



The amount of pyroxene components dissolved in the garnet solid solution becomes greater as pressure increases (about 2 mol % at 50 kbar, 9 mol % at 75 kbar and 20 mol % at 100 kbar). The ratio of grossular to pyrope molecules in the garnet solid solution decreases as temperature increases. The net amount of pyroxene components dissolved in the garnet solid solution, however, seems to be relatively insensitive to temperature at a given pressure. The composition of garnet obtained at 75 kbar and 1200°C in the CMAS system is slightly enriched in grossular component than that of a natural garnet lherzolite run at the same P/T condition by Akaogi & Akimoto (1979).

Alumina contents of ortho- and clinopyroxenes coexisting with garnet are shown in Fig.3 and Fig.4, respectively. Alumina isoplethal lines for the pyroxenes were drawn in accordance with the reversed experimental results of Parkins & Newton (1981) at 20 to 40 kbar and 900° to 1100°C. The dT/dP slope and the

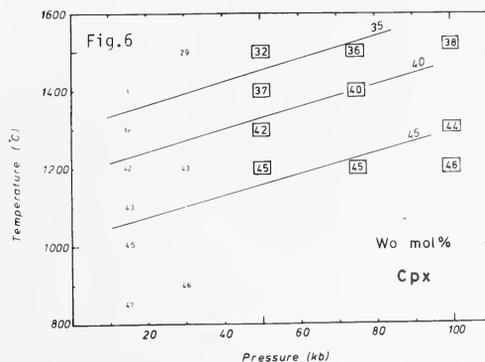
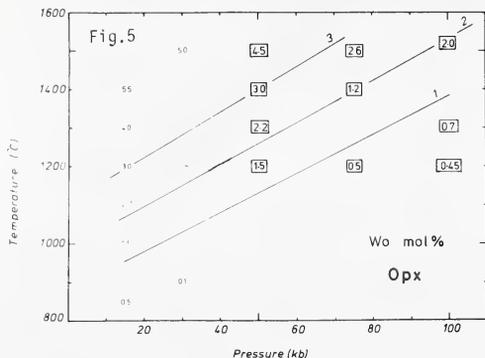
location of the isoplethal lines for orthopyroxene are in harmony with the estimation by Parkins & Newton but are not consistent with those of Akella (1976). The dT/dP slope of the isoplethal lines for clinopyroxene estimated by Parkins & Newton (broken lines in Fig.4), however, are appeared to be overestimated. In consequence of the gentle dT/dP slope of the isoplethal lines for clinopyroxene, the alumina content of clinopyroxene coexisting with orthopyroxene and garnet in the CMAS system is greater than that of orthopyroxene at pressures above about 50 kbar, whereas it is less aluminous than the latter at 30 kbar (Boyd,1970).

The pressure/temperature dependence of the Wo mol% (defined as  $100Ca/(Ca+Mg+0.5Al)$  in the CMAS system) of the coexisting ortho- and clinopyroxenes are shown in Fig.5 and Fig.6, respectively. Because pyroxenes in the present study contains very small amount of  $Al_2O_3$  (Fig.2), the Wo mol % of the pyroxenes in the CMAS system should not be different appreciably from those in the Al-free system. The present results, therefore, are compared with the reversed experimental data in the diopside-enstatite system by Mori & Green(1975) and Lindsley & Dixon (1976) in the pressure range 15 to 30 kbar. The pressure effect on the pyroxene solvus (Mori & Green,1975) is confirmed to be present at least up to 100 kbar in the light of the present results (Fig.5, Fig.6), and it follows that the equilibrium temperature estimation from the pyroxene solvus cannot be made without knowing the pressure of equilibration.

Given above observations, sheared garnet lherzolite xenoliths from Lesotho kimberlites (Nixon & Boyd,1973) are considered to have derived from the pressure range 50 to 70 kbar, whereas the granular garnet lherzolites from the same area may have originated at pressures below 50 kbar. The inferred pressures for the sheared lherzolite xenoliths are higher than the estimations by the previous authors (e.g. Boyd,1973; Parkins & Newton,1980).

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## H12 CHEMICAL AND ISOTOPIC CHARACTERISATION OF UPPER MANTLE METASOMATISM IN PERIDOTITE NODULES FROM THE BULTFOONTEIN KIMBERLITE

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Further major, trace element and Sr-isotope measurements, together with new REE and Nd-isotope measurements, have been made on samples from a much larger peridotite suite than that studied previously [1,2]. For present purposes the suite has been divided into garnet peridotites (GP) which contain no texturally equilibrated or "primary" phlogopite, garnet phlogopite peridotites (GPP), phlogopite peridotites (PP) and phlogopite K-richterite peridotites (PKP). The latter two groups contain no garnet, while diopside may or may not be present in all four groups. The above sequence was previously considered [1] to represent one of progressive mantle metasomatism, culminating in the devel-

opment of K-richterite. However, in view of the greatly increased number of PP rocks now obtained, which appear to have been essentially harzburgitic in original composition, it is questionable whether garnet removal was involved or is essential in the development of the PP and PKP groups. Most samples studied are coarse grained peridotites, with deformed textures being much more common in the GP and GPP groups. However three PKP samples have deformed textures in which both phlogopite and K-richterite have been involved in the deformation process, indicating that these minerals formed before kimberlite emplacement. Additional PKP samples include many more veined examples in which the