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Stratigraphic and paleocurrent analysis of the Ecca series and Lowermost Beaufort Beds in the Karroo basin of South Africa

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A P P E N D I X 1

STATISTICAL DATA ON RIPPLE MARKS IN THE NORTH-WESTERN PORTION OF THE BASIN

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	Symmetry of Crests	No. of Measure-ments	Mean Strike	Ripple Index
1	Fauresmith	Klein Platberg 756	On side of road	Lowermost Beaufort	Shale	Symmetrical	5	160°	5.39
6	Fauresmith	Goede Hoop 219	In stream	Lowermost Beaufort	Siltstone	Symmetrical	3	174°	15.00
7	Fauresmith	Ruigtepoort 61	In stream	Lowermost Beaufort	Siltstone	Symmetrical	6	43°	7.41
8	Fauresmith	Fauresmith Townlands 167	In stream	Lowermost Beaufort	Siltstone	Symmetrical	10	157°	6.65
9	Fauresmith	Fauresmith Townlands 167	In stream	Lowermost Beaufort	Siltstone	Symmetrical	6	136°	7.33
12	Fauresmith	Sandymount Park 1126	In stream	Lowermost Beaufort	Fine sandstone	Symmetrical	8	39°	5.36
14	Fauresmith	Riet Puts Dam 115	Above cliff	Lowermost Beaufort	Siltstone	Symmetrical	10	83°	10.20
17	Fauresmith	Jagersfontein 14	Side of hill	Lowermost Beaufort	Fine Sandstone	Symmetrical	7	108°	5.26
20	Trompsburg	Morgenzon 339	In stream	Lowermost Beaufort	Siltstone	Symmetrical	3	176°	10.33

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of Crests	No. of Measurements	Mean Strike	Ripple Index
25	Bloemfontein	Tafelkop 712	Cliffs	Lowermost Beaufort	Fine sandstone	Symmetrical	3	52°	7.85
34	Theuni sen	Heldersfontein 139	In stream	Lowermost Beaufort	Fine sandstone	Symmetrical	10	109°	9.86
39	Virginia	Weltevreden 445	In Doornspruit	Lowermost Beaufort	Fine	Symmetrical	20	113°	8.32
41	Virginia	Adamsonsvlei 655	Next to road	Lowermost Beaufort	Medium-fine sandstone	Symmetrical	7	52°	6.64
42	Virginia	Glen Harmony	Sandstone cliff	Lowermost Beaufort	Medium-fine sandstone	Symmetrical	5	95°	7.05
43	Kennenman	Rietgat 276	Below bridge in Riet-spruit	Lowermost Beaufort	Fine sandstone	Symmetrical	2	29°	7.69
45	Kroonstad	Highlands 2343	In quarry	Lowermost Beaufort	Medium sandstone	Asymmetrical (Linguoid)	5	4°	9.25
53	Hoopstad	De Aar 459	South bank of Vaal	Middle Ecca	Medium sandstone	Symmetrical	9	156°	11.60
54	Hoopstad	Nieuwhoudts Rust	In donga	Middle Ecca	Medium sandstone	Symmetrical	2	149°	17.25
57	Hoopstad	Elizabeth's Rust 47	Side of road	Middle Ecca	Medium sandstone	Symmetrical	4	107°	49.5
74	Viljoenskroon	Vierfontein	Vierfontein Colliery West Shaft	Middle Ecca	Medium to fine sandstone	Asymmetrical	10	163°	7.67

APPENDIX 2

STATISTICAL DATA ON CROSS-BEDDING IN THE NORTH-WESTERN PORTION OF THE BASIN

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratic	Mean thickness of planar cross-bedded units
5	Fauresmith	Oorlogspoort 961	Small hill	Lowermost Beaufort	Fine-medium sandstone	5	34°	0.90	
12	Fauresmith	Sandymount Park 109	In stream	Lowermost Beaufort	Medium sandstone	3	301°	0.97	
19	Trompsburg	Bloemhof 186	Small hill	Lowermost Beaufort	Medium sandstone	3	348°	0.33	30.0"
21	Edenburg	Townlands 104	Small hill	Lowermost Beaufort	Coarse felspathic sandstone	11	298°	0.71	24.0"
22	Edenburg	Modderfontein 78	In Ospoort-spruit	Lowermost Beaufort	Fine-medium sandstone	7	148°	0.96	16.0"
23	Reddersburg	Reddersburg 291	In quarry	Lowermost Beaufort	Fine-medium sandstone	6	191°	0.92	20.0"
26	Bloemfontein	Tafelkop 712	Cliffs	Lowermost Beaufort	Fine-medium sandstone	10	308°	0.93	16.0"
26	Bloemfontein	Tafelkop 712	Road cutting	Lowermost Beaufort	Coarse-medium sandstone	8	226°	0 91	11.5"
31	Theunissen	Klein Begin 370	Below bridge across Vet River	Lowermost Beaufort	Fine sandstone	2	254°	0.99	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of planar cross-bedded units
32	Brandfort	Portion 222	Small hill	Lowermost Beaufort	Fine-medium sandstone	10	318°	0.90	23.3"
33	Brandfort	Townlands 720	Road cutting	Lowermost Beaufort	Grit and conglomerate	5	271°	0.96	27.5"
34	Theunissen	Heldersfontein 139	In stream	Lowermost Beaufort	Fine sandstone	10	221°	0.82	9.0"
35	Theunissen	Abraham's Hof 323	Side of hill	Lowermost Beaufort	Coarse felspathic grit	10	231°	0.96	14.0"
36	Theunissen	Mamre 211	Lowermost Cliff, Lion Hill	Lowermost Beaufort	Fine-medium sandstone	2	320°	0.93	
36	Theunissen	Mamre 211	Upper cliff, Lion Hill	Lowermost Beaufort	Coarse felspathic sandstone	6	221°	0.78	48.0"
42	Virginia	Glen Harmony	Cliffs above Sand River	Lowermost Beaufort	Medium-coarse sandstone	10	202°	0.78	5.5"
44	Kroonstad	Elandsrand 2466	Side of hill	Lowermost Beaufort	Coarse felspathic sandstone	14	278°	0.82	
45	Kroonstad	Highlands 2343	In quarry	Lowermost Beaufort	Medium sandstone	6	130°	0.93	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of planar cross-bedded units
46	Kroonstad	Townlands 460	Near road	Lowermost Beaufort	Coarse felspathic sandstone	8	140°	0.73	
47	Kroonstad	Cornerton 610	Cliffs	Lowermost Beaufort	Medium-coarse sandstone	4	270°	0.98	
48	Kroonstad	Mooivlei j 1458	Side of road	Lowermost Beaufort	Medium sandstone	5	312°	0.98	
49	Heilbron	Rietgat 1082	Road cutting	Lowermost Beaufort	Medium felspathic sandstone	5	282°	0.88	
50	Heilbron	Christiana 690	Cliffs north of River	Middle Ecca	Coarse felspathic sandstone	7	242°	0.97	32.0"
51	Heilbron	Mooifontein 590	Side of hi.	Middle Ecca	Coarse felspathic sandstone	5	245°	0.96	30.0"
52	Heilbron	Rietfontein 156	In stream	Middle Ecca	Coarse felspathic sandstone	5	246°	0.98	32.0"
53	Hoopstad	De Aar 459	South bank of Vaal	Middle Ecca	Medium sandstone	3	252°	0.98	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of planar cross-bedded units
54	Hoopstad	Nieuwhoudts Rust 514	In donga	Middle Ecca	Medium-fine sandstone	3	206°	0.98	10.0"
55	Hoopstad	Smitsrust 415	Cliffs	Middle Ecca	Medium sandstone	4	169°	0.93	9.0"
56	Hoopstad	De Rots 9	Cliffs	Middle Ecca	Medium sandstone	2	152°	0.95	
58	Hoopstad	Elizabeth's Rust 47	In Vaal River	Middle Ecca	Fine sandstone	6	208°	0.87	
59	Wesselsbron	Clerkstroom 297	Cliff above Sandspruit	Middle Ecca	Medium sandstone	4	156°	0.95	
60	Wesselsbron	Clerkstroom 297	Side of road	Middle Ecca	Medium-coarse sandstone	3	141°	0.97	
61	Bothaville	Witkrans 267	Cliffs	Middle Ecca	Medium-coarse sandstone	6	159°	0.68	27.0"
62	Bothaville	Strydom 603	Cliffs	Middle Ecca	Medium sandstone	10	159°	0.46	41.5"
63	Bothaville	Mahomed 605	East bank of Vaal	Middle Ecca	Medium sandstone	8	167°	0.58	33.0"
64	Bothaville	Strydfontein 256	In donga	Middle Ecca	Medium sandstone	5	131°	0.97	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of planar cross-bedded units
65	Bothaville	Zandfontein	Side of road	Middle Ecca	Medium sandstone	3	149°	0.93	
66	Wolmarans-stad	Baviaans Krans H.P. 80	Cliff next to Vaal	Middle Ecca	Medium sandstone	10	174°	0.83	30.0"
67	Bothaville	Haasfontein	Cliffs	Middle Ecca	Medium sandstone	5	154°	0.88	15.0"
68	Bothaville	De Bank 407	Cliffs	Middle Ecca	Medium sandstone	6	138°	0.85	
69	Bothaville	Johannas Hoop 408	South bank of Vals river	Middle Ecca	Medium sandstone	10	241°	0.98	48.0"
70	Bothaville	Bothamia 9	Side of road	Middle Ecca	Medium sandstone	2	103°	0.95	
71	Bothaville	Klipfontein 459	In stream	Middle Ecca	Medium sandstone	10	236°	0.58	
75	Viljoens-kroon	Vierfontein 512	Near old adit	Middle Ecca	Medium-fine sandstone	10	121°	0.97	
76	Van der Bijl Park	Zandfontein 46	North bank of Vaal River	Middle Ecca	Coarse felspathic sandstone	8	214°	0.93	36.0"

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consistency Ratio	Mean thickness of planar cross-bedded units
77	Sasolburg	Verdun 1183	Cliffs above Taaibos Spruit	Middle Ecca	Medium sandstone	19	272°	0.77	38.5"
78	Sasolburg	Amelia 518	Cliffs above Taaibos Spruit	Middle Ecca	Medium sandstone	5	282	0.94	14.0"
79	Vereeniging	Kookfontein 57	Road cutting	Middle Ecca	Grit and Conglomerate	4	128°	0.99	

APPENDIX 3

STATISTICAL DATA ON FUCOID STRUCTURES IN THE NORTH-WESTERN PORTION OF THE BASIN

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Mean Length of Fucoids	Arithmetic Means	Varience	Standard deviation	Ratio of No. of measurements constituting each mean
2	Fauresmith	Wilgedraai 504	In donga	Ecca series	Shale	14	5.11"	208° 124°	-	-	1.33 1.00
3	Fauresmith	Rondefontein 99	In donga	Ecca series	Shale	5	3.10"	170° 266°	-	-	1.00 1.50
4	Jacobsdal	Du Toits dam 391	Side of road	Ecca series	Shale	9	3.56"	171° 250°	-	-	1.00 1.25
10	Fauresmith	Townlands 167	In stream	Ecca series	Shale	8	6.13"	269° 322°	-	-	1.66 1.00
11	Fauresmith	Kipersol 613	In stream	Ecca series	Shale	10	13.15"	182° 268°	-	-	1.00 1.50
13	Fauresmith	Brandewyns-kuil Oost 116	In stream	Ecca series	Shale	14	15.00"	214° 279°	-	-	3.70 1.00
15	Fauresmith	Kalkfontein 677	In donga	Ecca series	Shale	8	4.25"	251° 331°	-	-	3.00 1.00
16	Fauresmith	Schraalfontein	In donga	Ecca series	Shale	15	6.30"	213° 316°	-	-	1.50 1.00
27	Bloemfontein	Uitvlugt West 2810	In Modder River	Ecca series	Shale	40	9.53"	253° 341°	211 653	15° 26°	1.00 1.50

Out-crop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Mean length of Fucoids	Arithmetic Means	Varience	Standard deviation	Ratio of No. of measurements constituting each mean
28	Brandfort	Lombards Drift 832	In Modder Riv	Ecca series	Shale	70	18.37"	242° 339°	1344 82	37° 9°	2.90 1.00
29	Brandfort	Diephoek 410	In donga	Ecca series	Shale	7	4.43"	343° 270°	-	-	1.33 1.00
30	Brandfort	Wilhelmina 112	In stream	Ecca series	Shale	10	4.75"	311° 34°	-	-	1.50 1.00
37	Jacobsdal	Blaawbanks Drift 195	In Riet River	Ecca series	Shale	14	5.64"	224° 143°	-	-	1.80 1.00
38	Boshof	Ryansdale 685	In Modder River	Ecca series	Shale	7	5.79"	336° 244°	-	-	1.00 1.33
40	Theunissen	Mond van Doorn Rivier 38	In Doring River	Ecca series	Shale	16	9.00"	288° 360°	-	-	1.00 1.30

APPENDIX 4

STATISTICAL DATA ON PARTING LINEATIONS IN THE NORTH-WESTERN PORTION OF THE BASIN

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent	No. Measurements	Mean Orientation	Remarks
18	Fauresmith	Lockshoek 192	In donga	Lowermost Beaufort	Medium sandstone	10	83°	
24	Bloemfontein	Koppieskraal 407	Small hill	Lowermost Beaufort	Fine sandstone	10	8°	
72	Bothaville	Randfontein 154	Low ridge	Middle Ecca	Fine sandstone (beach deposit)	2	39°	Contains abundant heavy minerals
73	Bothaville	Broekzansfontein 538	Edge of pan	Middle Ecca	Fine sandstone (beach deposit)	5	39°	Contains abundant heavy minerals

APPENDIX 5

STATISTICAL DATA ON RIPPLE MARKS IN THE CAPE PROVINCE AND SOUTHERNMOST ORANGE FREE STATE

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	Symmetry of crests	No. Measure-ments	Mean Strike	Ripple Index
7	Peddie	Woodlands Ped.Q.23-5	Road cutting	Lower Ecca	Shale	Symmetrical	6	347°	9.77
9	Albany	Trumpeters Aly.Q.15-30	Road cutting	Lower Ecca	Siltstone	Symmetrical	3	280°	5.19
10	Peddie	Tyefu's Location	Top of Committees Pass	Upper Ecca	Fine sand-stone	Symmetrical	5	293°	8.00
11	Albany	Lot RH Aly.Q.12-20	Cliff	Lower Ecca	Fine sand-stone	Symmetrical	5	349°	9.81
15	Albany	Lot A.G. Aly.Q.12-13	Sandstone ledge	Lower Ecca	Fine sand-stone	Symmetrical	3	80°	13.00
16	Albany	-	Side of road	Upper Ecca	Fine sand-stone	Symmetrical	4	292°	3.43
21	Albany	Wentzel Koester	South bank of Fish River	Middle Ecca	Shale and sandstone	Asymmetrical	7	323°	-
23	Albany	Olifantskloof Aly.Q.16-10	In stream	Upper Ecca	Fine sand-stone	Symmetrical	6	348°	6.21
25	Albany	Uitkyk Aly.Q.3-41	In stream	Upper Ecca	Fine sand-stone	Symmetrical	3	48°	8.50

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	Symmetry of crests	No. Measure-ments	Mean Strike	Ripple Index
26	Bedford	Collisfontein Som.Q.5-45	In donga	Upper Ecca	Fine sand-stone	Symmetrical	3	294°	4.80
27	Somerset East	Brakfontein Som.Q.18-2	In stream	Lower Ecca	Fine sand-stone	Symmetrical	3	247°	16.67
28	Somerset East	Driefontein Som.Q.6-53	Road cutting	Lower Ecca	Fine sand-stone	Symmetrical	3	282°	9.70
33	Somerset East	Palmietfontein Som.Q.6-21	In donga	Upper	Fine sand-stone	Symmetrical	3	111°	3.33
34	Somerset East	Rietfontein Som.Q.6-16	Road cutting	Upper Ecca (lowermost Beaufort)	Fine sand-stone	Symmetrical	3	236°	2.67
35	Somerset East	Kruis Rivier Som.Q.6-13	In stream	Upper Ecca	Shales	Symmetrical	10	99°	4.22
36	Somerset East	Paddefontein Som.Q.6-14	In stream on side of road	Lower Ecca	Shales	Symmetrical	6	115°	5.05
37	Somerset East	Klipfontein	-	Lower Ecca	Fine sand-	Symmetrical	3	33°	9.53
38	Somerset East	Volkers Rivier Som.Q.16-17	-	Upper Ecca	Fine sand-stone	Symmetrical	3	124°	7.08
39	Somerset East	Volkers Rivier Som.Q.16-17	-	Middle Ecca	Shales	Symmetrical	6	107°	6.93

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
40	Somerset East	Bouwersfontein Som.Q.6-46	In donga	Upper Ecca	Fine sandstone	Symmetrical	5	102°	3.61
41	Somerset East	Welbedagt Som.Q.15-11	In Voels River	Upper Ecca	Shales	Symmetrical	2	99°	8.57
42	Somerset East	Vaal Krantz Som.Q.15-13	-	Upper Ecca	Fine sandstone	Symmetrical	5	106°	9.06
43	Jansenville	Welbevonden Uit.Q.4C.97	In donga	Upper Ecca	Fine sandstone	Symmetrical	5	110°	5.67
44	Jansenville	Draaihoek Jan.Q.7-10	-	Upper Ecca	Siltstone	Symmetrical	4	311°	9.43
45	Jansenville	Ganna Vlakte Uit.Q.4C.97	In stream	Upper Ecca	Fine sandstone	Symmetrical	10	251°	5.03
46	Jansenville	Kalkfontein Jan.Q.1-5	-	Upper Ecca	Shale	Symmetrical	5	90°	5.64
47	Jansenville	Verse Kraal	In Brak Rivier	Middle Ecca	Shale	Symmetrical	5	78°	19.53
49	Jansenville	Ganna Kraal	Palmiet Spruit	Middle Ecca	Shale	Symmetrical	6	325°	13.13
50	Jansenville	De Brokke Rivier Uit.Q.2-72	-	Upper Ecca	Shale	Symmetrical	3	104°	5.43

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
52	Jansenville	Klein Wolvenfontein Uit.Q.7-38	In Delports River	Upper Ecca	Siltstone	Symmetrical	4	82°	4.00
53	Janserville	Klein Brak Rivier Uit.Q.2-28	In stream	Upper Ecca	Shale	Symmetrical	3	115°	4.00
54	Jansenville	Klein Brak Rivier Uit.Q.2-28	In Delports river	Upper Ecca	Shale and siltstone	Symmetrical	3	109°	4.12
55	Jansenville	Karroo Vlakte Uit.Q.10.56	Side of road	Upper Ecca	Shale	Symmetrical	3	308°	8.36
56	Jansenville	Zwart Rivier Jan.Q.4-18	In stream	Upper Ecca	Fine sandstone	Symmetrical	7	123°	5.47
57	Jansenville	Klipfontein Uit.Q.2-41	In stream	Lower Ecca	Fine sandstone	Asymmetrical	6	114°	6.03
58	Aberdeen	Hops Rivier GR.Q.13-1	In stream	Lower Ecca	Shale	Asymmetrical	8	88°	6.52
59	Aberdeen	Hops Rivier GR.Q.13-1	In stream	Lower Ecca	Shale and siltstone	Symmetrical	4	47°	9.29
60	Aberdeen	Hops Rivier Lot No. 17 GR.Q.13-41	In Hops River	Lowermost Beaufort	Fine sandstone	Symmetrical	2	127°	4.00
61	Willowmore	Hottentots River	Outcrop in river	Lowermost beaufort	Fine sandstone	Symmetrical	4	74°	7.00

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
62	Willowmore	Grobbelaar Bf.W.Q.9-39	In Salt River	Upper Ecca	Shale and fine sandstone	Symmetrical	4	82°	5.95
65	Willowmore	Zoetendalsvlai P.A.Q.1-36	In stream	Lower Ecca	Fine sandstone	Symmetrical	3	240°	7.47
67	Willowmore	Slabbertspoort Wim.Q.2-9	In stream	Lower Ecca	Fine sandstone	Symmetrical	4	81°	4.76
70	Prince Albert	Modderdrift P.A.Q.2-21	Road cutting	Lower Ecca	Shale and siltstone	Symmetrical	5	303	7.91
72	Prince Albert	Jansens Kraal and Carolus Kraal Bf.W.Q.6-33	In donga	Lower Ecca	Fine sandstone	Symmetrical	3	97°	3.64
74	Prince Albert	Rietfontein Bf.W.Q.5-20	In stream	Lower Ecca	Fine sandstone	Symmetrical	10	338°	6.56
76	Prince Albert	Wolwe Kraal Bf.W.Q.5-23	Road cutting	Upper Ecca	Fine sandstone	Symmetrical	3	91°	5.88
78	Prince Albert	Swarte Bulletjie Bf.W.Q.5-24	Sandstone ledge	Upper Ecca	Fine sandstone	Symmetrical	4	342°	5.21
79	Prince Albert	Frans Kraal 1939-11-96	-	Upper Ecca	Fine sandstone	Symmetrical	3	270°	4.33
80	Prince Albert	Elandsberg and Jackalswater P.A.Q.2-10	In donga	Upper Ecca	Siltstone	Symmetrical	6	83°	6.13

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
81	Prince Albert	Tuin Kraal and Riet Kraal Bf.W.Q.4-56	Road cutting	Lowermost Beaufort	Fine sandstone	Symmetrical	3	66°	12.71
82	Prince Albert	Blaaukrans Bf.W.Q.4-57	Road cutting	Upper Ecca	Shale	Symmetrical	3	82°	10.86
83	Laingsburg	Kettangs Hoogte P.A.Q.4-6	Road cutting	Upper Ecca	Shale	Symmetrical	2	357°	11.15
84	Laingsburg	Leenderts-Kraal Wor.Q.12-33	In donga	Upper Ecca	Shale	Symmetrical	3	96°	9.00
85	Laingsburg	Gemsbokfontein Gr.159/1928	Outcrop on hillside	Upper Ecca	Shale	Symmetrical	3	271°	10.00
86	Laingsburg	Grootfontein Wor.Q.12-46	In stream	Upper Ecca	Shale	Symmetrical	4	302°	5.52
87	Laingsburg	Grootfontein Wor.Q.12-46	In donga	Upper Ecca	Shale	Symmetrical	3	315°	8.17
88	Laingsburg	Faberskraal Wor.Q.18-45	In Geelbecks river	Upper Ecca	Fine sandstone	Symmetrical	5	147°	11.79
89	Laingsburg	Geelbecks-kraal P.A.Q.2-1	Quarry	Middle Ecca	Shale	Symmetrical	4	107°	20.00

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
90	Laingsburg	Visch Kuil,etc. Wor.Q.12-51	Road cutting	Lower Ecca	Shale	Asymmetrical	4	97°	23.23
91	Laingsburg	Visch Kuil,etc. Wor.Q.12-51	Road cutting	Lower Ecca	Shale	Symmetrical	5	84°	10.09
92	Laingsburg	Doornkloof Wor.Q.15-8	Road cutting	Lower Ecca	Fine sandstone	Symmetrical	7	282°	9.95
93	Laingsburg	Doornkloof Wor.Q.15-8	Quarry	Lower Ecca	Shale	Symmetrical	3	184°	8.36
9-	Laingsburg	Wilgenhoutfontein Wor.Q.12-44	In stream	Middle Ecca	Shale and fine sandstone	Symmetrical	10	329°	8.29
95	Laingsburg	Wilgenhoutfontein Wor.Q.12-44	Road cutting	Upper Ecca	Fine sandstone		3	343°	11.11
96	Laingsburg	Fortuin Wor.Q.8-34	In donga	Lowermost Beaufort	Fine sandstone	Symmetrical	3	338°	16.00
99	Laingsburg	Hartjeskraal Wor.Q.20-8	Cliff	Middle Ecca	Fine sandstone	Symmetrical	4	128°	12.75
100	Laingsburg	De Rante Wor.Q.23-1	In stream	Lower Ecca	Shale and siltstone	Asymmetrical	7	160°	16.58
101	Laingsburg	Drie Koppen Wor.Q.21-21	In stream	Lower Ecca	Shale and siltstone	Symmetrical	3	165°	16.88

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
102	Ceres	Bantamsfontein 1935.231	In donga	Middle Ecca	Siltstone	Symmetrical	3	105°	10.89
103	Ceres	Bantamsfontein 1935.231	Side of road	Middle Ecca	Fine sandstone	Symmetrical	4	127°	13.75
107	Sutherland	Bloemfontein Su.Q.3-15	In stream	Upper Ecca	Fine sandstone	Symmetrical	8	142°	13.81
108	Ceres	Thyskraal Cer.Q.2-4	In donga	Upper Ecca	Fine sandstone	Symmetrical	2	93°	11.80
109	Ceres	Thyskraal Cer.Q.2-4	Side of road	Upper Ecca	Fine sandstone	Symmetrical	5	161°	17.10
110	Ceres	Oude Muur Cer.Q.1-19	Road cutting	Upper Ecca	Fine sandstone	Symmetrical	3	171°	19.17
111	Ceres	Oude Muur Cer.Q.1-19	In donga	Upper Ecca	Fine sandstone	Symmetrical	3	176°	19.00
112	Ceres	Oude Muur Cer.Q.1-19	Side of road	Middle Ecca	Siltstone	Symmetrical	3	123°	14.00
113	Ceres	Pienaarsfontein Cer.Q.2-10	In stream	Middle Ecca	Shale and siltstone	Symmetrical	4	168°	13.09
114	Sutherland	De Hoop Su.Q.3-13	In Tenqua River	Upper Ecca	Fine sandstone	Symmetrical	2	178°	15.00
115	Sutherland	Waterval Su.Q.4-1	Road quarry	Middle Ecca	Shale and fine sandstone	Symmetrical	4	126°	14.38

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
116	Sutherland	Waterval Su.Q.4-1	Gorge below waterfall	Middle Ecca	Shale	Symmetrical	8	141°	14.56
117	Sutherland	Tanqua Rivier Su.Q.3-5	In stream	Middle Ecca	Shale	Symmetrical	4	150°	17.88
118	Sutherland	Klip Drift	In donga	Upper Ecca	Fine sandstone	Symmetrical	3	156°	7.75
119	Sutherland	Klipbanks Rivier Wor.Q.20-1	Cliff	Upper Ecca	Fine sandstone	Symmetrical	3	253°	12.57
120	Sutherland	Blaauheuwel Su.Q.1-11	In Harthoeks River	Middle Ecca	Shale	Asymmetrical	3	112°	13.33
121	Sutherland	Bovenste wagen drift	West end of Koedoesberg	Middle Ecca	Fine sandstone	Symmetrical	4	136°	16.25
122	Sutherland	Leeu Kloof Su.Q.2-1	In Kloof	Middle Ecca	Siltstone and fine sandstone	Symmetrical	10	146°	16.81
123	Sutherland	Langekloof Su.Q.5-1	Cliffs	Middle Ecca	Fine sandstone	Symmetrical	10	175°	13.26
124	Calvinia	Kleinfontein	Top of Gannaga Pass	Upper Ecca	Fine sandstone	Symmetrical	10	159°	13.44
125	Calvinia	Gannaga Outspan 21-1950	Middle of Gannaga Pass	Middle Ecca	Fine sandstone	Symmetrical	3	13°	11.64

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	Symmetry of crests	No. Measure-ments	Mean Strike	Ripple Index
126	Calvinia	Kleinfontein Clv.Q.9-2	Top of Gannaga Pass	Lowermost Beaufort	Siltstone	Symmetrical	8	79°	8.92
127	Calvinia	Blaauwkop Clv.Q.16-5	Baviaanskop	Upper Ecca	Fine sand-stone	Symmetrical	4	169°	15.88
128	Calvinia	Klip Plaat Annexure Clv.Q.29-11	Cliffs	Upper Ecca	Shale and siltstone	Symmetrical	4	169°	20.86
129	Calvinia	Roodefortein Clv.Q.2-31	Cliffs	Upper Ecca	Shale and fine sand-stone	Symmetrical	6	160°	17.09
130	Calvinia	Roodefontein Clv.Q.2-31	Cliffs	Upper Ecca	Fine sand-stone	Symmetrical	10	158°	16.14
131	Calvinia	Aurets Kloof Clv.Q.22-20	Cliffs	Upper Ecca	Fine sand-stone	Symmetrical	10	161°	16.40
132	Calvinia	Uitkomst Clv.Q.2-35	Side of road	Upper	Fine sand-	Symmetrical	7	178°	18.33
133	Calvinia	Hangnes Clv.Q.32-10	In stream	Upper Ecca	Fine sand-stone	Symmetrical	5	141°	12.79
134	Calvinia	Rietfontein Clv.Q.2-26	Cliffs	Upper Ecca	Fine sand-stone	Symmetrical	8	155°	16.81
135	Calvinia	Albertfonteins Rugpens Clv.Q.3-50	Cliffs	Upper Ecca	Siltstone	Symmetrical	5	157°	18.80

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
136	Calvinia	Mierskloof Wor.Q.4-63	Cliffs	Upper Ecca	Fine sandstone	Symmetrical	8	139°	15.22
137	Calvinia	Driekuil 1947.70	Side of hill	Upper Ecca	Fine sandstone	Symmetrical	4	106°	12.58
138	Calvinia	Driekuil 1947.70	In stream	Middle Ecca	Shale	Symmetrical	2	94°	32.00
139	Calvinia	Groot Vloeren Clv.Q.13-37	Cliffs	Upper Ecca	Shale and fine sandstone	Symmetrical	8	164°	20.43
140	Calvinia	Leeuwenkuil Clv.Q.2-8	Sandstone ledge	Lowermost Beaufort	Fine sandstone	Symmetrical	8	169°	20.14
141	Calvinia	Hamburg 1929.140	Cliffs	Lowermost Beaufort	Fine sandstone	Symmetrical	4	166°	23.33
142	Williston	Rietfontein	Road cutting	Lowermost Beaufort	Fine sandstone	Symmetrical	4	171°	28.40
143	Williston	Lekker Leg Fr.Q.3-22	Road cutting	Lowermost Beaufort	Fine sandstone	Symmetrical	6	137°	15.46
144	Williston	Lunskloof Fr.Q.7-12	Road cutting	Lowermost Beaufort	Fine sandstone	Symmetrical	6	149°	18.09
145	Williston	Voorste van Zyls Plaats Fr.Q.8-7	In donga	Lowermost Beaufort	Fine sandstone	Symmetrical	6	145°	23.10

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
146	Williston	Springersburg Leegte Fr.Q.9-36	In donga	Upper Ecca	Shale	Symmetrical	4	183°	16.00
147	Williston	Elias Leegte Fr.Q.5-36	Side of hill	Upper Ecca	Fine sandstone	Symmetrical	3	161°	16.50
148	Williston	Bakoven Fr.Q.11-4	Cliffs	Upper Ecca	Fine sandstone	Symmetrical	4	183°	15.88
149	Williston	Agterste van Zyls Plaats Fr.Q.9-18	In stream	Upper Ecca	Shale	Symmetrical	2	190°	18.25
130	Williston	Onseluksfontein Fr.Q.9-13	Side of road	Lowermost Beaufort	Fine sandstone	Symmetrical	3	122°	15.50
151	Williston	Vaalhoek Fr.Q.1-24	Side of road	Lowermost Beaufort	Siltstone	Symmetrical	2	118°	20.00
152	Williston	Bloemfontein Fr.Q.2-20	In donga	Lowermost Beaufort	Siltstone	Symmetrical	2	123°	28.00
155	Williston	Dassie Kloof Fr.Q.3-15	In donga	Upper Ecca	Fine sandstone	Symmetrical	3	180°	15.52
156	Williston	Van Reenens Plaats Fr.Q.1-11	In stream	Upper Ecca	Shale	Symmetrical	10	170°	18.17
157	Williston	Karreeboom Fr.Q.3-14	In donga	Upper Ecca	Shale	Symmetrical	3	176°	21.80

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
158	Williston	Kareeboom Fr.Q.3-14	In donga	Upper Ecca	Fine sandstone	Symmetrical	4	154°	15.38
159	Williston	Klein Paarde Kloof Fr.Q.4-1	In donga	Upper Ecca	Fine sandstone	Symmetrical	5	127°	15.73
160	Williston	Ruitersfontein Fr.Q.2-16	In stream	Lowermost Beaufort	Fine sandstone	Symmetrical	3	95°	34.66
161	Williston	Drooge Puts	In donga	Lowermost Beaufort	Fine sandstone	Symmetrical	3	158°	18.50
162	Carnarvon	Klip Kalk Fr.Q.1-21	Side of road	Lowermost Beaufort	Fine sandstone	Symmetrical	2	165°	15.00
163	Carnarvon	Witfontein Car.Q.4-1	Side of road	Lowermost Beaufort	Shale and siltstone	Symmetrical	4	175°	16.89
164	Carnarvon	Witfontein Car.Q.4-1	Side of road	Lowermost Beaufort	Shale and siltstone	Symmetrical	4	160°	14.30
165	Carnarvon	Konka A 1936-157	Side of hill	Upper Ecca	Fine sandstone	Symmetrical	6	173°	18.27
166	Carnarvon	Klederenfontein Bf.W.Q.3-47	In donga	Lowermost Beaufort	Shale	Symmetrical	5	161°	16.40
167	Carnarvon	Carnarvon Commonage	Road cutting	Lowermost Beaufort	Fine sandstone	Symmetrical	6	164°	11.59
168	Carnarvon	Carnarvon Commonage	Sandstone ledge	Upper Ecca	Fine sandstone	Symmetrical	8	153°	20.53

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
169	Carnarvon	Rem Blaauw Krantz Bf.W.Q.3-63	Side of Hill	Lowermost Beaufort	Shale and fine sandstone	Symmetrical	6	162°	17.17
170	Carnarvon	Kareebosch Fontein Bf.W.Q.3-63	In stream	Upper Ecca	Fine sandstone	Symmetrical	6	144°	16.33
171	Carnarvon	Remainder of Lower Zwartrand V.W.Q. 1-24	Side of hill	Upper Ecca	Siltstone	Symmetrical	3	171°	18.40
172	Carnarvon	Upper Zwartrand V.W.Q.1-24	In stream	Upper Ecca	Shale	Symmetrical	2	171°	-
173	Victoria West	Biesjes Dam	Aasvoelkop	Upper Ecca	Shale and siltstone	Symmetrical	4	132°	16.63
174	Victoria West	Pampoenpoort V.W.Q.3-2	Side of road	Lowermost Beaufort	Fine sandstone	Symmetrical	8	113°	13.74
175	Victoria West	Pampoenpoort V.W.Q.3-2	Side of road	Lowermost Beaufort	Fine sandstone	Symmetrical	6	164°	14.29
176	Victoria West	Biesjeskuil 888/1944	In stream	Lowermost	Fine sand-	Symmetrical	5	141°	9.47
177	Victoria West	Riet Poort Bf.W.Q.2-56	In stream	Lowermost Beaufort	Fine sandstone	Symmetrical	2	60°	11.50

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	Symmetry of crests	No. Measure-ments	Mean Strike	Ripple Index
178	Victoria West	Vaark Fontein Bf.W.Q.2-38	In stream	Lowermost Beaufort	Fine sand-stone	Symmetrical	8	136°	17.20
180	Victoria West	Wolwekop V.W.Q.3-21	Near dam	Upper Ecca	Fine sand-stone	Symmetrical	2	113°	29.50
181	Britstown	Daggafontein Bf.W.Q.23.45	Leebskop	Upper Ecca	Shale and fine sand-stone	Symmetrical	10	162°	15.18
182	Victoria West	Lot 453 of Biesjes Dam Ric.Q.1-15	Cliff	Lowermost Beaufort	Fine sand-stone	Symmetrical	8	165°	16.75
183	Richmond	Biesjes Dam Ric.Q.1-14½	In donga	Lowermost Beaufort	Fine sand-stone	Symmetrical	5	117°	11.89
184	Richmond	Schramfontein Ric.Q.5-6	Side of hill	Lowermost Beaufort	Fine sand-stone	Symmetrical	3	115°	13.86
185	Richmond	Allemans Combeis Ric.Q.1-20	-	Lowermost Beaufort	Fine sand-stone	Symmetrical	4	166°	14.11
186	Britstown	Combeisfontein Co.Q.2-55	Quarry	Lowermost Beaufort	Shale	Symmetrical	10	145°	18.00
187	Britstown	Jackals Kuylen Co.Q.2-52	In gul[illegible]	Lowermost Beaufort	Shale	Symmetrical	4	161°	24.67
188	Britstown	Jackals Kuylen Co.Q.2-52	Cutting	Lowermost Beaufort	Fine sand stone	Symmetrical	2	1°	19.00

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	Symmetry of crests	No. Measure-ments	Mean Strike	Ripple Index
189	De Aar	Bosjesmans Fountain Co.Q.4-28	Side of road	Upper Ecca	Fine sand-stone	Symmetrical	2	144°	17.50
190	Britstown	Twyfelhoek Co.Q.3-63	Quarry	Upper Ecca	Shale	Symmetrical	3	117°	20.40
191	De Aar	De Aar Ric.Q.3-11	Quarry	Upper Ecca	Shale	Symmetrical	8	133°	11.88
192	De Aar	Paarde Vley No. 1.Br.F. 1-1	Road Quarry	Upper Ecca	Shale	Symmetrical	8	155°	25.91
193	De Aar	Jackhals Fontein Co.Q.8-5	Cutting	Upper Ecca	Shale	Symmetrical	4	138°	17.25
194	De Aar	Weigegund Co.Q.5-97	Cutting	Upper Ecca	Shale	Symmetrical	4	136°	19.25
195	De Aar	Pienaars Kloof Ph.Q.1-10	-	Upper Ecca	Shale	Symmetrical	2	143°	32.00
196	Philipstown	Modderfontein Ph.Q.2-3	Side of road	Upper Ecca	Fine sand-	Symmetrical	3	147°	19.17
198	Philips-town	Slingers-fontein Ph.Q.1-16	In stream	Lowermost Beaufort	Shale	Symmetrical	6	64°	28.00
199	Philips-town	Winkel Haak Ph.Q.1-9	Side of road	Lowermost Beaufort	Fine sand-stone	Symmetrical	3	94°	7.00

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
200	Colesberg	Bischuitfontein Co.Q.3-19	In donga	Lowermost Beaufort	Shale	Symmetrical	7	125°	12.95
202	Colesberg	Schaapekraal Gr.Q.7-19	In donga	Ecca Series	Shale	Asymmetrical	16	135°	12.64
210	Philipstown	Rietvalley Co.Q.3-32	In stream	Lowermost Beaufort	Fine sandstone	Symmetrical	11	148°	8.75
211	Philippolis	Somersfontein 69	In donga	Lowermost Beaufort	Shale	Symmetrical	3	88°	9.67
213	Philippolis	Uitzicht 185	In Knopsak river	Lowermost Beaufort	Fine sandstone	Asymmetrical	5	84°	7.14
214	Philippolis	Witfontein 39	Side of road	Lowermost Beaufort	Shale	Symmetrical	4	153°	5.00
215	Philippolis	Vrede 491	Road quarry	Lowermost Beaufort	Fine sandstone	Symmetrical	5	58°	6.40
216	Philippolis	Boesmansfontein 6	In donga	Lowermost Beaufort	Siltstone	Symmetrical	8	86°	4.24
217	Philippolis	Philippolis 143	Side of road	Lowermost Beaufort	Shale	Symmetrical	3	160°	3.33
219	Philippolis	Otterpoort 243	In donga	Lowermost Beaufort	Siltstone	Symmetrical	8	99°	7.81

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. Measurements	Mean Strike	Ripple Index
220	Philippolis	Groot Waaihoek 284	In donga	Lowermost Beaufort	Siltstone	Symmetrical	12	163°	5.27
222	Colesberg	Blaauw Krans Co.Q.9-15	In van der Walts river	Lowermost Beaufort	Siltstone	Symmetrical	8	13°	3.56
224	Colesberg	Twyffels Poort Gr.Q.7-26	In stream	Lowermost Beaufort	Shale	Symmetrical	20	159°	5.94
225	Colesberg	Gannahoek Gr.Q.7-27	In donga	Lowermost Beaufort	Shale	Symmetrical	2	52°	7.69
226	Colesberg	Twyffels Poort Gr.Q.7-26	In donga	Lowermost Beaufort	Shale	Symmetrical	5	15°	7.20
229	Trompsburg	Koortshoek 302	In donga	Lowermost Beaufort	Fine sandstone	Symmetrical	10	91°	6.70
230	Trompsburg	Koortshoek 302	In donga	Lowermost Beaufort	Fine sandstone	Symmetrical	5	56°	7.24

APPENDIX 6

STATISTICAL DATA ON CROSS-BEDDING IN THE CAPE PROVINCE AND SOUTHERNMOST ORANGE FREE STATE

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
1	East London	-	South bank of Buffalo river	Lowermost Beaufort	Fine sandstone	4	38°	0.99	21"
2	East London	-	Chalumna Pass	Middle Beaufort	Coarse sandstone and conglomerate	3	327°	0.63	
3	East London	Kidds Beach	Rocks along shore line	Middle Beaufort	Coarse sandstone and conglomerate	10	14°	0.38	21"
4	East London	Farm No. 7 E.L.Q.5-7	Above Keiskamma river	Lowermost Beaufort	Fine sandstone	2	352°	0.75	
5	Peddie	Hamburg Commonage	South bank of Keiskamma river	Lowermost Beaufort	Fine sandstone	2	347°	0.80	
14	Albany	Lot A.1 Aly.Q.12-15	Road cutting	Lower Ecca	Fine sandstone	2	46°	0.98	
16	Albany	-	Road cutting	Upper Ecca	Fine sandstone	2	358°	0.99	
17	Albany	Thrieve Farm Aly.Q.19-7	Road cutting	Upper Ecca	Fine sandstone	8	346°	0.49	18"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar C. oss-bedded units
18	Albany	Lifford Aly.Q.20-7	Road cutting	Upper Ecca	Fine sand-stone	3	338°	0.98	22"
19	Albany	Fontein Floot Aly.Q.10-5	Road cutting	Upper Ecca	Fine sand-stone	4	32°	0.88	14"
22	Albany	Schelm Drift Aly.Q.20-6	In donga	Upper Ecca	Fine sand-stone	2	341°	0.98	27"
23	Albany	Olifants Kloof Aly.Q.16-10	In stream	Upper Ecca	Fine sand-stone	3	2°	0.97	13"
24	Albany	Mountain top Aly.Q.10-58	Sandstone ledge	Upper Ecca	Fine sand-stone	3	19°	0.97	24"
26	Bedford	Collisfontein Som.Q.5-45	In stream	Upper Ecca	Fine sand-stone	3	9°	0.97	17"
29	Bedford	Caffirs Kloof Som.Q.3-24	In donga	Upper Ecca	Fine sand-stone	5	347°	0.68	15"
30	Somerset East	Middleton Som.Q.16-12	Road cutting	Upper Ecca	Fine sand-stone	8	349°	0.84	22"
32	Somerset East	Palmiet-fontein Som.Q.6-21	In donga	Upper Ecca	Fine sand-stone	2	355°	0.65	19"

Cut-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
48	Jansenville	Driekops Vley East Jan.Q.2-17	In Driekops River	Lowermost Beaufort	Fine sand-stone	3	344°	0.95	
71	Prince Albert	Modderdrift P.A.Q.2-21	In stream	Lower Ecca	Fine sand-stone	2	35°	0.98	
75	Prince Albert	Prince Albert Commonage Bf.W.Q.5-5	Prince Albert hill	Upper Ecca	Fine sand-stone	3	316°	0.97	16"
97	Laingsburg	Barendskraal Wor.Q.8-57	Cliff	Upper Ecca	Fine sand-stone	4	86°	0.65	20"
98	Laingsburg	Barendskraal Wor.Q.8-57	Cliff	Upper Ecca	Fine sand-stone	4	89°	0.98	72"
104	Ceres	Gats Rivier	Cliff	Upper Ecca	Fine sand-stone	3	89°	0.97	20"
106	Sutherland	Wind Heuvel Su.Q.4-10	Cliff	Upper Ecca	Fine sand-stone	4	333°	0.93	20"
153	Williston	Koega Fr.Q.11-23	In stream	Lowermost Beaufort	Fine sand-stone	8	54°	0.98	
154	Williston	Oest	In stream	Lowermost	Fine sand-	5	32°	0.94	
179	Victoria	Kraanvoegel Vley V. .Q.11-33	In Brok River	Upper Ecca	Fine sand-stone	6	54°	0.98	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
201	Colesberg	Kuipers-fontein G.R.Q.7-15	In Seekoei river	Lowermost Beaufort	Fine sand-stone	8	338°	0.86	8"
218	Philippolis	Philippolis 143	Cliff	Lowermost Beaufort	Medium sand-stone	4	308°	0.99	18"
221	Colesberg	Rietbult G.R.Q.7-29	Sandstone ledge	Lowermost Beaufort	Fine sand-stone	6	74°	0.87	16"
223	Colesberg	Blaauwkrans Co.Q.9-15	Cliff	Lowermost Beaufort	Medium sand-stone	4	78°	0.99	
227	Colesberg	Schaape kraal G.R.Q.7-19	Sandstone ledge	Lowermost Beaufort	Medium sand-stone	3	34°	0.93	
228	Colesberg	Schaape kraal G.R.Q.7-19	Cliff above Seekoei river	Upper Ecca	Fine sand-stone	3	65°	0.87	7"

APPENDIX 7

STATISTICAL DATA ON GROOVE CASTS IN THE CAPE PROVINCE AND SOUTHERNMOST ORANGE FREE STATE

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Mean Orientation	Remarks
6	Peddie	Gnusha Poort Ped.Q.22-25	Road cutting	Lower Ecca	Siltstone	6	74°	
8	Peddie	Hogsback Ped.Q.1-3	Along shoreline	Lower Ecca	Siltstone	3	72°	
12	Albany	Lot A.H. Aly.Q.12-14	Road cutting	Lower Ecca	Siltstone	10	40°	
13	Albany	Lot A.L. Aly.Q.12-15	Road cutting	Lower Ecca	Siltstone	3	72°	
20	Albany	Jordaans Kraal Aly.Q.3-36	Cliff	Lower Ecca	Siltstone	7	354°	
59	Aberdeen	Hops Rivier Gr.Q.131	In stream	Lower Ecca	Fine sandstone	12	351°	
-3	Willowmore	Blabberts Poort Estate 1931-63	Small hill	Lower Ecca	Siltstone	12	5°	
64	Willowmore	Zoetendals Vlei P.A.Q.1-36	In stream	Lower Ecca	Siltstone	5	271°	
66	Willowmore	Schilpads Vlakte Lot 2 Wlm.Q.2-1	In strear	Lower	Siltstone	4	84°	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Mean Orientation	Remarks
68	Prince Albert	Riet Kuil P.A.Q.3-4	Side of road	Lower Ecca	Siltstone	3	107°	
69	Prince Albert	Klipgat P.A.Q.67	In stream	Lower Ecca	Siltstone	10	82°	
73	Prince Albert	Groot Tygerberg	Road cutting	Lower Ecca	Fine sandstone	3	353°	
77	Prince Albert	Swart Billetie Bf.W.Q.5-24	Road cutting	Lower Ecca	Siltstone	4	336°	

APPENDIX 8

STATISTICAL DATA ON PARTING LINEATIONS IN THE CAPE PROVINCE AND SOUTHERNMOST ORANGE FREE STATE

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Mean Orientation	Remarks
31	Somerset East	Botha's Baaken Som.Q.17-28	In quarry	Upper Ecca	Fine sand-stone	6	336°	
33	Somerset East	Palmietfontein	In donga	Upper Ecca	Fine sand-stone	5	38°	
51	Jansenville	Jansenville Commonage	Below Sundays river bridge	Lowermost Beaufort	Fine sand-stone	3	360°	
105	Sutherland	Wind Heuvel Su.Q.4-10	In stream	Upper Ecca	Fine sand-stone	3	53°	

APPENDIX 9

STATISTICAL DATA ON FUCOID STRUCTURES IN THE CAPE PROVINCE AND SOUTHERNMOST ORANGE FREE STATE

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Mean length of Fucoids	Arithmetic Mean		Standard Deviation	Ratio of No. of measurements constituting each mean
197	Philipstown	Slagtkraal Ph.Q.2-10	In stream	Ecca Series	Shale	11	16.32"	194° 119°	-	-	1.80 1.00
203	Colesberg	Bultfontein Gr.Q.7-18	In Seekoei river	Ecca Series	Shale	20	6.15"	285° 24°	-	-	2.33 1.00
204	Colesberg	Deerde Poort Gr.Q.7-20	In stream	Ecca Series	Shale	10	6.38"	272° 335°	-	-	1.00 2.33
205	Colesberg	Deerde Poort Gr.Q.7-20	In donga	Ecca Series	Shale	6	10.25"	274° 356°	-	-	2.00 1.00
206	Colesberg	Doorn Kloof Gr.Q.7-22	In donga	Ecca Series	Shale	5	6.20"	272° 346°	-	-	1.00 1.50
207	Colesberg	Broeder-strom Co.Q.3-30	In donga	Ecca Series	Shale	7	5.36"	290° 207°	-	-	2.10 1.00
208	Colesberg	Kattegat Co.Q.3-29	In donga	Ecca Series	Shale	6	5.00"	259° 351°	-	-	1.00 1.00
209	Colesberg	Kattegat Co.Q.3-29	In stream	Ecca Series	Shale	6	5.93"	220° 325°	-	-	1.00 1.00

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constit-uent Material	No. of Measure-ments	Mean length of Fucoids	Arith-metic Means	Vari-ence	Stan-dard Devia-tion	Ratio of No. of measure-ments con-stituting each mean
212	Philippolis	Bloedfontein 120	In stream	Ecca Series	Shale	5	8.20"	253° 167°	-	-	1.00 1.50

APPENDIX 10

STATISTICAL DATA ON CROSS-BEDDING IN THE EASTERN PORTION OF THE KARROO BASIN

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
1	Umvoti	Mount Ernestena 1802	Cutting	Middle Ecca	Medium sandstone	4	163°	0.96	
2	Umvoti	Rust 1112	Cutting	Middle Ecca	Coarse-medium sandstone	4	217°	0.99	
3	Umvoti	Bankfontein	Side of hill	Middle Ecca	Coarse sandstone	5	164°	0.62	
4	Umvoti	Rustenburg 1116	Above Umvoti river	Middle Ecca	Coarse felspathic sandstone	7	205°	0.96	15"
5	Estcourt	-	Side of road	Lowermost Beaufort	Medium sandstone	3	295°	0.97	
6	Lions River	Wellington 2212	Road cutting	Lowermost Beaufort	Medium sandstone	3	2°	0.97	
7	Estcourt	Estcourt Townlands	In Bushmans river	Lowermost Beaufort	Medium sandstone	5	240°	0.92	
8	Pietermaritzburg	Otto's Bluff 13013	Cliffs	Middle Ecca	Coarse sandstone	6	144°	0.98	66"

Outcrop No.	District	Farm	Cutcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
9	Pietermaritzburg	Pietermaritzburg Townlands	Cliffs on Town hill	Middle Ecca	Coarse sandstone	7	246°	0.98	22"
10	Pietermaritzburg	Pietermaritzburg Townlands	Sweet waters quarry	Middle Ecca	Coarse sandstone	6	264°	0.57	25"
11	Mpendle	Elandshoek 1024	Side of road	Lowermost Beaufort	Medium sandstone	5	282°	0.78	
12	Pietermaritzburg	Zwart Kop Native Location	Road cutting	Middle Ecca	Coarse sandstone	4	179°	0.90	
13	Pietermaritzburg	Zwart Kop Native Location	Road cutting	Middle Ecca	Coarse sandstone	10	278°	0.87	14"
14	Richmond	Drie Fontein 854	Road cutting	Middle Ecca	Medium sandstone	4	206°	0.98	15"
15	Richmond	Dunbar Estate 1478	Road cutting	Middle Ecca	Medium sandstone	5	223°	0.94	
16	Richmond	Weltevreden 1298	In stream	Middle Ecca	Medium sandstone	6	222°	0.67	26"
17	Richmond	Roselands 13833	Above waterfall	Middle Ecca	Medium sandstone	3	240°	0.98	"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
18	Ixopo	-	Hele-Hele pass	Middle Ecca	Coarse sandstone	4	210°	0.80	
19	Ixopo	-	Hele-Hele pass	Middle Ecca	Coarse sandstone	10	247°	0.72	20"
20	Underberg	-	Side of road	Lowermost Beaufort	Medium sandstone	5	245°	0.97	
21	Underberg	-	Road cutting	Middle Beaufort	Medium sandstone	3	337°	0.97	
22	Polela	Location No.2	Sandstone ledge	Lowermost Beaufort	Coarse sandstone	3	246°	0.93	
23	Inanda	Tongaat Beach	Along shore-line	Middle Ecca	Fine-medium sandstone	8	326°	0.84	6.5"
24	Inanda	Cenozzana Beach	Along shore-line	Middle Ecca	Fine-medium sandstone	5	322°	0.82	15.0"
25	Inanda	-	South bank of Umdhloti river	Middle Ecca	Coarse grit and sand-stone	3	230°	0.97	21.0"
26	Inanda	Umhlanga Rocks	Rocks along beach	Middle Ecca	Coarse grit and sand-stone	14	252°	0.91	26.4"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded Units
27	Inanda	Duffs Road	Railway cutting	Middle Ecca	Coarse sandstone	6	223°	0.50	15.0"
28	Inanda	Zeekoe Vallei 787	Quarry	Middle Ecca	Coarse sandstone	7	123°	0.83	21.0"
29	Umlazi	Umnini Location 1788	Rocks along shoreline	Middle Ecca	Coarse grit and sandstone	14	283°	0.94	16.0"
30	Ixopo	-	Above Qunu Falls	Middle Ecca	Medium sandstone	5	137°	0.54	10.0"
31	Ixopo	Cassington 4287	Road cutting	Middle Ecca	Medium sandstone	2	229°	0.85	11.0"
32	Ixopo	-	Road cutting	Middle Ecca	Coarse felspathic sandstone	5	196°	0.98	10.0"
33	Umzimkulu	-	Road cutting	Middle Ecca	Coarse sandstone	2	207°	0.80	13.5"
34	Umzimkulu	-	Road cutting	Middle Ecca	Coarse sandstone	5	151°	0.86	9.0"
35	Umzimkulu	Location No. 23	Road cutting	Middle Ecca	Coarse sandstone	4	220°	0.95	12.0"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
36	Alfred	The Uplands 7885	Road cutting	Middle Ecca	Medium sandstone	3	230°	0.93	7.0"
37	Kokstad	Zuurfontein G.E.Q.1-13	In stream	Lowermost Beaufort	Fine sandstone	3	277°	0.97	
38	Port Shepstone	Sea Park	Side of hill	Middle Ecca	Fine-medium sandstone	2	248°	0.85	
39	Mount Frere	Rode Location No. 28	Road cutting	Lowermost Beaufort	Medium sandstone	3	305°	0.98	
40	Mount Frere	Mount Frere Commonage	Road cutting	Middle Beaufort	Medium-coarse sandstone	5	36°	0.98	
41	Qumbu	Lwandlana Location No. 32	Road cutting	Middle Beaufort	Medium sandstone	3	330°	0.97	
42	Qumbu	Qumbu Commonage 102	Road cutting	Middle Beaufort	Medium sandstone	4	27°	0.90	
43	Tsolo	Mbokotwana Location No. 3	South bank of Tsitsa river	Middle Beaufort	Medium sandstone	4	322°	0.95	
44	Libode	Sibangweni Location No. 9	Road cutting	Lowermost Beaufort	Fine sandstone	3	353°	0.98	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
45	Umtata	Umtata Commonage 912 Umt. F.2-5	Cliff	Lowermost Beaufort	Fine sandstone	4	325	0.85	
47	Nggeleni	Mpoza Location No. -3	Road cutting	Ecca Series	Siltstone	2	55°	0.98	10.5"
50	Nggeleni	Lucingweni Location No.	Road cutting	Lowermost Beaufort	Medium sandstone	10	83°	0.93	16.0"
54	Lusikisiki	Lower Ntafufu Location No. 35	Rocks along shoreline	Lowermost Beaufort	Fine sandstone	4	32°	0.93	
55	Port St. John's	Port St. Johns Commonage	1st Beach	Lowermost Beaufort	Medium sandstone	3	60°	0.93	24.0"
58	Elliotdale	Hobeni Location No. 27	Rocks along shoreline	Ecca Series	Fine sandstone	5	344°	0.62	18.5"
59	Xentani	Geina Location No. 12	Rocks along shoreline	Lowermost Beaufort	Fine sandstone	7	11°	0.77	17.5"
60	Willowvale	Ntlabane Location No. 10	Sandstone ledge	Lowermost Beaufort	Fine sandstone	3	6°	0.77	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-Bedded units
61	Willowvale	Nqadu Location No. 9	Sandstone ledge	Lowermost Beaufort	Fine sand-stone	3	339°	0.77	
63	Elliotdale	Sholora Location No. 36	Left bank of Beshee river	Ecca Series	Fine sand-stone	2	324°	0.99	14.0"
64	Elliotdale	Xora Loca-tion No. 20	In Xora river	Lowermost Beaufort	Fine sand-stone	7	351°	0.86	
65	Kentani	Sholora Loca-tion No. 47	Rocks along shoreline	Middle Beaufort	Medium-coarse sandstone	12	299°	0.92	20.0"
66	East London	Glen Garrif Beach	Rocks along shoreline	Middle Beaufort	Medium-coarse sandstone	5	331°	0.86	
67	East London	-	Road cutting	Middle Beaufort	Medium-coarse sandstone	3	6°	0.90	
68	Komga	-	South bank of the Kei river	Lowermost Beaufort	Fine sand-stone	5	286°	0.80	

APPENDIX 11

STATISTICAL DATA ON PARTING LINEATIONS IN THE EASTERN PORTION OF THE KARROO BASIN

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Mean Orientatio..	Remarks
46	Port St. Johns	Ntsimbini Location No. 3	Road quarry	Ecca Series	Shale	2	211°	
49	Ngqeleni	Lower Ndungunyeni Location No. 47	Side of road	Lowermost Beaufort	Medium sandstone	4	176°	
53	Lusikisiki	Lower Ntafufu Location No. 35	Quarry	Ecca Series	Shale	8	212°	
56	Mganduli	Ntonjane Location No. 18	Rocks along shoreline	Ecca Series	Shale and siltstone	3	319°	

APPENDIX 12

STATISTICAL DATA ON GROOVE CASTS IN THE EASTERN PORTION OF THE KARROO BASIN

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Mean Orientation	Remarks
51	Mquanduli	Lower Nenga Location No. 19	Cliffs along shoreline	Ecca Series	Siltstone and shale	12	312°	Prod casts also present.
52	Mquanduli	Lower Nenga Location No. 19	Cliffs along shoreline	Ecca Series	Siltstone	10	18°	Prod casts also present.
57	Elliotdale	Mncwasa Location No. 1	Mbolompo Point	Ecca Series	Siltstone	3	360°	
62	Willowvale	Gakazana Location No. 23	Road cutting	Ecca Series	Siltstone	3	291°	

APPENDIX 13

STATISTICAL DATA ON RIPPLE MARKS IN THE EASTERN PORTION OF THE KARROO BASIN

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	Symmetry of crests	No. of Measurements	Mean Strike	Ripple Index
48	Ngqeleni	Intsimbini Location No. 48	In donga	Lowermost Beaufort	Fine sandstone	Symmetrical	4	237°	4.20
54	Lusikisiki	Lower Ntafufu Location	Rocks along shoreline	Lowermost Beaufort	Siltstone	Symmetrical	2	190°	6.00

APPENDIX 14

STATISTICAL DATA ON CROSS-BEDDING IN THE SOUTH-EASTERN PORTION OF THE BASIN

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
1	Dundee	-	Cutting	Below coal zone	Coarse sandstone and grit	10	178°	0.59	92"
2	Msinga	Kliprivier Location 4672	In stream	Below coal zone	Coarse-medium sandstone	26	160°	0.78	20"
3	Dundee	Uithoek 1078	In stream	Below coal zone	Coarse grit and sandstone	15	229°	0.91	27"
4	Dundee	Uithoek 1078	In stream	Below coal zone	Coarse sandstone	1	248°	-	-
5	Dundee	Vermanks kraal 1124	In stream	Below coal zone	Coarse grit and sandstone	6	202°	0.93	-
6	Dundee	Vermanks kraal 1124	In stream	Below coal zone	Coarse grit and sandstone	15	207°	0.60	-
7	Dundee	Verrelegen 1157	In stream	Below coal zone	Coarse sandstone	5	196°	0.96	34"

Out-crop No.	District	Farm	Outcrop description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
8	Dundee	Uitval 1244	Quarry	Below coal zone	Coarse sand-stone	7	194°	0.89	-
9	Dundee	Goede Keuse 1066	[illegible] stream	Below coal zone	Medium sandstone	3	161°	0.90	8"
10	Dundee	Goede Keuse 1066	[illegible] spruit	Below coal zone	Medium sandstone	5	158°	0.98	-
11	Dundee	Goede Keuse 1066	[illegible] stream	Below coal zone	Coarse-medium sandstone	5	204°	0.98	-
12	Dundee	Uitval 1244	[illegible]de of road	Below coal zone	Medium sandstone	5	181°	0.58	11"
13	Dundee	Vaal Kop 1164	[illegible]de of road	Below coal zone	Medium sandstone	6	159°	0.68	-
14	Dundee	Vaal Kop 1164	[illegible] Waschbank river	Below coal zone	Coarse sandstone	14	229°	0.88	14"
15	Dundee	Uitvlucht 1156	[illegible]de of road	Below coal zone	Coarse sand-stone and grit	11	106°	0.96	42"
16	Dundee	Uitvlucht 1156	[illegible] stream	Below coal zone	Coarse sandstone	5	195°	0.92	-

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
17	Dundee	Uitvlucht 1156	Small hill	Below coal zone	Coarse sandstone	13	295°	0.92	32"
18	Dundee	Uitvlucht 1156	In stream	Below coal zone	Coarse sandstone	7	166°	0.81	-
19	Dundee	Uitvlucht 1156	In stream	Below coal zone	Coarse sandstone	7	221°	0.89	-
20	Kliprivier	Opmerkzaamheid 1394	Side of road	Below coal zone	Coarse sandstone	8	198°	0.98	-
21	Kliprivier	Olifants Kop 1259	In donga	Below coal zone	Medium sandstone	5	208°	0.44	-
22	Kliprivier	Opmerkzaamheid 1394	In stream	Below coal zone	Coarse sandstone and grit	15	260°	0.78	-
23	Kliprivier	Olifants Kop 1259	In donga	Below coal zone	Fine sandstone	9	299°	0.64	-
24	Dundee	Petronella	In donga	Below coal zone	Coarse sandstone and grit	15	253°	0.95	-
25	Dundee	Niekerks Kraal 1167	Cutting	Above coal zone	Coarse sandstone and grit	10	178°	0.33	73"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
26	Dundee	Niekerks Kraal 1167	In stream	Above coal zone	Coarse sandstone	11	176°	0.76	18"
27	Dundee	Kleine Water-val 1125	In stream	Below coal zone	Coarse sandstone	15	219°	0.93	120"
28	Dundee	Klipfontein	In stream	Below coal zone	Coarse sandstone	10	147°	0.91	-
29	Dundee	Kuick Vlei Settlement 12751	In stream	Below coal zone	Fine sand-stone	6	202°	0.78	-
30	Dundee	Kuick Vlei Settlement	Small hill	Below coal zone	Coarse sandstone	5	210°	0.98	120"
31	Dundee	Verdruk 2080	In stream	Below coal zone	Coarse sandstone	8	134°	0.84	32"
32	Dundee	Krantz-Kop 1065	In stream	Below coal zone	Coarse sandstone	10	172°	0.95	120"
33	Dundee	Goedekeuse 1066	In spruit	Below coal zone	Coarse sandstone	7	188°	0.83	18"
34	Dundee	Paarde Berg 1068	Cliffs	Coal zone	Fine-medium sandstone	3	236°	0.97	7"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
35	Dundee	Paarde Berg 1068	In donga	Coal zone	Coarse-medium sandstone	10	185°	0.91	
36	Dundee	Paarde Berg 1068	In donga	Above coal zone	Fine-medium sandstone	13	191°	0.81	8"
37	Dundee	Paddafontein 3214	Road cutting	Above coal zone	Coarse sand-stone	8	218°	0.94	72"
38	Dundee	Kuick Vlei 1396	In Waschbank River	Below coal zone	Medium sand-stone	3	85°	0.60	
39	Dundee	Kuick Vlei 1396	In stream	Below coal zone	Fine-medium sandstone	3	216°	0.97	
40	Dundee	Kleine Water-val 1125	Cliffs	Below coal zone	Fine-medium sandstone	10	234°	0.83	
41	Kliprivier	Kleinfontein 1262	Quarry	Above coal zone	Medium sand-stone	5	255°	0.78	
42	Kliprivier	Plat Berg 1241	In stream	Above coal zone	Fine-medium sandstone	5	237°	0.82	
43	Kliprivier	Plat Berg 1241	In stream	Above coal zone	Coarse sand-stone and grit	5	238°	0.96	14"
44	Kliprivier	Elandslaagte 1239	In stream	Above coal zone	Coarse sand-stone and grit	8	277°	0.79	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
45	Kliprivier	Roode Poort 1045	Road cutting	Above coal zone	Coarse sandstone	5	220°	0.96	40"
46	Kliprivier	Plat Berg 1241	In stream	Above coal zone	Coarse sandstone and grit	5	281°	0.48	9"
47	Kliprivier	Stein Coal Spruit 1171	In stream	Above coal zone	Coarse sandstone	9	283°	0.62	33"
48	Kliprivier	Stein Coal Spruit 1171	In stream	Above coal zone	Coarse sandstone and grit	6	298°	0.88	33"
49	Kliprivier	Stein Coal Spruit 1171	In stream	Above coal zone	Coarse sandstone and grit	10	331°	0.94	21"
50	Kliprivier	Stein Coal Spruit 1171	In stream	Above coal zone	Coarse sandstone	11	259°	0.92	18"
51	Dundee	Mooispruit 2398	Sandstone ledge	Above coal zone	Coarse sandstone	6	283°	0.88	
52	Dundee	Lyell 2398	In stream	Above coal zone	Coarse sandstone and grit	10	153°	0.92	13"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
53	Dundee	Mooispruit 2398	Side of road	Above coal zone	Coarse sandstone and grit	8	283°	0.97	12"
54	Klipprivier	Stein Coal Spruit 1171	In donga	Above coal zone	Medium sandstone	3	153°	0.93	
55	Dundee	Bosch Kloof 1073	Sandstone ledge	Above coal zone	Fine sandstone	4	174°	0.95	
56	Klipprivier	Waterkloof 4244	In stream	Above coal zone	Coarse sandstone	9	218°	0.93	
57	Newcastle	Quaggas Kirk	In stream	Above coal zone	Coarse sandstone	5	174°	0.96	
58	Newcastle	One Tree Hill 3301	Cliffs	Lowermost Beaufort	Medium sandstone	12	210°	0.84	36"
59	Newcastle	Waag Alles 8899	In stream	Above coal zone	Medium sandstone	3	228°	0.90	28"
60	Dundee	Burnside 8287	Cliffs	Lowermost Beaufort	Medium sandstone	10	209°	0.80	44"
61	Dundee	Burnside 8287	In stream	Above coal zone	Coarse sandstone	5	261°	0.90	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratic	Mean thickness of Planar Cross-bedded units
62	Dundee	Burnside 8287	Busi river	Below coal zone	Coarse sandstone and grit	11	217°	0.71	18"
63	Dundee	Uithoek 1335	In donga	Above coal zone	Fine sandstone	5	253°	0.94	12"
64	Dundee	Uithoek 1335	In donga	Coal zone	Coarse sandstone and grit	8	214°	0.71	
65	Dundee	Uithoek 1335	In stream	Below coal zone	Medium sandstone	6	202°	0.90	19"
66	Dundee	Uithoek 1335	In Busi river	Below coal zone	Coarse sandstone and grit	6	157°	0.53	12"
67	Dundee	Biggarsgat 12753	In stream	Below coal zone	Coarse sandstone and grit	41	314°	0.88	23"
68	Dundee	Biggarsgat 12753	Cutting	Coal zone	Coarse sandstone	12	209°	0.80	28"
69	Dundee	Uithoek 1335	In donga	Above coal zone	Coarse sandstone	3	222°	0.80	18"
70	Dundee	Boschfontein 3307	Cliffs	Lowermost Beaufort	Medium sandstone	32	134°	0.83	25"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
71	Dundee	Fair Play 4261	Sandstone ledges	Below coal zone	Coarse sandstone and grit	18	218°	0.83	31"
72	Dundee	Fair Play 2465	In stream	Below coal zone	Coarse sandstone and grit	30	210°	0.96	13"
73	Dundee	Fair Play 4261	Cutting	Below coal zone	Coarse sandstone	5	200°	0.98	28"
74	Dundee	Fair Play 4261	Cutting	Below coal zone	Coarse sandstone	16	170°	0.92	
75	Dundee	Dundee 4339	In Steenkool Spruit	Below coal zone	Coarse sandstone	12	186°	0.92	31"
76	Dundee	Craigside 2272	Side of hill	Below coal zone	Coarse sandstone	12	207°	0.88	
77	Dundee	Craigside 2272	In stream	Below coal zone	Coarse sandstone	5	224°	0.96	
78	Newcastle	Driehoek 9171	In donga	Below coal zone	Coarse sandstone	6	281°	0.87	13"
79	Newcastle	Cardwell 4340	Cliffs on Krantz Kop	Lowermost Beaufort	Fine-medium sandstone	9	140°	0.86	19"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
80	Newcastle	Driehoek 9171	In stream	Above coal zone	Medium sand-stone	6	225°	C.87	
81	Dundee	Davelsfontein 4348	In river	Below coal zone	Coarse sand-stone	3	239°	0.93	
82	Dundee	Alleta 4350	In stream	Below coal zone	Fine sand-stone	6	193°	0.62	
83	Dundee	Morgenstond 3347	In stream	Below coal zone	Medium sand-stone	4	170°	0.92	10"
84	Dundee	Davelsfontein 4348	In donga	Below coal zone	Coarse sand-stone and grit	12	177°	0.95	
85	Dundee	Forfar 4473	In stream	Below coal zone	Coarse sand-stone	2	135°	0.95	12"
86	Dundee	Cotswold 4332	Road cutting	Below coal zone	Coarse sand-stone	?	183°	0.76	120"
87	Dundee	Van Rooyan 4252	In Sandspruit	Below coal zone	Coarse sand-stone	5	226°	0.98	
88	Dundee	Van Rooyan 4252	In spruit	Below coal zone	Coarse sand-stone	2	139°	0.95	
89	Dundee	Dalry 2413	In donga	Coal zone	Coarse sand-stone	10	224°	0.79	29"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
90	Dundee	Dalry 2413	In stream	Below coal zone	Coarse sand-stone	9	209°	0.89	7"
91	Dundee	Hazeldene 12649	In donga	Coal zone	Coarse sand-stone and grit	17	209°	0.79	24"
92	Dundee	Sunshine Farm 4450	In donga	Below coal zone	Coarse sand-stone	14	114°	0.96	
93	Dundee	Sunshine Farm 4450	In donga	Below coal zone	Coarse sand-stone	3	347°	0.97	70"
94	Dundee	Winkle 5054	In stream	Below coal zone	Coarse sand-stone	5	211°	0.94	6"
95	Dundee	Nursling 4495	Mlungwane Hill	Below coal zone	Coarse sand-stone	9	183°	0.87	6"
96	Dundee	Langefontein 2397	Top of Hill	Above coal zone	Coarse sand-stone	31	163°	0.84	
97	Dundee	Matatana 13024	Cliffs	Below coal zone	Coarse sand-stone	10	180°	0.71	28"
98	Dundee	Matatana 13024	In stream	Below coal zone	Coarse sand-stone and grit	13	173°	0.98	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
99	Dundee	Overton 3315	In stream	Below coal zone	Coarse sandstone and grit	11	136°	0.95	
100	Dundee	Menteith 3328	In stream	Below coal zone	Coarse sandstone	13	159°	0.93	80"
101	Dundee	Menteith 3328	Bank of Buffalo river	Below coal zone	Coarse sandstone	5	202°	0.96	240"
102	Utrecht	Kruisfontein 112	In stream	Below coal zone	Medium sandstone	9	223°	0.87	
103	Dundee	Prestwick 2415	Cutting	Below coal zone	Medium sandstone	2	83°	0.90	60"
104	Utrecht	De Jagersdrift North 12852	In river	Below coal zone	Coarse sandstone	9	218°	0.91	120"
105	Utrecht	Rietvlei 101	Side of road	Below coal zone	Coarse sandstone	7	213°	0.96	24"
106	Utrecht	Rietvlei 101	Bank of Buffalo river	Below coal zone	Medium sandstone	11	195°	0.92	53"
107	Utrecht	De Jagersdrift North 12852	In stream	Below coal zone	Coarse grit and sandstone	5	139°	0.98	55'

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Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
108	Utrecht	De Jagersdrift North 12852	In stream	Below coal zone	Medium sand-stone	9	155°	0.76	7"
109	Utrecht	Nooitgedacht 60	In stream	Below coal zone	Coarse sand-stone	5	210°	0.92	
110	Utrecht	Nooitgedacht 60	In stream	Below coal zone	Coarse sand-stone	6	217°	0.88	
111	Utrecht	Klipspruit 64	Side of hill	Below coal zone	Coarse sand-stone	8	48°	0.74	10"
112	Utrecht	Klipspruit 106	Cutting	Below coal zone	Coarse sand-stone	5	182°	0.76	
113	Dundee	Bulwer 4250	Side of hill	Above coal zone	Coarse sand-stone and grit	10	278°	0.66	
114	Newcastle	Perth 7540	In donga	Below coal zone	Fine sand-stone	4	79°	0.85	
115	Dundee	Flint 9350	In Poona spruit	Below coal zone	Medium sand-stone	10	189°	0.96	130"
116	Utrecht	Eersteling 174	Below dam	Below coal zone	Coarse sand-stone	11	259°	0.87	
117	Utrecht	Ruigtefontein 94	In donga	Below coal zone	Coarse sand-stone	3	208°	0.93	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
118	Newcastle	Peach Hill 13672	In stream	Below coal zone	Medium sand-stone	8	103°	0.84	
119	Utrecht	Ruigtefontein 54	Side of road	Below coal zone	Coarse sand-stone	9	259°	0.79	
120	Utrecht	Geluk 158	Side of road	Below coal zone	Coarse sand-stone and grit	10	264°	0.83	13"
121	Newcastle	Springbok-laagte 9666	In donga	Below coal zone	Medium sand-stone	8	105°	0.76	
122	Newcastle	Farm No. 3733	Tendega river	Below coal zone	Coarse sand-stone and grit	10	113°	0.94	8"
123	Newcastle	Vlaklaagte 9482	In stream	Below coal zone	Coarse sand-stone	3	121°	0.93	6"
124	Newcastle	Drycut 8198	Cutting	Below coal zone	Coarse sand-stone	5	142°	0.72	
125	Utrecht	Groothoek 152	Side of hill	Coal zone	Coarse sand-stone	10	185°	0.81	16"
126	Utrecht	Klipspruit	Side of road	Below coal zone	Coarse sand-stone	3	201°	0.93	
127	Utrecht	Frischgewaagd	In stream	Below coal zone	Coarse sand-stone	4	213°	0.88	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
128	Utrecht	Waaihoek 173	Side of hill	Below coal zone	Coarse sand-stone and grit	10	195°	0.73	21"
129	Utrecht	Gum Tree Grove 126	In stream	Below coal zone	Coarse sand-stone and grit	5	106°	0.98	120"
130	Utrecht	Gum Tree Grove 126	In donga	Below coal zone	Coarse sand-stone	6	152°	0.90	
131	Utrecht	Weltevreden 53	Cutting	Coal zone	Coarse sand-stone and grit	12	161°	0.81	27"
132	Utrecht	Utrecht Townlands	In stream	Below coal zone	Medium sandstone	6	168°	0.68	9"
133	Utrecht	Vergenoegd 107	Cliffs on Uys Kop	Lowermost Beaufort	Medium sandstone	10	191°	0.77	
134	Utrecht	Frischgewaagt 105	Ledges	Above coal zone	Coarse sandstone	8	218°	0.94	
135	Utrecht	Weihoek 171	In stream	Above coal zone	Coarse sandstone	11	264°	0.74	17"
136	Utrecht	Vaalbank 103	Side of hill	Above coal zone	Medium sandstone	10	202°	0.89	35"
137	Utrecht	Rustverwacht 151	In stream	Below coal zone	Medium sandstone	14	101°	0.81	
138	Utrecht	Doornkop 172	In donga	Coal zone	Medium sandstone	9	170°	0.81	14"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vecto. Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
139	Utrecht	Doornkop 172	In stream	Coal zone	Medium sandstone	6	241°	0.93	
140	Utrecht	Vaalspruit 115	In stream	Below coal zone	Medium sandstone	8	22°	0.81	
141	Utrecht	Kromellenboog 170	In stream	Below coal seam	Medium sandstone	6	158°	0.92	
142	Utrecht	Novembersdrift 87	In Kweek Spruit	Below coal zone	Coarse sandstone	9	158°	0.71	
143	Utrecht	Dageraad 49	Side of mountain	Lowermost Beaufort	Medium sandstone	10	219°	0.84	13"
144	Utrecht	Wasbank 149	In donga	Below coal zone	Medium sandstone	3	174°	0.93	
145	Utrecht	Hartebeestspruit 111	In stream	Below coal zone	Coarse sandstone	15	153°	0.91	126"
146	Utrecht	Utrecht Townlands	In stream	Below coal zone	Coarse sandstone	6	215°	0.87	9"
147	Newcastle	Brakfontein 4278	Side of road	Coal zone	Coarse sandstone	6	253°	0.95	
148	Newcastle	Alcocksprui[illegible] 7329	Side of hill	Below coal zone	Medium sandstone	2	246°	0.85	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
149	Newcastle	Kopij Aleen 8816	Road quarry	Above coal zone	Coarse sandstone	6	234°	0.97	
150	Amersfoort	Wasbank 62	Side of hill	Lowermost Beaufort	Medium sandstone	5	179°	0.76	8"
151	Amersfoort	Driefontein 70	Side of hill	Lowermost Beaufort	Medium sandstone	6	181°	0.65	11"
152	Amersfoort	Grootfontein 64	In little Vaal	Above coal zone	Coarse sandstone	10	208°	0.77	
153	Wakkerstroom	Twyfelhoek 358	Cutting	Coal zone	Coarse sand-stone and grit	6	204°	0.82	22"
154	Wakkerstroom	Makwassa 344	Small Hill	Below coal zone	Coarse sandstone	12	287°	0.71	9"
155	Wakkerstroom	Langverwacht 291	Side of mountain	Coal zone	Coarse sandstone	8	264°	0.94	20"
156	Wakkerstroom	Elandsfontein 141	Cliffs	Above coal zone	Coarse sand-stone and grit	11	260°	0.20	30"
157	Wakkerstroom	Pampoenkraal 144	Side of road	Below coal zone	Coarse sandstone	8	276°	0.83	32"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
158	Wakkerstroom	Amsterdam 3	In stream	Below coal zone	Coarse sandstone	10	311°	0.55	19"
159	Wakkerstroom	Grootrietvlei 228	In Assegaai river	Below coal zone	Coarse sandstone	8	230°	0.96	
160	Wakkerstroom	Rivierveld 87	In Assegaai river	Below coal zone	Medium sandstone	2	164°	0.95	
161	Wakkerstroom	Vergelegen 68	In stream	Below coal zone	Medium sandstone	4	179°	0.95	
162	Wakkerstroom	Vryheid 27	Cliff	Coal zone	Coarse sandstone	3	148°	0.93	
163	Wakkerstroom	In Malkaar 312	In donga	Coal zone	Coarse sand-stone	15	33°	0.65	
164	Wakkerstroom	Loskop 219	In donga	Coal zone	Coarse sand-stone and grit	6	181°	0.45	11"
165	Wakkerstroom	Naauwgevonden 369	Cliff	Below coal zone	Coarse sand-stone and grit	6	201°	0.90	24"
166	Wakkerstroom	Naauwgevonden 369	Side of hill	Coal zone	Coarse sandstone	10	258°	0.41	11'
167	Utrecht	Springfontein 238	In stream	Above coal zone	Coarse sandstone	10	231°	0.94	11"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratic	Mean thickness of Planar Cross-bedded units
168	Wakkerstroom	Zuurbron 30	In stream	Above coal zone	Coarse sandstone	3	157°	0.97	
169	Wakkerstroom	Johannesloop 376	Cutting	Above coal zone	Coarse sandstone and grit	5	238°	0.84	18"
170	Wakkerstroom	Suikerhoek 28	In donga	Coal zone	Coarse sandstone	10	205°	0.66	
171	Wakkerstroom	Vaalbank 200	Small hill	Coal zone	Coarse sandstone	10	238°	0.90	16"
172	Wakkerstroom	Plaatjesfon-tein 178	Side of road	Below coal zone	Coarse sandstone	5	280°	0.80	
173	Wakkerstroom	Plaatjesfon-tein 178	Side of hill	Coal zone	Coarse sand-stone	10	256°	0.76	7"
174	Wakkerstroom	Doornhoek 370	Side of road	Below coal zone	Coarse sandstone	10	166°	0.53	
175	Wakkerstroom	Van Der Walts Poort 56	Cliffs	Coal zone	Coarse sandstone	8	189°	0.83	40"
176	Wakkerstroom	Van Der Walts Poort 56	Cliffs	Coal zone	Coarse sandstone and grit	10	244°	0.93	11"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
177	Wakkerstroom	Kromhoek 76	Side of mountain	Coal zone	Coarse sandstone and grit	10	225°	0.94	
178	Utrecht	Mooifontein 366	Side of hill	Lowermost Beaufort	Medium sandstone	7	293°	0.93	
179	Utrecht	Vredehof 17	Side of road	Above coal zone	Coarse sandstone	5	148°	0.84	10"
180	Utrecht	Vredehof 17	Side of road	Below coal zone	Coarse sandstone and grit	10	205°	0.79	21"
181	Utrecht	Rooipoort 97	Cliffs	Coal zone	Coarse sandstone	10	233°	0.79	36"
182	Utrecht	Kaffirsdrift 116	Cliffs	Below coal zone	Coarse sandstone	7	254°	0.94	26"
183	Utrecht	Kaffirsdrift 116	Side of road	Below coal zone	Coarse sandstone	10	215°	0.69	
184	Utrecht	Kemps Lust	In stream	Below coal zone	Coarse sandstone	10	238°	0.37	13"
185	Wakkerstroom	Marthinus Wesselstroom 276	Cutting	Lowermost Beaufort	Medium sandstone	5	236°	0.97	19"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
186	Utrecht	Puntje 330	Cliffs	Lowermost Beaufort	Medium sandstone	6	218°	0.62	14"
187	Utrecht	Engelbrechts Drift 258	Side of mountain	Lowermost Beaufort	Medium sandstone	10	220°	0.79	
188	Utrecht	Spitzkop	Cliffs	Coal zone	Coarse sandstone	12	182°	0.83	
189	Utrecht	Gojaagd 99	Cliffs	Lowermost Beaufort	Coarse sandstone and grit	6	181°	0.85	12"
190	Volksrust	Drie Poort 71	Ledges	Coal zone	Medium sandstone	11	186°	0.80	14"
191	Volksrust	Daarieklip 26	In sand spruit	Above coal zone	Medium sandstone	6	293°	0.95	
192	Volksrust	Paardekop 48	Quarry	Lowermost Beaufort	Medium sandstone	10	201°	0.92	13"
193	Amersfoort	Schulpspruit 57	In Schulp-spruit	Above coal zone	Medium sandstone	5	184°	0.40	
194	Amersfoort	Schulpspruit 57	In Schulp-spruit	Above coal zone	Medium sandstone	6	138°	0.55	
195	Amersfoort	Enon 58	Side of hill	Above coal zone	Medium sandstone	4	127°	0.85	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
196	Utr cht	Witklip	In stream	Coal zone	Coarse sandstone and grit	11	202°	0.91	15"
197	Utrecht	Witklip	Sandstone ledges	Below coal zone	Medium grained	10	266°	0.94	120"
198	Utrecht	Schuilklip 109	Sandstone ledges	Below coal zone	Medium sandstone	11	195°	0.74	
199	Utrecht	Schuivepoort 102	Cliffs	Above coal zone	Medium sandstone	12	232°	0.32	19"
200	Newcastle	Dumfirmline 3321	In Ingogo river	Above coal zone	Coarse sandstone and grit	12	352°	0.77	
201	Newcastle	Wykom 2368	In stream	Coal zone	Medium sandstone	10	282°	0.89	
202	Newcastle	Buffalo river 4308	In stream	Coal zone	Coarse sandstone	22	34°	0.15	6"
203	Newcastle	Tweefontein 3344	Cutting	Coal zone	Coarse sandstone	11	248°	0.65	27"
204	Newcastle	Tweefontein 3344	Cutting	Coal zone	Coarse sandstone and grit	11	209°	0.86	18"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
205	Newcastle	Newcastle Townlands 4702	Quarry	Above coal zone	Coarse sandstone	4	266°	0.98	24"
206	Newcastle	Tiger Kloof 3383	Cliffs	Abov coal zone	Coarse sandstone	17	205°	0.79	
207	Newcastle	Kilbarchen 2969	In donga	Above coal zone	Medium sandstone	9	267°	0.88	7"
208	Newcastle	Ballengeich 3299	Bank of Horn river	Above coal zone	Medium sandstone	16	257°	0.79	
209	Newcastle	Ballengeich 3299	In stream	Above coal zone	Coarse sandstone	29	138°	[illegible]	22"
210	Newcastle	Farm No.11634	Top of mountain	Lowermost Beaufort	Medium sandstone	13	278°	0.72	13"
211	Newcastle	Farm No.10877	Road cutting	Lowermost Beaufort	Medium sandstone	6	207°	0.22	
212	Wakkerstroom	Klipspruit 461	Cutting	Coal zone	Coarse sandstone and grit	6	176°	0.90	
213	Piet Retief	Annysspruit 143	Old mine	Coal zone	Coarse sandstone	6	251°	0.97	20"

Out-crop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
214	Piet Retief	Goedehoop 122	Side of hill	Below coal zone	Coarse sandstone	10	169°	0.70	
215	Piet Retief	Tafelberg 125	Cliffs	Below coal zone	Coarse sandstone	5	269°	0.62	
216	Piet Retief	Cuderdom 12	Cliffs	Below coal zone	Coarse sandstone	10	320°	0.76	
217	Utrecht	Kempslust 81	Side of mountain	Coal zone	Coarse sandstone	10	189°	0.72	16"
218	Paulpietersburg	Uitkoest 36	In donga	Below coal zone	Coarse sandstone	7	182°	0.96	19"
219	Paulpietersburg	Moothook 34	Side of hill	Coal zone	Coarse sandstone	7	190°	0.94	
220	Paulpietersburg	Boschkraas 69	Small hill	Coal zone	Coarse sandstone and grit	11	284°	0.65	22"
221	Paulpietersburg	Vaksteeskop 59	Cliffs	Below coal zone	Medium sandstone	20	140°	0.71	
222	Paulpietersburg	Paulpietersburg Townlands	Side of mountain	Coal zone	Coarse sandstone	15	258°	0.93	19"
223	Paulpietersburg	Paulpietersburg Townlands	Side of mountain	Below coal zone	Medium sandstone	14	190°	0.87	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
224	Wakkerstroom	Langewacht 247	Side of mountain	Coal zone	Coarse sandstone and grit	10	305°	0.72	11"
225	Paulpietersburg	Geluk 58	Side of hill	Coal zone	Coarse sandstone	8	185°	0.52	15"
226	Paulpietersburg	Geluk 58	Side of hill	Below coal zone	Coarse sandstone	12	179°	0.90	61"
227	Paulpietersburg	Trekdrift 39	Side of hill	Below coal zone	Coarse sandstone and grit	7	174°	0.91	
228	Vryheid	Goltewreden 300	Cliffs	Below coal zone	Medium sandstone	22	235°	0.42	33"
229	Vryheid	Erfstuk 4	Side of hill	Below coal zone	Medium sandstone	11	249°	0.82	
230	Vryheid	Erfstuk 4	In stream	Coal zone	Coarse sandstone and grit	15	250°	0.84	13"
231	Vryheid	Kambula	Top of cliff	Below coal zone	Medium sandstone	6	147°	0.97	
232	Vryheid	Nooitgedacht 388	Side of mountain	Coal zone	Medium sandstone	16	255°	0.69	33'

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
233	Vryheid	Nocitgedacht 388	In stream	Below coal zone	Coarse sandstone	7	166°	0.99	48"
234	Vryheid	Schaapkopje 194	Ledges	Below coal zone	Medium sandstone	21	153°	0.86	
235	Vryheid	Schaapkopje 194	Ledges	Coal zone	Coarse sandstone	18	266°	0.96	17"
236	Vryheid	Vryheid Townlands	In donga	Below coal zone	Coarse sandstone	4	175°	0.95	
237	Vryheid	Aanstoot 231	Side of hill	Below coal zone	Medium sandstone	10	173°	0.97	
238	Utrecht	Goede Hoop 177	Side of hill	Coal zone	Coarse sandstone	10	223°	0.61	29"
239	Utrecht	Goede Hoop 177	Side of hill	Coal zone	Coarse sandstone	10	204°	0.83	14"
240	Utrecht	Zoetmelks Rivier 86	In stream	Coal zone	Coarse sandstone and grit	10	215°	0.76	25"
241	Utrecht	Klipspruit 106	Side of hill	Below coal zone	Medium sandstone	4	192°	0.91	
242	Vryheid	Bembaskop 7086	Ledges	Below coal zone	Coarse sandstone	8	152°	0.36	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
243	Vryheid	Aardappel Kraal 282	Side of hill	Below coal zone	Medium sandstone	3	194°	0.78	18"
244	Vryheid	Aardappel Kraal 282	Cliffs	Coal zone	Coarse sandstone and grit	10	202°	0.71	17"
245	Vryheid	Welgevonden 287	Cliffs	Coal zone	Coarse sandstone and grit	20	201°	0.90	35"
246	Vryheid	Hlobane 506	In stream	Coal zone	Medium sandstone	4	226°	0.98	
247	Vryheid	Hlobane 506	Side of hill	Coal zone	Coarse sandstone	15	191°	0.77	
248	Vryheid	Welgevonden 287	In donga	Below coal zone	Coarse sandstone	6	177°	0.98	
249	Vryheid	Leeuwnek 51	Side of mountain	Coal zone	Coarse sandstone	20	188°	0.50	17"
250	Vryheid	Leeuwnek 51	Side of road	Below coal zone	Medium sandstone	18	242°	0.79	
251	Nqutu	Native Reserve No. 18	Side of hill	Below coal zone	Medium sandstone	10	188°	0.75	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
252	Dundee	Mchjeaane 225	Hill	Below coal zone	Coarse sandstone	3	160°	0.93	9"
253	Nqutu	Native Reserve No. 18	Bank of Buffalo river	Below coal zone	Medium sandstone	11	199°	0.74	8"
254	Ngotshe	Broedersrust 144	Side of road	Below coal zone	Medium sandstone	2	237°	0.95	
255	Ngotshe	Smaldeel 575	Quarry	Coal zone	Coarse	16	283°	0.78	27"
256	Ngotshe	Mooiklip	Side of mountain	Coal zone	Coarse sandstone	30	212°	0.24	20"
257	Vryheid	Waterval 310	Quarry	Below coal zone	Coarse sandstone	9	211°	0.67	23"
258	Vryheid	Veelsgeluk 171	In stream	Coal zone	Coarse sand-stone and grit	12	206°	0.91	12"
259	Vryheid	Veelsgeluk 171	Side of hill	Coal zone	Coarse sandstone	16	211°	0.67	20"
260	Vryheid	Veelsgeluk 171	Small hill	Coal zone	Coarse sandstone	20	185°	0.86	53"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
261	Vryheid	Vaalbank 450	Adit	Coal zone	Coarse sandstone	2	228°	0.95	30"
262	Vryheid	Vaalkrans 306	Cutting	Coal zone	Coarse sand-stone and grit	17	198°	0.94	33"
263	Vryheid	Riversdale 372	In donga	Coal zone	Coarse sandstone	9	194°	0.87	
264	Vryheid	Bloemendal 18	Side of mountain	Coal zone	Coarse sandstone	11	187°	0.92	14"
265	Vryheid	Langkrans 367	Side of mountain	Below coal zone	Medium sandstone	11	191°	0.58	119"
266	Vryheid	Bloemendal 18	Cutting	Coal zone	Coarse sandstone	16	248°	0.90	22"
267	Vryheid	Riversdale 75	Side of mountain	Below coal zone	Medium sandstone	10	192°	0.75	26"
268	Vryheid	Riversdale 75	Side of mountain	Coal zone	Coarse sand-stone and grit	25	218°	0.60	31"
269	Ngotshe	Frischgewaagte 401	Side of hill	Below coal zone	Coarse sand-stone and grit	9	210°	0.75	25"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
270	Ngotshe	Isihlengeni 689	Side of road	Below coal zone	Coarse sandstone and grit	3	123°	0.93	9"
271	Ngotshe	Waterval 553	Cutting	Below coal zone	Coarse sandstone	3	183°	0.77	10"
272	Hlatikulu		In stream	Coal zone	Coarse sandstone and grit	20	224°	0.87	17"
273	Hlatikulu		In Ngwavuma River	Coal zone	Coarse sandstone and grit	10	293°	0.94	
274	Hlatikulu		Side of hill	Coal zone	Coarse sandstone	3	222°	0.47	
275	Hlatikulu		In stream	Coal zone	Coarse sandstone	5	236°	0.98	
276	Piet Retief	Pongola 160	Side of road	Below coal zone	Coarse sandstone	5	270°	0.26	
277	Piet Retief	Pongola 160	Small hill	Below coal zone	Coarse sandstone	19	151°	0.78	25"
278	Ngotshe	Mogut 12436	Cutting	Coal zone	Coarse sandstone	24	170°	0.85	16"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
279	Nongoma	Native Reserve No. 12	Cliffs	Below coal zone	Coarse sandstone and grit	15	223°	0.93	19"
280	Nongoma	Nongoma Townlands	Cutting	Above coal zone	Medium sandstone	5	172°	0.72	
281	Nongoma	Native Reserve No. 12	In donga	Coal zone	Coarse sandstone	20	207°	0.66	13"
282	Nongoma	Native Reserve No. 12	In stream	Below coal zone	Coarse sandstone	5	193°	0.96	22"
283	Nongoma	Native Reserve No. 12	Side of hill	Above coal zone	Coarse sandstone	4	212°	0.58	11"
284	Hlabisa		Side of hill	Below coal zone	Coarse sandstone	2	290°	0.90	18"
285	Lower Umfolozi	Umfolozi Game Reserve	In stream	Below coal zone	Coarse sandstone and grit	25	203°	0.80	22"
286	Lower Umfolozi	Umfolozi Game Reserve	In stream	Below coal zone	Coarse sandstone and grit	10	196°	0.84	65"
287	Umvoti	Olivefontein 4427	Side of mountain	Below coal zone	Medium sandstone	5	143°	0.96	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
288	Umvoti	Olivefontein 4427	Cutting	Coal zone	Medium sandstone	4	201°	0.85	18"
289	Msinge	Impofana Location No. 4677	Side of mountain	Below coal zone	Medium sandstone	20	173°	0.79	29"
290	Msinga	Impofana Location No. 4377	Side of mountain	Below coal zone	Coarse sandstone	6	219°	0.83	30"
291	Umvoti	Roode Bok Vlakte 1858	In donga	Below coal zone	Coarse sandstone	10	125°	0.85	
292	Umvoti	Mount St. Bernard 2121	In stream	Below coal zone	Medium sandstone	6	132°	0.98	
293	Umvoti	Geluk Stadt 1847	Cliff	Below coal zone	Medium sandstone	7	251°	0.83	
294	Weenen	Erskine 2200	Cliffs	Coal zone	Coarse sandstone	8	179°	0.79	
295	Umvoti	Nietgedacht 1192	Cliff	Below coal zone	Coarse sandstone	3	163°	0.99	
296	Umvoti	Nietgedacht 1192	Small hill	Below coal zone	Medium sandstone	7	130°	0.91	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
297	Umvoti	Geluk Stadt 1847	Cliffs	Below coal zone	Coarse sandstone	6	162°	0.98	
298	Umvoti	Geluk Stadt 1847	Cliff	Coal zone	Coarse sandstone	10	231°	0.95	26"
299	Umvoti	Nietgedacht 1192	Cliff	Below coal zone	Coarse sandstone	2	138°	0.99	180"
300	Estcourt	Estcourt Townlands	Cliffs	Lowermost Beaufort	Medium sandstone	5	282°	0.80	19"
302	Kliprivier	Vertrek 1091	Cutting	Lowermost Beaufort	Medium sandstone	2	88°	0.96	
303	Estcourt	-	Side of hill	Lowermost Beaufort	Medium sandstone	4	160°	0.93	

A P P E N D I X 15

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	Symmetry of Crests	No. of Measure-ments	Mean Strike	Ripple Index
171	Wakkerstroom	Vaalbank 200	Side of hill	Coal zone	Fine sand-stone	Asymmetrical	3	195°	12.02
202	Newcastle	Wykom 2368	In stream	Coal zone	Fine sand-stone	Symmetrical	12	154°	8.4

APPENDIX 16

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
1	Wakkerstroom	Twyfelhoek 338	In stream	Below coal zone	Coarse sandstone	12	239°	0.74	37"
2	Wakkerstroom	Driefontein 331	Side of hill	Below coal zone	Coarse sandstone	10	277°	0.81	11"
3	Wakkerstroom	Driefontein 331	Cliffs	Below coal zone	Coarse sandstone and grit	8	220°	0.53	23"
4	Wakkerstroom	Sobbeken 385	Cliffs	Below coal zone	Coarse sandstone and grit	6	44°	0.17	16"
5	Wakkerstroom	Buhrmanns Bosch 303	In stream	Below coal zone	Coarse sandstone	4	254°	0.60	11"
6	Wakkerstroom	Buhrmanns Bosch 303	In stream	Coal zone	Coarse sandstone	5	170°	0.86	27"
7	Wakkerstroom	Lyden 278	Side of mountain	Above coal zone	Medium sandstone	5	301°	0.98	
8	Amersfoort	Uitgezocht	Cutting	Above coal zone	Coarse sandstone	2	156°	0.99	
9	Amersfoort	Uitgezocht 32	Above Little Vaal river	Above coal zone	Coarse sandstone	6	194°	0.43	17"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
10	Amersfoort	Willem Hendriks Vallei 26	Side of hill	Above coal zone	Medium sandstone	8	280°	0.93	
11	Amersfoort	Willem Hendriks Vallei 26	In stream	Above coal zone	Coarse sandstone	4	274°	0.99	
12	Amersfoort	Goedehoop 25	Cliffs	Above coal zone	Medium sandstone	8	222°	0.93	
13	Ermelo	Goedenoop 24	Cliffs	Above coal zone	Medium sandstone	17	239°	0.55	
14	Ermelo	De Emigratie 271	Ledge	Above coal zone	Coarse sandstone and grit	10	214°	0.93	17"
15	Ermelo	Rotterdam 117	Cliffs	Above coal zone	Medium sandstone	10	266°	0.78	
16	Ermelo	Mavieriestad 116	At mine	Coal zone	Coarse sandstone	10	275°	0.90	
17	Ermelo	Mavieriestad 116	Cliffs	Below coal zone	Coarse sandstone and grit	10	158°	0.83	
18	Ermelo	Mavieriestad 116	In dongs	Below coal zone	Coarse sandstone	3	287°	0.93	
19	Ermelo	Rietvallei 102	Side of road	Below coal zone	Coarse sandstone	6	162°	0.98	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Co.stituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
20	Ermelo	Klipfontein 284	Above water-fall	Coal zone	Coarse sandstone	5	140°	0.74	
21	Ermelo	Witbank 272	Small hill	Coal zone	Coarse sandstone	2	195°	0.95	
22	Ermelo	Zandspruit 103	Near beacon	Coal zone	Coarse sandstone	8	288°	0.93	
23	Ermelo	Waaihoek 170	Above water-fall	Coal zone	Coarse sandstone	3	129°	0.93	
24	Ermelo	Waaihoek 170	Cliff	Coal zone	Coarse sandstone	5	253°	0.96	
25	Ermelo	Klipbank 104	Cliffs	Above coal zone	Medium sandstone	9	282°	0.80	9"
26	Ermelo	Weltevreden 5	Cutting	Above coal zone	Medium sandstone	4	311°	0.85	9"
27	Ermelo	Witpunt 16	Cliffs	Above coal zone	Coarse sandstone	12	251°	0.94	
28	Ermelo	Witpunt 16	Top of hill	Above coal zone	Coarse sandstone	10	267°	0.83	
29	Ermelo	Uitkomst 273	Quarry	Above coal	Coarse	8	172°	0.93	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
30	Ermelo	Jarhendriks-fontein 13	Ledges above pan	Above coal zone	Coarse sandstone	6	254°	0.98	
31	Ermelo	Witbank	Ledge	Coal zone	Coarse sandstone	6	242°	0.30	
32	Ermelo	Onverwacht 90	Side of road	Above coal zone	Medium sandstone	5	115°	0.97	
33	Ermelo	Bankplaats	Side of road	Coal zone	Coarse sandstone	4	236°	0.98	
34	Ermelo	Bankplaats 87	Cliffs	Coal zone	Coarse sandstone	3	268°	0.43	
35	Amersfoort	Vermaakskraal 532	In stream	Above coal zone	Coarse sandstone	3	253°	0.97	
37	Amersfoort	Kaffirskraal 513	In donga	Above coal zone	Medium sandstone	7	270°	0.90	12"
38	Amersfoort	Kaffirskraal 513	Side of hill	Above coal zone	Medium sandstone	5	275°	0.93	
39	Standerton	Katspruit 519	In stream	Above coal zone	Fine sandstone	10	225°	0.35	
40	Standerton	Katspruit 516	In stream	Above coal zone	Medium sandstone	3	215°	0.90	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
41	Ermelo	Uitspanning 491	Side of hill	Coal zone	Coarse sandstone and grit	8	274°	0.81	
42	Ermelo	Vaalkop 490	In stream	Above coal zone	Coarse sandstone	10	215°	0.87	
43	Standerton	Protest 486	Above Pan	Above coal zone	Coarse sandstone	5	171°	0.94	
44	Ermelo	Morgenzon 466	Cutting	Above coal zone	Coarse sandstone	10	170°	0.83	11"
45	Ermelo	Tweefontein 479	Side of road	Above coal zone	Coarse sandstone	2	169°	0.98	
46	Ermelo	Tweefontein 479	Side of road	Above coal zone	Coarse sandstone	4	261°	0.98	
47	Amersfoort	Mooifontein 497	Cutting	Above coal zone	Coarse sandstone	4	256°	0.88	
48	Amersfoort	Begin der Lyn 474	Cutting	Above coal zone	Coarse sandstone	6	194°	0.93	
49	Ermelo	Holland 471	Side of road	Above coal zone	Coarse sandstone	3	284°	0.80	
50	Ermelo	Dorpsplaats 470	In stream	Above coal zone	Coarse sandstone	7	252°	0.83	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
51	Ermelo	Drinkwater 443	Side of road	Above coal zone	Coarse sandstone	4	263°	0.93	
52	Ermelo	Drinkwater 451	In stream	Above coal zone	Medium sandstone	11	287°	0.85	
53	Ermelo	Witzicht	In stream	Above coal zone	Coarse sandstone	6	248°	0.92	
54	Ermelo	Drinkwater 451	Cutting	Above coal zone	Medium sandstone	10	298°	0.90	
55	Ermelo	Brakfontein 452	Side of road	Above coal zone	Coarse sandstone	2	282°	0.95	
56	Bethal	Roodekrans 457	In stream	Above coal zone	Coarse sandstone	10	253°	0.70	25"
57	Ermelo	Nelspan 449	Side of road	Above coal zone	Medium sandstone	3	241°	0.97	
58	Ermelo	Cshoek	In stream	Above coal zone	Coarse sandstone	2	249°	0.95	
59	Bethal	Klipfontein 422	Side of road	Above coal zone	Coarse sandstone	4	281°	0.95	
60	Bethal	Sukkelaar 421	Cliff	Above coal	Coarse	5	259°	0.92	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
61	Bethal	Sukkelaar 421	Quarry	Above coal zone	Coarse sandstone and grit	6	240°	0.90	12"
62	Ermelo	De Vereeniging 448	Side of hill	Above coal zone	Fine sandstone	14	300°	0.92	
63	Ermelo	Rietspruit 437	Cliffs above pan	Above coal zone	Medium sandstone	7	252°	0.86	22"
64	Ermelo	Nooitgedacht 268	Quarry	Coal zone	Coarse sandstone and grit	6	247°	0.82	10"
65	Ermelo	Uitgezocht 436	Quarry	Coal zone	Medium sandstone	6	283°	0.83	
66	Ermelo	Winkelhaal	In stream	Above coal zone	Coarse sandstone	11	261°	0.59	14"
67	Ermelo	Remhoogte 428	Side of road	Above coal zone	Coarse sandstone and grit	8	238°	0.95	
68	Ermelo	Rietvlei 433	Side of hill	Above coal zone	Medium sandstone	10	202°	0.81	11"
69	Ermelo	De Roo epoort	Side of road	Above coal zone	Medium sandstone	5	25°	0.96	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
70	Ermelo	De Roodepoort 435	In stream	Above coal zone	Medium sandstone	10	271°	0.36	13"
71	Ermelo	Nooitgedacht 268	Old mine	Coal zone	Coarse sandstone and grit	10	152°	0.79	27"
72	Ermelo	Mooifontein 287	Cutting	Coal zone	Medium sandstone	2	197°	0.95	8"
73	Ermelo	Spitskop 276	Side of hill	Coal zone	Coarse sandstone	5	211°	0.92	8"
74	Ermelo	Kaffirspruit 274	Cutting	Coal zone	Coarse sandstone and grit	2	176°	0.95	28"
75	Ermelo	Voegelfontein 245	Cutting	Coal zone	Coarse sandstone ani grit	4	182°	0.85	
76	Ermelo	Bosmanskrans 217	Side of road	Coal zone	Coarse sandstone and grit	5	235°	0.96	
77	Middelburg	Tweefontein 203	Side of hill	Coal zone	Coarse sandstone	5	234°	0.92	
78	Ermelo	Goedehoop 205	Cliffs	Coal zone	Coarse sandstone and grit	6	230°	0.90	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded nits
79	Middelburg	Kaffirstad 195	In river	Coal zone	Coarse sandstone	6	218°	0.98	
80	Bethal	Brakpan 225	Above pan	Coal zone	Coarse sandstone	3	228°	0.93	
81	Bethal	Halfgewonnen 190	In stream	Coal zone	Coarse sandstone	2	214°	0.98	
82	Middelburg	Roodepoort 151	Ledges	Coal zone	Coarse sandstone	3	187°	0.97	
83	Middelburg	Boschmanskop 154	Cliffs	Coal zone	Coarse sandstone and grit	6	197°	0.95	
84	Middelburg	Groot Drakenstein 157	Cutting	Coal zone	Coarse sandstone	6	358°	0.93	18"
85	Ermelo	Kranspan 95	Quarry	Coal zone	Coarse sandstone and grit	3	227°	0.93	11"
86	Ermelo	Smitsfield 137	Cutting	Coal zone	Coarse sandstone and grit	6	169°	0.88	
87	Ermelo	Lietgekozen 183	Cliff	Coal zone	Medium sandstone	7	185°	0.61	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
88	Ermelo	Lothair 195	Cliffs	Coal zone	Coarse sandstone	2	239°	0.90	
89	Ermelo	Bloemfontein 288	Cutting	Coal zone	Coarse grits and sandstone	4	200°	0.93	
90	Ermelo	Welgelegen 132	Side of hill	Coal zone	Coarse grits and sandstone	9	153°	0.84	25"
91	Ermelo	Klipstapel 145	Next to stream	Coal zone	Coarse sandstone	4	180°	0.95	
92	Ermelo	Lilliput 142	Side of road	Coal zone	Medium sandstone	3	259°	0.98	
93	Carolina	Goedverwachting 221	Old Mine	Coal zone	Coarse sandstone	5	231°	0.66	20"
94	Ermelo	Bothwell 140	Side of lake	Coal zone	Medium sandstone	12	281°	0.98	
95	Ermelo	Florence 174	Side of pan	Coal zone	Medium sandstone	4	189°	0.95	380"
96	Ermelo	Klockdn 178	Side of road	Coal zone	Coarse sandstone	5	192°	0.76	19"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
97	Ermelo	Hamilton 118	Above pan	Coal zone	Medium sandstone	4	249°	0.98	
98	Ermelo	Kelvinside 163	Cliffs	Coal zone	Coarse sandstone	5	1°	0.98	
99	Carolina	Kleinbuffels-spruit 111	Small hill	Below coal zone	Coarse sandstone and grit	10	226°	0.89	
100	Carolina	Onbekend 172	Side of hill	Below coal zone	Coarse sandstone and grit	2	145°	0.98	
101	Carolina	Onbekend 172	Side of hill	Coal zone	Coarse sandstone	2	234°	0.96	
102	Carolina	Noortgedacht 51	In stream	Coal zone	Coarse sandstone	10	248°	0.87	
103	Carolina	Paardeplaats 187	Side of road	Coal zone	Coarse sandstone	3	233°	0.98	
104	Carolina	Kwaggafontein 55	Coal mine	Coal zone	Coarse sandstone	4	231°	0.98	
105	Carolina	Jagtlust 245	Side of hill	Below coal zone	Coarse sandstone	10	235°	0.97	

Cut-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
106	Belfast	Zoekop 426	Small hill	Coal zone	Coarse sandstone and grit	4	228°	0.99	
107	Belfast	Leeuwbank 427	Cliffs	Coal zone	Coarse sandstone and grit	7	195°	0.80	30"
108	Belfast	Wonderfontein 428	Side of pan	Coal zone	Coarse sandstone	3	228°	0.77	8"
109	Carolina	Klippan 452	Side of pan	Coal zone	Coarse sandstone	7	149°	0.66	
110	Middelburg	Vlesbokfon-tein 485	Side of hill	Coal zone	Coarse sandstone	4	238°	0.95	
111	Middelburg	Rietvlei 397	Side of road	Coal zone	Coarse sandstone	3	174°	0.83	
112	Witbank	Kromdraai 279		Coal zone	Coarse sandstone and grit	-	213°	0.91	
113	Witbank	Noolgedacht	Near colliery	Coal zone	Coarse sandstone and grit	6	223°	0.73	
114	Witbank	Elandsfontein 309	Side of hill	Coal zone	Coarse sandstone and grit	5	264°	0.98	9"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
115	Witbank	Blesboklaagte 296	Near location	Coal zone	Coarse sandstone and grit	3	209°	0.93	
116	Witbank	Blauwkrans 323	Above pan	Above coal zone	Medium sandstone	8	240°	0.78	
117	Middelburg	Driefontein 338	Below kraal	Coal zone	Coarse sandstone and grit	10	152°	0.86	
118	Middelburg	Driefontein 338	Cliffs	Coal zone	Coarse sandstone and grit	3	172°	0.98	
119	Middelburg	Bankfontein 340	Above stream	Coal zone	Coarse sandstone	11	198°	0.85	31"
120	Middelburg	Sterkwater	Side of pan	Coal zone	Coarse sandstone	2	175°	0.98	
121	Middelburg	Elandspruit 291	Cliffs	Coal zone	Coarse sandstone and grit	2	168°	0.98	
122	Witbank	Klipplaat 14	Side of hill	Coal zone	Coarse sandstone and grit	10	228°	0.75	24"

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
123	Witbank	Zaaiwater 11	In stream	Coal zone	Coarse sandstone and grit	6	180°	0.97	
124	Bethel	Middeldrift 42	Steenkool spruit	Coal zone	Coarse sandstone and grit	4	169°	0.68	
125	Witbank	Van Dyksdrift 19	Cliffs	Coal zone	Coarse sandstone and grit	3	182°	0.98	
126	Middelburg	Haasfontein 28	Cliffs	Coal zone	Coarse sandstone and grit	9	161°	0.88	14"
127	Middelburg	Leeuwfontein 48	Side of hill	Coal zone	Fine sandstone	3	220°	0.87	6"
128	Bethal	Onverwacht 70	In stream	Coal zone	Coarse sandstone and grit	10	252°	0.99	
129	Bethal	Kaffirstad 79	Near old mine	Coal zone	Coarse sandstone	6	163°	0.82	
130	Bethal	Ystervark-fontein 106	Cutting	Coal zone	Coarse sandstone and grit	8	145°	0.91	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
131	Bethal	Vaalkop 104	In stream	Above coal zone	Medium sandstone	10	191°	[illegible]	22"
132	Bethal	Trichardts-fontein 140	Ledges	Above coal zone	Coarse sandstone and grit	10	210	0.91	
133	Bethal	Uitmalkaar 126	Cutting	Above coal zone	Medium sandstone	6	180°	0.98	48"
134	Standerton	Springbokdraai 277	Side of road	Above coal zone	Coarse sandstone	5	159°	0.96	
135	Standerton	De Bank 280	Quarry	Above coal zone	Fine sandstone	3	259°	0.60	
136	Standerton	Roodebank 323	Waterval river	Above coal zone	Coarse sandstone	10	263°	0.98	
137	Bethal	Goedehoop 301	Cutting	Above coal zone	Coarse sandstone	4	167°	0.98	
138	Bethal	Witbank 303	In stream	Above coal zone	Medium sandstone	4	230°	0.95	
139	Bethal	Sterkfontein 299	Side of road	Above coal zone	Coarse sandstone	8	211°	0.84	24"
140	Bethal	Vlakspruit 308	In stream	Above coal zone	Coarse sandstone	6	235°	0.98	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
141	Standerton	Liebenberg 345	In stream	Above coal zone	Medium sandstone	4	237°	0.93	
142	Standerton	Twee drank 378	West bank of Vaal river	Above coal zone	Coarse sandstone and grit	10	189°	0.94	26"
143	Standerton	Diepspruit	In stream	Above coal zone	Coarse sandstone and grit	5	208°	0.98	21"
144	Standerton	Langverwyl 410	In stream	Above coal zone	Medium sandstone	5	232°	0.90	
145	Standerton	Brizak 51	In stream	Above coal zone	Fine sandstone	2	259°	0.95	7"
146	Vrede	Kleinfontein 431	In stream	Above coal zone?	Fine sandstone	4	238°	0.83	
147	Vrede	Farm 481	Cliffs	Above coal zone?	Fine sandstone	3	247°	0.97	
148	Vrede	Tweefontein 335	In stream	Above coal zone?	Coarse sandstone	10	272°	0.79	18"
149	Vrede	Farm 1125	South bank of river	Above coal zone?	Medium sandstone	10	240°	0.96	12"

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
150	Vrede	Krynnauws Lust 275	Ledges	Above coal zone	Coarse sandstone and grit	8	103°	0.65	29"
151	Vrede	Farm 833	Small hill	Lowermost Beaufort	Coarse sandstone	10	225°	0.94	18"
152	Vrede	Middelkop 453	Side of hill	Above coal zone?	Coarse sandstone	7	230°	0.94	
153	Frankfort	Annie 106	In stream	Lowermost Beaufort	Coarse sandstone	3	205°	0.97	
154	Frankfort	Farm 1032	In stream	Lowermost Beaufort	Medium sandstone	5	193°	0.78	
155	Frankfort	Farm 324	Verkyker" kop	Lowermost Beaufort	Fine sandstone	10	8°	0.90	30"
156	Frankfort	Frankfort	South bank of Wilge river	Above coal zone	Coarse sandstone	5	274°	0.82	
157	Frankfort	Frankfort Townlands	Side of hill	Above coal zone	Medium sandstone	10	350°	0.90	
158	Frankfort	Farm 845	Cutting	Above coal zone	Coarse sandstone and grit	5	267°	0.85	

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59	Frankfort	Grootvley 136	Cutting	Above coal zone	Medium sandstone	3	249°	0.97	
60	Heidelberg	Dwaalhoek 246	Small hill	Above coal zone	Medium sandstone	3	117°	0.80	
62	Balfour	Draaifontein 278	Small hill	Above coal zone	Medium sandstone	6	247°	0.42	
64	Sasolburg	Anniesrust 763	Side of pan	Coal zone	Medium sandstone	2	194°	0.98	
65	Heidelberg	Rietspruit 225	South bank of river	Below coal zone	Fine sandstone	4	171°	0.98	
66	Heidelberg	Modderfontein 56	In stream	Below coal zone	Coarse sandstone	7	288°	0.63	19"
67	Balfour	Malanskraal 73	Cliff	Below coal zone	Coarse sandstone and grit	3	197°	0.90	
168	Witbank	Klipfontein 566	Quarry	Coal zone	Coarse sandstone and grit	4	193°	0.90	
169	Balfour	Modderfontein 562	Side of pan	Below coal zone	Medium sandstone	8	246°	0.81	14"
170	Balfour	Witbank 340	In stream	Coal zone	Medium sandstone	7	190°	0.69	

Outcrop No.	District	Farm	Outcrop Description	Stratigraphic position	Constituent Material	No. of Measurements	Vectoral Mean	Consistency Ratio	Mean thickness of Planar Cross-bedded units
171	Standerton	Rietkuil	Side of road	Above coal zone	Coarse sandstone	5	193°	0.98	
172	Balfour	Saltpeterkranz 351	Cliffs	Above coal zone	Coarse sandstone	10	240°	0.76	19"
173	Nigel	Honingfontein 339	In stream	Above coal zone	Medium sandstone	3	305°	0.97	
174	Nigel	Varkensfontein 169	Quarry	Coal zone	Coarse sandstone and grit	6	126°	0.90	
175	Nigel	Nooitgedacht	Quarry	Coal zone	Medium sandstone	5	215°	0.96	
176	Witbank	Kromdraai 263	In stream	Coal zone	Coarse sandstone and grit	4	165°	0.90	
177	Witbank	Kromdraai 263	Small hill	Coal zone	Coarse sandstone and grit	3	229°	0.90	14"
178	Delmas	Brakfontein 264	Small hill	Coal zone	Coarse sandstone and grit	4	282°	0.95	12"
179	Witbank	Honingkranz 536	Cliffs	Coal zone	Coarse sandstone and grit	12	125°	0.51	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
180	Stegi		Lutala river	Coal zone	Coarse sandstone and grit	3	219°	0.90	
181	Stegi		In stream	Coal zone	Coarse sandstone and grit	4	231°	0.98	
182	Stegi		Fraser Shaft	Coal zone	Coarse sandstone and grit	5	244°	0.94	41"
183	Stegi		Side of road	Coal zone	Coarse sandstone and grit	6	154°	0.92	
184	Manzini		Rail cutting	Coal zone	Coarse sandstone and grit	20	220°	0.91	33"
185	Manziri		Uzimpofu river	Coal zone	Coarse sandstone	4	241°	0.98	
186	Stegi		Mtendekwa river	Above coal zone	Medium sandstone	8	187°	0.96	
187	Hlatikulu		Mhloyo river	Coal zone	Coarse sandstone and grit	5	190°	0.92	

Out-crop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	No. of Measure-ments	Vectoral Mean	Consis-tency Ratio	Mean thickness of Planar Cross-bedded units
188	Hlatikulu		In stream	Coal zone	Coarse sandstone and grit	20	209°	0.86	

APPENDIX 17

STATISTICAL DATA ON RIPPLE MARKS IN THE NORTHERN PORTION OF THE BASIN

Outcrop No.	District	Farm	Outcrop Description	Strati-graphic position	Constituent Material	Symmetry of crests	No. of Measure-ments	Mean Strike	Ripple Index
13	Ermelo	Goedehoop 24	Cliffs	Above coal zone	Medium sandstone	Symmetrical	2	269°	6.00
36	Ermelo	Mooifontein 497	In stream	Above coal zone	Fine sandstone	Symmetrical	3	280°	5.40
56	Bethal	Roodekrans 457	In stream	Above coal zone	Coarse sandstone	Symmetrical	[illegible]	88°	3.47
89	Ermelo	Bloemfontein 288	Cutting	Coal zone	Fine sandstone	Symmetrical	3	111°	1.88
125	Witbank	Van Dyks Drift 19	Cliffs	Coal zone	Fine sandstone	Symmetrical	6	133°	11.00
135	Standerton	De Bank 280	Above stream	Above coal zone	Medium sandstone	Symmetrical	5	68°	5.15
161	Balfour	Leeuwfontein 159	Ledges	Above coal zone	Medium sandstone	Symmetrical	7	19°	11.37
163	Balfour	Britzville 10	Side of hill	Above coal zone	Medium sandstone	Symmetrical	2	65°	10.56
169	Balfour	Modderfontein 562	In pan	Below coal zone	Medium sandstone	Symmetrical	3	121°	35.00
178	Delmas	Brakfontein 264	In Wilge river	Coal zone	Fine sandstone	Symmetrical	3	151°	15.00

APPENDIX 18

PEBBLE SIZES

Outcrop No.	District	Farm	Outcrop Description	Mean length of long axis of 10 largest pebbles
98	Dundee	Matatana 13024	In stream	3.4"
99	Dundee	Overton 3315	In stream	3.1"
87	Dundee	Van Ro[illegible]n 4252	In Sandspruit	5.8"
52	Dundee	Lyell 2398	In stream	1.8"
198	Utrecht	Schuilklip 109	Side of hill	1.1"
196	Utrecht	Witklip [illegible]	In stream	1.3"
110	Utrecht	Nooitgedacht 60	In stream	5.7"
142	Utrecht	Novembersdrift 87	In donga	4.3"
227	Paulpietersburg	Trekdrift 39	Near bridge	3.8"
221	Paulpietersburg	Makateeskop 59	Side of hill	5.6"
262	Vryheid	Vaalkrans 306	Cutting	2.6"
265	Vryheid	Langkrans 367	Side of mountain	6.0"
230	Vryheid	Erfstuk 4	In stream	4.9"
268	Vryheid	Riversdale 75	Side of mountain	5.0"
277	Piet Retief	Pongola 160	Mititulu hill	6.8"
281	Nongoma	Native Reserve No. 12	In donga	5.6"
165	Wakkerstroom	Nauwgevonden 369	Cliff	2.6"
212	Wakkerstroom	Klipspruit 461	In donga	4.2"

Outcrop No.	District	Farm	Outcrop Description	Mean length of long axis of 10 largest pebbles
133	Bethal	Uitmolkaar 126	Cutting	4.8"
64	Ermelo	Nooitgedacht	Quarry	2.3"
-	Middleburg	Uitkyk 290	Quarry	5.9"
179	Witbank	Honingkranz	Old mine	6.1"
184	Manzini	-	Rail cutting	5.5"
188	Hlatikulu	-	In stream	3.2"
-	Ermelo	Bellevue 176	Cutting	9.0"
100	Carolina	Onbekend 172	Side of hill	10.1"
99	Carolina	Kleinbuffel-spruit 111	Side of hill	9.4"
167	Balfour	Malanskraal 562	Ledges	20.1"
169	Balfour	Modderfontein 562	Side of pan	5.3"
-	Vereeniging	Klipplaatdrift 83	North bank of river	5.6"

APPENDIX 19

BOREHOLE CONTROL POINTS USED IN THE CONSTRUCTION OF ISOPACH MAP OF THE TOTAL ECCA PLUS UPPER DWYKA SHALE

Reference No.	Locality	Thickness	Source of Information	Remarks
1	Brakfontein 953	1,425'	Kingston Report (1961)	
2	Dannhauser G.S.D.1	1,670'	Kingston Report (1961)	Incomplete section
3	Amersfoort S.12	1,472'	Kingston Report (1961)	Incomplete section
4	Langbank 1165	973'	Kingston Report (1961)	Incomplete section
5	Mara 1	977'	Kingston Report (1961)	
6	Nooitgedacht 1	1,165'	Kingston Report (1961)	
7	Novo 1	1,201'	Kingston Report (1961)	
8	Rietpan 1	965'	Kingston Report (1961)	
9	Tierbank Noord 257	1,013'	Kingston Report (1961)	
10	Paardefontein	973'	Kingston Report (1961)	
11	Cliefontein 856	881'	Kingston Report (1961)	
12	Roodewal 779	1,088'	Kingston Report (1961)	Incomplete section
13	Fairview 2009	705'	Kingston Report (1961)	
14	Frischweld 647	986'	Kingston Report (1961)	
15	Windsor 528	894'	Kingston Report (1961)	
16	Nooitgedacht 298	956'	Kingston Report (1961)	
17	Zuurfontein 301	871'	Kingston Report (1961)	
18	Steynsrust Townlands	904'	Kingston Report (1961)	
19	Laverstock 272	994'	Kingston Report (1961)	
20	Blaauwboschbank 643	854'	Kingston Report (1961)	

Reference No.	Locality	Thickness	Source of Information	Remarks
21	Geneva 895	648'	Kingston Report (1961)	
22	Olie 50	797'	Kingston Report (1961)	
23	Mocipan 721	914'	Kingston Report (1961)	
24	Wonderheuwel 250	990'	Kingston Report (1961)	
25	Vaalbank 206	943'	Kingston Report (1961)	
26	Kafferspruit 265	891'	Kingston Report (1961)	
27	Welgelegen 382	1,041'	Kingston Report (1961)	
28	Bosrand 2289	1,090'	Kingston Report (1961)	
29	Wynandsfontein 653	1,150'	Kingston Report (1961)	
30	Madeleine 380	1,203'	Kingston Report (1961)	
31	Kranakraal 87	1,065'	Kingston Report (1961)	
32	Waterpan 376	1,486'	Kingston Report (1961)	
33	Middelkop 622	1,158'	Kingston Report (1961)	Incomplete section
34	Williesdam 334	1,352'	Kingston Report (1961)	Incomplete section
35	Leeuwkuil 698	1,219'	Kingston Report (1961)	
36	Brandfort Townlands	1,191'	Kingston Report (1961)	
37	Koolklip 318	932'	Kingston Report (1961)	
38	Sunny Vale 784	892'	Kingston Report (1961)	
39	Middelspruit 2029	729'	Kingston Report (1961)	
40	Jagersfontein Mine	1,620'	Kingston Report (1961)	
41	Plaatjesfontein 143	1,630'	Kingston Report (1961)	
42	Plaatjesfontein 143	1,334'	Kingston Report (1961)	

Reference No.	Locality	Thickness	Source of Information	Remarks
43	Lucerne 264	1,695'	Kingston Report (1961)	
44	Lucerne 264	1,711'	Kingston Report (1961)	
45	Vlakfontein 165	1,694'	Kingston Report (1961)	
46	Vlakfontein 165	1,639'	Kingston Report (1961)	
47	Mynhoop 62	1,926'	Kingston Report (1961)	
48	Dubbelde Vlei	3,060'	Kingston Report (1961)	
49	Sambokkraal	8,025'	Haughton et al 1953	
50	De Aar Townlands	1,300'	Rogers (1907)	Incomplete section
51	Paardekraal	1,503'	Anglo American Corporation	Incomplete section
57	Standerton Townlands	710'	Schlke and van der Merwe (1959)	Incomplete section
58	Somerset	2,960'	Southern Oil Exploration Corp.	
59	Tuinplaats 307	2,000'	Union Corporation	
60	Klip Drift Wor. Q.16-2	5,456'	Southern Oil Exploration Corp.	
61	Quaggas Fontein Fr. Q. 9-12	4,051'	Southern Oil Exploration Corp.	
62	Abrahams Kraal B.f.W.Q.1-23	4,664'	Southern Oil Exploration Corp.	
63	Karee Bosch Mu.Q. 1-30	5,885'	Southern Oil Exploration Corp.	

APPENDIX 20

MEASURED SECTION CONTROL POINTS USED IN THE CONSTRUCTION OF ISOPACH MAP OF THE TOTAL ECCA PLUS UPPER DWYKA SHALE

Reference No.	Locality	Thickness	Source of Information	Remarks
1	Southern Swaziland	2,475'	Scogings and Lenz (1961)	
2	Natal-Transvaal border	1,750'	Visser et al (1958)	
3	Vryheid	1,850'	Blignaut & Furter (1940)	Incomplete section, Upper Ecca estimated to be 600'
4	Dundee	2,350'	Du Toit (1918)	
5	Tugela Valley	3.200'	Du Toit (1931)	
6	Greytown	2,600'	Du Toit (1918)	3.075' measured by geologist of the Standard Vac. Co.
7	Pietermaritzburg	2,700'	King (1948)	
8	Umzimkulu Valley	2,600'	Du Toit (1918)	
9	Durban	±2,500'	King (1964)	Only lower and middle Ecca represented
10	North of Durban	±3,000'	Kent (1938)	Only lower and middle Ecca represented
11	Port St. Johns	2,500'	Du Toit (1918)	1705' measured by geologists of the Standard Vac. Co.
12	Roggerveld Escarpment	2,610'	Kingston Report (1961)	
13	Koedoesberge	4,085'	Kingston Report (1961)	

Reference No.	Locality	Thickness	Source of Information	Remarks
14	Beukesfontein	4,085'	Kingston Report (1961)	
15	Hantamsberge	±1,800'	Du Toit (1904)	Incomplete section; estimated thickness of Upper Dwyka Stage = 600'
16	Willemskraal west of Dwyka River	6,938'	Haughton et al (1953)	
17	Along Dwyka River	6,643'	Haughton et al (1953)	
18	Along Gamka River	7,213'	Haughton et al (1953)	
19	Prince Albert	6,783'	Haughton et al (1953)	
20	Hangklip-Groot Waterval	7,436'	Haughton et al (1953)	
21	Zwartkraal	7,164'	Haughton et al (1953)	
22	Kommande Kraal-Waalkraal	7,854'	Haughton et al (1953)	
23	North of Miller Station	10,894'	Haughton et al (1953)	
24	N. of Wolwefontein Station	9,450' +	Haughton et al (1953)	
25	North of Grahamstown	10,900'	Geol. Surv. S.A. (Johnstone)	

APPENDIX 21

STATISTICAL DATA ON DIRECTIONAL SEDIMENTARY STRUCTURES

Portion of Basin	Cross-bedding		Ripple Marks		Groove Casts		Parting Lineations		Fucoid Structures		Sub Total	
	No. of Measurements	No. of Outcrops	No. of Measurements	No. of Outcrops	No. of Measurements	No. of Outcrops	No. of Measurements	No. of Outcrops	No. of Measurements	No. of Outcrops	No. of Measurements	No. of Outcrops
North-Western	311	49	135	20	-	-	27	4	247	15	720	88
Cape Province and southernmost Orange Free State	136	33	884	176	82	13	17	4	93	13	1,212	239
Eastern	295	59	6	2	28	4	17	4	-	-	346	69
North-Eastern	2,786	300	15	2	-	-	-	-	-	-	2,801	302
Northern	1,070	175	37	10	-	-	-	-	-	-	1,107	185
Sub Total	4,598	616	1,077	210	110	17	61	12	340	28	6,186	883

Grand Total

APPENDIX 22

AVERAGE NUMBER OF DIRECTIONAL SEDIMENTARY STRUCTURAL MEASUREMENTS PER OUTCROP

Portion of Basin	Cross-Bedding	Ripple Marks	Groove Casts	Parting Lineations	Fucoid Structures	Population Average
North-Western	6.3	6.8	-	6.8	16.5	8.2
Cape Province and southernmost Orange Free State	4.1	5.0	6.3	4.3	7.2	5.1
Eastern	5.0	3.0	7.0	4.3	-	5.0
North-Eastern	9.3	7.5	-	-	-	9.3
Northern	6.1	3.7	-	-	-	6.0
Population Average	7.5	5.1	6.5	5.1	12.1	7.0

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FIG. 34 Groove, bounce and prod casts

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FIG. 53 Vertical worm burrows in carbonaceous sandstone

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FIG. 55 Graph showing bimodal orientation of fucoid structures

FIG. 56 Graph showing bimodal orientation of fucoid structures

FIG. 57 Graph showing bimodal orientation of fucoid structures

FIG. 58 Graph showing bimodal orientation of fucoid structures

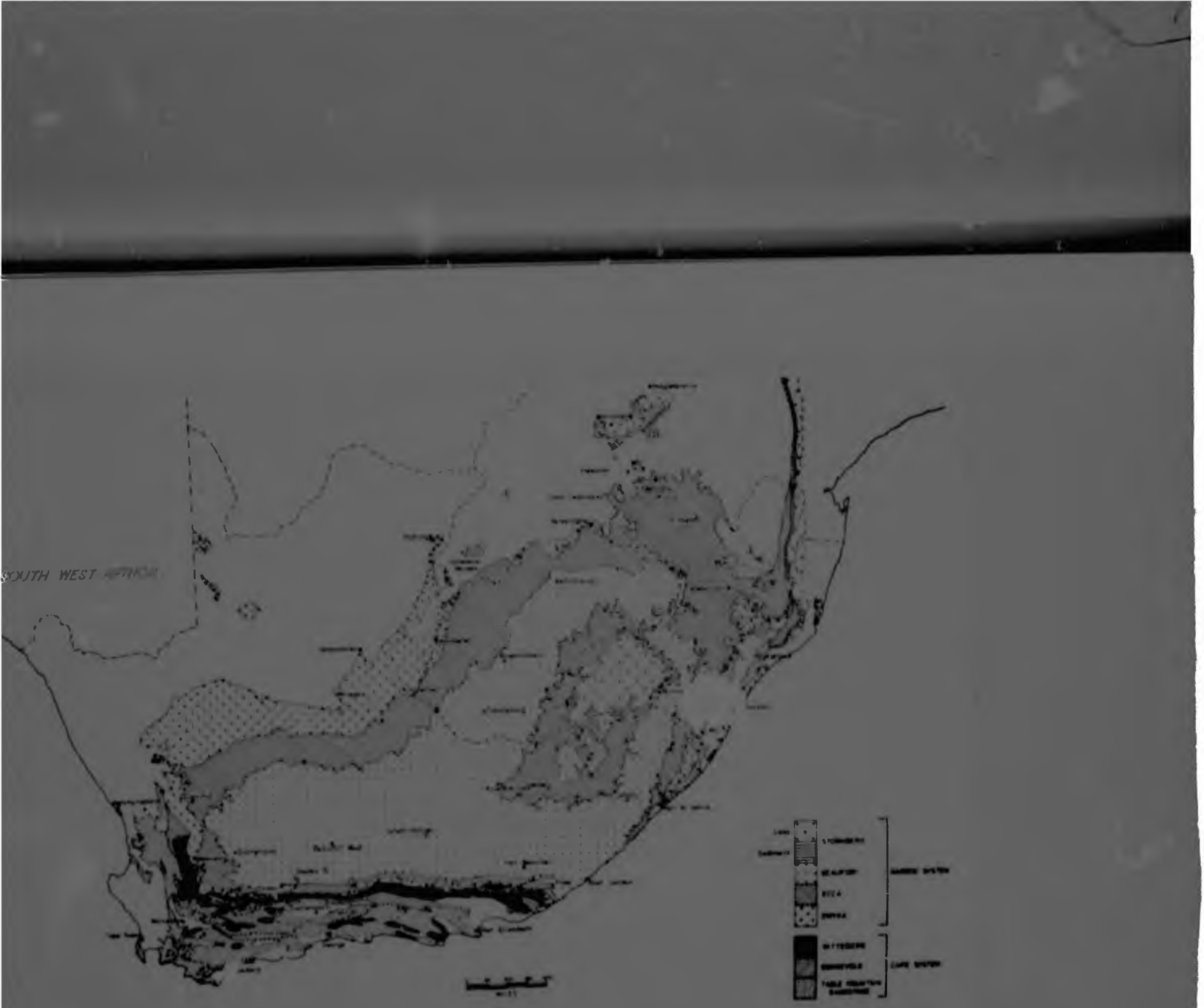


FIG. 1 GENERALIZED GEOLOGICAL MAP OF THE CAPE AND KARROO SYSTEMS IN THE REPUBLIC OF SOUTH AFRICA



FIG. 2 THE WHITE BAND NORTH OF MATJIESFONTEIN, LAINGSBURG DISTRICT, CAPE



FIG. 3 RECTANGULAR JOINTING IN MASSIVE BEDDED SANDSTONE, MIDDLE ECCA GROUP, WESTERN FACIES, SUTHERLAND DISTRICT



FIG. 4 THE WESTERN FLANK OF THE KOEDOESBERG, SUTHERLAND DISTRICT. CLIFFS AND FLANKS COMPOSED OF ECCA STRATA (WESTERN FACIES). MOUNTAIN CAPPED BY THIN SUCCESSION OF LOWERMOST BEAUFORT BEDS



FIG. 5 TYPICAL LOWER ECCA SHALE, NORTHERN FACIES, UMBINGA DISTRICT, NATAL



FIG. 6 THE EASTERN ESCARPMENT NEAR GREYTOWN, NATAL. BUILT UP OF MIDDLE ECCA SEDIMENTS AND THICK DOLERITE SILLS



FIG. 7 SANDSTONE FORMATIONS IN THE MIDDLE ECCA GROUP, NORTHERN FACIES, MOOI RIVER VALLEY, NATAL



FIG. 8 THE SECOND AND THIRD SANDSTONE FORMATIONS, MIDDLE ECCA GROUP, NEAR [illegible] DEN, NATAL

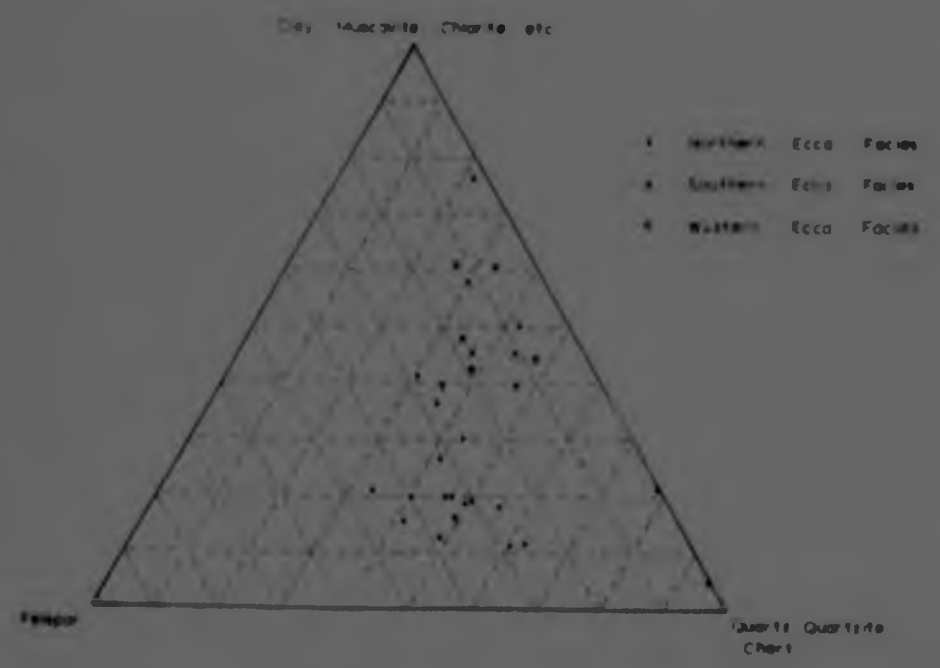


FIG. 9 TRIANGULAR DIAGRAM ILLUSTRATING PERCENTAGE MINERAL COMPOSITIONS OF ECCA [illegible] SANDSTONES



FIG. 10 TYPICAL COARSE-GRAINED MIDDLE ECCA SANDSTONE OF THE NORTHERN ECCA FACIES: SHOWING DETRITAL MUSCOVITE BENT ROUND QUARTZ GRAINS. LARGE GRAINS OF MICROCLINE ARE ABUNDANT X 62.5

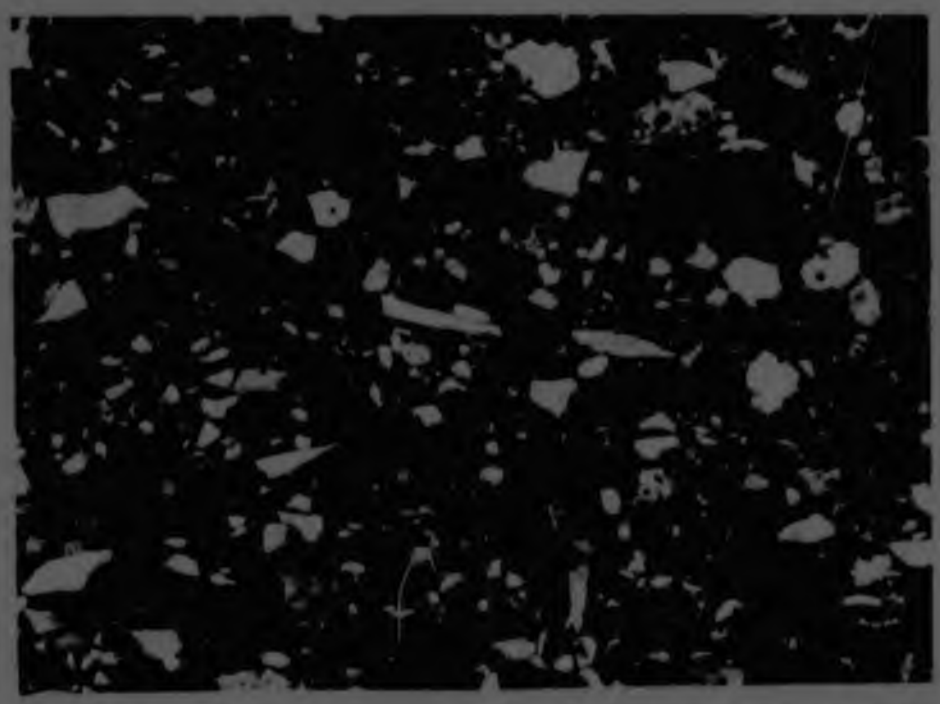


FIG. 11 TYPICAL GRAYWACKE SANDSTONE OF THE SOUTHERN ECCA FACIES, SHOWING POINTED SLIVERS OF QUARTZ

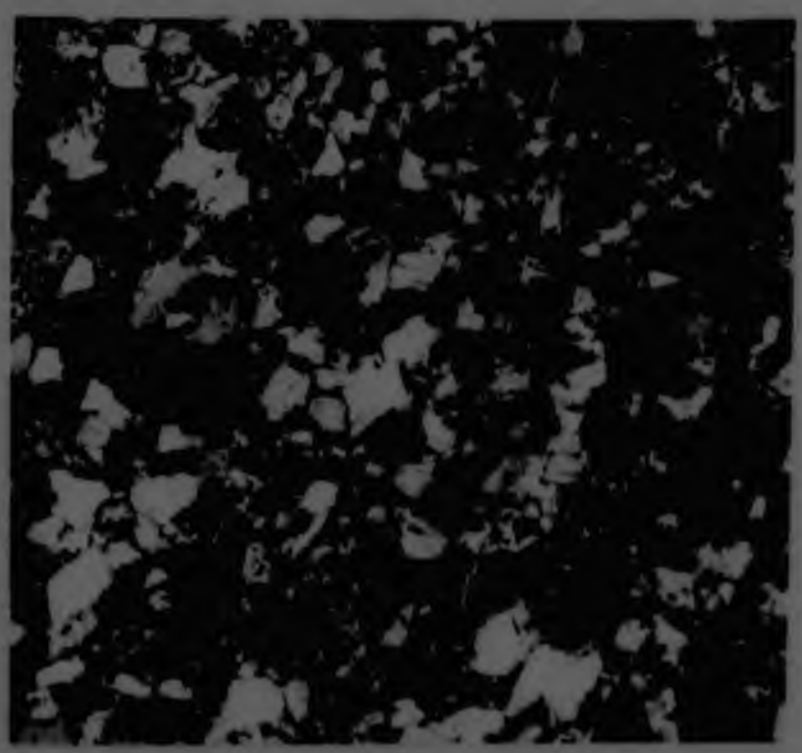


FIG. 12 TYPICAL SUB-GRAYWACKE SANDSTONE FROM THE UPPER ECCA GROUP OF THE WESTERN ECCA FACIES. NOTE THE ANGULAR POORLY SORTED NATURE OF THE GRAINS AND THE PRESENCE OF MATRIX. X 62.5

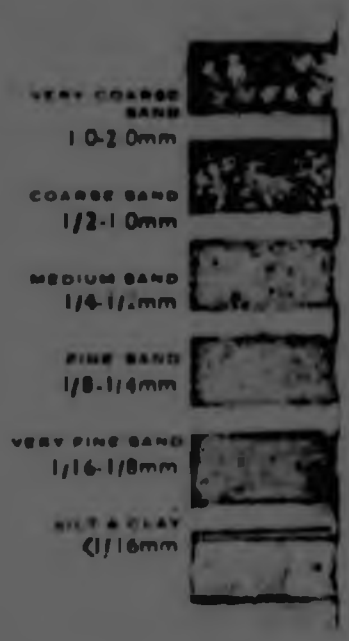


FIG. 13 VISUAL WENTWORTH SIZE CHART USED FOR DETERMINING AVERAGE GRAIN SIZE OF ECCA SANDSTONES

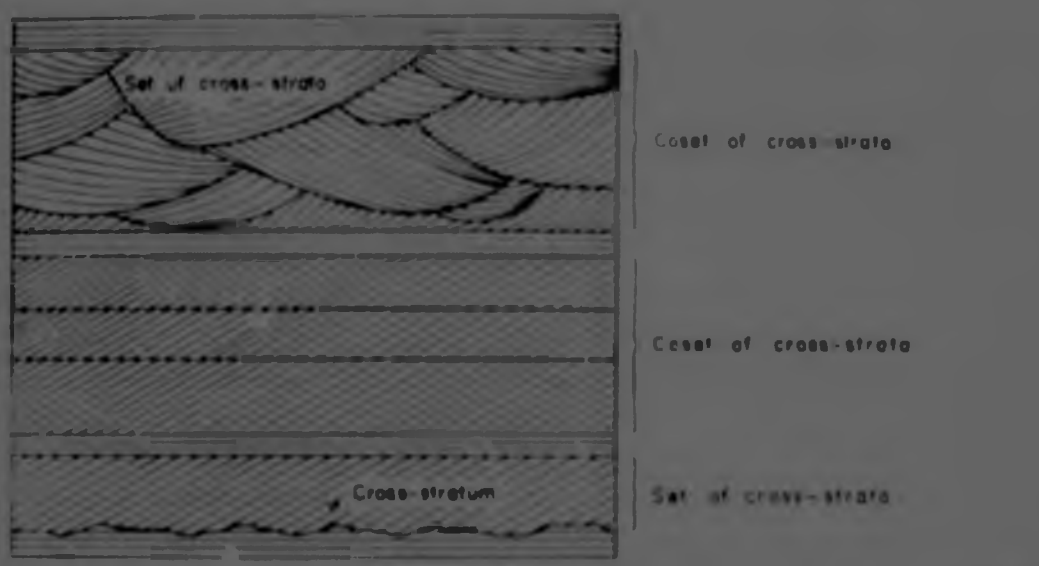


FIG. 14 CLASSIFICATION OF CROSS-BEDDING
(McKEE AND WEIR, 1953)

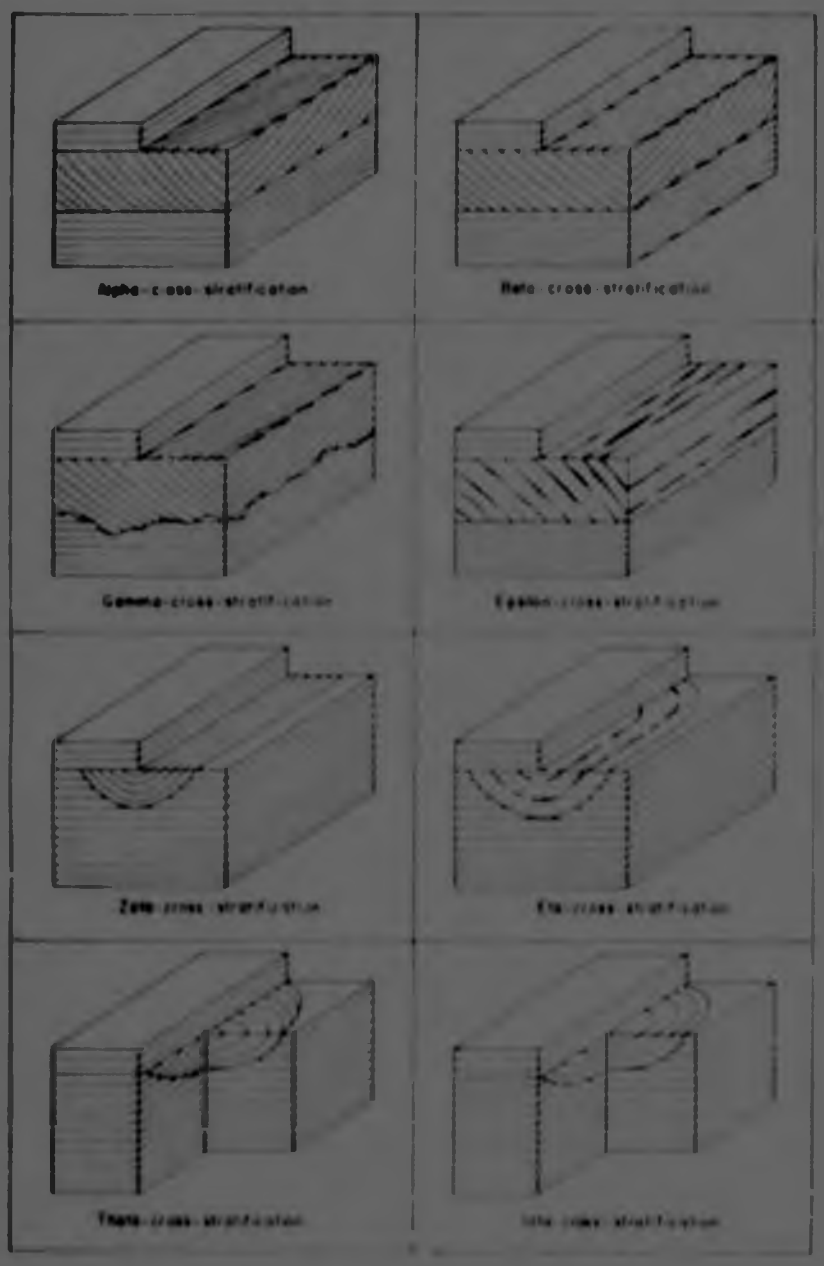


FIG. 15 GENERALIZED BLOCK DIAGRAMS ILLUSTRATING TYPES OF CROSS-BEDDING (ALLEN, 1963)



FIG. 16 ALPHA - CROSS-BEDDING OVERLYING A COAL SEAM IN THE MIDDLE ECCA GROUP, NORTHERN FACIES, DUNDEE DISTRICT, NATAL



FIG. 17 BETA - CROSS-BEDDING IN THE MIDDLE ECCA GROUP, NORTHERN FACIES, VRYHEID DISTRICT, TRANSVAAL



FIG. 18 VERY LARGE SCALE BETA - CROSS-BEDDING, MIDDLE ECCA GROUP, NORTHERN FACIES, NEWCASTLE DISTRICT, NATAL



FIG. 1 GAMMA - CROSS-BEDDING, MIDDLE ECCA GROUP, NORTHERN FACIES, NEWCASTLE DISTRICT, NATAL



FIG. 20 CONTEMPORANEOUS EROSION CHANNEL OR ZETA-CROSS-BEDDING IN THE UPPER ECCA GROUP, WESTERN FACIES SUTHERLAND DISTRICT, CAPE

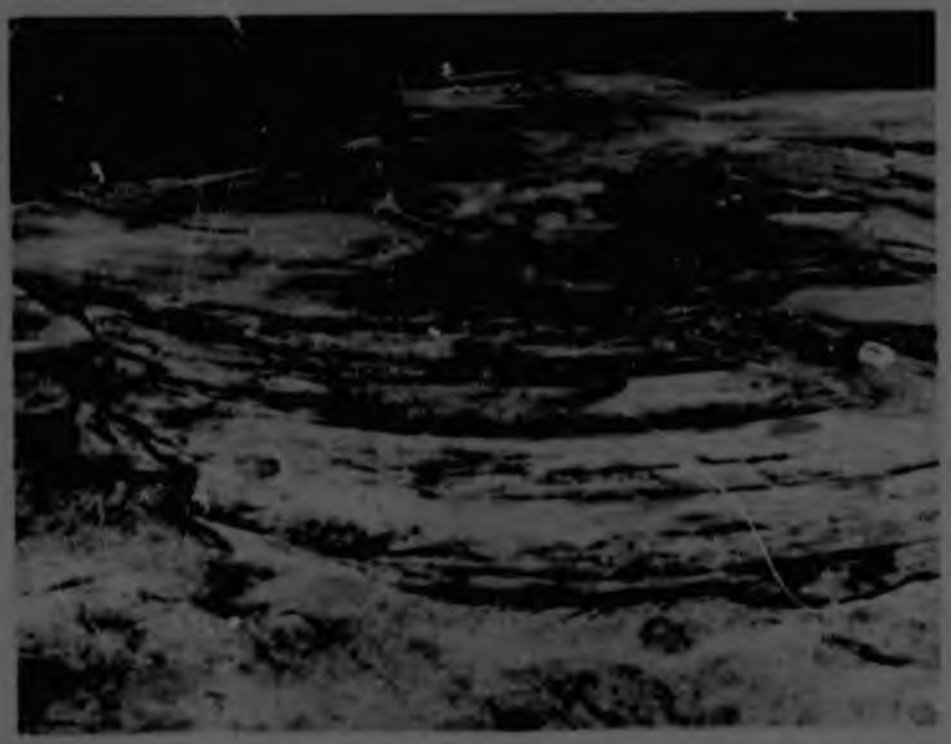


FIG. 21 THETA - CROSS-BEDDING IN MIDDLE ECCA GROUP, NORTHERN FACIES, ERMELO DISTRICT, TRANSVAAL

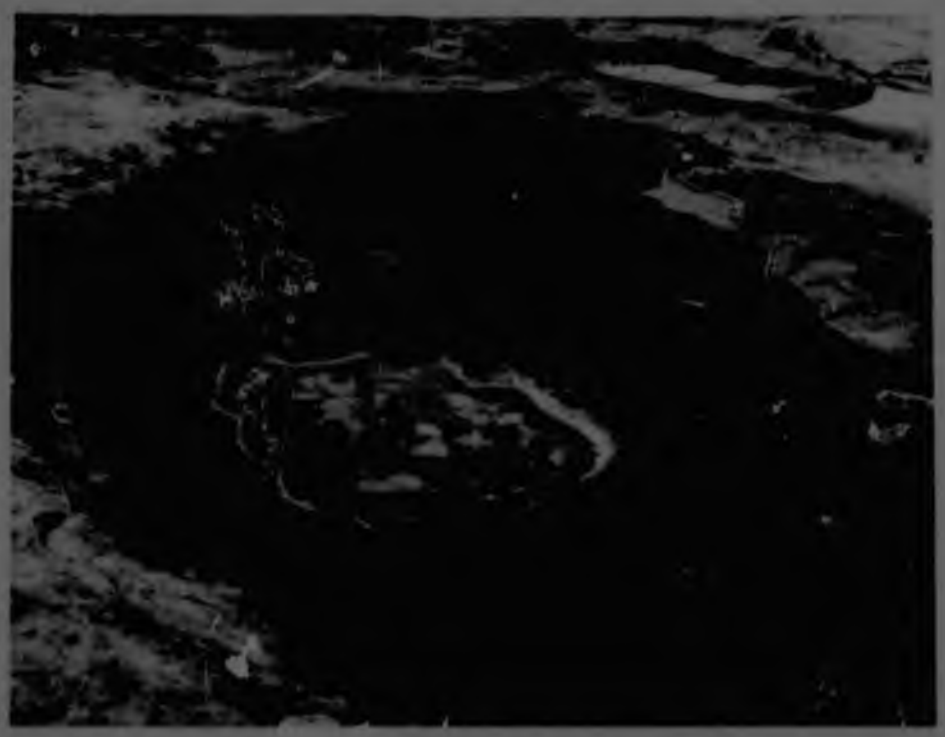


FIG. 22 IOTA - Cross-BEDDING IN THE UPPER SANDSTONE FORMATION, [illegible] DISTRICT, TRANSVAAL

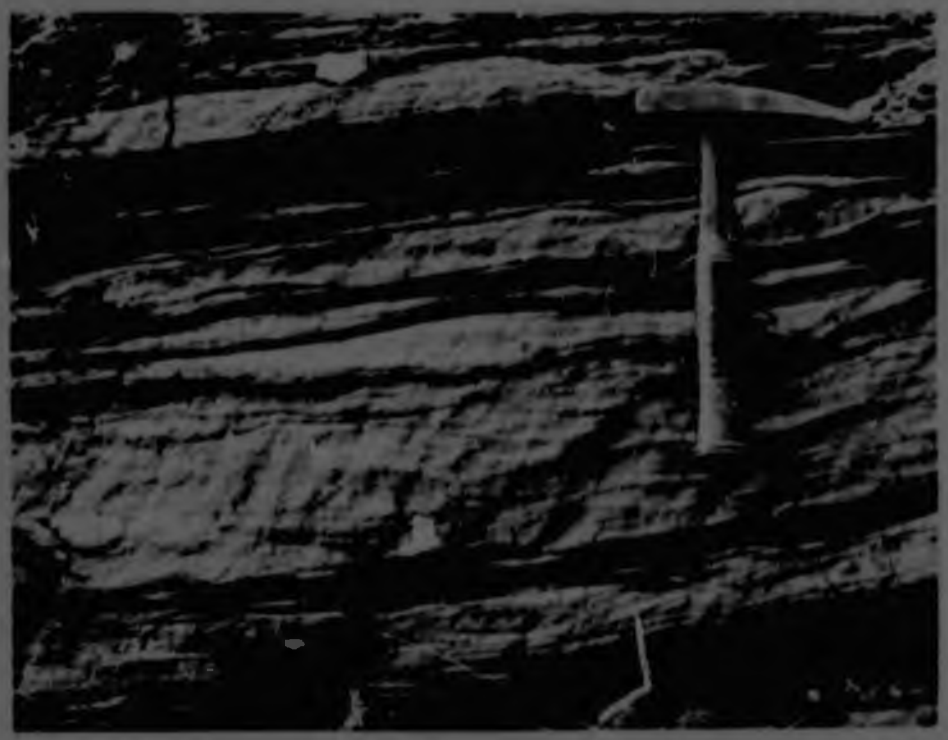


FIG. 23 FLAZER BEDDING IN THE MIDDLE ECCA GROUP, NORTHERN FACIES, UTRECHT DISTRICT, NATAL

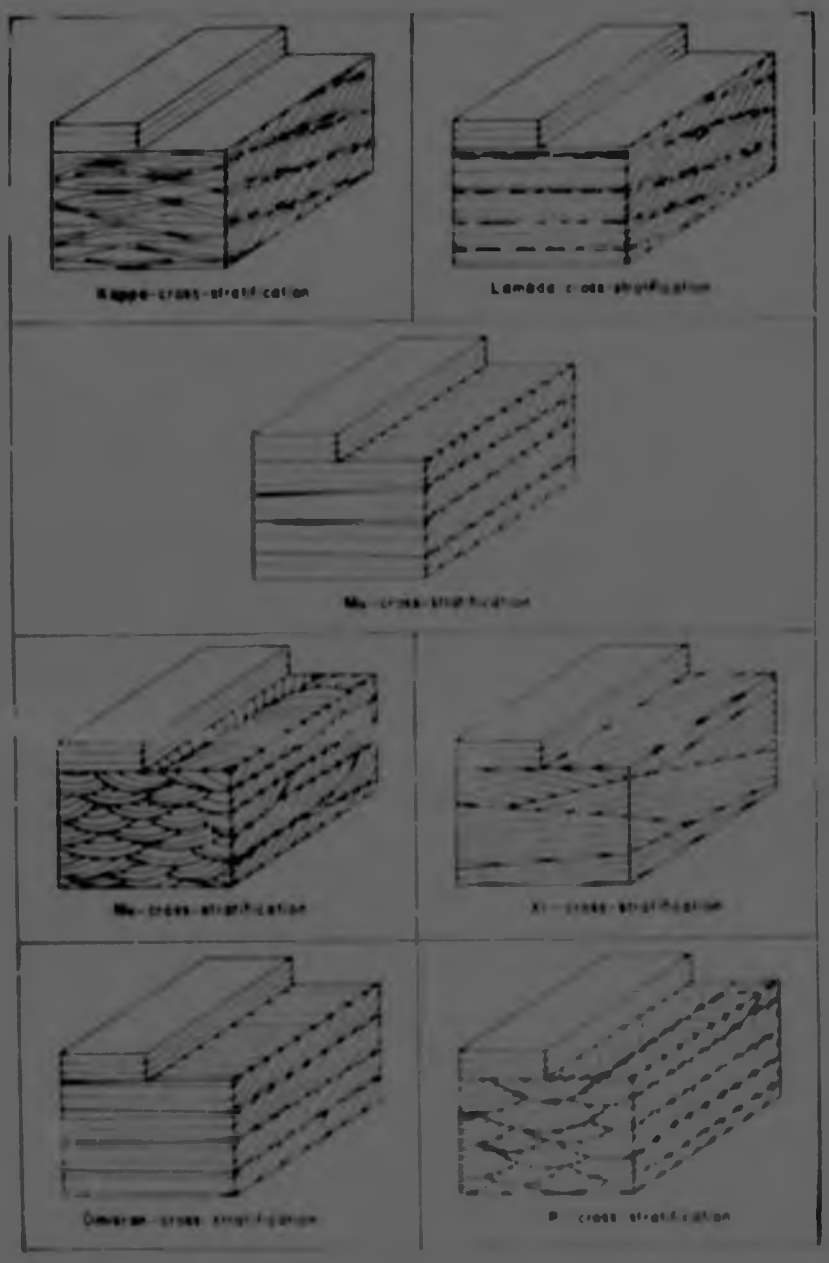


FIG. 24 GENERALIZED BLOCK DIAGRAMS ILLUSTRATING TYPES OF CROSS-BEDDING (ALLEN, 1963)

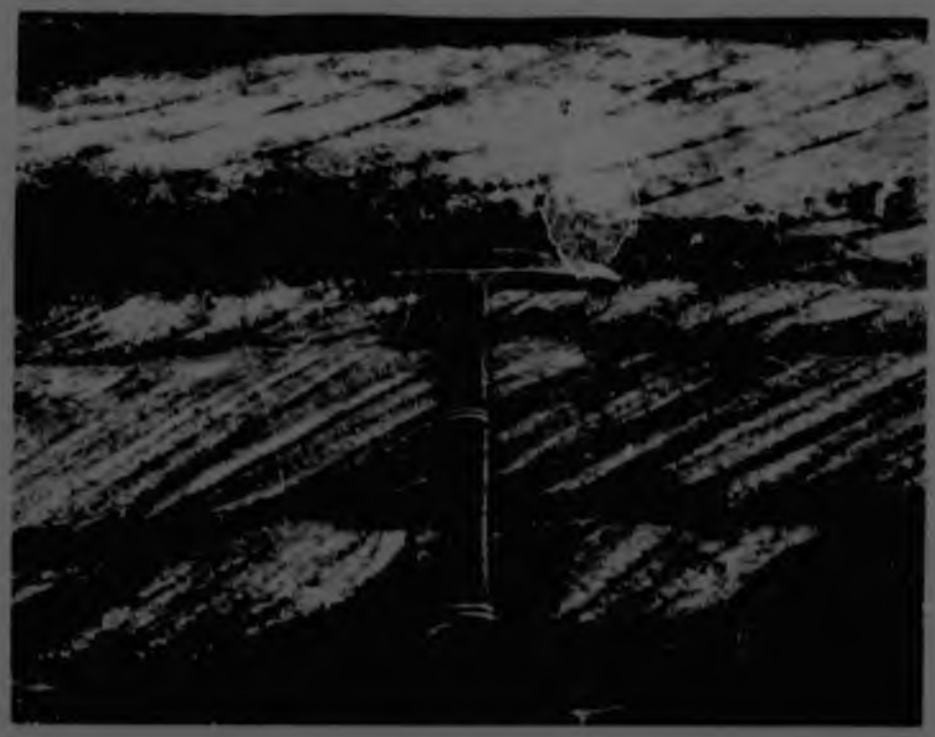


FIG. 25 CMIKRON - CROSS-BEDDING IN MIDDLE ECCA GROUP, NORTHERN FACIES, NEWCASTLE DISTRICT, NATAL. NOTE THICKNESS VARIATIONS BETWEEN SETS

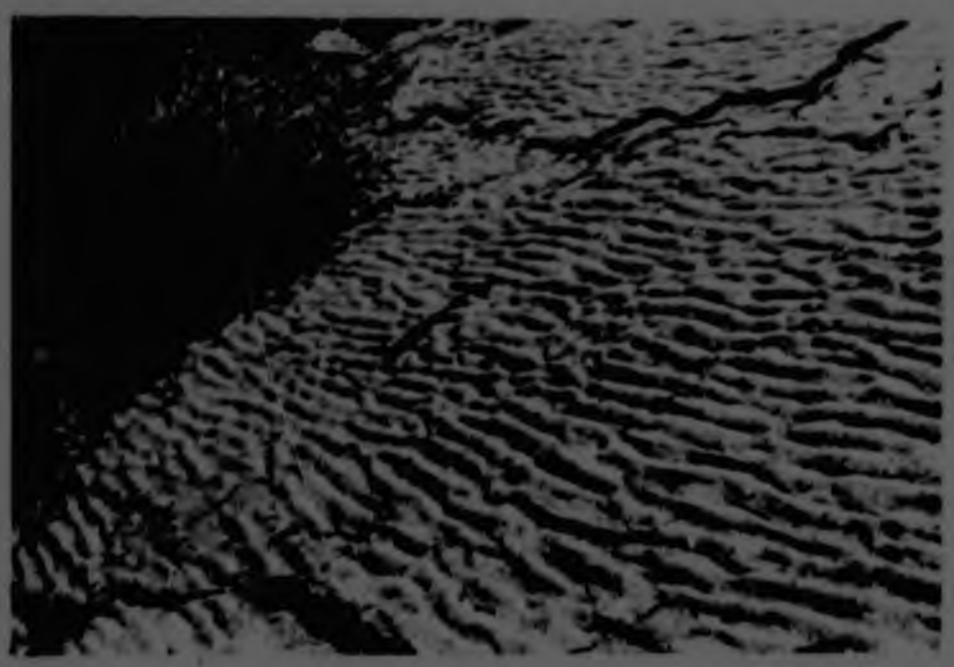


FIG. 26 SYMETRICAL RIPPLE MARKS IN THE LOWER ECCA GROUP OF THE SOUTHERN FACIES



FIG. 27 SLIGHTLY ASYMMETRICAL RIPPLE MARKS IN THE LOWER ECCA GROUP OF THE SOUTHERN FACIES, LADYSMITH DISTRICT, CAPE



FIG. 28 POLISH SECTION OF ASYMMETRICAL RIPPLE MARK IN THE LOWER ECCA GROUP OF THE WESTERN FACIES



FIG. 27 SLIGHTLY ASYMMETRICAL RIPPLE MARKS IN THE LOWER ECCA GROUP OF THE SOUTHERN FACIES, LANGEBURG DISTRICT, CAPE



FIG. 28 POLISH SECTION OF ASYMMETRICAL RIPPLE MARK IN THE LOWER ECCA GROUP OF THE WESTERN FACIES



FIG. 29 INTERFERENCE RIPPLE MARKS IN THE MIDDLE ECCA GROUP OF THE WESTERN FACIES, CERES DISTRICT, CAPE



FIG. 30 SAND WAVE IN THE GLOBULAR BEDS OF THE NORTHERN FACIES, SUTHERLAND DISTRICT, TRANSVAAL

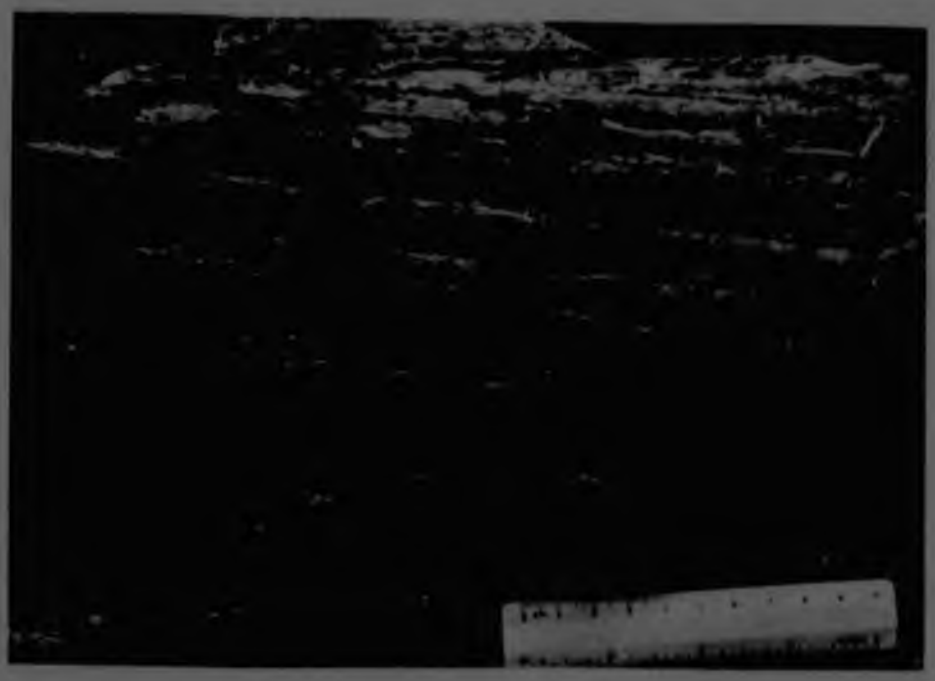


FIG. 31 TWO SETS OF GROOVE CASTS ON UNDERSIDE OF GRAYWACKE SANDSTONE, LOWER ECCA GROUP, SOUTHERN FACIES

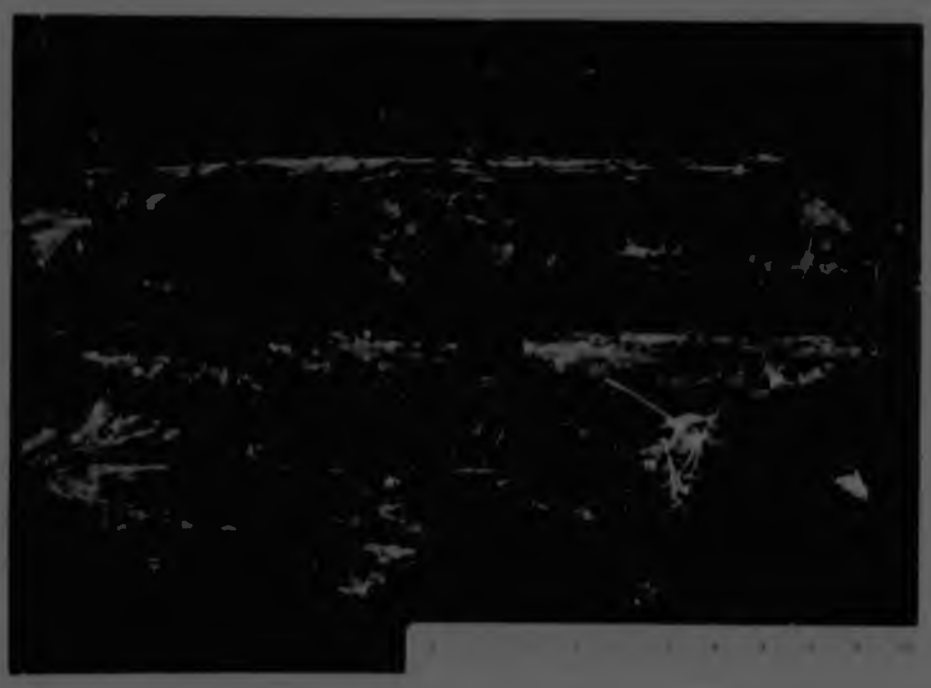


FIG. 32 LARGE GROOVE CAST CONTAINING SMALLER SUPERIMPOSED GROOVES ON THE UNDERSIDE OF GRAYWACKE SANDSTONE, LOWER ECCA GROUP, SOUTHERN FACIES

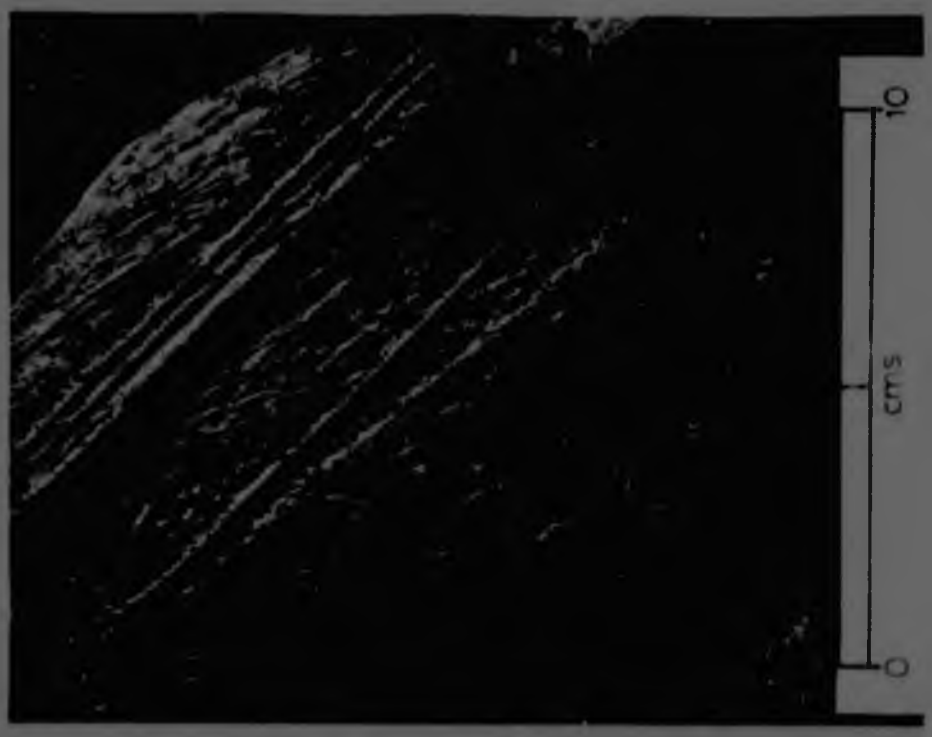


FIG. 33 GROOVE, BOUNCE AND PROD CASTS ON THE UNDERSIDE OF A GREYWACKE SANDSTONE, LOWER ECCA GROUP, SOUTHERN FACIES



FIG. 34 GROOVE, BOUNCE AND PROD CASTS ON THE UNDERSIDE OF A GREYWACKE SANDSTONE, LOWER ECCA GROUP, SOUTHERN FACIES

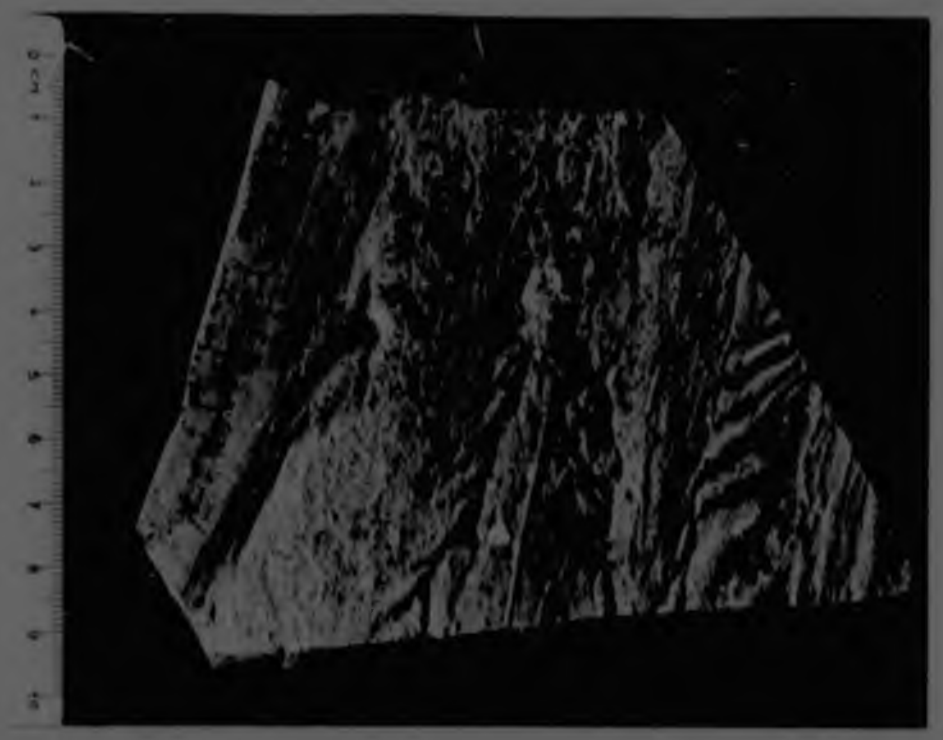


FIG. 35 CHEVRON AND HALF-CHEVRON CASTS ON THE UNDERSURFACE OF A GREYWACKE SANDSTONE. LOWER ECCA GROUP. SOUTHERN FACIES

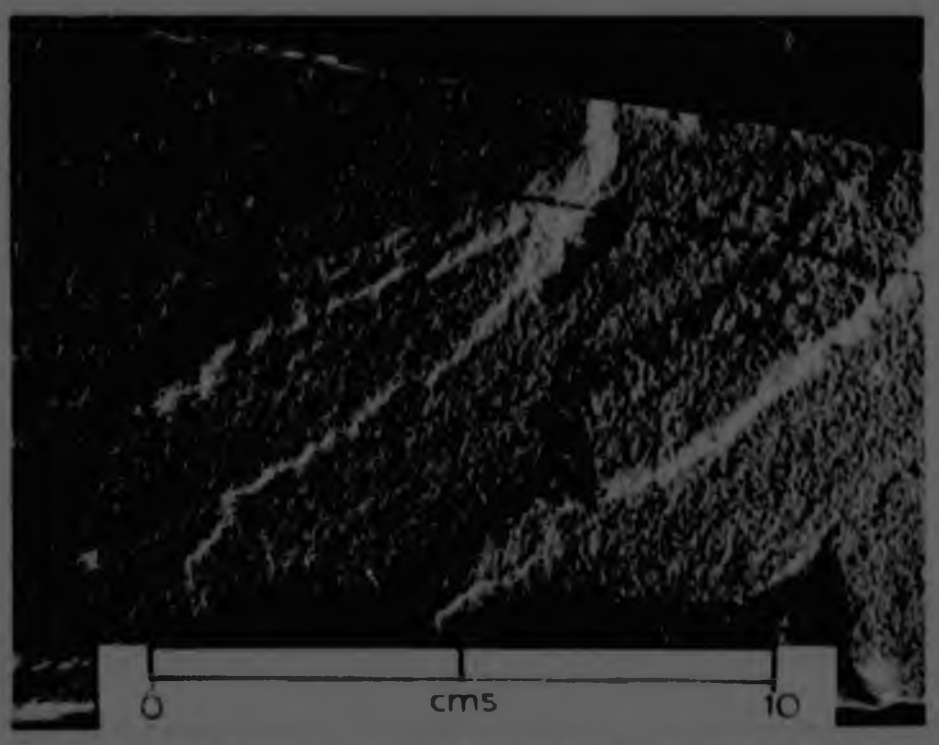


FIG. 36 PARTING LINEATION IN SANDSTONE OF THE UPPER ECCA GROUP. SOUTHERN FACIES



FIG. 37 FUCOID STRUCTURES IN BLUISH-BLACK SHALE OF THE CENTRAL ECCA FACIES, LOMBARDS DRIFT 832, BRANDFORT DISTRICT, ORANGE FREE STATE



FIG. 38 FUCOID STRUCTURE DISPLAYING A SEMI-CIRCULAR TERMINATION, LOMBARDS DRIFT 832, BRANDFORT DISTRICT, ORANGE FREE STATE

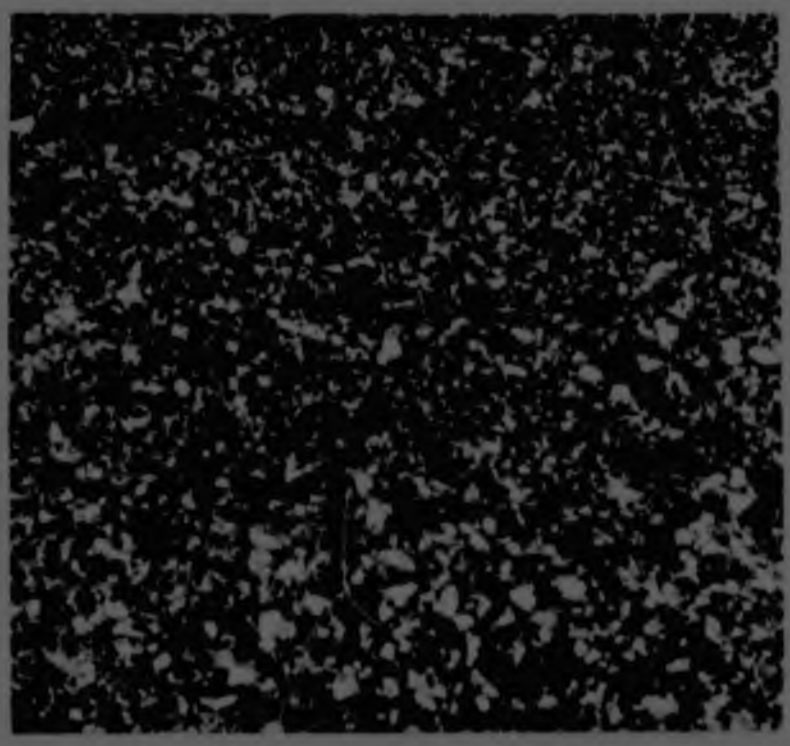


FIG. 39 GRADED BEDDING ON A MICROSCOPIC SCALE IN SANDSTONE OF THE LOWER ECCA GROUP, SOUTHERN FACIES X 62.5



FIG. 40 SILTLE PEBBLE CONGLOMERATE IN THE LOWER ECCA GROUP, SOUTHERN FACIES, PRINCE ALBERT DISTRICT, CAPE

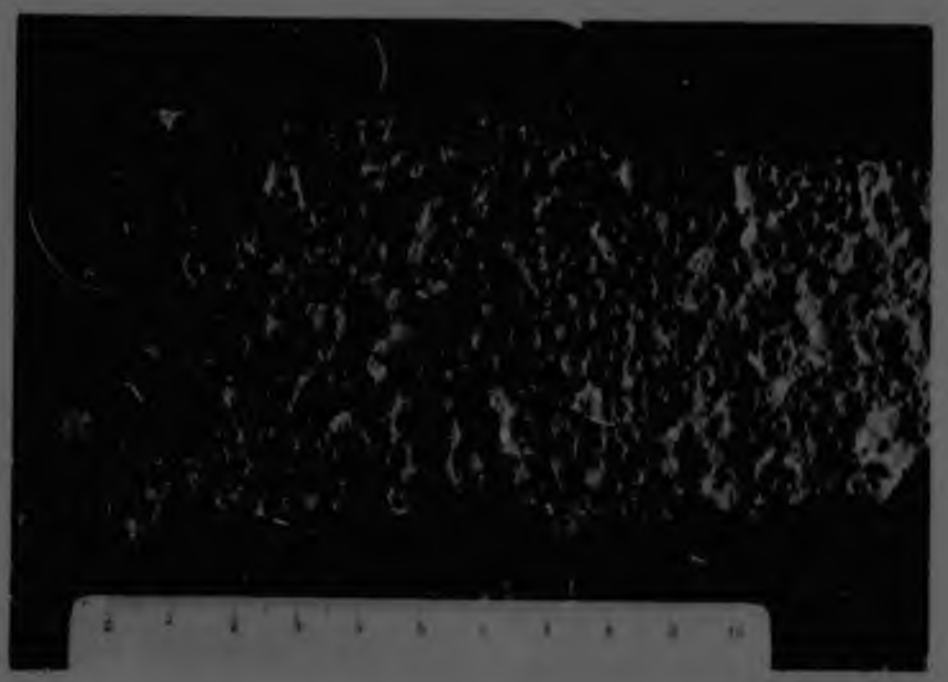


FIG. 41 SPHERICAL GAS PITS IN THE LOWERMOST BEAUFORT BEDS, WESTERN FACIES, WILLISTON DISTRICT, CAPE

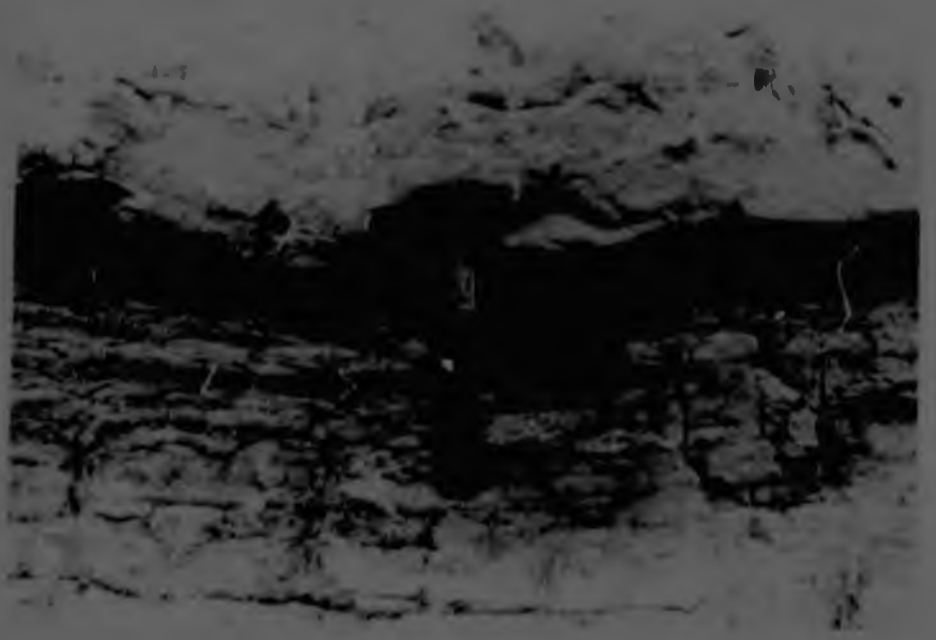


FIG. 42 LOAD STRUCTURES IN THE MIDDLE ECCA GROUP, NORTHERN FACIES. NOTE THE DEFORMED NATURE OF THE UNDERLYING SHALES



FIG. 43 BALL-AND-PILLOW STRUCTURES ISOLATED IN SHALE, MIDDLE ECCA GROUP, WESTERN FACIES, CALVINIA DISTRICT, CAPE



FIG. 44 PENECONTEMPORANEOUS RECUMBENT FOLD IN MIDDLE ECCA SANDSTONE, NORTHERN FACIES, INANDA DISTRICT, NATAL



FIG. 45 INCOHERENT SLUMP STRUCTURES, LOWER ECCA GROUP, SOUTHERN FACIES, NORTH OF COFFEE BAY, TRANSKEI



FIG. 46 SANDSTONE SILLS AND DYKES INTRUSIVE INTO SHALE OF THE SOUTHERN ECCA FACIES, COFFEE BAY, TRANSKEI



FIG. 47 COMPACTION WRINKLES IN SANDSTONE DYKE, COFFEE BAY, TRANSKEI. NOTE ALSO THE TRANSGRESSING SILL

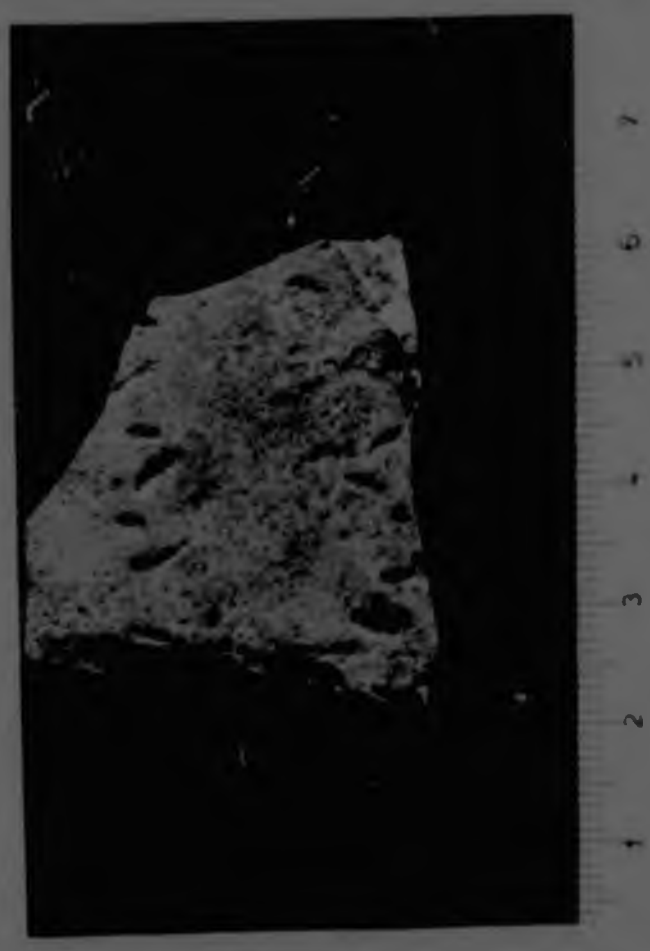


FIG. 48 PROBABLE CRUSTACEAN TRACKS IN CHERTY SHALE NEAR BASE OF CENTRAL ECCA FACIES, KOFFIEFONTEIN DISTRICT, ORANGE FREE STATE

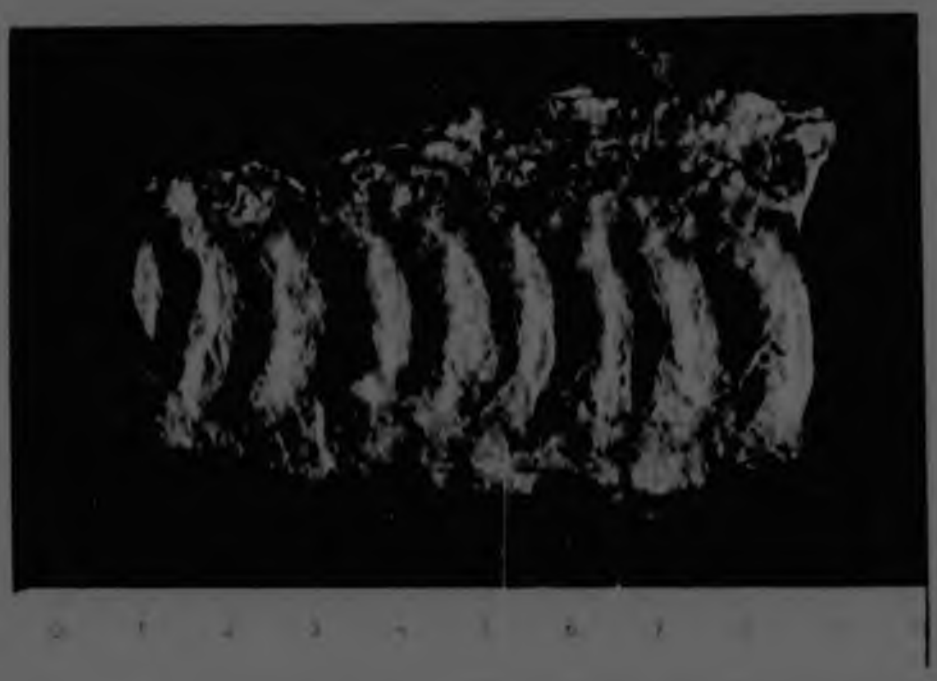


FIG. 49 POSSIBLE TRACKS FOUND IN SHALE OF THE CENTRAL ECCA FACIES AND THE UPPER ECCA GROUP OF THE NORTHERN FACIES

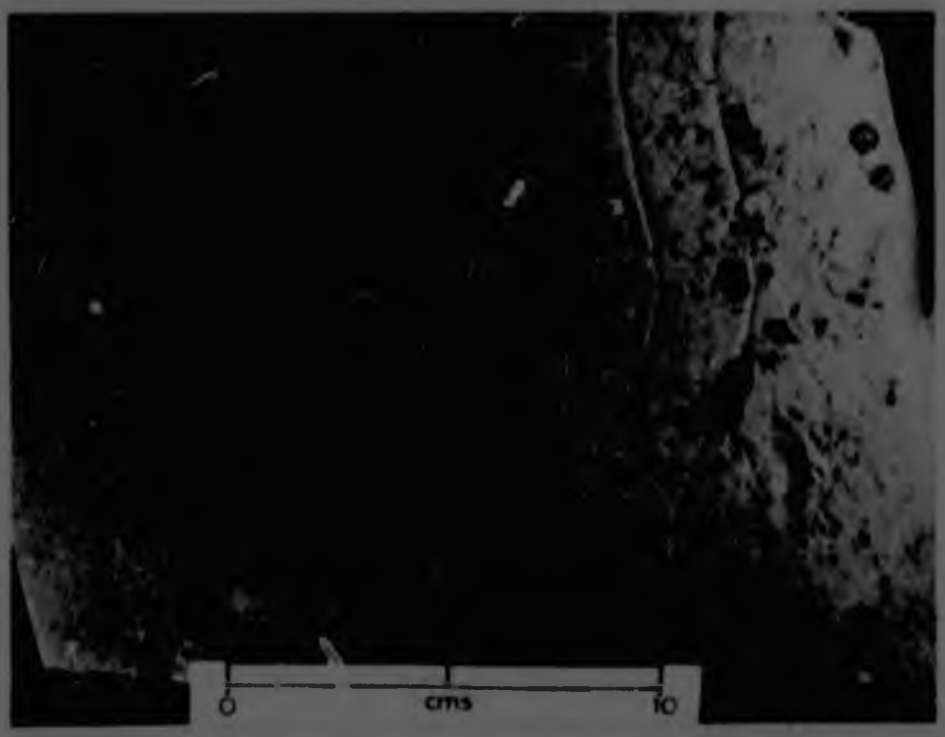


FIG. 50 FISH TRAILS IN SHALE OF THE MIDDLE ECCA GROUP, SOUTHERN ECCA FACIES, ALBANY DISTRICT, CAPE



FIG. 51
WORM TRAILS, UPPER ECCA GROUP, WESTERN FACIES, CALVINIA DISTRICT, CAPE

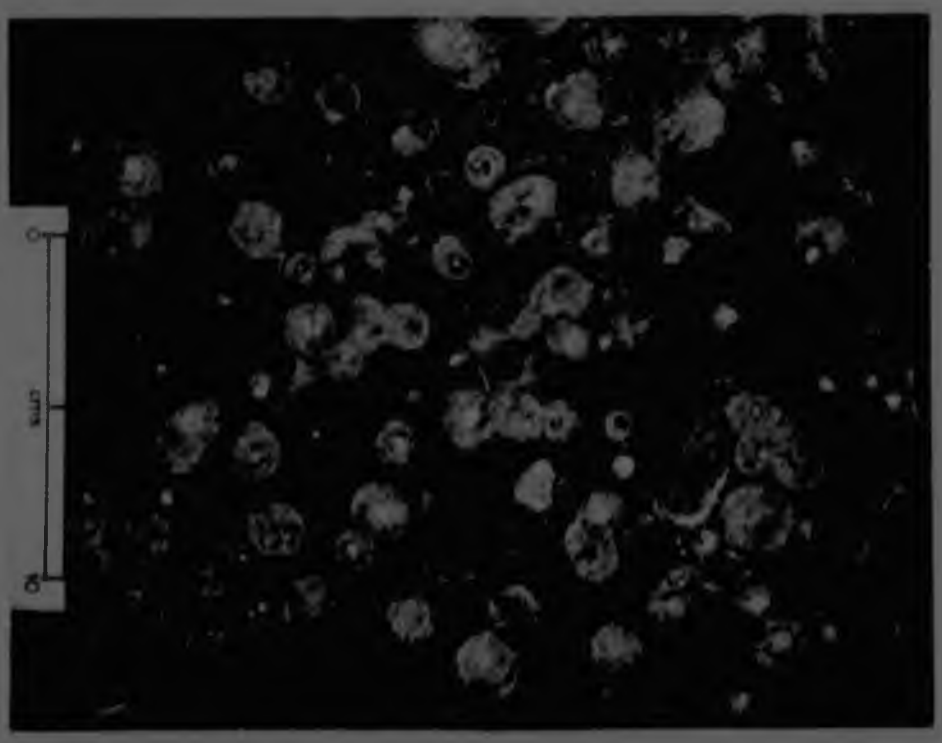


FIG. 52 PLAN VIEW OF VERTICAL WORM BURROWS IN ARGILLACEOUS SANDSTONE OF THE MIDDLE ECCA GROUP, NORTHERN FACIES, HOOFSTAD DISTRICT, ORANGE FREE STATE



FIG. 53 VERTICAL WORM BURROWS IN CARBONACEOUS SANDSTONE OF THE MIDDLE ECCA GROUP, NORTHERN FACIES, UTRECHT DISTRICT, NATAL



FIG. 54 BIFURCATING WORM BURROWS LYING APPROXIMATELY PARALLEL TO THE BEDDING IN SHALE OF THE LOWER ECCA GROUP ABOUT ½ MILE SOUTH OF UMTATA MOUTH, TRANSKEI

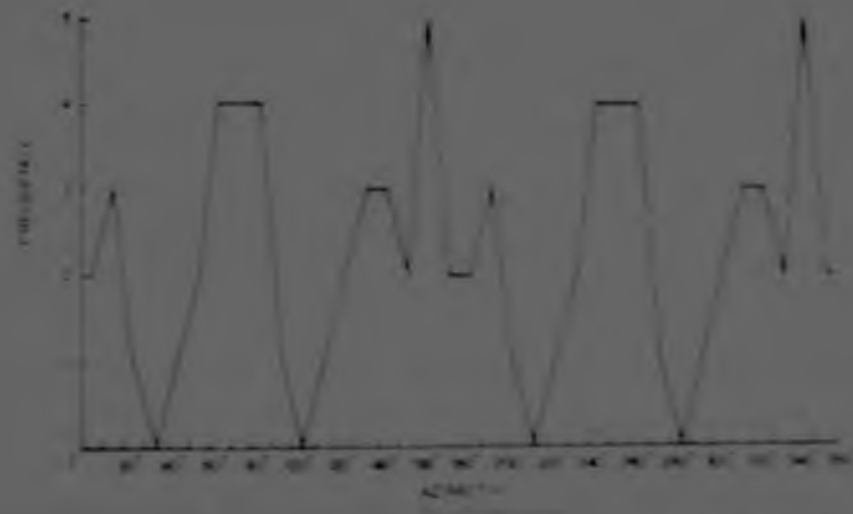


FIG. 55 GRAPH SHOWING THE BIMODAL ORIENTATION OF FOSSIL BRACHIOPODS AT OUTCROP 27

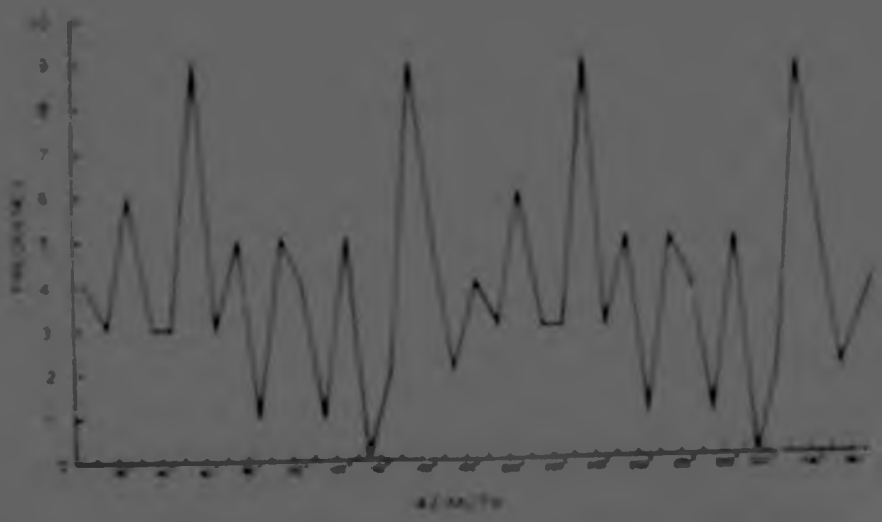


FIG. 56 GRAPH SHOWING THE BIMODAL ORIENTATION OF FOSSIL BRACHIOPODS AT OUTCROP 28

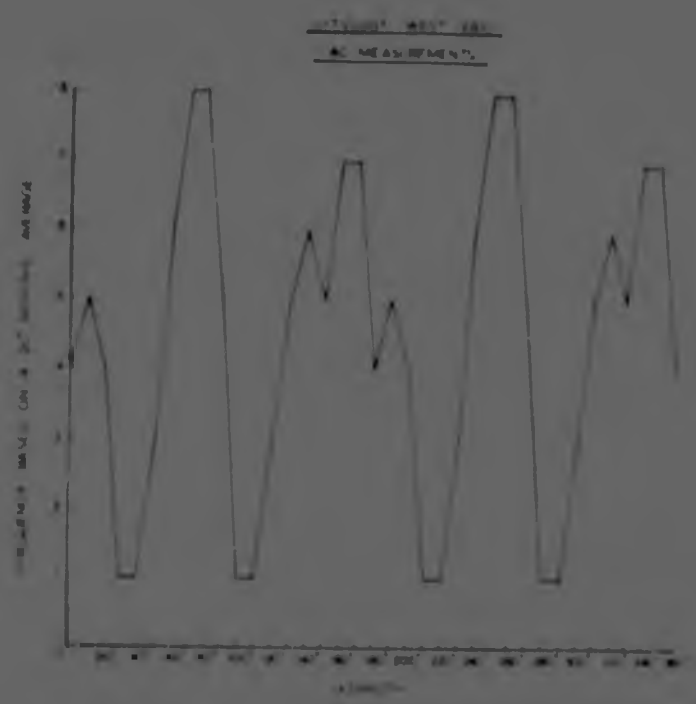


FIG. 57 GRAPH SHOWING THE BIMODAL ORIENTATION OF FUCOID STRUCTURES AT OUTCROP 27. NOTE FREQUENCY BASED ON A 20° MOVING AVERAGE

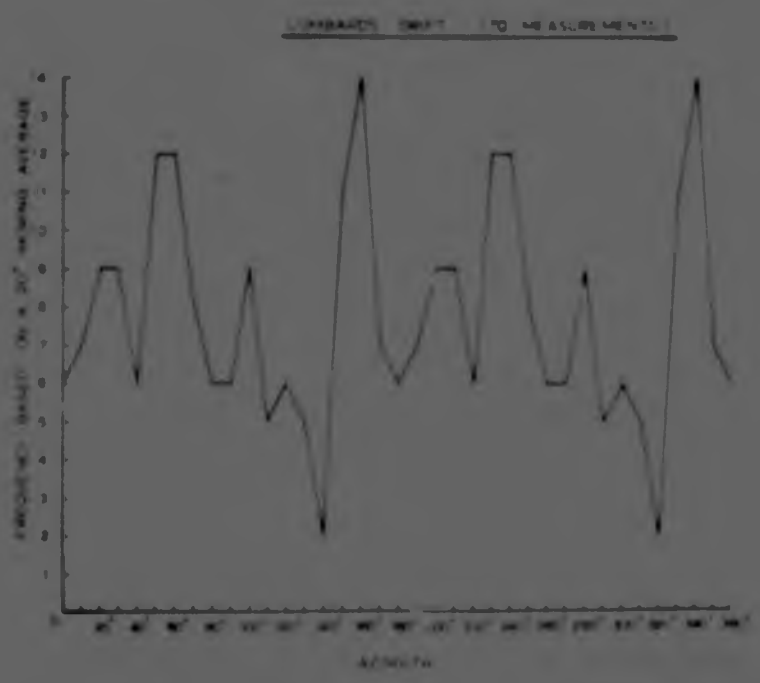


FIG. 58 GRAPH SHOWING THE BIMODAL ORIENTATION OF FUCOID STRUCTURES AT OUTCROP 28. NOTE FREQUENCY BASED ON A 20° MOVING AVERAGE

LIST OF FOLDERS

FOLDER 1 — Isopach Map of Total Ecca plus Upper Dwyka Shale in the Karroo Basin.

FOLDER 2 — Facies distribution map of the Ecca Series in the Karroo Basin.

FOLDER 3 — Paleocurrent map of the Ecca Series and Lowermost Beaufort Beds in the Cape Province and Southernmost Orange Free State.

FOLDER 4 — SE - NW diagrammatic section across the Karroo Basin at the end of the Ecca Period.

FOLDER 5 — Paleocurrent map of the Ecca Series and Lowermost Beaufort Beds in the north-western portion of the Karroo Basin.

FOLDER 6 — Paleocurrent map of the Ecca Series and Lowermost Beaufort Beds in the northern portion of the Karroo Basin.

FOLDER 7 — Paleocurrent map of the Ecca Series and Lowermost Beaufort Beds in the north-eastern portion of the Karroo Basin.

FOLDER 8 — Paleocurrent map of the Ecca Series and certain Beaufort Beds in the eastern part of the Karroo Basin.

FOLDER 9 — NW - SE diagrammatic section across the northern portion of the Karroo Basin at the end of the Ecca Period.

FOLDER 10 — Average grain size of Ecca Sandstones in the Karroo Basin.

FOLDER 11 — Average length of long axis of 10 largest pebbles in conglomerates of the Middle Ecca in the northern portion of the Karroo Basin.

FOLDER 12 — Rose diagrams of Fucoid Structures in the Ecca Series.

FOLDER 13 — Interpretive paleocurrent map of the Ecca Series in the Karroo Basin.

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FOLDER 15 — Ripple-index in the Ecca Series and Lowermost Beaufort Beds of the Karroo Basin.

FOLDER 16 — Tectonic framework during the Ecca Period.

FOLDER 17 — Gravity map of the Karroo Basin.

FOLDER 18 — Distribution of undifferentiated Karroo System in part of Southern and Central Africa.

LIST OF FOLDERS

FOLDER 1	Isopach Map of Total Ecca plus Upper Volvka Shale in the Karroo Basin.
FOLDER 2	Facies distribution map of the Ecca Series in the Karroo Basin.
FOLDER 3	Paleocurrent map of the Ecca Series and Lowermost Beaufort Beds in the Cape Province and Southernmost Orange Free State.
FOLDER 4	NE - SW diagrammatic section across the Karroo Basin at the end of the Ecca Period.
FOLDER 5	Paleocurrent map of the Ecca Series and Lowermost Beaufort Beds in the north-western portion of the Karroo Basin.
FOLDER 6	Paleocurrent map of the Ecca Series and Lowermost Beaufort Beds in the northern portion of the Karroo Basin.
FOLDER 7	Paleocurrent map of the Ecca Series and Lowermost Beaufort Beds in the north-eastern portion of the Karroo Basin.
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FOLDER 10	Average grain size of Ecca Sandstones in the Karroo Basin.
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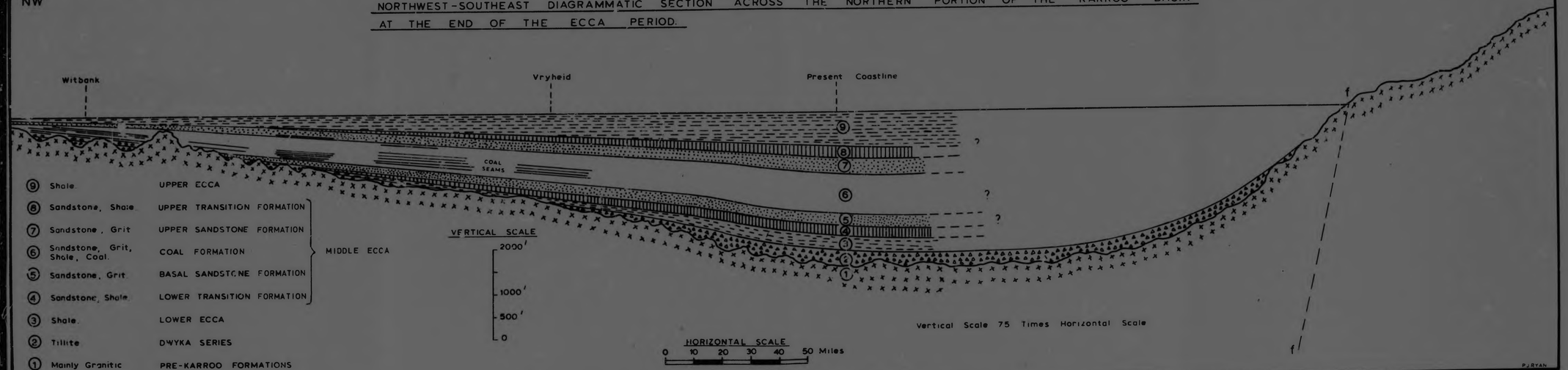

BOTSWANA
SOUTH WEST AFRICA
JOHANNESBURG
Barberton
SWAZILAND
MOÇAMBIQUE
KIMBERLEY
BLOEMFONTEIN
Maseru
LESOTHO
INDIAN OCEAN
DURBAN
ATLANTIC OCEAN
Middelburg
Queenstown
Beaufort West
Sutherland
East London
Grahamstown
Oudtshoorn
AVERAGE LENGH OF LONG AXIS OF 10 LARGEST PEBBLES IN CONGLOMERATES OF THE MIDDLE ECCA IN THE NORTHERN PORTION OF THE KARROO BASIN.
SIZE SCALE
16 - 32 inches
8 - 16 " "
4 - 8 " "
2 - 4 " "
1 - 2 " "
SCALE
0 10 20 30 40 50 60 70 80 90 100 Miles


BOTSWANA
SOUTH WEST AFRICA
JOHANNESBURG
Barberton
SWAZILAND
MOÇAMBIQUE
Ecca Series Poorly Exposed
KIMBERLEY
BLOEMFONTEIN
Maseru
LESOTHO
ESTIMATED LIMIT OF NORTHERN ECCA SANDSTONES
INDIAN OCEAN
DURBAN
Middelburg
Queenstown
Beaufort West
Sutherland
ATLANTIC OCEAN
East London
Grahamstown
Oudtshoorn
AVERAGE GRAIN SIZE OF ECCA SANDSTONES IN THE KARROO BASIN.
SIZE SCALE
1 mm Coarse Sandstone and Grit
½ " Coarse Sandstone
¼ " Medium Sandstone
⅛ " Fine Sandstone
1/16 " Siltstone
Ecca Series composed almost entirely of shale
SCALE
0 10 20 30 40 50 60 70 80 90 100 miles
Compiled and Drawn by P.J.Bykerk

NW

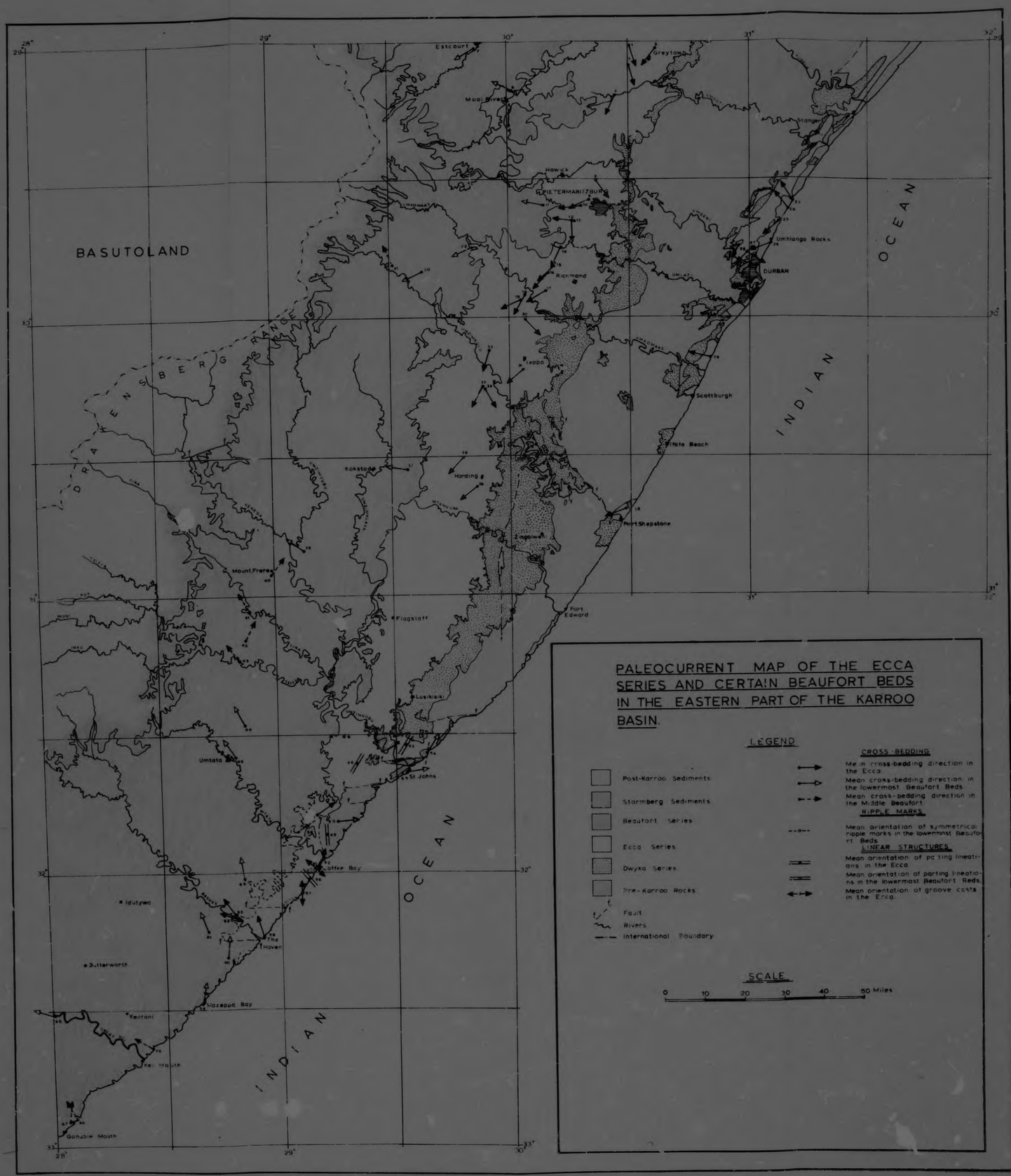
SE

NORTHWEST-SOUTHEAST DIAGRAMMATIC SECTION ACROSS THE NORTHERN PORTION OF THE KARROO BASIN AT THE END OF THE ECCA PERIOD.



⑨	Shale	UPPER ECCA	
⑧	Sandstone, Shale	UPPER TRANSITION FORMATION	MIDDLE ECCA
⑦	Sandstone, Grit	UPPER SANDSTONE FORMATION	
⑥	Sandstone, Grit, Shale, Coal	COAL FORMATION	
⑤	Sandstone, Grit	BASAL SANDSTONE FORMATION	
④	Sandstone, Shale	LOWER TRANSITION FORMATION	
③	Shale	LOWER ECCA	
②	Tillite	DWYKA SERIES	
①	Mainly Granitic Rocks	PRE-KARROO FORMATIONS	





PALEOCURRENT MAP OF THE ECCA SERIES AND CERTAIN BEAUFORT BEDS IN THE EASTERN PART OF THE KARROO BASIN.

LEGEND

- Post-Karroo Sediments
- Stormberg Sediments
- Beaufort Series
- Ecca Series
- Dwyka Series
- Pre-Karroo Rocks
- Fault
- Rivers
- International Boundary

CROSS BEDDING

- Mean cross-bedding direction in the Ecca
- Mean cross-bedding direction in the lowermost Beaufort Beds
- Mean cross-bedding direction in the Middle Beaufort

RIPPLE MARKS

- Mean orientation of symmetrical ripple marks in the lowermost Beaufort Beds

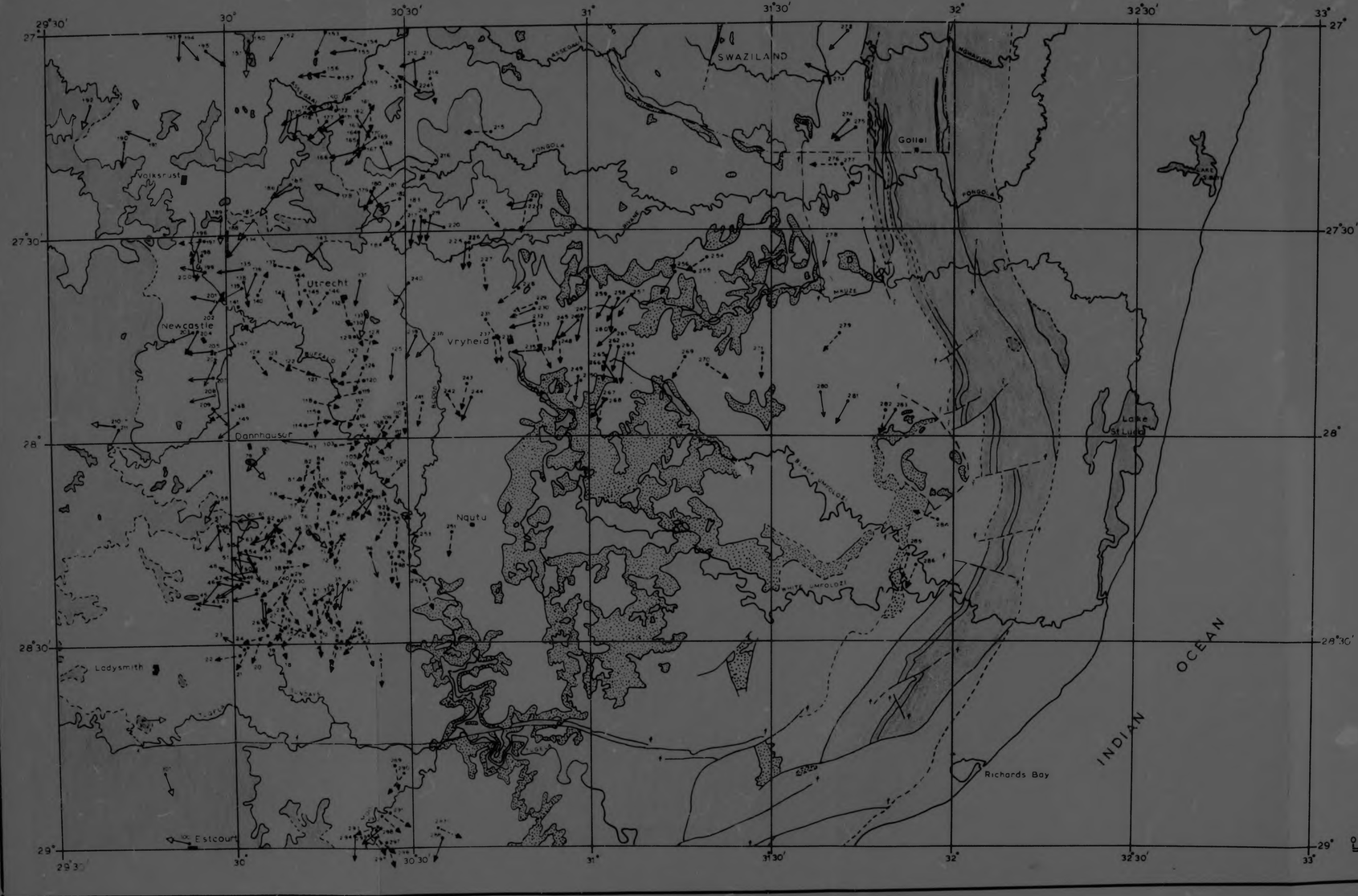
LINEAR STRUCTURES

- Mean orientation of parting lineations in the Ecca
- Mean orientation of parting lineations in the lowermost Beaufort Beds
- Mean orientation of groove casts in the Ecca

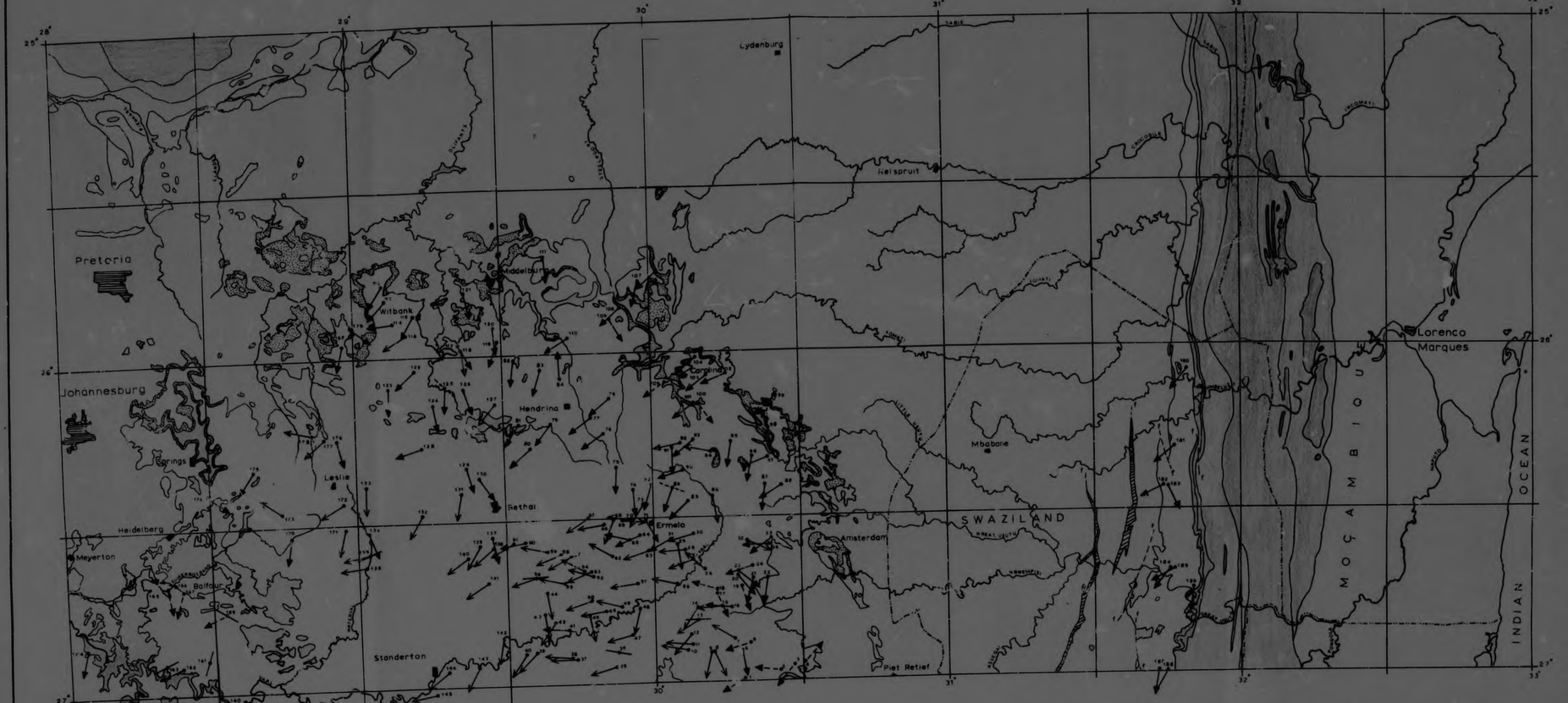
SCALE

0 10 20 30 40 50 Miles

PALEOCURRENT MAP OF THE ECCA SERIES AND LOWERMOST BEAUFORT BEDS IN THE NORTH-EASTERN PORTION OF THE BASIN







PALEOCURRENT MAP OF THE ECCA SERIES AND LOWERMOST BEAUFORT BEDS IN THE NORTHERN PORTION OF THE BASIN.

LEGEND

- Post-Karroo Sediments
- Lebombo Rhyolite
- Stormberg Basalt
- Stormberg Sediments
- Beaufort Series
- Ecca Series
- Dwyka Series
- Pre-Karroo Rocks
- Shear or Mylonite Zone
- International Boundary
- Fault
- Pan
- Rivers and Dams

CROSS-BEDDING

- Mean cross-bedding direction in the lowermost Beaufort Beds.
- Mean cross-bedding direction above the Coal Formation, Middle Ecca.
- Mean cross-bedding direction within the Coal Formation, Middle Ecca.
- Mean cross-bedding direction below the Coal Formation, Middle Ecca.

RIPPLE MARKS

- Mean orientation of symmetrical ripple marks above the Coal Formation, Middle Ecca.
- Mean orientation of symmetrical ripple marks within the Coal Formation, Middle Ecca.
- Mean orientation of symmetrical ripple marks below the Coal Formation, Middle Ecca.

SCALE

0 10 20 30 40 50 60 Miles

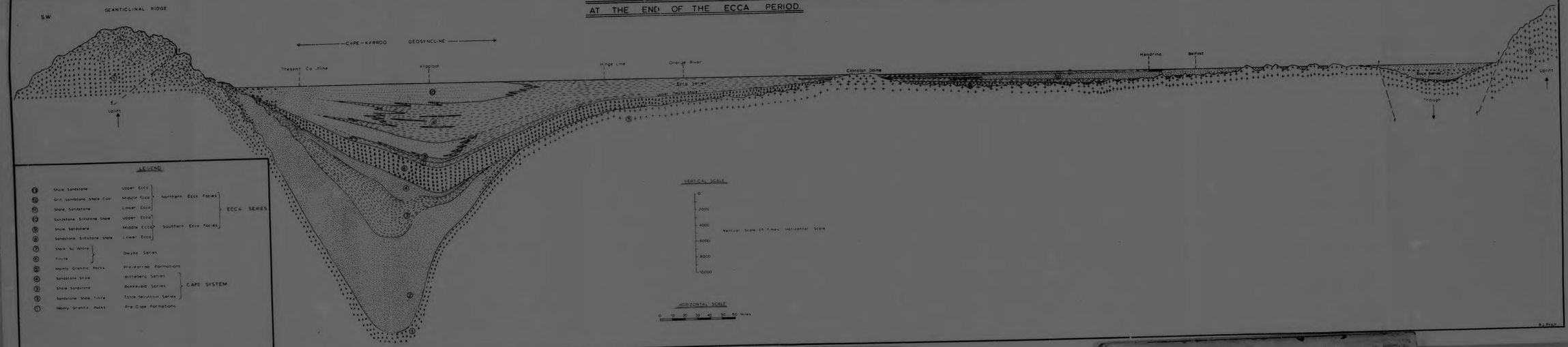
PALEOCURRENT MAP OF THE ECCA SERIES AND LOWERMOST BEAUFORT BEDS IN THE NORTH-WESTERN PORTION OF THE BASIN

SCALE

0 5 10 20 30 40 50 60 70 80 Miles



NORTHEAST – SOUTHWEST DIAGRAMMATIC SECTION ACROSS THE KARROO BASIN AT THE END OF THE ECCA PERIOD.



PALEOCURRENT MAP OF THE ECCA SERIES AND LOWERMOST BEAUFORT BEDS IN THE CAPE PROVINCE AND SOUTHERNMOST ORANGE FREE STATE

LEGEND

- Post-Karroo Sediments
- Dwyka Series
- Ecca Series
- Beaufort Series
- Pre-Karroo Rocks
- Fault
- Pans
- National Road
- Rivers and Dams

CROSS-BEDDING

- Mean cross-bedding direction in the Lower Ecca
- Mean cross-bedding direction in the Upper Ecca
- Mean cross-bedding direction in the lowermost Beaufort Beds
- Mean cross-bedding direction in the Middle Beaufort

RIPPLE MARKS

- Mean orientation of symmetrical ripple marks in the Lower Ecca
- Mean orientation of symmetrical ripple marks in the Middle Ecca
- Mean orientation of symmetrical ripple marks in the Upper Ecca
- Mean orientation of symmetrical ripple marks in the lowermost Beaufort Beds
- Mean orientation of asymmetrical ripple marks

LINEAR STRUCTURES

- Mean orientation of parting lineations in the Upper Ecca
- Mean orientation of parting lineations in the lowermost Beaufort Beds
- Mean orientation of groove casts in the Lower Ecca
- Orientation of fucoid structures in the Ecca Series

SCALE

0 5 10 20 30 40 50 miles

CAPE FOLDED BELT

ORANGE FREE STATE

TRANSKEI

ATLANTIC OCEAN

INDIAN OCEAN



Author Ryan P J
Name of thesis Stratigraphic and Paleocurrent analysis of the Ecca series and lowermost Beaufort Beds in the Karoo Basin of South Africa 1967

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