INVESTIGATION REPORT 129

A SURVEY OF MAGNETIC PROPERTIES OF SOME ROCKS FROM NORTHWESTERN AUSTRALIA

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SUMMARY

Directions and intensities of the natural remanent magnetisation and magnetic susceptibilities have been measured in rock samples from the Banded Iron Formations of the Mount Bruce Supergroup, and Kylena, Mt Jope and Woongarra igneous sequences. Results have also been obtained from the Lower Proterozoic Cooya Pooya Dolerite, the igneous complex at Dampier, intrusions into the Joffre Member of the Brockman Iron Formation, two dykes intruding the Rocklea Dome and the igneous complex (Kukabubba) in the Nabberu Basin. Oriented core sections of banded iron formations from holes 47A and 51 supplied by the Geological Survey of Western Australia were also studied. The stability of remanent magnetisation has been tested using standard techniques of alternating field (AF) and thermal demagnetisation. Although stable components can be isolated, post-tilting components remain evident.

EXPLANATION OF SYMBOLS AND TABLE HEADINGS

Site: describes an area (usually a single rock outcrop) over which magnetic parameters are averaged.

N: number of units (specimens) averaged to obtain a site-mean value

Dec: declination measured easterly, 0-360°

Inc: inclination measured upward negative and downward positive. In the stereographic plots (Appendix 3) upward pointing directions are plotted as open symbols and downward pointing directions as closed symbols.

Int: intensity of remanent magnetisation, units in $10^{-3}Am^{-1}$
($\equiv 10^{-6}$ Gauss $\equiv 10^{-6}$ emu cm^{-3})
A range is given when SD > $\overline{Int}$

S.D.: standard deviation

χ: magnetic susceptibility normalized to specimen volumes
A range is given when SD > $\overline{\chi}$
An average value denotes measurement of a 100 mm length of 25 mm dia. core using a Bison susceptibility bridge.

k: estimate of the precision parameter (kappa) and indicates the degree of dispersion within a population of directions - following Fisher[1]

R: resultant vector obtained by averaging N unit vectors. The significance points for R (at 95% and 99% confidence levels) as given in Watson[2], Vincenz and Bruckshaw[3] and Irving[4]

1. INTRODUCTION

Measurements of the magnetic properties intensity of remanent (permanent) magnetisation, direction of the remanence, and magnetic susceptibility have been carried out in a preliminary survey of the palaeomagnetism and rock magnetism of rocks from northwestern Australia. The stability of the remanent magnetisation has also been tested using alternating field and thermal demagnetisation techniques. For a description of these techniques and a general outline of the palaeomagnetic method see works by Irving[4], Collinson *et al.*[5] and McElhinny[6].

The rock collection, initiated by B.J.J. Embleton and W.A. Robertson in 1975 and extended by W.A. Robertson in 1976, covers igneous horizons and banded iron formations within the Mount Bruce Supergroup, igneous intrusions into it, two dykes which crop out in the Rocklea Dome and an igneous complex (Kukabubba) intruding the Proterozoic of the Nabberu Basin. The area covered by sampling is shown in Fig. 1.

As well as providing basic information about the magnetic properties of rocks in this region, this study is part of our research programme directed at understanding the spatial relationships and evolution of the crustal nuclei which comprise the main Australian platform. Results published to date from the northwestern region have been obtained by Porath[1] and Porath and Chamalaun[8] from the Mount Tom Price, Mount Newman and Mount Goldsworthy iron ore deposits and by Embleton[9] from the NNE trending Black Range Dolerite and the Cajuput Dyke.

The data obtained from these initial studies have revealed that the Pilbara block has been contiguous with the Yilgarn block to the south since at least about 2400 million years ago[9]. This provides an important constraint on tectonic models which may be applied to the formation of rocks and structures within these regions.

2. TECHNIQUE CONVENTIONS

In almost all cases, samples (blocks and field-drilled cores) were oriented using both sun and magnetic compasses. This practice is essential, whilst collecting strongly magnetic rocks, for obtaining true north azimuths. Bedding plane attitudes (given in Appendix 1) have been measured by reading

strike towards the right-hand and the dip, down towards the observer e.g. 135°, 45C° indicates strike at 135° and dip = 45° to the southwest ('C' indicates that dip measured in a direction 90° 'clockwise' from the strike direction).

3. NOTES ON THE RESULTS

Sampling details, measurement of magnetic parameters and plotted directions of magnetisation are contained in Appendixes 1-3. The directions of the present magnetic field (crossed diamond) and the dipole field (open diamond) are shown in the figures in Appendix 3.

The Kylena Basalt: well-grouped natural remanent magnetisation (NRM) directions. Magnetisation directionally stable to alternating field (AF) treatment.

Mount Jope Volcanics: although the magnetisation is directionally stable to AF and thermal demagnetisation, post tilting components are still evident.

Dales Gorge Member, Brockman Iron Formation: generally strongly magnetic. The specimens with lower intensities ($< 1\ Am^{-1}$) consistently clean (AF) to shallow inclinations in the northwest quadrant of the stereogram.

Brockman Iron Formation, Wittenoom Gorge: NRM results indicate consistent northwesterly directed components.

Brockman Iron Formation, Joffre Gorge: NRM directions are westerly.

Brockman Iron Formation, drill core from holes 47A and 51: a significant improvement in the grouping of the directions has been achieved with AF treatment yielding predominantly shallow inclinations to the northwest.

Woongarra Volcanics: structural unfolding at the two sites in these volcanics has failed to improve the directional grouping even after AF and thermal demagnetisation indicating post-tilting components are present.

The Boolgeeda Iron Formation: post-tilting components of magnetisation are

Igneous Complex (Kukabubba), Nabberu Basin: scattered directions remain after AF treatment.

Joffre Intrusions, dyke and sill: AF cleaning reduces the scatter of directions. Resultant direction is oblique to directions measured in the banded iron formations.

Rocklea Dome Dykes: strongly magnetic dolerite with scattered NRM directions. Results after AF cleaning indicate that the two dykes have opposite polarities of magnetisation.

Cooya Pooya Dolerite: responds well to AF treatment though a stable end-point has not been reached. NRM directions are well-grouped in the northwest quadrant.

Igneous Complex, Dampier: NRM directions cluster about the present field direction. AF cleaning, carried out on 10 test specimens labelled 'pilot' in Fig. A3-13, improves the grouping after treatment at 10 mT (100 oersteds) but with further treatment the scatter progressively increases.

Further work is required to remove post-tilting components of magnetisation. This will be attempted by means of a more intensive study involving concentrated sampling within the individual units. Surface weathering is believed to contribute significantly to the post-tilting components since the banded iron formation drill core did not exhibit the same degree of stable secondary remanence. Weathering effects (e.g. chemical leaching and partial recrystallization) on samples collected from surface outcrop, have only been partially removed by the application of AF and thermal demagnetisation techniques: the weathering products, particularly in the banded iron formations are resistant to these standard cleaning procedures. Chemical leaching techniques are currently under development to investigate the problem.

4. ACKNOWLEDGEMENTS

The Geological Survey of Western Australia kindly supplied samples of drill-core from the type sections through the banded iron formations. We are also grateful, for field assistance during sampling, to Hamersley Exploration. Help with the laboratory work by H. Brown and D. Stait is acknowledged.

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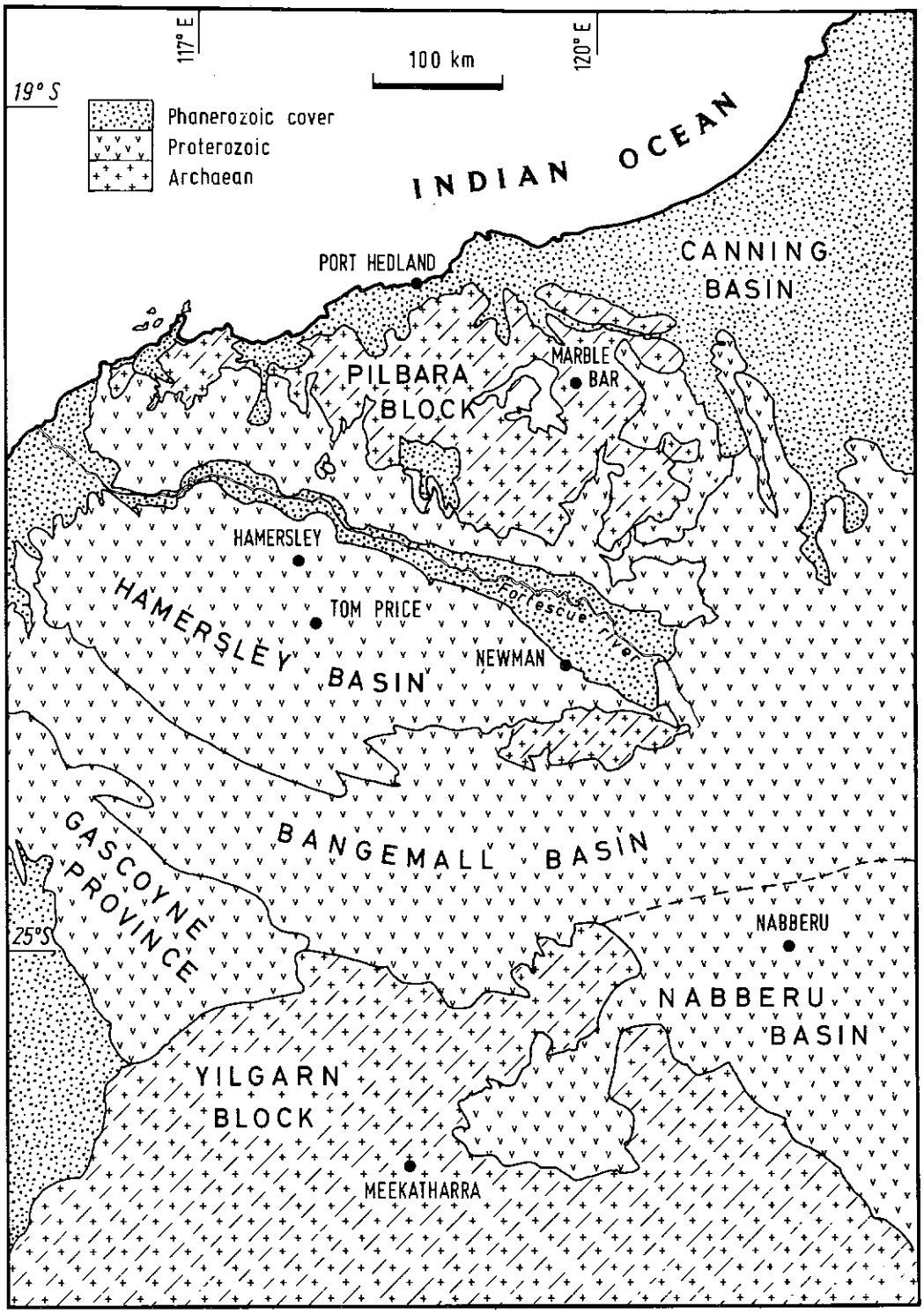


FIG. 1. PRINCIPAL TECTONIC PROVINCES OF NORTHWESTERN AUSTRALIA. SAMPLES COLLECTED FROM THE NABBERU BASIN, THE HAMERSLEY BASIN AND THE PILBARA BLOCK.

APPENDIX 1 : SAMPLING DETAILS

KYLENA BASALT

Site	Samples	Locality and map reference	Bedding	Notes
1	6	Roadcut on descent from Mt Herbert 21°19'S, 117°12'E	horizontal?	Amygdaloidal basalt (calcite). Flow has green tinge. All Samples from single flow, massive.

MOUNT JOPE VOLCANICS

Site	Samples	Locality and map reference	Bedding strike, dip	Notes
1	6	Roadcut 2 km WSW of Soda Well 22°56'S, 117°19'E	235°,30°C	Fine grained basalt with some pillows. Well-jointed, blasted roadcut.
2	6	16 km W of Mt Turner 22°41'S, 117°17'E	340°,15°C	Single flow in creek bed. Columnar structure and coarse needle (actinolite) patches.
3	5	14 km WSW of Mt Turner 22°44'S, 117°18'E	280°,48°C	Strike measured in overlying coarse sandstone. Samples from underlying even-grained basalt.
4	5	19 km WSW of Mt Turner 22°39'S, 117°15'E	290°,24°C	Fine-grained basalt overlain by bedded tuff.
5	6	Rail-cut 9 km NNW of Tom Price 22°37'S, 117°44'E	128°,17°C	Flow with vesicular top and massive base, overlain by bedded tuff.
6	6	Rail-cut 8 km NNW of Tom Price rail bend 22°38'S, 117°44'E	116°,13°C	Massive basalt, strike measured in tuff bands.

DALES GORGE MEMBER, BROCKMAN IRON FORMATION

Site	Samples	Locality and map reference	Bedding strike, dip	Notes
1	6	9 km WNW Mt Brockman 22°31'S, 117°13'E	78°-104°, 48°-71°C	Lower third of sequence sampled on N side of Brockman syncline.
2	3	12 km W Mt McRae, E side of track 22°17'S, 117°27'E	330°,22°C	Well bedded cliff section.
3	15	Dales Gorge. Creek off gorge between 400 and 500 feet contours 22°28'S, 118°34'E	Max. dip 5°	Highest level in Dales Gorge Member, covering 44 m.
4	2	Beazley River, about 1 km NE Cajuput Pool 22°52'S, 117°08'E	127°,41°C	Weathered lower Dales Gorge Member.

BROCKMAN IRON FORMATION, WITTENOOM GORGE

Site	Samples	Locality and map reference	Bedding strike, dip	Notes
1	6	East Creek off Wittenoom Gorge 22°18'S, 118°18'E	horizontal?	
2	2	200 m W of site 1, W slope of Gorge 22°18'S, 118°18'E	horizontal?	20 m higher in sequence than site 1.
3	2	22°18'S, 118°18'E	horizontal?	20 m higher than site 2.

BROCKMAN IRON FORMATION, JOFFRE GORGE

Site	Samples	Locality and map reference	Bedding	Notes
1	7	Joffre Falls 22°24'S, 118°14'E	horizontal?	Samples cover approx. 12 m sequence.

BROCKMAN IRON FORMATION DRILL CORE

A. Hole 47A at Wittenoom (Geological Survey of Western Australia) Joffre Member, Brockman Iron Formation.

Samples	Height above base of Joffre
2	48'
3	49'
3	50'

approx.

B. Hole 51 at Wittenoom (22°18'S, 118°17'E) (Geological Survey of Western Australia) Dales Gorge Member, Brockman Iron Formation.

Samples	Drilling depth (ft)	Approx. type section footage	Macroband
1	313.5	331	BIF 13
2	330.0	312	BIF 12
1	334.0	307	BIF 12
1	334.5		
1	335.0		
1	341.0	301	BIF 12
1	341.5		
1	397.0	249	BIF 10
1	397.5		

WOONGARRA VOLCANICS

Site	Samples	Locality and map reference	Bedding strike, dip	Notes
A	5	Beasley River, 1 km N of Cajuput Pool 22°52'S, 117°08'E	120,70 SW	Massive dacite.
B	5	Beasley River, 1 km N of Cajuput Pool, 100 m S of site A 22°52'S, 117°08'E	115,67 SW	Porphyritic dacite.

BOOLGEEDA IRON FORMATION

Site	Samples	Locality and map reference	Bedding strike, dip	Notes
1	5	N limb of Turner Syncline 22°41'S, 117°36'E	092°,30°C	Strongly banded haematite chert with many lenses. Forms cliff 10 m above creek. Samples within 1.5 m of cliff-top.
2	4	Cliff by creek, S side of Turner Syncline 22°43'S, 117°34'E	315°,70°C	Sampled near creek level.
3	3	W of highway, S limb of Turner Syncline	282°,76°C	Well-bedded and highly siliceous in places, bedding regular with few kinks.
4	3	Woongarra Pool, Beasley River 22°53'S, 117°07'E	125°,65°C	About 15 m stratigraphically above Woongarra volcanics.
5	3	Prominent rib near Beasley River track 22°54'S, 117°06'E	126°,62°C	About 80 m above site 5 and 8 m above shale band.

IGNEOUS COMPLEX (KUKABUBBA)

Site	Samples	Locality and map reference	Bedding strike, dip	Notes
A	5	Wiluna No. 2 bore 26°04'S, 121°26'E	144°,15°C	Medium grained, weakly foliated gabbro, lower sill.
B	6	Close to site A 26°04'S, 121°26'E	160°,23°C	Lower sill, medium grained, weakly foliated gabbro with xenolithic inclusion
C	6	2 km N of sites A, B 26°03'S, 121°25'E	165°,17°C	Upper sill, medium gabbro.
D	6	NE of Killara Homestead 26°17'S, 119°00'E	080°,30°C	Massive, jointed, even-grained dolerit
E	6	12 km E of site D 26°17'S, 119°10'E	069°,50°C	Massive, jointed, even, fine-grained dolerite.

JOFFRE INTRUSIONS

Site	Samples	Locality and map reference	Attitude (strike, dip)	Notes
1	6	22 km NE Mt Brockman Homestead 22°13'S, 117°28'E	vertical	The Joffre that this dyke intrudes is flat-lying. Width of dyke unknown due to confusion with sill.
2	8	1 km S of Mt Sheila 22°15'S, 117°35'E	(096°,7.5°C)	Dip from underlying Joffre. Medium-grained dolerite sill.

HAMERSLEY DYKES - ROCKLEA DOME

Site	Samples	Locality and map reference	Attitude	Notes
1	5	1 km NW of Sandy Creek Well 22°52'S, 117°22'E	vertical	Strongly magnetic dyke. 18 m wide. Strikes 307°.
2	6	1 km NW of Sandy Creek Well 22°52'S, 117°22'E	vertical	Even-grained dolerite dyke, 16 m wide. Strikes 288°. Cut and offset by site 1 dyke. Strongly magnetic.

COOYA-POOYA DOLERITE

Site	Samples	Locality and map reference	Bedding	Notes
1	6	SW of Hwy between Mt Herbert and Python Pool 22°18'S, 117°14'E	No correction. horizontal?	Even medium-grained dolerite, green/grey on fresh surfaces, red/brown weathered.

DAMPIER IGNEOUS INTRUSION

Site	Samples	Locality and map reference	Bedding	Notes
1	10	Roadcut 1.5 km SE railbridge near Dampier 20°41'S, 116°42'E	No correction.	Medium-fine grained granophyre with fine pink/grey mottled appearance. Vertical fracturing (jointing) prominent in 2 planes, SW and SE.

KYLENA BASALT

Site	Natural Remanent Magnetisation						A.F. Cleaned			
	N	Dec	Inc	Int ± S.D.	χ ± S.D.	k	R	N	Dec Inc	k	R
1	15	302	-59	1.65 ± 0.83	34.2 ± 6.4	5.7	12.58	6	316-53	25.4	5.80

MOUNT JOPE VOLCANICS

Site	Correction	Natural Remanent Magnetisation N	Dec Inc	Int ± S.D. mAm^{-1} ($x10^{-6}$ emu/cm^3)	χ ± S.D.	k	R	A.F. Cleaned N	Dec Inc	k	R	Thermally Cleaned N	Dec Inc	k	R
1	Field	13	310 -29	3.85 ± 1.43	82.0 ± 4.0	46.0	12.74	5	314 -18	102	4.96	6	311 -09	215	5.98
	Bedding	13	300 -56			48.2	12.75	5	309 -47	94.1	4.96	6	307 -38	234	5.98
2	Field	14	316 -54	4.14* ± 1.67	74.6 ± 20.0	12.0	12.92	5	313 -27	109	4.96	6	307 -17	19.4	5.74
	Bedding	14	301 -46			13.0	13.01	5	308 -19	110	4.96	6	304 -08	19.4	5.74
3	Field	10	295 -23	3.61 ± 1.08	54.3 ± 1.2	6.0	8.51	5	315 -30	15.3	4.74	5	288 -33	7.8	4.49
	Bedding	10	271 -26			6.0	8.50	5	277 -44	15.6	4.74	5	258 -27	7.8	4.49
4	Field	13	064 -39	1.56 ± 0.53	76.0 ± 3.1	4.8	10.52	5	053 -45	1.9	2.95	3	315 -20	3.2	2.39
	Bedding	13	084 -54			4.8	10.52	5	075 -62	1.9	2.95	3	304 -29	3.3	2.40
5	Field	10	250 -70	1.69 ± 1.09	50.1 ± 1.5	2.0	5.55	3	324 -21	10.4	2.81	6	180 -11	<1	-
	Bedding	10	306 -79			2.0	5.53	3	329 -16	10.4	2.81	6	177 -23	<1	-
6	Field	14	309 -61	7.05 ± 2.33	66.9 ± 13.0	26.2	13.50	5	096 -44	<2	-	5	305 -22	16.2	4.75
	Bedding	14	329 -56			26.1	13.50	5	085 -38	<2	-	5	309 -19	16.6	4.76

*1 sample not included: anomalously high magnetisation at 150 mAm^{-1}

DALES GORGE MEMBER - BROCKMAN IRON FORMATION

Correction	Natural Remanent Magnetisation						A.F. Cleaned			
	N	Dec Inc	Int (range)	χ (average)*	k	R	N	Dec Inc	k	R
Field	11	026 +39	510-193,000	163†	1.2	2.95	4	053 +48	1.0	-
Bedding	11	136 +62			1.4	4.20	4	141 +50	1.5	-
Field	13	191 -19	245-26,700	2490-26120	3.5	9.64	4	187 -09	19.0	3.84
Bedding	13	194 -04			3.5	9.64	4	187 +05	18.9	3.84
Field	44	358 -25	<1-42800	1000	2.7	28.62	17	343 -20	3.1	11.85
Bedding	44	359 -24			2.7	28.60	17	343 -19	3.0	11.81
Field	9	315 -45	116-630	240	25.3	8.68	3	311 -46	26.8	2.93
Bedding	9	345 -28			25.5	8.69	3	343 -31	27.4	2.93

Measured with a Bison susceptibility meter

Specimens with intensities < 1 Am^{-1} measured

BROCKMAN IRON FORMATION, WITTENOOM GORGE

Site	N	Dec	Inc	Natural Remanent Magnetisation Int ± S.D. (range)	χ ± S.D. (range)	k	R
1	8	352	-09	(1,980-97,500)	(3000-28,400)	6.3	6.90
2	8	298	-37	2000 ± 650	-	7.4	7.05
3	6	226	-35	(200-6,800)	2400±200	2.4	3.94

BROCKMAN IRON FORMATION, JOFFRE GORGE

	Natural Remanent Magnetisation					
N	Dec	Inc	Int range	Susc. range	k	R
7	255	-41	140-17,050	1,600-4,250	5.9	5.99

Site
-22.45 118.4E

BROCKMAN IRON FORMATION - DRILL CORE

e	Natural Remanent Magnetisation						A.F. cleaned				
	N	Dec	Inc	Int ± S.D.	χ (average)*	k	R	N	Dec	Inc	k	R
47A	29	275	+06	32,000±16,000	24,200	2.0	15.23	10	309	-08	10.7	9.16
51	28	286	-45	15,400±12,500	19,600	1.3	7.63	10	306	-13	14.0	9.36

Measured with a Bison susceptibility meter

20 307.5 -10.5 13.3 18.496 19.9

pole
-36.6 [illegible] 4.6 9.1

A2-6

WOONGARRA VOLCANICS

...on	Natural Remanent Magnetisation						A.F. Cleaned					Thermally Cleaned			
	N	Dec	Inc	Int ± S.D.	χ ± S.D.	k	R	N	Dec	Inc	k	R	N	Dec	Inc	k	R
	15	024	-73	0.63 ± 0.4	26.2 ± 2.2	3.6	11.04	5	308	-36	31.5	4.87	5	292	-21	7.7	4.49
	15	029	-03			3.5	11.04	5	337	-06	31.5	4.87	5	317	-14	7.9	4.50
	9	335	-47	26.5 ± 6.6	55.3 ± 12.2	52.0	8.86	4	324	+14	40.5	3.92	4	328	+32	74.0	3.96
	9	353	+07			52.1	8.85	4	293	+32	40.6	3.93	4	272	+39	72.0	3.96

BOOLGEEDA IRON FORMATION

Site	Correction	Natural Remanent Magnetisation N	Dec	Inc	Int ± S.D.	χ ± S.D.	k	R	A.F. Cleaned N	Dec	Inc	k	R
1	Field	10	002	-29	5000±2300	450 ± 200	1.2	2.94	4	307	-36	87.6	3.97
	Bedding	10	002	+02			1.2	2.93	4	320	-14	75.7	3.96
2	Field	14	002	-33	2400±500	33500†	35.6	13.63	4	357	-23	87.8	3.97
	Bedding	14	288	-50		5000	35.7	13.64	4	302	-46	95.4	3.97
3	Field	10	249	-02	4500±1000*	1800**	2.4	6.29	-	-	-	-	-
	Bedding	10	271	+31			2.4	6.29	-	-	-	-	-
4	Field	9	353	-66	8800±5000	7000††	22.6	8.65	2	349	-46	24.1	1.96
	Bedding	9	019	-06		33800	23.1	8.65	2	005	+08	25.4	1.96
5	Field	8	170	+40	Range 530	6900±350	4.2	6.35	1	353	-58	-	-
	Bedding	8	182	-09	to 51240		4.2	6.34	1	014	-03	-	-

*2 specimens from one sample excluded: intensities of 38500 and 288260 $mA.m^{-1}$

†Two samples have high χ and two, lower susceptibilities

**One sample only. The sample with high initial remanence (see note 1 above) has χ = 580

††One sample has χ = 7000 and two samples at 33,800

IGNEOUS COMPLEX (KUKABUBBA)

Correction	Natural Remanent Magnetisation							A.F. Cleaned				
	N	Dec	Inc	Int range	$\chi \pm$ S.D.	k	R	N	Dec	Inc	k	R
Field	5	010	-18	8.3-17.3	71.3±4.8	4.3	4.08	5	356	+28	34.4	4.88
Bedding	5	012	-07			4.3	4.08	5	348	+35	32.8	4.88
Field	6	104	-76	9.8-343	74.9±7.6	1.6	2.95	6	016	-52	1.5	2.83
Bedding	6	083	-57			1.6	3.02	6	028	-40	1.5	-
Field	6	325	-07	3.3-8.3	66.7±0.9	2.6	4.11	6	343	+21	18.6	5.73
Bedding	6	328	-12			2.6	4.12	6	338	+20	18.3	5.73
Field	6	076	-45	0.8-252	58.1±2.6	1.2	-	6	010	-20	1.7	3.17
Bedding	6	050	-36			1.2	-	6	009	+08	1.7	3.17
Field	6	017	-70	0.7-1770	68.8±4.8	1.6	3.03	6	333	-36	3.4	4.54
Bedding	6	352	-23			1.6	3.03	6	334	+14	3.4	4.54

JOFFRE INTRUSIONS

Site	Natural Remanent Magnetisation N	Dec	Inc	Int ± S.D. (range)	χ ± S.D.	k	R	A.F. Cleaned N	Dec	Inc	k	R
1 dyke)	6	066	-55	607±590 (27-1,380)	9,810±9,200 (1,930-32,300)	1.7	3.22	6	342	-67	3.8	4.70
2 sill)	8	099	-44	1400±620 (469-2,120)	11,400±7,000 (3,600-33,100)	3.5	6.02	8	094	-47	3.6	6.12

HAMERSLEY DYKES - ROCKLEA DOME

Natural Remanent Magnetisation				A.F. Cleaned	
N	Dec Inc	Int ± S.D. (range)	χ ± S.D.	N	Dec Inc
5	scattered	88,199±64,038 (229,300-32,500)	2228±1283	5	scattered
6	scattered	45,926±44,869 (135,000-1,923)	1821±394	6	scattered

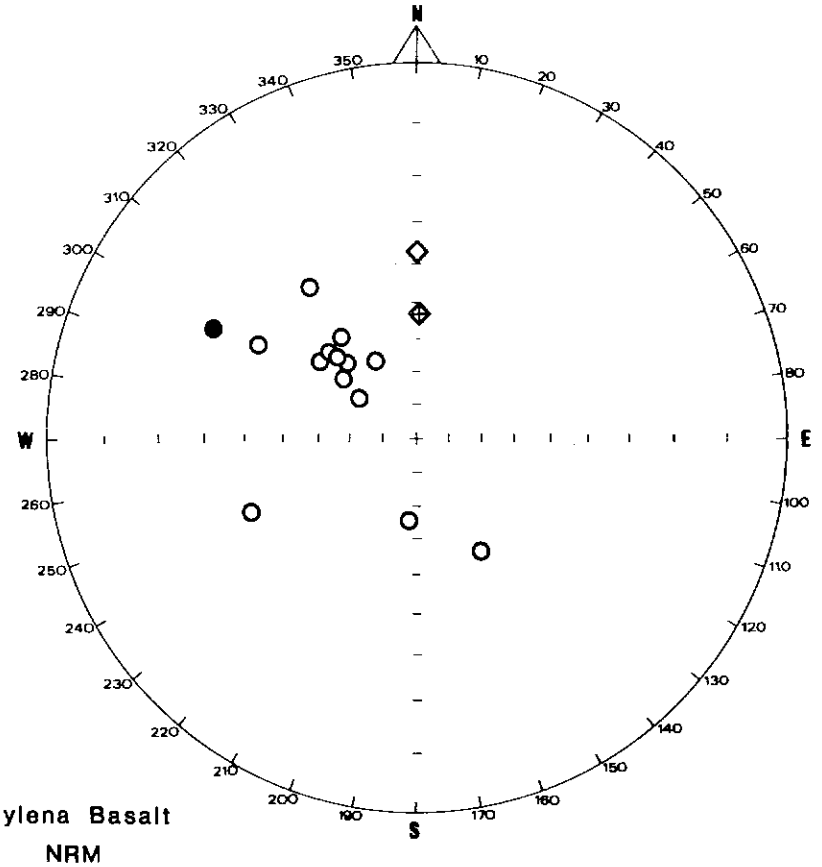
COOYA-POOYA DOLERITE

Site	N	Natural Remanent Magnetisation Dec	Inc	Int ± S.D.	χ ± S.D.	k	R
1	6	294	-32	5.9 ± 1.8	53.7 ± 4.1	12.1	5.59

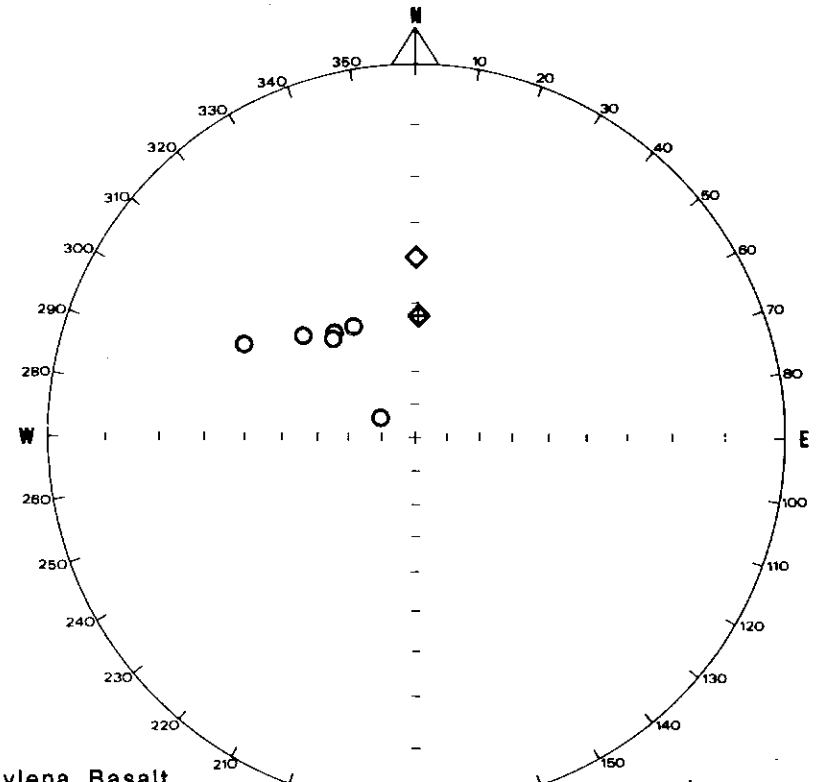
DAMPIER IGNEOUS INTRUSION

e	Natural Remanent Magnetisation						
	N	Dec	Inc	Int ± S.D.	χ ± S.D.	k	R
	10	014	-64	293 ± 148	1375 ± 704	15.5	9.42

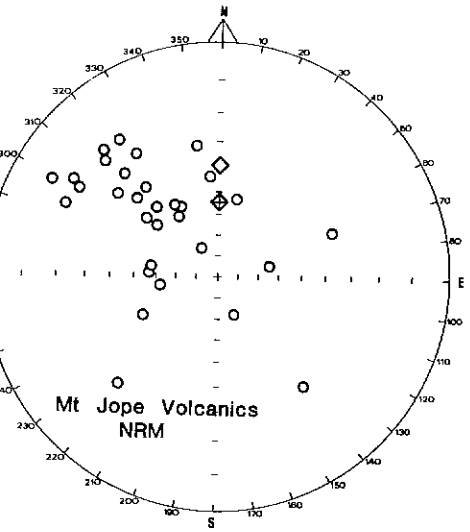
APPENDIX 3 : STEREOGRAPHIC PROJECTIONS (EQUAL ANGLE)

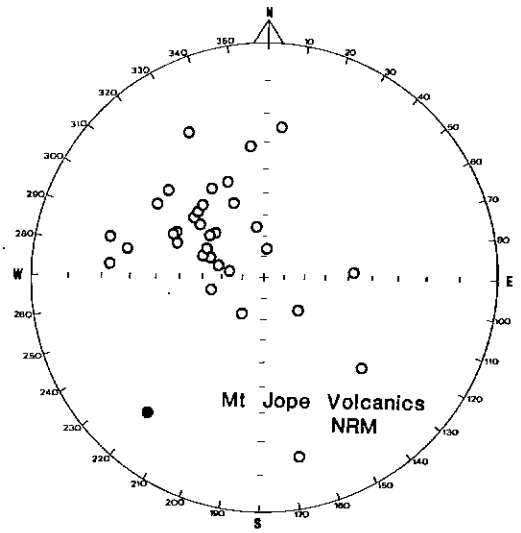


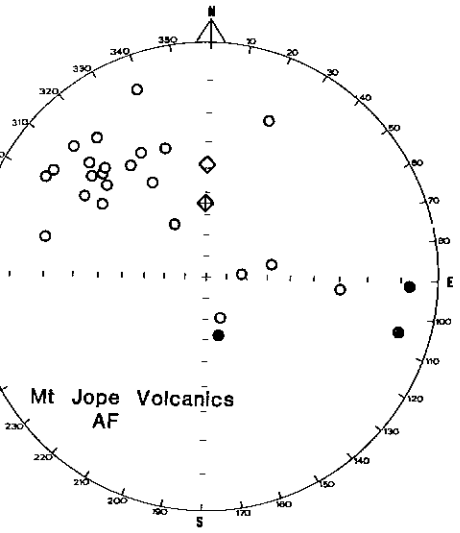
Kylena Basalt
NRM

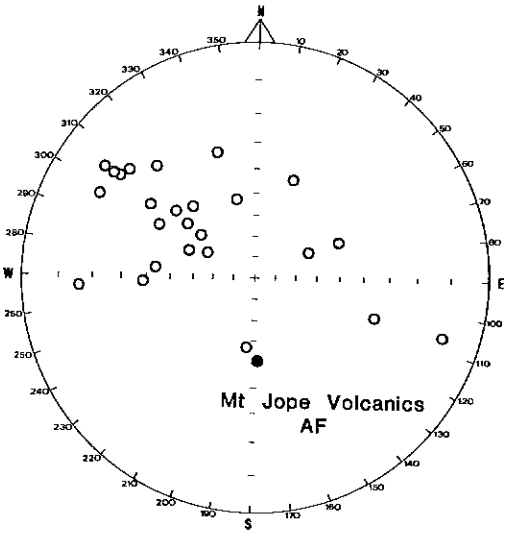


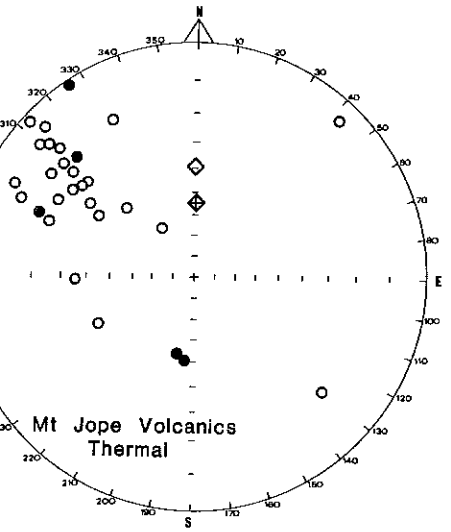
Kylena Basalt

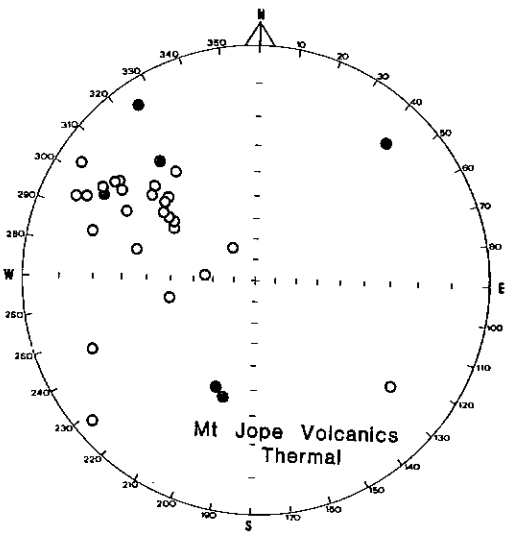

N
E
S
Mt Jope Volcanics
NRM

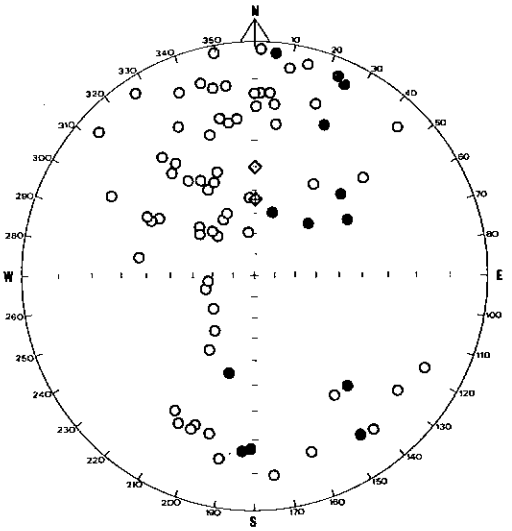

N
W
E
S
Mt Jope Volcanics
NRM


N
E
S
Mt Jope Volcanics
AF

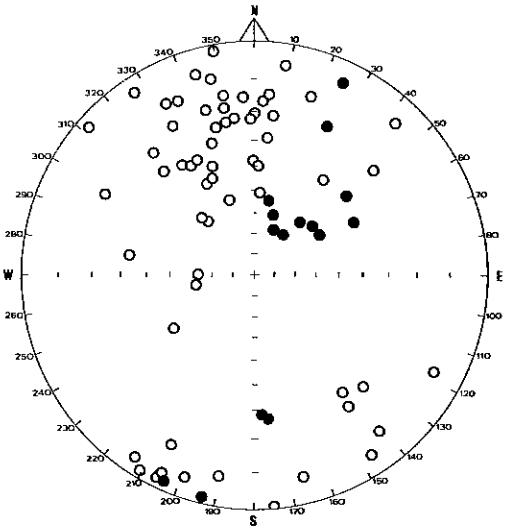

N
W
E
S
Mt Jope Volcanics
AF


N
E
S
Mt Jope Volcanics
Thermal

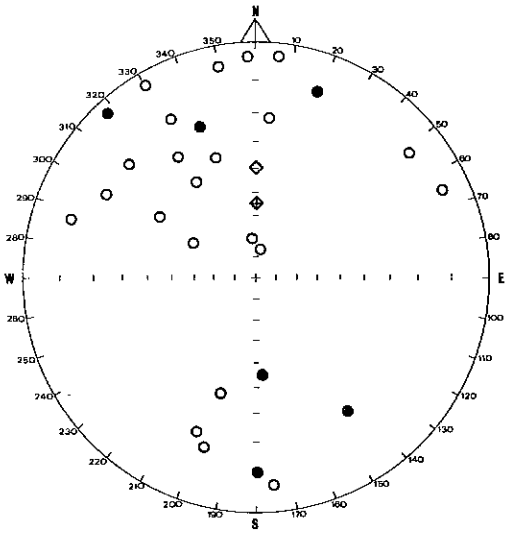

N
W
E
S
Mt Jope Volcanics
Thermal



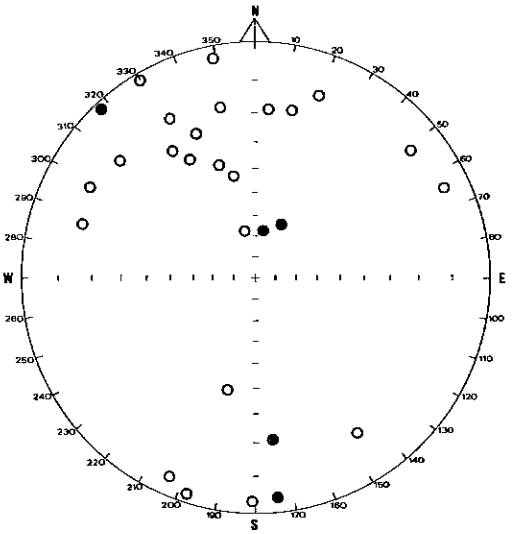
Dales Gorge Member
NRM



Dales Gorge Member
NRM



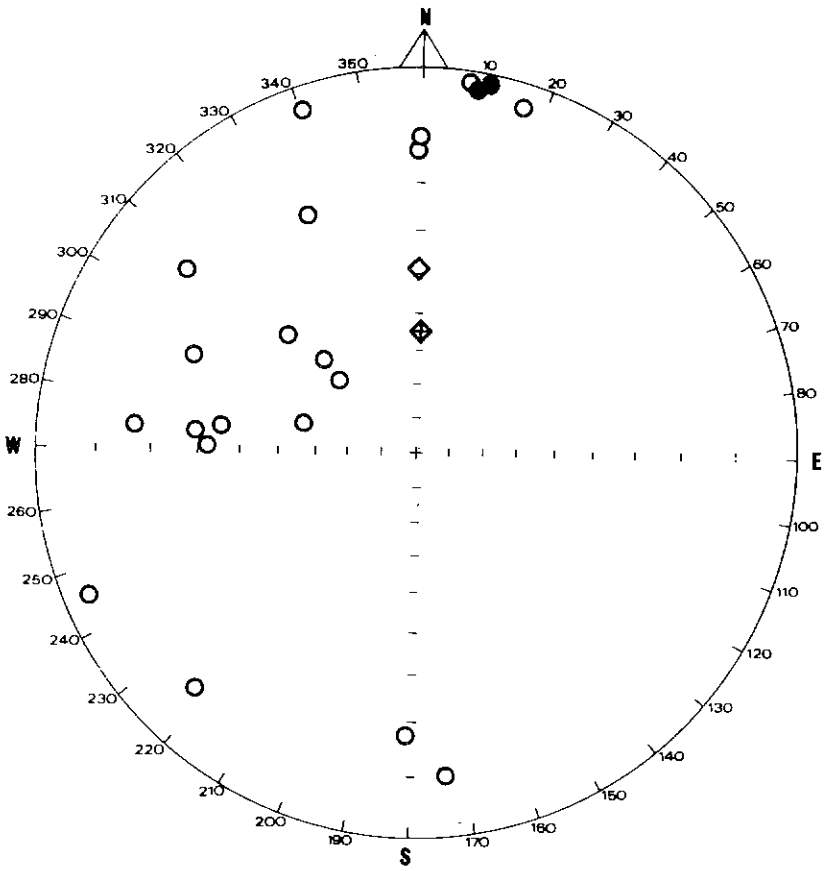
Dales Gorge Member AF



Dales Gorge Member AF

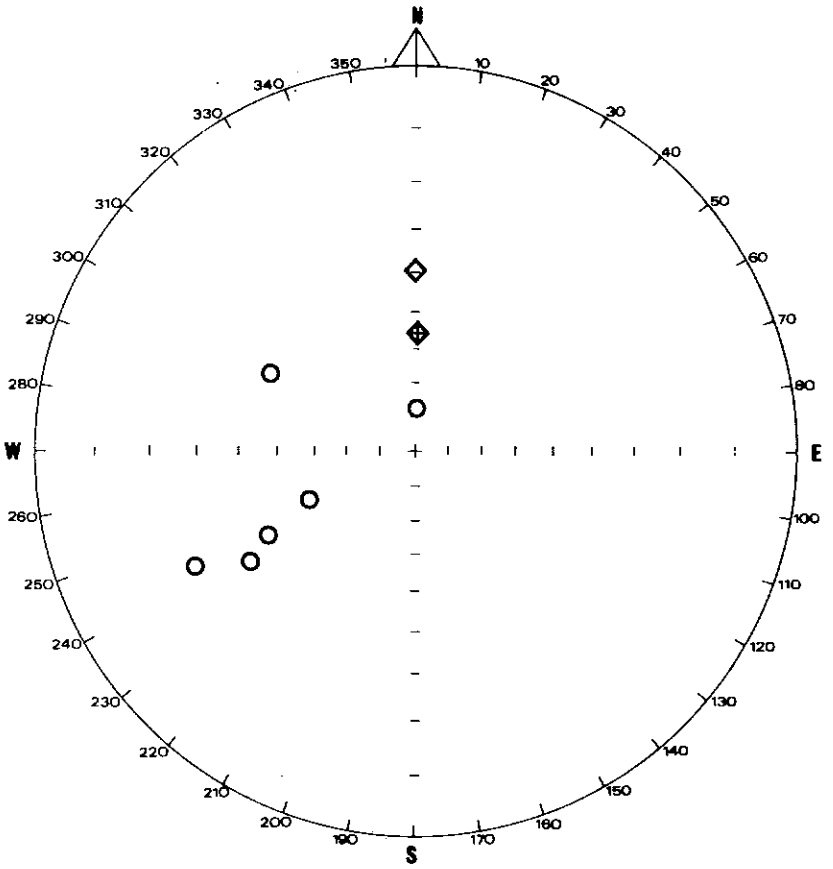
WITH RESPECT TO PRESENT HORIZONTAL

WITH RESPECT TO BEDDING PLANES



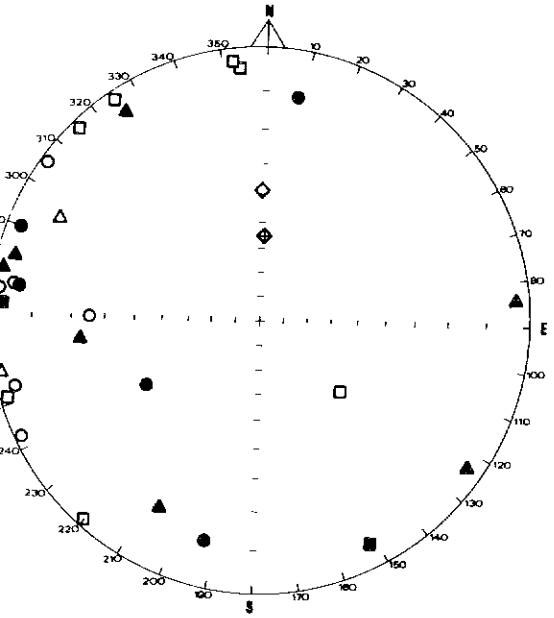
Banded Iron Formation Wittenoom Gorge

All Sites - NRM



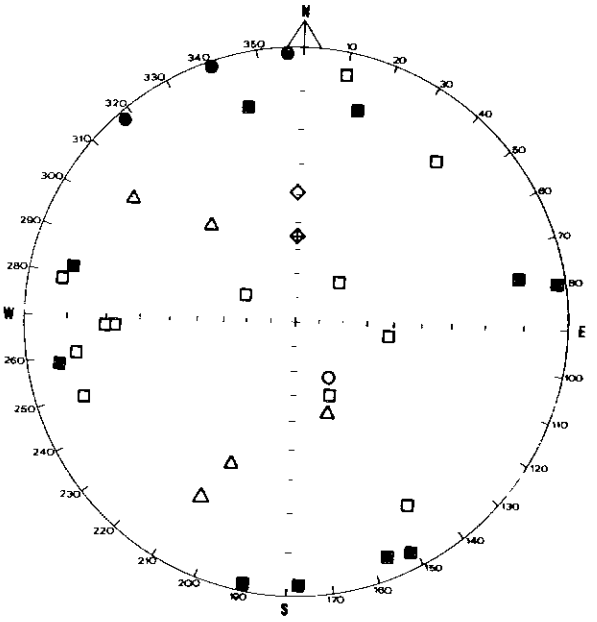
Banded Iron Formation Joffre Falls

NRM



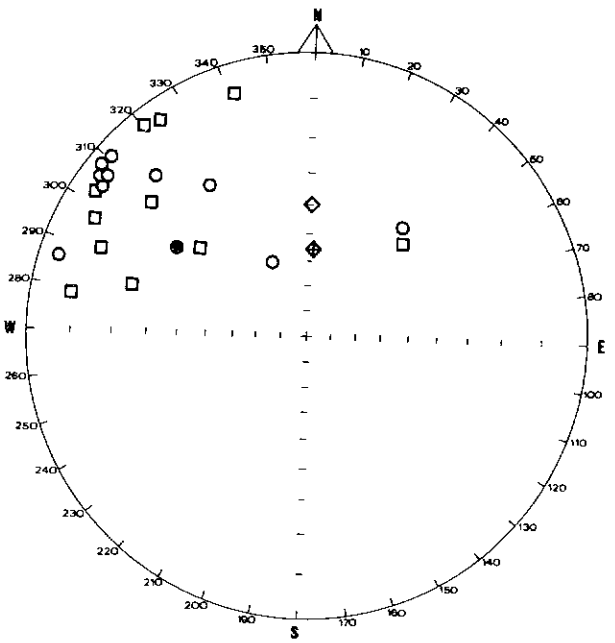
Banded Iron Formation Hole 47A NRM

○ 48' □ 49' △ 50'

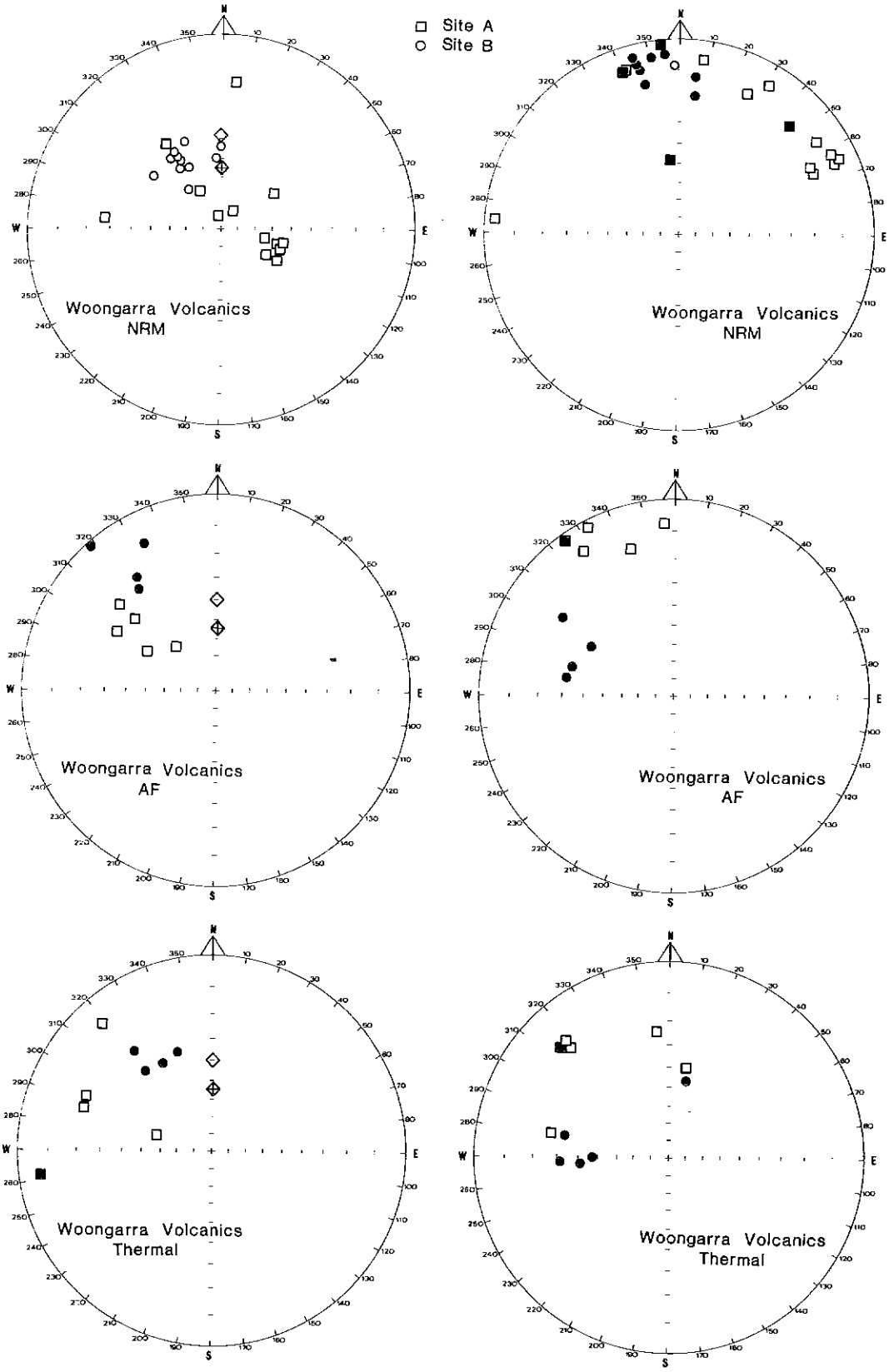


Banded Iron Formation Hole 51 NRM

○ BIF 13 □ BIF 12 △ BIF 10

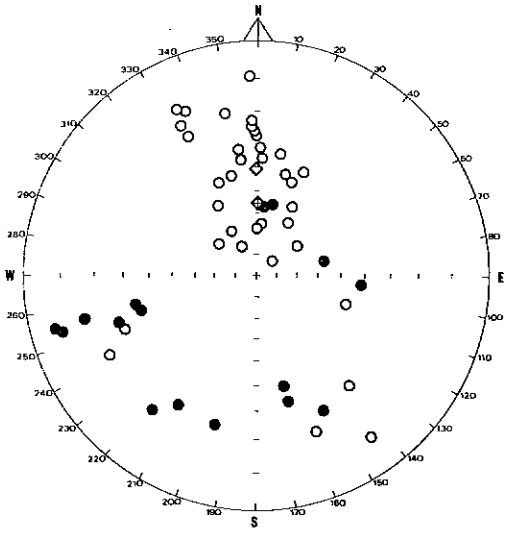


Drill Core - AF

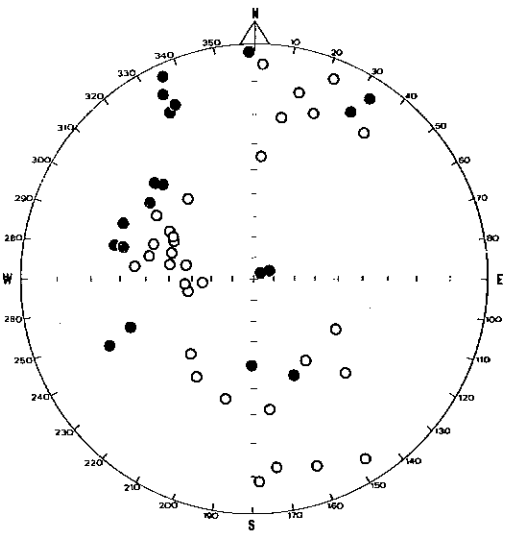


WITH RESPECT TO PRESENT HORIZONTAL

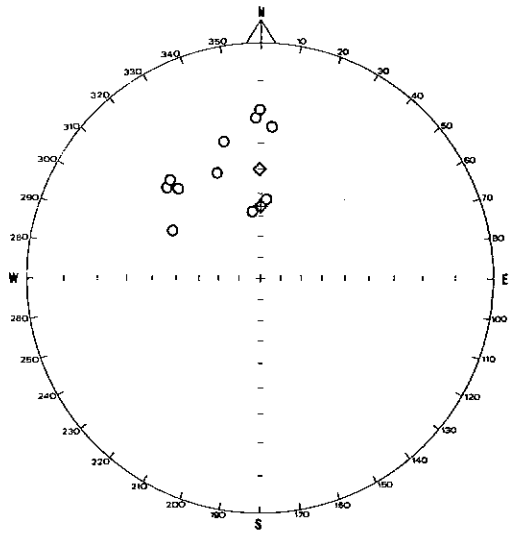
WITH RESPECT TO BEDDING PLANES



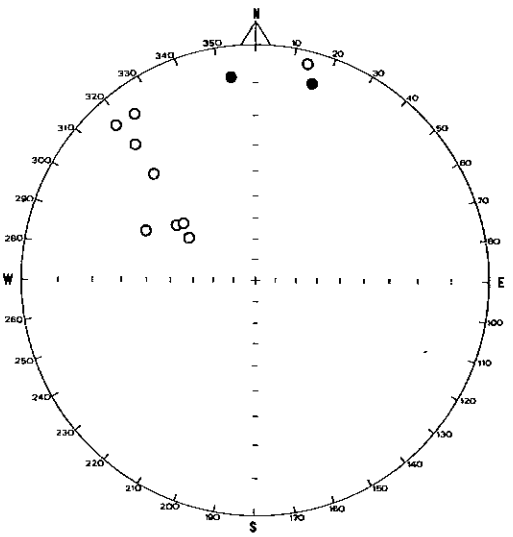
Boolgeeda Iron Formation
NRM



Boolgeeda Iron Formation
NRM



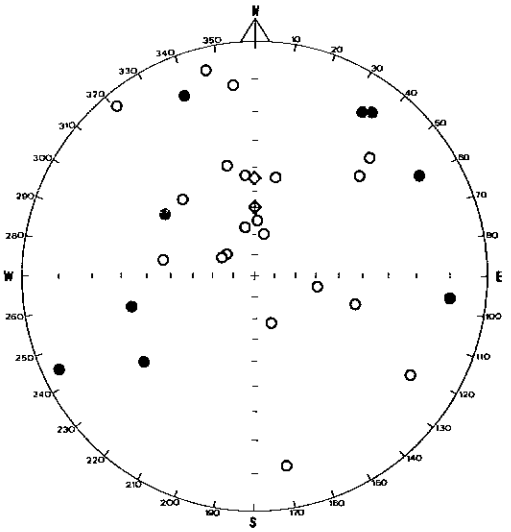
Boolgeeda Iron Formation AF



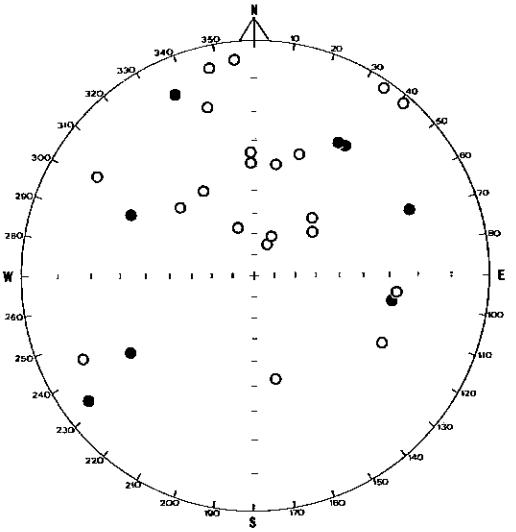
Boolgeeda Iron Formation AF

WITH RESPECT TO PRESENT HORIZONTAL

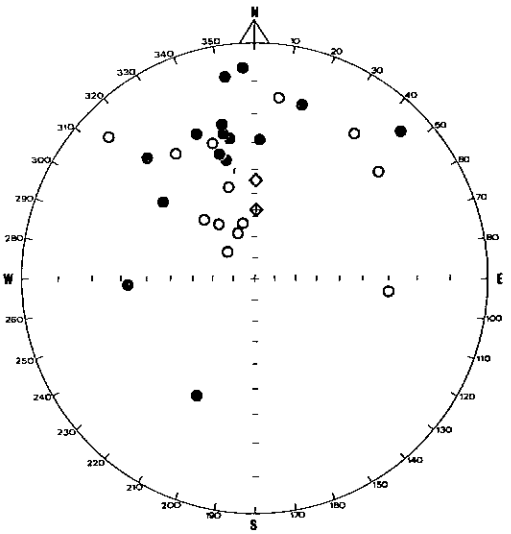
WITH RESPECT TO BEDDING PLANES



Kukabubba Igneous Complex
NRM

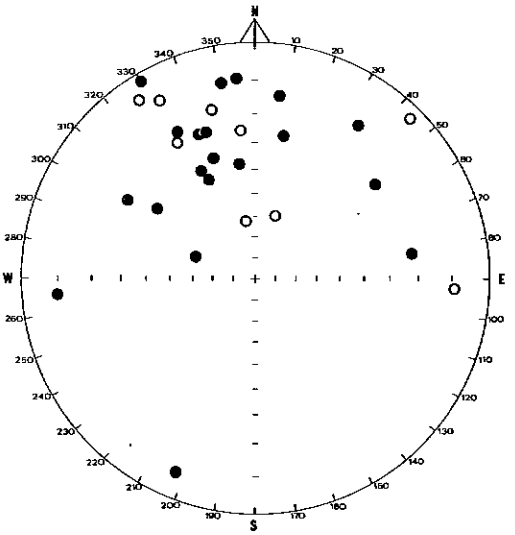


Kukabubba Igneous Complex
NRM



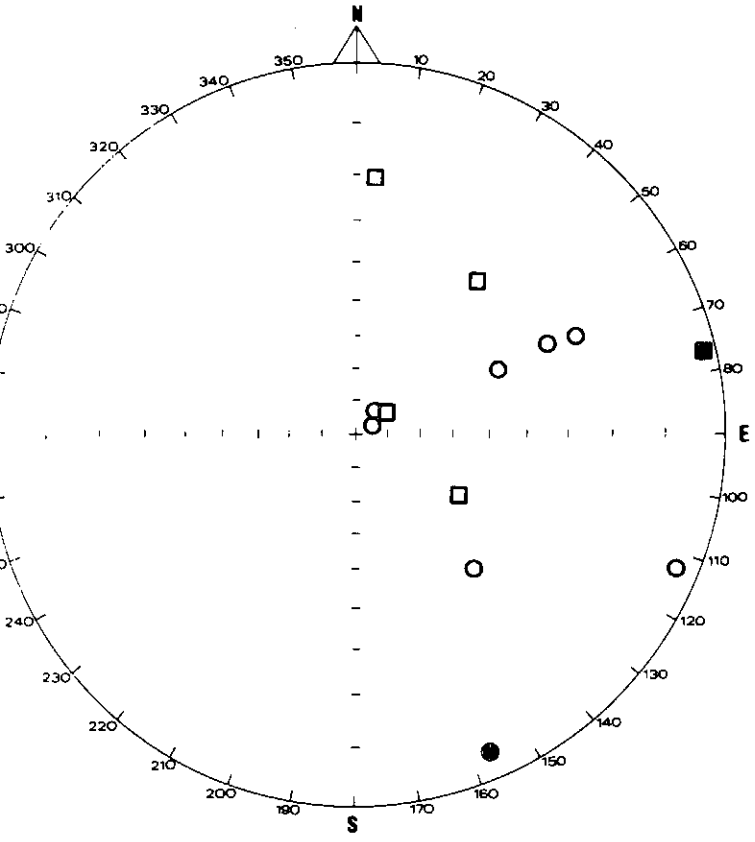
Kukabubba Igneous Complex AF

WITH RESPECT TO PRESENT HORIZONTAL

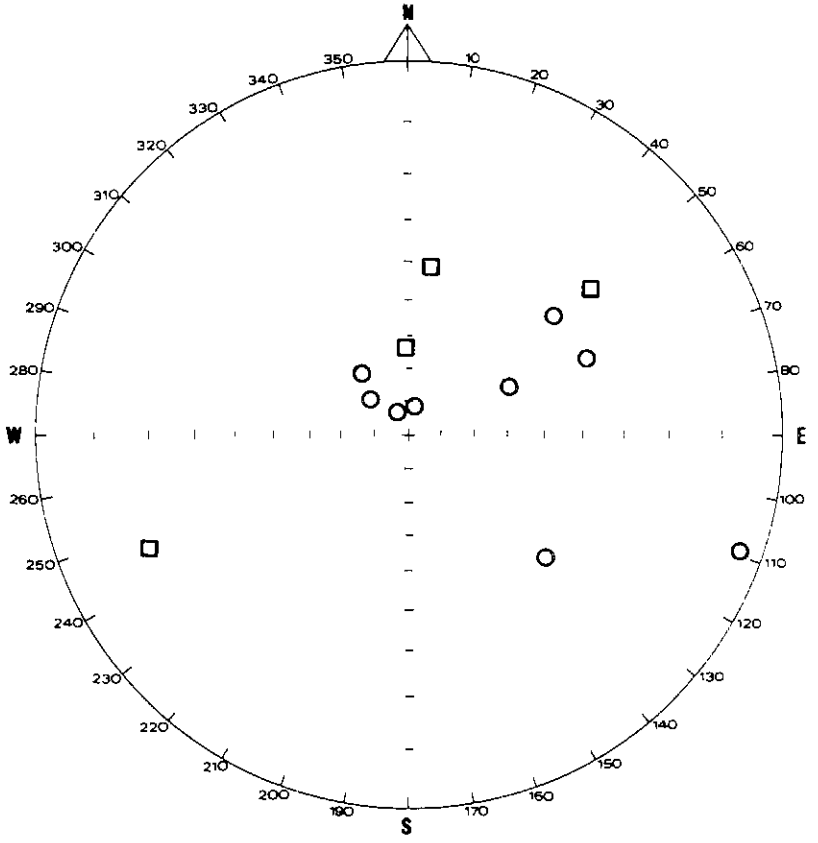


Kukabubba Igneous Complex AF

WITH RESPECT TO BEDDING PLANES



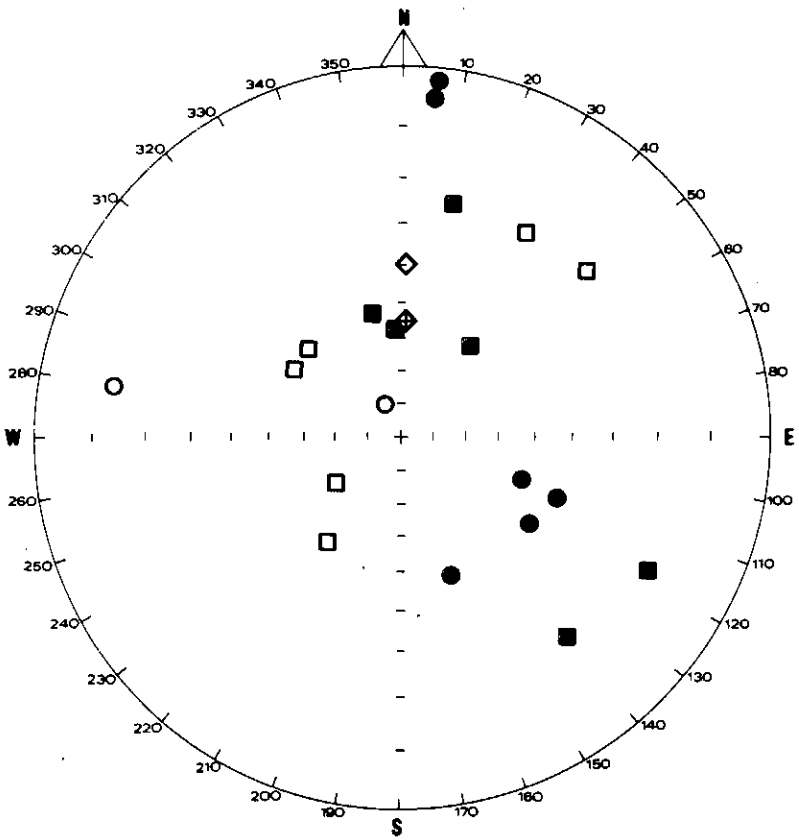
Joffre Intrusions NRM



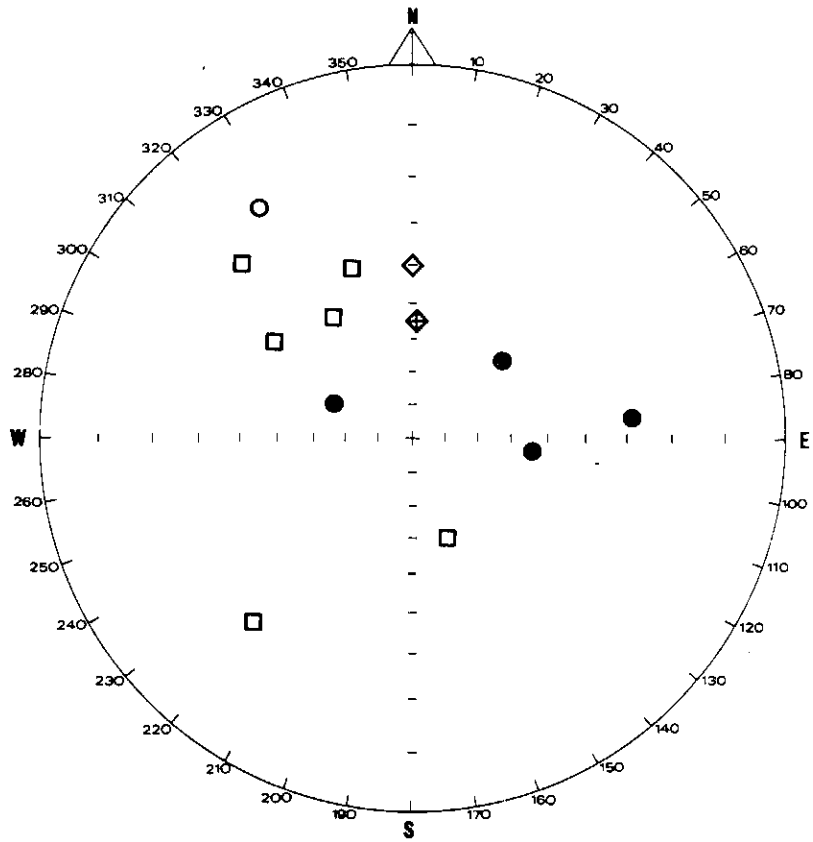
Joffre Intrusions AF Cleaned

□ Dyke

○ Sill

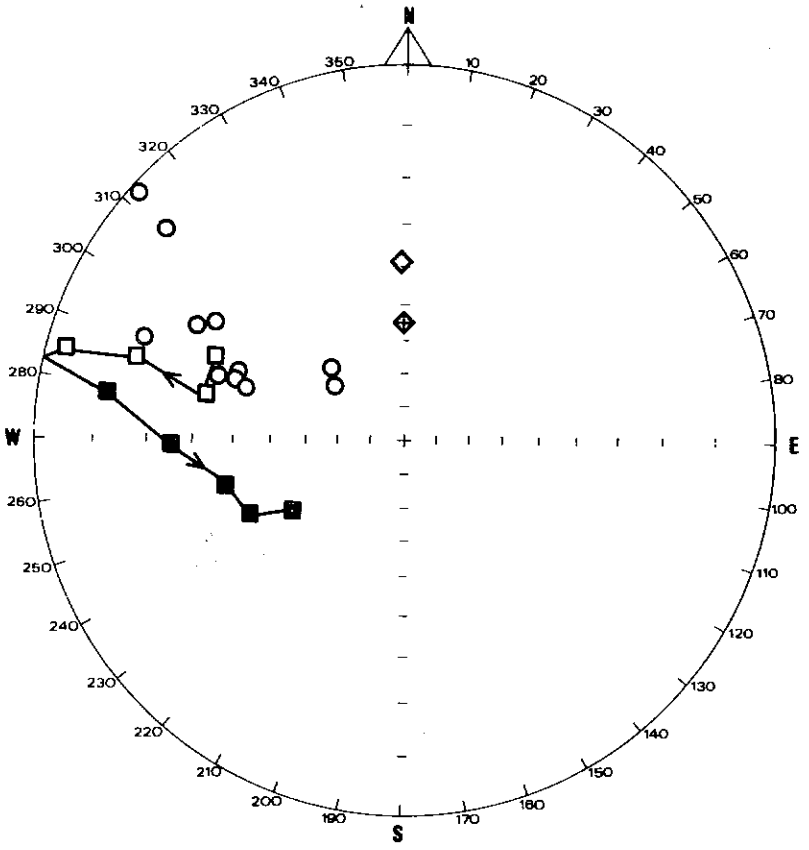


Rocklea Dome Dykes NRM



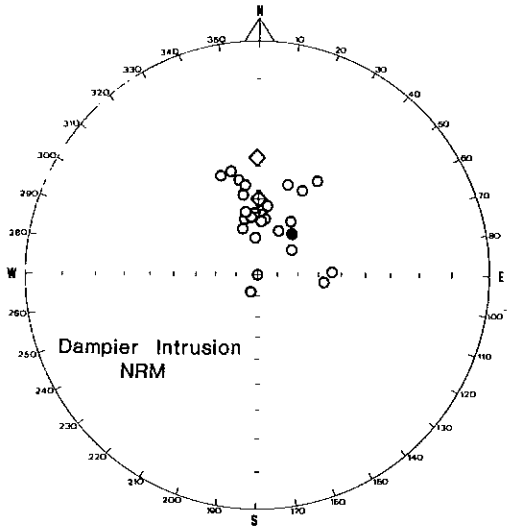
Rocklea Dome Dykes AF Cleaned

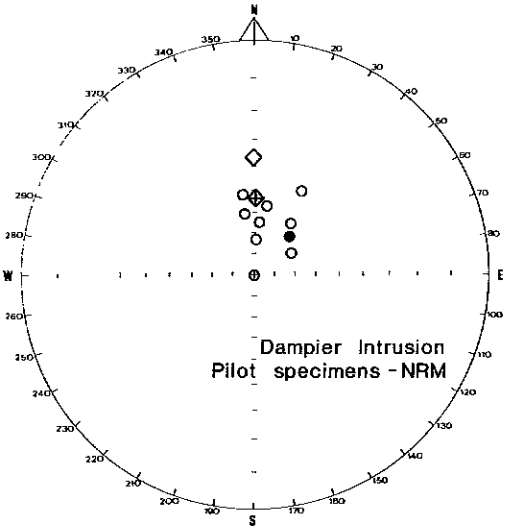
○ Site 1
□ Site 2

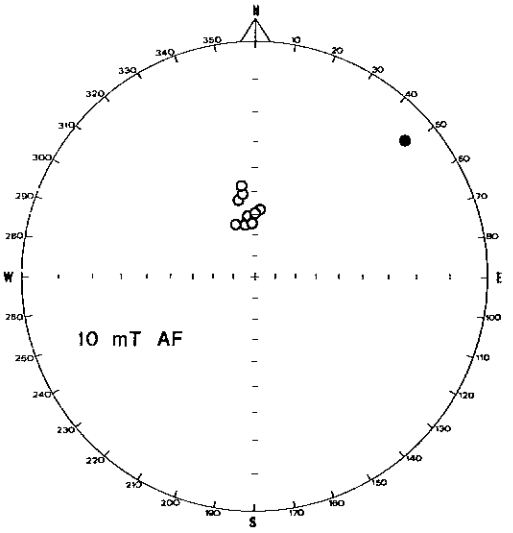


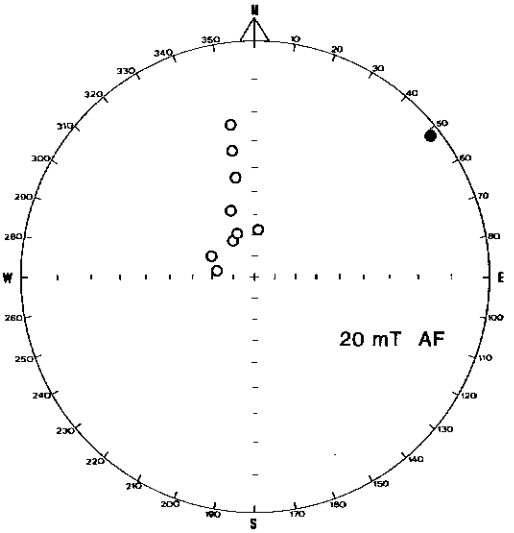
Cooya - Pooya Dolerite

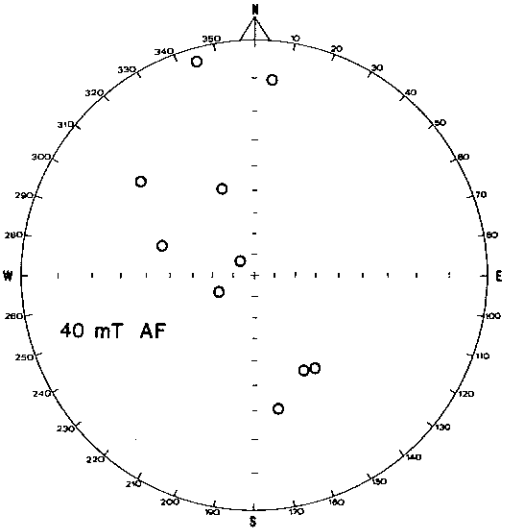
○ NRM □ AF demag. trend


Dampier Intrusion
NRM


Dampier Intrusion
Pilot specimens - NRM


10 mT AF


20 mT AF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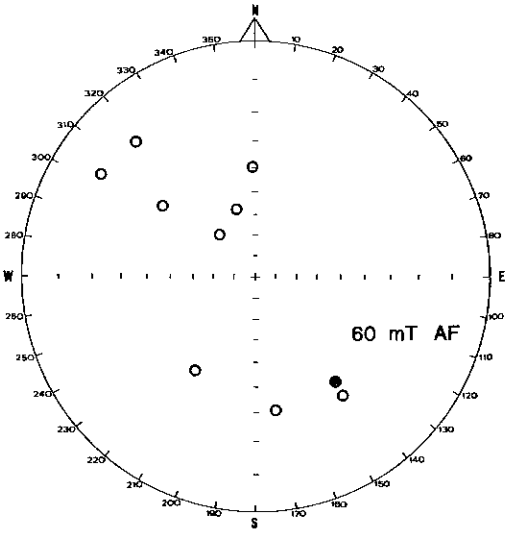
60 mT AF