

IGNEOUS FRACTIONATION TRENDS IN ROBERTS VICTOR ECLOGITES

C.J. Hatton and J.J. Gurney

(Dept. of Geochemistry, University of Cape Town, Rondebosch 7700, South Africa)

A wide range in compositions has been revealed in general studies of the Roberts Victor eclogites (Kushiro & Aoki, 1968; MacGregor & Carter, 1970; Whitfield, 1971). MacGregor & Carter (1970) recognised two groups on textural grounds and identified the group I eclogites as cumulates and group II eclogites as the corresponding liquids. The higher K_2O in clinopyroxene of group I (Erlank, 1970) suggests that group II eclogites cannot be coexisting liquids. Data of the present study indicates that most, if not all of the eclogites are cumulates. The pervasive secondary alteration along grain boundaries by kimberlite has obscured the nature of the original intercumulus mineralogy. The possible effects of reequilibration of the cumulates with intercumulus material are therefore difficult to evaluate. Group I eclogites present a rather altered appearance, in contrast to the group II eclogites which are, by comparison, fresh in appearance.

Several important points were noted during an examination of two hundred eclogite slabs. In certain eclogites kyanite was found to be confined to discrete zones of chemically distinctive character (Hatton & Gurney, 1977b). Clinopyroxene megacrysts were found entirely surrounded by biminerallitic eclogite (e.g. HRV77). Altered orthopyroxene was found to be present in a number of Mg-rich eclogites. High values of Cr_2O_3 (> 1wt%) in garnet and clinopyroxene of orthopyroxene bearing eclogites and certain other eclogites were found. In most cases the chrome rich eclogites exhibited considerable compositional inhomogeneity. Primary mica was identified in at least two eclogites. Na_2O contents of garnet and K_2O contents of clinopyroxene at levels greater than 0.10wt% were common in group I eclogites but are generally lower in group II. No genetic association of Na_2O in garnet or K_2O in clinopyroxene with diamond or graphite eclogites was discerned.

Representative analyses covering the range of composition in the thousand analyses carried out during this study are presented in table 1 and figure 1. In figure 1 clinopyroxene and garnet compositions lie at the upper and lower ends of the tie lines.

Analyses c, a and b are from a distinctly layered eclogite, HRV15 which contains hercynite spinel as a primary phase, and which was selected because the specimen illustrates the wide range in composition which may be found in a single group II eclogite nodule. Garnet and clinopyroxene of composition c lie 1cm from one end of the nodule. Compositions change toward those represented by analyses a lying 8cm from c. At the far end of the nodule compositions given by analyses b appear to be reverting toward those of c. A relatively rapid change in the magma toward more Mg, Cr compositions is indicated from c to a with a reversion toward Mg, Cr-poor compositions between a and b.

Garnet composition a is fairly typical of most type II garnets examined.

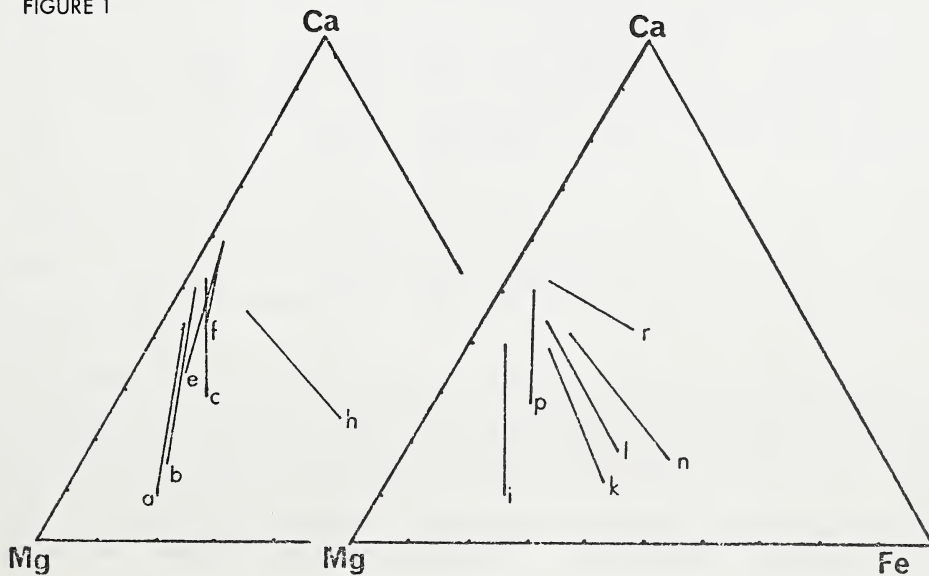
Core and rim analyses of a garnet and a clinopyroxene in a corundum eclogite RV372 of variable composition are tabulated as analyses e and f respectively. Iron rich members of the group II eclogites are represented by JYG6-h.

The most magnesian rich member of group I eclogites is HRV249-i. Most

TABLE 1

	Group II						Group I					
	c	a	b	e	f	h	i	k	l	n	p	r
	HRV15	HRV15	HRV15	RV372	RV372	JJG6	HRV249	HRV77	HRV77	XRV5	JJG30	PJL17
	Gt1	Gt5	Gt6	Gt1	Gt1	Gt	Gt	Gt3 in	Gt3 in	Gt	Gt	Gt
				Core	Rim			eclogite	megacr			
SiO ₂	41.9	42.1	42.5	41.5	41.1	39.7	42.4	39.9	39.8	39.6	40.7	39.7
TiO ₂	.12	.15	.17	.03	b.d.	.13	.42	.26	.27	.31	.25	.35
Al ₂ O ₃	24.0	23.6	24.1	24.0	23.7	22.4	23.8	22.7	22.7	22.2	23.2	22.7
Cr ₂ O ₃	.16	.83	.21	.11	.10	.09	.03	.17	.21	.09	.08	b.d.
FeO	7.55	8.21	7.62	7.21	6.52	19.1	11.0	18.0	17.5	21.7	11.4	13.0
MnO	.13	.23	.19	.12	.14	.34	.27	.43	.38	.37	.21	.23
HgO	16.1	21.2	20.1	14.5	12.5	9.54	19.7	13.7	12.2	9.89	14.2	8.29
CaO	11.6	3.56	6.02	12.9	16.0	9.06	3.74	4.47	6.93	6.10	10.5	16.0
Na ₂ O	b.d.	b.d.	.05	.05	b.d.	.07	.12			.16	.09	.11
Total	101.6	99.9	101.0	100.3	100.0	100.4	101.4	99.6	100.0	100.4	100.7	100.4
	c	a	b	e	f	h	i	k	l	n	p	r
	Cp1	Cp4	Cp7	Cp1	Cp1	Cp	Cp	Cp in	Cp in	Cp	Cp	Cp
				Core	Rim			eclogite	megacr			
SiO ₂	53.5	56.1	54.6	50.9	51.0	55.5	56.0	54.8	55.4	54.9	56.9	56.3
TiO ₂	.09	.17	.05	.03	b.d.	.15	.39	.30	.33	.37	.27	.29
Al ₂ O ₃	14.1	6.09	11.5	20.1	20.5	9.56	4.16	7.60	9.86	8.38	16.7	17.4
Cr ₂ O ₃	.16	.48	.18	.13	.13	.10	.05	.17	.19	.11		b.d.
FeO	1.33	2.12	1.25	1.01	.94	5.58	4.03	6.29	4.41	6.99	1.63	2.03
MnO	b.d.	.04	b.d.	b.d.	.03	.03	.08	.10	.04	.09		b.d.
MgO	10.3	14.8	11.4	7.09	6.94	9.47	16.7	11.5	10.2	10.2	6.91	6.06
CaO	15.8	16.9	16.6	15.3	15.0	14.4	17.2	13.1	13.7	13.9	10.9	10.7
Na ₂ O	4.95	3.65	4.76	5.68	6.11	5.86	2.68	5.37	5.89	5.22	7.32	7.51
K ₂ O	.05	.05	.06	b.d.	b.d.	b.d.	.11	.11	.13	.17	.10	.16
Total	101.3	100.4	100.4	100.2	100.6	100.6	101.4	99.3	100.1	100.3	100.7	101.0
lnK _D	1.29	.99	1.24	1.25	1.35	1.22	.84	.88	1.20	1.16	1.22	1.54
T(°C)	1058	1177	1077	1073	1037	1083	1248	1230	1093	1107	1083	971
at 40kb												

FIGURE 1



group I compositions lie near to HRV77 eclogite-k. HRV77 consists of a clinopyroxene megacryst surrounded by biminerallitic eclogite. Garnet l is of the opposite edge of garnet k but lying within the large (10cm) clinopyroxene megacryst. XRV5-n is an iron rich end member of the group I eclogites which can be chemically distinguished from iron rich end members of group II eclogites by the lower CaO garnet and the presence of greater than 0.10wt% K₂O in clinopyroxene. Grossular garnet and jadeitic clinopyroxene end members are represented by kyanite eclogites JJG30-p and PJJ17-r.

Ages of a comprehensive suite of eclogites (Kramers, 1977) indicate that the eclogites originated during a single pre Cambrian thermal event. However the eclogites cannot be related by fractional crystallisation of a single magma. Multiple magma intrusion and magma mixing is indicated by samples HRV15, RV372, HRV77 and others. Small scale inhomogeneities are more common in group II eclogites which appear to have formed from relatively small volumes of magma, while the more homogeneous group I eclogites may have crystallised from larger batches of magma in which the effects of magma mixing will be less marked. The evolution of group II eclogites was dominated by partial melting processes while fractional crystallisation was more important in evolution of group I eclogites.

The presence of kyanite in JJG30 indicates that the coexisting magma lay on the SiO₂ rich side of the eclogite thermal divide (O'Hara & Yoder, 1967). The presence of H₂O during partial melting of garnet lherzolite can lead to the production of silica rich melts (Kushiro & Yoder, 1974). The relatively low temperatures of equilibration (Table 1) are consistent with presence of volatiles. The magma from which HRV15 crystallised lay on the MgO rich side of the eclogite thermal divide (MgAl₂O₄ present) hence if volatiles were present during melting the CO₂/H₂O ratio was probably high (Eggler, 1974).

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