

28. DATA REPORT: GEOCHEMISTRY OF ROCKS AND MINERALS OF THE GABBRO COMPLEX FROM THE MARK AREA¹

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INTRODUCTION

Leg 153 represents an Ocean Drilling Program (ODP) offset drilling leg in the MARK area (Mid-Atlantic Ridge at the Kane Transform), around 22°33' N, 45°1.9' W. Shipboard documentation has shown that the gabbroic rocks from Sites 921, 922, and 923 are part of a layered complex and are generally similar, although cumulus textures are particularly well developed in the rocks from Site 922. These rocks also exhibit some special geochemical features.

Major- and trace-element chemistries were studied from a limited pool of 26 samples from nine holes. In some polished thin sections, the chemical compositions of olivines, orthopyroxenes, clinopyroxenes, amphiboles, and plagioclases were determined using an electron microprobe. These data are presented here as a data report; a detailed paper will be prepared, if additional rock samples are analyzed, and if fluid inclusions and oxygen isotope data become available.

SAMPLE MATERIAL

All gabbroic rock samples in this study are from Holes 153-921A, 921B, 921C, 921E, 922A, 922B, and 923A. Two diabase vein rocks are from Holes 920B and 920D. The special designations correspond to shipboard documentation and to standard ODP sample nomenclature conventions, but, for clarity, single numbers are generally used in the data tables (Table 1). The individual rock names were determined after microscopic investigation and calculation of mineral norms in accordance with the CIPW system (after the authors Cross, Iddings, Pearson, and Washington).

ANALYTICAL METHODS

Whole-Rock Chemistry

Major-element oxides and the trace elements Cl, Co, Cr, Cu, F, Ga, Nb, Ni, Pb, S, Sc, V, Y, Zn, and Zr were measured by X-ray fluorescence spectroscopy using a Phillips PW 1480 sequential spectrometer. Glass discs were prepared by melting the powdered, but not ignited, whole-rock material with lithium tetraborate. International reference rocks, as well as two internal mafic standard samples, were used for calibration of the method.

K, Li, Na, Rb, and Zn were analyzed using flame photometry, and Ba and Sr were analyzed using inductively coupled plasma-atomic emission spectroscopy using a Perkin-Elmer PLASMA 1000 spectrometer. B was determined by optical spectroscopy, with boron-free spectral carbons, using a Carl Zeiss PGS 2 spectrograph.

¹Karson, J.A., Cannat, M., Miller, D.J., and Elthon, D. (Eds.), 1997. *Proc. ODP, Sci. Results, 153*: College Station, TX (Ocean Drilling Program).

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Table 1. Sample information.

Sample name	Hole, core, section, piece	Depth (mbsf)	Rock name
2 D	920B-9R-3 (Piece 12A)	83.7	Diabase
7 M-D	920D-9R-2 (Piece 6B)	78.1	Metadiabase
100 GbNo	921A-2R-1 (Piece 7)	8.3	Gabbronorite
102 Gb	921B-1W-2 (Piece 3)	1.6	Gabbro
103 GbNo	921B-2R-2 (Piece 7)	16.9	Gabbronorite
104 OIGb	921B-4R-1 (Piece 4)	34.4	Olivine gabbro
142 OIGN	921B-4R-3 (Piece 3)	37.2	Olivine gabbronorite
108 OIGb	921C-3R-1 (Piece 5A)	20.1	Olivine gabbro
109 OIGb	921C-3R-3 (Piece 3)	22.7	Olivine gabbro
110 Gb	921E-2R-1 (Piece 5B)	10.6	Gabbro
113 GbNo	921E-4R-2 (Piece 1B)	31.2	Gabbronorite
114 OIGb	921E-5R-1 (Piece 5)	40.0	Olivine gabbro
115 OIGN	921E-5R-1 (Piece 11)	40.5	Olivine gabbronorite
116 OIGb	921E-5R-2 (Piece 6)	41.8	Olivine gabbro
118 Gb	921E-6R-1 (Piece 12)	50.8	Gabbro
119 OIGb	921E-7R-3 (Piece 2)	63.1	Olivine gabbro
121 TR	922A-2R-1 (Piece 8)	7.7	Troctolite
122 TR	922A-2R-2 (Piece 1C)	8.6	Troctolite
123 OINo	922A-2R-4 (Piece 2A)	11.3	Olivine norite
124 OINo	922A-2R-5 (Piece 2B)	13.2	Olivine norite
125 OIGb	922A-3R-1 (Piece 4A)	14.2	Olivine gabbro
126 OIGN	922B-1W-1 (Piece 7)	1.0	Olivine gabbronorite
127 OINo	922B-2R-1 (Piece 1C)	14.6	Olivine norite
129 OIGN	922B-3R-1 (Piece 4A)	19.8	Olivine gabbronorite
130 OINo	922B-3R-2 (Piece 1)	20.3	Olivine norite
133 GbNo	923A-2R-2 (Piece 1)	17.7	Gabbronorite
134 OIGb	923A-7R-1 (Piece 2B)	27.0	Olivine gabbro
136 GbNo	923A-10R-2 (Piece 2A)	38.5	Gabbronorite
137 Gb	923A-10R-3 (Piece 2A)	39.4	Gabbro
138 Gb	923A-11R-2 (Piece 1A)	42.6	Gabbro
139 OIGN	923A-15R-3 (Piece 1)	63.0	Olivine gabbronorite
141 GbNo	923A-16R-4 (Piece 6)	68.9	Gabbronorite
GABI OIGb*			Olivine gabbro

Note: * = Leg 153 internal laboratory standard.

The results of the chemical investigation are compiled in Table 2 (major-element oxides in wt%) and Table 3 (trace elements in ppm). The CIPW norm mineral data are presented in Table 4 and supplemented by the Thornton-Tuttle Index (TTI: Q + or + ab + lc + ne), normative anorthite content in plagioclase (An*), and the Mg number (Mg# = Mg/[Mg + Fe]). Selected element ratios are also listed in Table 4.

Finally, Table 5 presents the mean values of our analytical data from Leg 153 gabbroic rock types (major-element oxides and trace elements); results of calculations of the CIPW norms are listed in Table 6. Initial views of the positions of the individual gabbroic rocks are indicated in Figures 1–5.

Mineral Chemistry

The chemical composition of the individual minerals was measured from polished thin sections on a WDX microprobe, using the CAMEBAX S 50 at the Ruhr-Universität Bochum. Several synthetic reference samples were available for calibration.

Altogether, more than 2500 points were analyzed, hence, only a selection of typical data is given in Tables 7–11. In most cases, the

Table 2. Major-element compositions (wt%) of Leg 153 gabbros.

Sample no.:	100	103	104	142	108	109	113	115	118	119	121
Rock name:	GbNo	GbNo	OIGb	OIGN	OIGb	OIGb	GbNo	OIGN	Gb	OIGb	TR
Hole:	921A	921B	921B	921B	921C	921C	921E	921E	921E	921E	922A
Core:	2R	2R	4R	4R	3R	3R	4R	5R	6R	7R	2R
Section, piece:	1, 7	2, 7	1, 4	3, 3	1, 5A	3, 3	2, 1B	1, 11	1, 12	3, 2	1, 8
Depth (mbsf):	8.3	16.9	34.4	37.2	20.1	22.7	31.2	40.5	50.8	63.1	7.7
SiO ₂	52.7	50.9	49.1	47.1	48.8	48.6	50.4	49.5	50.7	49.5	45.2
TiO ₂	0.43	0.47	0.38	0.19	0.32	0.38	0.41	0.22	0.4	0.28	0.19
Al ₂ O ₃	16.3	16.5	17.1	19.1	18.3	17.3	15.8	19.5	16.6	18.4	18.5
Cr ₂ O ₃	0.011	0.026	0.14	0.033	0.29	0.27	0.056	0.076	0.052	0.078	0.050
Fe ₂ O ₃	7.18	6.1	6.95	7.5	4.35	4.8	7.22	4.7	5.26	5.14	6.42
MnO	0.157	0.111	0.124	0.116	0.077	0.089	0.136	0.082	0.109	0.092	0.107
MgO	8.15	9.1	10.3	11.9	10.6	11.4	9.9	10.0	9.1	9.8	16.6
NiO	0.009	0.014	0.025	0.038	0.033	0.035	0.017	0.027	0.016	0.027	0.072
CaO	10.8	12.7	12.5	10.2	14.2	13.8	12.7	12.3	14.3	13.4	9.8
Na ₂ O	3.25	2.65	2.3	2.2	1.85	1.85	2.25	2.15	2.3	2.2	1.45
K ₂ O	0.044	0.046	0.041	0.046	0.024	0.032	0.029	0.028	0.039	0.033	0.061
P ₂ O ₅	0.018	0.085	0.026	0.021	0.02	0.029	0.024	0.019	0.020	0.017	0.035
LOI	0.85	1.1	0.8	1.7	1.0	1.25	0.7	1.2	0.8	0.85	1.5
Total	99.90	99.80	99.79	100.14	99.86	99.82	99.64	99.80	99.70	99.82	99.98

Table 2 (continued).

Sample no.:	122	123	124	126	127	129	130	133	134	136
Rock name:	TR	OINo	OINo	OIGN	OINo	OIGN	OINo	GbNo	OIGb	GbNo
Hole:	922A	922A	922A	922B	922B	922B	922B	923A	923A	923A
Core:	2R	2R	2R	1W	2R	3R	3R	2R	7R	10R
Section, piece:	2, 1C	4, 2A	5, 2B	1, 7	1, 1C	1, 4A	2, 1	2, 1	1, 2B	2, 2A
Depth (mbsf):	8.6	11.3	13.2	1.0	14.6	19.8	20.3	17.7	27.0	38.5
SiO ₂	46.5	46.7	47.6	46.9	46.4	47.3	45.2	51.9	49.8	50.6
TiO ₂	0.17	0.65	0.75	0.63	0.28	0.38	0.7	0.39	0.30	0.33
Al ₂ O ₃	22.2	17.1	21.85	18.3	20.3	18.8	17.9	15.9	18.6	17.4
Cr ₂ O ₃	0.012	0.014	0.008	0.145	0.045	0.065	0.010	0.018	0.018	0.118
Fe ₂ O ₃	5.28	10.3	6.71	7.25	5.7	5.72	7.86	7.38	6.72	6.56
MnO	0.084	0.183	0.108	0.12	0.080	0.085	0.107	0.15	0.115	0.118
MgO	11.9	12.0	7.2	10.9	11.5	11.8	14.5	8.6	9.1	8.7
NiO	0.051	0.044	0.024	0.043	0.049	0.040	0.057	0.010	0.018	0.015
CaO	11.05	9.45	11.1	11.5	10.8	11.15	9.0	11.7	11.9	12.6
Na ₂ O	1.9	1.75	2.6	1.93	1.85	1.9	1.51	3.0	2.65	2.6
K ₂ O	0.057	0.058	0.061	0.063	0.049	0.055	0.08	0.062	0.048	0.035
P ₂ O ₅	0.044	0.152	0.33	0.18	0.040	0.048	0.051	0.029	0.022	0.017
LOI	1.2	1.6	1.5	2.2	2.8	2.7	2.9	0.55	0.5	0.7
Total	100.35	100.00	99.84	100.16	99.89	100.04	99.88	99.69	99.79	99.79

Table 2 (continued).

Sample no.:	137	138	139	141	2	7	
Rock name:	Gb	Gb	OIGN	GbNo	D	M-D	
Hole:	923A	923A	923A	923A	920B	920D	
Core:	10R	11R	15R	16R	9R	9R	
Section, piece:	3, 2A	2, 1A	3, 1	4, 6	3, 12A	2, 6B	
Depth (mbsf):	39.4	42.6	63.0	68.9	83.7	78.1	
						GABI	
						OIGb	
SiO ₂	50.6	50.4	47.9	50.8	46.4	46.2	48.0
TiO ₂	0.42	0.39	0.17	0.48	0.96	0.92	0.26
Al ₂ O ₃	16.1	15.2	21.9	15.7	16.3	15.7	17.8
Cr ₂ O ₃	0.031	0.051	0.065	0.077	0.051	0.063	0.26
Fe ₂ O ₃	6.91	6.75	5.05	6.01	8.51	8.85	4.54
MnO	0.13	0.127	0.077	0.122	0.145	0.24	0.085
MgO	9.1	9.8	8.8	9.2	11.7	13.4	11.4
NiO	0.013	0.016	0.028	0.013	0.029	0.036	0.034
CaO	13.2	13.4	12.0	13.6	9.9	7.4	14.2
Na ₂ O	2.7	2.45	2.35	2.3	2.3	2.9	1.75
K ₂ O	0.038	0.036	0.033	0.044	0.042	0.054	0.028
P ₂ O ₅	0.021	0.019	0.019	0.041	0.08	0.08	0.015
LOI	0.5	1.3	1.5	1.4	3.5	4.1	1.5
Total	99.76	99.94	99.89	99.79	99.92	99.94	99.87

Notes: GbNo = gabbro, OIGb = olivine gabbro, OIGN = olivine gabbro, Gb = gabbro, TR = troctolite, OINo = olivine norite, D = diabase, M-D = metadiabase. LOI = loss on ignition.

Table 3. Trace-element compositions (ppm) of Leg 153 gabbros.

Sample no.:	100	103	104	142	108	109	113	115	118	119	121
Rock name:	GbNo	GbNo	OIGb	OIGN	OIGb	OIGb	GbNo	OIGN	Gb	OIGb	TR
B	5	6	5	6	4	5	6	4	5	5	4
Li	5	6	8	7	7	9	8	9	9	8	8
Rb	—	1	2	-1	—	<1	—	—	1	2	<1
Sr	150	134	125	148	121	112	125	133	138	142	126
Ba	11	6.7	8.6	18	18	8.5	8.4	12	9	6.1	12.3
Ga	15	14	9	10	10	11	10	9	12	10	4
Pb	—	6	6	8	3	—	2	4	3	4	4
Cu	33	78	94	72	88	101	82	79	65	93	64
Zn	48	39	45	50	24	30	41	29	32	28	52
Y	8	13	8	4	9	12	10	5	8	6	9
Nb	—	~2	—	-1	<1	~1	~1	<1	~1	<1	~1
Zr	16	45	19	14	14	23	20	13	18	14	21
V	180	162	129	53	127	137	168	88	186	110	42
Ni	70	108	195	300	260	275	135	215	125	210	565
Co	36	38	40	52	35	33	34	36	28	39	47
Cr	74	180	965	225	1965	1855	385	520	355	535	340
Sc	37	42	29	14	35	34	49	20	50	33	9
S	205	300	425	400	330	455	585	335	265	305	260
As	3.6	3.1	1.5	9.3	2.5	3.1	15	5.3	2.5	17	42
Sb	0.03	0.02	—	0.05	0.15	—	0.12	1.06	0.11	6.5	0.37
Cl	<21	<45	1135	<52	<40	<88	1100	<25	<51	<24	195
F	<86	330	190	—	310	355	265	350	390	220	205

Table 3 (continued).

Sample no.:	122	123	124	126	127	129	130	133	134	136
Rock name:	TR	OINo	OINo	OIGN	OINo	OIGN	OINo	GbNo	OIGb	GbNo
B	4	3	3	4	4	4	5	3	4	5
Li	8	4	5	6	6	5	5	6	8	7
Rb	2	—	-1	-2	-2	1	1	2	-1	-1
Sr	152	129	166	128	129	132	117	145	152	149
Ba	10	15	10.5	7.6	9.8	10.1	10	10.3	8.7	11.8
Ga	12	8	15	12	11	12	9	12	15	12
Pb	5	3	4	6	3	3	<1	6	<2	<2
Cu	38	88	36	68	25	23	36	71	60	79
Zn	43	96	56	66	46	51	64	45	41	48
Y	10	26	30	28	16	18	12	16	8	9
Nb	2	3	5	5	3	4	3	3	~1	<1
Zr	32	58	98	82	66	78	48	72	20	9
V	27	76	105	120	53	90	80	164	108	130
Ni	405	345	190	340	385	315	445	82	142	116
Co	41	44	30	43	49	36	48	29	43	36
Cr	80	94	57	995	310	445	68	123	215	228
Sc	7	20	12	31	10	19	10	43	30	37
S	210	1020	340	410	255	240	400	350	415	370
As	41	4	10.5	1.55	1.63	4.8	9.3	6.4	9.02	8.7
Sb	0.92	0.10	0.03	0.04	0.04	0.82	2.40	3.50	0.76	1.01
Cl	147	202	265	1235	165	185	116	133	<43	<38
F	200	200	375	180	220	490	210	305	<14	<60

Table 3 (continued).

Sample no.:	137	138	139	141	2	7	GABI
Rock name:	Gb	Gb	OIGN	GbNo	D	M-D	OIGb
B	5	5	5	4	3	5	4
Li	7	7	8	7	9	11	9
Rb	~1	~1	~1	~1	1	—	—
Sr	132	145	144	118	266	319	112
Ba	11	5.7	6.8	12.2	20.4	19	19
Ga	12	8	13	14	12	10	11
Pb	5	—	<4	4	3	<2	4
Cu	69	67	63	41	21	8	93
Zn	37	36	31	38	64	88	22
Y	11	10	<2	14	21	20	6
Nb	~1	≤1	<1	-2	3	2	<1
Zr	19	15	11	32	69	66	14
V	170	168	51	178	166	174	110
Ni	103	124	220	101	230	285	268
Co	38	26	42	30	46	43	36
Cr	212	350	445	525	390	430	1790
Sc	50	47	10	42	35	34	30
S	415	560	390	325	72	56	370
As	63	5.6	12.7	8.3	6.4	13.8	10
Sb	0.83	0.04	0.03	0.02	0.73	0.03	0.08
Cl	<42	<23	<57	<38	180	<71	<39
F	100	285	110	590	—	—	420

Notes: GbNo = gabbonorite, OIGb = olivine gabbro, OIGN = olivine gabbonorite, Gb = gabbro, TR = troctolite, OINo = olivine norite, D = diabase, M-D = metadiabase, — = not detected.

Table 4. CIPW norm of Leg 153 gabbros.

Sample no.:	100	103	104	142	108	109	113	115	118	119
Rock name:	GbNo	GbNo	OIGb	OIGN	OIGb	OIGb	GbNo	OIGN	Gb	OIGb
Or	0.26	0.27	0.24	0.28	0.14	0.19	0.17	0.17	0.23	0.20
Ab	27.95	22.82	19.77	19.03	15.87	15.92	19.35	18.50	19.75	18.88
An	30.24	33.58	36.79	43.05	42.15	39.48	33.46	44.21	35.36	40.81
Opx	17.63	10.58	6.60	7.10	5.44	5.47	13.49	12.79	7.67	6.64
Cpx	19.53	24.15	20.98	6.93	23.24	23.90	24.55	14.21	29.26	21.24
Ol	2.45	6.55	13.60	22.03	11.41	13.12	6.99	8.84	6.07	10.78
Cm	0.02	0.04	0.21	0.05	0.43	0.41	0.08	0.11	0.08	0.12
Mt	1.05	0.90	1.02	1.11	0.65	0.71	1.06	0.69	0.76	0.75
Il	0.83	0.91	0.73	0.37	0.62	0.73	0.79	0.43	0.77	0.54
Ap	0.04	0.20	0.06	0.05	0.05	0.07	0.06	0.05	0.05	0.04
TTI	28.2	23.1	20.0	19.3	16.0	16.1	19.5	18.7	20.0	19.1
An*	52	60	65	69	73	73	63	70	64	68
Mg#	68.7	74.3	74.2	75.6	82.6	82.2	72.7	80.5	77.0	78.7
Ni/Co	1.94	2.84	4.88	5.77	7.43	8.33	3.97	5.97	4.46	5.38
Cr/Ni	1.06	1.67	4.95	0.75	7.56	6.75	2.85	2.42	2.84	2.55
Cr/Y	9.2	13.8	120	56	220	155	38	105	44	89
Ti/Cr	35	15.7	2.36	5.07	0.98	1.23	6.4	2.54	6.75	3.14
V/Cr	2.43	0.90	0.13	0.24	0.06	0.07	0.44	0.17	0.52	0.21
Cu/Zn	0.69	2.0	2.09	1.44	3.67	3.37	2.0	2.7	2.03	3.32

Table 4 (continued).

Sample no.:	121	122	123	124	126	127	129	130	133	134
Rock name:	TR	TR	OINo	OINo	OIGN	OINo	OIGN	OINo	GbNo	OIGb
Or	0.37	0.34	0.35	0.37	0.38	0.30	0.34	0.49	0.37	0.28
Ab	12.52	16.26	15.18	22.50	16.77	16.19	16.58	13.26	25.74	22.71
An	44.69	52.48	39.61	48.85	42.19	48.55	43.92	43.42	30.16	39.21
Opx	6.07	4.97	19.08	9.67	9.54	10.08	11.36	15.05	13.14	7.43
Cpx	3.81	2.23	6.11	4.39	12.30	5.36	10.28	2.14	23.14	16.53
Ol	31.07	22.50	16.49	10.98	15.85	17.95	15.72	22.94	5.52	12.18
Cm	0.07	0.02	0.02	0.01	0.21	0.07	0.10	0.01	0.03	0.05
Mt	0.95	0.78	1.53	0.99	1.09	0.86	0.85	1.19	1.08	0.98
Il	0.37	0.32	1.26	1.45	1.23	0.55	0.74	1.38	0.75	0.58
Ap	0.08	0.10	0.37	0.79	0.44	0.09	0.11	0.12	0.07	0.05
TTI	12.9	16.6	15.5	22.9	17.2	16.5	16.9	13.8	26.1	23.0
An*	78	76	72	68	72	75	73	77	54	63
Mg#	83.4	81.5	69.4	67.7	74.5	79.8	80.1	78.3	69.3	72.5
Ni/Co	12	9.9	7.8	6.33	7.9	7.86	8.75	9.3	2.83	3.30
Cr/Ni	0.60	0.20	0.27	0.46	2.93	0.80	1.41	0.15	1.50	1.51
Cr/Y	38	8.0	3.62	1.90	36	19	25	5.67	7.7	27
Ti/Cr	3.35	12.8	42	79	3.80	5.42	5.12	62	19	8.4
V/Cr	0.12	0.34	0.81	1.84	0.12	0.17	0.20	1.18	1.33	0.51
Cu/Zn	1.23	0.88	0.92	0.64	1.03	0.54	0.45	0.56	1.58	1.46

Table 4 (continued).

Sample no.:	136	137	138	139	141	2	7	GABI
Rock name:	GbNo	Gb	Gb	OIGN	GbNo	D	M-D	OIGb
Or	0.21	0.22	0.21	0.20	0.26	0.26	0.34	0.17
Ab	22.35	23.15	21.12	20.29	19.85	20.34	25.80	15.10
An	36.26	32.11	30.94	50.12	33.02	35.56	31.18	41.40
Opx	9.98	4.54	6.84	5.04	12.34	8.40	5.85	2.55
Cpx	21.91	27.53	29.54	8.49	28.57	12.34	5.66	24.13
Ol	7.59	10.53	9.48	14.65	3.93	19.63	27.70	15.05
Cm	0.05	0.05	0.08	0.10	0.11	0.08	0.09	0.40
Mt	0.97	1.01	0.99	0.73	0.89	1.29	1.34	0.66
Il	0.64	0.81	0.75	0.33	0.93	1.90	1.84	0.50
Ap	0.04	0.05	0.05	0.05	0.10	0.20	0.20	0.04
TTI	22.6	23.4	21.3	20.5	20.1	20.6	26.1	15.3
An*	62	58	59	71	62	64	55	73
Mg#	72.0	71.9	73.8	77.2	74.8	72.8	74.4	83.0
Ni/Co	3.22	2.71	4.77	5.24	3.57	5.0	6.63	7.44
Cr/Ni	1.97	2.06	2.82	2.02	5.20	1.70	1.51	6.68
Cr/Y	25	19	35	>220	37	18.6	21.5	298
Ti/Cr	8.68	11.9	6.69	2.29	5.49	14.8	12.8	0.87
V/Cr	0.57	0.80	0.48	0.11	0.34	0.43	0.40	0.061
Cu/Zn	1.65	1.86	1.86	2.03	1.08	0.33	0.091	4.23

Notes: GbNo = gabbro, OIGb = olivine gabbro, OIGN = olivine gabbro, Gb = gabbro, TR = troctolite, OINo = olivine norite, D = diabase, M-D = metadiabase. Or = orthoclase, Ab = albite, An = anorthite, Opx = orthopyroxene, Cpx = clinopyroxene, Ol = olivine, Cm = chromite, Mt = magnetite, Il = ilmenite, Ap = apatite, TTI, An*, and Mg# are defined in the text.

Table 5. Mean values of Leg 153 gabbro types.

Type:	Gb	OIGb	GbNo	OIGN	OINo	TR
n:	3	6	6	5	4	2
Major-element composition (wt%):						
SiO ₂	50.55	48.95	51.2	47.75	46.5	45.85
TiO ₂	0.40	0.32	0.42	0.32	0.60	0.18
Al ₂ O ₃	15.95	17.9	16.25	19.5	19.3	20.35
Cr ₂ O ₃	0.122	0.178	0.037	0.077	0.019	0.031
Fe ₂ O ₃	6.31	5.42	6.74	6.04	7.64	5.85
MnO	0.122	0.097	0.132	0.096	0.120	0.096
MgO	9.35	10.45	8.95	10.7	11.3	14.25
NiO	0.015	0.029	0.013	0.035	0.043	0.062
CaO	13.65	13.35	12.35	11.45	10.1	10.4
Na ₂ O	2.48	2.10	2.68	2.11	1.93	1.68
K ₂ O	0.038	0.034	0.033	0.045	0.062	0.059
P ₂ O ₅	0.020	0.022	0.034	0.057	0.143	0.040
LOI	0.87	0.98	0.88	1.86	2.2	1.35
sum	99.88	99.83	99.72	100.04	99.96	100.20
Trace-element composition (ppm):						
Sr	134	124	133	133	134	137
Ba	8.6	11.5	10.4	10.9	11.3	11.2
Cu	67	88	64	61	46	51
Zn	35	32	43	45	64	48
Y	9.7	8.2	11.7	11.4	21	9.5
Zr	17	17	32	39	67	26
V	175	120	164	80	78	34
Ni	117	225	102	278	341	485
Co	24	38	29	42	43	44
Cr	832	1220	252	526	132	210
Sc	42	32	42	19	13	8
S	415	385	355	355	505	235
Ni/Co	4.88	5.92	3.52	6.62	7.93	11
Cr/Ni	7.11	5.42	2.47	1.89	0.39	0.43
Cr/Zr	49	72	7.9	13.5	1.97	8.1
Ti/Cr	2.88	1.57	10	3.65	27	5.14
V/Cr	0.21	0.10	0.65	0.15	0.59	0.16
Ti/P	28	20	17	7.68	5.76	6.17
Cu/Zn	1.91	2.75	1.49	1.36	0.72	1.06

Notes: GbNo = gabbronorite, OIGb = olivine gabbro, OIGN = olivine gabbronorite, Gb = gabbro, TR = troctolite, OINo = olivine norite; n = number of analyses.

Table 6. CIPW norms, Leg 153 gabbro types.

Type:	Gb	OIGb	GbNo	OIGN	OINo	TR
n:	3	6	6	5	4	2
Or	0.22	0.20	0.20	0.28	0.39	0.36
Ab	21.31	18.06	23.09	18.28	16.82	14.45
An	32.80	39.97	32.80	44.66	45.12	48.64
Opx	6.20	5.42	12.74	8.96	13.39	5.53
Cpx	28.83	21.76	23.66	10.54	4.47	2.88
Ol	8.72	12.86	5.58	15.52	17.13	26.80
Cm	0.18	0.27	0.05	0.11	0.03	0.05
Mt	0.92	0.79	0.99	0.89	1.13	0.85
Il	0.77	0.62	0.81	0.62	1.17	0.35
Ap	0.05	0.05	0.08	0.14	0.35	0.09
TTI	21.5	18.3	23.3	18.6	17.2	14.8
An*	61	69	59	71	73	77
Mg#	74.2	78.9	72.0	77.5	74.2	82.6

Note: Abbreviations as in Table 3.

mean values from several analyses with nearly equal results of an individual grain are listed. In some cases, the analytical data of profiles through one grain are provided.

The Mg value (Mg#) is given for the minerals olivine, orthopyroxene, clinopyroxene, and amphibole; Ca# (= Ca/[Ca + Mg]) is also provided for clinopyroxenes; and the calculated anorthite content (An#) is presented for plagioclases.

SUMMARY

Twenty-six samples of gabbroic rocks from Leg 153 were analyzed for major-element oxides and 21 trace elements. In a limited number of thin sections, the mineral chemistries of olivine, orthopyroxene, clinopyroxene, amphibole, and plagioclase were investigated using an electron microprobe. This data report will form the basis for further work.

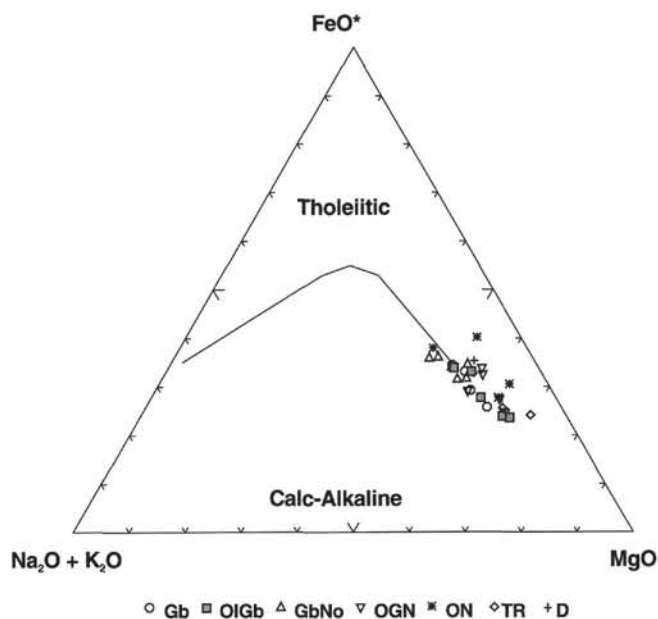


Figure 1. Projection of compositions of Leg 153 gabbros on a (Na₂O + K₂O) - FeO* - MgO (= AFM) triangle, after Irvine and Baragar (1971).

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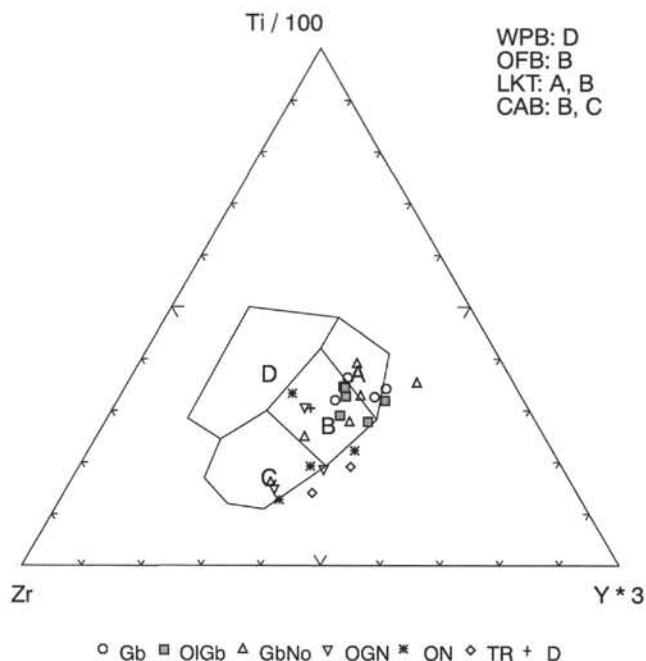


Figure 2. Compositions of Leg 153 gabbros plotted on a Zr-Ti-Y triangle, after Pearce and Cann (1973).

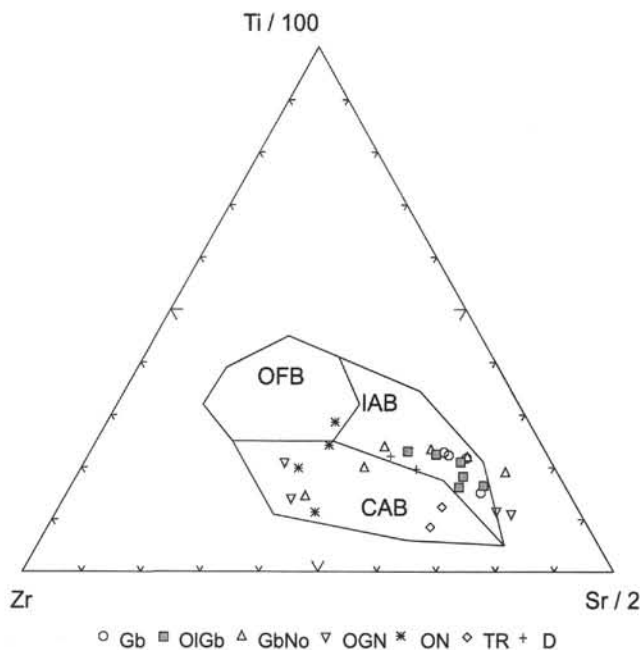


Figure 3. Compositions of Leg 153 gabbros plotted on a Zr-Ti-Sr triangle, after Pearce and Cann (1973).

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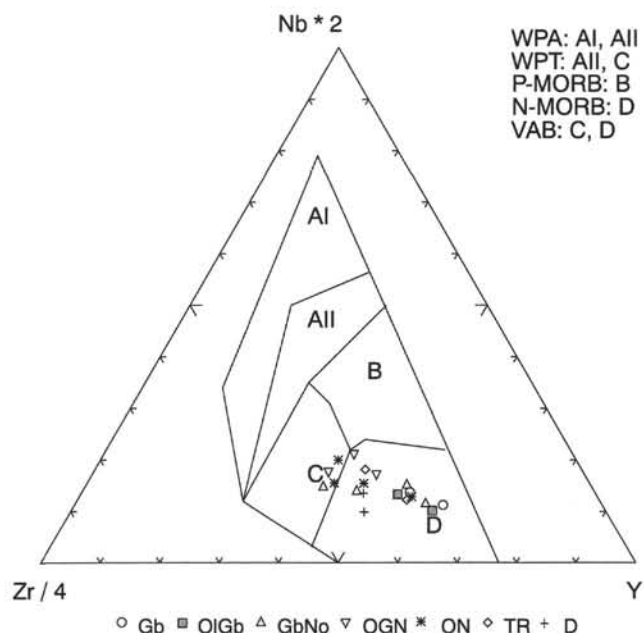


Figure 4. Compositions of Leg 153 gabbros plotted on a Zr-Nb-Y triangle, after Meschede (1986).

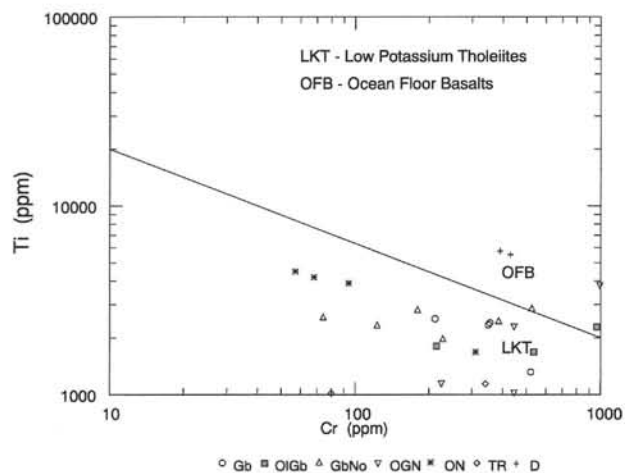


Figure 5. Compositions of Leg 153 gabbros plotted on a Cr/Ti correlation diagram, after Pearce (1975).

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Ms 153SR-031

Table 7. Chemical composition of selected olivines.

Sample no.:	102				104			114		
Rock name:	Gb				Gb			OlGb		
n:	2	7	2	8	15	5	10	1	10	1
SiO ₂	35.72	35.93	36.14	36.16	36.60	36.81	37.58	38.48	38.68	38.7
TiO ₂	0.02	0.03	0.02	0.04	0.02	0.02	0.03	—	0.02	0.03
Al ₂ O ₃	0.01	0.02	0.01	0.03	0.02	0.02	0.02	0.02	0.02	0.04
Cr ₂ O ₃	0.02	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.03	0.04
FeO	33.56	32.85	32.51	32.08	28.05	27.60	22.35	20.03	19.40	18.82
MnO	0.52	0.52	0.51	0.47	0.41	0.40	0.33	0.32	0.30	0.29
MgO	29.99	30.17	30.72	30.97	34.40	34.68	39.23	41.06	41.42	41.33
NiO	0.06	0.09	0.12	0.08	0.12	0.11	0.14	0.13	0.12	0.22
CaO	0.07	0.06	0.03	0.06	0.05	0.05	0.05	0.03	0.05	0.05
Total	99.97	99.68	100.07	99.91	99.68	99.71	99.75	100.08	100.04	99.53
Mg#	61.4	62.0	62.7	63.2	68.6	69.1	75.8	78.5	79.2	79.6

Table 7 (continued).

Sample no.:	119			113			124			
Rock name:	OlGb			GbNo			OlNo			
n:	3	4	5	6	1	4	7	2	3	3
SiO ₂	38.52	38.58	38.60	38.44	37.23	37.21	37.19	38.91	39.00	38.84
TiO ₂	0.02	0.01	0.02	0.02	0.03	0.01	0.03	0.02	0.02	0.02
Al ₂ O ₃	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.03	0.03
Cr ₂ O ₃	0.01	0.04	0.01	0.01	—	0.04	0.02	0.02	—	0.02
FeO	20.77	20.64	20.62	20.27	28.58	28.16	28.45	21.07	21.04	20.72
MnO	0.28	0.32	0.27	0.32	0.43	0.44	0.43	0.34	0.31	0.33
MgO	40.34	40.44	40.68	40.71	34.14	34.52	34.30	40.19	40.49	40.56
NiO	0.15	0.14	0.14	0.15	0.02	0.09	0.05	0.17	0.17	0.20
CaO	0.03	0.03	0.03	0.04	0.07	0.05	0.07	0.06	0.04	0.04
Total	100.13	100.22	100.39	99.98	100.53	100.54	100.55	100.79	101.10	100.76
Mg#	77.6	77.7	77.9	78.2	68.0	68.6	68.2	77.3	77.5	77.7

Table 7 (continued).

Sample no.:	122						121			
Rock name:	TR						TR			
n:	3	6	5	5	10	5	10	10	10	10
SiO ₂	40.07	39.77	39.54	39.81	39.78	39.83	39.84	39.75	39.93	39.93
TiO ₂	0.03	0.02	0.02	0.01	0.02	0.01	0.02	0.03	0.03	0.03
Al ₂ O ₃	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02
Cr ₂ O ₃	0.04	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02
FeO	14.32	15.90	16.02	15.46	15.26	15.13	14.28	14.26	14.19	14.31
MnO	0.25	0.27	0.29	0.25	0.24	0.26	0.24	0.24	0.25	0.24
MgO	45.33	44.53	44.17	44.57	44.68	44.62	45.42	45.47	45.51	45.50
NiO	0.17	0.20	0.21	0.19	0.21	0.23	0.21	0.23	0.18	0.22
CaO	0.03	0.03	0.04	0.03	0.04	0.04	0.05	0.05	0.04	0.04
Total	100.25	100.76	100.32	100.35	100.26	100.15	100.07	100.05	100.16	100.31
Mg#	84.9	83.3	83.1	83.7	83.9	84.0	85.0	85.0	85.1	85.0

Notes: Abbreviations as in Table 1; n = number of analyses; — = not detected.

Table 8. Chemical composition of selected orthopyroxenes.

Sample no.:	102					118				
Rock name:	Gb					Gb				
	Within clinopyroxene									
n:	2	1	6	4	2	3	3	2	2	2
SiO ₂	52.28	52.76	52.83	53.43	53.73	53.40	53.58	53.75	53.57	53.89
TiO ₂	0.27	0.31	0.32	0.36	0.36	0.41	0.38	0.38	0.31	0.31
Al ₂ O ₃	0.95	1.09	1.12	1.28	1.24	1.29	1.21	1.14	1.36	1.29
Cr ₂ O ₃	0.01	—	0.03	0.05	0.09	0.04	0.07	0.08	0.04	0.03
FeO	19.53	19.33	19.85	16.34	16.10	16.28	16.49	16.82	14.95	15.10
MnO	0.50	0.47	0.53	0.34	0.37	0.38	0.37	0.43	0.38	0.28
MgO	23.82	23.88	23.59	26.34	26.70	26.48	26.44	26.18	27.58	27.38
NiO	0.01	—	0.06	0.04	0.05	0.02	0.06	0.02	0.07	0.04
CaO	1.15	1.35	1.38	1.08	1.07	1.17	1.16	1.06	1.10	1.27
Na ₂ O	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02	—	0.02
Total	98.53	99.20	99.72	99.39	99.72	99.49	99.67	99.88	99.36	99.61
Mg#	68.0	68.8	67.9	74.2	74.7	74.4	74.1	73.5	76.7	76.4

Table 8 (continued).

Sample no.:	104	114	116		119					
Rock name:	OIGb	OIGb	OIGb		OIGb					
	Within clinopyroxene									
n:	1	2	6	2	5	4	3	3	2	
SiO ₂	53.54	55.20	54.02	54.25	54.38	54.80	54.39	54.33	54.04	
TiO ₂	0.23	0.21	0.21	0.21	0.24	0.34	0.30	0.26	0.31	
Al ₂ O ₃	0.95	1.04	2.50	2.49	2.36	1.38	1.21	1.32	1.52	
Cr ₂ O ₃	0.11	0.14	0.13	0.10	0.14	0.06	0.13	0.09	0.08	
FeO	16.75	12.13	11.93	11.98	12.00	12.92	14.01	14.53	14.96	
MnO	0.49	0.24	0.28	0.24	0.27	0.30	0.33	0.34	0.34	
MgO	26.54	30.05	29.24	29.20	29.34	29.12	28.02	27.93	27.16	
NiO	0.03	0.03	0.05	0.04	0.04	0.05	0.06	0.06	0.05	
CaO	0.81	0.88	0.87	0.98	0.96	0.92	1.08	0.98	1.27	
Na ₂ O	—	0.01	0.01	0.03	0.01	0.01	0.01	0.02	0.02	
Total	99.45	99.93	99.24	99.52	99.74	99.90	99.54	99.86	99.75	
Mg#	73.8	81.5	81.4	81.3	81.4	80.1	78.1	77.4	76.4	

Table 8 (continued).

Sample no.:	123			124		121	122			
Rock name:	OINo			OINo		TR	TR			
n:	2	5	3	5	3	6	3	2	3	3
SiO ₂	51.44	52.25	52.04	52.45	52.22	55.43	56.01	55.91	55.42	55.85
TiO ₂	0.23	0.20	0.30	0.43	0.41	0.23	0.33	0.42	0.50	0.34
Al ₂ O ₃	0.65	0.44	0.95	1.32	1.47	1.07	1.25	1.46	1.53	1.44
Cr ₂ O ₃	0.02	0.03	0.01	0.04	0.02	0.02	0.16	0.18	0.20	0.21
FeO	27.81	26.76	24.70	22.78	21.99	12.77	9.06	8.97	10.20	9.27
MnO	0.89	0.83	0.62	0.59	0.53	0.36	0.24	0.25	0.29	0.21
MgO	18.03	19.30	20.29	21.70	21.45	29.46	31.98	31.94	30.92	31.74
NiO	0.03	0.05	0.05	0.02	0.05	0.05	0.07	0.05	0.05	0.03
CaO	1.14	0.99	1.50	1.32	2.20	0.85	0.72	0.81	1.19	0.82
Na ₂ O	—	0.02	0.04	0.03	0.04	0.02	0.01	0.03	0.01	0.01
Total	100.24	100.87	100.5	100.68	100.38	100.26	99.83	100.02	100.31	99.92
Mg#	53.6	56.2	59.4	62.9	63.5	80.4	86.3	86.4	84.4	85.9

Note: Abbreviations as in Table 4; — = not detected.

Table 9. Chemical composition of selected clinopyroxenes.

Sample no.:	102					110			
Rock name:	Gb					Gb			
n:	4	2	3	3	2	5	4	10	7
SiO ₂	50.83	50.90	50.65	52.94	53.57	51.59	52.10	52.35	52.46
TiO ₂	0.82	0.75	0.79	0.24	0.08	0.90	0.84	0.58	0.59
Al ₂ O ₃	2.70	2.27	2.37	0.91	0.76	2.51	2.86	2.83	2.92
Cr ₂ O ₃	0.02	0.03	0.05	0.02	0.03	0.08	0.11	0.17	0.15
FeO	9.20	9.30	9.44	8.47	7.51	9.22	6.27	6.53	5.91
MnO	0.25	0.25	0.31	0.30	0.29	0.23	0.19	0.19	0.19
MgO	14.66	14.25	14.19	14.45	14.93	14.58	15.22	16.52	16.92
NiO	0.02	0.03	0.01	0.01	0.03	0.04	0.02	0.02	0.02
CaO	20.50	21.50	21.37	22.96	23.00	20.93	22.34	20.76	20.85
Na ₂ O	0.52	0.44	0.43	0.20	0.16	0.40	0.47	0.36	0.36
K ₂ O	—	—	0.01	—	—	0.01	—	—	—
Total	99.52	99.72	99.62	100.49	100.36	100.49	100.42	100.31	100.37
Mg#	73.9	73.2	72.8	75.3	78.0	73.8	81.2	81.9	83.6
Ca#	50.0	50.7	52.0	53.3	53.1	50.6	51.3	47.5	47.0

Table 9 (continued).

Sample no.:	118								
Rock name:	Gb								
n:	Profile 1					Profile 2			
	7	3	6	3	3	3	5	2	5
SiO ₂	50.74	51.19	51.18	51.19	50.52	51.31	50.69	50.91	50.82
TiO ₂	1.08	0.85	0.92	0.97	1.04	0.94	0.99	1.02	1.01
Al ₂ O ₃	2.73	2.45	2.70	2.65	2.78	2.50	2.66	2.64	2.71
Cr ₂ O ₃	0.12	0.12	0.17	0.06	0.12	0.10	0.13	0.16	0.14
FeO	7.07	6.93	7.20	6.95	6.91	7.05	6.93	6.98	7.02
MnO	0.23	0.25	0.23	0.27	0.21	0.21	0.22	0.17	0.23
MgO	15.10	15.13	15.24	15.24	14.98	15.30	14.94	15.10	15.24
NiO	0.01	0.02	0.04	0.02	0.08	0.06	0.02	0.02	0.07
CaO	21.93	22.45	21.82	21.75	22.16	21.73	22.10	22.01	21.86
Na ₂ O	0.42	0.41	0.42	0.44	0.42	0.46	0.45	0.44	0.41
K ₂ O	0.01	—	0.01	0.01	—	0.01	—	0.02	0.01
Total	99.44	99.80	99.93	99.55	99.22	99.67	99.15	99.47	99.52
Mg#	79.2	79.6	79.1	79.7	79.4	79.5	79.3	79.4	79.5
Ca#	58.4	51.6	50.7	50.4	51.5	50.5	51.5	51.2	50.8

Table 9 (continued).

Sample no.:	104				114				
Rock name:	OIGb				OIGb				
n:	Profile				Profile				
	2	4	4	5	2	2	3	1	1
SiO ₂	51.16	51.29	51.02	51.34	52.11	52.00	52.56	52.62	52.57
TiO ₂	0.61	0.43	0.39	0.80	0.32	0.41	0.48	0.37	0.50
Al ₂ O ₃	2.96	3.01	3.03	2.77	2.09	2.70	1.99	2.00	2.03
Cr ₂ O ₃	0.54	0.54	0.56	0.51	0.23	0.28	0.31	0.25	0.26
FeO	5.32	5.62	6.02	5.46	4.96	4.85	4.75	4.83	4.73
MnO	0.16	0.17	0.20	0.18	0.17	0.18	0.13	0.20	0.14
MgO	15.93	16.50	17.38	15.88	16.34	16.13	16.16	16.20	16.36
NiO	0.08	0.08	0.06	0.02	0.04	0.04	0.05	0.08	0.04
CaO	22.17	21.36	20.08	22.05	22.70	22.62	22.93	22.79	23.10
Na ₂ O	0.38	0.39	0.32	0.39	0.37	0.38	0.35	0.35	0.38
K ₂ O	0.01	—	—	—	—	0.01	0.01	—	—
Total	99.32	99.39	99.06	99.40	99.33	99.60	99.72	99.69	100.11
Mg#	84.2	84.0	83.7	83.8	85.4	85.6	85.8	85.7	86.0
Ca#	50.0	48.2	45.4	50.0	50.0	50.2	50.5	50.3	50.4

Table 9 (continued).

Sample no.:	119				
Rock name:	OIGb profile				
n:	2	2	2	1	3
SiO ₂	51.12	51.59	51.57	51.71	50.66
TiO ₂	0.98	0.84	0.70	0.64	1.03
Al ₂ O ₃	2.81	2.82	2.70	2.78	2.82
Cr ₂ O ₃	0.22	0.24	0.26	0.32	0.30
FeO	5.74	6.49	6.98	6.17	5.92
MnO	0.23	0.21	0.18	0.17	0.13
MgO	15.72	16.80	17.64	16.12	15.68
NiO	0.04	0.03	0.02	0.01	0.05
CaO	22.76	20.51	19.16	21.70	22.28
Na ₂ O	0.37	0.35	0.37	0.38	0.38
K ₂ O	—	—	0.01	0.01	0.01
Total	99.99	99.88	99.59	100.01	99.26
Mg#	83.0	82.2	81.8	82.3	82.5
Ca#	51.0	46.8	43.9	49.2	50.5

Table 9 (continued).

Sample no.:	113						
Rock name:	GbNo						
n:	Profile				Grains		
	3	2	2	2	2	2	
SiO ₂	51.33	51.75	51.92	52.23	52.04	52.43	51.88
TiO ₂	1.03	0.61	0.54	0.61	0.57	0.59	0.64
Al ₂ O ₃	2.78	2.76	2.82	2.93	2.88	2.73	2.79
Cr ₂ O ₃	0.12	0.22	0.13	0.20	0.17	0.16	0.14
FeO	7.93	7.77	6.85	6.42	5.56	6.51	6.90
MnO	0.25	0.26	0.23	0.23	0.16	0.19	0.20
MgO	14.78	16.06	16.04	16.46	15.86	17.31	16.75
NiO	0.03	0.01	0.06	0.05	0.05	0.02	0.05
CaO	21.70	20.61	21.16	20.97	22.55	20.09	20.42
Na ₂ O	0.42	0.44	0.40	0.41	0.42	0.36	0.38
K ₂ O	—	0.01	0.01	—	—	—	0.01
Total	100.37	100.51	100.16	100.51	100.26	100.39	100.16
Mg#	76.9	78.6	80.7	82.1	83.6	82.6	81.2
Ca#	51.3	48.8	48.7	47.8	50.5	45.5	46.7

Table 9 (continued).

Sample no.:	123				124	
Rock name:	OINo				OINo	
n:	4	2	4	2	4	2
SiO ₂	51.68	52.00	52.54	52.36	52.59	53.38
TiO ₂	0.48	0.35	0.17	0.47	0.62	0.73
Al ₂ O ₃	1.46	1.20	0.88	1.75	1.96	2.22
Cr ₂ O ₃	0.02	0.01	0.03	0.03	0.04	0.08
FeO	13.40	12.33	11.57	8.26	5.03	4.91
MnO	0.46	0.41	0.42	0.31	0.18	0.18
MgO	12.91	12.82	13.02	14.88	16.03	18.12
NiO	0.07	0.02	0.04	0.01	0.03	0.05
CaO	19.67	20.73	21.48	21.90	22.90	19.20
Na ₂ O	0.42	0.42	0.41	0.34	0.29	0.46
K ₂ O	—	0.01	—	0.01	0.01	0.02
Total	100.57	100.30	100.56	100.32	99.68	99.35
Mg#	63.2	65.0	66.7	76.3	85.0	86.7
Ca#	52.3	53.8	54.3	51.4	50.7	43.3

Table 9 (continued).

Sample no.:	121				122					
Rock name:	TR				TR					
n:	Profile			Grain, profile				Grains		
	2	2	1	2	4	2	2	3	6	8
SiO ₂	52.34	52.44	53.08	52.10	51.58	51.48	52.28	52.12	51.93	52.30
TiO ₂	1.04	0.85	0.48	0.78	0.72	0.58	0.75	1.07	0.94	0.96
Al ₂ O ₃	2.64	2.46	1.66	2.82	3.26	3.82	2.59	2.90	2.60	2.67
Cr ₂ O ₃	0.29	0.31	0.26	0.46	0.54	0.50	0.46	0.37	0.32	0.36
FeO	3.60	3.38	3.12	3.40	3.85	3.94	3.78	4.21	4.09	3.87
MnO	0.10	0.17	0.12	0.16	0.16	0.16	0.16	0.14	0.17	0.15
MgO	16.52	16.51	16.93	16.53	16.93	18.71	16.67	15.93	16.37	16.10
NiO	0.05	0.08	0.06	0.06	0.05	0.02	0.02	0.07	0.01	0.04
CaO	23.51	23.85	24.17	22.93	22.25	19.64	22.44	22.75	22.91	23.60
Na ₂ O	0.37	0.36	0.26	0.42	0.42	0.43	0.37	0.39	0.46	0.41
K ₂ O	—	—	—	0.01	0.01	0.01	—	0.01	0.02	0.01
Total	100.46	100.41	100.14	99.67	99.77	99.29	99.53	99.96	99.82	100.47
Mg#	89.1	89.7	90.6	89.6	88.7	89.4	88.7	87.1	87.7	88.1
Ca#	50.5	50.9	50.6	49.9	48.6	42.4	49.2	50.6	50.1	51.3

Notes: Abbreviations as in Tables 1 and 4. Ca# = calcium number, — = not detected.

Table 10. Chemical composition of selected amphiboles.

Edenitic/pargasitic amphiboles									
Sample no.:	110						125		
Rock name:	Gb						OIGb		
n:	Profile								
	6	3	2	2	3	1	3	10	6
SiO ₂	45.27	45.95	48.52	48.74	46.63	49.21	43.90	47.42	42.36
TiO ₂	1.05	1.27	2.07	0.76	1.32	0.66	0.35	1.35	2.65
Al ₂ O ₃	8.86	6.87	6.19	6.03	4.91	6.23	9.78	7.07	11.28
Cr ₂ O ₃	0.03	0.05	0.12	0.04	0.13	0.12	0.02	0.01	0.02
FeO	16.61	15.38	11.18	13.34	14.09	12.84	21.61	16.42	13.54
MnO	0.25	0.24	0.20	0.22	0.21	0.23	0.38	0.30	0.22
MgO	11.76	12.17	14.58	14.18	13.26	14.62	8.48	12.86	12.79
NiO	0.08	0.07	0.02	0.09	0.04	0.02	0.03	0.04	0.06
CaO	11.89	12.13	14.09	12.37	12.24	12.17	11.18	11.06	11.14
Na ₂ O	1.78	1.38	1.42	0.97	1.20	0.85	2.22	1.68	2.42
K ₂ O	0.39	0.32	0.01	0.22	0.22	0.17	0.12	0.21	0.38
Cl	0.32	0.11	0.01	0.12	0.09	0.19	0.75	0.03	0.02
H ₂ O	1.96	1.97	2.04	1.99	1.98	1.97	1.80	2.07	2.03
Total	100.25	95.91	100.44	97.95	97.64	97.42	100.62	100.52	98.91
Mg#	55.8	58.5	69.9	65.4	62.7	67.0	41.1	58.2	62.7

Table 10 (continued).

Edenitic/pargasitic amphiboles								
Sample no.:	124					121		
Rock name:	OINo					TR		
n:	Profile		3	Grain		2	2	4
	2	3		in P	Antho			
	2	3	2	3	2	2	4	
SiO ₂	43.88	46.17	44.01	43.28	55.58	40.25	44.76	45.05
TiO ₂	3.51	2.61	3.42	0.12	0.27	0.15	3.15	2.10
Al ₂ O ₃	11.51	9.72	11.39	15.16	0.92	14.65	11.55	11.54
Cr ₂ O ₃	0.10	0.07	0.09	0.02	0.04	0.05	0.32	0.60
FeO	7.48	6.48	7.55	9.02	13.83	17.02	5.17	5.02
MnO	0.08	0.11	0.13	0.10	0.36	0.34	0.11	0.09
MgO	16.15	17.65	16.49	14.89	24.08	9.02	17.38	17.92
NiO	0.08	0.10	0.10	0.04	0.02	0.05	0.08	0.05
CaO	12.07	12.34	11.99	12.40	0.91	12.38	12.46	12.59
Na ₂ O	2.60	2.31	2.74	2.93	0.03	2.86	2.61	2.62
K ₂ O	0.31	0.22	0.26	0.15	0.02	0.22	0.23	0.18
Cl	0.02	0.01	0.01	0.19	0.09	0.55	0.01	0.01
H ₂ O	2.08	2.11	2.17	2.06	2.0	1.84	2.11	2.12
Total	99.86	99.90	100.35	100.36	96.15	99.38	99.94	99.89
Mg#	79.4	82.3	79.6	74.6	75.6	48.3	85.7	86.4

Table 10 (continued).

Tremolitic/actinolitic amphiboles								
Sample no.:	125			123		124		
Rock name:	OIGb			OINo		OINo		
n:	Profile			Profile		2	2	4
	3	2	4	2	5			
SiO ₂	48.15	43.01	49.16	48.80	50.08	51.30	48.04	56.78
TiO ₂	0.39	0.28	0.36	0.24	0.25	0.25	0.26	0.03
Al ₂ O ₃	6.74	2.54	5.59	5.28	4.22	3.38	6.18	0.91
Cr ₂ O ₃	0.03	0.02	0.02	0.01	0.04	0.02	0.01	0.02
FeO	18.63	16.62	18.81	17.54	17.06	17.43	17.45	5.25
MnO	0.44	0.50	0.48	0.37	0.38	0.50	0.39	0.22
MgO	11.51	14.21	11.84	12.61	13.50	14.25	12.43	21.60
NiO	0.03	0.05	0.03	0.02	0.05	0.02	0.04	0.07
CaO	10.45	10.85	9.87	10.80	10.81	9.79	10.85	12.59
Na ₂ O	1.59	0.65	1.33	1.28	1.10	0.78	1.49	0.35
K ₂ O	0.07	0.04	0.08	0.13	0.07	0.06	0.13	0.01
Cl	0.20	0.06	0.08	0.17	0.12	0.09	0.20	0.02
H ₂ O	2.01	2.10	2.05	2.00	2.05	2.09	2.01	2.18
Total	100.24	100.93	99.70	99.25	99.71	99.66	99.48	100.09
Mg#	52.4	60.4	52.8	56.0	58.5	59.3	55.9	87.4

Table 10 (continued).

Tremolitic/actinolitic amphiboles				
Sample no.:	121			
Rock name:	TR			
n:	Profile			Grain in clino- pyroxene
	2	2	1	3
SiO ₂	56.38	58.26	56.19	55.04
TiO ₂	0.02	0.01	0.05	0.14
Al ₂ O ₃	1.70	0.18	1.19	2.41
Cr ₂ O ₃	0.03	0.02	—	0.18
FeO	3.93	2.65	5.20	4.60
MnO	0.11	0.13	0.13	0.21
MgO	21.72	22.84	21.67	21.37
NiO	0.09	0.04	0.01	0.07
CaO	13.55	13.80	12.80	12.93
Na ₂ O	0.56	0.07	0.43	0.70
K ₂ O	0.02	—	0.02	0.02
Cl	0.03	0.01	0.02	0.03
H ₂ O	2.16	2.19	2.17	2.16
Total	100.30	100.20	99.88	99.86
Mg#	90.8	93.9	88.1	89.2

Notes: Abbreviations as in Tables 1 and 4. Cpx = clinopyroxene, in P = plagioclase, Antho = anthophyllite; — = not detected.

Table 11. Chemical composition of selected plagioclases.

Sample no.:	102						110					
	Gb						Gb					
	Profile 1						Profile 2					
n:	1	2	4	2	4	4	10	4	4	2	2	1
SiO ₂	54.13	53.66	54.24	55.02	54.96	55.25	52.71	53.82	54.55	55.89	54.57	53.18
TiO ₂	0.10	0.05	0.08	0.06	0.04	0.04	0.02	0.03	0.02	0.04	0.02	0.04
Al ₂ O ₃	28.42	28.22	28.39	27.86	27.98	27.71	30.07	29.40	28.89	27.93	28.70	29.79
Fe ₂ O ₃	0.28	0.21	0.27	0.30	0.26	0.28	0.11	0.05	0.06	0.06	0.17	0.11
MgO	0.03	0.01	0.03	0.02	0.03	0.03	0.02	0.02	0.01	0.03	0.02	0.03
CaO	11.31	12.18	11.25	10.48	10.74	10.39	12.81	11.98	11.44	10.33	10.98	12.28
Na ₂ O	5.53	5.52	5.56	6.00	5.93	6.10	4.62	5.15	5.47	6.16	5.58	4.89
K ₂ O	0.05	0.09	0.07	0.08	0.07	0.06	0.07	0.06	0.07	0.11	0.09	0.07
Total	99.85	99.94	99.89	99.82	100.01	99.86	100.43	100.51	100.51	100.57	100.13	100.38
An#	52.9	54.7	52.5	49.0	49.8	48.4	60.3	56.0	53.4	47.9	51.9	57.9

Table 11 (continued).

Sample no.:	118						At contact with	
	Gb						cpx ⇒ amph	
	Profile 3						1	1
n:	2	3	2	2	3	1	1	
SiO ₂	52.79	52.79	52.91	53.51	53.15	51.84	49.88	51.76
TiO ₂	0.06	0.10	0.10	0.10	0.08	0.05	0.07	0.04
Al ₂ O ₃	29.30	29.35	28.90	28.72	29.01	30.36	29.71	29.67
Fe ₂ O ₃	0.28	0.24	0.25	0.24	0.24	0.18	0.92	0.58
MgO	0.03	0.03	0.05	0.02	0.02	0.01	0.90	0.32
CaO	12.16	12.39	12.03	11.63	11.82	13.16	13.19	13.04
Na ₂ O	5.06	4.92	5.10	5.34	5.30	4.50	3.89	4.36
K ₂ O	0.06	0.06	0.06	0.07	0.07	0.05	0.04	0.07
Total	99.84	99.86	99.40	99.63	99.69	100.15	98.60	99.84
An#	57.1	58.0	56.5	54.4	55.0	61.6	65.1	62.1

Table 11 (continued).

Sample no.:	104								
Rock name:	OIGb								
	Profile 1								Grain in amph
n:	2	2	3	2	5	4	1	1	2
SiO ₂	51.32	49.96	50.23	50.74	50.02	51.23	49.38	51.46	59.76
TiO ₂	0.03	0.06	0.06	0.04	0.05	0.06	0.04	0.08	0.06
Al ₂ O ₃	30.32	31.02	30.87	30.51	30.76	30.11	31.39	30.32	25.32
Fe ₂ O ₃	0.16	0.20	0.18	0.20	0.24	0.15	0.19	0.22	0.19
MgO	0.03	0.02	0.03	0.02	0.03	0.02	0.01	0.02	0.02
CaO	13.71	14.68	14.34	13.72	14.32	13.38	14.72	13.54	7.21
Na ₂ O	4.29	3.73	3.88	4.08	3.85	4.38	3.53	4.37	7.50
K ₂ O	0.05	0.04	0.06	0.04	0.04	0.06	0.03	0.05	0.18
Total	99.91	99.71	99.65	99.35	99.31	99.33	99.29	100.06	100.24
An#	63.7	68.3	66.9	64.9	67.2	62.6	69.6	63.0	34.3

Table 11 (continued).

Sample no.:	119								
Rock name:	OIGb								
	Profile 3					Profile 4			
n:	1	1	1	1	1	2	1	1	
SiO ₂	49.93	50.68	50.79	50.49	50.33	48.94	52.06	50.23	
TiO ₂	—	0.02	0.02	0.03	0.01	0.05	0.06	0.04	
Al ₂ O ₃	31.56	31.27	31.04	31.24	31.39	32.22	30.18	31.18	
Fe ₂ O ₃	0.15	0.16	0.14	0.19	0.14	0.28	0.26	0.26	
MgO	0.01	0.02	0.01	0.02	0.02	0.03	0.01	0.05	
CaO	15.04	14.64	14.37	14.28	14.88	15.88	13.10	14.49	
Na ₂ O	3.52	3.63	3.81	3.70	3.51	2.82	4.57	3.68	
K ₂ O	0.05	0.01	0.03	0.03	0.01	0.01	0.03	0.04	
Total	100.26	100.43	100.21	99.98	100.29	100.23	100.27	99.97	
An#	70.0	69.0	67.4	68.0	70.0	75.6	61.2	68.4	

Table 11 (continued).

Sample no.:	125										
Rock name:	OIGb										
	Profile 5										
n:	10	8	6	5	4	3	2	3	6	2	
SiO ₂	50.67	50.33	50.07	49.17	48.50	48.16	49.11	49.81	50.22	50.39	
TiO ₂	0.05	0.06	0.03	0.02	0.04	0.02	0.03	0.05	0.05	0.03	
Al ₂ O ₃	31.06	31.62	32.08	32.57	33.08	32.97	32.52	31.81	31.84	31.78	
Fe ₂ O ₃	0.17	0.11	0.07	0.06	0.08	0.10	0.14	0.13	0.12	0.07	
MgO	0.03	0.03	0.01	0.03	0.03	0.02	0.01	0.02	0.02	0.01	
CaO	14.15	14.71	14.97	15.69	16.28	16.45	15.67	14.87	14.82	14.73	
Na ₂ O	3.76	3.54	3.34	2.97	2.54	2.40	2.90	3.30	3.39	3.53	
K ₂ O	0.06	0.05	0.02	0.03	0.02	0.03	0.03	0.02	0.04	0.05	
Total	99.95	100.45	100.59	100.54	100.57	100.15	100.41	100.01	100.50	100.59	
An#	67.3	69.5	71.2	74.4	77.9	79.1	74.8	71.3	70.6	69.5	

Table 11 (continued).

Sample no.:	113										
Rock name:	GbNo										
	Profile 2										
n:	3	4	3	4	3	2	2	5	3	7	9
SiO ₂	53.41	52.01	51.74	52.00	51.86	52.01	52.49	52.63	52.79	52.91	52.68
TiO ₂	0.03	0.05	0.06	0.05	0.06	0.05	0.07	0.07	0.05	0.06	0.06
Al ₂ O ₃	29.61	30.54	30.55	30.50	30.47	30.28	30.12	30.03	30.02	29.94	30.04
Fe ₂ O ₃	0.09	0.13	0.18	0.16	0.25	0.28	0.28	0.21	0.15	0.16	0.21
MgO	0.01	0.02	0.03	0.03	0.04	0.03	0.02	0.03	0.02	0.03	0.02
CaO	12.22	13.33	13.55	13.39	13.50	13.27	12.98	12.89	12.82	12.73	12.86
Na ₂ O	5.04	4.34	4.28	4.39	4.28	4.44	4.56	4.61	4.70	4.67	4.66
K ₂ O	0.05	0.05	0.03	0.04	0.05	0.05	0.04	0.05	0.05	0.05	0.05
Total	100.46	100.47	100.42	100.56	100.51	100.41	100.56	100.52	100.60	100.55	100.58
An#	57.1	62.8	63.5	62.7	63.3	62.1	61.0	60.5	60.0	59.9	60.2

Table 11 (continued).

Sample no.:	123						124			
Rock name:	OINo						OINo			
	Grains						Profile 1			
n:	2	3	3	3	4	5	2	2	3	2
SiO ₂	57.73	57.41	56.67	56.18	48.49	48.55	49.53	49.04	49.86	49.27
TiO ₂	0.02	0.02	0.03	0.03	0.04	0.03	0.02	0.04	0.02	0.02
Al ₂ O ₃	26.63	27.10	27.45	27.69	33.04	33.04	32.52	32.55	32.13	32.73
Fe ₂ O ₃	0.13	0.12	0.10	0.09	0.09	0.06	0.04	0.09	0.06	0.10
MgO	0.02	0.02	0.03	0.02	0.03	—	0.02	0.02	0.01	0.01
CaO	8.64	9.16	9.68	10.11	16.22	16.16	15.38	15.73	15.16	15.48
Na ₂ O	7.19	6.69	6.51	6.25	2.64	2.73	3.13	2.90	3.29	2.98
K ₂ O	0.05	0.10	0.11	0.10	0.03	0.02	0.04	0.03	0.03	0.03
Total	100.41	100.62	100.58	100.47	100.58	100.61	100.66	100.40	100.57	100.62
An#	39.9	42.9	44.8	46.9	77.0	76.5	72.9	74.9	71.6	74.1

Table 11 (continued).

Sample no.:	121									
Rock name:	TR									
	Profile 1									
n:	1	1	1	5	1	1	2	1	1	2
SiO ₂	46.81	48.62	45.22	48.49	47.77	47.45	47.96	46.39	47.66	48.07
TiO ₂	0.03	0.02	—	0.05	0.02	0.02	0.03	0.02	0.02	0.03
Al ₂ O ₃	34.15	32.07	35.37	32.95	33.41	33.84	33.26	34.46	33.55	33.37
Fe ₂ O ₃	0.25	0.33	0.25	0.14	0.15	0.09	0.12	0.10	0.08	0.07
MgO	0.02	0.06	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01
CaO	17.59	15.97	18.90	16.17	16.90	17.14	16.49	17.94	16.97	16.58
Na ₂ O	1.96	2.45	1.09	2.82	2.38	2.21	2.56	1.74	2.31	2.57
K ₂ O	0.01	—	—	0.02	0.01	0.02	0.02	—	0.02	0.02
Total	100.82	99.52	100.85	100.66	100.66	100.79	100.45	100.67	100.63	100.72
An#	83.2	78.3	90.5	76.0	79.6	81.0	78.0	85.1	80.1	78.1

Table 11 (continued).

Sample no.:	121									
Rock name:	TR									
	Profile 2					Profile 3				
n:	2	1	2	2	2	1	2	1	1	2
SiO ₂	48.77	48.50	48.40	48.44	48.90	48.52	48.91	49.35	48.64	48.77
TiO ₂	0.06	0.08	0.08	0.12	0.08	0.06	0.09	0.07	0.04	0.05
Al ₂ O ₃	32.67	33.06	32.92	32.69	32.64	32.73	32.62	31.95	32.72	32.74
Fe ₂ O ₃	0.26	0.19	0.26	0.23	0.22	0.13	0.19	0.22	0.18	0.18
MgO	0.06	0.06	0.04	0.03	0.04	0.02	0.04	0.06	0.04	0.03
CaO	15.86	16.17	16.24	16.03	15.86	16.18	15.92	15.09	15.88	15.97
Na ₂ O	2.87	2.80	2.66	2.80	2.84	2.81	2.98	3.26	3.01	2.89
K ₂ O	0.03	—	0.02	0.03	0.03	0.03	0.03	0.03	0.01	0.02
Total	100.58	100.86	100.62	100.37	100.61	100.48	100.78	100.03	100.52	100.65
An#	75.2	76.1	77.1	75.8	75.4	76.0	74.6	71.8	74.4	75.3

Table 11 (continued).

Sample no.:	122									
Rock name:	TR									
	Profile									
n:	3	1	1	1	1	1	2	1	1	1
SiO ₂	48.88	52.19	50.95	52.70	49.48	51.32	49.80	51.72	49.93	49.28
TiO ₂	0.03	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.02
Al ₂ O ₃	32.61	30.65	31.17	30.42	32.46	31.35	32.21	30.79	31.79	32.41
Fe ₂ O ₃	0.13	0.05	0.12	0.14	0.06	0.13	0.07	0.05	0.08	0.06
MgO	0.03	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01
CaO	15.81	13.28	14.28	12.69	15.45	13.84	15.08	13.67	14.83	15.25
Na ₂ O	2.88	4.54	3.96	4.68	3.19	3.82	3.34	4.26	3.41	3.18
K ₂ O	0.03	0.10	0.04	0.07	0.01	0.06	0.01	0.06	0.04	0.04
Total	100.40	100.84	100.57	100.74	100.68	100.57	100.55	100.59	100.13	100.25
An#	75.1	61.6	66.5	59.7	72.8	66.5	71.4	63.8	70.5	72.4

Notes: Abbreviations as in Tables 1 and 4; amph = amphibole, cpx = clinopyroxene; An# is defined in the text; — = not detected.