2. Previous experiments

YODER and TILLEY (1962) showed that the stable subsolidus assemblage for many basaltic rocks is amphibolite for $P_T = P_{H_2O} > 2$ kb, < 10 kb, T > 600 °C, and concluded that eclogite is unstable in the presence of water for *all* water pressures. However the beginning of melting could develop a positive slope and the disappearance of amphibole a negative slope at high water pressures due to the formation of garnet and the high compressibility of water. The combination of these two effects leads to the stabilization of eclogite relative to amphibolite at sufficiently high water pressures (fig. 1).
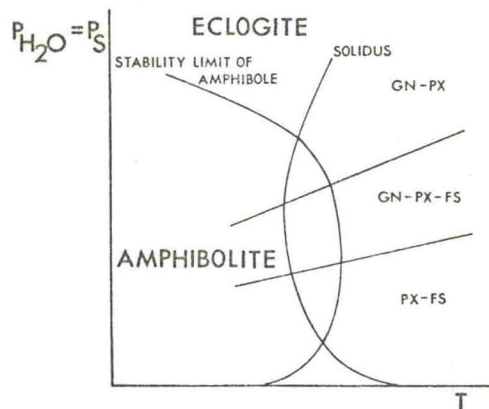

Fig. 1. A possible geometry for the beginning of melting and the stability of amphibole in basaltic rocks. The solid–solid transformation of feldspar to garnet and the high compressibility of water combine to stabilize eclogite at high water pressures. Fs = Feldspars, Px = Pyroxenes, gn = garnet.

This geometry has been confirmed in preliminary synthesis experiments on hornblende stability under its own composition and in a gabbro by LAMBERT and WYLLIE (1968). HENSEN and GREEN (unpublished) established the synthesis limit of hornblende in an alkali olivine basalt* with similar results also for $P_{H_2O} \approx P_T$ (fig. 2). These experiments show that eclogite is stable at high water pressures but represent syntheses mostly in the supersolidus region.

3. Thermodynamic calculations

Many simple amphiboles can be shown to be unstable at high water pressures by thermodynamic cal-

* The composition of this alkali-olivine basalt as well as the albite-rich quartz tholeiite used in following experiments is listed in GREEN and RINGWOOD (1967).
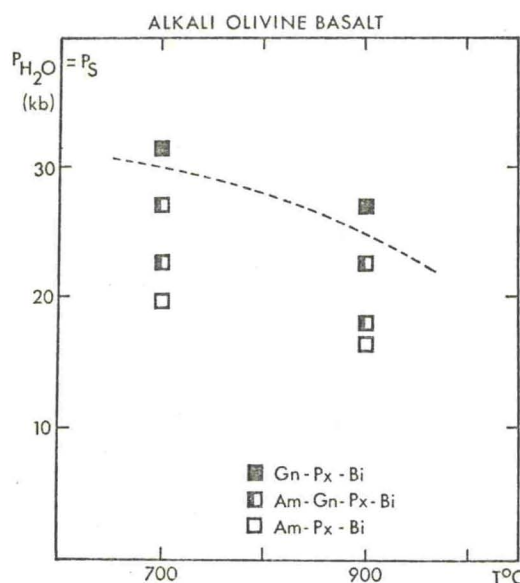

Fig. 2. Stability of amphibole for an alkali olivine basalt as determined by syntheses in cold-sealed gold capsules. The restriction of garnet to relatively high pressures is probably a reflection of the lack of initial garnet nuclei. This stability of amphibole compares well with the hot-sealed synthesis runs of fig. 3, showing that water pressures were not significantly lowered by chance leaks during the run. Am = Amphibole, Bi = Biotite, Px = Pyroxenes.

culations which permit extension of experimental data to higher water pressures (see Appendix 1 for thermodynamic data and procedures)*. The simple dehydration of tremolite (BOYD, 1959) will develop a negative slope at high water pressures due only to the rapid compressibility of water vapor, as predicted by GREEN and RINGWOOD (1967). At high enough water pressures the tremolite = diopside + enstatite + quartz + water curve will cross the talc = enstatite + quartz + water curve and a solid–solid decomposition of tremolite = talc + diopside is found instead (fig. 3). A similar solid–solid transformation predicted for anthophyllite by GREENWOOD (1963) is also shown in fig. 3, though calculations using ROBIE *et al.*'s (1967) volume data would move this curve to at least 50 kb. Glaucophane might similarly be expected to break down to talc + jadeite at high pressures (shown schematically in fig. 3), and the curve could be located more exactly if dependable experiments were available for the stability of glaucophane. Amphiboles may also break down at

* These calculations ignore the possibility of partial melting at high water pressures.

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