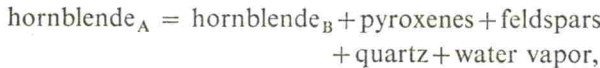


Fig. 3. Stability of various amphiboles estimated at high water pressures. Trem = Tremolite, Di = Diopside, En = Enstatite, Q = Quartz, Hnbde = "Hornblende", Gn = Garnet, Opx = Orthopyroxene, Cpx = Clinopyroxene, An = Anorthite, Anth = Anthophyllite, Tc = Talc, Jd = Jadeite, Gl = Glaucophane.

high water pressures because the products themselves react to form denser phases, as shown in fig. 3 for a "hornblende" - $\text{Ca}_2\text{Mg}_4\text{Al}_2\text{Si}_7\text{O}_{22}(\text{OH})_2$. The initial point for the curve "hornblende" = anorthite + diopside + enstatite + water is taken at 900 °C and 1 kb* and when the feldspar reacts with pyroxenes to yield garnet the stability of this amphibole is sharply back-bent (fig. 3). While the true stability of this "hornblende" may be represented instead by some reaction as



the effect of high water pressures when garnet is produced may be qualitatively represented as in fig. 3**.

The instability of these amphiboles at high water pressures disagrees markedly with similar estimates by O'HARA (1967), who extended the stability of amphiboles vertically regardless of reactions among the products giving garnet at the expense of feldspars. O'Hara's schematic amphibole stability curves are unrealistic and

* This is an estimate taken from BOYD's (1959) experiments. When Boyd attempted to determine the stability of pargasite + quartz the pargasite broke down to form an amphibole close to $\text{Ca}_2\text{Mg}_4\text{Al}_2\text{Si}_7\text{O}_{22}(\text{OH})_2$ stable to ~900 °C, 1 kb.

** Following preparation of this manuscript, GILBERT's (1969) note on the experimental stability of end-member amphiboles appeared in the Ann. Rept. Geophys. Lab. Carnegie Inst. Wash. Gilbert's preliminary experiments on tremolite and "hornblende" are generally consistent with the calculations shown in fig. 3.

should be disregarded. Extrapolation of simple amphibole stabilities to high water pressures demonstrates that they may decompose by increasing water pressure but bear little on the stability of complex amphiboles which may first react with other phases in natural basaltic compositions.

4. Present experiments

The writers attempted to establish the upper stability limit of amphibole in an alkali olivine basalt and a quartz tholeiite for $P_{\text{H}_2\text{O}} = P_S$ by sealing glassy and crystalline samples with water and holding them in a piston cylinder apparatus at P and T for >24 hours (see appendix II for details of experimental procedure). Amphibole disappeared rather sharply within a 2 kb interval (figs. 4, 5) and in the case of the alkali olivine basalt, compared rather well with earlier experiments with cold-sealed capsules (fig. 3). When the crystallized mixtures of the earlier runs (amphibolite and eclogite) were rerun, amphibole was found to be unstable in the region where it had previously been synthesized, and it did not perceptibly grow at the expense of the garnet and pyroxene until the pressure had been lowered 5-10 kb below the original synthesis limit. While the reversal limits are rather wide in these preliminary experiments, they illustrate the danger of accepting short-time synthesis experiments as representing equilibrium at these relatively low temperatures, even if the syn-

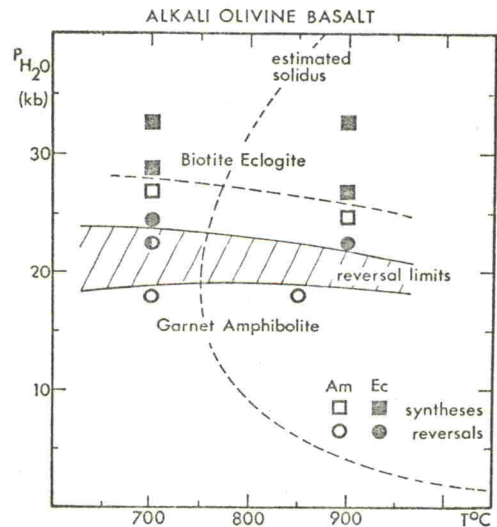


Fig. 4. Stability limit of amphibole in an alkali olivine basalt, comparing synthesis runs with reversals. Am = Amphibolite, Ec = Eclogite.

P_{H2O} (kb) 30 20 10

Fig. 5. S th

thesis be producible. The composition of the amphibole and near the synthesis limit in figs. 4 and 5. TILLEY's data on the stability of amphibole in the quartz tholeiite have been used in the quartz tholeiite. The synthesis runs are not likely to be representative of natural conditions.