



Fig. 2. Diagram illustrating the P, T fields of different mineral assemblages in pyrolite III composition. The figures 1% Al_2O_3 , 2% Al_2O_3 etc. refer to the Al_2O_3 content of orthopyroxene in equilibrium with garnet in the garnet pyrolite field. The oceanic and Precambrian shield geotherms are those illustrated by RINGWOOD *et al.* (1964). (From GREEN and RINGWOOD, 1967a.)

roxenes + spinel field but such curves, combined with data on the pyroxene miscibility gap, will ultimately provide a very useful means of estimating the P, T conditions of equilibration of natural spinel and garnet pyrolite (O'HARA, 1967). With variation in bulk composition, the conditions for appearance of garnet will vary; compositions with higher Al_2O_3 /pyroxene ratio will yield spinel up to solidus temperatures and garnet will appear at 23–24 kb at the solidus. For a bulk composition such that, with all Al_2O_3 in pyroxenes, the orthopyroxene would contain only 3.0% Al_2O_3 , then spinel would be expected to disappear above 1000 °C, 10–18 kb and there would be a greatly expanded field of olivine and aluminous pyroxenes. Garnet would not appear on the solidus of such a composition until pressures of approximately 60 kb.

4. Mineralogy in a pyrolite upper mantle

In the following discussion, it is assumed that the average composition of the upper mantle beneath oceanic and geologically "young" regions is that of pyrolite III. In continental regions and particularly in Precambrian shield regions, there is probably a much greater proportion of refractory residual peridotite at shallower levels and the upper mantle may be chemically zoned. Mineralogical variation in the upper oceanic mantle is thus determined by the intersection of geothermal gradients with the stability fields of fig. 1. The variation of temperature in the continental and oceanic crusts and upper mantle has been discussed by CLARK (1962) and CLARK and RINGWOOD (1964). It is clear from these papers that there is a large difference

Minor melting, Ol + Opx + Cpx + spinel
 No melting, Ol + Opx + Cpx + Ga + Spinel
 Nil, uncommon spinel
 Trace garnet, uncommon spinel
 2.2
 2.1
 4.2
 5.0
 —
 —
 3.0
 5.9
 Opx
 Opx
 Pt
 Pt
 1
 1
 22.5
 24.8
 1400
 1400