mixes of natural minerals separated from a garnet peridotite and an eclogite. He reported lower solidus temperatures in olivine + garnet + pyroxene mixes than in simple garnet + pyroxene mixtures and, comparing his data with that of YODER and TILLEY (1962) on quartz-bearing eclogites, concluded that the whole range of garnet + pyroxene assemblages must be considered a thermal barrier at 30 kb between lower temperature liquids in either olivine-bearing or quartz-bearing eclogitic rocks. If this conclusion is valid then a quartz-bearing eclogite, or a liquid of that composition, cannot be derived by partial melting of a garnet peridotite at 30 kb.

DAVIS (1964) and DAVIS and SCHAIRER (1965) have reported results on the system diopside—forsterite—pyrope at 40 kb. The minimum liquidus temperature in this system is at $1670 \pm 10°C$ and at a composition $Di_{47}\,Py_{47}\,Fo_6$. DAVIS and SCHAIRER deduce that the primary liquid for melting of the Ol + Ga + Cpx + Opx assemblage in the CaO-MgO-Al_2O_3-SiO_2 system will have a composition of approximately $Di_{47}\,Py_{47}\,Ens_3\,Fo_3$. Expressed in the CIPW norm to illustrate the approximate low pressure mineralogy, this composition gives $An_{32}\,Di_{22}\,Ens_{26}\,Fo_{20}$.

Thus, the studies at both 30 kb and 40 kb suggests that the compositions of liquids derived by partial melting of peridotite would contain around 20% or more olivine if expressed in the low pressure CIPW norm. Such liquids would be similar to rocks transitional between olivine tholeiites with around 10% olivine and tholeiitic picrites with 25—30% of olivine.

b) Basaltic Compositions Chosen for Study

In the previous section, evidence from natural volcanic sequences and from experimental studies at high pressure has been summarized, leading to the conclusion that liquids derived from partial melting of peridotite will have 20% or more normative olivine. In the initial selection of an olivine tholeiite composition for experimental study we used the estimate by MACDONALD and KATSURA (1961) of a "parental magma" composition of the Kilauea Iki 1959 lava lake. The composition used contains 20% olivine in the CIPW norm and, when expressed in an ideal eclogite norm, contains 46% garnet, 50% pyroxene, 4% ilmenite or alternatively 46% garnet, 49% pyroxene (Di + Jd + Ens) 3% olivine, 2% rutile depending on the assumed role of TiO_2. This compares closely in terms of mineral proportions, though not in mineral compositions, with DAVIS and SCHAIRER'S (1965) estimate of the reaction point Ol + Ga + Cpx + Opx + *Liq* at 40 kb in garnet, two-pyroxene, olivine assemblage, i.e. $Pyrope_{47}\,Diopside_{47}\,Ens_3\,Fo_3$. It is considered therefore that the olivine tholeiite composition is significant and relevant in studies of fractionation of basalts at high pressure. Conversely tholeiitic basalts with less than about 12% normative olivine cannot be considered "primary" basaltic liquids in the sense of being derived without fractionation from depths of more than 40 kms within the earth and are not relevant compositions for study of basalt fractionation at pressure in excess of 10 kb. Picritic compositions with more than 20% normative olivine (CIPW norm) may also be important as possible liquids or liquid + crystal derivatives from parental mantle peridotite.

The choice of an alkali basalt composition for experimental study was influenced both by the observed and inferred fractionation trends of the olivine tholeiite

towards an alkali olivine basalt between 12 and 18 kb, and by petrological considerations of a more general nature. Thus most alkali olivine basalt liquids, as observed in extrusive or chilled rocks, have probably progressed some way along a low pressure fractionation trend controlled by olivine separation. The average "alkali basalt" (mostly olivine-bearing) of the Hawaiian Islands listed by MACDONALD and KATSURA (1964) contains 14% normative olivine and neither hypersthene nor nepheline in the norm. The average Hawaiian alkali olivine basalt listed by KUNO et al. (1957) contains 18% normative olivine and the average from Japan (KUNO, 1960) contains 17% normative olivine. The composition chosen for study contains high normative olivine (26%), low normative nepheline (2%) but

Table 1. *Chemical compositions, CIPW norms and "eclogite" norms of compositions used experimentally*

	Olivine tholeiite	Olivine basalt	Alkali olivine basalt	Picrite
SiO_2	46.95	47.05	45.39	45.51
TiO_2	2.02	2.31	2.52	1.93
Al_2O_3	13.10	14.17	14.69	12.44
Fe_2O_3	1.02	0.42	1.87	0.92
FeO	10.07	10.64	12.42	8.67
MnO	0.15	0.16	0.18	0.15
MgO	14.55	12.73	10.37	18.79
CaO	10.16	9.87	9.14	9.67
Na_2O	1.73	2.21	2.62	1.64
K_2O	0.08	0.44	0.78	0.08
P_2O_5	0.21	—	0.02	0.20
	100.04	100.00	100.00	100.00
$\frac{100\,Mg}{Mg+Fe^{++}}$ (atomic ratio)	72.0	68.1	59.8	79.4
CIPW Norms				
Or	0.6	2.7	4.5	0.5
Ab	14.7	18.9	18.0	13.9
Ne	—	—	2.2	—
An	27.6	27.3	26.2	26.3
Di	17.0	17.6	15.7	16.5
Hy	12.3	1.3	—	2.8
Ol	21.9	27.2	25.8	34.6
Ilm	3.8	4.4	4.8	3.7
Mt	1.4	0.6	2.9	1.3
Ap	0.5	—	—	0.4
"Eclogite" Norm — assuming TiO_2 in ilmenite, small "K_2O" solubility in acmite-omphacite. Garnet is $Ca_{0.5}$ (Mg, Fe)$_{2.5}$ $Al_2Si_3O_{12}$ in all compositions.				
Pyroxene	50	52	47	40
Garnet	46	44	46	43
Olivine	—	—	2	13
Quartz	tr	tr	—	—
Ilmenite	4	4	5	4