normally present a small ($<5\%$) melt fraction. It is considered that this region corresponds to the seismic low velocity zone, the small melt fraction producing low seismic velocity and high seismic attenuation. The lower boundary of the low-velocity zone may be caused either by decreasing water content or by entry of water into higher pressure silicate phases.

The discussion in this section has illustrated the very sensitive controls exerted by P, T and P_{H_2O} in determining the mineralogy and solidus temperature of the model pyrolite composition. Attention in the following section is directed at the liquidus phases of basaltic magmas at high pressures since if these magmas are derived from the pyrolite composition by partial melting then the liquidus phases of the basalt and the residual phases in pyrolite at a given P, T and % melting must match one another. The study of the liquidus and near-liquidus phases of basalts at high pressure also shows the possible fractionation trends which a basalt magma, separated from its source peridotite, may follow at various depths in the upper mantle and crust.

4. CRYSTALLIZATION OF BASALTIC MAGMAS AT HIGH PRESSURE

(a) *Basalt nomenclature used* In studies of basalts where the chemical composition of a magma is the principal concern, it is convenient to adopt a normative (i.e. indirect chemical) classification rather than a modal (mineralogical) classification. The nomenclature used is as follows:

> *Tholeiite*: basalt with normative hypersthene
> *Quartz tholeiite*: basalt with normative hypersthene and quartz
> *Olivine tholeiite*: basalt with normative hypersthene and olivine, hypersthene $>3\%$
> *Olivine basalt*: with normative olivine and with $0-3\%$ normative hypersthene; no normative nepheline
> *Alkali olivine basalt*: with normative olivine and nepheline; nepheline $<5\%$

FIG. 2 (Green 1970). Diagram illustrating the amphibole stability limit at high pressure and the solidus for pyrolite composition containing approximately 0.1% H_2O. Also shown (dotted lines) are the solidus for anhydrous pyrolite and the boundary for appearance of garnet (from Green and Ringwood 1967a). The numbered dashed curves show the % liquid present above the solidus and the petrochemical character of these liquids is indicated. The geothermal gradient shown is the oceanic geotherm illustrated by Ringwood (1966b).

The positions of the curves on this diagram, other than the anhydrous boundaries, are estimated from reconnaissance experiments on the solidus and amphibole stability in pyrolite with $0.1-0.2\%$ water and by experiments establishing the degree of depression of the liquidus temperatures of various basalts by addition of known amounts of water.

Ordinate — Temperature within the earth.
Abscissa — P_{total} = Load Pressure or Solid Pressure.
P_{H_2O} = equilibrium water pressure.
P_I = water pressure along solidus for pyrolite with 0.1% H_2O.

P_I varies along the solidus to P'_I and an arrow indicates the intersection of the solidus with a subsolidus breakdown curve for amphibole at $P_{H_2O} = P'_I$

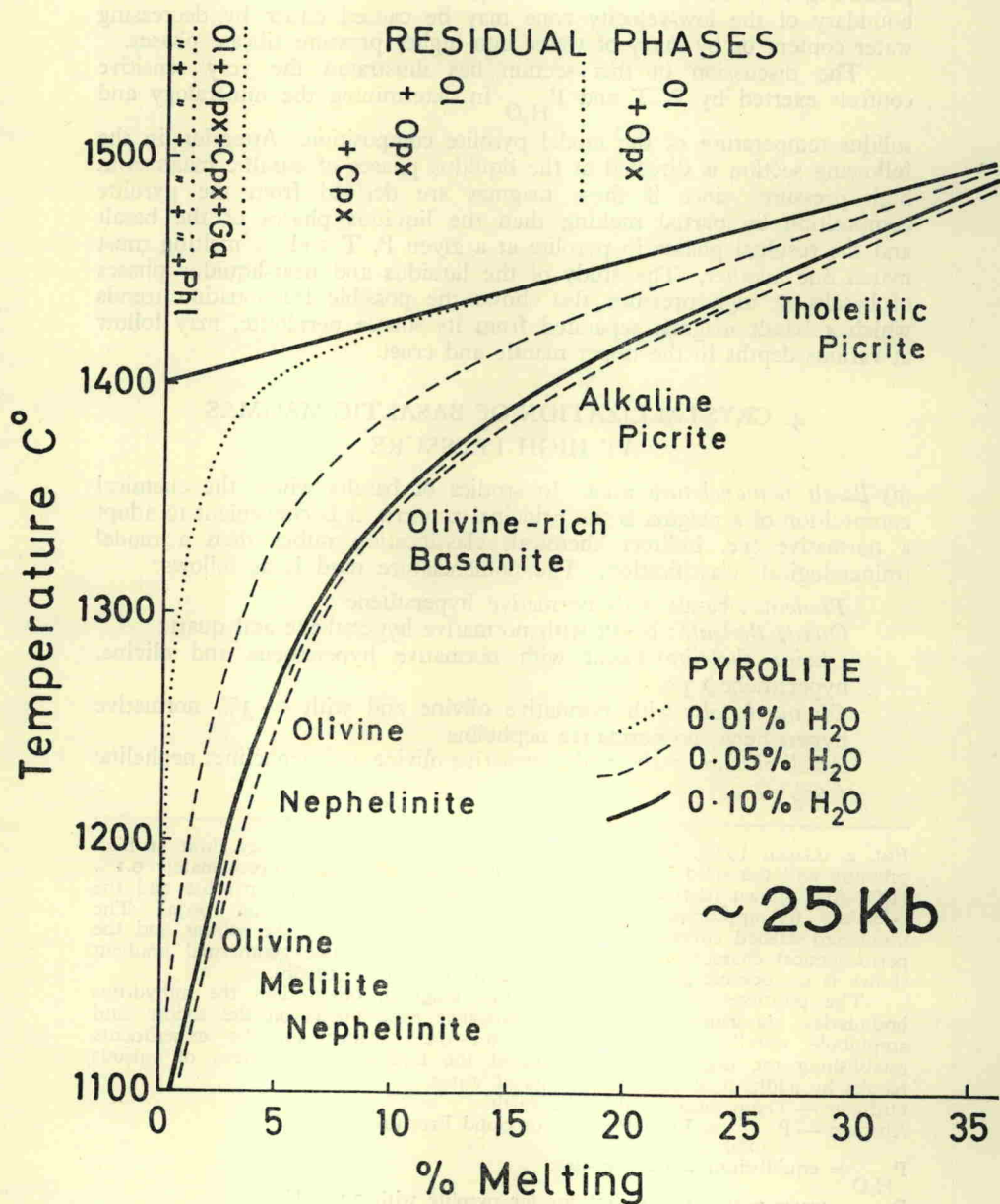also (amphibole $\longrightarrow$ pyroxenes + garnet + olivine + water).

FIG. 3 (Green 1970). Diagram contrasting the melting behaviour of anhydrous pyrolite with melting in pyrolite compositions containing 0.01, 0.05 and 0.10% H_2O. The nature of the residual phases and the petrochemical character of the liquids derived are shown for example with 0.10% H_2O.