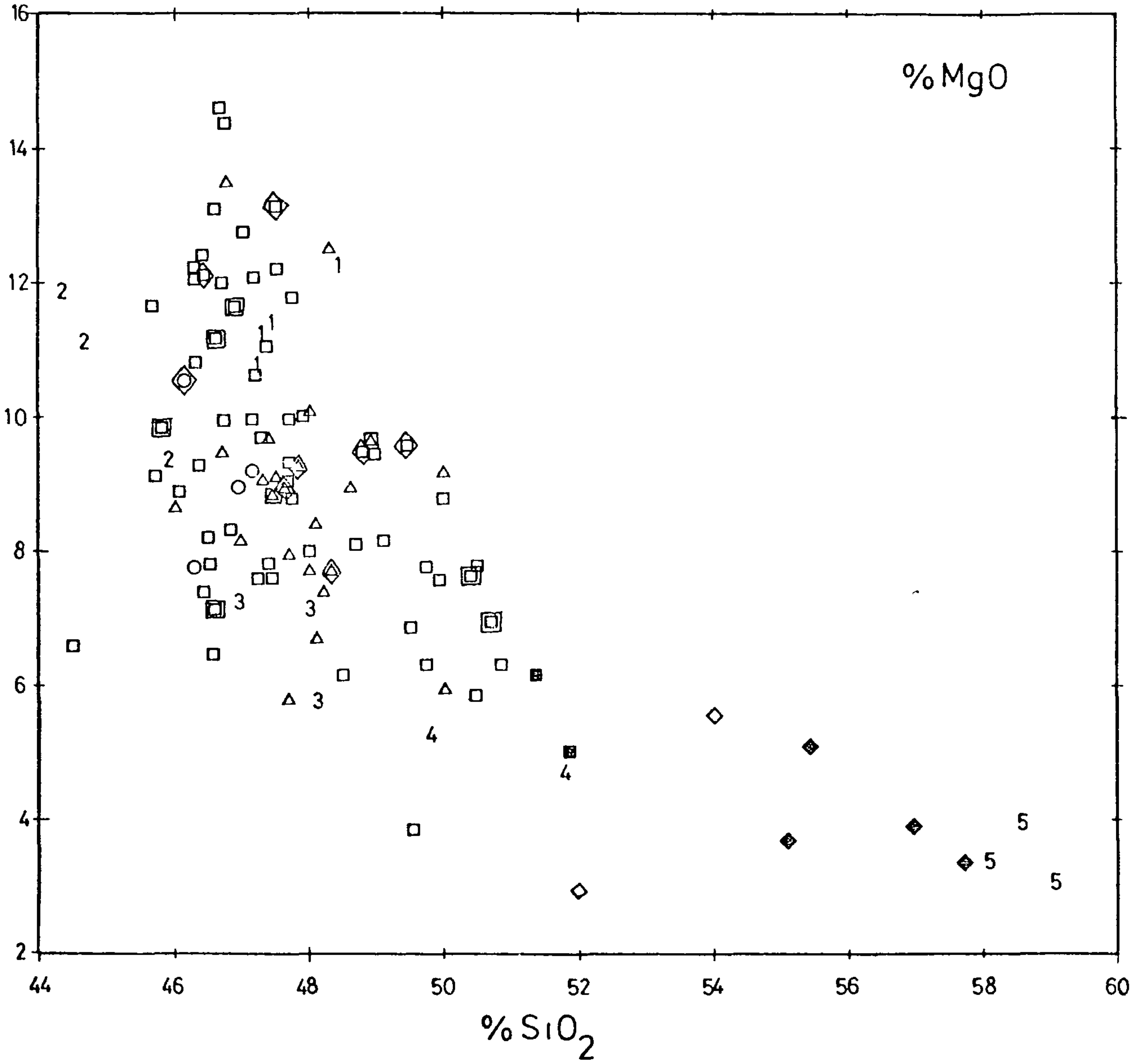


Figure 10 9c

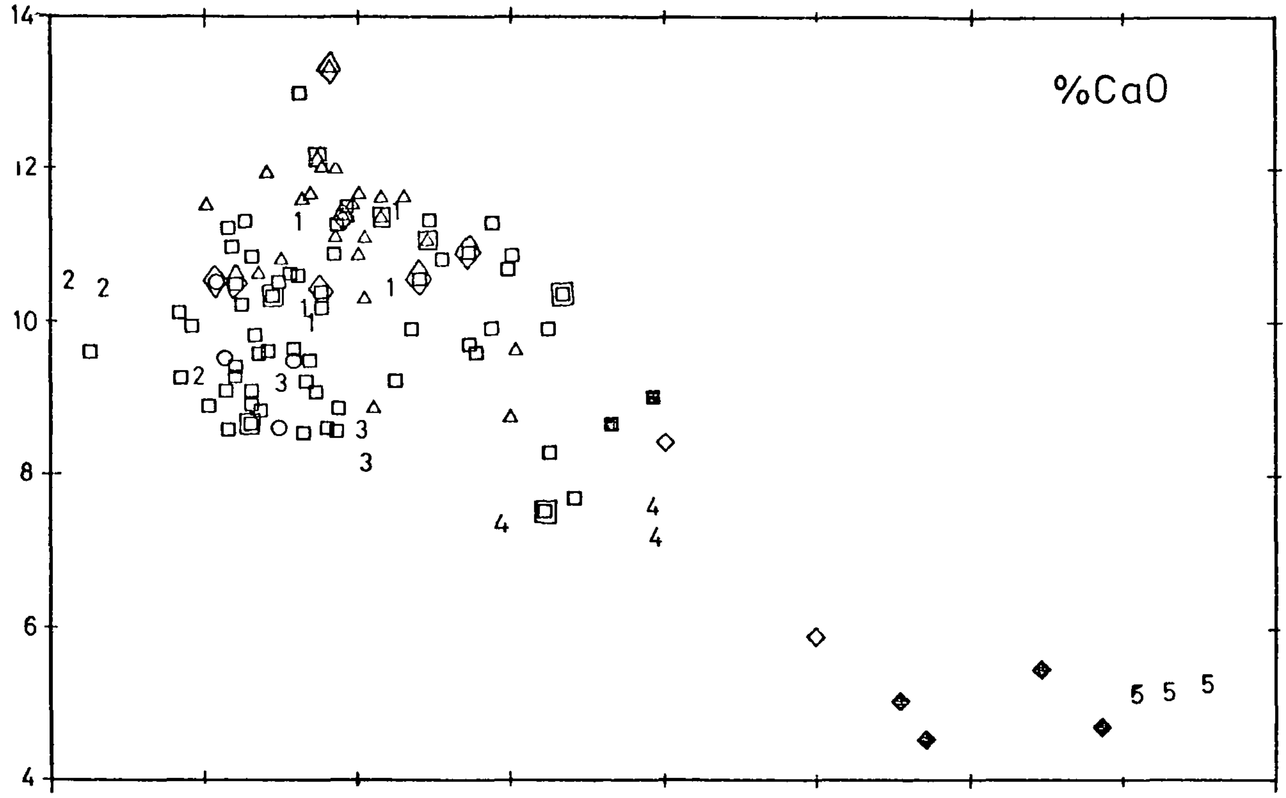


Figure 10 9d

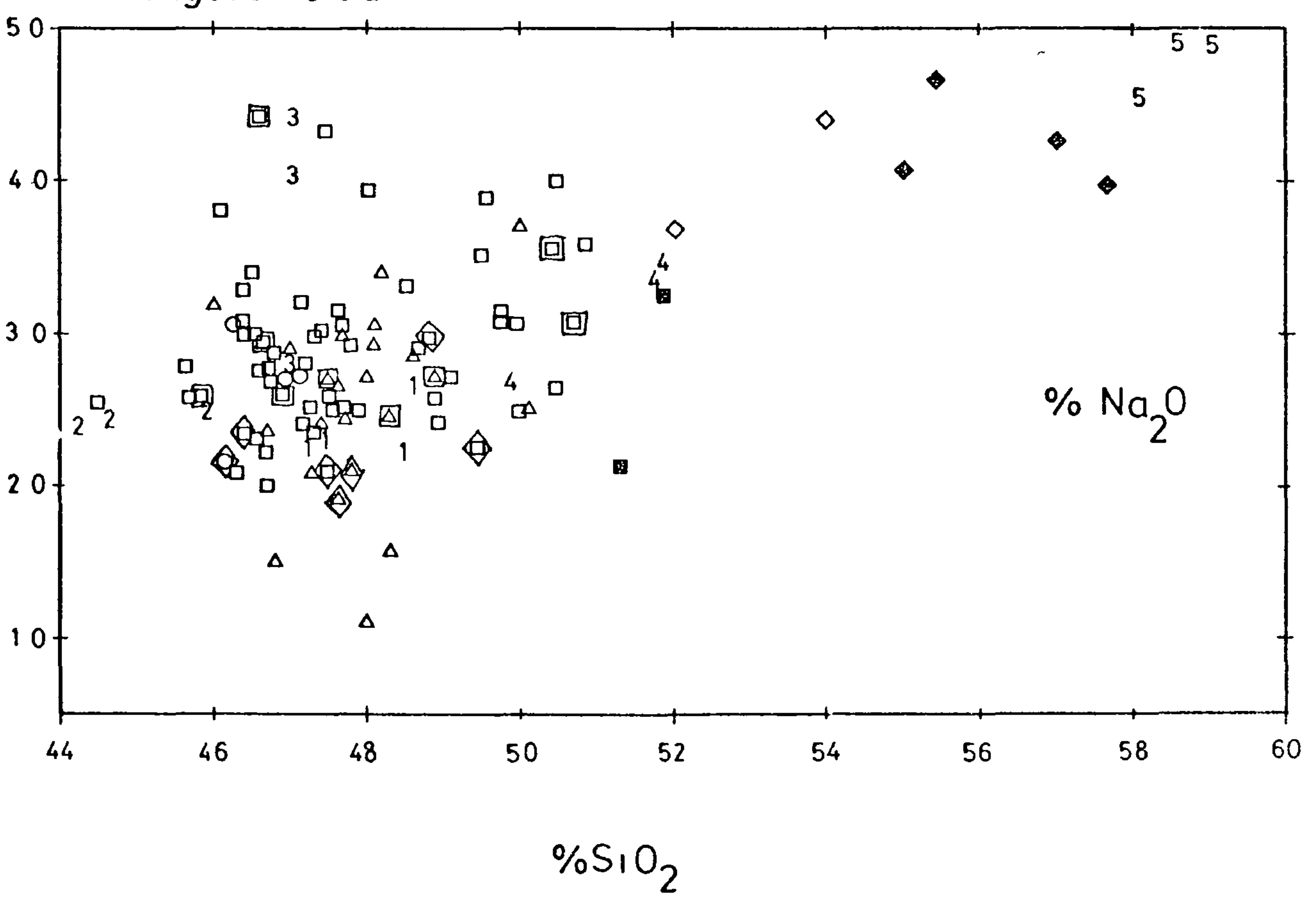


Figure 10 9e

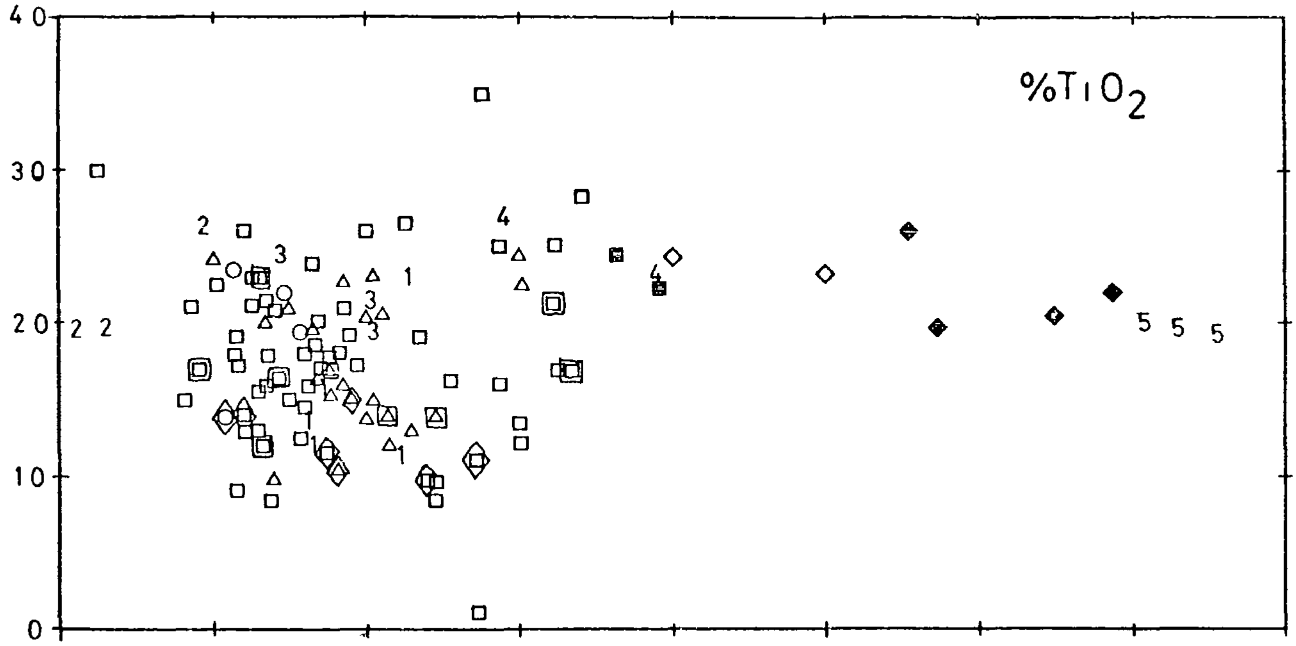


Figure 10 9f

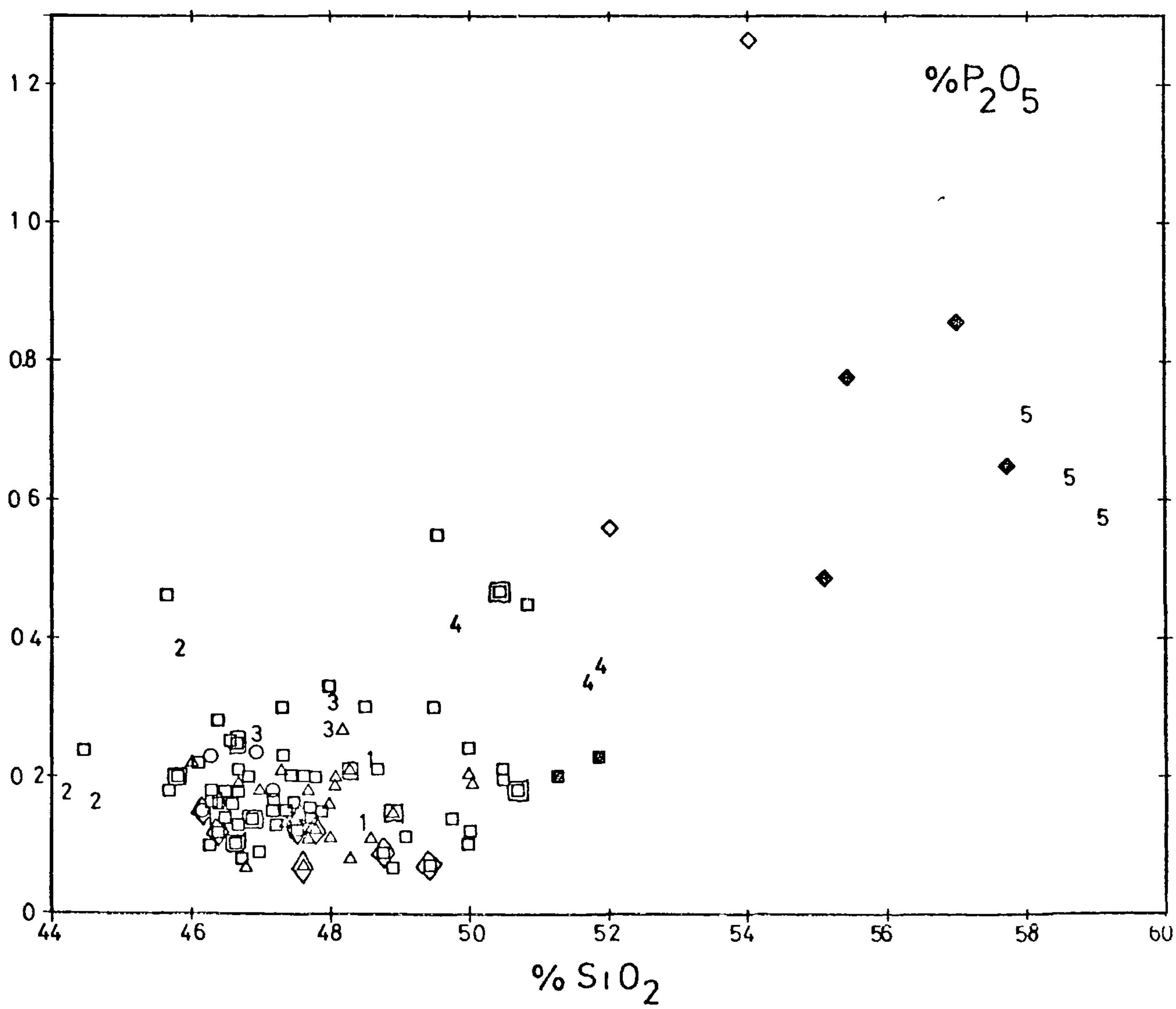


Figure 10.10

Selected Harker diagrams for all fresh extrusive samples.

(Trace elements)

Key as for Figure 10.7

Figure 10 10a

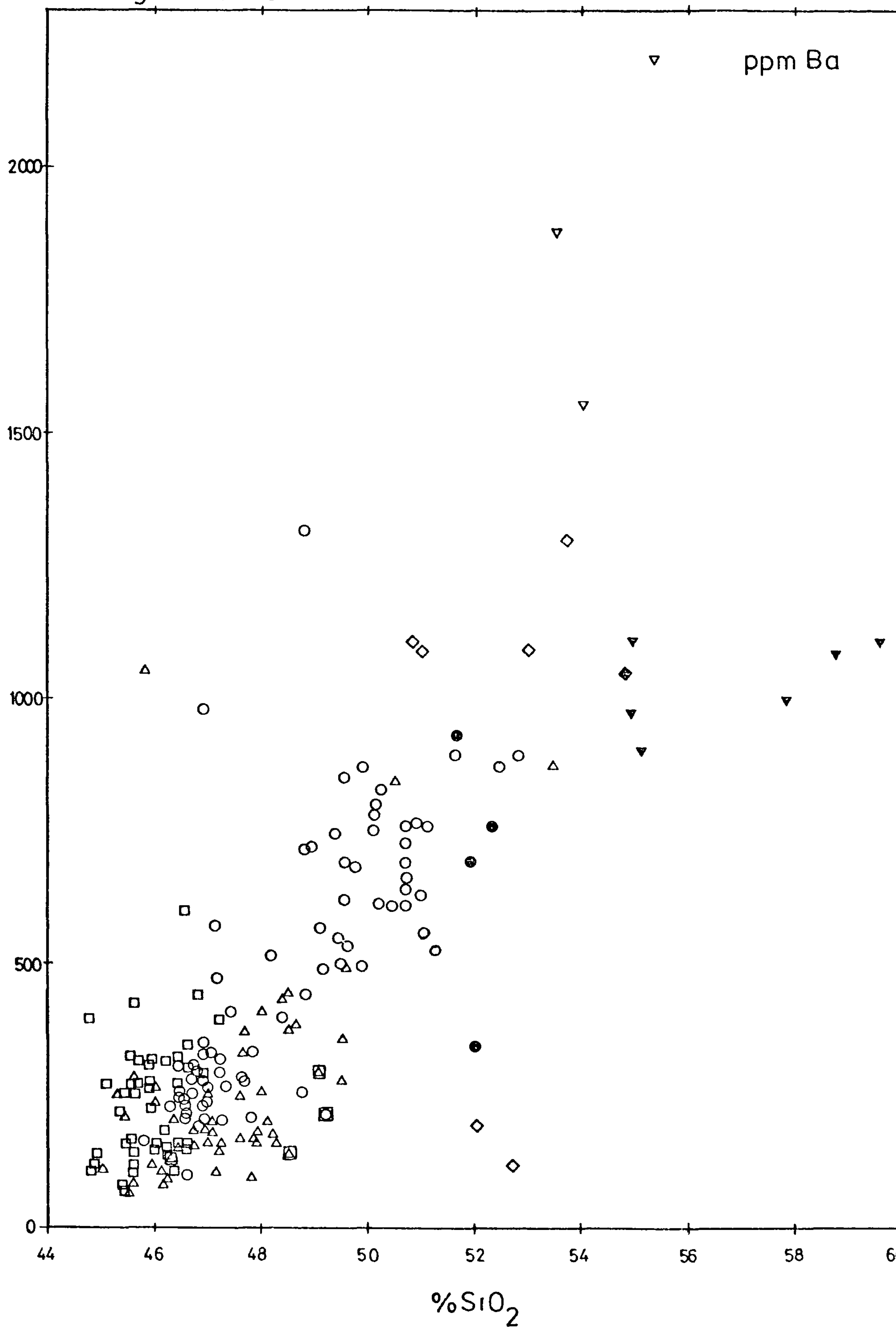


Figure 10 10b

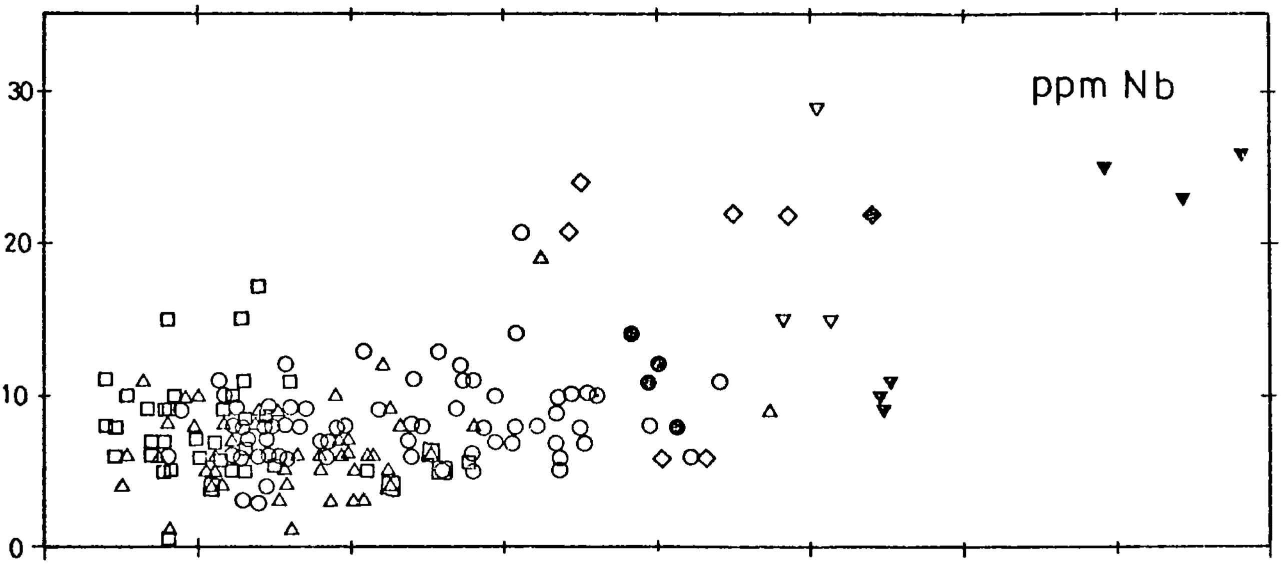


Figure 10 10c

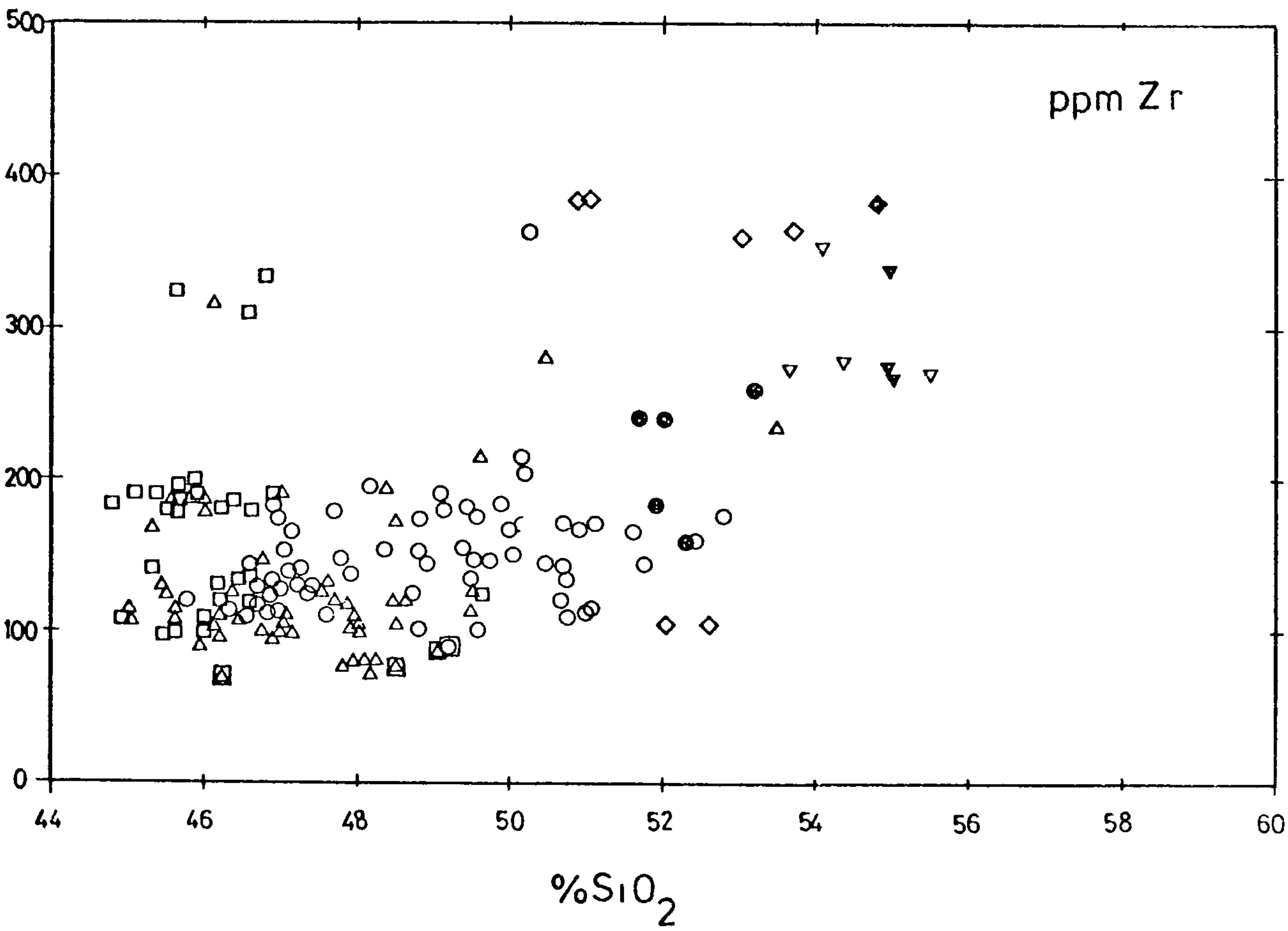


Figure 10 10d

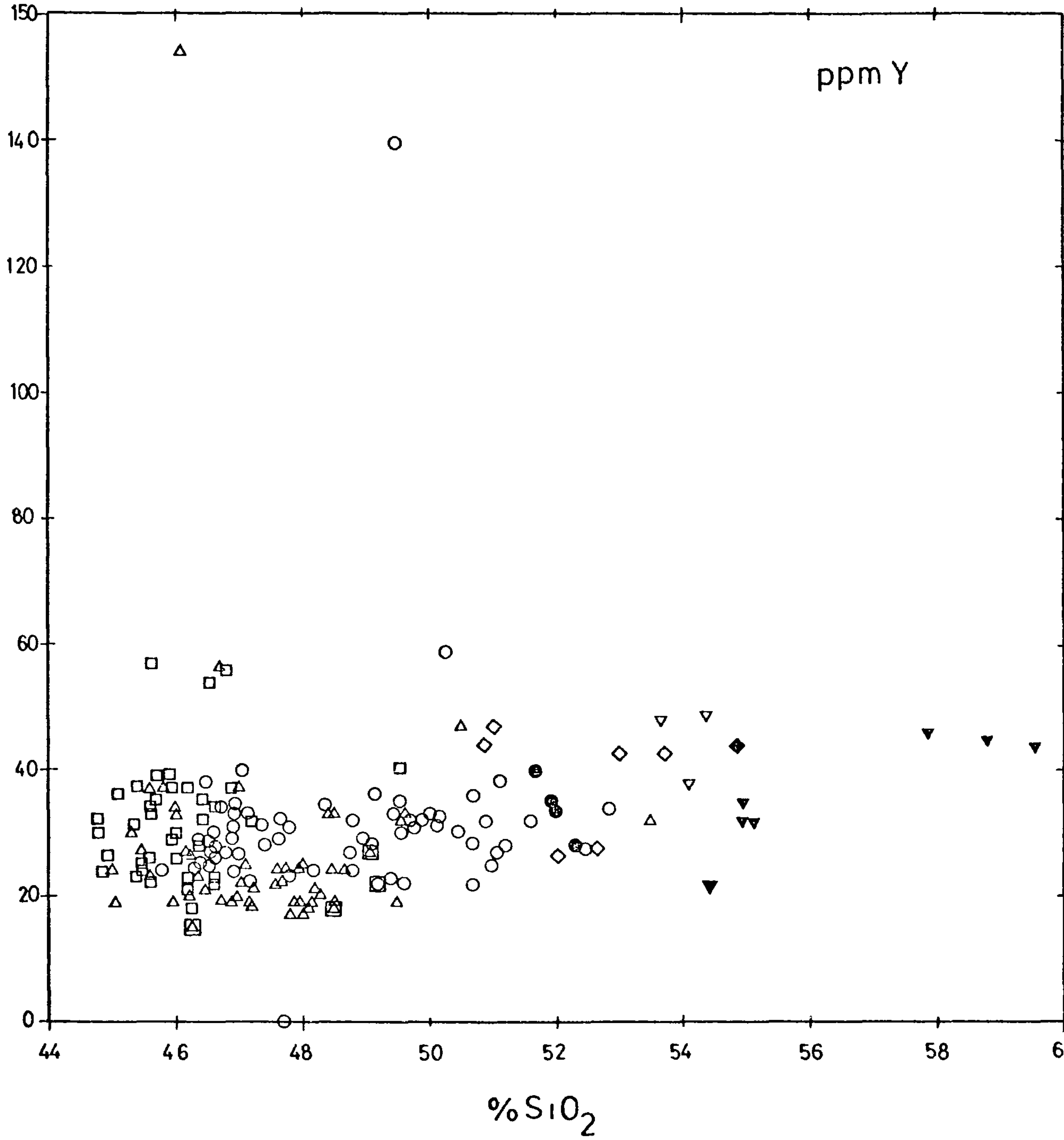


Figure 10 10e

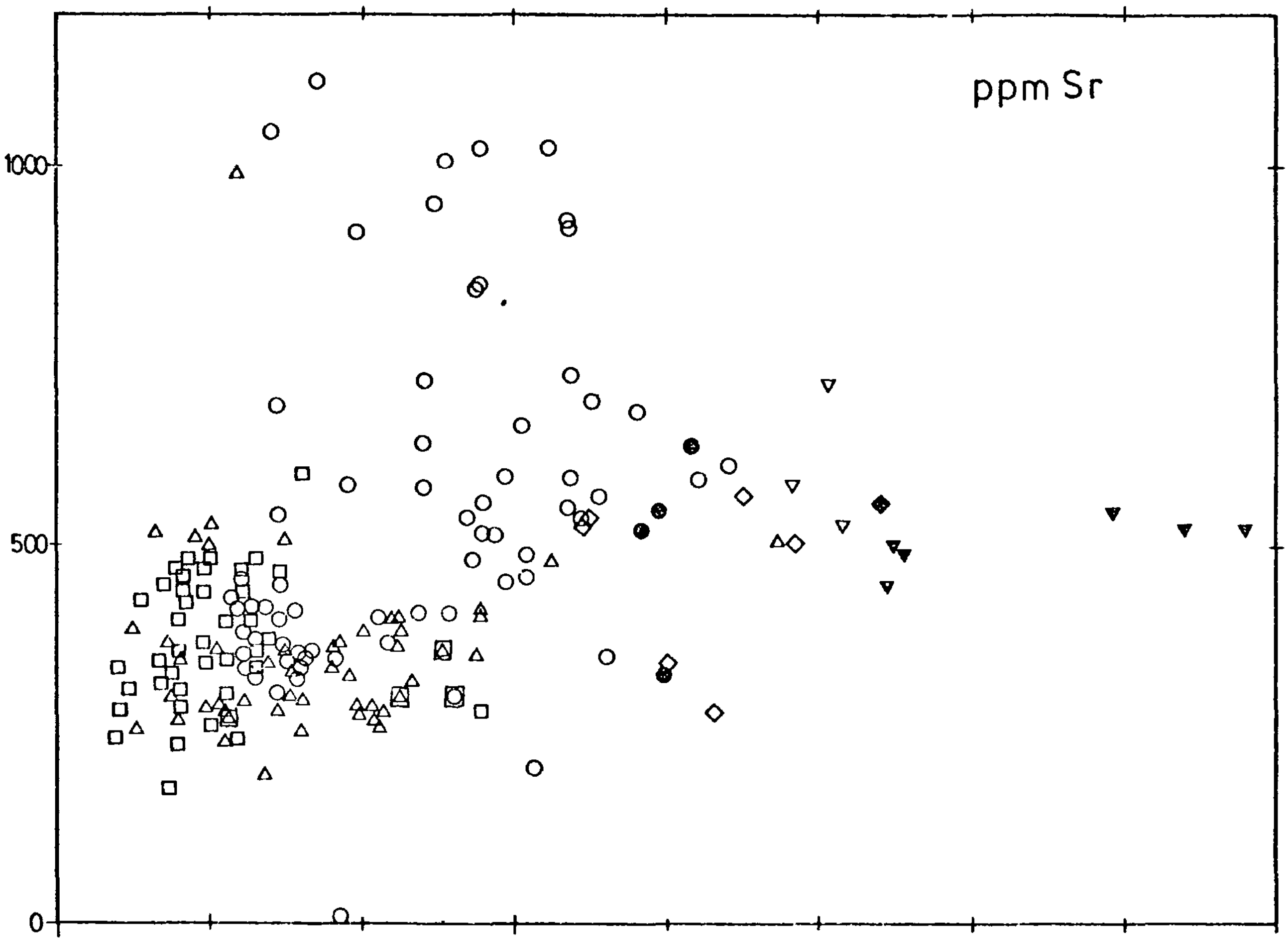


Figure 10 10f

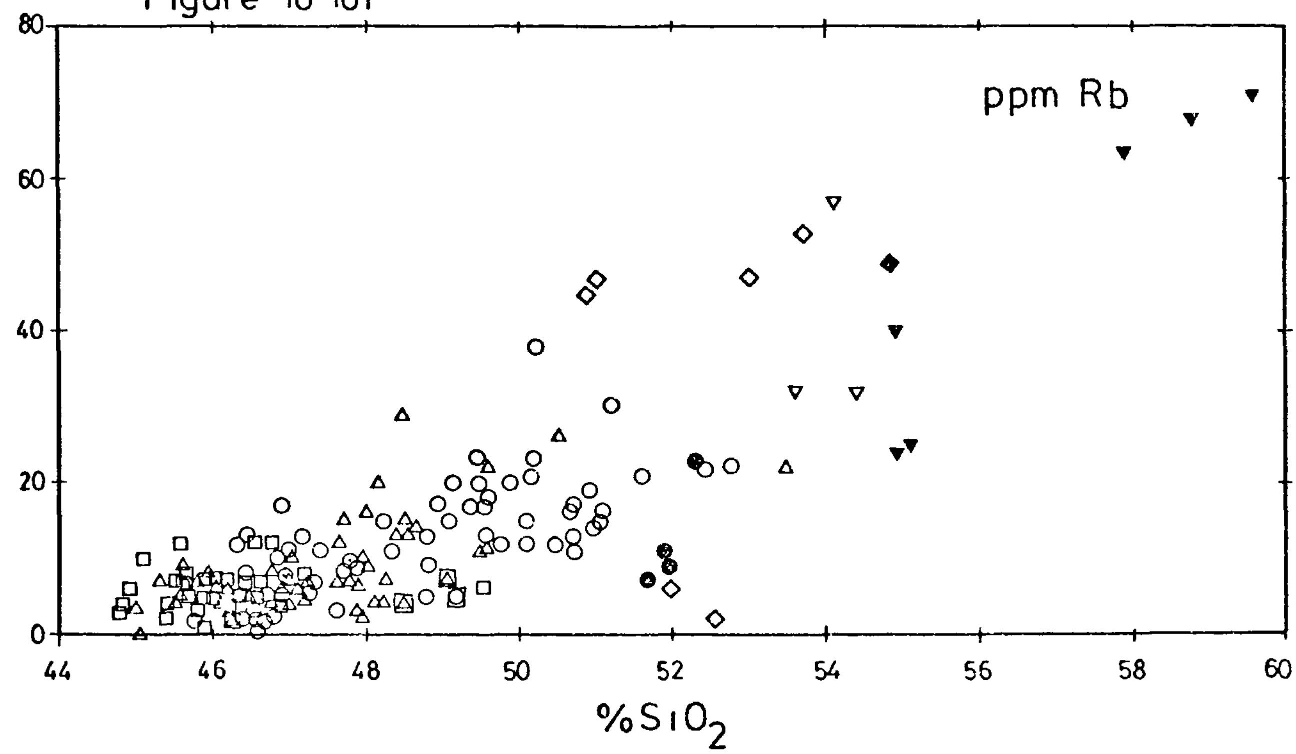


Figure 10 10g

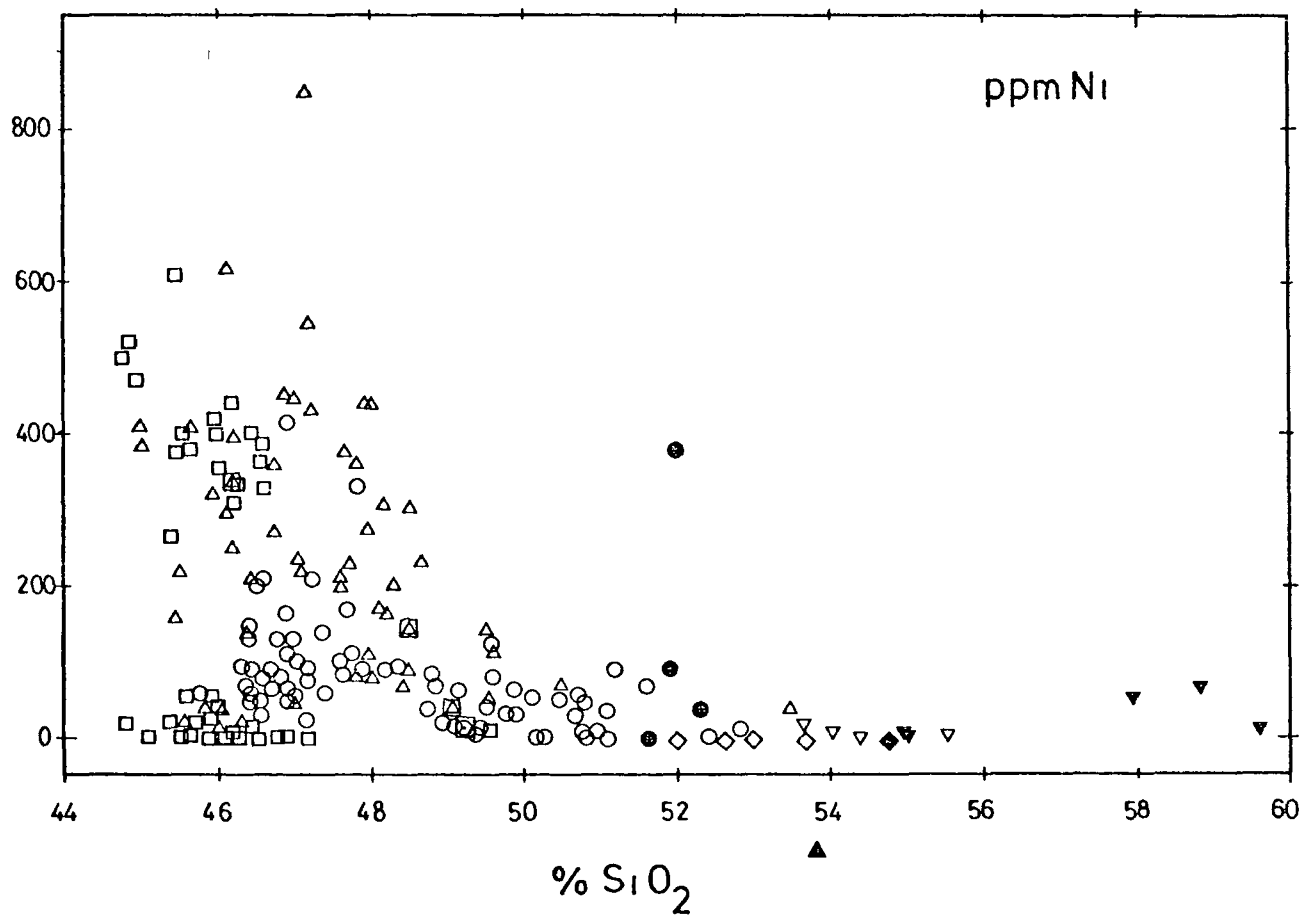


Figure 10 10h

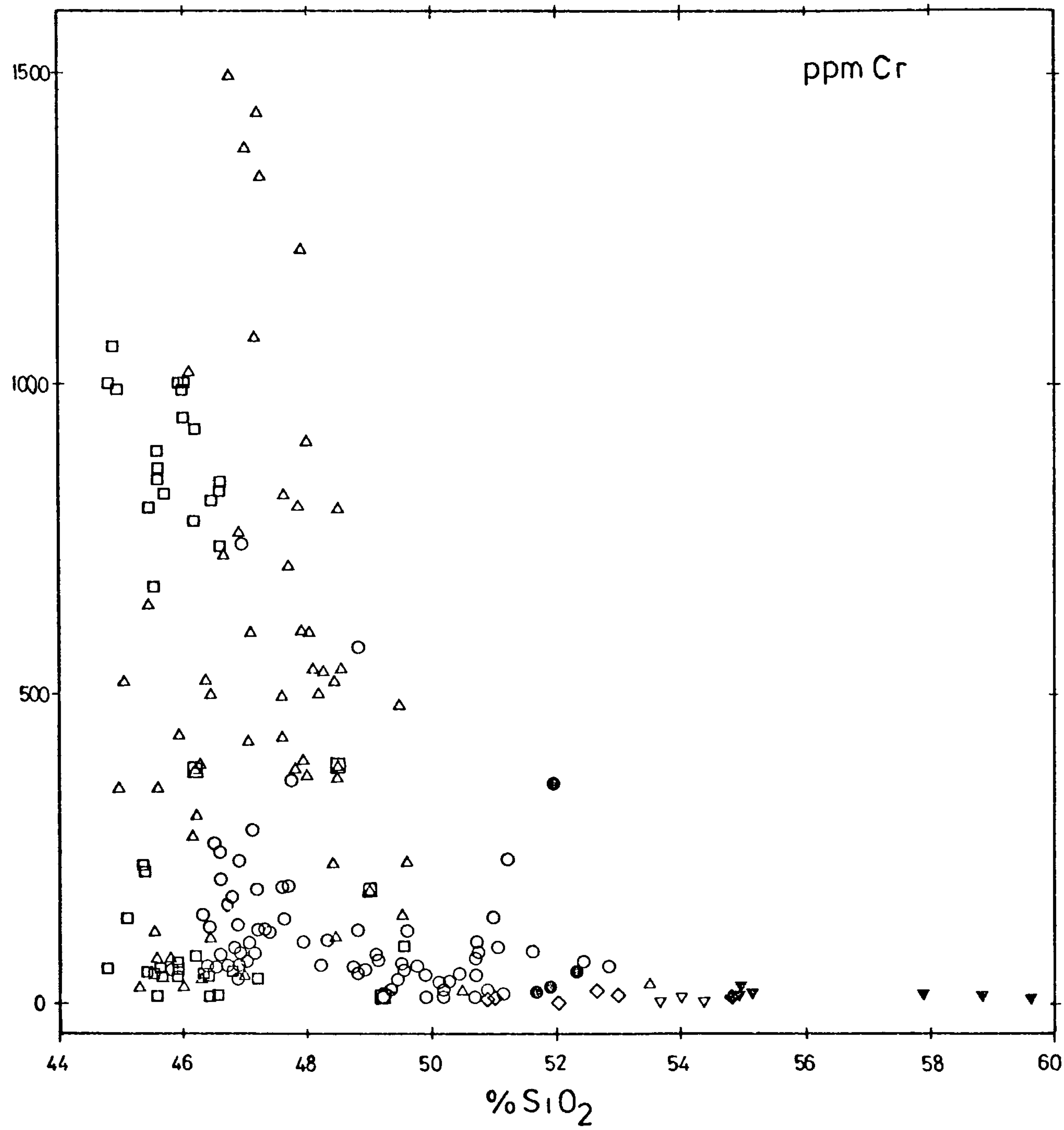


Figure 10.11

Selected Harker diagrams for aphyric and sparsely porphyritic extrusive samples. (Trace elements)

Key as for Figure 10.8

Figure 10 11a

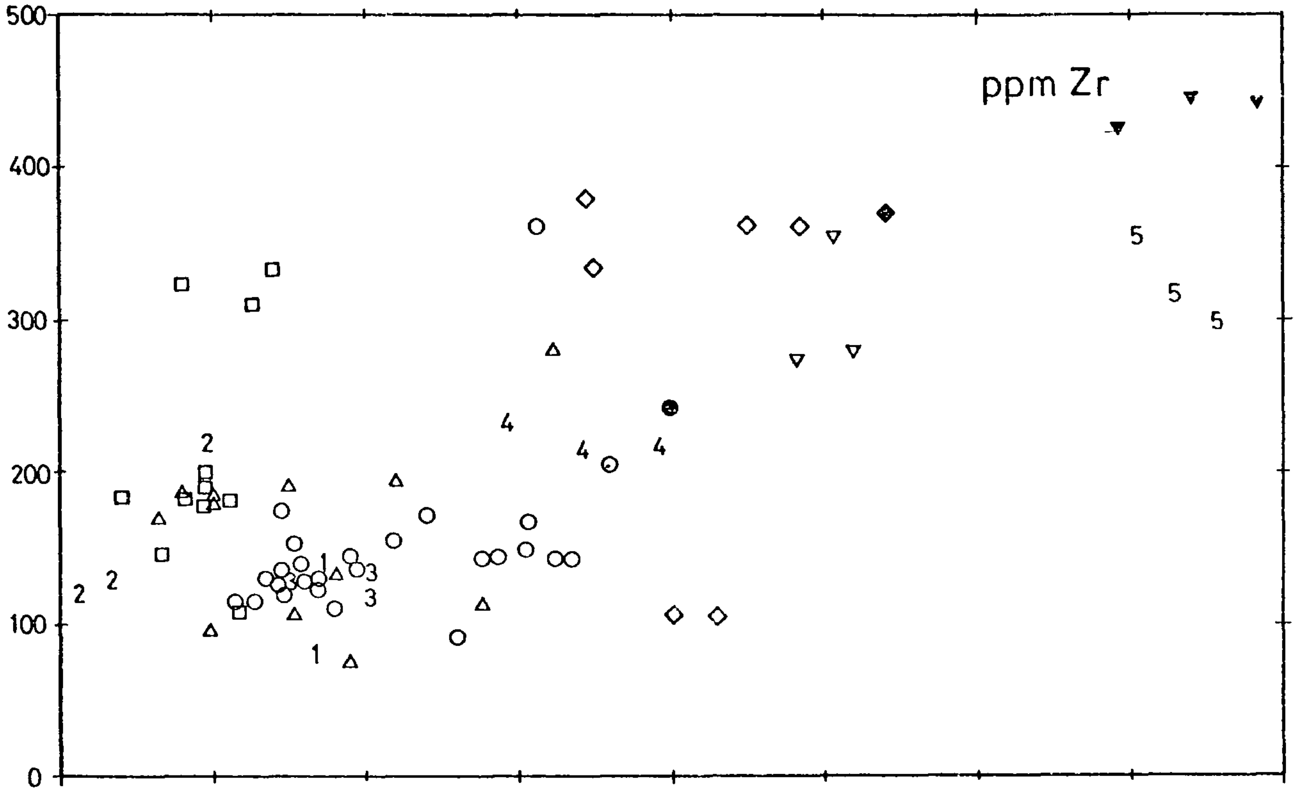


Figure 10 11b

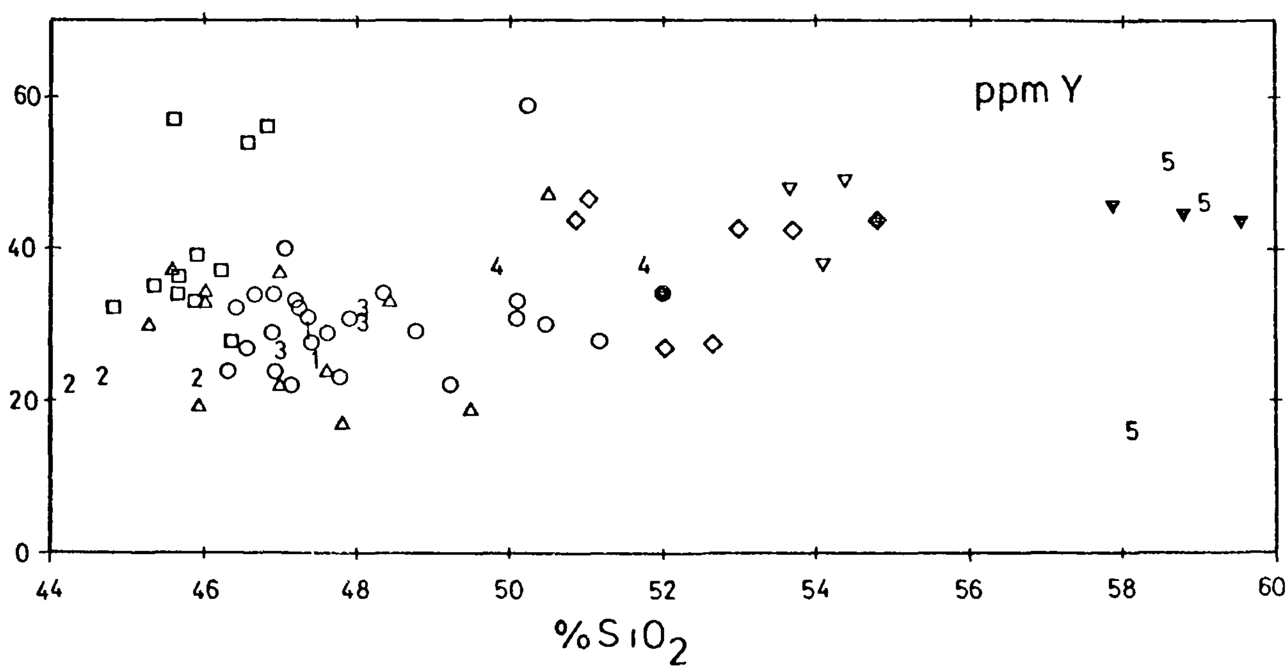


Figure 10 11c

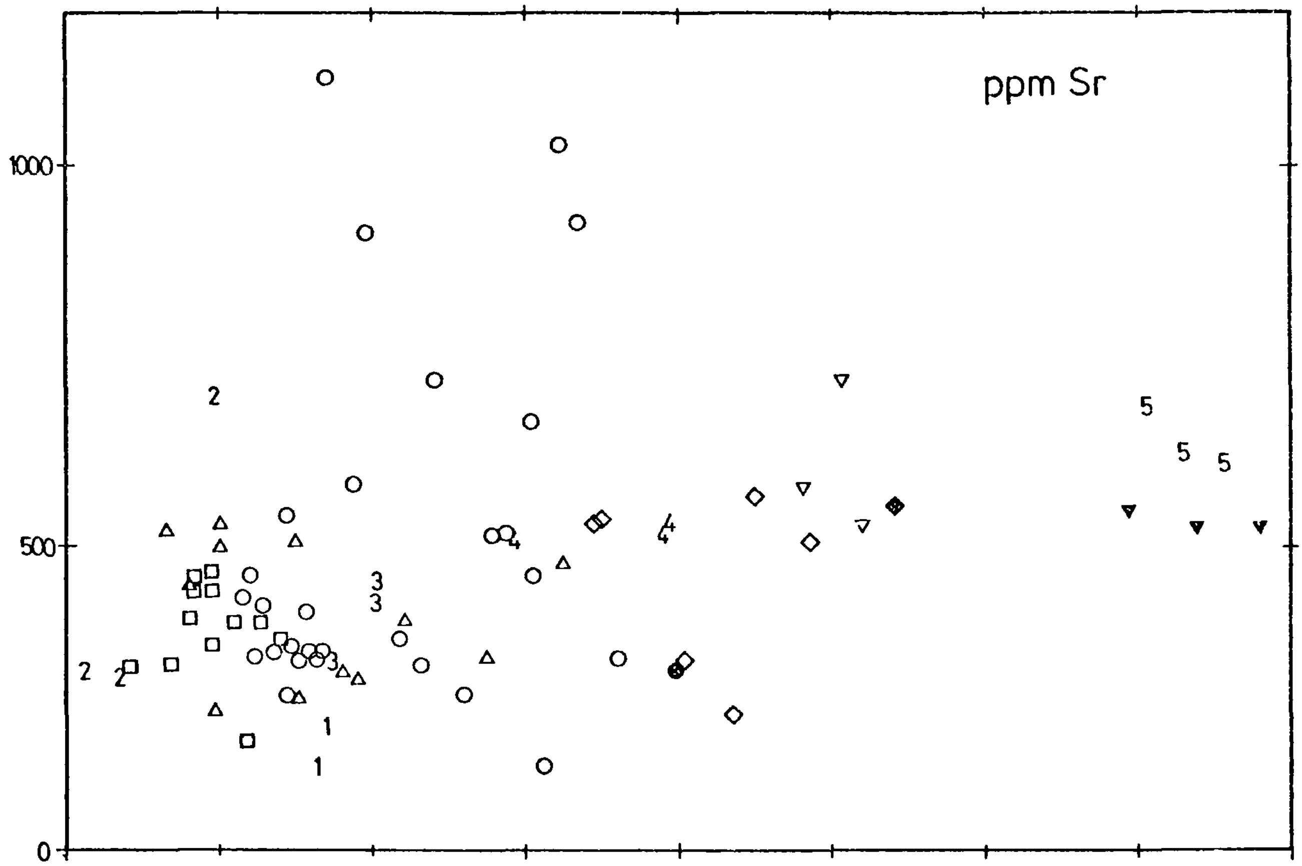


Figure 10 11d

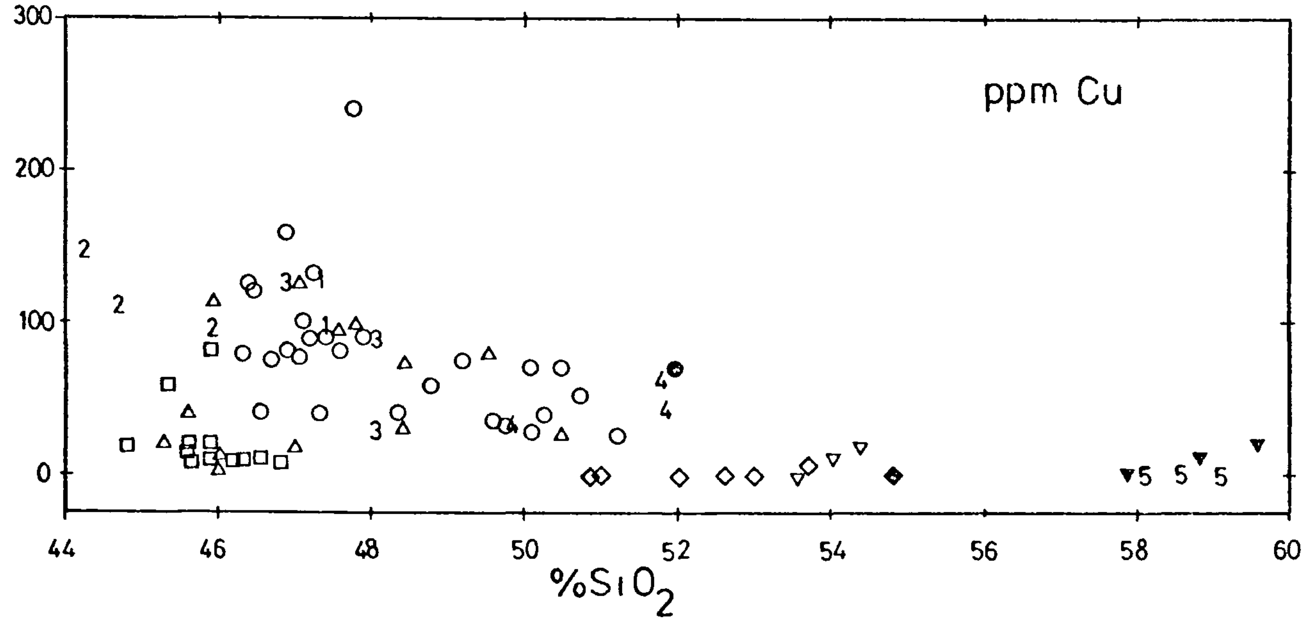


Figure 10 11e

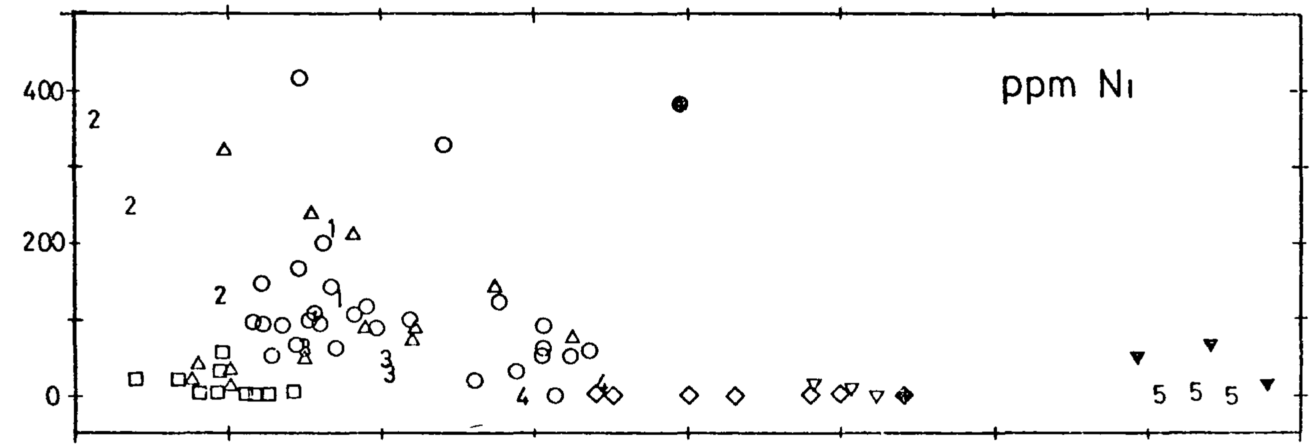


Figure 10 11f

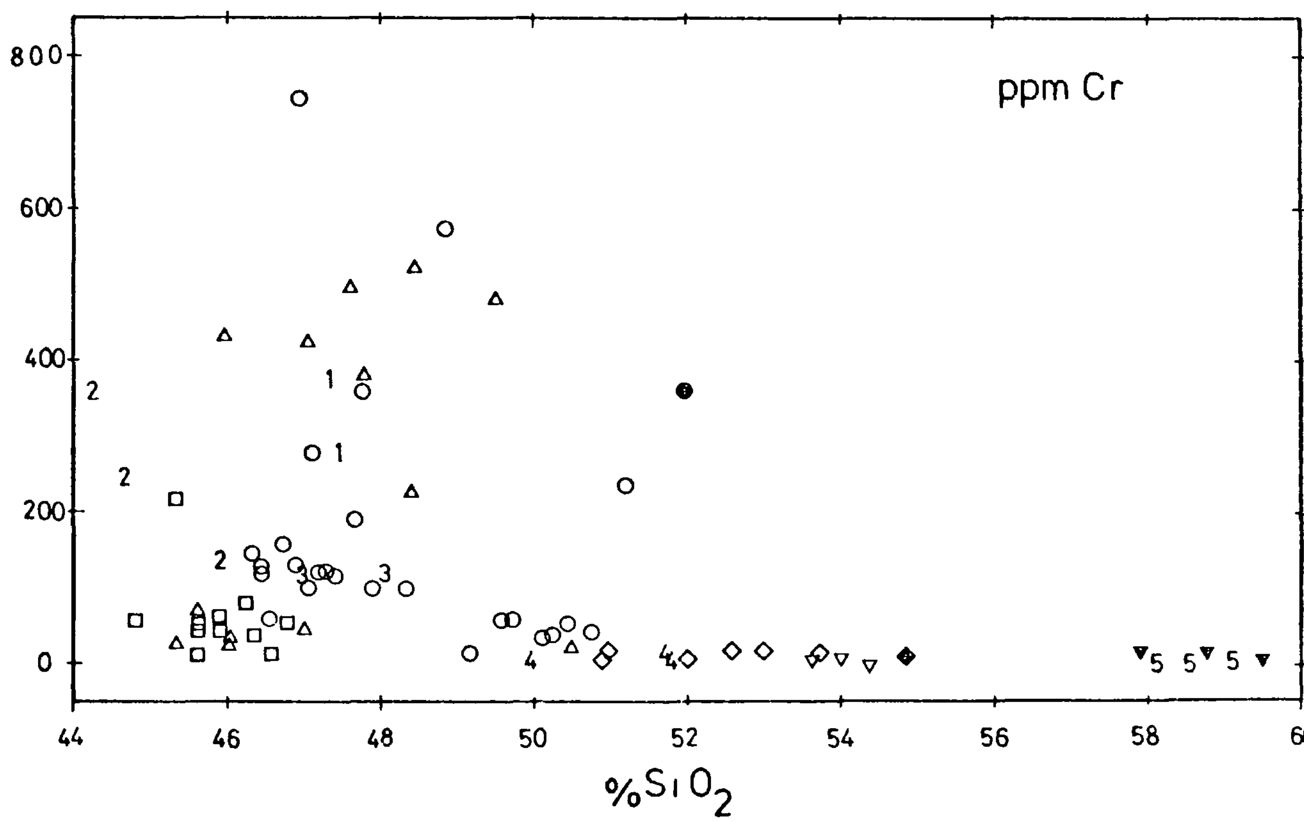


Figure 10.12

Selected harker diagrams for all fresh intrusive samples

(Trace elements)

Key as for Figure 10.9

Figure 10 12a

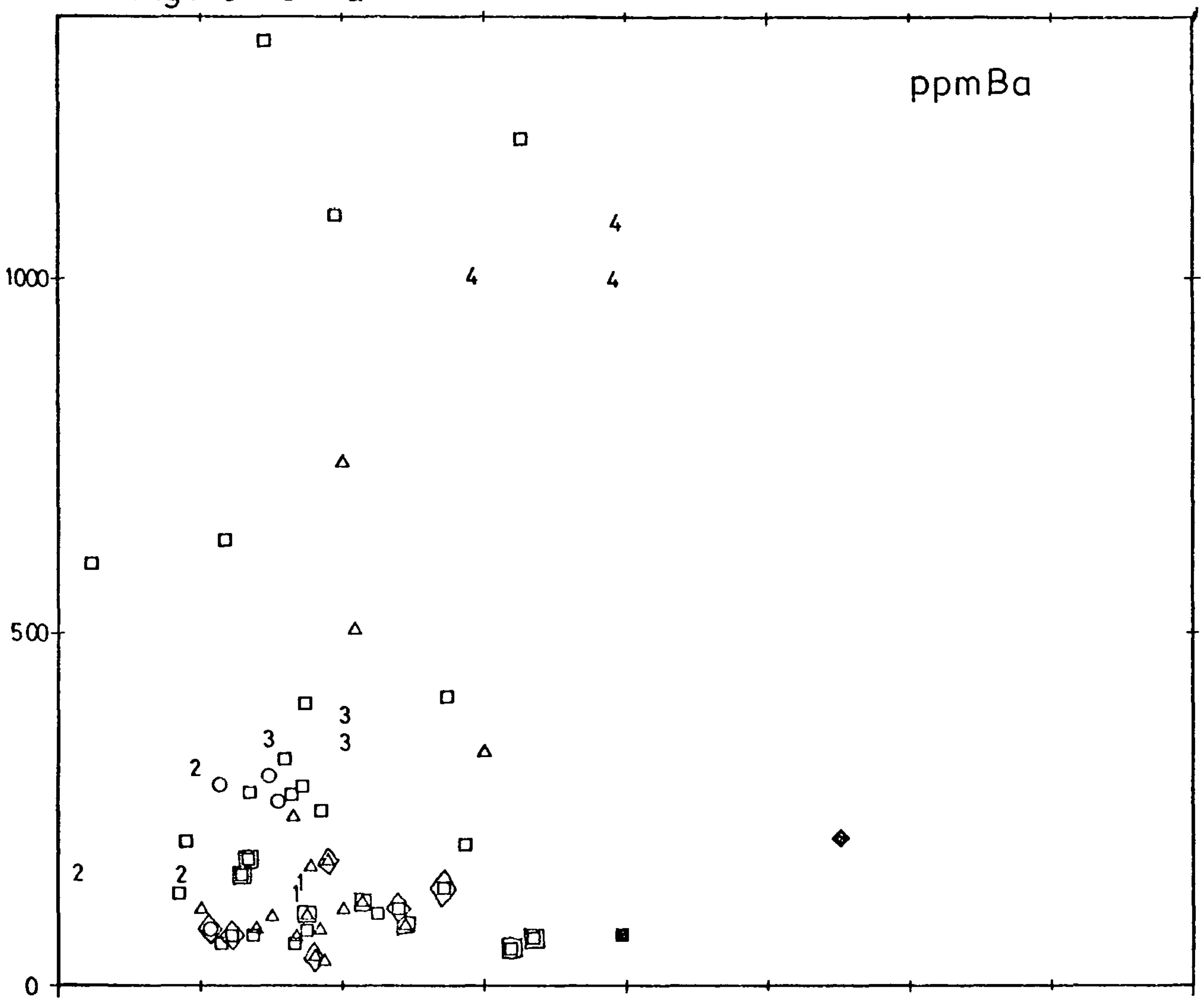


Figure 10 12b

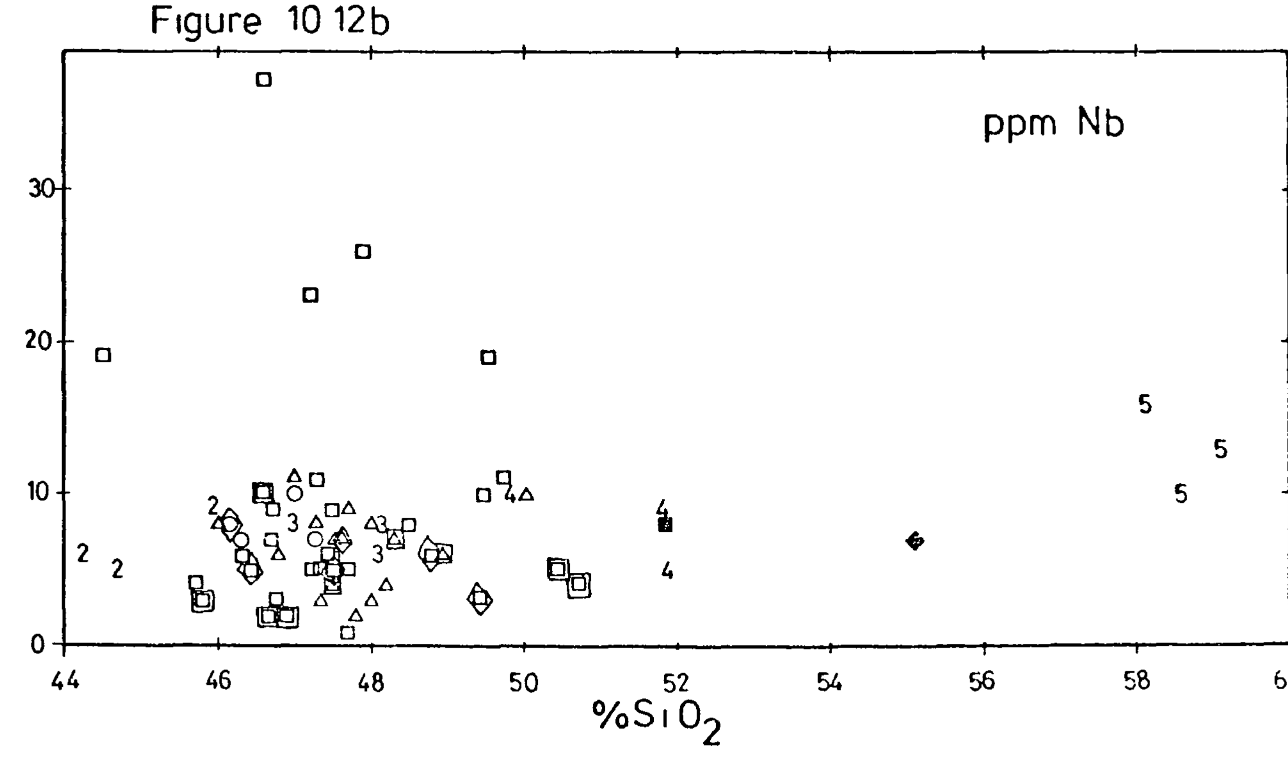


Figure 10 12c

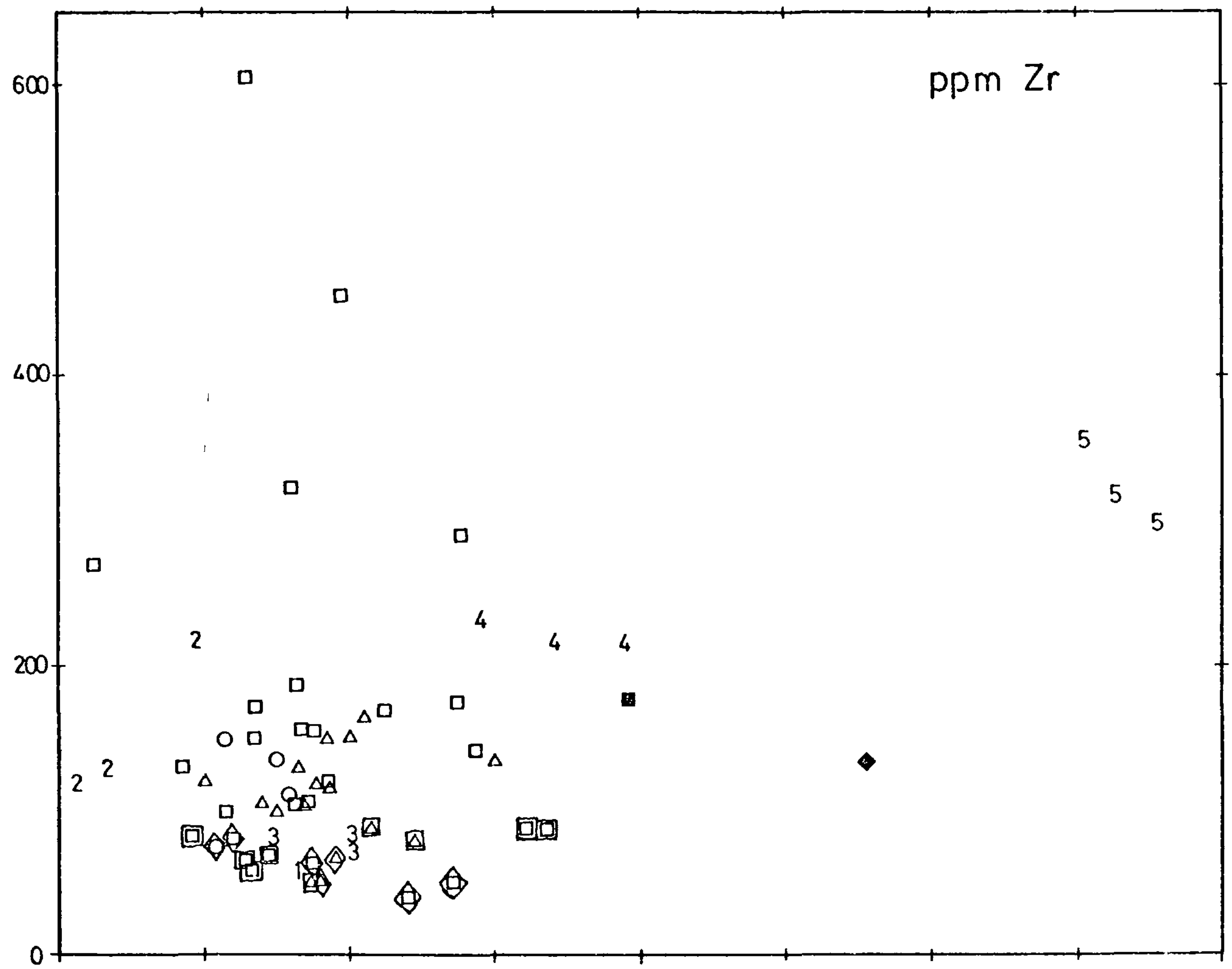


Figure 10 12d

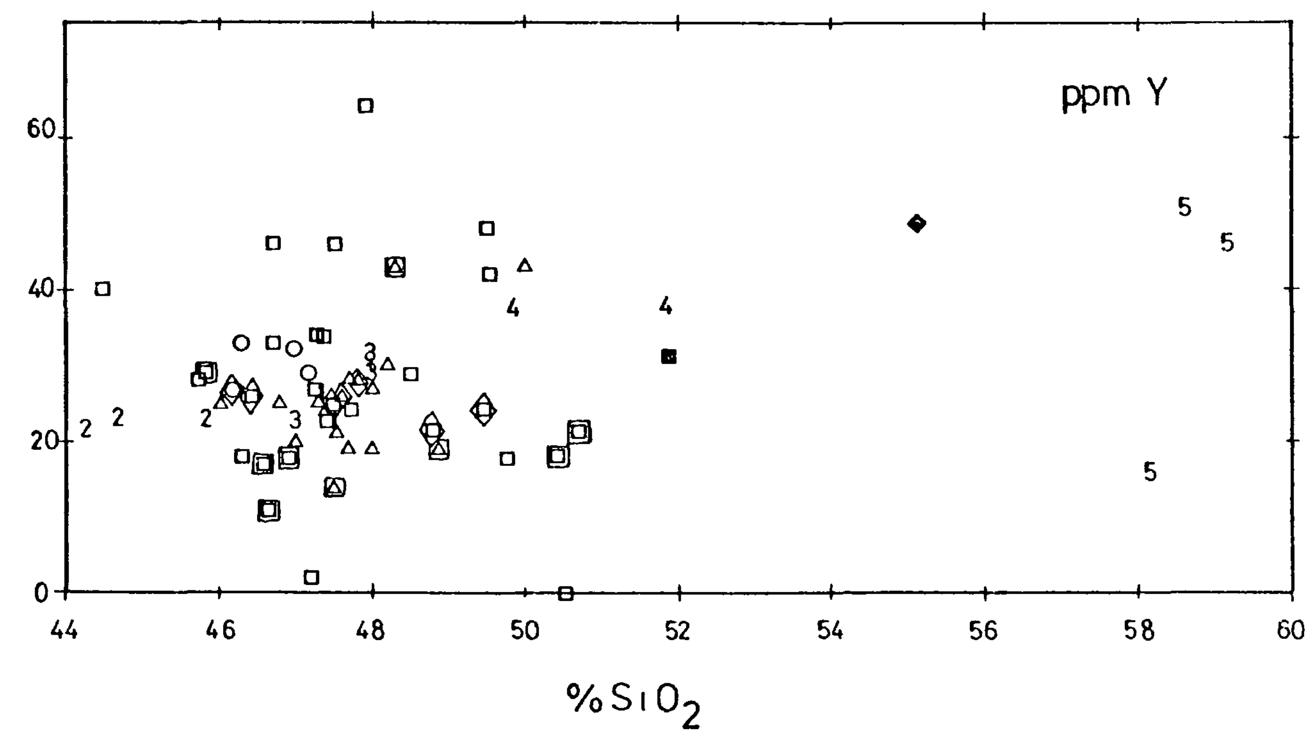


Figure 10 12e

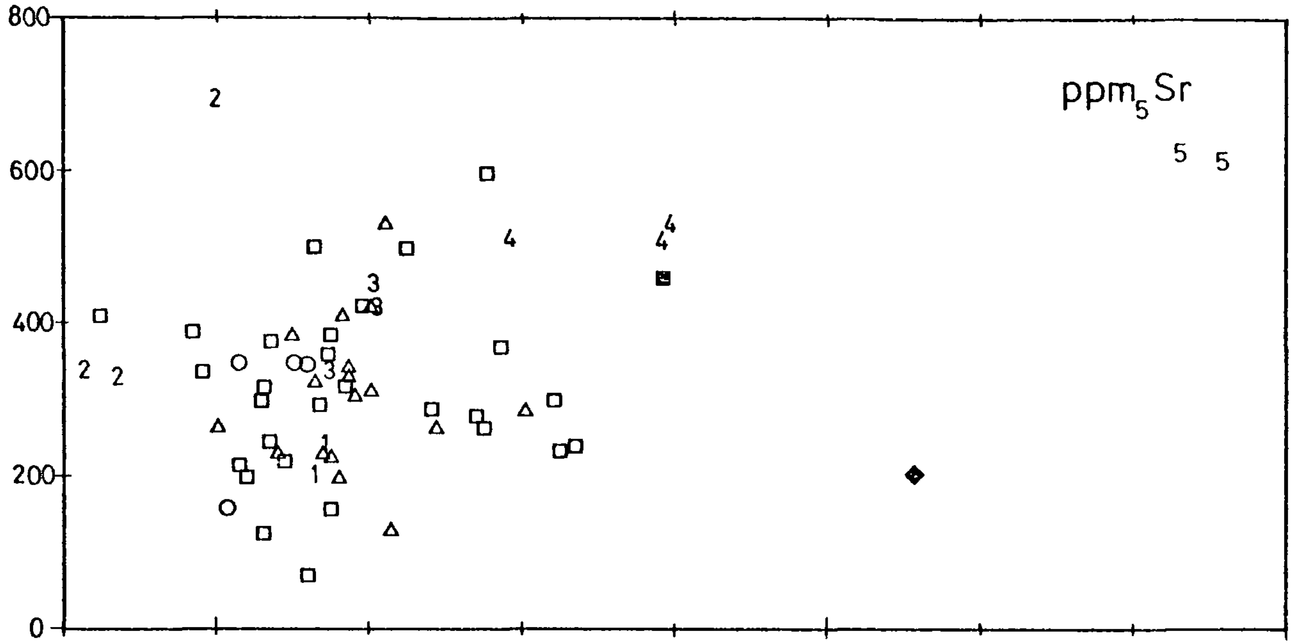


Figure 10 12f

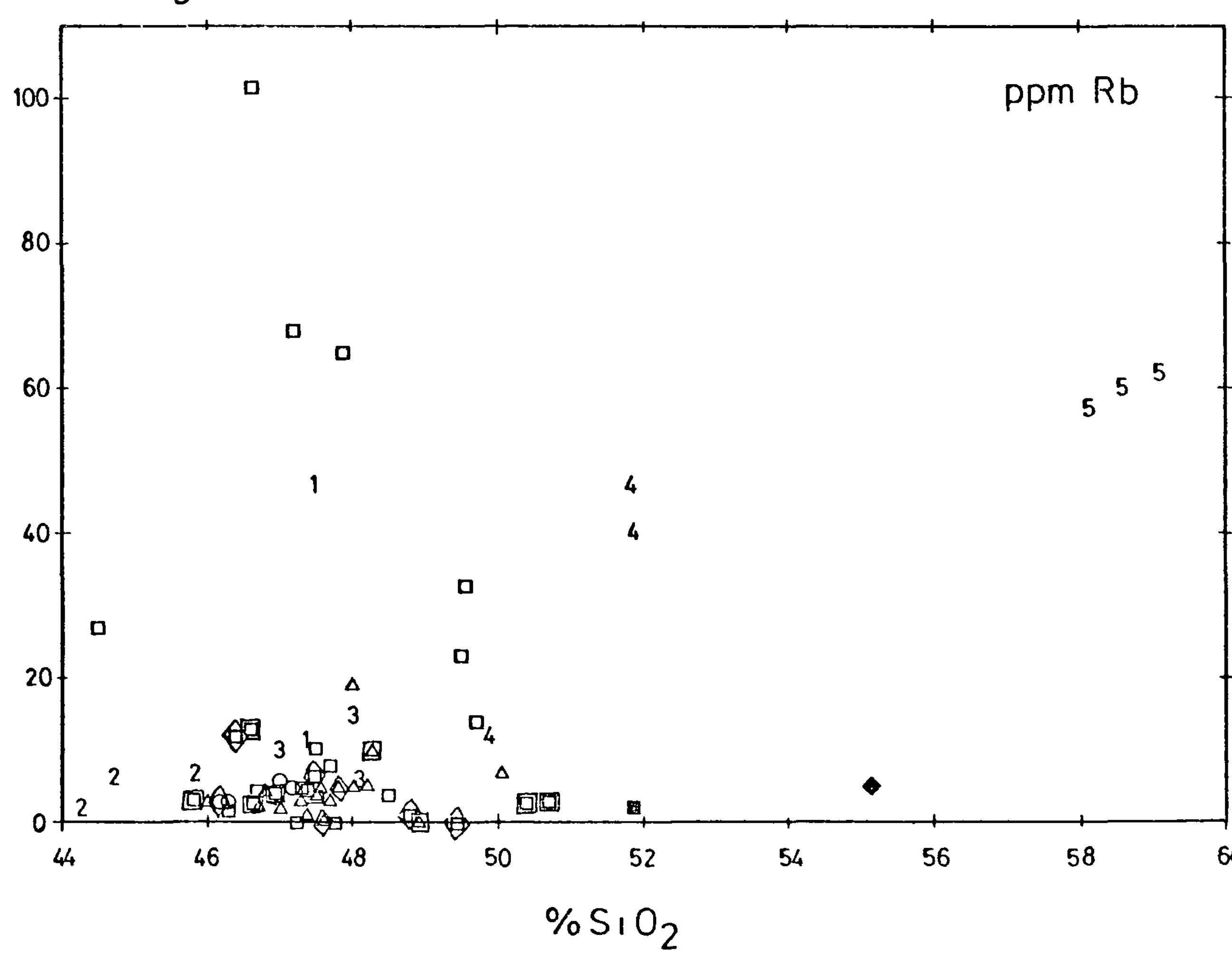


Figure 10 12g

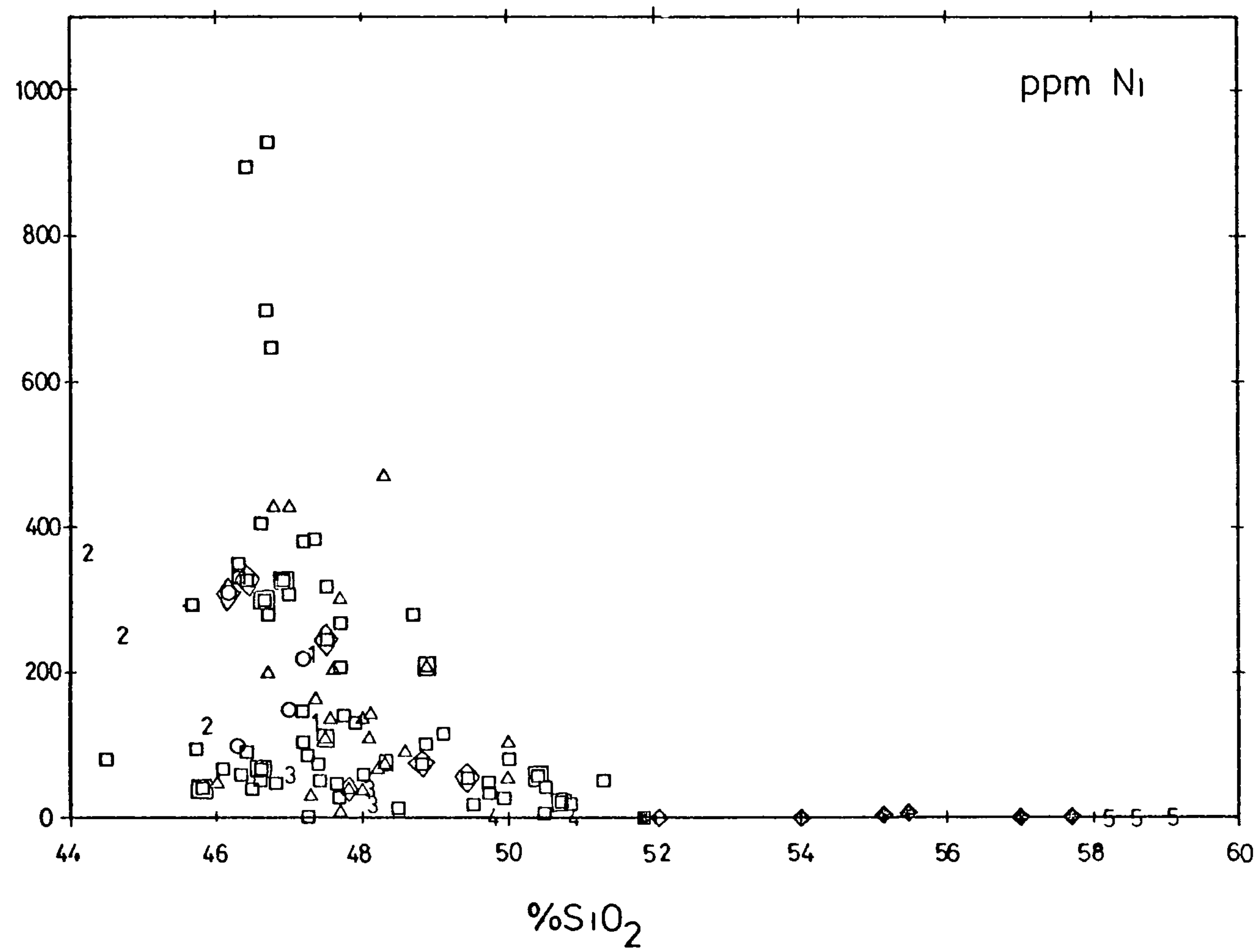


Figure 10 12h

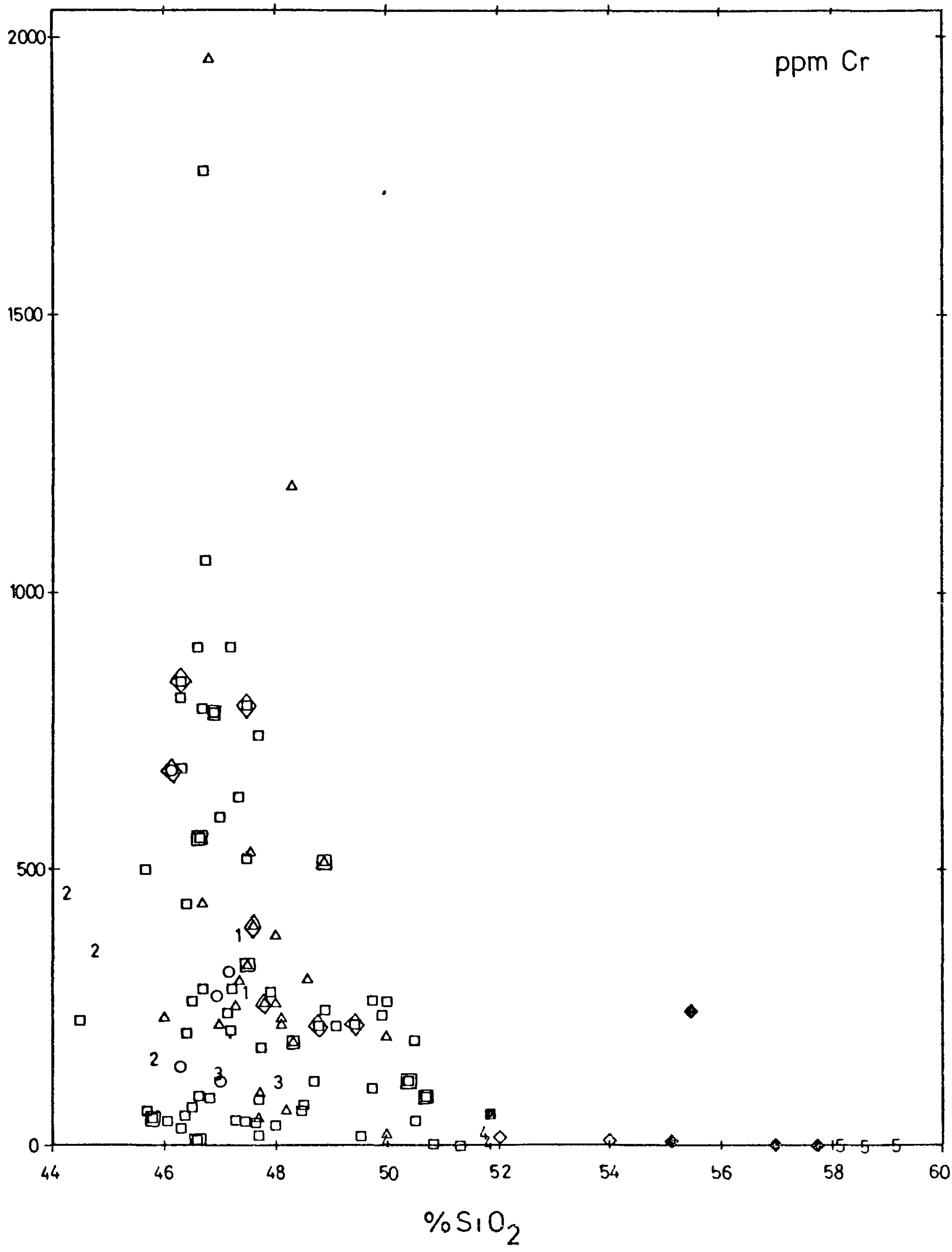
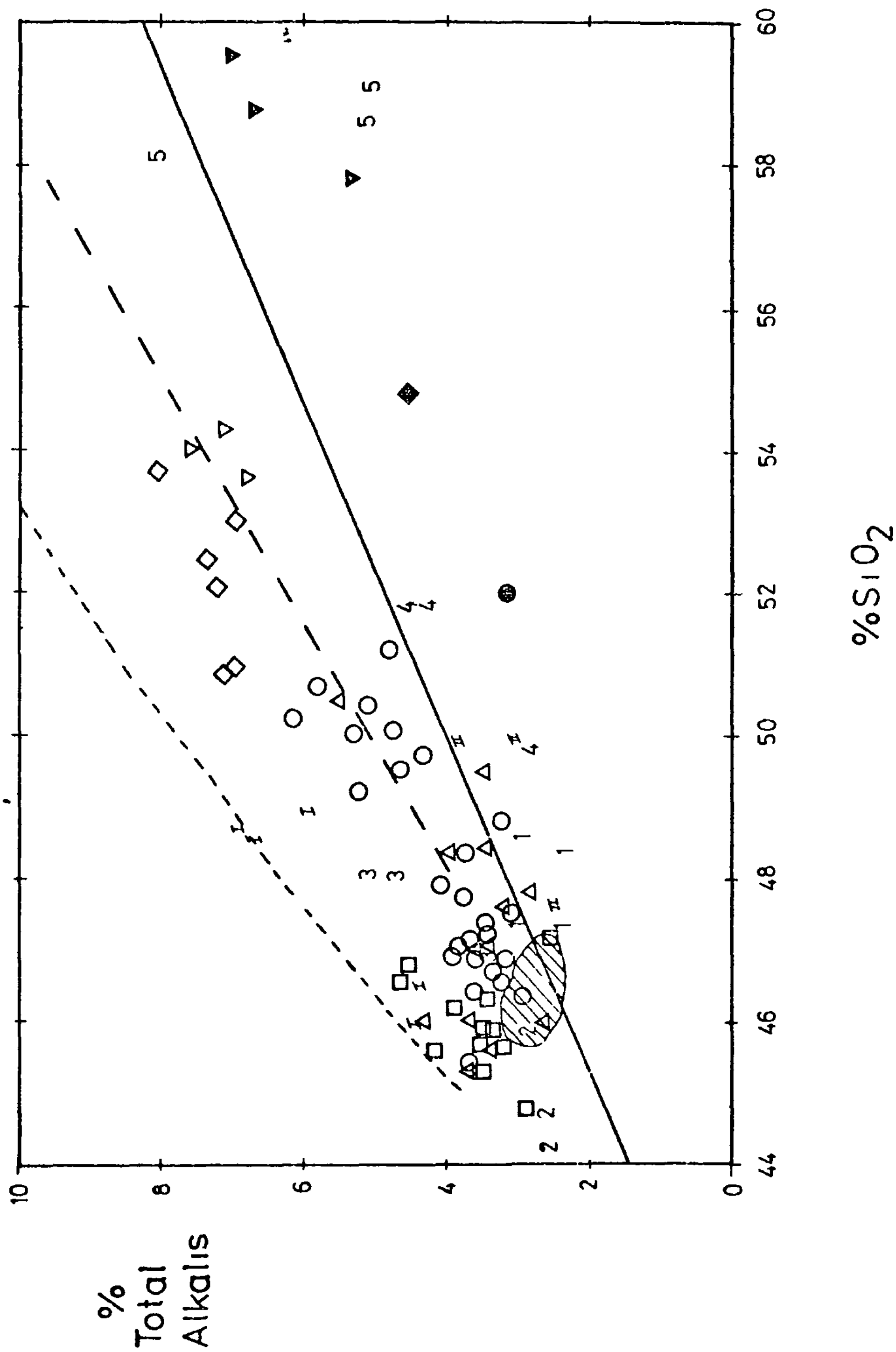


Figure 10.13

Total alkalis versus silica for aphyric and sparsely porphyritic samples.

Figure 10.13a Extrusive samples



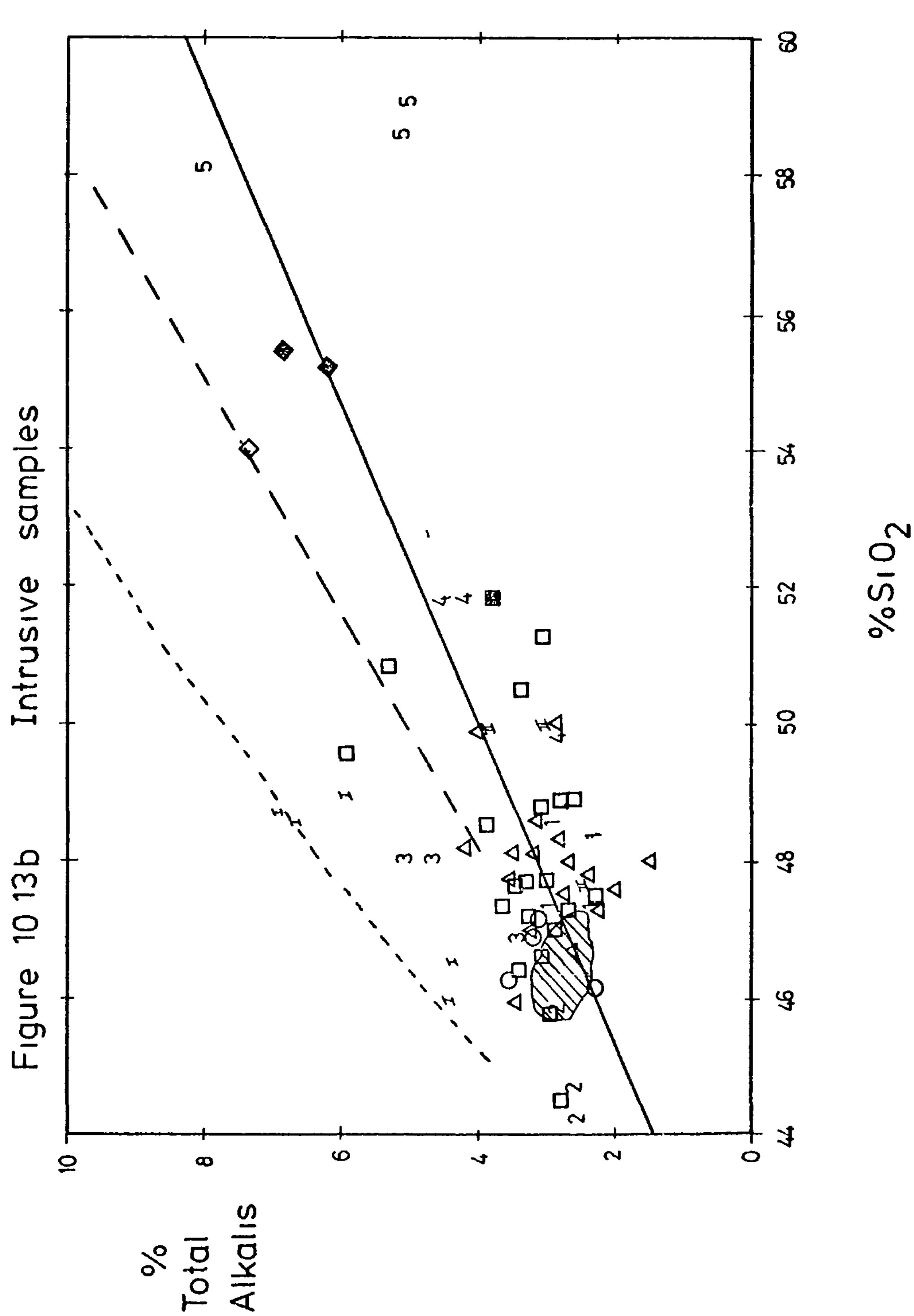


Figure 10 13b
Intrusive samples
%
Total
Alkalis
%SiO2
0
2
4
6
8
10
44
46
48
50
52
54
56
58
60

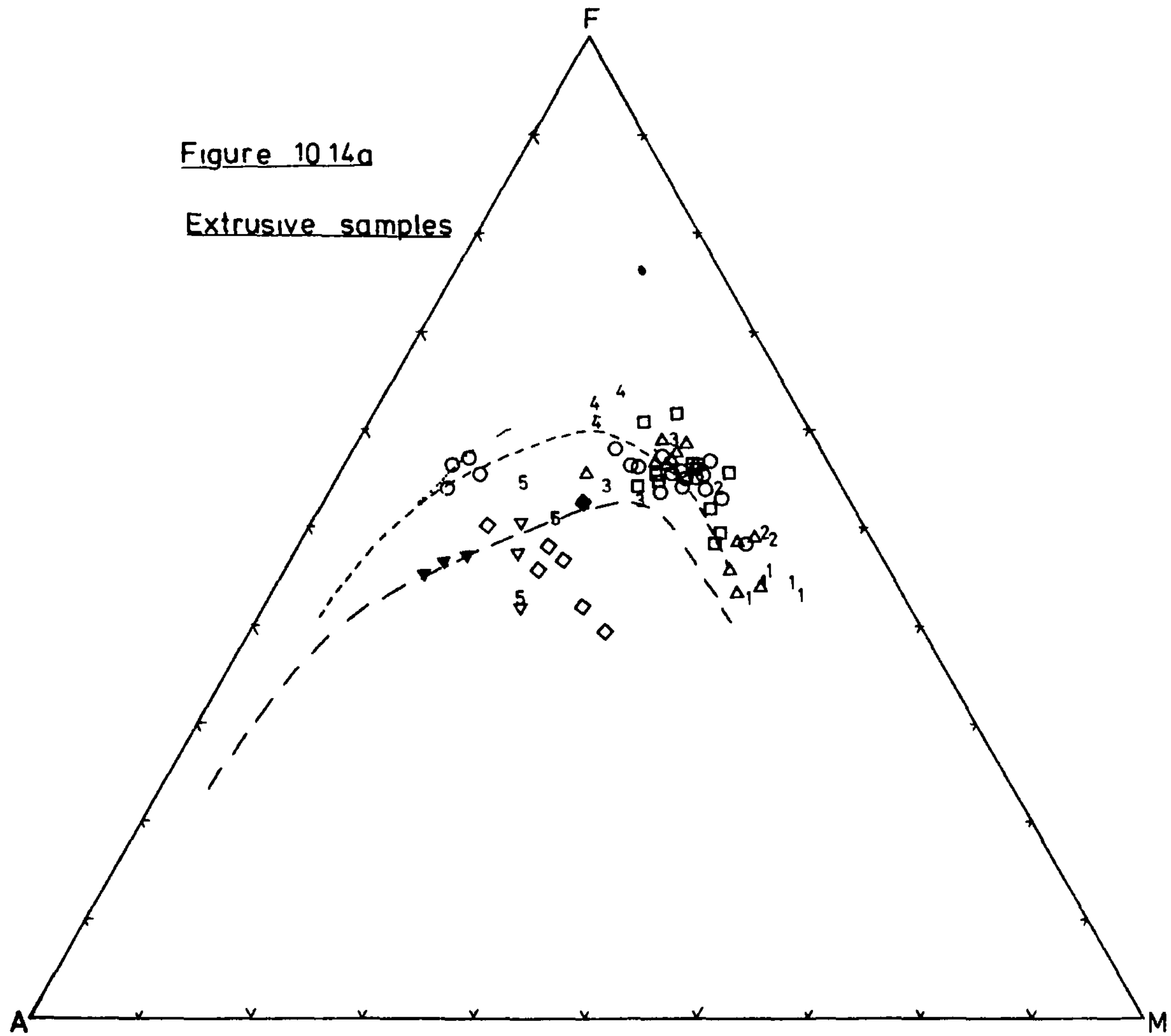
Figure 10.14

Aphyric and sparsely porphyritic samples plotted on AFM diagram.

NB. $F = FeO + Fe_2O_3$

Figure 10.14a

Extrusive samples



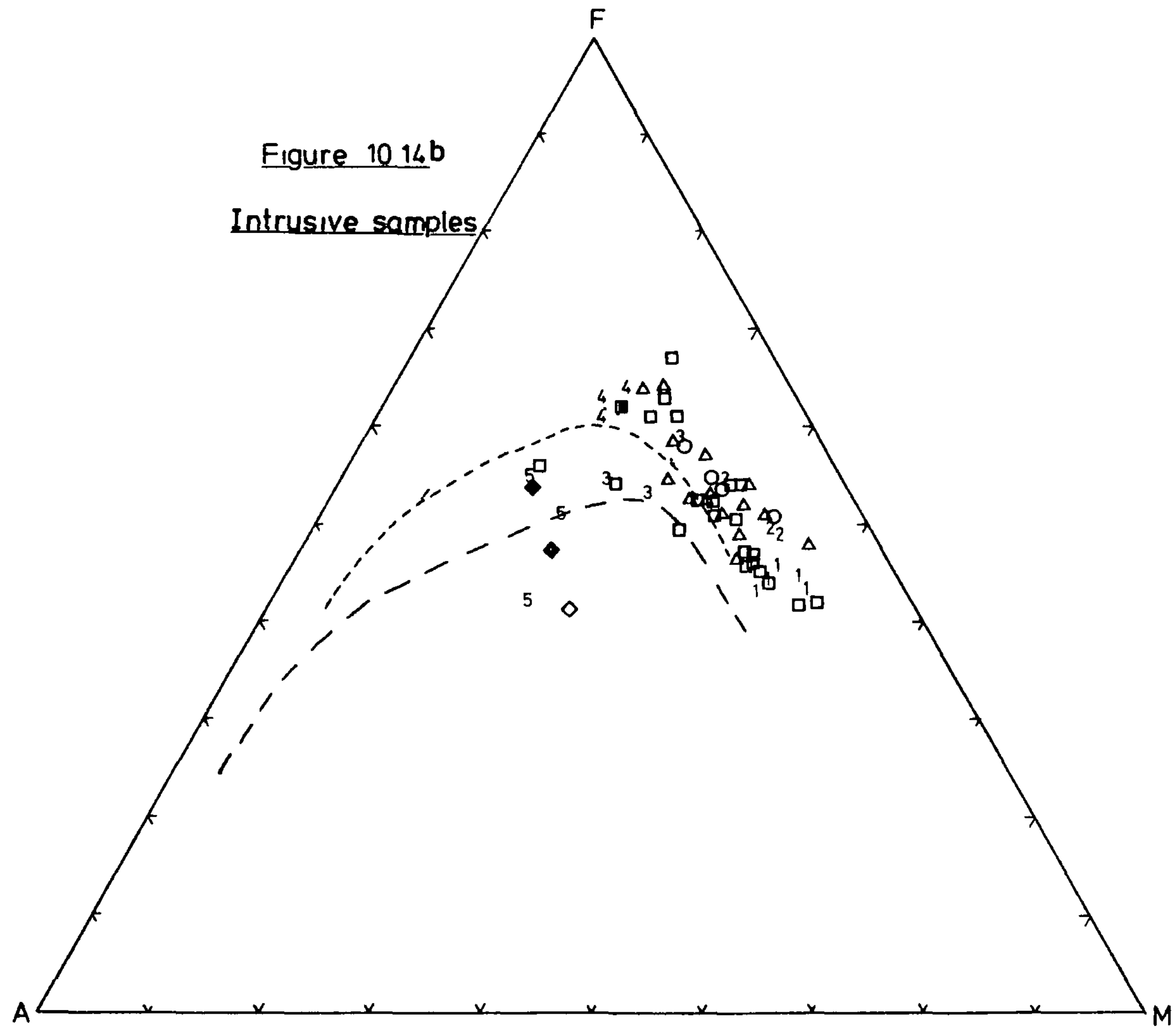


Figure 10.14b

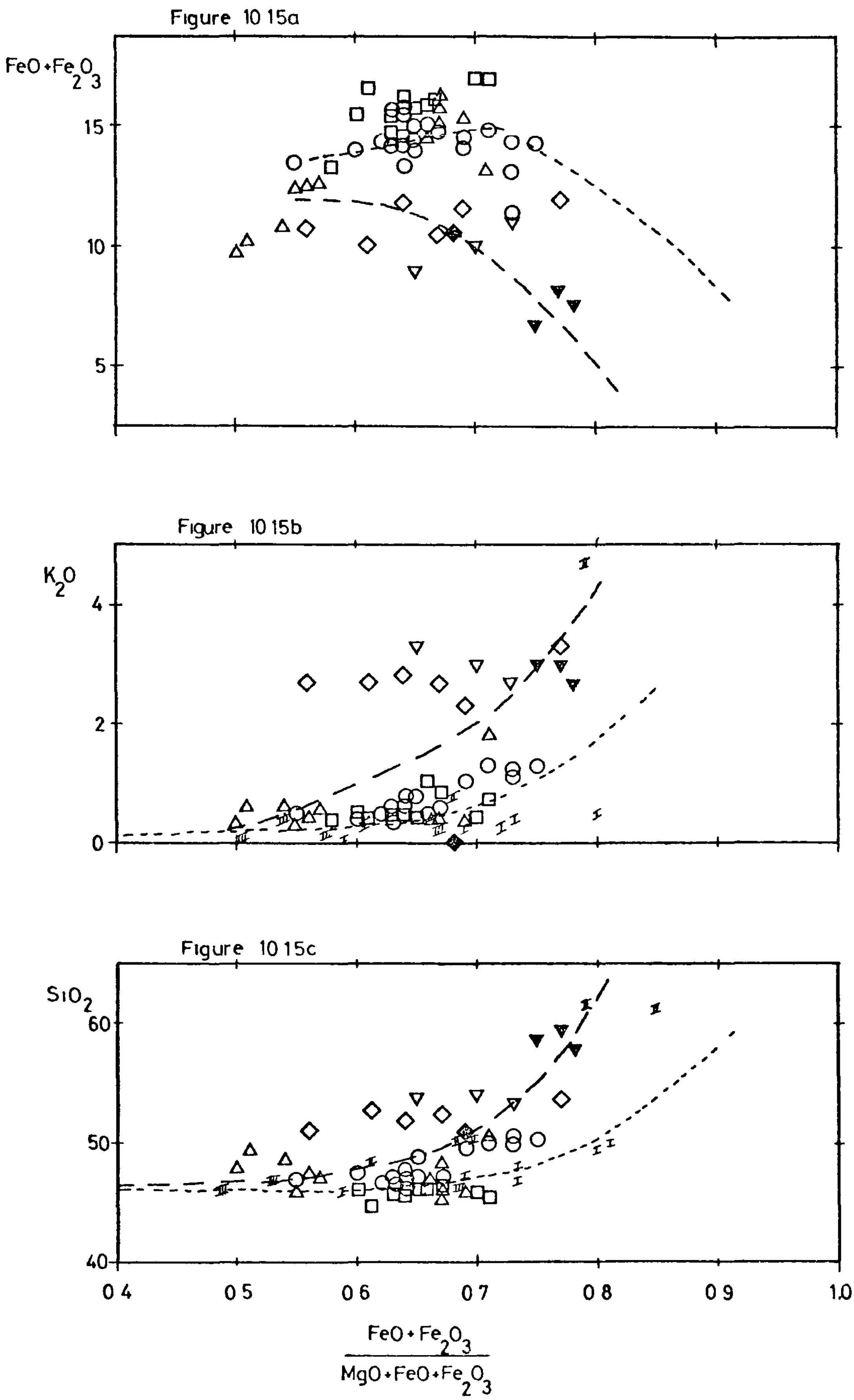
Intrusive samples

Figure 10.15

Selected oxides plotted against iron-magnesium ratio.

(Aphyric and sparsely porphyritic samples)

Extrusive samples



Intrusive samples

Figure 10 15d

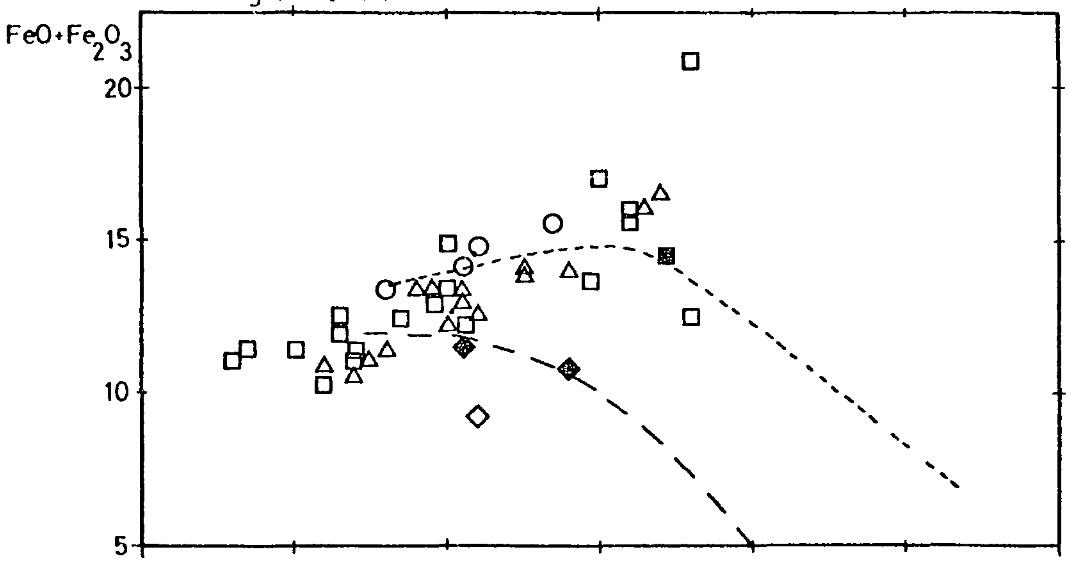


Figure 10 15e

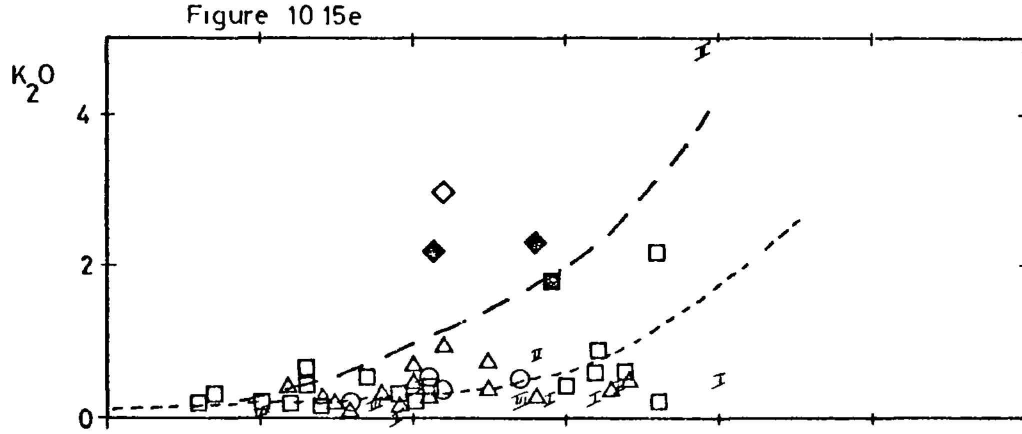


Figure 10 15f

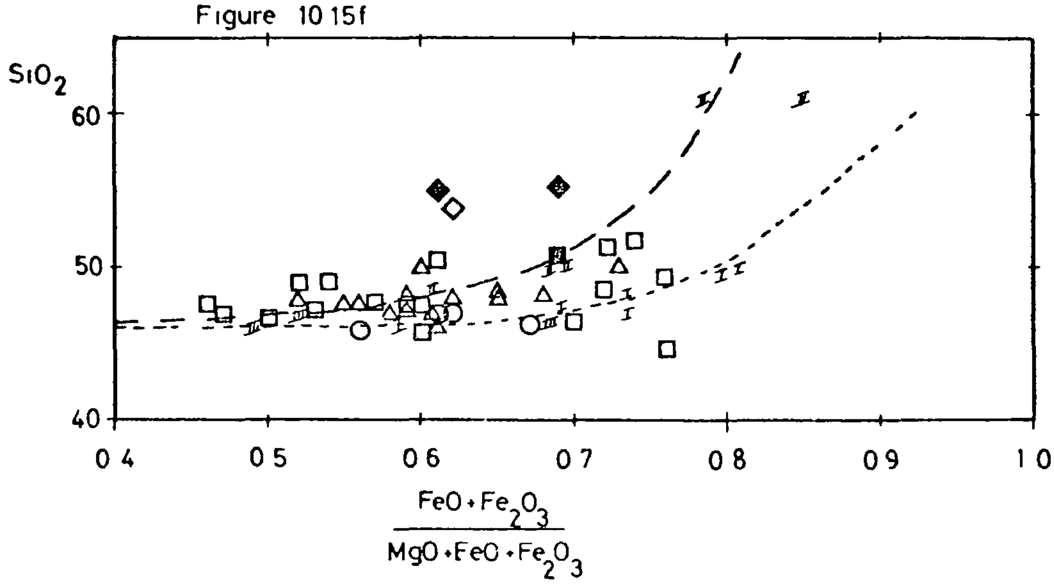


Figure 10.16

Plot of K_2O against Na_2O for aphyric and sparsely porphyritic samples.

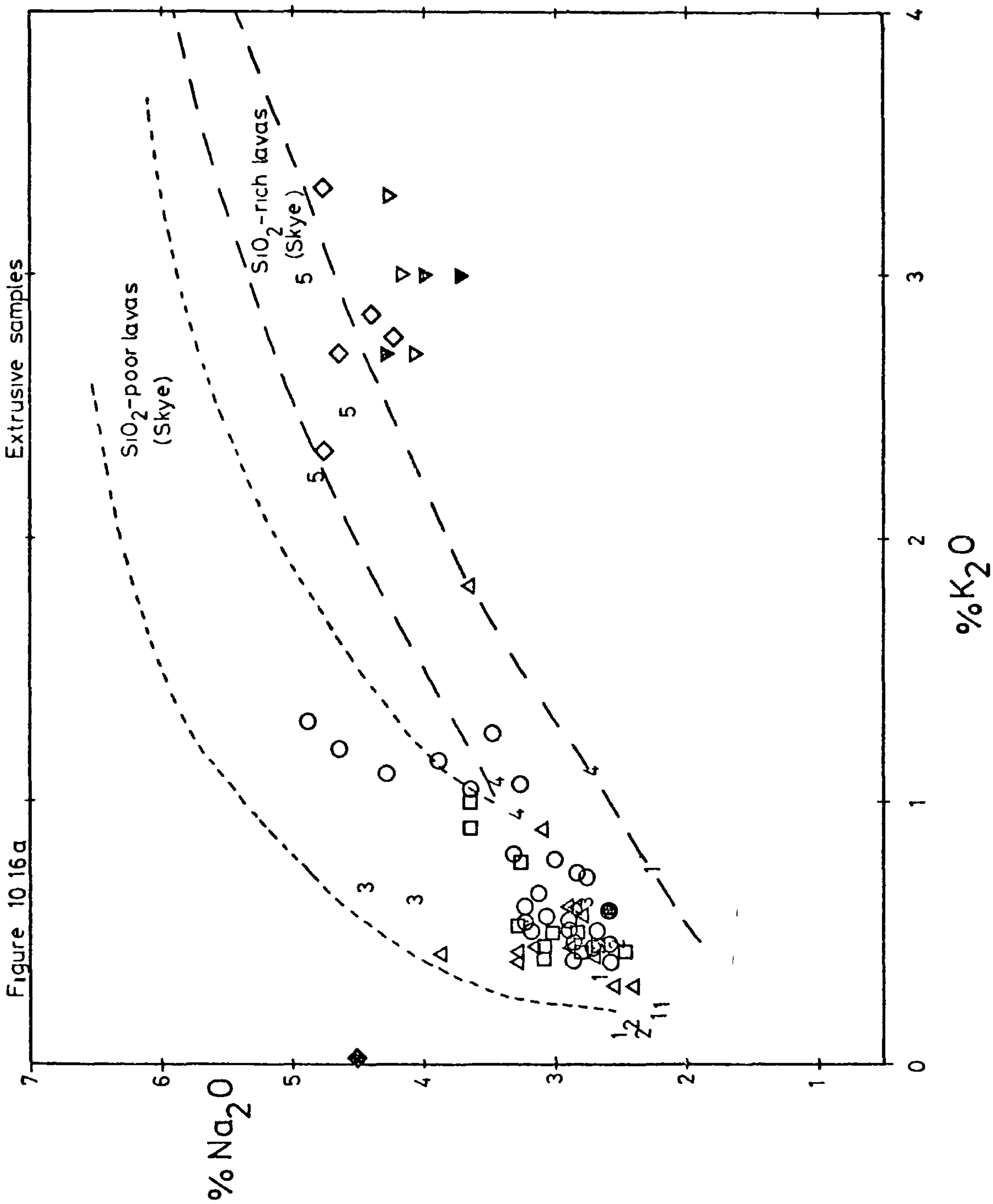


Figure 10 16a

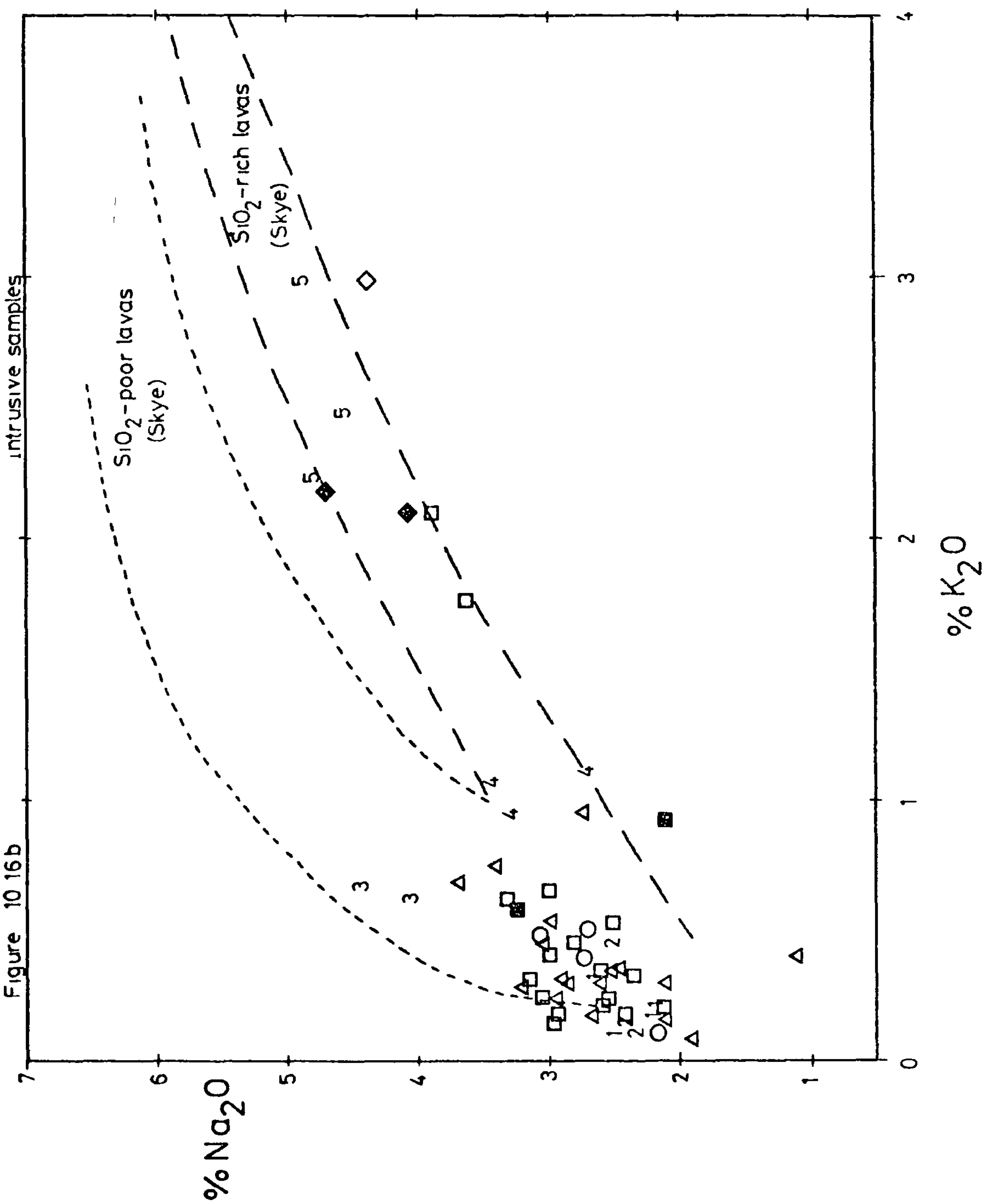


Figure 10.16b
intrusive samples
SiO_2-poor lavas (Skye)
SiO_2-rich lavas (Skye)
% Na_2O
% K_2O

Figure 10.17

Selected major and trace elements plotted against Zr.

(Aphyric and sparsely porphyritic samples only)

Figure 10 17a Extrusives

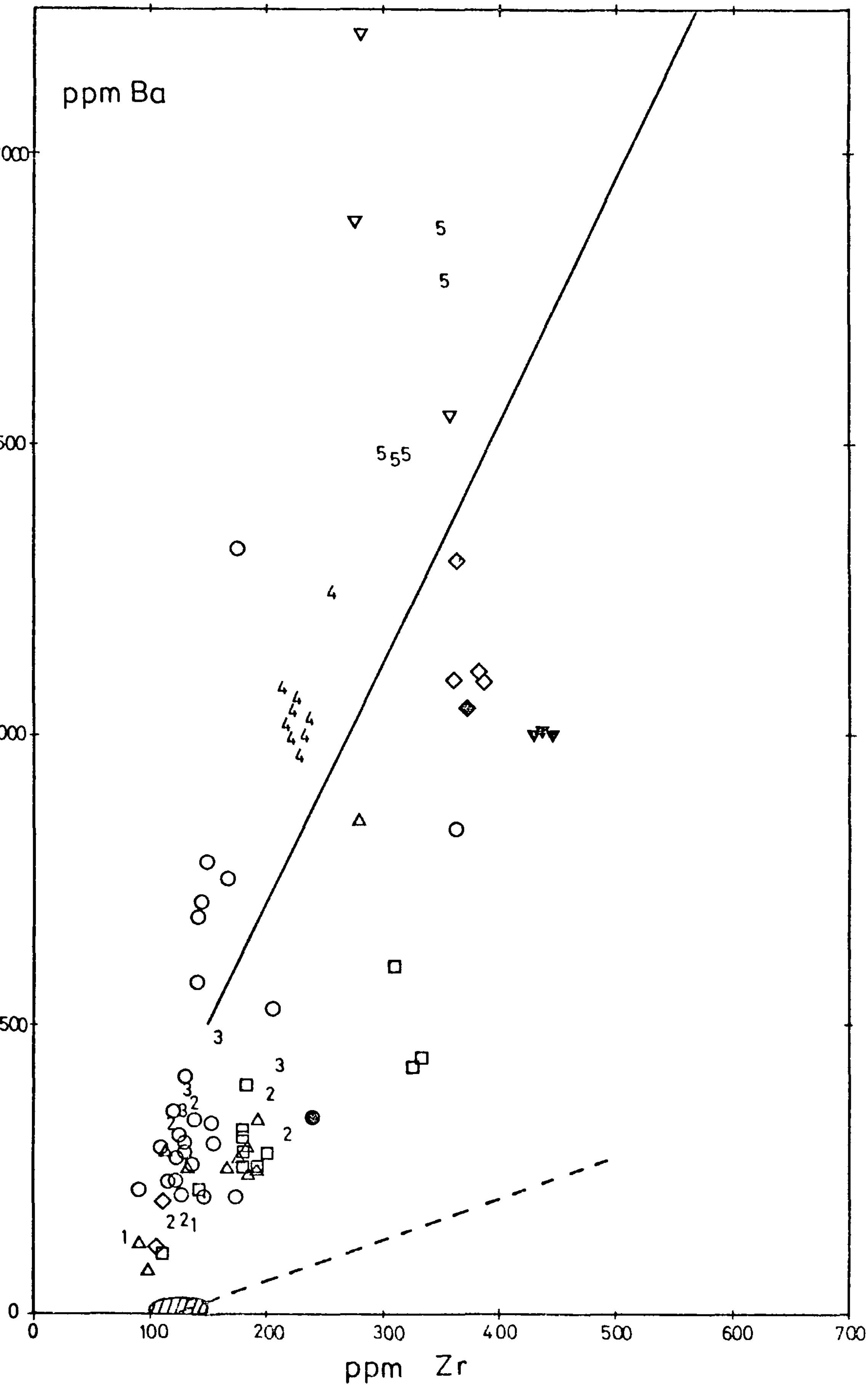


Figure 10 17b Extrusives

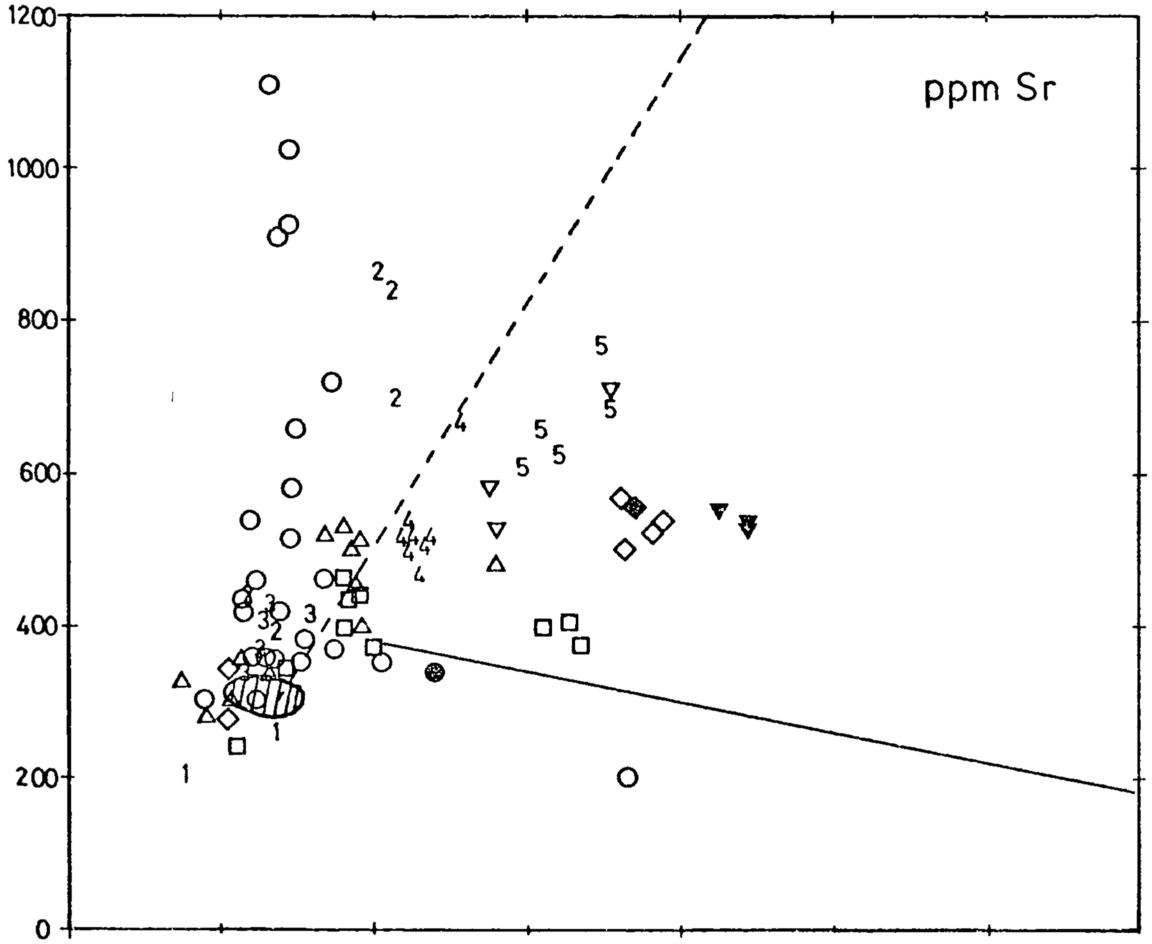


Figure 10 17c Extrusives

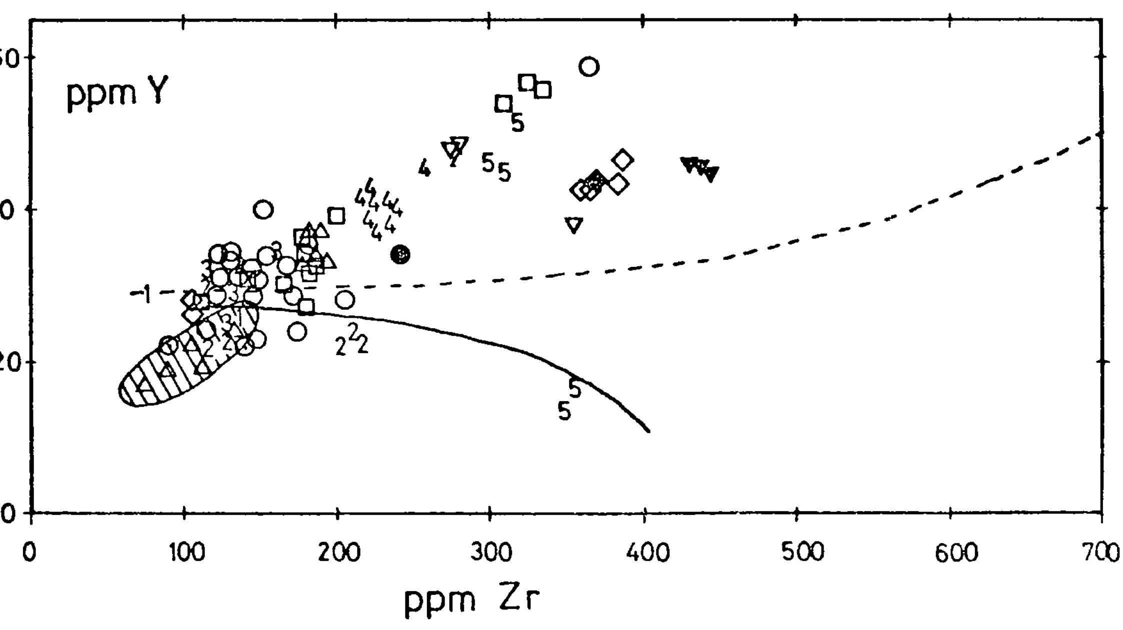
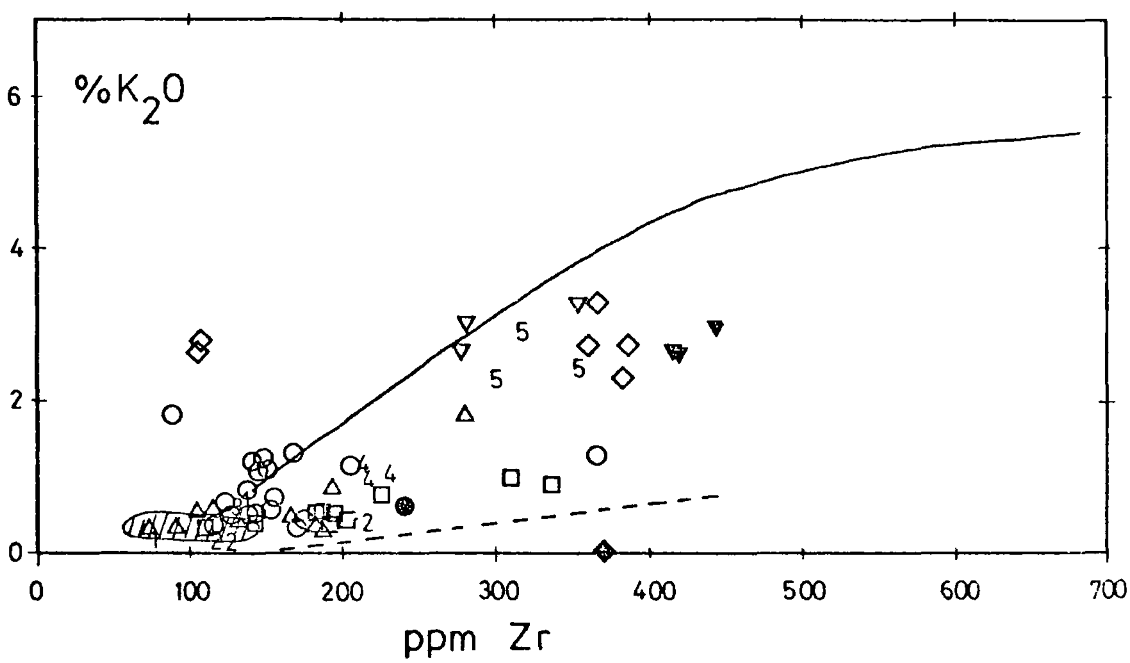


Figure 10 17d Extrusives



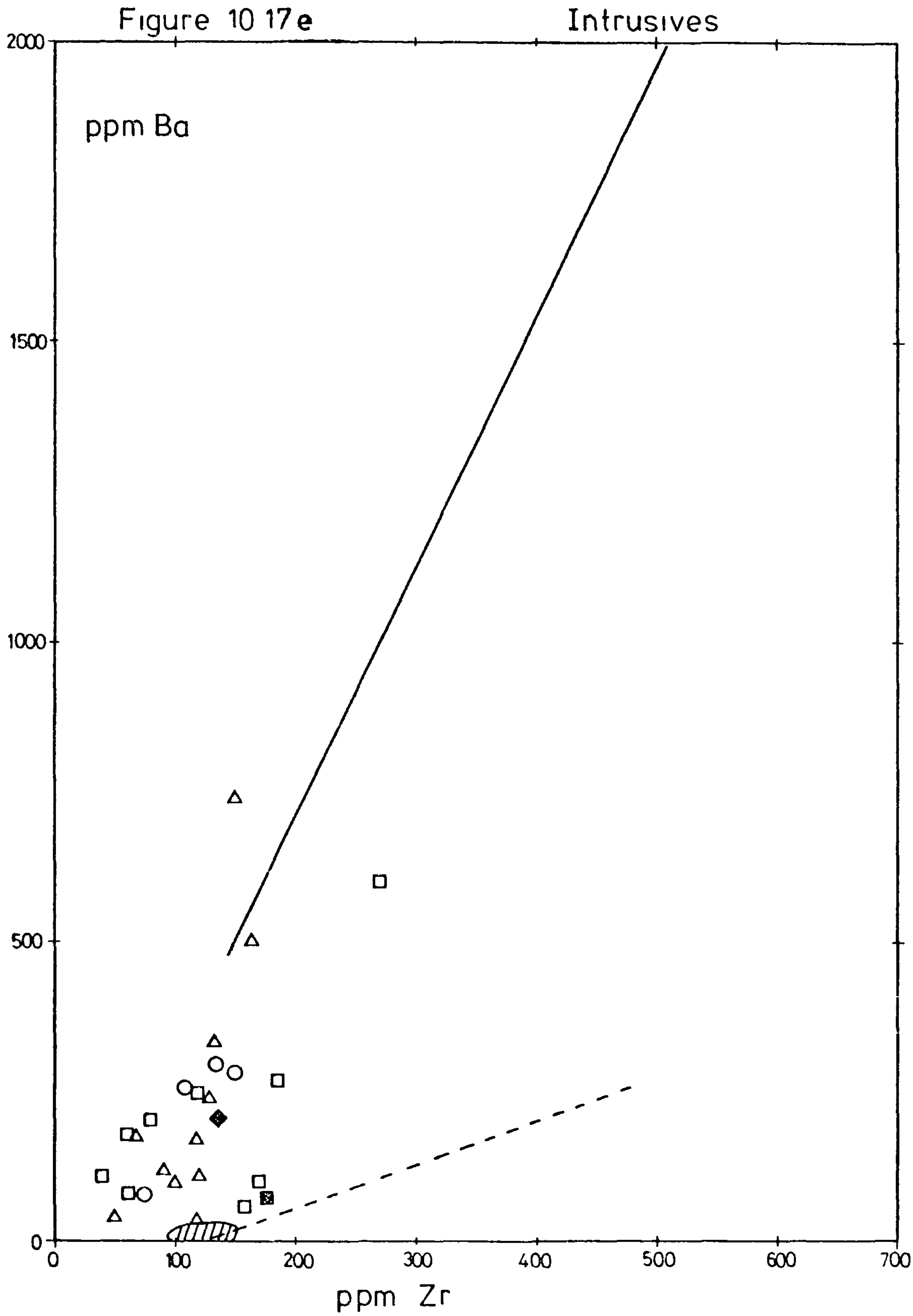


Figure 10 17e
Intrusives
ppm Ba
2000
1500
1000
500
0
0
100
200
300
400
500
600
700
ppm Zr

Figure 10 17f Intrusives

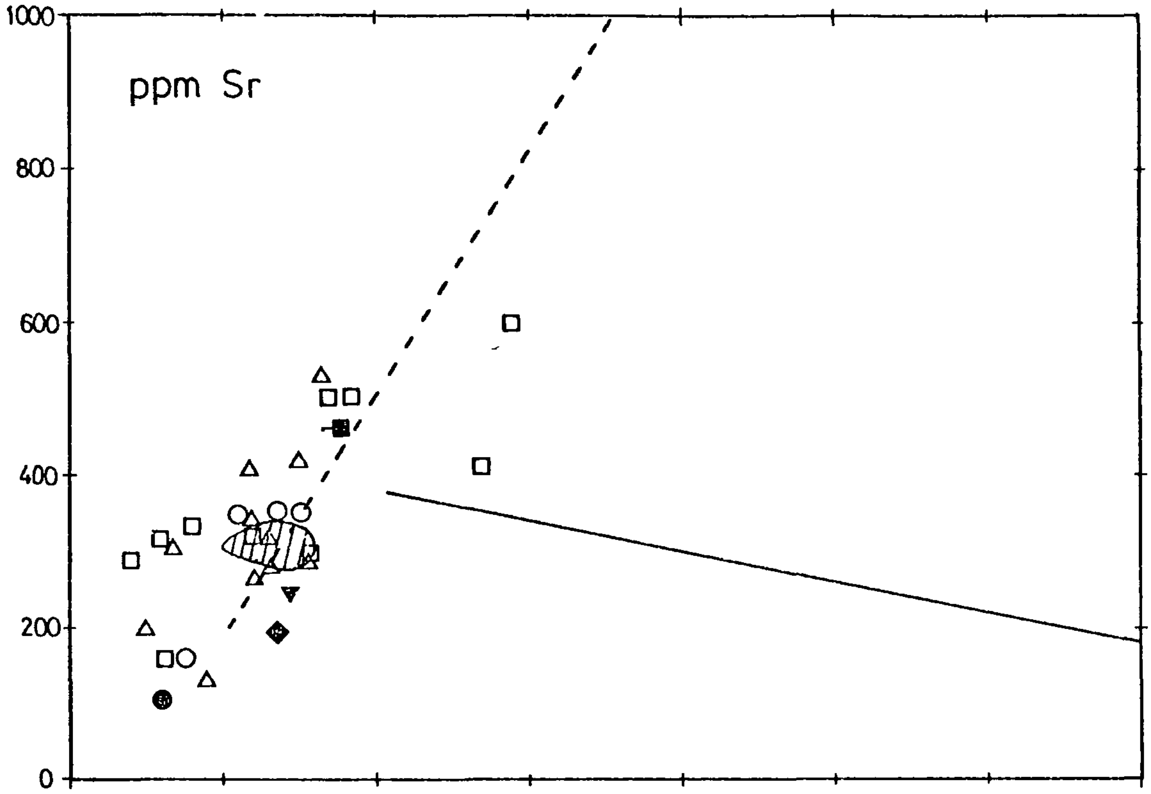


Figure 10 17g Intrusives

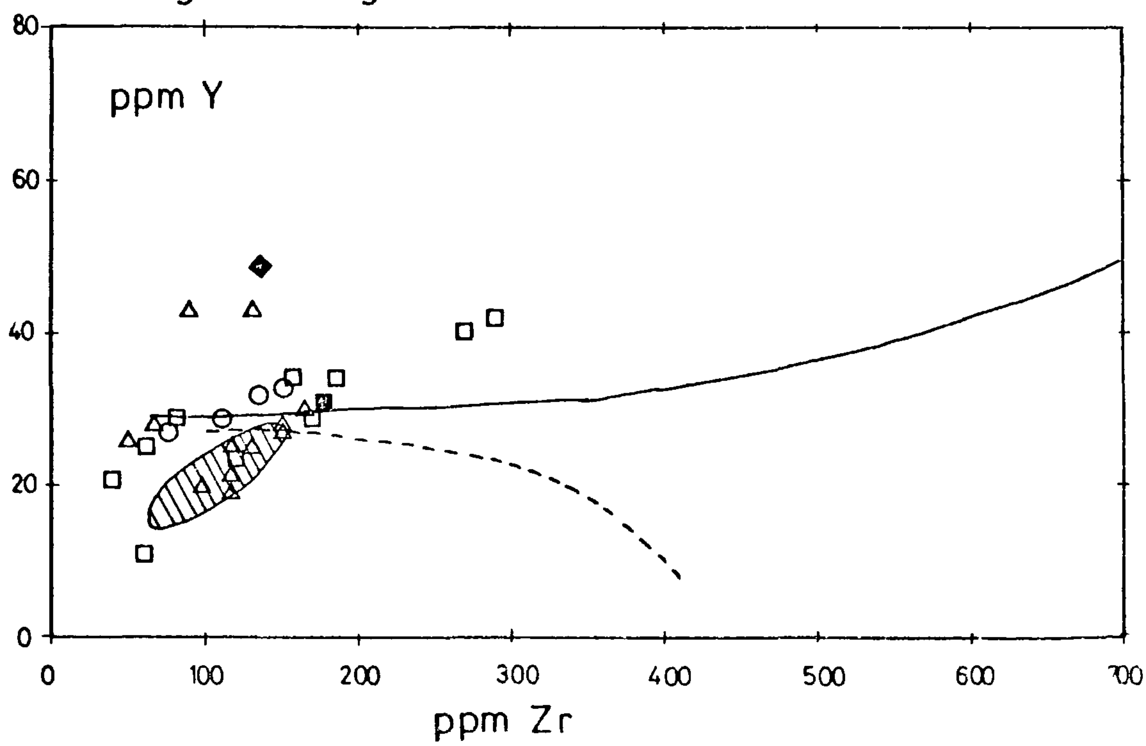


Figure 10 17h Intrusives

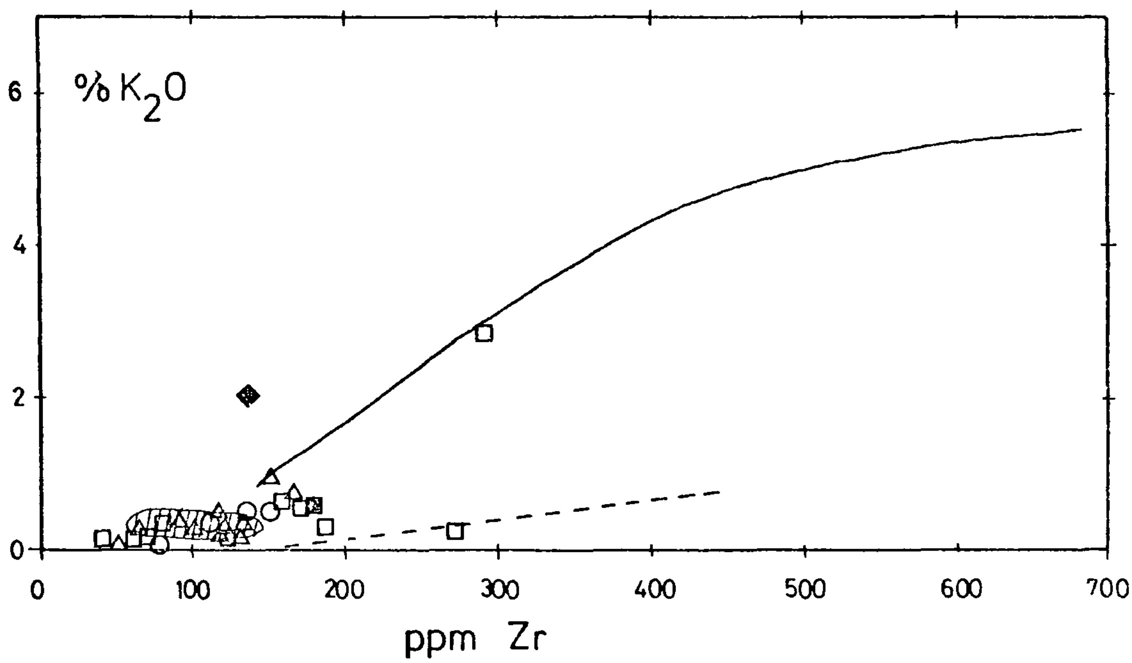


Figure 10.18

K_2O and TiO_2 plotted against P_2O_5.

(Aphyric and sparsely porphyritic samples only)

(Key as for Figure 10.17)

Figure 10 18a Extrusives

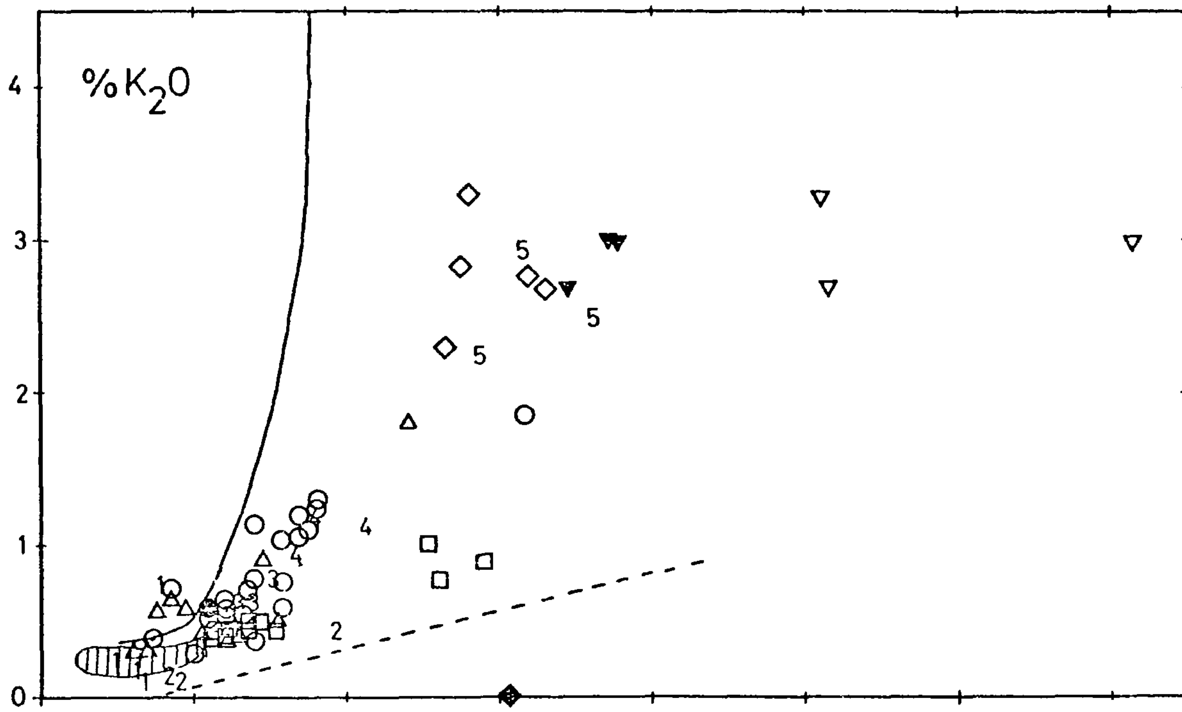
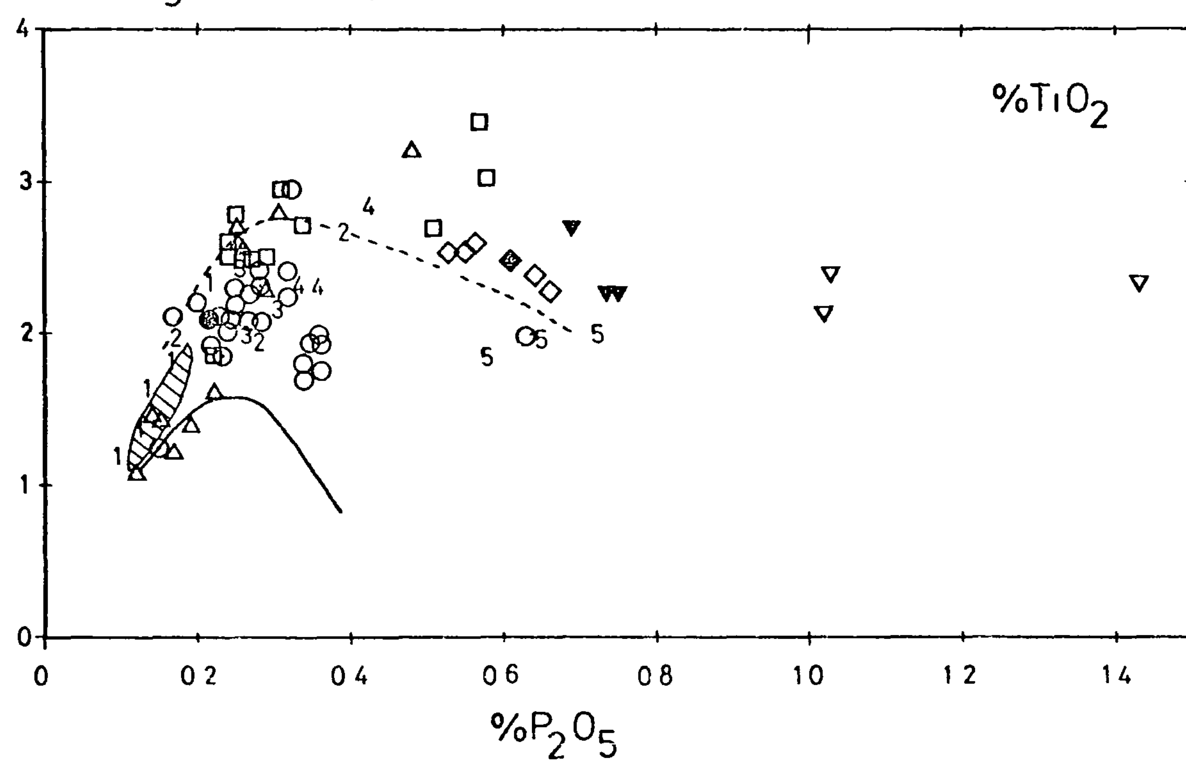


Figure 10 18b Extrusives



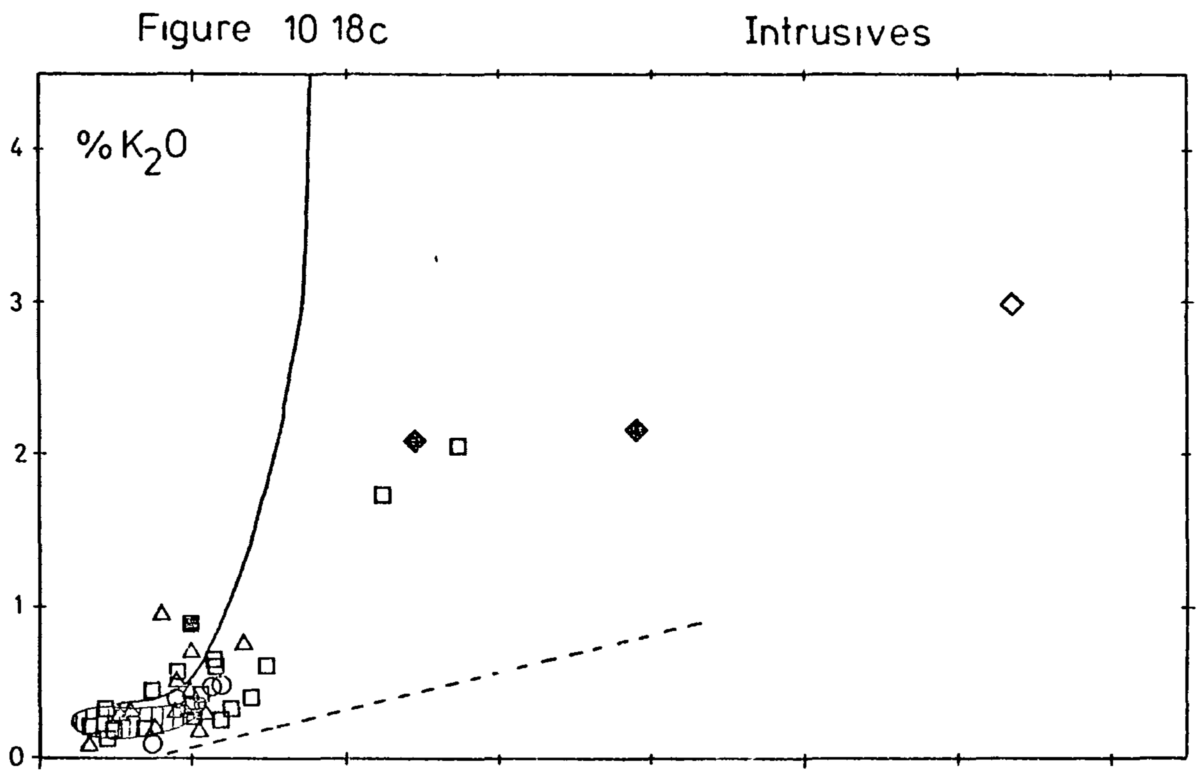


Figure 10 18c
Intrusives
%K2O
4
3
2
1
0

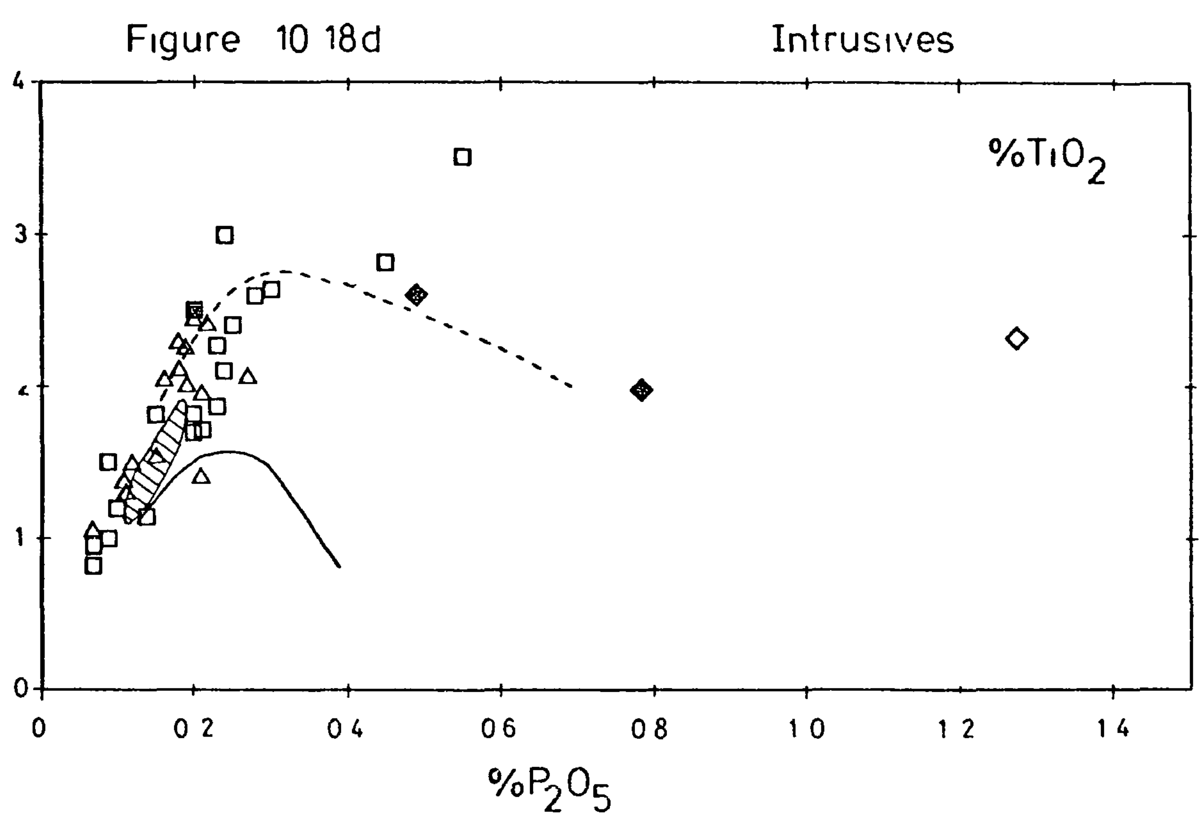
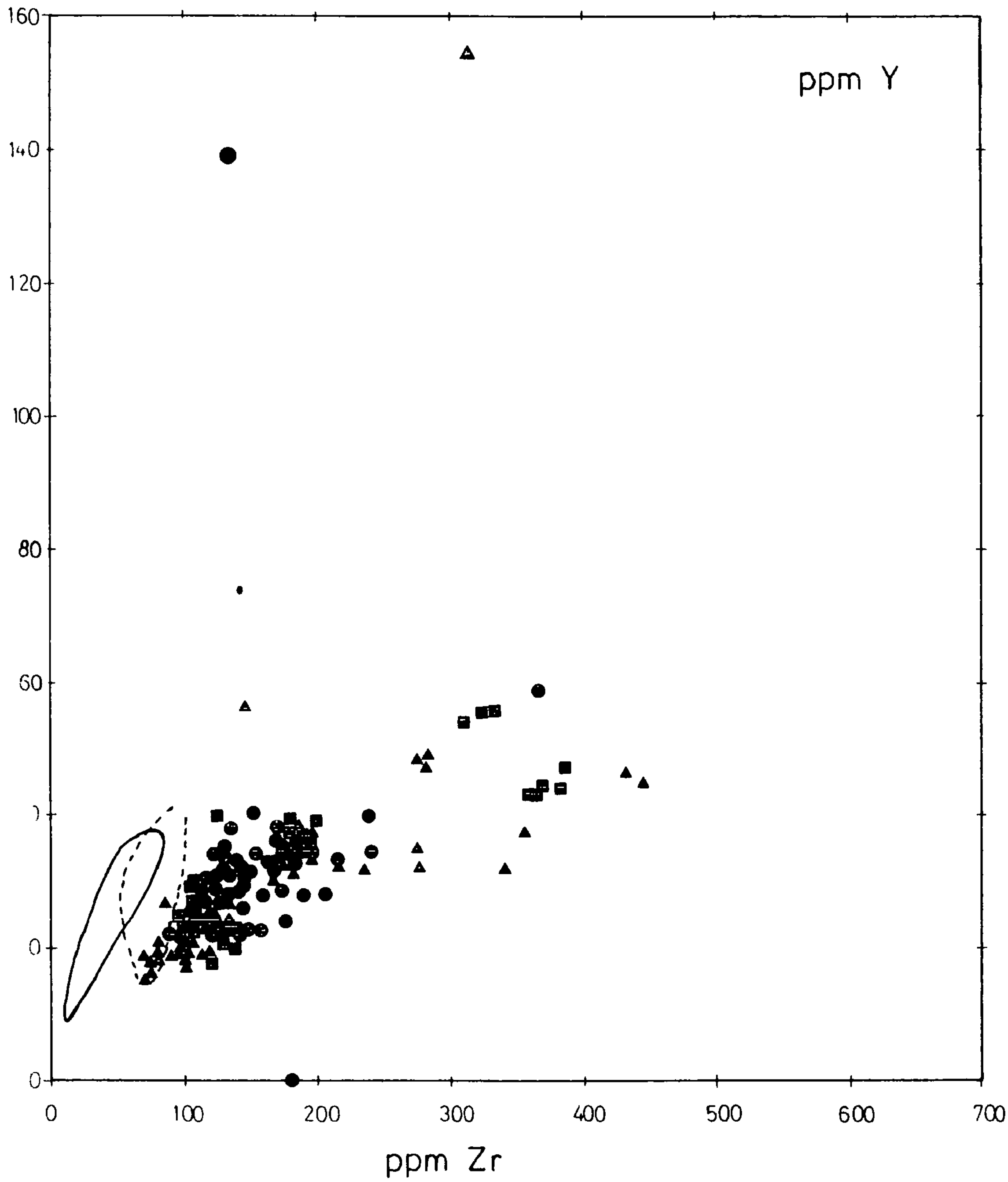


Figure 10 18d
Intrusives
%TiO2
4
3
2
1
0
0
0 2
0 4
0 6
0 8
1 0
1 2
1 4
%P2O5

Figure 10.19

Y and Ti plotted against Zr to identify Preshal Mhor and Fairy Bridge type samples. (All fresh samples)

Figure 10 19a Extrusives



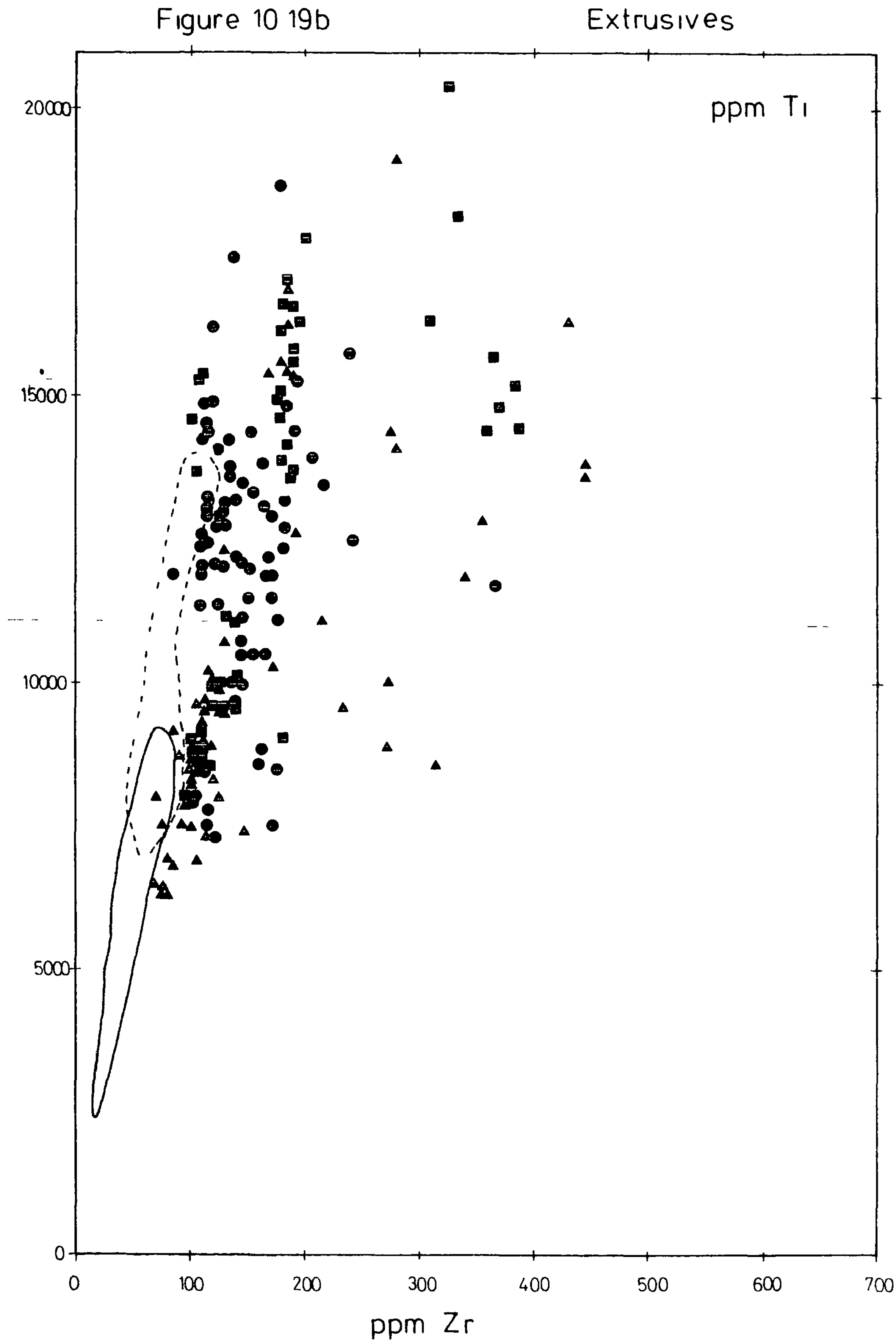


Figure 10 19b
Extrusives
ppm Ti
20000
15000
10000
5000
0
0
100
200
300
400
500
600
700
ppm Zr

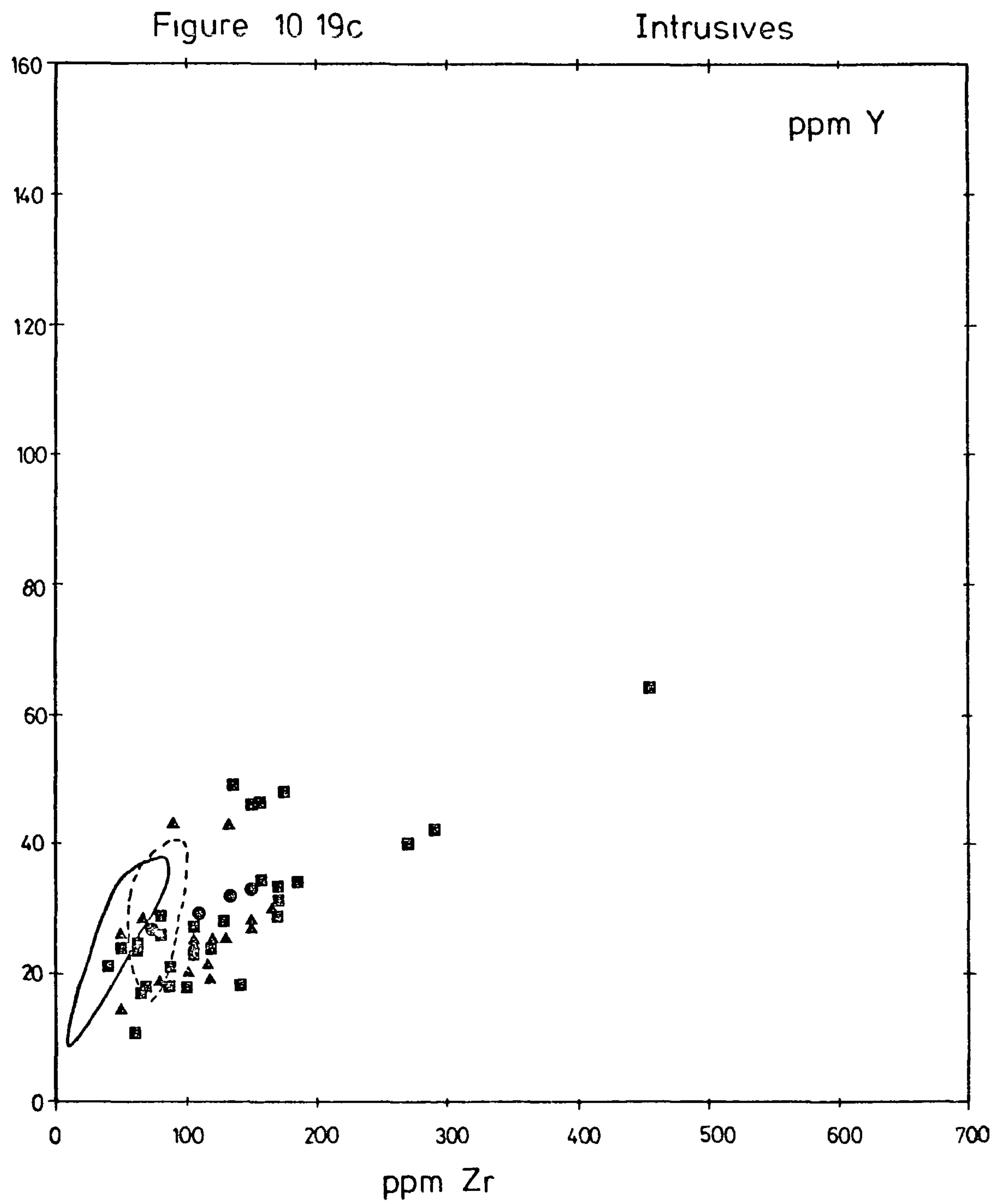


Figure 10 19c
Intrusives
ppm Y
160
140
120
100
80
60
40
20
0
0
100
200
300
400
500
600
700
ppm Zr

Figure 10 19d Intrusives

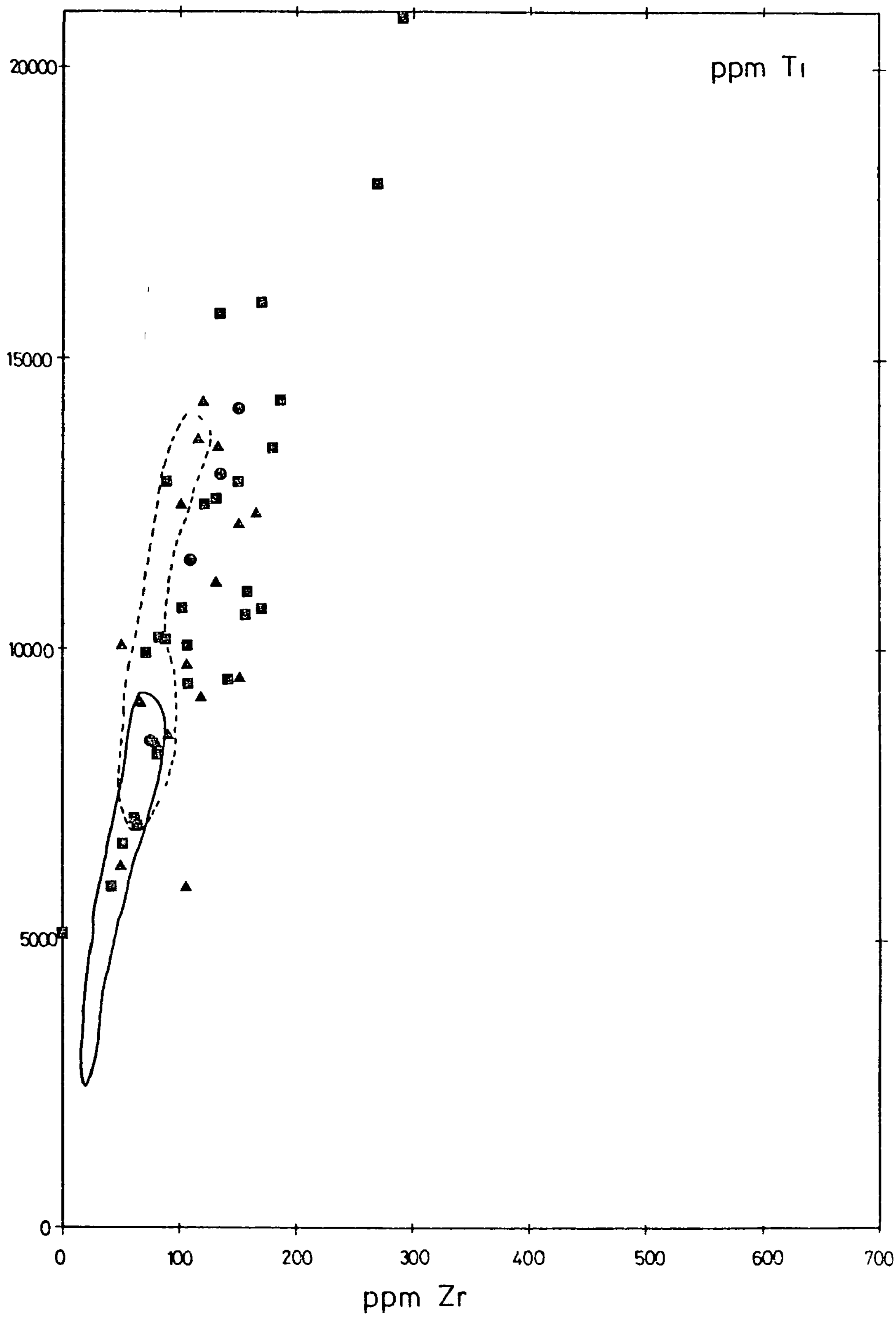


Figure 11.1

a) Acid rocks of Eigg plotted on quartz - albite - orthoclase diagram

b) Acid rocks of Eigg with their associated alkali feldspars plotted on quartz - albite - orthoclase diagram

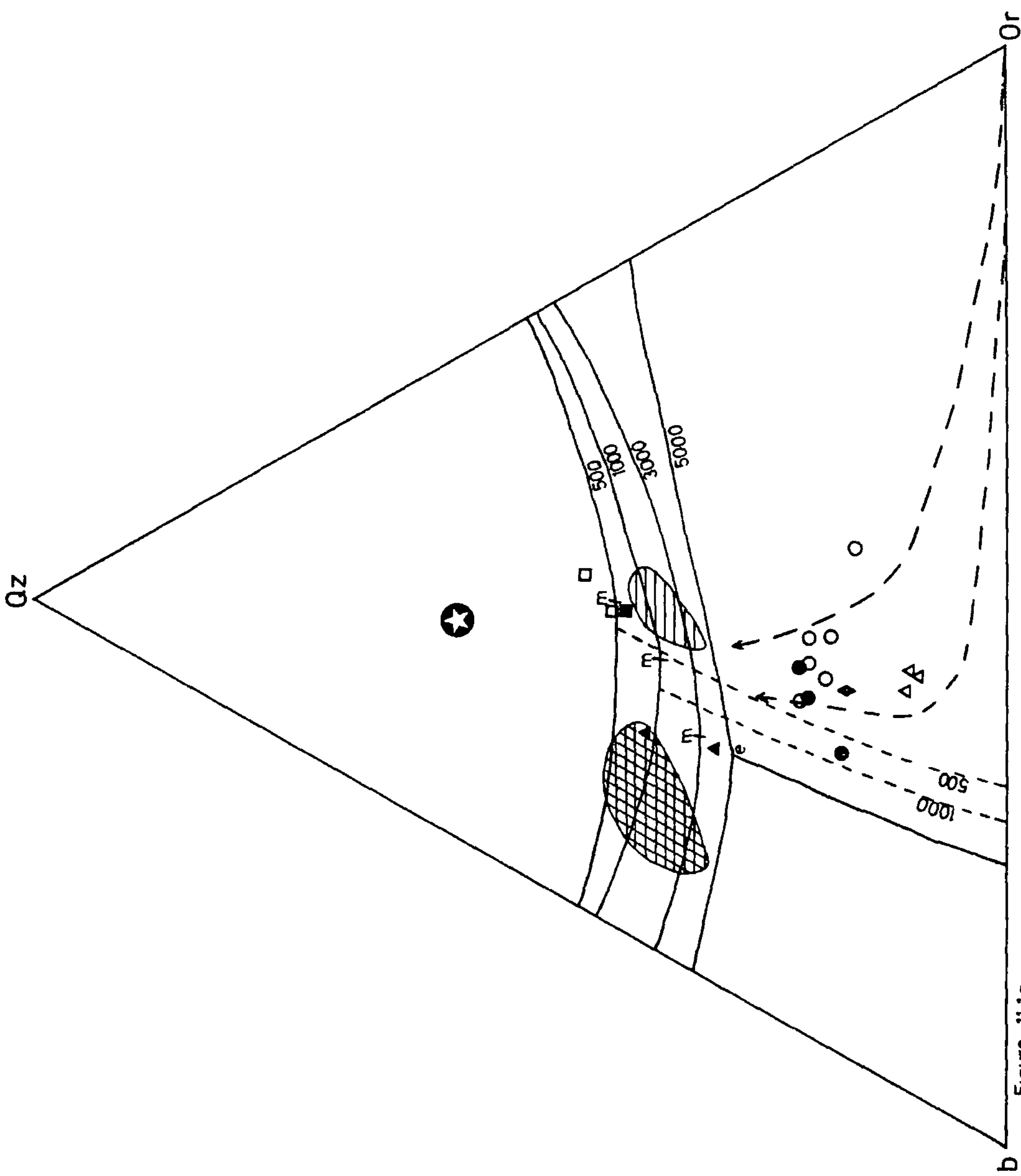


Figure 111a

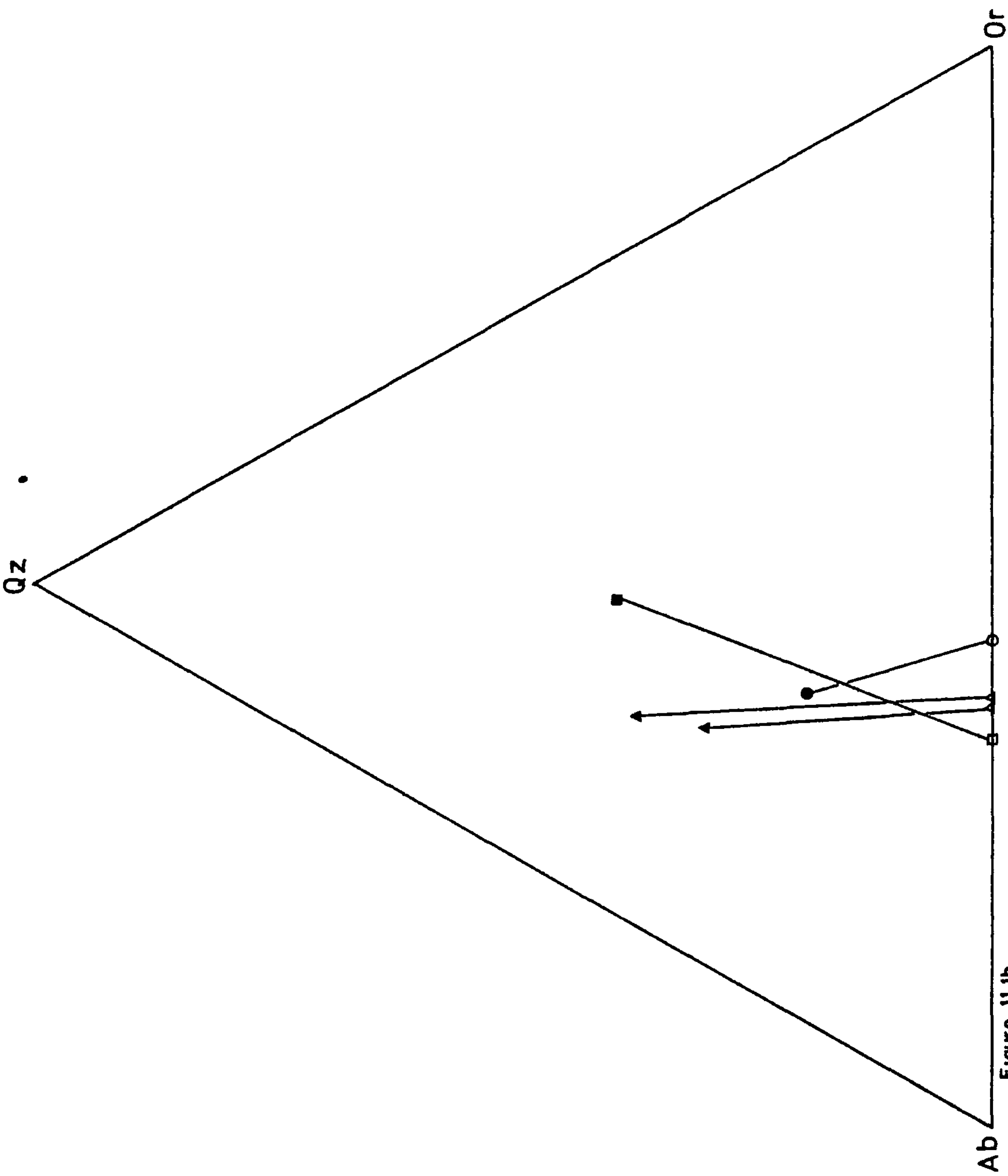


Figure 11b

Figure 11 2   Thorton Tuttle Differentiation Index versus SiO_2 content - acid rocks

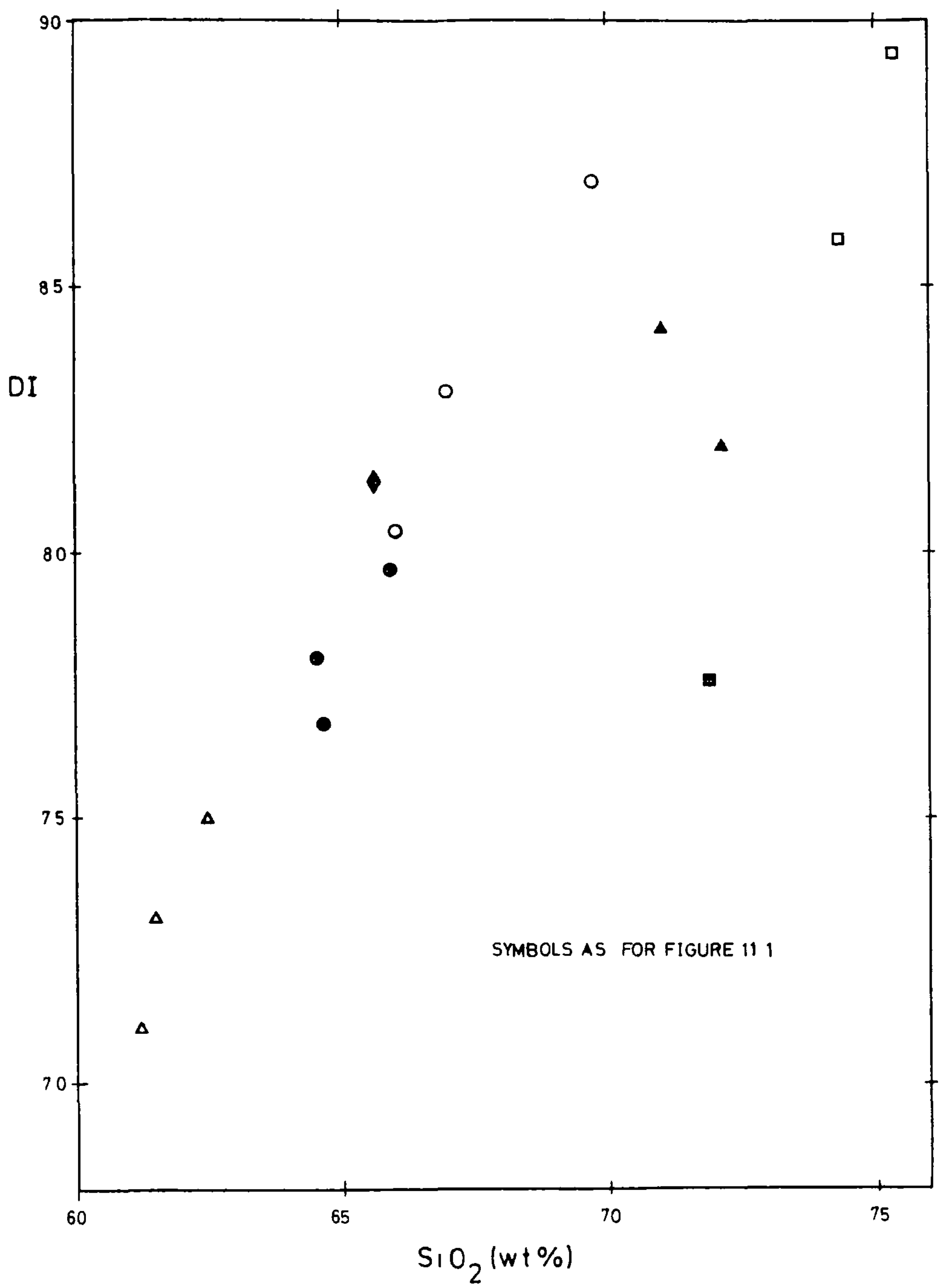


Figure 11.3

Group 1 basalts, icelandites and acid rocks of Eigg plotted on a total alkalis versus silica diagram.

Figure 11.3

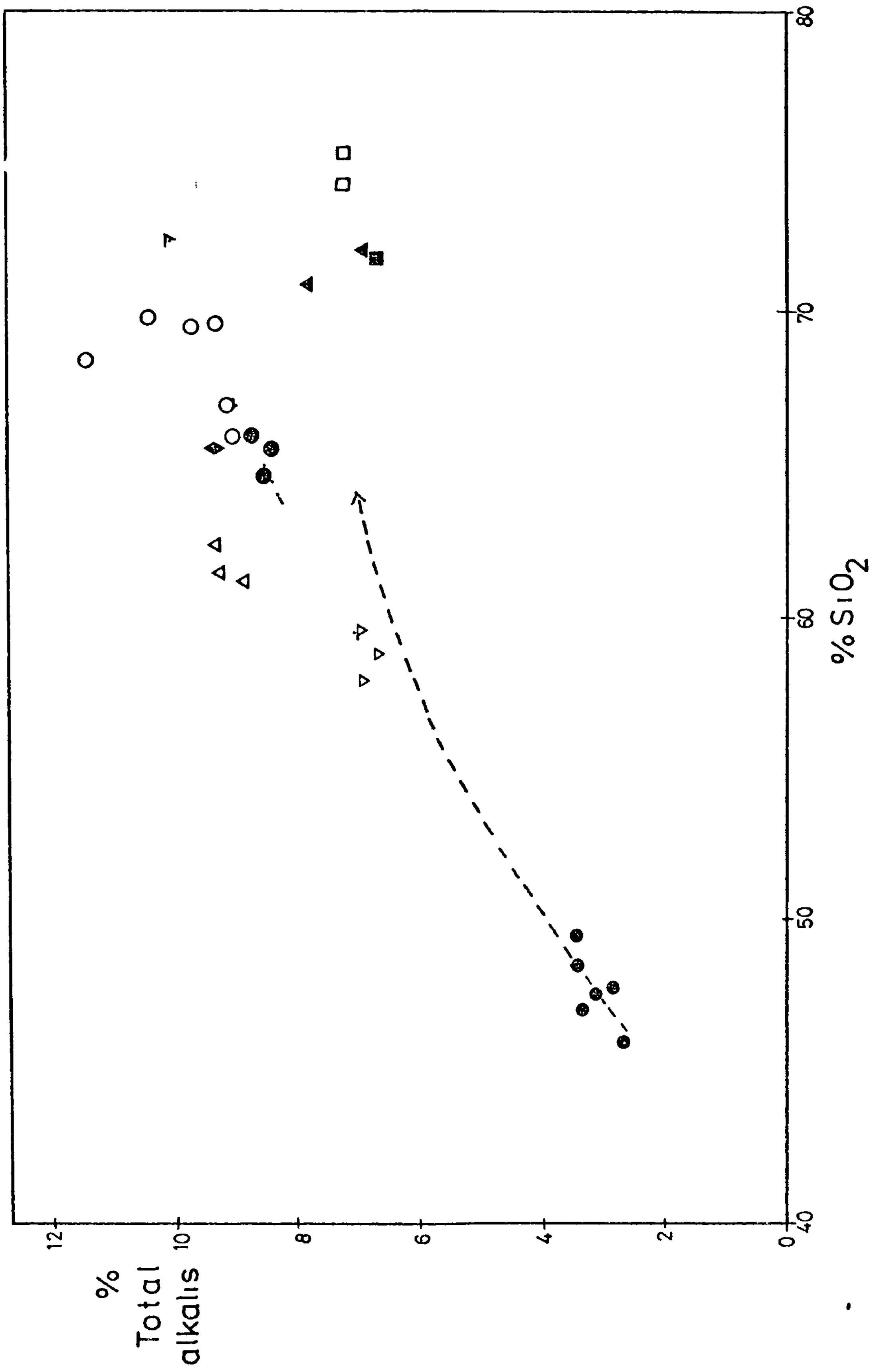


Figure 11.4

Selected Harker diagrams showing Group 1 basalts, icelandites and acid rocks of Eigg

Key as for Figure 11.3

Figure 11 4a

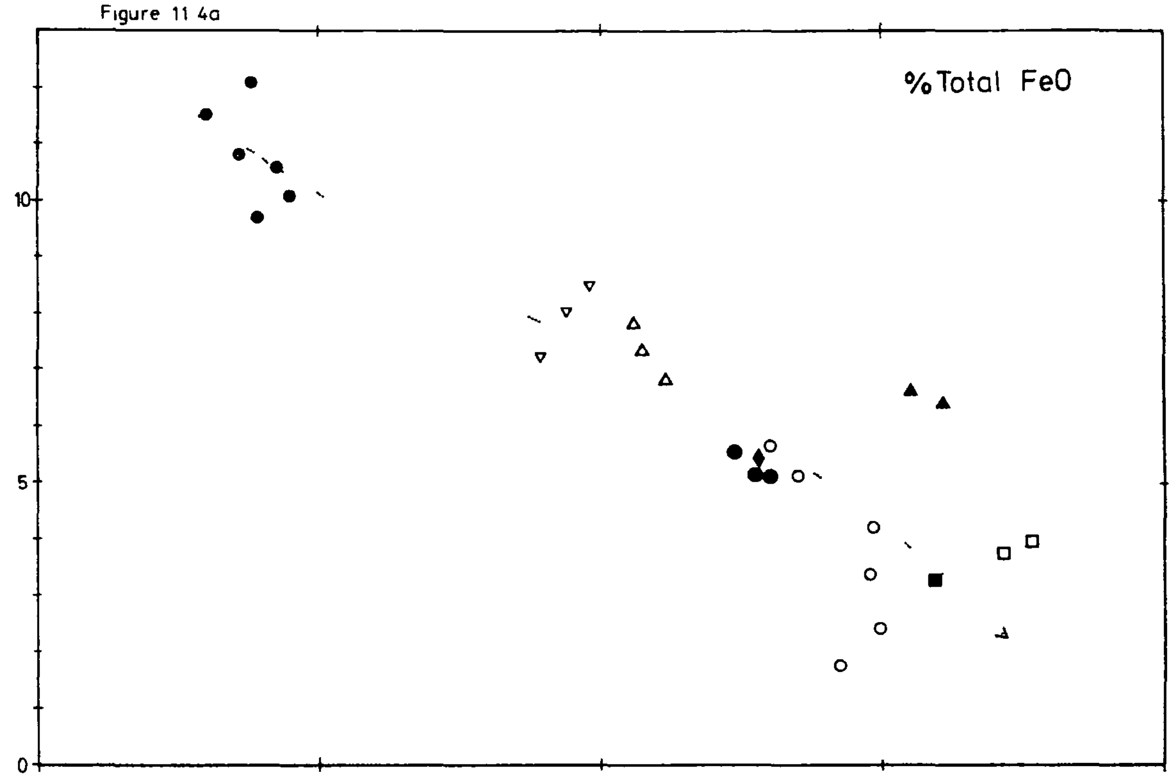


Figure 11 4b

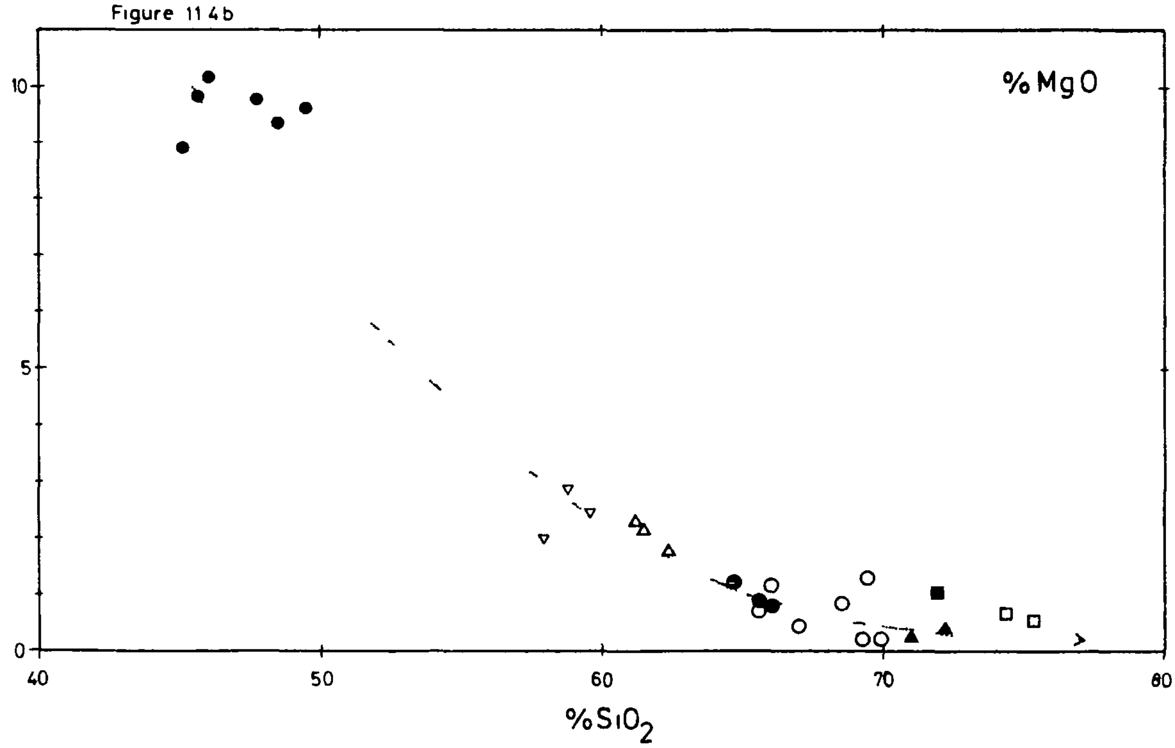


Figure 11.4c

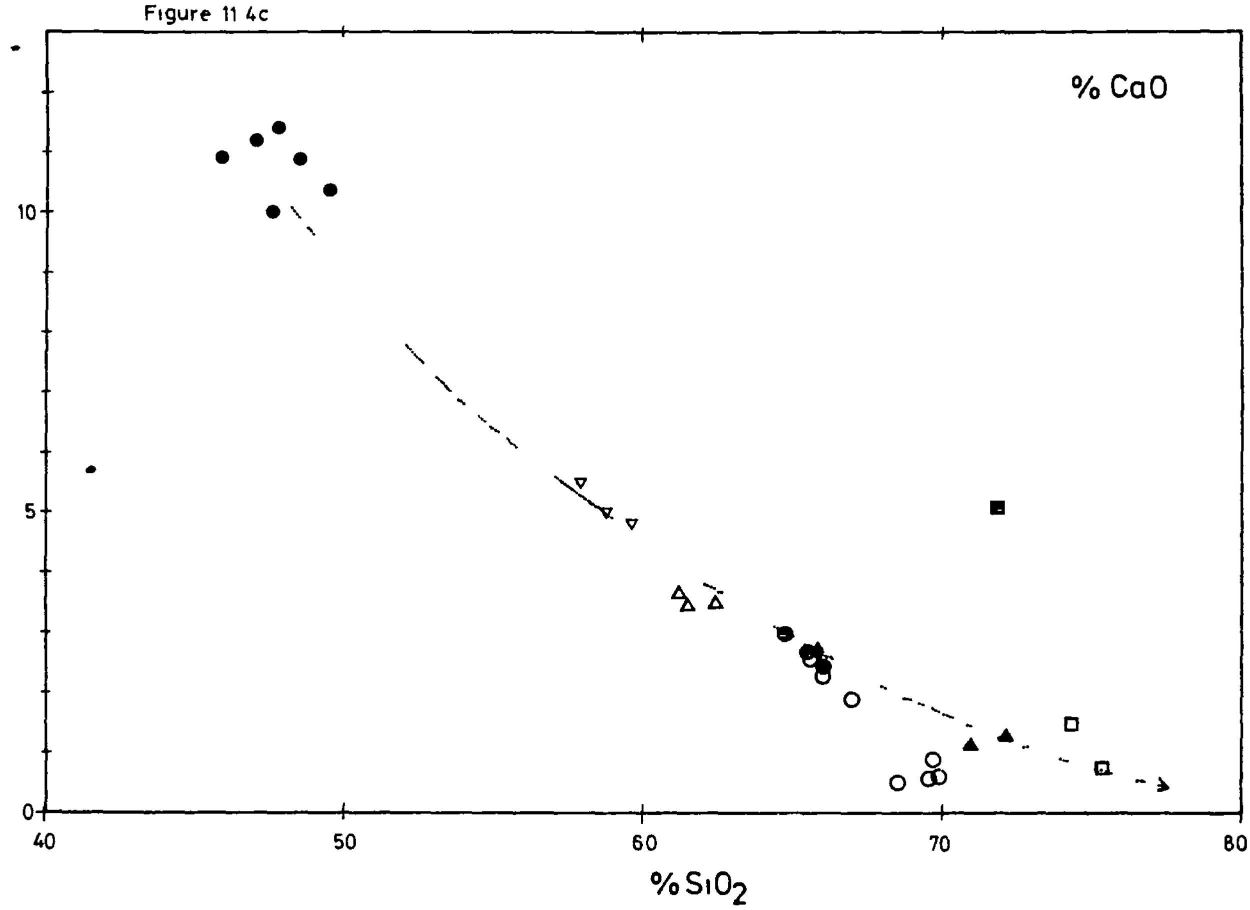


Figure 11.4d

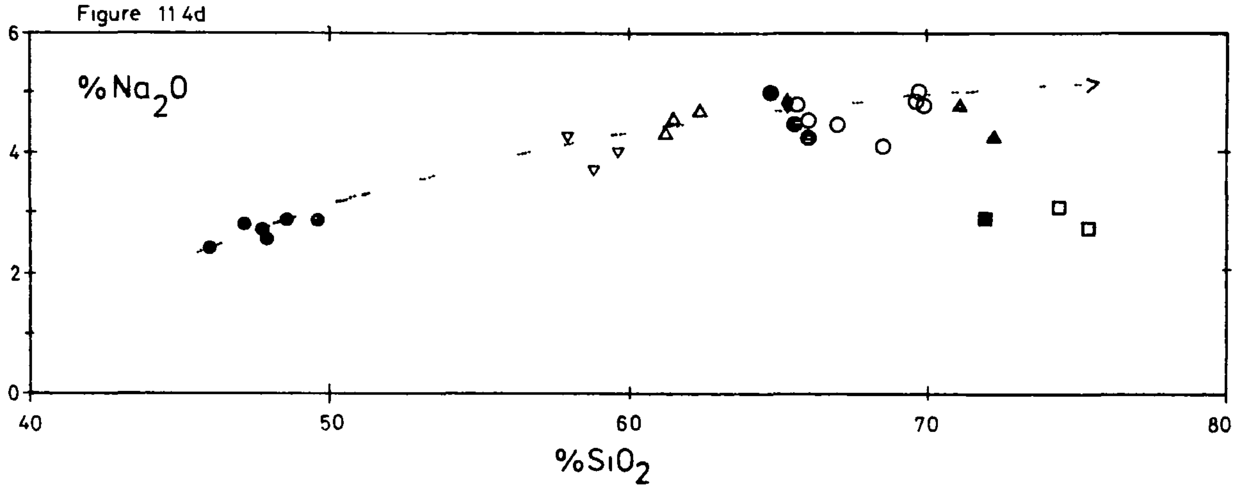


Figure 11.4e

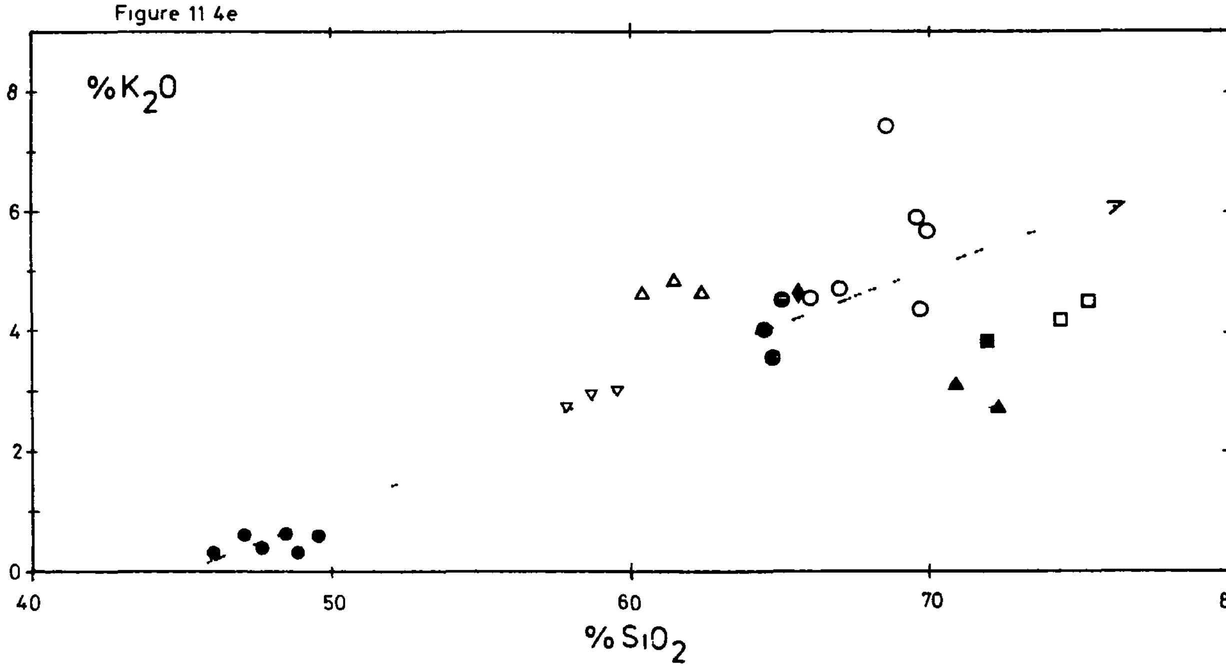


Figure 11 4f

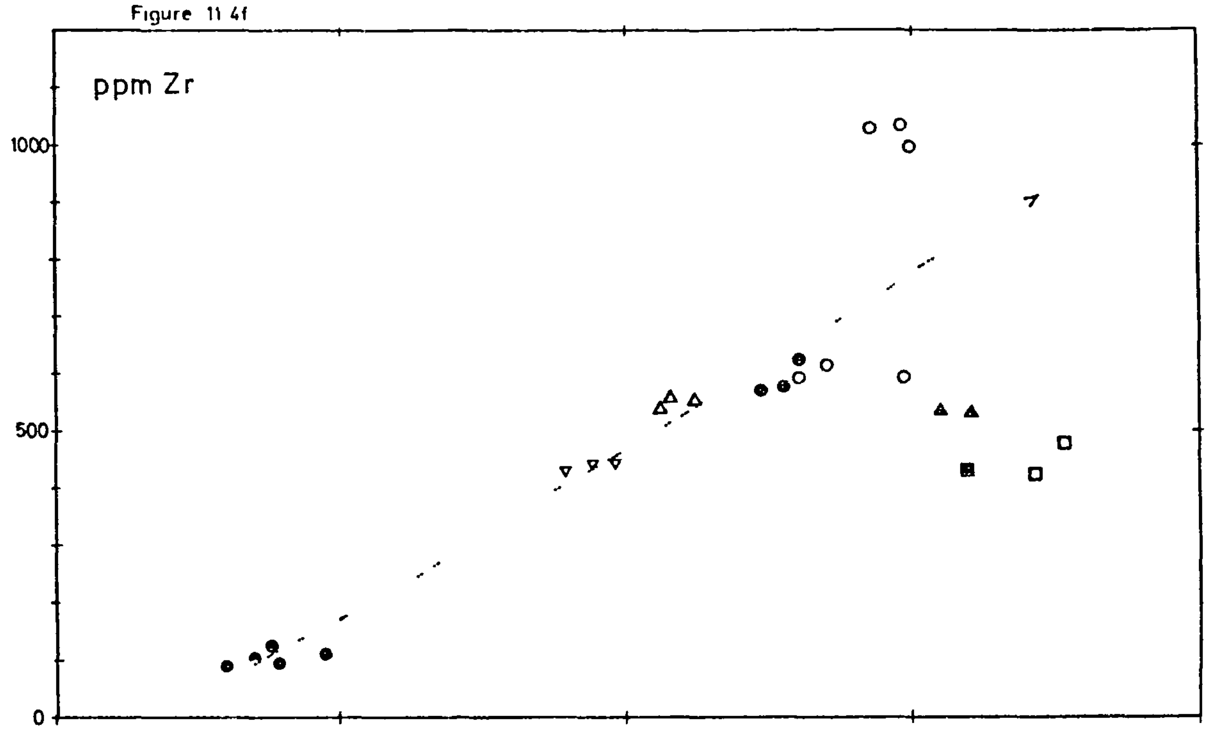


Figure 11 4g

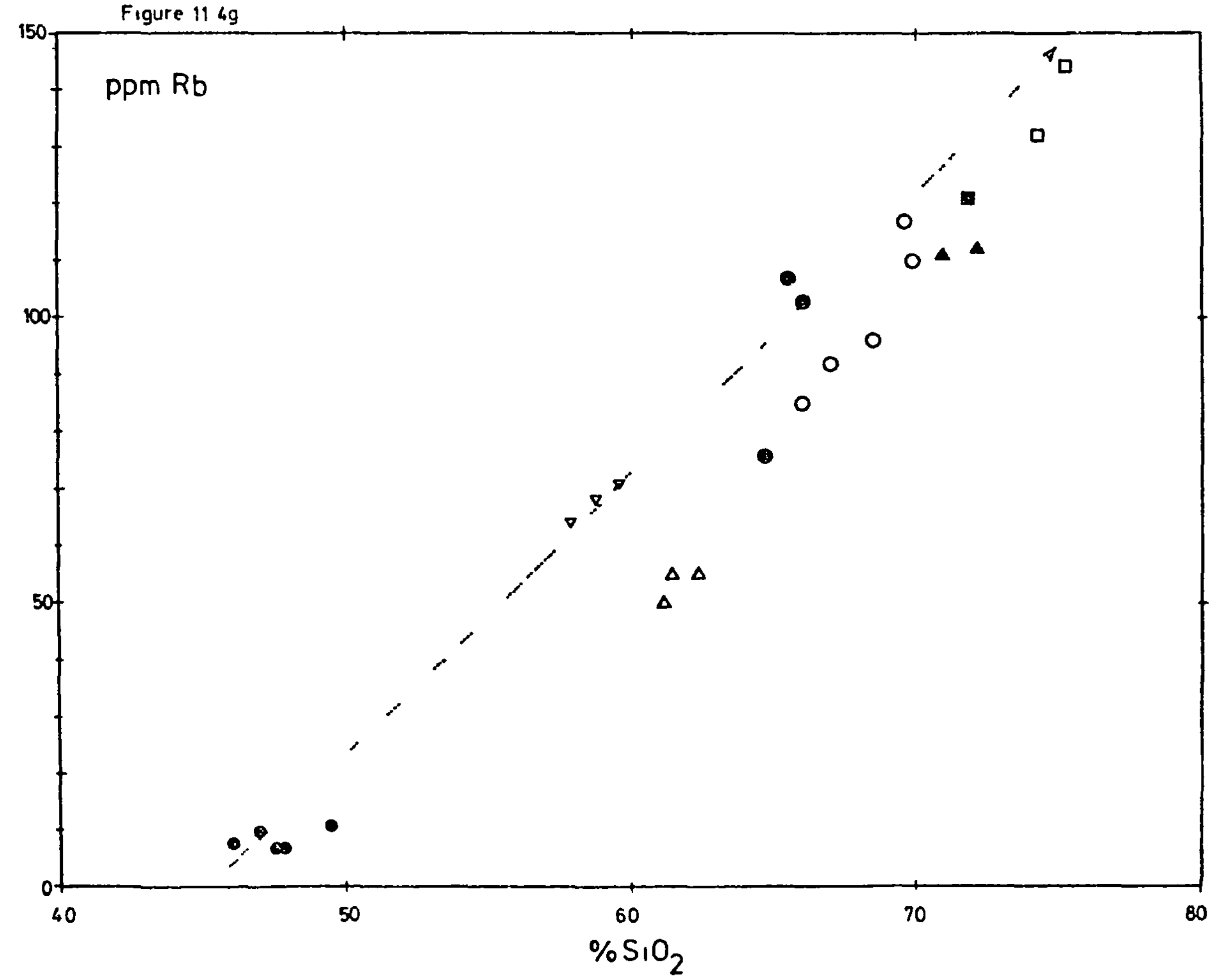
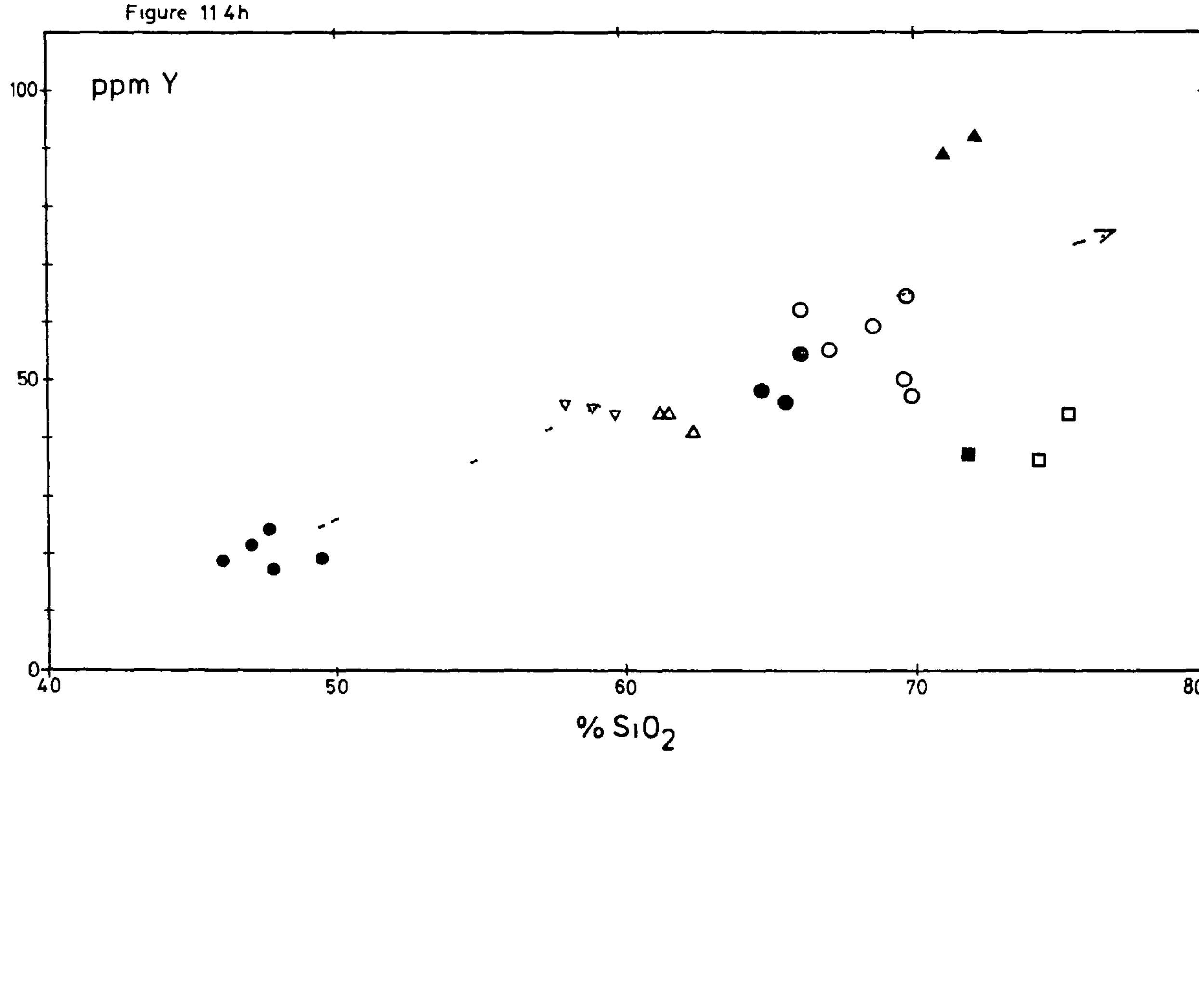


Figure 11 4h



T A B L E S

LOCALITY	GRID REF	THICKNESS	INCLUDED BASALTIC FRAGMENTS	COMMENTS
Gully between Sron na Teiste and Sgorr nan Laogh	40307888	0 40	None	No stratification, highly jointed deposit
Bay near Sgurr a Murchadh	35397948	0 15	Rare	Red bed exposed at HWM, underlain by coarse plagio-clase phyric flow
An Stac cliffs	40407910	?	?	Inaccessible
Torr nam Firheach	40807937	c 0 20	None	-
Sloc an Dubhaich cliffs	41637853	?	?	Inaccessible
South-east of Torr Creagach	42787938	0 80 (max)	Fairly abundant	-
" " " "	42867937	0 25	Fairly abundant	-

Table 2 2.1 Localities of the Main Red Bed

GROUP	MAXIMUM THICKNESS	BASAL MARKER HORIZON	NOW MARKER WAS RECOGNISED	COMMENTS ON GROUP
Cora-bhein	65m.	Plagioclase phyric flow	Field(verified by petrography).	Variable flows depending on locality.
Cnoc Creagach	85m.	Fine grained flow with small olivine phenocrysts	Petrographically	Predominantly olivine phyric flows
Brutach Dearg	85m	Very fine grained, olivine phyric flow.	Field	Olivine phyric and olivine and plagioclase phyric flows mainly.
Glac on Dorchadais	105m.	Flow with extremely abundant olivine phenocrysts.	Field	Plagioclase phyric flows in south, olivine phyric flows in north.
Gleann Charadail	70m	Grey rock (mugearite)	Field	Variable groups of lows
Laig	20m	Mesozoic/Tertiary unconformity	Field	Variable groups of flows

TABLE 2 3.1. DETAILS OF THE GROUPS OF WESTERN EIGG

GROUP	MAXIMUM THICKNESS	MARKER HORIZON(S)	COMMENTS ON THE GROUP
Upper Cleadale	70m.	Olivine and clinopyroxene phyric flows	Olivine phyric flows above basal group of olivine and clinopyroxene phyric flows.
Middle Cleadale	130m.	Flows lying above the olivine and plagioclase phyric flows at the top of the lower Cleadale Group.	Predominantly olivine phyric flows above the Lower Cleadale Group.
Lower Cleadale	50m.	Grey rock (mugearite) at the base.	Varied group of flows with distinctive olivine and plagioclase phyric flow at the top.
Basal	c.40m.	Mesozoic/Tertiary unconformity.	Varied group of flows.

TABLE 2.3.2. DETAILS OF THE GROUPS OF NORTHERN EIGG

TABLE 2.4.1

EASTERN BLOCK SUCCESSION

(Listed from Top to Base)

NOTES * Petrographically distinct flow

Any phrase underlined was used in petrographical correlations.

FLOW NO	SAMPLES	SPECIMEN DESCRIPTION ETC	
6	HC75109 HC75110	Abundant plagioclase phenocrysts, rare large corroded plagioclase phenocrysts, fairly abundant olivine, fine grained matrix	High ground (30 - 40 m) (e.g 28900410)
5	HC75108	Fairly abundant plagioclase phenocrysts, rare large corroded plagioclase phenocrysts, fairly abundant olivine phenocrysts, very rare micro-phenocrysts of clinopyroxene, fine grained matrix.	Crags above cliff top - east coast (e.g 29200417)
4	HC75106	Fairly abundant plagioclase phenocrysts, rare large corroded plagioclase phenocrysts, fairly abundant olivine pheno-crysts, fine grained matrix	Cliffs east of Dun Beag (28840382)
3	HC75104	Aphyric, very fine grained matrix chilled against coarse inclusions (probably xenoliths)	Cliffs east of Dun Beag (28770390)
-	-	Conglomerate - small pebbles of basalt and red sandstone c 10 m across.	Cliffs east of Dun Beag (28830382)
2	HC75103* HC75112	Very abundant plagioclase and olivine phenocrysts in fairly fine grained matrix. <u>Characteristic because of the extreme abundance of phenocrysts</u>	Foot of cliff east of Dun Beag (28820383) Cliff of Rubha Camas Stiana-bhaig (28870433)
-	-	Conglomerates (red sandstone and basalt pebbles), sediments, tuffs and coal lenses	Foot of cliff, Rubha Camas Stianabhaig (28770437) Wave cut plat-form below cliffs of east coast.
1	HC75111	Abundant small plagioclase phenocrysts, <u>which seem to grade in size with matrix</u>, rare large plagioclase phenocrysts, fairly abundant olivine phenocrysts (pseudo-morphed), fairly fine matrix	Only seen in up-faulted sequences of Rubha Camas Stianabhaig (28750432)

TABLE 2 4 2

EAST CENTRAL BLOCK SUCCESSION

(Listed from top to base)

NOTES

* Petrographically distinctive flow

(2) Numbers refer to flows in Eastern block (*see* Figure 2 4 1) and imply correlation between the flow after which the number in brackets occurs and the flow from the Eastern block indicated by the number in brackets

e g 5 (2) implies that flow 5 of Eastern Central block correlates with flow 2 of the Eastern block

Phrases underlined refer to some characteristic feature of the flow

FLOW NO	SAMPLES	SPECIMEN DESCRIPTION ETC	
6 (4)	HC7598	Abundant plagioclase phenocrysts, rare large corroded plagioclase phenocrysts, abundant olivine phenocrysts, fine grained.	N.E of disused R C. Church (27600482)
-	-	Conglomerate of basalt and red sandstone pebbles Does not occur on north coast or on Dun Beag	Creag nam Faoi-leann (28710381)
5 (2)	HC7597 HC75101* HC75102	Very abundant plagioclase and olivine phenocrysts Characteristic because of extreme abundance of its phenocrysts	Foreshore Rubha Feannag (27360501) High ground north of Creag nam Faoi-leann (28640410) Top flow - Creag nam Faoileann Cliffs (28600380)
5 (1)	HC7599	Abundant plagioclase phenocrysts, which grade in size with matrix plagioclase, rare large corroded plagioclase phenocrysts, fairly abundant small olivine phenocrysts, fairly fine grained matrix	Crags west of Camas Stianabhaig (28430416). Top flow Dun Beag (28830377)
3	-	Fairly coarse grained with abundant small plagioclase phenocrysts	Top flow Dun Mor (28730375)
-	-	Conglomerate - red sandstone and basalt pebbles *inaccessible*	Below top flow Dun Mor (28730375). In cliffs north of Dun Mor (28750380).
2	C7776 C7773 C7772	Fairly abundant plagioclase and olivine phenocrysts, olivines unusually pseudomorphed. Appeared to be aphyric in the field C7772 -plagioclase pheno-crysts in glass	North west of Camas Stianabhaig (28470433). Lower flow Dun Mor (28730375).
-	C7771	Carbonaceous shales (sampled) overlying conglomerate with red sandstone and basalt pebbles.	Base of cliffs at east end of Creag nam Faoi-leann (28780385) Base of Dun Mor (27730375).
1	-	Unknown	Top of flow forms wave cut platform below Dun Mor and Dun Beag

Petrographical Type	Average of 3 islands	Eigg	Muck	Canna
BASALTS				
Aphyric	8	4	7	14
Olivine phyric	27	39	44	4
Plagioclase phyric	6	6	2	8
Plagioclase & olivine phyric	30	10	25	52
other types	12	23	-	8
DIFFERENTIATES				
Hawaiite	6	6	2	10
Mugearite	11	12	20	4
Total Differentiates	17	18	22	14
Total Basalts	83	82	78	86

Table 3 1 Relative Abundances of the Main Petrographical Groups in the Extrusives

TABLE 3 2

PETROGRAPHICAL CLASSIFICATION OF THE BASIC

EXTRUSIVE SAMPLES

PETROGRAPHICAL TYPE	EIGG	MUCK	CANNA
APHYRIC BASALT	E7458, E7467,	M7547, M7567, M7639, M7643,	C7504, C7508, C7511, C7515, C7545, C7538, C7548, C7576, C7582, C75104, T521.
OLIVINE PHYRIC BASALT	E7432, E7444, E7461, E7463, E7464, E7465, E7466, E7468, E7469, E7470, E7480, E7482, E7483, E7486, E7487, E7493, E7635, E7636, E7639, E7649, E7654, E7662, EA13, EA18, EA41, EA51	M7548, M7553, M7555, M7568, M7569, M7570, M7571, M7576, M7591, M75139, M75140 M75141, M7620, M7622, M7624, M7627, M7629, M7630, M7644 M7646, M7648, M7649A, M7658, M7659.	C7530, C7586, C15.

PETROGRAPHICAL TYPE	EIGG	MUCK	CANNA
PLAGIOCLASE PHYRIC BASALTS	E7430, E7457, E7473, E7644,	M7651B	C7540, C7541, C7569, C7571, T522.
PLAGIOCLASE AND OLIVINE PHYRIC BASALTS	E7429, E7459, E7630, E7650, EA8, EA14, EA17.	M7532, M7533, M7538, M7546, M7552, M7577, M7578, M7594, M7595, M75143, M7603, M7615, M7636, M7664	C7505, C7514, C7517, C7536, C7537, C7539, C7546, C7555, C7558, C7559, C7560, C7562, C7563, C7566, C7657, C7573, C7588, C7592, C7596, C7599, C75100, C75101, C75103, C75107, C75109, C75113, C75114, C75117, C75118, C75121, SR246, T520, T523, T524, T525, T526, T52 , T528, T529, T530.
PLAGIOCLASE AND CLINOPYROXENE PHYRIC BASALTS	EA35.	-	-
OLIVINE AND SPINEL PHYRIC BASALTS	E7632, E7665, EA12, EA16, EA42	-	-

PETROGRAPHICAL TYPE	EIGG	MUCK	CANNA
PLAGIOCLASE OLIVINE AND SPINEL PHYRIC BASALTS	-	-	C75124
PLAGIOCLASE, OLIVINE AND CLINOPYROXENE PHYRIC BASALTS	E7460, E7472, EA25.	-	C7533, C7535, C7575, C7585, C75108.
OLIVINE AND CLINOPYROXENE PHYRIC BASALTS	E7413, E7475, E7606, E7634, E7641, E7652.	-	-
PLAGIOCLASE, CLINOPYROXENE, OLIVINE AND SPINEL PHYRIC BASALTS	EA30	-	-

PETROGRAPHICAL TYPE	EIGG	MUCK	CANNA
HAWAIITE	E7422, E7427, E7474, E7479	M7612	C7503, C7531, C7534, C7553, C7564, C75125, C20.
MUGEARITE	E7412, E7438, E7471, EA21B, EA21C, EA24B, EA24D, EA29.	M7531, M7543, M7579, M7597, M75127,M75144, M75146, M7608,M7638, M7653, M75148	C7552, SR252, SR254.

TABLE 3 3

CHEMICAL CLASSIFICATION OF BASIC EXTRUSIVE SAMPLES

CHEMICAL CLASSIFICATION	EIGG	MUCK	CANNA
BASALTS	E7413, E7422, E7427, E7429, E7430, E7432, E7438, E7444, E7457, E7458, E7459, E7460, E7461, E7463, E7464, E7465, E7466, E7467, E7468, E7469, E7470, E7473, E7474, E7475, E7482, E7483, E7486, E7487, E7493, E7606, E7630, E7632, E7634, E7635, E7636, E7639, E7641, E7644, E7649, E7650, E7652, E7654, E7665, EA8 EA12, EA13, EA14, EA16, EA17, EA18, EA41, EA42, EA51.	M7532, M7533, M7538, M7543, M7546, M7547, M7548, M7568, M7569, M7570, M7571, M7576, M7577, M7578, M7591, M7594, M7595, M75139, M75140, M75141, M75143, M75148, M7603, M7612, M7615, M7620, M7622, M7625, M7627, M7629, M7630, M7636, M7639, M7643, M7644, M7648, M76499, M7658, M7659, M7664.	C7503. C7504, C7511, C7530, C7533, C7534, C7548, C7553, C7573, C7575, C7576, C7582, C7585, C7586, C7588, C7592, C7596, C7598, C7599, C75100, C75101, C75104, C75107, C75108, C75109, C75113, C75114, C75117, C75118, SR246, C15, C20, T522.

CHEMICAL CLASSIFICATION	EIGG	MUCK	CANNA
HAWAIITES	E7472, E7479, E7662, EA21C, EA38	M7531, M7552, M7553, M7555, M7567, N7646, M7651B.	C7505, C7514, C7515, C7517, C7531, C7535, C7536, C7537, C7538, C7539, C7540, C7541, C7546, C7550, C7552, C7558, C7559, C7560, C7562, C7563, C7564, C7566, C7567, C7569, C7571, C75121, C75124, C75125, SR254, T520, T521, T523, T524, T525, T526, T527, T528, T529, T530, TX, TY.
MUGEARITE	E7412, E7471, EA21B, EA24B, EA24D, EA25, EA29, EA30, EA35.	M7579, M7597, M75127, M75146, M7608, M7638 M7653.	SR252

Area	Average trend	Average strike	No of dykes	Total dyke thickness (m)	Average dyke width (m)	length of strip (m)	% dykes	% extension by dykes	% extension (corrected for trend)
W of Camas Mhor	N160°E	N250°E	24	66 3	2 76	725	9 14	10 07	10 15
E of Camas Mhor/ W of Camas Mhor gabbro	N159°E	N249°E	19	47 4	2 49	540	8 78	9 62	9.72
Average of dykes W of Camas Mhor gabbro	N160°E	N250°E	43	113 7	2 64	-	-	-	-
E of Camas Mhor gabbro/N of Port Mhor	N115°E	N245°E	32	86 65	2 71	765	11 33	12 77	12 91
E of Cairn (42657911)/east coast of Muck	N151°E	N241°E	28	42 5	1 52	750	6 24	9 71	9 98
Average of dykes E of Camas Mhor gabbro	N153°E	N243°E	60	129 15	2 15	-	-	-	-
Average for all south coast dykes	N'56°E	N246°E	103	242.85	2 36	-	-	-	-
Average for all dykes of Muck	N156°E	N246°E	123	262 36	2 13 (of 116 dykes)	-	9 43	10 43	10 60

Table 4 1a Dykes from the South Coast of Muck

Area	Average trend	Average strike	No of dykes	Total dyke thickness (m)	Average dyke width (m)	Length of strip (m)	% dykes	% extension by dykes	% extension (corrected for trend)
Gallanach Bay (excluding MD31)	N152°E	N242°E	12	19 49	1 62	21 50	9 07	9 97	10 22
Gallanach Bay (including MD31)	N158°E	N248°E	13	-	-	-	-	-	-
N W Muck	N161°E	N251°E	6	-	-	-	-	-	-
Average of north coast dykes (excluding MD31)	N155°E	N245°E	18	-	-	-	-	-	-
Average of north coast dykes (including MD31)	N159°E	N249°E	19	-	-	-	-	-	-
Average for all dykes of Muck	N156°E	N246°E	123	262 34	2 13 (of 116 dykes)	-	9 43	10 43	10 60

Table 4 1b Dykes from the North Coast of Muck

Total number of dykes examined	31
Average width (average of 22)	1.68 m
Average trends	NW
Hade (measured on some Laig Bay dykes)	30° (maximum) 25° (average) Majority are vertical

Laig Bay Dykes only.-

No. of dykes	8
Aggregate thickness	15.25 m
Average thickness	1.91 m
Length of strip	315 m
% dykes	6.56
% extension (uncorrected for trend)	5.09

Table 4.2: Summary of Information on the Dykes of Eigg

TABLE 5.1

PETROGRAPHICAL CLASSIFICATION OF THE BASIC MINOR INTRUSIVE SAMPLES

PETROGRAPHICAL CLASSIFICATION	EIGG	MUCK	CANNA
BASALTS APHYRIC	E7401, E7402, E7404, E7418, E7424, E7433, E7434, E7450 E7484, E7633, EA33, EA34, EA40	MD6, MD10, MD15, MD19A, MD19B, MD35(1), MD35(2), MD36, MD45, MD51, MD54(1), MD54(2), MD56B, MD62, MD64, MD68, MD69, MD71, MD79, MD81, MD86, MD89, MD94, MD110, MD112, MD115, MD116, MD117 MD118, MD119.	T504, T506, T508, T514.
OLIVINE PHYRIC	E7651.	MD4, MD5, MD12, MD13, MD14, MD27, MD28, MD32, MD40(1), MD40(2), MD42, MD43, MD47, MD60, MD61, MD65, MD70, MD74, MD76, MD77, MD83, MD88, MD104, MD105.	SR250.
PLAGIOCLASE PHYRIC	E7409, E7448, E7494	MD35T, MD37(2), MD53, MD57B MD67, MD82, MD91, MD95.	-
PLAGIOCLASE AND OLIVINE PHYRIC.	E7417, E7447, E7449, EA39	MD2, MD3, MD16, MD17, MD18, MD31A, MD31B, MD39, MD41, MD46, MD48, MD49, MD56A, MD57A, MD63, MD80, MD85,MD92, MD96(1), MD103, MD106, MD109, MD111, MD113, MD114.	C7506, C7507, T509, T511, T512, T513, T515, T516, T524.

Cont/...

PETROGRAPHICAL CLASSIFICATION	EIGG	MUCK	CANNA
PLAGIOCLASE AND CLINOPYROXENE PHYRIC	-	MD73	-
PLAGIOCLASE AND OPAQUE PHYRIC	-	MD56C	-
OLIVINE AND OPAQUE PHYRIC	E7631	MD44, MD50, MD52, MD54(2), MD84.	-
OLIVINE AND CLINOPYROXENE PHYRIC	E7666	-	-
PLAGIOCLASE, OLIVINE AND OPAQUE PHYRIC	E7637	MD9, MD72, MD96(2)	-
PLAGIOCLASE, OLIVINE AND CLINOPYROXENE PHYRIC	E7403, E7602, E7613.	MD75, MD100.	C7523, C7524.
DOLERITES	E7414, E7435.	MD11A, MD11B, MD55A, MD93.	T501, T507, C7581, C7587.
DIFFERENTIATES HAWAIITE	E7446, E7476, E7615.	MD8.	SR247, T505, C7565.
MUGEARITE	E7646	MD1, MD7, MD36M, MD99, MD108, M7524, M7506, M7609.	T503

TABLE 5.2

CHEMICAL CLASSIFICATION OF THE BASIC MINOR

INTRUSIVE SAMPLES

CHEMICAL CLASSIFICATION	EIGG	MUCK	CANNA
BASALTS	E7403, E7404, E7409, E7414, E7418, E7433, E7434, E7447, E7449, E7450, E7613, E7626, E7631, E7633, E7637, E7646, E7651, E7666, E7439, EA40.	M7609, MD2, MD3, MD4, MD5, MD6, MD9, MD10, MD11B, MD12, MD13, MD14, MD15, MD19A, MD19B, MD35T, MD37, MD41, MD44, MD45, MD48, MD49, MD53, MD54(1), MD54(2), MD56C, MD57A, MD60, MD61, MD65, MD70, MD77, MD79, MD80, MD81, MD82, MD85, MD88, MD89, MD92, MD95, MD100, MD106, MD109, MD111, MD112, MD114, MD116, MD118, MD119.	C7506, C7507, SR249, SR250.
HAWAIITES	E7402, E7446, E7615(B)	MD8, MD17, MD35, MD36, MD56A, MD57B(B), MD63, MD67, MD72, MD73(B), MD75(B), MD110.	-
MUGEARITES	-	M7520, M7606, MD7, MD36M, MD99, MD108.	-

(B) = BASALTIC HAWAIITE.

TABLE 5.3

RELATIVE ABUNDANCE OF THE PETROGRAPHICAL GROUPS IN THE INTRUSIVES (FIGURES FOR EXTRUSIVES GIVEN IN BRACKETS)

PETROGRAPHICAL TYPE	AVERAGE OF 3 ISLANDS	EIGG	MUCK	CANNA
BASALTS				
APHYRIC	26.8 (8.6)	39.4 (4.3)	25.2 (7.3)	16.7 (13.7)
OLIVINE PHYRIC	15.9 (27.4)	3.0 (39.1)	22.4 (43.6)	4.2 (4.1)
PLAGIOCLASE PHYRIC	6.1 (5.6)	9.1 (5.8)	6 5 (1.8)	- (8.2)
PLAGIOCLASE AND OLIVINE PHYRIC	22.6 (29.9)	12.1 (10.1)	22.4 (25.5)	37.5 (52.1)
PLAGIOCLASE AND CLINOPYROXENE PHYRIC	0.6 (0.5)	- (1.4)	0.9 (-)	- (-)
PLAGIOCLASE AND OPAQUE PHYRIC	0.6 (-)	- (-)	0.9 (-)	- (-)
OLIVINE AND OPAQUE PHYRIC	3.7 (2.5)	3.0 (7.2)	4.7 (-)	- (-)
OLIVINE AND CLINOPYROXENE PHYRIC	0.6 (8.7)	3.0 (8.7)	- (-)	- (-)
PLAGIOCLASE, OLIVINE AND OPAQUE PHYRIC	2.4 (0.5)	3.0 (-)	2.8 (-)	- (1.4)
PLAGIOCLASE, OLIVINE AND CLINOPYROXENE PHYRIC	4.3 (4 1)	9.1 (4.3)	1.9 (-)	8.3 (6.8)
DOLERITES	6.1 (-)	6.2 (-)	3.9 (-)	16 6 (-)
DIFFERENTIATES				
HAWAIITE	4.3 (6.1)	9.1 (5.8)	0.9 (1.8)	12.5 (9 6)
MUGEARITE	6.1 (11.2)	3 0 (11.6)	7.5 (20.0)	4.2 (4.1)
% DIFFERENTIATES	10.4 (17.3)	12.1 (17.4)	8.4 (21.8)	16.7 (13.7)
% BASALTS	89.6 (82.7)	87.9 (82.6)	91.6 (78.2	83.3 (86.3)

TABLE 6.1

PETROGRAPHY OF THE CONGLOMERATES

Sample Number(s)	Petrography	Notes
E7496A E7675A E7675B	Arkosic sand-stone	Greenish coloured; contain ipidote and chlorite. 2 are fine grained (0.1 - 0.2 mm) 1 is coarser (0.4 mm)
E7496C E7496E	Basalt	Plagioclase-phyric Olivine-phyric
E7496D E7675C	Acidic igneous	Quartz-phyric glass Felsite with anorthoclase, plagioclase and opaque oxide phenocrysts

Table 6.1a: Recess West of Botterill's Crack

(46068462)

Sample Number(s)	Petrography	Notes
EA21B	'Mugearitic' basalts (chemically quartz normative)	Plagioclase, clinopyroxene and opaque oxide phenocrysts
EA21C		Aphyric; with flow aligned plagioclases
EA22B		Very fine grained; aphyric; with flow aligned plagioclases
EA22D		Very fine grained; aphyric
EA24B		Plagioclase-phyric glass
EA24D		" " "

Table 6.1b: Below Collie's Cleft

(46308460)

Sample Number(s)	Petrography	Notes
EA2	Red arkosic sandstones	0.20 mm) average grain size
EA3		0.25 mm
EA5		0.40 mm
EA6		0.30 mm
EA4	Red arkose	0.40 mm average grain size
EA7	Pitchstone breccia	Clinopyroxene, anorthoclase, plagioclase and opaque oxide phenocrysts; flow banded.

Table 6.1c: About 100 m West of Loch Caol na Cora-bheinn

OUTCROP	FIELD RELATIONSHIP	ANORTHO-CLASE	SANI-DINE	ORTHO-CLASE	PLAGIO CLASE	CLINO-PYROXENE	ORTHO-PYROXENE	OPAQUES	QUARTZ
1a Sgurr pitchstones	Extrusive	✓			✓	✓	✓	✓	
1b Sgurr felsites	Partially intrusive	✓			✓	✓		✓	
1c Sgurr felsites	Definitely intrusive	✓			✓	(✓)	(✓)	✓	
1d Sgurr felsites	Unknown	✓			✓	✓		✓	
2 Grulin felsite	Intrusive sheet	✓		✓	✓	✓		✓	
3 Rudh'an Tancaird pitchstones and felsite	Dykes		✓		?			✓	
4 North Pier pitchstone	Dyke or plug								
5 Sron Laimrhige and Sgorr Sgaileach felsites	Plugs	✓							✓

(✓) phenocrysts in Dyke E7442

Table 7 1 Phenocryst Assemblages of the Acidic Rocks of Eigg

	ANORTHO-CLASE	PLAGIO-CLASE	OPAQUES	CLINO-PYROXENE	ORTHO-PYROXENE	MATRIX
Extrusive pitchstones						
E7406 (above base)	6 77	8 84	1 85	1 16	1 75	79 64
E7443 (above base)	6 45	13 38	0 81	2 15	0 81	75 07
EA1 (at base)	10 54	16 01	2 62	1 10	2 97	66 75
Intrusive felsites which merge with pitchstone						
EA27	7 02	11 19	0 90	0 24	-	80 65
EA43	6 73	9 20	1 56	0 27	-	82 24
EA44 *	✓	–	✓	✓	–	
Definite intrusions						
E7442 (dyke)	9 49	12 74	2 05	2 27	0 47	73 46
EA48 (cross-cuts flow banding)	8 14	7 64	1 18	-	-	83 04
Relationships unknown						
EA9 Felsites at base of pitchstone mass	5 38	14 07	2 72	0 99	-	76 84
EA46	15 71	11 38	1 13	1 20	-	70 59
Carmichael (1960b) EC20	19 2 (alk fs)	trace	0 51	1 0 (pyroxene)		79 3

Table 7 2 Modal Analyses of the Sgurr Pitchstones and Felsites (Vol %)

* Modal analysis not available Phenocryst assemblage indicated

(a) Proportions of the different types of phenocrysts and matrix *

	Salic Phenocrysts	Mafic Phenocrysts	Matrix
Extrusive pitchstones	15 61 - 19 83	3 77 - 6 69	66 75 - 79 64
Partially intrusive felsites	15 93 - 18 21	1 14 - 2 83	80 85 - 82 24
Definitely intrusive felsites	22 23	1 18	83 04

(b) Proportions of the different mafic phenocrysts *

	Opaque oxides	Clino-pyroxene	Ortho-pyroxene
Extrusive pitchstones	0 81 - 2 62	1 10 - 2 15	0 81 - 2.95
Partially intrusive felsites	0 90 - 1 56	0 24 - 0 27	0 00
Definitely intrusive felsites	1 18	0 00	0 00

* Values given as modal percentage, see Table 7 2 for details of individual samples

Table 7 3 Intrusive and Extrusive Rocks of the Sgurr Pitchstone Mass

No identifiable fragments	Crystal fragments only	Crystal and lithic fragments
M7535	M7540	M7563
M7539	M7542	M7572
M7541	M7641	M7613
M7523	M7661	M7616
	E7616	M7631
	E7640	M7635
	C7771	M7652
		M7668
		E7619
		E7648
		C7726
Relative Proportions 18%	32%	50%

Table 8.1: Fragments in the Fine Grained Deposits

T A B L E 8.2

MINERALOGY OF THE CRYSTAL FRAGMENTS IN THE FINE GRAINED DEPOSITS

Sample No.	Qtz	Alk.fs.	Plag.	Musc.	Biot.	Epid	Ol.	Pyrox.	Opq.
M7540		a	✓	✓					
M7542	✓								
M2641								cpx	
M7661 (r)		f							
E7616	✓	f					(v)		
E7640		f	✓						
C7771	✓	f			✓	✓			✓
M7563		a	✓				✓	cpx	
M7572		a							
M7613	✓		✓	✓			(v)		
M7616	✓	o	✓						✓
M7631		m	✓					?	✓
M7635	✓	f			✓			cpx	
M7652	✓	m?	✓		✓			opx	✓
M7668		f		✓	✓				✓
E7619		f	✓					cpx	
E7648	✓		✓	✓	✓				✓
C7726	✓						✓		✓

Basic Pebbles	Sedimentary Rock Pebbles	Acidic Pebbles
Gabbros	Sandstones	Porphyritic felsites
C7510A	C7502B	C7502C
C7510E	C7502D	C7510C
Basalts	C7502E	C7510G
C7501A	C7502J	C7591A
C7501B	C7510B	
C7501C	C7591F	Granophyres
C7501D	Feldspathic sandstones	C7510F
C7501F	C7502A	C7591D
C7501G	C7502F	C7510I
C7502G	C7502H	
C7518A	C7502I	
C7518C	C7510D	
C7522B	C7591B	
Hawaiites	C7591E	
C7501E	C7591G	
C7510H	Arkoses	
	C7518B	
	C7522A	
	Quartzitic sand-stones	
	C7591C	

Table 8.3: Rock Types found as Pebbles in the Coarse Grained Sediments of Canna

Line	KeV	Crystal	Peak angle	Background measured on	Standard
Na K_{α_*}	1.041	KAP	53° 12'	MgO	Jadeite
Mg K_{α_*}	1.254	"	43° 37'	Al_2O_3 std.	MgO
Al K_{α_1}	1.487	"	36° 30'	MgO std	Al_2O_3
Si K_{α_1}	1.740	"	31° 00'	Al_2O_3 std.	Wollastonite
Ca K_{α_1}	3.691	LiF	113° 03'	Al_2O_3 std.	"
Ti K_{α_1}	4.510	"	86° 09'	Cr_2O_3 std.	TiO_2
Cr K_{α_1}	5 414	"	69° 22'	TiO_2 std.	Cr_2O_3
Mn K_{α_1}	5 898	"	62° 59'	2° either side of peak	Mn
Fe K_{α_1}	6.403	"	57° 31'	"	Fe
Ni K_{α_1}	7.477	"	48° 38'	"	Ni
K K_{α_1}	3.313	PET	50° 30'	"	Orthoclase

Table 9 1 Electron Microprobe analysing Conditions and Standards used

TABLE 9.2

OLIVINE ANALYSES FROM BASIC ROCKS

Analyses of Olivines from Aphyric Basalts

	1	2	3	4	5
SiO_2	39.70	37.29	38.60	39.02	38.54
FeO	18.29	29.19	21.64	15.04	17.55
MgO	41.98	32.73	37.25	46.16	44.07
MnO	0.31	0.53	0.34	-	-
NiO	0.25	0.21	0.24	-	-
Total	100.53	99.95	98.57	100.22	100.16
% Fost-erite	80.36	66.64	75.67	84.54	75.33

1. Core of olivine from E7481.
2. Margin of same olivine (E7481).
3. Another olivine from E7481.
4. Most fosteritic olivine from E9, a 2 ft wide dyke at Kildonnan, Eigg - a basalt. Analysis from Ridley (1973).
5. Least fosteritic olivine from E9 (as 4).

Analyses of Olivines from Olivine - Phyric Basalt

	1	2	3	4	5
SiO_2	38.55	36.45	40.29	37.10	38.47
FeO	14.99	24.75	15.04	27.11	18.15
MgO	44.50	36.91	44.06	33.49	42.31
MnO	0.23	0.43	0.23	0.46	0.23
NiO	0.37	0.30	0.33	0.24	0.39
Total	98.65	98.84	99.95	98.40	99.55
% Fost-erite	84.10	72.66	83.92	68.76	80.60

	6	7	8	9	10
SiO_2	37.21	40.01	38.42	39.69	36.98
FeO	26.27	14.46	20.82	12.75	28.03
MgO	35.59	44.60	39.15	45.49	33.50
MnO	0.47	0.26	0.37	0.22	0.48
NiO	0.25	0.25	0.21	0.39	0.28
Total	99.79	99.58	98.97	98.54	99.27
% Fost-erite	70.72	84.61	77.02	86.41	68.05

1. Core of olivine phenocryst from E7468.
2. Margin of the same.
3. Core of olivine phenocryst from E7486.
4. Margin of the same.
5. Core of olivine phenocryst from E7465.
6. Margin of the same
7. Core of olivine phenocryst from E7482.
8. Margin of the same.
9. Core of olivine phenocryst from E7487.
10. Margin of the same.

Analyses of Olivines from Eigg Intrusive Rocks

	1	2	3	4
SiO_2	34.99	39.22	40.05	40.17
FeO	30.95	22.80	12.51	12.54
MgO	31.84	36.59	46.16	46.49
MnO	0.59	0.34	0.15	0.17
NiO	0.16	0.16	0.30	0.25
Total	98.53	99.01	98.87	99.27
% Fost-erite	64.70	74.09	86.80	86.85

1. Olivine from E7402 (aphyric hawaiite).
2. Olivine from E7402 (aphyric hawaiite).
3. Core of olivine phenocryst from E7403 (plagioclase, olivine and clinopyroxene phyric basalt).
4. Margin of 3.

Analyses of Olivines from MD13 (olivine-phyric basalt dyke from Muck)

	1	2	3	4
SiO_2	40.02	40.40	40.52	39.95
FeO	15.73	14.77	11.13	11.49
MgO	42.01	43.73	47.18	47.82
MnO	0.04	0.03	0.19	0.19
NiO	0.03	0.25	0.28	0.36
Total	97.83	99.18	99.30	99.81
% Fost-erite	82.63	84.07	88.31	88.12

1 & 2. Olivines from groundmass.

3. Core of olivine phenocryst.

4. Margin of 3.

Analyses of Olivines from E2, 15 ft wide porphyritic dyke, located 0.5 ml north of Kildonnan, Eigg (Ridley 1973)

	1	2	3
SiO_2	39.71	40.01	40.26
FeO	14.04	10.07	13.04
MgO	46.11	48.59	46.31
CaO	0.37	0.39	0.40
Total	100.23	99.04	100.01
% Fost-erite	85.44	89.58	86.37

1. Average of 8 groundmass olivines analysed.
2. Most fosteritic of 5 olivine microphenocrysts analysed.
3. Least fosteritic of 5 olivine microphenocrysts analysed.

TABLE 9.3

CLINOPYROXENE ANALYSES FROM BASIC ROCKS

Analyses of Groundmass Clinopyroxenes from E7481

(Aphyric Basalt)

	1	2	3
SiO_2	51.56	50.10	50.29
Al_2O_3	2.20	3.66	2.52
TiO_2	0.82	0.96	1.22
FeO	8.14	7.97	10.62
MnO	0.23	0.24	0.32
CaO	20.72	21.26	20.52
MgO	14.64	14.88	13.36
Na_2O	0.32	0.37	0.45
Total	98.63	99.44	99.30
Proportions of the three end members			
Fe	13.39	12.91	17.49
Mg	42.92	42.97	39.21
Ca	43.69	44.13	43.30

1. Core of clinopyroxene.

2. Core of clinopyroxene.

3. Margin of 2.

Analyses of Groundmass Clinopyroxenes from Olivine Phyric Basalts

	1	2	3	4	5
SiO_2	50.32	50.44	51.56	49.94	50.51
Al_2O_3	3.43	2.37	2.24	2.93	3.15
TiO_2	0.94	1.39	0.51	1.18	1.24
FeO	7.78	11.94	6.67	7.96	7.95
MnO	0.21	0.38	0.20	0.25	0.25
CaO	20.24	19.41	20.88	21.57	21.18
MgO	15.09	13.24	15.99	14.36	14.33
Na_2O	0.33	0.45	0.29	0.54	0.68
Total	98.33	99.62	98.34	99.34	99.29
Proportion of the 3 end members					
Fe	12.84	19.76	10.78	13.00	13.11
Mg	44.37	39.07	46.02	41.17	42.12
Ca	42.79	41.17	43.20	45.17	44.76

1. Core of clinopyroxene from E7468.
2. Margin of the same.
3. Most magnesian clinopyroxene found in E7468.
4. Core of clinopyroxene from E7486.
5. Margin of the same.

Analyses of Groundmass Clinopyroxenes from E7471

(Mugearite)

	1	2	3
SiO_2	48.76	49.45	50.99
Al_2O_3	4.41	4.22	2.61
TiO_2	1.06	0.93	0.61
FeO	11.74	11.94	11.45
MnO	0.29	0.27	0.00
CaO	16.85	16.85	20.91
MgO	14.24	13.81	12.79
Na_2O	3.60	3.49	1.20
Total	100.95	100.96	100.56
Proportions of the three end members			
Fe	19.99	20.53	18.76
Mg	43.23	42.33	37.35
Ca	36.78	37.13	43.90

1. Core of large brownish clinopyroxene.

2. Margin of the same.

3. Colourless clinopyroxene.

Analyses of Clinopyroxene Phenocryst from E7403

(plagioclase, olivine and clinopyroxene phyric basalt)

	Core	Margin
SiO_2	50.78	51.31
Al_2O_3	4.69	4.99
TiO_2	0.43	0.46
FeO	4.84	4.63
MnO	0.11	0.08
CaO	21.65	20.99
MgO	16.03	16.37
Na_2O	0.30	0.32
Total	98.83	99.15
Proportions of the three end members		
Fe	7.92	7.63
Mg	46.71	48.07
Ca	45.37	44.31

Analyses of Groundmass Clinopyroxenes from Eigg Intrusive Rocks

	1	2	3	4
SiO_2	47.97	48.75	51.03	50.26
Al_2O_3	3.27	5.07	2.32	4.11
TiO_2	2.22	1.78	0.61	1.21
FeO	13.92	12.98	9.46	10.39
MnO	0.33	0.25	0.31	0.25
CaO	21.01	20.75	17.55	19.77
MgO	9.85	10.03	17.41	14.37
Na_2O	0.61	0.61	0.24	0.48
Total	99.18	100.22	98.93	100.84
Proportions of the three end members				
Fe	23.84	22.60	15.02	16.94
Mg	30.06	31.12	49.27	41.76
Ca	46.10	46.28	35.71	41.30

1. Clinopyroxene from E7402 (hawaiite).

2. As 1.

3. Clinopyroxene from E7446 (hawaiite).

4. As 3.

Analyses of Clinopyroxene from Matrix of MD13

(olivine phyric basalt dyke from Muck)

	1	2
SiO_2	50.47	50.40
Al_2O_3	4.59	3.91
TiO_2	1.96	1.88
FeO	12.77	12.82
MnO	0.05	0.04
CaO	18.70	20.03
MgO	12.16	11.85
Na_2O	0.06	0.04
Total	100.76	100.97
Proportions of the three end members		
Fe	21.86	21.51
Mg	37.12	35.43
Ca	41.02	43.06

Analyses of Pyroxenes from Eigg and Muck Basic Dykes

(Ridley 1973)

	E9	E2	E1	M12
SiO_2	48.94	49.30	47.85	50.38
Al_2O_3	3.38	2.82	4.39	3.12
TiO_2	1.49	0.98	2.03	1.49
FeO	10.57	12.62	11.57	8.99
MnO	0.21	n.a.	0.24	0.27
CaO	20.44	19.99	20.59	21.34
MgO	14.10	12.93	13.28	14.53
Total	99.13	98.64	99.95	100.13
Proportions of the three end members				
Fe	17.09	20.64	18.77	14.47
Mg	40.61	37.56	38.41	41.61
Ca	42.30	41.80	42.81	43.92

E9 Average of 7 analyses from a 2 ft wide dyke (basalt), Kildonnan, Eigg.

E2 Average of 3 analyses from a 15 ft wide porphyritic dyke (basalt), ½ ml north of Kildonnan, Eigg.

E1 Average of 3 analyses from a 6" wide dyke (basalt), ½ ml north of Kildonnan, Eigg.

M12 Average of 5 analyses from a coarse dyke (hawaiite), Blar Mor, Muck.

SAMPLE	FERROSILITE		ENSTATITE		WOLLASTONITE	
	Core	Margin	Core	Margin	Core	Margin
E7403 (I)	7.9	7.6	46.7	48 1	45.4	44.3
E7468	12.8	19.8	44.4	39 1	42 8	41 2
E7471	20 0	20.5	43.2	42 3	36 8	37.1
E7481	12.9	17.5	43 0	39.2	44.1	43.3
E7486	13.0	13.1	41 2	42.1	45 2	44 8

(I) - Intrusive sample

Table 9.4 Compositional Zoning in Five Clinopyroxenes from Basic Rocks

Sample Number	Colour of pyroxene	% TiO_2 in pyroxene	Host rock type	Discriminant function score
E7402*	Deep pink-brown	1.8 - 2.2	Hawaiite	- 0.671
E7403*	Pink-brown	0.4 - 0.5	Basalt	+ 0.549
E7446*	Faintly pink	0.6 - 1.2	Hawaiite	+ 0.232
E7468 core	Colourless	0.9	Basalt	- 0.136
E7468 margin	Pink-brown	1.4		
E7471	Colourless	0.6	Mugearite	n.p.
	Brown	0.9 - 1.1		
E7481	Brownish-pink	0.8 - 1.2	n.a.	n.p.
E7486	Pink	1.2	Basalt	n.p.
MD13*	Purple to orange brown	1.9 - 2.0	Basalt	n.p.

* Basic minor intrusions

n.a. Whole rock not analysed

n.p. Sample not processed by discriminant analysis program

Discriminant function scores: Negative values indicate alkaline affinities.

Positive values indicate tholeiitic affinities.

Table 9.5: TiO_2 Content and Colour of Pyroxenes (Basic Rocks)

T A B L E 9.6

PLACIOCLASE ANALYSES FROM BASIC ROCKS

Plagioclase Analyses from Eigg Lavas

	1	2	3	4
SiO_2	53.40	52.26	53.66	49.91
Al_2O_3	28.38	28.91	28.44	32.45
FeO	0.58	0.63	0.59	0.53
MgO	0.07	0.07	0.08	0.16
CaO	12.80	12.76	12.93	14.38
Na_2O	4.15	4.32	3.86	3.30
K_2O	0.22	0.30	0.25	0.11
Total	99.60	99.25	99.81	100.82
An	62.21	60.95	63.97	70.22
Ab	36.52	37.36	34.59	29.14
Or	1.27	1.69	1.45	0.64

1. Core of plagioclase phenocryst from E7472 (Hawaiite).
2. Margin of 1.
3. Core of another plagioclase phenocryst from E7472 (Hawaiite).
4. Plagioclase phenocryst from E7481 (Basalt).

Plagioclase Analyses from Basic Rocks of Eigg and Muck

(Ridley 1973)

	1	2	3	4	5	6
An	71.37	42.30	41.21	1.53	43.54	1.68
Ab	28.76	56.08	56.45	78.08	56.42	72.08
Or	0.29	1.24	3.50	21.50	2.34	26.20

	7	8	9	10	11	12
An	45.78	0.34	54.90	0.94	61.63	12.35
Ab	53.55	65.56	44.76	71.23	38.32	75.88
Or	2.80	34.30	2.60	28.60	2.11	12.60

1. Most anorthite rich plagioclase from E1, 6" wide dyke, located ½ ml north of Kildonnan, Eigg. (Partial analyses)

2. Least anorthite rich plagioclase from E1 (as 1) .

3,4 Core/margin pair from M12, a coarse dyke, Blar Mor, Muck.

5,6 " " " " " " " " " " "

7,8 " " " " " " " " " " "

9,10 " " " " " " " " " " "

11,12 " " " " " " " " " " "

	E10	E1
FeO	71.70	69.73
Al_2O_3	1.97	1.74
TiO_2	20.13	22.00
MnO	1.00	0.88
MgO	0.79	0.80
Ulvospinel basis		
FeO	46.49	47.85
Fe_2O_3	28.05	24.57
Ilmenite basis		
FeO	34.41	34.65
Fe_2O_3	43.78	39.20

E10 Average of 2 analyses from a porphyritic flow (Hawaiite), 100 ft below Sgurr of Eigg.

E1 Average of 5 analyses from 6" wide dyke (Basalt), ½ ml north of Kildonnan, Eigg.

Table 9.7: Iron-titanium Oxides from Basic Rocks (Ridley 1973)

	Ca-rich pyroxenes				Ca-poor pyroxenes	
	EP28	EP18	EC20	EP24	EP28	EC20
SiO_2	51.95	51.41	51.72	47.36	53.82	51.88
Al_2O_3	1.86	1.64	1.02	0.22	0.62	1.46
TiO_2	0.74	0.68	0.62	0.38	0.33	0.57
Fe_2O_3	-	-	2.40	-	-	2.55
FeO	10.72*	10.95*	7.56	31.37*	18.97*	16.80
MnO	0.69	0.84	1.27	1.43	1.41	1.88
CaO	19.02	18.26	19.84	18.39	1.58	2.19
MgO	14.21	15.06	15.12	0.07	24.20	22.37
Na_2O	0.55	0.58	0.32	0.72	n.d.	0.23
Total	99.74	99.42	99.90	99.94	100.93	99.94
Fe	17.74	17.88	17.3	56.99	29.61	33.0
Mg	41.92	43.86	42.5	0.20	67.23	62.6
Ca	40.34	38.26	40.1	42.80	3.16	4.4

* Iron as total FeO

EP18)
) Sgurr pitchstone (Ridley 1973)
EP28)

EP24 Western pitchstone dyke, Rudh' an Tancaird (Ridley 1973)

EC20 Sgurr pitchstone (Carmichael 1960a)

(N.B. Rudh an Chromain of Ridley is same place as Rudh' an Tancaird of most recent O.S. maps.)

Table 9.8 Pyroxenes from the Acid Rocks of Eigg

	Skaergaard ferroaugites	Sgurr augites	Sgurr hypersthenes	Rudh' an Tancaird ferrohedenbergite
MnO	1.1	0.68	0.45	0.38
TiO_2	2.0	1.51	1.04	0.22
Al_2O_3	0.32	0.93	1.65	1.43

(N.B. Skaergaard and both Sgurr pyroxene types quoted as average weight percentages.)

Table 9.9 MnO, TiO_2 and Al_2O_3 in Pyroxenes from the Acid Rocks of Eigg compared with the Skaergaard Ferroaugites

	Alkali Feldspars				Plagioclase Feld-spars	
	EC20	EP24 (av.of 4)	EP21 (av.of 12)	EP6 (av.of 13)	EP24 (most calcic)	EP24 (least calcic)
SiO_2	64.58	66.61	PARTIAL ANALYSIS	PARTIAL ANALYSIS	59.42	63.82
Al_2O_3	20.30	19.94			24.15	21.79
Fe_2O_3	0.43	n.d.			n.d.	n.d.
CaO	1.26	0.16			8.84	3.53
Na_2O	6.06	7.09			6.22	7.33
K_2O	7.12	6.49			0.84	3.17
Total	99.75	100.29			99.47	99.64
An	6.1	0.84	0.86	3.95	43.84	17.50
Ab	51.5	59.99	60.32	60.70	52.62	62.05
Or	42.4	38.51	39.87	34.28	4.96	18.73

n.d. - not determined

Partial analysis - Na_2O, CaO and K_2O only determined for sample.

EP6 Felsite dyke associated with main felsite intrusion, Cleadale (Ridley 1973).

EP21 Felsitic part of eastern pitchstone dyke, Rudh' an Tancaird (Ridley 1973).

EP24 Western pitchstone dyke, Rudh' an Tancaird (Ridley 1973).

EC20 Sgurr pitchstone (Carmichael 1960b)

Table 9.10 Feldspars from the Acid Rocks of Eigg

	Microcline[1] - low albite series	Orthoclase[1] - low albite series	Sanidine-[1] Anorthoclase - high albite series	High[1] Sanidine - high albite series	Sgurr[2] alkali feldspar
α	1.514-1.529	1.518-1.529	1.518-1.527	1.518-1.527	1.525
β	1.518-1.533	1.522-1.533	1.522-1.532	1.523-1.532	1.530
γ	1.521-1.539	1.522-1.539	1.522-1.534	1.524-1.534	1.532
2V	$66^0 - 103^0$	$33^0 - 103^0$	$18^0 - 54^0$	$63^0 - 54^0$	$45^0 - 52^0$

Key:

α, β, γ least, intermediate and greatest refractive indices.

2V optic axial angle

1. Date from Deer, Howie and Zussman 1966.

2. Data from Carmichael 1960b.

Table 9.11: Optical Properties of the Alkali Feldspar Series

	Titanomagnetites		Ilmenites	
	EC20	EP28	EC20	EP18
SiO_2	0.08	n.d.	*	n.d.
TiO_2	13.50	13.73	45.60	37.96
Al_2O_3	1.42	1.89	0.13	0.48
V_2O_3	0.14	n.d.	*	n.d.
Cr_2O_3	0.01	n.d.	*	n.d.
FeO	76.70	77.38	48.20	56.33
MnO	1.16	0.86	1.25	0.55
MgO	2.12	2.01	3.31	2.80
CaO	0.02	n.d.	0.03	n.d.
ZnO	0.19	n.d.	*	n.d.
<u>Ulvospinel basis</u>				
FeO	39.23	39.75		
Fe_2O_3	41.70	41.88		
<u>Ilmenite basis</u>				
FeO	31.09	31.47	33.93	28.90
Fe_2O_3	50.68	51.01	15.86	30.43

* Below limit of sensitivity (0.01%).

n.d. – not determined

EC20 Sgurr of Eigg pitchstone (Carmichael 1960a)

EP28)
) Sgurr of Eigg pitchstones (Ridley 1973)
EP18)

<u>Table 9.12</u>: <u>Iron-titanium Oxides from the Sgurr of Eigg</u>

	INTRUSIVES			EXTRUSIVES		
	Ne	Hy	Qtz	Ne	Hy	Qtz
EIGG	35	65	0	42	46	12
MUCK	41	49	10	64	35	1
CANNA	33	67	0	18	81	1

Ne - Nepheline in norm.

Hy - Hypersthene but no quartz in norm.

Qtz - Quartz in norm.

Table 10.1: Relative Proportions of Nepheline, Hypersthene and Quartz Normative Samples in Basic Rocks

SiO_2	44 - 50 wt. %
Al_2O_3	less than 18 wt. %
$FeO + Fe_2O_3$	less than 16 wt. %
MgO	less than 15 wt. %
CaO	less than 12 - 13 wt. %
Ni	less than 1000 ppm
Cr	" " " "
Ba	" " " "
Zr	less than 200 ppm

Table 10.2: Restrictions on Input Data for Discriminant Analysis Program

Ridley (1971, 1973)

	Basalt	Hawaiite	Mugearite	Benmoreite
DI	40	40 - 50	50 - 65	65 - 75

Thompson et al (1972)

	Basalt	Hawaiite	Mugearite	Benmoreite	Trachyte
DI	30	30	45 - 65	65 - 75	75
% An	50 - 70	30 - 50	15 - 30	5 - 15	0 - 10

Present work

	Basalt	Basaltic Hawaiite			Hawaiite	Mugearite
DI	30	30	or	30	30 - 45	45 - 65
		+		+		
% An	50 - 70	30 - 50		50 - 70	30 - 50	15 - 30

Note:-

DI Thorton Tuttle Differentiation Index

% An Normative plagioclase anorthite content
(also composition of model plagioclase of Thompson et al)

Table 10.3: Nomenclature used in Recent Work on Hebridean Basic Volcanics

	Quartz tholeiites < 52% SiO_2	Basaltic Icelandites 52 - 56% SiO_2	Icelandites > 56% SiO_2
INTRUSIVES			
	MD35	MD36M	MD7
	MD35T	MD108	MD99
EXTRUSIVES			
	C7518C	M7653	EA21B
	C7550	EA25	EA24B
	SR254	EA30	EA24D
		EA35	
		C7536	

Table 10:4: Quartz Normative Samples - Nomenclature

Group 1

High MgO	over 9%
High CaO	10 - 12%
Low iron	12%
Low Na_2O	c. 2.5 - 3%
Low TiO_2	1 - c.1.6%
Low P_2O_5	0.1 - c.0.2%

Basalts:- E7467, E7469, E7636, E7649, E7654, EA8

Hawaiites.- E7662, EA21C

Group 2

Low MgO	8% or less
Low CaO	8 - 9%
High FeO	13.5% or more
High Na_2O	over c.3%
High TiO_2	over c.2.5%
High P_2O_5	over c.0.25%

Basalts:- E7427, E7429, E7430, E7458

Hawaiites:- E7479

Table 10.5: Major Element Characteristics of the Two Groups of Eigg Basalts

(Hawaiites associated with each group are also listed.)

Discriminant Analysis Group	Sample Number	Discriminant Function Store	Harker Diagram Group (see Tab.10.5)
Tholeiite	E7654	+ 0.254	1
"	EA8	+ 0.245	1
"	E7649	+ 0.182	1
"	E7636	+ 0.003	1
Alkaline	E7469	- 0.171	1
"	E7662	- 0.257	1
"	E7467	- 0.279	1
"	E7427	- 0.303	2
"	E7458	- 0.537	2
"	E7429	- 0.615	2
"	E7479	- 0.832	2
"	E7430	- 0.838	2

Table 10.6: Discriminant Function Scores for the Two Groups of Eigg Basalts and Hawaiites

Rhum Groups		FeO (total)	MgO	CaO	Na_2O	TiO_2	P_2O_5
1	Pebbles older than Group 2	Eigg Group 1 Some Canna pebbles	Some Canna pebbles	Eigg Group 1 Some Canna pebbles	None	Eigg Group 1 Some Canna pebbles	Eigg Group 1 Some Canna pebbles
2	Olivine basalts from	Possibly Eigg Group 1	Canna and Muck or Eigg Group 1	Canna	Canna or Eigg Group 1	Canna	None
3	Orval Hawai-ites	Canna lavas	Canna lavas	Canna lavas	Canna lavas	Canna lavas	Canna lavas
4	Differentiates from Fionchra and Blood-stone Hill	Canna Hawai-ites	Canna Hawai-ites	Canna Hawai-ites	None	Muck mugear-ites	Canna Hawai-ites
5	Icelandites from Blood-stone Hill and South Fionchra	Icelandite pebbles from Eigg	Icelandite pebbles from Eigg	Icelandite pebbles from Eigg	Icelandite pebbles from Eigg	Icelandite pebbles from Eigg	Icelandite pebbles from Eigg

Table 10 7 Summary of Geochemical Comparisons of the Eigg, Muck and Canna Extrusives with the Rhum Lavas (Major Elements)

	Rhum Group	FeO (total)	MgO	CaO	Na_2O	TiO_2	P_2O_5
1	Pebbles older than Group 2	Lowest FeO samples	Highest MgO samples	Highest CaO samples	Main bulk of samples	Lower TiO_2 samples	Lower P_2O_5 samples
2	Olivine basalts from Rhum	Majority of samples	Majority of samples	Low CaO samples	Main bulk of samples	Main bulk of samples	Main bulk of samples
3	Orval Hawaiites	Majority of samples	Lowest MgO samples	Low CaO samples	Higher CaO than majority	Highest TiO_2 samples	Highest P_2O_5 samples
4	Differentiates from Fionchra and Bloodstone Hill	Highest FeO samples + Quartz tholei-ites	Lowest MgO samples + Quartz tholei-ites	Low CaO samples	Quartz tholei-ite	Quartz Hawai-ites	None
5	Icelandites from Bloodstone Hill and South Fionchra	Porphyritic icelandites	Porphyritic icelandites	Porphyritic icelandites	Porphyritic icelandites	Porphyritic icelandites	Porphyritic icelandites

Table 10.8 Summary of the Comparisons of the Basic Minor Intrusives with the Rhum Lavas (Major Elements)

Element	ppm Group 1	ppm Group 2
Ba	100 - 200	over 1000
Nb	c.6	20 - 25
Zr	c.100	350 - 400
Y	25	40
Sr	350 - 450	500
Rb	10	40

Samples in Group 1:- M7597, M75127

Samples in Group 2:- M7579, M75146, M7608, M7638, M7653

Table 10.9: Trace Element Characteristics of the Two Groups of Extrusive Mugearites from Muck

Element	ppm Group 1	ppm Group 2
Zr	150	150 - 200
Y	15 - 25	30 - 40
Sr	250 - 400	450 - 550
Cu	70	50
Ni	90	50
Cr	350	c.50

Lavas in Group 1:- E7467, E7469, E7636, E7649, E7654, EA8

Lavas in Group 2:- E7427, E7429, E7430, E7458

Table 10.10: Trace Element Characteristics of the Two Groups of Extrusive Basalts from Eigg

Rhum Groups		Zr	Y	Sr	Cu	Ni	Cr
1	Pebbles older than Group 2	Group 1 Eigg Some Canna pebbles	Canna lavas and some pebbles	Lowest Sr samples (i e some of Eigg Group 1)	Group 1 Eigg and some Canna lavas	Group 1 Eigg and some Canna lavas	Some Group 1 Eigg (lower Cr samples) and some Canna pebbles
2	Olivine basalts from	Group 2 Eigg or Canna lavas possibly	Canna lavas	Canna lavas (except EM9868 - very high Sr)	Canna lavas	Possibly Canna lavas	Possibly Canna lavas
3	Orval hawaiites	Group 1 Eigg and Canna lavas	Canna lavas	Canna lavas	Group 1 Eigg and some Canna lavas	Canna lavas	Canna lavas
4	Differentials from Bloodstone Hill and Fionchra	Quartz tholeiite (Canna pebble) and other Canna pebbles	Quartz tholeiite (Canna pebble)	Some Canna hawaiite lavas	Some Canna hawaiites and quartz tholeiite (Canna pebble)	Muck and Canna mugearites	Muck mugearites
5	Icelandites from Bloodstone Hill and south Fionchra	None	Eigg Icelandite pebbles	Eigg Icelandite pebbles	Eigg Icelandite pebbles	Eigg Icelandite pebbles	Eigg Icelandite pebbles

Table 10 11 Summary of the Comparison of the Eigg, Muck and Canna extrusives with the Rhum lavas (trace elements)

Rhum Groups		Ba	Nb	Zr	Y	Sr	Rb	Ni	Cr
1	Pebbles older than Group 2	Eigg samples	Majority of samples	Lowest Zr samples	Majority of samples	Lowest Sr samples	Variable like some Muck samples	Majority of samples	Majority of samples
2	Olivine basalts	Few of Muck basalts	None	None	None	Few of Muck basalts	None	None	None
3	Orval hawaiites	Some Muck basalts	Majority of samples	Lowest Zr basalts and hawaiites	Majority of samples	Highest Sr basalts and hawaiites	Some Muck basalts	Lowest Ni basalts and hawaiites	Lowest Cr basalts and hawaiites
4	Differentiates from Bloodstone Hill and Fionchra	None	Quartz tholeiite (Muck)	Fairly similar to quartz tholeiite (Muck)	Fairly similar to quartz tholeiite (Muck)	Quartz tholeiite (Muck)	None	None	None
5	Icelandites from Bloodstone Hill and south Fionchra	*	*	*	*	*	*	* Icelandites of Muck	* Icelandites of Muck

* Icelandites of Muck only analysed for Ni and Cr

<u>Table 10 12</u> <u>Summary of the Comparisons of Basic Minor Intrusions with Rhum Lavas (trace elements)</u>

	Muck trend (Mildly alkaline)	Canna trend (Skye SiO_2-rich trend)	Ardnamurchan cone sheets trend (tholeiitic)
BASALTS	E7429 (2)	E7427 (2)	E7636 (1)
	E7430 (2)	E7467 (1)	E7649 (1)
	E7458 (2)	E7469 (1)	E7654 (1)
			EA8 (1)
HAWAIITES & BASALTIC ICELANDITES	E7479 (2)	E7662 (1)	
		EA21C (1)	
MUGEARITES & ICELANDITES	-	E7412	EA21B
		E7471	EA24B
		EA29	EA24D

Note:- (1) or (2) indicates Group to which sample belongs as defined by major and trace element geochemistry.

Table 10.13: Trends followed by the Aphyric and Sparsely Porphyritic Extrusives of Eigg on Total Alkalis versus Silica Diagram

	Skye dyke swarm	Basic Minor Intrusives of Eigg, Muck and Canna
SiO_2	44.28 - 49.92	46.06 - 49.45
Al_2O_3	13.40 - 20.72	13.59 - 15.52
Fe_2O_3	1.50 - 3.82	1.50 - 1.64
FeO	5.33 - 11.90	9.46 - 12.06
MgO	6.07 - 11.83	8.98 - 13.15
CaO	10.31 - 13.42	9.96 - 13.34
Na_2O	1.44 - 2.75	1.91 - 2.94
K_2O	0.04 - 0.45	0.08 - 0.30
TiO_2	0.37 - 1.38	0.98 - 1.52
MnO	0.10 - 0.23	0.18 - 0.24
P_2O_5	0.05 - 0.14	0.07 - 0.15
Total Alkalis	1.55 - 3.13	1.99 - 3.42
Nb	0 - 9	2 - 8
Rb	0 - 8	0 - 12
Sr	95 - 276	128 - 334
Y	8 - 37	11 - 43
Zr	20 - 83	40 - 89
Ti/Zr	100 - 144	95 - 203
Y/Zr	0.25 - 0.66	0.19 - 0.53

N.B. Major element ranges quoted as weight per cent oxide.
Trace element ranges quoted as parts-per-million element.

Table 10.14. Major and Trace Element Concentrations in Samples belonging to the Preshal Mhor Magma Type

	Skye dyke swarm	Basic Minor Intrusions of Eigg, Muck and Canna*	Basic Extrusives of Eigg, Muck and Canna*
SiO_2	45 73 - 47 79	45 83 - 48 90 (50 70)	46 24 - 49 06 (49 23)
Al_2O_3	13 86 - 17 15	13 81 - 15 36 (17 27)	14 39 - 15 55 (16 39)
Fe_2O_3	1 50 - 2 11	1 47 - 1 60 (2 00)	1 47 - 1 56 (2 02)
FeO	8 42 - 12 11	9 12 - 13 29	9 18 - 10 71 (11 76)
MgO	5 26 - 7 95	6 95 - 11 64	6 35 - 11 28
CaO	6 99 - 9 73	9.96 (8 65) - 12 10	10 40 (7 67) - 11 28
Na_2O	2 72 - 4 23	2 42 - 3 07 (4 42)	2 41 - 3 13 (3 33)
K_2O	0 36 - 0 68	0 15 - 0 37 (1 37)	0 16 - 0 48 (1 85)
TiO_2	1 04 - 2 00	1 18 - 1 71 (2 30)	1 25 - 1 53 (1 99)
MnO	0 14 - 0 23	0 16 - 0 30	0 19 - 0 21 (0 26)
P_2O_5	0 12 - 0 32	0 10 - 0 21 (0 47)	0 12 - 0 20 (0 63)
Total Alkalis	3 08 - 4 91	2 77 - 3 42 (4 96)	2 57 - 3 61 (5 18)
Nb	4 - 7	2 - 7 (10)	4 - 6
Rb	0 - 11	0 - 10 (13)	2 - 7
Sr	267 - 570	128 - 334	272 - 362
Y	25 - 35	11 - 29	15 - 27
Zr	68 - 95	50 - 89	66 - 86 (88)
Ti/Zr	90 - 131	95 - 203 (212)	99 - 118 (136)
Y/Zr	0 30 - 0 42	0 19 - 0.35	0 22 - 0 31

N B Major element ranges quoted as weight per cent oxide
Trace element ranges quoted as parts-per-million element

* Figures in brackets are ranges (where different) if hawaiites are included

Table 10 15 Major and trace element concentrations in samples belonging to the Fairy Bridge magma type

	1	2	3	4a	4b	4c
SiO_2	73.83	71.47	61.71	65.38	69.33	67.55
Al_2O_3	12.24	13.54	15.30	15.99	15.72	14.62
FeO	2.14	4.57	4.89	3.45	1.10	3.22
MgO	0.78	0.35	2.09	1.01	0.41	1.00
CaO	2.45	1.19	3.54	2.69	0.57	1.71
Na_2O	2.92	4.54	4.53	4.60	4.58	4.67
K_2O	4.18	2.91	4.68	4.03	6.34	4.56
TiO_2	0.28	0.51	1.50	1.29	0.75	1.05
MnO	0.09	0.24	0.11	0.14	0.05	0.33
P_2O_5	0.33	0.03	0.63	0.36	0.12	0.24
Ba	968	61	1568	2295	1013	1904
Nb	22	41	16	27	33	30
Zr	447	539	552	594	1021	604
Y	39	90	43	49	52	60
Sr	76	80	298	264	37	179
Rb	132	112	52	95	108	67
Zn	100	250	95	105	87	93
Cu	4	5	12	8	1	2
Cr	12	10	8	18	15	11
Ni	6	0	3	0	9	17

1 Sgorr Sgaileach/Sron Laimrhige felsites

2 Rudh' an Tancaird dykes

3 Grulin felsite

4 Sgurr pitchstones and felsites
- a Extrusive samples (E7406, E7443, EA1)
- b Intrusive samples (EA43, EA46, EA48)
- c Other felsitic samples (EA9, E74442, EA24C)

Table 11.1: Average Analyses of the Acid Rocks of Eigg

wt. %	Pantellerite	Comendite	Icelandic rhyolite (Thingmuli)
SiO_2	69.81	73.06	74.96
Al_2O_3	8.59	9.76	12.55
FeO*	7.81	5.17	2.66
MgO	0.10	0.10	0.02
CaO	0.42	0.32	0.90
Na_2O	6.46	5.64	4.41
K_2O	4.49	4.34	3.65
TiO_2	0.45	0.32	0.23
MnO	0.28	0.13	0.04
P_2O_5	0.13	0.02	0.04
H_2O	0.19	0.72	0.99
ppm.			
Ba	10	21	1000
Nb	320	72	26
Zr	1800	1250	400
Y	145	157	45
Sr	5	2	120
Rb	175	143	120
Zn	440	290	125
Cu	3.6	4.2	9
Ni	1.2	-	0.7

Table 11.2. Analyses of Rhyolites (Carmichael et. al. 1974)

Phenocryst	Size (cm)	Settling rate (m/yr)	Distance settled (m)		
			100 yrs	1,000 yrs	10,000 yrs
Alkali feldspar	0 1 - 0 5	0 1 - 0 5	10 - 50	100 - 500	1000 - 5000
Plagioclase	0 05 - 0 25	0 2	20	200	2000
Pyroxene	c 0 1	0 2	20	200	2000

Table 11 3 Crystal settling rates in Sgurr magma (after Shaw 1965)

APPENDICES

APPENDIX 1

SAMPLE NUMBERING

The sample numbers quoted in this thesis differ slightly from those used on hand specimens and thin sections of the author's material, which is at the Department of Geological Sciences, University of Durham. The numeric part of the sample identifier has not been changed, but the preceding letters have been in certain cases. The accompanying table lists these changes. It also includes approximate date of collection and source for the material not collected by the author.

SAMPLE NUMBER FORMATS

Island	Thin Section/ Hand Specimen	Usage in Thesis	Date of Collection/ Receipt of Sample
Eigg	HE74— —	E74— —	September 1974
	E6— —	E76— —	April 1976
	EA— —	EA— —	August 1976
Canna	HC75— —	C75— —	August 1975
	C7— —	C77— —	April 1977
	SR— — —	SR— — —	October 1977[1]
	T— — —	T— — —	September 1977[2]
	C15, C20	C15, C20	October 1974[3]
Muck	HM75— — —	M75— — —	July 1975
	M76— —	M76— —	April 1976
	MD— — —	MD— — —	April 1976[4]
Oigh Sgeir	SR303—	SR303—	August 1974[5]

1. Collected by Dr. C. H. Emeleus, October 1972.
2. Collected by Drs. A. Mussett and P. Dagley, Dept. of Geophysics, Liverpool University.
3. Collected by P. MacAllister-Hall, undergraduate at Aberdeen University, c. 1974.
4. Muck dyke samples, collected by R. P. Allwright, April 1976.
5. Collected by Mr. D. H. McGaw, Principal Keeper of Oigh Sgeir lighthouse.

APPENDIX 2

DETAILS OF THE BASIC MINOR INTRUSIONS

Geographical location (by grid reference, where known), trend, thickness and any notable features of all the basic minor intrusions examined by the author are given in the accompanying tables. A special study was made of the dykes of Muck and as a result they dominate the tables. The dykes and other minor intrusions of Canna and Eigg were not studied in detail, but the available information is included.

A2.1 Details of basic dykes of Muck

Sample No.	Grid Ref.	Trend (N x° E)	Thickness (m)	Notable features
MD1	42207920	160	1.60	
MD2	42217913	141	2.10	
MD3	42237903	153	0.65	
MD4	42337892	153	0.50-1.90	
MD5	42247887	153	2.00	
MD6	42227880	159	1.15	
MD7	42267864	144	2.40	
MD8	42277864	143	1.40	
MD9	42257861	135	0.60	
MD10	42207858	164	3.50	
MD11	42067861	162	16.70	
MD12	41987860	147	0.80-1.50	
MD13	41987857	156	0.70	
MD14	41967858	152	0.80	
MD15	42357923	160	1.20	0.04m thick chilled margins; platey jointing.
MD16	42667919	152	1.10	Jointing in various directions.
MD17	42437918	160	1.80	0.20-0.30m marginal vesicular zone; central core - smaller vesicles and platey jointing.
MD18	42697908	154	1.90	Columnar jointing; vesicles in lines paralleling margin.
MD19	42717908	145	2.70	
MD20	42427920	156	0.80	
MD21	42407919	130	0.25	
MD22	40658019	132	2.25	Tachylitic margins; bifurcates.
MD23	40668020	142	0.35	
MD24	40668021	159	1.10	
MD25	40678021	142	0.04-0.08	
MD26	40238019	144	0.35	
MD27	40738018	163	0.90	Irregular.
MD28	40778017	160	2.00	

Sample No.	Grid Ref.	Trend (N x^{o} E)	Thickness (m)	Notable features
MD29	40788017	168	0.10-0.35	Vertical jointing
MD30	40828019	140	6.70	Fine grained margins; v. altered in centre.
MD31	40818020	050	0.30	Cross cuts MD32.
MD32	40848020	148	2.80	Vesicular central part.
MD33	40868020	166	2.20	Variable orientation of jointing.
MD34	40878020	154	0.45	Vesicular core.
MD35	42757924	180	0.20-2.60	Tachylitic margins.
MD36	42867926	140	1.00	Vesicular core.
MD37	42877928	150	1.60	
MD38	42787927	158	0.30	
MD39	42877930	160	0.60	Disappears on entering breccia.
MD40	42867932	142	1.40	Subhorizontal jointing at margins.
MD41	42867938	150	3.00	
MD42	42817935	148	1.00	
MD43	42857932	141	0.50	
MD44	42887932	139	1.30	
MD45	42897941	158	1.50-2.30	
MD46	42897944	143	2.50	
MD47	42957946	162	0.80	
MD48	42987947	138	7.70	
MD49	43007950	172	4.80	
MD50	43907952	153	0.60	
MD51	43017954	151	2.20	
MD52	43027953	151	1.10	
MD53	40327994	165	0.90	Horizontal & vertical jointing.
MD54	39287962	145	0.15-0.43	Glassy.
MD55	39287962	161	3.50-8.70	) Multiple dyke intrusion
MD56	39267970	166	2.70	) along same line of
MD57	39247970	166	3.00	) weakness.
MD58	39817989	160	1.10	
MD59	39807999	167	1.20	
MD60	41967866	158	1.70	
MD61	41967866	161	3.30	

Sample No.	Grid Ref.	Trend (N x^{o} E)	Thickness (m)	Notable features
MD62	41967866	163	1.90	
MD63	41967866	163	3.40	
MD64	41937858	175	0.35	
MD65	41947856	169	8.00	
MD66	41907858	166	0.20-0.50	
MD67	41907857	159	3.80	
MD68	41897854	148	1.00	
MD69	41887852	160	3.50	
MD70	41887853	152	1.30	
MD71	41887850	151	1.50	
MD72	41877848	142	1.30	
MD73	41867848	152	2.60	
MD74	41867843	161	9.50	
MD75	41807837	151	1.50	
MD76	41747834	155	1.50-2.00	
MD77	43037953	155	1.10	
MD78	43047953	150	0.40	
MD79	41817947	148	2.50	
MD80	39477904	167	0.90	
MD81	39507902	167	1.10	
MD82	39587887	149	1.70	
MD83	39607886	150	0.70	
MD84	39567895	154	1.20	
MD85	39677878	0.4	0.05-0.55	
MD86	39677888	159	7.40	
MD87	39787882	167	1.20-1.50	
MD88	39797882	163	1.50	
MD89	39807883	155	4.50	
MD90	39907877	156	2.00	
MD91	39927877	157	1.40	
MD92	39937878	153	0.60	
MD93	39917888	173	5.00	
MD94	39967881	174	1.50-2.00	
MD95	40027879	162	9.0	
MD96	40077874	154	0.25	
MD97	40127873	157	2.50	

Sample No.	Grid Ref.	Trend (N x° E)	Thickness (m)	Notable features
MD98	40167873	170	2.00	
MD99	40227870	159	7.00	
MD100	40207878	159	5.00	
MD101	40327868	146	2.00	
MD102	40257887	148	1.00	
MD103	40277890	156	5.50	
MD104	40557915	154	1.80	
MD105	41027935	161	1.30	
MD106	40987936	151	0.45	
MD107	40917935	158	0.90	
MD108	40887933	156	4.30	
MD109	40787931	153	5.20	
MD110	40747974	155	1.90	
MD111	40687927	163	7.80	
MD112	40647926	153	3.20	
MD113	40637922	147	1.50	
MD114	40637921	172	0.45	
MD115	40627921	160	0.60	
MD116	40607921	157	2.20	
MD117	40597920	156	4.50	
MD118	40547913	164	0.70	
MD119	40567913	152	2.50	
MD120	42427921	130	0.25	0.03m thick chilled margins; vesicular.
MD121	40967937	167	1.10	10-30cm chilled margins.
MD122	40737935	174	1.30	Updomes surrounding Jurassic sediments.
MD123	40737935	174	5.70	

A2.2 Details of basic dykes of Eigg

Sample No.	Location	Trend (N x° E)	Thickness (m)	Notable features
E7402	47178864	153	0.55	Thermally metamorphoses ssr, dyke.
E7403	46938918	153	4.00	V. coarse grained dyke.
E7404	46928925	153	3.50	Bakes sediments, dyke with sill-like extensions.
E7409	47328750	?	0.50	Dyke in Sron Laimrhige felsite.
E7414	46478765	?	?	Intrudes grey rock.
E7417	47968829	?	3.00	Dyke with flow alignment of feldspars
E7418				Chilled margins 0.5 & 0.8m wide
E7435	46758468	?	?	Plug.
E7447	48738437	?	?	Cuts Kildonnan Sheet.
E7448	48778440	?	?	Cut by Kildonnan Sheet.
E7449	48818444	?	?	Cut by Kildonnan Sheet.
E7476	47188742	?	?	Intrudes basalts below Grey rock only.
E7484	47878798	125	1.50	Well-jointed.
E7602	47568662	152	1.10	Horizontal slab jointing.
E7613	47218746	?	?	V. altered margins.
E7615	47168743	?	?	V. fine grained + abundant feldspars.
E7626	46578698	112	c.6.00	Vesicular.
E7631	46688625	154	0.60	
E7633	46668622	150	0.70	Vesicular.
E7636	46188594	153	1.50	Coarse grained centre; v. fine grained margins.
E7646	48188584	144	1.90	
E7666	45978539	120	0.66	
EA38	45518461	146	0.50	} Join together
EA34	"	"	0.65	
EA39	45408437	142	1.00	Jointing in 3 planes.
EA40	45238450	176	1.50	Intrudes basalt but not Sgurr pitchstone.

Dykes with no hand specimen

Location	Grid Ref.	Trend	Thickness (m)	Notable features
Laig Bay	47118868	NNW/SSE	0.50	
"	47058882	W/E	1.00-1.20	Sill-like extension.
"	47808883	NNW/SSE	2.00	Includes a lens of sst; veined by quartz.
"	47708891	WNW/ESE	3.00	Sill-like extensions; internal chilled margins.
"	46898831	NW/SE	0.50	
The Nose	46388465	?	c.1.00	Cut off by Sgurr pitchstone.

A2.3 Details of basic sheets and sills of Eigg

Sample No.	Location	Thickness (m)	Notable features
E7401	47248851	0.70-1.00	Glassy margins; lmst. recrystallised with 0.17m of sill.
E7424	48449130	?	Dies out eastwards; inclined sheet.
E7446	48558428	?	Tachylitic margins; inclined sheet.
E7433	48029087	?	Splits up into smaller sills.
E7434	48059085	?	" " " " "
E7450	48738447	?	Kildonnan Sheet.

A2.4 Details of basic dykes of Canna collected by the author

Sample No.	Grid Ref.	Trend (N x° E)	Thickness (m)	Notable features
C7506, C7507, SR247	28080585	c.N/S	Irregular	Contains xenoliths of fine grained gabbros and baked sediments. Cuts agglomerate of Garbh Asgarnish.
C7523	27780510	030	1.00	Intrudes conglomerate nr. pier.
C7524	27810505	020	1.20	Forms E. end of pier.

APPENDIX 3

WHOLE ROCK GEOCHEMICAL ANALYSES - ADDITIONAL INFORMATION

A3.1 Sample preparation and X-ray fluorescence analysis

Samples for analysis were stripped of weathered surfaces and reduced to fragments a few centimetres in maximum dimension using a Cutrock Engineering hydraulic splitter. These fragments were reduced to 1 centimetre chips in a Sturtevant 2" x 6" Roll Jaw Crusher. Any chips with weathered surfaces were removed before the aggregate was ground to a fine powder using a Tema Laboratory Disc Mill. The length of time required for the material to reach a finely ground state varied, but usually took between 1 and 4 minutes.

Sufficient powder to form a pellet c. 3 millimetres thick was mixed with a few drops of an inert organic binding agent (Mowiol). The powder was then compressed at 800 - 900 Kg cm^{-2} (5 - 6 tons $inch^{-2}$) to form a pellet. The pellets were then analysed on a Philips PW1212 automatic spectrometer fitted with a Torrens Industries TE108 Automatic loader. Operating conditions were as given by Johannesson (1975).

The elements Si, Al, Fe, Ca, Mg, Na, K, Ti and P were determined using a Cr target and an evacuated tube. Mn was determined separately using W radiation. W radiation was also used to determine the trace elements Ba, Nb, Y, Sr, Rb, Zn, Cu, Ni and Cr. A monitor was included during major element analysis to enable use of a 'fixed count' time method for accumulation of the counts for the unknowns. This method minimises machine drift and instability.

The data handling method used for the major elements is described in Chapter 10. In all six tray loads of samples (each tray holds 108 pellets) were analysed. The finally accepted calibration of the data used sixteen standards for five of the six trays. BCR1 was omitted from Run 2. The standards used include BR, DTS, PCC1, W1, BCR1, GR, G P1, G2, G1, GH of the International Standards (see Flanagan 1973 for analyses) The lack of any standards of similar SiO_2 content to the basalts and hawaiites that the author anticipated (43% to 50%) led to the inclusion of several of the other 'standards'. They were received from various sources - see Table A3.1 for details. The other non-basaltic material used as standards (e.g. OK272, R174) was included to improve the cubic spline polynomial regression.

The trace elements were processed using the computer program TRATIO (written by R. C. O. Gill). This program calculates the function P/B - 1, where P is the counts accumulated at the peak position and B is the background counts value. A linear regression is performed on the functions for a set of samples of known composition (standards). The standards used in this case were synthetic spiked glasses produced by the Pilkington Research Laboratory for use in lunar investigations Brown et al 1970). TRATIO also compensates for mass absorption and matrix effects by using a scattered background radiation as an internal standard. Correction is made for the interferences of Sr K_β on Zr K_α, Rb K_β on Y K_α, and Y K_β on Nb K_α using experimentally determined interference factors. Nominal detection limits for the trace elements, and the upper limit of the standards used, are as given by Johannesson (1975).

A3.2 Reproducibility of the standards used for major element calibration

It required six tray loads (108 pellets in each tray of the Automatic Loader) to analyse the material from Eigg, Muck and Canna. The computer program first performs the cubic spline polynomial regression using the standards for calibration. It then calculates the concentrations of each element for the standards by treating them as unknowns. The degree of accuracy by which they are reproduced gives an estimate of the 'goodness' of the cubic spline polynomial fit to the data. Table A3.2 gives the actual concentrations of each element and those calculated by the six runs of the XRF data, along with the mean and standard deviation of the data.

Runs 1 and 2 were analysed consecutively and contained most of the Muck dyke material. Runs 3 through 6 were also run consecutively, but at a later date than runs 1 and 2. These latter runs contain all the basic extrusive samples, the intrusives of Canna and Eigg, the acidic rocks of Eigg and Oigh Sgeir, and a few Muck dykes.

Reproduction for SiO_2 is good apart from BCR1, GR and GSP1. BCR1 and GR are estimated about 2% above their actual value, while GSP1, for some of the runs, is up to 2% below. These discrepancies could not be corrected, but they were retained as standards as they did not seem to grossly affect reproduction of the other standards. They reproduce fairly well for the other elements.

The other elements are reproduced fairly well, with the exception of the MgO content of OK272. The quoted value is 1.04%, whereas the method of analyses used here suggests that it should be about 0.65%.

Sample Reference	Rock Type	Location	Analysis Method	Relevant Literature	Source of Material
L5	Basalt	Wiedemann Fjord, E Greenland	XRF	Unknown	P. E Brown, Aberdeen Univ
40524	Mafic gabbro	Tutquteq-Narssaq gabbros, Greenland	Wet chemistry	Unknown	B Upton, Edinburgh Univ
SK931	Hawaiite	5 5 km N of Portree, Skye	Wet chemistry	Thompson et al 1972	J Esson, Manchester Univ
BOB1	Olivine tholeiite	Fast spreading centre, East Scotia Sea (3290 m) 56^{o} 23 6' S 30^{o} 39 5' W	XRF (FeO by titration against N/20 ceric sulphate)	Unknown	Birmingham Univ
R174	Basic nepheline syenite	Marangudzi (?)	Wet chemistry	Unknown	A D Chambers (see Chambers 1978)
OK272	Unknown	South Africa	Unknown	Unknown	Cape Town Univ , South Africa (acquired by J G Holland)

Table A3 1 Details of Additional Standards used for Calibration

TABLE A3.2

REPRODUCTION OF THE STANDARDS USED FOR CALIBRATION

Notes:

$\bar{x}$ - mean of six XRF runs.

σ - standard deviation of six XRF runs.

n.a. - not analysed

(a) Reproduction for SiO_2

STANDARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	38.20	39.38	39.74	38.58	38.47	38.37	38.63	38.86	0.23
L5	39.24	39.48	39.42	39.37	39.09	39.38	39.17	39.32	0.15
DTS1	40.50	40.91	40.57	40.23	40.32	40.32	40.35	40.33	0.02
PCC1	41.90	40.21	40.27	41.80	41.75	41.83	41.85	41.29	0.56
40524	43.10	43.38	42.80	42.32	42.66	42.65	42.12	42.66	0.54
SK931	46.86	46.79	46.76	48.26	47.54	47.95	47.85	47.53	0.15
BOB1	50.60	51.46	51.53	51.05	51.61	51.01	51.11	51.30	0.19
W1	52.64	52.13	52.60	52.28	52.14	52.41	52.21	52.30	0.85
R174	53.94	52.54	53.08	52.35	52.15	52.33	52.83	52.55	0.28
BCR1	54.50	56.14	n.a.	56.56	56.54	56.52	56.30	56.41	0.11
OK272	61.30	60.26	61.20	60.24	60.13	60.34	60.03	60.37	0.34
GR	65.90	66.25	67.20	65.97	67.01	65.90	65.92	66.38	0.46
GSP1	67.38	65.73	65.83	65.86	65.55	65.70	66.38	65.84	0.54
G2	69.11	69.95	68.45	70.23	69.22	69.94	70.22	69.67	0.55
G1	72.64	72.95	73.44	72.76	73.84	73.50	72.61	73.18	0.57
GH	75.80	75.49	75.79	75.56	75.08	75.23	75.73	75.48	0.25

(b) Reproduction for Al_2O_3

STAN-DARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	10.31	10.31	10.31	10.49	10.45	10.46	10.42	10.41	0.01
L5	0.27	0.29	0.28	0.17	0.17	0.17	0.16	0.21	0.05
DTS1	0.24	0.30	0.38	0.18	0.19	0.18	0.20	0.24	0.04
PCC1	0.74	0.32	0.29	0.18	0.19	0.18	0.20	0.23	0.03
40524	14.77	14.27	14.28	14.38	14.40	14.43	14.29	14.34	0.52
SK931	15.68	15.74	16.16	16.27	16.48	16.41	16.78	16.31	0.47
BOB1	14.41	15.14	15.02	14.92	15.03	15.08	14.75	14.99	0.24
W1	15.00	15.35	15.13	15.34	15.12	15.29	15.30	15.26	0.05
R174	19.27	19.22	19.14	19.10	19.05	19.05	18.90	19.08	0.18
BCR1	13.61	13.60	n.a.	13.66	13.89	13.75	13.91	13.76	0.15
OK272	16.38	16.20	16.33	16.12	16.17	16.08	15.90	16.13	0.23
GR	14.75	14.50	14.47	14.70	14.23	14.19	14.73	14.47	0.26
GSP1	15.25	14.92	14.88	14.87	14.75	14.72	14.63	14.80	0.16
G2	15.40	15.43	15.25	15.20	15.11	15.21	15.24	15.24	0.00
G1	14.04	13.93	14.07	13.97	14.22	14.19	14.03	14.07	0.04
GH	12.50	12.74	12.77	12.35	12.50	12.53	12.52	12.57	0.05

(c) Reproduction for Fe_2O_3 (total iron)

STANDARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	12.80	12.61	12.80	12.93	12.84	12.88	12.73	12.80	0.07
L5	15.82	15.82	15.74	15.85	15.82	15.97	15.82	15.84	0.02
DTS1	8.64	9.18	8.11	8.68	8.70	8.65	8.65	8.66	0.02
PCC1	8.35	8.80	8.82	8.32	8.29	8.36	8.37	8.49	0.12
40524	18.62	18.57	18.48	18.13	18.10	17.95	18.04	18.21	0.17
SK931	15.04	14.50	14.28	14.98	14.94	15.19	14.98	14.81	0.17
BOB1	8.96	9.43	9.86	9.21	9.25	9.22	9.14	9.35	0.21
W1	11.09	10.91	11.22	11.27	11.41	11.12	11.30	11.21	0.10
R174	7.37	7.29	7.55	7.37	7.35	7.41	7.46	7.41	0.05
BCR1	13.40	12.86	n.a.	13.83	13.76	13.88	13.88	13.64	0.24
OK272	6.61	5.60	5.71	5.54	5.53	5.54	5.56	5.58	0.02
GR	4.05	4.24	4.41	4.13	4.24	4.28	4.07	4.23	0.16
GSP1	4.33	4.34	3.84	4.42	4.32	4.28	4.52	4.29	0.23
G2	2.65	2.96	3.01	3.11	3.01	2.95	3.14	3.03	0.11
G1	1.94	2.01	1.98	2.04	1.95	1.96	1.94	1.98	0.04
GH	1.34	1.54	1.64	1.39	1.60	1.62	1.35	1.53	0.17

(d) Reproduction for MgO

STAN-DARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	13.21	13.16	13.26	13.43	13.42	13.47	13.37	13.35	0.18
L5	44.21	44.11	44.16	44.10	44.02	44.20	44.08	44.11	0.03
DTS1	49.80	50.11	49.57	49.88	49.89	49.86	49.85	49.86	0.01
PCC1	43.18	43.56	43.46	43.22	43.15	43.19	43.18	43.29	0.11
40524	12.01	11.99	11.95	11.30	11.40	11.27	11.28	11.53	0.25
SK931	4.31	4.25	3.88	4.22	3.93	4.02	4.05	4.06	0.01
BOB1	8.45	8.58	8.67	8.84	8.76	8.85	8.91	8.77	0.14
W1	6.62	6.49	6.54	6.88	6.72	6.72	6.88	6.71	0.18
R174	1.81	1.75	1.51	1.74	1.60	1.62	1.78	1.67	0.11
BCR1	3.46	2.78	n.a.	3.18	2.96	3.02	3.14	3.02	0.12
OK272	1.04	0.66	0.58	0.66	0.68	0.65	0.64	0.65	0.01
GR	2.40	3.01	3.01	2.39	3.13	3.03	2.39	2.83	0.44
GSP1	0.96	1.07	1.07	1.14	1.07	1.14	1.21	1.12	0.09
G2	0.76	0.99	0.89	1.06	1.02	0.94	1.18	1.01	0.17
G1	0.38	0.23	0.25	0.40	0.30	0.30	0.37	0.31	0.06
GH	0.03	0.11	0.16	0.00	0.07	0.08	0.03	0.08	0.05

(e) Reproduction for CaO

STAN-DARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	13.89	13.96	13.77	13.89	13.83	13.86	13.87	13.86	0.01
L5	0.55	0.51	0.57	0.51	0.60	0.59	0.53	0.55	0.02
DTS1	0.15	0.11	0.11	0.16	0.15	0.14	0.15	0.14	0.01
PCC1	0.51	0.44	0.38	0.51	0.51	0.51	0.52	0.48	0.04
40524	6.17	6.39	6.08	6.50	6.32	6.39	6.42	6.35	0.07
SK931	6.66	6.47	6.12	6.49	6.50	6.57	6.56	6.45	0.11
BOB1	11.23	11.50	11.77	11.42	11.41	11.44	11.47	11.50	0.03
W1	10.96	10.90	11.22	11.09	11.23	11.13	10.99	11.09	0.10
R174	4.93	4.83	5.06	5.05	5.04	4.98	5.05	5.00	0.05
BCR1	6.92	6.62	n.a.	6.61	6.64	6.61	6.61	6.62	0.00
OK272	2.36	2.20	2.30	2.20	2.18	2.20	2.15	0.21	0.60
GR	2.50	2.49	2.66	2.49	2.54	2.58	2.50	2.48	0.23
GSP1	2.02	2.05	1.97	2.03	2.05	2.02	2.05	2.03	0.02
G2	1.94	2.16	2.33	2.13	2.16	2.15	2.13	2.18	0.05
G1	1.39	1.40	1.29	1.37	1.26	1.29	1.37	1.33	0.04
GH	0.69	0.71	0.58	0.66	0.61	0.60	0.66	0.64	0.02

(f) Reproduction for Na_2O

STAN- DARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	3.07	3.22	3.62	3.38	3.43	3.69	3.33	3.45	0.12
L5	0.56	0.00	0.00	0.27	0.00	0.40	0.00	0.11	0.16
DTS1	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.01	0.01
PCC1	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.01	0.01
40524	2.60	3.48	2.98	2.68	2.75	2.62	2.55	2.84	0.29
SK931	4.75	4.75	4.93	5.00	4.77	4.94	4.80	4.87	0.07
BOB1	3.17	3.06	3.08	3.06	3.05	3.06	3.09	3.07	0.02
W1	2.15	2.33	2.36	2.46	2.35	2.28	2.29	2.35	0.06
R174	2.70	3.26	2.50	2.62	2.52	2.88	2.61	2.73	0.12
BCR1	3.27	3.29	n.a.	3.21	3.49	3.32	3.25	3.31	0.06
OK272	5.26	5.26	5.12	5.01	5.25	5.02	5.24	5.15	0.09
GR	3.80	3.46	3.70	3.71	3.73	3.74	3.78	3.69	0.09
GSP1	2.80	2.57	2.60	2.49	2.63	2.58	2.72	2.60	0.12
G2	4.07	3.68	3.67	3.99	4.04	4.00	4.00	3.90	0.10
G1	3.32	2.88	3.26	3.26	3.26	3.18	3.31	3.19	0.12
GH	3.85	3.55	3.72	3.92	3.56	3.50	3.84	3.68	0.16

(g) Reproduction for K_2O

STANDARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	1.38	1.38	1.40	1.37	1.40	1.39	1.37	1.39	0.02
L5	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DTS1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCC1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40524	0.59	0.59	0.60	0.63	0.62	0.63	0.62	0.62	0.01
SK931	0.77	0.68	0.70	0.71	0.72	0.70	0.73	0.71	0.02
BOB1	0.31	0.40	0.37	0.34	0.32	0.34	0.32	0.35	0.03
W1	0.64	0.67	0.64	0.64	0.63	0.64	0.64	0.64	0.00
R174	7.90	7.84	7.85	7.81	7.77	7.81	7.84	7.82	0.02
BCR1	1.70	1.68	n.a.	1.73	1.75	1.73	1.73	1.72	0.01
OK272	5.04	4.96	5.22	5.04	5.16	5.12	4.98	5.08	0.10
GR	4.50	4.67	4.83	4.47	4.47	4.46	4.50	4.57	0.07
GSP1	5.53	5.28	5.23	5.36	5.39	5.34	5.40	5.33	0.07
G2	4.51	4.76	4.46	4.63	4.57	4.58	4.60	4.60	0.00
G1	5.48	5.43	5.28	5.44	5.45	5.44	5.47	5.42	0.05
GH	4.76	4.61	4.73	4.77	4.65	4.74	4.71	4.71	0.06

(h) Reproduction for TiO_2

STAN-DARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	2.61	2.72	2.83	2.76	2.74	2.72	2.77	2.76	0.01
L5	0.06	0.04	0.07	0.03	0.05	0.05	0.03	0.05	0.02
DTS1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00
PCC1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00
40524	1.82	1.59	1.57	1.56	1.57	1.58	1.57	1.57	0.00
SK931	3.34	3.28	3.22	3.31	3.29	3.33	3.31	3.29	0.02
BOB1	1.45	1.50	1.49	1.47	1.43	1.46	1.44	1.47	0.03
W1	1.07	1.11	1.10	1.10	1.09	1.07	1.10	1.10	0.01
R174	1.01	1.11	1.16	1.17	1.17	1.16	1.18	1.16	0.21
BCR1	2.20	2.25	n.a.	2.25	2.29	2.28	2.26	2.27	0.01
OK272	1.04	1.00	0.97	1.01	0.98	0.99	0.98	0.99	0.01
GR	0.65	0.69	0.70	0.63	0.68	0.68	0.65	0.67	0.02
GSP1	0.66	0.66	0.64	0.67	0.68	0.66	0.69	0.67	0.02
G2	0.50	0.51	0.54	0.52	0.53	0.52	0.51	0.52	0.01
G1	0.26	0.23	0.21	0.26	0.21	0.22	0.24	0.23	0.01
GH	0.08	0.05	0.04	0.06	0.05	0.05	0.08	0.06	0.03

(i) Reproduction for MnO

STANDARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	0.20	0.21	0.20	0.21	0.21	0.21	0.21	0.21	0.00
L5	0.21	0.21	0.21	0.21	0.00	0.21	0.21	0.18	0.04
DTS1	0.11	0.13	0.13	0.11	0.11	0.11	0.11	0 12	0.01
PCC1	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01
40524	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.00
SK931	0.20	0.18	0.00	0.18	0.18	0.19	0.18	0.15	0.03
BOB1	0.17	0.16	0.16	0.16	0.16	0.16	0.18	0.16	0.00
W1	0.17	0.18	0.17	0.18	0.17	0.18	0.18	0.18	0.00
R174	0.14	0.13	0.13	0.14	0.14	0.14	0.13	0.14	0.01
BCR1	0.18	0.19	n.a.	0.19	0.19	0.20	0.19	0.19	0.00
OK272	0.24	0.23	0.24	0.24	0.24	0.24	0.23	0.24	0.00
GR	0.06	0.00	0.06	0.06	0.06	0.06	0.06	0.05	0.01
GSP1	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00
G2	0.03	0.04	0.03	0.04	0.03	0.03	0.04	0.04	0.01
G1	0.03	0.00	0.00	0.03	0.03	0.03	0.03	0.02	0.01
GH	0.05	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01

(j) Reproduction for P_2O_5

STAN-DARD	ACTUAL	XRF RUNS						$\bar{x}$	σ
		1	2	3	4	5	6		
BR	1.04	1.05	1.05	1.05	1.04	1.05	1.04	1.05	0.01
L5	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
DTS1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
PCC1	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00
40524	0.41	0.49	0.48	0.48	0.48	0.48	0.48	0.48	0.00
SK931	0.47	0.42	0.41	0.41	0.40	0.41	0.41	0.41	0.00
BOB1	0.15	0.15	0.15	0.13	0.14	0.14	0.13	0.14	0.01
W1	0.14	0.16	0.16	0.16	0.17	0.17	0.16	0.16	0.00
R174	0.34	0.40	0.39	0.40	0.40	0.40	0.40	0.40	0.00
BCR1	0.36	0.34	n.a.	0.35	0.35	0.35	0.35	0.35	0.00
OK272	0.27	0.28	0.27	0.28	0.28	0.28	0.28	0.28	0.00
GR	0.28	0.27	0.26	0.28	0.28	0.27	0.28	0.28	0.01
GSP1	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G2	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G1	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.00
GH	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00

A3.3 Water content

Total water content was determined by a gravimetric method. Water is driven off the specimen by heating a sample of powder to 1100 - 1200°C and flushed, by nitrogen, through an absorption tube filled with $CaCl_2$. The difference in weight of the absorption tube before and after water absorption allows calculation of the water content.

A total of 17 samples from XRF runs 3 and 4 were analysed for total water content. The samples were carefully chosen to cover the range of totals seen in the initial analyses. Each sample was analysed twice and the average total water content for the samples is given in Table A3.3.

A plot of the water content against the initial XRF analysis total for each of the 17 samples analysed for water shows little correlation between the two values (see Figure A3.3). One might expect that the samples with the lowest totals should show the highest water contents. As no such correlation is seen, the range in initial analyses totals must be due to some other factor than water content.

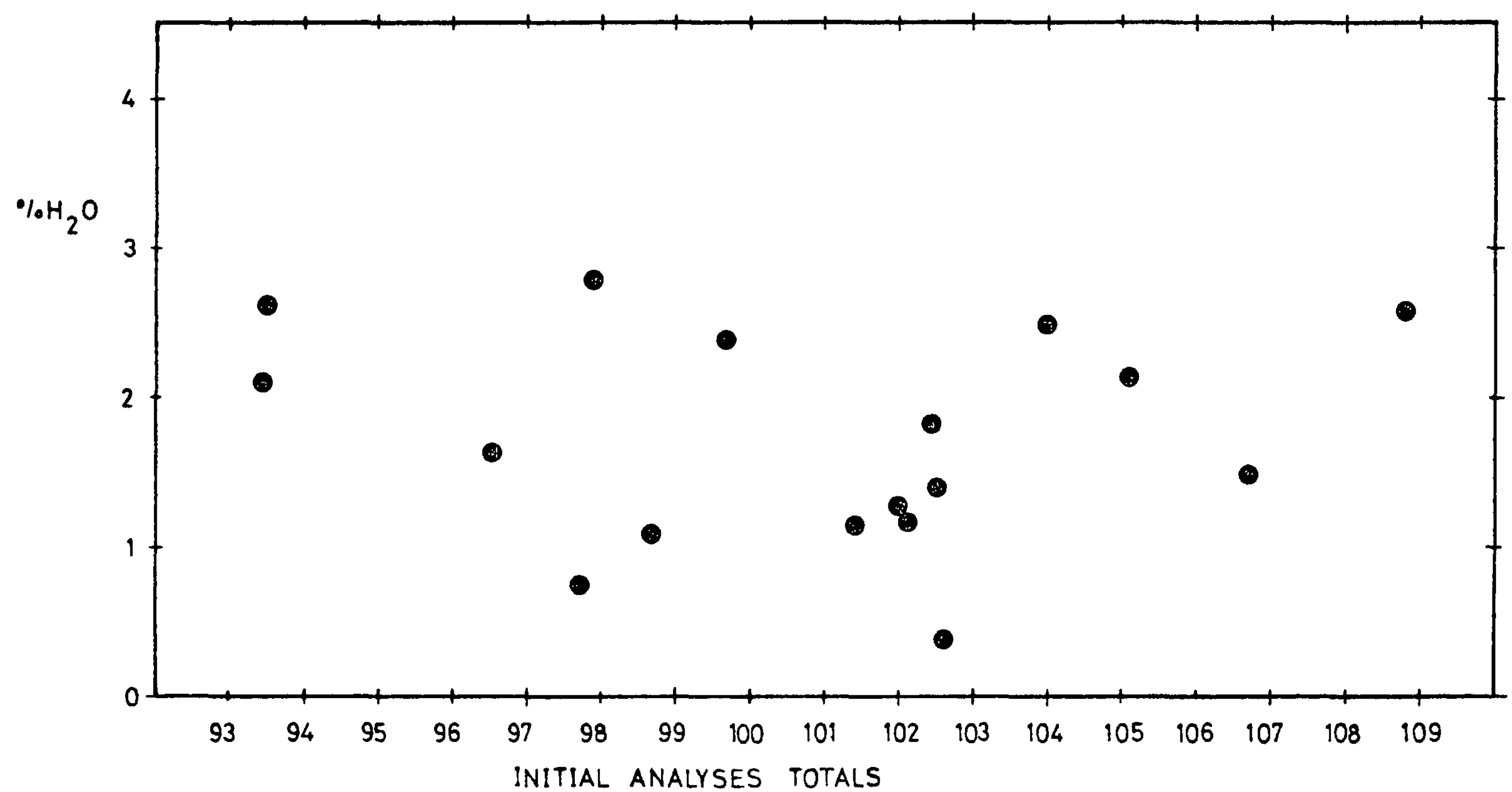


Figure A3.3 Plot of initial analyses totals versus total water content

Sample Number	Initial Analysis Total (wt. %)	Total Water Content (wt. %)
SR165	97.91	2.28
C7548	97.76	0.76
C7541	102.50	1.41
C7553	102.10	1.18
C7515	93.53	2.63
C7538	102.04	1.32
C7507	102.62	0.43
C7599	106.77	1.48
E7409	99.66	2.37
E7403	98.68	1.11
E7434	102.45	2.84
E7446	104.00	2.49
E7406	93.41	2.08
E7422	96.56	1.66
E7468	101.44	1.15
E7429	105.11	2.16
E7479	108.78	2.59

Table A3.3: Total water content of 17 samples

A3.4 Possible anomalous values caused by the cubic spline polynomial regression

The cubic spline polynomial regression is very sensitive to the standards used for the calibration (pers. comm. A. Peckett, 1978). Thus extrapolation beyond the range of concentrations of the standards, or interpolation between standards of greatly differing compositions, may lead to erroneous estimates of the concentrations for unknown material. The compositional ranges of each oxide for the standards used and the unknowns quoted in this thesis are given in Table A3.4.1. In all cases, the lower limit of the unknown data is greater than that of the standards. With the exception of MgO, there are few significant gaps in the range of compositions of the standards for the various oxides. Thus it is predominantly in the higher concentrations of each oxide that anomalous concentrations could arise. For the analyses from Eigg, Muck and Canna, the major elements affected are Al_2O_3, Fe_2O_3, TiO_2, MnO and P_2O_5.

Several additional samples (potential standards) of known composition were included as unknowns in several of the analysis runs. Some of these show, for certain oxides, concentrations in excess of the available standards. They were, however, not included as standards because they did not reproduce well for all oxides and, in some cases, adversely affected the cubic spline polynomial regression so that the International Standards failed to reproduce with sufficient accuracy. However, they can be used as a guide to the quality of analyses which contain oxides in excess of the standard concentration ranges. Table A3.4.2 lists the measured and actual concentrations of certain of these samples for the five oxides noted above as being possible sources of error at high concentrations.

Reproduction of the TiO_2 and P_2O_5 concentrations for the samples selected is good, despite the fact that the concentrations (measured and actual) are in excess of the upper limit of the standards. Thus concentrations of these two oxides above the upper limit of the standards (as high as 4.71% TiO_2 and 3.14% P_2O_5 at least) are probably reasonably accurate. For MnO, reproduction of the chosen samples, which show concentrations in excess of the range of the standards, is variable, and usually rather lower than the actual concentration. Thus MnO contents much above 0.25% must therefore be a little suspect.

Only one of the additional samples of known composition shows total iron in excess of the standards. The measured concentration is rather higher than the actual, and thus analyses quoted herein with total iron contents greater than 18.62% may well be higher than the true concentration. For Al_2O_3, there are two samples with concentrations in excess of the standards. In both cases, the measured concentrations are lower than actual. Thus analyses with high Al_2O_3 contents (c.20%) must be treated with caution.

There is a problem with MgO in that there were no suitable standards in the range 14 to 43%. Only one of the additional samples has an MgO content in this range, and it reproduces very badly - 18.90% as opposed to an actual concentration of 23.27%. Unfortunately, there was insufficient time to obtain, or make, intermediate standards, and then rerun any samples with MgO contents in this range. Thus any analysis with an MgO concentration of between 14% and 43% may well be in error by an unknown amount.

The lighter elements (Si, Al, Mg and Na) all proved problematical during development of the method of processing the raw data (pers. comm. A. Peckett, 1980) No mass absorption correction could improve the simple counts versus percentage of the standards. This was particularly true of Al and Na, and as a result no mass absorption correction was applied to these data. It is known that the borate fusion method of sample preparation gives more reliable analyses for these lighter elements than the pressed powder method used for the author's analyses.

	STANDARDS	UNKNOWNS
SiO_2	38.20 - 75.80	44.48 - 75.34
Al_2O_3	0.24 - 19.27	11.35 - 20.59
Fe_2O_3	1.34 - 18.62	6.87 - 19.10
MgO	0.03 - 49.80*	0.18 - 14.94
CaO	0.15 - 13.89	0.51 - 13.34
Na_2O	0.00 - 5.26	1.11 - 5.01
K_2O	0.00 - 7.90	0.03 - 7.40
TiO_2	0.01 - 3.34	0.11 - 3.63
MnO	0.01 - 0.24	0.02 - 0.38
P_2O_5	0.00 - 1.04	0.03 - 1.43

* There is a gap in the MgO contents of the standards between BR (13.21) to PCC1 (43.18).

Table A3.4.1: Ranges of Standards and Unknowns for Each Element

Oxide	Upper limit of standards	Sample number	Measured concentration	Actual concentration
Al_2O_3	19.27	85964	21.40	23.78
		R28	22.46	23.09
Fe_2O_3*	18.62	30684	22.05	19.60
TiO_2	3.34	30684	4.38	4.71
		40551	3.71	3.76
MnO	0.24	SK942	0.17	0.26
		SK981	0.24	0.25
		SK986	0.25	0.28
		27099	0.25	0.26
P_2O_5	1.04	85995	1.05	1.08
		30684	3.13	3.14

* Fe_2O_3 as total iron

Table A3.4.2: Concentrations (actual and as measured at Durham) of Selected Oxides for Samples of Known Composition

A3.5 Effects of re-summing analyses to 100%

Four samples for the lavas of Skye (SK894, SK971, SK981 and SK986), for which analyses have been published (see Thompson et al 1972), were analysed as unknowns. The quoted analyses were done by wet chemical methods at Manchester University. The FeO and Fe_2O_3 contents of the literature analyses were recalculated to total iron (as Fe_2O_3) prior to comparison with the analyses done at Durham by X-ray fluorescence. The Durham analyses used for comparison are the initial analyses before recalculation of iron. The greatest discrepancies are seen in SiO_2, Al_2O_3 and MgO.

The effect of re-summing any analysis to 100% is to express it only in terms of the oxides listed. In the case of the XRF analyses from Durham this excludes water content (among other oxides). Although the water content of the Manchester samples is known, it was not measured for most of the samples analysed at Durham. Thus to realistically compare the re-summed Durham analyses, the literature analyses must also be recalculated to exclude water (and any other oxides not analysed at Durham). The four sets of analyses thus acquired for these Skye lavas (Manchester wet chemical, Manchester wet chemical re-summed, Durham initial analyses and Durham analyses re-summed) are listed in Table A3.5.

Overall, there is a slight improvement in the Durham analyses compared with the anhydrous Manchester analyses, when the former are re-summed to 100%. The greatest absolute error is in SiO_2, and reproduction of this oxide is, as expected, always improved by re-summing. Greatest relative errors are in MgO and Al_2O_3 (A. Peckett, pers. comm. 1978). In only one of the four samples (SK986) does the re-summation procedure show an improvement in reproduction of the quoted Al_2O_3 value. Two of the four (SK894 and SK981) show an improvement in the reproduction of the quoted concentrations for MgO, when recalculated to 100%.

Table A3.5: Analyses of Skye Lavas

Notes:

$Fe_2O_3^*$	Total iron as Fe_2O_3
Q	Manchester analysis, as quoted in Thompson et al (1972)
Q'	As Q but re-summed to 100% (excluding water etc.)
D	Initial Durham analysis
D'	As D but re-summed to 100%

	SK894				SK971			
	Q	Q'	D	D'	Q	Q'	D	D'
SiO_2	46 15	47 17	45 55	46 93	46 94	47 08	47 94	46 58
Al_2O_3	13 72	14 02	14 73	15 17	17 15	17 20	17 29	16 80
Fe_2O_3*	12 22	12 49	12 20	12 57	13 02	13 06	14 23	13 83
MgO	11 73	11 99	10 59	10 91	7 69	7 71	7 42	7 21
CaO	9 20	9 40	9 32	9 56	9 73	9 76	10 19	9 90
Na_2O	2 47	2 52	2 94	3 03	3 01	3 02	3 60	3 49
K_2O	0 55	0 56	0 53	0 54	0 43	0 43	0 40	0 39
TiO_2	1 42	1 45	1 13	1 16	1 37	1 37	1 47	1 42
MnO	0 18	0 18	0 18	0 18	0 19	0 19	0 19	0 18
P_2O_5	0 19	0 19	0 15	0 16	0 18	0 18	0 20	0 20

	SK981				SK986			
	Q	Q'	D	D'	Q	Q'	D	D'
SiO_2	45 08	45 54	47 86	45 61	58 18	59 13	56 34	60 12
Al_2O_3	15 62	15 78	15 43	14 70	16 49	16 76	14 57	15 53
Fe_2O_3*	17 25	17 42	18 86	17 97	8 69	8 83	8 72	9 30
MgO	5 59	5 65	6 93	6 61	0 94	0 96	1 41	1 48
CaO	7 93	8 01	8 38	7 99	2 88	2 93	2 88	3 07
Na_2O	3 21	3 24	3 21	3 06	5 98	6 08	5 34	5 69
K_2O	0 97	0 98	0 88	0 84	3 48	3 54	3 40	3 62
TiO_2	2 77	2 80	2 83	2 72	0 81	0 82	0 81	0 86
MnO	0 25	0 25	0 24	0 23	0 28	0 28	0 25	0 27
P_2O_5	0 33	0 33	0 30	0 28	0 66	0 67	0 29	0 31

APPENDIX 4

ANALYSES OF SKYE AND RHUM LAVAS DONE AT MANCHESTER AND DURHAM

The accompanying Tables list the analyses of the Skye and Rhum lavas. Columns headed by 'Wet chem.' signify analyses performed by wet chemical methods at Manchester University Geology Department. The analyses have been recalculated to 100% (H_2O free) and the FeO + Fe_2O_3 has been expressed as total iron (Fe_2O_3) This applies to the Skye lavas.

Columns headed by 'Durham' are analyses done by X-ray fluorescence at Durham University Department of Geological Sciences. They are the initial analyses, prior to recalculation of the Fe_2O_3 (as described in Chapter 10), but re-summed to 100%.

Columns headed 'XRF' are the analyses of the Rhum lavas done by X-ray fluorescence techniques at Manchester University Department of Geology. These have been re-summed to 100%.

N.B. $Fe_2O_3^*$ in the table represents total iron (as Fe_2O_3).

	SK894		SK971		SK981		SK986	
	Wet chem	Durham	Wet chem	Durham	Wet chem	Durham	Wet chem	Durham
SiO_2	47 17	46 93	47 08	46 58	45 54	45 61	59 13	60 12
M_2O_3	14 02	15 17	17 20	16 80	15 78	14 70	16 76	15 53
Fe_2O_3*	12 49	12 57	13 06	13 83	17 42	17 97	8 83	9 30
MgO	11 99	10 91	7 71	7 21	5 65	6 61	0 96	1 48
CaO	9 40	9 56	9 76	9 90	8 01	7 99	2 93	3 07
Na_2O	2 52	3 03	3 02	3 49	3 24	3 06	6 08	5 69
K_2O	0 56	0 54	0 43	0 39	0 98	0 84	3 54	3 62
TiO_2	1 45	1 16	1 37	1 42	2 80	2 72	0 82	0 86
MnO	0 18	0 18	0 19	0 18	0 25	0 23	0 28	0 27
P_2O_5	0 19	0 16	0 18	0 20	0 33	0 28	0 67	0 31

Table A4 1 Analyses of Skye Lavas

	SR244C		SR244D		SR244E		SR244F		SR244G	
	XRF	Durham	XRF	Durham	XRF	Durham	XRF	Durham	XRF	Durham
SiO_2	47 70	47 94	46 78	46 97	46 23	46 81	46 93	46 84	48 08	48 24
Al_2O_3	15 52	13 37	16 44	14 51	16 27	14 38	16 76	14 50	16 24	15 01
$Fe_2O_3^*$	12 71	12 18	12 91	12 26	12 99	12 26	13 20	12 67	11 14	10 15
MgO	8 94	12 12	8 07	11 27	7 45	10 66	8 80	12 05	6 31	9 36
CaO	11 31	10 29	11 22	9 82	12 76	11 24	11 01	10 08	12 48	11 35
Na_2O	1 62	2 20	1 61	2 29	1 78	2 46	1 33	2 16	2 21	2 65
K_2O	0 49	0 19	0 75	0 75	0 48	0 12	0 50	0 24	0 54	0 35
TiO_2	1 32	1 37	1 80	1 81	1 59	1 65	1 12	1 20	2 42	2 34
MnO	0 21	0 18	0 20	0 16	0 27	0 28	0 19	0 16	0 31	0 33
P_2O_5	0 18	0 13	0 22	0 16	0 18	0 13	0 16	0 10	0 27	0 22

Table A4 2 Analyses of Rhum Lavas

	SR157		SR217		DU9868		DU9873		DU13847	
	XRF	Durham	XRF	Durham	XRF	Durham	XRF	Durham	XRF	Durham
SiO_2	44 21	44 13	43 70	43 70	44 80	45 28	45 99	46 31	47 72	47 52
Al_2O_3	16 68	14 55	16 39	14 24	16 48	14 38	16 89	14 88	17 94	16 36
$Fe_2O_3^*$	14 39	14 95	14 97	15 14	15 73	15 83	15 91	16 30	13 74	14 12
MgO	8 21	11 14	8 50	11 75	6 59	9 27	4 61	7 20	3 19	5 72
CaO	11 41	10 33	11 46	10 32	10 35	9 14	10 16	9 10	9 15	8 59
Na_2O	2 68	2 39	2 04	2 38	2 40	2 48	2 91	2 73	4 84	4 40
K_2O	0 03	0 16	0 48	0 13	0 28	0 43	0 48	0 61	0 59	0 67
TiO_2	1 99	1 96	2 00	1 94	2 73	2 63	2 52	2 44	2 21	2 12
MnO	0 19	0 21	0 23	0 21	0 17	0 18	0 19	0 17	0 18	0 19
P_2O_5	0 21	0 17	0 22	0 17	0 47	0 38	0 34	0 26	0 44	0 31

Table A4 2 (continued)

	DU13848		SR165		SR237		DU9871		SR230	
	XRF	Durham	XRF	Durham	XRF	Durham	XRF	Durham	XRF	Durham
SiO_2	47 37	47 50	49 30	49 05	51 70	51 08	51 07	51 14	53 87	58 11
Al_2O_3	17 71	15 65	14 47	13 26	15 27	13 00	14 62	13 04	16 89	16 46
Fe_2O_3*	14 43	14 53	18 01	18 08	14 51	16 67	15 86	16 36	11 00	10 36
MgO	4 04	7 13	3 00	5 24	3 05	4 61	2 68	4 83	2 42	3 97
CaO	8 81	8 05	8 15	7 27	8 05	7 50	7 92	7 21	5 27	5 13
Na_2O	4 49	4 03	2 60	2 69	3 79	3 32	3 89	3 41	4 57	4 91
K_2O	0 53	0 62	0 99	1 11	0 87	0 96	1 06	1 17	2 95	0 17
TiO_2	2 08	2 04	2 71	2 65	2 07	2 29	2 24	2 29	1 98	0 09
MnO	0 18	0 19	0 21	0 23	0 18	0 22	0 20	0 21	0 16	0 17
P_2O_5	0 38	0 27	0 56	0 42	0 50	0 33	0 45	0 35	0 88	0 62

Table A4 2 (continued)

	SR232		DU13852	
	XRF	Durham	XRF	Durham
SiO_2	56 06	58 62	57 26	57 46
Al_2O_3	15 44	14 90	15 22	14 44
Fe_2O_3*	10 80	10 49	10 19	9 48
MgO	1 75	3 07	1 80	3 31
CaO	5 60	5 21	5 25	5 13
Na_2O	4 81	4 81	4 53	4 57
K_2O	2 67	0 22	2 62	2 47
TiO_2	1 85	1 93	1 94	1 99
MnO	0 17	0 18	0 21	0 23
P_2O_5	0 85	0 57	0 99	0 72

Table 4 2 (continued)

APPENDIX 5

ANALYSES OF EXTRUSIVE BASIC SAMPLES FROM EIGG, MUCK AND CANNA

NA - analysis not available for this element.

A5 1 1 EXTRUSIVE BASALTS FROM LIGG

	E7413	E7422	E7427	E7429	E7430	E7432	E7444	E7458	E7459	E7460
WT %										
SIO2	47.09	45.45	47.02	45 58	45.31	46.36	48.51	46 02	45.79	47.99
AL2O3	14.48	14.48	15 61	14.51	15.46	14.61	14.89	16.25	14 98	15 36
FE2O3	1 49	1.57	1 45	1.45	1.46	1.56	1.53	1.46	1.48	1.99
FEO	10 87	11.94	13 12	14.87	14.30	11.19	9.43	13.90	14.39	8.65
MGO	10.63	8.35	7 34	8.17	7 88	11 20	10.62	6 96	8 43	8.82
CAO	10 81	12 98	8 86	8.70	8.88	10.61	10.19	8 67	8.61	11.43
NA2O	2.30	2 34	3 13	2.92	3.27	2.16	2.52	3 27	2.82	3.39
K2O	0.35	0.37	0 45	0 45	0.43	0.36	0.80	0.41	0.49	0 60
TIO2	1.59	2 05	2 56	2 81	2.57	1 58	1.15	2.60	2 57	1 41
MNO	0.20	0 25	0.19	0 21	0.20	0 19	0.18	0 20	0 20	0.20
P2O5	0.19	0 21	0.26	0.31	0.25	0 19	0.18	0.25	0 30	0 16
PPM										
BA	179	209	254	284	252	207	375	266	1065	262
NB	5	6	6	8	11	8	4	10	10	5
ZR	112	128	189	184	167	124	104	178	186	104
Y	25	27	37	37	30	23	19	33	37	25
SR	332	371	508	451	520	990	387	529	512	385
RB	6	4	4	9	7	5	15	7	7	9
ZN	81	78	85	94	85	78	70	84	88	71
CU	68	26	17	42	20	10	115	13	35	51
NI	220	158	49	41	20	138	304	12	38	80
CR	599	645	45	70	23	520	798	24	69	365
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	2 10	2.20	2.70	2 70	2.50	2.10	4.70	2.40	2.90	3 50
AB	19 50	12.70	26.50	24.20	21 90	18.30	21 30	25.70	23.80	19 70
AN	28.20	27.90	27 20	25 20	26 20	29.10	27.00	28.50	26.80	24 90
NE	-	3.90	-	0.30	3.10	-	-	1.00	-	4 90
DI	19 70	28.90	12.50	13.30	13.40	18.10	18.20	10.80	11.50	25.00
HY	2.50	-	2.50	-	-	1.50	2.40	-	0.90	-
OL	22.40	17.80	21.10	26.30	25.20	25.20	21.50	23.90	26 20	16.10
MG	2 20	2 30	2 10	2.10	2 10	2.30	2.20	2 10	2.10	2 90
IL	3.00	3.90	4.90	5.30	4.90	3.00	2.20	4.90	4.90	2.70
AP	0.40	0 50	0.60	0.70	0.60	0.40	0.40	0.60	0.70	0.40
D.I	21 50	18 70	29.10	27.10	27 60	20 40	26 00	29.20	26.70	28.10

A5 1 1 EXTRUSIVE BASALTS FROM EIGG

	E7461	E7463	L7464	E7465	L7466	E7467	L7468	E7469	E7470	L7473
WT %										
SIO2	47 17	47.21	45.62	46.14	46.19	45.95	48 02	47 05	47.64	48.47
AL2O3	13 54	13.51	14 95	15.95	15 91	16 10	15.16	16 00	15 01	16 08
FE2O3	1 58	1.51	1.47	1.50	1 49	1 48	1.54	1.51	1 53	1.51
FEO	11 19	10.98	12.30	11.00	11.06	10.87	9.91	10.16	10.39	10.68
MGO	13 55	12.16	10.85	10.11	9 85	10 21	10.45	8 90	9.82	7 52
CAO	8 65	10 05	10.42	10.66	10 61	10.89	9.05	11.22	10.29	9.80
NA2O	2.27	2.49	2.26	2 69	2 72	2.40	2.59	2.82	2 52	2 63
K2O	0.41	0.30	0.15	0 16	0 26	0.29	0.86	0.57	0 82	1.16
TIO2	1.31	1.45	1.62	1 42	1 55	1.45	1.25	1.43	1 56	1.69
MNO	0.19	0.19	0.21	0.20	0.21	0.21	0.20	0.19	0.19	0.22
P2O5	0 15	0.16	0 16	0 15	0.14	0.14	0 16	0 15	0 22	0 23
PPM										
BA	105	145	83	79	137	122	411	198	328	2886
NB	4	1	1	4	6	8	3	3	7	5
ZR	97	100	114	103	109	91	101	105	128	119
Y	19	18	23	27	26	19	17	22	24	24
SR	592	254	270	286	281	284	274	303	363	375
RB	4	5	5	4	3	8	16	10	12	29
ZN	79	84	86	77	70	76	76	64	59	83
CU	77	101	162	182	54	113	71	125	82	113
NI	856	547	403	303	395	322	438	234	377	92
CR	1076	1439	347	269	377	430	906	420	820	105
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	2 40	1 80	0 90	0.90	1.50	1.70	5.10	3.40	4 80	6.90
AB	19 20	21 10	18.70	19.10	19.00	17.60	21.90	18 30	21 20	22.30
AN	25.50	24.80	30.20	31.00	30.40	32.30	27 20	29.30	27.20	28 60
NE	-	-	0.20	2.00	2 20	1 40	-	3 00	-	-
DI	13 30	19.50	16.70	17 10	17 40	17 00	16.80	20.70	18.30	15 20
HY	7 20	0.70	-	-	-	-	-	-	-	4.20
OL	27 20	26 90	27.70	24 70	24 00	24 70	24 10	20.00	22.70	16.90
MG	2 30	2.20	2 10	2.20	2 20	2.10	2.20	2.20	2.20	2.20
IL	2 50	2.80	3.10	2 70	2 90	2.80	2 40	2.70	3.00	3 20
AP	0.40	0.40	0.40	0.40	0.30	0 30	0.40	0.40	0.50	0 50
D I	21.60	22 80	19.80	22.00	22 70	20 80	27 00	24 70	26.10	29 10

A5.1.1 EXTRUSIVE BASALTS FROM EIGG

	E7474	E7475	E7482	E7483	E7486	E7487	E7493	E7606	E7630	E7634
WT %										
SIO2	47.94	48.14	48.66	46.12	47.00	47.24	45.02	46.77	45.05	46.46
AL2O3	15.26	15.95	15.63	13.91	14.19	14.31	14.72	14.43	15.37	14.51
FE2O3	1.51	1.53	1.51	1.56	1.52	1.51	1.49	1.56	1.54	1.58
FEO	10.09	9.37	9.22	11.43	10.74	10.37	13.04	10.34	12.44	11.23
MGO	10.21	9.38	8.64	13.01	11.39	11.08	10.96	11.41	11.20	11.99
CAO	10.67	11.06	11.19	9.82	10.16	9.92	10.32	10.96	10.14	9.80
NA2O	2.55	2.49	2.58	2.12	2.69	3.45	2.16	2.61	2.15	2.53
K2O	0.30	0.69	0.83	0.26	0.52	0.38	0.20	0.33	0.13	0.34
TIO2	1.15	1.09	1.38	1.43	1.43	1.38	1.71	1.23	1.60	1.22
MNO	0.20	0.18	0.17	0.20	0.20	0.19	0.23	0.20	0.21	0.20
P2O5	0.12	0.10	0.18	0.15	0.16	0.16	0.15	0.16	0.15	0.15
PPM										
BA	NA	205	386	105	167	161	110	186	115	NA
NB	6	3	8	5	9	6	4	9	6	NA
ZR	78	70	118	314	99	99	116	147	106	NA
Y	19	19	24	154	20	21	24	56	19	NA
SR	273	272	320	360	363	294	388	197	260	NA
RB	10	20	14	4	7	7	3	4	0	NA
ZN	76	75	71	76	67	77	80	128	76	NA
CU	133	92	78	110	110	68	160	113	166	132
NI	273	305	228	617	446	431	411	270	383	207
CR	600	502	538	1210	1378	1336	345	720	518	503
CIPW NORMS										
QZ	–	–	–	–	–	–	–	–	–	–
OR	1.80	4.10	4.90	1.50	3.10	2.20	1.20	2.00	0.80	2.00
AB	21.60	20.80	21.80	17.90	19.30	20.10	17.00	17.70	17.90	19.50
AN	29.30	30.30	28.60	27.70	25.10	22.40	29.90	26.70	31.90	27.20
NL	–	0.10	–	–	1.90	4.90	0.70	2.40	0.10	1.10
DI	18.50	19.50	21.00	16.30	19.70	20.90	16.70	21.60	14.20	16.60
HY	2.60	–	0.80	2.20	–	–	–	–	–	–
OL	21.50	20.60	17.60	29.00	25.60	24.20	28.80	24.70	29.40	28.70
MG	2.20	2.20	2.20	2.30	2.20	2.20	2.20	2.30	2.20	2.30
IL	2.20	2.10	2.60	2.70	2.70	2.60	3.20	2.30	3.00	2.30
AP	0.30	0.20	0.40	0.40	0.43	0.40	0.40	0.40	0.40	0.40
D.I.	23.30	25.00	26.70	19.50	24.30	27.30	18.90	22.00	16.80	22.50

A5 1.1 EXTRUSIVE BASALTS FROM EIGG

	E7635	E7636	E7639	E7641	E7644	E7649	E7650	E7652	E7654	E7665
WT %										
SIO2	47.95	47.62	47.70	48.27	46.28	49.51	47.91	46.76	48.46	48.12
AL2O3	14.90	15.04	14.44	15.40	15.39	15.21	14.22	14.01	15.39	16.03
FE2O3	1.46	1.50	1.51	1.49	1.49	1.54	1.49	1.62	1.53	1.56
FEO	10.80	10.81	10.93	9.93	14.68	8.66	10.33	11.25	9.23	9.14
MGO	9.59	9.84	10.30	9.93	7.62	9.65	11.69	12.84	9.34	9.83
CAO	10.52	10.03	9.56	10.99	8.18	10.36	9.82	9.38	10.85	10.75
NA2O	2.59	2.72	2.44	2.34	2.86	2.91	2.44	1.97	2.85	2.86
K2O	0.33	0.42	0.92	0.30	0.45	0.61	0.37	0.39	0.59	0.35
TIO2	1.49	1.60	1.78	1.05	2.61	1.22	1.39	1.41	1.40	1.05
MNO	0.21	0.19	0.20	0.18	0.21	0.16	0.19	0.19	0.17	0.19
P2O5	0.16	0.22	0.21	0.12	0.24	0.17	0.16	0.17	0.19	0.13
PPM										
BA	182	250	371	161	NA	281	176	155	NA	203
NB	7	5	3	6	NA	4	6	8	NA	3
ZR	110	133	129	80	NA	113	101	101	NA	78
Y	24	24	22	20	NA	19	19	19	NA	18
SR	272	336	368	279	NA	353	289	345	NA	291
RB	2	7	15	7	NA	11	6	8	NA	4
ZN	66	74	76	82	NA	70	74	79	NA	63
CU	125	94	127	71	8	79	120	125	73	102
NI	109	208	231	200	18	144	439	357	88	172
CR	390	496	705	535	40	480	1222	1497	520	540
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	2.00	2.50	5.40	1.80	2.70	3.60	2.20	2.30	3.50	2.10
AB	21.90	23.00	20.60	19.80	24.20	24.60	20.60	16.70	23.10	22.80
AN	28.10	27.60	25.70	30.60	27.80	26.60	26.80	28.20	27.50	29.90
NE	-	-	-	-	-	-	-	-	0.50	0.70
DI	18.90	16.90	16.60	18.80	9.30	19.20	17.00	14.00	20.40	18.40
HY	4.10	1.90	3.30	6.80	6.30	3.50	6.00	9.20	-	-
OL	19.80	22.40	22.20	17.80	22.10	17.50	22.20	24.20	19.60	21.60
MG	2.10	2.20	2.20	2.20	2.20	2.20	2.20	2.30	2.20	2.30
IL	2.80	3.00	3.40	2.00	5.00	2.30	2.60	2.70	2.70	2.00
AP	0.40	0.50	0.50	0.30	0.60	0.40	0.40	0.40	0.40	0.30
D I	23.90	25.50	26.10	21.60	26.90	28.20	22.80	19.00	27.10	25.60

A5.1 1 EXTRUSIVE BASALTS FROM EIGG

	EA8	EA12	EA13	EA14	EA17	EA18	EA41	EA42	EA51
WT %									
SIO2	47 81	45 53	46.18	46.44	49.54	48.18	47.85	46.92	47 58
AL2O3	16 92	15 77	16.18	15.02	16.37	14 89	13.97	14.47	15.80
FE2O3	1.56	1 55	1 50	1.52	1.58	1.58	1.55	1.61	1.49
FEO	8.32	12.24	10.40	11.76	9.80	9 96	10.09	9 76	10 55
MGO	9 78	10.25	9.32	10.42	7.74	11 17	11 63	12 36	8 74
CAO	11 39	9.99	11 70	10 40	10 12	10 32	9.23	11.00	10 50
NA2O	2.55	2.48	2.71	2.19	2.81	2 15	2.93	2 13	2 95
K2O	0 31	0.17	0.27	0.31	0 74	0.30	0 87	0.21	0.36
TIO2	1.07	1 67	1.41	1.49	1.33	1.13	1.48	1 24	1.65
MNO	0.17	0.20	0.20	0 20	0 16	0 20	0.19	0.19	0.20
P2O5	0.12	0 16	0.13	0.16	0.20	0 13	0 21	0 11	0.18
PPM									
BA	97	63	89	153	362	177	167	187	172
NB	10	6	5	7	5	6	7	7	6
ZR	75	123	97	106	125	79	117	93	124
Y	17	24	20	21	32	21	19	19	22
SR	324	299	239	294	412	261	383	282	363
RB	7	4	6	5	11	4	3	6	7
ZN	58	79	66	84	75	81	61	87	71
CU	98	118	142	93	75	102	130	189	38
NI	81	223	250	148	51	163	358	452	198
CR	375	115	305	105	143	502	698	760	429
CIPW NORMS									
QZ	-	-	-	-	-	-	-	-	-
OR	1 80	1.00	1.60	1.80	4.40	1.80	5.10	1.20	2.10
AB	21.50	19 70	16.20	18 50	23.80	18.20	21.60	18 00	23.50
AN	33 80	31.40	31.20	30.20	29.90	30.10	22.40	29.30	28.80
NE	0 10	0.70	3.60	-	-	-	1.70	-	0 80
DI	17.80	14.00	21 30	16.90	15.60	16.40	17.90	19.90	18.10
HY	-	-	-	3.00	6 50	11 40	-	1 90	-
OL	20 50	27.40	21.00	24.00	14 60	17 40	25 70	24 80	21.00
MG	2.30	2.20	2.20	2.20	2.30	2 30	2.20	2.30	2.20
IL	2 00	3.20	2.70	2.80	2.50	2.10	2.80	2 40	3 10
AP	0.30	0 40	0.30	0.40	0.40	0 30	0 50	0 50	0 40
D I.	23 40	21.40	21.40	20.40	28.10	20 00	28 50	19.30	26.40

A5.1.2 EXTRUSIVE HAWAIITES FROM EIGG

	E7472	E7479	E7662	EA16	EA21C	EA38
WT %						
SIO2	53.45	46.00	48.39	48.51	50.48	49.57
AL2O3	16.62	14.55	13.87	15.23	13.65	14.91
FE2O3	2.02	1.87	1.86	2.01	1.94	2.01
FEO	7.40	14.09	13.27	11.13	11.30	10.65
MGO	5.06	7.74	7.46	8.46	5.28	7.89
CAO	7.64	8.32	8.37	8.27	8.03	8.09
NA2O	3.64	3.86	3.11	3.23	3.65	3.35
K2O	2.05	0.42	0.89	0.92	1.82	1.09
TIO2	1.60	2.71	2.27	1.72	3.19	1.87
MNO	0.10	0.21	0.21	0.19	0.18	0.19
P2O5	0.43	0.25	0.29	0.32	0.48	0.38
PPM						
BA	877	238	435	446	847	494
NB	9	10	12	9	19	8
ZR	235	185	193	172	281	216
Y	32	34	33	33	47	33
SR	506	502	399	405	478	413
RB	22	6	13	13	26	22
ZN	82	87	121	91	199	89
CU	26	3	58	76	24	42
NI	38	37	70	150	70	144
CR	30	24	226	363	18	233
CIPW NORMS						
QZ	–	–	–	–	–	–
OR	12.10	2.50	5.30	5.40	10.80	6.40
AB	30.80	24.90	26.30	27.30	30.90	28.30
AN	23.00	21.10	21.30	24.30	15.50	22.40
NE	–	4.20	–	–	–	–
DI	9.90	15.30	15.20	12.00	17.60	12.50
HY	16.30	–	6.70	3.50	5.90	7.30
OL	1.90	23.50	17.50	20.50	9.40	15.60
MG	2.90	2.70	2.70	2.90	2.80	2.90
IL	3.10	5.10	4.30	3.30	6.10	3.60
AP	1.00	0.60	0.70	0.80	1.10	0.90
D.I	43.20	31.60	31.60	32.80	41.60	34.80

A5 1 3 EXTRUSIVE MUGEARITES FROM LIGG

	E7412	E7471	EA29
WT %			
SIO2	54.08	53 63	54.36
AL2O3	15.43	14.33	14.75
FE2O3	2 47	2.02	2.53
FEO	6.60	9.35	7 65
MGO	4.80	4.13	4.32
CAO	5.57	5.74	5.30
NA2O	4.27	4.17	4 17
K2O	3 29	2 69	3.00
TIO2	2.14	2.40	2 35
MNO	0.15	0.23	0.16
P2O5	1.19	1 32	1.43
PPM			
BA	1556	1883	2213
NB	29	15	15
ZR	355	274	279
Y	38	46	49
SR	715	585	531
RB	57	32	32
ZN	88	144	117
CU	10	0	17
NI	8	21	0
CR	9	8	2
CIPW NORMS			
QZ	-	0.50	2.00
OR	19.40	15 90	17.70
AB	36 10	35.30	35 30
AN	13 20	12 40	12.70
NE	-	-	-
DI	5 40	6.20	3.50
HY	13 40	19.20	17.40
OL	2 00	-	-
MG	3.60	2.90	3.70
IL	4.10	4.60	4.50
AP	2.80	3.10	3.40
D.I	55.50	51 60	54.90

A5.2 1 EXTRUSIVE BASALTS FROM MUCK

WT %	M7532	M7533	M7538	M7543	M7546	M7547	M7548	M7568	M7569	M7570
SIO2	45.66	45.40	45.89	44.78	46.40	45.89	45 99	45.60	45.52	46.24
AL2O3	14.53	14.47	14.46	13.54	14.62	14.67	13.77	14.18	15.04	14 69
FE2O3	1.52	1.51	1.50	1.51	1.55	1.51	1.59	1.54	1.52	1.50
FEO	14.61	14.86	14 07	15 10	13.99	15.40	11.60	11.92	11.42	11 53
MGO	9.04	9 08	9.69	10.78	9 06	7.37	13.18	12.45	11.40	11.40
CAO	8.36	8.32	8 54	8.08	8.18	8.53	9.38	9.71	9.95	9.64
NA2O	2.82	2.86	3 12	2.47	2.81	2.67	2.37	2.45	2 88	2 58
K2O	0.43	0.43	0.45	0.43	0.55	0.44	0.27	0 28	0 45	0.34
TIO2	2.71	2.76	2.60	2.77	2.37	2.96	1.48	1.50	1.46	1.66
MNO	0.20	0.19	0.30	0.28	0.20	0.24	0.19	0 21	0.20	0.20
P2O5	0.27	0.29	0.25	0.25	0.30	0.31	0.18	0 16	0.16	0 22

PPM	M7532	M7533	M7538	M7543	M7546	M7547	M7548	M7568	M7569	M7570
BA	253	253	262	395	321	274	146	119	162	138
NB	5	7	8	11	10	8	6	7	5	4
ZR	180	190	188	183	186	200	109	99	100	121
Y	34	37	33	32	35	39	30	24	24	18
SR	439	451	442	340	442	371	265	237	332	351
RB	7	3	1	3	5	7	6	4	7	4
ZN	80	89	94	88	69	98	71	79	76	78
CU	9	10	8	18	18	82	131	103	88	55
NI	0	23	29	21	17	55	402	396	377	335
CR	54	52	53	56	40	65	994	846	888	757

CIPW NORMS	M7532	M7533	M7538	M7543	M7546	M7547	M7548	M7568	M7569	M7570
QZ	-	-	-	-	-	-	-	-	-	-
OR	2.50	2.50	2.50	2.50	3.20	2.60	1.60	1 70	2.70	2.00
AB	22 60	22.00	23.50	20.90	23.80	22 60	19.50	17.70	15.60	20.60
AN	26 70	25 00	25.20	24.60	25.60	26.70	26.10	26 90	26.80	27.50
NE	-	1.70	0.70	-	-	-	0.30	1.60	4.80	0.70
DI	11.10	12.20	13.20	11.40	10.70	11.30	15.60	16 50	17.50	15.40
HY	3.30	-	-	1 90	4.40	8.10	-	-	-	-
OL	25 90	28 50	27.10	30 60	24.80	20.20	31.30	30 20	27 30	28.00
MG	2.20	2.20	2.20	2.20	2.20	2.20	2 30	2.20	2 20	2.20
IL	5 10	5.30	4.90	5.30	4.50	5.60	2.80	2 80	2.80	3.20
AP	0 60	0.70	0.60	0.60	0.70	0.70	0.40	0.40	0 40	0.50
D.I.	25.10	26.10	26.80	23.40	27.00	25.20	21.40	21.00	23 00	23.30

A5.2 1 EXTRUSIVE BASAITS FROM MUCK

	M7571	M7576	M7577	M7578	M7591	M7594	M7595	M75139	M75140	M75141
WT %										
SIO2	46.57	46.18	45 69	46.54	45.94	45 60	45.97	44.94	44.87	44 79
AL2O3	14.24	13.23	14.29	14.97	14.53	15.22	14.92	14.19	13.61	13.74
FE2O3	1.50	1.56	1.52	1.51	1.49	1.55	1.51	1.56	1.56	1 55
FEO	11.43	11.96	14.79	13.73	11.03	14.16	14.09	11.50	12.51	12.47
MGO	11.51	12.74	9.13	8.45	11.42	8.56	8.97	12.34	13.11	13 12
CAO	9.75	9.57	8.18	8.26	9.92	8.56	8 27	9.55	9.81	9 81
NA2O	2.54	2 32	2 71	2.97	3.49	2.88	2.78	3.81	2.41	2.41
K2O	0.33	0.43	0.47	0 55	0.37	0 52	0.49	0.26	0.25	0 22
TIO2	1.69	1.61	2.72	2.52	1.43	2.45	2.50	1 48	1.52	1 54
MNO	0.21	0 21	0.20	0.19	0.20	0.19	0.22	0.20	0.21	0 20
P2O5	0.21	0.19	0.31	0.29	0.19	0.30	0.27	0.19	0 17	0.19
PPM										
BA	157	186	269	323	214	142	316	140	123	103
NB	11	5	10	9	8	1	8	6	8	8
ZR	137	120	196	180	110	98	181	105	108	108
Y	20	23	35	33	29	24	37	26	24	30
SR	338	303	427	472	346	313	470	312	286	246
RB	5	7	5	7	5	7	7	6	4	3
ZN	82	85	85	77	75	81	74	77	78	67
CU	67	65	19	12	100	19	13	162	105	104
NI	360	440	20	13	419	0	18	468	518	501
CR	830	929	49	50	999	45	50	990	1058	1000
CIPW NORMS										
QZ	–	–	–	–	–	–	–	–	–	–
OR	2 00	2.50	2.80	3.30	2.20	3.10	2.90	1.50	1.50	1.30
AB	21.30	19.10	22 90	25.10	16.00	23.60	23.50	13.30	14.90	15.10
AN	26.50	24.40	25.40	25.90	22.90	27 10	26.80	20.80	25.60	26.10
NE	0.10	0.30	–	–	7.30	0.40	–	10.20	3.00	2.80
DI	16 70	17.70	10.80	10.90	20.40	11.10	10.30	20.60	17.90	17.40
HY	–	–	4.30	3.10	–	–	3.30	–	–	–
OL	27.60	30 20	25.70	24.10	25.80	27.10	25.70	28.00	31 60	31 70
MG	2.20	2.30	2.20	2.20	2.20	2.20	2.20	2.30	2.30	2.20
IL	3.20	3.10	5.20	4.80	2.70	4.70	4.70	2.80	2 90	2.90
AP	0.50	0.40	0.70	0 70	0.40	0.70	0.60	0.40	0 40	0.40
D.I.	23.40	21.90	25.70	28.40	25.50	27.10	26.40	25.10	19.40	19.20

A5.2 1 EXTRUSIVE BASALTS FROM MUCK

	M75143	M75148	M7603	M7612	M7615	M7620	M7622	M7624	M7627	M7629
WT %										
SIO2	46.61	46 35	46.92	45 88	46.43	46.61	46.59	46.18	45.46	46.44
AL2O3	14.82	14 24	14.88	14.95	14.88	14.55	14.87	15.43	13.69	14.10
FE2O3	1 50	1 51	1.49	1.50	1.50	1.53	1.51	1.51	1.63	1 52
FEO	14.03	14 29	14.28	14.10	13.97	10.88	10.63	11.03	12.33	11 54
MGO	8.16	8.67	7.83	8.65	7.95	11 44	11 15	10.60	14.94	11 50
CAO	8.48	8.58	8.55	8.61	8.69	9.70	9.75	10.13	8.16	9.88
NA2O	2.90	2.94	2.30	2.86	2.64	2.99	3.06	2 75	1.89	2 54
K2O	0.52	0 44	0.55	0.49	0.52	0.47	0.39	0 35	0.24	0.40
TIO2	2.48	2 55	2.64	2.49	2.84	1.43	1.61	1 60	1.34	1 67
MNO	0.20	0.17	0.29	0.20	0.27	0 19	0.19	0.19	0.20	0 19
P2O5	0.29	0.26	0.28	0.27	0.36	0.21	0.24	0.23	0.13	0.22
PPM										
BA	303	106	294	310	272	334	151	150	73	160
NB	7	9	9	8	9	8	5	7	6	5
ZR	179	110	190	181	164	120	138	131	95	133
Y	34	24	37	33	32	23	22	21	25	22
SR	483	246	464	467	467	405	357	361	181	395
RB	7	5	4	5	5	7	5	4	4	7
ZN	80	77	68	77	90	87	82	75	61	76
CU	8	12	3	18	15	93	59	59	153	81
NI	0	0	1	0	0	386	333	309	612	399
CR	57	48	46	46	49	840	738	680	800	813
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	3.10	2.60	3 20	2 90	3.10	2.80	2.30	2 10	1.40	2 40
AB	24.50	24.90	19.50	24.20	22.30	19 30	20.30	19.40	16.00	20.10
AN	25.90	24.40	28.60	26 50	27.20	24.90	25.70	28.70	28.20	25.90
NE	-	-	-	-	-	3.20	3.10	2.10	-	0.80
DI	11.80	13.60	9.90	11 90	11 50	17.80	17.20	16.30	9.30	17.70
HY	4.30	1.60	17.30	0 10	8.70	-	-	-	7.70	-
OL	22 80	25.30	13.60	26 80	18.90	26.60	25.70	25.60	32.30	27 30
MG	2.20	2.20	2.20	2 20	2.20	2.20	2.20	2.20	2.40	2.20
IL	4.70	4.80	5.00	4.70	5 40	2.70	3.10	3.00	2.50	3.20
AP	0.70	0.60	0.70	0.60	0 70	0.50	0.60	0.50	0.30	0.50
D.I	27.60	27.50	22.70	27 10	25.40	25.30	25.60	23.60	17.40	23.20

A5.2.1 EXTRUSIVE BASALTS FROM MUCK

	M7630	M7636	M7639	M7643	M7644	M7648	M7649A	M7658	M7659	M7664
WT %										
SIO2	45.38	45.60	45.66	45.34	45.71	45.54	45.57	46.03	46.01	45.52
AL2O3	15.54	14.93	15.01	15.34	14.61	13.86	14.63	14.50	14.88	14.34
FE2O3	1.52	1.54	1.52	1.57	1.58	1.58	1.58	1.56	1.54	1.50
FEO	12.47	14.06	13.91	11.73	11.63	12.51	11.38	11.51	11.06	14.55
MGO	10.12	9.06	8.94	9.76	12.24	12.85	11.99	12.22	11.37	9.24
CAO	10.07	8.47	8.46	10.47	9.61	9.24	9.68	9.48	10.15	8.28
NA2O	2.52	2.92	3.03	3.12	2.46	2.27	3.13	2.80	2.85	2.96
K2O	0.15	0.50	0.49	0.40	0.32	0.38	0.23	0.04	0.32	0.42
TIO2	1.87	2.46	2.48	1.85	1.50	1.46	1.47	1.47	1.47	2.64
MNO	0.19	0.18	0.20	0.19	0.19	0.18	0.19	0.19	0.19	0.23
P2O5	0.17	0.28	0.29	0.22	0.20	0.13	0.15	0.20	0.17	0.30
PPM										
BA	80	268	282	216	314	171	105	154	157	NA
NB	6	8	9	9	9	7	6	7	6	NA
ZR	133	177	179	143	181	111	102	106	109	NA
Y	23	34	36	31	39	26	22	26	26	NA
SR	322	461	459	346	482	236	283	262	480	NA
RB	2	7	8	3	7	7	4	5	4	NA
ZN	77	86	82	77	87	74	78	76	97	NA
CU	117	7	18	60	130	107	116	92	117	13
NI	268	55	0	18	374	402	386	356	351	0
CR	216	42	43	221	821	669	860	947	990	52
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	0.90	3.00	2.90	2.40	1.90	2.20	1.40	0.20	1.90	2.50
AB	19.50	23.30	23.50	15.80	18.60	17.90	16.90	20.90	17.60	24.10
AN	30.60	26.20	25.90	26.70	28.10	26.50	25.20	26.90	26.90	24.60
NE	1.00	0.80	1.10	5.70	1.00	0.70	5.20	1.50	3.50	0.50
DI	14.90	11.60	11.70	19.50	14.90	15.10	17.80	15.30	18.20	12.00
HY	-	-	-	-	-	-	-	-	-	-
OL	26.90	27.70	27.20	23.60	29.90	32.20	28.20	29.60	26.50	28.40
MG	2.20	2.20	2.20	2.30	2.30	2.30	2.30	2.30	2.20	2.20
IL	3.60	4.70	4.70	3.50	2.80	2.80	2.80	2.80	2.80	5.00
AP	0.40	0.70	0.70	0.50	0.50	0.30	0.40	0.50	0.40	0.70
D I	21.40	27.00	27.60	23.90	21.50	20.90	23.40	22.60	23.00	27.10

A5.2 2 EXTRUSIVE BASALTIC HAWAIITES AND HAWAIITES FROM MUCK

	M75144	M7531	M7552	M7553	M7555	M7567	M7646A	M7651B
WT %								
SIO2	45 11	46.22	46 45	45.61	46.82	46 55	49 55	47 20
AL2O3	16 20	14.22	14 16	14.56	13 46	14 23	13.40	15.98
FE2O3	1.56	1 85	1 99	2.00	1 92	2 05	1 47	2 08
FEO	11.93	13.77	14.82	15.00	14.17	13 64	13 75	11 27
MGO	9 39	10 35	6 32	6 85	8.03	8.19	5.89	8 39
CAO	8.94	6.71	7.45	7.64	7 17	7.22	9.47	7 95
NA2O	3.11	3.39	3.49	3.37	3.66	3.65	3.35	3 58
K2O	1 04	0.52	0.83	0.77	0 89	0.98	0.49	0 81
TIO2	2 29	2.53	3.63	3.41	3.03	2.72	2 15	2 26
MNO	0 16	0.21	0.28	0.22	0.27	0.26	0 27	0 17
P2O5	0.27	0.24	0.58	0.57	0 58	0.51	0 21	0 32
PPM								
BA	276	315	NA	427	443	598	354	395
NB	10	6	NA	15	17	15	6	11
ZR	188	181	NA	326	334	310	126	192
Y	36	37	NA	57	56	54	40	32
SR	433	398	NA	404	375	399	279	596
RB	10	7	NA	12	12	12	6	8
ZN	73	70	NA	102	86	101	110	73
CU	2	9	25	15	7	8	127	0
NI	0	0	0	2	0	0	10	0
CR	140	78	12	13	53	14	93	40
CIPW NORMS								
QZ	-	-	-	-	-	-	-	-
OR	6.10	3 10	4 90	4.50	5 30	5.80	2.90	4.80
AB	16.30	27 80	29 50	27.70	29.60	27.40	28.30	27 40
AN	27.20	22 00	20.50	22 30	17.70	19 50	20.10	25.10
NE	5.40	0.50	-	0 40	0 70	1.90	-	1 60
DI	12.60	7.90	10 60	10 10	11.70	10 90	21.40	10.00
HY	-	-	2 80	-	-	-	8 10	-
OL	25 10	30.60	20 60	24 20	25 10	25.30	12.50	23.10
MG	2.30	2.70	2 90	2.90	2 80	3.00	2.10	3.00
IL	4.30	4.80	6 90	6 50	5 80	5 20	4 10	4.30
AP	0 60	0.60	1 40	1.20	1.40	1.20	0 50	0.80
D.I	27.90	31.30	34.40	32.70	35 60	35.10	31.20	33 70

A5.2.3 EXTRUSIVE MUGEARITES FROM MUCK

	M7579	M7597	M75127	M75146	M7608	M7636
WT %						
SIO2	51 02	52.57	52.04	50.87	53 03	53 70
AL2O3	15.45	15.05	14.45	15.82	15.08	14.69
FE2O3	2 01	2.55	2.43	2.54	2.00	2 45
FEO	8.87	8.02	9.37	9.66	8.04	9 66
MGO	8.50	5.13	6.53	5.27	6.54	3.68
CAO	4.14	5.70	4.54	6.05	5.04	4.33
NA2O	4.24	4.67	4.41	4.81	4.24	4 79
K2O	2.77	2.69	2.85	2.33	2 77	3.33
TIO2	2.42	2.29	2.55	2.54	2 41	2.62
MNO	0.38	0.14	0.27	0.18	0.22	0.20
P2O5	0.64	0.65	0.55	0.53	0.64	0 56
PPM						
BA	1097	120	199	1111	1095	1307
NB	24	6	6	21	22	22
ZR	387	106	107	383	360	365
Y	47	28	27	44	43	43
SR	539	279	348	530	572	504
RB	47	3	6	45	47	53
ZN	104	84	90	104	101	125
CU	0	0	0	0	0	7
NI	0	0	0	0	0	0
CR	21	21	10	14	17	13
CIPW NORMS						
QZ	-	-	-	-	-	-
OR	16.40	15.90	16.80	13.80	16.40	19.70
AB	31.10	39 30	37.30	35.10	35.90	40.50
AN	16.50	13 80	11 20	14.70	13.90	8.70
NE	-	0.10	-	3.00	-	-
DI	-	8 30	6.30	9.70	5.60	7.60
HY	11 00	-	2.40	-	9.00	3.70
OL	15.60	13.00	16.20	13.90	10.20	10.00
MG	2 90	3.70	3.50	3.70	2.90	3.60
IL	4 60	4 30	4.80	4.80	4.60	5 00
AP	1.50	1.60	1.30	1.30	1.50	1.30
D.I	47 50	55.30	54.10	51 90	52.20	60.20

A5.3.1 EXTRUSIVE BASALTS FROM CANNA

	C7503	C7504	C7511	C7530	C7533	C7534	C7548	C7553	C7573	C7575
WT %										
SIO2	46.46	46.43	47.38	47.58	46 90	46 60	47 25	46.52	47.71	46.89
AL2O3	15.37	15.53	16.02	14 57	14 54	15.05	15 09	14 70	15.52	14.56
FE2O3	1 47	1.58	1.59	1.50	1.54	1 47	1 56	1 49	1.53	1 58
FEO	13 67	13.45	12.35	12.49	13.85	12.89	12 91	13.19	12.41	11.87
MGO	8 01	8.07	7.45	9.28	9 05	8.67	8.33	9.37	7.73	11.06
CAO	8.86	8.95	9.17	9.18	7 81	9.90	8 88	9 35	9.06	8.49
NA2O	2 91	2.85	2.77	2 62	2.80	2.56	2 89	2.67	2 85	2.69
K2O	0.50	0.73	0.72	0.46	0.48	0.33	0 52	0 42	0 68	0 51
TIO2	2 27	2.12	2 07	1.91	2 48	2.08	2.12	2.01	2.05	1.90
MNO	0.24	0.21	0.21	0 20	0.25	0.23	0.22	0.19	0.21	0 21
P2O5	0.24	0.17	0.27	0 22	0 28	0.21	0.24	0.19	0.24	0 22
PPM										
BA	305	309	410	287	276	306	207	240	277	230
NB	8	6	9	7	8	7	9	6	6	9
ZR	134	124	132	112	183	115	127	110	180	123
Y	38	32	28	29	33	28	32	29	0	34
SR	385	462	1114	344	449	359	351	342	12	304
RB	8	13	11	3	5	2	5	5	8	5
ZN	96	92	85	87	78	96	95	88	99	90
CU	100	125	92	80	0	116	134	113	63	160
NI	62	147	58	100	40	129	212	201	170	165
CR	121	130	115	190	40	245	120	258	190	230
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	3.00	4.30	4.30	2 70	2.80	2.00	3.10	2.50	4.00	3.00
AB	24.60	22.70	23.40	22.20	23.70	21.70	24.40	21.70	24.10	22 80
AN	27.40	27.40	29.10	26 60	25.70	28.60	26.70	27.30	27.50	26 20
NE	-	0 80	-	-	-	-	-	-	-	-
DI	12.40	13.10	12.10	14.40	9.30	15.80	13.10	14.70	13.10	11 90
HY	1 00	-	5.60	8.20	9.90	3.80	4.50	3.20	5.80	3.70
OL	24.60	25.00	18.70	19.60	21.00	21 70	21.40	24.20	18.80	26 10
MG	2 10	2.30	2.30	2.20	2.20	2.10	2.30	2.20	2.20	2.30
IL	4 30	4.00	3.90	3.60	4 70	4 00	4.00	3.80	3.90	3.60
AP	0.60	0 40	0.50	0.50	0.70	0.50	0.60	0 40	0.60	0.50
D I.	27.60	27 80	27.70	24.90	26.50	23.60	27.50	24 20	28.10	25 80

A5.3.1 EXTRUSIVE BASALTS FROM CANNA

	C7576	C7582	C7585	C7586	C7588	C7592	C7596	C7598	C7599	C75100
WT %										
SIO2	46.69	47.19	47.19	47.36	47.65	47.01	46.45	46.35	48.74	46.70
AL2O3	14.96	15.45	15.15	15.16	15.18	14.77	14.60	15.08	14.06	15.16
FE2O3	1.51	1.49	1.55	1.45	1.51	1.53	1.49	1.48	1.43	1.47
FEO	13.15	12.75	12.82	12.98	12.97	12.87	13.61	13.90	13.44	13.39
MGO	9.05	8.12	8.11	8.31	7.97	9.51	9.42	8.36	8.09	8.27
CAO	8.55	8.92	8.87	8.78	8.58	8.72	8.90	8.59	8.44	8.76
NA2O	2.88	2.92	3.04	2.91	3.00	2.76	2.56	2.84	2.50	2.82
K2O	0.51	0.56	0.55	0.48	0.51	0.42	0.37	0.39	0.45	0.41
TIO2	2.21	2.13	2.21	2.13	2.13	1.99	2.07	2.49	2.35	2.49
MNO	0.23	0.22	0.22	0.21	0.22	0.20	0.24	0.23	0.21	0.23
P2O5	0.25	0.25	0.29	0.23	0.28	0.22	0.21	0.29	0.30	0.29
PPM										
BA	282	295	317	269	284	239	205	206	253	255
NB	7	6	9	8	7	8	7	10	7	7
ZR	130	128	140	123	132	111	108	113	125	117
Y	34	33	33	31	32	27	25	29	27	27
SR	360	359	342	361	357	369	358	422	411	418
RB	5	6	7	7	7	8	5	2	5	2
ZN	98	84	75	88	94	91	86	96	79	95
CU	76	88	82	39	88	55	20	43	39	38
NI	92	92	78	141	82	61	80	68	42	67
CR	160	120	186	120	139	73	82	64	58	60
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	3.00	3.30	3.20	2.80	3.00	2.50	2.20	2.30	2.70	2.40
AB	24.40	24.70	25.70	24.00	25.40	23.40	21.70	24.00	21.10	23.90
AN	26.40	27.40	26.10	26.90	26.40	26.70	27.20	27.20	25.80	27.50
NE	-	-	-	-	-	-	-	-	-	-
DI	11.90	12.60	13.20	12.50	11.80	12.50	12.80	11.10	11.70	11.60
HY	2.60	3.40	2.10	5.40	6.90	5.20	6.30	4.80	23.40	6.20
OL	24.80	21.80	22.40	21.00	19.50	23.30	23.20	22.90	8.10	20.80
MG	2.20	2.20	2.20	2.10	2.20	2.20	2.20	2.10	2.10	2.10
IL	4.20	4.00	4.20	4.00	4.00	3.80	3.90	4.70	4.50	4.70
AP	0.60	0.60	0.70	0.50	0.70	0.50	0.50	0.70	0.70	0.70
D.I.	27.40	28.00	29.00	27.50	28.40	25.80	23.80	26.30	23.80	26.30

A5 3.1 EXTRUSIVE BASALTS FROM CANNA

	C75101	C75104	C75107	C75108	C75109	C75113	C75114	C75117	C75118	SR246
WT %										
SIO2	46.55	46.32	46.40	46.79	46 59	47.00	46 92	46.80	46.92	46 45
AL2O3	15.33	14.67	15.53	15 08	15.48	14 94	15 79	15 92	15.19	15.09
FE2O3	1.47	1 51	1 48	1 49	1 48	1.50	1 48	1.48	1.55	1.44
FEO	13.26	14.04	13.32	13.04	13.13	13 58	12.92	12.64	12.71	13.69
MGO	8.51	8.80	8.19	8.40	8.36	8.44	7.67	7.31	8.83	7.94
CAO	8 71	9.11	8.81	9 42	9 37	8.62	8 75	9.18	8.51	8.93
NA2O	2.86	2.59	3.00	2 87	2.63	2.75	3.15	2.94	2.62	3.19
K2O	0 38	0.38	0.40	0.38	0.37	0.51	0.64	0.73	1.04	0 49
TIO2	2.42	2 20	2 33	2 10	2.16	2.18	2.22	2 13	2 16	2.30
MNO	0.22	0.17	0 22	0.21	0.22	0.24	0 23	0.22	0.21	0 23
P2O5	0.28	0 20	0 27	0 23	0 22	0 24	0.24	0 65	0.25	0 25
PPM										
BA	230	233	245	190	220	262	324	297	981	261
NB	9	11	8	6	8	5	4	3	7	9
ZR	115	114	110	111	116	127	115	127	131	136
Y	27	24	25	27	30	35	31	27	31	32
SR	422	433	448	376	377	352	687	1044	402	355
RB	4	12	2	3	0	11	6	10	17	7
ZN	80	96	82	92	97	83	85	99	91	102
CU	40	79	27	35	55	92	99	76	99	120
NI	50	95	51	81	82	138	114	129	108	92
CR	62	145	60	90	78	63	82	174	63	120
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	2.20	2 20	2 40	2 20	2.20	3 00	3.80	4.30	6.10	2.90
AB	24.20	21.90	25.40	24.30	22.20	23 30	25.70	24.90	22.20	24.50
AN	27.90	27.30	27.70	27.10	29 30	26.90	27 00	28.10	26.60	25 40
NE	-	-	-	-	-	-	0.50	-	-	1 40
DI	11.10	13 70	11 70	14.90	13.00	11 80	12 20	10.90	11.50	14 30
HY	4.70	4 70	0.90	1.20	5.30	6.90	-	2.80	3.00	-
OL	22 40	23 30	24.60	23 50	21.20	21.20	23.80	21.20	23.60	24.50
MG	2 10	2.20	2 10	2.20	2 10	2.20	2.10	2.10	2.20	2.10
IL	4 60	4 20	4.50	4.00	4.10	4.10	4 20	4.00	4.10	4.40
AP	0 70	0.50	0.60	0.50	0.50	0.60	0.60	1.50	0.60	0 60
D.I.	26.40	24 20	27 70	26.50	24.40	26.30	30 00	29 20	28 30	28.70

A5.3 1 EXTRUSIVE BASALTS FROM CANNA

	C15	C20	T522	C7501C	C7501F	C7501G	C7502G
WT %							
SIO2	46.60	45 77	47.16	46.95	47.13	48.79	47 77
AL2O3	16.63	15.49	14.55	14.35	14.95	15.15	16.73
FE2O3	1.63	1.46	1 55	1 57	1.59	1.61	1 55
FEO	10.59	13 75	14.41	11 55	9.51	9.22	8.75
MGO	9 51	7.73	8 82	11.45	11.37	10.16	7 54
CAO	9.24	9 01	7.42	8.70	9.20	10 33	11 08
NA2O	3.72	3.34	2.27	2.78	3.07	2 80	3.24
K2O	0.26	0 30	1 00	0.46	0.56	0.42	0.53
TIO2	1 66	2.71	2.31	1.85	2.04	1 25	2.26
MNO	0.20	0.21	0.19	0 12	0.34	0.12	0.30
P2O5	0 23	0 22	0.23	0.23	0 24	0 15	0.27
PPM							
BA	100	166	469	205	574	1318	204
NB	3	9	12	6	8	11	8
ZR	146	122	164	174	138	173	147
Y	26	24	33	24	22	29	23
SR	324	428	327	372	415	716	579
RB	1	2	13	8	8	13	9
ZN	80	101	86	92	75	129	107
CU	105	65	46	80	102	59	242
NI	210	61	20	415	102	333	113
CR	203	54	82	745	280	575	362
CIPW NORMS							
QZ	-	-	-	-	-	-	-
OR	1 50	1.80	5 90	2.70	3 30	2.50	3.10
AB	22.70	23.90	19.20	23.50	22 90	23 70	23.50
AN	27.20	26.40	26.60	25.30	25.40	27 50	29.50
NE	4 70	2 30	-	-	1.70	-	2 10
DI	14.00	14.00	6.70	13.30	15 10	18.50	19.30
HY	-	-	17.00	1 30	-	3.40	-
OL	23.70	23.80	17.20	27 50	24 90	19.40	15 30
MG	2.40	2.10	2.20	2 30	2 30	2.30	2.20
IL	3 20	5 10	4.40	3 50	3 90	2 40	4.30
AP	0.50	0.50	0.80	0.30	0 60	0.40	0 60
D.I.	29 00	28.10	25.10	26.20	27 90	26.20	28.70

A5.3 2 EXTRUSIVE BASALTIC HAWAIITES AND HAWAIITES FROM CANNA

	C7545	C75103	C7505	C7515	C7517	C7531	C7535	C7537	C7538	C7539
WT %										
SIO2	48.34	46.56	48.17	47.89	49 15	47.06	51.06	50 67	50 14	48.94
AL2O3	14.84	14 75	14.96	16.16	15.39	15.54	18.80	20.59	14.82	15.13
FE2O3	1.54	1 52	2.06	1 62	2.06	1.55	2.03	2 12	1.99	2.07
FEO	12.83	13 42	12.94	11.67	11.79	13.18	7.52	6 83	12.41	12.87
MGO	7.45	8.71	6.72	7 33	6.63	7.27	4 76	4.08	5 78	6.68
CAO	8 33	8 66	7.74	8.65	7.75	8.60	8.75	8 80	7 36	7.73
NA2O	2.98	3.07	3.18	3.34	3 23	3 23	4 43	4.81	3.61	2.95
K2O	0.77	0.44	1.15	0.79	1.13	0.61	0 97	1.13	1 40	1.30
TIO2	2 24	2.38	2.54	2.07	2.29	2 41	1 26	1 22	1 92	1 86
MNO	0.22	0.20	0.22	0.19	0.19	0.22	0 14	0.13	0 20	0.18
P2O5	0.32	0 29	0.33	0.28	0.39	0 32	0 27	0 28	0 37	0.29
PPM										
BA	394	246	516	335	489	332	559	609	802	719
NB	9	6	13	8	13	5	7	7	8	8
ZR	154	115	195	137	178	153	114	121	170	144
Y	34	25	34	31	36	40	27	22	32	29
SR	378	420	404	909	407	352	691	931	459	955
RB	11	3	15	9	20	6	15	16	21	17
ZN	91	80	98	75	87	95	69	75	105	91
CU	41	41	78	88	41	77	33	0	6	17
NI	96	31	93	88	62	99	37	28	0	21
CR	100	60	58	100	69	101	94	75	35	53
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	4.50	2.60	6.80	4.70	6.70	3.60	5.70	6 70	8.30	7 70
AB	25.20	25.90	26 90	28 00	27 30	27.30	35.60	34.70	30.50	25 00
AN	24.80	25.20	23 10	26.80	24 20	26.10	28.50	34.10	20.10	24 20
NE	-	-	-	0.10	-	-	1.00	0.40	-	-
DI	11.90	13.10	10.90	11.80	9.70	12.00	10.80	6 40	11 70	10.20
HY	10.20	-	7.10	-	11.70	0 60	-	-	8.00	11 60
OL	16.10	25.70	16 60	21.60	12.10	22.80	12.40	11.80	14 00	14 10
MG	2 20	2.20	3.00	2.30	3 00	2.20	2 90	3.10	2 90	3.00
IL	4.30	4 50	4 80	3.90	4.30	4 60	2 40	2.30	3 60	3.50
AP	0 80	0 70	0.80	0.70	0.90	0 80	0.60	0.70	0 90	0 70
D I	29 80	28.60	33.70	32.80	34.00	30 90	42.30	41.70	38.80	32.60

A5.3.2 EXTRUSIVE BASALTIC HAWAIITES AND HAWAIITES FROM CANNA

	C7540	C7541	C7546	C7552	C7558	C7559	C7560	C7562	C7563	C7564
WT %										
SIO2	49.55	48.79	49.51	49.57	49.74	50.72	49.89	50.70	49.54	49.88
AL2O3	15.29	14.68	14.34	14.57	15.29	16.85	15.37	14.24	15.92	15.28
FE2O3	2.06	1.98	1.99	1.96	1.99	2.08	2.00	1.99	2.04	2.02
FEO	12.61	13.52	12.24	12.64	12.14	10.33	12.71	12.99	11.31	11.15
MGO	5.93	6.23	6.94	6.47	6.47	4.64	4.69	4.79	5.33	6.64
CAO	7.27	7.65	7.68	7.62	7.70	7.31	8.57	7.78	8.18	8.16
NA2O	3.81	3.64	3.13	3.65	3.27	4.67	3.14	3.50	3.53	3.02
K2O	1.09	1.09	1.20	1.04	1.07	1.19	0.94	1.14	1.28	1.11
TIO2	1.89	2.02	2.38	1.96	1.80	1.71	2.19	2.16	2.32	2.20
MNO	0.18	0.21	0.20	0.20	0.19	0.16	0.21	0.20	0.19	0.18
P2O5	0.32	0.31	0.40	0.32	0.34	0.34	0.29	0.34	0.35	0.36
PPM										
BA	623	716	499	692	687	761	871	725	850	496
NB	6	6	11	5	8	9	7	10	11	10
ZR	145	152	134	145	144	143	166	171	176	183
Y	30	32	139	32	31	29	33	36	35	32
SR	846	637	837	517	517	926	590	551	1024	457
RB	13	13	20	13	12	16	20	11	17	18
ZN	90	101	93	96	86	77	110	117	95	91
CU	85	68	29	36	32	54	100	93	50	36
NI	42	80	40	125	30	57	29	56	37	59
CR	48	49	63	59	60	47	8	9	62	49
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	6.40	6.40	7.10	6.10	6.30	7.00	5.60	6.70	7.60	6.60
AB	32.20	29.90	26.50	30.90	27.70	37.00	26.60	29.60	29.90	25.60
AN	21.40	20.90	21.50	20.30	23.90	21.50	25.10	20.30	23.80	24.90
NE	-	-	-	-	-	1.40	-	-	-	-
DI	10.50	12.50	11.50	12.80	10.00	10.50	13.10	13.50	12.00	11.00
HY	4.70	3.40	14.30	5.80	13.20	-	17.50	16.10	6.20	17.20
OL	17.40	19.40	10.70	16.80	11.70	15.60	4.50	6.00	12.40	6.90
MG	3.00	2.90	2.90	2.80	2.90	3.00	2.90	2.90	3.00	2.90
IL	3.60	3.80	4.50	3.70	3.40	3.20	4.20	4.10	4.40	4.20
AP	0.80	0.70	0.90	0.80	0.80	0.80	0.70	0.80	0.80	0.90
D.I.	38.70	36.40	33.60	37.00	34.00	45.40	32.10	36.30	37.40	32.10

A5.3.2 EXTRUSIVE BASALTIC HAWAIITES AND HAWAIITES FROM CANNA

	C7566	C7567	C7569	C7571	C75121	C75124	C75125	T520	T521	T523
WT %										
SIO2	50.10	51.58	50.46	50.09	49.21	49.44	50.17	49.42	46.90	50.73
AL2O3	14.20	15.97	16.67	15.05	15.80	16.74	15.90	14.64	15.40	15.50
FE2O3	1.96	2.08	2.10	1.99	1.99	2.04	2.01	2.02	1.55	2.09
FEO	12.96	10.21	11.07	12.35	11.64	10.45	10.31	12.64	13.38	9.67
MGO	6.06	5.17	4.81	5.34	6.00	5.89	6.02	6.88	8.32	6.97
CAO	7.40	7.48	7.48	7.32	8.21	8.29	8.03	7.41	8.23	7.97
NA2O	3.47	3.56	3.89	4.28	3.05	3.33	3.30	3.92	3.13	3.78
K2O	1.28	1.58	1.25	1.11	1.24	1.19	1.41	1.32	0.65	1.17
TIO2	1.99	1.76	1.75	1.93	2.40	2.07	2.26	1.92	2.02	1.67
MNO	0.22	0.17	0.17	0.18	0.18	0.17	0.18	0.15	0.20	0.13
P2O5	0.36	0.44	0.36	0.35	0.36	0.38	0.40	0.32	0.24	0.33
PPM										
BA	750	872	609	779	569	552	617	746	351	661
NB	7	8	8	8	13	12	14	9	9	5
ZR	167	166	146	149	188	180	216	155	126	135
Y	33	32	30	31	28	33	33	23	29	28
SR	460	676	1026	661	1007	497	485	538	541	592
RB	15	21	12	12	15	23	23	17	6	13
ZN	104	88	78	94	91	93	92	90	64	76
CU	31	23	71	70	66	42	17	46	82	62
NI	50	71	50	58	13	12	0	7	64	12
CR	35	87	51	36	78	41	23	24	131	92
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	7.60	9.30	7.40	6.60	7.30	7.00	8.30	7.80	3.80	6.70
AB	29.40	30.10	32.90	35.80	25.80	28.20	27.90	27.80	26.10	32.00
AN	19.40	22.90	24.30	18.60	25.80	27.20	24.40	21.30	26.00	21.90
NE	-	-	-	0.20	-	-	-	-	0.20	-
DI	12.50	9.40	8.70	12.90	10.50	9.50	10.60	11.10	10.90	12.70
HY	11.10	15.70	7.50	-	12.50	9.00	12.20	8.90	-	5.70
OL	12.60	5.10	12.00	18.60	9.80	11.30	8.40	15.80	26.20	13.90
MG	2.80	3.00	3.00	2.90	2.90	3.00	2.90	2.90	2.20	3.00
IL	3.80	3.30	3.30	3.70	4.60	3.90	4.30	3.60	3.80	3.20
AP	0.90	1.00	0.90	0.80	0.90	0.90	0.90	0.80	0.60	0.80
D.I.	36.90	39.50	40.30	42.60	33.10	35.20	36.20	35.60	30.20	38.90

A5 3.2 EXTRUSIVE BASALTIC HAWAIITES AND HAWAIITES FROM CANNA

	T524	T525	T526	T527	T528	T529	T530	TX	TY	C7522B
WT %										
SIO2	50.72	50.76	50.98	52.43	49.60	52.80	48.83	50.90	51.12	51.19
AL2O3	16.36	16.92	18.54	15.72	16.53	15.74	16.48	14.65	15.05	16.03
FE2O3	1.95	2.08	2.09	2.01	1.97	2.01	1.51	1.94	2.02	2.07
FEO	9.94	8.60	7.83	9.06	9.55	8.98	10.53	12.40	12.00	7.92
MGO	5.78	7.05	4.87	5.56	7.79	5.29	8.15	4.61	4.60	7.07
CAO	8.14	8.21	8.91	7.67	8.66	7.79	8.71	7.93	7.77	8.15
NA2O	3.73	3.62	3.93	3.94	3.37	3.75	3.35	3.69	3.65	3.72
K2O	1.27	1.07	1.13	1.61	0.86	1.64	0.69	1.30	1.26	1.15
TIO2	1.62	1.23	1.30	1.44	1.32	1.43	1.34	2.04	1.98	2.32
MNO	0.17	0.15	0.14	0.15	0.17	0.16	0.17	0.18	0.18	0.11
P2O5	0.32	0.31	0.29	0.40	0.25	0.41	0.23	0.36	0.33	0.26
PPM										
BA	692	633	630	871	537	890	444	763	762	529
NB	7	5	8	6	6	11	8	10	10	10
ZR	141	111	116	162	101	176	99	167	171	204
Y	28	28	25	28	22	34	24	32	38	28
SR	591	724	683	588	558	607	577	542	564	355
RB	17	13	14	22	13	22	9	19	16	31
ZN	67	77	105	86	87	44	76	92	91	99
CU	36	17	62	48	58	57	42	47	34	24
NI	51	13	12	0	80	13	68	0	0	92
CR	103	82	140	64	120	60	119	17	17	239
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	7.50	6.30	6.70	9.50	5.10	9.70	4.10	7.70	7.40	6.80
AB	31.60	30.60	33.20	33.30	28.50	31.70	28.30	31.20	30.90	31.50
AN	24.10	26.80	29.60	20.50	27.40	21.30	27.90	19.60	21.00	23.60
NE	-	-	-	-	-	-	-	-	-	-
DI	11.70	9.80	10.50	12.40	11.10	12.10	11.30	14.60	12.70	12.10
HY	6.00	7.90	3.00	9.80	5.40	14.80	1.60	11.00	14.50	9.90
OL	12.40	12.60	10.80	8.00	16.50	3.80	21.50	8.40	5.90	8.00
MG	2.80	3.00	3.00	2.90	2.90	2.90	2.20	2.80	2.90	3.00
IL	3.10	2.30	2.50	2.70	2.50	2.70	2.50	3.90	3.80	4.40
AP	0.80	0.70	0.70	0.90	0.60	1.00	0.50	0.90	0.90	0.70
D I	39.10	36.90	39.90	42.80	33.60	41.40	32.40	38.90	38.30	38.30

A5.3 3 EXTRUSIVE MUGEARITES FROM CANNA

	SR252
WT %	
SIO2	50.26
AL2O3	14.86
FE2O3	1.96
FEO	12.42
MGO	4.90
CAO	6.89
NA2O	4.91
K2O	1.29
TIO2	1.95
MNO	0.21
P2O5	0.36
PPM	
BA	830
NB	21
ZR	364
Y	59
SR	209
RB	38
ZN	88
CU	39
NI	0
CR	39
CIPW NORMS	
QZ	-
OR	7.60
AB	35.10
AN	14.70
NE	3.50
DI	14.40
HY	-
OL	17.40
MG	2.80
IL	3.70
AP	0.90
D I.	46.20

A5.4 QUARTZ NORMATIVE LAVAS FROM EIGG, MUCK AND CANNA

	EA25	EA30	EA35	EA21B	EA24B	LA24D	C7518C	C7536	C7550	SR254
WT %										
SIO2	55 13	54.96	54 89	57.87	58.88	59 56	51.98	52.32	51.90	51 66
AL2O3	16 42	17.01	16 87	16 62	14.82	14.82	15.75	16.49	14.39	13 73
FE2O3	2 02	2.08	2.00	2.02	2.06	2.04	1.56	2 09	1.61	1.99
FEO	6.67	6.36	5 90	5.43	6.63	6 19	7.09	9.20	12.34	12 50
MGO	4.82	4.11	4.06	2 11	2.90	2 44	9.62	5 34	4.40	4.80
CAO	7 00	7.07	6 03	5.49	4.98	4.83	8.39	7.91	7 92	7.44
NA2O	3.65	3.78	3 67	4.27	3.73	4.01	2 62	3 31	3.27	3.40
K2O	2.25	2.27	2.98	2.70	3.00	3.01	0.58	1.36	0 99	1.25
TIO2	1.49	1.73	1 98	2.72	2.27	2 30	2.09	1.47	2 13	3.63
MNO	0.11	0.16	0 14	0.10	0.08	0.07	0.10	0 16	0.22	0 22
P2O5	0.42	0.48	0.48	0.69	0.75	0.74	0.22	0.37	0 28	0 40
PPM										
BA	903	982	1116	1002	1090	1111	340	759	693	935
NB	11	9	10	25	23	26	12	8	11	14
ZR	273	275	340	429	445	445	241	159	183	241
Y	32	35	32	46	45	44	34	28	35	40
SR	492	499	450	551	530	533	341	635	549	523
RB	25	24	40	64	68	71	9	23	11	7
ZN	88	94	134	170	90	84	156	87	117	117
CU	37	34	42	3	13	19	70	0	67	20
NI	5	10	7	53	71	17	382	38	93	0
CR	21	32	22	20	16	8	362	55	20	18
CIPW NORMS										
QZ	2.70	3.00	2 20	8.90	10.70	11.30	1.30	0.40	1.10	0.60
OR	13 30	13.40	17 60	15.90	17.70	17.80	3.40	8.00	5 90	7.40
AB	30 90	32.00	31 00	36 10	31 60	33 90	22.20	28.00	27.70	28 80
AN	21.80	22.70	20 80	18.20	14.80	13.50	29.50	26.10	23 10	18 50
NE	-	-	-	-	-	-	-	-	-	-
DI	8 30	7 50	4 90	3 70	4 10	4.60	8.60	8.80	12.10	13.20
HY	16 20	13.90	15 70	7 40	12.10	9.80	28.30	21.90	23.10	22 70
OL	-	-	-	-	-	-	-	-	-	-
MG	2 90	3.00	2 90	2 90	3.00	3.00	2 30	3.00	2.30	2 90
IL	2.80	3 30	3.80	5.20	4 30	4.40	4.00	2 80	4.00	5 00
AP	1.00	1.10	1 10	1 60	1.80	1 80	0 50	0 90	0.70	0.90
D I	46.90	48 40	50.80	60 90	59.90	63.00	26 90	36 40	34 70	36 80

A5 4 QUARTZ NORMATIVE LAVAS FROM EIGG, MUCK AND CANNA

	M7653
WT %	
SIO2	54.79
AL2O3	16.85
FE2O3	2.11
FEO	8.35
MGO	4.89
CAO	5.22
NA2O	4 53
K2O	0 03
TIO2	2.47
MNO	0 16
P2O5	0 61
PPM	
BA	1052
NB	22
ZR	369
Y	44
SR	562
RB	49
ZN	110
CU	0
NI	0
CR	13
CIPW NORMS	
QZ	7 10
OR	0.20
AB	38 30
AN	21 90
NE	-
DI	-
HY	22.00
OL	-
MG	3.10
IL	4.70
AP	1.40
D.I.	45.80

A5.5 FAIRY BRIDGE TYPE LAVAS FROM EIGG, MUCK AND CANNA

	E7438	E7457	E7632	C7501E
WT %				
SIO2	48.52	49.06	46.24	49.23
AL2O3	15.67	16.39	15.55	14.39
FE2O3	1.49	1.47	1.56	2.02
FEO	9.18	10.70	10.71	11.76
MGO	9.21	6.35	11.28	6.87
CAO	11.28	10.47	10.40	7.67
NA2O	2.85	3.13	2.41	3.33
K2O	0.25	0.48	0.16	1.85
TIO2	1.25	1.53	1.34	1.99
MNO	0.19	0.21	0.20	0.26
P2O5	0.12	0.20	0.15	0.63
PPM				
BA	140	296	135	216
NB	4	6	6	5
ZR	76	86	68	88
Y	18	27	15	22
SR	299	362	272	303
RB	4	7	2	5
ZN	69	74	65	80
CU	72	82	164	76
NI	145	40	334	16
CR	381	180	381	15
CIPW NORMS				
QZ	-	-	-	-
OR	1.50	2.80	0.90	10.90
AB	23.90	26.50	19.70	28.20
AN	29.20	29.30	31.10	18.80
NE	0.10	-	0.40	-
DI	21.10	17.70	15.80	12.50
HY	-	3.80	-	2.80
OL	19.30	14.40	26.80	18.60
MG	2.20	2.10	2.30	2.90
IL	2.40	2.90	2.50	3.80
AP	0.30	0.50	0.40	1.50
D I	25.50	29.30	21.00	39.10

APPENDIX 6

ANALYSES OF BASIC MINOR INTRUSIONS FROM EIGG, MUCK AND CANNA

NA - analysis not available for this element.

A5.1.1 INTRUSIVE BASALTS FROM EIGG

	E7404	E7418	E7433	E7447	E7449	E7450	E7613	E7626	E7631	E7633
WT %										
SIO2	45.98	48.02	47.29	48.59	48.11	48.12	46.79	47.68	47.00	48.01
AL2O3	14.15	14.65	14.24	15.73	15.47	14.24	14.75	14.21	15.40	16.23
FE2O3	1.60	1.54	1.54	1.53	1.49	1.52	1.60	1.61	1.45	1.65
FEO	11.83	11.07	11.72	9.00	10.88	12.40	8.58	11.91	11.47	9.20
MGO	8.63	7.76	9.07	8.94	8.40	6.70	13.51	7.94	8.15	10.10
CAO	11.50	10.85	11.57	11.52	10.29	11.09	11.93	12.00	10.78	11.65
NA2O	3.19	2.73	2.08	2.74	3.05	2.93	1.52	2.45	2.92	1.11
K2O	0.28	0.95	0.17	0.31	0.45	0.27	0.11	0.27	0.32	0.41
TIO2	2.39	2.03	1.94	1.27	1.50	2.31	0.97	1.59	2.10	1.37
MNO	0.22	0.24	0.17	0.26	0.18	0.21	0.16	0.23	0.21	0.17
P2O5	0.22	0.16	0.21	0.11	0.20	0.19	0.07	0.11	0.18	0.11
PPM										
BA	108	740	239	NA	NA	NA	81	79	100	112
NB	8	8	8	NA	NA	NA	6	9	11	3
ZR	121	148	129	NA	NA	NA	105	152	98	2139
Y	25	27	25	NA	NA	NA	25	28	20	19
SR	265	423	323	NA	NA	NA	230	325	385	312
RB	3	19	3	NA	NA	NA	4	3	2	5
ZN	80	80	85	NA	NA	NA	68	80	67	55
CU	166	57	91	204	131	174	224	118	138	187
NI	49	40	27	91	145	110	428	303	429	136
CR	235	257	255	303	219	230	1960	52	218	381
CPIW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	1.70	5.60	1.00	1.80	2.70	1.60	0.70	1.60	1.90	2.40
AB	17.20	21.50	17.60	23.20	24.80	24.80	12.90	20.70	22.40	9.40
AN	23.50	24.90	29.00	29.70	27.20	24.90	33.10	27.00	28.00	38.10
NE	5.30	0.90	-	-	0.50	-	-	-	1.30	-
DI	26.40	22.90	22.20	21.80	18.50	24.00	20.60	26.30	20.00	15.40
HY	-	-	9.50	0.70	-	3.10	6.70	1.30	-	24.60
OL	18.60	17.70	14.30	17.90	20.80	14.60	21.70	17.60	20.00	4.80
MC	2.30	2.20	2.20	2.20	2.20	2.20	2.30	2.30	2.10	2.40
IL	4.50	3.90	3.70	2.40	2.80	4.40	1.80	3.00	4.00	2.60
AP	0.50	0.40	0.50	0.30	0.50	0.50	0.20	0.30	0.40	0.30
D.I.	24.20	28.00	18.60	25.60	28.00	26.40	13.50	22.30	25.50	11.80

A6.1.1 INTRUSIVE BASALTS FROM EIGG

	E7637	E7646	E7651	E7666	FA40
WT %					
SIO2	46.28	50.04	46.70	47.37	47.56
AL2O3	15.55	12.83	14.85	14.57	15.56
FE2O3	1.57	1.41	1.56	1.52	1.57
FEO	9.40	14.55	11.78	10.67	9.54
MGO	12.49	5.94	9.50	9.69	9.10
CAO	11.59	9.66	10.57	11.64	11.99
NA2O	1.57	2.51	2.36	2.40	2.06
K2O	0.09	0.36	0.30	0.19	0.18
TIO2	1.20	2.25	2.01	1.63	1.53
MNO	0.19	0.25	0.19	0.19	0.18
P2O5	0.08	0.19	0.19	0.13	0.15
PPM					
BA	NA	329	NA	70	170
NB	NA	1[illegible]	NA	3	7
ZR	NA	133	NA	104	117
Y	NA	43	NA	24	21
SR	NA	283	NA	229	411
RB	NA	7	NA	1	5
ZN	NA	110	NA	65	65
CU	167	71	131	162	133
NI	1195	102	199	166	537
CR	468	20	439	303	137
CPIW NORMS					
QZ	-	-	-	-	-
OR	0.50	2.10	1.80	1.10	1.10
AB	13.30	21.20	20.00	20.30	20.80
AN	35.10	22.70	29.00	28.40	30.00
NE	-	-	-	-	0.90
DI	17.70	20.10	18.10	23.20	23.20
HY	7.20	27.00	4.00	1.20	-
OL	21.50	-	20.60	20.10	18.50
MG	2.30	2.00	2.30	2.20	2.30
IL	2.30	4.30	3.80	3.10	2.90
AP	0.20	0.40	0.40	0.30	0.40
D.I	13.80	23.40	21.70	21.40	22.80

A6 1 2 INTRUSIVE BASALTIC HAWAIITES AND HAWAIITES FROM EIGG

	E7615	E7402	E7446
WT %			
SIO2	46.43	48.20	49.97
AL2O3	14.88	14.78	13.63
FE2O3	1.50	2.00	1.98
FEO	13.97	12.04	10.59
MGO	7.95	7.41	8.25
CAO	8.69	8.84	8.77
NA2O	2.64	3.42	3.34
K2O	0.52	0.76	0.67
TIO2	2.84	2.06	2.41
MNO	0.27	0.21	0.18
P2O5	0.30	0.27	0.21
PPM			
BA	36	505	NA
NB	5	4	NA
ZR	117	165	NA
Y	19	30	NA
SR	339	533	NA
RB	4	5	NA
ZN	67	77	NA
CU	108	108	40
NI	8	68	55
CR	93	64	198
CIPW NORMS			
QZ	-	-	-
OR	3.10	4.50	4.00
AB	23.20	28.50	28.30
AN	19.40	22.70	20.20
NE	1.10	0.20	-
DI	29.30	16.00	17.90
HY	-	-	10.30
OL	17.00	20.60	11.50
MG	2.20	2.90	2.90
IL	4.30	3.90	4.60
AP	0.40	0.60	0.50
D.I.	27.40	33.20	32.20

A6.2.1 INTRUSIVE BASALTS FROM MUCK

	M7609	MD2	MD3	MD4	MD5	MD6	MD9	MD10	MD11B	MD12
WT %										
SIO2	47.32	46.31	46.49	47.00	48.68	47.76	46.83	48.93	47.36	49.76
AL2O3	14.24	17.74	14.91	13.63	14.76	14.05	15.00	15.38	13.87	13.37
FE2O3	1.49	1.62	1.51	1.56	1.51	1.57	1.50	1.53	1.50	1.58
FEO	13.28	7.43	11.40	9.83	11.48	10.15	12.79	9.52	11.04	10.83
MGO	9.70	12.23	8.23	12.75	8.10	11.80	8.33	9.55	11.12	7.74
CAO	8.53	11.23	11.29	10.49	9.90	8.84	9.62	11.29	9.21	9.93
NA2O	2.35	2.10	3.40	2.59	2.91	2.97	2.87	2.40	2.99	3.13
K2O	0.33	0.19	0.25	0.33	0.34	0.49	0.52	0.18	0.66	0.47
TIO2	2.38	0.92	2.13	1.49	1.90	1.91	2.13	0.96	1.84	2.53
MNO	0.14	0.13	0.20	0.24	0.21	0.19	0.22	0.18	0.18	0.21
P2O5	0.25	0.10	0.18	0.09	0.21	0.27	0.20	0.07	0.23	0.24
PPM										
BA	269	NA	NA	NA	NA	NA	NA	NA	60	0
NB	11	NA	NA	NA	NA	NA	NA	NA	5	0
ZR	186	NA	NA	NA	NA	NA	NA	NA	157	0
Y	34	NA	NA	NA	NA	NA	NA	NA	34	474
SR	499	NA	NA	NA	NA	NA	NA	NA	296	6
RB	5	NA	NA	NA	NA	NA	NA	NA	5	2
ZN	92	NA	NA	NA	NA	NA	NA	NA	89	6
CU	7	142	193	109	66	66	102	159	102	102
NI	0	333	40	307	280	143	48	105	383	48
CR	47	683	264	595	118	180	87	218	630	105
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	1.90	1.10	1.50	2.00	2.00	2.90	3.10	1.10	3.90	2.80
AB	19.90	17.20	18.80	18.60	24.60	25.10	23.60	20.30	22.40	26.50
AN	27.30	38.40	24.70	24.60	26.20	23.60	26.50	30.70	22.50	21.60
NE	-	0.30	5.40	1.80	-	-	0.40	-	1.50	-
DI	11.00	13.40	24.80	21.70	17.70	15.00	16.40	20.30	17.70	21.40
HY	17.20	-	-	-	8.40	1.20	-	9.00	-	10.60
OL	15.40	25.20	18.20	26.00	14.80	25.70	23.30	14.50	25.80	9.50
MG	2.20	2.30	2.20	2.30	2.20	2.30	2.20	2.20	2.20	2.30
IL	4.50	1.70	4.00	2.80	3.60	3.60	4.00	1.80	3.50	4.80
AP	0.60	0.20	0.40	0.20	0.50	0.60	0.50	0.20	0.50	0.60
D 1	21.80	18.60	25.70	22.40	26.60	28.00	27.00	21.40	27.90	29.30

A6.2 1 INTRUSIVE BASALTS FROM MUCK

	MD13	MD14	MD15	MD19A	MD19b	MD37	MD44	MD49	MD53	MD54-1
WT %										
SIO2	46.69	46.42	47.71	46.43	44.48	47.25	46.76	47.72	47.88	46.69
AL2O3	12.39	14.41	14.03	13.30	13.64	16.98	13.65	15.69	14.49	15.40
FE2O3	1.57	1.57	1.53	1.45	1.49	1.50	1.64	1.54	1.57	1.49
FEO	10.45	10.47	11.03	15.59	17.78	6.92	9.96	11.87	9.76	11.19
MGO	14.59	12.39	9.34	7.41	6.60	7.59	14.42	8.81	9.99	11.99
CAO	9.83	9.43	10.88	9.29	9.59	12.99	9.59	8.56	11.48	8.79
NA2O	2.23	3.33	2.48	2.98	2.55	2.53	2.69	3.06	2.49	2.02
K2O	0.27	0.36	0.53	0.41	0.24	0.24	0.19	0.24	0.29	0.24
TIO2	1.62	1.30	2.08	2.59	3.01	1.57	0.85	2.09	1.73	1.78
MNO	0.21	0.18	0.21	0.27	0.38	0.30	0.19	0.18	0.19	0.24
P2O5	0.13	0.16	0.18	0.28	0.24	0.13	0.08	0.24	0.15	0.18
PPM										
BA	0	6	4	NA	601	44	1	247	1087	178
NB	0	1	1	NA	19	5	3	5	26	7
ZR	0	1	0	NA	271	104	0	120	456	172
Y	256	35	56	NA	40	27	0	24	64	33
SR	6	17	5	NA	411	214	5	320	426	246
RB	4	1	0	NA	27	0	1	8	65	4
ZN	13	8	1	NA	114	79	30	91	109	84
CU	121	121	160	147	159	131	117	48	147	100
NI	930	895	207	89	80	87	1060	33	128	283
CR	1760	442	84	205	225	287	650	21	280	790
CIPW NORMS										
QZ	–	–	–	–	–	–	–	–	–	–
OR	1.60	2.10	3.10	2.40	1.40	1.40	1.10	1.40	1.70	1.40
AB	18.90	18.20	21.00	25.10	21.60	19.00	18.70	25.90	21.10	17.10
AN	23.00	23.30	25.60	21.70	25.10	39.70	24.60	28.40	27.50	32.20
NE	–	5.40	–	0.10	–	1.30	2.20	–	–	–
DI	20.10	18.20	22.20	18.80	17.60	19.30	18.10	10.30	23.10	8.30
HY	0.90	–	2.90	–	0.10	–	–	3.10	1.90	14.70
OL	29.90	27.70	18.50	24.20	25.80	13.70	31.10	19.20	18.80	20.30
MG	2.30	2.30	2.20	2.10	2.20	2.20	2.40	2.20	2.30	2.20
IL	3.10	2.50	3.90	4.90	5.70	3.00	1.60	4.00	3.30	3.40
AP	0.30	0.40	0.40	0.70	0.60	0.30	0.20	0.60	0.40	0.40
D.I.	20.50	25.70	24.10	27.60	23.00	21.70	22.00	27.30	22.80	18.50

A6.2.1 INTRUSIVE BASALTS FROM MUCK

	MD54-2	MD56C	MD57A	MD60	MD61	MD65	MD70	MD77	MD79	MD80
WT %										
SIO2	46.32	46.29	46.36	45.58	47.20	47.52	46.72	45.66	47.66	47.15
AL2O3	15.61	14.43	14.75	14.09	14.59	13.50	14.31	14.92	15.97	15.64
FL2O3	1.50	1.57	1.58	1.62	1.58	1.61	1.57	1.50	1.54	1.59
FEO	10.97	12.64	11.57	11.10	10.40	9.95	10.93	11.06	11.59	9.69
MGO	12.10	10.83	9.32	12.95	12.09	12.21	9.95	11.66	9.02	10.03
CAO	9.08	8.54	11.01	8.92	9.57	10.17	10.90	10.09	8.56	10.58
NA2O	2.09	3.07	3.04	2.76	2.40	2.62	2.75	2.78	3.16	3.39
K2O	0.15	0.37	0.28	0.34	0.37	0.30	0.23	0.19	0.31	0.36
TIO2	1.78	1.90	1.73	1.29	1.45	1.77	2.15	1.50	1.80	1.24
MNO	0.23	0.19	0.21	0.16	0.19	0.19	0.28	0.18	0.19	0.17
P2O5	0.16	0.18	0.16	0.16	0.17	0.16	0.21	0.46	0.20	0.17
PPM										
BA	62	4399	3466	628	318	397	275	NA	NA	NA
NB	6	262	134	37	23	9	9	NA	NA	NA
ZR	100	4330	2317	606	322	154	151	NA	NA	NA
Y	18	0	3	0	2	46	46	NA	NA	NA
SR	214	902	481	123	69	384	276	NA	NA	NA
RB	2	831	423	115	68	10	2	NA	NA	NA
ZN	71	0	476	132	57	110	116	NA	NA	NA
CU	112	42	36	116	112	140	148	123	58	140
NI	348	50	57	406	380	320	702	293	47	150
CR	810	32	54	900	901	523	283	503	40	240
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	0.90	2.20	1.70	2.00	2.20	1.80	1.40	1.10	1.80	2.10
AB	17.70	22.90	18.20	21.00	20.30	22.20	21.00	19.10	26.70	19.40
AN	32.80	24.50	25.80	25.10	27.90	24.20	26.00	27.70	28.50	26.40
NE	-	1.70	4.10	1.30	-	-	1.20	2.40	-	5.10
DI	9.10	13.70	22.80	14.70	14.90	20.40	21.80	15.80	10.40	20.30
HY	11.10	-	-	-	4.30	0.50	-	-	3.70	-
OL	22.50	28.80	21.60	30.70	24.90	24.90	21.80	27.80	22.70	21.70
MG	2.20	2.30	2.30	2.30	2.30	2.30	2.30	2.20	2.20	2.30
IL	3.40	3.60	3.30	2.50	2.80	3.40	4.10	2.80	3.40	2.40
AP	0.40	0.40	0.40	0.40	0.40	0.40	0.50	1.10	0.50	0.40
D I	18.60	26.80	23.90	24.30	22.50	23.90	23.60	22.60	28.60	26.50

A6 2 1 INTRUSIVE BASALTS FROM MUCK

	MD81	MD82	MD85	MD86	MD89	MD92	MD95	MD100	MD106	MD109
WT %										
SIO2	46.78	49.94	47.37	46.06	50.49	47.68	49.09	49.98	46.61	45.43
AL2O3	14.01	15.03	15.55	15.99	14.11	13.74	14.16	14.80	14.00	16.28
FE2O3	1.54	1.52	1.55	1.99	1.49	1.49	1.50	1.55	1.54	1.56
FEO	10.98	10.29	12.47	11.47	10.74	11.34	11.32	9.69	16.44	13.06
MGO	10.85	7.61	7.80	8.90	7.74	9.94	8.15	8.81	6.52	9.16
CAO	10.54	10.67	9.51	8.87	9.90	11.26	10.81	10.85	9.12	9.27
NA2O	2.82	3.07	3.02	3.79	2.98	2.49	2.72	2.50	2.33	2.57
K2O	0.37	0.29	0.28	0.26	0.41	0.25	0.31	0.18	0.36	0.21
TIO2	1.73	1.23	2.02	2.25	1.71	1.49	1.63	1.34	2.56	2.10
MNO	0.23	0.21	0.28	0.20	0.22	0.18	0.21	0.21	0.29	0.20
P2O5	0.15	0.12	0.15	0.22	0.21	0.15	0.11	0.10	0.25	0.18
PPM										
BA	NA	NA	NA	NA	NA	NA	NA	NA	NA	131
NB	NA	NA	NA	NA	NA	NA	NA	NA	NA	4
ZR	NA	NA	NA	NA	NA	NA	NA	NA	NA	130
Y	NA	NA	NA	NA	NA	NA	NA	NA	NA	28
SR	NA	NA	NA	NA	NA	NA	NA	NA	NA	391
RB	NA	NA	NA	NA	NA	NA	NA	NA	NA	3
ZN	NA	NA	NA	NA	NA	NA	NA	NA	NA	73
CU	124	115	45	75	94	76	109	118	88	60
NI	104	27	75	46	42	270	117	83	53	97
CR	209	238	52	65	194	740	218	265	93	63
CIPW NORMS										
QZ	-	-	-	-	-	-	-	-	-	-
OR	2.20	1.70	1.70	1.50	2.40	1.50	1.80	1.10	2.10	1.20
AB	19.20	26.00	25.60	23.70	25.20	21.10	23.00	21.20	19.70	21.70
AN	24.50	26.40	28.00	25.80	23.90	25.60	25.50	28.60	26.70	32.30
NE	2.50	-	-	4.60	-	-	-	-	-	-
DI	21.80	21.20	15.00	13.70	19.60	24.00	22.50	20.00	14.20	10.30
HY	-	7.20	2.40	-	15.40	1.20	8.20	16.70	15.90	1.40
OL	23.90	12.70	20.90	23.00	7.60	21.40	13.40	7.40	13.70	26.30
MG	2.20	2.20	2.20	2.90	2.20	2.20	2.20	2.20	2.20	2.30
IL	3.30	2.30	3.80	4.30	3.20	2.80	3.10	2.50	4.90	4.00
AP	0.40	0.30	0.40	0.50	0.50	0.40	0.30	0.20	0.60	0.40
D.I	23.90	27.70	27.20	29.70	27.60	22.50	24.80	22.20	21.80	23.00

A6.2 1 INTRUSIVE BASALTS FROM MUCK

	MD112	MD114
WT %		
SIO2	48 93	46 51
AL2O3	16.23	15.94
FE2O3	1.51	1.52
FEO	8.73	12.06
MGO	9 43	7 78
CAO	11.29	10 22
NA2O	2 57	3.01
K2O	0 21	0.25
TIO2	0.83	2.31
MNO	0 18	0.20
P2O5	0.07	0.20
PPM		
BA	NA	NA
NB	NA	NA
ZR	NA	NA
Y	NA	NA
SR	NA	NA
RB	NA	NA
ZN	NA	NA
CU	123	43
NI	245	39
CR	99	72
CIPW NORMS		
QZ	-	-
OR	1 20	1.50
AB	21 80	23.50
AN	32.10	29.20
NE	-	1.00
DI	19.10	16.60
HY	5.70	-
OL	16 20	21.00
MG	2 20	2.20
IL	1.60	4 40
AP	0.20	0.50
D I.	23.00	26.10

A6 2.2 INTRUSIVE BASALTIC HAWAIITES AND HAWAIITES FROM MUCK

	MD57B	MD75	MD8	MD17	MD36-3	MD564	MD67	MD110
WT %								
SIO2	50.62	49.74	50.84	48.02	48.48	47.45	49.49	49.54
AL2O3	11.35	14.53	12.57	15.25	13.34	16.70	16.63	14.40
FE2O3	1.41	1.50	1.92	2.01	1.59	2.00	2.06	2.23
FEO	15.78	11.13	11.87	11.18	14.03	10.56	10.53	10.22
MGO	5.87	6.30	6.31	8.01	6.14	7.58	6.86	3.87
CAO	8.33	11.29	7.68	8.03	9.26	9.04	9.68	9.57
NA2O	2.65	3.13	3.58	3.94	3.31	4.33	3.53	3.88
K2O	1.04	0.42	1.76	0.46	0.60	0.29	0.61	2.09
TIO2	2.48	1.59	2.83	2.58	2.66	1.68	0.11	3.49
MNO	0.27	0.24	0.19	0.18	0.27	0.17	0.20	0.17
P2O5	0.20	0.14	0.45	0.33	0.30	0.20	0.30	0.55
PPM								
BA	1200	200	NA	NA	103	284	413	3756
NB	70	11	NA	NA	8	6	10	19
ZR	1186	143	NA	NA	169	105	176	290
Y	0	18	NA	NA	29	23	48	42
SR	236	369	NA	NA	499	361	255	603
RB	219	14	NA	NA	4	5	23	33
ZN	232	86	NA	NA	80	65	132	147
CU	55	149	46	40	71	44	65	37
NI	7	37	18	63	17	54	59	22
CR	47	265	4	38	75	48	72	20
CIPW NORMS								
QZ	-	-	-	-	-	-	-	-
OR	6.10	2.50	10.40	2.70	3.50	1.70	3.60	12.30
AB	22.40	26.50	30.30	31.90	28.00	26.10	28.80	27.50
AN	16.00	24.40	13.00	22.60	19.80	25.30	27.70	15.70
NE	-	-	-	0.80	-	5.70	0.60	2.90
DI	20.20	2.50	18.30	12.40	20.20	15.00	15.20	23.40
HY	26.10	3.30	8.20	-	5.00	-	-	-
OL	1.90	12.30	10.60	21.10	15.40	19.60	20.20	7.00
MG	2.00	2.20	2.80	2.90	2.30	2.90	3.00	3.20
IL	4.70	3.00	5.40	4.90	5.10	3.20	0.20	6.00
AP	0.50	0.30	1.10	0.80	0.70	0.50	0.70	1.30
D I	28.60	29.00	40.70	35.40	31.60	33.50	33.00	42.70

A6.2 3 INTRUSIVE MUGEARITES FROM MUCK

	M7520	M7606
WT %		
SIO2	54.00	52.01
AL2O3	13.98	15.53
FE2O3	2.55	2.20
FEO	6.70	6 72
MGO	5 60	3.01
CAO	5 89	8 47
NA2O	4.42	3.71
K2O	2.98	3 07
TIO2	2 36	2 46
MNO	0 23	0.26
P2O5	1 27	0.56
PPM		
BA	NA	NA
NB	NA	NA
ZR	NA	NA
Y	NA	NA
SR	NA	NA
RB	NA	NA
ZN	NA	NA
CU	6	0
NI	0	0
CR	10	19
CIPW NORMS		
QZ	-	-
OR	17 60	18.10
AB	37.40	30 90
AN	9.50	16.70
NE	-	0.20
DI	9.20	18.20
HY	12.20	-
OL	2 90	6.70
MG	3.70	3.20
IL	4 50	4 70
AP	3.00	1 30
D.I.	55.00	49 30

A6 3 INTRUSIVE BASALTS FROM CANNA

	C7506	C7507	SR247
WT %			
SIO2	46.97	47.17	46.27
AL2O3	14.84	14 47	14 43
FE2O3	1.48	1.48	1.47
FEO	13 31	12 67	14 18
MGO	8.94	9.22	7.74
CAO	8.59	9.53	9.52
NA2O	2 73	2.74	3 07
K2O	0.50	0.39	0.48
TIO2	2.18	1.94	2.36
MNO	0.22	0 22	0.25
P2O5	0.24	0.18	0.23
PPM			
BA	297	259	284
NB	10	7	7
ZR	135	108	148
Y	32	29	33
SR	352	348	350
RB	6	5	3
ZN	100	94	101
CU	126	132	117
NI	152	219	99
CR	120	315	143
CIPW NORMS			
QZ	-	-	-
OR	3 00	2.30	2.80
AB	23 10	23.20	22.70
AN	26 80	26 00	24.20
NL	-	-	1.80
DI	11 80	16 50	17.90
HY	6 60	2 80	-
OL	21 90	23 00	23 50
MG	2 10	2.10	2.10
IL	4 10	3.70	4.50
AP	0 60	0.40	0.50
D I	26 10	25.50	27.30

A6 4 QUARTZ NORMATIVE BASIC MINOR INTRUSIVES FROM EIGG, MUCK AND CANNA

	MD7	MD35	MD35T	MD36M	MD99	MD108
WT %						
SIO2	56 94	51.85	51 33	55.09	57 73	55.44
AL2O3	14.35	12.98	11 94	15.07	14.71	14.24
FE2O3	2.60	1.48	1 57	2 13	2.59	2.13
FEO	6 14	13 08	14.29	9.51	5.74	8.69
MGO	3.91	5.01	6 20	3.69	3.38	5.10
CAO	5.53	9.04	8 67	5.10	4.73	4 57
NA2O	4.37	3.24	2.13	4 08	3.94	4.71
K2O	3.01	0 58	0 92	2 10	4.05	2 17
TIO2	2.04	2.25	2 47	2.63	2.23	1.98
MNO	0.25	0 26	0 27	0.13	0.26	0.18
P2O5	0 86	0 23	0 20	0.49	0.65	0.78
PPM						
BA	NA	75	NA	212	NA	NA
NB	NA	8	NA	7	NA	NA
ZR	NA	177	NA	136	NA	NA
Y	NA	31	NA	49	NA	NA
SR	NA	462	NA	197	NA	NA
RB	NA	2	NA	6	NA	NA
ZN	NA	88	NA	107	NA	NA
CU	0	40	48	3	8	0
NI	0	63	48	7	7	12
CR	3	38	0	13	0	250
CIPW NORMS						
QZ	4 30	0.90	3 10	4 20	5.50	0.80
OR	17 80	3.40	5.40	12.40	23.90	12.80
AB	37.00	27.40	18 00	34.50	33.30	39 80
AN	10.60	19.20	20.30	16.60	10.50	11.30
DI	9.10	20 30	17.90	4.60	7 10	5 20
HY	11.50	21 80	27 80	18 50	10 10	21 40
MG	3.80	2 10	2 30	3 10	3 80	3.10
IL	3 90	4.30	4 70	5 00	4.20	3.80
AP	2 00	0.50	0.50	1 20	1 50	1.80
D I	59.10	31.70	26.50	51 10	62.70	53.40

A6 5 PRESHAL MHOR TYPE BASIC MINOR INTRUSIVES FROM EIGG, MUCK AND CANNA

	E7409	E7414	SR250	MD41	MD111	MD116	MD118
WT %							
SIO2	47.63	47.81	46.16	46.06	48.86	47.48	48.80
AL2O3	15.40	13.59	15.29	13.97	14.16	14.11	15.52
FE2O3	1.52	1.53	1.52	1.53	1.49	1.64	1.53
FEO	9.84	12.06	11.92	11.55	11.18	9.46	9.78
MGO	8.98	9.32	10.56	12.12	9.59	13.15	9.49
CAO	13.34	11.42	10.51	10.51	10.93	10.37	10.53
NA2O	1.91	2.10	2.17	2.34	2.26	2.11	2.94
K2O	0.08	0.30	0.12	0.19	0.15	0.21	0.15
TIO2	1.04	1.52	1.40	1.39	1.10	1.16	0.98
MNO	0.18	0.24	0.20	0.20	0.21	0.19	0.18
P2O5	0.07	0.12	0.15	0.12	0.07	0.14	0.09
PPM							
BA	42	176	78	70	137	79	108
NB	7	2	8	5	3	5	6
ZR	50	67	76	79	48	63	40
Y	26	28	27	26	24	25	21
SR	198	304	161	198	283	158	290
RB	0	5	3	12	0	6	1
ZN	67	75	80	95	78	59	65
CU	188	82	115	152	137	127	122
NI	203	38	311	330	55	246	76
CR	410	257	682	839	219	797	218
CIPW NORMS							
QZ	-	-	-	-	-	-	-
OR	0.50	1.80	0.70	1.10	0.90	1.20	0.90
AB	16.20	17.80	18.40	17.70	19.10	17.80	24.90
AN	33.20	26.80	31.60	27.10	28.10	28.40	28.70
NE	-	-	-	1.20	-	-	-
DI	26.60	23.90	16.00	19.80	21.00	17.80	18.70
HY	4.20	8.30	3.60	-	12.90	6.80	2.60
OL	15.00	16.10	24.50	28.10	13.50	23.00	19.90
MG	2.20	2.20	2.20	2.20	2.20	2.40	2.20
IL	2.00	2.90	2.70	2.60	2.10	2.20	1.90
AP	0.20	0.30	0.40	0.30	0.20	0.30	0.20
D I.	16.60	19.50	19.10	20.00	20.00	19.10	25.80

A6 6 FAIRY BRIDGE TYPE BASIC MINOR INTRUSIVES FROM EIGG, MUCK AND CANNA

	E7403	E7434	EA39	MD45	MD48	MD63	MD72	MD73	MD119
WT %									
SIO2	48.90	48.31	47.49	46.65	46.90	46.59	50.36	50.70	45 83
AL2O3	15.13	14.14	14 92	15 36	14.08	17.27	13.81	14 68	14.40
FE2O3	1 54	1.48	1 47	1 54	1.52	2.00	1.99	1.55	1.60
FEO	9.12	12.26	1 03	9 81	10 66	10 92	10.92	10.07	13.29
MGO	9.67	7.70	8 89	11.21	11 64	7 17	7 65	6.95	9 66
CAO	11 10	11.35	12.10	10.86	10 34	8.65	7 50	10.34	9.96
NA2O	2 65	2.46	2 70	2 94	2.61	4.42	3.59	3.07	2 57
K2O	0 16	0.37	0.15	0 18	0.24	0.25	1.37	0.35	0.36
TIO2	1.41	1.43	1 69	1 18	1.65	2.30	2.15	1.70	1.71
MNO	0.16	0.30	0 20	0 16	0 20	0.18	0 19	0 23	0 21
P2O5	0.15	0 21	0.14	0 10	0 14	0.25	0.47	0 18	0 20
PPM									
BA	87	121	100	180	1337	159	50	68	204
NB	6	7	4	2	2	10	5	4	3
ZR	81	89	50	58	70	65	87	87	82
Y	19	43	14	11	18	17	18	21	29
SR	265	128	224	316	219	300	289	241	334
RB	0	10	4	3	4	13	3	3	3
ZN	64	96	74	56	67	71	55	92	72
CU	162	28	130	117	132	52	52	82	24
NI	208	75	113	300	325	71	58	22	38
CR	514	188	325	563	785	10	120	97	51
CIPW NORMS									
QZ	–	–	–	–	–	–	–	–	–
OR	0.90	2.20	0 90	1 10	1.40	1 50	8 10	2.10	2.10
AB	23.10	20.80	20.50	17.90	20.70	26.40	33.10	26.00	19 50
AN	27 90	26 40	28 10	28.20	26.00	26.50	14.70	25.80	26 70
NE	–	–	1 30	3.80	0.80	6 00	1.20	–	1 20
DI	21.20	23.60	25 30	20.30	19.80	12.10	17.50	20 00	17.60
HY	5.40	6.70	–	–	–	–	–	14 70	–
OL	16 10	15.00	18 20	24 10	25.60	19 70	17.30	5.50	26.80
MG	2 20	2.10	2.10	2.20	2.20	2 90	2 90	2.20	2.30
IL	2 70	2.70	3.20	2.20	3.20	4 40	4.20	3 20	3.20
AP	0 40	0.50	0 30	0 20	0.30	0 60	1 10	0.40	0.50
D.I	24.00	23.00	22 70	22.70	22 90	33.80	42.40	28.00	22.90

APPENDIX 7

ANALYSES OF ACID ROCKS FROM EIGG AND OIGH SGEIR

NA - analysis not available for this element

A7.1 ACID ROCKS FROM LIGG AND OIGH SGEIR

	L7408	L7423	LA55	LA26	LA28	LA32	L7454	L7456	L7406	L7443
WT%										
SIO2	71 85	74 29	75.34	62 44	61 47	61.22	70.97	72.14	65 51	65 96
AL2O3	11 69	12.52	12 52	15 28	15.42	15.20	13.20	13.54	16 15	15.82
FE2O3	1 06	1 07	0 99	1 03	1 01	1.02	1 11	1.11	1.08	1.07
FEO	2 05	2 18	2.20	4.52	4.87	5.27	4.71	4.43	3.39	3 33
MGO	1 08	0 72	0.55	1 81	2 15	2 31	0.24	0 45	0.95	0 82
CAO	5 13	1 49	0 74	3 51	3.46	3.64	1.10	1.28	2.66	2 43
NA2O	2 89	3.12	2.75	4.72	4.54	4.32	4.81	4.26	4.48	4.32
K2O	3 85	4.18	4.52	4.65	4.78	4.60	3.12	2 69	4.05	4.47
TIO2	0.24	0 33	0.27	1.35	1.51	1.63	0.51	0.51	1.27	1 27
MNO	0 12	0.06	0.08	0.08	0.14	0.12	0.24	0.23	0 14	0 14
P2O5	0.03	0 04	0 03	0.60	0.65	0.65	0.03	0 03	0 33	0 36
PPM										
BA	862	1182	860	1525	1588	1590	87	34	2396	1977
NB	22	20	24	14	17	16	42	40	27	26
ZR	433	426	482	554	562	541	541	537	581	627
Y	37	36	44	41	44	44	89	92	46	54
SR	127	59	41	283	296	314	119	40	270	244
RB	121	132	144	55	55	50	111	112	107	103
ZN	97	101	101	108	89	88	266	234	97	113
CU	3	5	0	16	11	10	4	5	13	4
NI	8	8	1	0	0	8	0	0	0	0
CR	10	11	14	7	5	12	10	10	23	24
CIPW NORM										
QZ	30.40	34.80	38.40	7.70	6.50	7.30	25.10	30 40	16.20	16.80
OR	22.60	24 70	26.70	27.50	28.20	27 20	18.40	15 80	23.90	26.40
AB	24.50	26.40	23.30	39.90	38 40	36 60	40 70	35 80	37 90	36.60
AN	7.60	7.10	3.50	6.80	7.60	8 50	5 20	6.10	11.00	9.70
DI	10.90	-	-	5.60	4 40	4 40	-	-	-	-
HY	-	4 50	4.30	7 10	9.00	9.90	7 90	7.90	5 90	5.40
MG	1.50	1.60	1.40	1 50	1.50	1.50	1 60	1.60	1 50	1.60
IL	0.50	0.60	0.50	2 60	2 90	3.10	1 00	1.00	2.40	2.40
AP	-	0.10	0 10	1 40	1.50	1 50	0 10	0.10	0 90	0.90
D.I	77.60	85 90	88 40	75 10	73 10	71 10	84 20	82.00	78.00	79.70

A7.1 ACID ROCKS FROM EIGG AND OIGH SGEIR

	EA1	EA43	EA48	EA9	EA46	E7442	EA24C	SP303B
WT%								
SIO2	64.67	69.63	68.50	66.00	69.85	66.96	69.70	65.63
AL2O3	15.99	15.10	16.19	15.05	15.88	15.15	13.65	15.49
FE2O3	1.06	1.01	1.01	1.03	1.03	1.03	1.03	1.02
FEO	3.62	1.76	0.51	3.63	1.04	3.59	2.45	3.30
MGO	1.26	0.20	0.86	1.22	0.18	0.44	1.35	0.75
CAO	2.99	0.57	0.51	2.28	0.63	1.92	0.92	2.58
NA2O	5.01	4.85	4.09	4.55	4.80	4.48	4.99	4.80
K2O	3.58	5.92	7.40	4.56	5.71	4.70	4.42	4.62
TIO2	1.32	0.76	0.79	1.24	0.70	1.30	0.60	1.27
MNO	0.15	0.09	0.02	0.08	0.05	0.11	0.81	0.13
P2O5	0.38	0.11	0.13	0.34	0.11	0.31	0.17	0.34
PPM								
BA	2511	945	1131	2375	963	2401	936	NA
NB	27	36	30	27	34	29	35	NA
ZR	575	1039	1028	596	997	622	594	NA
Y	48	50	59	62	47	55	64	NA
SR	277	36	36	231	39	228	77	NA
RB	76	117	96	85	110	92	0	NA
ZN	104	89	100	108	73	108	63	NA
CU	6	0	0	13	3	0	2	0
NI	0	7	21	0	0	0	52	3
CR	8	15	15	7	15	17	0	10
CIPW NORM								
QZ	13.20	17.00	14.50	15.00	18.80	17.30	18.60	13.50
OR	21.60	35.00	43.70	27.00	33.80	27.80	26.10	27.30
AB	42.40	41.00	34.60	38.50	40.60	37.90	42.20	40.60
AN	10.60	2.00	1.00	7.20	2.40	7.40	1.80	7.10
DI	1.50	0.10	-	1.60	-	0.10	1.90	3.00
HY	6.30	1.70	2.10	6.20	0.50	4.80	6.60	3.90
MG	1.50	1.50	-	1.50	1.50	1.50	1.50	1.50
IL	2.50	1.40	1.10	2.40	1.30	2.50	1.10	2.40
AP	0.90	0.30	0.30	0.80	0.30	0.70	0.20	0.80
D.I	76.80	93.00	92.90	80.40	93.10	83.00	86.90	81.40

A7.2 ACID ROCKS FROM EIGG - ANALYSES QUOTED IN THE LITERATURE

WT%	E1	EP20	EP21	EP24	E2	E4	E6	1R	L28	E26
SIO2	67 00	67 93	65.99	66.36	72 20	72 15	75 76	66 00	61.53	67.11
AL2O3	12.20	12 28	11.63	12 48	11.30	11 17	9 44	15 10	15.14	15 98
FE2O3	0.70	0 89	1.85	0.52	0.90	3.37	-	1.50	0 40	1 03
FEO	4.00	4 46	5.31	5.46	1.60	0.95	2.84	1 20	5 82	1.91
MGO	0.18	1 21	0.36	0.77	0.22	0.40	0.36	0 69	1 62	0.36
CAO	1.00	1.69	1.83	1.67	0 90	0.70	0.71	1 20	3 16	1.04
NA2O	1 53	3 97	4.99	4.46	4.40	3.12	3.21	4.90	4 27	4 48
K2O	2.80	3 57	3 14	2.16	2.40	5 04	5.19	6.20	4 15	6 21
TIO2	0.45	0.49	0.68	0.49	0 31	0.44	0.15	0.71	0.48	0.36
MNO	0 19	0.31	0.28	0.22	0 06	-	0.05	0.11	0.12	0 07
P2O5	0 04	0.12	0 17	0.19	0 05	0.14	0.08	0.11	0 23	0 07
H2O	6 00	3.53	3.55	4.90	5.60	2.82	2.72	1.10	3 04	1 51

APPENDIX 8

COLLECTION LOCALITIES AND PETROGRAPHICAL CLASSIFICATION OF THE EXTRUSIVE BASIC ROCKS OF EIGG, MUCK AND CANNA

The tables, which comprise this appendix, consist of a grid reference, or an approximate location when the grid reference is not known, for each extrusive basic sample analysed. Also listed is the petrographical type and the last column contains ' √ ' when the sample belongs to the aphyric and sparsely porphyritic group.

The samples are listed in the same order as they are tabulated in Appendix 5.

A8.1.1 Eigg Basalts

Sample No.	Grid Reference	Petrography	Aphyric?
E7413	46858733	Olivine and clinopyroxene phyric basalt.	
E7422	47839053	Olivine and plagioclase phyric basalt.	
E7427	47859050	Aphyric hawaiite.	✓
E7429	47859049	Olivine and plagioclase phyric basalt.	✓
E7430	47839052	Plagioclase phyric basalt.	✓
E7432	47839052	Olivine phyric basalt.	
E7444	44898687	" " "	
E7458	46488700	Aphyric basalt.	✓
E7459	46518745	Olivine and plagioclase phyric basalt.	
E7460	c.46398734	Plagioclase,olivine and clino-pyroxene phyric basalt.	
E7461	c.46338742	Olivine phyric basalt.	
E7463	c.46208748	" " "	
E7464	c.46088751	" " "	
E7465	c.45798733	" " "	
E7466	c.45688728	" " "	
E7467	c.45538724	Aphyric basalt.	✓
E7468	c.45418712	Olivine phyric basalt.	
E7469	c.45318705	" " "	✓
E7470	c.45258720	" " "	
E7473	c.45608570	Plagioclase phyric basalt.	
E7474	c.45708570	Olivine phyric basalt.	
E7475	c.45838565	Olivine and clinopyroxene phyric basalt.	
E7482	47868812	Olivine phyric basalt.	
E7483	47928797	" " "	
E7486	48048798	" " "	

Sample No.	Grid Reference	Petrography	Aphyric?
E7487	48228802	Olivine phyric basalt.	
E7493	48618923	" " "	
E7606	47288620	" " "	
E7630	46578640	Olivine and plagioclase phyric basalt.	
E7634	46378618	Olivine and clinopyroxene phyric basalt.	
E7635	46218593	Olivine phyric basalt.	
E7636	46168596	" " "	✓
E7639	46108539	" " "	
E7641	45928553	Olivine and clinopyroxene phyric basalt.	
E7644	48168619	Plagioclase phyric basalt.	
E7649	47898525	Olivine phyric basalt.	✓
E7650	47428522	Olivine and plagioclase phyric basalt.	
E7652	47298525	Olivine and clinopyroxene phyric basalt.	
E7654	47068529	Olivine phyric basalt.	✓
E7665	45888532	Olivine and spinel phyric basalt.	
EA8	45348545	Plagioclase and olivine phyric basalt.	✓
EA12	47068439	Olivine and spinel phyric basalt.	
EA13	47028442	Olivine phyric basalt.	
EA14	47938454	Olivine and plagioclase phyric basalt.	
EA17	47698565	Plagioclase and olivine phyric basalt.	
EA18	47378573	Olivine phyric basalt.	
EA41	45248450	" " "	
EA42	45218455	Olivine and spinel phyric basalt.	
EA51	44638679	Olivine phyric basalt.	

A8.1.2 Eigg Hawaiites

Sample No.	Grid Reference	Petrography	Aphyric?
E7472	c.45198619	Plagioclase, olivine and clinopyroxene phyric basalt.	
E7479	47638775	Aphyric hawaiite.	✓
E7662	47598505	Olivine phyric basalt.	✓
EA16	47838560	Olivine and spinel phyric basalt.	
EA21C*	46328459	Aphyric mugearite.	✓
EA38	45438442	Olivine phyric basalt.	

A8.1.3 Eigg Mugearites

Sample No.	Grid Reference	Petrography	Aphyric?
E7412	47008730	Spinel phyric mugearite.	✓
E7471	c.45208621	" " "	✓
EA29	45958451	Plagioclase, orthopyroxene and spinel phyric mugearite.	✓

* Pebble in conglomerate

A8.2.1 Muck Basalts

Sample No.	Grid Reference	Petrography	Aphyric?
M7532	40387879	Olivine and plagioclase phyric basalt.	✓
M7533	40307889	Plagioclase and olivine phyric basalt.	
M7538	40337887	" " " " "	✓
M7543	40777938	Aphyric mugearite	✓
M7546	40777939	Plagioclase and olivine phyric basalt.	
M7547	40787939	Aphyric basalt.	✓
M7548	40797941	Olivine phyric basalt.	
M7568	40038008	" " "	
M7569	39858022	" " "	
M7570	40297891	" " "	
M7571	40297890	" " "	
M7576	40317887	" " "	
M7577	40327886	Plagioclase and olivine phyric basalt.	
M7578	40337885	" " " " "	
M7591	42477938	Olivine phyric basalt.	
M7594	42307935	Plagioclase and olivine phyric basalt.	
M7595	42307936	" " " " "	
M75139	41587856	Olivine phyric basalt.	
M75140	41687856	" " "	
M75141	41617866	" " "	
M75143	41797846	Plagioclase and olivine phyric basalt.	
M75148	41857839	Aphyric mugearite.	✓
M7603	40547943	Olivine and plagioclase phyric basalt.	
M7612	40517938	" " " " "	✓
M7615	40477929	" " " " "	
M7620	40307889	Olivine phyric basalt.	

Sample No.	Grid Reference	Petrography	Aphyric?
M7622	40287891	Olivine phyric basalt.	
M7624	40247899	" " "	
M7627	40297890	" " "	
M7629	40287891	" " "	
M7630	40387908	" " "	
M7636	42397922	Plagioclase and olivine phyric basalt.	
M7639	42687918	Aphyric basalt.	✓
M7643	42807938	" "	✓
M7644	42837943	Olivine phyric basalt.	
M7648	39357948	" " "	
M7649A	39297949	" " "	
M7658	42217879	" " "	
M7659	42177864	" " "	
M7664	42097857	Plagioclase and olivine phyric basalt	

A8.2.2 Muck Basaltic Hawaiites and Hawaiites

Sample No.	Grid Reference	Petrography	Aphyric?
M75144	41867839	Plagioclase phyric mugearite.	
M7531	40367880	Aphyric mugearite.	✓
M7552	40328058	Plagioclase and olivine phyric basalt.	
M7553	40068075	Olivine phyric basalt.	✓
M7555	40128081	" " "	✓
M7567	40118018	Aphyric basalt.	✓
M7646A	39327956	Olivine phyric basalt.	
M7651B	41887839	Plagioclase phyric basalt.	

A8.2.3 Muck Mugearites

Sample No.	Grid Reference	Petrography	Aphyric?
M7579	40337885	Opaque phyric mugearite.	✓
M7597	42757903	Aphyric mugearite.	✓
M75127	40847933	" "	✓
M75146	41837840	" "	✓
M7608	40547943	" "	✓
M7638	42427916	" "	✓

A8.3.1 Canna Basalts

Sample No.	Grid Reference	Petrography	Aphyric?
C7503	28080596	Olivine and plagioclase phyric hawaiite.	
C7504	28030594	Plagioclase and olivine phyric basalt.	✓
C7511	27620631	Aphyric basalt.	✓
C7530	27360567	Olivine phyric basalt.	✓
C7533	27230561	Glomerophyric basalt.	
C7534	27050535	Olivine and plagioclase phyric hawaiite.	
C7548	26700553	Aphyric basalt.	✓
C7553	26890547	Olivine phyric basalt.	
C7573	25670560	Olivine and plagioclase phyric basalt.	
C7575	26030511	Aphyric basalt.	✓
C7576	26010590	Aphyric basalt.	✓
C7582	24680557	Aphyric basalt.	✓
C7585	26840487	Plagioclase and olivine phyric basalt.	
C7586	26450474	Olivine phyric basalt.	✓
C7588	26540438	Plagioclase and olivine phyric basalt.	
C7592	27120422	Plagioclase and olivine phyric basalt.	
C7596	27160462	Plagioclase and olivine phyric basalt.	
C7598	27590483	Plagioclase and olivine phyric basalt.	
C7599	28440426	Plagioclase and olivine phyric basalt.	
C75100	28430416	Plagioclase and olivine phyric basalt.	
C75101	28630402	Plagioclase and olivine phyric basalt.	✓
C75104	28770392	Aphyric basalt.	✓
C75107	29180408	Plagioclase and olivine phyric basalt.	
C75108	29120417	Plagioclase, olivine and clino-pyroxene phyric basalt.	

Sample No.	Grid Reference	Petrography	Aphyric?
C75109	28880422	Plagioclase and olivine phyric basalt.	
C75113	23700577	Plagioclase and olivine phyric basalt.	
C75114	23410614	Plagioclase and olivine phyric basalt.	
C75117	23280605	Plagioclase and olivine phyric basalt.	
C75118	23240606	Plagioclase and olivine phyric basalt.	
SR246	28060585	Plagioclase and olivine phyric basalt.	✓
C15	9 miles NW of Compass Hill (100' below S.L.)	Olivine phyric basalt.	
C20	c.1 mile SE of Sanday (140' below S.L.)	Plagioclase and olivine phyric basalt.	
T522	21290413	Plagioclase phyric basalt.	
C7501C	28170612	Olivine and plagioclase phyric basalt.	
C7501F	28170612	Olivine and plagioclase phyric basalt.	
C7501G	28170612	Olivine and plagioclase phyric basalt.	
C7502G	28160611	Aphyric basalt.	

AB.3.2 Canna Basaltic Hawaiites and Hawaiites

Sample No.	Grid Reference	Petrography	Aphyric?
C7545	26950588	Aphyric basalt.	✓
C75103	28810385	Plagioclase and olivine phyric basalt.	
C7505	28020606	Plagioclase and olivine phyric basalt.	
C7515	27510612	Aphyric basalt.	✓
C7517	27320585	Plagioclase and olivine phyric basalt.	
C7531	27300573	Aphyric hawaiite.	✓
C7535	26680634	Plagioclase, olivine and clino-pyroxene phyric basalt.	
C7537	26760610	Plagioclase and olivine phyric basalt.	
C7538	26720595	Plagioclase phyric hawaiite.	
C7539	26720594	Plagioclase and olivine phyric basalt.	
C7540	26790599	Plagioclase phyric basalt.	
C7541	26780598	Plagioclase phyric basalt.	
C7546	26950588	Plagioclase and olivine phyric basalt.	
C7552	26570586	Plagioclase phyric mugearite.	✓
C7558	26050578	Plagioclase and olivine phyric basalt.	✓
C7559	26060574	Plagioclase and olivine phyric basalt.	✓
C7560	26250536	" " " " "	
C7562	26220543	" " " " "	
C7563	26330557	" " " " "	
C7564	26380572	Plagioclase, olivine and spinel phyric basalt.	
C7566	25570629	Plagioclase and olivine phyric hawaiite.	✓
C7567	25430622	Plagioclase and olivine phyric basalt.	
C7569	25350597	Plagioclase phyric basalt.	✓
C7571	25560589	" " "	✓
C75121	23540590	Plagioclase and olivine phyric basalt.	

Sample No.	Grid Reference	Petrography	Aphyric?
C75124	22700495	Plagioclase, olivine and spinel phyric basalt.	
C75125	23030512	Plagioclase and spinel phyric hawaite.	
T520 }	21530402	Plagioclase and olivine phyric basalt.	
T521 }		Aphyric basalt.	✓
T523	21270417	Plagioclase and olivine phyric basalt.	
T524	21290418	Plagioclase, olivine and spinel phyric basalt.	
T525	21350420	Plagioclase and olivine phyric basalt.	
T526	21390423	" " " " "	
T527	21470431	" " " " "	
T528	21510449	" " " " "	
T529	21650451	" " " " "	
T530	21850441	Olivine and plagioclase phyric basalt.	
TX	26190540	?	
TY	26170535	?	
C7522B	27620538	Aphyric basalt.	

A8.3.3 Canna Mugearites

Sample No.	Grid Reference	Petrography	Aphyric?
SR252	26440602	Plagioclase, olivine and spinel phyric mugearite.	✓

A8.4 Quartz Normative Lavas

Sample No.	Grid Reference	Petrography	Aphyric?
EA25	46128459	Plagioclase, olivine and clino-pyroxene phyric basalt.	
EA30	45888458	" " " " " "	
EA35	45268471	Plagioclase and clinopyroxene phyric basalt.	
EA21B*	46328459	Plagioclase, olivine and clino-pyroxene phyric basalt.	✓
EA24B* }	46278458	Plagioclase phyric mugearite	✓
EA24D* }		Glassy mugearite.	✓
C7518C	27080518	Aphyric basalt.	
C7536	26730618	Plagioclase and olivine phyric basalt.	
C7550	26720533	" " " " "	
SR254	27090502	Plagioclase, clinopyroxene and spinel phyric mugearite.	
M7653	41817840	Aphyric mugearite.	✓

* Pebble in conglomerate

A8.5 Fairy Bridge Type Lavas

Sample No.	Grid Reference	Petrography	Aphyric?
E7438	46368478	Olivine, plagioclase and spinel phyric mugearite.	
E7457	46488754	Plagioclase phyric basalt.	
E7632	46688622	Olivine and spinel phyric basalt.	
C7501E	28170612	Plagioclase phyric hawaiite.	

APPENDIX 9

COLLECTION LOCALITIES AND PETROGRAPHICAL CLASSIFICATION OF THE BASIC MINOR INTRUSIVE SAMPLES FROM EIGG, MUCK AND CANNA

The tables, which comprise this appendix, consist of a grid reference for each basic minor intrusion for which an X-ray fluorescence analysis is available. The petrographical classification of each sample is also indicated and there is a ' √ ' in the last column when the sample belongs to the aphyric and sparsely porphyritic group.

The samples are listed in the same order as they are tabulated in Appendix 6.

A9.1.1 Eigg Basalts

Sample No.	Grid Reference	Petrography	Aphyric?
E7404	46928925	Aphyric basalt.	✓
E7418	47968829	" "	✓
E7433	48029087	" "	✓
E7447	48738437	Plagioclase and olivine phyric basalt.	✓
E7449	48818444	Olivine and plagioclase phyric basalt.	✓
E7450	48738447	Aphyric basalt.	✓
E7613	47218746	Plagioclase, olivine and clino-pyroxene phyric basalt	
E7626	46578698	?	
E7631	46688625	Olivine and spinel phyric basalt.	✓
E7633	46668622	Aphyric basalt.	✓
E7637	46188594	Plagioclase, olivine and spinel phyric basalt.	
E7646	48188584	Plagioclase and clinopyroxene phyric basalt.	✓
E7651	47328526	Olivine phyric basalt.	✓
E7666	45978539	Olivine and clinopyroxene phyric basalt.	
EA40	45238450	Aphyric basalt.	✓

A9.1.2 Eigg Basaltic Hawaiites and Hawaiites

Sample No.	Grid Reference	Petrography	Aphyric?
E7615	47168743	Glassy hawaiite.	✓
E7402	47178864	Aphyric basalt.	✓
E7446	48558428	Aphyric hawaiite	✓

A9.2.1 Muck Basalts

Sample No.	Grid Reference	Petrography	Aphyric?
M7609	41007941	Plagioclase and olivine phyric basalt.	✓
MD2	42217913	Plagioclase and olivine phyric basalt.	
MD3	42237903	Plagioclase and olivine phyric basalt.	
MD4	42337892	Olivine phyric basalt.	✓
MD5	42247887	" " "	
MD6	42227880	Aphyric basalt.	✓
MD9	42257861	Plagioclase, olivine and spinel phyric basalt.	
MD10	42207858	Aphyric basalt.	✓
MD11B	42067861	Dolerite.	✓
MD12	41987860	Olivine phyric basalt.	
MD13	41987857	" " "	
MD14	41967858	" " "	
MD15	42357923	Aphyric basalt.	✓
MD19A	42717908	" "	
MD19B	42717908	" "	
MD37	42877928	Plagioclase phyric basalt.	
MD44	42887932	Olivine and spinel phyric basalt.	
MD49	43007950	Plagioclase and olivine phyric basalt.	✓
MD53	40327994	Plagioclase phyric basalt.	
MD54-1	39287962	Aphyric basalt	✓
MD54-2	39287962	Olivine and spinel phyric basalt.	
MD56C	39267970	Plagioclase and spinel phyric basalt.	
MD57A	39247970	Plagioclase and olivine phyric basalt.	
MD60	41967866	Olivine phyric basalt.	
MD61	41967866	" " "	
MD65	41947856	" " "	

Sample No.	Grid Reference	Petrography	Aphyric?
MD70	41887853	Olivine phyric basalt.	
MD77	43037953	Olivine and plagioclase phyric basalt.	
MD79	41817947	Aphyric basalt.	✓
MD80	39477904	Plagioclase and olivine phyric basalt.	
MD81	39507902	Aphyric basalt.	✓
MD82	39587887	Plagioclase phyric basalt.	
MD85	39677878	Plagioclase and olivine phyric basalt.	
MD88	39797882	Olivine phyric basalt.	
MD89	39807883	Aphyric basalt.	✓
MD92	39937878	Olivine and plagioclase phyric basalt.	
MD95	40027879	Plagioclase phyric basalt.	
MD100	40207878	Plagioclase, olivine and clino-pyroxene phyric basalt.	
MD106	40987936	Plagioclase and olivine phyric basalt.	
MD109	40787931	" " " " "	
MD112	40647926	Aphyric basalt.	✓
MD114	40637921	Olivine and plagioclase phyric basalt.	

A9.2.2 Muck Basaltic Hawaiites and Hawaiites

Sample No.	Grid Reference	Petrography	Aphyric?
MD57B	39247970	Plagioclase and olivine phyric basalt.	
MD75	41807837	Plagioclase, olivine and clino-pyroxene phyric basalt.	
MD8	42277864	Spinel phyric hawaiite.	✓
MD17	42437918	Plagioclase and olivine phyric basalt.	
MD36-3	42867926	Aphyric basalt.	✓
MD56A	39267970	Plagioclase and olivine phyric basalt.	
MD67	41907857	Plagioclase phyric basalt.	
MD110	40747974	Aphyric basalt.	✓

A9.2.3 Muck Mugearites

Sample No.	Grid Reference	Petrography	Aphyric?
M7520	40818020	Aphyric mugearite.	✓
M7606	41047935	" "	

A9.3 Canna Basalts

Sample No.	Grid Reference	Petrography	Aphyric?
C7506	28080585	Olivine and plagioclase phyric basalt.	
C7507	28080585	Olivine and plagioclase phyric basalt.	
SR247	28080585	Plagioclase and olivine phyric basalt.	

A9.4 Quartz Normative Basic Minor Intrusions

Sample No.	Grid Reference	Petrography	Aphyric?
MD7	42267864	Plagioclase, clinopyroxene and spinel phyric mugearite.	
MD35	42757924	Aphyric basalt.	✓
MD35T	42757924	Glassy basalt.	✓
MD36M	42867926	Aphyric mugearite.	✓
MD99	40227870	Olivine and plagioclase phyric mugearite	
MD108	40887933	Aphyric mugearite.	✓

A9.5 Preshal Mhor Type Basic Minor Intrusions

Sample No.	Grid Reference	Petrography	Aphyric?
E7409	47328750	Plagioclase phyric basalt.	✓
E7414	46478765	Dolerite.	✓
SR250	26730642	Olivine phyric basalt	
MD41	42867938	Olivine and plagioclase phyric basalt.	
MD111	40687927	Plagioclase and olivine phyric basalt.	
MD116	40607921	Aphyric basalt.	✓
MD118	40547913	" "	✓

A9.6 Fairy Bridge Type Basic Minor Intrusions

Sample No.	Grid Reference	Petrography	Aphyric?
E7403	46938918	Plagioclase, olivine and clino-pyroxene phyric basalt.	
E7434	48059085	Aphyric basalt.	✓
EA39	45408437	Plagioclase and olivine phyric basalt.	
MD45	42897941	Aphyric basalt.	✓
MD48	42987947	Olivine and plagioclase phyric basalt.	
MD63	41967866	Olivine and plagioclase phyric basalt.	
MD72	41877848	Plagioclase, olivine and spinel phyric basalt.	
MD73	41867848	Plagioclase and clinopyroxene phyric basalt.	
MD119	40567913	Aphyric basalt.	✓

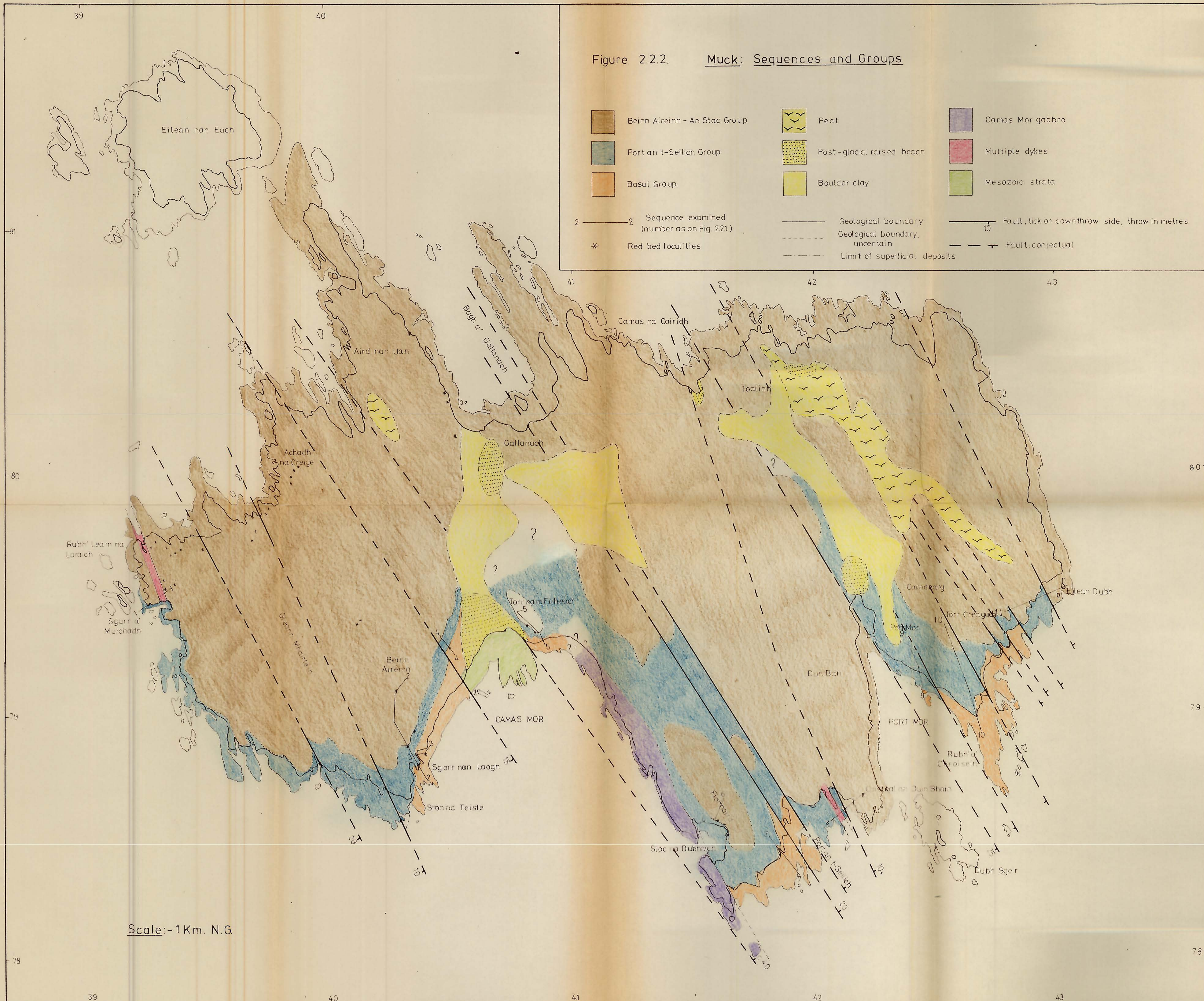


Figure 2.2.2. Muck: Sequences and Groups

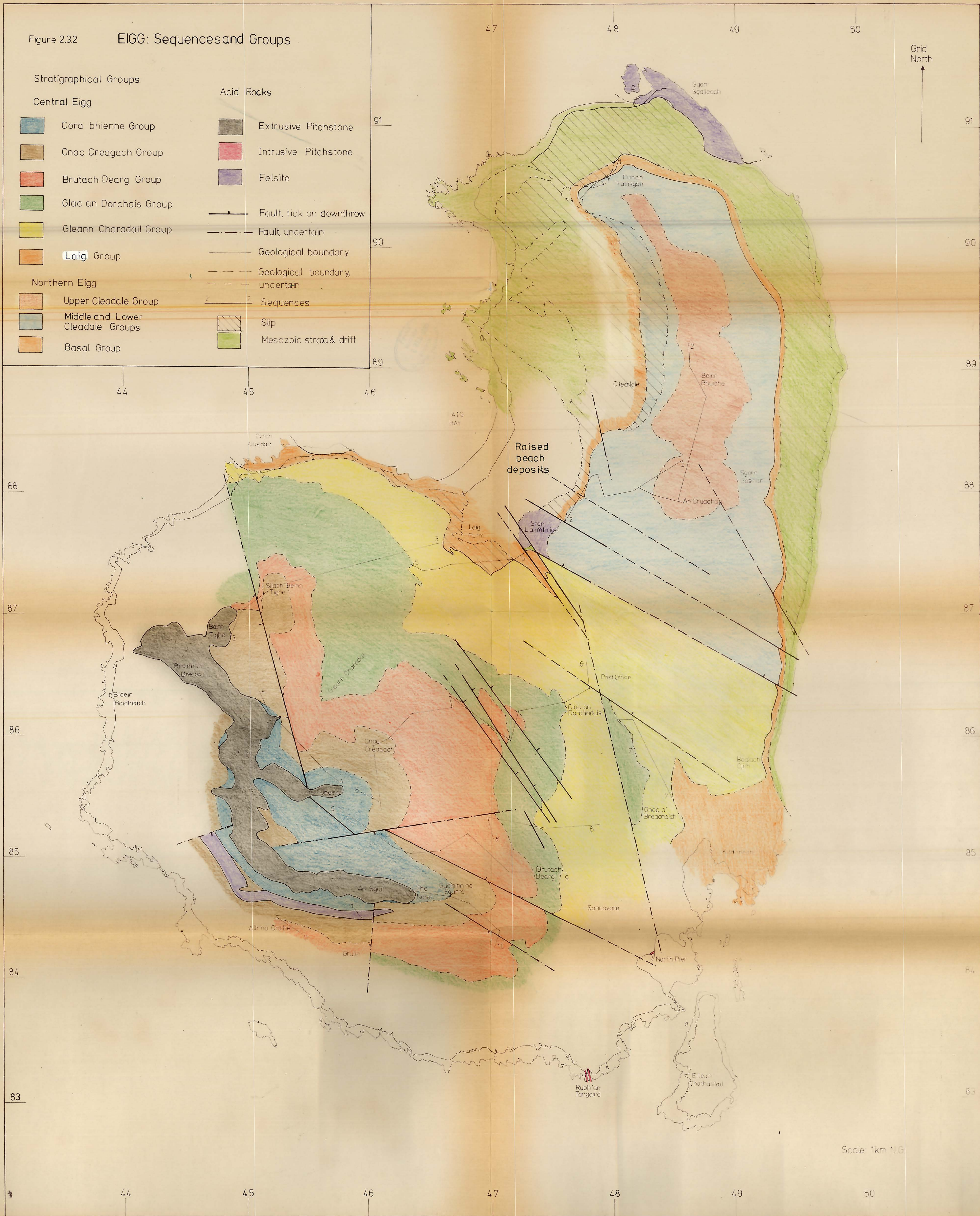


Figure 2.32 EIGG: Sequences and Groups