APPENDIX B

MAJOR AND TRACE ELEMENT ANALYSES, CATION NORMS, AND SAMPLE LOCALITIES FOR PBOC PERIDOTITES AND OLIVINE NORITES

NOTE:

(i) Major element analyses are recalculated to original totals on a volatile-free basis. Trace element values are also recalculated on a volatile-free basis.

(ii) Fe_2O_3/FeO ratios of all analyses in Tables B-2 to B-7 are adjusted to that of the freshest (and coincidentally, the most 'evolved') olivine norite (sample 440, $Fe_2O_3/FeO = 0.07 \pm 0.004$, three determinations). Measured FeO (FeO^1) is listed for most analyses.

(iii) In all samples, LREE (La, Ce and Nd) abundances, and most probably all other REE abundances (see Section 5.4.4), are below XRF detection limits (< 2 µg/g).

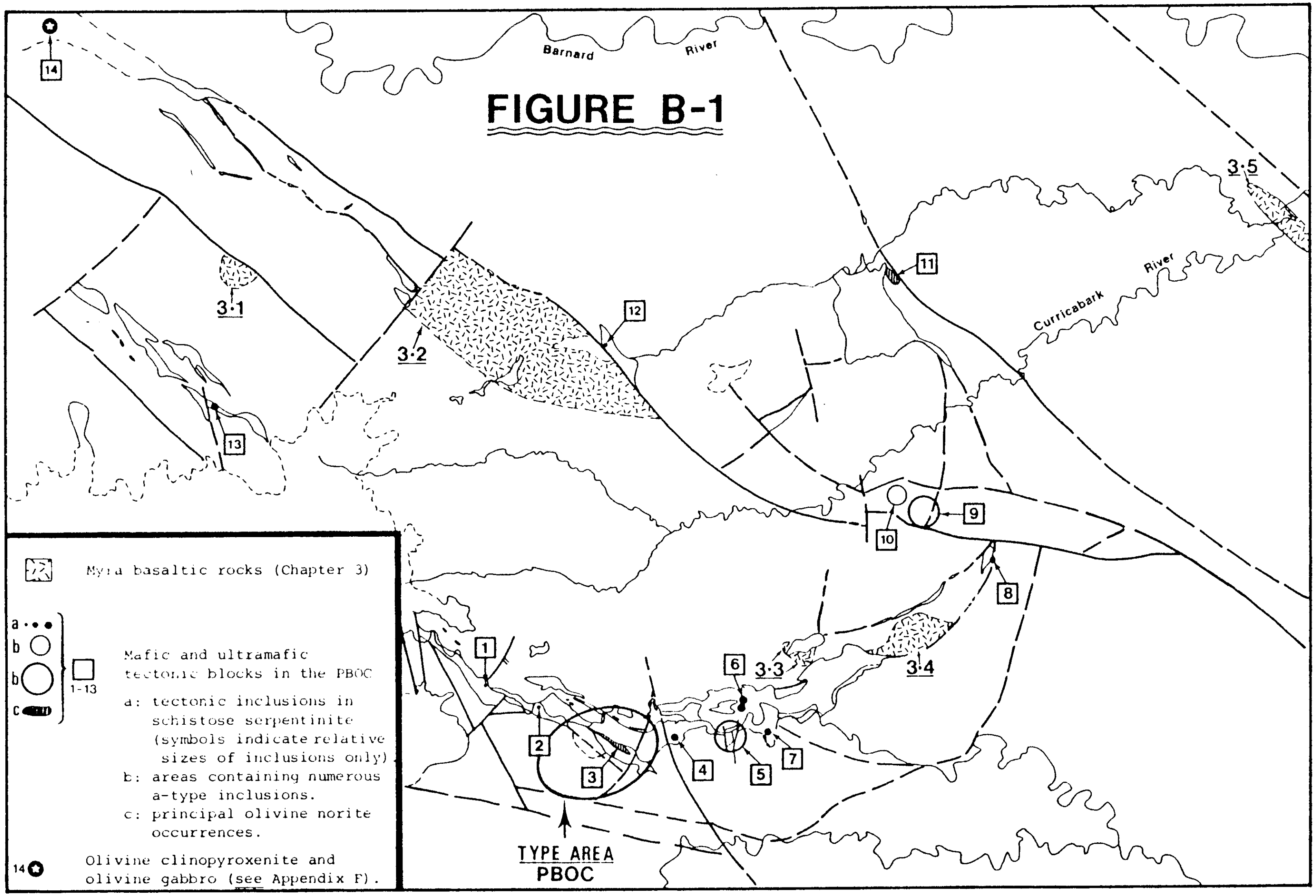


Fig. B-1: Location of the type area of the PBOC and sample localities referred to in Chapters 3 (3.1 - 3.5) and 5 (1 - 13), and listed in Tables B-1 to B-7.
NOTE : For geological details see Map 1.

TABLE B-1

Major and Trace Element Analyses and Normative Mineralogy of Serpentinized Harzburgites from the Pigna Barney Ophiolitic Complex

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11	12	13
SAMPLE	492	502	495	503	506	504	505	507	498	496	493	497	508*
OLIVINE (Fo)	91.4	n.d.	91.6	n.d.	n.d.	n.d.	n.d.	n.d.	92.3	92.0	91.5	92.2	n.d.
SiO_2	45.78	46.67	46.46	46.56	47.67	45.90	45.84	46.23	45.68	47.10	46.25	46.31	45.35
TiO_2	0.01	0.01	0.01	-	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.01
Al_2O_3	1.17	1.13	1.10	1.06	0.87	1.16	0.71	0.36	0.91	1.15	1.20	1.08	1.38
Cr_2O_3	0.33	0.36	0.39	0.38	0.37	0.41	0.41	0.38	0.37	0.41	0.39	0.39	0.46
ΣFeO	8.08	7.94	7.84	7.80	7.76	7.86	7.96	7.70	7.30	7.04	7.08	6.87	7.31
NiO	0.35	0.33	0.32	0.34	0.31	0.36	0.35	0.34	0.32	0.31	0.29	0.35	0.29
MnO	0.14	0.13	0.13	0.14	0.12	0.14	0.11	0.14	0.17	0.14	0.11	0.13	0.14
MgO	42.68	42.68	43.15	42.85	42.32	43.42	44.41	45.62	44.68	43.40	44.15	43.31	45.17
CaO	0.06	0.09	0.07	0.09	0.04	0.06	0.04	0.05	0.11	0.33	0.34	0.29	0.25
Na_2O	0.02	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.03	0.06	0.03	0.03	0.03
K_2O	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
P_2O_5	0.01	0.01	0.01	0.01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
TOTAL	98.64	99.39	99.52	99.27	99.50	99.36	99.88	100.87	99.59	99.96	99.57	99.33	100.40
ΣVol[1]	12.58	12.35	12.03	12.14	12.53	12.33	11.80	12.12	12.52	11.93	12.55	11.95	11.03
FeO[1]	0.89	0.99	1.10	0.90	2.08	1.07	1.35	0.88	0.99	1.44	1.11	1.23	1.21
Mg*	90.3	90.4	90.6	90.6	90.5	90.7	90.8	91.2	91.5	91.5	91.7	91.3	91.6
CATION NORM													
PL	0.8	–	–	–	–	–	–	–	–	–	–	0.1	–
CPX	–	–	–	–	–	–	–	–	0.1	–	0.8	0.6	0.5
OPX	33.8	39	36.7	39	44	34	31	32	n.d.	38.9	33.5	35.4	28
OL	65.0	60	62.2	60	56	65	68	67	69.3	60.6	64.5	63.4	70
SP	0.4	1.0	1.1	1.0	1.0	1.2	0.6	0.5	0.6	0.5	1.1	0.4	1.5
TRACE ELEMENTS (μg/g)													
Na	154	n.d.	n.d.	n.d.	176	n.d.	173	185	200	417	n.d.	218	240
K	66	n.d.	n.d.	n.d.	102	n.d.	46	70	58	124	n.d.	65	69
Sr	2	n.d.	n.d.	n.d.	2	n.d.	<1	1	<1	<1	n.d.	2	16
Ti	73	83	76	78	84	84	191	73	100	104	119	104	110
Ni	2789	2597	2574	2683	2419	2820	2726	2639	2534	2438	2317	2712	2243
Co	133	n.d.	n.d.	n.d.	102	137	112	114	119	122	n.d.	113	124
V	28	53	43	58	53	60	21	30	34	36	44	30	35
Cr	2250	2471	2653	2620	2507	2781	2827	2611	2556	2795	2675	2565	3142
Cu	9	n.d.	n.d.	n.d.	19	n.d.	3	2	5	3	n.d.	6	15
Zn	59	n.d.	n.d.	n.d.	44	n.d.	40	41	50	38	n.d.	50	60

[1] See Appendix G

Mg* = 100(Mg+Ni)/(Mg+ΣFe+Mn+Ni)

* Antigorite harzburgite, near Nundle, N.S.W. : **Not a member of the PBOC**

n.d. = not determined

TABLE B-2

Major and Trace Element Analyses and Normative Mineralogy of Isolated Gabbroic Inclusions in Schistose Serpentinite near Localities 1, 2, 5, 6 and 7 (Fig. B-1)

ANALYSIS No.	1	2	3	4	5	6	7
SAMPLE	463	466	527	469	459	526	480
LOCALITY	1	2	5	6	5	5	7
OLIVINE(Fo)	84.9	85.1	n.d.	85.5	85.5	n.d.	86.4
SiO_2	47.19	50.01	50.96	51.68	46.86	51.89	47.82
TiO_2	0.03	0.03	0.02	0.03	0.02	0.03	0.02
Al_2O_3	6.16	10.26	16.50	11.08	13.12	12.67	9.32
Cr_2O_3	0.62	0.39	0.26	0.42	0.31	0.35	0.48
Fe_2O_3	0.63	0.48	0.34	0.43	0.45	0.39	0.45
FeO	8.96	6.80	4.82	6.17	6.40	5.54	6.36
NiO	0.16	0.09	0.03	0.07	0.10	0.05	0.10
MnO	0.19	0.16	0.12	0.16	0.15	0.15	0.15
MgO	32.06	25.03	16.07	23.15	22.99	21.02	26.98
CaO	3.90	6.63	10.31	5.12	9.52	8.10	7.79
Na_2O	0.17	0.05	0.06	0.03	0.45	0.39	0.04
K_2O	0.05	0.09	0.19	1.28	0.12	0.06	0.19
P_2O_5	-	0.01	0.02	0.01	0.01	0.01	0.02
TOTAL	100.12	100.03	99.70	99.63	100.50	100.65	99.72
ΣVol.[1]	5.92	2.82	0.72	1.67	5.60	1.23	4.30
FeO[1]	6.92	6.97	4.65	4.74	5.60	5.89	5.51
Mg*	85.5	85.8	84.5	86.0	85.5	86.1	87.5
CATION NORM							
PL	13.2	25.1	43.1	26.5	33.9	31.1	21.2
CPX	2.8	4.8	7.5	-	13.0	7.1	12.1
OPX	41.2	51.2	49.3	69.6	19.9	57.4	35.9
OL	41.9	18.7	0.1	3.9	33.1	4.3	30.5
SP	0.9	0.28	-	0.1	0.2	0.1	0.3
TRACE ELEMENTS (μg/g)							
K	409	746	1595		1016	527	1603
Rb	<1	<1	20	25	3	2	1
Ba	9	<3	6	420	<3	8	<3
Sr	19	5	1	135	6	20	4
Li	-	2.3	-	5.6	1.2	1.1	-
Zr	<1	<1	1	2	<1	<1	1
Y	<2	3	3	3	<2	<2	3
Ti	176	184	223	236	172	239	219
Cu	5	10	10	11	9	5	8
Zn	48	52	40	49	40	43	34
Ni	1286	733	272	538	750	414	794
Co	109	82	64	85	93	64	79
V	64	62	79	66	77	78	81
Cr	4233	2647	1765	2870	2112	2380	3313

[1] See Appendix G (Fe_2O_3/FeO adjusted to 0.07)

Mg* = 100(Mg+Ni)/(Mg+ΣFe+Mn+Ni)

n.d. = not determined

TABLE B-3

Major and Trace Element Analyses and Normative Mineralogy of Olivine Norites from Locality 3 (Fig. B-1)

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SAMPLE	440	441	443	445	448	449	450	452	456	460	467	470	532	530	514	529	531
OLIVINE (Fo)	80.5	80.5	82.0	82.7	83.0	83.0	83.2	83.4	84.0	84.4	85.3	85.5	n.d.	n.d.	n.d.	n.d.	n.d.
SiO_2	49.64	49.30	48.34	46.94	46.99	46.59	46.62	46.16	45.88	45.22	43.28	48.44	44.48	47.15	48.65	46.33	47.90
TiO_2	0.05	0.05	0.04	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.04	0.06	0.04	n.d.
Al_2O_3	13.13	11.10	10.66	10.85	9.96	9.77	9.75	9.22	8.17	7.24	4.86	7.95	6.59	10.67	6.40	9.85	18.44
Cr_2O_3	0.28	0.35	0.45	0.48	0.50	0.52	0.52	0.50	0.70	0.78	0.69	0.73	0.66	0.45	0.61	0.51	0.32
Fe_2O_3	0.52	0.59	0.55	0.60	0.59	0.59	0.58	0.62	0.65	0.66	0.74	0.54	0.78	0.56	0.66	0.60	0.26
FeO	7.40	8.34	7.93	8.52	8.48	8.48	8.35	8.92	9.31	9.49	10.64	7.78	11.08	8.04	9.44	8.63	3.74
NiO	0.05	0.07	0.10	0.11	0.12	0.12	0.12	0.13	0.15	0.15	0.19	0.13	0.16	0.11	0.11	0.11	0.04
MnO	0.16	0.19	0.18	0.17	0.18	0.18	0.18	0.19	0.20	0.20	0.21	0.18	0.21	0.17	0.21	0.21	0.11
MgO	19.48	21.88	23.71	25.39	25.98	26.80	26.23	27.43	29.94	31.66	36.60	29.54	31.32	24.39	28.74	26.69	14.62
CaO	8.59	7.57	7.63	6.70	7.01	6.65	6.85	6.38	4.97	4.62	2.72	4.93	4.05	7.44	5.07	6.55	13.70
Na_2O	0.58	0.48	0.40	0.36	0.38	0.35	0.39	0.35	0.25	0.15	0.08	0.42	0.40	0.44	0.32	0.44	0.36
K_2O	0.02	0.09	0.04	0.07	0.07	0.04	0.05	0.04	0.04	0.02	0.01	0.02	0.02	0.02	0.03	0.02	0.11
P_2O_5	0.01	0.01	-	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	n.d.	0.02
TOTAL	99.91	100.02	100.03	100.23	100.31	100.14	99.70	99.98	100.30	100.23	100.05	100.69	99.78	99.49	100.31	99.98	99.62
ΣVol^1	1.20	2.74	3.54	4.83	4.85	4.43	4.32	5.79	5.61	7.55	9.90	5.20	6.80	4.83	3.62	5.18	2.94
FeO^1	7.38	8.29	6.18	6.74	6.98	7.17	7.23	6.31	7.24	6.65	5.48	6.62	6.82	6.48	7.71	7.22	n.d.
Mg*	81.2	81.2	83.1	83.1	83.5	83.9	83.8	83.5	84.1	84.6	85.0	86.2	82.4	83.3	83.4	83.6	86.5
CATION NORM																	
PL	34.5	28.3	26.9	27.7	24.9	24.3	24.5	22.5	19.9	17.2	10.6	18.1	15.7	26.9	14.1	24.8	49.2
CPX	8.2	8.6	9.1	5.5	9.1	7.5	8.6	7.6	3.8	4.6	1.0	3.8	3.9	9.5	8.1	6.9	18.3
OPX	44.6	45.5	38.5	31.5	29.5	28.9	29.8	29.2	29.7	26.2	19.9	44.2	26.1	32.3	46.2	28.3	18.4
OL	12.5	17.1	25.0	34.4	35.7	38.5	36.4	39.9	45.4	50.7	67.2	32.8	53.1	30.6	30.3	39.1	14.0
SP	0.3	0.5	0.6	0.8	0.9	0.8	0.8	0.8	1.2	1.4	1.3	1.1	1.3	0.7	1.0	0.9	0.1
TRACE ELEMENTS (μg/g)																	
K	147	769	345	622	574	326	407	298	320	197	109	160	178	132	216	197	910
Rb	<1	3	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	2
Ba	2	7	4	<3	3	<3	<3	<3	<3	5	<3	<3	<3	<3	5	3	19
Sr	8	11	5	10	7	5	5	5	6	5	2	1	6	5	5	2	107
Li	1.1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	7.1	n.d.	n.d.	n.d.	5.2
Zr	2	1	4	3	2	1	2	<1	<1	1	1	<1	3	1	<1	1	1
Y	4	3	3	<2	4	2	3	4	<2	<2	3	2	<2	<2	3	3	<2
Ti	341	361	294	274	341	278	309	243	226	240	124	167	210	281	387	272	184
Cu	28	31	19	26	43	24	21	21	19	16	7	24	5	19	29	32	21
Zn	59	59	55	53	53	52	57	64	42	52	47	55	67	53	65	63	31
Ni	430	545	754	903	911	941	930	1051	1144	1162	1529	1056	1292	840	872	876	284
Co	75	89	90	87	103	107	98	100	104	128	114	95	135	95	102	95	86
V	96	108	96	82	98	89	93	81	82	87	54	74	68	90	120	84	56
Cr	1906	2389	3059	3317	3395	3540	3536	3449	4766	5321	4717	5024	4534	3084	4148	3458	2167
Sc	32	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

[1] See Appendix G (Fe_2O_3/FeO adjusted to 0.07)

Mg* = 100(Mg+Ni)/(Mg+ΣFe+Mn+Ni)

n.d. = not determined

TABLE B-4

Major and Trace Element Analyses and Normative Mineralogy of Olivine Norites and Plagioclase-Bearing Peridotites from Localities 4, 5, 6 and 7 (Fig. B-1)

ANALYSIS No.	1	2	3	4	5	6	7	8
SAMPLE	453	458	472	473	486	447	523	479
LOCALITY	5	5	6	4	5	7	7	7
OLIVINE (Fo)	83.7	84.2	85.7	85.8	88.0	82.9	n.d.	86.5
SiO_2	47.98	42.60	43.12	41.41	41.26	47.64	46.24	43.77
TiO_2	0.03	0.03	0.03	0.02	0.01	0.05	0.02	0.02
Al_2O_3	10.13	3.51	4.05	5.32	8.89	10.35	7.65	5.51
Cr_2O_3	0.50	0.73	0.79	0.52	0.46	0.42	0.56	0.75
Fe_2O_3	0.53	0.85	0.71	0.77	0.55	0.50	0.57	0.64
FeO	7.62	12.18	10.21	10.94	7.91	7.17	8.09	9.10
NiO	0.11	0.22	0.19	0.23	0.19	0.10	0.14	0.19
MnO	0.17	0.22	0.20	0.03	0.16	0.17	0.18	0.19
MgO	24.98	38.35	37.12	39.12	34.17	23.87	30.47	35.46
CaO	7.65	1.23	3.38	1.36	5.94	9.01	5.41	4.04
Na_2O	0.04	0.08	0.08	0.07	0.06	0.29	0.14	0.07
K_2O	0.02	0.01	0.02	0.01	0.01	0.4	0.08	0.01
P_2O_5	0.01	n.d.	0.01	0.01	0.01	0.01	0.02	0.01
TOTAL	99.77	100.01	99.91	99.81	99.62	100.05	99.57	99.76
ΣVol [1]	4.67	10.14	8.38	11.08	9.95	4.01	7.11	8.51
FeO	6.32	5.57	5.55	6.50	5.58	5.75	7.64	6.55
Mg*	84.4	83.9	85.7	85.7	87.7	84.6	86.1	86.5
CATION NORM								
PL	25.3	7.5	8.9	13.5	23.5	25.4	18.1	12.8
CPX	10.4	n.d.	6.3	n.d.	5.8	17.5	7.5	5.5
OPX	34.4	18.0	14.4	1.3	-5.2	27.9	29.1	16.2
OL	29.4	72.8	69.2	84.3	74.9	28.6	44.6	64.4
SP	0.6	1.8	1.3	0.9	1.0	0.6	0.7	1.2
TRACE ELEMENTS (μg/g)								
K	157	117	163	98	54	n.d.	685	96
Rb	1	<1	<1	1	<1	7	2	<1
Ba	3	<3	3	<3	<3	12	<3	<3
Sr	4	<1	1	2	2	35	5	5
Li	n.d.	n.d.	n.d.	n.d.	6.7	4.6	n.d.	1.2
Zr	1	2	<1	<1	<1	2	1	2
Y	<2	<2	4	<2	<2	3	2	<2
Ti	244	153	219	115	132	357	170	131
Cu	16	11	20	5	12	19	5	6
Zn	45	56	49	51	43	42	44	42
Ni	838	1751	1485	1797	1477	753	1074	1480
Co	83	155	138	125	137	98	124	112
V	89	62	72	30	27	106	65	55
Cr	3391	4937	5383	3557	3149	2865	3848	5150

[1] See Appendix G.

Mg* = 100(Mg+Ni)/(Mg+ΣFe+Mn+Ni)

n.d. = not determined

NOTE: Sample 486 contains insufficient SiO_2 to from the required normative minerals (see Appendix A).

TABLE B-5

Major and Trace Element Analyses and Normative Mineralogy of Olivine Norites from Localities 8, 9 and 10 (Fig. B-1)

	LOCALITY 8					LOCALITY 9			LOCALITY 10		
ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11
SAMPLE	510	511	461	471	522	455	478	482	524	476	477
OLIVINE (Fo)	n.d.	n.d.	84.7	85.5	n.d.	83.9	86.4	86.8	n.d.	86.2	86.2
SiO_2	43.24	43.50	46.58	48.58	43.56	49.02	43.69	42.34	48.18	47.78	47.80
TiO_2	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02
Al_2O_3	4.49	4.73	6.52	9.04	6.64	7.32	8.12	7.50	10.07	9.02	7.60
Cr_2O_3	0.59	0.75	0.49	0.50	0.79	0.63	0.50	0.45	0.46	0.67	0.67
Fe_2O_3	0.79	0.72	0.63	0.53	0.67	0.61	0.59	0.61	0.53	0.52	0.53
FeO	11.24	10.35	9.02	7.63	9.51	8.66	8.42	8.78	7.54	7.46	7.55
NiO	0.21	0.17	0.15	0.11	0.20	0.12	0.15	0.19	0.12	0.15	0.15
MnO	0.21	0.22	0.20	0.18	0.19	0.20	0.18	0.18	0.17	0.18	0.18
MgO	36.19	36.58	31.64	27.16	34.55	28.30	32.37	35.03	26.27	29.17	30.98
CaO	3.05	2.64	4.32	5.71	3.94	5.04	5.65	4.85	6.04	5.39	4.63
Na_2O	0.08	0.06	0.21	0.03	0.07	0.20	0.15	0.11	0.02	0.23	0.21
K_2O	0.01	0.01	0.04	0.02	0.01	0.02	0.09	0.05	0.02	0.06	0.04
P_2O_5	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01
TOTAL	100.13	99.76	99.83	99.53	100.16	100.16	99.94	100.12	99.46	100.66	100.37
ΣVol [1]	10.06	10.44	6.89	4.08	9.02	4.19	8.38	9.72	5.29	5.41	5.94
FeO[1]	4.18	4.63	6.13	6.67	6.40	7.51	7.07	6.42	6.76	5.73	5.71
Mg*	84.2	85.3	85.2	85.4	85.7	84.3	86.4	86.8	85.1	86.5	87.1
CATION NORM											
PL	9.8	10.1	14.9	21.7	15.1	16.9	20.4	19.1	24.8	21.4	17.4
CPX	3.1	0.9	4.1	3.6	2.4	4.9	6.6	4.9	2.7	3.1	3.5
OPX	18.1	22.3	34.8	46.1	18.6	49.7	11.1	3.6	43.0	39.2	40.2
OL	67.9	65.3	45.6	28.2	62.4	27.7	61.2	71.7	29.1	35.4	38.1
SP	1.0	1.4	0.6	0.5	1.5	0.8	0.7	0.7	0.5	1.0	0.9
TRACE ELEMTS (μg/g)											
K	104	114	324	135	79	141	724	379	138	327	477
Rb	<1	1	1	<1	<1	<1	1	<1	4	<1	<1
Ba	<3	<3	<3	<3	<3	3	<3	4	3	<3	<3
Sr	4	3	3	3	4	1	7	13	7	<1	<1
Zr	3	<1	<1	<1	<1	1	1	<1	1	1	1
Y	<2	<2	<2	<2	2	2	<2	<2	2	2	3
Ti	130	134	154	176	128	201	176	178	200	174	170
Cu	9	5	5	5	6	10	9	8	11	10	12
Zn	59	45	40	40	44	52	52	45	46	41	40
Ni	1662	1322	1155	835	1602	949	1197	1498	961	1033	1170
Co	138	124	114	90	122	92	99	118	73	101	92
V	51	45	62	81	53	93	42	38	93	79	68
Cr	4046	5144	3314	3445	5345	4310	3427	3085	3152	4493	4597

[1] See Appendix G

Mg* = 100(Mg+Ni)/(Mg+ΣFe+Mn+Ni)

n.d. = not determined

TABLE B-6

Major and Trace Element Analyses and Normative Mineralogy of Olivine Norites and Plagioclase-Bearing Harzburgites from Localities 11 and 12 (Fig. B-1)

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SAMPLE	516	521	451	444	515	517	465	519	520	518	501	462	513	512	500
OLIVINE (Fo)	n.d.	n.d.	83.2	82.5	n.d.	n.d.	85.0	n.d.	n.d.	n.d.	n.d.	84.8	n.d.	n.d.	n.d.
SiO_2	49.26	48.38	47.75	48.73	48.62	48.93	46.59	47.67	48.28	48.02	42.72	45.41	44.92	44.63	42.92
TiO_2	0.04	0.04	0.04	0.04	0.05	0.04	0.03	0.04	0.03	0.03	0.02	0.09	0.08	0.08	0.02
Al_2O_3	8.05	9.88	9.38	10.35	6.80	9.19	9.24	9.26	17.67	17.48	3.02	7.45	7.04	6.32	2.94
Cr_2O_3	0.47	0.42	0.42	0.42	0.49	0.44	0.50	0.47	0.33	0.32	0.62	0.69	0.69	0.26	0.66
Fe_2O_3	0.61	0.56	0.58	0.55	0.63	0.58	0.60	0.59	0.29	0.29	✸	0.67	0.67	0.68	✸
FeO	8.72	8.01	8.34	7.80	9.05	8.23	8.58	8.42	4.18	4.13	11.64	9.56	9.61	9.75	12.22
NiO	0.10	0.08	0.10	0.08	0.10	0.09	0.11	0.10	0.03	0.03	0.24	0.16	0.15	0.14	0.28
MnO	0.18	0.18	0.19	0.18	0.21	0.18	0.19	0.19	0.11	0.12	0.26	0.20	0.19	0.20	0.18
MgO	26.56	24.87	26.10	24.48	28.44	25.84	27.18	26.73	14.64	14.84	41.25	29.36	30.66	31.74	40.79
CaO	5.80	6.78	6.35	7.07	5.26	6.37	6.27	6.23	12.85	13.32	0.05	6.09	5.66	5.19	0.07
Na_2O	0.34	0.05	0.39	0.46	0.30	0.20	0.35	0.37	0.23	0.20	0.04	0.41	0.24	0.46	0.04
K_2O	0.01	0.02	0.02	0.02	0.02	0.05	0.03	0.02	1.27	0.98	0.01	0.03	0.02	0.02	0.01
P_2O_5	0.02	0.02	0.02	0.02	0.01	-	0.02	0.01	0.02	0.02	-	0.03	0.02	0.02	0.01
TOTAL	100.16	99.29	99.68	100.20	99.98	100.14	99.69	100.10	99.93	99.78	99.87	100.15	99.95	99.49	100.14
ΣVol [1]	2.94	3.05	4.58	3.13	2.60	3.14	5.42	4.59	3.86	4.02	13.14	7.11	6.70	5.13	12.06
FeO[1]	7.66	7.25	7.61	7.08	3.77	7.42	7.26	7.24	3.98	4.16	1.66	6.87	7.00	7.45	2.35
Mg*	83.4	83.6	83.7	83.8	83.8	83.8	83.9	83.9	85.2	85.4	86.1	83.5	84.0	84.3	85.5
CATION NORM															
PL	18.9	24.6	23.3	25.7	15.4	22.3	23.0	22.8	48.8	48.0	6.5	18.0	17.5	16.2	6.1
CPX	8.0	8.5	7.7	8.2	8.4	7.8	7.6	7.4	16.7	19.1	✸	11.2	10.9	9.9	✸
OPX	48.1	40.6	37.7	41.1	45.2	43.7	30.5	36.3	5.9	4.9	12.5	22.4	17.2	16.2	14.7
OL	24.4	25.8	30.9	24.3	30.1	25.5	38.1	32.8	28.1	27.6	79.9	47.1	53.1	57.4	78.0
SP	0.8	0.5	0.5	0.7	0.8	0.7	0.8	0.6	0.5	0.4	1.1	1.3	1.3	0.4	1.2
TRACE ELEMENTS (μg/g)															
K	96	131	152	140	149	387	231	n.d.	n.d.	n.d.	108	269	165	143	70
Rb	<1	<1	<1	<1	<1	<1	<1		21	15	<1	<1	<1	<1	<1
Ba	3	4	4	<3	5	4	<3		633	808	<3	3	<3	4	<3
Sr	4	5	5	5	3	5	4		156	139	<1	3	3	4	<1
Zr	4	3	2	<1	2	4	1		3	2	<2	<1	1	1	<2
Y	3	4	3	2	2	3	<2		4	4	<2	5	5	4	<2
Ti	342	324	286	326	340	342	233		336	321	109	517	523	555	114
Cu	23	24	15	26	21	5	12		45	38	6	41	32	38	35
Zn	59	52	59	50	59	41	50		31	29	50	54	54	53	58
Ni	773	664	766	655	769	786	844		218	227	1859	1294	1191	1120	2220
Co	114	86	107	90	97	90			66	62	156	119	118	104	127
V	109	99	86	100	108	104	83		84	87	31	123	122	123	38
Cr	3192	2873	3197	2883	3370	3002	3243		2227	2211	4219	4733	4698	1803	4487

Locality 11 ← | → Locality 12

[1] See Appendix G (Fe_2O_3/FeO adjusted to 0.07)

Mg* = 100 (Mg+Ni)/(Mg+ΣFe+Mn+Ni)

✸ Total Iron as FeO

✸ Corrected for apparent Ca loss

n.d. = not determined

TABLE B-7

Major and Trace Element Analyses and Normative Mineralogy of Amphibolitized and Saussuritized Gabbroic Rocks

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11	12
SAMPLE	326[2]	325[2]	323[3]	457[2]	324[4]	322[4]	327[4]	330[4]	321[2]	328[3]	329[3]	420[5]
LOCALITY	3	3	3	3	3	3	3	5	7	2	3	13
SiO_2	49.39	48.56	50.92	44.86	49.66	50.30	46.03	51.43	43.80	43.23	43.11	40.78
TiO_2	0.05	0.04	0.03	0.03	0.10	0.10	0.11	0.12	0.02	0.04	-	0.04
Al_2O_3	12.89	10.73	9.40	7.17	9.83	9.24	13.36	10.84	5.57	18.03	30.11	29.10
Cr_2O_3	0.28	0.38	0.36	0.77	0.35	0.19	0.28	0.16	0.71	0.17	0.06	0.01
Fe_2O_3	0.51	0.56	0.43	0.66	0.45	0.43	0.39	0.35	0.64	0.33	0.05	0.10
FeO	7.30	8.01	6.07	9.41	6.36	6.09	5.51	4.99	9.14	4.73	0.70	1.49
NiO	0.06	0.08	0.05	0.15	0.08	0.07	0.07	0.05	0.19	0.10	0.01	-
MnO	0.18	0.19	0.17	0.21	0.16	0.19	0.24	0.14	0.19	0.09	0.03	0.05
MgO	19.38	23.24	20.36	30.72	18.90	18.53	18.51	19.09	35.22	22.77	2.53	3.33
CaO	8.79	7.25	11.63	4.46	12.58	12.73	13.44	11.97	3.70	9.94	22.21	24.81
Na_2O	0.31	0.48	0.56	0.31	1.40	1.31	1.19	0.21	0.09	0.03	0.59	0.26
K_2O	0.15	0.08	0.03	0.02	0.04	0.04	0.04	0.08	0.01	0.32	0.40	0.04
P_2O_5	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.03	0.05
TOTAL	99.30	99.61	100.02	98.78	99.93	99.24	99.19	99.45	99.29	99.79	99.83	100.08
ΣVol.[1]	2.07	2.44	4.81	6.36	2.86	1.91	2.09	2.89	8.71	7.24	5.60	4.90
FeO[1]	7.06	7.45	5.49	6.99	5.11	5.26	4.84	4.26	5.08	3.10	0.53	1.40
Mg*	81.3	82.7	84.6	84.3	83.0	83.2	84.4	86.2	86.4	88.8	85.4	78.4
CATION NORM												
PL	33.8	27.5	22.3	17.3	24.3	22.8	35.7	27.9	13.1	49.1	86.5	
CPX	9.9	7.8	31.1	4.0	34.1	36.2	29.7	27.4	3.9	3.00	30.2	
OPX	43.8	41.7	37.3	28.3	30.2	33.6	5.5	40.6	18.9	-4.9	-40.9	
OL	12.2	22.5	9.3	49.0	11.2	7.4	29.0	5.1	63.0	52.5	24.4	
SP	0.3	0.6	0.1	1.4	0.2	-	0.2	-	1.1	0.3	-0.3	
TRACE ELEMENTS (μg/g)												
K	-	-	229	155	330	317	371	701	92	-	-	-
Rb	3	<1	1	<1	<1	<1	1	<1	<1	10	8	344
Ba	21	6	3	5	8	10	<3	7	<3	13	61	57
Sr	53	10	23	5	3	1	4	24	1	395	191	744
Li	0.6	1.1	-	-	1.7	-	-	-	1.2	11.9	9.3	40
Zr	1	<1	2	1	5	7	3	5	2	5	3	10
Y	5	4	2	<2	7	11	5	10	<2	2	<2	<2
Ti	368	320	323	237	804	721	933	872	129	337	190	221
Cu	29	21	8	14	16	8	8	4	6	4	19	9
Zn	63	59	53	75	22	18	18	26	44	36	16	21
Ni	454	616	372	1147	629	581	587	402	1503	784	59	38
Co	n.d.	n.d.	n.d.	113	65	76	n.d.	53	n.d.	90	n.d.	58
V	102	97	84	85	243	196	198	220	53	20	14	42
Cr	1938	2591	2495	5253	2421	1304	1932	1089	4865	1142	435	99

[1] See Appendix G

Mg* = 100(Mg+Ni)/(Mg+ΣFe+Mn+Ni)

[2] Numerous thin amphibolitized shears

[3] Amphibolitized plagioclase-rich horizon

[4] Amphibolite

[5] Completely saussuritized plagioclase-rich horizon

Sample 325 contains 200 μg/g F, <10 μg/g B

Sample 324 contains 190 μg/g F, <10 μg/g B

NOTE: Samples 328, 329 and 420 contain insufficient SiO_2 to form the required normative minerals.

APPENDIX C

ANALYSES OF PRIMARY AND SECONDARY PHASES IN PBOC INTRUSIVES

NOTE:

(i) For comparative purposes, analyses which represent average compositions of a particular anhydrous phase (Tables C2-C4, C-7, C-10, and some analyses in Table C-9) are normalized to totals of 100.0%. Analyses whose original totals were < 99% or > 101% were rejected.

(ii) In all pyroxene analyses, total Fe is listed as FeO. Calculation of Fe_2O_3 (Papike *et al.*, 1974) for many of these pyroxenes results in unreasonably high Fe_2O_3/FeO ratios.

(iii) In Table C-2 cation proportions are listed adjacent to their respective oxides.

TABLE C-1

Variation of Selected Mineral Compositional Parameters from Olivine Norites and Peridotites from the Pigna Barney Ophiolitic Complex

SAMPLE	HOST	OL	OL'	OPX	CPX	SPINEL					PLAG
	Mg*	Mg*	Mg*	*mg*	*mg*	*M*	Cr/Cr+Al	$Fe^{3\#}$	Cr#	Al#	An
440	81.2	80.3	81.4	81.2	86.0	15.7	0.624	0.297	0.438	0.264	85.5
441	81.1	80.4	81.4	81.5	86.3	16.3	0.569	0.288	0.405	0.307	86.6
442	-	80.9	-	82.3	86.5	25.5	0.558	0.269	0.408	0.323	86.0
443	83.1	81.9	83.6	83.2	86.8	29.2	0.571	0.170	0.474	0.356	86.0
444	83.7	82.5	84.7	83.6	87.4	27.7	0.525	0.191	0.424	0.385	86.4
445	83.1	82.7	83.6	83.7	86.9	24.8	0.555	0.194	0.448	0.359	86.2
446	-	82.5	-	83.7	87.0	24.1	0.555	0.200	0.444	0.356	86.7
447	84.5	82.8	85.4	83.6	87.5	32.8	0.545	0.124	0.477	0.399	86.2
448	83.4	82.9	84.0	83.6	86.8	33.9	0.548	0.155	0.464	0.382	85.5
449	83.9	82.9	84.3	84.2	88.3	32.2	0.561	0.174	0.464	0.362	86.4
450	83.8	83.1	84.6	83.7	87.4	27.6	0.559	0.187	0.455	0.358	86.3
451	83.7	83.1	83.7	84.1	87.9	32.3	0.557	0.137	0.481	0.382	85.5
452	83.5	83.3	83.7	84.2	87.3	27.6	0.558	0.159	0.469	0.372	86.1
453	84.3	83.6	85.4	84.4	89.5	35.2	0.556	0.142	0.478	0.381	86.2
454	-	83.7	-	84.2	88.5	31.2	0.615	0.163	0.514	0.323	87.5
455	84.3	83.8	85.0	84.3	-	34.5	0.611	0.145	0.523	0.333	88.7
456	84.1	83.8	84.8	84.7	87.9	31.2	0.557	0.123	0.488	0.389	87.1
457	84.3	84.0	85.0	85.1	-	33.0	0.564	0.120	0.497	0.383	-
458	83.8	84.1	84.2	85.0	88.4	34.1	0.537	0.119	0.473	0.408	-
459	85.5	84.2	85.7	85.1	87.8	35.2	0.571	0.155	0.483	0.362	89.2
460	84.6	84.3	85.3	84.9	88.8	34.6	0.554	0.108	0.494	0.398	86.7
461	85.2	84.6	85.4	85.5	88.6	42.5	0.501	0.082	0.460	0.458	87.4
462	83.5	84.8	83.6	85.2	87.2	38.3	0.535	0.159	0.449	0.391	84.9
463	85.5	84.9	86.3	85.6	87.6	28.6	0.574	0.134	0.497	0.369	86.9
464	-	85.0	-	85.7	88.6	34.7	0.597	0.145	0.510	0.345	-
465	-	84.9	-	84.1	87.6	28.1	0.539	0.226	0.417	0.357	89.0
466	85.8	85.0	86.8	85.4	89.1	33.4	0.595	0.140	0.511	0.348	88.2
467	85.0	85.2	85.4	85.7	89.3	41.9	0.510	0.083	0.468	0.449	90.4
468	-	85.3	-	85.5	-	25.7	0.494	0.068	0.461	0.472	88.4
469	-	85.4	93.6	85.5	88.1	39.9	0.593	0.157	0.500	0.343	-
470	-	85.5	-	86.1	89.2	42.6	0.543	0.099	0.489	0.411	88.7
471	85.4	85.5	85.1	86.0	89.2	39.3	0.532	0.104	0.477	0.419	88.7
472	85.7	85.6	86.2	86.3	88.4	38.4	0.544	0.103	0.488	0.409	-
473	85.5	85.7	86.1	-	89.4	38.2	0.615	0.108	0.549	0.343	85.3
474	-	85.9	-	86.5	89.0	38.5	0.553	0.101	0.497	0.402	87.4
475	-	86.1	-	86.6	88.1	40.9	0.559	0.104	0.501	0.395	88.2
476	86.5	86.3	87.4	86.8	89.0	44.4	0.553	0.095	0.500	0.405	-
477	87.1	86.1	88.2	86.3	-	44.8	0.544	0.093	0.493	0.414	89.4
478	86.3	86.5	86.7	86.4	88.8	35.7	0.634	0.121	0.557	0.322	87.2
479	86.5	86.4	87.4	86.8	90.1	40.3	0.533	0.096	0.482	0.422	-
480	87.4	86.4	87.8	87.1	89.5	35.2	0.520	0.126	0.455	0.419	89.4
481	-	86.7	-	-	89.0	42.6	0.607	0.101	0.546	0.353	87.0
482	86.8	86.7	87.1	86.9	89.1	38.7	0.623	0.121	0.547	0.331	84.9
483	-	87.0	-	87.9	90.7	39.5	0.565	0.084	0.517	0.399	-
484	-	87.4		88.1	91.3	51.7	0.412	0.050	0.391	0.559	-
485	-	87.9	89.0	-	-	23.3	0.609	0.102	0.547	0.351	87.5
486	87.7	88.0	a	88.4	90.6	41.4	0.563	0.126	0.492	0.381	-
487	-	88.1	-	88.4	-	48.1	0.465	0.041	0.446	0.513	-
488	-	89.3	-	89.3	-	59.2	0.265	0.046	0.253	0.701	-
489	90.7	90.4	91.5	90.9	-	33.5	0.838	0.090	0.763	0.147	-
490	-	91.0	-	91.5	95.0	-	-	-	-	-	-
491	-	91.2	-	91.3	94.2	64.0	0.270	0.011	0.267	0.722	-
492	90.2	91.5	89.9	91.4	95.3	65.3	0.425	0.004	0.424	0.573	-
493	91.6	91.6	91.8	91.7	95.3	65.5	0.369	0.012	0.365	0.623	-
494	-	91.6	-	91.3	94.3	61.0	0.381	0.020	0.374	0.606	-
495	90.6	91.6	90.3	92.0	95.2	72.8	0.326	0.007	0.324	0.669	-
496	91.5	92.1	91.4	92.0	95.0	66.8	0.395	0.019	0.388	0.594	-
497	91.8	92.2	91.6	92.4	-	69.9	0.406	0.020	0.398	0.582	-
498	91.4	92.3	91.2	92.4	95.1	74.2	0.356	0.016	0.351	0.634	-

M = $100Mg/(Mg+Fe^{2+})$

mg = $100Mg/(Mg+\Sigma Fe+Mn)$

Mg^* = $100(Mg+Ni)/(Mg+Ni+\Sigma Fe+Mn)$

OL' = Normative olivine composition (see Appendix A)

\# = $R^{3+}/\Sigma R^{3+}$ (V^{3+} omitted from ΣR^{3+})

a = Insufficient SiO_2 to form normative olivine (see Appendix A)

An = 100 Ca/(Ca+Na)

For sample lithologies see Table C-2

Analyses of Ferromagnesian Phases in Olivine Norites and Peridotites from the Pigna Barney Ophiolitic Complex

SAMPLE	440		441		442		443		444		445		446	
HOST	OmN		OmN		OmN†		OmN		OmN		OmN		OmN†	
Fo	*80.5*		*80.5*		*81.0*		*82.0*		*82.5*		*82.7*		*82.7*	
OLIVINE														
SiO_2	39.10	*0.998*	39.15	*0.998*	39.23	*0.999*	39.39	*0.999*	39.57	*1.001*	39.35	*0.995*	39.26	*0.994*
FeO	18.29	*0.390*	18.20	*0.388*	17.77	*0.378*	16.90	*0.358*	16.41	*0.347*	16.31	*0.345*	16.37	*0.347*
NiO	0.22	*0.005*	0.25	*0.005*	0.23	*0.005*	0.24	*0.005*	0.27	*0.005*	0.35	*0.007*	0.29	*0.006*
MnO	0.21	*0.005*	0.20	*0.004*	0.22	*0.005*	0.19	*0.004*	0.16	*0.003*	0.15	*0.003*	0.22	*0.005*
MgO	42.17	*1.605*	42.26	*1.606*	42.56	*1.615*	43.28	*1.636*	43.50	*1.641*	43.85	*1.654*	43.85	*1.655*
Σ Cations (4 O)		*3.003*		*3.002*		*3.001*		*3.001*		*2.999*		*3.005*		*3.006*
ORTHOPYROXENE														
SiO_2	55.22	*1.958*	55.13	*1.954*	54.87	*1.947*	55.30	*1.953*	55.50	*1.955*	55.50	*1.955*	55.30	*1.949*
Al_2O_3	1.74	*0.073*	1.69	*0.071*	1.87	*0.078*	1.74	*0.072*	1.76	*0.073*	1.73	*0.072*	1.86	*0.077*
Cr_2O_3	0.24	*0.007*	0.26	*0.007*	0.41	*0.012*	0.30	*0.008*	0.23	*0.006*	0.27	*0.008*	0.38	*0.011*
FeO	11.96	*0.355*	11.98	*0.355*	10.98	*0.326*	10.77	*0.318*	10.63	*0.313*	10.54	*0.310*	10.42	*0.307*
MnO	0.24	*0.007*	0.18	*0.005*	0.19	*0.006*	0.16	*0.005*	0.17	*0.005*	0.20	*0.006*	0.27	*0.008*
MgO	29.67	*1.568*	29.96	*1.583*	29.24	*1.547*	30.36	*1.598*	30.92	*1.623*	30.92	*1.623*	30.84	*1.620*
CaO	0.93	*0.035*	0.81	*0.031*	2.45	*0.093*	1.39	*0.053*	0.80	*0.030*	0.84	*0.032*	0.93	*0.035*
Σ Cations (6 O)		*4.003*		*4.007*		*4.008*		*4.007*		*4.006*		*4.006*		*4.007*
mg		*81.2*		*81.5*		*82.3*		*83.2*		*83.6*		*83.7*		*83.7*
CLINOPYROXENE														
SiO_2	52.38	*1.952*	52.77	*1.936*	52.57	*1.931*	52.55	*1.928*	52.30	*1.918*	52.70	*1.933*	52.68	*1.931*
Al_2O_3	2.51	*0.109*	2.32	*0.100*	2.31	*0.100*	2.42	*0.105*	2.90	*0.125*	2.38	*0.103*	2.52	*0.108*
Cr_2O_3	0.68	*0.020*	0.61	*0.018*	0.85	*0.025*	0.72	*0.021*	0.82	*0.024*	0.74	*0.021*	0.79	*0.023*
FeO	4.71	*0.145*	4.58	*0.141*	4.54	*0.139*	4.46	*0.137*	4.13	*0.127*	4.41	*0.135*	4.30	*0.132*
MgO	16.26	*0.891*	16.26	*0.889*	16.20	*0.887*	16.39	*0.897*	16.07	*0.879*	16.39	*0.896*	16.21	*0.886*
CaO	23.23	*0.914*	23.21	*0.912*	23.28	*0.916*	23.29	*0.916*	23.51	*0.924*	23.21	*0.921*	23.27	*0.914*
Na_2O	0.24	*0.017*	0.23	*0.016*	0.25	*0.018*	0.18	*0.011*	0.29	*0.021*	0.15	*0.011*	0.23	*0.016*
Σ Cations (6 O)		*4.020*		*4.013*		*4.016*		*4.015*		*4.017*		*4.011*		*4.011*
Ca:Mg:Fe	*46.9:45.7:7.4*		*47.0:45.8:7.2*		*47.2:45.7:7.1*		*47.0:46.0:7.0*		*47.9:45.5:6.6*		*47.2:45.9:6.9*		*47.3:45.9:6.8*	
SPINEL														
TiO_2	0.82	*0.171*	0.78	*0.161*	0.57	*0.117*	0.55	*0.109*	0.58	*0.115*	0.63	*0.126*	0.52	*0.104*
Al_2O_3	12.52	*4.093*	14.73	*4.762*	15.76	*5.056*	17.93	*5.585*	19.44	*6.032*	17.83	*5.598*	17.76	*5.581*
V_2O_3	0.74	*0.165*	0.69	*0.152*	0.55	*0.120*	0.54	*0.114*	0.43	*0.091*	0.63	*0.135*	0.55	*0.118*
Cr_2O_3	30.98	*6.794*	29.01	*6.291*	29.67	*6.385*	35.54	*7.426*	31.37	*6.655*	33.21	*6.993*	32.98	*6.952*
*Fe_2O_3	22.08	*4.609*	21.68	*4.475*	20.54	*4.207*	13.36	*2.657*	15.11	*2.994*	15.08	*3.023*	15.66	*3.142*
FeO	29.04	*6.736*	29.09	*6.672*	28.69	*6.531*	25.53	*5.642*	26.15	*5.758*	26.79	*5.968*	27.33	*6.094*
NiO	0.29	*0.065*	0.19	*0.042*	-	-	0.26	*0.055*	0.10	*0.021*	0.32	*0.069*	-	-
MnO	0.39	*0.092*	0.41	*0.095*	0.37	*0.085*	0.39	*0.087*	0.49	*0.109*	0.33	*0.074*	0.33	*0.075*
MgO	3.04	*1.252*	3.19	*1.304*	3.55	*1.440*	5.30	*2.324*	5.61	*2.202*	4.96	*1.970*	4.87	*1.936*
ZnO	0.10	*0.020*	0.23	*0.047*	0.29	*0.058*	-	-	0.12	*0.023*	0.23	*0.045*	-	-
Σ Cations (32 O)		*24.000*		*24.001*		*24.000*		*24.001*		*24.000*		*24.001*		*24.001*
M		*15.7*		*16.3*		*25.5*		*29.2*		*27.7*		*24.3*		*24.1*
Cr		*62.4*		*56.9*		*55.8*		*57.1*		*52.5*		*55.5*		*55.5*

Fo = 100 Mg/(Mg+ΣFe) olivine
mg = 100 Mg/(Mg+ΣFe+Mn)
M = 100 $Mg/(Mg+Fe^{2+})$
Cr = 100 Cr/(Cr+Al)
Ca:Mg:Fe = cation proportions (atomic %)
FeO = all Fe as FeO
* = Spinel Fe_2O_3 calculated assuming stoichiometry

NOTE: Each analysis represents the mean of between 3 and 10 grains from each sample, recalculated to 100.0% (see Appendix G)

✱ - zoned orthopyroxene - see table C-3
✱ - zoned clinopyroxene - see table C-4

HOST See next page for key to host rock nomenclature.

n.d. = not determined *or* not found

NOTE: Hosts 440 - 498 are listed consecutively. Sample numbers increase regularly with increasing Fo content of their respective olivines. See Table C-1 for a summary.

SAMPLE	447		448		449		450		451		452		453	
HOST	OmGN		OmN		OmN		OmN		OmN		OmN		OmGN	
Fo	82.9		83.0		83.0		83.2		83.2		83.4		83.7	
OLIVINE														
SiO_2	39.45	0.997	39.57	0.999	39.67	1.001	39.58	0.999	39.53	0.997	39.58	0.998	39.66	0.999
FeO	16.19	0.342	16.04	0.339	16.02	0.338	15.89	0.335	15.94	0.336	15.75	0.332	15.38	0.324
NiO	0.32	0.007	0.27	0.005	0.28	0.006	0.24	0.005	0.23	0.005	0.25	0.005	0.33	0.007
MnO	0.18	0.004	0.13	0.003	0.21	0.004	0.20	0.004	0.12	0.003	0.16	0.003	0.21	0.004
MgO	43.86	1.653	43.99	1.655	43.83	1.649	44.08	1.658	44.18	1.662	44.26	1.664	44.44	1.668
Σ Cations (4 O)		3.003		3.001		2.999		3.001		3.003		3.002		3.001
ORTHOPYROXENE														
SiO_2	55.15	1.944	55.22	1.957	55.69	1.958	55.45	1.953	55.43	1.950	55.65	1.956	55.47	1.952
Al_2O_3	2.08	0.086	1.68	0.070	1.73	0.072	1.77	0.073	1.83	0.076	1.74	0.072	1.79	0.074
Cr_2O_3	0.30	0.008	0.15	0.004	0.33	0.009	0.33	0.009	0.35	0.010	0.27	0.008	0.43	0.012
FeO	10.66	0.314	10.57	0.313	10.18	0.299	10.46	0.308	10.32	0.304	10.21	0.300	9.99	0.294
MnO	0.16	0.005	0.15	0.004	0.15	0.004	0.23	0.007	0.16	0.005	0.21	0.006	0.21	0.006
MgO	30.94	1.625	30.69	1.621	30.74	1.611	30.84	1.619	31.17	1.635	31.18	1.634	30.93	1.622
CaO	0.70	0.026	0.96	0.036	1.24	0.049	0.93	0.035	0.73	0.028	0.76	0.029	1.19	0.045
Σ Cations (6 O)		4.009		4.005		4.001		4.005		4.007		4.004		4.005
mg	83.6		83.6		84.2		83.7		84.1		84.2		84.4	
CLINOPYROXENE														
SiO_2	52.36	1.923	52.38	1.922	52.74	1.928	52.81	1.935	52.77	1.932	52.92	1.936	53.05	1.939
Al_2O_3	2.76	0.119	2.71	0.117	2.43	0.105	2.29	0.099	2.49	0.107	2.53	0.109	2.25	0.097
Cr_2O_3	0.80	0.023	0.87	0.025	0.86	0.025	0.77	0.022	0.70	0.020	0.72	0.021	0.76	0.022
FeO	4.17	0.128	4.40	0.135	4.03	0.123	4.22	0.129	4.05	0.124	4.25	0.130	3.44	0.105
MgO	16.39	0.897	16.18	0.885	17.08	0.931	16.38	0.895	16.46	0.898	16.35	0.892	16.86	0.891
CaO	23.06	0.907	23.19	0.911	22.64	0.887	23.38	0.918	23.29	0.913	23.04	0.903	23.86	0.935
Na_2O	0.24	0.017	0.17	0.012	0.18	0.013	0.11	0.008	0.19	0.013	0.27	0.019	0.29	0.021
Σ Cations (6 O)		4.015		4.010		4.013		4.007		4.010		4.009		4.011
Ca:Mg:Fe	47.0:46.4:6.6		47.2:45.8:7.0		45.7:48.0:6.3		47.3:46.1:6.6		47.2:46.4:6.4		46.9:46.3:6.8		48.4:46.1:5.5	
SPINEL														
TiO_2	0.62	0.119	0.78	0.153	0.47	0.093	0.62	0.123	0.57	0.112	0.48	0.095	0.36	0.070
Al_2O_3	24.77	7.434	19.36	5.945	18.37	5.686	17.97	5.609	19.50	5.997	18.77	5.839	19.63	6.010
V_2O_3	0.40	0.082	0.57	0.119	0.56	0.118	0.49	0.104	0.42	0.088	0.46	0.097	0.39	0.081
Cr_2O_3	30.35	6.111	35.05	7.220	35.04	7.276	33.99	7.120	36.60	7.550	35.32	7.370	36.68	7.534
*Fe_2O_3	11.16	2.139	12.30	2.412	13.84	2.735	14.66	2.922	10.91	2.142	12.61	2.504	11.43	2.234
FeO	25.20	5.367	24.46	5.330	24.62	5.407	26.27	5.818	24.79	5.409	25.91	5.719	23.70	5.149
NiO	0.21	0.043	-	-	0.27	0.057	-	-	0.23	0.048	0.22	0.047	0.05	0.010
MnO	0.40	0.086	0.30	0.066	0.27	0.060	0.38	0.085	0.36	0.080	0.45	0.101	0.42	0.092
MgO	6.90	2.619	7.04	2.734	6.56	2.568	5.62	2.219	6.62	2.575	5.55	2.184	7.22	2.796
ZnO	-	-	0.11	0.021	-	-	-	-	-	-	0.23	0.044	0.12	0.025
Σ Cations (32 O)		24.000		24.000		24.000		24.000		24.001		24.000		24.001
M		32.8		33.9		32.2		26.7		32.3		27.6		35.2
Cr		54.5		54.8		56.1		55.9		55.7		55.8		55.6

Host rock nomenclature after Streckeisen (1976). The nomenclature of most samples is based on their cation normative mineralogy (see Appendix A, and Tables 5.1, B-1 to B-7). Samples marked † have been classified according to their estimated modal compositions.

N = norite
mN = mela-norite
ON = olivine norite
OmN = olivine mela-norite
OGN = olivine gabbronorite
OmGN = olivine mela-gabbronorite
OG = olivine gabbro
T = troctolite
mT = mela-troctolite
P = peridotite
PℓP = plagioclase-bearing peridotite (Pℓ<10)
OO = olivine-bearing orthopyroxenite (ol<10)
H = harzburgite
PℓH = plagioclase-bearing harzburgite (Pℓ<10)
AH = amphibole-bearing harzburgite (A<10)
D = dunite
PℓD = plagioclase-bearing dunite (Pℓ<10)

SAMPLE	454		455		456		457		458		459		460	
HOST	OmN†		OmN		OmN		OmN		PℓH		OGN		OmN	
Fo	*83.8*		*83.9*		*84.0*		*84.0*		*84.2*		*84.3*		*84.4*	
OLIVINE														
SiO_2	39.68	*0.999*	39.93	*1.000*	39.67	*0.997*	39.86	*1.001*	39.95	*1.002*	39.81	*0.999*	39.68	*0.997*
FeO	15.30	*0.322*	15.33	*0.321*	15.20	*0.320*	15.18	*0.319*	15.06	*0.316*	14.90	*0.313*	14.83	*0.312*
NiO	0.35	*0.007*	0.36	*0.007*	0.20	*0.004*	0.24	*0.005*	-	-	0.22	*0.004*	0.34	*0.007*
MnO	0.18	*0.004*	0.14	*0.003*	0.17	*0.004*	-	-	0.06	*0.001*	0.16	*0.003*	0.19	*0.004*
MgO	44.49	*1.669*	44.66	*1.668*	44.77	*1.678*	44.72	*1.674*	44.94	*1.680*	44.92	*1.681*	44.97	*1.684*
Σ Cations (4 O)		*3.001*		*2.999*		*3.003*		*2.999*		*2.998*		*3.001*		*3.003*
ORTHOPYROXENE														
SiO_2	55.37	*1.951*	55.35	*1.951*	55.71	*1.957*	55.84	*1.959*					55.56	*1.951*
Al_2O_3	1.89	*0.079*	1.74	*0.072*	1.70	*0.070*	1.69	*0.070*					1.80	*0.075*
Cr_2O_3	0.46	*0.013*	0.43	*0.012*	0.36	*0.010*	0.36	*0.010*					0.37	*0.010*
FeO	9.94	*0.293*	10.04	*0.296*	9.90	*0.291*	9.69	*0.284*					9.76	*0.287*
MnO	0.20	*0.006*	0.16	*0.005*	0.18	*0.005*	0.11	*0.003*	*		*		0.17	*0.005*
MgO	30.42	*1.597*	30.85	*1.621*	31.24	*1.636*	31.35	*1.639*					31.49	*1.648*
CaO	1.71	*0.065*	1.33	*0.050*	0.92	*0.035*	0.97	*0.036*					0.84	*0.031*
Σ Cations (6 O)		*4.004*		*4.007*		*4.003*		*4.002*						*4.007*
mg	*84.2*		*84.3*		*84.7*		*85.1*							
CLINOPYROXENE														
SiO_2	52.81	*1.931*			52.58	*1.925*			52.95	*1.930*			52.92	*1.936*
Al_2O_3	2.40	*0.103*			2.55	*0.110*			2.58	*0.111*			2.29	*0.099*
Cr_2O_3	0.94	*0.027*			0.89	*0.026*			0.86	*0.025*			0.78	*0.023*
FeO	3.90	*0.119*			4.10	*0.126*			4.11	*0.125*	*		3.68	*0.113*
MgO	16.85	*0.918*	n.d.		16.75	*0.914*	n.d.		17.61	*0.957*			16.47	*0.898*
CaO	22.98	*0.900*			22.90	*0.898*			21.57	*0.843*			23.70	*0.929*
Na_2O	0.14	*0.010*			0.16	*0.011*			0.21	*0.015*			0.16	*0.011*
Σ Cations (6 O)		*4.009*				*4.012*				*4.008*				
Ca:Mg:Fe	*46.5:47.4:6.1*				*46.3:47.2:6.5*				*43.8:49.7:6.5*				*47.9:46.3:5.8*	
SPINEL														
TiO_2	0.34	*0.068*	0.33	*0.065*	0.45	*0.088*	0.42	*0.082*	0.36	*0.070*	0.34	*0.067*	0.40	*0.078*
Al_2O_3	16.27	*5.090*	16.92	*5.249*	19.90	*6.115*	19.68	*6.040*	21.17	*6.441*	18.57	*5.714*	20.59	*6.275*
V_2O_3	0.41	*0.087*	0.42	*0.089*	0.43	*0.090*	0.40	*0.084*	0.38	*0.079*	0.44	*0.092*	0.42	*0.087*
Cr_2O_3	38.68	*8.117*	39.64	*8.249*	37.26	*7.681*	38.02	*7.828*	36.55	*7.460*	36.91	*7.619*	38.06	*7.781*
*Fe_2O_3	12.87	*2.571*	11.53	*2.284*	9.89	*1.940*	9.62	*1.885*	9.68	*1.880*	12.43	*2.442*	8.75	*1.702*
FeO	24.72	*5.487*	23.74	*5.225*	25.28	*5.512*	24.44	*5.322*	24.32	*5.250*	23.66	*5.166*	24.11	*5.213*
NiO	-	-	0.10	*0.021*	-	-	0.20	*0.042*	-	-	0.10	*0.021*	-	-
MnO	0.41	*0.092*	0.32	*0.071*	0.36	*0.079*	0.34	*0.075*	0.42	*0.092*	0.26	*0.057*	0.37	*0.081*
MgO	6.29	*2.489*	7.00	*2.747*	6.42	*2.495*	6.74	*2.616*	7.06	*2.717*	7.22	*2.810*	7.15	*2.756*
ZnO	-	-	-	-	-	-	0.14	*0.027*	0.06	*0.012*	0.77	*0.013*	0.15	*0.028*
Σ Cations (32 O)		*24.001*		*24.001*		*24.000*		*24.001*		*24.001*		*24.001*		*24.001*
M	*31.2*		*34.5*		*31.2*		*33.0*		*34.1*		*35.2*		*34.6*	
Cr	*61.5*		*61.1*		*55.7*		*56.4*		*53.7*		*57.1*		*55.4*	

SAMPLE	461		462		463		464		465		466		467	
HOST	OmN		OGN		OmN		PℓH†		OmN		OmN		OmN	
Fo	*84.7*		*84.8*		*84.9*		*84.9*		*85.0*		*85.1*		*85.3*	
OLIVINE														
SiO_2	39.93	*1.000*	39.73	*0.998*	39.92	*1.000*	39.84	*0.998*	40.10	*1.004*	40.01	*1.001*	40.09	*1.002*
FeO	14.54	*0.305*	14.49	*0.304*	14.33	*0.300*	14.37	*0.301*	14.25	*0.298*	14.18	*0.297*	13.99	*0.292*
NiO	0.25	*0.005*	0.26	*0.005*	0.33	*0.007*	0.33	*0.007*	0.23	*0.005*	0.26	*0.005*	0.23	*0.005*
MnO	0.11	*0.002*	-	-	0.13	*0.003*	-	-	0.14	*0.003*	0.12	*0.003*	0.14	*0.003*
MgO	45.18	*1.687*	45.21	*1.694*	45.30	*1.691*	45.46	*1.697*	45.19	*1.686*	45.44	*1.694*	45.55	*1.697*
Σ *Cations* (4 O)		2.999		*3.002*		*3.000*		*3.002*		*2.996*		*2.999*		*2.998*
ORTHOPYROXENE														
SiO_2	*		55.68	*1.952*	55.34	*1.942*	55.91	*1.959*	55.43	*1.950*	55.45	*1.947*	*	
Al_2O_3			1.74	*0.072*	2.39	*0.099*	1.60	*0.066*	1.74	*0.072*	1.89	*0.078*		
Cr_2O_3			0.34	*0.009*	0.41	*0.011*	0.44	*0.012*	0.38	*0.011*	0.45	*0.012*		
FeO			9.67	*0.283*	9.16	*0.269*	9.20	*0.270*	10.32	*0.304*	9.36	*0.275*		
MnO			0.17	*0.005*	0.11	*0.003*	0.16	*0.005*	0.18	*0.005*	0.15	*0.004*		
MgO			31.75	*1.659*	30.84	*1.613*	31.50	*1.645*	31.19	*1.636*	31.30	*1.638*		
CaO			0.71	*0.027*	1.75	*0.066*	1.20	*0.045*	0.79	*0.030*	1.40	*0.053*		
Σ *Cations* (6 O)				*4.008*		*4.003*		*4.002*		*4.008*		*4.008*		
mg				*85.2*		*85.6*		*85.7*		*84.1*		*85.4*		
CLINOPYROXENE														
SiO_2	52.59	*1.921*	52.38	*1.920*	51.63	*1.891*	52.23	*1.900*	52.83	*1.936*	52.74	*1.929*	*	
Al_2O_3	2.77	*0.119*	2.69	*0.116*	3.73	*0.161*	2.47	*0.106*	2.33	*0.101*	2.36	*0.102*		
Cr_2O_3	1.02	*0.029*	0.68	*0.020*	1.10	*0.032*	1.00	*0.029*	0.84	*0.024*	0.83	*0.024*		
FeO	3.89	*0.119*	4.38	*0.134*	4.22	*0.129*	4.31	*0.131*	4.07	*0.125*	3.72	*0.114*		
MgO	17.05	*0.929*	16.71	*0.913*	16.69	*0.911*	18.86	*1.023*	16.18	*0.884*	17.08	*0.931*		
CaO	22.41	*0.877*	22.63	*0.889*	22.47	*0.882*	21.45	*0.836*	23.61	*0.927*	23.06	*0.903*		
Na_2O	0.26	*0.018*	0.30	*0.021*	0.17	*0.012*	0.22	*0.016*	0.15	*0.011*	0.17	*0.012*		
Σ *Cations* (6 O)		*4.013*		*4.018*		*4.018*		*4.041*		*4.007*		*4.015*		
Ca:Mg:Fe	*45.6:48.2:6.2*		*45.9:47.2:6.9*		*45.9:47.4:6.7*		*42.0:51.4:6.6*		*47.9:45.7:6.4*		*46.4:47.3:6.8*			
SPINEL														
TiO_2	0.21	*0.040*	0.93	*0.180*	0.27	*0.053*	0.60	*0.118*	0.40	*0.080*	0.32	*0.063*	0.20	*0.038*
Al_2O_3	24.54	*7.262*	19.98	*6.076*	18.84	*5.844*	17.45	*5.400*	17.97	*5.617*	17.79	*5.504*	24.03	*7.130*
V_2O_3	0.36	*0.072*	0.55	*0.114*	0.33	*0.070*	0.47	*0.099*	0.46	*0.098*	0.38	*0.080*	0.28	*0.057*
Cr_2O_3	36.69	*7.283*	34.21	*6.979*	37.78	*7.862*	38.51	*7.994*	31.29	*6.561*	38.92	*8.078*	37.30	*7.424*
*Fe_2O_3	6.90	*1.304*	12.73	*2.472*	10.70	*2.119*	11.50	*2.272*	17.87	*3.566*	11.20	*2.213*	6.94	*1.315*
FeO	21.68	*4.552*	23.14	*4.993*	25.62	*5.639*	23.71	*5.206*	25.83	*5.728*	24.16	*5.304*	21.94	*4.619*
NiO	0.08	*0.016*	-	-	0.12	*0.025*	0.13	*0.027*	0.16	*0.034*	-	-	0.04	*0.008*
MnO	0.29	*0.062*	0.38	*0.083*	0.47	*0.105*	0.32	*0.071*	0.37	*0.083*	0.42	*0.093*	0.20	*0.043*
MgO	9.98	*3.361*	8.07	*3.104*	5.75	*2.256*	7.07	*2.767*	5.65	*2.234*	6.81	*2.665*	8.88	*3.332*
ZnO	0.27	*0.049*	-	-	0.13	*0.027*	0.24	*0.047*	-	-	-	-	0.19	*0.035*
Σ *Cations* (32 O)		*24.001*		*24.001*		*24.000*		*24.001*		*24.001*		*24.001*		*24.001*
M		*42.5*		*38.3*		*28.6*		*34.7*		*28.1*		*33.4*		*41.9*
Cr		*50.1*		*53.5*		*57.4*		*59.7*		*53.0*		*59.5*		*51.0*

SAMPLE	468		469		470		471		472		473		474	
HOST	PℓH[+]		mN		OmN		OmN		PℓH		PℓD		PℓP[±]	
Fo	*85.4*		*85.5*		*85.5*		*85.5*		*85.7*		*85.8*		*85.8*	
OLIVINE														
SiO_2	40.17	*1.003*	40.14	*1.002*	40.01	*0.999*	40.16	*1.003*	40.08	*1.000*	40.36	*1.006*	40.21	*1.002*
FeO	13.91	*0.291*	13.85	*0.289*	13.86	*0.290*	13.80	*0.288*	13.62	*0.284*	13.48	*0.281*	13.51	*0.282*
NiO	0.23	*0.005*	0.25	*0.005*	0.29	*0.006*	0.36	*0.007*	0.32	*0.006*	0.23	*0.005*	0.26	*0.005*
MnO	0.13	*0.003*	0.08	*0.002*	–	–	0.07	*0.001*	0.13	*0.003*	0.15	*0.003*	–	–
MgO	45.56	*1.696*	45.68	*1.700*	45.84	*1.706*	45.61	*1.698*	45.86	*1.706*	45.78	*1.700*	46.02	*1.709*
Σ *Cations* (4 O)		*2.998*		*2.998*		*3.001*		*2.997*		*2.999*		*2.995*		*2.998*
ORTHOPYROXENE														
SiO_2	*		55.48	*1.946*	56.00	*1.955*	55.65	*1.951*	55.66	*1.949*	n.d.		55.35	*1.955*
Al_2O_3			2.08	*0.086*	1.92	*0.079*	1.89	*0.078*	2.05	*0.085*			1.85	*0.076*
Cr_2O_3			0.55	*0.015*	0.44	*0.012*	0.50	*0.014*	0.40	*0.011*			0.42	*0.012*
FeO			9.26	*0.272*	9.02	*0.263*	8.85	*0.259*	8.77	*0.257*			8.70	*0.254*
MnO			0.13	*0.004*	0.10	*0.003*	0.21	*0.006*	0.10	*0.003*			0.11	*0.003*
MgO			31.25	*1.634*	31.58	*1.643*	31.23	*1.632*	31.39	*1.638*			31.71	*1.652*
CaO			1.25	*0.047*	1.18	*0.044*	1.67	*0.063*	1.64	*0.062*			1.28	*0.048*
Σ *Cations* (6 O)				*4.003*		*3.999*		*4.003*		*4.004*				*4.001*
mg				*85.5*		*86.1*		*86.0*		*86.3*				*86.5*
CLINOPYROXENE														
SiO_2	n.d.		52.68	*1.928*	*		52.76	*1.926*	52.43	*1.916*	52.79	*1.930*	52.77	*1.922*
Al_2O_3			2.59	*0.112*			2.67	*0.115*	2.93	*0.126*	2.37	*0.102*	2.63	*0.113*
Cr_2O_3			0.95	*0.027*			0.98	*0.028*	1.04	*0.030*	1.04	*0.030*	0.98	*0.028*
FeO			4.01	*0.123*			3.64	*0.111*	3.99	*0.122*	3.55	*0.109*	3.89	*0.119*
MgO			16.67	*0.909*			16.93	*0.921*	17.12	*0.933*	16.82	*0.917*	17.77	*0.965*
CaO			23.05	*0.904*			22.84	*0.893*	22.23	*0.870*	23.28	*0.912*	21.70	*0.847*
Na_2O			–	–			0.19	*0.013*	0.26	*0.018*	0.16	*0.011*	0.27	*0.019*
Σ *Cations* (6 O)				*4.003*				*4.009*		*4.015*		*4.010*		*4.017*
Ca:Mg:Fe			*46.7:47.0:6.3*				*46.4:47.3:5.8*		*45.2:48.5:6.3*		*47.1:47.3:5.6*		*43.8:50.0:6.2*	
SPINEL														
TiO_2	0.21	*0.040*	0.31	*0.062*	0.23	*0.044*	0.23	*0.044*	0.47	*0.091*	0.40	*0.078*	0.25	*0.048*
Al_2O_3	25.27	*7.476*	17.26	*5.417*	21.75	*6.519*	22.05	*6.632*	21.29	*6.431*	17.63	*5.414*	21.08	*6.371*
V_2O_3	0.34	*0.068*	0.38	*0.081*	0.33	*0.067*	0.39	*0.080*	0.47	*0.097*	0.38	*0.079*	0.31	*0.064*
Cr_2O_3	36.81	*7.305*	37.54	*7.904*	38.55	*7.751*	37.44	*7.554*	37.86	*7.672*	41.99	*8.650*	38.30	*7.866*
*Fe_2O_3	5.68	*1.073*	12.35	*2.475*	8.23	*1.575*	8.58	*1.648*	8.40	*1.620*	8.67	*1.700*	8.31	*1.603*
FeO	22.76	*4.777*	26.49	*5.899*	21.26	*4.521*	22.47	*4.795*	22.32	*4.912*	22.63	*4.931*	22.89	*4.908*
NiO	0.03	*0.006*	0.14	*0.030*	0.12	*0.025*	0.12	*0.025*	–	–	–	–	–	–
MnO	0.25	*0.053*	0.40	*0.090*	0.57	*0.123*	0.37	*0.080*	0.41	*0.089*	0.37	*0.082*	0.31	*0.067*
MgO	8.47	*3.169*	5.14	*2.041*	8.84	*3.351*	8.17	*3.108*	8.00	*3.056*	7.86	*3.053*	8.04	*3.073*
ZnO	0.18	*0.034*	–		0.13	*0.025*	0.19	*0.035*	0.16	*0.034*	0.07	*0.014*	–	–
Σ *Cations* (32 O)		*24.001*		*24.000*		*24.001*		*24.001*		*24.001*		*24.001*		*24.001*
M		*25.7*		*39.9*		*42.6*		*39.3*		*38.4*		*38.2*		*38.6*
Cr		*49.4*		*59.3*		*54.3*		*53.2*		*54.4*		*61.5*		*55.3*

SAMPLE	475		476		477		478		479		480		481	
HOST	PℓP†		OmN		OmN		OmN		CmN		OGN		mT†	
Fo	*86.0*		*86.2*		*86.2*		*86.4*		*86.4*		*86.4*		*86.8*	
OLIVINE														
SiO_2	40.35	*1.005*	40.26	*1.002*	39.99	*0.997*	40.20	*1.000*	40.31	*1.003*	40.38	*1.002*	40.46	*1.004*
FeO	13.13	*0.279*	13.16	*0.274*	13.28	*0.277*	13.02	*0.271*	12.98	*0.270*	12.89	*0.270*	12.57	*0.261*
NiO	0.14	*0.003*	0.30	*0.006*	0.19	*0.004*	0.21	*0.004*	0.27	*0.005*	0.25	*0.005*	0.32	*0.006*
MnO	-	-	-	-	0.08	*0.002*	-	-	0.08	*0.002*	0.15	*0.002*	0.13	*0.003*
MgO	46.37	*1.718*	46.28	*1.716*	46.35	*1.723*	46.57	*1.726*	46.37	*1.717*	46.34	*1.719*	46.52	*1.721*
Σ Cations (4 O)		*3.005*		*2.998*		*3.003*		*3.001*		*2.997*		*2.998*		*2.995*
ORTHOPYROXENE														
SiO_2	55.60	*1.946*	55.88	*1.950*	55.70	*1.950*	55.66	*1.949*	55.75	*1.948*				
Al_2O_3	2.08	*0.086*	2.06	*0.085*	1.89	*0.078*	1.78	*0.073*	2.04	*0.084*				
Cr_2O_3	0.49	*0.014*	0.42	*0.012*	0.48	*0.013*	0.59	*0.016*	0.42	*0.012*				
FeO	8.59	*0.251*	8.59	*0.251*	8.76	*0.256*	8.73	*0.256*	8.50	*0.248*				
MnO	0.13	*0.004*	0.04	*0.001*	0.17	*0.005*	0.18	*0.005*	0.15	*0.004*	*		n.d.	
MgO	31.62	*1.650*	31.99	*1.664*	31.55	*1.647*	31.79	*1.659*	31.85	*1.659*				
CaO	1.40	*0.053*	1.03	*0.039*	1.45	*0.054*	1.27	*0.047*	1.29	*0.048*				
Σ Cations (6 O)		*4.004*		*4.002*		*4.004*		*4.005*		*4.004*				
mg	*86.6*		*86.8*		*86.3*		*86.4*		*86.3*					
CLINOPYROXENE														
SiO_2	52.87	*1.921*			52.94	*1.929*	52.52	*1.919*	52.61	*1.922*	52.44	*1.915*	52.34	*1.912*
Al_2O_3	2.73	*0.117*			2.32	*0.100*	2.75	*0.118*	2.73	*0.118*	2.95	*0.127*	2.62	*0.113*
Cr_2O_3	0.89	*0.026*			0.96	*0.028*	1.00	*0.029*	1.07	*0.031*	1.09	*0.031*	1.07	*0.031*
FeO	4.58	*0.139*	n.d.		3.97	*0.121*	3.85	*0.118*	3.28	*0.100*	3.54	*0.108*	4.00	*0.122*
MgO	19.03	*1.031*			18.08	*0.982*	17.12	*0.932*	16.78	*0.914*	17.15	*0.934*	18.11	*0.986*
CaO	19.77	*0.770*			21.75	*0.849*	22.78	*0.892*	23.41	*0.916*	22.57	*0.883*	21.63	*0.847*
Na_2O	0.12	*0.009*			-	-	-	-	0.07	*0.005*	0.23	*0.016*	0.17	*0.012*
Σ Cations (6 O)		*4.013*				*4.008*		*4.008*		*4.006*		*4.014*		*4.022*
Ca:Mg:Fe	*39.7:53.1:7.2*				*43.5:50.3:6.2*		*45.9:48.0:6.1*		*47.5:47.3:5.2*		*45.9:48.5:5.6*		*43.3:50.4:6.3*	
SPINEL														
TiO_2	0.22	*0.042*	0.21	*0.040*	0.25	*0.048*	0.48	*0.095*	0.23	*0.044*	0.25	*0.048*	0.41	*0.080*
Al_2O_3	20.72	*6.257*	22.01	*6.559*	21.44	*6.412*	16.35	*5.070*	22.32	*6.691*	21.93	*6.640*	18.26	*5.559*
V_2O_3	0.35	*0.072*	0.31	*0.063*	0.32	*0.065*	0.26	*0.055*	0.29	*0.059*	0.34	*0.070*	0.51	*0.106*
Cr_2O_3	39.16	*7.933*	39.10	*7.817*	39.47	*7.918*	42.21	*8.780*	37.97	*7.636*	35.46	*7.203*	42.09	*8.596*
*Fe_2O_3	8.58	*1.654*	7.79	*1.482*	7.91	*1.510*	9.63	*1.907*	7.98	*1.527*	10.30	*1.991*	8.14	*1.582*
FeO	21.69	*4.648*	20.90	*4.419*	20.84	*4.422*	23.37	*5.142*	22.32	*4.747*	24.07	*5.171*	21.09	*4.556*
NiO	0.27	*0.056*	-	-	0.13	*0.027*	-	-	0.08	*0.016*	-	-	0.13	*0.027*
MnO	0.39	*0.085*	0.17	*0.036*	0.29	*0.062*	0.42	*0.094*	0.30	*0.065*	0.32	*0.070*	0.44	*0.096*
MgO	8.41	*3.212*	9.51	*3.585*	9.35	*3.537*	7.29	*2.859*	8.45	*3.204*	7.33	*2.807*	8.73	*3.381*
ZnO	0.22	*0.042*	-	-	-	-	-	-	0.06	*0.012*	-	-	0.20	*0.038*
Σ Cations (32 O)		*24.001*		*24.001*		*24.001*		*24.001*		*24.001*		*24.001*		*24.000*
M		*40.9*		*44.4*		*44.8*		*35.7*		*40.3*		*35.2*		*42.6*
Cr		*55.9*		*55.3*		*54.4*		*63.4*		*53.3*		*52.0*		*60.7*

SAMPLE	482		483		484		485		486		487		488	
HOST	PℓD		PℓH†		PℓP†		T(?)†		PℓD		P†		AH†	
Fo	*86.8*		*87.1*		*87.4*		*87.8*		*88.0*		*88.1*		*89.2*	
OLIVINE														
SiO_2	40.22	*0.999*	40.23	*0.999*	40.55	*1.003*	40.82	*1.008*	40.59	*1.002*	40.75	*1.005*	40.77	*1.002*
FeO	12.64	*0.263*	12.43	*0.258*	12.11	*0.251*	11.69	*0.241*	11.58	*0.239*	11.45	*0.236*	10.43	*0.214*
NiO	0.23	*0.005*	0.26	*0.005*	0.16	*0.003*	0.20	*0.004*	0.22	*0.004*	0.25	*0.005*	0.44	*0.009*
MnO	0.18	*0.004*	0.14	*0.003*	0.07	*0.001*	-	-	0.05	*0.001*	-	-	-	-
MgO	46.73	*1.731*	46.93	*1.737*	47.11	*1.738*	47.28	*1.739*	47.57	*1.751*	47.55	*1.749*	48.36	*1.772*
Σ Cations (4 O)		*3.001*		*3.001*		*2.997*		*2.992*		*2.998*		*2.995*		*2.998*
ORTHOPYROXENE														
SiO_2	56.03	*1.957*	56.19	*1.956*					55.88	*1.950*	56.31	*1.954*	56.82	*1.963*
Al_2O_3	1.69	*0.070*	1.75	*0.072*					1.79	*0.074*	2.03	*0.083*	1.78	*0.072*
Cr_2O_3	0.40	*0.011*	0.37	*0.010*					0.45	*0.012*	0.44	*0.012*	0.15	*0.004*
FeO	8.44	*0.247*	8.05	*0.234*					7.34	*0.214*	7.63	*0.221*	7.20	*0.208*
MnO	0.10	*0.003*	-	-	*		n.d.		0.15	*0.004*	0.10	*0.003*	-	-
MgO	31.96	*1.664*	32.60	*1.692*					31.90	*1.659*	32.99	*1.706*	33.86	*1.744*
CaO	1.39	*0.052*	1.04	*0.039*					2.50	*0.093*	0.53	*0.020*	0.20	*0.007*
Σ Cations (6 O)		*4.003*		*4.003*						*4.007*		*3.999*		*3.999*
Mg		*86.9*		*87.9*						*88.4*		*88.4*		*89.3*
CLINOPYROXENE														
SiO_2	52.99	*1.928*	52.93	*1.930*	52.82	*1.926*			53.02	*1.934*				
Al_2O_3	2.40	*0.103*	2.43	*0.104*	2.78	*0.119*			2.36	*0.101*				
Cr_2O_3	1.04	*0.030*	0.94	*0.027*	1.03	*0.030*			0.80	*0.023*				
FeO	3.98	*0.121*	3.14	*0.096*	2.82	*0.086*			3.12	*0.095*				
MgO	18.28	*0.992*	17.21	*0.935*	16.70	*0.908*	n.d.		16.91	*0.920*	n.d.		n.d.	
CaO	21.15	*0.825*	23.29	*0.910*	23.60	*0.922*			23.81	*0.931*				
Na_2O	0.18	*0.013*	-	-	0.26	*0.018*			-	-				
Σ Cations (6 O)		*4.012*		*4.004*		*4.009*				*4.004*				
Ca:Mg:Fe	*42.6:51.2:6.2*		*46.9:48.2:4.9*		*48.1:47.4:4.5*				*47.8:47.3:4.9*					
SPINEL														
TiO_2	0.38	*0.075*	0.19	*0.037*	0.14	*0.025*	0.77	*0.154*	0.47	*0.091*	0.14	*0.026*	0.08	*0.014*
Al_2O_3	16.95	*5.222*	20.94	*6.324*	31.41	*8.891*	17.45	*5.478*	19.84	*6.010*	28.31	*8.158*	41.67	*11.180*
V_2O_3	0.41	*0.086*	0.29	*0.060*	0.25	*0.048*	0.36	*0.077*	0.31	*0.064*	0.24	*0.047*	0.16	*0.029*
Cr_2O_3	41.76	*8.630*	40.51	*8.208*	32.77	*6.222*	40.54	*8.538*	38.17	*7.757*	36.70	*7.094*	22.42	*4.035*
*Fe_2O_3	9.73	*1.914*	6.93	*1.336*	4.37	*0.790*	7.98	*1.600*	10.28	*1.988*	3.54	*0.651*	4.26	*0.730*
FeO	22.34	*4.883*	22.25	*4.768*	18.39	*3.814*	27.63	*6.155*	21.71	*4.666*	20.13	*4.116*	16.83	*3.204*
NiO	-	-	0.11	*0.023*	-	-	-	-	-	-	-	-	0.32	*0.059*
MnO	0.38	*0.084*	0.38	*0.082*	0.26	*0.053*	0.55	*0.124*	0.52	*0.113*	0.31	*0.064*	0.25	*0.048*
MgO	7.90	*3.078*	8.15	*3.113*	11.46	*4.088*	4.72	*1.874*	8.59	*3.291*	10.46	*3.812*	13.70	*4.649*
ZnO	0.15	*0.029*	0.26	*0.05*	0.39	*0.069*	-	-	0.11	*0.021*	0.18	*0.032*	0.32	*0.054*
Σ Cations (32 O)		*24.001*		*24.001*		*24.000*		*24.000*		*24.001*		*24.000*		*24.001*
Mg		*38.7*		*39.5*		*51.7*		*23.3*		*41.4*		*48.1*		*59.2*
Cr		*62.3*		*56.5*		*41.2*		*60.9*		*56.3*		*46.5*		*26.5*

SAMPLE	489		490		491		492		493		494		495	
HOST	OO		H†		H†		H		H		H†		H	
Fo	*90.4*		*91.0*		*91.1*		*91.4*		*91.5*		*91.6*		*91.6*	
OLIVINE														
SiO_2	41.19	*1.006*	41.13	*1.002*	41.40	*1.008*	41.26	*1.003*	41.31	*1.004*	41.26	*1.003*	41.21	*1.003*
FeO	9.37	*0.191*	8.77	*0.179*	8.60	*0.175*	8.38	*0.170*	8.25	*0.168*	8.21	*0.167*	8.20	*0.167*
NiO	0.21	*0.004*	0.30	*0.006*	0.33	*0.007*	0.30	*0.006*	0.28	*0.006*	0.23	*0.004*	0.39	*0.008*
MnO	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MgO	49.23	*1.792*	49.84	*1.811*	49.67	*1.802*	50.11	*1.817*	50.15	*1.818*	50.31	*1.823*	50.19	*1.820*
Σ Cations (4 O)		*2.994*		*2.998*		*2.992*		*2.997*		*2.996*		*2.997*		*2.997*
ORTHOPYROXENE														
SiO_2	57.68	*1.985*	56.68	*1.949*	56.55	*1.945*	56.89	*1.955*	56.78	*1.949*	56.53	*1.946*	56.06	*1.926*
Al_2O_3	0.54	*0.022*	2.27	*0.092*	2.76	*0.112*	2.19	*0.089*	2.38	*0.096*	2.46	*0.100*	3.17	*0.128*
Cr_2O_3	0.19	*0.005*	0.58	*0.016*	0.38	*0.010*	0.46	*0.012*	0.23	*0.006*	0.46	*0.013*	0.63	*0.017*
FeO	6.29	*0.181*	5.70	*0.164*	5.72	*0.165*	5.73	*0.165*	5.56	*0.160*	5.84	*0.168*	5.31	*0.153*
MnO	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MgO	35.08	*1.800*	34.43	*1.765*	33.72	*1.729*	34.43	*1.763*	34.62	*1.772*	34.15	*1.752*	34.47	*1.765*
CaO	0.20	*0.007*	0.33	*0.012*	0.88	*0.032*	0.30	*0.011*	0.43	*0.016*	0.53	*0.020*	0.35	*0.013*
Σ Cations (6 O)		*4.001*		*3.997*		*3.994*		*3.995*		*3.999*		*3.998*		*4.002*
mg		*90.9*		*91.5*		*91.3*		*91.4*		*91.7*		*91.3*		*92.0*
CLINOPYROXENE														
SiO_2	n.d.		53.48	*1.943*	52.43	*1.907*	54.12	*1.962*	53.87	*1.952*	52.93	*1.924*	54.05	*1.959*
Al_2O_3			1.91	*0.082*	3.31	*0.142*	1.13	*0.048*	1.88	*0.080*	2.70	*0.116*	1.52	*0.065*
Cr_2O_3			0.65	*0.019*	1.05	*0.030*	0.46	*0.013*	0.56	*0.016*	1.00	*0.029*	0.36	*0.010*
FeO			1.64	*0.050*	1.88	*0.057*	1.58	*0.048*	1.55	*0.047*	1.84	*0.056*	1.62	*0.049*
MgO			17.45	*0.945*	17.04	*0.924*	18.09	*0.978*	17.70	*0.956*	17.17	*0.930*	18.03	*0.974*
CaO			24.88	*0.968*	24.30	*0.947*	24.64	*0.957*	24.46	*0.949*	24.38	*0.949*	24.16	*0.938*
Na_2O			-	-	-	-	-	-	-	-	-	-	0.26	*0.018*
Σ Cations (6 O)				*4.007*		*4.007*		*4.007*		*4.000*		*4.004*		*4.013*
Ca:Mg:Fe			*49.3:48.1:2.5*		*49.1:47.9:3.0*		*48.3:49.3:2.4*		*48.6:49.0:2.4*		*49.0:48.1:2.9*		*47.8:49.7:2.5*	
SPINEL														
TiO_2	0.15	*0.031*	n.d.		-	-	-	-	-	-	0.09	*0.016*	-	-
Al_2O_3	7.22	*2.342*			43.65	*11.530*	33.33	*9.141*	36.74	*9.942*	35.24	*9.656*	40.67	*10.691*
V_2O_3	0.19	*0.042*			0.13	*0.023*	0.21	*0.039*	0.27	*0.050*	0.22	*0.041*	0.14	*0.025*
Cr_2O_3	55.74	*12.130*			24.12	*4.274*	36.76	*6.764*	32.06	*5.819*	32.37	*5.950*	29.38	*5.181*
*Fe_2O_3	6.88	*1.425*			1.03	*0.174*	0.32	*0.056*	1.10	*0.190*	1.84	*0.322*	0.62	*0.104*
FeO	22.88	*5.266*			14.99	*2.809*	14.23	*2.769*	14.24	*2.734*	15.99	*3.109*	11.68	*2.178*
NiO	-	-			0.24	*0.043*	-	-	-	-	-	-	-	-
MnO	0.47	*0.110*			0.27	*0.051*	0.16	*0.032*	0.29	*0.056*	-	-	-	-
MgO	6.47	*2.655*			14.95	*4.995*	14.99	*5.200*	15.15	*5.185*	14.06	*4.873*	17.51	*5.822*
ZnO	-	-			0.61	*0.101*	-	-	0.14	*0.024*	0.20	*0.034*	-	-
Σ Cations (32 O)		*24.001*				*24.001*		*24.001*		*24.000*		*24.001*		*24.001*
M		*33.5*				*64.0*		*65.3*		*65.5*		*61.0*		*72.8*
Cr		*83.8*				*27.0*		*42.5*		*36.9*		*38.1*		*32.6*

SAMPLE	496		497		498		499		525	
HOST	H		H		H		PℓD		H	
Fo	*92.0*		*92.2*		*92.3*		-		-	
OLIVINE										
SiO_2	41.38	*1.004*	41.36	*1.013*	41.61	*1.008*				
FeO	7.78	*0.158*	7.57	*0.153*	7.53	*0.153*				
NiO	0.31	*0.006*	0.25	*0.005*	0.34	*0.007*				
MnO	-	-	-	-	-	-				
MgO	50.53	*1.828*	50.32	*1.815*	50.52	*1.825*				
Σ Cations (4 O)		*2.996*		*2.987*		*2.992*				
ORTHOPYROXENE										
SiO_2	56.36	*1.940*	56.48	*1.938*	56.38	*1.934*				
Al_2O_3	2.41	*0.098*	2.39	*0.097*	2.75	*0.111*				
Cr_2O_3	0.54	*0.015*	0.57	*0.016*	0.52	*0.014*				
FeO	5.13	*0.148*	5.14	*0.147*	5.12	*0.147*				
MnO	0.14	*0.004*	-	-	-	-				
MgO	34.29	*1.759*	35.11	*1.796*	34.95	*1.787*				
CaO	1.14	*0.042*	0.30	*0.011*	0.28	*0.010*				
Σ Cations (6 O)		*4.006*		*4.005*		*4.003*				
mg		*92.0*		*92.4*		*92.4*				
CLINOPYROXENE										
SiO_2	54.05	*1.957*			53.97	*1.954*				
Al_2O_3	1.87	*0.080*			1.65	*0.070*				
Cr_2O_3	0.67	*0.019*			0.44	*0.013*				
FeO	1.66	*0.050*			1.67	*0.051*				
MgO	17.68	*0.954*	n.d.		18.29	*0.987*				
CaO	24.08	*0.934*			23.98	*0.930*				
Na_2O	-	-			-	-				
Σ Cations (6 O)		*3.994*				*4.005*				
Ca:Mg:Fe	*48.2:49.2:2.6*				*47.3:50.1:2.6*				Massive Podiform Chromite	
SPINEL										
TiO_2	0.07	*0.012*	-	-	-	-	0.10	*0.019*	0.20	*0.036*
Al_2O_3	34.76	*9.459*	34.33	*9.311*	36.88	*9.835*	22.38	*6.734*	21.38	*6.093*
V_2O_3	0.24	*0.044*	-	-	0.19	*0.034*	0.24	*0.049*	0.07	*0.014*
Cr_2O_3	33.84	*6.178*	35.00	*6.368*	32.75	*5.859*	37.55	*7.579*	48.85	*9.340*
*Fe_2O_3	1.70	*0.295*	1.86	*0.322*	1.60	*0.272*	8.35	*1.604*	2.66	*0.484*
FeO	13.71	*2.647*	12.50	*2.405*	11.07	*2.095*	23.18	*4.956*	9.73	*1.970*
NiO	0.10	*0.019*	-	-	-	-	-	-	0.10	*0.019*
MnO	0.13	*0.025*	-	-	-	-	0.41	*0.089*	0.64	*0.131*
MgO	15.46	*5.321*	16.31	*5.595*	17.51	*5.906*	7.80	*2.970*	16.40	*5.913*
ZnO	-	-	-	-	-	-	-	-	-	-
Σ Cations (32 O)		*24.001*		*24.001*		*24.001*		*24.000*		*24.000*
M		*66.8*		*69.9*		*74.2*		*37.5*		*75.0*
Cr		*39.5*		*40.6*		*35.6*		*53.0*		*60.5*

TABLE C-3

Analyses of Zoned Orthopyroxenes in Olivine Norites and Peridotites from the PBOC

SAMPLE	458		459		461		467		468		480		484	
HOST	PℓH		OGN		OmN		OmN		PℓH†		OGN		PℓP†	
	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM
SiO_2	55.39	55.73	55.65	55.57	55.63	55.03	55.22	56.21	55.47	56.11	55.30	55.65	55.95	56.21
Al_2O_3	2.05	1.94	2.02	1.66	2.10	1.89	2.18	1.61	2.09	1.68	2.44	2.01	2.24	1.76
Cr_2O_3	0.49	0.52	0.43	0.48	0.59	0.33	0.46	0.14	0.44	0.36	0.60	0.41	0.48	0.23
FeO	9.52	9.66	9.67	10.07	9.16	9.52	9.09	9.29	9.32	8.91	8.14	8.42	7.65	8.37
MnO	0.20	0.15	-	0.30	0.16	0.14	0.17	0.18	0.19	0.18	0.18	0.17	0.15	-
MgO	31.01	31.43	31.15	31.42	30.87	32.52	31.01	32.13	31.57	31.87	31.32	32.33	32.25	33.06
CaO	1.34	0.57	1.08	0.50	1.49	0.57	1.87	0.44	0.93	0.90	2.02	1.01	1.28	0.37
Numbers of cations on the basis of 6 *oxygens*:														
Si	1.946	1.954	1.952	1.953	1.951	1.931	1.940	1.964	1.944	1.961	1.935	1.944	1.947	1.955
Al^{IV}	0.054	0.046	0.048	0.047	0.049	0.069	0.060	0.036	0.056	0.039	0.065	0.056	0.053	0.045
Al^{VI}	0.031	0.034	0.036	0.022	0.038	0.009	0.030	0.030	0.030	0.030	0.036	0.027	0.039	0.027
Cr	0.014	0.014	0.012	0.013	0.016	0.009	0.013	0.004	0.012	0.010	0.017	0.011	0.013	0.006
ΣFe	0.280	0.283	0.284	0.296	0.269	0.280	0.267	0.271	0.273	0.260	0.238	0.246	0.223	0.243
Mn	0.006	0.005	-	0.009	0.005	0.004	0.005	0.005	0.006	0.005	0.005	0.005	0.004	-
Mg	1.624	1.642	1.628	1.646	1.614	1.701	1.624	1.673	1.650	1.660	1.634	1.683	1.673	1.714
Ca	0.050	0.021	0.040	0.019	0.056	0.021	0.070	0.016	0.035	0.034	0.076	0.038	0.048	0.014
Σ Cations	4.005	3.999	4.000	4.005	3.998	4.024	4.009	3.999	4.006	3.999	4.006	4.010	4.000	4.004
mg	85.0	85.1	85.1	84.4	85.5	85.7	85.7	85.8	85.5	86.2	87.1	87.0	88.1	87.6
Ca at.%	2.6	1.1	2.0	1.0	2.9	1.0	3.6	0.8	1.8	1.7	3.9	1.9	2.5	0.7
Mg at.%	82.8	84.1	83.5	83.6	83.0	84.8	82.6	85.1	84.0	84.8	83.7	85.4	85.9	87.0
Fe' at.%	14.6	14.8	14.5	15.4	14.1	14.2	13.8	14.1	14.2	13.5	12.4	12.7	11.6	12.3

mg = 100 Mg/(Mg+ΣFe+Mn)

Note: For key to host rock nomenclature see Table C-2.

<u>TABLE C-4</u>

Analyses of Zoned Clinopyroxenes in Olivine Norites from the Pigna Barney Ophiolitic Complex

SAMPLE	459		467		470	
HOST	OGN		OmN		OmN	
	CORE	RIM	CORE	RIM	CORE	RIM
SiO_2	52.60	53.67	52.44	53.07	52.50	52.59
Al_2O_3	2.72	1.37	2.74	2.10	2.81	2.43
Cr_2O_3	1.06	0.31	1.05	0.84	1.02	0.85
FeO	4.24	3.31	3.57	3.19	3.55	3.76
MgO	17.11	16.99	16.63	16.92	16.33	16.92
CaO	22.26	24.35	23.33	23.60	23.69	23.35
Na_2O	-	-	0.24	0.28	0.10	0.10
Numbers of cations on the basis of 6 oxygens:						
Si	1.922	1.960	1.919	1.938	1.921	1.924
Al^{IV}	0.078	0.040	0.081	0.062	0.079	0.076
Al^{VI}	0.039	0.019	0.037	0.028	0.042	0.029
Cr	0.031	0.009	0.030	0.024	0.030	0.025
ΣFe	0.130	0.101	0.109	0.098	0.108	0.115
Mg	0.932	0.925	0.907	0.921	0.891	0.923
Ca	0.872	0.953	0.914	0.924	0.928	0.916
Na	-	-	0.017	0.020	0.007	0.007
Σ	4.004	4.007	4.014	4.015	4.006	4.015
mg	87.8	90.2	89.3	90.4	89.2	88.9
Ca (at.%)	45.1	48.2	47.4	47.6	48.2	46.9
Mg (at.%)	48.2	46.7	47.0	47.4	46.2	47.2
Fe' (at.%)	6.7	5.1	5.6	5.0	5.6	5.9

mg = 100 Mg/(Mg+ΣFe+Mn)

Note: For key to host rock nomenclature <u>see</u> Table C-2.

TABLE C-5

Representative Analyses of Plagioclases in Gabbroic and Ultramafic Rocks from the Pigna Barney Ophiolitic Complex

ANALYSIS No.	1	2	3	4	5	6	7
SAMPLE	028	026	440	443	456	460	474
SiO_2	47.47	45.31	46.43	46.05	45.97	45.92	46.10
Al_2O_3	32.46	33.61	33.91	34.08	34.63	33.93	34.35
ΣFeO	0.88	0.69	0.23	0.19	0.24	0.19	0.26
MgO	0.09	0.09	-	-	-	-	-
CaO	17.30	17.69	17.93	17.81	17.99	18.17	17.76
Na_2O	2.04	1.47	1.60	1.60	1.47	1.40	1.45
K_2O	-	-	-	-	-	-	-
TOTAL	100.24	98.86	100.10	99.73	100.30	99.61	99.92
Numbers of cations on the basis of 32 oxygens:							
Si	8.745	8.473	8.551	8.511	8.451	8.503	8.499
Al	7.048	7.408	7.360	7.424	7.504	7.405	7.464
ΣFe	0.136	0.108	0.035	0.029	0.037	0.029	0.040
Mg	0.025	0.025	-	-	-	-	-
Ca	3.415	3.544	3.538	3.527	3.544	3.605	3.508
Na	0.729	0.533	0.571	0.573	0.524	0.503	0.518
Σ	20.096	20.091	20.055	20.064	20.060	20.046	20.029
An	82.4	86.9	86.1	86.0	87.1	87.8	87.1

An = 100 Ca/(Ca+Na)

Analyses 1,2 from gabbro

Analyses 3-6 from olivine mela-norites

Analysis 7 from plagioclase-bearing peridotite.

TABLE C-6

Representative Analyses of Primary and Secondary Amphiboles in PBOC Intrusives

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11
HOST	AH	T	T	OmN	OmN	OmN	OmN	OmN	G	G	D
SAMPLE	488	485	485	457	325	324	324	439	026	028	032
SiO_2	46.35	53.16	49.84	50.00	48.94	48.46	52.75	46.09	52.77	52.64	48.65
TiO_2	-	-	-	-	-	-	-	-	0.17	0.29	0.61
Al_2O_3	12.97	5.89	9.81	8.67	9.73	10.09	5.28	12.01	3.08	2.30	4.24
Cr_2O_3	1.12	-	-	-	-	0.28	0.20	0.38	0.08	-	-
ΣFeO	4.54	3.56	4.70	5.14	6.40	7.05	5.16	7.47	13.18	15.43	21.12
MnO	-	-	-	-	-	-	-	-	0.37	0.26	0.31
MgO	18.59	21.59	19.70	20.18	19.31	18.57	20.19	17.49	16.60	14.87	11.10
CaO	12.38	12.98	12.38	11.85	11.37	12.27	12.81	12.01	10.66	11.70	9.92
Na_2O	1.51	0.28	0.81	1.06	1.27	1.76	0.57	2.02	0.17	0.20	1.45
K_2O	-	-	-	-	-	-	-	-	-	-	0.34
TOTAL	97.46	97.46	97.24	96.90	97.02	98.48	96.96	97.47	97.08	97.69	97.74
Fe_2O_3	3.06	3.73	4.17	4.30	4.90	4.95	2.98	5.22	2.19	2.74	2.34
FeO	1.79	0.20	0.95	1.27	1.99	2.08	2.48	2.79	11.21	12.96	18.96
New Total	97.77	97.83	97.66	97.33	97.51	98.46	97.26	98.01	97.30	97.96	97.92
Numbers of cations on the basis of 23 (O,OH)											
Si	6.296	7.301	6.908	6.968	6.844	6.757	7.358	6.504	7.593	7.623	7.299
Al^{IV}	1.704	0.699	1.092	1.032	1.156	1.243	0.642	1.496	0.407	0.377	0.750
Al^{VI}	0.516	0.254	0.511	0.392	0.448	0.415	0.226	0.502	0.115	0.015	-
Ti	-	-	-	-	-	-	-	-	0.018	0.032	0.069
Cr	0.129	-	-	-	-	0.031	0.022	0.042	0.009	-	-
Fe^{3+}	0.334	0.386	0.435	0.451	0.516	0.519	0.313	0.554	0.237	0.299	0.264
Fe^{2+}	0.218	0.023	0.110	0.148	0.233	0.243	0.290	0.330	1.351	1.570	2.383
Mn	-	-	-	-	-	-	-	-	0.045	0.032	0.040
Mg	4.025	4.419	4.069	4.191	4.024	3.860	4.198	3.679	3.561	3.209	2.482
Ca	1.927	1.910	1.839	1.769	1.704	1.833	1.914	1.816	1.643	1.815	1.595
Na	0.425	0.075	0.218	0.286	0.344	0.476	0.154	0.533	0.047	0.056	0.422
K	-	-	-	-	-	-	-	-	-	-	0.064
Σ	15.574	15.067	15.182	15.238	15.269	15.377	15.117	15.476	15.026	15.028	15.368
M	0.949	0.995	0.974	0.966	0.945	0.941	0.935	0.918	0.725	0.671	0.510

Fe^{3+} calculated following the method of Papike *et al.* (1974).
$M = Mg/(Mg+Fe^{2+})$

HOST: G = gabbro
D = dolerite

For other host rock nomenclature see Table C-2

Analyses:

1 = primary tschermakitic hornblende
2,7 = secondary tremolitic hornblende
3,4,5,6,8 = secondary magnesio-hornblende
9,10 = secondary actinolite
11 = secondary actinolitic hornblende

Amphibole nomenclature after Leake (1978).

TABLE C - 7

Average Compositions of Metamorphic Spinels in Amphibolitized Olivine Norites from the Pigna Barney Ophiolitic Complex and in an Olivine Gabbro from the Curricabark Fault Zone

ANALYSIS No.	1		2		3		4	
SAMPLE	328		457		325 & 326		421	
	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
Al_2O_3	63.53	±2.23	62.93	±0.65	61.87	±0.68	62.60	±0.34
Cr_2O_3	1.37	±1.22	2.94	±0.61	2.29	±0.47	-	
Fe_2O_3	3.30	±0.14	1.70	±0.23	2.73	±0.37	4.40	±0.41
FeO	11.91	±0.30	13.80	±0.45	16.04	±0.58	15.97	±0.30
NiO	0.27	±0.02	0.34	±0.08	0.33	±0.07	-	
MnO	-		0.10	±0.09	0.04	±0.07	-	
MgO	19.35	±0.45	18.01	±0.20	16.50	±0.33	16.77	±0.04
ZnO	0.27	±0.11	0.18	±0.03	0.16	±0.17	0.27	±0.19
M	74.3		69.9		64.7		65.2	
Numbers of cations on the basis of 32 oxygens:								
Al	15.273		15.262		15.191		15.313	
Cr	0.221		0.478		0.377		-	
Fe^3	0.507		0.263		0.428		0.687	
Fe^2	2.032		2.375		2.795		2.772	
Ni	0.044		0.056		0.055		-	
Mn	-		0.017		0.007		-	
Mg	5.884		5.522		5.123		5.188	
Zn	0.040		0.027		0.025		0.041	
Σ	24.001		24.000		24.001		24.001	
N	8		5		14		6	

$M = 100Mg/(Mg + Fe^{2+})$

Fe^{3+} calculated assuming stoichiometry

Olivine gabbro = sample 421

N = number of grains analysed, several analyses each grain

$\bar{X}$ = mean ; s = standard deviation

TABLE C-8

Chemical Analyses of Hydrogarnets and Prehnites

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10
SAMPLE	420	329	438	472	472	473	475	475	478	478
SiO_2	38.79	40.69	37.42	37.30	36.13	29.25	37.78	29.63	32.49	32.72
Al_2O_3	27.67	28.41	26.54	23.03	23.40	22.96	22.45	21.25	20.11	24.86
ΣFe_2O_3	1.67	0.79	4.46	0.20	1.41	1.16	0.72	16.67	5.20	4.96
MnO	0.05	0.03	0.19	0.12	-	-	0.21	0.30	-	-
MgO	3.17	2.39	3.53	-	-	0.18	-	4.00	7.25	0.85
CaO	23.59	20.96	20.76	38.18	36.77	38.51	38.12	23.67	27.40	29.33
Na_2O	0.25	0.56	0.40	-	-	-	-	-	-	-
ΣVol.	4.73	5.52	6.63	1.17	2.29	7.89	0.82	4.48	7.55	7.28
TOTAL	100.08*	99.86**	100	100	100	100	100	100	100	100
Cl^-	n.d.	n.d.	0.07	-	-	0.06	-	-	-	-
Si } atom.%	40.2	42.1	41.1	35.4	35.0	30.0	36.0	37.0	38.0	35.0
Al } atom.%	33.7	34.7	34.4	25.8	26.7	27.7	25.2	31.3	27.7	31.4
Ca } atom.%	26.1	23.2	24.5	38.8	38.2	42.3	38.9	31.7	34.3	33.6

ANALYSIS No.	11	12	13	14	15	16	17	18	19	20
SAMPLE	479	482	482	486	486	035	440	448	460	464
SiO_2	34.99	28.32	27.58	35.04	31.17	37.29	42.54	42.44	43.07	42.85
Al_2O_3	22.75	22.77	22.03	20.85	22.33	9.55	25.25	26.15	25.22	24.97
ΣFe_2O_3	0.78	1.42	6.65	4.61	7.71	17.24	0.43	0.13	-	0.20
MnO	-	-	-	-	-	0.23	-	-	-	-
MgO	-	0.15	1.83	2.37	5.78	0.51	0.10	-	0.07	-
CaO	38.21	39.09	32.64	31.59	26.25	34.23	27.22	27.00	27.31	27.67
Na_2O	-	-	-	-	-	-	0.14	-	-	-
ΣVol.‡	3.27	8.20	9.27	5.54	6.76	0.56	4.24	4.28	4.33	4.31
TOTAL	100	100	100	100	100	100†	100	100	100	100
Cl^-	-	0.05	-	-	-	-	0.08	-	-	-
Si } atom.%	34.1	29.2	31.2	37.5	36.4	43.8	41.9	41.5	42.2	42.0
Al } atom.%	26.1	27.7	29.3	26.3	30.7	13.2	29.3	30.2	29.1	28.9
Ca } atom.%	39.8	43.2	39.5	36.2	32.9	43.0	28.8	28.3	28.7	29.1

Analyses 1-16 = hydrogarnet, analyses 1 and 2 by XRF and wet chemistry. Analyses 17-20 = prehnite. Analysis 16 from hyaloclastite, remainder from mafic and ultramafic intrusives.

†Total includes TiO_2, 0.22; V_2O_3, 0.17.

*Total includes TiO_2, 0.04; Cr_2O_3, 0.01; (Fe_2O_3, 0.19; FeO, 1.33); K_2O, 0.04; P_2O_5, 0.05.

**Total includes Cr_2O_3, 0.06; (Fe_2O_3, 0.05; FeO, 0.66); NiO, 0.01; K_2O, 0.38; P_2O_5, 0.03.

ΣVol determined by ignition loss for analyses 1 and 2. Remaining analyses by microprobe for which volatiles have been determined by difference.

n.d. = not determined.

TABLE C-9

Representative Analyses of Pyroxenes in Low-Ti Gabbros and Doleritic Rocks from the PBOC

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11	12
	ORTHOPYROXENES					CLINOPYROXENES						
	CORE	RIM	CORE	RIM							CORE	RIM
SAMPLE	025	025	028	028	028	027	025	026	028	028	032	032
SiO_2	54.99	54.64	54.24	54.12	52.63	52.62	53.07	52.74	52.41	51.62	51.37	51.14
TiO_2	-	-	-	-	-	-	-	-	-	-	-	0.22
Al_2O_3	1.42	1.43	1.45	1.00	0.90	2.82	2.00	1.54	1.67	1.53	3.07	2.26
Cr_2O_3	0.17	0.10	0.35	0.16	-	0.71	0.49	0.44	0.56	-	-	-
ΣFeO	13.14	15.05	14.64	17.06	22.59	6.01	7.11	7.68	7.14	11.55	10.23	11.51
MnO	0.16	0.27	0.29	0.23	0.34	0.26	0.07	0.16	0.19	0.39	0.19	0.27
MgO	27.75	26.30	28.61	25.38	21.46	16.83	17.75	15.67	15.85	12.94	15.76	14.06
CaO	2.36	2.20	2.32	2.04	2.08	20.97	19.39	21.77	22.16	21.58	19.38	20.41
Na_2O	-	-	-	-	-	-	0.13	-	-	-	-	-
TOTAL	99.99	99.99	101.90	99.99	100.00	100.22	100.01	100.00	99.98	99.61	100.00	99.87
Numbers of cations on the basis of 6 oxygens:												
Si	1.967	1.971	1.958	1.972	1.970	1.927	1.946	1.954	1.942	1.956	1.913	1.926
Al^{IV}	0.033	0.029	0.042	0.028	0.030	0.073	0.054	0.046	0.058	0.044	0.087	0.074
Al^{VI}	0.027	0.032	0.020	0.015	0.010	0.049	0.032	0.021	0.015	0.024	0.048	0.026
Ti	-	-	-	-	-	-	-	-	-	-	-	0.006
Cr	0.005	0.003	0.010	0.005	-	0.021	0.014	0.013	-	-	-	-
ΣFe	0.394	0.455	0.443	0.520	0.708	0.184	0.218	0.238	0.222	0.366	0.319	0.363
Mn	0.005	0.008	0.009	0.007	0.011	0.008	0.002	0.005	0.006	0.013	0.006	0.009
Mg	1.480	1.414	1.428	1.378	1.198	0.919	0.970	0.865	0.875	0.731	0.874	0.789
Ca	0.090	0.085	0.096	0.080	0.083	0.823	0.762	0.864	0.880	0.876	0.773	0.824
Na	-	-	-	-	-	-	0.009	-	-	-	-	-
Σ	4.001	3.997	4.006	4.005	4.010	4.004	4.007	4.006	3.998	4.010	4.020	4.017
mg	78.8	75.3	76.0	72.3	62.5	82.7	81.5	78.1	79.3	65.9	72.9	68.0
Ca atom.%	4.6	4.3	4.9	4.0	4.2	47.5	39.0	43.8	44.4	44.1	39.2	41.6
Mg atom.%	75.1	72.1	72.3	69.4	59.9	42.6	49.7	43.9	44.1	36.8	44.3	39.7
Fe' atom.%	20.3	23.6	22.8	26.6	35.9	9.9	11.3	12.3	11.5	19.1	16.5	18.7

mg = 100 Mg/(Mg+ΣFe+Mn)

Note: some analyses recalculated to 100.0% to compensate for slight filament current drift during microprobe analysis of the samples concerned.

Analyses 11,12 from low-Ti doleritic intrusive, remainder from low-Ti gabbros.

Anorthite contents of plagioclases in low-Ti gabrros and doleritic rocks

SAMPLE	025	026	027	028	032
	88-77	89-76	87-77	89-51	69-0

TABLE C-10

Representative Analyses of Cr-Al Spinels in Watchimbark Cumulate Harzburgites and Sedimentary Serpentinites

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11	12	13
SAMPLE	491	429	428	494	427	436	434	261	432	432	432	432	432
TiO_2	-	-	0.12	0.09	0.27	-	-	-	-	-	-	-	-
Al_2O_3	43.65	42.29	36.38	35.4	22.03	12.92	11.12	48.45	44.69	31.74	24.64	10.98	3.50
V_2O_3	0.13	0.18	0.16	0.22	0.36	0.29	0.28	0.17	0.17	0.19	0.28	0.32	-
Cr_2O_3	24.12	26.71	30.47	32.37	39.91	55.12	59.49	18.78	22.78	35.72	43.87	58.86	68.05
$*Fe_2O_3$	1.03	0.80	2.58	1.84	6.29	1.81	0.31	2.03	2.46	2.36	0.93	0.99	0.75
FeO	14.99	13.27	15.01	15.99	22.18	21.55	18.92	12.64	11.35	16.31	18.96	19.04	18.41
NiO	0.24	-	0.22	-	-	-	-	0.29	0.28	-	-	-	-
MnO	0.27	-	0.30	-	0.31	0.32	0.39	0.18	0.31	0.27	0.26	0.50	-
MgO	14.95	16.46	14.37	14.06	8.60	7.99	9.49	17.21	17.33	13.31	10.74	9.32	9.29
ZnO	0.61	0.29	0.39	0.20	0.05	-	-	0.25	0.13	0.10	0.32	-	-
	100	100	100	100	100	100	100	100	100	100	100	100	100
Numbers of cations on the basis of 32 oxygens:													
Ti	-	-	0.021	0.016	0.052	-	-	-	-	-	-	-	-
Al	11.530	11.122	9.912	9.656	6.600	4.034	3.460	12.413	11.598	8.358	7.188	3.424	1.128
V	0.023	0.032	0.030	0.041	0.073	0.062	0.059	0.030	0.030	0.036	0.056	0.068	-
Cr	4.274	4.712	5.569	5.950	8.021	11.544	12.419	3.228	3.966	6.678	8.585	12.312	14.718
Fe^{3+}	0.174	0.134	0.449	0.322	1.203	0.361	0.062	0.332	0.408	0.421	0.173	0.197	0.154
Fe^{2+}	2.809	2.476	2.902	3.109	4.715	4.774	4.178	2.298	2.182	3.230	3.924	4.212	4.211
Ni	0.043	-	0.041	-	-	-	-	0.051	0.050	-	-	-	-
Mn	0.051	-	0.059	-	0.067	0.072	0.087	0.033	0.058	0.054	0.055	0.112	-
Mg	4.995	5.475	4.952	4.873	3.259	3.155	3.735	5.577	5.689	4.698	3.963	3.676	3.788
Zn	0.101	0.048	0.067	0.034	0.009	-	-	-	0.021	0.017	0.058	-	-
Σ	24.001	24.001	24.001	24.001	24.000	24.001	24.001	24.001	24.000	24.001	24.001	24.001	24.001
M	64.0	68.9	63.1	61.0	40.9	39.8	47.2	70.8	72.3	59.3	50.2	46.6	47.4
Cr	27.0	29.8	36.0	38.1	54.9	74.1	78.2	20.6	25.5	43.0	54.4	78.2	92.9

$*Fe_2O_3$ calculated assuming stoichiometry

$M = 100\ Mg/(Mg+Fe^{2+})$

$Cr = 100\ Cr/(Cr+Al)$

Analyses 1-7 from Watchimbark cumulate harzburgites

Analyses 8-13 from sedimentary serpentinite

Summary of variations in *M* and *Cr* displayed by spinel populations in samples of sedimentary serpentinite.

SAMPLE	*M*	*Cr*	(n)
260	69-61	33-30	3
261	72-54	43-20	16
432	73-44	93-25	14
268	63-39	94-34	6
269	66-59	42-40	3
270	59-19	83-45	6

(n) = no. of grains analysed

APPENDIX D

Olivine-spinel and two-pyroxene geothermometry of mafic and ultramafic rocks in the PBOC.

TABLE - D

SAMPLE	*Fo*	1	2	3	4	5	SAMPLE	*Fo*	1	2	3	4	5
440	80.5	680	407	445	878	917	470	85.5	1128	697	694	896	982
441	80.5	649	399	429	869	933	471	85.5	1023	637	651	959	1049
442	81.0	676	419	446	886	976	472	85.7	1002	621	643	988	930
443	82.0	967	593	601	891	938	473	85.8	1099	653	681	-	-
444	82.5	867	570	566	902	889	474	85.8	1013	624	649	1022	989
445	82.7	806	499	526	901	931	475	86.0	1149	708	705	-	-
446	82.7	789	489	516	-	-	476	86.2	1159	710	708	1063	963
447	82.9	867	570	566	902	889	477	86.2	1076	659	672	1156	1046
448	83.0	1029	638	630	899	723	478	86.4	1028	607	649	981	1136
449	83.0	1001	617	611	962	918	479	86.4	1000	623	645	923	931
450	83.2	866	536	553	900	938	480	86.4	867	546	575	974	976
451	83.2	983	606	621	901	1030	481	86.8	1151	685	704	-	-
452	83.4	858	530	561	907	952	482	86.8	1070	634	664	1077	928
453	83.7	1040	641	641	820	1036	483	87.1	990	605	647	945	925
454	83.8	1006	602	621	948	984	484	87.4	1037	695	681	874	859
455	83.9	1093	653	661	-	-	485	87.8	682	404	501	-	-
456	84.0	919	566	601	938	969	486	88.0	990	607	629	913	1034
457	84.0	974	597	625	-	-	487	88.1	983	636	662	-	-
458	84.2	958	597	618	1042	1059	488	89.2	875	657	599	-	-
459	84.3	1038	635	634	923	1121	489	90.4	1025	549	665	-	-
460	84.4	984	606	634	867	950	490	91.0	-	-	-	787	1057
461	84.7	1096	693	690	975	971	491	91.1	858	640	608	861	847
462	84.8	1050	656	635	932	1042	492	91.4	1125	742	747	838	900
463	84.9	843	515	565	968	940	493	91.5	1149	853	767	866	762
464	84.9	1026	619	636	1043	1006	494	91.6	930	636	645	856	915
465	85.0	786	493	504	868	993	495	91.6	1202	850	786	848	1120
466	85.1	982	593	621	937	1000	496	92.0	1072	724	715	922	994
467	85.3	1061	668	676	878	816	497	92.2	1185	791	764	-	-
468	85.4	979	623	648	-	-	498	92.3	1257	867	802	929	1015
469	85.5	780	471	531	956	1041							

Geothermometry of PBOC intrusives. Mineral equilibration temperatures in degrees centigrade.

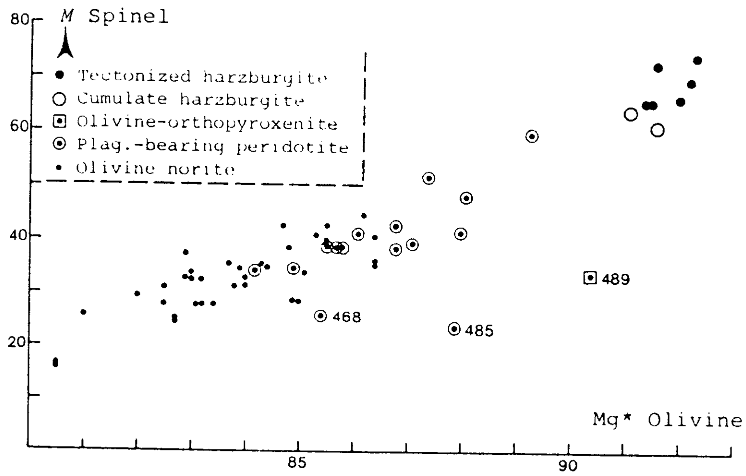
Olivine-Spinel 1. Jackson (1969)
2. Roeder *et.al.* (1979)
3. Fabries (1979)

Opx.-Cpx. 4. Wells (1977).
5. Mysen (1976)

Fo= 100Mg/(Mg+Fe^{2+}) OLIVINE in host rock.

For samples with zoned pyroxenes, temperature listed is average of core-core and rim-rim determinations. For rock-types, see Table C-2.

Fig. D-1: Fe:Mg relations of coexisting olivine and spinel in PBOC intrusives



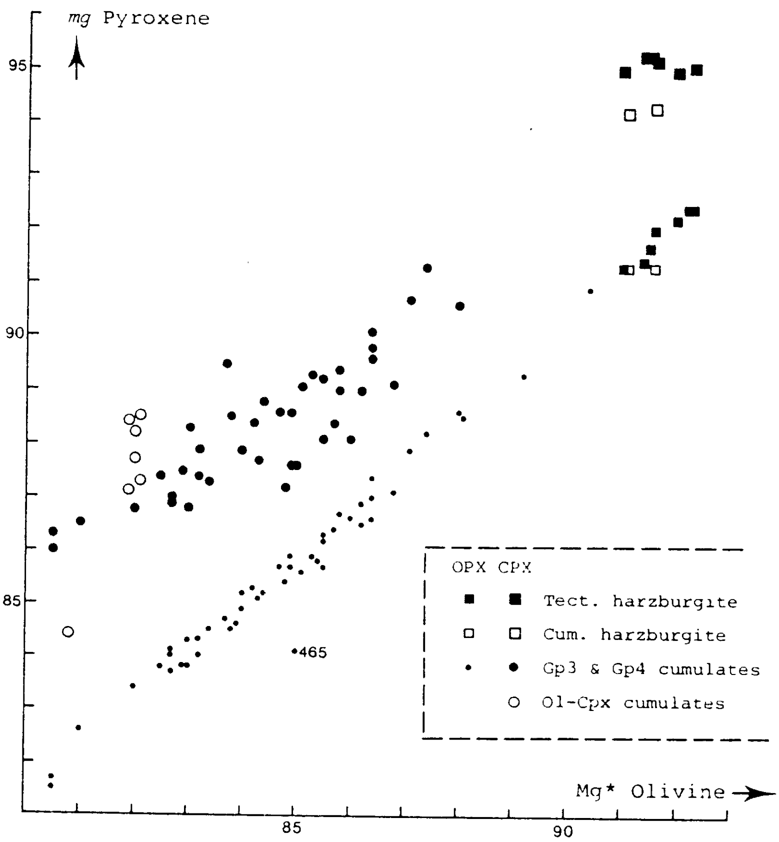


Fig. D-2: Fe:Mg relations of coexisting olivine and pyroxenes in PBOC intrusives and Ol-Cpx-(Plag) cumulates from the Curricabark Fault Zone, Glenrock Station area (see Appendix F)

APPENDIX E

MICROPROBE ANALYSES OF MINERALS IN PBOC LOW-Ti BASALTS AND IN BASALTIC AND SEDIMENTARY ROCKS FROM THE MYRA BEDS AND GLEN WARD BEDS

NOTE:

(i) Analyses in Tables E-1 to E-9 are normalized to 100.0%. Totals include calculated Fe_2O_3. Analyses whose original totals were < 99% or > 101% were rejected.

(ii) Analyses of Ca-rich pyroxenes listed in Tables E-1 to E-8 are average compositions of 3-10 grains from each sample, 4-10 analyses each grain. Prior to quantitative analysis, grains were checked for chemical heterogeneities by microprobe scans for selected elements using an audible count-rate meter. Grains with sector- or complex zoning were quickly identified by this method. By this method the more chemically homogeneous and presumably best-equilibrated grains were selected for analyses. Variations in the chemistries of coexisting grains of this type were usually small or negligible.

TABLE E-1

Analyses of representative Ca-rich pyroxenes and some relict plagioclase compositions from Low-Ti basaltic rocks in the Pigna Barney Ophiolitic Complex.

	MICRODOLERITIC ROCKS†				APHANITIC EXTRUSIVES				
SAMPLE	005 CORE	005 RIM	017 CORE	017 RIM	007 -	016 CORE	016 RIM	009 -	015 -
SiO_2	53.07	52.64	52.40	52.07	52.52	51.93	50.53	51.69	50.67
TiO_2	a	0.05	a	a	0.06	0.15	a	a	0.33
Al_2O_3	2.84	3.08	2.67	2.51	2.53	2.91	2.10	2.68	3.71
Cr_2O_3	0.72	0.04	0.23	0.11	0.07	-	-	-	-
ΣFeO	5.71	11.38	7.26	10.50	9.20	10.56	16.62	10.86	11.46
MnO	0.05	0.20	-	-	0.15	0.22	0.34	0.18	0.19
MgO	19.16	17.20	17.66	15.59	17.34	17.66	14.40	15.80	15.01
CaO	18.43	15.34	19.64	18.90	18.06	16.45	15.74	18.65	18.50
Na_2O	-	0.07	-	0.19	-	-	-	-	-
$*Fe_2O_3$	0.06	-	1.35	1.22	0.59	1.19	2.62	1.43	1.34
FeO	5.66	11.38	6.04	9.40	8.67	9.49	14.26	9.57	10.25
Numbers of cations on the basis of 6 oxygens									
Si	1.931	1.942	1.920	1.933	1.934	1.915	1.915	1.921	1.890
Al^{IV}	0.069	0.058	0.080	0.067	0.066	0.085	0.085	0.079	0.110
Al^{VI}	0.053	0.076	0.035	0.042	0.044	0.042	0.009	0.038	0.053
Ti	-	0.001	-	-	0.002	0.004	-	-	0.009
Cr	0.014	0.001	0.007	0.003	0.001	-	-	-	-
Fe^{3+}	0.002	-	0.037	0.034	0.016	0.033	0.074	0.040	0.038
Fe^{2+}	0.172	0.351	0.185	0.292	0.267	0.293	0.453	0.298	0.320
Mn	0.002	0.006	-	-	0.005	0.007	0.011	0.006	0.006
Mg	1.039	0.946	0.965	0.863	0.952	0.971	0.814	0.875	0.835
Ca	0.718	0.606	0.771	0.752	0.713	0.650	0.639	0.743	0.739
Na	-	0.005	-	0.014	-	-	-	-	-
Σ cations	4.000	3.992	4.000	4.000	4.000	4.000	4.000	4.000	4.000
M	85.8	72.9	83.9	74.7	78.1	76.8	64.2	74.6	72.3
mg	85.5	72.6	81.3	72.6	76.8	74.5	60.2	71.8	69.6
Ca	37.2	31.8	39.4	38.8	36.5	33.3	32.1	37.9	38.2
Mg (atomic %)	53.7	49.5	49.2	44.4	48.7	49.7	40.9	44.6	43.1
Fe'	9.1	18.7	11.4	16.8	14.8	17.0	27.0	17.5	18.7
Plag.(An mol.%)	76 - 72		(2)*		78 - 76	84 - 83		42 - 33 (22-2)*	

ΣFeO = total Fe calculated as FeO

Fe' = $Fe^{2+}+Fe^{3+}+Mn$

a = all determinations < 0·07 wt % (see Section 5·7·3)

M = $100\ Mg/(Mg+Fe^{2+})$

mg = $100\ Mg/(Mg+Fe^{2+}+Fe^{3+}+Mn)$

* Fe_2O_3 calculated following the method of Papike *et al.* (1974)

† possibly intrusives.

* albitized plagioclase compositions in parentheses

TABLE E-2

Analyses of representative Ca-rich pyroxenes and some plagioclase compositions from basaltic extrusives in the Glen Ward beds.

	077	077	077	077	069	069	070	070	071	071	067	067	072	072	073	073	066	066	084	084
	PHENOCRYST		MICROPHENOCRYST																	
	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM	CORE	RIM
SiO_2	51.63	51.53	52.35	50.70	50.83	50.94	50.66	50.83	51.86	49.39	51.58	51.86	50.13	50.39	49.98	50.24	50.20	49.81	51.61	51.81
TiO_2	0.45	0.52	0.35	0.72	0.60	0.61	0.85	0.87	0.43	1.08	0.50	0.42	0.81	0.80	1.03	0.83	0.62	0.77	0.25	0.26
Al_2O_3	3.71	3.59	2.50	2.99	3.76	3.36	3.85	3.51	2.55	4.31	2.60	2.20	3.96	3.47	3.76	3.51	2.61	3.25	1.93	2.36
Cr_2O_3	0.61	0.16	0.21	-	0.23	0.09	0.10	0.16	0.10	-	0.07	-	0.14	-	-	-	-	-	-	-
ΣFeO	5.59	6.84	6.74	12.36	7.60	7.60	7.96	10.55	9.62	11.87	9.56	9.45	10.00	10.43	10.87	9.56	11.08	11.25	12.16	11.79
MnO	-	0.12	-	0.28	0.04	0.10	0.10	0.13	0.19	0.16	0.25	0.24	0.16	0.16	0.17	0.18	0.42	0.32	0.26	0.13
MgO	16.36	16.06	17.42	16.67	16.12	15.55	15.55	15.44	17.09	13.97	16.24	16.18	14.22	14.30	14.60	14.76	14.92	14.14	15.07	15.50
CaO	21.34	20.84	20.09	15.69	20.43	21.47	20.57	18.51	17.89	18.74	18.93	19.24	20.19	20.05	19.04	20.30	19.49	19.88	18.60	18.10
Na_2O	0.20	0.24	0.19	0.30	0.17	0.08	0.17	-	0.12	0.26	0.11	0.22	0.20	0.20	0.30	0.33	0.29	0.24	-	-
*Fe_2O_3	0.94	1.45	1.64	2.84	2.20	2.02	1.75	0.35	1.50	2.33	1.55	2.00	1.81	1.90	2.39	3.03	3.58	3.42	1.27	0.59
FeO	4.74	5.54	5.27	9.81	5.62	5.79	6.39	10.23	8.27	9.78	8.17	7.65	8.37	8.72	8.72	6.83	7.85	8.17	11.02	11.26
Numbers of cations on the basis of 6 *oxygens*:																				
Si	1.895	1.896	1.917	1.885	1.873	1.883	1.872	1.892	1.914	1.851	1.910	1.920	1.870	1.881	1.865	1.869	1.882	1.867	1.932	1.932
Al^{IV}	0.105	0.105	0.083	0.115	0.127	0.117	0.128	0.108	0.086	0.149	0.090	0.080	0.130	0.119	0.135	0.131	0.115	0.133	0.068	0.068
Al^{VI}	0.056	0.050	0.025	0.016	0.036	0.029	0.040	0.046	0.025	0.041	0.024	0.016	0.044	0.034	0.030	0.023	-	0.011	0.017	0.036
Ti	0.012	0.014	0.010	0.020	0.017	0.017	0.024	0.024	0.012	0.030	0.014	0.012	0.023	0.022	0.029	0.023	0.017	0.022	0.007	0.007
Cr	0.019	0.003	0.006	-	0.007	0.003	0.003	0.003	0.003	-	0.002	-	0.004	-	-	-	-	-	-	-
Fe^{3+}	0.026	0.040	0.045	0.080	0.061	0.056	0.049	0.010	0.042	0.066	0.043	0.056	0.051	0.053	0.067	0.085	0.101	0.096	0.036	0.017
Fe^{2+}	0.146	0.170	0.162	0.304	0.173	0.179	0.198	0.319	0.256	0.307	0.253	0.237	0.261	0.274	0.274	0.212	0.246	0.256	0.346	0.351
Mn	-	0.004	-	0.009	0.001	0.003	0.003	0.004	0.006	0.005	0.008	0.008	0.005	0.005	0.005	0.006	0.013	0.010	0.008	0.004
Mg	0.895	0.880	0.951	0.924	0.886	0.857	0.857	0.857	0.941	0.780	0.897	0.893	0.791	0.796	0.812	0.818	0.828	0.790	0.841	0.862
Ca	0.839	0.821	0.788	0.625	0.807	0.850	0.815	0.738	0.708	0.752	0.751	0.763	0.807	0.802	0.761	0.809	0.778	0.798	0.746	0.723
Na	0.014	0.017	0.013	0.022	0.012	0.006	0.012	-	0.009	0.019	0.008	0.016	0.014	0.014	0.022	0.024	0.021	0.017	-	-
Σ cations	4.000	4.000	4.000	4.000	4.000	4.000	4.001	4.000	4.000	4.000	4.000	4.001	4.000	4.000	4.000	4.000	4.001	4.000	4.001	4.000
M	86.0	83.8	85.5	75.2	83.7	82.7	81.3	72.9	78.6	71.8	78.0	79.0	75.2	74.5	74.9	79.4	77.2	75.5	70.9	71.1
mg	83.9	80.4	82.1	70.2	79.0	78.3	77.4	72.0	75.6	67.4	74.7	74.8	71.4	70.6	70.1	73.0	69.7	68.6	68.3	69.9
Ca	44.0	42.9	40.5	32.2	41.8	43.7	42.4	38.3	36.3	39.4	38.5	39.0	42.1	41.6	39.7	41.9	39.6	40.9	37.7	36.9
Mg (atomic %)	47.0	45.9	48.9	47.6	46.0	44.0	44.6	44.5	48.2	40.9	45.9	45.6	41.3	41.3	42.3	42.4	42.2	40.5	42.5	44.1
Fe'	9.0	11.2	10.6	20.2	12.2	12.3	13.0	17.2	15.5	19.7	15.6	15.4	16.6	17.1	18.0	15.7	18.2	18.6	19.8	19.0
Plag.(An mol %)	2		2		20 - 0		65 - 47		3 - 1		0		65 - 62		2 - 1		67 - 33		69 - 0	

ΣFeO = total Fe calculated as Feo

Fe' = $Fe^{2+}+Fe^{3+}+Mn$

M = $100\ Mg/(Mg+Fe^{2+})$

mg = $100\ Mg/(Mg+Fe^{2+}+Fe^{3+}+Mn)$

*Fe_2O_3 calculated following the method of Papike *et al.* (1974)

TABLE E-3

Analyses of representative Ca-rich pyroxenes and some plagioclase compositions from doleritic intrusives in the Glen Ward beds.

SAMPLE	074 CORE	074 RIM	060 CORE	060 RIM	075 CORE	075 RIM	076 CORE	076 RIM	063 CORE	063 RIM	068 CORE	068 RIM	064 CORE	064 RIM
SiO_2	51.96	50.67	52.19	51.52	50.77	49.85	50.38	50.86	50.09	50.09	51.64	50.87	49.88	50.26
TiO_2	0.26	0.58	0.54	0.77	0.70	0.76	0.88	0.70	0.76	0.75	0.65	0.81	0.77	0.72
Al_2O_3	3.09	2.83	2.51	2.28	4.03	4.40	2.93	2.61	3.81	3.40	1.99	2.88	3.14	2.60
Cr_2O_3	0.47	0.10	0.40	-	0.36	0.22	0.24	-	-	-	-	-	0.05	-
ΣFeO	5.65	9.95	6.21	8.51	6.45	10.62	8.12	8.91	9.42	10.99	9.96	9.15	10.89	11.68
MnO	-	0.17	0.08	0.17	0.07	0.19	0.13	0.24	0.15	0.35	0.18	0.14	0.20	0.22
MgO	16.75	14.57	16.88	15.94	15.69	14.69	15.42	14.93	14.82	13.97	15.70	14.81	15.43	15.09
CaO	21.64	20.72	21.14	20.45	21.44	18.81	21.38	21.14	20.55	19.77	19.50	20.88	19.05	19.05
Na_2O	0.06	0.16	-	0.17	0.28	0.25	0.20	0.30	0.14	0.38	0.20	0.24	0.20	0.08
$^*Fe_2O_3$	1.24	2.48	0.61	1.97	2.10	2.17	3.17	3.07	2.62	3.03	1.87	2.20	3.86	2.84
FeO	4.53	7.71	5.66	6.74	4.56	8.67	5.26	6.15	7.06	8.27	8.27	7.17	7.42	9.12
Number of cations on the basis of 6 oxygens:														
Si	1.904	1.890	1.916	1.907	1.869	1.857	1.868	1.891	1.863	1.874	1.920	1.892	1.860	1.882
Al^{IV}	0.096	0.110	0.084	0.093	0.131	0.143	0.128	0.109	0.137	0.126	0.080	0.108	0.138	0.115
Al^{VI}	0.037	0.014	0.025	0.006	0.044	0.050	-	0.005	0.030	0.024	0.007	0.018	-	-
Ti	0.007	0.016	0.015	0.021	0.019	0.021	0.025	0.020	0.021	0.021	0.018	0.023	0.022	0.020
Cr	0.014	0.003	0.012	-	0.010	0.006	0.007	-	-	-	-	-	0.001	-
Fe^{3+}	0.034	0.070	0.017	0.056	0.058	0.061	0.089	0.086	0.073	0.085	0.052	0.062	0.108	0.080
Fe^{2+}	0.139	0.242	0.173	0.209	0.141	0.271	0.164	0.190	0.220	0.259	0.251	0.223	0.232	0.286
Mn	-	0.005	0.002	0.005	0.002	0.006	0.004	0.008	0.005	0.011	0.006	0.004	0.006	0.007
Mg	0.915	0.810	0.924	0.880	0.861	0.816	0.853	0.827	0.822	0.779	0.866	0.821	0.858	0.842
Ca	0.850	0.828	0.832	0.811	0.845	0.751	0.850	0.842	0.819	0.793	0.778	0.832	0.761	0.764
Na	0.004	0.012	-	0.012	0.020	0.018	0.014	0.022	0.010	0.028	0.014	0.017	0.014	0.006
Σ cations	4.000	4.000	4.000	4.000	4.000	4.000	4.002	4.000	4.000	4.000	4.000	4.000	4.000	4.002
M	86.8	77.0	84.2	80.8	85.9	75.1	83.9	81.3	78.9	75.0	77.5	78.6	78.7	74.6
mg	84.1	71.9	82.8	76.5	81.1	70.7	76.8	74.4	73.4	68.7	73.7	74.0	71.3	69.3
Ca :	43.9	42.4	42.7	41.4	44.3	39.4	43.4	43.1	42.2	41.2	39.6	42.8	38.7	38.6
Mg (atomic %) :	47.2	41.5	47.4	44.9	45.2	42.9	43.5	42.3	42.4	40.4	44.3	42.3	43.7	42.5
Fe' :	8.9	16.1	9.9	13.7	10.5	17.7	13.1	14.6	15.4	18.4	16.1	14.9	17.6	18.9
Plag(An mol.%)	55 - 23		77 - 63		51 - 36		-		1		50 - 80		49 - 39	

ΣFeO = total Fe calculated as FeO

Fe' = $Fe^{2+} + Fe^{3+}$ + Mn

M = 100 Mg/(Mg+Fe^{2+})

mg = 100 Mg/(Mg+Fe^{2+}+Fe^{3+}+Mn)

$^*Fe_2O_3$ calculated following the method of Papike *et al.* (1974)

TABLE E-4

Analyses of representative detrital Ca-rich pyroxenes and some plagioclase compositions from volcaniclastic sedimentary rocks in the Glen Ward beds.

SAMPLE	400 CORE	400 RIM	400 CORE	400 RIM	402	402	403	403 CORE	403 RIM	401 CORE	401 RIM	404 CORE	404 RIM	405
SiO_2	54.21	52.11	51.62	51.68	51.46	51.03	51.74	51.16	51.60	50.67	50.02	50.80	50.75	52.34
TiO_2	-	0.12	0.44	0.40	0.32	0.55	0.27	0.41	0.25	0.32	0.38	0.11	0.22	0.11
Al_2O_3	1.20	3.16	2.71	2.12	2.98	2.65	2.69	2.38	1.32	4.43	4.24	2.79	2.56	1.50
Cr_2O_3	0.63	-	-	-	0.14	-	0.17	-	-	0.12	-	-	-	-
ΣFeO	3.42	8.23	9.87	10.99	8.59	9.80	9.36	11.35	15.01	10.29	12.63	10.94	13.00	10.35
MnO	-	0.22	0.25	0.27	-	0.24	-	0.25	0.41	0.16	0.12	0.28	0.37	0.37
MgO	18.08	16.36	16.07	15.90	15.34	14.76	15.62	14.23	12.19	14.38	13.53	14.52	14.16	13.79
CaO	22.46	19.51	18.65	18.00	20.77	20.61	19.88	19.66	18.98	19.32	18.44	20.11	18.56	21.18
Na_2O	-	0.18	0.21	0.39	0.21	0.15	0.13	0.33	0.19	0.20	0.40	0.16	0.14	0.24
$*Fe_2O_3$	-	1.10	1.68	2.54	1.88	2.12	1.26	2.54	0.48	0.97	2.40	3.03	2.37	0.97
FeO	3.42	7.24	8.36	8.70	6.90	7.89	8.23	9.06	14.58	9.42	10.47	8.21	10.87	9.48
Numbers of cations on the basis of 6 oxygens:														
Si	1.972	1.919	1.913	1.920	1.905	1.902	1.918	1.914	1.963	1.885	1.876	1.897	1.908	1.959
Al^{IV}	0.028	0.081	0.087	0.080	0.095	0.098	0.082	0.086	0.037	0.115	0.124	0.103	0.092	0.041
Al^{VI}	0.024	0.056	0.031	0.013	0.035	0.018	0.036	0.019	0.022	0.079	0.063	0.020	0.021	0.025
Ti	-	0.003	0.012	0.011	0.009	0.015	0.008	0.012	0.007	0.009	0.011	0.003	0.006	0.003
Cr	0.012	-	-	-	0.004	-	0.005	-	-	0.004	-	-	-	-
Fe^{3+}	-	0.030	0.047	0.071	0.052	0.059	0.035	0.071	0.014	0.027	0.068	0.085	0.067	0.027
$Fe2^{+}$	0.104	0.223	0.259	0.271	0.214	0.246	0.255	0.284	0.465	0.294	0.329	0.257	0.342	0.298
Mn	-	0.007	0.008	0.008	-	0.008	-	0.008	0.013	0.005	0.004	0.009	0.012	0.012
Mg	0.981	0.898	0.888	0.881	0.847	0.820	0.863	0.794	0.691	0.798	0.756	0.809	0.794	0.769
Ca	0.876	0.770	0.740	0.717	0.824	0.823	0.790	0.788	0.774	0.770	0.741	0.805	0.748	0.849
Na	-	0.013	0.015	0.028	0.015	0.011	0.009	0.024	0.014	0.014	0.029	0.012	0.010	0.017
Σ cations	3.997	4.000	4.000	4.000	4.000	4.000	4.001	4.000	4.000	4.000	4.001	4.000	4.000	4.000
M	90.4	80.1	77.4	76.5	79.8	76.9	77.2	73.7	59.8	73.1	69.7	75.9	69.9	72.1
mg	90.4	77.5	73.9	71.6	76.1	72.4	74.8	68.6	58.4	71.0	65.3	69.7	65.3	69.5
Ca	44.7	39.9	38.1	36.8	42.6	42.1	40.6	40.5	39.6	40.7	39.0	41.0	38.1	43.4
Mg	50.0	46.6	45.7	45.2	43.7	41.9	44.5	40.8	35.3	42.1	39.9	41.2	40.5	39.4
Fe'	5.3	13.5	16.2	18.0	13.7	16.0	14.9	18.7	25.1	17.2	21.1	17.8	21.4	17.2
Plag.(An mol.%)	-		-	-	58 - 0					2		0		5 - 1

ΣFeO = total Fe calculated as FeO

Fe' = Fe^{2+}+Fe^{3+}+Mn

M = 100 Mg/(Mg+Fe^{2+})

mg = 100 Mg/(Mg+Fe^{2+}+Fe^{3+}+Mn)

$*Fe_2O_3$ calculated following the method of Papike *et al.* (1974)

<u>TABLE E-5</u>

Analyses of representative Ca-rich pyroxenes and some plagioclase compositions from basaltic rocks of the Tamworth Group in the Morrisons Gap area.

	EXTRUSIVES						INTRUSIVES					
SAMPLE	057 CORE	057 RIM	055 CORE	055 RIM	056 CORE	056 RIM	058 CORE	058 RIM	059 CORE	059 RIM	054 CORE	054 RIM
SiO_2	51.51	49.66	50.29	49.63	47.16	50.13	51.07	50.92	51.30	51.66	48.71	49.18
TiO_2	0.80	1.32	1.08	1.56	1.69	0.92	0.74	0.85	0.78	0.64	1.39	1.36
Al_2O_3	2.61	3.97	3.10	2.41	5.49	3.16	2.44	2.52	1.91	1.52	4.18	3.82
Cr_2O_3	0.25	0.16	-	-	-	-	-	-	-	-	0.04	0.13
ΣFeO	7.43	10.22	11.23	12.74	12.24	10.60	9.48	9.58	10.17	10.64	11.96	12.01
MnO	-	0.16	0.22	0.28	0.23	-	-	0.20	0.32	0.32	0.20	0.24
MgO	15.45	13.79	14.72	14.28	13.27	14.70	15.36	15.11	15.11	15.19	12.94	12.93
CaO	21.58	20.11	18.98	18.78	18.97	20.10	20.44	20.52	20.02	19.78	19.91	19.72
Na_2O	0.23	0.39	0.18	0.20	0.44	0.13	0.20	0.10	0.20	0.12	0.36	0.37
$*Fe_2O_3$	1.49	2.16	1.91	1.17	5.02	2.62	2.47	2.00	1.95	1.41	3.18	2.47
FeO	6.09	8.28	9.51	11.70	7.70	8.24	7.26	7.78	8.42	9.37	9.10	9.79
Numbers of cations on the basis of 6 oxygens:												
Si	1.904	1.856	1.881	1.875	1.775	1.872	1.898	1.896	1.914	1.930	1.835	1.853
Al^{IV}	0.096	0.144	0.119	0.107	0.225	0.128	0.102	0.104	0.084	0.069	0.165	0.147
Al^{VI}	0.018	0.031	0.018	-	0.019	0.011	0.005	0.007	-	-	0.021	0.023
Ti	0.022	0.037	0.030	0.044	0.048	0.026	0.021	0.024	0.022	0.018	0.039	0.039
Cr	0.007	0.005	-	-	-	-	-	-	-	-	0.001	0.004
Fe^{3+}	0.041	0.061	0.054	0.033	0.142	0.074	0.069	0.055	0.055	0.040	0.090	0.070
Fe^{2+}	0.189	0.259	0.297	0.370	0.242	0.258	0.226	0.243	0.263	0.293	0.287	0.308
Mn	-	0.005	0.007	0.009	0.007	-	-	0.006	0.010	0.010	0.006	0.008
Mg	0.852	0.768	0.821	0.804	0.745	0.818	0.851	0.839	0.840	0.846	0.727	0.726
Ca	0.855	0.805	0.760	0.760	0.765	0.804	0.814	0.819	0.800	0.792	0.803	0.796
Na	0.016	0.028	0.013	0.015	0.032	0.009	0.014	0.007	0.014	0.009	0.026	0.027
Σ cations	4.000	4.000	4.000	4.017	4.000	4.000	4.000	4.000	4.002	4.007	4.000	4.001
M	81.8	74.8	73.4	68.5	75.5	76.0	79.0	77.5	76.2	74.3	71.7	70.2
mg	78.7	70.3	69.6	66.1	65.6	71.1	74.3	73.4	71.9	71.2	65.5	65.3
Ca	44.1	42.4	39.2	38.5	40.2	41.2	41.5	41.7	40.7	40.0	42.0	41.7
Mg (atomic %)	44.0	40.5	42.3	40.7	39.1	41.9	43.4	42.8	42.7	42.7	38.0	38.1
Fe'	11.9	17.1	18.5	20.8	20.7	16.9	15.1	15.5	16.6	17.3	20.0	20.2
Plag.(An mol.%)	63 - 41		5 - 2		51 - 0		22 - 2		3 - 1		2 - 0	

ΣFeO = total Fe calculated as FeO

Fe' = $Fe^{2+}+Fe^{3+}+Mn$

M = 100 Mg/($Mg+Fe^{2+}$)

mg = 100 Mg/($Mg+Fe^{2+}+Fe^{3+}+Mn$)

$*Fe_2O_3$ calculated following the method of Papike *et al.* (1974)

TABLE E-6

Analyses of representative Ca-rich pyroxenes and some plagioclase compositions from basaltic extrusives in the Myra beds.

	Type 1				*Type 2*				*Type 3*	Woolomin beds	
SAMPLE	201 CORE	201 RIM	209 CORE	209 RIM	208 CORE	208 RIM	207 CORE	207 RIM	240 CORE	(Cawood, 1982b) $\bar{x}$	s
SiO_2	50.30	50.86	50.94	49.71	51.48	50.72	51.52	49.39	49.86	51.38	(1.22)
TiO_2	1.37	1.51	0.77	1.40	0.78	1.16	0.76	1.22	1.11	0.86	(0.24)
Al_2O_3	5.98	4.10	3.92	3.89	4.38	5.19	3.31	2.96	2.93	3.65	(0.80)
Cr_2O_3	-	-	0.34	0.11	0.38	0.43	0.12	-	0.34	-	
ΣFeO	6.71	9.94	7.01	11.26	6.19	7.18	9.32	15.06	10.81	7.57	(2.51)
MnO	-	0.20	0.19	0.18	-	0.24	-	0.25	0.32	0.22	(0.06)
MgO	15.36	13.74	15.69	14.37	16.93	15.95	16.32	12.19	14.08	16.35	(0.89)
CaO	19.83	19.09	20.87	18.56	19.56	18.66	18.65	18.37	19.96	19.57	(0.99)
Na_2O	0.44	0.56	0.16	0.33	0.31	0.47	-	0.34	0.31	0.28	(0.06)
$*Fe_2O_3$	0.16	-	1.12	1.85	0.64	0.25	0.01	2.21	2.88	1.17	
FeO	6.57	9.94	6.00	9.60	5.61	6.96	9.31	13.07	8.22	6.52	
Numbers of cations on the basis of 6 oxygens:											
Si	1.846	1.893	1.878	1.859	1.881	1.864	1.905	1.879	1.869	1.890	
Al^{IV}	0.154	0.107	0.122	0.141	0.119	0.136	0.095	0.121	0.129	0.110	
Al^{VI}	0.105	0.073	0.048	0.030	0.069	0.089	0.050	0.012	-	0.048	
Ti	0.038	0.042	0.021	0.039	0.021	0.032	0.021	0.035	0.031	0.024	
Cr	-	-	0.010	0.003	0.011	0.008	0.002	-	0.010	-	
Fe^{3+}	0.004	-	0.032	0.052	0.018	0.007	-	0.064	0.081	0.032	
Fe^{2+}	0.202	0.309	0.186	0.301	0.172	0.214	0.288	0.416	0.258	0.201	
Mn	-	0.006	0.006	0.006	-	0.007	-	0.008	0.010	0.007	
Mg	0.840	0.762	0.862	0.801	0.922	0.874	0.900	0.691	0.787	0.897	
Ca	0.780	0.761	0.824	0.744	0.766	0.735	0.739	0.749	0.802	0.771	
Na	0.031	0.040	0.011	0.024	0.022	0.034	-	0.025	0.023	0.020	
Σ cations	4.000	3.993	4.000	4.000	4.001	4.000	4.000	4.000	4.000	4.000	
M	80.6	71.1	82.3	72.7	84.3	80.3	75.8	62.4	75.3	81.7	
mg	80.3	70.8	79.4	69.1	82.9	79.3	75.8	58.6	69.3	78.9	
Ca	42.7	41.4	43.2	39.1	40.8	40.0	38.3	38.8	41.4	40.4	
Mg (atomic %)	46.0	41.5	45.2	42.1	49.1	47.6	46.7	35.9	40.6	47.0	
Fe'	11.3	17.1	11.6	18.8	10.1	12.4	15.0	25.3	18.0	12.6	
Plag.(An mol.%)	45 - 32		2 - 0		-		59 - 43		4		

ΣFeO = total Fe calculated as FeO

Fe' = $Fe^{2+}+Fe^{3+}+Mn$

M = 100 $Mg/(Mg+Fe^{2+})$

mg = 100 $Mg/(Mg+Fe^{2+}+Fe^{3+}+Mn)$

$*Fe_2O_3$ calculated following the method of Papike *et al.* (1974)

$\bar{x}$ Mean of Ca-rich pyroxene compositions from 8 basaltic rocks in the Woolomin beds, north of Nundle (Cawood, 1982b)

s = standard deviation

TABLE E-7

Analyses of representative Ca-rich pyroxenes and some plagioclase compositions from doleritic intrusives in the Myra beds.

	Type 1				*Type 2*							
SAMPLE	215 CORE	215 RIM	216 CORE	216 RIM	210 CORE	210 RIM	211 CORE	211 RIM	212 CORE	212 RIM	213 CORE	213 RIM
SiO_2	49.48	49.86	49.77	50.35	51.96	51.03	52.84	52.13	50.27	50.28	49.84	49.08
TiO_2	1.30	1.50	1.45	1.06	0.44	0.78	0.57	0.65	1.27	1.36	1.21	1.42
Al_2O_3	2.91	2.38	3.42	2.55	2.86	3.25	2.04	2.82	4.88	4.93	4.34	2.66
Cr_2O_3	-	-	-	-	0.84	-	-	-	0.33	0.15	0.36	-
ΣFeO	11.69	13.17	12.73	13.42	5.32	8.28	7.06	6.86	7.00	7.19	8.23	15.79
MnO	0.31	0.27	0.26	0.29	-	0.13	-	0.16	-	-	0.13	0.38
MgO	13.49	13.14	12.28	12.14	16.57	15.13	16.80	16.20	15.40	15.28	14.76	10.91
CaO	20.33	19.32	19.65	19.90	21.94	20.93	20.69	21.02	20.54	20.45	20.89	19.23
Na_2O	0.23	0.23	0.34	0.21	-	0.29	-	0.14	0.24	0.30	0.11	0.33
$*Fe_2O_3$	2.56	1.32	0.89	0.72	0.48	1.98	-	0.58	0.66	0.71	1.37	2.02
FeO	9.39	11.98	11.93	12.77	4.89	6.50	7.06	6.34	6.41	6.55	7.00	13.97
Numbers of cations on the basis of 6 oxygens:												
Si	1.865	1.888	1.882	1.910	1.907	1.890	1.942	1.917	1.853	1.853	1.850	1.882
Al^{IV}	0.129	0.106	0.118	0.090	0.093	0.110	0.058	0.083	0.147	0.147	0.150	0.118
Al^{VI}	-	-	0.035	0.024	0.031	0.032	0.030	0.039	0.065	0.067	0.040	0.002
Ti	0.037	0.043	0.041	0.030	0.012	0.022	0.016	0.018	0.035	0.038	0.034	0.041
Cr	-	-	-	-	0.024	-	-	-	0.010	0.004	0.011	-
Fe^{3+}	0.073	0.038	0.025	0.021	0.013	0.055	-	0.016	0.018	0.020	0.038	0.058
Fe^{2+}	0.296	0.380	0.378	0.406	0.150	0.202	0.217	0.196	0.198	0.202	0.218	0.448
Mn	0.010	0.009	0.008	0.009	-	0.004	-	0.005	-	-	0.004	0.012
Mg	0.758	0.742	0.692	0.686	0.907	0.835	0.920	0.888	0.846	0.840	0.817	0.624
Ca	0.821	0.784	0.796	0.809	0.863	0.830	0.815	0.828	0.811	0.808	0.831	0.790
Na	0.017	0.017	0.025	0.015	-	0.021	-	0.010	0.017	0.021	0.008	0.025
Σ cations	4.006	4.007	4.000	4.000	4.000	4.001	3.998	4.000	4.000	4.000	4.001	4.000
M	71.9	66.1	64.7	62.8	85.8	80.5	80.9	81.9	81.0	80.6	78.9	58.2
mg	66.7	63.5	62.7	61.1	84.8	76.2	80.9	80.4	79.7	79.1	75.9	54.6
Ca	41.9	40.2	41.9	41.9	44.6	43.1	41.7	42.8	43.3	43.2	43.6	40.9
Mg (atomic %)	38.7	38.0	36.5	35.6	46.9	43.4	47.2	46.0	45.2	44.9	42.8	32.3
Fe'	19.4	21.8	21.6	22.5	8.5	13.5	11.1	11.2	11.5	11.9	13.6	26.8
Plag.(An mol.%)	63 - 28		39 - 17		48 - 15		-		53 - 32		13 - 2	

ΣFeO = total Fe calculated as FeO

Fe' = $Fe^{2+}+Fe^{3+}+Mn$

M = 100 Mg/(Mg+Fe^{2+})

mg = 100 Mg/(Mg+Fe^{2+}+Fe^{3+}+Mn)

$*Fe_2O_3$ calculated following the method of Papike *et al.* (1974)

TABLE E-8

Analyses of representative detrital Ca-rich pyroxenes and some plagioclase compositions from volcaniclastic sedimentrary rocks in the Myra beds.

SAMPLE	241 CORE	241 RIM	241 CORE	241 RIM	241 CORE	241 CORE	241 CORE	241 CORE	242 CORE	242 RIM	242 CORE	242 CORE
SiO_2	52.76	51.04	51.37	50.55	50.53	52.62	48.96	48.01	51.53	51.02	48.95	52.70
TiO_2	0.38	0.56	0.63	0.81	0.78	0.20	1.23	1.86	0.36	0.31	0.25	0.30
Al_2O_3	2.23	3.26	2.78	3.00	3.25	0.85	4.44	5.22	3.19	5.08	3.58	2.34
V_2O_3	-	-	-	-	-	-	0.15	-	0.16	-	-	0.13
Cr_2O_3	0.31	0.13	-	-	-	-	-	0.36	0.50	0.34	-	-
ΣFeO	6.47	7.55	8.81	8.90	9.60	9.63	10.55	11.20	4.94	4.79	17.20	18.63
MnO	-	-	0.23	0.26	0.21	0.30	0.20	0.34	-	-	0.64	0.70
MgO	17.57	15.25	14.68	14.44	15.19	13.75	14.15	15.00	16.32	15.89	11.63	13.06
CaO	19.90	21.77	21.17	21.29	19.78	22.62	19.45	17.29	22.85	22.50	16.85	11.51
Na_2O	0.27	0.21	0.19	0.43	0.32	-	0.47	0.38	-	-	0.50	0.63
*Fe_2O_3	1.14	2.25	1.35	3.35	2.88	0.41	3.80	3.41	1.55	0.70	4.15	-
FeO	5.44	5.52	7.60	5.89	7.01	9.26	7.13	8.13	3.55	4.16	13.46	18.63
Numbers of cations on the basis of 6 oxygens:												
Si	1.930	1.887	1.909	1.880	1.878	1.970	1.829	1.794	1.890	1.867	1.871	1.992
Al^{IV}	0.070	0.113	0.081	0.120	0.122	0.030	0.171	0.206	0.110	0.133	0.129	0.008
Al^{VI}	0.026	0.029	0.040	0.012	0.020	0.008	0.025	0.025	0.028	0.086	0.032	0.096
Ti	0.010	0.016	0.018	0.023	0.022	0.006	0.035	0.052	0.010	0.009	0.007	0.009
V	-	-	-	-	-	-	0.004	-	0.005	-	-	0.004
Cr	0.009	0.004	-	-	-	-	-	0.007	0.015	0.010	-	-
Fe^{3+}	0.031	0.062	0.038	0.094	0.081	0.012	0.107	0.096	0.043	0.019	0.119	-
Fe^{2+}	0.167	0.171	0.237	0.183	0.218	0.290	0.223	0.254	0.109	0.127	0.431	0.590
Mn	-	-	0.007	0.008	0.007	0.010	0.006	0.011	-	-	0.021	0.022
Mg	0.958	0.841	0.813	0.801	0.841	0.767	0.788	0.836	0.892	0.867	0.663	0.736
Ca	0.780	0.862	0.843	0.848	0.788	0.907	0.778	0.692	0.898	0.882	0.690	0.466
Na	0.019	0.015	0.014	0.031	0.023	-	0.034	0.027	-	-	0.037	0.046
Σ cations	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	3.969
M	85.2	83.1	77.4	81.4	79.4	72.6	77.9	76.7	89.1	87.2	60.6	55.5
mg	82.9	78.3	74.2	73.8	73.3	71.1	70.1	69.8	85.4	85.6	53.7	54.6
Ca	40.3	44.5	43.5	43.9	40.7	45.7	40.9	36.7	46.3	46.6	35.9	25.7
Mg	49.5	43.4	42.0	41.4	43.5	38.6	41.4	44.2	45.9	45.7	34.4	40.6
Fe'	10.2	12.1	14.5	14.7	15.8	15.7	17.7	19.1	7.8	7.7	29.7	33.7
Plag.(An mol.%)	-		57 - 6		-		-		-		-	

ΣFeO = total Fe calculated as FeO
Fe' = $Fe^{2+}+Fe^{3+}+Mn$

M = 100 $Mg/(Mg+Fe^{2+})$
mg = 100 $Mg/(Mg+Fe^{2+}+Fe^{3+}+Mn)$

*Fe_2O_3 calculated following the method of Papike *et al.* (1974)

TABLE E-9

Average analyses of spinels from Low-Ti basaltic extrusives in the Pigna Barney Ophiolitic Complex

ANALYSIS No.	1	2	3	4	5
SAMPLE	003(5)	001(5)	004(6)	002(5)	006(7)
SiO_2	-	-	-	-	-
TiO_2	0.25	0.43	0.09	0.08	0.17
Al_2O_3	35.54	33.23	23.74	24.36	22.32
V_2O_3	0.34	0.23	0.22	0.11	0.28
Cr_2O_3	30.64	32.33	42.13	42.28	42.66
Fe_2O_3*	4.67	4.93	5.80	4.96	6.24
FeO	10.33	12.07	12.82	13.45	14.31
NiO	0.20	0.21	0.13	-	0.07
MnO	0.30	0.05	0.28	0.23	0.15
MgO	17.68	16.53	14.79	14.53	13.80
CaO	-	-	-	-	-
Total	100	100	100	100	100
Numbers of cations on the basis of 32 oxygens:					
Si	-	-	-	-	-
Ti	0.043	0.075	0.016	0.015	0.031
Al	9.530	9.048	6.783	6.952	6.455
V	0.061	0.043	0.043	0.021	0.055
Cr	5.517	5.905	8.076	8.094	8.277
Fe^{3+}	0.800	0.857	1.057	0.904	1.152
Fe^{2+}	1.967	2.332	2.598	2.723	2.937
Ni	0.037	0.039	0.025	-	0.014
Mn	0.058	0.010	0.057	0.047	0.031
Mg	6.002	5.693	5.345	5.245	5.048
Ca	-	-	-	-	-
Σ	24.001	24.000	24.000	24.000	24.000
M	75.3	70.9	67.3	65.8	63.2
100Cr/(Cr+Al)	36.7	39.5	54.4	53.8	56.2
Cr (atom.%)	34.8	37.4	50.8	50.8	52.1
Fe^{3+} (atom.%)	5.1	5.4	6.6	5.6	7.3
Al (atom.%)	60.1	57.2	42.6	43.6	40.6

Fe_2O_3* Calculated assuming stoichiometry of normalized totals.

( ) = No. of grains analysed, several analyses each grain.

\- = not detected.

TABLE E-10

Representative analyses of spinels from *Type* 3 basaltic extrusives in the Myra beds and some from Mid-Atlantic Ridge and Hawaiian basaltic extrusives.

ANALYSIS No.	1 (brown)	2 (opaque)	3	4	5	6	7
SAMPLE	232	232	Sample 1	Stn. J	Stn. J	Kilauea Iki	Makaopuhi
SiO_2	-	-	0.92	0.22	-	0.09	n.d.
TiO_2	1.49	1.60	2.14	1.75	1.67	2.34	3.18
Al_2O_3	31.69	30.42	17.80	21.0	21.3	13.4	12.98
V_2O_3	n.d.	n.d.	n.d.	n.d.	n.d.	0.20	n.d.
Cr_2O_3	28.03	26.61	36.34	38.7	38.6	43.13	38.5
Fe_2O_3	9.18	11.31	12.70	8.2	7.9	10.76	n.d.
FeO	14.84	15.99	15.88	16.0	16.6	16.32	25.4(ΣFe)
NiO	0.21	0.18	n.d.	n.d.	n.d.	0.16	n.d.
MnO	0.11	0.11	0.15	0.23	0.21	0.18	n.d.
MgO	14.67	13.92	14.02	13.6	12.9	12.58	10.5
CaO	0.84	0.69	0.36	-	-	0.05	n.d.
Total	101.05	100.83	100.31	99.7	99.2	99.21	
Si	-	-	0.229	0.05	-	0.02	
Ti	0.261	0.284	0.400	0.32	0.31	0.45	
Al	8.703	8.459	5.218	6.13	6.26	4.08	
V	-	-	-	-	-	0.04	
Cr	5.164	4.964	7.146	7.58	7.63	8.83	
Fe^{3+}	1.610	2.008	2.377	1.53	1.48	2.09	
Fe^{2+}	2.896	3.159	3.303	3.30	3.46	3.53	
Ni	0.039	0.034	-	-	-	0.03	
Mn	0.022	0.022	0.032	0.05	0.04	0.04	
Mg	5.096	4.896	5.199	5.08	4.81	4.86	
Ca	0.210	0.174	0.096	-	-	0.01	
Σ	24.001	24.000	24.000	24.04	23.99	23.98	
M	63.8	60.8	61.2	60.6	58.2	57.9	
100 Cr/(Cr+Al)	37.2	37.0	57.8	55.3	54.7	68.4	
Cr	33.4	32.2	48.5	49.7	49.6	58.9	
Fe^{3+} (atom.%)	10.4	13.0	16.1	10.0	9.6	13.9	
Al	56.2	54.8	35.4	40.3	40.8	27.2	

$Fe_2O_3^*$ calculated assuming stoichiometry. n.d. = not determined. - = not detected. *M* = 100 Mg/(Mg+Fe^{2+}).

Analyses 1,2 = spinel inclusions in pseudomorphed olivine, *Type* 3 basaltic extrusives, Myra beds.

Analysis 3 = spinel from MORB sample 1, Mid-Atlantic Ridge 26°45'N (O'Donnell and Presnall, 1980).

Analyses 4,5 = spinels from olivine basalt, station J, Mid-Atlantic Ridge 35°N (Sigurdsson and Schilling, 1976).

Analysis 6 = average of 4 analyses of spinels from the 1959 Kilauea Iki eruption (Evans and Wright, 1972).

Analysis 7 = average of 2 analyses of spinels from the 1965 Makaopuhi (Kilauea) eruption (Evans and Wright, 1972).

TABLE E-11

Analyses of representative plagioclases from Low-Ti basaltic rocks of the Pigna Barney Ophiolitic Complex

SAMPLE	007 MPh.	007 Gm.	016 Gm.	006 Gm.	005 Gm.	009 Gm.
SiO_2	45.42	50.55	51.46	51.03	50.84	60.19
Al_2O_3	34.37	29.95	26.75	31.34	31.19	25.62
FeO	0.45	1.06	n.d.	n.d.	n.d.	n.d.
MgO	-	-	n.d.	n.d.	n.d.	n.d.
CaO	18.59	15.45	19.48	16.16	14.98	7.57
Na_2O	0.98	2.38	2.22	2.34	2.85	7.17
K_2O	-	-	-	-	-	-
Total	99.81	99.39	99.91	100.87	99.86	100.55
Numbers of cations on the basis of 32 oxygens.						
Si	8.409	9.308	9.506	9.223	9.263	10.657
Al	7.500	6.499	5.824	6.676	6.698	5.346
Fe	0.070	0.163	-	-	-	-
Mg	-	-	-	-	-	-
Ca	3.687	3.047	3.855	3.129	2.924	1.436
Na	0.352	0.851	0.795	0.820	1.007	2.461
K	-	-	-	-	-	-
Σ	20.018	19.868	19.980	19.848	19.892	19.900
mol.% Ab	8.7	21.8	17.1	20.8	25.6	63.2
mol.% An	91.3	78.2	82.9	79.2	74.4	36.8
mol.% Or	-	-				
Host rock (C.I.P.W.) *an*	69	69	-	57	61	61

n.d. = not determined.
 - = not detected.

MPh. = microphenocryst.
Gm. = groundmass.

TABLE E-12

Analyses of representative plagioclases from basaltic rocks in the Glen Ward beds.

SAMPLE		074 CORE	074 RIM	060 CORE	060 RIM	064 CORE	064 RIM	066 CORE	066 RIM	068 CORE	068 RIM	072 CORE	072 RIM
SiO_2		55.25	62.34	48.98	54.61	56.85	59.07	51.47	56.57	55.83	65.22	52.34	53.23
Al_2O_3		29.06	23.77	32.71	28.67	28.19	26.46	30.31	27.27	28.27	22.29	30.34	29.62
ΣFeO		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.81	1.05
MgO		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.29	0.15
CaO		11.33	5.10	15.86	10.90	10.18	8.09	13.55	9.31	10.35	3.17	13.30	12.57
Na_2O		5.16	8.51	2.69	5.42	5.89	6.92	3.71	5.78	5.79	9.74	3.95	4.24
K_2O		-	0.17	-	0.08	0.09	0.17	0.28	0.45	0.13	0.44	0.11	0.18
Total		100.80	99.89	100.24	99.68	101.20	100.71	99.32	99.38	100.37	100.86	101.14	101.04
Numbers of cations on the basis of 32 oxygens:													
Si		9.876	11.050	8.937	9.879	10.095	10.478	9.421	10.215	10.013	11.407	9.432	9.590
Al		6.123	4.966	7.034	6.113	5.900	5.532	6.539	5.804	5.976	4.595	6.444	6.290
Fe		-	-	-	-	-	-	-	-	-	-	0.122	0.158
Mg		-	-	-	-	-	-	-	-	-	-	0.078	0.040
Ca		2.170	0.969	3.100	2.113	1.937	1.538	2.657	1.801	1.989	0.594	2.568	2.426
Na		1.788	2.925	0.952	1.901	2.028	2.380	1.317	2.024	2.013	3.303	1.380	1.481
K		-	0.038	-	0.018	0.020	0.038	0.065	0.104	0.030	0.098	0.025	0.041
Σ		19.957	19.948	20.023	20.024	19.980	19.966	19.999	19.948	20.021	19.997	20.049	20.026
mol.%	Ab	44.9	74.4	23.5	47.2	50.9	60.2	32.6	51.5	49.3	82.6	34.8	37.5
	An	55.1	24.6	76.5	52.4	48.6	38.8	65.7	45.8	50.0	14.9	64.6	61.5
	Or	-	1.0	-	0.4	0.5	1.0	1.6	2.7	0.7	2.5	0.6	1.0
Host rock													
mg		62.8		60.4		44.9		40.3		39.5		n.d.	
K_2O		0.77		0.45		1.06		2.10		0.55		n.d.	

n.d. = not determined.

ΣFeO = all Fe calculated as FeO.

TABLE E-13

Selected analyses of Fe-Ti oxides from some basaltic rocks in the Myra beds, Glen Ward beds and Tamworth Group.

	Myra beds (*Type* 1)		Glen Ward beds					Tamworth Group (Morrisons Gap area)			
ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11
SAMPLE	215	216	064	072	066	074	060	053	053	059	055
SiO_2	1.71	3.89	-	0.15	2.91	3.56	-	1.41	1.63	0.17	0.41
TiO_2	21.11	26.64	10.19	13.45	14.54	15.17	47.06	1.97	8.65	12.28	15.54
Al_2O_3	4.26	2.19	2.13	4.37	2.91	3.58	0.73	0.81	1.64	2.87	2.18
V_2O_3	1.30	0.77	0.95	n.d.	0.94	0.59	0.47	0.46	0.99	1.01	0.61
Cr_2O_3	-	-	-	-	-	-	-	-	-	-	-
Fe_2O_3*	17.58	6.80	44.79	36.75	31.21	25.95	11.64	61.98	47.50	41.63	36.62
FeO	52.17	57.45	39.18	42.65	49.25	45.88	38.68	34.47	40.69	43.03	44.66
MnO	0.76	0.36	1.02	-	-	0.47	3.22	0.76	0.91	0.61	1.81
MgO	0.11	0.16	0.12	0.85	0.15	0.62	0.21	-	0.20	-	0.21
CaO	0.35	3.19	-	-	0.10	2.20	-	0.27	0.33	-	0.27
Total	99.35	101.45	98.38	98.22	102.01	98.02	102.01	102.13	102.54	101.60	102.31
Usp.(mol.%)	64.6	85.2	29.3	38.5	50.0	52.5		10.8	29.7	34.6	44.2
Cations per O =	4	4	4	4	4	4	6	4	4	4	4
Si	0.063	0.138	-	0.006	0.105	0.131	-	0.052	0.060	0.006	0.015
Ti	0.583	0.713	0.293	0.378	0.395	0.426	1.752	0.055	0.238	0.340	0.426
Al	0.184	0.092	0.096	0.193	0.124	0.156	0.042	0.036	0.071	0.124	0.094
V	0.038	0.022	0.029	-	0.027	0.017	0.019	0.014	0.029	0.030	0.018
Cr	-	-	-	-	-	-	-	-	-	-	-
Fe^{3+}	0.485	0.182	1.288	1.037	0.848	0.721	0.434	1.734	1.306	1.153	1.005
Fe^{2+}	1.604	1.712	1.254	1.339	1.489	1.418	1.602	1.074	1.244	1.326	1.364
Mn	0.024	0.011	0.033	-	-	0.015	0.135	0.024	0.028	0.021	0.056
Mg	0.006	0.008	0.007	0.047	0.008	0.034	0.016	-	0.011	-	0.011
Ca	0.014	0.122	-	-	0.004	0.087	-	0.011	0.013	-	0.011
Σ	3.000	3.000	3.000	3.000	3.000	3.000	4.000	3.000	3.000	3.000	3.000

* Fe_2O_3 calculated following the procedure of Carmichael (1967). Usp. = ulvospinel. n.d. = not determined.

TABLE E-14

Representative analyses of chlorites from some Tamworth Belt and PBOC basaltic rocks

ANALYSIS No.	1	2	3	4	5	6	7
SAMPLE	077	074	063	073*	053	055	032
SiO_2	27.79	27.60	26.18	24.91	26.12	25.58	27.39
Al_2O_3	17.72	16.63	18.91	18.06	18.31	18.44	17.67
V_2O_3	-	-	0.17	-	0.15	-	-
ΣFeO	25.23	26.66	28.70	35.22	30.76	32.13	26.40
MnO	0.44	0.39	0.47	0.82	0.50	0.59	0.44
MgO	16.21	15.20	13.87	8.97	12.75	11.64	15.85
CaO	0.30	0.44	0.21	-	-	0.15	0.22
Na_2O	0.40	0.21	0.19	0.33	0.34	0.35	0.37
TOTAL	88.09	87.13	88.70	88.31	88.93	88.88	88.34
Cl^-	0.05	-	-	-	0.05	0.05	-
mg (chlor.)	52.9	50.0	45.9	30.7	42.1	38.8	51.3
mg (host)	50.9	62.8	49.2	40.9	35.6	n.d.	49.7
Numbers of cations on the basis of 36 (O,OH)							
Si	5.840	5.919	5.572	5.553	5.615	5.552	5.780
Al^{IV}	2.160	2.081	2.428	2.447	2.385	2.448	2.220
Al^{VI}	2.227	2.124	2.315	2.299	2.253	2.270	2.175
V	-	-	0.029	-	0.025	-	-
ΣFe^{2+}	4.434	4.781	5.109	6.568	5.528	5.832	4.657
Mn	0.079	0.071	0.084	0.155	0.092	0.108	0.078
Mg	5.077	4.859	4.399	2.980	4.083	3.766	4.986
Ca	0.068	0.101	0.047	-	-	0.036	0.049
Na	0.162	0.087	0.079	0.141	0.143	0.148	0.153
Σ cations	20.047	20.023	20.062	20.143	20.124	20.160	20.098
Cl	0.017	-	-	-	0.019	0.018	-

* Filling vesicles. n.d. = not determined.

Glen Ward beds: Analyses 1,3 from doleritic intrusives; 2,4 from basaltic extrusives.

Tamworth Group (M.Gap): Analyses 5,6 from basaltic extrusives.

PBOC.: Analysis 7 from Low Ti doleritic intrusive.

TABLE E-15

Some references containing descriptions of pyroxene-rich, olivine-poor or olivine-free basalts recovered from various ocean-floor localities

LOCALITY	REFERENCES
Mid-Atlantic Ridge:	Bougault and Hekinian (1974), Frey *et al.* (1974a), Bryan and Thompson (1977), Dickey *et al.* (1977), Flower *et al.* (1977), Bryan (1979), Le Roex and Dick (1981), Le Roex *et al.* (1981), Sigurdsson (1981).
East Pacific Rise:	Johnson (1979), Ludden *et al.* (1980), Thompson and Humphris (1980), Delaney *et al.* (1981).
Galapagos Ridge:	Anderson *et al.* (1975), Byerly (1980).
Juan de Fuca Ridge:	Dietrick and Lynn (1975).
Nazca Plate:	Bunch (1974), Bunch and La Borde (1976), Mazzullo and Bence (1976).
Panama Fracture Zone:	Bass (1972).
N.E. Indian Ocean:	Hekinian (1974b), Robinson and Whitford (1974), Frey *et al.* (1980).
90-East Ridge	Hekinian (1974a), Ludden *et al.* (1980).
Caroline Ridge:	Ridley *et al.* (1974).
South Fiji Basin:	Stoeser (1975).
Minami-Daito Basin: (Northern Philippine Sea)	Dick (1982).
Tyrrhenian Sea:	Dietrich *et al.* (1977).
Tasman Sea:	Ovenshire *et al.* (1975).

APPENDIX F

CLINOPYROXENE-RICH CUMULATES FROM THE CURRICABARK FAULT ZONE, GLENROCK STATION AREA.

These olivine + clinopyroxene ± plagioclase ± 'hornblende cumulates occur as tectonic blocks in schistose serpentinite. Although they possess atypically low abundances of incompatible elements, they differ from PBOC cumulates in that: (i) they are completely devoid of modal orthopyroxene; (ii) they are relatively clinopyroxene-rich, and clinopyroxene crystallized from their parental melts significantly before plagioclase; (iii) for a given *mg* value they are enriched in Ca (Fig. 5.5), Ti, and Al (Fig. 5.6), and depleted in Cr relative to clinopyroxenes in PBOC cumulates; (iv) their plagioclases are more Ca-rich than any in PBOC cumulates; and (v) the gabbroic variants contain significant primary modal amphibole.

Although few data are available for comparison, these Glenrock cumulates appear to resemble variants most commonly found associated with the Peel Fault System to the northwest of the Pigna Barney-Curricabark area. It is conceivable that cumulates of this type might be related to basaltic rocks in the adjacent stratigraphic associations. However, the latter are too varied and the relevant data are too few to enable this possibility to be evaluated with any confidence at this stage.

TABLE F-1

Major and Trace Element Analyses of Olivine Clinopyroxenites and an Olivine Gabbro from the Curricabark Fault Zone in the Glenrock Station Area

ANALYSIS	1	2	3	4	5
SAMPLE	421	423	424	425	420*
SiO_2	44.60	47.61	47.23	47.34	40.31
TiO_2	0.11	0.14	0.14	0.13	0.04
Al_2O_3	8.76	2.09	1.89	1.89	29.10
Cr_2O_3	0.12	0.18	0.17	0.19	0.01
ΣFeO	9.35	9.53	9.36	9.46	1.58
NiO	0.03	0.03	0.04	0.04	-
MnO	0.19	0.18	0.17	0.16	0.05
MgO	23.60	26.34	27.13	27.25	3.33
CaO	12.88	14.00	13.43	13.22	24.81
Na_2O	0.26	0.18	0.18	0.21	0.26
K_2O	0.05	0.01	0.02	0.02	0.04
P_2O_5	0.03	0.03	0.03	0.03	0.05
TOTAL	99.98	100.32	99.79	99.94	100.08
ΣVol[1]	5.63	5.23	5.30	6.05	4.90
FeO[1]	5.96	4.18	3.86	4.14	1.40
mg	81.5	82.9	83.5	83.5	78.4
TRACE ELEMENTS (ug/g)					
K	397	112	165	144	344
Rb	2	<1	<1	<1	<1
Ba	12	7	8	6	57
Sr	194	12	15	12	744
Li	15.2	1.8	1.2	2.3	40
Zr	4	2	2	2	10
Nb	<3	<3	<3	<3	<3
Y	3	3	4	<3	<3
Ti	772	973	883	906	221
Ni	284	272	318	309	38
Co	104	88	88	109	58
V	117	126	156	155	42
Cr	824	1196	1173	1304	99
Sc	n.d.	n.d.	n.d.	68	n.d.
La	3	n.d.	n.d.	n.d.	-
Ce	8	n.d.	n.d.	n.d.	8
Nd	2	n.d.	n.d.	n.d.	-
Cu	9	6	6	9	9
Zn	56	51	48	48	21

1 See Appendix G. n.d. = not determined

* Saussuritized plagioclase horizon from 421

mg = 100 Mg/(Mg + ΣFe + Mn)

Major element analyses recalculated to original totals on a volatile-free basis. Trace element analyses also recalculated on a volatile-free basis.

TABLE F-2

Representative Analyses of Ferromagnesian Phases in an Olivine Gabbro and Olivine Clinopyroxenites from the Curricabark Fault Zone, Glenrock Station Area

ANALYSIS No.	1	2	3	4	5	6	7	8
	OLIVINE		CLINOPYROXENE			AMPHIBOLE		
SAMPLE	421	a	421	b	c	421	421	421
SiO_2	39.12	39.55	50.94	52.19	52.57	43.92	43.79	45.72
TiO_2	-	-	0.23	0.10	-	0.65	0.50	0.44
Al_2O_3	-	-	4.00	2.84	2.45	14.22	14.37	9.78
Cr_2O_3	-	-	0.22	0.18	0.21	0.31	0.25	0.23
$Fe_2O_3^*$	n.d.	n.d.	n.d.	n.d.	n.d.	3.86	4.39	8.65
FeO	18.07	17.13	5.48	4.08	3.83	3.67	3.30	2.49
MnO	0.20	0.18	-	-	-	-	-	-
MgO	42.30	43.35	15.86	16.30	16.34	16.60	16.40	17.77
Cao	-	-	23.13	24.19	24.49	12.57	12.66	11.00
Na_2O	-	-	-	-	-	2.41	2.18	1.49
K_2O	-	-	-	-	-	-	-	0.07
TOTAL	99.69	100.21	99.86	99.88	99.89	98.21	97.84	97.64
CATIONS (O=)	4	4	6	6	6	23	23	23
Si	0.999	1.000	1.880	1.916	1.929	6.224	6.222	6.520
Al^{IV}	-	-	0.120	0.084	0.071	1.776	1.778	1.480
Al^{VI}	-	-	0.054	0.039	0.035	0.599	0.628	0.164
Cr	-	-	0.006	0.005	0.006	0.035	0.028	0.026
Ti	-	-	0.006	0.003	-	0.069	0.053	0.047
Fe^{3+}	-	-	-	-	-	0.412	0.469	0.928
Fe^{2+}	0.387	0.363	0.169	0.125	0.118	0.436	0.393	0.297
Mn	0.004	0.004	-	-	-	-	-	-
Mg	1.611	1.634	0.873	0.892	0.894	3.507	3.472	3.778
Ca	-	-	0.915	0.952	0.963	1.908	1.927	1.681
Na	-	-	-	-	-	0.662	0.601	0.412
K	-	-	-	-	-	-	-	0.013
Σ	3.001	3.001	4.023	4.016	4.016	15.628	15.571	15.346
M	80.6	81.8	83.8	87.7	88.3	88.9	89.8	92.7
Ca atom.%			46.8	48.4	48.7			
Mg atom.%			44.6	45.3	45.3			
Fe' atom.%			8.6	6.3	6.0			

*Fe_2O_3 calculated following the method of Papike *et al.* (1974). n.d. = not determined.
a = mean of 11 olivines from olivine clinopyroxenites (samples 422-425)
b = mean of 11 clinopyroxene cores from olivine clinopyroxenites (samples 422-425)
c = mean of 10 clinopyroxene rims from olivine clinopyroxeneites (samples 422-425)
Analysis 6 = cumulus (?) pargasite; 7 = post-cumulus pargasite; 8 = secondary magensio-hornblende. Sample 421 is an olivine gabbro, plag = An_{94-93}.

APPENDIX G

ANALYTICAL METHODS

WHOLE-ROCK ANALYSES

Sample Preparation

Prior to initial crushing of all samples any veined portions and weathered surfaces were removed using a diamond saw (lubricated by water). In most cases 0.5-2 kg of each sample remained available for crushing. Using coarse carborundum powder, sawn surfaces were ground free of saw-marks and possible metal contaminants. All samples of basaltic rocks and those of the least-altered PBOC intrusives were sawn into thin slabs, ground clean (as outlined above), broken into -1cm fragments with a tungsten-carbide-tipped chisel, and split into two sub-equal portions. The remaining samples were reduced to -1cm in a jaw-crusher with hardened steel plates. These crushes were split until two representative fractions each weighing ∿200-500 g were obtained. Each fraction was inspected with a magnifying glass and any fragments contaminated by the jaw-crusher were discarded. The representative samples prepared by sawing and chiselling, and by jaw-crushing, were finally crushed to -200# using a Siebtechnik ring-grinder - one fraction of each sample in a tungsten-carbide vessel and the other in a chrome-steel vessel (to avoid cobalt contamination derived from the tungsten-carbide vessel). The 'chrome-steel crush' was used for all wet-chemical determinations.

Major Element Analyses

The major oxides, SiO_2, TiO_2, Al_2O_3, total Fe as Fe_2O_3, MnO, MgO, CaO and P_2O_5, were determined by X-ray fluorescence spectrometry (XRF) using a Philips PW1540 manual spectrometer at the Geology Department, U.N.E. The method employed was that outlined by Norrish and Hutton (1969) involving linear calibration after sample dilution in a lanthanum oxide-lithium tetraborate glass. Prior to fusion all samples were ignited at 1100°C for 10 hours (see below) to remove all volatiles and oxidize Fe^{2+}. Sodium nitrate was added to the fusion mix as an additional oxidant. Measured losses of Na during ignition were invariably $\ll 0.2\%$ of the total sample weight (and usually undetectable) and consequent relative enrichment in the remaining elements was insignificant.

MgO was determined by atomic absorption spectrometry (AAS) for samples in which it was found to be at low concentrations (<2 wt% MgO). Also, for a number of critical samples (e.g. PBOC low-Ti basaltic rocks and olivine norite 440), XRF determinations of Fe and Mg were checked (and vindicated) by AAS. Na_2O and K_2O were determined on a Corning Eel flame photometer following dissolution of 1 gram of sample using hydrofluoric and perchloric acids, and subsequent dilutions with appropriate quantities of a standard Li_2SO_4 solution.

Ferrous iron* was determined by titration with a standardized ammonium cerric sulphate solution following dissolution of 0.5 g of sample in a mixture of concentrated hydrofluoric and sulphuric acids. N-phenyl anthranilic acid was used as an indicator.

The total wt% volatiles (ΣVol ; almost entirely H_2O + minor CO_2) in each sample was determined from the weight-loss following ignition of ∿1 g of sample at 1100°C for approximately 10 hours. Under those conditions at least 98% of Fe^{2+} is oxidized to Fe^{3+} (experimentally verified), and corrections were made for any weight-gains due to uptake of oxygen *via* this reaction. Total H_2O was also determined on a range of PBOC samples and U.S.G.S. standard rocks by weighing the cooled condensate collected in a specially designed apparatus after ignition of the powdered sample at 1050°C for one hour. In every case these results were in close agreement with ΣVol determinations on the same samples. Thus, ΣVol values listed in this study provide a significantly more reliable indication of the total wt% volatile species than do the loss-on-ignition (LOI) values quoted in many published studies (i.e. in studies where FeO has not been determined on samples analysed). The presence or absence of 'significant' CO_2 (see, for example, Tables 3.6a-3.8a) was crudely assessed by simple close observation to detect any release of bubbles during the initial addition of acids for sample dissolution. H_2O^- was determined on all samples by measuring the loss in weight after heating ∿1 g of sample at 105°C for one hour. However, H_2O^- abundances ($H_2O^- \ll 0.5$ wt%) are of little relevance to the present study and they have not been reported separately in the analyses listed (i.e. H_2O^- is included in ΣVol). Fluorine and chlorine (e.g. Table 5.2) were determined by X-ray Assay Laboratories (XRAL) Ltd, Ontario. The methods of analysis for F and Cl are not available.

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* The Fe_2O_3/FeO ratios of analyses in most tables are adjusted to 0.1, 0.07, or ∿0. In these cases, measured Fe_2O_3/FeO is listed beneath ΣVol.

Trace Element Analyses

Li, Cu, Zn and Co were determined by AAS from perchlorate solutions containing 1.0 g sample/100 ml. Because Cr-Al spinel was not digested following sample dissolution, actual Zn and Co abundances in rocks containing this phase are likely to be slightly higher than those reported.

Trace amounts of Na and K were determined using a Corning Eel flame photometer calibrated using approximately 40 standard solutions falling within the appropriate concentration range (0-5 μg/ml for 1 g samples/100 ml of most PBOC ultramafics and related rocks). Results also obtained by addition of various amounts of Na+K standard solutions to a variety of PBOC sample solutions were in excellent agreement with the 'calibration and direct comparison' method more generally employed for these and all other samples.

Scandium was determined by instrumental neutron activation analysis performed by XRAL. Boron abundances in several samples were also determined by XRAL but the method was not disclosed.

Rb, Ba, Sr, Zr, Nb, Y, Ni, V, Cr and (unless stated otherwise) La, Ce, and Nd were analysed by XRF on pelletized powder samples following the general procedures outlined by Norrish and Chappell (1977). Linear calibrations were obtained using a number of USGS and NIM international rock standards. Mass absorption coefficients were calculated from major element analyses and, where necessary, corrections were applied to remove the effects of interfering peaks.

Ti is reported as a trace element in some analyses. However, due to possible masking of Ti by Ca in pressed pellet matrices (Nesbitt and Stanley, 1977*), the accuracy of these Ti determinations relative to TiO_2 determinations on the same samples remains uncertain. Where quoted in this study, "Ti" is calculated from TiO_2 determined on a fused bead.

Isotopes and REE

Isotopic analyses were performed by Dr H.D. Hensel (Rb-Sr, Nd) and D. Kimbrough (U-Pb) using well-established mass-spectrometry techniques and

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* Nesbitt, R.W. and Stanley, J. (1977). Measurement of TiO_2-explanation of some discrepancies. In R.W. Nesbitt and J. Stanley (eds). Compilation of Analytical Geochemistry Reports 1973-1979, Department of Geology and Mineralogy, University of Adelaide, pp. 133-136.

instruments at the Research School of Earth Sciences, Australian National University, and at the University of California, Santa Barbara, respectively. Rare earth element (REE) abundances in samples 047 and 048 were determined by Dr J.D. Kleeman using instrumental neutron activation facilities at the University of Oregon, and Dr S.R. Taylor (RSES) determined REE abundances in sample 440 by mass spectrometry. Instrumental conditions and experimental uncertainties are not available for these isotopic and REE analyses, but they are very likely to be "routine".

Analytical Precision and Accuracy

Precision of the major element analyses is generally considered to be better than ±1 per cent relative. Precision for the trace elements determined by XRF is better than 5 per cent for most elements. The accuracy of the major and trace element analyses determined at U.N.E. was monitored by concurrent analysis of a number of international rock standards (in particular, U.S.G.S. standard rocks G-2, GSP-1, AGV-1, BCR-1, BHVO-1, PCC-1 and DTS-1) for each element determined. With very rare exceptions, all of these U.S.G.S. standards (using the recommended values of Flanagan, 1973*) fell on linear calibrations for each element following routine matrix correction procedures (*cf.* Norrish and Chappell, 1977). Almost all of the data reduction was performed using a hand calculator. Any random human error is believed to be absolutely minimal. Any unusual or unsuspected results were re-examined and, on some occasions, samples were reanalysed. Critical samples for which some trace element abundances approach the detection limits of the equipment used (e.g. low-Ti basaltic rocks - Nb, Rb, Zr, REE) were analysed in triplicate, and extended counting times were employed. These results were averaged.

MINERAL ANALYSES

With very few exceptions, electron probe microanalyses listed in this study were determined at the Research School of Earth Sciences (A.N.U.) using a T.P.D. electron microprobe fitted with a Si(Li) detector and an energy-dispersive spectrometer. Detection limits were: SiO_2, Al_2O_3, MgO, Na_2O, NiO = 0.1 wt%; ΣFeO, MnO = 0.09 wt%; TiO_2, Cr_2O_3, V_2O_3 = 0.08 wt%;

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* Flanagan, F.J. (1973). 1972 values for international geochemical reference samples. *Geochim. Cosmochim. Acta*, 37:1189-1200.

CaO = 0.07 wt%; K_2O, Cl = 0.05 wt%. On-line data reduction was achieved using the ZAF correction procedure. The remaining analyses were obtained on instruments at U.N.E. and the University of Wellington, N.Z. These instruments have detection limits comparable to those listed for the RSES microprobe.

X-RAY DIFFRACTION ANALYSES

All X-ray diffraction determinations were performed on pelletized powders using a Philips PW1050/30 scanning goniometer, PW1130 X-ray generator, and cobalt radiation. Semi-quantitative modal determinations followed the general method outlined in Flinter (1975). Plagioclase compositions were estimated following the methods of Smith (1956)* and Smith and Gay (1958)**, which were adapted to Co radiation.

MINERAL SEPARATIONS

Samples selected for isotopic dating were initially crushed to -1cm in a jaw-crusher and then reduced to -60# by repeated passes through a disc-mill. The final crush was classified by sieving into the following size ranges: 60-80#, 80-100#, 100-140#, 140-200#, 200-250# and -250#. The -250# fraction was discarded and the remainder washed repeatedly to remove fine dust. Relatively ferromagnetic phases were removed following repeated runs through a Franz Isodynamic separator. Zircon, sphene, apatite and muscovite were separated from the appropriate non-magnetic fractions by use of heavy liquids (tetrabromoethane, diodomethane and Clerici's solution) and final separates were hand-picked to 100% purity (not allowing for any undetected 'foreign' inclusions within grains). Pyroxenes and plagioclase in olivine norite sample 440 were separated to >95% purity using a Franz Isodynamic (magnetic) separator. Dr H.D. Hensel kindly completed the purification of these particular separates.

In all, almost 300 kg of rock was processed following the above procedures. Unfortunately, all of the U-Pb and one of the Rb-Sr (sample 440) isotopic "dates" presently available remain somewhat enigmatic. However,

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* Smith, J.V. and Gay, P. (1958). The powder patterns and lattice parameters of plagioclase feldspars. II. *Mineral. Mag.*, 31:744-762.

** Smith, J.V. (1956). The powder patterns and lattice parameters of plagioclase fledspars. I. The soda-rich plagioclases. *Mineral. Mag.*, 31:47-68.

additional U-Pb data (not yet available) on sphene and apatite separates should constrain the age(s) of the Pola Fogal Suite sufficiently to enable a more confident assessment of its geological significance.

APPENDIX H : ISOTOPIC DATA

TABLE H-1

Isotopic Data on Zircons from Pola Fogal Tonalitic Intrusives and Zone A Granodiorites

	POLA FOGAL		BARRINGTON TOPS			MT EPHRAIM
SAMPLE	342	341	a	b	c	384
^{206}Pb (ug/g)	13.99	40.82	13.56	14.50	13.25	18.91
^{238}U (Ug/g)	306.9	874.3	393.3	422.0	384.4	656.4
$^{208}Pb/^{206}Pb$	0.17534	0.51194	0.20642	0.19205	0.19121	0.29655
$^{207}Pb/^{206}Pb$	0.062335	0.058220	0.059565	0.05732	0.056993	0.066854
$^{204}Pb/^{206}Pb$	0.000464	0.000223	0.000523	0.000373	0.000344	0.001034
$^{207}Pb/^{206}Pb$	0.055593	0.054974	0.05192	0.0518644	0.051962	0.05174
Calculated Ages (m.y.):						
$^{206}Pb/^{238}U$	331	339	252	251	252	211
$^{207}Pb/U$	344	348	255	254	255	216
$^{207}Pb/^{206}Pb$	434	409	279	277	281	270

a non-magnetic fraction, ½° slope, 1.65amps.

b " " " 1° " , " (minus a).

c " " " 2° " , " (minus a+b).

Analyst: Dr. D. Kimbrough, University of California, Santa Barbara

TABLE H-2

Miscellaneous Rb-Sr Isotopic Data

SAMPLE	Rb (ug/g)	Sr (ug/g)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	$S \times 10^5$ (No.)	AGE m.y.
440 (rock)	0.39	8.73	0.1289	0.70409	(1)	- *
440 (cpx)	0.44	5.14	0.0986	0.70475	18(7)	- *
440 (opx)	0.18	1.39	0.3638	0.705	(1)	- *
440 (plag)	0.57	25.00	0.6832	0.70476	24(4)	- *
008 (rock)	3.75	91.81	0.1179	0.70481	10(3)	-
009 (rock)	1.69	69.5	0.0702	0.70489	11(5)	-
380 (rock)	54.1	411.45	0.3804	0.70524	1(3)	-
380 (biot)	388.11	9.95	117.715	1.14249	(1)	262
381(rock)	50.1	436.9	0.3317	0.70483	7(4)	-
382 (rock)	66.05	383.65	0.4980	0.70555	9(2)	-
384 (rock)	66.8	722.6	0.2674	0.70493	10(4)	-
301 (rock)	17.35	66.29	0.7561	0.71563	7(7)	-
301 (musc)	165.99	74.37	6.4688	0.74630	8(7)	378

S = standard deviation

(No.) = number of determinations

Analyst: Dr. H.D. Hensel
Research School of Earth Sciences,
Australian National University.

440 = PBOC olivine (mela-) norite

008 = PBOC Low - Ti microdolerite

009 = PBOC Low - Ti aphanitic pillow basalt

380-2 = Barrington Tops granodiorite

384 = Mount Ephraim granodiorite

301 = PBOC blueschist

* These data do not yield a well-defined isochron.

TABLE I-1

Major and trace element partial analyses of basaltic rocks from the Tamworth Group, Morrisons Gap area
(from Cross, 1974)

ANALYSIS No.	1	2	3	4	5	6	7	8	9	10	11	12	13
SAMPLE	R31429	R31421	R31451	R31433	R31430	R31516	R31540	R31549	R31491	R31502	R31539	R31518	R31447
TiO_2	2.40	2.16	2.40	2.26	2.06	1.90	2.16	2.10	2.61	3.00	2.50	2.66	2.76
Al_2O_3	14.74	13.98	14.55	13.98	13.60	15.53	14.74	12.83	18.31	14.55	14.57	14.55	14.17
ΣFeO	12.76	10.65	13.33	13.05	11.71	10.16	11.45	13.80	8.22	14.15	11.45	13.09	12.51
MnO	0.19	0.20	0.19	0.20	0.24	0.18	0.17	0.21	0.18	0.20	0.17	0.17	0.25
MgO	5.86	4.53	4.90	4.63	4.14	7.35	5.75	6.17	3.68	6.13	4.79	4.50	4.26
CaO	7.64	7.19	5.31	6.11	9.44	9.80	7.91	8.63	7.82	9.80	9.35	7.01	5.03
Na_2O	4.60	5.32	5.87	5.00	4.95	2.37	2.06	3.22	3.05	6.15	3.50	5.38	5.68
K_2O	0.08	0.03	tr.	tr.	tr.	0.02	0.08	0.05	0.05	0.11	tr.	0.03	0.11
TOTAL	48.3	44.1	46.6	45.2	46.1	47.3	44.3	47.0	43.9	54.0	46.3	47.4	44.8
$\Sigma FeO/MgO$	2.18	2.35	2.72	2.82	2.83	1.38	1.99	2.24	2.23	2.31	2.39	2.91	2.94
mg	44.6	42.7	39.2	38.4	38.2	55.9	46.9	44.0	43.8	43.2	42.4	37.7	37.3
TRACE ELEMENTS ($\mu g/g$)													
Rb*	2	3	n.d.	-	-	n.d.	n.d.	n.d.	n.d.	n.d.	2	4	n.d.
Sr*	127	157	n.d.	139	181	n.d.	n.d.	n.d.	n.d.	n.d.	293	282	n.d.
Zr*	78	111	n.d.	74	76	n.d.	n.d.	n.d.	n.d.	n.d.	130	135	n.d.

n.d. = not determined. ΣFeO = total Fe as FeO.

Analyses 1-5 = basaltic extrusives; 6-13 = doleritic intrusives (analysis 12 = albite gabbro).

* The relative error in these determinations might be as high as ±10%.

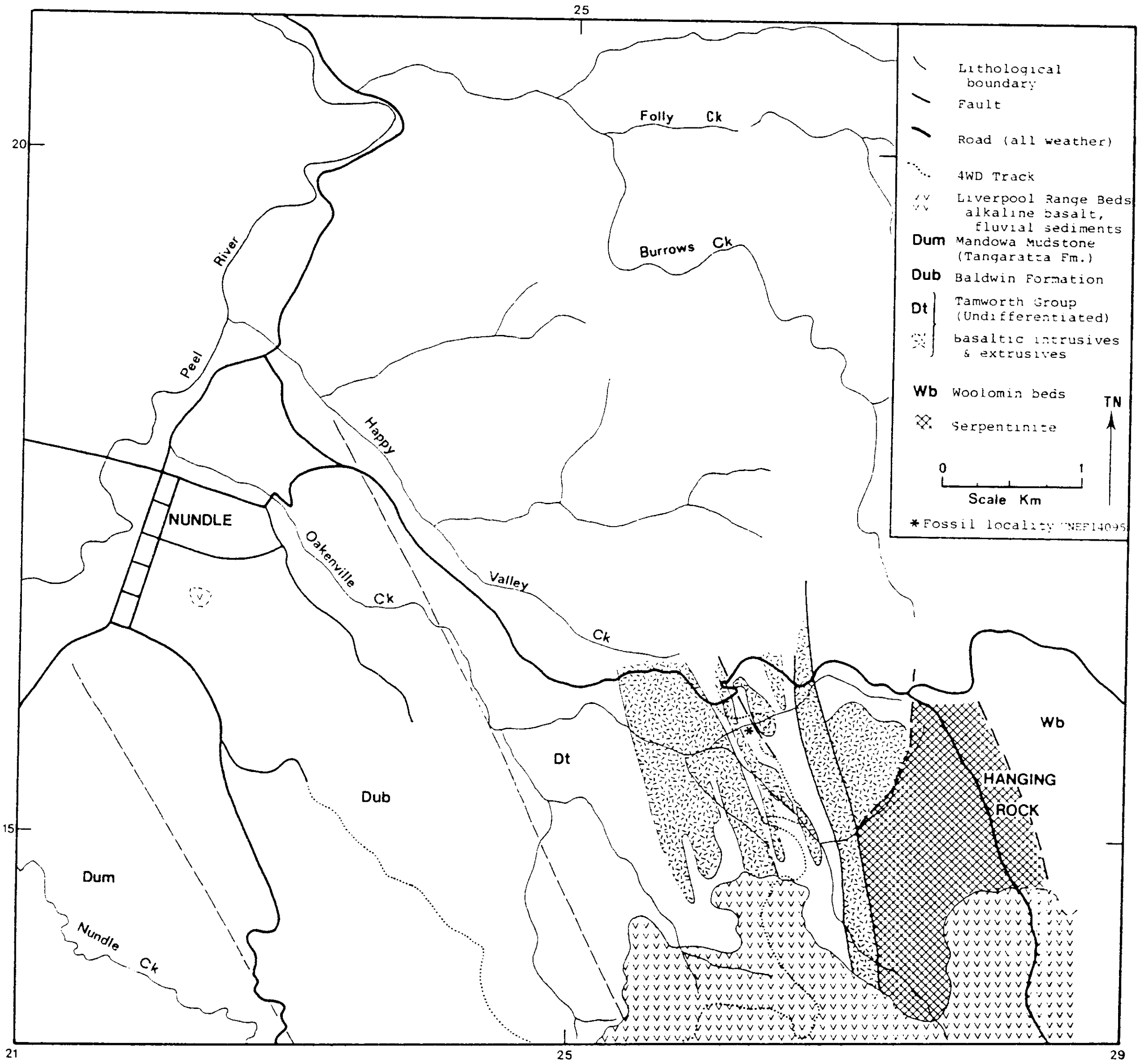

Fig. I-1: Geological sketch map of the Nundle - Hanging Rock area.

Grid as for Map 2

APPENDIX J

GRID REFERENCES FOR SAMPLES REFERRED TO IN THE TEXT

Map 1 : Grid references fall in the range : 55..,.... to 81..,....

Map 2 : " " " " " " : 19..,.... to 32..,....

S = sample number (001 ≡ R49001 in UNE collection, 002 ≡ R49002 and so on).

GR = grid reference. In most cases grid references cited are believed to be accurate to better than ±0005 (i.e. ∿ ±50 metres).

A generalized lithological key follows the grid references listed below.

001	6308,8047	031	6386,8109	067	5776,8413	097	6460,8100
002	6307,8045	032	6389,8137	068	6630,7994	098	5768,8402
003	6308,8046	033	6377,8132	069	5784,8438	099	5653,8494
004	"	034	6385,8128	070	5940,8396	100	6051,8348
005	6318,8054	035	6389,8138	071	5780,8478	101	5582,8543
006	"	036	6373,8102	072	5785,8430	102	5589,8537
007	6332,8071	037	6235,8182	073	5726,8355	103	5704,8348
008	6348,8091	038	6435,8042	074	6243,8198	104	6196,7996
009	6357,8100	039	6308,8047	075	6431,8181	105	6219,7737
010	6341,8081	040	6351,8094	076	6631,7996	106	6505,8062
011	6325,8060	047	2808,0698	077	6040,8038	107	6251,8246
012	6447,8124	048	2855,0690	078	5807,8362	108	5941,8427
013	6346,8088	049	2854,0686	079	5781,8478	109	5930,8470
014	6358,8108	050	2855,0690	080	5646,8484	110	5792,8440
015	6373,8102	051	2950,0598	081	5863,8210	111	"
016	6358,8108	052	2810,0699	082	6013,7992	112	5784,8438
017	6346,8056	053	2808,0698	083	5646,8484	113	6033,7980
018	6298,8180	054	3000,0475	084	6445,8107	114	6715,8000
019	6358,8108	055	2810,0698	085	6225,8176	115	"
020	6307,8045	056	2811,0699	086	6241,8200	116	6305,8022
021	6308,8046	057	2848,0695	087	6030,8403	117	"
022	6305,8038	058	3010,0425	088	6240,8181	118	6235,7984
023	"	059	2982,0352	089	6167,7963	119	6121,7964
024	"	060	6218,8200	090	6633,8105	120	6003,8414
025	6429,8113	061	6183,8190	091	6584,8006	161	5770,8314
026	"	062	6427,8048	092	5889,8419	162	"
027	6457,8121	063	5979,8097	093	6652,8000	163	"
028	6454,8129	064	5787,8454	094	5941,8427	164	"
029	6458,8129	065	5776,8413	095	5807,8414	165	"
030	6379,8141	066	7332,8029	096	6208,7896	166	5956,8400

184	7300,8062	226	7958,9130	276	7125,9143	329	6501,8124
185	7262,8057	227	6360,8273	277	7126,9144	330	7267,8538
186	6060,8330	228	7645,9370	278	7126,9143	331	7267,8540
187	5640,8466	229	7618,9356	279	7127,9142	332	8230,8620
188	7823,9210	230	6334,9150	280	7125,9143	340	6490,8135
189	6230,8297	231	8025,9304	281	"	341	6325,8213
190	6464,8476	232	6957,8340	291	6750,8210	342	6205,8276
191	7558,9078	233	"	292	"	343	"
192	7768,9208	234	"	293	"	344	6923,8189
193	6490,8486	235	"	294	6575,8198	350	7133,8014
194	7523,9065	236	"	295	6568,8195	351	7049,8166
195	6873,8564	237	"	296	6996,8316	352	6976,8168
196	8042,9350	238	"	297	707,829	353	7209,8318
197	6475,9036	239	6892,8354	299	6567,8190	354	7092,8238
198	5886,8419	240	7160,8341	300	6572,8190	355	6751,8097
199	6538,7998	241	6653,9368	301	6567,8190	356	6773,8012
200	7750,9405	242	7589,9375	302	"	357	6742,8079
201	7218,9360	243	8039,9291	303	6568,8195	358	7103,8171
202	"	244	6014,8396	304	"	359	726,832
203	8025,9305	245	6427,8196	305	6922,8271	360	"
204	"	246	6425,8196	306	6895,8225	370	6538,7998
205	"	247	6770,8241	307	577,945	371	7270,8005
206	7915,9329	248	8043,9348	308	6876,8204	372	6387,7994
207	8029,9298	249	7533,9068	309	6875,8202	380	6050,7075*
208	7393,9413	258	6913,8805	311	7011,8260	384	2655,1000
209	7473,9368	259	6865,8254	312	6878,8198	388	7660,9116
210	8031,9315	260	7125,9143	313	6750,8210	389	7750,9176
211	8030,9312	261	"	314	707,829	390	7750,9189
212	8026,9310	262	"	315	6951,8218	391	7660,9116
213	8047,9302	263	"	316	6417,8225	392	7506,9068
214	7940,9218	264	"	317	6929,8239	393	"
215	7250,9370	265	"	318	6205,8267	394	7751,9174
216	7255,9380	266	"	319	6846,8210	395	7750,9189
217	7495,9038	267	7126,9143	320	7064,8305	396	7823,9211
218	7305,9365	268	7125,9143	321	6490,8135	397	8038,9229
219	"	269	"	322	6500,8127	398	7762,9206
220	8075,9305	270	"	323	6519,8103	399	5680,8514
221	8066,9323	271	"	324	6501,8127	400	"
222	7286,9381	272	"	325	6500,8128	401	6184,7962
223	7288,9380	273	"	326	"	402	7513,8422
224	7235,9365	274	"	327	6486,8119	403	7323,8027
225	7398,9381	275	"	328	6720,8160	404	7264,8055

405	6271,8028	438	6500,8127	471	7354,8571	504	6560,8135
406	7927,9338	439	6500,8128	472	6776,8217	505	6264,8226
407	"	440	6500,8127	473	6625,8147	506	6516,8514
408	7911,9344	441	"	474	7355,8571	507	6841,8141
409	5774,8405	442	7056,8397	475	6848,8130	508	2743,0747
410	8036,9293	443	6516,8114	476	7120,8658	509	6814,8119
411	5838,8433	444	7139,9198	477	"	510	7350,8554
412	8039,9289	445	6522,8110	478	7192,8692	511	7363,8544
413	2805,0700	446	"	479	6848,8130	512	6475,9061
414	6225,7963	447	6848,8130	480	6841,8171	513	"
415	5844,8415	448	6501,8124	481	7207,8660	514	6447,8168
416	6263,8002	449	6516,8116	482	7182,8702	515	7139,9198
417	5670,8512	450	"	483	6804,8232	516	"
418	5900,8312	451	7129,9129	484	6543,8997	517	"
419	6090,8305	452	6516,8117	485	6720,8160	518	7129,9196
420	5225,9825†	453	6722,8148	486	6719,8163	519	7129,9192
421	"	454	8230,8620	487	6510,8994	520	7129,9196
422	"	455	"	488	7212,8693	521	7137,9195
423	"	456	6522,8170	489	7225,8648	522	7362,8560
424	"	457	"	490	6463,8171	523	6840,8168
425	"	458	6760,8128	491	7101,9203	524	7121,8658
426	7072,9155	459	"	492	6141,8327	525	6764,8195
427	7093,9195	460	6522,8108	493	6516,8154	526	6722,8148
428	7094,9157	461	7364,8543	494	7093,9195	527	6729,8165
429	7095,9155	462	6475,9061	495	6156,8514	528	5760,9400
430	7125,9143	463	6205,8266	496	6183,8259	529	6516,8116
431	"	464	7135,9195	497	6205,8266	530	"
432	"	465	7129,9196	498	6508,8149	531	6487,8138
433	7087,9190	466	6332,8205	499	6495,8146	532	6519,8103
434	7087,9170	467	6487,8138	500	6475,9061	534	6156,8514
435	7082,9173	468	6848,8130	501	7135,9195		
436	7087,9165	469	6787,8236	502	6594,8151		
437	6500,8128	470	6487,8138	503	6558,8134		

*Barrington Tops Granodiorite (to the south of Map 1)

†420-425 clinopyroxene-rich cumulates, locality 14 (Fig.B-1).

See next page for a generalized key to lithologies.

In addition to those listed above, approximately 1200 other samples were also collected from the Pigna Barney-Curricabark and Morrisons Gap areas during the course of this study. These were examined in varying detail and most are housed in the Geology Department, UNE.

SAMPLES

001-024 : PBOC low-Ti basaltic extrusives and shallow intrusives

025-029 : PBOC low-Ti gabbro(norite)s

030-035 : PBOC low-Ti doleritic intrusives

036-040 : PBOC low-Ti basaltic extrusives and shallow intrusives

047-059 : Tamworth Group basaltic intrusives and extrusives, Morrisons Gap area.

060-120 : Basaltic intrusives and extrusives in the Glen Ward beds

161-166 : Slightly hornfelsed sedimentary rocks from adjacent to Glen Ward doleritic intrusives

184-187 : Glen Ward sedimentary rocks

188-197 : Myra sedimentary rocks

198-199 : Glen Ward sedimentary rocks

200-249 : Basaltic intrusives and extrusives in the Myra beds

258-259 : Carbonated serpentinite

260-265 : Sedimentary serpentinite

266-267 : Manning Group pebbly sandstones

268-276 : Sedimentary serpentinite

277-279 : Manning Group pebbly sandstones and siltstone

280-281 : Sedimentary serpentinite

291-320 : PBOC relatively higher grade metamorphic blocks

321-331 : PBOC significantly amphibolitized and/or saussuritized olivine norites

332 : PBOC olivine norite containing folded layers

340-344 : Pola Fogal Suite (hornblendite-tonalite) intrusives

350-360 : Pitch Creek Volcanics (andesite-?rhyodacite)

370-373 : Glen Ward sedimentary rocks

380 : Barrington Tops Granodiorite

384 : Mount Ephraim Granodiorite

388-419 : Myra and Glen Ward sedimentary rocks

420-425 : Olivine clinopyroxenites and olivine gabbro, Glenrock Station

426-429 : PBOC Watchimbark harzburgites

430-432 : Sedimentary serpentinite

433-436 : PBOC Watchimbark harzburgites

438-534 : PBOC olivine-bearing cumulates and tectonized harzburgites. Samples 492, 493, 495-498, 502-507 and 523 are tectonized harzburgite, and sample 525 is massive chromitite

NOTE: lithological classifications of samples 440-498 are listed in Table C-1. All samples (001-534, and others) are individually classified according to rock-type in the relevant catalogues, Geology Department, UNE.

APPENDIX K

NOTES ON MAPS 1 AND 2

MAP 1

(i) The base map was compiled from the following topographic sheets:

Ellerston	1:31,680	(9134-II-N),	N.S.W. Department of Lands
Pigna Barney	1:31,680	(9234-III-N)	"
Curricabark	1:25,000	(9234-IV-S)	"
Glenrock	1:25,000	(9234-I-S)	"

The area is also covered by the Ellerston (9134) and Upper Manning (9234) 1:100,000 topographic sheets, and the Tamworth (SH56-13) and Hastings (SH56-14) 1:250,000 geological sheets (N.S.W. Department of Mines).

(ii) Only the major faults are displayed on the map. Fault nomenclature follows that of Mayer (1972). Minor faults are abundant in the area, especially in the Myra beds.

(iii) All contacts between serpentinite and adjacent Palaeozoic lithologies, and between the Myra beds and other Palaeozoic lithologies (with the possible exception of Myra- ?Manning Group contacts in the McKenzies Creek - Orham Creek area; see pp 27-28) are faulted. However, for reasons of clarity many of these contacts are not shown as faults on the map.

(iv) The fault block largely lying between McKenzies and Orham creeks is assigned to the Manning Group solely on the basis of lithological comparisons. Consequently, this correlation remains somewhat speculative.

(v) The small uncoloured blocks in PBOC serpentinites are predominantly altered basaltic rocks, or fragments of Myra sedimentary rocks.

(vi) The gross internal structure of the northeastern block of the Myra beds is displayed in Figure 1.3.

MAP 2

(i) Base map ≡ Crawney Pass 1:25,000 topographic map (9134-IV-N, N.S.W. Department of Lands). The area is also covered by the Ellerston 1:100,000 topographic sheet (9134) and the Tamworth 1:250,000 geological sheet (SH56-13, N.S.W. Department of Mines).

(ii) Minor faults are abundant in the Morrisons Gap area but only the more clearly-defined examples are shown on the map.

APPENDIX L

GLOSSARY OF ABBREVIATIONS MOST COMMONLY USED THROUGHOUT THE THESIS

1. PETROLOGICAL RATIOS etc.

M = $Mg/(Mg + Fe^{2+})$

M = $100Mg/(Mg + Fe^{2+})$

Mg* = $100(Mg + Ni)/(Mg + Ni + \Sigma Fe + Mn)$

mg = $100Mg/(Mg + \Sigma Fe + Mn)$

Mg = $100Mg/(Ca + Mg + \Sigma Fe + Mn)$

Ca = 100Ca/(")

Fe' = 100Fe'/(")

Cr = 100Cr/(Cr + Al)

An = 100Ca/(Ca + Na)

ΣFeO = total Fe calculated as FeO

Fe' = $Fe^{2+} + Fe^{3+} + Mn$

LOI = loss on ignition (see Appendix G)

ΣVol = total volatile content (see Appendix G)

2. GENERAL MAGMA TYPES

AB = alkaline basalts

ALK = alkaline

BAB = back-arc basalt(s)

CAB = calc-alkaline basalt(s)

CTB = continental tholeiitic basalt(s)

FAB = fore-arc basalt(s)

HT = Hawaiian tholeiites

IAT = island-arc tholeiite(s)

MORB = mid-ocean ridge basalt(s)

MORG = mid-ocean ridge gabbro(s)

OAB = oceanic alkaline basalt(s)

OFA = ocean-floor alkaline basalt(s)

OFB = ocean-floor basalt(s) {≡ MORB}

OIA = ocean-island alkaline basalt(s)

OIB = ocean-island basalt(s)

OIT = ocean-island tholeiite(s)

TH = tholeiitic

VAB = volcanic arc basalt(s)

WPA = within-plate alkaline basalt(s)

WPB = within-plate basalt(s)

WPT = within-plate tholeiite(s)

NOTE: Many of the above abbreviations are used only on certain figures which display reference fields defined by other workers.

3. Nomenclature for mafic and ultramafic intrusives (terminology largely following Streckeisen, 1976)

D = dolerite

G = gabbro

GN = gabbronorite

OG = olivine gabbro

OGN = olivine gabbronorite

OmGN = olivine mela-gabbronorite

N = norite

mN = mela-norite

ON = olivine norite

OmN = olivine mela-norite

T = troctolite

mT = mela-troctolite

PlP = plagioclase-bearing peridotite ($Pl < 10$)

PlH = " " harzburgite(")

PlD = " " dunite (")

AH = amphibole-bearing harzburgite ($Pl < 20$)

OO = olivine orthopyroxenite

H = harzburgite

D = dunite

P = peridotite

4. C.I.P.W. normative minerals

qz = quartz

or = orthoclase

ab = albite

an = anorthite

c = corundum

di = diopside

hy = hypersthene (*en* = enstatite)

ol = olivine {(Fo = forsterite) (Fa = fayalite)

mt = magnetite

chr = chromite

il = ilmenite

ap = apatite