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MINERAL ANALYSES AND ROCK DESCRIPTIONS FOR CUMULATE PERIDOTITES AND GABBROS FROM THE MARUM OPHIOLITE COMPLEX, NORTHERN PAPUA NEW GUINEA

by

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CONTENTS

ABSTRACT

Representative microprobe analyses of mineral phases in cumulate peridotites and gabbros from the Marum ophiolite complex in northern Papua New Guinea are presented, together with petrographic descriptions and locality data for the relevant rock samples.

INTRODUCTION

This microfiche Record presents representative mineral analyses for cumulate peridotites and gabbros from the Marum ophiolite complex, the petrology and petrogenesis of which is described in a separate publication (Jaques, in press). The samples analysed here were selected from some 500 rock samples which were collected and examined. Approximately 2500 complete mineral analyses for 10 elements (Na-Fe) for some 50 representative rock samples from the layered sequence were obtained by microprobe using an energy-dispersive Si (Li) detector attached to the TPD electron probe at the Research School of Earth Sciences, Australian National University. Analytical technique and correction procedures are given in Reed & Ware (1975). Selected bulk pyroxene analyses (host plus lamellae) were obtained by rapid, reduced-area scans (100-250 microns) using a JEOL JX 50A microprobe-scanning electron microscope fitted with an EDAX energy-dispersive system. The analytical method follows that of Reed & Ware (1975) and is described in detail by Griffin (1979).

Representative analyses of phases are presented in Tables 1 to 9, and brief petrographic descriptions and locality data are given in Table 10. Unless otherwise stated all iron is reported as FeO. Fe^{3+} and Fe_2O_3 in chromites (Table 2) were calculated assuming an ideal $RO.R_2O_3$ spinel formula. Fe_2O_3 and FeO contents, and molecular percent ulvöspinel and R_2O_3 components in magnetite and ilmenite (Table 8) were calculated from the probe analysis following the method of Carmichael (1967). Estimated temperatures and oxygen fugacities for co-existing ilmenite-magnetite pairs were determined using the $T\text{-}f_{O_2}\text{-}X$ curves of Buddington & Lindsley (1964).

TABLE 1. REPRESENTATIVE ANALYSES OF CUMULUS OLIVINE

	DUNITE							
	221[1]	497[1]	567	421	1046	428	504[2]	059[2]
SiO_2	41.76	41.22	41.30	41.13	40.88	40.81	40.67	40.44
FeO	4.49	5.75	6.51	7.92	8.72	9.09	9.59	9.72
MnO	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
MgO	53.72	52.65	52.24	50.95	50.57	50.01	50.04	49.40
Total	99.97	99.62	100.05	100.49	100.17	99.91	100.30	99.56
	Cations on the basis of 4 oxygens							
Si	0.998	0.995	0.996	0.998	0.994	0.997	0.992	0.995
Fe	0.090	0.116	0.131	0.161	0.178	0.186	0.196	0.200
Mn	-	-	-	-	-	-	-	-
Mg	1.914	1.894	1.877	1.843	1.834	1.821	1.820	1.811
Total	3.002	3.005	3.004	3.002	3.006	3.003	3.008	3.005
100 Mg/Mg+Fe	95.5	94.2	93.5	92.0	91.2	90.7	90.3	90.1
Ni ppm	2500		2490	3540		1960		

All CaO, Al_2O_3 and TiO_2 contents <0.07%

1. Olivine in chromitite layer

2. Rock contains poikilitic clinopyroxene

TABLE 1. REPRESENTATIVE ANALYSES OF CUMULUS OLIVINE (continued)

	PERIDOTITE							
	209	186	415	180	502	271	238	166
SiO_2	40.67	40.52	40.27	39.77	40.15	39.95	39.80	39.34
FeO	9.93	10.57	11.85	11.76	13.08	12.97	13.19	15.22
MnO	<0.09	<0.09	<0.09	0.11	<0.09	0.13	<0.09	<0.09
MgO	49.16	48.70	47.89	47.70	47.32	47.08	46.91	45.08
Total	99.76	99.79	100.01	99.34	100.55	100.13	99.90	99.64
	Cations on the basis of 4 oxygens							
Si	0.999	0.998	0.995	0.991	0.993	0.992	0.992	0.992
Fe	0.204	0.218	0.245	0.245	0.271	0.270	0.275	0.321
Mn	-	-	-	0.002	-	0.003	-	-
Mg	1.799	1.787	1.764	1.771	1.744	1.743	1.742	1.695
Total	3.001	3.002	3.005	3.009	3.007	3.008	3.008	3.008
100 Mg/Mg+Fe	89.8	89.2	87.8	87.8	86.6	86.6	86.4	84.1
Ni ppm	2200	2530	1940	1570	2560	2100	1200	1930

All CaO, Al_2O_3 and TiO_2 contents <0.07%

TABLE 1. REPRESENTATIVE ANALYSES OF CUMULUS OLIVINE (continued)

	GABBRO				
	191	051	073	225	162
SiO_2	40.06	39.63	38.85	38.69	38.39
FeO	13.55	15.74	19.23	19.23	19.90
MnO	<0.09	<0.09	0.21	0.14	0.21
MgO	46.68	45.03	41.88	41.75	41.25
Total	100.29	100.40	100.18	99.81	99.75
	Cations on the basis of 4 oxygens				
Si	0.995	0.994	0.994	0.993	0.990
Fe	0.281	0.330	0.412	0.413	0.429
Mn	-	-	0.005	0.003	0.005
Mg	1.728	1.683	1.597	1.598	1.586
Total	3.005	3.007	3.006	3.007	3.010
100 Mg/Mg+Fe	86.0	83.6	79.5	79.5	78.7
Ni ppm	1090	1380			

Al, CaO, Al_2O_3 and TiO_2 contents <0.07%

TABLE 2. REPRESENTATIVE ANALYSES OF CUMULUS CHROME SPINEL

Sample No.	567	059	221*	421	DUNITE 092	497*	428
TiO_2	<0.07	<0.07	0.14	<0.07	<0.07	0.13	<0.07
Al_2O_3	5.95	7.45	8.52	9.21	9.87	10.29	11.75
Cr_2O_3	63.31	58.62	60.66	58.85	57.95	59.55	52.75
Fe_2O_3	3.16	4.59	4.15	3.87	3.64	3.79	6.39
FeO	16.08	21.13	14.35	18.17	18.26	13.92	20.97
MnO	0.36	<0.09	<0.09	0.25	<0.09	<0.09	<0.09
MgO	10.62	7.72	12.32	9.83	9.94	12.87	8.45
CaO	0.15	0.11	0.20	0.07	<0.07	0.24	0.07
Total	99.63	99.62	100.34	100.25	99.68	100.79	100.38
	Cations on the basis of 4 oxygens						
Ti	-	-	0.003	-	-	0.003	-
Al	0.236	0.300	0.328	0.361	0.388	0.391	0.459
Cr	1.684	1.582	1.568	1.543	1.522	1.515	1.382
Fe^{3+}	0.080	0.118	0.102	0.096	0.091	0.092	0.159
Fe^{2+}	0.452	0.603	0.392	0.504	0.507	0.375	0.580
Mn	0.010	-	-	0.007	-	-	-
Mg	0.533	0.393	0.600	0.486	0.492	0.617	0.417
Ca	0.006	0.004	0.007	0.003	-	0.007	0.003
100 $Mg/(Mg+Fe^{2+})$	54.1	39.4	60.5	49.1	49.3	62.2	42.0
$Cr/(Cr+Al)$	0.877	0.841	0.827	0.811	0.797	0.795	0.751
$Cr/(Cr+Al+Fe^{3+})$	0.842	0.791	0.785	0.771	0.761	0.785	0.691
$Al/(Cr+Al+Fe^{3+})$	0.118	0.150	0.164	0.180	0.194	0.196	0.230
$Fe^{3+}/(Cr+Al+Fe^{3+})$	0.040	0.059	0.051	0.048	0.045	0.046	0.079
Co-existing olivine (Mg)	93.5	90.0	95.0	92.0	93.3	96.0	90.6

Fe determined as total iron; Fe^{3+} and Fe_2O_3 calculated from ideal $RO.R_2O_3$ spinel formula

*Chromitite

TABLE 2. REPRESENTATIVE ANALYSES OF CUMULUS CHROME SPINEL (continued)

	DUNITE		PERIDOTITE			
Sample No.	504	1046	415	186	189	238
TiO_2	0.19	0.15	0.34	0.44	0.41	0.21
Al_2O_3	12.89	21.21	14.56	17.93	16.52	18.20
Cr_2O_3	48.03	41.00	46.52	41.65	37.42	36.10
Fe_2O_3	9.61	8.69	8.46	9.90	15.38	15.09
FeO	21.31	17.21	23.00	21.19	23.49	23.66
MnO	0.66	<0.09	0.24	0.53	0.34	0.60
MgO	7.90	12.10	7.23	8.48	7.01	6.93
CaO	0.11	0.14	0.07	0.13	0.12	0.11
Total	100.70	100.50	100.42	100.25	100.35	100.90
	Cations on the basis of 4 oxygens					
Ti	0.005	0.004	0.009	0.011	0.010	0.005
Al	0.502	0.780	0.566	0.683	0.639	0.697
Cr	1.254	1.012	1.214	1.065	0.971	0.929
Fe^{3+}	0.239	0.204	0.210	0.241	0.380	0.369
Fe^{2+}	0.589	0.434	0.635	0.573	0.643	0.643
Mn	0.018	-	0.007	0.015	0.010	0.017
Mg	0.389	0.562	0.356	0.408	0.343	0.336
Ca	0.004	0.005	0.003	0.004	0.004	0.004
100 $Mg/(Mg+Fe^{2+})$	39.8	56.4	35.9	41.6	34.8	34.3
$Cr/(Cr+Al)$	0.714	0.565	0.682	0.609	0.603	0.571
$Cr/(Cr+Al+Fe^{3+})$	0.629	0.507	0.610	0.533	0.488	0.466
$Al/(Cr+Al+Fe^{3+})$	0.251	0.391	0.284	0.346	0.321	0.349
$Fe^{3+}/(Cr+Al+Fe^{3+})$	0.120	0.102	0.106	0.121	0.191	0.185
Co-existing Olivine (Mg)	90.3	91.2	87.9	89.2	87.8	86.4

Fe determined as total iron; Fe^{3+} and Fe_2O_3 calculated from ideal $RO.R_2O_3$ spinel formula

TABLE 2. REPRESENTATIVE ANALYSES OF CUMULUS CHROME SPINEL (continued)

Sample No.	PERIDOTITE 271	203	441	166	168	107
TiO_2	0.31	0.42	0.41	0.27	0.26	0.47
Al_2O_3	22.34	23.08	24.49	24.65	23.21	9.50
Cr_2O_3	35.78	32.27	34.28	33.17	34.38	36.33
Fe_2O_3	10.61	13.24	10.00	11.37	10.69	22.72
FeO	23.73	23.53	22.28	21.60	23.18	29.12
MnO	<0.09	0.73	<0.09	0.58	0.38	0.50
MgO	7.69	7.53	8.83	8.94	7.66	2.56
CaO	0.11	<0.07	0.10	0.15	0.26	0.09
Total	100.57	100.80	100.39	100.73	100.02	101.29
	Cations on the basis of 4 oxygens					
Ti	0.008	0.010	0.009	0.007	0.006	0.012
Al	0.838	0.864	0.905	0.907	0.872	0.390
Cr	0.900	0.810	0.850	0.819	0.866	1.001
Fe^{3+}	0.254	0.316	0.236	0.267	0.256	0.596
Fe^{2+}	0.632	0.625	0.584	0.564	0.617	0.849
Mn	-	0.019	-	0.015	0.011	0.015
Mg	0.364	0.356	0.413	0.416	0.363	0.133
Ca	0.004	-	0.003	0.005	0.009	0.004
100 $Mg/(Mg+Fe^{2+})$	36.6	36.3	41.4	42.4	37.0	13.5
$Cr/(Cr+Al)$	0.518	0.484	0.484	0.475	0.498	0.720
$Cr/(Cr+Al+Fe^{3+})$	0.452	0.407	0.427	0.411	0.434	0.504
$Al/(Cr+Al+Fe^{3+})$	0.421	0.434	0.454	0.455	0.437	0.196
$Fe^{3+}/(Cr+Al+Fe^{3+})$	0.127	0.159	0.119	0.134	0.129	0.300
Co-existing Olivine (Mg)	86.7	86.4	84.4	83.6	84.3	-

Fe determined as total iron; Fe^{3+} and Fe_2O_3 calculated from ideal $RO.R_2O_3$ spinel formula

TABLE 3. REPRESENTATIVE ANALYSES OF PRIMARY ORTHOPYROXENE

Sample	PERIDOTITE 186	415	238	502	166	503
SiO_2	55.62	56.11	56.06	55.14	54.82	53.69
Al_2O_3	1.37	1.22	1.17	2.66	2.14	2.85
Cr_2O_3	0.46	0.45	0.58	0.60	0.51	0.61
FeO	6.79	7.67	8.38	8.12	9.53	9.40
MnO	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
MgO	32.65	32.74	31.62	30.74	30.42	29.85
CaO	1.78	1.46	2.42	2.36	2.53	2.15
Total	98.67	99.65	100.23	99.62	99.95	98.55
	Cations on the basis of 6 oxygens					
Si	1.958	1.961	1.960	1.937	1.935	1.920
Al^{IV}	0.042	0.039	0.040	0.063	0.065	0.080
Al^{VI}	0.015	0.011	0.008	0.047	0.024	0.040
Cr	0.013	0.012	0.016	0.017	0.014	0.017
Fe	0.200	0.224	0.245	0.239	0.281	0.281
Mn	-	-	-	-	-	-
Mg	1.713	1.705	1.647	1.609	1.599	1.591
Ca	0.067	0.055	0.091	0.089	0.096	0.082
Total	4.007	4.008	4.008	4.000	4.014	4.011
Ca	3.4	2.8	4.5	4.6	4.8	4.2
Mg	86.5	85.9	83.1	83.1	80.9	81.4
Fe	10.1	11.3	12.4	12.3	14.2	14.4
100 Mg/Mg+Fe	89.5	88.4	87.1	87.1	85.1	85.0

All TiO_2 <0.07%, Na_2O <0.20%.

TABLE 3. REPRESENTATIVE ANALYSES OF PRIMARY ORTHOPYROXENE (continued)

Sample	GABBRO 051	191	174	073	1020
SiO_2	56.09	55.03	55.66	54.83	54.42
Al_2O_3	0.48	1.98	1.07	1.47	1.24
Cr_2O_3	0.13	0.11	0.08	<0.07	0.22
FeO	10.13	9.88	11.29	11.34	15.72
MnO	0.12	<0.09	0.18	0.20	0.21
MgO	31.88	30.76	30.20	28.95	27.30
CaO	1.42	1.69	2.14	2.24	1.37
Total	100.25	99.45	100.62	99.03	100.48
	Cations on the basis of 6 oxygens				
Si	1.972	1.947	1.962	1.965	1.958
Al^{IV}	0.020	0.053	0.038	0.035	0.042
Al^{VI}	-	0.030	0.006	0.027	0.011
Cr	0.004	0.003	0.002	-	0.006
Fe	0.298	0.292	0.333	0.340	0.473
Mn	0.004	-	0.005	0.006	0.006
Mg	1.665	1.622	1.586	1.546	1.464
Ca	0.054	0.064	0.081	0.086	0.053
Total	4.016	4.010	4.014	4.004	4.013
Ca	2.7	3.2	4.1	4.4	2.7
Mg	82.5	82.0	79.3	78.4	73.6
Fe	14.8	14.8	16.6	17.2	23.7
100 Mg/Mg+Fe	84.8	84.7	82.7	82.0	75.6

All TiO_2 <0.07%, Na_2O <0.20%.

TABLE 4. REPRESENTATIVE ANALYSES OF PRIMARY CLINOPYROXENE

Sample No.	PERIDOTITE 059*	209	186	415	238
SiO_2	54.46	52.55	53.16	53.01	53.14
TiO_2	<0.07	<0.07	<0.07	<0.07	<0.07
Al_2O_3	0.16	2.62	2.54	2.33	1.46
Cr_2O_3	0.80	0.89	0.85	1.35	0.95
FeO	1.40	2.79	3.29	3.39	3.62
MnO	<0.09	<0.09	<0.09	<0.09	<0.09
MgO	17.35	18.12	19.40	18.23	19.18
CaO	24.84	22.10	20.56	21.29	20.77
Total	99.00	99.07	99.80	99.57	99.12
	Cations on the basis of 6 oxygens				
Si	1.995	1.925	1.927	1.933	1.946
Al^{IV}	0.005	0.075	0.073	0.067	0.054
Al^{VI}	0.002	0.036	0.036	0.033	0.009
Ti	-	-	-	-	-
Cr	0.023	0.026	0.024	0.039	0.028
Fe	0.043	0.085	0.100	0.103	0.111
Mn	-	-	-	-	-
Mg	0.947	0.989	1.048	0.991	1.047
Ca	0.975	0.867	0.799	0.832	0.815
Total	3.990	4.006	4.006	3.998	4.009
Ca	49.6	44.7	41.0	43.2	41.3
Mg	48.2	50.9	53.8	51.4	53.1
Fe	2.2	4.4	5.2	5.4	5.6
$\frac{100\ Mg}{Mg+Fe}$	95.7	92.0	91.3	90.6	90.4

All Na_2O <0.20%

*Poikilitic intercumulus pyroxene

TABLE 4. REPRESENTATIVE ANALYSES OF PRIMARY CLINOPYROXENE (continued)

Sample No.	PERIDOTITE 502	180	166	271	503
SiO_2	52.58	54.36	53.80	53.01	52.15
TiO_2	<0.07	<0.07	<0.07	<0.07	<0.07
Al_2O_3	3.23	1.51	2.18	2.15	3.94
Cr_2O_3	0.87	0.64	0.94	1.05	1.10
FeO	3.70	3.93	3.94	4.44	4.68
MnO	<0.09	<0.09	<0.09	<0.09	<0.09
MgO	19.21	19.62	18.40	18.79	17.90
CaO	19.91	20.45	20.92	20.49	20.30
Total	99.50	100.51	100.18	99.93	100.07
	Cations on the basis of 6 oxygens				
Si	1.912	1.958	1.948	1.931	1.897
Al^{IV}	0.088	0.042	0.052	0.069	0.103
Al^{VI}	0.051	0.022	0.041	0.023	0.066
Ti	-	-	-	-	-
Cr	0.025	0.018	0.027	0.030	0.032
Fe	0.113	0.118	0.119	0.135	0.142
Mn	-	-	-	-	-
Mg	1.041	1.053	0.994	1.020	0.971
Ca	0.776	0.789	0.811	0.800	0.791
Total	4.006	4.001	3.992	4.008	4.002
Ca	40.2	40.3	42.2	40.9	41.5
Mg	54.0	53.7	51.6	52.2	51.0
Fe	5.8	6.0	6.2	6.9	7.5
$\frac{100\ Mg}{Mg+Fe}$	90.2	89.9	89.3	88.3	87.2

All Na_2O <0.20%

TABLE 4. REPRESENTATIVE ANALYSES OF PRIMARY CLINOPYROXENE (continued)

Sample No.	GABBRO 191	051	174	073	264	1020
SiO_2	52.66	54.57	52.45	53.05	52.77	52.72
TiO_2	<0.07	<0.07	0.13	<0.07	<0.07	0.13
Al_2O_3	2.22	0.61	2.64	2.64	1.79	2.55
Cr_2O_3	0.43	0.41	0.26	0.32	0.30	0.27
FeO	4.41	4.85	5.67	5.96	7.96	9.25
MnO	<0.09	<0.09	<0.09	<0.09	0.10	0.10
MgO	18.77	19.66	18.78	17.95	17.99	18.62
CaO	20.23	20.11	18.72	20.06	18.91	16.96
Total	98.73	100.21	98.65	99.98	99.82	100.60
	Cations on the basis of 6 oxygens					
Si	1.937	1.977	1.932	1.936	1.944	1.926
Al^{IV}	0.063	0.023	0.068	0.064	0.056	0.074
Al^{VI}	0.033	0.003	0.047	0.050	0.022	0.036
Ti	-	-	0.004	-	-	0.004
Cr	0.013	0.012	0.008	0.009	0.009	0.008
Fe	0.136	0.147	0.175	0.182	0.245	0.283
Mn	-	-	-	-	0.003	0.003
Mg	1.029	1.062	1.031	0.977	0.988	1.014
Ca	0.797	0.781	0.739	0.784	0.746	0.664
Total	4.008	4.004	4.003	4.002	4.013	4.011
Ca	40.6	39.2	38.0	40.4	37.7	33.9
Mg	52.4	53.4	53.0	50.3	49.9	51.7
Fe	6.9	7.4	9.0	9.3	12.4	14.4
$\frac{100\ Mg}{Mg+Fe}$	88.3	87.8	85.5	84.3	80.1	78.2

All Na_2O <0.20%

TABLE 5. REPRESENTATIVE ANALYSES OF COEXISTING SUBSOLIDUS PYROXENES

Sample No.	186		180		238	
	opx	cpx	opx	cpx	opx	cpx
SiO_2	56.31	52.52	56.11	54.02	57.49	52.87
TiO_2	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Al_2O_3	1.37	2.10	1.61	1.56	0.95	1.35
Cr_2O_3	0.39	1.10	0.29	0.68	0.22	0.73
FeO	7.01	2.73	8.10	2.74	8.89	2.99
MnO	<0.09	<0.09	<0.09	<0.09	0.11	<0.09
MgO	33.90	16.81	33.33	17.34	33.18	17.13
CaO	0.41	23.50	0.33	24.48	0.51	23.91
Na_2O	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Total	99.39	98.76	99.77	100.82	101.35	98.98
	Cations on the basis of 6 oxygens					
Si	1.961	1.938	1.955	1.953	1.977	1.951
Al^{IV}	0.039	0.062	0.045	0.047	0.023	0.049
Al^{VI}	0.017	0.030	0.021	0.020	0.016	0.009
Ti	-	-	-	-	-	-
Cr	0.011	0.032	0.008	0.019	0.006	0.021
Fe	0.204	0.084	0.236	0.083	0.256	0.092
Mn	-	-	-	-	0.003	-
Mg	1.759	0.924	1.731	0.934	1.700	0.942
Ca	0.015	0.929	0.013	0.948	0.019	0.945
Na	-	-	-	-	-	-
Total	4.006	4.000	4.008	4.004	4.000	4.010
Ca	0.8	48.0	0.6	48.2	1.0	47.8
Mg	88.9	47.7	87.5	47.5	86.0	47.6
Fe	10.3	4.3	11.9	4.2	13.0	4.7

opx = orthopyroxene, cpx = clinopyroxene

TABLE 5. REPRESENTATIVE ANALYSES OF COEXISTING SUBSOLIDUS PYROXENES (continued)

Sample No.	191		225		073	
	opx	cpx	opx	cpx	opx	cpx
SiO_2	55.92	53.61	55.45	53.19	55.48	53.46
TiO_2	<0.07	<0 07	<0.07	<0.07	<0.07	<0.07
Al_2O_3	1.05	1.35	1.19	1.34	1.40	1.80
Cr_2O_3	<0.07	0.51	0.15	0.50	<0.07	0.34
FeO	10.43	2.95	11.87	4.12	12.93	4.11
MnO	0.20	<0.09	0.18	<0.09	0.19	<0.09
MgO	31.55	17.20	30.57	16.31	29.86	16.30
CaO	0.48	24.19	0.44	23.84	0.62	23.57
Na_2O	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Total	99.63	99.81	99.85	99.30	100.48	99.58
	Cations on the basis of 6 oxygens					
Si	1.972	1.959	1.965	1.962	1.963	1.962
Al^{IV}	0.028	0.041	0.035	0.038	0.037	0.038
Al^{VI}	0.016	0.017	0.014	0.021	0.022	0.040
Ti	-	-	-	-	-	-
Cr	-	0.015	0.004	0.015	-	0.010
Fe	0.308	0.090	0.352	0.127	0.383	0.126
Mn	0.006	-	0.006	-	0.006	-
Mg	1.659	0.937	1.615	0.897	1.575	0.892
Ca	0.018	0.947	0.017	0.942	0.023	0.927
Na	-	-	-	-	-	-
Total	4.006	4.005	4.008	4.002	4.008	3.995
Ca	0.9	48.0	0.8	47.9	1.2	47.7
Mg	83.6	47.4	81.4	45.6	79.5	45.9
Fe	15.5	4.6	17.7	6.5	19.3	6.5

opx = orthopyroxene, cpx = clinopyroxene

TABLE 5. REPRESENTATIVE ANALYSES OF COEXISTING SUBSOLIDUS PYROXENES (continued)

Sample No.	249		264		1020	
	opx	cpx	opx	cpx	opx	cpx
SiO_2	55.52	53.58	54.53	52.51	53.87	52.45
TiO_2	<0.07	<0.07	<0.07	0.12	<0.07	0.17
Al_2O_3	0.47	0.64	1.12	1.82	1.42	1.60
Cr_2O_3	<0.07	0.34	<0.07	0.31	<0.07	0.37
FeO	13.28	4.54	15.96	6.08	16.97	5.66
MnO	0.19	<0.09	0.22	<0.09	0.30	0.15
MgO	29.92	16.61	28.03	15.74	26.95	15.51
CaO	0.68	23.54	0.63	22.89	0.53	23.30
Na_2O	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Total	100.06	99.25	100.49	99.47	100.04	99.21
	Cations on the basis of 6 oxygens					
Si	1.978	1.979	1.959	1.947	1.954	1.950
Al^{IV}	0.020	0.021	0.041	0.053	0.046	0.050
Al^{VI}	-	0.007	0.006	0.026	0.015	0.020
Ti	-	-	-	0.003	-	0.005
Cr	-	0.010	-	0.009	-	0.011
Fe	0.395	0.140	0.479	0.188	0.515	0.176
Mn	0.006	-	0.007	-	0.009	0.005
Mg	1.588	0.915	1.501	0.870	1.457	0.859
Ca	0.026	0.932	0.025	0.909	0.021	0.929
Na	-	-	-	-	-	-
Total	4.013	4.003	4.018	4.006	4.016	4.005
Ca	1.3	46.9	1.2	46.2	1.0	47.3
Mg	79.0	46.0	74.9	44.2	73.1	43.8
Fe	19.7	7.1	23.9	9.6	25.8	9.0

opx = orthopyroxene, cpx = clinopyroxene

TABLE 5. REPRESENTATIVE ANALYSES OF COEXISTING SUBSOLIDUS PYROXENES (continued)

Sample No.	008		123		163	
	opx	cpx	opx	cpx	opx	cpx
SiO_2	53.59	52.60	52.62	52.04	53.51	52.97
TiO_2	<0.07	<0.07	<0.07	<0.07	<0.07	0.14
Al_2O_3	0.79	2.26	0.59	1.32	0.71	1.23
Cr_2O_3	<0.07	<0.07	<0.07	0.27	<0.07	0.23
FeO	18.36	7.12	20.30	7.99	21.62	8.29
MnO	0.38	<0.09	0.55	0.21	0.38	<0.09
MgO	25.90	15.04	24.44	14.19	23.96	14.38
CaO	0.63	22.52	0.50	22.99	0.71	22.67
Na_2O	<0.17	0.17	<0.17	<0.17	<0.17	<0.17
Total	99.65	99.71	99.00	99.01	100.89	100.08
	Cations on the basis of 6 oxygens					
Si	1.966	1.950	1.965	1.959	1.968	1.969
Al^{IV}	0.034	0.050	0.026	0.041	0.031	0.031
Al^{VI}	-	0.049	-	0.018	-	0.023
Ti	-	-	-	-	-	0.008
Cr	-	-	-	0.008	-	0.007
Fe	0.563	0.221	0.634	0.252	0.665	0.258
Mn	0.012	-	0.018	0.007	0.012	-
Mg	1.416	0.831	1.360	0.796	1.313	0.797
Ca	0.025	0.895	0.020	0.927	0.028	0.903
Na	-	0.013	-	-	-	0.012
Total	4.016	4.009	4.022	4.008	4.017	4.008
Ca	1.2	46.0	1.0	46.9	1.4	46.1
Mg	70.7	42.7	67.5	40.3	65.5	40.7
Fe	28.1	11.3	31.5	12.7	33.1	13.2

opx = orthopyroxene, cpx = clinopyroxene

TABLE 5. REPRESENTATIVE ANALYSES OF COEXISTING SUBSOLIDUS PYROXENES (continued)

Sample No.	431		128	
	opx	cpx	opx	cpx
SiO_2	52.21	52.61	52.01	52.44
TiO_2	<0.07	<0.07	<0.07	<0.07
Al_2O_3	1.03	1.08	0.31	1.08
Cr_2O_3	<0.07	0.20	<0.07	0.16
FeO	23.99	8.89	25.60	9.49
MnO	0.38	<0.09	0.60	0.19
MgO	22.09	13.90	21.11	13.79
CaO	0.71	23.19	0.47	22.56
Na_2O	<0.17	<0.17	<0.17	<0.17
Total	100.41	99.87	100.10	99.71
	Cations on the basis of 6 oxygens			
Si	1.954	1.968	1.969	1.969
Al^{IV}	0.045	0.032	0.014	0.031
Al^{VI}	-	0.006	-	0.017
Ti	-	-	-	-
Cr	-	0.006	-	0.005
Fe	0.751	0.278	0.810	0.298
Mn	0.012	-	0.019	0.006
Mg	1.232	0.775	1.192	0.772
Ca	0.029	0.930	0.019	0.908
Na	-	-	-	-
Total	4.023	4.005	4.024	4.005
Ca	1.4	46.9	0.9	45.9
Mg	61.3	40.0	59.0	39.0
Fe	37.3	14.4	40.1	15.1

opx = orthopyroxene, cpx = clinopyroxene

TABLE 6. REPRESENTATIVE ANALYSES OF CLINOPYROXENE HOST AND ORTHOPYROXENE EXSOLUTION LAMELLAE

Sample No.	238 Host	238 lamellae	051 Host	051 lamellae	174 Host	174 lamellae	1020 Host	1020 lamellae
SiO_2	53.32	56.31	53.95	56.68	53.20	55.24	51.71	53.67
Al_2O_3	1.05	1.08	0.60	0.47	1.27	1.12	1.99	1.42
Cr_2O_3	0.83	0.30	0.55	<0.09	0.31	<0.09	0.44	0.14
FeO	2.81	9.07	3.35	10.46	4.01	12.78	6.18	17.29
MnO	<0.09	<0.09	<0.09	0.16	<0.09	0.16	<0.09	0.17
MgO	17.23	32.74	17.21	32.24	16.38	29.95	15.24	26.85
CaO	24.16	0.52	24.04	0.75	24.13	0.61	22.74	0.58
Total	99.40	100.03	99.70	100.76	99.30	99.85	98.30	100.12
Si	1.958	1.966	1.976	1.978	1.963	1.966	1.943	1.948
Al^{IV}	0.042	0.034	0.024	0.019	0.037	0.034	0.057	0.052
Al^{VI}	0.003	0.012	0.002	-	0.018	0.013	0.031	0.009
Cr	0.024	0.008	0.016	-	0.009	-	0.013	0.004
Fe	0.086	0.265	0.103	0.305	0.124	0.380	0.194	0.525
Mn	-	-	-	0.005	-	0.005	-	0.005
Mg	0.943	1.704	0.940	1.677	0.901	1.589	0.853	1.453
Ca	0.951	0.019	0.943	0.028	0.954	0.023	0.915	0.023
Total	4.007	4.007	4.003	4.012	4.005	4.010	4.007	4.019
Ca	48.0	1.0	47.3	1.4	48.2	1.2	46.6	1.1
Mg	47.6	85.7	47.5	83.4	45.5	79.7	43.5	72.6
Fe	4.4	13.3	5.2	15.2	6.2	19.1	9.9	26.2
$\frac{100\ Mg}{Mg+Fe}$	91.6	86.5	90.1	84.6	87.9	80.7	81.5	73.5

TiO_2 and Na_2O all less than 0.07 and 0.20% respectively

TABLE 7. REPRESENTATIVE PLAGIOCLASE ANALYSES

	PERIDOTITE				GABBRO	
	203	271	186	238	131	148
SiO_2	45.35	44.45	45.27	46.28	44.51	44.55
Al_2O_3	35.15	35.39	35.49	34.42	35.86	35.30
FeO	<0.07	0.16	<0.07	<0.07	0.27	0.20
CaO	19.05	18.52	18.04	17.89	18.85	18.25
Na_2O	0.83	1.00	1.14	1.80	0.80	1.08
K_2O	0.08	<0.06	<0.06	0.07	0.10	<0.06
Total	100.46	99.52	99.94	99.76	100.39	99.38
	Cations on the basis of 8 oxygens					
Si	2.084	2.063	2.085	2.132	2.050	2.069
Al	1.904	1.935	1.926	1.870	1.947	1.932
Fe	-	0.006	-	-	0.010	0.008
Ca	0.938	0.921	0.890	0.849	0.930	0.908
Na	0.074	0.090	0.102	0.162	0.072	0.097
K	0.005	-	-	0.004	0.006	-
Total	5.004	5.015	5.003	5.016	5.015	5.014
An	92.3	91.1	89.8	83.7	92.3	90.3
Ab	7.3	8.9	10.2	15.9	7.1	9.7
Or	0.4	-	-	0.4	0.6	-

All MnO, MgO <0.09%. c = core, r = rim. All other analyses of core composition.

TABLE 7. REPRESENTATIVE PLAGIOCLASE ANALYSES (continued)

	GABBRO							
	191c	191r	162c	162r	264	123	1020c	1020r
SiO_2	45.75	44.63	45.29	44.72	45.86	46.48	47.80	46.06
Al_2O_3	35.22	36.10	35.18	35.29	35.12	34.19	33.09	34.99
FeO	0.13	<0.07	0.21	0.24	0.15	0.15	0.16	0.13
CaO	18.07	19.11	18.00	18.43	18.05	17.27	16.58	18.18
Na_2O	1.21	0.76	1.26	0.96	1.43	1.84	2.14	1.43
K_2O	0.09	0.07	0.08	<0.06	0.08	0.10	<0.06	<0.06
Total	100.47	100.67	100.02	99.64	100.69	100.02	100.61	100.79
	Cations on the basis of 8 oxygens							
Si	2.098	2.048	2.088	2.071	2.100	2.138	2.197	2.106
Al	1.904	1.953	1.912	1.927	1.396	1.854	1.793	1.886
Fe	0.005	-	0.008	0.009	0.006	0.006	0.006	0.005
Ca	0.888	0.939	0.889	0.915	0.885	0.851	0.816	0.891
Na	0.108	0.067	0.113	0.086	0.127	0.164	0.191	0.127
K	0.005	0.004	0.005	-	0.005	0.006	-	-
Total	5.007	5.011	5.015	5.008	5.018	5.020	5.003	5.015
An	88.7	92.9	88.3	91.4	87.0	83.3	81.0	87.5
Ab	10.8	6.7	11.2	8.6	12.5	16.1	19.0	12.5
Or	0.5	0.4	0.5	-	0.5	0.6	-	-

All MnO, MgO <0.09%. c = core, r = rim. All other analyses of core composition.

TABLE 7. REPRESENTATIVE PLAGIOCLASE ANALYSES (continued)

	GABBRO					
	128	163c	163r	431[1]	578c[2]	578r[2]
SiO_2	48.83	50.43	49.14	44.13	46.86	53.58
Al_2O_3	32.87	31.35	32.63	36.18	34.25	29.57
FeO	<0.07	0.23	0.27	0.29	0.26	0.15
CaO	15.15	13.66	15.28	19.37	16.96	11.36
Na_2O	2.87	3.65	2.69	0.59	2.00	5.03
K_2O	0.09	0.13	<0.07	0.07	0.16	0.20
Total	99.81	99.45	100.01	100.63	100.49	99.89
	Cations on the basis of 8 oxygens					
Si	2.234	2.309	2.244	2.031	2.146	2.425
Al	1.772	1.692	1.757	1.963	1.849	1.577
Fe	-	0.009	0.010	0.011	0.010	0.006
Ca	0.743	0.670	0.747	0.955	0.832	0.551
Na	0.255	0.324	0.239	0.053	0.177	0.442
K	0.005	0.008	-	0.004	0.010	0.012
Total	5.010	5.011	4.997	5.016	5.023	5.013
An	74.0	66.8	75.8	94.4	81.7	54.9
Ab	25.4	32.4	24.2	5.2	17.4	44.0
Or	0.6	0.8	-	0.4	0.9	1.1

All MnO, MgO <0.09%. c = core, r = rim. All other analyses of core composition.

1. Mafic pegmatoid.

2. Granophyric diorite.

TABLE 8. REPRESENTATIVE ANALYSES OF TITANIFEROUS MAGNETITE AND FERRIAN ILMENITE

Magnetite	128c	128r	128	128[1]	128[2]	148[3]	163[4]	163
				Cumulus				
SiO_2	<0.10	<0.10	0.10	<0.10	<0.10	0.36	0.12	0.30
TiO_2	4.55	2.16	6.97	2.47	1.21	1.80	2.75	6.25
Al_2O_3	1.14	1.01	1.94	1.27	0.95	1.10	1.77	0.63
Cr_2O_3	0.28	0.32	0.28	0.35	0.27	0.19	0.27	0.43
Fe_2O_3	59.49	64.31	53.82	62.19	65.96	62.60	60.95	55.47
FeO	35.74	33.53	37.71	32.92	32.65	31.86	33.64	36.17
MnO	0.14	<0.09	0.33	<0.09	<0.09	<0.09	0.16	0.89
MgO	<0.10	<0.10	0.15	0.20	<0.10	0.64	0.13	0.14
CaO	<0.07	0.12	0.12	0.16	<0.07	0.10	0.07	0.19
Total	101.34	101.45	101.42	99.56	101.04	98.65	99.79	100.47
Mol % ulvöspinel	13.0	6.2	20.2	7.2	3.5	6.7	8.5	19.1

Ilmenite	128	128[1]	128[2]	148[3]	163[4]
SiO_2	<0.10	<0.10	<0.10	0.41	0.26
TiO_2	48.78	50.62	48.24	50.92	50.16
Al_2O_3	0.13	<0.10	<0.10	0.33	<0.10
Cr_2O_3	<0.08	<0.08	<0.08	<0.08	<0.08
Fe_2O_3	8.10	5.51	9.95	4.28	3.65
FeO	42.90	41.85	41.44	39.10	37.74
MnO	0.51	0.90	0.65	1.56	7.48
MgO	0.16	1.45	0.72	3.00	<0.10
CaO	0.13	0.14	0.07	0.20	0.08
Total	100.71	100.47	101.00	99.80	99.37
Mol % R_2O_3	7.8	5.2	9.4	4.2	3.5
T^oC	675	580	<600	<600	<600
$-\log f_{O_2}$	17.7	20.9	<20	<20	<20

Total iron determined as total iron; Fe_2O_3 and mol % ulvöspinel and R_2O_3 calculated following Carmichael (1967).

Superscripts 1,2,3 etc indicate ilmenite lamellae - magnetite pair; analyses without superscripts are of discrete grains.

c = core, r = rim

TABLE 8. REPRESENTATIVE ANALYSES OF TITANIFEROUS MAGNETITE AND FERRIAN ILMENITE (continued)

Magnetite	Cumulus 129c	Cumulus 129r	Non-cumulus 543^5	Non-cumulus 543^6	Non-cumulus 150^7	Non-cumulus 431	Non-cumulus 431c	Non-cumulus 431r
SiO_2	<0.10	0.10	0.24	0.27	0.25	<0.10	<0.10	<0.10
TiO_2	5.30	9.58	1.24	1.74	1.71	7.62	18.47	13.98
Al_2O_3	1.39	1.42	2.47	3.78	2.38	4.79	6.63	2.08
Cr_2O_3	0.66	0.62	0.46	0.45	<0.08	0.37	0.33	0.37
Fe_2O_3	56.86	47.90	62.58	61.18	63.03	49.77	15.90	40.47
FeO	35.95	38.31	31.36	32.71	32.53	36.91	56.61	43.16
MnO	<0.09	0.48	<0.09	<0.09	0.21	0.29	0.72	0.51
MgO	0.16	0.82	0.82	0.75	0.54	1.37	2.01	0.74
CaO	0.13	0.08	0.08	0.10	<0.07	<0.07	<0.07	<0.07
Total	100.45	99.31	99.25	100.98	100.65	101.12	100.67	101.31
Mol % ulvöspinel	15.3	28.0	4.5	6.0	5.9	21.7	51.5	39.4

Ilmenite	543^5	543^6	150^7
SiO_2	<0.10	0.27	0.22
TiO_2	43.63	49.62	50.02
Al_2O_3	0.89	0.35	0.20
Cr_2O_3	0.26	0.63	<0.08
Fe_2O_3	16.60	4.61	4.96
FeO	37.31	42.54	40.37
MnO	0.98	1.40	1.91
MgO	0.47	0.55	1.65
CaO	0.08	<0.07	<0.07
Total	100.22	99.98	99.33
Mol % R_2O_3	16.7	5.0	4.8
T^oC	<600	<600	<600
$-\log f_{O_2}$	<20	<20	<20

Total iron determined as total iron; Fe_2O_3 and mol % ulvöspinel and R_2O_3 calculated following Carmichael (1967).

Superscripts 1,2,3 etc indicate ilmenite lamellae - magnetite pair; analyses without superscripts are of discrete grains.

c = core, r = rim

TABLE 9. REPRESENTATIVE AMPHIBOLE ANALYSES

Sample No.	186	107	008	578	123	431
SiO_2	54.79	54.59	53.08	50.40	52.17	50.03
TiO_2	<0.07	<0.07	0.15	0.50	0.36	0.29
Al_2O_3	3.11	3.44	4.59	5.79	4.48	6.08
Cr_2O_3	0.71	0.49	0.08	<0.08	0.15	<0.08
FeO	2.57	4.89	9.10	10.67	11.25	11.94
MnO	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
MgO	22.18	21.32	18.89	17.36	17.04	16.36
CaO	13.02	12.50	12.07	11.26	12.60	11.54
Na_2O	0.32	0.53	0.39	0.91	0.48	0.50
K_2O	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Total	96.72	97.76	98.27	96.88	98.59	96.75
	Cations on the basis of 23 oxygens					
Si	7.619	7.581	7.459	7.266	7.418	7.261
Al^{IV}	0.381	0.419	0.541	0.734	0.582	0.739
Al^{VI}	0.129	0.144	0.219	0.250	0.170	0.301
Ti	-	-	0.016	0.054	0.038	0.032
Cr	0.078	0.054	0.009	-	0.017	-
Fe	0.299	0.568	1.069	1.287	1.338	1.449
Mn	-	-	-	-	-	-
Mg	4.597	4.413	3.956	3.730	3.611	3.539
Ca	1.940	1.441	1.817	1.739	1.920	1.795
Na	0.086	0.143	0.106	0.255	0.133	0.141
K	-	-	-	-	-	-
Total	15.130	14.763	14.653	14.581	14.645	14.518
Ca	28.4	27.2	26.6	25.7	27.9	26.5
Mg	67.2	64.5	57.8	55.2	52.6	52.2
Fe	4.4	8.3	15.6	19.0	19.5	21.4

TABLE 10. PETROGRAPHIC DESCRIPTIONS AND LOCALITY DATA FOR ANALYSED SPECIMENS

Sample numbers refer to the BMR-GSPNG field numbers and have the prefix 74540 (001-288), 75540 (400-497) and 76540 (500-578) and were collected by the author in 1974-76. Additional samples 74541020 and 74541046 were collected by C.J. Pigram. Samples are held at the University of Tasmania, Hobart and the Geological Survey of Papua New Guinea.

Place names and locality data are taken from the 1:100 000 scale geological map of the Marum ophiolite complex (Jaques, 1978).

Modal percentages are based on visual estimates except those given to a decimal place, which were obtained by point counting and/or least-squares major-element mixing models using the bulk rock and constituent mineral compositions.

Sample No.	*Description*
008	Norite-gabbro; o/c with rhythmic layering, Yomi River, 5°33'S 145°02'E. Allotriomorphic granular plagioclase (55 percent), orthopyroxene (30 percent), clinopyroxene (15 percent), and accessory Fe-Ti oxide, trace FeS.
051	Olivine-bearing websterite; interlayered with dunite, Gagiowa River, 5°33'S 145°09'E. Allotriomorphic granular olivine (4 percent), orthopyroxene (34 percent) and clinopyroxene (62 percent).
059	Clinopyroxene-bearing dunite; Imbrum River, 5°44'S 145°17'E. Cumulus olivine with postcumulus clinopyroxene and disseminated chrome spinel; strongly serpentinised.
073	Olivine norite-gabbro; layered o/c in tributary to Simbai River, 5°21'S 144°53'E. Hypidiomorphic granular olivine (10 percent), clinopyroxene (15 percent), orthopyroxene (20 percent), and plagioclase (55 percent).
092	Dunite; drill core DDH 71 19 m 5°33'S 145°12'E. Xenomorphic granular (deformed adcumulate?) olivine with accessory chrome spinel.
107	Bronzitite; interlayered with olivine pyroxenite, upper Gagiowa River, 5°37'S 145°10'E. Allotriomorphic granular orthopyroxene with minor clinopyroxene and accessory chrome spinel.

123 Anorthosite; rhythmically layered anorthosite and norite-gabbro, tributary to Mambu River, 5°29'S 144°59'E. Allotriomorphic granular plagioclase, clinopyroxene, orthopyroxene, and magnetite with traces of apatite.

128 Flaser gabbro; flow layered norite-gabbro, tributary to Nep River, 5°29'S 144°09'E. Xenoblastic plagioclase and quartz (commonly mortar textured) in a matrix of orthopyroxene, clinopyroxene, quartz, magnetite and ilmenite with trace apatite.

129 Mylonitic gabbro; flow layer norite-gabbro, 50 upstream from 128. Blastomylonitic mortar-textured plagioclase, quartz, orthopyroxene, clinopyroxene, magnetite and ilmenite.

131 Norite-gabbro; rhythmic layering, tributary to Nep River, 5°28'S 144°56'E. Allotriomorphic granular plagioclase (65 percent), clinopyroxene (15 percent), orthopyroxene (19 percent) and magnetite (1 percent).

148 Ferronorite-gabbro; mineral-graded layering, tributary to Nep River, 5°33'S 144°54'E. Allotriomorphic granular plagioclase (55 percent), orthopyroxene (15 percent), clinopyroxene (15 percent), and magnetite and ilmenite (15 percent).

150 Gabbro pegmatoid; intrudes layered norite-gabbro, 150 m upstream from 148. Hypidiomorphic granular to granophyric plagioclase (70 percent), orthopyroxene (10 percent), clinopyroxene (15 percent), and magnetite and ilmenite (5 percent).

162 Olivine-bearing norite-gabbro; rhythmically layered, Mambu River 5°31'S 145°02'E. Allotriomorphic granular olivine (8 percent), plagioclase (45 percent), clinopyroxene (22 percent) and orthopyroxene (commonly poikilitic, 25 percent). Symplectic olivine-orthopyroxene-magnetite.

163 Ferronorite-gabbro; rhythmic and mineral-graded Fe-Ti oxides, Mambu River, 5°32'S 145°01'E. Allotriomorphic granular plagioclase, clinopyroxene, orthopyroxene, magnetite and ilmenite.

166 Lherzolite; interlayered with olivine pyroxenite and plagioclase lherzolite, tributary to Wendink River, 5°25'S 144°51'E. Cumulus olivine and orthopyroxene with poikilitic orthopyroxene and clinopyroxene, and accessory chrome spinel.

168 Plagioclase lherzolite; tributary to Wendink River, 5°26'S 144°50'E. Cumulus olivine and chrome spinel with postcumulus (commonly poikilitic) clinopyroxene, orthopyroxene and plagioclase.

174 Olivine-bearing norite-gabbro; rhythmic layering, Wendink River, 5°25'S 144°51'E. Allotriomorphic granular olivine (< 5 percent), clinopyroxene (20 percent), orthopyroxene (15 percent) and plagioclase (60 percent).

180 Wehrlite; interlayered with dunite, Wendink River, 5°24'S 144°50'E. Hypidiomorphic granular olivine (15 percent), clinopyroxene (65 percent), and orthopyroxene (20 percent).

186 Plagioclase lherzolite; tributary to Wendink River, 5°26'S 144°52'E. Cumulus olivine, orthopyroxene and chrome spinel with postcumulus (commonly poikilitic) orthopyroxene, clinopyroxene and plagioclase.

189 Lherzolite; oikocrysts of clinopyroxene, orthopyroxene and plagioclase, tributary to Wendink River, 5°26'S 144°53'E. Cumulus olivine and chrome spinel, postcumulus pyroxene and plagioclase.

191 Olivine norite-gabbro; rhythmic layering of olivine and plagioclase. Allotriomorphic granular olivine, orthopyroxene, clinopyroxene and plagioclase.

203 Plagioclase lherzolite; interlayered with dunite and lherzolite, Kandandau River, 5°22'S 144°53'E. Cumulus olivine and chrome spinel, postcumulus clinopyroxene, orthopyroxene and plagioclase.

209 Wehrlite; interlayered with dunite and lherzolite, tributary to Baia River, 5°38'S 145°16'E. Cumulus olivine, clinopyroxene and chrome spinel with postcumulus clinopyroxene.

221 Chromitite-dunite; fine-scale rhythmic layering, tributary to Baia River, 5°38'S 145°16'E. Xenoblastic olivine and subhedral chrome spinel.

225 Olivine-bearing norite-gabbro; rhythmic layering, tributary to Baia River, 5°38'S 145°16'E. Allotriomorphic to hypidiomorphic granular olivine (3 percent), orthopyroxene (10 percent), clinopyroxene (46 percent) and plagioclase (41 percent).

238 Lherzolite; interlayered with wehrlite and olivine pyroxenite, Okura River, 5°26'S 144°59'E. Cumulus olivine, orthopyroxene, clinopyroxene and chrome spinel; postcumulus orthopyroxene and clinopyroxene.

249 Websterite; Marum River, 5°34'S 145°07'E. Allotriomorphic granular clinopyroxene (60 percent) and orthopyroxene (40 percent).

264 Plagioclase websterite; interlayered with websterite and norite-gabbro, lower Marum River, 5°32'S 145°10'E. Allotriomorphic granular clinopyroxene (45 percent), orthopyroxene (40 percent) and plagioclase (15 percent).

271 Plagioclase lherzolite; interlayered with pyroxenite; Wendink River, 5°26'S 144°54'E. Cumulus olivine and chrome spinel; postcumulus orthopyroxene (commonly poikilitic), clinopyroxene and plagioclase.

415 Lherzolite; layered river boulder, 5°34'S 145°12'E. Xenoblastic granular olivine (70 percent), clinopyroxene (10 percent), and orthopyroxene (20 percent) with accessory chrome spinel.

421 Dunite; river boulder, 5°33'S 145°13'E. Xenomorphic granular olivine and accessory euhedral chrome spinel.

428 Dunite; tributary to Gagiowa River, 5°34'S 145°10'E. Xenomorphic granular olivine with accessory chrome spinel (some mineral-graded layering).

431 Gabbro pegmatoid; river boulder, upper Gagiowa River, $5^{o}34'S$ $145^{o}11'E$. Hypidiomorphic granular orthopyroxene, clinopyroxene, plagioclase, Fe-Ti oxide and quartz. Extensive secondary alteration.

441 Plagioclase lherzolite; interlayered with troctolite, $5^{o}41'S$ $145^{o}17'E$. Cumulus olivine, clinopyroxene and chrome spinel; postcumulus orthopyroxene and plagioclase.

497 Layered chromitite-dunite, small river boulder, Gagiowa River.

502 Lherzolite; tributary to Baia River, $5^{o}38'S$ $145^{o}15'E$. Cumulus olivine, clinopyroxene, orthopyroxene and chrome spinel; postcumulus pyroxene.

503 Lherzolite; interlayered with pyroxenite and wehrlite, as for 502.

504 Clinopyroxene-bearing dunite; tributary to Baia River, $5^{o}37'S$ $145^{o}15'E$. Cumulus olivine and chrome spinel; postcumulus clinopyroxene.

543 Gabbro pegmatoid; river boulder, upper Gagiowa River, $5^{o}37'S$ $145^{o}10'E$. Hypidiomorphic granular to granophyric plagioclase, orthopyroxene, clinopyroxene, and Fe-Ti oxide; extensive secondary alteration.

567 Dunite; river boulder, Gagiowa River. Xenomorphic granular olivine and euhedral chrome spinel.

578 Granophyric diorite; intrudes norite-gabbro, tributary to Mambu River, $5^{o}29'S$ $144^{o}59'E$. Hypidiomorphic granular to granophyric-textured plagioclase, orthopyroxene, quartz, Fe-Ti oxide and poikilitic hornblende.

1020 Norite-gabbro; layered, Singari River, $5^{o}32'S$ $145^{o}05'E$. Allotriomorphic granular plagioclase (34 percent), clinopyroxene (37 percent) and orthopyroxene (29 percent) with rare interstitial CuFeS.

1046 Dunite; chromitite layering, Gagiowa River, $5^{o}35'S$ $145^{o}12'E$.

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