Record 1979/85

GEOCHEMICAL DATA, MARRABA 1:100 000 SHEET AREA, NORTHWEST QUEENSLAND

by

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PREAMBLE

This Record is an assembly of geochemical data pertaining to the Marraba 1:100 000 Sheet area. Selected analyses from this data base are incorporated in the MARRABA Map Commentary (Derrick, 1980), which also provides some discussion and interpretation of the data.

CONTENTS

TABLE 1A. CHEMICAL DATA, ARGYLLA FORMATION ACID VOLCANICS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Reg'd No.	7220 5035	6920 0317	7020 0417	7020 0418	7020 0421	7020 0457	7020 0458	7020 0414	7020 0419	7020 0440	7020 5034	7120 1258	7120 1393	Bea	Bel	Bea	72205033 Bgt
SiO_2%	69.0	67.0	71.0	72.0	70.0	71.0	63.0	69.0	70.0	71.0	71.0	72.0	69.0	69.4	70.7	67.31	75.0
TiO_2	0.71	0.8	0.51	0.52	.51	0.61	0.58	0.59	0.51	0.54	0.50	0.45	.50	0.58	0.39	0.78	0.26
Al_2O_3	12.8	12.8	12.3	12.8	12.3	12.55	15.0	12.4	12.5	12.6	12.1	11.3	11.5	12.74	12.92	12.54	10.6
Fe_2O_3*	6.3	8.2	4.7	3.25	6.4	4.9	6.0	7.9	6.2	5.5	5.4	5.8	8.6	5.8	4.35	3.76	4.6
FeO																3.20	
MnO	0.05	0.02	0.03	0.02	0.02	0.08	0.09	0.02	0.02	0.03	0.05	0.02	0.02	0.03	0.04	0.04	0.02
MgO	0.95	0.71	1.4	1.2	0.10	0.42	0.92	0.92	0.3	0.52	0.4	0.38	0.24	0.69	0.85	1.11	0.61
CaO	1.7	2.0	2.4	2.2	1.05	1.8	5.1	1.3	1.2	2.05	1.75	1.03	0.77	1.74	2.31	1.22	0.33
Na_2O	2.9	5.65	3.8	3.9	4.15	3.15	3.2	3.5	3.3	3.8	2.8	2.4	2.4	3.65	3.24	2.72	1.65
K_2O	5.1	2.1	2.4	3.2	4.3	4.5	2.8	3.7	4.7	3.7	5.2	5.5	6.3	3.79	3.74	5.10	6.5
P_2O_5	.18	0.25	0.18	0.12	0.14	0.14	0.18	0.2	0.17	0.14	0.08	0.10	0.11	0.16	0.14	0.18	.02
L on I	.49	0.59	.98	0.81	0.45	0.58	2.65	0.45	.67	0.39	0.45	0.88	0.42				0.36
Total	100.18	100.12	99.7	100.02	99.42	99.7	99.5	100.0	99.6	100.1	99.7	99.8	99.8	98.85	98.68	98.88	99.9
Rb ppm	190	50	60	65	80	220	180	60	145	80	85	165	130	110	139	164	115
Sr	75	90	125	115	35	90	165	50	50	100	45	30	25	85	190	43	40
Rb/Sr	2.53	.55	.48	.56	2.28	2.44	1.09	1.2	2.9	.8	1.88	5.5	5.2	1.51	.73	3.8	2.87
K/Rb	225	274	326	393	450	176	137	460	270	400	225	293	396	303	236	257	465

* All values are for total iron, except for analysis 16.

Analyses 1, 2: Argylla Formation, Chumvale area
Analyses 3-7: Argylla Formation, unit Bea_3, Duck Creek and Bulonga Anticlines
Analyses 8-11: Argylla Formation, unit Bea_4, Duck Creek and Bulonga Anticlines
Analyses 12-13: Argylla Formation, Wonga Belt, Mary Kathleen Sheet
Analysis 14: Average of analyses 1-11 of the Argylla Formation
Analysis 15: Average of 14 analyses of Leichhardt Metamorphics acid volcanics from the Mary Kathleen and Prospector 1:100 000 Sheet areas
Analysis 16: Average of analyses of the Argylla Formation from the Mary Kathleen and Prospector 1:100 000 Sheet areas
Analysis 17: Tommy Creek Microgranite

TABLE 1B. SAMPLE KEY, ARGYLLA FORMATION ACID VOLCANICS

Area	Sample	Analysis no.	Description
Chumvale	5035	1	Pea: Pink to grey feldspar porphyry
	317	2	Pea: As above
Duck Creek and Bulonga Anticlines	417	3	Pea_3: grey, laminated porphyritic rhyolite/tuff; bands of plagioclase and quartz phenocrysts in quartzofeldspathic matrix, interlayered with bands of granoblastic quartz.
	418	4	Pea_3: pale grey-pink porphyritic rhyolite with quartz and plagioclase phenocrysts, in a fine-grained quartzofeldspathic matrix with some biotite and chlorite. Matrix ca 90%
	421	5	Pea_3: As for 418
	457	6	Pea_3: Pale pinky grey porphyritic microgranite; quartz and plagioclase phenocrysts (10%) set in a K-feldspar-quartz matrix, with biotite and epidote
	458	7	Pea_3: Microgranite or quartz-feldspar porphyry with K-feldspar (30%) quartz (10%) and plagioclase (5%) phenocrysts, in quartzofeldspathic matrix
Duck Creek and Bulonga Anticlines	414	8	Pea_4: Quartz-feldspar porphyry (rhyodacite), with 10% plagioclase and 8% quartz phenocrusts, in quartzofeldspathic matrix; biotite defines foliation
	419	9	Pea_4: Quartz-feldspar porphyry (rhyodacite), with 10% quartz and 15% plagioclase phenocrysts, in quartzofeldspathic matrix
	440	10	Pea_4: Quartz-feldspar porphyry (rhyolite); with 10% quartz, 6% plagioclase and 4% K-feldspar as phenocrysts, in quartzofeldspathic matrix
	5034	11	Pea_4: As above
Wonga belt, Mary Kathleen Sheet	1258	12	Pea: streaky, laminated, metarhyolite or rhyodacite, with 3% K-feldspar and 1% plagioclase phenocrysts, and K-feldspar-quartz-rich matrix
	1393	13	Pea: sheared, laminated rhyolitic acid volcanics with no phenocrysts; mainly a fine-grained mosaic of quartz and K-feldspar

TABLE 2. CHEMICAL ANALYSES OF MALBON GROUP METABASALT: CONE CREEK METABASALT MEMBER OF THE MARRABA VOLCANICS, AND WAKEFUL METABASALT MEMBER OF THE MITAKOODI QUARTZITE (after Ellis, in prep.)

	1	2	3	4	5	6	7	8
SiO_2%	54.52	50.57	53.63	53.85	48.51	48.36	53.08	52.00
TiO_2	1.42	2.29	1.01	0.94	3.09	2.63	0.68	1.64
Al_2O_3	14.65	13.76	14.86	14.72	12.12	13.01	13.48	14.84
Fe_2O_3	12.83	17.88	11.31	10.89	20.02	18.12	11.66	4.82
FeO								8.16
MnO	0.28	0.15	0.34	0.25	0.36	0.24	0.15	0.27
MgO	5.17	3.33	6.79	6.98	4.64	5.46	3.67	5.47
CaO	4.79	5.40	8.17	7.45	7.63	8.95	16.58	8.89
Na_2O	3.04	2.83	1.72	2.43	2.07	1.99	0.31	1.94
K_2O	3.08	3.49	2.52	2.31	1.32	0.87	0.16	1.72
P_2O_5	0.19	0.28	0.15	0.15	0.34	0.39	0.14	0.23
Ba ppm	1150		2000	860	420	220	97	791
Rb	50		50	40	30	30	10	35
Sr	145		160	150	70	110	280	152
Y	27		27	24	46	10	40	34
Pb	10		15	15	15	225	10	12
Zr	150		100	100	200	42	110	147
Zn	60		140	120	70	35	25	75
Cu	56		29	60	75	72	42	56
Ni	72		100	125	40	50	41	
Cr	58		190	240	38	85	73	114
V	250		190	200	330	280	170	237
Sc	28		23	34	43	40	33	33
K/Rb	511		418	479	365	240	132	399
Na_2O/K_2O	0.98	0.81	0.68	1.05	1.56	2.28	1.93	1.1

Note: All analyses recalculated to 100% and volatile-free basis; analyst, AMDEL.

Sample key:

1. 70200305
2. 70200307
3. 70200308
4. 70200309
5. 70200310
6. 70200311
7. 70200312
8. Average of 1 to 7.

50000

1-3 = Wakeful Metabasalt Member
4-7 = Cone Creek Metabasalt Member

TABLE 3. CHEMICAL ANALYSES OF SLATES AND SILTSTONES OF THE MARIMO SLATE AND THE CORELLA FORMATION

Analyses by AMDEL, Adelaide

		Marimo Slate													
Sample Nos.*	1.	279	280	281	282	283	284	285	286	287+	288	289	290	291	292
SiO_2%	71.05	76.11	69.29	81.20	83.06	75.06	71.59	87.08	72.84	58.63	78.44	74.63	66.53	72.26	43.00
TiO_2	.52	0.57	0.74	0.75	0.21	0.46	0.56	0.276	0.59	0.48	0.49	0.69	0.67	0.57	0.38
Al_2O_3	12.46	14.27	17.77	10.53	7.27	9.00	12.30	7.41	13.99	12.76	13.28	14.12	15.83	13.62	8.93
Fe_2O_3	2.0	0.25	1.46	0.195	2.83	0.939	3.72	0.33	0.53	1.11	0.30	0.92	1.99	2.03	0.69
MnO	0.00	0.29	0.00	0.00	0.010	0.00	0.00	0.059	0.00	0.009	0.00	0.00	0.009	0.00	0.00
MgO	0.62	0.778	0.378	0.488	0.77	0.092	0.919	0.69	0.67	0.615	0.78	0.67	0.924	0.86	8.34
CaO	0.08	0.078	0.019	0.029	0.029	0.046	0.119	0.098	0.029	0.42	0.117	0.048	0.037	0.095	13.46
Na_2O	0.31	0.19	0.47	0.195	0.19	0.18	0.09	0.098	0.19	2.46	0.19	0.19	0.18	0.19	0.156
K_2O	3.71	4.61	3.96	3.21	1.53	6.68	2.56	2.46	4.50	1.16	3.58	4.26	5.37	4.49	3.16
P_2O_5	.16	0.049	0.057	0.088	0.067	0.101	0.27	0.079	0.067	0.23	0.165	0.29	0.15	0.057	0.055
Total		96.93	94.14	96.69	95.97	92.55	92.13	98.58	93.41	77.87	97.34	95.82	91.69	94.17	78.17
Ignition Loss		2.79	5.60	2.39	4.25	7.95	8.13	1.65	3.88	12.13	2.75	4.25	7.59	4.81	22.12
Total		99.72	99.74	99.08	100.22	100.50	100.26	100.23	97.29	90.00	100.09	100.07	99.28	98.98	100.29

+ These samples contain more than 3% Cu

* BMR registered numbers eg, 70200279

1. Average of Marimo Slate and Corella Formation samples

TABLE 3 (cont)

	Marimo Slate						Corella Formation Slates (Ekc_{2s})					
Sample Nos.	293	294+	295	296	297	298	299	300	301	302	303	304
SiO_2	55.38	50.05	63.00	65.66	70.91	84.7	82.38	37.36	70.86	66.28	68.15	60.79
TiO_2	0.59	0.21	0.61	0.42	0.62	0.25	0.25	0.35	0.51	0.54	0.67	0.81
Al_2O_3	16.91	8.95	7.27	12.25	15.28	8.04	6.29	3.67	13.71	15.04	16.86	16.43
Fe_2O_3	11.83	0.71	5.01	8.16	0.57	0.47	1.51	0.19	0.39	0.70	0.69	1.48
MnO	0.009	0.026	0.00	0.009	0.00	0.00	0.010	0.00	0.00	0.00	0.028	0.009
MgO	1.20	0.43	0.40	0.74	0.86	0.38	0.096	5.99	0.46	0.62	0.46	0.70
CaO	0.25	0.043	0.079	0.35	0.038	0.029	0.038	19.52	0.027	0.018	0.056	0.07
Na_2O	0.18	0.00	0.16	0.18	0.28	0.096	0.192	0.14	0.36	0.35	0.65	0.35
K_2O	4.33	2.01	1.68	3.10	5.00	1.92	4.41	1.09	4.27	4.63	4.65	4.88
P_2O_5	0.52	0.14	0.19	0.85	0.096	0.067	0.16	0.09	0.046	0.07	0.12	0.10
Total	91.20	62.57	79.00	91.61	93.66	95.95	95.34	68.4	90.62	88.25	92.33	85.68
Ignition Loss	8.01	13.37	20.95	7.78	4.26	4.38	4.08	31.17	8.84	12.12	7.39	11.90
Total	99.21	75.93	99.95	99.39	97.92	100.33	99.42	99.57	99.46	100.37	99.72	97.58

+ These samples contain more than 3% Cu

TABLE 4. CARBON ANALYSES AND TRACE ELEMENTS IN SLATES AND SILTSTONES OF THE MARIMO SLATE AND CORELLA FORMATION

(All analyses quantitative; trace elements Co to Zr, by direct-reading optical spectrograph, BMR; S to Rb, AMDEL; Ga and B, semi-quantitative emission spectroscopy, AMDEL)

			ppm																	
Number		C%	Co	Cr	Cu	Pb	Zn	Ba	La	Ni	Se	Sr	V	Y	Zr	S	CO_2	Na	Rb	Ga	B
279*		.80	10	100	17	5	5	1350	100	12	13	-30	370	31	150	400	500	900	150	30	25
280		1.92	8	100	22	10	5	380	125	13	18	73	100	34	230	2700	500	2800	140	50	25
281		.24	-8	64	10	15	5	340	105	10	13	36	86	40	280	2500	500	900	130	30	50
282		2.1	10	24	21	10	25	310	80	14	11	-30	48	35	120	350	500	300	40	20	5
283		5.3	9	50	22	15	5	820	105	14	12	-30	44	28	150	6100	500	900	10	20	25
284		4.1	13	56	42	5	10	420	115	33	17	90	110	54	230	1400	500	900	13	30	10
285		.36	9	90	25	-5	5	830	75	13	11	-30	62	28	100	450	500	400	80	20	10
286		1.08	15	100	+500	-5	5	710	110	18	15	-30	200	50	200	1100	3500	1100	150	50	20
287		3.9	+1000	54	+500	20	5	730	200	1000	25	270	300	120	280	1250	3000	18400	30	10	100
288		0.18	11	66	60	5	5	840	75	14	14	180	125	54	220	550	500	1200	70	40	15
289	MARIMO SLATE	1.63	8	85	29	5	5	2250	110	11	14	430	90	37	180	1650	1000	1300	100	50	30
290		3.2	9	60	13	-5	5	1700	110	11	27	120	110	41	250	7300	500	700	270	30	30
291		2.6	15	75	15	5	10	940	110	23	23	-30	240	35	170	1150	500	900	170	10	15
292		2.35	15	73	30	15	5	330	150	16	16	210	210	35	105	450	17.1%	1600	80	20	20
293		3.75	200	53	47	5	10	700	120	41	15	38	155	40	230	1200	500	700	140	15	30
294		1.18	150	72	+500	5	5	740	170	65	19	38	110	105	130	1950	7%	300	90	5	10
295		16.7	11	46	130	25	-5	500	180	12	14	75	130	50	280	4900	500	500	50	20	5
296		3.75	9	70	46	10	10	800	110	16	13	320	185	44	160	4500	500	900	100	20	5
297		2.05	10	90	330	-5	5	820	90	11	13	58	180	31	155	1050	2500	1300	190	40	25
298		2.6	8	33	14	5	5	295	90	13	12	-30	56	30	100	350	500	200	90	30	10

TABLE 4 (cont)

Number		C%	Co	Cr	Cu	Pb	Zn	Ba	La	Ni	Se	Sr	V	Y	Zr	S	CO_2	Na	Rb	Ga	B
											ppm										
299	Corella Formation	3.0	-8	24	31	5	5	1200	-60	11	7	35	56	18	-100	2500	500	600	120	10	3
300		7.65	8	33	20	15	5	400	68	11	11	80	42	23	170	200	21.2%	400	50	5	n.d.
301		6.45	-8	54	18	5	5	1200	65	11	11	-30	78	21	170	1350	500	900	220	30	30
302		9.4	-8	50	10	-5	5	640	84	9	12	-30	80	28	230	400	-500	2100	190	40	10
303		4.95	-8	77	33	15	15	2400	84	10	15	210	110	26	170	700	-500	3800	180	60	30
304		8.65	10	77	31	5	-5	1600	82	13	16	180	150	26	170	900	500	2100	170	40	30
Marimo/ Corella Average		3.8	8[2]	55	26[3]	7	5	895	106	14[4]	15	104	140	40	180	1820	900[5]	1100[6]	116	28	22
Average Shale			19	90	45	20	95	580	92	68	0.6	300	130	26	160	2400		9600	140	19	100

1. Turekian & Wedepohl (1961)
2. excludes 3 samples of 1000, 200 & 150 ppm
3. excludes 3 samples of 500 ppm each
4. excludes 1 value of 1000 ppm
5. excludes 3 values of 17%, 7% & 21%
6. excludes 1 value of 18400 ppm

Samples 279-298 = Marimo Slate
Samples 299-304 = Corella Formation
* BMR registered samples 70200279

TABLE 5. COMPARISON OF BLACK SHALE WITH SHALE OF OTHER STUDIES

	1 Average shale	2 Average black shale	3 Average for BMR Cloncurry DDH 5	4 Average for the Urquhart Shale	5 Average for black shale from the Marraba Sheet area
Ca**	2.21	1.50	2.01	8.80	0.05
Fe	4.72	2.00	5.33	4.30	1.38
Mg	1.50	0.70	1.78	4.30	.37
Mn	0.08	0.02	0.04	0.25	.00
Ti	0.46	0.02	0.30	0.15	.30
Ag	0.07	1.00	1.88	44.00	*
Ba	580.00	300.00	246.28	381.00	895
Bi	*	*	8.48	*	*
Cd	0.30	*	3.37	67.00	*
Co	19.00	10.00	60.77	32.00	8
Cu	45.00	70.00	358.70	254.00	26
Ni	68.00	50.00	67.44	22.00	14
Pb	20.00	20.00	10.03	2607.00	7
Sc	13.00	10.00	15.60	14.00	*
V	130.00	150.00	169.25	33.00	140
Y	26.00	30.00	33.48	32.00	40.00
Zn	95.00	300.00	1211.44	3963.00	5.00
Zr	160.00	70.00	130.64	188.00	180.00
Se	0.60	*	3.23	*	15.00
As	13.00	*	313.40	*	*
B	100.00	50.00	175.29	*	22.00
CO_2	*	*	1.05	*	.09
C org	*	3.20	2.47	*	3.8
S	0.24	*	4.23	*	0.18

1. Turekian & Wedepohl (1961)
2. Vine & Tourtelot (1970)
3. Duff (1975)
4. Smith & Walker (1971)
5. Derrick & others (1971)

* not included in analysis

** Ca to Ti in percent; Ag to B in ppm; CO_2 to S in percent

TABLE 6. COMPARISON OF BLACK SHALES FROM THE MARY KATHLEEN AND MARRABA SHEET AREAS WITH TWO SHALES FROM DIFFERENT PALAEOENVIRONMENTS

	1	2	3	4
	Houy Formation	Belden Shale	Marimo Slate, Marraba Sheet	BMR Cloncurry DDH 5, Shale, Mary Kathleen Sheet
Ag ppm	1.20	-		2
Co "	140	11	8	60
Cu "	210	40	26	358
Ni "	490	39	14	67
Pb "	52	26	7	10
V "	210	110	140	169
Zn "	920	-	5	1211
C %	5.1	1.3	3.8	2.5

1. Black shale from local basin in a shallow epicontinental marine shelf (after Vine & others, 1969).

2. Black shale deposited by relatively rapid dumping of sediment and rapid burial in a subsiding trough (after Vine & others, 1969).

3. Black shale, Marimo Slate (after Derrick & others, 1971).

4. Black shale from Corella Formation (after Duff, 1975).

TABLE 7. MAJOR ELEMENTS IN METAMORPHIC ROCKS FROM THE CORELLA FORMATION COMPARED WITH SOME AVERAGE SEDIMENTARY ROCKS

Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Element	1272	560	228	576	620	466	1270	129	564	660D	254	684	676	272	616	1260	1262	1266	1275	1276
SiO_2%	66.45	85.91	60.0	52.3	59.5	54.2	55.21	57.6	52.6	57.84	50.32	58.46	52.72	52.91	48.87	54.8	52.14	52.15	53.48	54.0
TiO_2	0.52	0.05	0.65	1.34	0.75	0.60	.66	0.40	0.50	0.85	.45	.50	.26	.60	2.09	0.5	.42	.43	.40	0.6
Al_2O_3	10.85	1.48	19.3	26.2	21.0	18.6	20.42	9.0	13.8	18.02	12.56	13.98	13.63	15.02	13.36	10.8	13.51	13.92	9.65	16.3
Fe_2O_3	8.35	7.29	5.50[t]	5.50[t]	6.5[t]	5.65[t]	1.81	3.95[t]	8.80[t]	0.4	1.25	0.08	.49	.44	5.31	3.3[t]	2.76	3.50	.25	5.5[t]
FeO	0.65						3.05			2.08	9.65	3.79	6.11	5.91	7.98		4.65	4.14	5.53	
MnO	0.1	0.07	0.05	0.03	0.02	0.05	.03	0.25	0.15	0.09	.35	.13	.18	.19	.09	0.30	.28	.27	.33	0.2
Mgo	0.14	2.98	3.65	0.75	2.70	3.45	1.52	7.80	2.85	2.05	1.93	2.95	3.72	3.88	4.71	1.95	2.53	2.01	6.35	2.25
CaO	0.55	2.99	1.50	1.05	0.75	7.4	3.82	12.9	12.6	7.06	16.01	9.19	13.92	11.06	10.70	22.1	14.12	14.21	15.95	11.9
Na_2O	0.66	0.63	6.60	1.15	0.60	4.0	8.18	1.90	5.10	4.92	4.56	3.87	5.62	6.30	3.47	2.45	5.46	5.55	3.79	6.40
K_2O	7.85	0.29	1.10	7.0	5.30	3.5	2.02	3.20	1.60	4.19	.47	4.81	.52	.81	1.08	2.50	1.05	1.26	1.18	1.40
P_2O_5	0.2	0.03	0.12	0.35	0.13	0.2	.23	0.06	0.07	0.24	.23	.20	.08	.03	.18	0.13	.19	.19	.18	0.15
L on I		.05	1.30	4.30	2.55	1.68		1.69	1.59							1.18				1.55
H_2O^+	1.24						1.40			.97	.24	.73	.37	1.79	1.03		1.01	.65	.50	
H_2O^-	.98						.03			.07	.08	.07		.10	.05		.04	.02	.07	
CO_2	.05					.50		0.5	.55	.20						1.33				.20
S	.01					.07		.06	.05	.09						.02				.05
Cl											1.61	0.28	1.71	1.41	1.30		1.58	1.44	1.18	
Total	98.6	101.77	99.8	99.9	99.8	99.9	99.75	99.3	100.3	99.07	99.71	99.05	99.3	100.45	100.23	100.3	99.7	99.75	98.84	100.5

t = total iron as Fe_2O_3

TABLE 7 (cont)

Sample	21	22	23	24	25	26	27	28	29	30	31	32	33
Element	270	662	370	660L	201	669M							
SiO_2	27.8	23.30	46.8	49.66	13.5	38.03	72.21	68.44	56.88	46.60	27.40	4.85	37.03
TiO_2	0.2	.04	.5	0.51	0.10	.52	.22		.76			.06	0.04
Al_2O_3	8.0	1.12	10.1	11.46	3.30	7.93	10.69	14.29	25.22	2.32	8.08	1.29	8.92
Fe_2O_3	1.2[t]	.28	3.9[t]	.38	2.50[t]	18.31	.80	3.66	3.73	1.54	2.84	1.20	18.34
FeO		.80		3.98		1.31	.72	1.69	6.75	1.38	1.30	0.67	2.25
MnO	0.2	.13	0.25	0.36	0.30	.49	.22	-	0.10	-	-	0.14	1.09
MgO	3.65	3.42	2.45	2.2	18.1	.20	1.47	1.48	1.33	3.49	3.38	4.52	0.83
CaO	36.3	37.83	16.1	23.15	26.2	30.67	3.85	2.04	0.98	23.05	30.10	46.53	30.26
Na_2O	0.05	0.05	0.75	2.95	0.05	.20	2.30	1.61	1.27	0.66	0.75	0.17	
K_2O	2.20	0.59	3.50	0.67	0.80	1.24	3.32	2.49	2.03	1.41	1.48	0.28	
P_2O_5	0.20	0.05	0.05	0.18	.05	.51	.10		.16			0.09	
L on I	.18		2.23		34.8								
H_2O^+				0.74		.15							0.48
H_2O^-						.09							0.16
CO_2	19.3	32.1	13.0	3.55		.10		4.31	1.80	19.74	24.66	40.51	
S	0.12		.07	.02		.10							
Cl													
Total	99.4	99.71	99.7	99.9	99.7	99.85							99.4

t = total iron as Fe_2O_3

Analyst: G.M. Derrick, samples 228, 270, 560, 662
AMDEL, remainder

TABLE 7 (cont)

SAMPLE KEY

Sedimentary group	Analysis no.	Sample no.	Description
arkose	1	71201272	pebbly arkose
quartzite	2	70200560	quartzite
sandy shale	3	69200228	cordierite-anthophyllite rock
schist	4	70200576	garnet schist
	5	70200620	sillimanite-biotite schist
	6	69200466	scapolite-biotite schist
	7	71201270	scapolite-biotite schist
granofels	8	69200129	biotite-quartz-scapolite granofels
	9	70200564	scapolite-diopside granofels
	10	73200660D	black cherty granofels
	11	69200254	scapolite-diopside-garnet granofels
	12	73200684	grey siliceous granofels
	13	73200676	scapolite-diopside-amphibole granofels
	14	69200272	scapolite-diopside granofels
	15	70200616	schistose scapolitic amphibolite
granofels subjected to metasomatism at Mary Kathleen	16	71201260	feldspar-scapolite granofels
	17	71201262	scapolite-garnet-diopside granofels
	18	71201262	scapolite-diopside-garnet granofels
	19	71201275	siliceous scapolitic granofels
	20	71201276	calc-silicate granofels
impure marble	21	69200270	vesuvianite-grossular-diopside marble
	22	73200662	wollastonite marble
	23	692003700	scapolite marble
	24	73200660L	scapolite-diopside-wollastonite granofels
marble	25	69200201	diopside marble
	26	73200669M	skarn
	27		average molasse arkose (Pettijohn, 1963)
	28		sandy shale and clay (after Hill & others, 1967)
	29		shale and clay (after Hill & others, 1967)
	30		calcareous sandstone (after Hill & others, 1967)
	31		calcareous shale and clay (after Hill and others, 1967)
	32		carbonate rocks (after Hill & others, 1967)
	33		andradite-grossularite, in the ratio 57:32 (Firman, 1957)

TABLE 8. TRACE ELEMENTS IN CORELLA FORMATION METAMORPHIC ROCKS (semiquantitative spectrographic analyses)

Element Number	Cu	Pb	Zn	Fe	Co	Ni	Cd	Mn	Cr	Zr	Nb	Rb	Ba	Y	La	Sr	B	F	Cl	CO_2	C	S	
228	5	40	10	1.8	-5	20	-1	120	45	140	20	20	200	30	100	200							sandy shale group
227	15	10	15	4.5	10	85	1	240	15	90	-	110	300	-	-	-							
576	5	90	15	2.5	10	10	-1	160	5	560	100	120	800	50	200	50							
620	-5	35	10	3.4	25	40	-1	160	30	110	20	290	800	50	100	-							
466	5	25	30	3.7	20	40	1	340	25	90	-	210	1000	10	100	150	10	.15	.16	.50	.45	.07	pelitic
139	10	45	20	2.2	15	25	1	1100	5	120	-	150	200	30	100	-	18	.20	.12	.50	.20	.06	group
129	30	50	10	0.7	-5	-5	-1	290	25	70	20	110	400	10	-	80							
564	-5	150	5	1.0	-5	-5	-1	170	5	100	-	50	600	10	-	50	16	.02	.09	.55	.20	.06	
1260	20	35	15	0.5	20	15	2	920	10	80	-	90	400	30	-	-	30	.03	.02	1.3	.10	.02	
1276	5	35	10	0.5	-5	-5	-1	130	25	120	-	10	200	30	-	80	25	.05	.11	.20	.25	.05	
138	15	55	15	1.9	15	25	-1	460	15	160	20	200	200	30	-	50							
312	70	40	100	2.0	-5	15	1	3500	35	210	-	130	2000	20	-	-							granofels group
316	30	25	10	3.3	15	30	1	180	45	140	-	180	2000	30	100	50							
324	10	25	30	3.3	20	10	2	7500	20	60	-	50	200	10	-	-							
565	30	35	5	0.7	-5	-5	-1	150	5	100	-	130	1000	10	-	50	20	.03	.05	.55	.15	.03	
594	-5	20	15	5.0	15	15	1	2300	20	50	-	240	500	-	-	-							
610	5	200	20	2.5	-5	10	1	670	10	240	-	10	200	50	-	100							
615	15	90	10	1.0	15	15	2	1400	10	80		90	400	10		100							
270	10	40	10	0.2	-5	15	2	1400	5	90	-	80	200	-	-	-	16	.18	.03	19.3	.10	.12	
370	4000	15	10	1.5	15	20	2	1600	15	130	-	280	500	10	-	50	105	.14	.08	13.0	-.05	.07	
344	190	30	10	0.5	50	20	2	810	15	30	-	20	-	80		50							impure marble group
593	5	30	30	0.4	10	10	1	1800	10	20	-	20	200	-	-	-							
595	35	220	20	3.6	15	15	1	7100	30	30	-	110	200	-	-	-							
201	10	60	30	1.0	15	15	2	1800	5	30	-	40	300	-	-	-							marble

Fe, F, Cl, CO_2, C, S in weight percent; all other elements in ppm

- not detected

TABLE 9. METAMORPHIC ROCKS FROM THE CORELLA FORMATION AND THEIR LIKELY SEDIMENTARY PRECURSORS

Sample nos	Analysis* no.	Metamorphic rock	Sedimentary precursor
1271	1	meta-arkose	arkose: resembles analysis 27 (Table 7) but lower in Ca and Na, and higher in K_2O values, which reflects the K-feldspar-rich and plagioclase-poor provenance.
560	2	quartzite	feldspathic sandstone, possibly with dolomitic matrix.
228	3	cordierite-anthophyllite rock	sandy shale and clay, enriched in Mg and Na (compare with analyses 28 and 29)
576	4	garnet schist	shale and clay (compare with analysis 29), except for high K in 576; high values of MgO and CaO may reflect dolomite in the shale; 1270 enriched in Na; possibly evaporitic.
620	5	sillimanite schist	
466	6	scapolite-biotite schist	
1270	7	scapolite-biotite schist	
129	8	calc-silicate	shale and clay, transitional to sodic, calcareous and dolomitic shale and clay (compare with analyses 29 and 30). Sample 129 is K and Mg-rich; other samples enriched in Na, and contain an average 1.5% Cl, suggestive of saline evaporitive conditions.
564	9	granofels	
660D	10	of	
254	11	various	
684	12	types	
676	13	(see Table 7)	
272	14		
616	15		
1260	16	metasomatised	as for analyses 8 to 15; metasomatism mainly diffusion-type between bands with exchange of elements. Whole-rock composition not appreciably different from other areas of granofels.
1262	17	calc-silicate	
1266	18	granofels	
1275	19	at Mary Kathleen	
1276	20		
270	21	impure marbles	calcareous shale and clay, and impure shaly limestone and dolomitic limestone; distinguished from the granofels group by low SiO_2, high CO_2 and high CaO. Compare with analyses 30 and 31.
662	22	with wollastonite	
370	23	vesuvianite, grossular,	
660L	24	diopside, and calcite	
201	25		impure magnesian limestone (compare analysis 32).

* Analyses listed in Table 7.

TABLE 10. MAJOR-ELEMENT ANALYSES OF SEDIMENTARY MARBLE AND SECONDARY VEIN MARBLE, CORELLA FORMATION

Sample Element	340	341	344	348	201	270	337	338	339	342	343	345	346	347	349	350	351	352	1	4
SiO_2%	17.6	17.0	18.9	29.5	13.5	27.8	1.0	5.6	0.0	4.6	12.0	2.4	0.6	5.5	4.9	0.1	0.3	0.00	5.14	11.99
TiO_2	0.9	0.13	0.33	0.12	0.10	0.2	.01	0.01	0.02	0.01	0.03	0.04	0.01	0.04	0.02	0.01	0.01	0.00	0.07	0.79
Al_2O_3	1.68	3.87	2.70	3.47	3.30	8.0	0.15	0.03	0.08	0.07	0.24	0.47	0.07	0.34	0.06	0.02	0.07	0.01	0.40	3.52
Fe_2O_3	1.29[t]	1.16[t]	1.74	1.71	2.5[t]	1.2[t]	0.62[t]	1.49[t]	0.68[t]	3.98[t]	7.67[t]	1.15[t]	0.63[t]	3.71[t]	0.78[t]	29.3[t]	1.16	27.4		3.09
FeO																			0.49	3.74
MnO	0.12	0.27	0.17	0.31	0.30	0.2	0.36	0.37	0.30	0.44	0.52	0.25	0.41	1.30	4.03	0.10	0.21	0.11	0.41	0.6
MgO	6.0	3.5	1.9	1.2	18.1	3.65	1.5	20.2	1.1	11.2	10.3	2.2	1.3	16.9	1.17	0.8	1.2	1.7	7.79	5.59
CaO	37.0	44.8	41.8	34.8	26.2	36.3	53.9	29.3	56.4	22.5	30.6	53.3	55.4	30.8	49.5	31.9	54.4	38.1	42.30	34.80
Na_2O	0.4		0.4	0.4	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.00	0.03	0.42
K_2O	0.71	0.37	0.51	1.57	0.80	2.20	0.01	0.01	0.01	0.00	0.01	0.04	0.01	0.01	0.07	0.01	0.01	0.00	0.16	1.48
P_2O_5	0.25	0.35	0.12	0.76	0.05	0.20	0.06	0.04	0.06	0.04	0.05	0.17	0.07	0.04	0.07	0.04	0.06	0.05	0.05	2.04
L on I	34.5	27.8	30.8	25.9	34.8	19.60	42.7	43.8	42.6	44.2	35.4	40.8	41.8	42.3	39.3	24.1	42.7	12.2		
Total	99.6	99.3	99.4	99.7	99.7	99.4	100.4	101.10	101.4	87.1*	96.9*	100.9	100.5	101.0	100	86.5*	100.2	79.7**		

Analyses by X-ray fluorescence; analyst J.W. Sheraton, BMR
Analysis 1: Average sedimentary carbonate
Analysis 4: Average carbonatite
t : total iron as Fe_2O_3
* : Samples contain more than 1% Cu
** : Samples contain abundant sulphide

Sample key

70200340	bedded limestone/marble	sedimentary marbles
0341	bedded limestone/marble	
0344	diopside-scapolite marble	
0348	impure marble	
0201	diopside marble	
0270	vesuvianite marble	
70200337, 338, 339, 345, 346, 347, 349	massive marble	vein marbles
342, 343, 350, 351, 352	massive marble with Cu Fe sulphides	

TABLE 11. TRACE-ELEMENT ABUNDANCES* IN SEDIMENTARY MARBLE AND SECONDARY VEIN MARBLE**, CORELLA FORMATION

Element / Sample	Ba	Co	Cu	La	Ni	Sc	Sr	V	Y	Zr	Ti%	Fe%	Mg%	Mn%	L on I
340	2162	6	8	-70	8	7	510	18	9	-100	.07	0.9	3.4	0.13	34.5
341	87	7	11	80	10	11	70	33	17	-100	.11	0.9 3	3.0	0.21	27.5
344	-50	48	104	-70	20	43	83	21	37	-100	.27	1.5	1.1	0.14	30.8
348	560	8	19	-70	9	10	110	19	26	237	.09	1.4	0.4	0.21	25.9
201	300	15	10	-	15	NA	-	NA	-	-100	.05	1.0	0.10	0.23	34.8
270	200	-5	10	-	15	NA	-	NA	-	-100	.11	0.2	2.19	0.10	19.5
337	57	18	11	143	18	92	530	43	143	-100	-.04	0.6	0.7	0.21	42.7
338	-50	6	11	-70	7	36	28	14	62	-100	-.04	1.1	3.5	0.21	43.8
339	-50	11	9	91	10	24	190	28	43	-100	-.04	0.5	0.2	0.21	42.6
342	-50	46	+250	-70	8	18	-20	84	13	-100	-.04	2.5	+3.5	0.21	44.2
343	-50	+175	+250	70	90	16	26	25	97	-100	-.04	4.5	+3.5	0.21	35.4
345	-50	15	9	112	13	24	270	38	36	-100	0.07	1.0	1.4	0.18	40.1
346	-50	8	9	81	10	70	280	26	99	-100	-0.04	0.6	0.2	+0.21	41.8
347	-50	7	16	-70	5	7	36	16	18	-100	0.04	2.8	3.5	+0.21	42.3
349	220	12	35	105	11	23	390	56	87	-100	-0.04	0.6	0.4	+0.21	38.2
350	-50	+175	+250	89	375	17	88	21	54	-100	-0.04	8.8	-0.2	0.07	6.6
351	-50	23	+250	109	17	26	185	29	103	-100	-0.04	1.0	0.2	0.19	42.7
352	-50	+175	+250	119	+900	12	150	18	95	-100	-0.04	9.0	0.8	0.09	4.7
														m	Nb
1	150±100	4.3	14±9	14±11	12±4	0.3	475±50	15±8	13±8	17±4	.03-.01			0.05	0.3
2	750	13	48		55			130							
3	2240	116	570		293			330							
4		17	2.5	516	8	10	3200		96	1120					1951

* Be and Nb analysed for, but not detected. NA = not analysed.

** also known as "crystalline limestone"

Samples 340, 341, 344, 348, 201, 270: Sedimentary marbles; 201 contains diopside, 270 contains garnet, vesuvianite; 344 contains diopside and scapolite.

Samples 337, 338, 339, 342, 343, 345, 346, 347, 349, 350, 351, 352: Vein marbles; 342, 350, 351, and 352 contain pyrite and chalcopyrite.

Analysis 1. Average sedimentary carbonate (Graf, 1960).
" 2. 'Near-shore' sediments.
" 3. 'Deep-sea' sediments.
" 4. Average carbonatite.

Analyses by optical emission spectroscopy, BMR
Analysts: S.E. Smith, T. Slezak.

TABLE 12. PICRITE AND GABBRO FROM THE LUNCH CREEK GABBRO, AND COMPARATIVE ANALYSES

	1	2	3	4	5	6
SiO_2%	47.16	46.4	49.16	53.8	52.43	52.35
TiO_2	0.84	2.0	2.29	2.0	1.36	2.85
Al_2O_3	9.31	8.5	13.33	13.9	14.81	13.03
Fe_2O_3	1.75	2.5	1.31	2.6	2.45	4.86
FeO	10.97	9.8	9.71	9.3	8.36	7.78
MnO	0.16	0.2	0.16	0.2	0.15	0.17
MgO	19.10	20.8	10.41	4.1	5.26	5.81
CaO	6.25	7.4	10.93	7.9	8.75	8.69
Na_2O	1.35	1.6	2.15	3.0	2.47	2.48
K_2O	0.95	0.3	0.15	1.5	1.57	1.53
P_2O_5	0.14	0.2	0.16	0.4	0.23	0.46
H_2O+	0.96				0.57	

1. Sample 217, Lunch Creek Gabbro, picrite phase
2. Hawaiiean tholeiitic picrite basalt (oceanite) (Macdonald, 1968).
3. Olivine tholeiite (Irvine & Baragar, 1971)
4. Tholeiite (Irvine & Baragar, 1971)
5. Average of 13 Lunch Creek Gabbro samples other than 217.
6. Average of 20 low-Mg Karroo basalts (Cox & others, 1967)

TABLE 13. CHEMICAL ANALYSES OF DOLERITE DYKES OF VARIOUS AGES, MARRABA SHEET AREA AND ADJACENT AREAS

Sample	1	2	3	4	5	6	7	8	9
Element	74205658	74205666	74205650	73205369	74205622	73205443	70200566	69200259	69200260
SiO_2 %	49.20	49.33	50.71	48.80	48.92	52.13	50.16	49.05	47.78
TiO_2	1.04	1.43	1.33	2.69	2.60	3.34	1.32	0.85	0.69
Al_2O_3	15.05	15.89	14.70	12.84	13.33	9.59	14.48	14.25	15.44
Fe_2O_3	1.46	3.97	3.39	4.41	3.61	10.31	12.64[t]	7.07[t]	7.34[t]
FeO	11.11	9.06	9.83	11.93	11.97	1.65			
MnO	.20	0.18	0.12	0.25	0.24	0.05	0.18	0.13	0.18
MgO	9.42	6.35	6.14	5.99	5.83	5.37	7.99	6.93	8.97
CaO	9.81	10.51	10.00	10.01	9.99	2.90	11.17	15.75	14.09
Na_2O	2.13	2.85	2.85	2.0	2.37	0.09	2.18	3.11	1.24
K_2O	0.50	0.33	0.79	0.72	0.75	7.78	0.21	1.25	2.81
P_2O_5	0.08	0.11	0.12	0.36	0.39	2.14	0.10	0.05	0.06
Ba ppm	139	211	198	228	189	2297			
Rb	19	8	34	41	38	290			
Sr	132	219	170	133	133	201			
Y	19	31	26	47	48	40			
Pb	8	2	2	4	7	12			
Zr	54	86	78	158	157	1196			
Zn	110	60	48	165	165	22			
Cu	65	22	172	90	80	238			
Ni	170	68	110	73	88	225			
Cr	105	250	175	160	135	290			
V	270	380	355	470	420	230			
Sc	10	30	15	5	15	10			
Rb/Sr	.144	.036	.20	.308	.286	1.44			
K/Rb	209	332	183	143	159	222			
Na_2O/K_2O	4.26	8.64	3.61	2.78	3.16	.01			

1. Dolerite ?do_4, intruding Marraba Volcanics, just south of Sheet area.
2. Dolerite intruding Marraba Volcanics, just south of Sheet area.
3. Dolerite, ?do_4, 3 km south of Cloncurry.
4. Lakeview Dolerite, do_6, near Lake Corella.
5. Lakeview Dolerite, do_6, near Lake Corella.
6. Biotite lamprophyre, Butcher Bore area.
7. Pyroxene dolerite (probably do_6) cutting Burstall Granite.
8. Scapolitised dolerite, just north of Mary Kathleen open cut, near radio hut.
9. Altered dolerite, near Mary Kathleen radio hut.

t = total iron as Fe_2O_3

Analyses 1-6 from Ellis (in prep.)

7-9 : Analyst - G.M. Derrick.

TABLE 14. CHEMISTRY OF WONGA AND BURSTALL GRANITES AND ASSOCIATED DYKE ROCKS

	1	2	3	4	5	6	7
SiO_2	70.77	72.97	71.2	75.93	74.22	72.30	68.30
TiO_2	0.68	.32	.40	.12	.28	.21	.28
Al_2O_3	14.97	12.86	14.7	11.91	13.27	13.13	18.30
Fe_2O_3	0.36	1.99	3.6[t]	.42	0.88	2.92[t]	.43[t]
FeO	2.78	.80		.34	.92		
MnO	tr.	.04	.05	.08	.05	.02	.02
MgO	0.18	.36	.55	.09	.29	.43	-
CaO	1.86	1.20	2.0	.78	1.59	1.53	.73
Na_2O	3.23	2.79	3.54	1.42	4.23	2.90	9.60
K_2O	5.04	6.09	4.18	8.35	3.18	5.26	.88
P_2O_5	-	.06	.16	.01	0.05	.04	-
Total	99.78	99.78	100.38	99.45	98.96	98.84	98.54

t = total Fe : H_2O+, H_2O-, CO_2 & S not listed.

1. Wonga Granite (Joplin & Walker, 1961)
2. Burstall Granite (average of 7 samples in Derrick, 1978)
3. Average granite (Taylor, 1968)
4. Burstall rhyolite (average of 10 samples in Derrick, 1978)
5. Average Taupo rhyolite, N.Z. (Ewart & others, 1968)
6. Aplite vein within Burstall Granite (Derrick, 1978)
7. Soda aplite vein within Burstall Granite (Derrick, 1978)

TABLE 15. COPPER CONTENTS OF CHIP SAMPLES OF BASIC ROCKS

Sample	Cu(ppm)	Sample	Cu(ppm)	Sample	Cu(ppm)
*69070052	45	69070063	180	69200217	82
69070053	50	69070064	90	69200235	106
69070054	55	69070065	95	69200236	125
69070055	95	69070066	40	69200239	90
69070056	60	69070067	80	69200240	78
69070057	60	69070068	315	69200368	85
69070058	26	69070069	145	69200656E2	185
69070059	50	69070070	35	69200656E1	210
69070060	145	69070071	55	69200656W	140
69070061	1320	69070072	50	69200687	325
69070062	670	69070073	52	69200688	74

Average for basic rocks 87 ppm (Turekian & Wedepohl, 1961)
Average for Marraba Sheet area basic rocks 121 ppm (excluding sample 61)
Average for Lunch Creek Gabbro 136 ppm.

Sample Key

52 to 58 Vicinity of GR 333798
59 to 62 " " GR 338786
63 to 68 " " GR 253041
69 to 73 " " GR 260782
217 to 688 Lunch Creek Gabbro, GR 030045

*BMR registered numbers: Analyst A.D. Haldane, samples 52-73;
AMDEL for samples 217-688.

TABLE 16. ASSAYS OF MANGANESE ORES FROM OVERHANG

	1.	2.	3.	4.
Mn%	43.6	53.3	49.6	
MnO_2		73.0	69.8	48.3
SiO_2	19.5	11.3	16.0	18.6
Fe_2O_3		4.2	5.5	4.5
BaO		0.1	0.2	
K_2O		0.0001	0.0005	
H_2O		2.44	1.75	
Co	0.04			
Ni	0.02			

1. Representative sample of high-grade ore (Carter & others, 1961).

2. Hard, dense, vuggy, submetallic ore. (Brooks, 1962).

3. Hard, dense, massive ore (Brooks, 1962).

4. Average of Mn ore produced in 1958 (Brooks, 1962).

TABLE 17. ANALYSES FOR Fe, Mn, Co, Cu, Ni, Pb in IRON-MANGANESE NODULES AND SEDIMENTS

Analyses by AMDEL, Adelaide

Formation	Registered no.*	Fe %	Mn %	Co ppm	Cu ppm	Ni ppm	Pb ppm	Description	Location**
Marimo Slate	325	10.2	41.0	470	25	100	30	Massive Mn with limonite	GR 357872
Overhang Jaspilite	326	9.4	31.5	200	10	60	30	Massive Mn	GR 318048
" "	327	1.1	26.5	70	330	30	25	Massive Mn with quartz	GR 204032
" "	328	0.4	30.0	530	1650	75	25	Nodular Mn with quartzite	8.4 km SW of Overhang
Corella Fmn	329	2.6	55.0	160	10	160	35	Massive Mn, nodular	GR 999122
Overhang Jaspilite	330	0.8	9.5	220	270	15	20	Botryoidal Mn with quartzite	8.4 km SE of Overhang
" "	331	1.0	33.9	200	80	60	30	Nodular Mn	GR 329937
Corella Fmn	332	7.6	3.5	20	55	15	20	Mn with garnet (meta-sediment)	GR 138172
Overhang Jaspilite	333	37.0	0.27	25	10	15	65	Banded iron formation	GR 347972
" "	334	48.5	0.11	40	5	10	25	Banded iron formation	GR 347972
" "	335	15.0	0.12	20	5	15	20	Banded iron formation	2 km SE of Overhang
" "	336	3.9	11.0	50	5	25	20	Mn-bearing marl	GR 319049
Overhang (Carter et al 1961)	-		43.6	400		200		Typical high-grade ore	GR 365792
Average Shale		4.72	0.085	19	45	68	20	Turekian & Wedepohl (1961)	
Average Carbonate		0.38	0.11	0.1	4	20	9	" "	
Average pelagic clay	-	5.06	0.48	100	300	200	60	Cronan (1969)	
Mn nodules	-	11.6	21.6	3000	2000	6200	1000	Ahrens & others (1967)	
Mn nodules	-	11.7	19.2	2800	4000	5800	1000	Manheim (1965)	
Mn nodules	-	10.8	12.6	800	2100	4500	700	Frazer & Ostwald (1970)	

** 1000 metre grid reference (GR), Marraba Sheet area
* BMR registered number, e.g., R 70200325

TABLE 18. Microprobe analyses of metamorphic minerals from the Corella Formation marble unit, Mary Kathleen syncline, Marraba 1:100 000 Sheet area. (Analyst B. Cruikshank)

(For each sample, first column shows weight %, second column structural formulae - cations on basis of number of oxygens.)

a. Diopside $CaMgSi_2O_6$

Sample	662a		662b		666a		666b	
SiO_2	53.57	1.992	54.22	1.988	53.79	1.985	53.59	1.986
Al_2O_3	0.0	.0	0.0	0	0	0	.17	.007
FeO	3.47	.108	3.38	.104	2.15	.066	3.71	.115
MnO	.39	.012	.56	.017	.14	.004	.67	.021
MgO	15.75	.873	15.92	.87	16.77	.922	15.49	.856
CaO	25.68	1.023	26.30	1.033	26.24	.037	25.83	1.025
Total	98.95	4.008	100.38	4.012	99.09	4.015	99.28	4.01

6 oxygen

	850		851a		851b		851c	
SiO_2	53.53	1.979	55.42	1.991	54.55	1.991	54.72	1.99
Al_2O_3	.77	.033	.37	.016	.29	.012	.17	.007
FeO	5.60	.173	1.99	.06	1.93	.059	1.34	.041
MnO	0	0	.40	.012	.41	.013	.26	.008
MgO	14.46	.797	16.75	.896	16.66	.906	17.14	.93
CaO	25.82	1.022	26.75	1.029	26.11	1.021	26.30	1.02
Total	100.18	4.005	101.68	4.003	99.95	4.003	99.93	4.004

	851d		851e		852	
SiO_2	54.61	1.992	54.43	1.989	54.51	1.980
Al_2O_3	.28	.012	.30	.013	1.22	.052
FeO	1.93	.059	1.99	.061	1.35	.041
MnO	.54	.017	.55	.017	.27	.008
MgO	16.71	.909	16.78	.914	16.81	.910
CaO	25.95	1.014	25.81	1.011	25.59	.996
Total	100.03	4.002	99.86	4.004	99.76	3.992

Notes: 851a, b stubby crystals in calcite;
851c inclusions in garnet;
851d prismatic crystals;
851e prismatic crystals with undulose extinction.

TABLE 18 (contd)

b. Wollastonite $CaSiO_3$

	662a		662b		662c		850	
SiO_2	51.12	1.985	50.06	1.984	51.06	1.984	51.06	1.984
CaO	48.52	2.031	47.87	2.033	48.68	2.027	48.67	2.027
Total	99.94	4.015	97.94	4.016	99.87	4.014	99.86	4.016
		6 oxygen						

c. K feldspar $(K,Na)(AlSi_3O_8)$

	666		850a		850b	
SiO_2	63.64	2.974	62.77	2.968	63.59	2.975
Al_2O_3	18.21	1.003	18.01	1.004	18.42	1.015
CaO	.97	.049	1.16	.059	.62	.031
K_2O	16.28	.97	16.32	.984	16.60	.991
Na_2O	.30	.027	.15	.014	0	
Total	99.40	5.02	98.41	5.029	99.22	5.012
		8 oxygen				

Notes: 850a, b feldspar rims on garnet

d. Garnet (Grossular) $Ca_3Al_2Si_3O_{12}$

	666		850		851	
SiO_2	38.91	2.953	38.89	2.942	38.59	2.944
TiO_2	-	-	.41	.024	-	-
Al_2O_3	22.54	2.016	21.95	1.957	22.05	1.983
FeO	.68	.043	.87	.055	.83	.053
MnO	.97	.062	-	-	.45	.029
Mgo	-	-	-	-	-	-
CaO	36.47	2.965	37.98	3.078	37.37	3.055
Total	99.56	8.039	100.11	8.056	99.29	8.064
		12 oxygen				

TABLE 18 (contd)

e. Vesuvianite $Ca_{10}Mg_2Al_4(Si_2O_7)_2(SiO_4)_5(OH)_4$

	666a		666b		666c		666d	
SiO_2	35.10	8.716	34.73	8.926	35.91	8.836	36.20	8.742
TiO_2	2.68	.501	.61	.117	.64	.118	2.66	.483
Al_2O_3	15.87	4.645	16.61	5.031	17.21	4.991	16.26	4.626
FeO	1.74	.361	1.66	.357	1.61	.33	1.75	.354
MnO	-	-	.13	.029	-	-	.13	.026
MgO	2.51	.928	2.32	.888	2.55	.935	2.57	.924
CaO	34.98	9.307	32.86	9.05	35.43	9.339	35.97	9.307
Na_2O	-	-	.17	.08	-	-	-	-
Cl	.77	.323	1.20	.523	.91	.381	.86	.350
Total	93.66	24.782	90.29	25.007	94.26	24.930	96.38	24.812

36 oxygen

	851a		851b		851c		851d	
SiO_2	36.41	8.765	36.09	8.725	36.22	8.755	36.27	8.836
TiO_2	1.92	.348	1.86	.337	2.21	.401	2.04	.373
Al_2O_3	16.50	4.680	16.51	4.703	16.13	4.596	15.99	4.590
FeO	1.44	.289	1.58	.319	1.39	.281	1.65	.336
MnO	-	-	-	-	-	-	-	-
MgO	2.78	.996	2.75	.993	2.82	1.016	2.70	.981
CaO	36.71	9.468	36.72	9.51	36.66	9.496	35.93	9.379
Na_2O	-	-	-	-	-	-	-	-
Cl	.87	.355	.93	.379	.91	.374	.94	.389
Total	96.63	24.902	96.43	24.965	96.35	24.920	95.52	24.884

	851e		852a		852b		852c	
SiO_2	35.79	8.766	35.92	8.938	35.98	9.111	36.89	8.764
TiO_2	2.05	.377	.70	.130	.57	.108	1.32	.236
Al_2O_3	16.02	4.623	17.02	4.992	17.21	5.137	17.46	4.888
FeO	1.31	.267	1.12	.233	1.13	.238	1.05	.209
MnO	-	-	-	-	.12	.026	.20	.040
MgO	2.84	1.036	2.81	1.041	2.55	.961	2.87	1.017
CaO	36.11	9.475	34.14	9.102	31.64	8.584	36.94	9.402
Na_2O	-	-	-	-	.19	.091	-	-
Cl	.91	.376	.82	.347	.58	.248	.96	.387
Total	95.02	24.921	92.52	24.782	89.96	24.505	97.68	24.943

TABLE 18 (contd)

	852d	
SiO_2	36.52	8.793
TiO_2	1.17	.213
Al_2O_3	17.22	4.886
FeO	1.39	.279
MnO	-	-
MgO	2.85	1.022
CaO	36.27	9.358
Na_2O	-	-
Cl	.90	.369
Total	96.32	24.920

Notes: 666b & c clouded and clear core of crystal;
666d rim zone of crystal;
852a, b core of crystal;
852c, d rim of crystal

f. Scapolite $(Na,Ca)_4[(Al,Si)_4O_8]_3(Cl,CO_3)$

	852	
SiO_2	49.24	7.181
Al_2O_3	26.19	4.502
CaO	12.90	2.015
K_2O	1.22	.227
Na_2O	5.35	1.514
Cl	1.85	.457
Total	96.76	15.896
		24 oxygen

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