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THE GEOLOGY OF THE LEWISIAN COMPLEX
NEAR POOLEWE, ROSS-SHIRE

by

ALAN CRANE

Volume 2 : Illustrations

The illustrations are presented in the following order :-

Maps

Tables

Plates

Figures

Each section of illustrations is separated from adjacent sections by means of stiff card pages.

A folded geological map of the areas described is included at the end of this volume.



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CONTAINS MAPS.

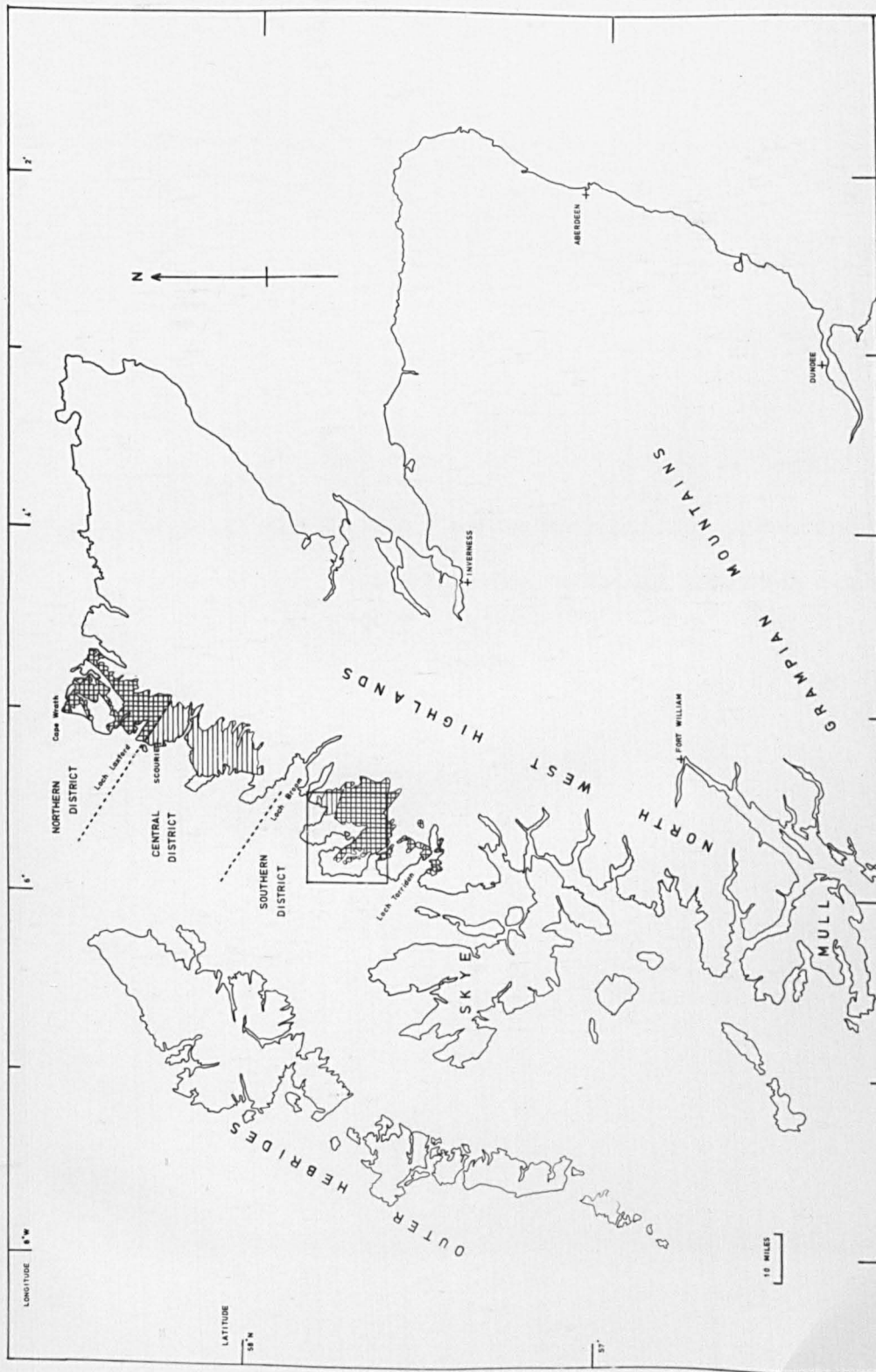
Maps

MAP 1.

Illustrating the Foreland Lewisian Outcrop.

The tripartite sub-division of Peach et al. (1907) and the Scourian and Laxfordian Complexes of Sutton and Watson (1951) are also shown.

The inset shows the location of the area of Map 2.



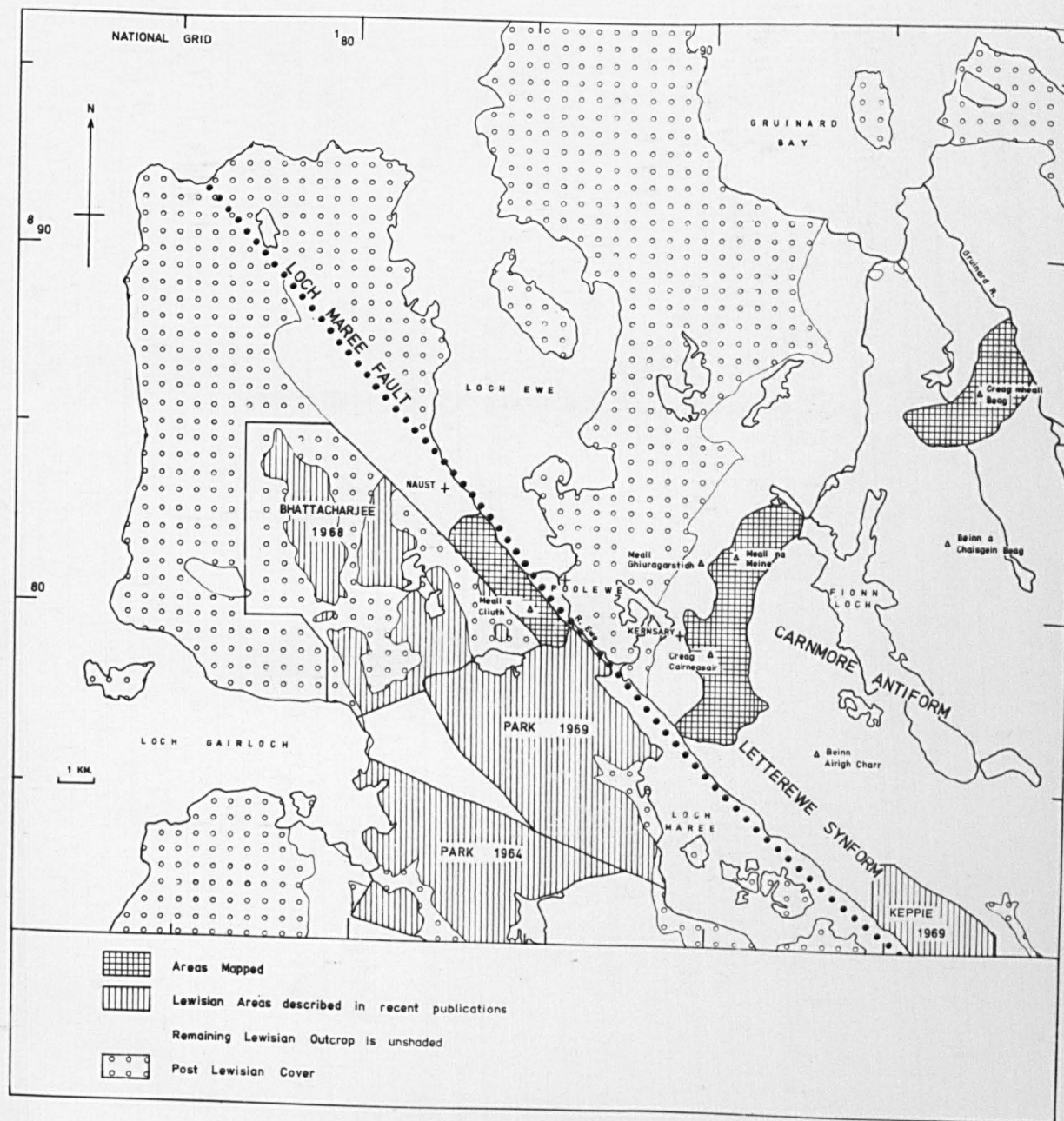
The Forland Lewisian Outcrop (shaded areas) of the Mainland, illustrating the tripartite subdivision of Peach et al. (1907).

 Northern District
 Central District
 Southern District

The inset includes the areas studied.

MAP 2.

Illustrating the location of the areas studied in relation to
areas described in recent publications.



MAP 3A.

Lithological Map of the Creag Mheall Beag Area.

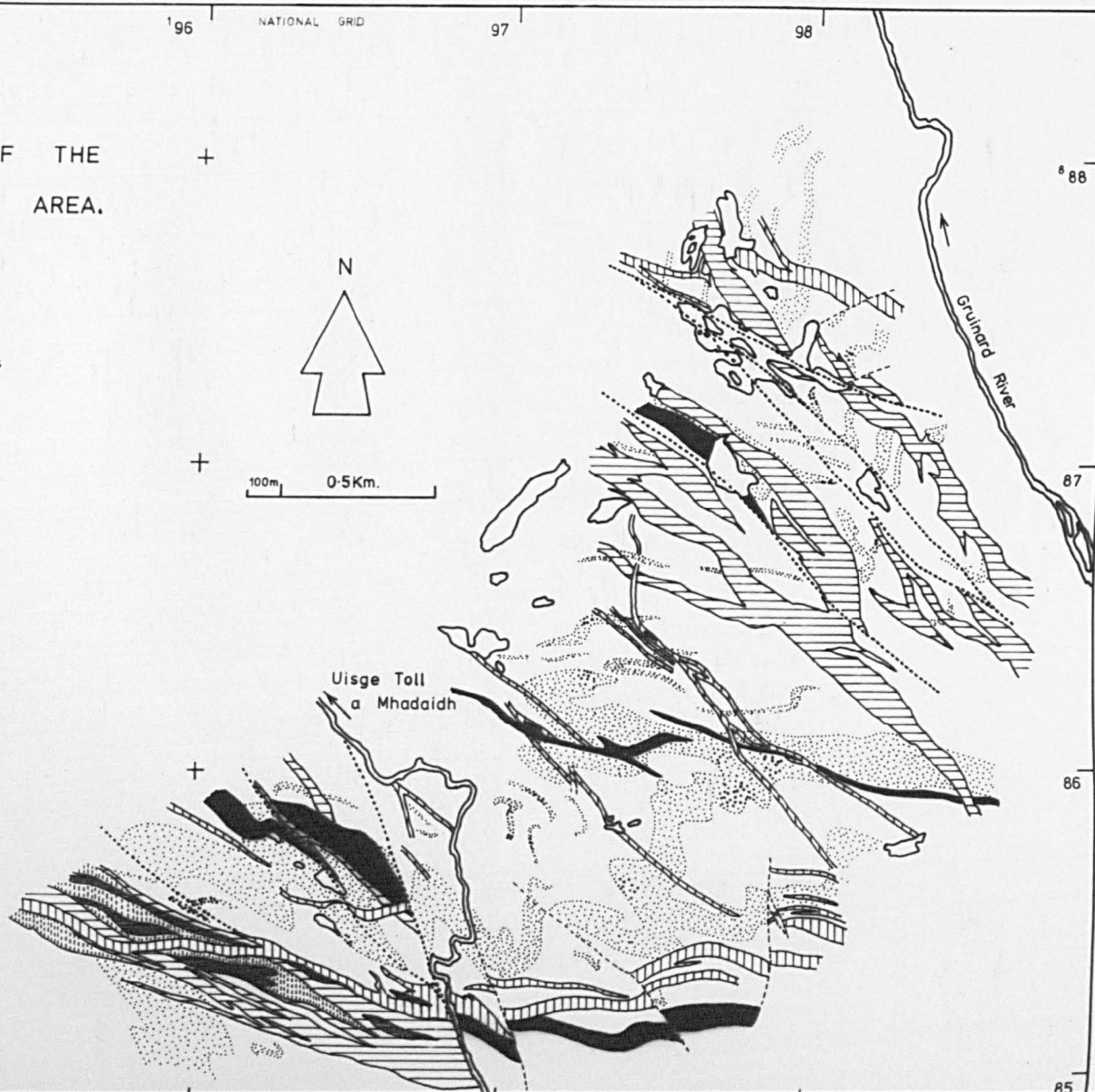
LITHOLOGICAL MAP OF THE CREAG MHEALL BEAG AREA.

- GNEISSES**
-  Acid Gneiss
 -  Basic and Dioritic Gneiss
- DYKES**
-  First Period
 -  Second Period
 -  Third Period
- GRUINARD**
-  Quartzite and Mica Schist
- METASEDIMENTS**
-  Garnet Amphibolite

-  Prominent Crush Zone
-  Fault



100m 0.5Km.



MAP 3B.

Structural Map of the Creag Mheall Beag Area illustrating S3 and
S5 Form-Lines.

STRUCTURAL MAP OF THE CREAG MHEALL BEAG AREA

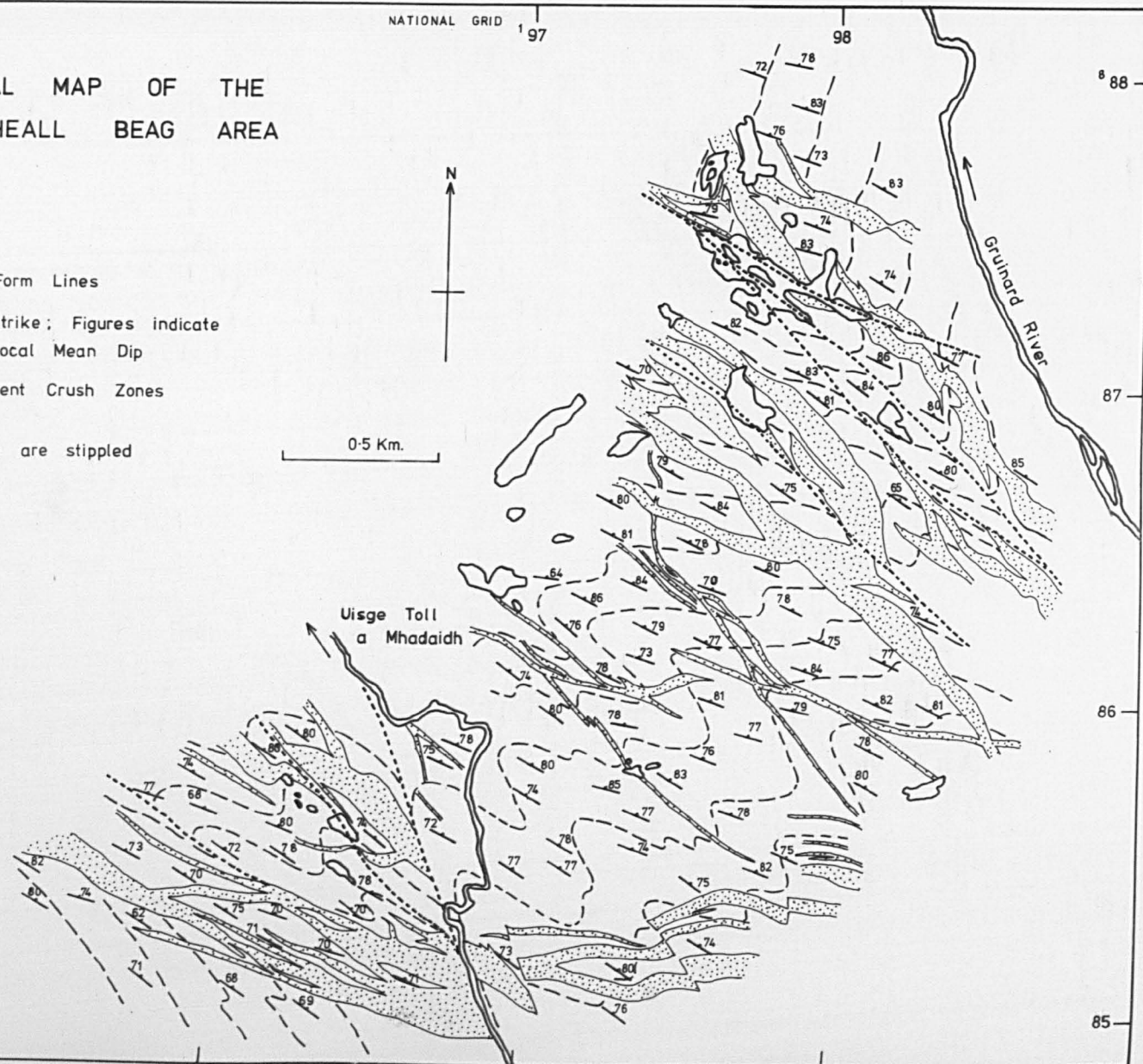
- - - S3 Form Lines
- / - S5 Strike; Figures indicate the Local Mean Dip
- . - Prominent Crush Zones

Dyke Outcrops are stippled

NATIONAL GRID 197



0.5 Km.



MAP 3C.

Structural Map of the Creag Mheall Beag Area illustrating S2
Form-Lines.

STRUCTURAL MAP OF THE CREAG MHEALL BEAG AREA

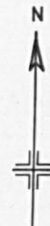
--- S2 Form Lines illustrating
Transposition to S3 (diagrammatic)

— S2 Strike, Figures indicate
the Local Mean Dip

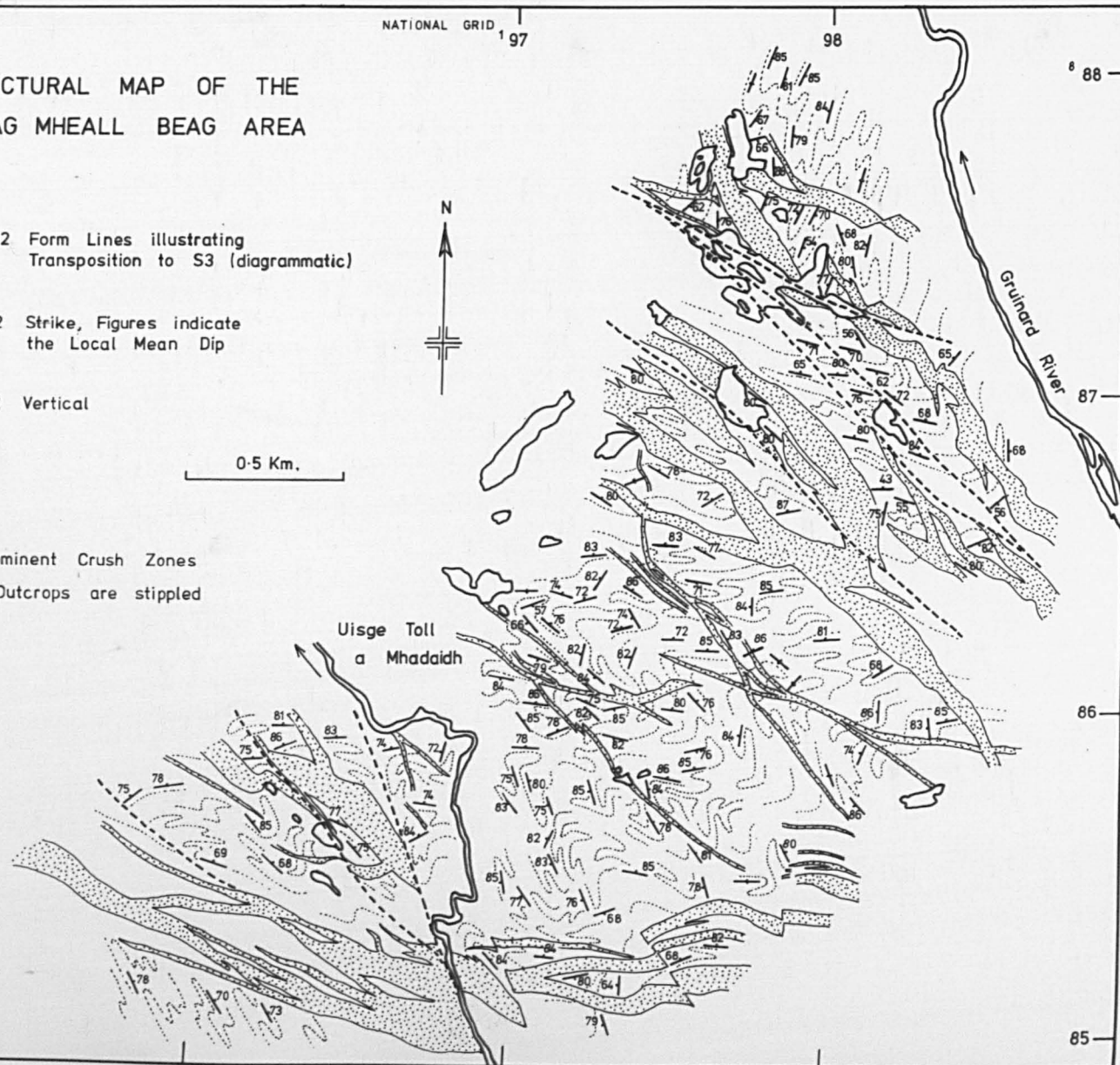
— S2 Vertical

- - - Prominent Crush Zones
Dyke Outcrops are stippled

NATIONAL GRID 197



0.5 Km.



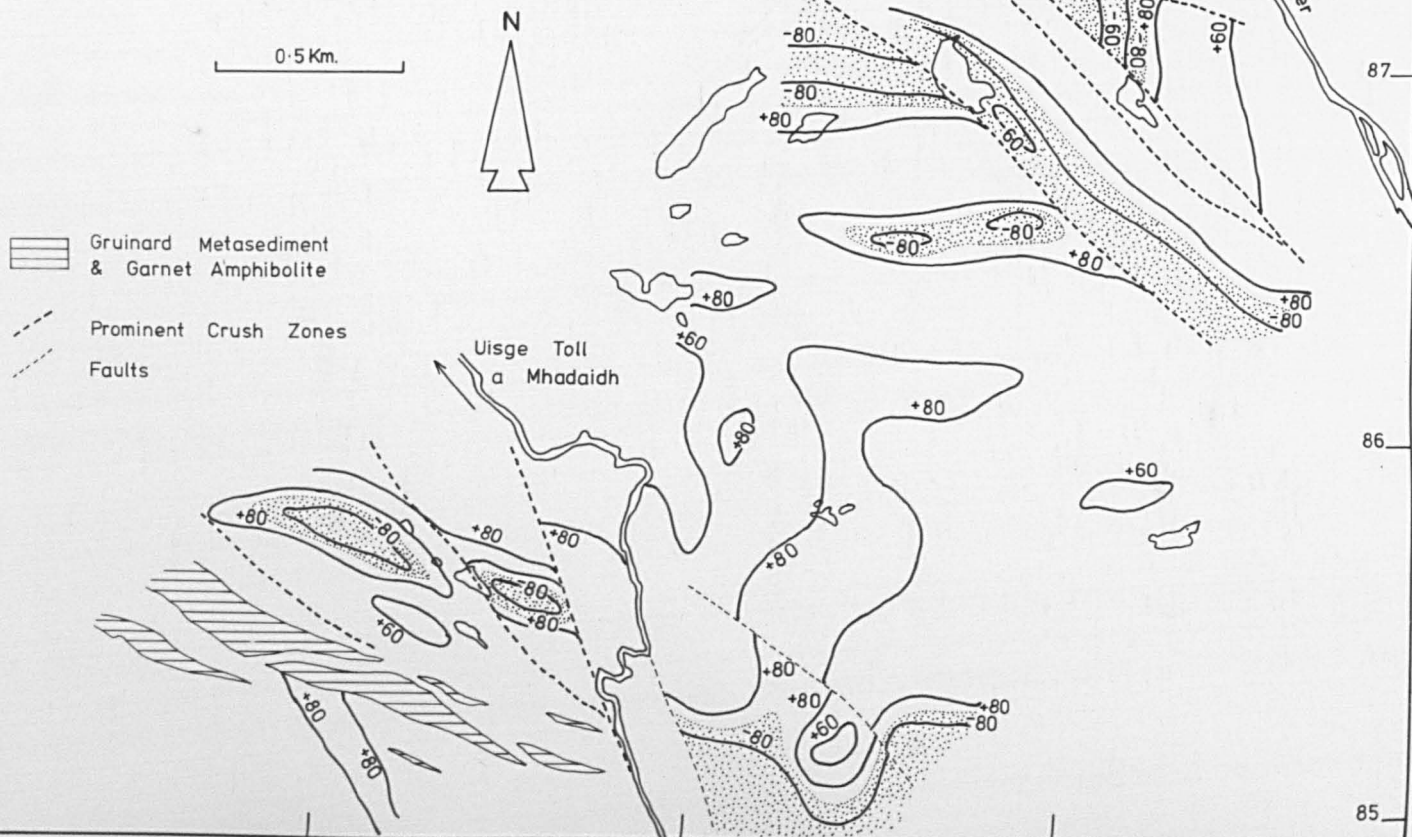
MAP 3D.

Constructed Mean L5-Lineation Pitch Isogen Map of the Creag Mheall
Beag Area.

CREAG MHEALL BEAG AREA

MEAN L5 LINEATION PITCH ISOGONS

Positive values refer to North West pitches
Negative values refer to South East pitches (stippled areas)



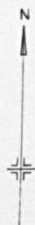
MAP 4.

Structural Map of the Kernsary Area.

STRUCTURAL MAP OF THE KERNSARY AREA.

-  S3 Form Lines; figures indicate Local Mean Dip
-  S5 Form Lines
-  S5 Strike; figures indicate Local Mean Dip
-  S6 Form Lines; figures indicate Local Mean Dip
-  Faults
-  Basic Dykes (now Amphibolites)
-  Early Basic Rocks

0.5 Km.



To Poolwe
3 miles

Kernsary

Letterewe
Estate Track

To Fionn Loch

Lochan
Sgeireach

Meall
Ghiuragarstidh

Meall na Meithe

Loch
Phail

Fionn
Loch

Loch na
Moine Buige

NATIONAL GRID

190

91

92

83

82

81

80

B
A
D

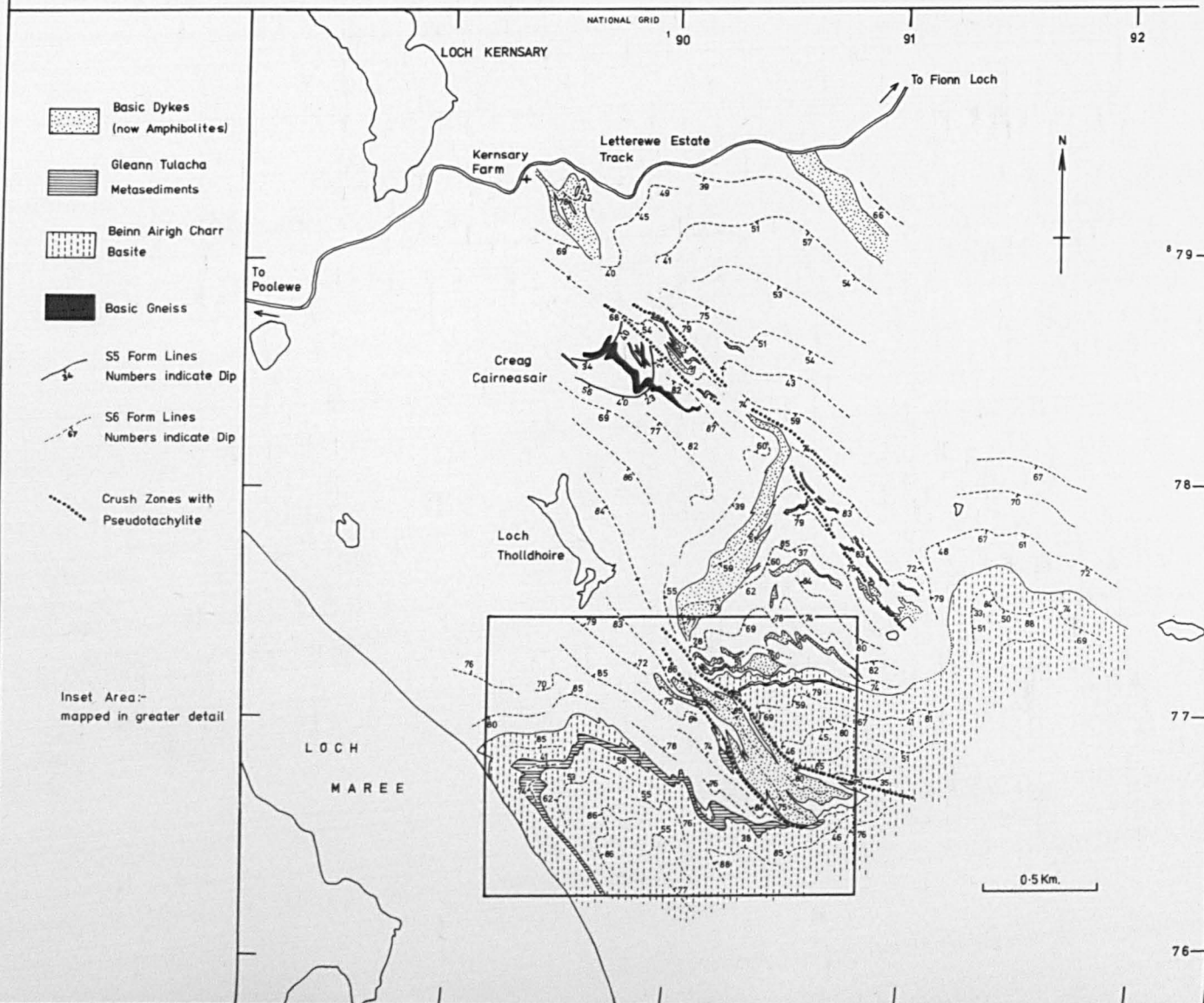
MAP 5A.

Geological Map of the Beinn Airigh Charr Area. The distribution of the main lithologies and the dominant structural trends are indicated. Acid gneiss outcrops are unshaded in the areas mapped.

The inset shows the location of the area of Map 5B.

BEINN AIRIGH CHARR AREA

STRUCTURAL MAP



MAP 5B.

Larger scale map of the inset area in Map 5A.

BEINN AIRIGH CHARR AREA - INSET MAP

 Basic Dykes
(now Amphibolites)

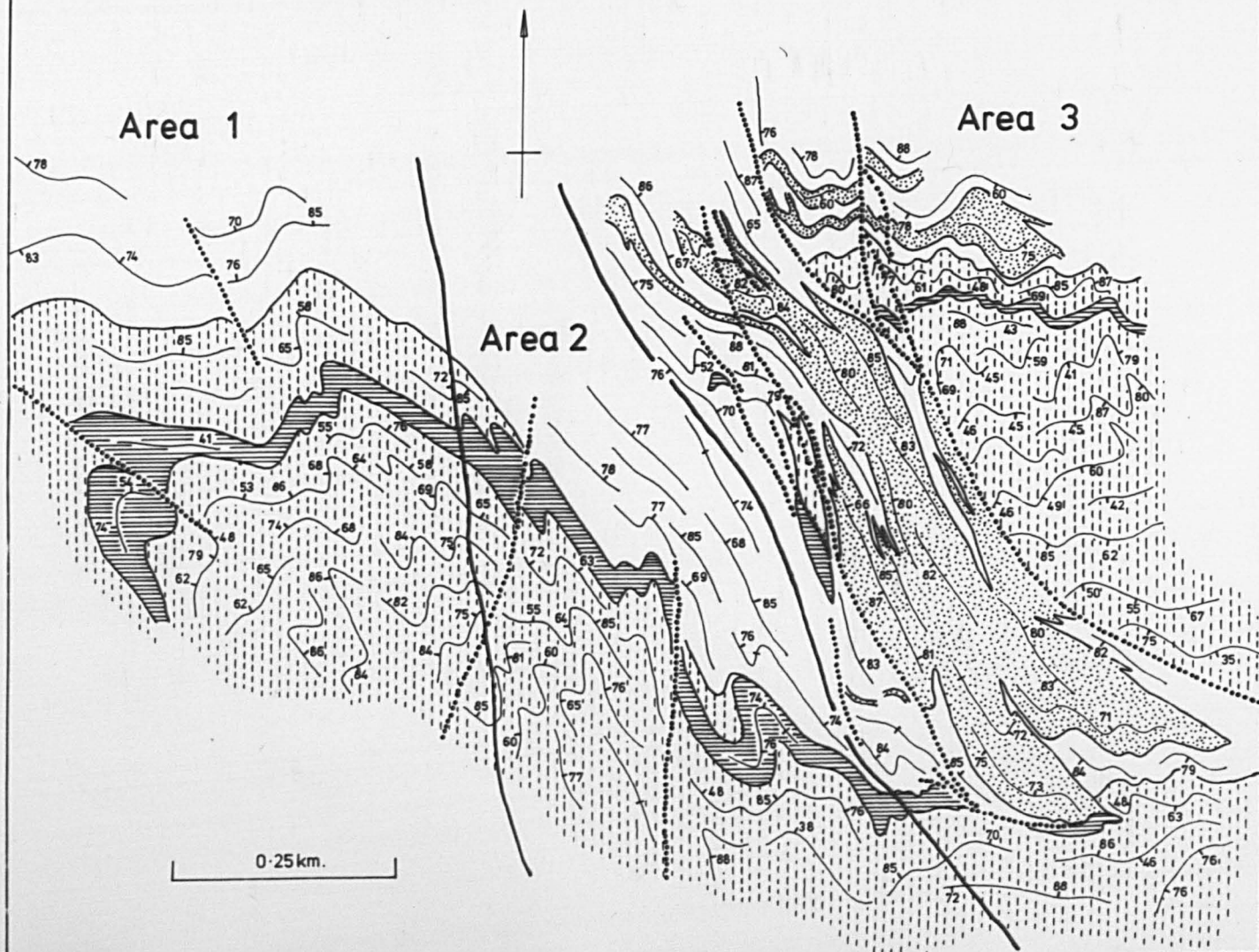
 Gleann Tulacha
Metasediments

 Beinn Airigh
Charr Basite

 S6 Form Lines
Numbers indicate Dip

 Crush Zones with
Pseudotachylite

 Sub-Area
Boundary



MAP 6.

Poolewe Area

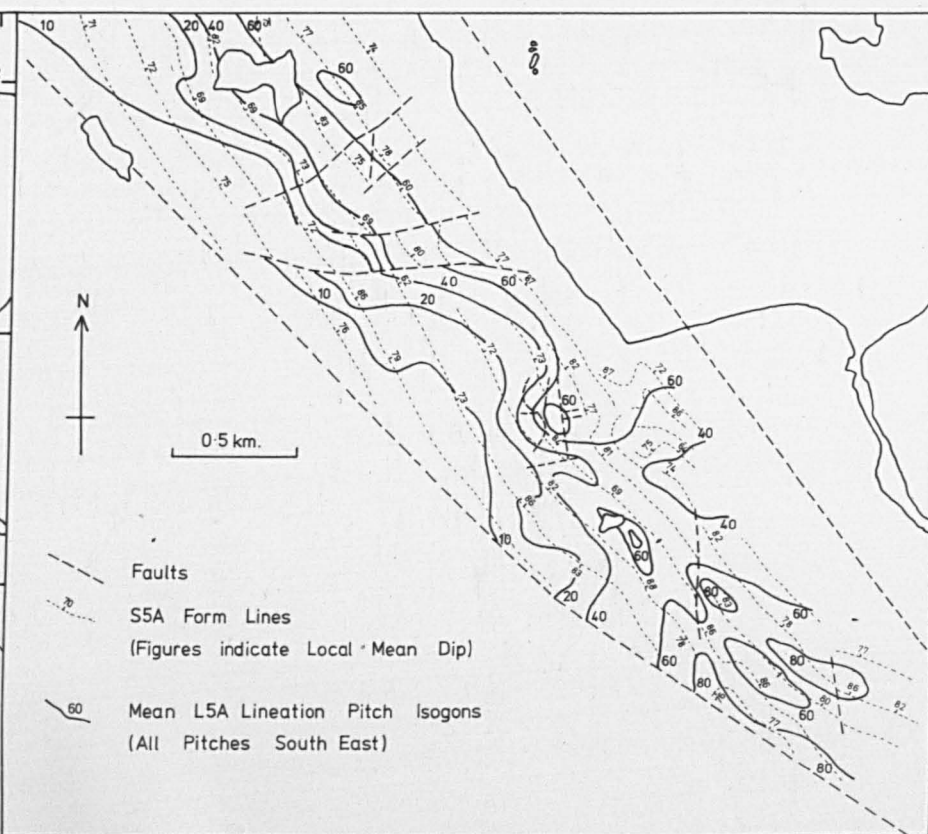
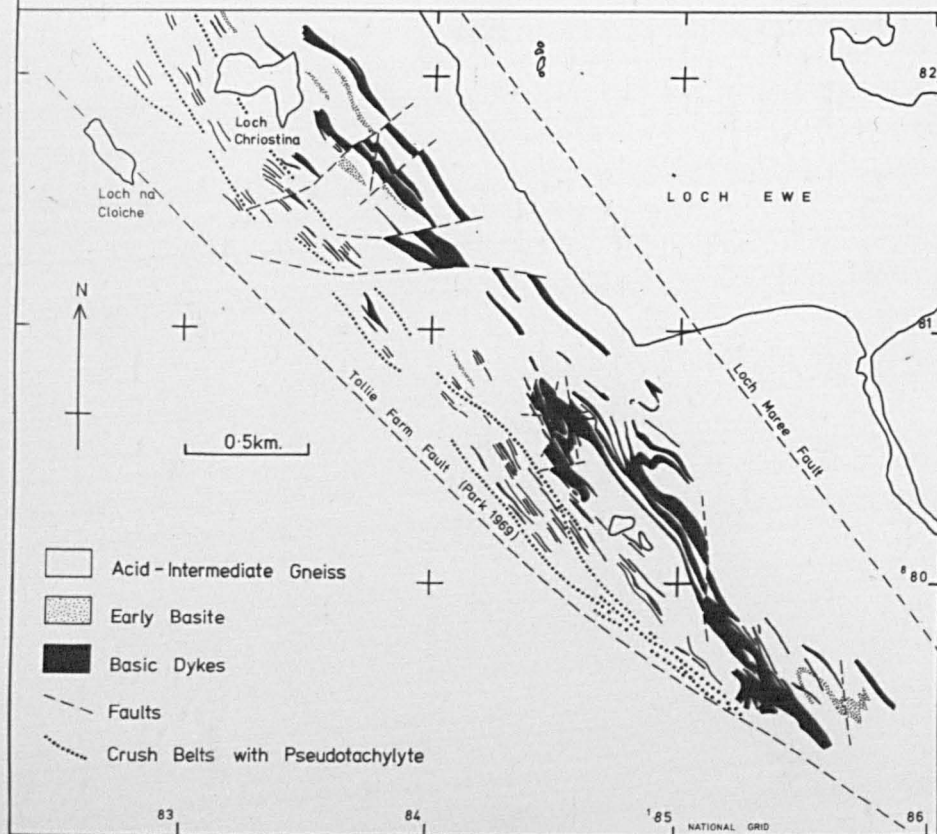
- (a) Lithological Map
- (b) Structural Map illustrating S5A Form Lines and
constructed Mean L5A Lineation Pitch Isogons.

P O O L E W E

A R E A

L I T H O L O G I C A L M A P

S T R U C T U R A L M A P



Tables

TABLE II.S. - EXPLANATION

Q = Quartz	Cl = Chlorite
K = K-feldspar	G = Garnet
P = Plagioclase	T = Tremolite
M = Muscovite	C = Calcite
B = Biotite	Ph = Phlogopite
E = Epidote	D = Dolomite
H = Hornblende	

* Gneiss named after the dominant mafic mineral present.

The dominant mineral in each lithological group is underlined.

TABLE II.S.

SUMMARY OF THE PRINCIPAL ROCK TYPES WITH
THEIR COMMON MINERALS

LITHOLOGICAL GROUP	LITHOLOGICAL UNIT	COMMON MINERALS
GNEISS COMPLEX	Granitic Gneiss	Q <u>K</u> P M B E
	Grandioritic Gneiss *	Q <u>P</u> B E ± K ± H
	Dioritic Gneiss *	Q <u>P</u> H B E ± K
	Basic Gneiss	Q P <u>H</u> B E ± K
BASIC DYKES	(Not Differentiated)	Q P <u>H</u> B E ± Cl
META- SEDIMENTS	Pure Quartzites	<u>Q</u> ± K ± M
	Impure Quartzites	<u>Q</u> ± P ± M ± B ± G ± H ± K ± E
	Mica Schists	<u>Q</u> P M B ± Cl ± K ± T ± E
	Pure Marbles	<u>C</u> ± Q
	Impure Marbles	<u>C</u> Q ± D ± Ph
	Calcareous Schists	C Q M B ± P ± Cl ± D ± G
	Calo-silicate Schists	C Q P T Cl ± K
BEINN AIRIGH CHARR & GRUINARD BASITES	(Not Differentiated)	Q P <u>H</u> ± B ± Cl ± G ± E ± K

TABLE II.1.

PETROGRAPHICAL DATA

(a) ACID GNEISS COMPLEX - PRE-DYKE FABRICS

FABRIC DOMAIN	GNEISS TYPE	QUARTZ	PLAGIOCLASE	BIOTITE	HORNBLLENDE	EPIDOTE
S3	Massive Gneiss	5-20 12	50-65 56	10-25 17	0-10 6	2-10 7
S3	Banded Gneiss Melanosomes	5-25 15	45-60 55	10-25 19	-	5-10 6
S3	Banded Gneiss Leucosomes	15-25 21	65-75 70	3-8 5	-	0-5 3
S3	All Banded Gneisses	18	64	9	-	4
S3	All Gneisses	15	59	14	4	5
S5	Biotite Gneiss	10-30 15	55-75 64	5-15 10	0-15 6	0-5 3
S5	Hornblende Gneiss	0-30 16	50-70 58	0-10 6	5-25 18	2-5 4

(b) ACID GNEISS COMPLEX - POST-DYKE FABRICS

GNEISS TYPE	QUARTZ	PLAGIO-CLASE	BIOTITE	HORN-BLENDE	EPIDOTE	MUSCOVITE	K-FELDSPAR
Acid Gneisses with no K-feldspar	0-30 17	65-80 69	2-10 6	0-5 1	0-10 3	0-5 2	-
Acid Gneisses with K-feldspar	0-35 20	10-90 47	0-20 8	0-15 1	0-10 3	0-20 6	0-40 14
All Gneisses	19	53	7	1	3	5	11

All figures quoted refer to percentage values.

Figures in red are arithmetic mean values.

TABLE II.2.

BASIC GNEISSES - PETROGRAPHICAL DATA

FABRIC DOMAIN	GNEISS TYPE	QUARTZ	PLAGIO- CLASE	BIOTITE	HORN- BLENDE	EPIDOTE	K- FELDSPAR
Pre dyke	Early Basite Melanosome	5-10 6	25-45 36	0-5 3	30-60 48	5-20 8	-
Pre dyke	Early Basite Leucosome	5-35 23	55-75 62	0-3 2	0-20 7	3-5 3	-
Post dyke	Early Basite Melanosome	0-10 7	15-30 22	5-15 9	40-60 52	0-10 3	0-10 6

All figures quoted refer to percentage values.

Figures in red are arithmetic mean values.

TABLE II.3.

PETROGRAPHICAL DATA

(a) GLEANN TULACHA AND GRUINARD METASEDIMENTS

METASEDIMENT TYPE	QUARTZ	CALCITE	FELD- SPAR	BIOTITE	MUSCO- VITE	CHLORITE	OTHER
Quartzite	90-98	-	tr.	tr.	tr.	tr.	Garnet Hornblende
Mica Schist	40-80	-	20-30	15-30	10-20	0-15	Staurolite Tremolite
Calcareous Rocks	0-40	30-100	0-25	0-15	0-25	0-10	Garnet Tremolite Phlogopite Dolomite Zoisite

(b) BEINN AIRIGH CHARR AND GRUINARD BASITES

TYPE	QUARTZ	FELDSPAR	BIOTITE	HORNBLLENDE	CHLORITE	GARNET
Beinn Airigh Charr Basite	0-10	10-25	0-15	55-85	0-20	0-15
Gruinard Basite	10-40	15-35	0-15	30-65	0-10	0-20

Figures quoted refer to percentage values.

tr. indicates phases present in small amounts.

TABLE II.4.

THE LOCATION AND FIELD RELATIONSHIPS OF THE MATERIAL ANALYSED GEOCHEMICALLY

SAMPLE NO.	AREA	GRID REF.	FIELD RELATIONSHIPS
GA	CMB	985867	Dyke centre
GB	CMB	985867	Dyke margin
GC	CMB	980868	Dyke centre
GD	CMB	980865	Dyke margin
GE	CMB	980865	Dyke centre
GF	CMB	976863	Thin dyke margin
GG	CMB	976863	Thin dyke centre
GH	CMB	975854	Thin dyke centre
GI	CMB	971853	Dyke centre
GJ	CMB	971853	Dyke margin
GK	CMB	971852	Dyke centre
GL	CMB	970853	Dyke centre
GO	CMB	966855	Dyke margin
GP	CMB	966855	Dyke centre
GQ	CMB	965855	Dyke margin
GR	CMB	965855	Dyke centre
GT	CMP	963855	Dyke centre

SAMPLE NO.	AREA	GRID REF.	FIELD RELATIONSHIPS
PA	P	835821	Dyke margin
PB	P	835821	Dyke centre
PC	P	835821	Dyke centre
PD	P	837814	Dyke centre
PF	P	838814	Dyke centre
PG	P	847807	Dyke centre
06401C	K	900796	Dyke centre
06602B	K	907796	Dyke centre
06703B	K	909806	Dyke centre
06903	K	906815	Dyke centre
07202	K	895798	Thin dyke centre

Explanation

CMB	=	Creag Mheall Beag Area
P	=	Poolewe Area
K	=	Kernsary Area

TABLE II.5.

RESULTS OF Ni - Cr CONTAMINATION TESTS

SAMPLE	METHOD OF CRUSHING		
	ROLLER MILL	TEMA MILL	AGATE CRUSHER
GS	500	880	-
	1120	1195	-
GM	83	815	79
	110	135	122
GN	75	805	69
	119	207	100

Nickel concentration ppm in black.

Chromium concentration ppm in red.

TABLE II.6.

THE RESULTS OF REPEATED ANALYSIS OF
GEOCHEMICAL STANDARDS

SAMPLE	BCR-1	BCR-1	BCR-1	BCR-1	BL3571	BL3571	BL3571	BL3571*
SiO ₂	54.58	53.82	54.21	54.48	46.89	N.D.	47.09	47.23
TiO ₂	2.20	2.17	2.19	2.23	0.52	0.49	0.53	0.54
Al ₂ O ₃	13.36	13.73	13.89	13.65	15.32	14.52	14.61	14.71
Fe ₂ O ₃	3.48	3.52	3.97	3.68	1.01	1.10	1.48	11.19
FeO	8.99	8.90	8.86	8.91	7.83	7.80	7.50	11.19
MnO	0.18	0.19	0.17	0.17	0.17	0.16	0.17	0.18
MgO	3.40	3.88	3.75	3.28	13.35	14.25	13.90	14.50
CaO	6.82	6.25	6.90	6.95	8.82	8.30	8.45	8.40
Na ₂ O	3.42	3.20	3.36	3.31	1.74	1.57	1.65	1.53
K ₂ O	1.86	1.96	1.85	1.68	0.99	1.00	0.96	0.96
P ₂ O ₅	0.35	0.33	0.32	0.36	0.14	0.16	0.15	0.14
TOTAL	98.63	97.95	99.47	98.70	96.78	49.35	96.49	

Figures in black are the values obtained in the present survey.

"Recommended" values are shown in red.

* Mean values of XRF analysis obtained by Leake et al. (1969).

TABLE IV 1A : MAJOR ELEMENT ANALYSES

FIRST PERIOD DYKES										SECOND PERIOD DYKES										THIRD PERIOD DYKES												
Sample	GK	GO	GP	GT	GA	GB	GC	GD	GE	GQ	GR	GU	PA	PB	PC	PD	PF	PG	06401C	06605B	06703B	06903	07202	GF	GG	GH	GI	GJ	GL			
SiO ₂	-	49.11	52.27	50.18	49.65	-	51.26	48.98	48.17	49.78	50.95	48.57	48.44	48.44	49.38	51.54	51.13	47.77	50.94	48.44	52.42	50.86	50.46	50.86	54.77	-	50.28	50.45	51.18	49.11	49.38	50.98
TiO ₂	-	0.65	0.59	0.63	0.58	-	0.87	0.88	1.41	1.53	1.69	1.91	1.85	1.90	1.19	0.83	0.97	1.53	1.30	1.55	1.28	1.54	1.85	1.65	1.50	-	1.53	1.40	0.51	0.48	0.54	0.49
Al ₂ O ₃	-	10.05	10.87	11.74	11.40	-	16.52	14.68	15.37	14.31	16.39	14.36	13.87	13.93	13.88	14.86	11.60	14.47	14.28	14.08	17.02	13.66	15.04	17.12	13.98	-	14.17	14.58	14.98	14.51	14.23	12.18
Fe ₂ O ₃	-	2.44	1.27	1.94	2.02	-	3.32	2.63	2.76	3.05	1.88	4.44	3.42	5.02	4.20	3.24	4.04	4.36	4.06	4.23	2.86	3.32	3.41	2.73	4.80	-	3.04	2.45	2.13	2.06	4.07	1.63
FeO	-	10.23	8.19	8.68	8.26	-	7.85	10.21	10.32	10.50	10.02	11.27	11.72	11.74	10.42	8.53	11.24	11.27	9.96	10.50	9.25	11.02	11.01	9.37	7.00	-	9.76	9.34	6.34	8.50	8.14	7.65
MnO	-	0.20	0.17	0.17	0.17	-	0.17	0.22	0.21	0.21	0.18	0.25	0.23	0.25	0.23	0.21	0.27	0.24	0.21	0.24	0.17	0.23	0.24	0.18	0.14	-	0.17	0.18	0.18	0.18	0.20	0.16
MgO	-	15.35	13.05	13.95	14.75	-	5.30	7.25	6.75	6.90	4.50	6.05	6.90	5.63	7.38	7.00	8.63	6.63	5.88	6.75	2.88	5.75	5.00	4.38	3.75	-	7.05	6.75	9.20	8.25	7.75	12.25
CaO	-	7.55	8.10	8.45	8.60	-	8.50	8.55	8.45	8.90	8.02	8.45	8.65	8.10	8.60	8.30	8.10	8.05	8.10	8.40	7.60	8.05	7.45	8.25	7.35	-	8.80	8.80	8.15	10.25	9.45	8.20
Na ₂ O	-	1.29	2.29	1.78	2.23	-	2.74	2.07	2.80	2.26	3.39	3.06	1.91	2.38	2.05	2.30	1.78	2.65	2.50	3.06	3.90	2.46	3.00	3.55	1.60	-	2.52	2.26	3.32	2.68	1.86	2.40
K ₂ O	-	0.47	1.58	0.83	0.69	-	1.13	0.73	0.80	0.61	0.80	0.62	1.02	0.90	0.83	1.38	0.95	1.10	0.78	0.72	1.30	1.80	1.20	0.61	3.15	-	0.52	0.54	1.79	0.94	0.50	1.52
P ₂ O ₅	-	0.08	0.05	0.08	0.07	-	0.06	0.07	0.08	0.10	0.11	0.17	0.15	0.14	0.09	0.05	0.12	0.05	0.14	0.08	0.23	0.14	0.27	0.13	0.24	-	0.10	0.04	0.05	0.03	0.04	0.08
TOTAL	-	97.42	98.43	98.43	98.42	-	97.72	96.27	97.12	98.15	97.93	99.15	98.16	98.43	98.25	98.24	98.83	98.12	98.15	98.05	98.91	98.83	98.93	98.83	98.28	-	97.94	96.79	97.83	96.99	96.16	97.54

TABLE IV 1B : N I G G L I V A L U E S

FIRST PERIOD DYKES										SECOND PERIOD DYKES										THIRD PERIOD DYKES												
Sample	GK	GO	GP	GT	GA	GB	GC	GD	GE	GQ	GR	GU	PA	PB	PC	PD	PF	PG	06401C	06605B	06703B	06903	07202	GF	GG	GH	GI	GJ	GL			
si	-	100.22	114.35	104.80	101.14	-	130.34	117.19	113.92	118.28	131.65	113.29	113.18	115.42	114.89	125.88	117.87	110.54	126.27	112.78	141.27	125.00	126.31	129.32	157.17	-	120.70	124.80	119.89	112.02	116.95	112.59
al	-	12.09	14.01	14.45	13.68	-	24.75	20.70	21.42	20.04	24.96	19.74	19.10	19.56	19.03	21.39	15.76	19.73	20.86	19.32	27.03	19.78	22.19	25.65	23.64	-	20.05	21.25	20.68	19.50	19.86	15.85
fm	-	68.24	59.94	61.93	62.25	-	43.50	51.47	49.54	51.18	43.03	51.30	53.40	52.90	53.68	49.30	58.86	52.74	50.39	51.75	38.60	50.33	48.64	42.13	43.54	-	50.66	49.15	48.65	48.15	51.13	57.46
c	-	16.51	18.99	18.91	18.77	-	23.16	21.92	21.41	22.66	22.20	21.12	21.65	20.68	21.44	21.72	20.01	19.96	21.51	20.95	21.94	21.20	19.98	22.47	22.60	-	22.63	23.32	20.45	25.05	23.98	19.40
alk	-	3.16	7.06	4.71	5.30	-	8.59	5.92	7.63	6.13	9.81	7.84	5.85	6.87	5.86	7.60	5.37	7.57	7.24	7.98	12.42	8.68	9.20	9.74	10.22	-	6.66	6.27	10.21	7.29	5.03	7.28
k	-	0.19	0.31	0.23	0.17	-	0.21	0.19	0.16	0.15	0.13	0.12	0.26	0.20	0.21	0.28	0.26	0.21	0.17	0.13	0.18	0.32	0.21	0.10	0.56	-	0.12	0.14	0.26	0.19	0.15	0.29
mg	-	0.68	0.71	0.70	0.72	-	0.46	0.50	0.48	0.48	0.40	0.41	0.45	0.38	0.48	0.52	0.50	0.43	0.43	0.45	0.30	0.42	0.38	0.39	0.37	-	0.50	0.51	0.66	0.58	0.54	0.70
ti	-	1.00	0.97	0.99	0.89	-	1.66	1.58	2.51	2.73	3.28	3.35	3.25	3.40	2.08	1.52	1.68	2.66	2.42	2.71	2.59	2.85	3.48	3.15	3.24	-	2.76	2.60	0.90	0.82	0.96	0.81
p	-	0.07	0.05	0.07	0.06	-	0.06	0.07	0.08	0.10	0.12	0.17	0.15	0.14	0.09	0.05	0.12	0.05	0.15	0.08	0.26	0.15	0.29	0.14	0.29	-	0.10	0.04	0.05	0.03	0.04	0.07

TABLE IV 2A : CATION PERCENTAGES

FIRST PERIOD DYKES										SECOND PERIOD DYKES										THIRD PERIOD DYKES												
Sample	GK	GO	GP	GT	GA	GB	GC	GD	GE	GQ	GR	GU	PA	PB	PC	PD	PF	PG	06401C	06605B	06703B	06903	07202	GF	GG	GH	GI	GJ	GL			
Si ⁴⁺	-	46.27	48.35	46.56	45.74	-	49.10	47.73	46.38	47.81	48.77	46.32	46.83	47.01	47.47	49.08	48.93	45.94	49.12	46.42	49.77	48.71	48.26	48.23	53.31	-	48.21	48.94	47.62	46.73	48.15	47.57
Ti ⁴⁺	-	0.46	0.41	0.44	0.40	-	0.63	0.64	1.02	1.11	1.22	1.37	1.35	1.39	0.86	0.59	0.70	1.11	0.94	1.12	0.91	1.11	1.33	1.18	1.10	-	1.10	1.02	0.36	0.34	0.40	0.34
Al ³⁺	-	11.16	11.85	12.84	12.38	-	18.65	16.86	17.44	16.20	18.49	16.14	15.80	15.93	15.73	16.68	13.08	16.40	16.23	15.90	19.05	15.42	16.95	19.13	16.04	-	16.01	16.67	16.43	16.27	16.35	13.40
Fe ³⁺	-	1.73	0.88	1.35	1.40	-	2.39	1.93	2.00	2.20	1.35	3.19	2.49	3.67	3.04	2.32	2.91	3.16	2.95	3.05	2.04	2.39	2.45	1.95	3.52	-	2.19	1.79	1.49	1.48	2.99	1.14
Fe ²⁺	-	8.06	6.34	6.74	6.36	-	6.29	8.32	8.31	8.43	8.02	8.99	9.48	9.53	8.38	6.79	8.99	9.06	8.03	8.42	7.34	8.83	8.81	7.43	5.70	-	7.83	7.58	4.93	6.76	6.64	5.97
Mn ²⁺	-	0.16	0.13	0.13	0.13	-	0.14	0.18	0.17	0.17	0.15	0.20	0.19	0.21	0.19	0.17	0.22	0.20	0.17	0.19	0.14	0.19	0.19	0.14	0.12	-	0.14	0.15	0.14	0.15	0.17	0.13
Mg ²⁺	-	21.56	17.99	19.29	20.25	-	7.57	10.53	9.69	9.88	6.42	8.60	9.94	8.14	10.57	9.94	12.31	9.50	8.45	9.64	4.08	8.21	7.13	6.19	5.44	-	10.08	9.76	12.76	11.70	11.26	17.04
Ca ²⁺	-	7.62	8.03	8.40	8.49	-	8.72	8.93	8.72	9.16	8.23	8.63	8.96	8.42	8.86	8.47	8.30	8.30	8.37	8.63	7.73	8.26	7.63	8.38	7.66	-	9.04	9.15	8.12	10.45	9.87	8.20
Na ⁺	-	2.36	4.11	3.20	3.98	-	5.09	3.91	5.23	4.21	6.29	5.66	3.58	4.48	3.82	4.25	3.30	4.94	4.67	5.69	7.18	4.57	5.56	6.53	3.02	-	4.68	4.25	5.99	4.94	3.52	4.34
K ⁺	-	0.56	1.86	0.98	0.81	-	1.38	0.91	0.98	0.75	0.98	0.75	1.26	1.11	1.02	1.68	1.16	1.35	0.96	0.88	1.57	2.20	1.46	0.74	3.91	-	0.64	0.67	2.12	1.14	0.62	1.81
P ⁵⁺	-	0.06	0.04	0.06	0.05	-	0.05	0.06	0.07	0.08	0.09	0.14	0.12	0.12	0.07	0.04	0.10	0.04	0.11	0.06	0.18	0.11	0.22	0.10	0.20	-	0.08	0.03	0.04	0.02	0.03	0.06

TABLE IV 2B : C. I. P. W. N O R M S

FIRST PERIOD DYKES										SECOND PERIOD DYKES										THIRD PERIOD DYKES										
Sample	GK	GO	GP	GT	GA	GB	GC	GD	GE	GQ	GR	GU	PA	PB	PC	PD	PF	PG	06401C	06605B	06703B	06903	07202	GF	GG	GH	GI	GJ	GL	
Q	-	-	-	-	2.91	1.03	-	2.11	0.61	-	1.10	2.24	2.10	2.51	3.88	-	4.67	-	1.39	1.14	1.44	0.71	12.57	-	2.25	3.76	-	-	3.72	-
Or	-	2.78	9.34	4.90	6.68	4.31	4.73	3.60	4.73	3.66	6.03	5.32	4.90	8.16	5.61	6.50	4.61	4.25	7.68	10.64	7.09	3.60	18.61	-	3.07	3.19	10.58	5.55	2.95	8.98
Ab	-	10.92	19.38	15.06	23.19	17.52	23.69	19.12	28.69	25.89	16.16	20.14	17.35	19.46	15.06	22.42	21.16	25.89	33.00	20.82	25.39	30.04	13.54	-	21.32	19.12	28.09	22.68	15.74	20.31
An	-	20.24	14.71	21.59	29.44	28.61	27.01	27.10	27.14	23.62	26.26	24.67	26.22	26.15	20.86	24.34	25.44	22.58	25.10	20.91	24.02	28.98	21.66	-	25.82	28.04	20.69	24.79	29.00	17.97
MgDi	-	9.84	14.92	11.88	5.97	6.28	6.72	7.75	4.70	7.76	7.13	6.32	7.79	7.51	9.17	7.03	6.39	8.94	3.66	7.76	4.57	4.61	6.67	-	8.51	7.49	11.53	13.44	9.55	13.24
FeDi	-	3.61	5.33	4.06	4.16	4.71	5.13	5.75	5.26	6.44	5.81	5.79	5.22	4.51	6.03	5.57	5.01	6.33	5.71	7.26	4.73	4.62	4.16	-	5.58	5.11	4.11	7.67	4.77	4.61
En	-	26.74	14.37	19.08	10.43	15.15	8.24	13.59	9.03	9.41	13.88	11.10	14.77	13.95	17.24	8.55	11.68	8.21	5.48	10.73	10.33	8.77	6.25	-	13.61	13.34	2.04	3.63	14.88	11.14
Fs	-	11.24	5.89	7.48	8.34	13.03	7.22	11.57	11.60	8.95	12.98	11.66	11.35	9.61	12.10	7.77	10.51	6.67	9.79	11.52	12.28	10.10	4.46	-	10.24	10.43	0.84	2.38	8.53	4.45
Fo	-	4.86	7.86	7.12	-	-	3.83	-	-	1.44	-	-	-	-	-	3.30	-	3.13	-	-	-	-	-	-	-	-	10.88	7.49	-	9.27
Fa	-	2.25	3.55	3.07	-	-	3.69	-	-	1.51	-	-	-	-	-	3.30	-	2.80	-	-	-	-	-	-	-	-	4.91	5.40	-	4.08
Mt	-	3.54	1.84	2.81	4.81	3.81	4.00	4.42	2.73	6.43	4.96	7.28	6.09	4.70	5.86	6.32	5.89	6.13	4.15	4.81	4.94	3.96	6.96	-	4.41	3.55	3.09	2.99	5.90	2.36
Il	-	1.23	1.12	1.20	1.65	1.67	2.68	2.90	3.21	3.63	3.51	3.61	2.26	1.58	1.84	2.91	2.47	2.94	2.43	2.92	3.51	3.13	2.85	-	2.91	2.66	0.97	0.91	1.03	0.93
Ap	-	0.19	0.12	0.19	0.14	0.17	0.19	0.24	0.26	0.40	0.36	0.33	0.21	0.12	0.28	0.12	0.33	0.19	0.54	0.33	0.64	0.31	0.57	-	0.24	0.09	0.19	0.07	0.09	0.19
TOTAL	-	97.43	98.44	98.44	97.73	96.28	97.13	98.16	97.94	99.17	98.18	98.45	98.26	98.25	98.85	98.13	98.16	98.06	98.93	98.85	98.95	98.84	98.30	-	97.95	96.80	97.84	97.00	96.17	97.55

TABLE IV 3A : TRACE ELEMENT ANALYSES P. P. M.

FIRST PERIOD DYKES										SECOND PERIOD DYKES										THIRD PERIOD DYKES										
Sample	GK	GP	GT		GA	GB	GB	GD	GE	GQ	GR	GU	PA	PB	PC	PD	PF	PG	06401C	06605B	06703B	06903	07202	-	GF	GG	GH	GJ	GL	
Sc	-	40	38	43	-	50	69	40	43	37	53	64	62	72	51	77	57	53	52	26	52	47	45	21	-	53	40	30	54	45
Cr	-	863	883	1385	-	142	165	144	129	99	189	231	75	158	131	272	112	133	150	46	78	137	77	78	-	151	168	425	225	745
V	-	184	161	209	-	230	263	338	328	353	268	305	450	335	266	330	488	308	480	180	350	305	298	163	-	370	295	163	210	160
Sr	-	15	113	255	-	305	208	273	208	363	205	163	275	293	370	205	245	223	153	410	208	245	345	630	-	228	218	300	153	205
Ba	-	70	246	227	-	241	150	291	126	230	92	345	350	276	655	305	353	300	184	503	605	415	96	1680	-	134	129	453	46	358
Cu	-	268	113	67	-	134	299	321	333	308	236	269	242	333	279	382	341	120	372	134	253	193	190	253	-	365	200	48	68	13
Ni	-	1015	568	630	-	92	112	175	182	135	170	205	59	76	83	103	102	98	86	43	66	89	66	75	-	191	155	229	1000	1100
Zr	-	57	56	56	-	105	65	69	95	95	100	179	82	39	23	56	63	102	76	257	156	155	96	366	-	99	69	39	39	61
Co	-	69	59	63	-	45	57	53	55	48	47	54	47	45	40	45	59	51	48	36	51	47	41	46	-	53	59	39	43	58

TABLE IV 3B : TRACE ELEMENT ANALYSES ERROR TERMS P. P. M.

Error Terms	Sc	Cr	V	Sr	Ba	Cu	Ni	Zr	Co
Standard Deviation	6.005	12.150	23.219	35.150	40.792	33.741	62.803	30.361	6.321
Confidence Limits %									
90	10.3	20.8	39.7	60.1	69.8	57.4	106.8	51.6	10.7
95	12.4	25.0	47.8	72.4	84.0	69.2	128.7	62.2	13.0
99	16.7	33.8	64.5	97.7	113.8	93.5	174.0	84.1	17.5

TABLE IV 4 : COMPARATIVE MAJOR ELEMENT ANALYSES

	A	B	C	D	E	F	G	H	I	J	K
SiO ₂	50.30	49.18	50.23	47.90	50.83	48.9	50.4	49.3	49.0	48.11	48.69
TiO ₂	0.61	1.38	0.83	1.16	2.03	1.9	1.8	2.2	1.4	0.65	1.49
Al ₂ O ₃	11.02	14.31	14.11	11.84	14.07	12.6	12.3	13.3	13.0	11.81	14.47
Fe ₂ O ₃	1.92	3.58	2.56	2.32	2.88	4.5	3.9	4.7	4.4	2.15	3.46
FeO	8.84	10.60	8.29	9.80	9.06	10.9	11.0	10.5	10.2	9.05	10.71
MnO	0.18	0.23	0.18	0.15	0.18	0.24	0.23	0.24	0.16	0.19	0.23
MgO	14.28	6.90	8.54	14.07	6.34	6.4	5.9	5.3	6.0	14.70	6.35
CaO	8.18	8.63	8.94	9.29	10.42	9.7	9.3	9.2	8.9	8.63	9.08
Na ₂ O	1.90	2.36	2.51	1.66	2.23	2.5	2.6	2.8	2.9	2.13	2.80
K ₂ O	0.89	0.70	0.97	0.54	0.82	0.56	0.68	1.2	0.9	0.56	1.30
P ₂ O ₅	0.07	0.10	0.06	0.19	0.23	0.18	0.17	0.23	0.13	0.08	0.15

A = Arithmetic mean of 4 samples of First-Period dykes

B = Arithmetic mean of 4 samples of Second-Period dyke margins

C = Arithmetic mean of 6 samples of Third-Period dykes

D = Arithmetic mean of 28 Tholeiitic Olivine Basalts (Nockolds 1954)

E = Arithmetic mean of 137 Normal Tholeiitic Basalts (Nockolds 1954)

F = Arithmetic mean of 34 samples of Dolerites from the Scourie Zone (Burns 1966)

G = Arithmetic mean of 17 samples of Dolerites from the Claisfearn-Foindle Zone (Burns 1966)

H = Arithmetic mean of 10 samples of Dolerites from the Badnabay-Laxford Zone (Burns 1966)

I = Arithmetic mean of 19 samples of Gairloch Basites (Park 1966)

J = Arithmetic mean of 5 samples of Torridon type-TB Basites (Cresswell 1969)

K = Arithmetic mean of 17 samples of Torridon type-TD Basites (Cresswell 1969)

TABLE V.1.

MEAN BREADTH : LENGTH RATIOS FOR SECTIONS
CUT PERPENDICULAR TO THE L6 LINEATION

SAMPLE NUMBER	TRAVERSE	QUARTZ		PLAGIOCLASE		BIOTITE	
00801	1	0.65	0.45	0.69	0.59	0.31	0.27
	2	0.66	0.48	0.68	0.62	0.30	0.29
01005	1	0.66	0.54	0.79	0.60	0.39	0.39
	2	0.65	0.53	0.79	0.68	0.30	0.36
05002B	1	0.72	0.61	0.82	0.70	0.38	0.33
	2	0.67	0.63	0.77	0.58	0.36	0.31
DOMAIN		Pre-S6	S6	Pre-S6	S6	Pre-S6	S6

TABLE V.2.

THE MEAN GRAIN MINERAL PARAGENESIS ROCK TYPES

Mineral	M3	M5 Dynamic	M5 Static	M6 Dynamic	M6 Static	M7	M8	Post M8
Quartz	0.7mm.		0.6mm.	0.5mm.				
Plagioclase	(0.7)		(0.6)	(0.5)				
K-feldspar								
Orthopyroxene	1.5mm.		0.7mm.	0.5mm.				
Clinopyroxene	equant		(0.7)	(0.6)				
Hornblende			0.6mm.					
Tremolite								
Actinolite	0.5mm.		0.3mm.	0.4mm.				
Cummingtonite								
Biotite			0.6mm.					
Muscovite								
Phlogopite			inequant					
Kyanite			0.2mm.	0.2mm.				
Staurolite								
Garnet								
Epidote								
Allanite								
Zoisite								
Clinozoisite								
Chlorite								
Prehnite			equant	inequant				
Calcite								
Dolomite								
Sphene								
Rutile								
Apatite								
Tourmaline								
Magnetite								
Ilmenite								
Pyrite								
Hematite								

TABLE V.3.

THE MEAN GRAIN SIZE IN VARIOUS ROCK TYPES

FABRIC	MODIFIED S3	S5	S6	MINERAL
ACID GNEISS	0.7mm. (0.7)	0.6mm. (0.6)	0.3mm. (0.3)	Qtz.
	1.5mm. equant	0.7mm. (0.7)	0.3mm. (0.6)	Plag.
	0.8mm.	0.6mm.		HB.
	0.5mm.	0.7mm.	0.4mm.	Biot.
BASIC GNEISS		0.6mm. inequant	0.4mm. inequant	Qtz.
		0.8mm. equant	0.9mm. equant	Plag.
		2mm.	2mm.	HB.
		0.9mm.	1mm.	Biot.
GLEANN TULACHA METASED. & BEINN AIRIGH CHARR BASITE		0.15mm. equant	0.1mm. inequant	Qtz.
		0.2mm. equant	0.2mm. inequant	Plag.
		0.1mm.	0.3mm.	HB.
		0.5mm.	0.25mm.	Biot.

Figures in black refer to mean grain size.

Red type refers to descriptions of grain shape e.g. equant.

Figures in red are mean breadth : length ratios.

TABLE VII.1.

COMPARISON OF STRUCTURAL SEQUENCES

Author's Sequence		Southern Mainland Park (in press)		Tollie Antiform Park (1969)		Scourian-Laxfordian Relationships Sutton & Watson (1969)		Letterewe Synform Keppie (1969)		North West Tollie Bhattacharjee (1968)	
Code	Code	Event	Code	Event			Code	Event			
D1	PD1	BADCALLIAN	D1	SCOURIAN (s.l.)	PRE-SCOURIAN CYCLE						
D2	PD2					SCOURIAN CYCLE	Early Scourian deformation, metamorphism, migmatisation c.2600m.y.				
D3	PD3		c.2900m.y.		D2						
D4	ID1	INVERIAN	D3			Inverian metamorphism and deformation c.2200m.y.	DM-3		Lithological layering in Acid Gneisses and Metasediments		
D5								DM-2			
D5A	ID2						c.2200m.y.			DM-1	
D Y K E					I N T R U S I O N					BASIC BANDS (lava flows/sills)	
D6	LD1 c.1700m.y.	LAXFORDIAN	D3	Early Phase ¹	LAXFORDIAN	Early Laxfordian deformation and metamorphism c.1650m.y.	DM	Main Phase ²	Main Phase ²		
D7	LD2 c.1500m.y.		D4	Main Phase ¹			DM+1	Mid Phase ²	Mid Phase ²		
D8	LD3 c.1400m.y.		D5	Late Phase ¹	CYCLE	Late Laxfordian metamorphism, migmatisation & pegmatite injection c.1450m.y.	DM+2	Late Phase ²	Late Phase ²		
"crush" belts	crush belts c.1100m.y.	POST-LAXFORDIAN	crush belts								

Double ruled horizontal lines indicate correlations

Single ruled horizontal lines represent divisions
and do not strictly represent correlations between

¹ Refers to the Gairloch Subdivisions

² Refers to stages in the "Laxfordian

between the various chronologies proposed.

between events in each of the chronologies proposed,
these chronologies.

of the Laxfordian (Park 1964).

orogeny".

Plates

PLATE II.1.

Detail from an outcrop of massive granitic gneiss indicating the presence of occasional bands rich in biotite and hornblende. A banded structure parallel to mafic layers is also faintly discernible in the "massive gneisses". Isolated pools of hornblende have biotite rims.

(Map Ref. 912818, Kernsary Area)



PLATE III.1.

- (a) Photomicrograph illustrating the essential features of the S5 fabric:- a granoblastic quartzo-feldspathic mosaic in which S5 is defined by the alignment of biotite flakes.

(Acid Gneisses, Kernsary Area. x 55, X.P.L.)

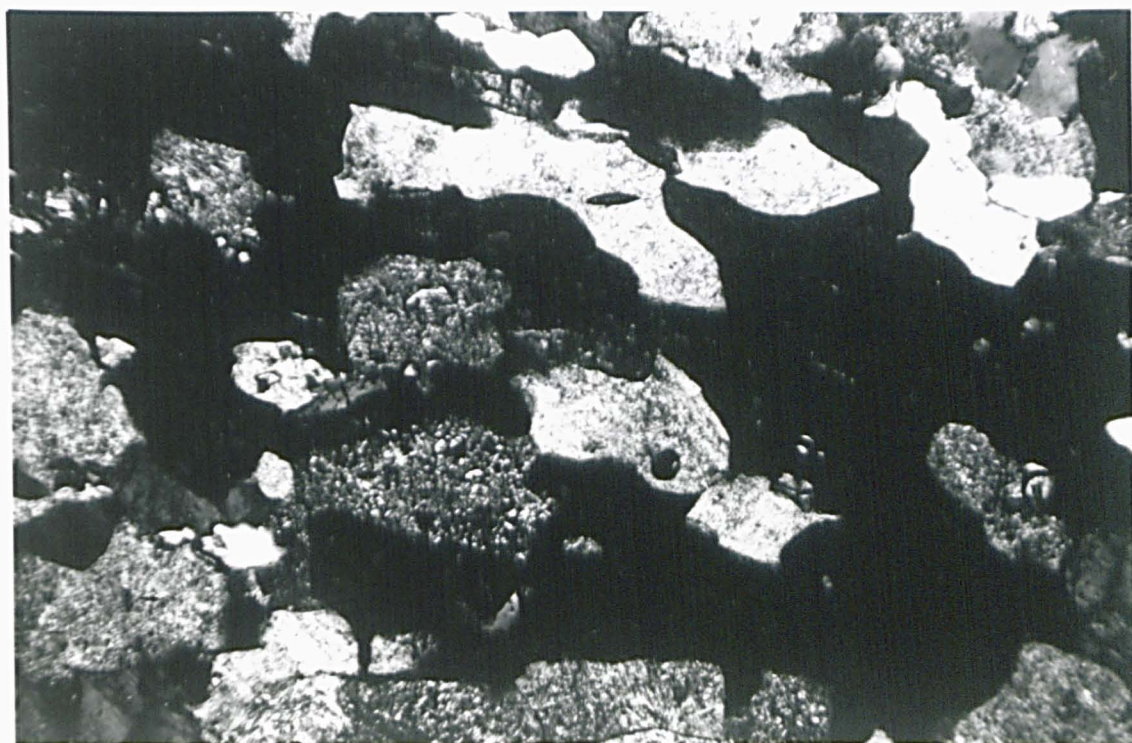
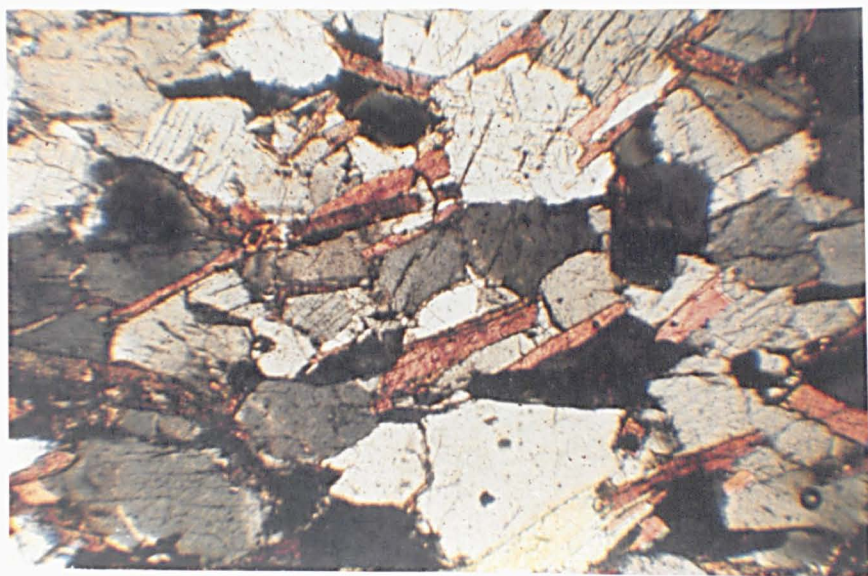
Section is cut perpendicular to L5.

- (b) Photomicrograph illustrating mimetic M5 hornblende.

L5 is defined by the elongation of hornblende and by alignment of quartz (clear) and feldspar (clouded).

(Hornblende Gneiss, Poolewe Area. x 55, X.P.L.)

Section is cut parallel to S5.



(a) Decussate Kyanite; Kyanite gneisses of the Kernsary area.

(Map Ref. 905814).

(b) Photomicrograph illustrating the essential features of the S3 fabric.

(Banded Acid Gneisses, Creag Mheall Beag Area. x 55, X.P.L.)



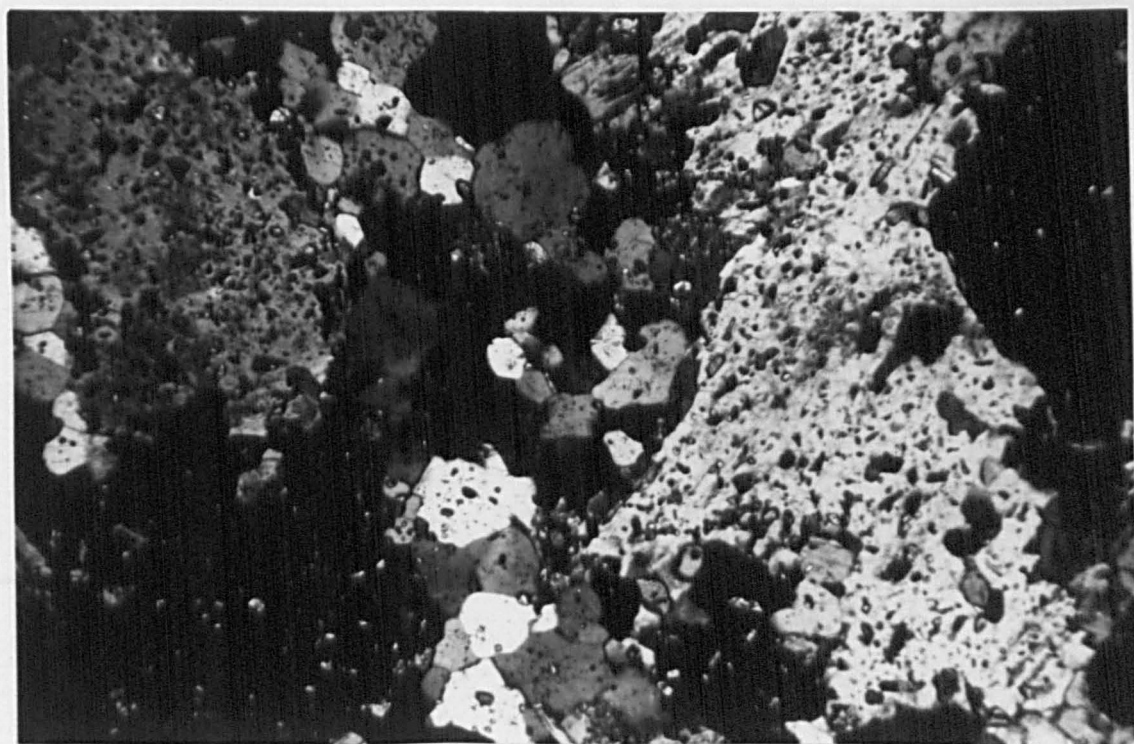
PLATE III.3.

- (a) Photomicrograph illustrating complex quartz-feldspar intergrowths along relict M3-plagioclase grain boundaries.

(Banded Acid Gneiss, Creag Mheall Beag Area. x 55, X.P.L.)

- (b) Photomicrograph illustrating the development of granoblastic S5 fabric along relict M3-plagioclase grain boundaries.

(Banded Acid Gneiss, Creag Mheall Beag Area. x 55, X.P.L.)



(a) Photomicrograph of M5 hornblende porphyroblast.

S5 is preserved as an internal subfabric, defined by inclusions of quartz and magnetite. This internal foliation has been subsequently rotated with respect to the external S6 foliation.

(Gleann Tulacha metasediments. x 55, X.P.L.)

(b) Photomicrograph of M5 staurolite, illustrating strain shadows and the effects of polygonisation.

(Gleann Tulacha metasediments. x 55, X.P.L.)

—S5—



S6



PLATE III.5.

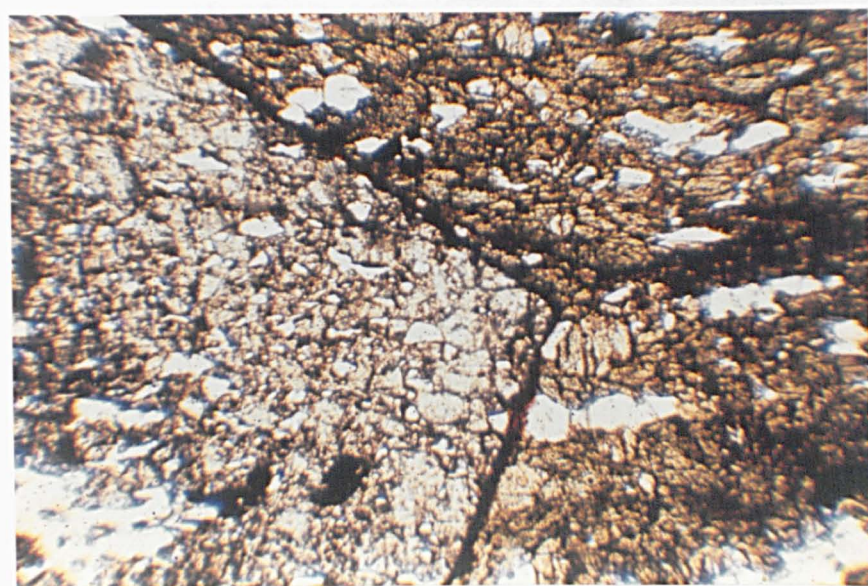
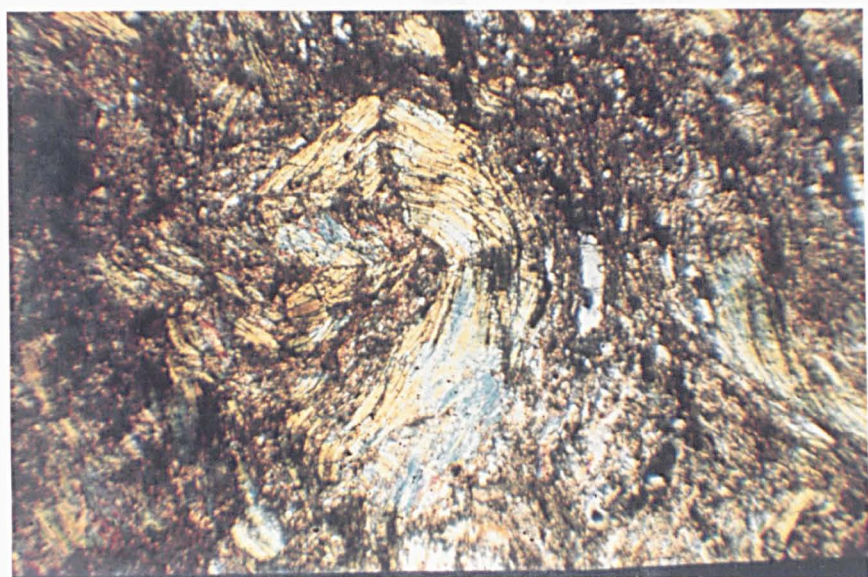
(a) Photomicrograph of M5 muscovite, folded in F6.

Post-F6 refolding is also illustrated.

(Gleann Tulacha metasediments. x 55, X.P.L.)

(b) Photomicrograph of static M5 garnet. Idioblastic garnet contains an internal foliation, continuous and parallel to external S5.

(Beinn Airigh Charr basite. x 55, P.P.L.)



- (a) Photomicrograph illustrating granoblastic S5 quartzo-feldspathic subfabrics. S5 is most clearly defined by the parallelism of magnetite crystals.

(Beinn Airigh Charr basite. x 55, X.P.L.)

- (b) Photomicrograph of M5 chlorite demonstrating the alignment of M5 magnetite parallel to the chlorite $\{001\}$ cleavage. M6 acicular hornblende has replaced chlorite parallel to these cleavage traces.

(Beinn Airigh Charr basite. x 55, X.P.L.)

Magnetite



S5

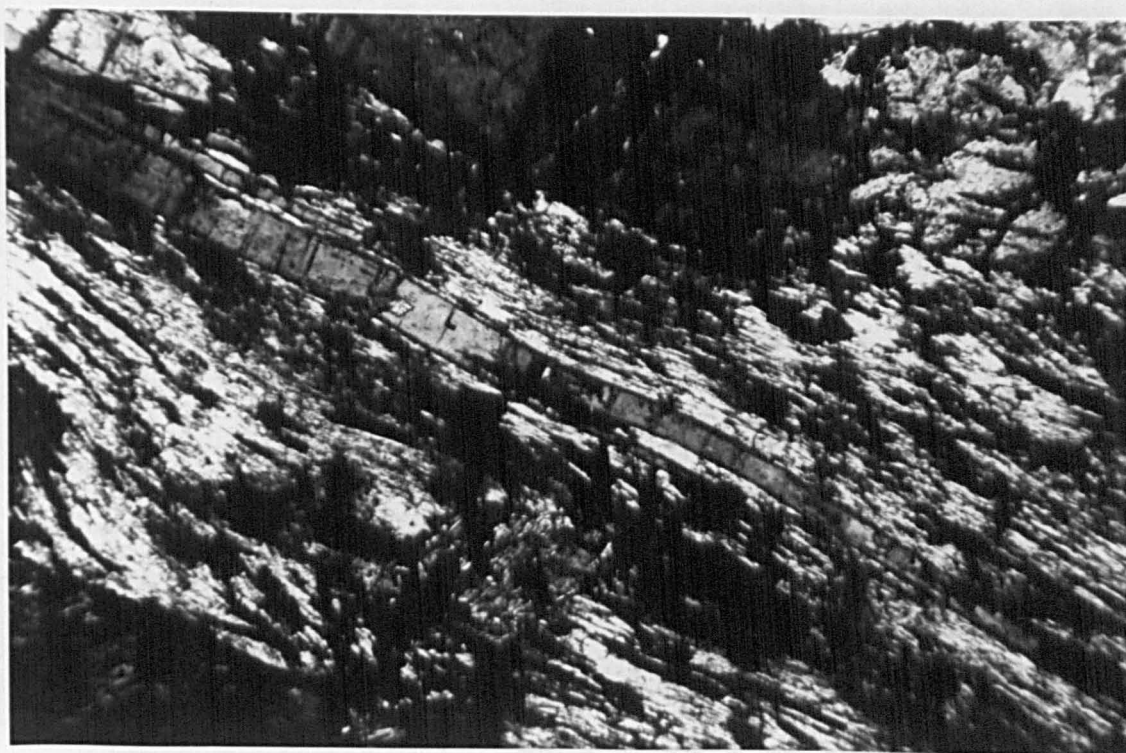


PLATE III.7.

- (a) The axial trace of an F2 folded early basite is cut by phlebitic neosome (above and to the right of the clinometer).

(Creag Mheall Beag Area, Map Ref. 978878)

- (b) D3 syn-tectonically migmatised early basite.

The pencil marks the trace of S3 penetrative foliation.

(Creag Mheall Beag Area, Map Ref. 978877)

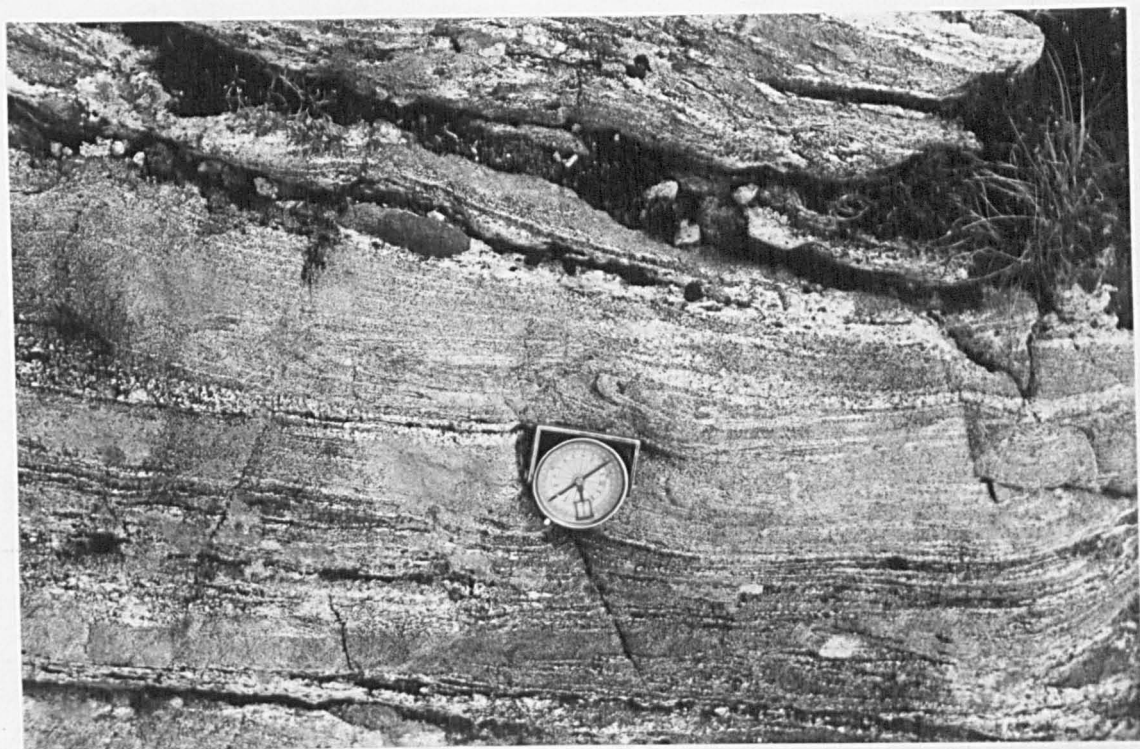


PLATE III.8.

Post-D3 migmatites. The neosome is locally discordant with S3, but has been folded in D5. Note the diffuse nature of the neosome margin, and the feldspar porphyroblasts.

(Banded Acid Gneisses, Kernsary Area, Map Ref. 923828)



PLATE III.9.

- (a) Segregation of mafic and felsic constituents in S₃ banded gneisses. The S₃ banding seen to the left of the illustration is only vaguely discernible in the right of the photograph where segregation effects are more strongly developed.

(Creag Mheall Beag Area, Map Ref. 978879)

- (b) Remnants of S₂ foliation and F₃ folds are preserved in spite of strong M₃ segregational effects.

(Creag Mheall Beag Area, Map Ref. 978879)

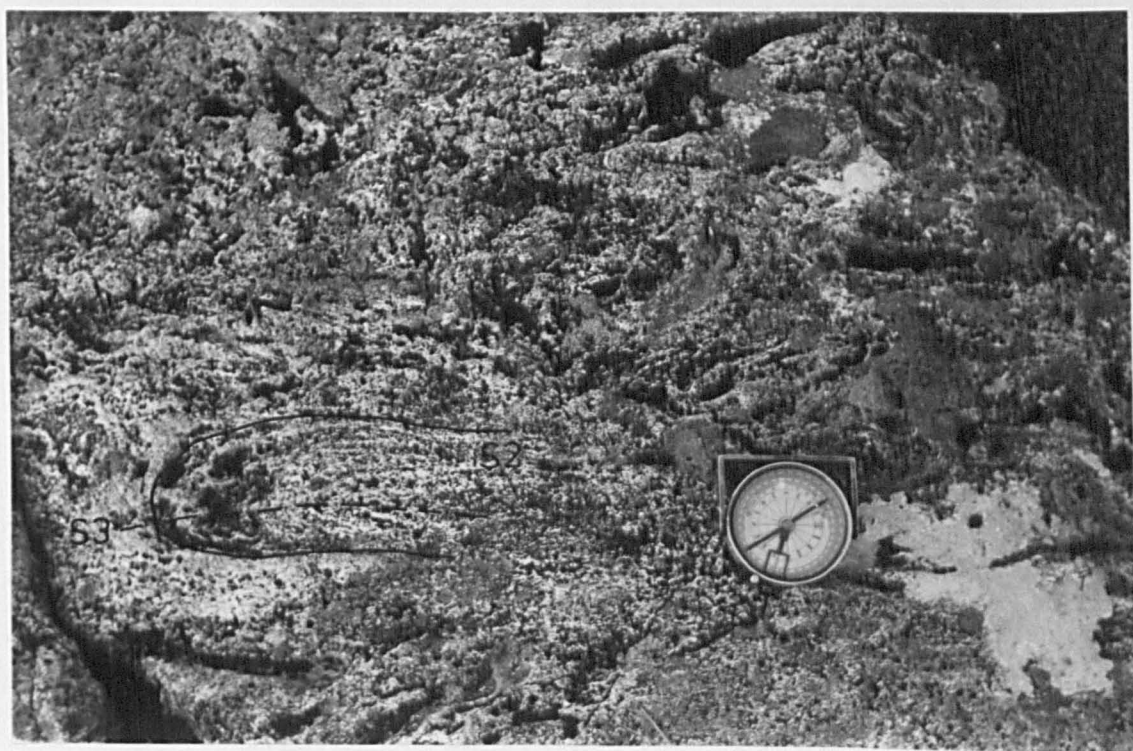
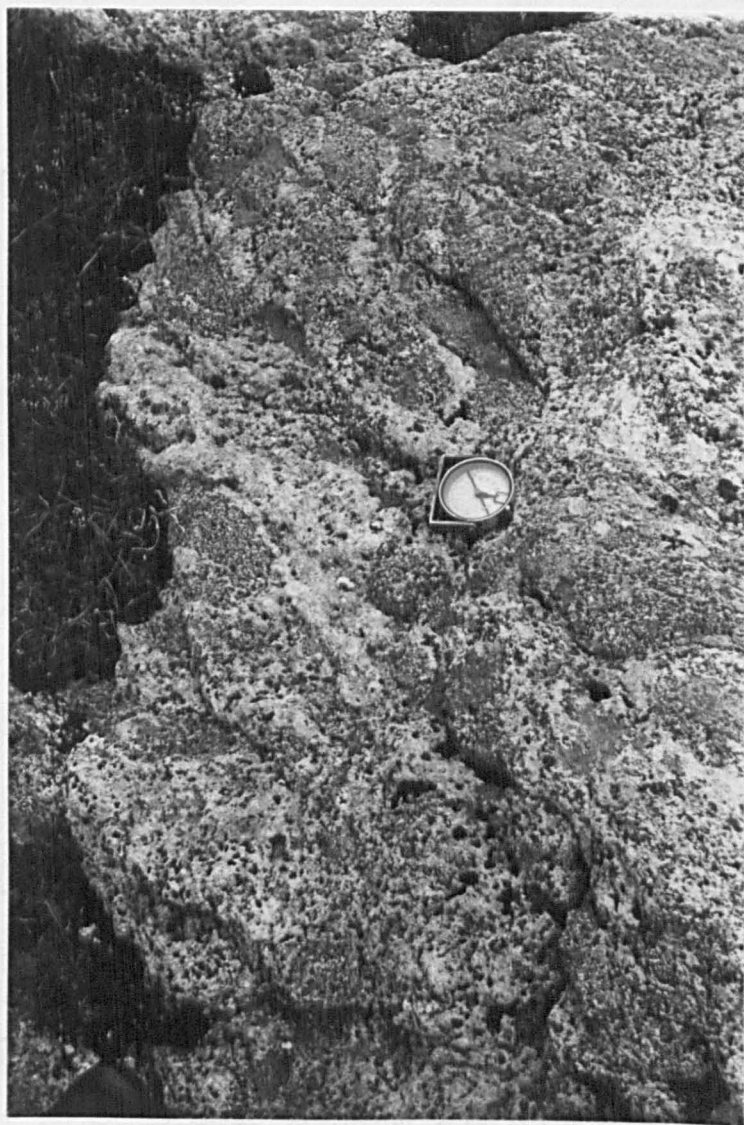


PLATE III.10.

Agmatised meladiorite: both neosome and palaeosome illustrate the segregation of mafic and felsic constituents.

(Creag Mheall Beag Area, Map Ref. 978880)



(a) F5 folded early basite.

(Creag Mheall Beag Area, Map Ref. 984866)

(b) D5 disruption and migmatisation of an early basite.

S5 is developed parallel to the hammer shaft.

F3 folds of S2 are preserved in the centre of the illustration.

(Kernsary Area, Map Ref. 924817)

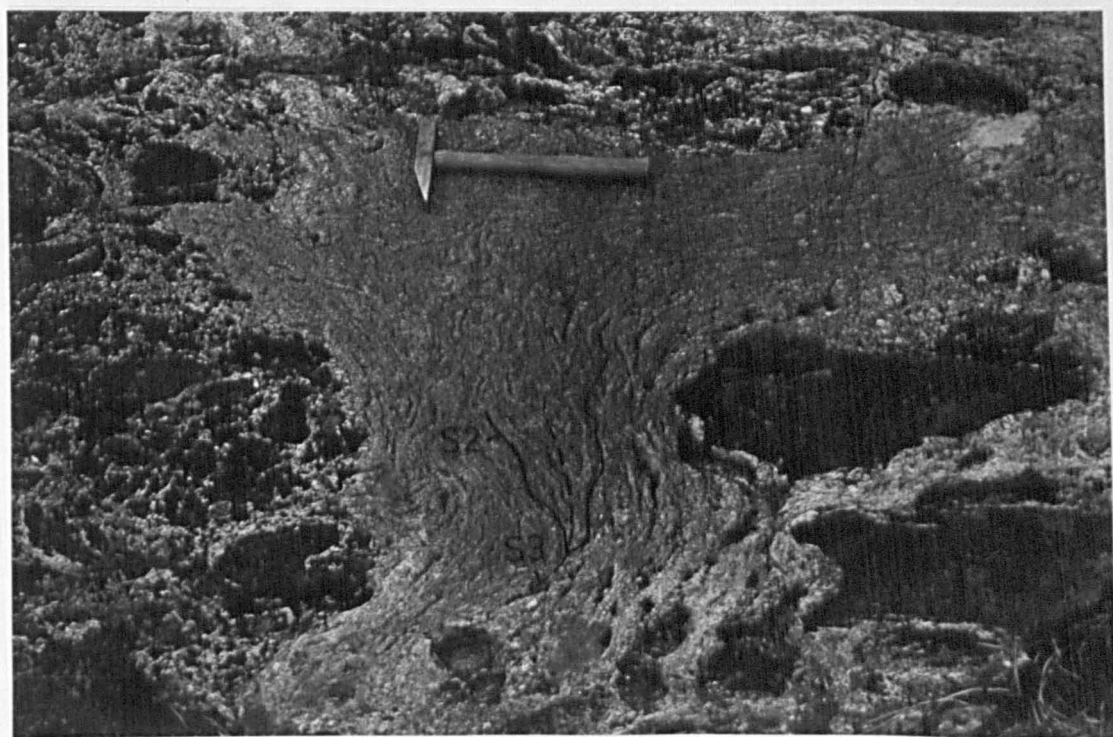


PLATE III.12.

Development of schlieren structure on the limb of an
F5-folded early basite.

(Kernsary Area, Map Ref. 918827)



PLATE III.13.

Development of basic inclusions: a rootless F3 fold has been rotated and further deformed in D5. The pencil indicates the trace of S5.

(Creag Mheall Beag Area, Map Ref. 977879)

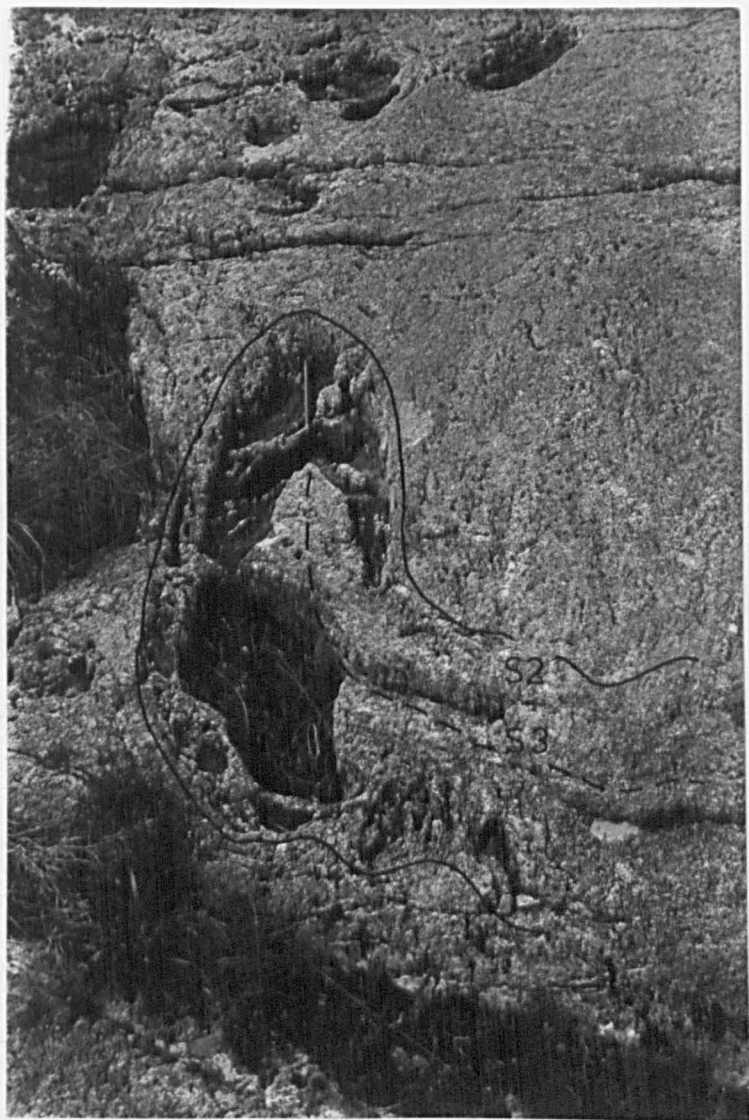


PLATE III.14.

D5 syn-tectonic migmatites.

Small scale F₅ folds of the S₃ gneissose banding have neosomes developed parallel to S₅ (see centre of photograph).

Note that neosomes are not developed in the relatively homogeneous gneisses at the bottom of the illustration.

(Creag Mheall Beag Area, Map Ref. 981874)



- (a) D5 syn-tectonic migmatites; the neosome is developed along the limbs of F5 folds.

(Kernsary Area, Map Ref. 916819)

- (b) D5 syn-tectonic migmatites illustrating diktyonitic structure.

(Kernsary Area, Map Ref. 916817)

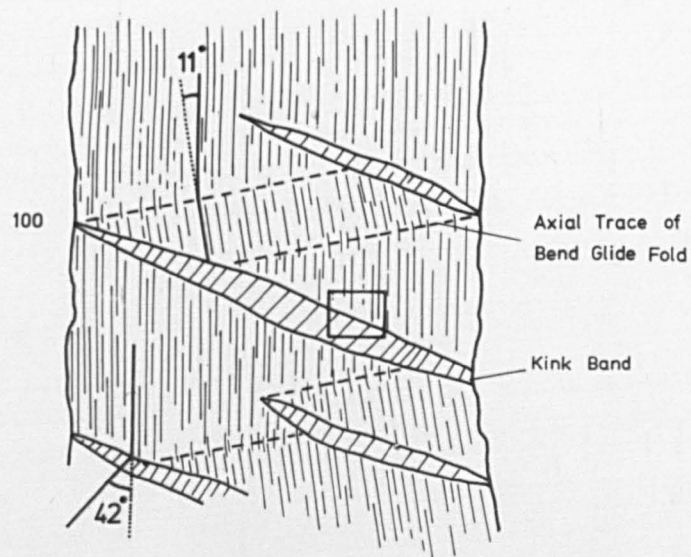


PLATE III 16 (a-b)

For explanation, see Appendix to Chapter III.

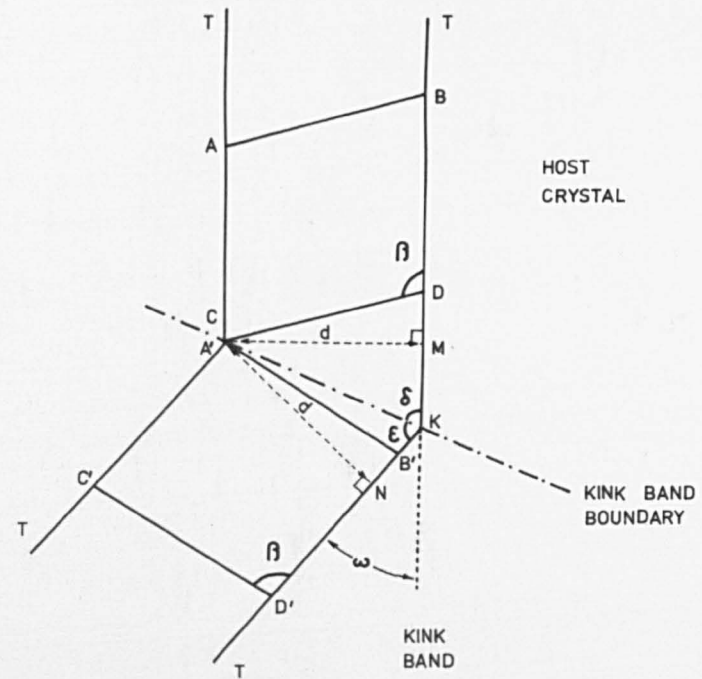
KINKING IN M5 KYANITE

(a)



Section Parallel to (010)

(b)



Diagrammatic Representation of Inset Area (left)

PLATE IV.1.

- (a) Photomicrograph illustrating secondary amphibole replacement of original hornblende. Replacement patches are aligned parallel to the $\{110\}$ cleavage traces of the host.

(First-Period Dyke, Creag Mheall Beag Area. x 55, X.P.L.)

- (b) Idioblastic - subidioblastic chlorite crystals illustrating the polysynthetic twinning.

(First-Period Dyke, Creag Mheall Beag Area. x 55, X.P.L.)

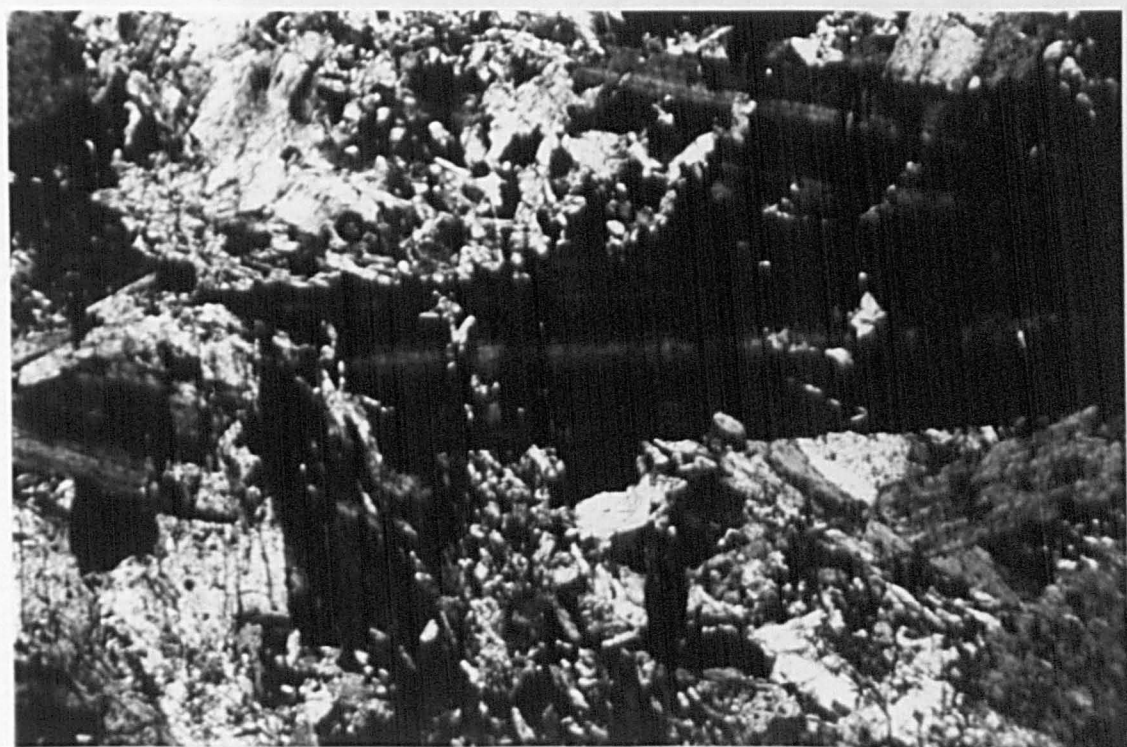


PLATE IV.2.

A Third-Period dyke exhibits chilled contacts towards a
Second-Period dyke.

(Poolewe Area, Map Ref. 853797)

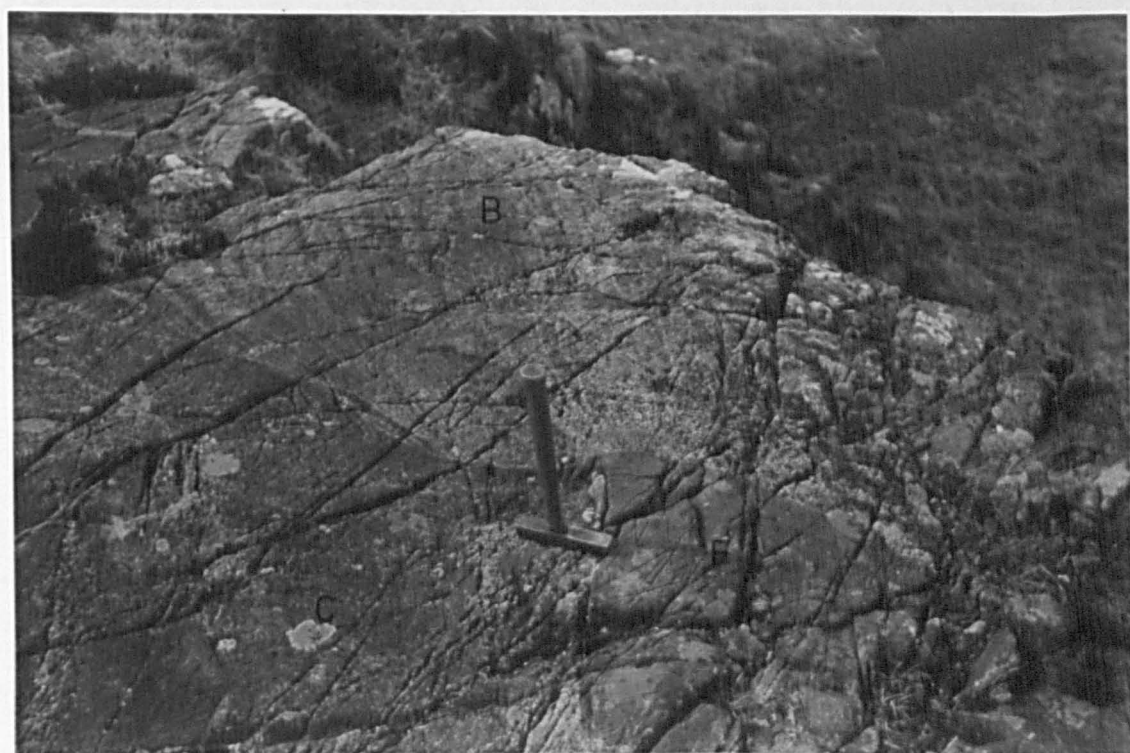


- (a) Second-Period dyke containing xenolith of coarse-grained epidiorite; the enclosing finer-grained epidiorite displays a chilled margin towards the xenolith and ultimately grades into a coarse-grained epidiorite similar to that of the xenolith.

(Creag Mheall Beag Area, Map Ref. 982873)

- (b) Second-Period dyke; the fine-grained epidiorite (F) chills against a coarse-grained epidiorite (C) and grades into a coarse epidiorite with a banded structure (B) which truncates earlier formed marginal facies.

(Creag Mheall Beag Area, Map Ref. 985867)



Second-Period dyke illustrating the sub-horizontal layering of mafic and felsic phases. The dyke margin is towards the right of the illustration.

(Creag Mheall Beag Area, Map Ref. 986866)



- (a) Compositional heterogeneity in a Second-Period dyke sometimes produces irregular fold-like forms.

(Creag Mheall Beag Area, Map Ref. 979865)

- (b) Compositional heterogeneity in a Second-Period dyke in the form of planar layering, imparting a banded structure.

(Creag Mheall Beag Area, Map Ref. 983863)

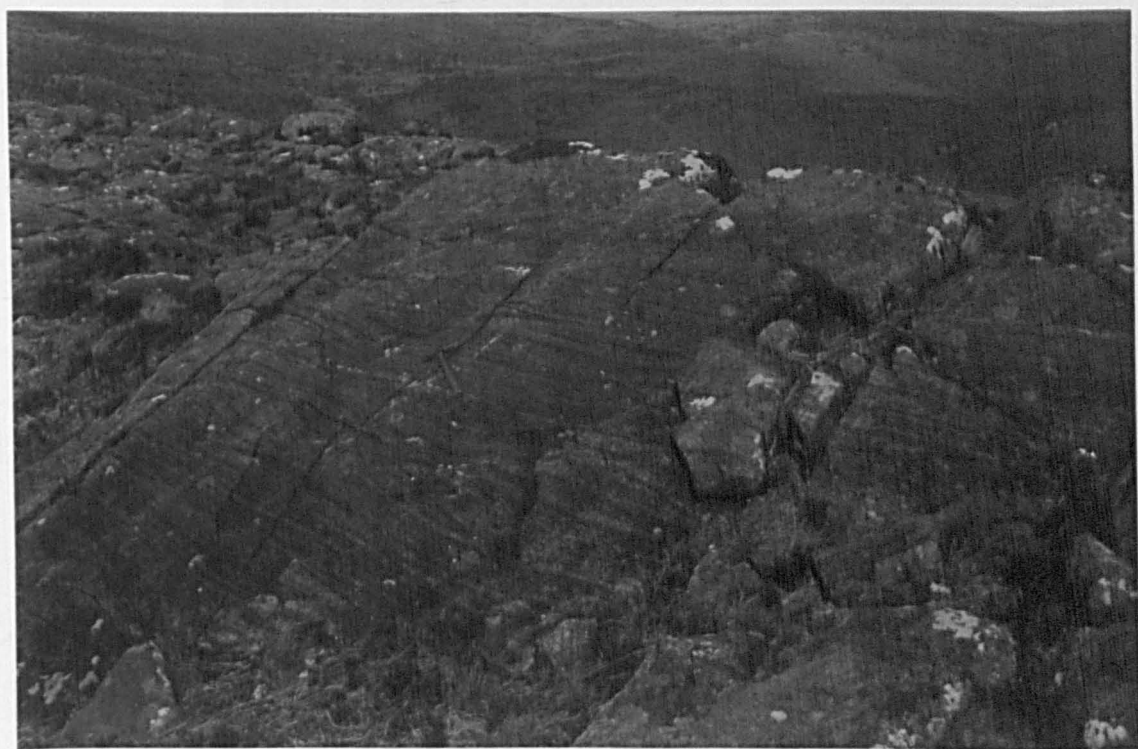


PLATE IV.6.

Second-Period dyke illustrating contacts between mafic and felsic domains. The contacts are sharp and the felsic domain is finer grained near the contact.

(Creag Mheall Beag Area, Map Ref. 979865)



PLATE IV.7.

Second-Period dyke, now hornblende schist. Igneous compositional heterogeneities have been flattened parallel to the schistosity.

(Poolewe Area, Map Ref. 846806)



PLATE IV.8.

- (a) Photomicrograph of sample from a Second-Period dyke
(now epidiorite). The initial igneous lath-shaped feldspar L
is still discernible.

(Creag Mheall Beag Area. x 55, X.P.L.)

- (b) Photomicrograph of a sample from a Second-Period dyke
(now hornblende schist). There is no relict igneous fabric
preserved; a well developed metamorphic planar structure,
S6, is the dominant fabric element.

(Poolewe Area. x 55, X.P.L.)

77

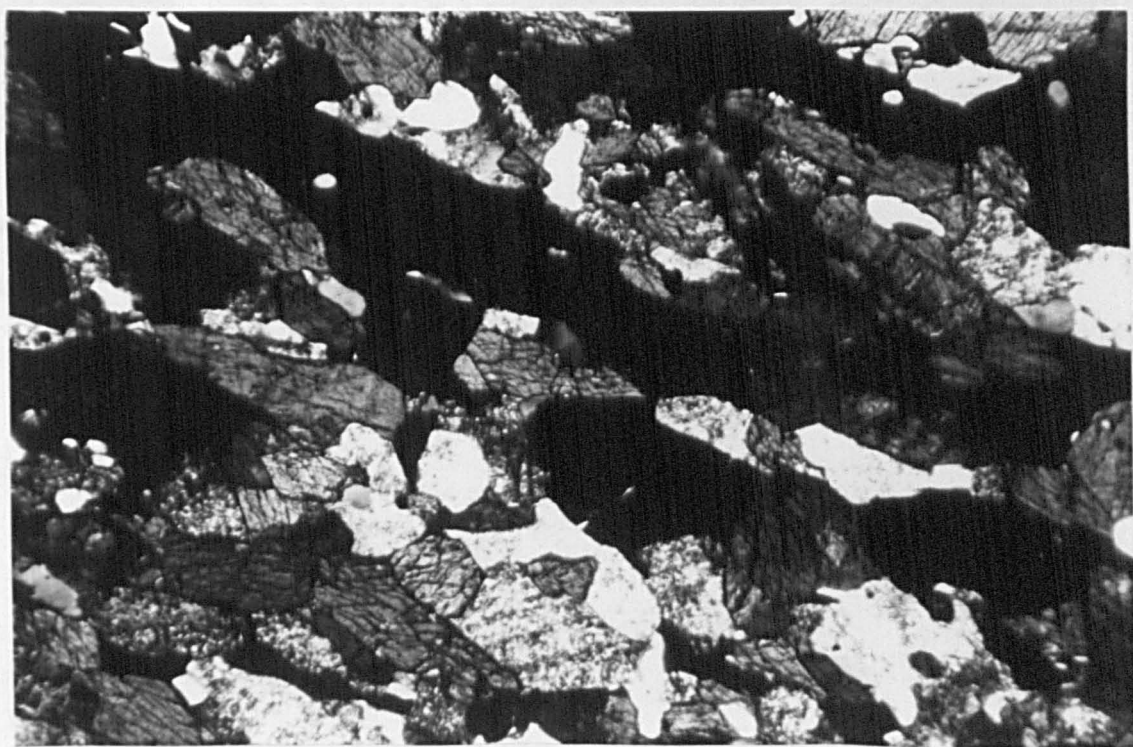


PLATE IV.9.

- (a) Photomicrograph illustrating compositional zonation in an M6 plagioclase crystal from a sampled Second-Period dyke.

(Kernsary Area. x 55, X.P.L.)

- (b) Photomicrograph illustrating development in M6 of polygonal feldspar grains from original igneous lath-shaped feldspars.

(Poolewe Area. x 55, X.P.L.)

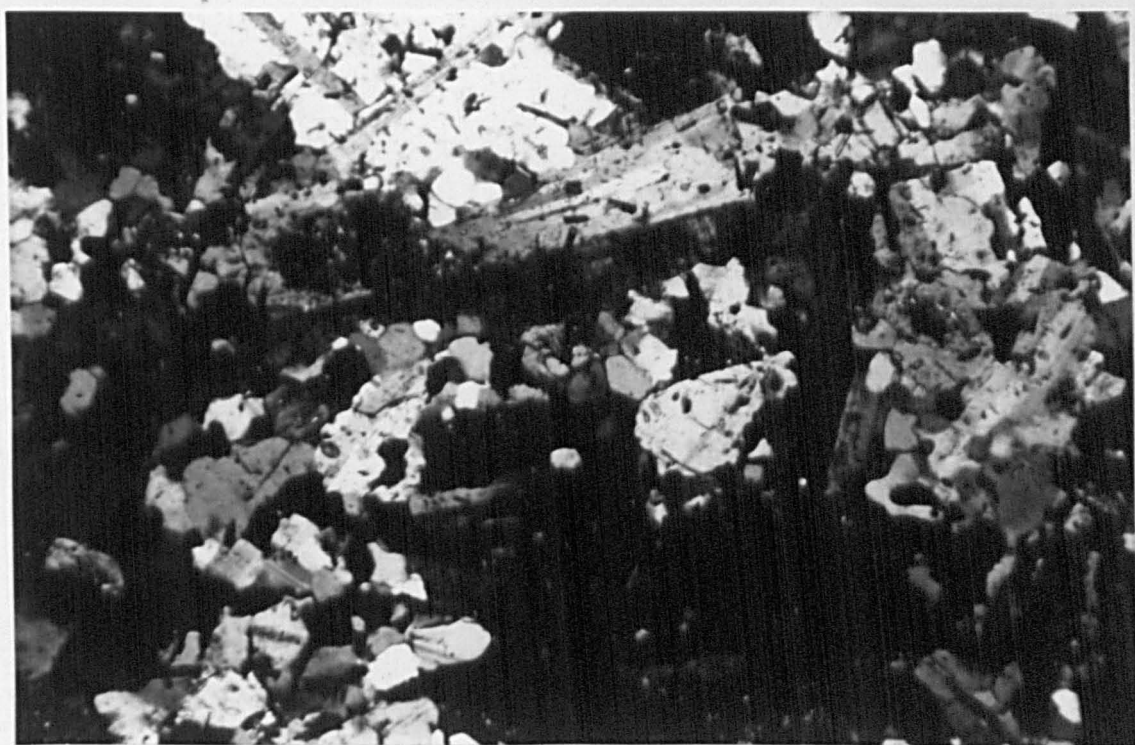


PLATE V.1.

- (a) Photomicrograph illustrating two generations of hornblende crystals. The large crystals formed in M6 and display planar preferred orientation. The smaller crystals formed in M5 and show strong linear orientation preference.

(Beinn Airigh Charr basite. x 55, X.P.L.)

- (b) M6 hornblende has replaced chlorite. Slender flakes of magnetite define S5 as an internal foliation within the M6 hornblende.

(Beinn Airigh Charr basite. x 55, X.P.L.)

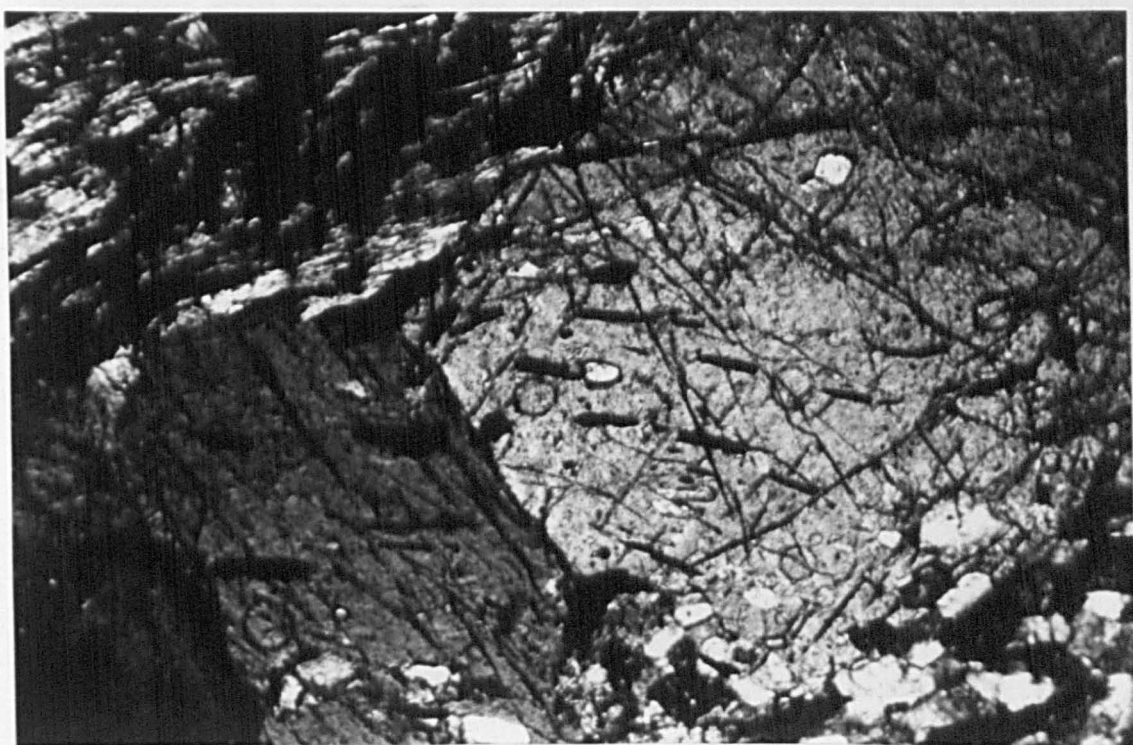
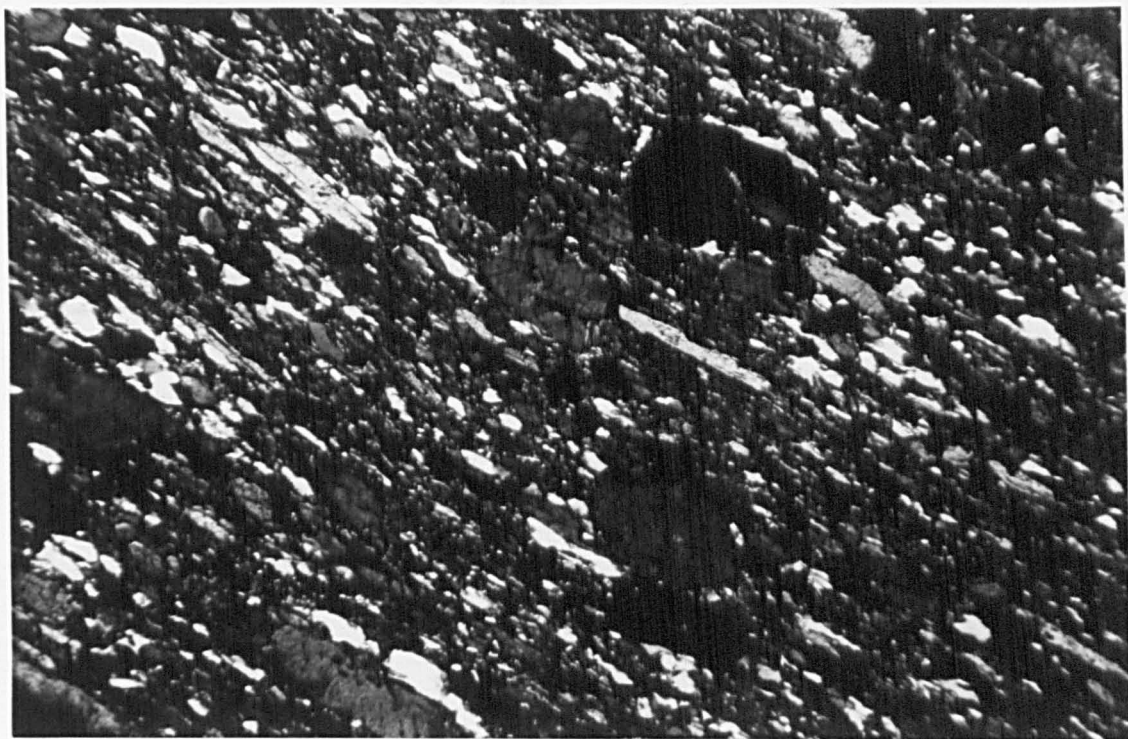


PLATE V.2.

- (a) Syn-tectonic M6 hornblende containing sigmoidal inclusion trails. The internal and external foliations are continuous.

(Beinn Airigh Charr basite. x 55, P.P.L.)

- (b) Asymmetric F8 fold illustrating a concentration of hornblende crystals on the thinned limb of the fold.

(Beinn Airigh Charr basite, x 55, P.P.L.)

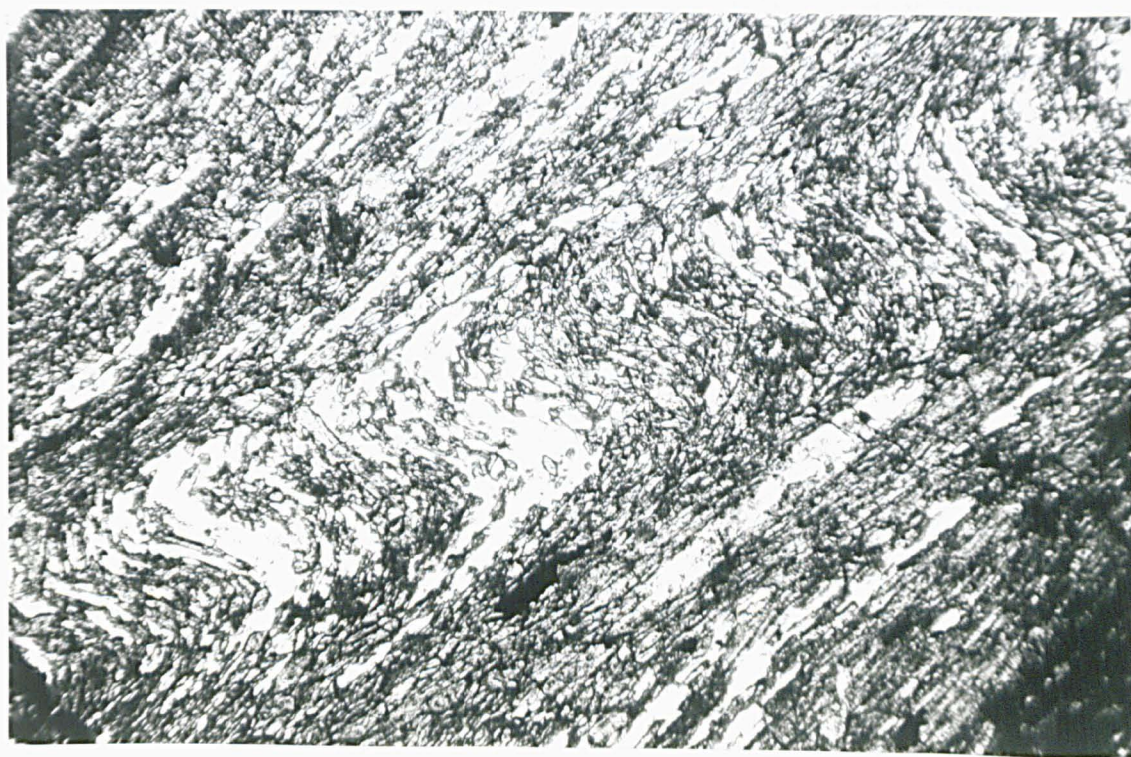
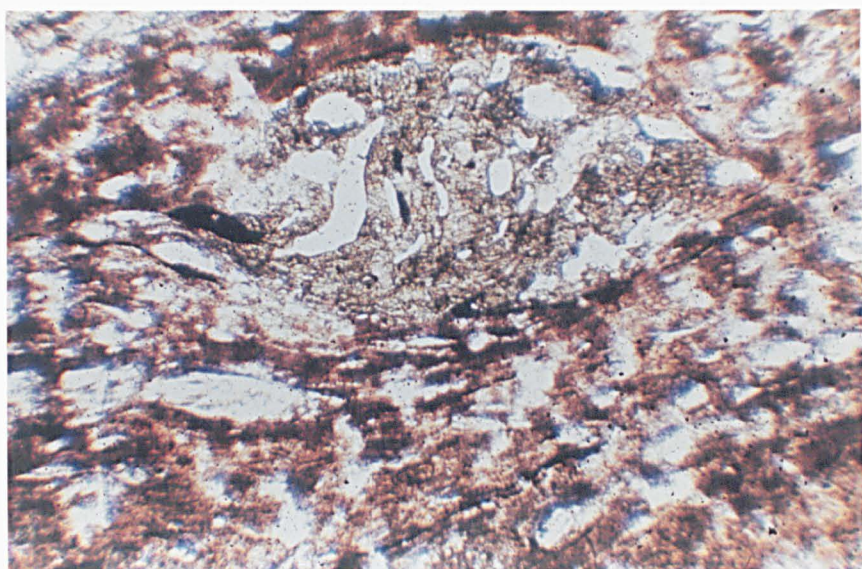


PLATE V.3.

F8 folding produces a highly strained quartz subfabric.
The hornblende crystals have suffered some granulation,
but are relatively unmodified.

(Beinn Airigh Charr basite. x 55, X.P.L.)



PLATE V.4.

- (a) Photomicrograph illustrating M7 folded quartz layer with associated polygonisation and recrystallisation of the crestal area of the fold.

(Gleann Tulacha metasediments. x 55, X.P.L.)

- (b) Mesoscopic F8 fold in impure marble.

S8 axial planar foliation is defined by alignment of quartz crystals.

(Gleann Tulacha metasediments. Map Ref. 895768)



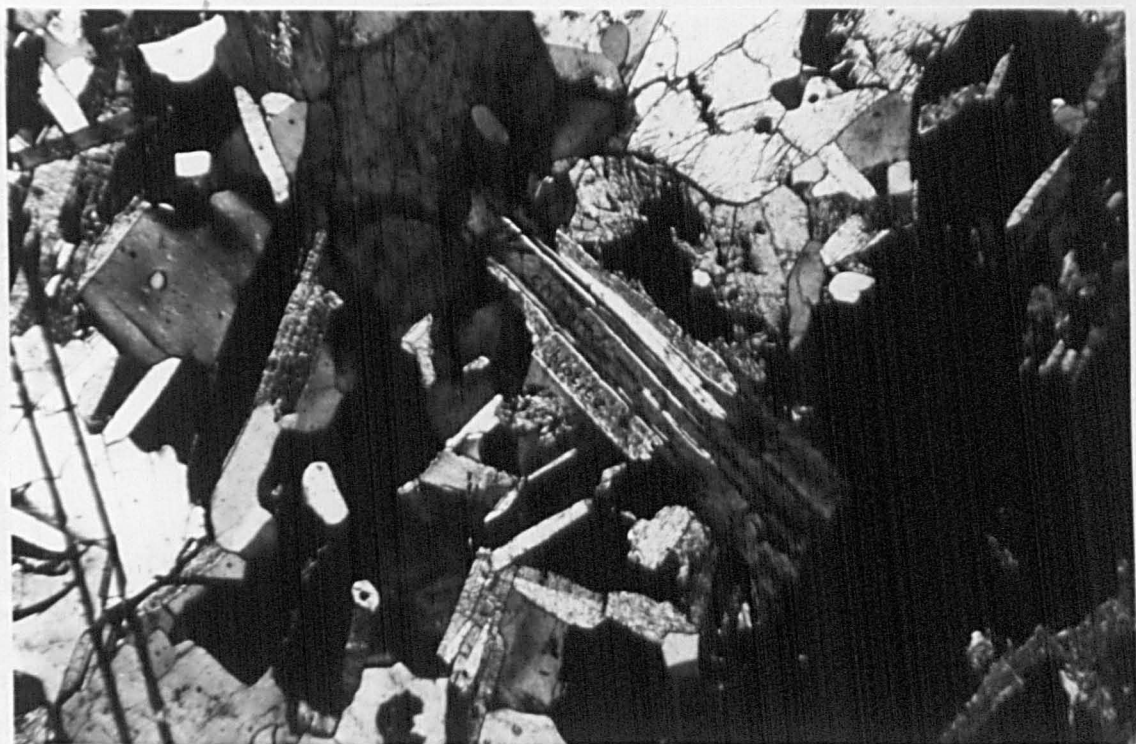
PLATE V.5.

- (a) Photomicrograph illustrating S5, defined by grain size contrasts; S8, defined by elongate quartz grains, is oblique to S5.

(Gleann Tulacha metasediments. x 55, X.P.L.)

- (b) Photomicrograph illustrating M6 biotite developed parallel to the $\{001\}$ cleavage traces of M5 chlorite.

(Gruinard basite. x 55, X.P.L.)



(a) Quartz foliae define S5 (parallel to the pencil).

S6 modification of S5 is apparent on the right of the illustration.

(Acid gneisses of the Beinn Airigh Charr Area. Map Ref.911774)

(b) Photomicrograph of the "new" S6 fabric. A granoblastic mosaic of quartz and feldspar is associated with decussate subfabrics of idioblastic and subidioblastic tremolite and biotite.

(Acid gneisses of the Creag Mheall Beag Area. x 55, X.P.L.)

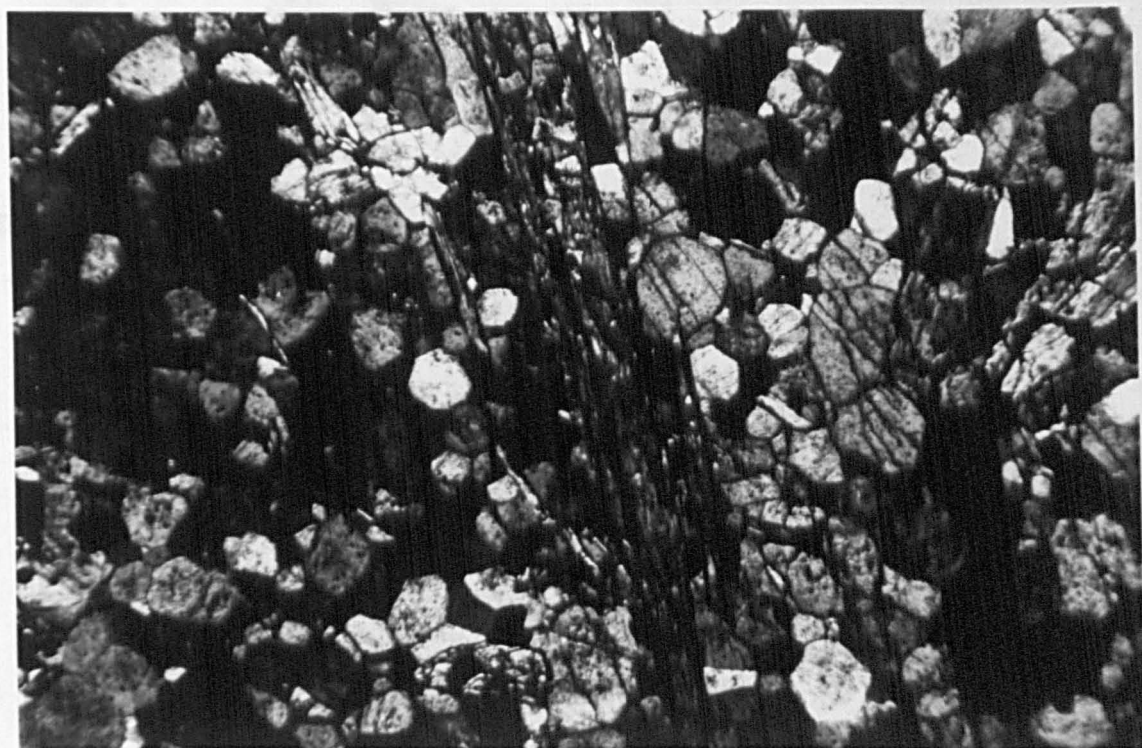
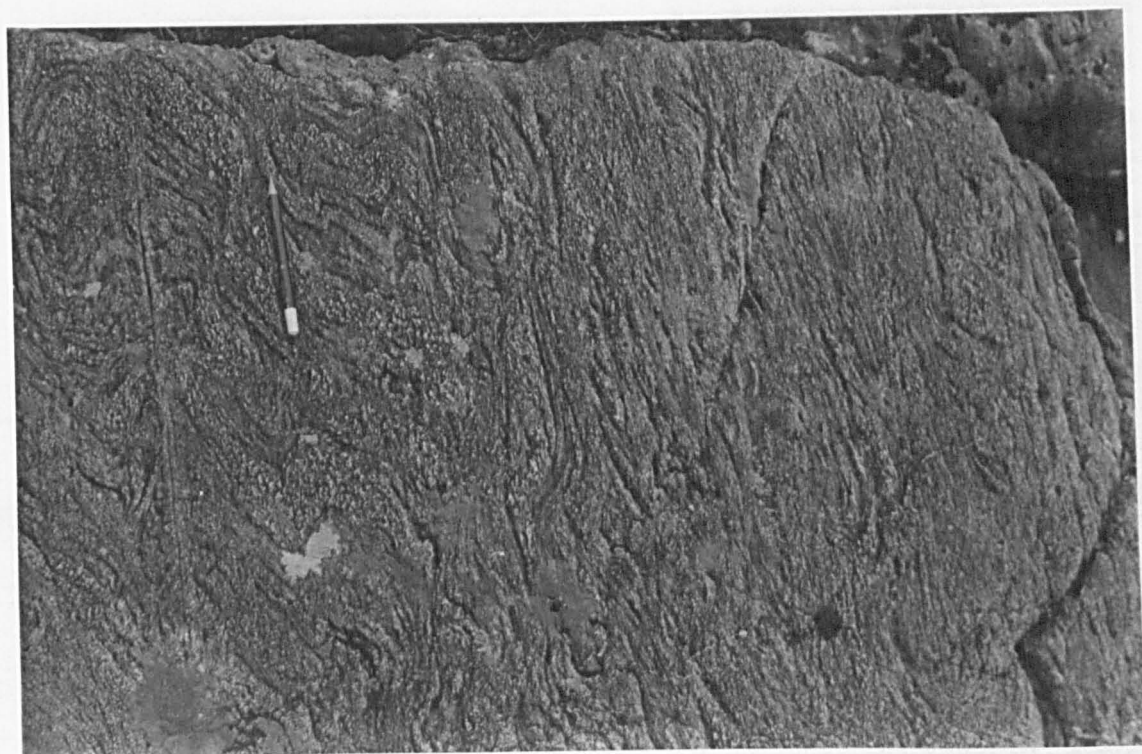


PLATE V.7.

- (a) Photomicrograph illustrating the S6 fabric domain of sample 00801 (see Table V.1).

(Acid gneisses of the Beinn Airigh Charr Area. x 55, X.P.L.)

- (b) Oscillatory zonation in M6 plagioclase.

(Acid gneisses of the Beinn Airigh Charr Area. x 55, X.P.L.)



PLATE V.8.

- (a) Photomicrograph illustrating relict S3 feldspar augen in a rock which otherwise demonstrates typical S6 fabric development. Augen is in extinction.

(Acid gneisses of the Beinn Airigh Charr Area. x 55, X.P.L.)

- (b) Aggregates of static-growth M6 hornblende have a preferred planar orientation parallel to S6.

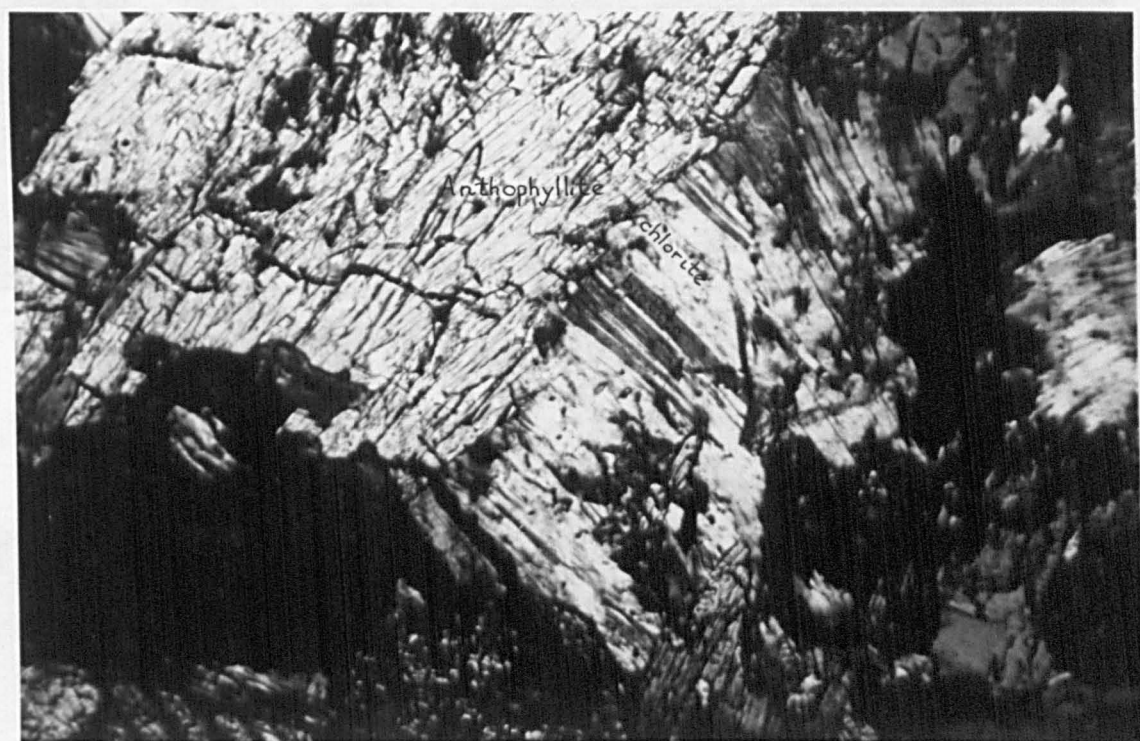
Acid gneisses of the Beinn Airigh Charr Area. Map Ref.896791)



PLATE V.9.

Photomicrograph illustrating M6 anthophyllite and biotite replacement of M5 chlorite.

("Anthophyllite rock" of the Kernsary Area. x 55, X.P.L.)



- (a) Photomicrograph illustrating F8 modification of the S6 fabric.

Granoblastic plagioclase crystals appear to be relatively unaffected. Muscovite and biotite are flexed and kinked; biotite particularly demonstrates granulation. Quartz shows evidence of extreme strain and the development of Boehm lamellae.

(Acid gneisses of the Beinn Airigh Charr Area. x 55, X.P.L.)

- (b) Photomicrograph illustrating further development of the fabric of (a) above. Most of the biotite is granulated.

Quartz has recrystallised.

(Acid gneisses of the Beinn Airigh Charr Area. x 55, X.P.L.)



- (a) Pseudotachylite development: irregular folds produced by inhomogeneous simple shear parallel to the regional foliation attitude.

(Acid gneisses of the Beinn Airigh Charr Area. Map Ref.902787)

- (b) Pseudotachylite development: a steeply dipping planar zone occupying the width of the hammer shaft contains rotated fragments of gneisses enclosed within a flinty matrix of ultramylonite and pseudotachylite.

(Hornblende gneisses of the Poolewe Area. Map Ref.837811)



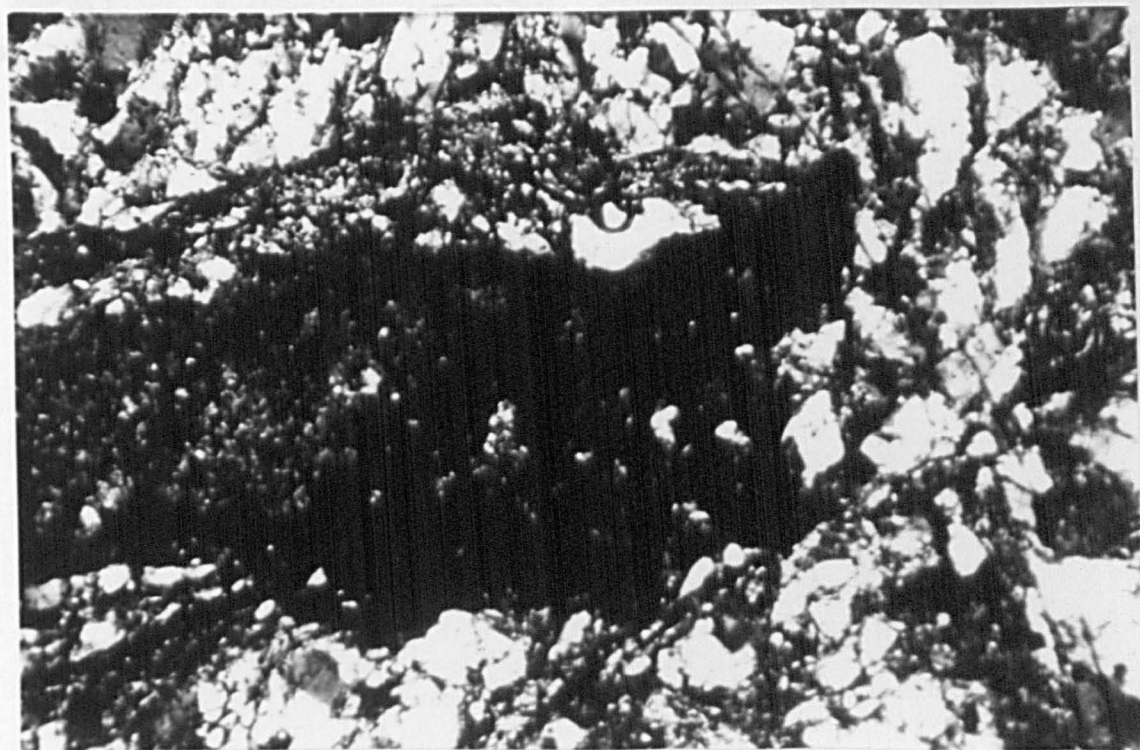
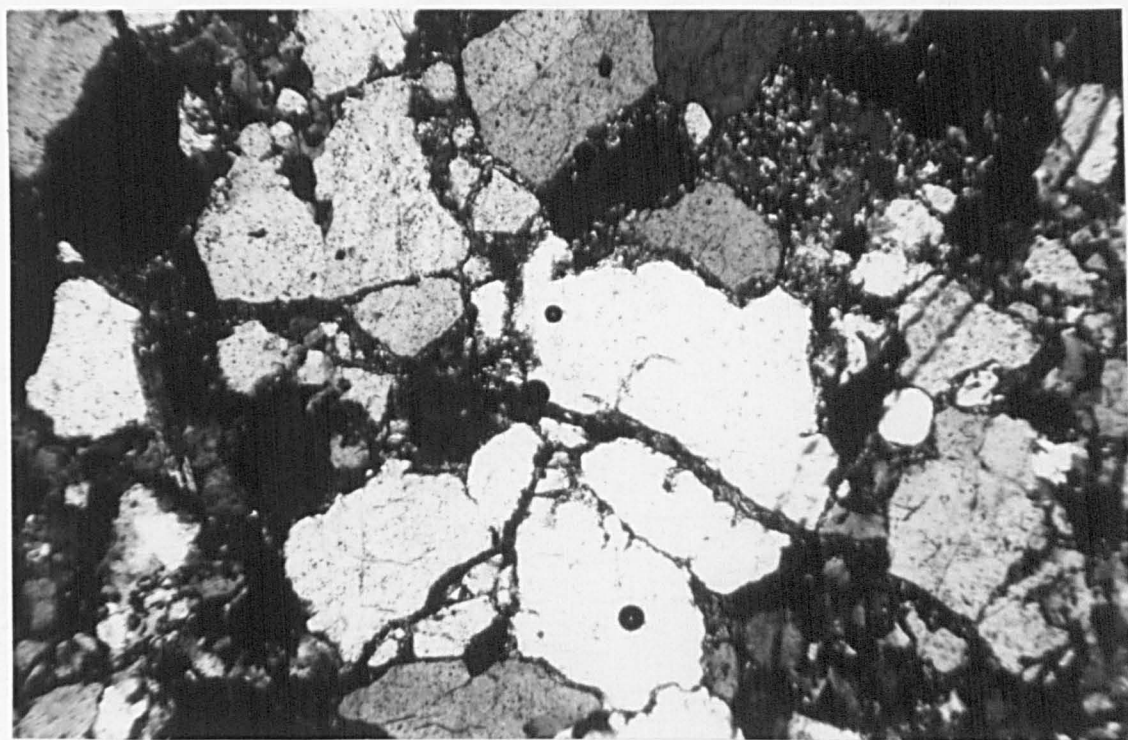
- (a) Photomicrograph illustrating the development of mortar texture in gneisses adjacent to a crush zone.

(Acid gneisses of the Creag Mheall Beag Area. x 55, X.P.L.)

- (b) A small ultramylonite sheet has been intruded by an irregular apophysis of partially devitrified aphanitic material.

The glassy material contains several inclusions of host rock and displays intrusive relationships.

(Acid gneisses of the Beinn Airigh Charr Area. x 55, X.P.L.)

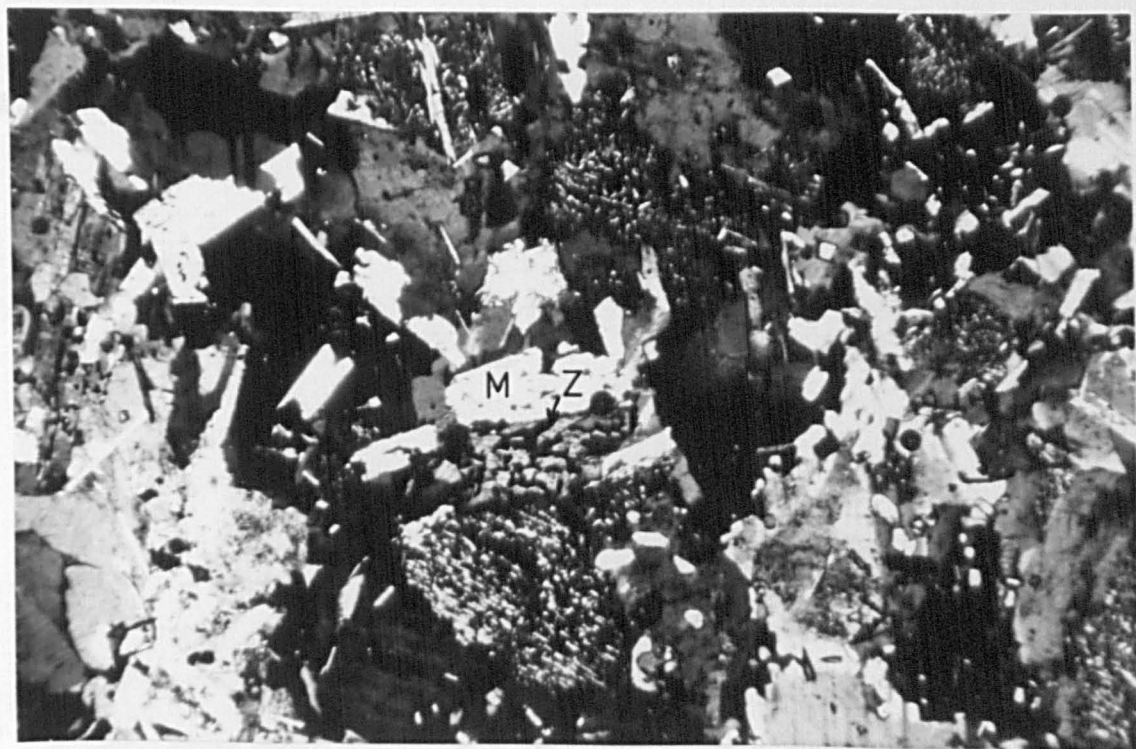
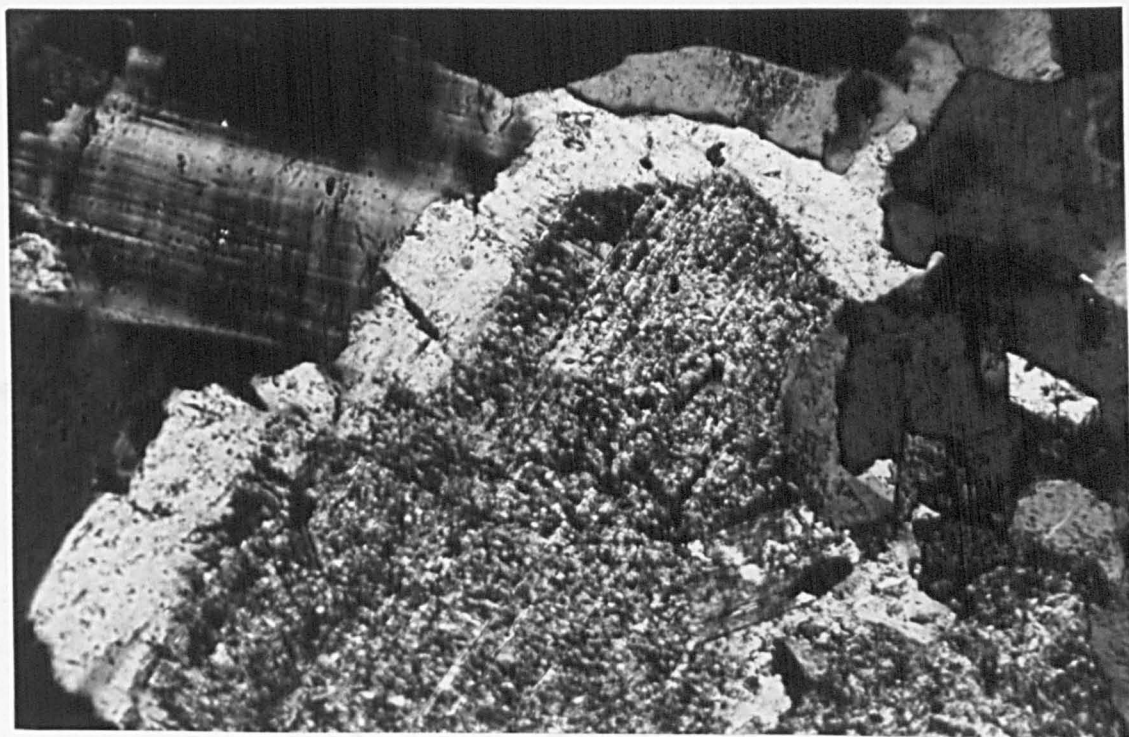


- (a) Photomicrograph illustrating a rim of alkali feldspar developed around an older plagioclase feldspar nucleus.

(Acid gneisses of the Kernsary Area. x 55, X.P.L.)

- (b) Photomicrograph illustrating intergrowths of quartz-muscovite M and quartz-zoisite Z

(Acid gneisses of the Kernsary Area. x 55, X.P.L.)



- (a) Photomicrograph of perthitic K-feldspar contiguous with antiperthite. Note the abundance of inclusions of zoisite, epidote and muscovite in the Na-feldspar.

(Acid gneisses of the Kernsary Area. x 55, X.P.L.)

- (b) Photomicrograph illustrating Na-feldspar which has been almost completely obscured by complex intergrowths of muscovite-epidote-zoisite-quartz.

(Acid gneisses of the Kernsary Area. x 55, X.P.L.)

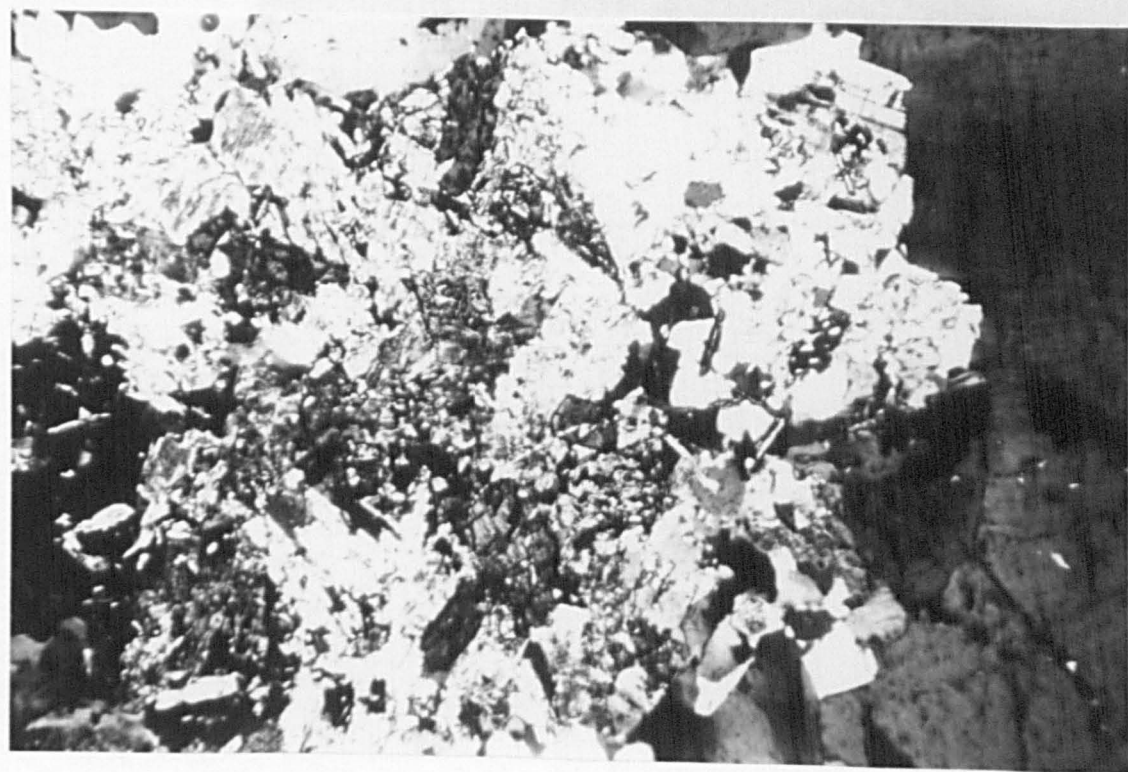
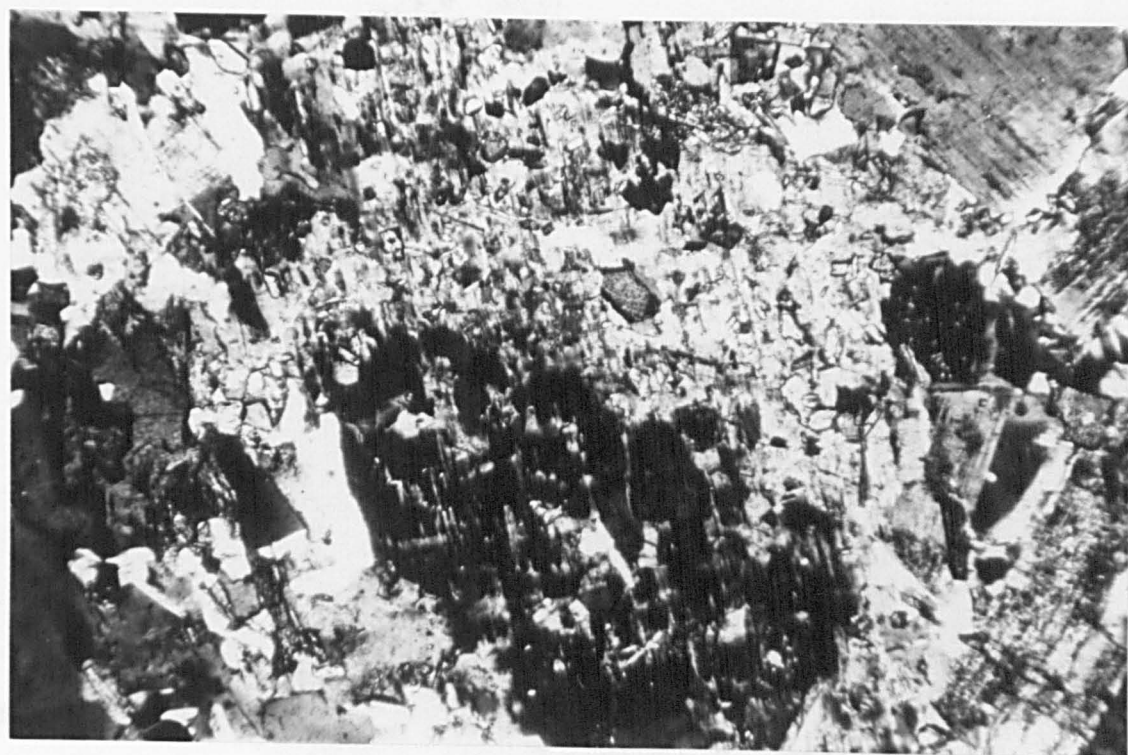


PLATE V.15.

Intrusive sheets with diffuse margins intrude acid gneisses. The sheets are dominantly composed of K-feldspar, often having idiomorphic form (see centre of illustration). S5 is the prominent foliation in the gneisses illustrated.

(Acid gneisses of the Kernsary Area. Map Ref.902826)

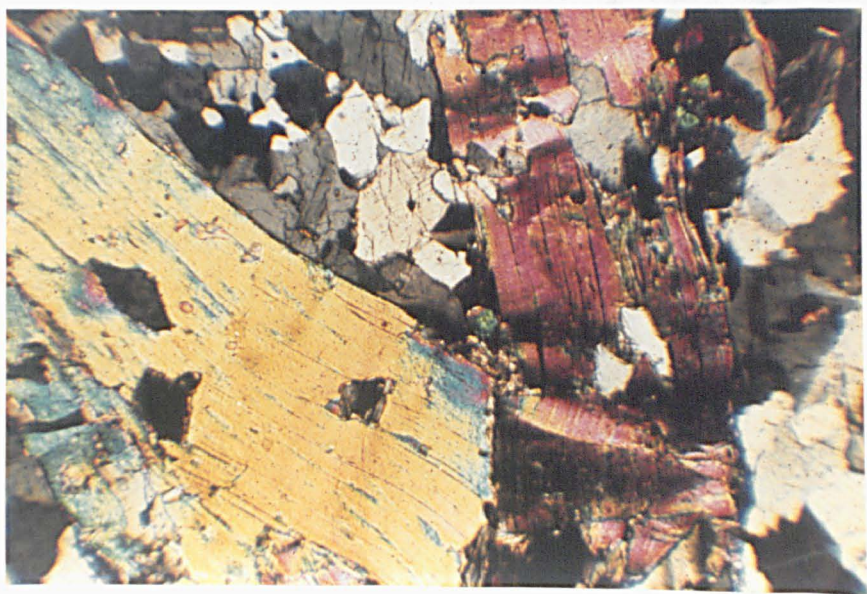
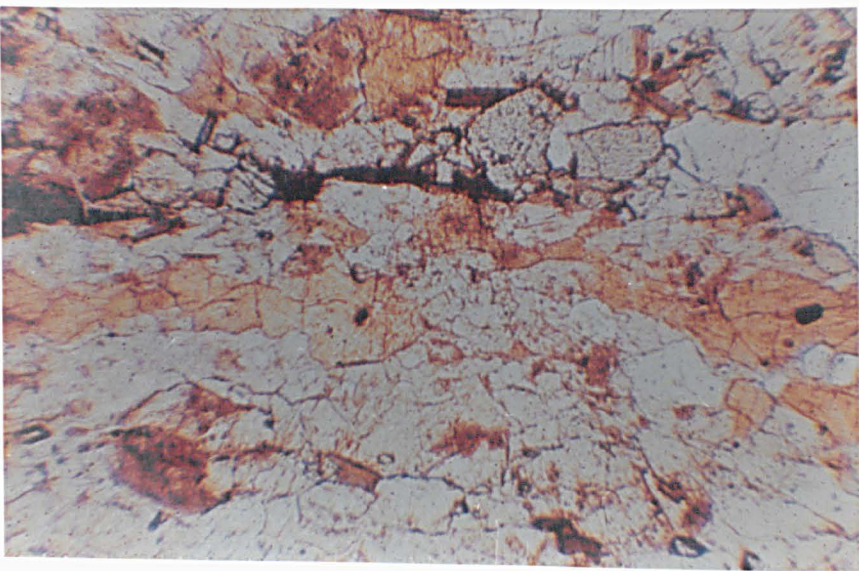


- (a) Coloured photomicrograph of a slide selectively stained to illustrate the K-feldspar. The K-feldspar is mostly microcline and is developed parallel to the S6 foliation.

(Acid gneisses of the Beinn Airigh Charr Area. x 55, P.P.L.)

- (b) Photomicrograph of post-M6 "discordant muscovites" illustrating how they have been flexed and kinked during the D8 deformation.

(Acid gneisses of the Beinn Airigh Charr Area. x 55, X.P.L.)



Metasomatic K-feldspar porphyroblast illustrating relative resistance to post-D6 flattening.

(Acid gneisses of the Beinn Airigh Charr Area. Map Ref.904774)



Photomicrograph illustrating intersecting planar deformational domains within a K-feldspar porphyroblast.

(Acid gneisses of the Beinn Airigh Charr Area. x 55, X.P.L.)



PLATE VI.1.

- (a) An unfoliated epidiorite dyke cuts a folded early basite.
The axial planar foliation in the early basite strikes
west north west - east south east.

(Kernsary Area. Map Ref. 917825)

- (b) Dyke branches are intruded parallel to the limbs of
F5A folds.

(Poolewe Area. Map Ref. 848806)



PLATE VI.2.

(a) Open F3 folds.

(Creag Mheall Beag Area. Map Ref. 976861)

(b) Tight to isoclinal F3 folds. The pencil is parallel to S5.

(Creag Mheall Beag Area. Map Ref. 983872)



PLATE VI.3.

F₃ folding: The early basite deformed by buckling.

The early ultra-basite has been boudinaged on the limbs of the F₃ fold.

(Creag Mheall Beag Area. Map Ref. 979875)



F5 folding illustrating boudinaged ultra-basite with weathered biotite coronas. Numerous basic inclusions are aligned parallel to the gneissose banding.

S5 is the steeply inclined foliation, axial planar to the F5 folds in the centre of the photograph.

(Creag Mheall Beag Area. Map Ref. 973866)

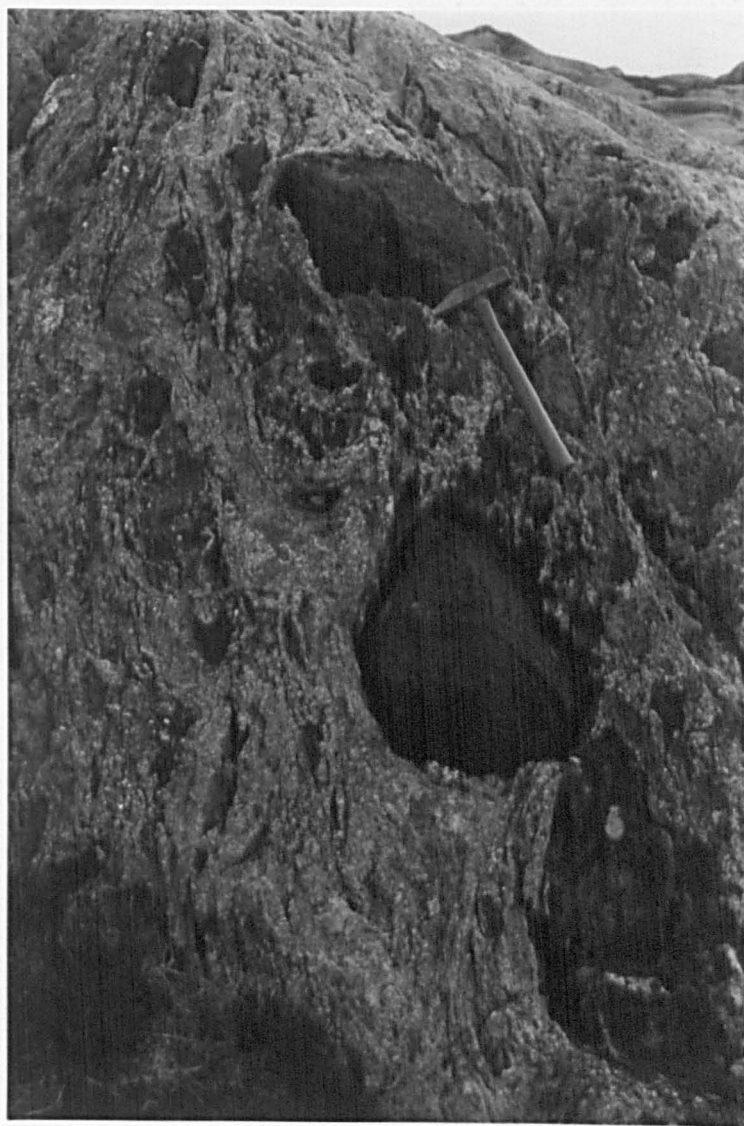


PLATE VI.5.

F5 folds superimposed upon earlier structures:

F3 folds of the gneissose banding have been refolded in F5,
and penetrative S5 foliation is developed parallel to the
pencil.

Acid gneisses of the Creag Mheall Beag Area. Map Ref. 972864)

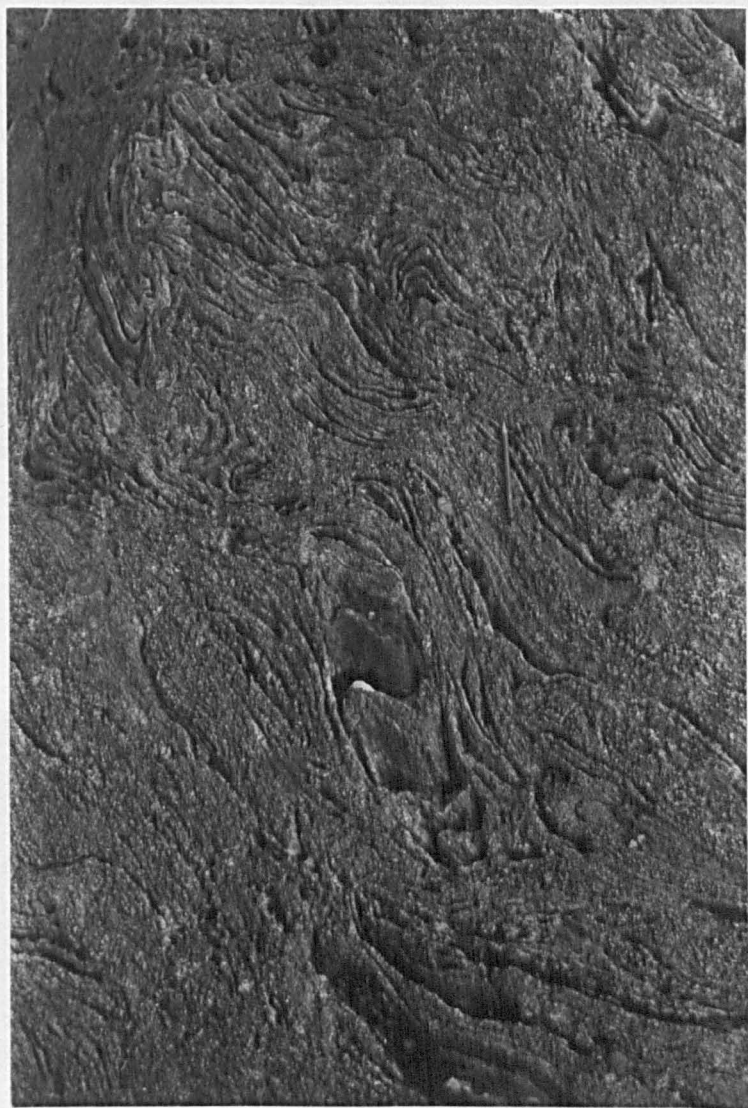


PLATE VI.6.

- (a) Photograph illustrating two foliations developed at right angles to each other: S3 runs parallel to the shorter edges of the illustration while S5 is parallel to the pencil.

(Acid gneisses of the Creag Mheall Beag Area. Map Ref. 981874)

- (b) Tight to isoclinal F5 folds in the Beinn Airigh Charr basite.

(Beinn Airigh Charr Area. Map Ref. 916774)



PLATE VI.7.

F5A folds; the effects of post-F5A modification and flattening may be observed on the right of the photograph.

(Hornblende gneisses of the Poolewe Area. Map Ref. 836813)



PLATE VI.8.

Interference between F5 and F5A fold sets. Most of the closures illustrated are of F5 generation; the effects of F5A refolding and the development of F5A folds are most clearly demonstrated slightly lower than the centre of the photograph.

(Hornblende gneisses of the Poolewe Area. Map Ref. 827821)



PLATE VI.9.

Two thin basic sheets (now hornblende schists) displaying no discordance with the S5A foliation in the country-rock gneisses.

(Poolewe Area. Map Ref. 834816)



PLATE VI.10.

- (a) Several thin screens of acid gneiss enclosed within a basic dyke.

(Poolewe Area. Map Ref. 854797)

- (b) Thin dyke which has intruded an early basite.

The foliation in the dyke has a sigmoidal form, but is only strictly penetrative within a few centimetres of the dyke margin.

(Creag Mheall Beag Area. Map Ref. 982874)



PLATE VI.11.

F6 folding: asymmetric folds appear to be genetically related to a series of planar zones, across which there is always a dextral sense of displacement.

(Acid gneisses of the Creag Mheall Beag Area. Map Ref. 974864)



PLATE VI.12.

- (a) Drawing made from a thin section illustrating the relationships between S5, S6 and S8.

(Mica Schist, Gleann Tulacha Metasediments)

- (b) F6 folded quartzite; the curvature of the F6 fold axial planes is due to post-D6 deformation. Natural size.

(Gleann Tulacha Metasediments)

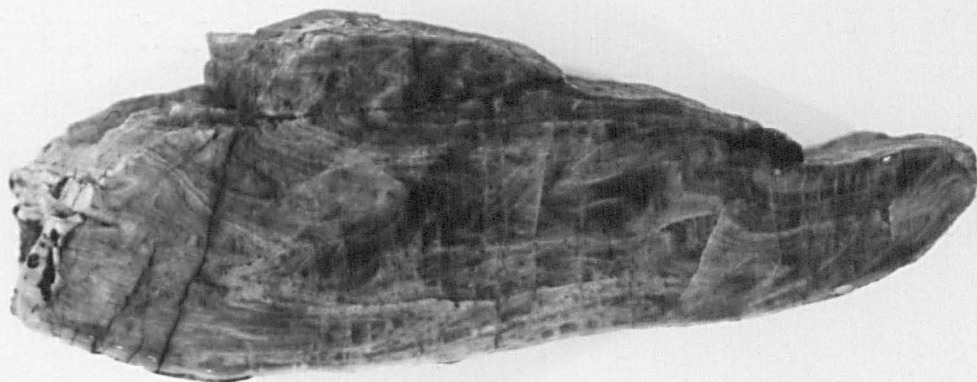


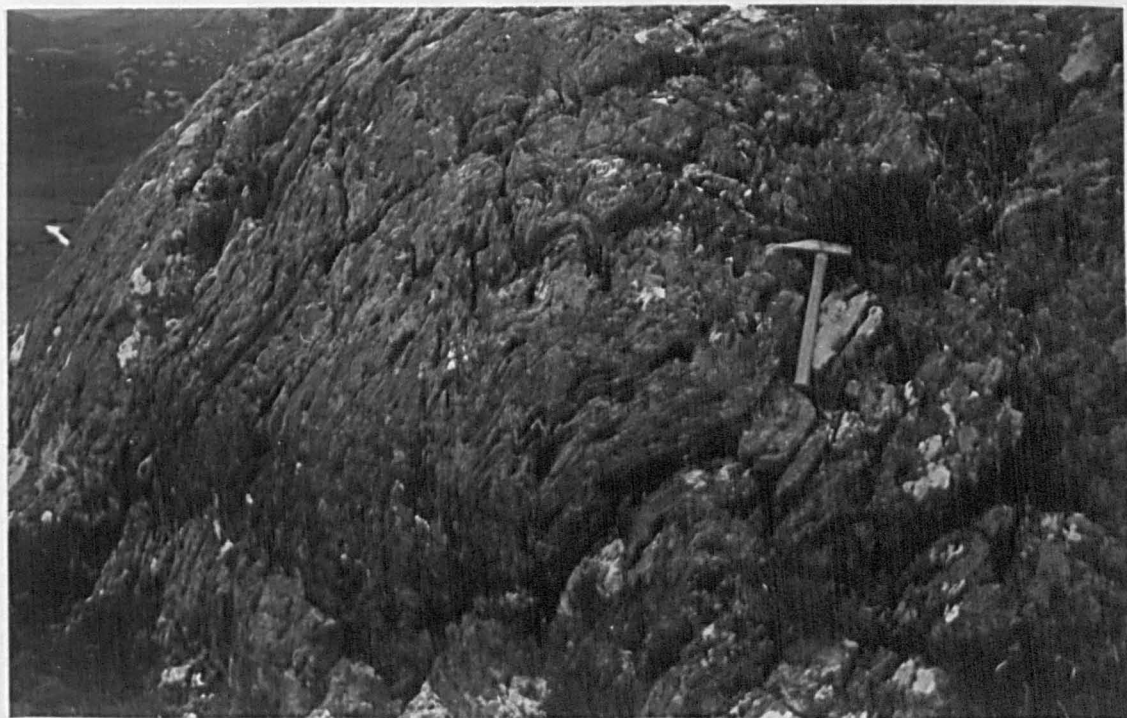
PLATE VI.13.

(a) F6 chevron folds in the Beinn Airigh Charr basite.

(Map Ref. 910771)

(b) F6 chevron folds in the Beinn Airigh Charr basite.

(Map Ref. 896766)



- (a) F7 folding: in the basic dyke S6 has been folded; in the acid vein which intrudes the dyke, penetrative S7 foliation is developed parallel to the axial plane of the F7 folds.

(Poolewe Area. Map Ref. 837815)

- (b) F6-folded impure marble has been refolded in F7; F6/F7 interference is best illustrated in the centre of the illustration.

(Gleann Tulacha Metasediments. Map Ref. 906765)

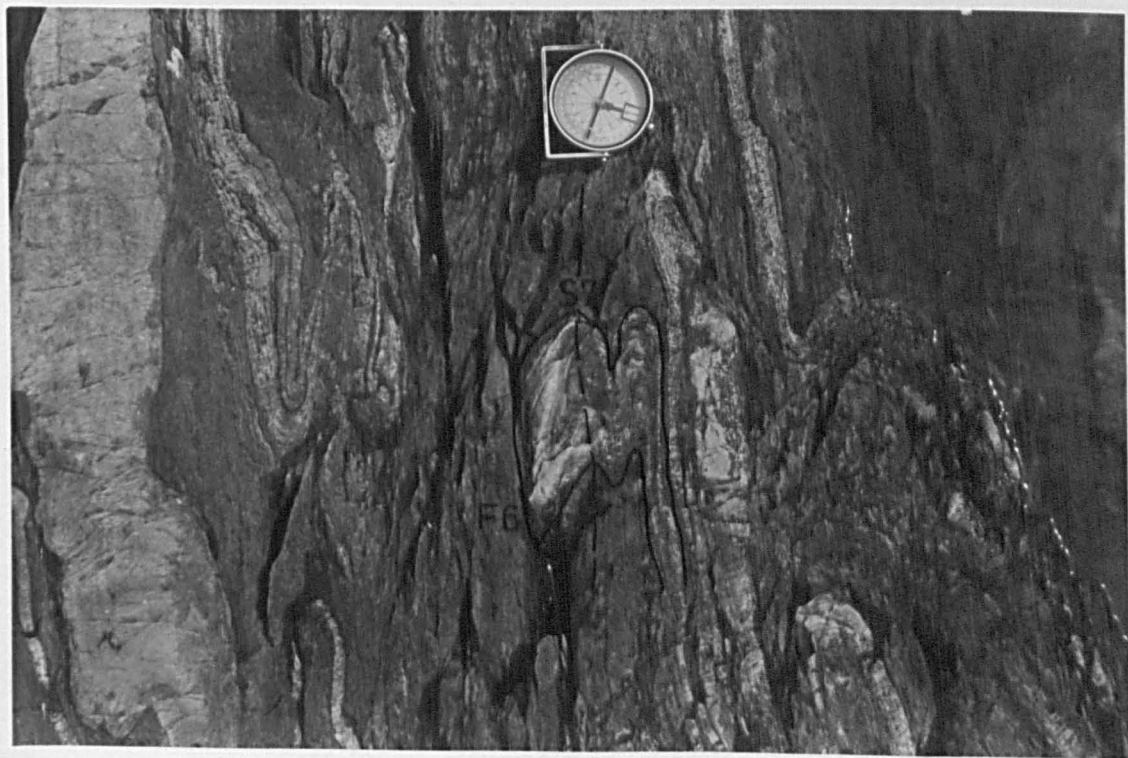
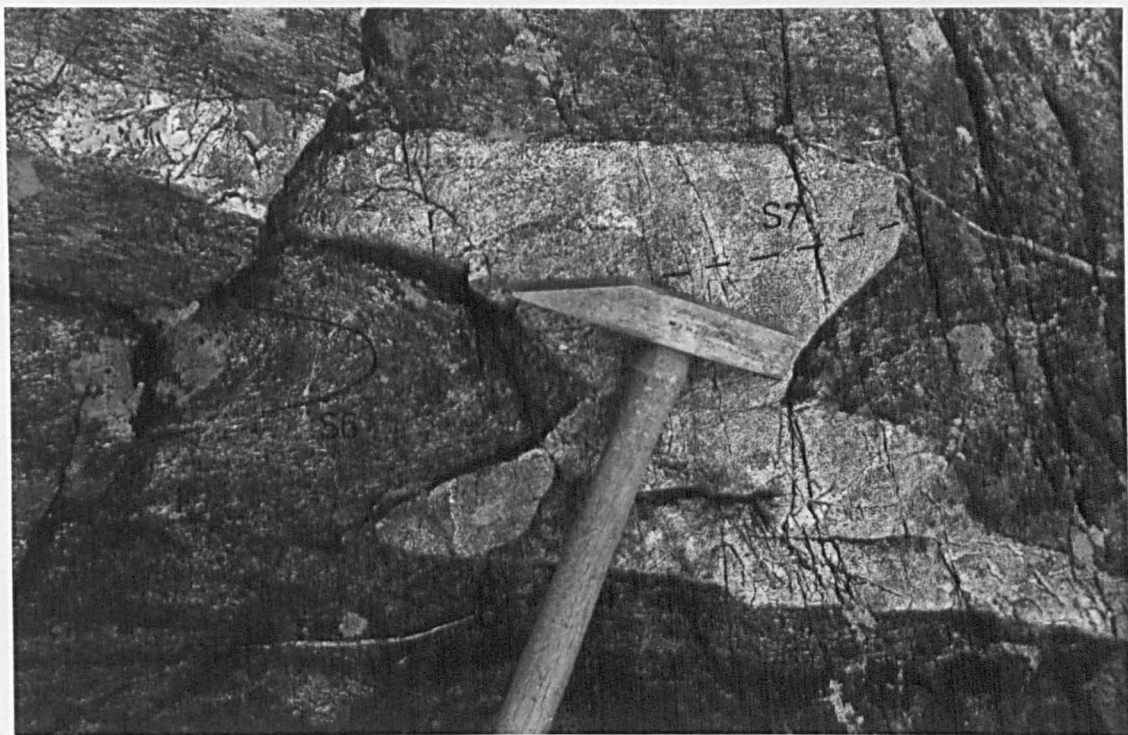


PLATE VI.15.

F6 chevron folds in the Beinn Airigh Charr basite have been refolded in F7; smaller scale F8 folds are developed on the F7 fold limb opposite to the hammer position.

(Beinn Airigh Charr Area. Map Ref. 898764)



Figures

FIGURE IV 1.

DIAGRAMMATIC SECTION
ACROSS A DIFFERENTIATED
SECOND-PERIOD DYKE

[CREAG MHEALL BEAG AREA]



50m.



Chilled Margin Facies



Homogeneous Metabasite(Epidiorite)



Metabasite(Epidiorite) with Subhorizontal Layering



Metabasite(Epidiorite) with Folded Inhomogeneities



Metabasite(Epidiorite) with Layering Parallel to Dyke Margins

FIGURE IV 2.

SiO_2 : $\text{Na}_2\text{O} + \text{K}_2\text{O}$ Plots

- (+) - First-Period Dykes
- (o) - Second-Period Dyke Margins
- (•) - Second-Period Dyke Centres
- (⊕) - Second-Period Dykes of the Kernsary Area
- (□) - Third-Period Dyke Margins
- (■) - Third-Period Dyke Centres

The Tholeiitic and Alkali Basalt Fields of Tilley (1950) and the High Alumina Basalt Field of Kuno (1968) are illustrated.

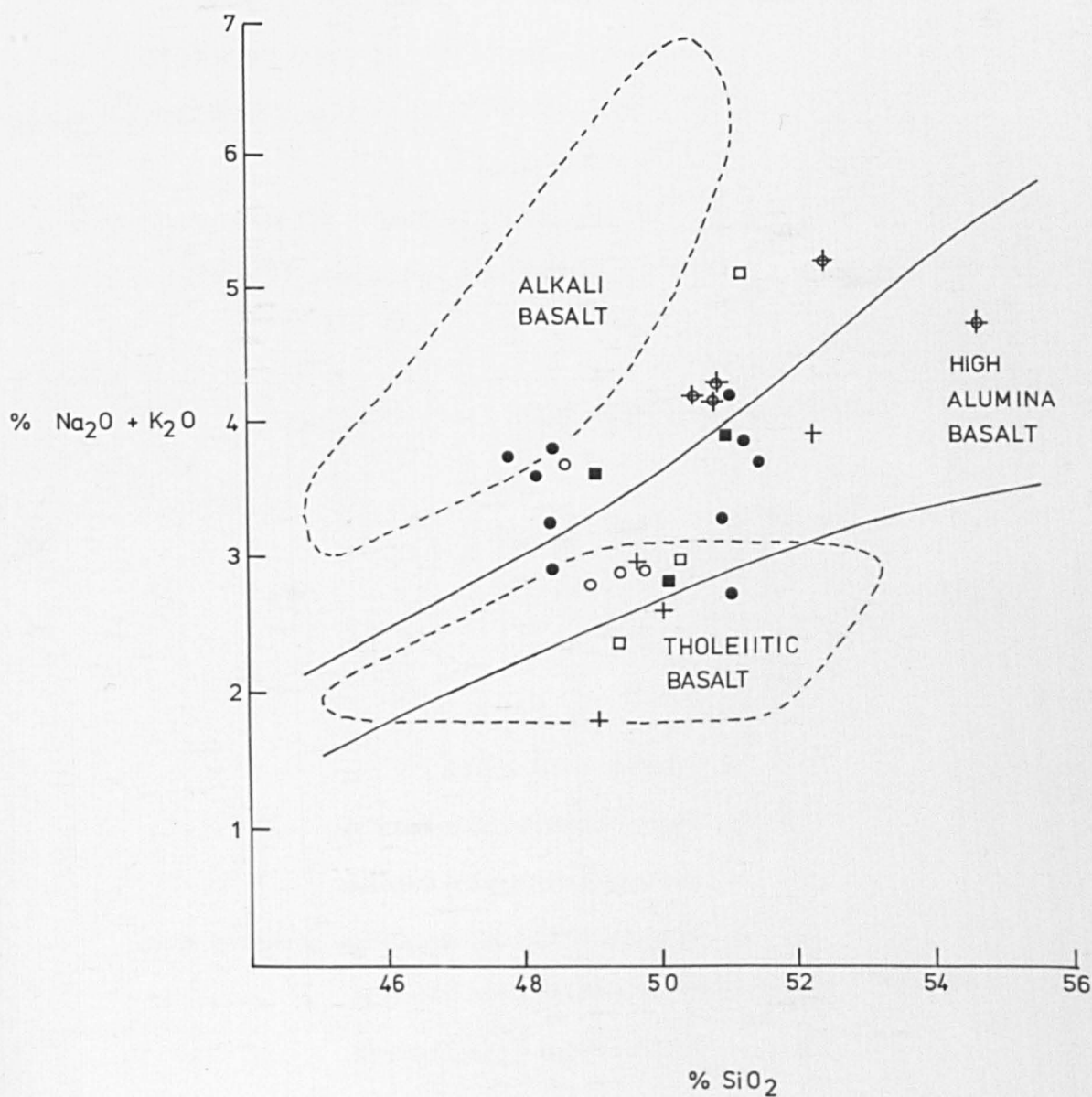


FIGURE IV 3.

(a) AFM Plots (Cation) : Total iron as Fe^{2+}

(b) AFM Plots (Oxide) : Total iron as FeO

- (1) Skaergaard trend {Wager & Deer (1939)}
- (2) Trend of Hawaiian olivine tholeiites {Yoder & Tilley (1962 - Fig.8)}
- (3) Karroo trend {Walker & Poldervaart (1949)}
- (4) Ilordleq trend {Watterson (1968a)}

(c) $\text{CaO} - \text{FeO} - \text{MgO}$ Plots

(d) $\text{Na}^+ - \text{K}^+ - \text{Ca}^{++}$ Plots

- (+) - First-Period Dykes
- (o) - Second-Period Dyke Margins
- (•) - Second-Period Dyke Centres
- (⊕) - Second-Period Dykes of the Kernsary Area
- (□) - Third-Period Dyke Margins
- (■) - Third-Period Dyke Centres

The approximate compositional fields of the three Dyke-Groups are indicated by Roman numerals.

Tie lines indicate samples from the same dyke.

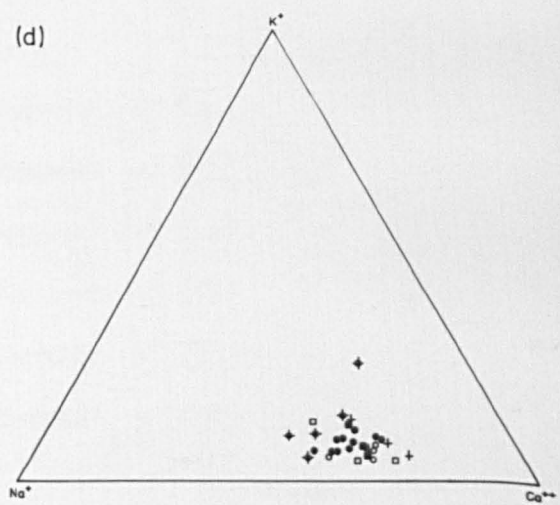
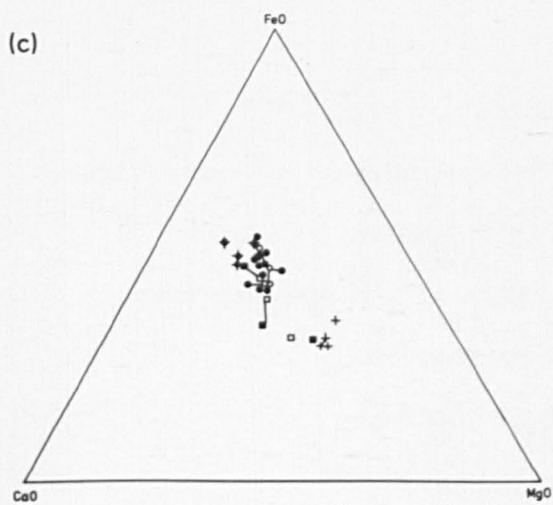
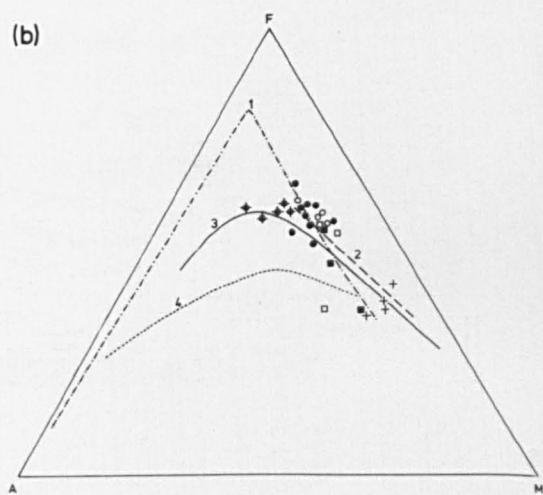
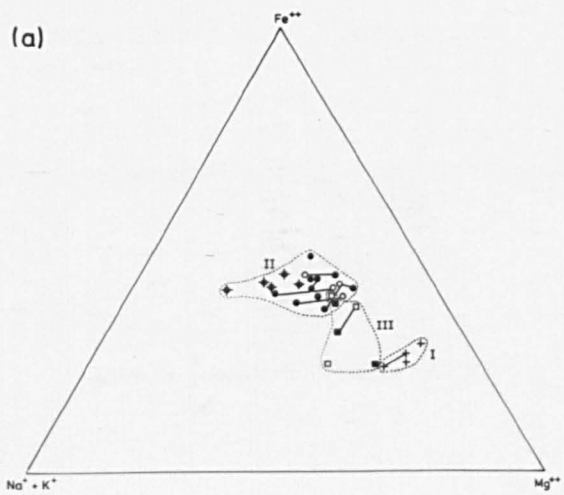


FIGURE IV 4.

(a) Mafic Index (Oxide) : SiO_2 Plots

- | | | |
|------------------------------|---|---------------------|
| (1) Skaergaard trend | } | After Osborn (1959) |
| (2) Average tholeiitic trend | | |

(b) Solidification Index : MgO Plots

(c) MgO : Alumina-Silica ratio Plots {After Watterson (1968a
Fig.31)}

(d) Felsic Index (Cation) : Mafic Index (Cation) Plots

- (+) - First-Period Dykes
- (o) - Second-Period Dyke Margins
- (●) - Second-Period Dyke Centres
- (⊕) - Second-Period Dykes of the Kernsary Area
- (□) - Third-Period Dyke Margins
- (■) - Third-Period Dyke Centres

The approximate compositional fields of the three Dyke-Groups are indicated by Roman numerals.

Karoo dolerite trends (Walker & Poldervaart, 1949) are also indicated.

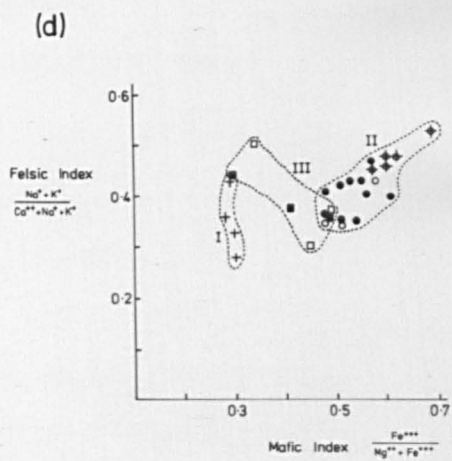
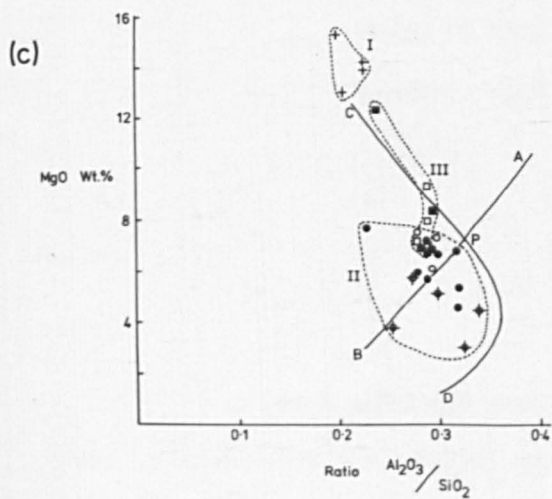
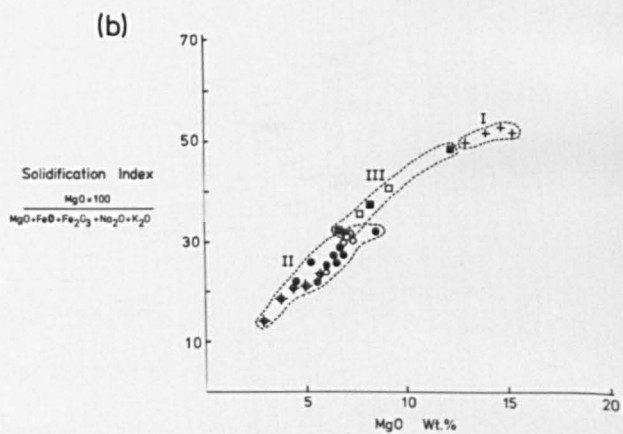
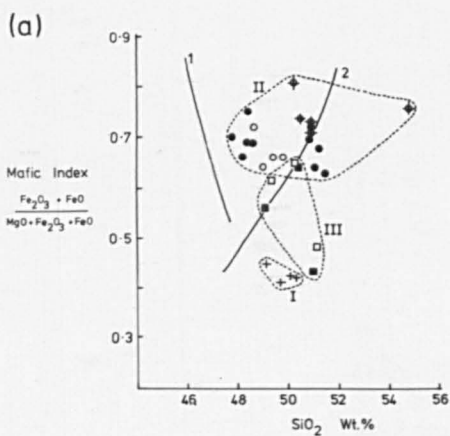


FIGURE IV 5.

(a) Plots of Niggli p, c, alk, k, and ti against Niggli mg.

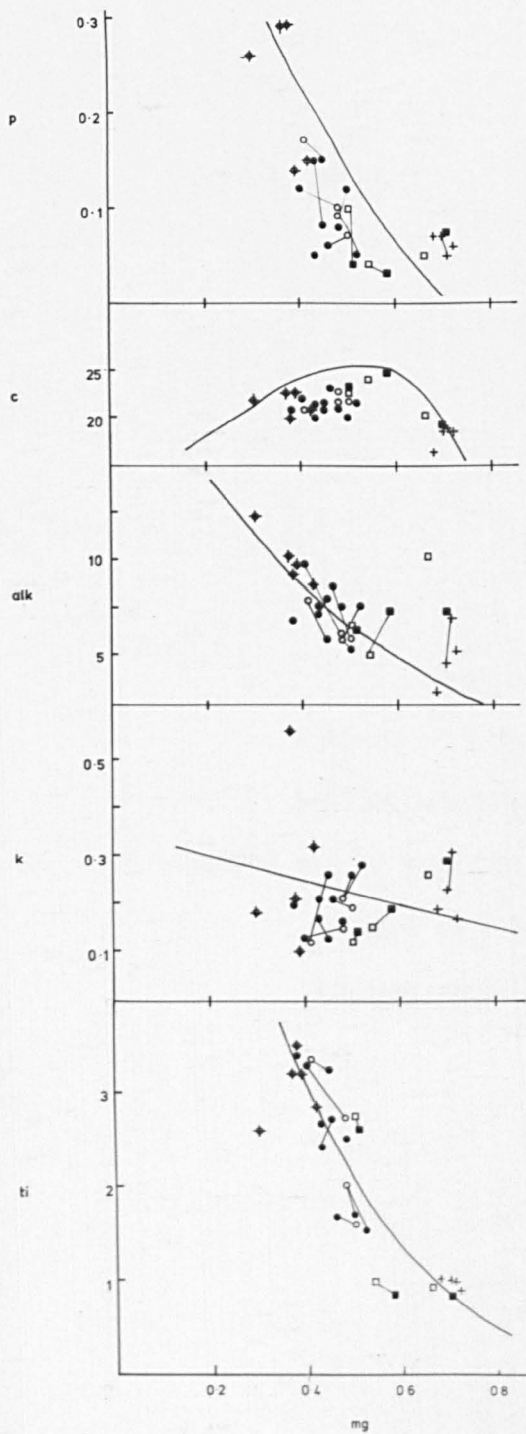
(b) Plots of Niggli fm, mg, ti, al, c, and alk against Niggli si.

- (+) - First-Period Dykes
- (o) - Second-Period Dyke Margins
- (●) - Second-Period Dyke Centres
- (⊕) - Second-Period Dykes of the Kernsary Area
- (□) - Third-Period Dyke Margins
- (■) - Third-Period Dyke Centres

Tie lines indicate samples from the same dyke.

Curves indicate Karroo trends (Walker and Poldervaart, 1949)

(a)



(b)

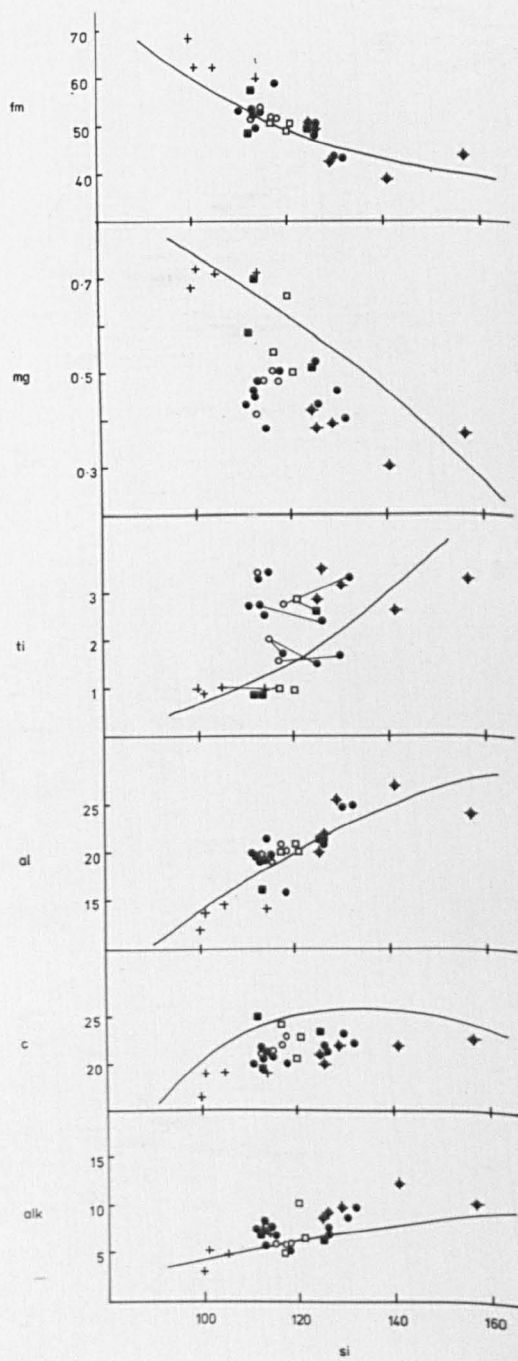


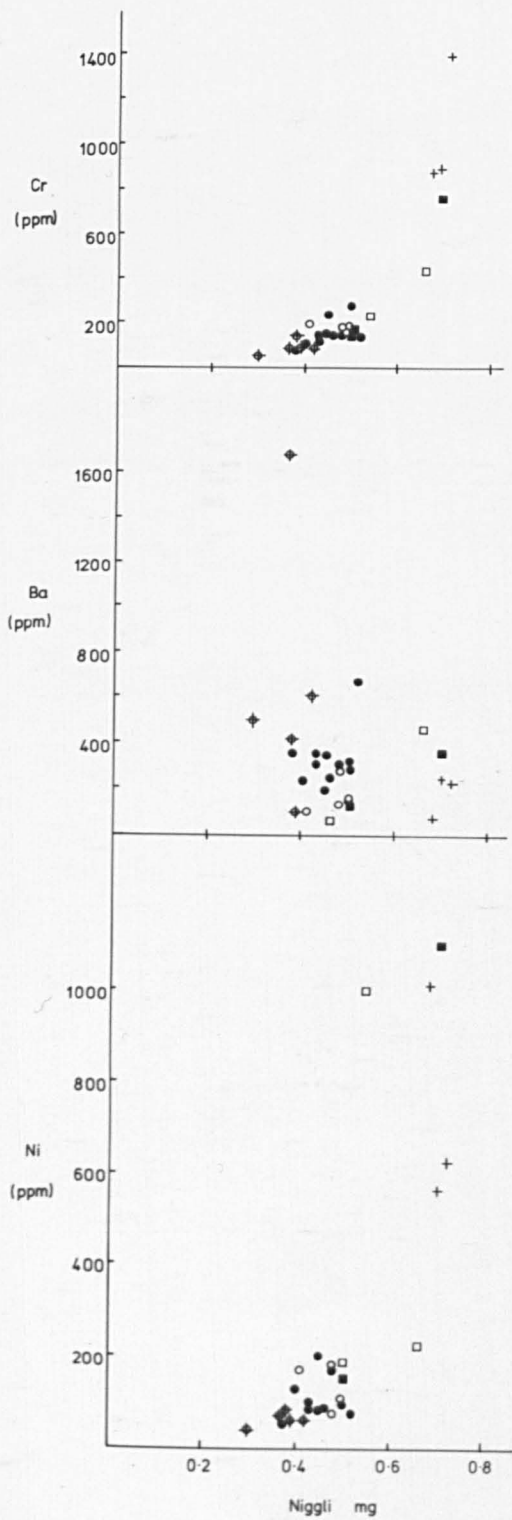
FIGURE IV 6.

(a) Plots of Cr, Ba, and Ni against Niggli mg.

(b) Plots of Cr, Ba, and Ni against Niggli ti.

- (+) - First-Period Dykes
- (○) - Second-Period Dyke Margins
- (●) - Second-Period Dyke Centres
- (⊕) - Second-Period Dykes of the Kernsary Area
- (□) - Third-Period Dyke Margins
- (■) - Third-Period Dyke Centres

(a)



(b)

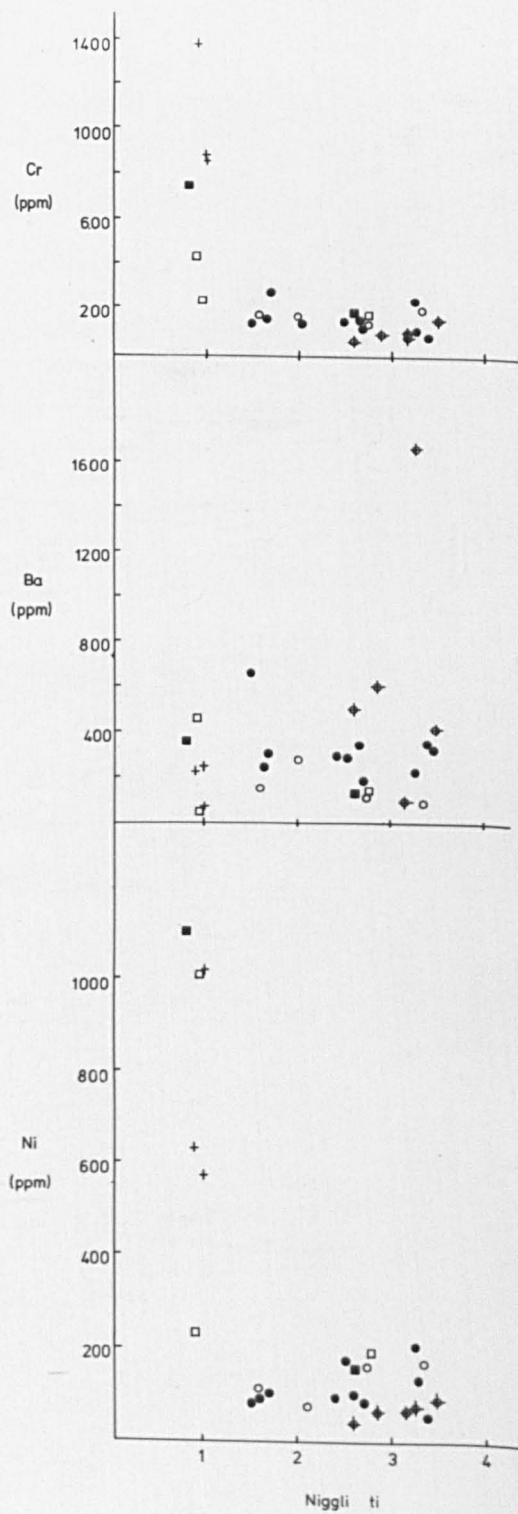


FIGURE VI 1.

A - H Sketches of Dyke-Gneiss Relationships.

In these illustrations the foliation in the dykes (fine line ornament) is distinguished from foliation in the gneisses (heavy line ornament).

A third planar structure defined by prominent gneissose banding (dotted lines) and the outcrop of early basic rocks (stippled) is also shown.

A - E ; examples from the Creag Mheall Beag Area.

F, G ; examples from the Kernsary Area.

H ; an example from the Poolewe Area.

SKETCHES OF DYKE-GNEISS RELATIONSHIPS

NORTH
↑

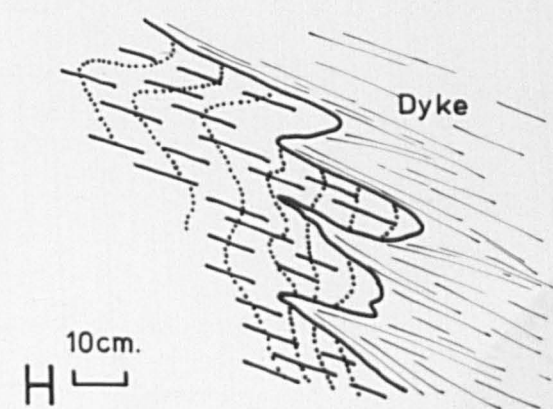
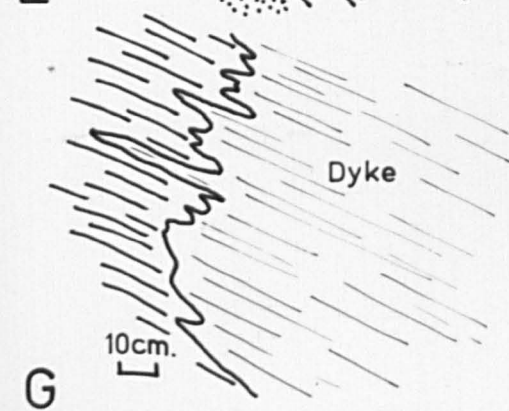
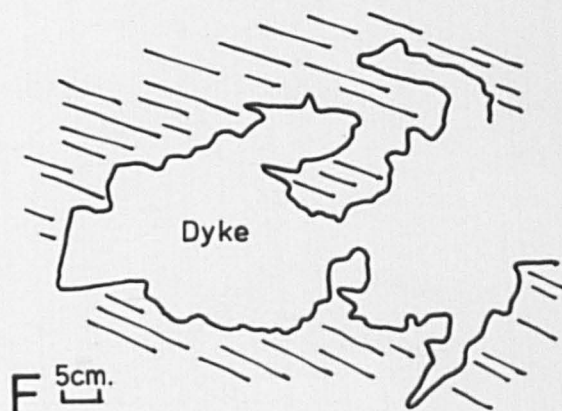
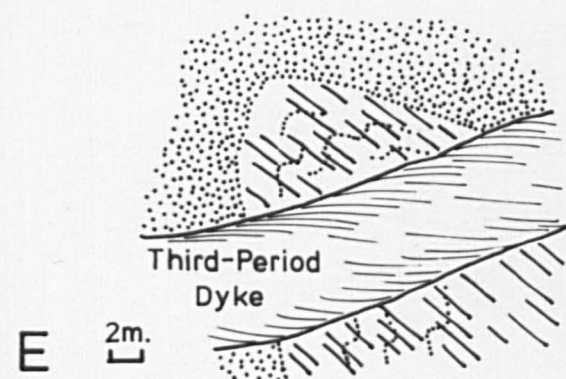
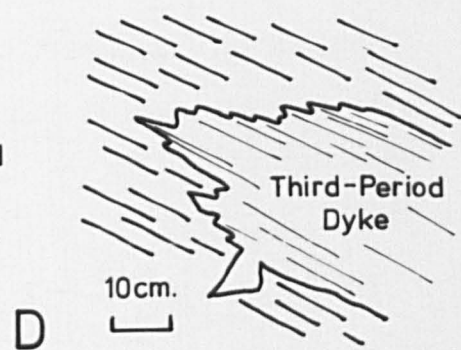
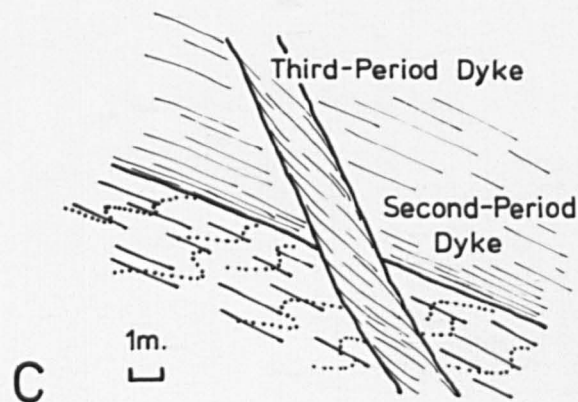
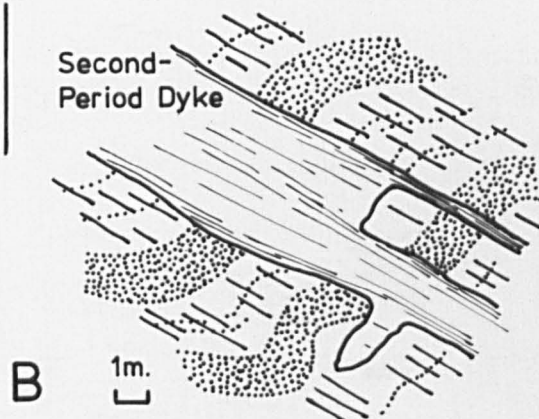
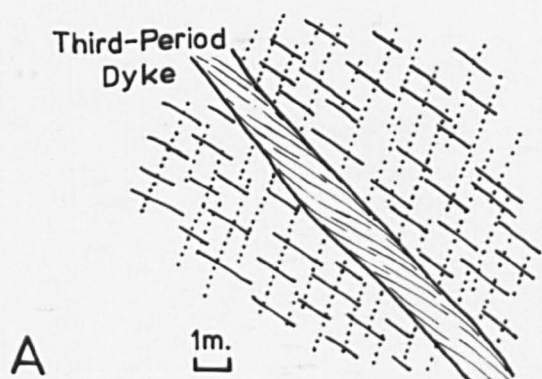
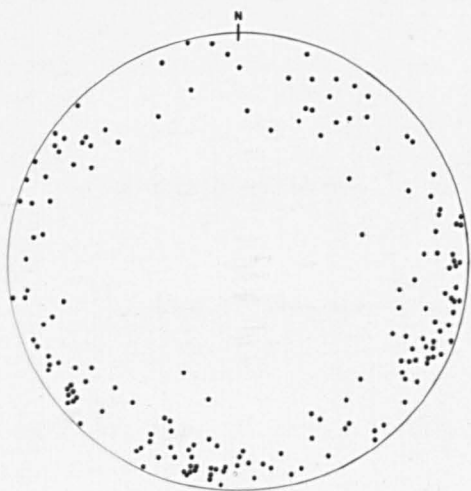


FIGURE VI 2.

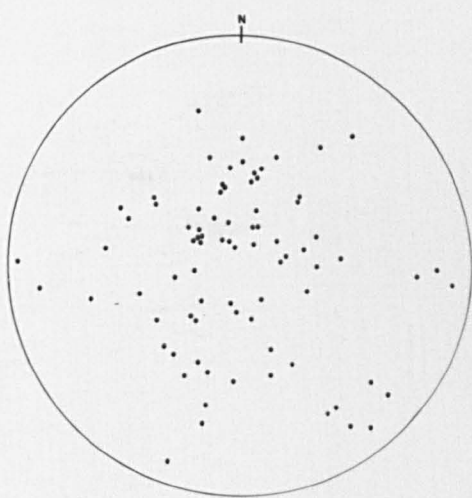
Pre-dyke structures in the Creag Mheall Beag Area

- (a) 175 plots of poles to S3
- (b) 78 plots of F3 axes
- (c) 99, L5-lineation plots (dots) and 102 plots of poles to S5 (crosses)

(a)



(b)



(c)

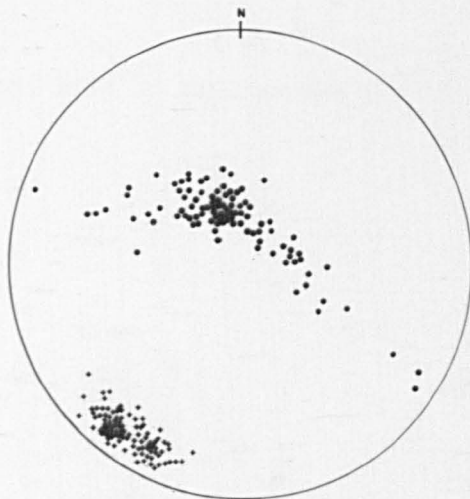


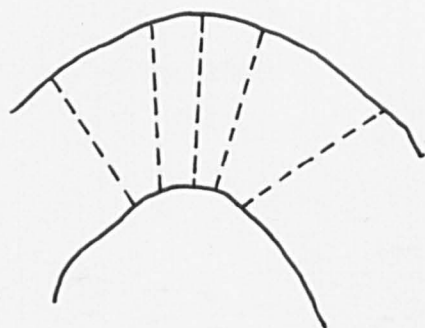
FIGURE VI 3a-c.

Geometry of folded layers in Pre-Dyke structures in the Creag
Mheall Beag Area

- (a) F₃-folded Early Basite : Geometry Class 1A
- (b) F₅-folded Early Basite : Geometry Class 1C
- (c) Complex geometry of folded layers in acid gneisses

(All drawn from photographs of fold profiles)

(a)



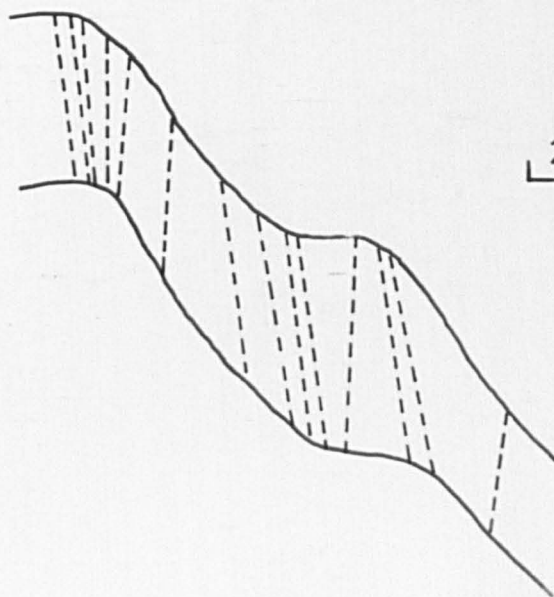
20cm.

(b)



50cm.

(c)



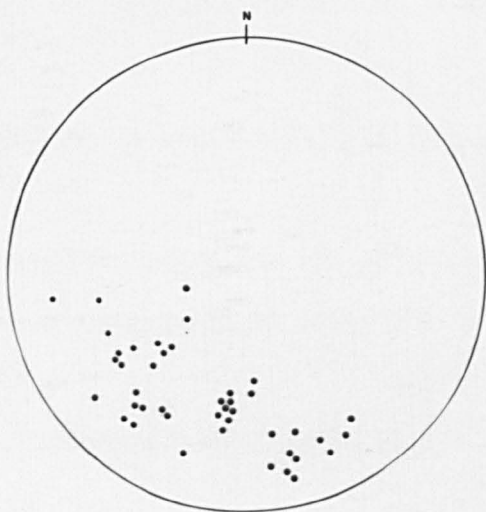
20cm.

FIGURE VI 4.

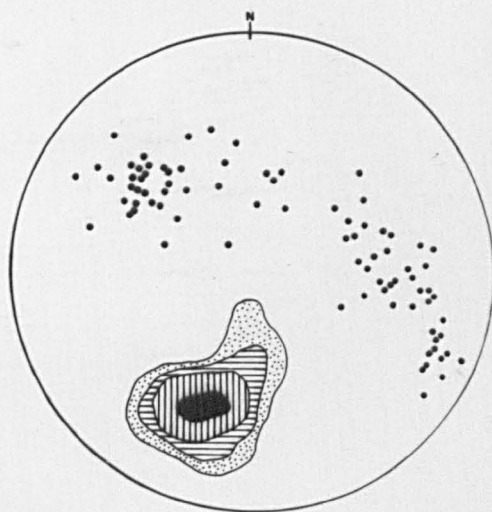
Pre-dyke structures in the Kernsary Area

- (a) 43 plots of poles to S3
- (b) 83, L5-lineation plots (dots) and contoured plot of
86 poles to S5 (contours at 2%, 5%, 10% and 20%)
- (c) 40 plots of F3 axes

(a)



(b)



(c)

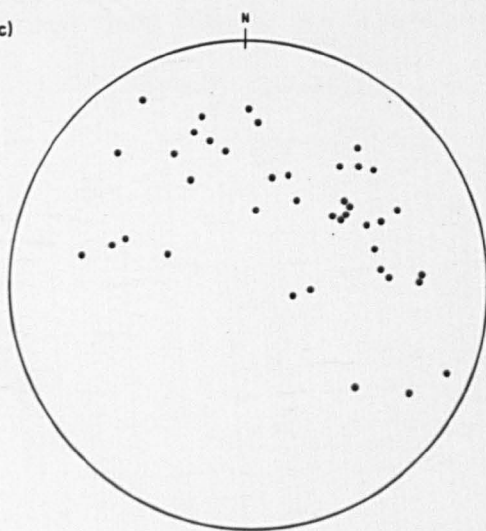
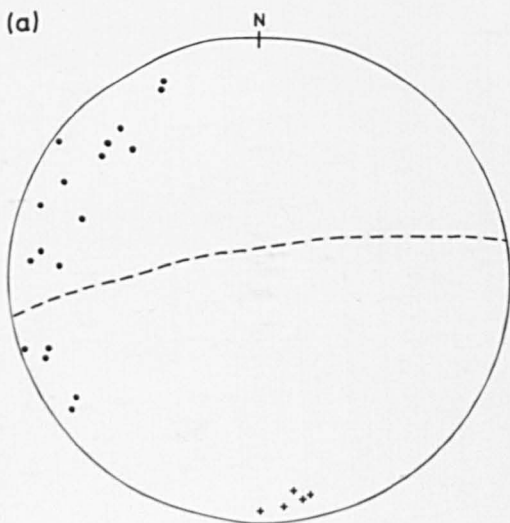


FIGURE VI 5.

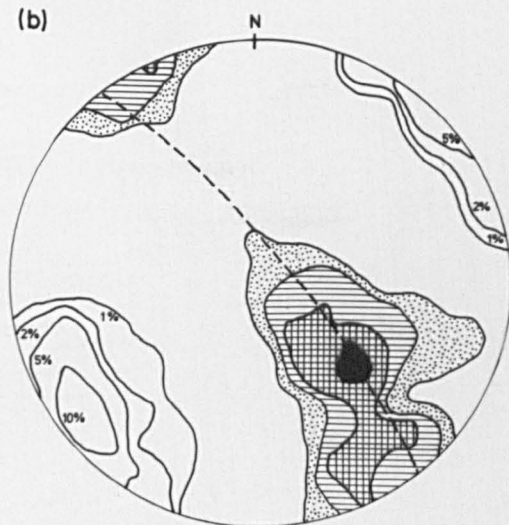
Pre-dyke and post-dyke structures in the Poolewe Area

- (a) Plots of 18 poles to S3 (dots) and poles to S4 (crosses)
- (b) Contoured plots of poles to S5A and L5A-lineations:-
 - unshaded plot of 163 poles to S5A (contours at 1%, 2%, 5% and 10%);
 - shaded plot of 142 L5A-lineations (contours labelled)
- (c) Planar and linear structures in the dykes:-
 - 78 poles to foliation (dots) and 57 lineation plots (crosses)

(a)



(b)



(c)

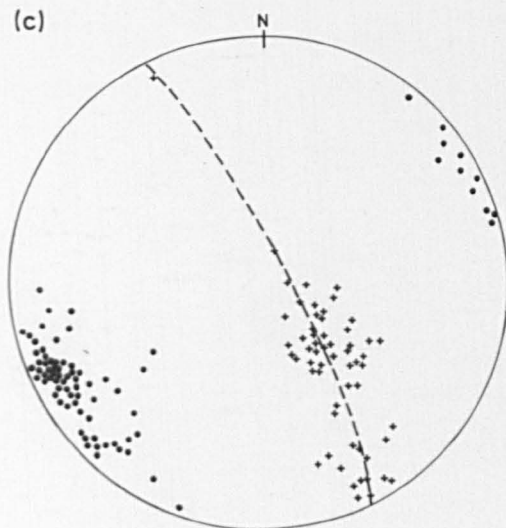


FIGURE VI 6.

Dihedral angles between dyke margins and internal S6 foliation

Open circles: - Poles to dyke margins

Arrow tips: - Poles to internal foliation

(All readings from the Creag Mheall Beag Area)

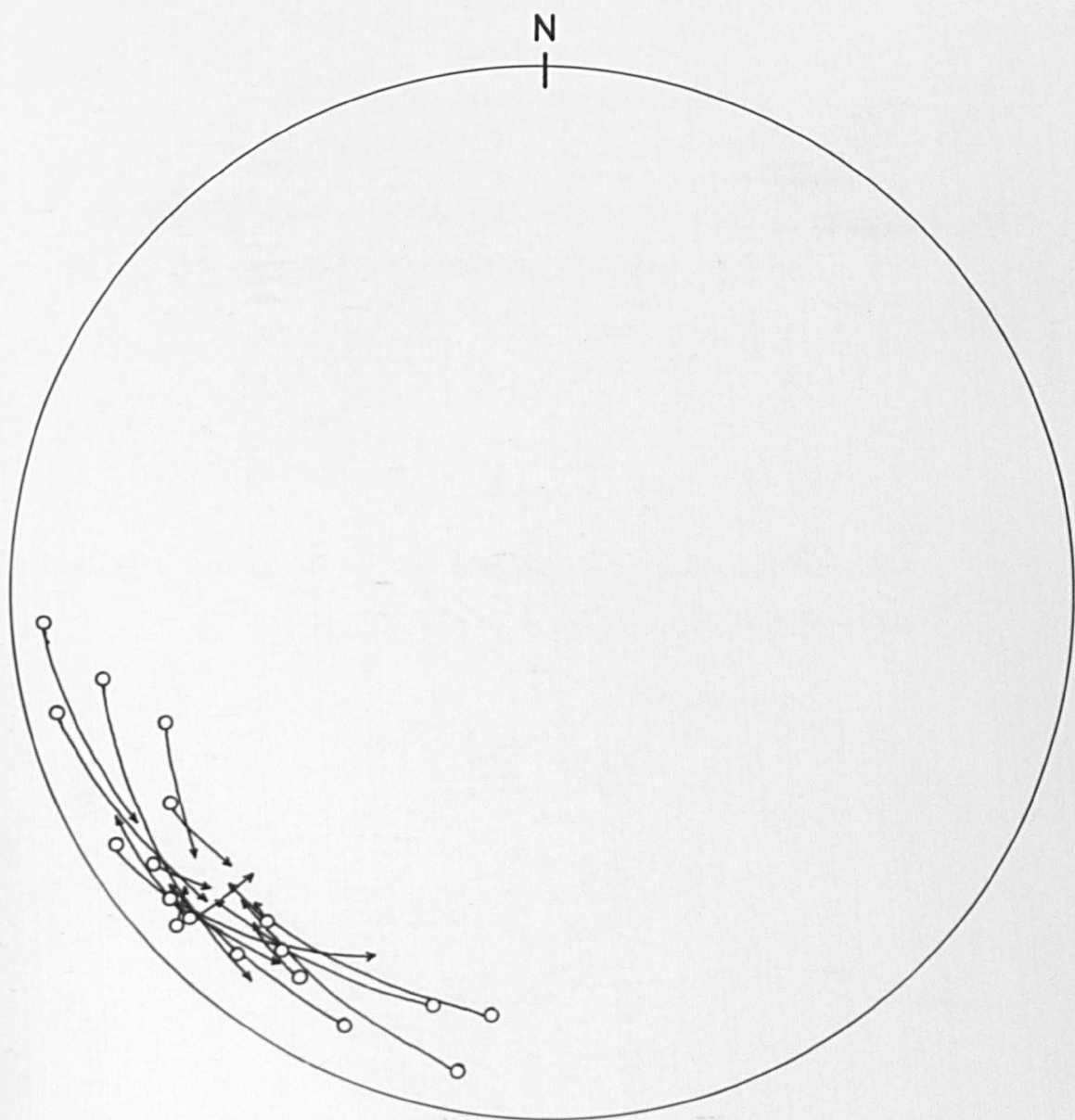
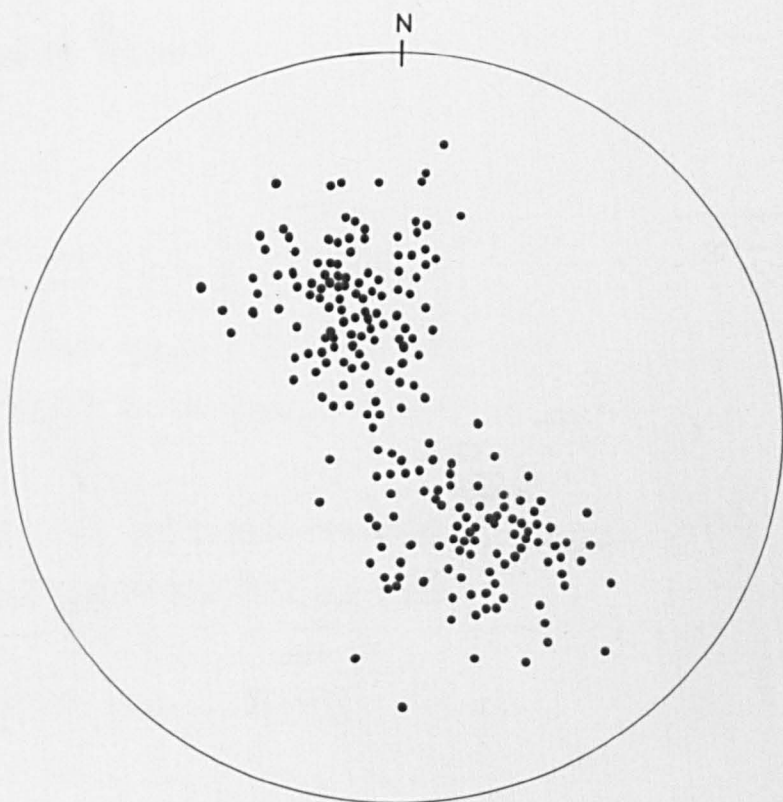


FIGURE VI 7.

- (a) 213 F7 and F8 fold axis plots
- (b) Contoured plot of 609 poles to foliation (S6 and transposed S5); contours at 0.5%, 1%, 2%, 3%, 4% and 5%.

All readings obtained in the area of Map 5B (Inset Area in the Beinn Airigh Charr Area).

(a)



(b)

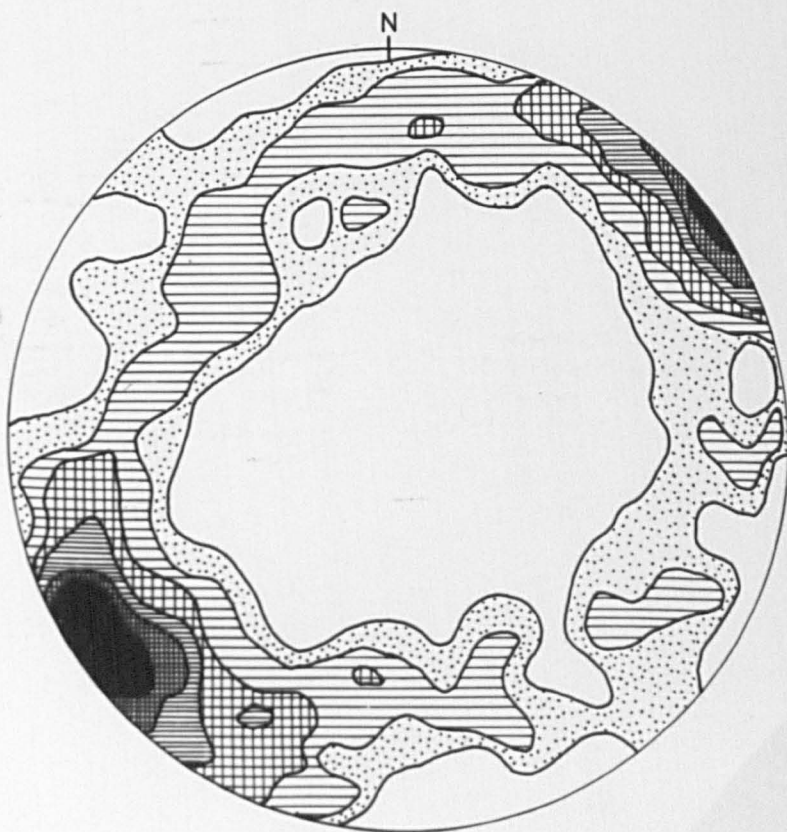
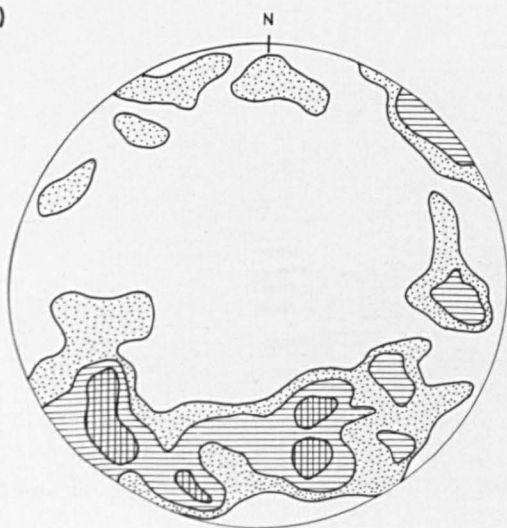


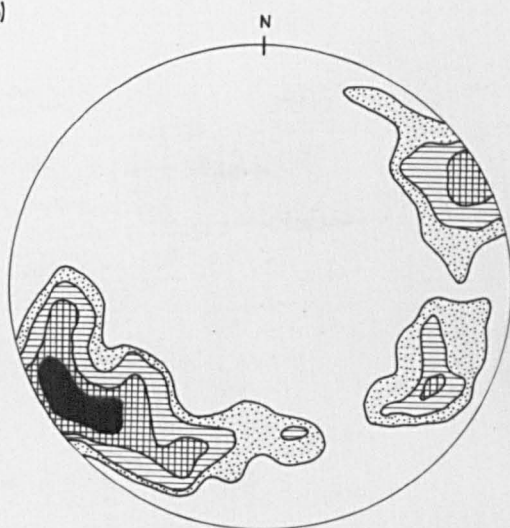
FIGURE VI 8.

- (a) Contoured plot of 104 poles to foliation (Sub-area 1, Map 5B); contours at 1%, 2% and 4%.
- (b) Contoured plot of 144 poles to foliation (Sub-area 2, Map 5B); contours at 1%, 2%, 4% and 6%.
- (c) Contoured plot of 361 poles to foliation (Sub-area 3, Map 5B); contours at 0.5%, 1%, 2%, 4% and 6%.

(a)



(b)



(c)

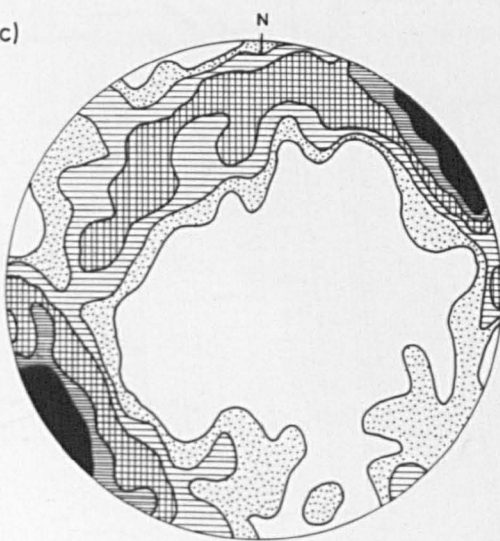
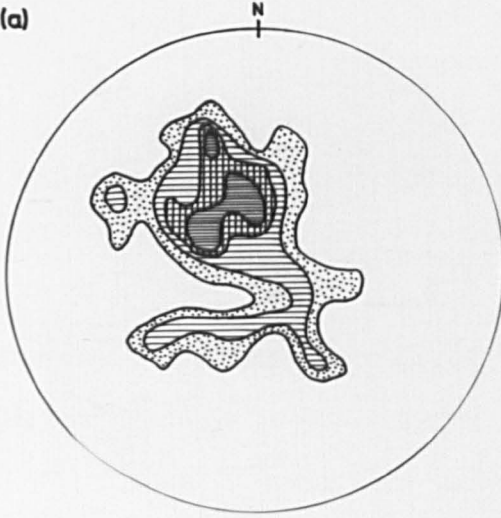


FIGURE VI 9.

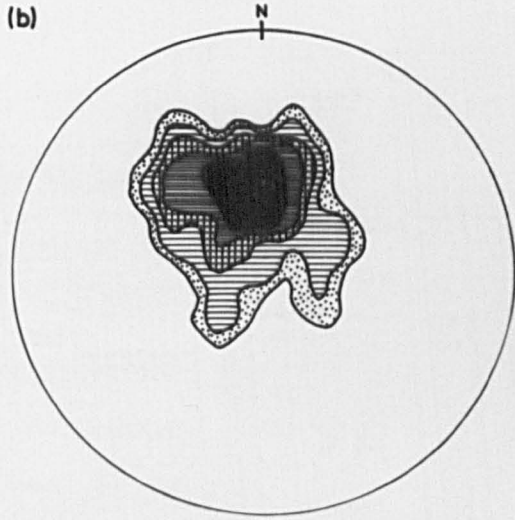
Refolded L5-lineations in the Beinn Airigh Charr Area
(Inset Map 5B)

- (a) Contoured plot of 76 measurements; contours at 1%, 2%, 4% and 6% (Sub-Area 1)
- (b) Contoured plot of 116 measurements; contours at 1%, 2%, 4%, 6% and 10% (Sub-Area 2)
- (c) Contoured plot of 269 measurements; contours at 1%, 2%, 4%, 6% and 8% (Sub-Area 3)

(a)



(b)



(c)

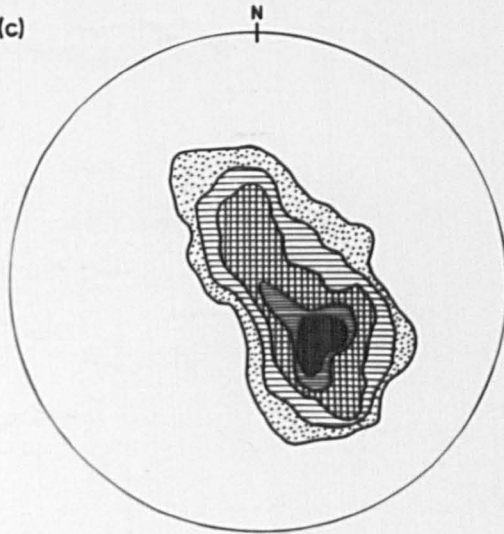


FIGURE VI 10.

Stereographic plots of Post-Dyke structures in the Beinn Airigh Charr Area.

- (a) Contoured plot of 235 poles to foliation; contours at 1%, 2%, 3%, 4% and 5%.
- (b) Contoured plot of 137 lineations (quartzo-feldspathic rodding and hornblende lineation); contours at 1.5%, 3%, 6%, 10%, and 15%.
- (c) Contoured plot of 124 F7 and F8 fold axis measurements; contours at 1%, 3%, 6% and 10%.

(Readings obtained in the Inset Area, Map 5B, are not reproduced here.)

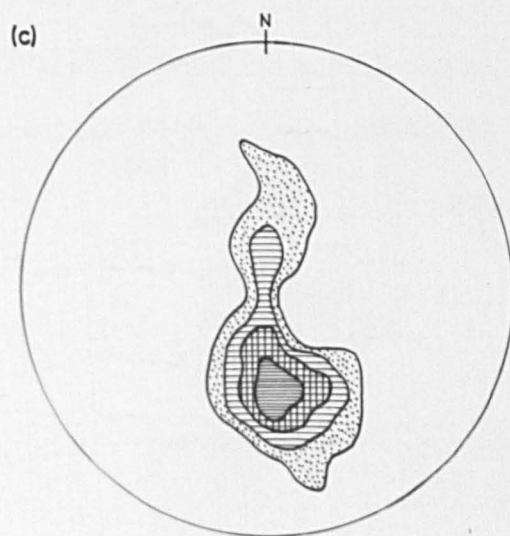
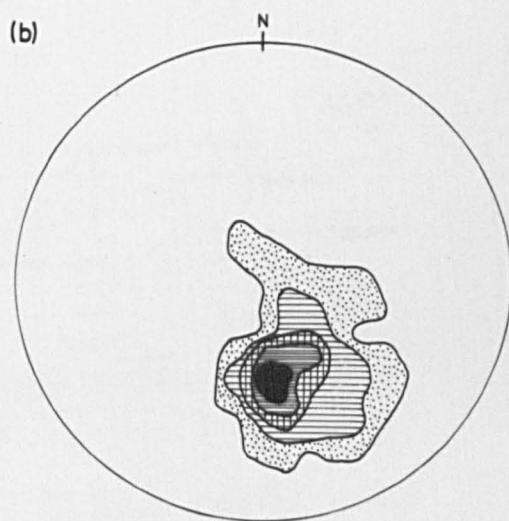
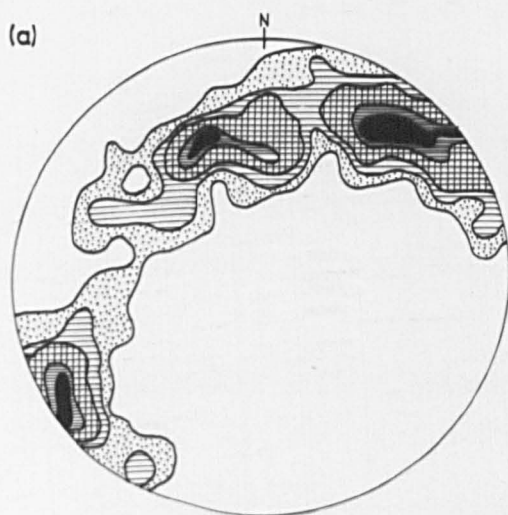


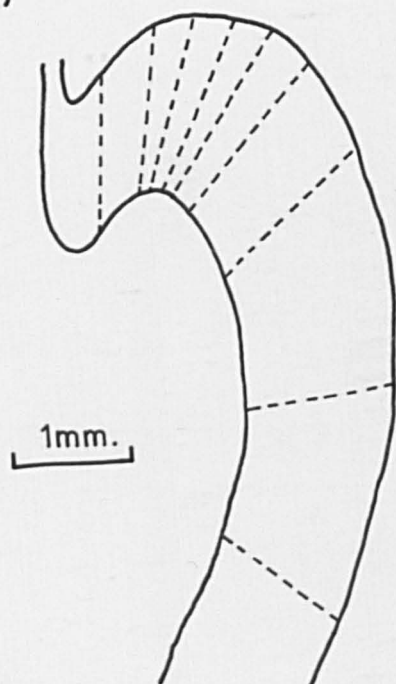
FIGURE VI 11a-d.

10 - fold profiles illustrating constructed dip-isogons

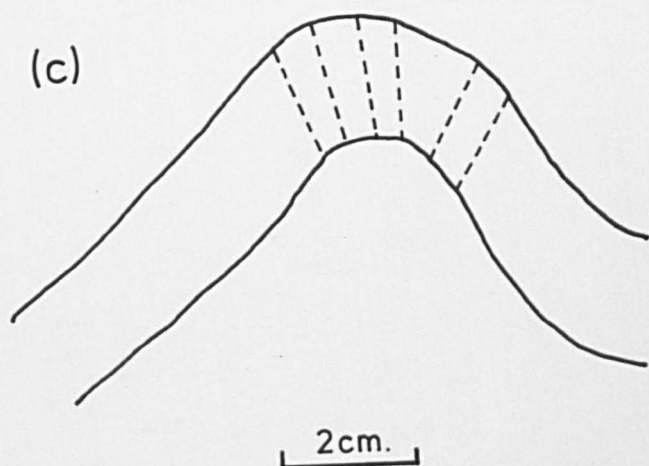
- (a) Folded layer in calcareous schists : Geometry Class 1C,
but complicated by original variation in layer thickness
so that lowest part of diagram has Class 1A geometry.
- (b) Folded layer in calcareous schists : Geometry Class 1C.
- (c) Folded layer in acid gneiss : Geometry Class 1C.
(Beinn Airigh Charr Area)
- (d) Folded layers in Beinn Airigh Charr Basites :
Combination of Class 1C and Class 3 geometry.

(a and b traced from thin section; c from hand specimen, d from a
photograph)

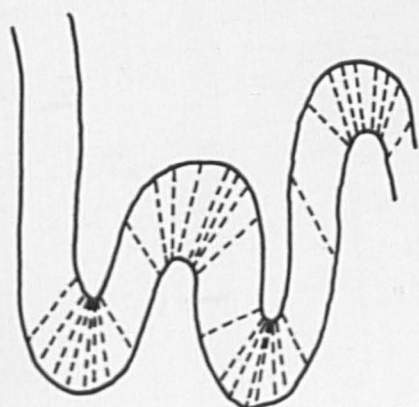
(a)



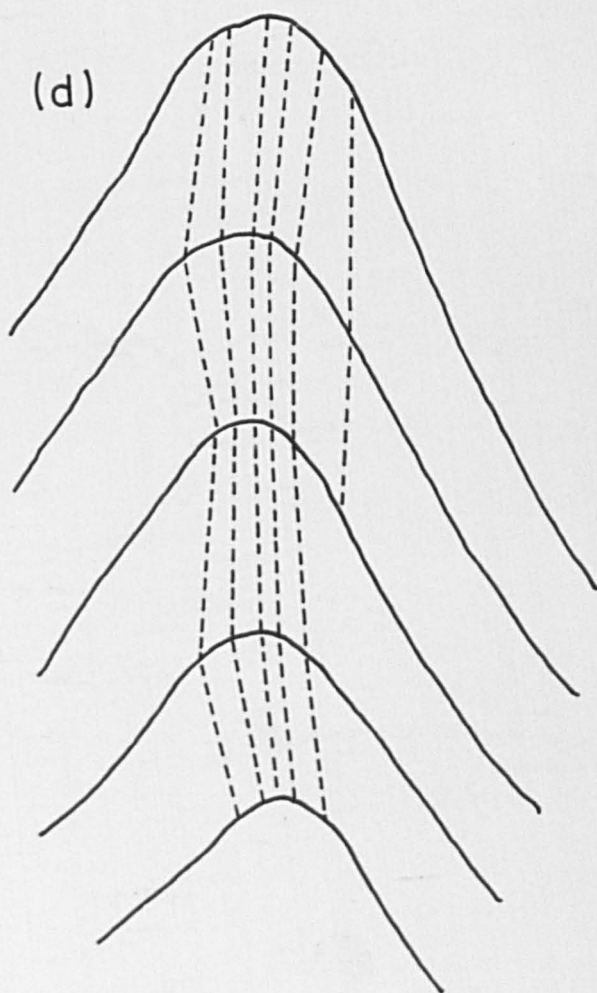
(c)



(b)



(d)



GEOLOGICAL MAP OF THE LEWISIAN ROCKS
NEAR POOLEWE ROSS-SHIRE

