Our data show that the nature of the liquidus phase, the sequence of appearance and nature of other phases, and the temperature interval for crystallization are strongly dependent on load pressure. The data on which the following discussion is based are shown in Figs. 4, 5, 6 and 7. Principal fractionation trends at several different pressures are compared in Figs. 8 and 9.

*a) Fractionation at Upper Crustal Levels (<15 km)*

The behaviour of the three basalts during fractionation in the upper continental crust or within the oceanic crust or uppermost mantle (i.e. at pressures <5 kb)

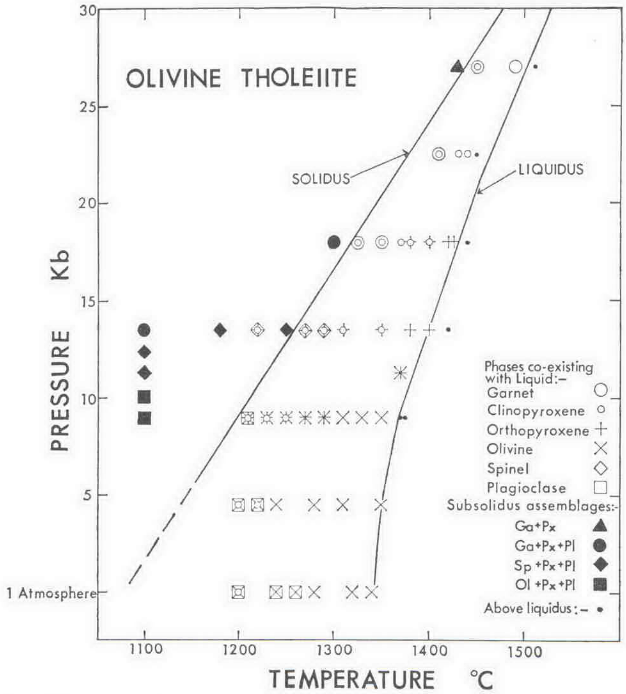


Fig. 4. Detail of melting experiments carried out on the olivine tholeiite composition at high pressures. Run descriptions are given in Table 4

can be discussed on the basis of the experimental results at atmospheric pressure on the olivine tholeiite and alkali olivine basalt compositions. A further, most important, source of information on the fractionation of basaltic magmas at low pressures is the detailed and comprehensive study of basalt melting relations at 1 Atmosphere carried out by Tilley, Yoder and Schairer (1963, 1964, 1965). The observed sequence of appearance of phases at atmospheric pressure (Table 4) and in particular the appearance of plagioclase before clinopyroxene, could also have been deduced by comparison of the olivine tholeiite and alkali olivine basalt with the chemical compositions and crystallization sequences of the basalts studied by Yoder and Tilley (1962); Tilley, Yoder and Schairer (1963, 1964, 1965) and Yagi (1964). Although the early crystallization of olivine in the olivine tholeiite composition results in a fractionation trend of $SiO_2$, $Al_2O_3$, and CaO enrichment at low pressure, the appearance of very calcic plagioclase as the second phase curtails the $Al_2O_3$ and CaO enrichment trend (Table 13), instead maintaining the well documented, tholeiitic fractionation to iron-rich, Na + K enriched quartz tholeiites with 50% or more $SiO_2$ and 12—14% $Al_2O_3$.

As the olivine tholeiite composition was initially derived from an estimate by Macdonald and Katsura (1961) for the average magma composition of the 1959—1960 Kilauea Iki lava lake, it is of interest to compare the low pressure

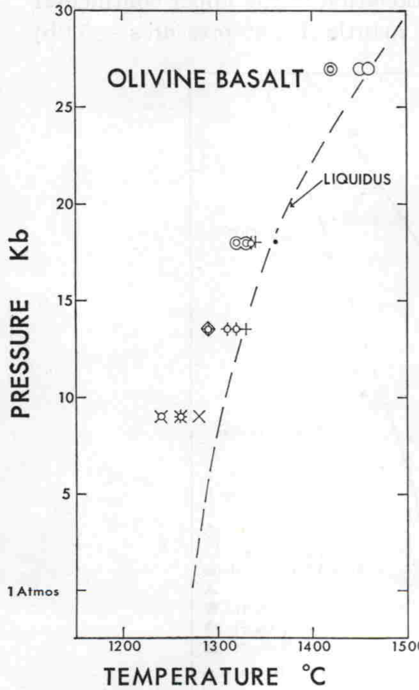


Fig. 5

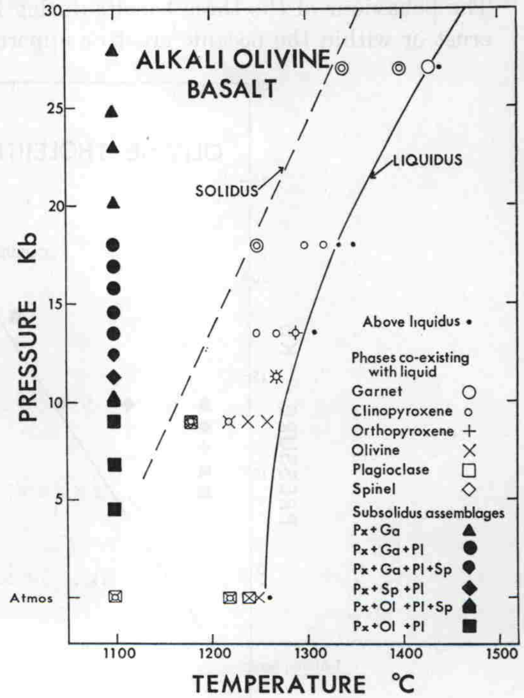


Fig. 6

Fig. 5. Detail of melting experiments on the olivine basalt composition at high pressures. Symbols are the same as those in Figs. 4 and 6. Run descriptions are given in Table 5

Fig. 6. Detail of melting and subsolidus experiments on the alkali olivine basalt composition. Run descriptions are given in Table 6

fractionation trend of the olivine tholeiite with the thoroughly documented fractionation trends of the 1959—1960 Kilauea Iki eruption. Tilley, Yoder and Schairer (1963, 1964, 1965) have shown experimentally that rocks and glasses derived from the 1959—1960 Kilauea Iki and other Kilauean eruptions contain olivine as the liquidus phase and that olivine alone remains the liquidus phase even into the field of quartz-normative liquids. The same conclusion also follows from the quartz-normative composition for the low magnesia terminus of the olivine control lines in the 1950—1960 Kilauea Iki differentiation series of Murata and Richter (1966a, b). Tilley et al. (op. cit.) have shown that clinopyroxene is usually the second phase to crystallize from Kilauean lavas but may appear simultaneously with plagioclase or be very closely followed by plagioclase. The