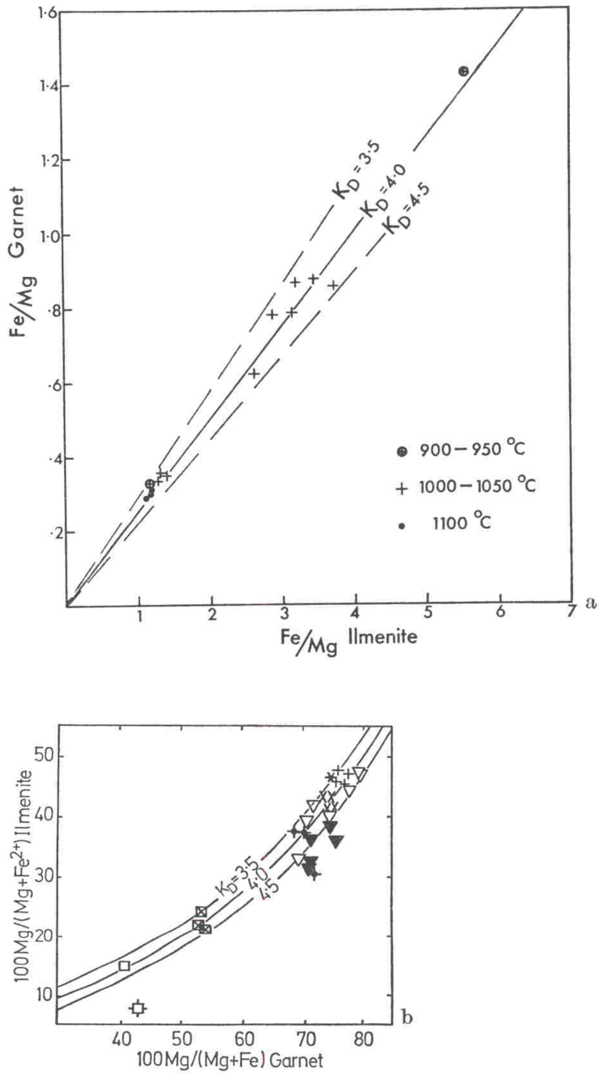

Fig. 2a and b. Partitioning of Fe and Mg between garnet and ilmenite for synthesized samples (a) and for both natural and synthesized ilmenites (b). Symbols (b) as for Fig. 1

of compositional (Mg-value only) variation over the range of compositions of interest for natural ultramafic or basic rocks.

The temperature range over which K_D variation can be examined is not large in the experiments reported and further experiments are required at lower and higher temperatures to evaluate the K_D vs T relationship. It may be noted that $K_{D(\mathrm{Fe,\,Mg})}^{\mathrm{ga\text{-}cpx}}$ has values of 4.7 (900° C), 4.0 (950° C), 3.0 (1050° C) and 2.7 (1100° C) at 30 kb (Raheim and Green, 1974) and the data presented herein shows that $K_{D(\mathrm{Fe,\,Mg})}^{\mathrm{ilm\text{-}ga}}$ is less sensitively dependent on temperature than $K_{D(\mathrm{Fe,\,Mg})}^{\mathrm{ga\text{-}cpx}}$. Our data

Table 5. Compositional features of coexisting synthesized garnets and ilmenites

Run conditions		Garnet				Ilmenite						
P (kbar)	T (° C)	n[a]	$\frac{100\,Mg}{Mg+Fe}$	TiO_2	Cr_2O_3	n[a]	$\frac{100\,Mg}{Mg+Fe}$	Al_2O_3	Cr_2O_3	SiO_2	CaO	Na_2O
Pyrolite less 40% Olivine												
21–40	1100	9	76.2	1.3	2.0	4	46.7	0.8	2.0	0.7	0.4	0.2
21–31	1000	7	74.4	0.8	1.8	7	43.1	0.6	1.8	0.7	0.3	0.2
30	950	5	75.7	0.6	2.1	3	45.7	0.5	2.1	0.2	0.2	—
Olivine basanite												
25–30	1050	3	53.4	1.5	—	4	23.1	0.8	—	0.8	0.5	0.3
25	900	5	41.2	1.0	—	1	15.2	0.7	—	1.0	0.8	0.3

[a] n = No. of analyses obeying structural formulae and S_1O_2 (in ilmenite) restrictions, see text.

suggests that Fe/Mg partition between ilmenite and clinopyroxene (or olivine, or orthopyroxene) is likely to be more useful as a petrological tool in deduction of P, T conditions of equilibration than Fe/Mg partition between ilmenite and garnet. From Fig. 2 and the data of Raheim and Green (1974) $K_{D\,(Fe,\,Mg)}^{ilm\text{-}cpx} \approx 18.8$ at 900° C, 30 kb and $K_{D\,(Fe,\,Mg)}^{ilm\text{-}cpx} \approx 10.8$ at 1100° C, 30 kb.

In Table 3, we list analyses of coexisting phases from an ilmenite-bearing garnet peridotite from the Wesselton mine, South Africa. For this assemblage $K_{D\,(Fe,\,Mg)}^{ilm\text{-}ga} = 4.26$ and $K_{D\,(Fe,\,Mg)}^{ilm\text{-}cpx} = 8.75$. Garnet and ilmenite from two Yakutian garnet peridotite xenoliths are listed in Table 4 and both ilmenites contain much higher Fe_2O_3 contents than the synthetic or Wesselton minerals. $K_{(Fe^{++},\,Mg)}^{ilm\text{-}ga} = 5.98$ and 5.34 for these two assemblages if Fe^{+++} is allocated to ilmenite and garnet to satisfy structural formulae constraints. Boyd and Dawson (1973) list analyses of coexisting ilmenite and garnet from the Excelsior Pipe in which ilmenite has intermediate (7–9%) Fe_2O_3 contents and in which $K_{D\,(Fe^{++},\,Mg)}^{ilm\text{-}ga} = 5.1$ and 4.86 if Fe^{+++} is allocated to garnet according to structural formulae constraints (note that garnet then has minor Fe_2O_3 content). For the Wesselton garnet peridotite (Table 4), $K_{D\,(Fe^{++},\,Mg)}^{ilm\text{-}cpx} = 8.75$; for ilmenite (8.6% Fe_2O_3) and diopside (sub-calcic) in lamellar intergrowth from Uintjes Berg Pipe, $K_{D\,(Fe^{++},\,Mg)}^{ilm\text{-}cpx} \simeq 8.02$ (Boyd and Nixon, 1973) and for ilmenite (2.61% Fe_2O_3) and diopside (sub-calcic) from Matsoku Pipe $K_{D\,(Fe^{++},\,Mg)}^{ilm\text{-}cpx} \simeq 7.15$ (Akella and Boyd, 1973).

We conclude, from the experimental data and the comparison with natural ilmenite/garnet and ilmenite/clinopyroxene parageneses that $K_{D\,(Fe^{++},\,Mg)}^{ilm\text{-}ga} = 4.0 \pm 0.5$ for a range of P, T conditions about 20–40 kb, 900–1100° C and is probably not sensitively dependent on P, T or Mg-value of the bulk composition. However, $K_{D\,(Fe^{++},\,Mg)}^{ilm\text{-}ga}$ is probably sensitively and positively correlated with Fe_2O_3 substitution in ilmenite. It appears probable that $K_{(Fe^{++},\,Mg)}^{ilm\text{-}cpx}$ is more sensitively dependent on temperature and it is of interest that two independent parameters (the more sub-calcic pyroxene and lower $K_{D\,(Fe^{++},\,Mg)}^{ilm\text{-}cpx}$ indicate that the Matsoku Ol+Cpx+Opx+Ilm assemblage (Akella and Boyd, 1973) is a higher temperature assemblage than the Wesselton example (Table 3).