olivine tholeiite, high-alumina quartz tholeiite, basaltic andesite, andesite, dacite compositions

Basaltic andesite					Andesite				Dacite			
18 kb 1,250°C 60mins	27 kb 1,360°C 40mins	27 kb 1,390°C 35mins	36 kb 1,460°C 20mins	36 kb 1,475°C 15mins	22.5 kb 1,300°C 60mins	27 kb 1,340°C 60mins	36 kb 1,420°C 20mins	36 kb 1,440°C 15mins	27 kb 960°C 60mins Wet	27 kb 1,040°C 60mins Wet	27 kb 1,100°C 60mins Wet	27 kb 1,140°C 60mins Wet
cpx[b], plag[b]	cpx[b]	cpx[b]	cpx[b]	cpx[b]	—	—	cpx[b]	—	cpx, ky, qz	cpx, qz	cpx[b]	—
38.0	38.2	38.3	38.0	38.1	39.2	39.1	39.0	39.9	38.8	39.8	39.9	38.9
1.5	1.6	1.1	1.2	1.0	1.1	1.1	1.0	0.9	2.1	2.3	1.9	1.6
22.1	22.3	22.5	22.2	22.6	22.2	22.4	22.7	22.9	20.9	21.4	22.3	22.3
19.1	17.8	15.9	18.8	15.7	17.6	17.7	18.4	16.8	25.5	22.8	22.1	20.9
0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
10.0	10.3	11.9	9.6	11.4	10.8	10.7	10.5	11.0	4.3	7.3	8.2	9.4
7.1	8.2	7.9	8.4	8.4	7.0	7.4	7.4	7.0	11.9	10.7	9.7	9.3
98.2	98.7	97.9	98.5	97.5	98.3	98.8	99.4	98.9	103.8	104.6	104.4	102.7
48.3	50.8	57.1	47.6	56.4	52.2	51.9	50.4	53.9	23.1	36.3	39.8	44.5
4.6	4.6	3.1	3.5	2.9	3.2	3.2	2.9	2.6	5.9	6.3	5.1	4.3
15.0	17.7	18.2	19.4	19.9	16.2	17.1	17.2	17.0	25.4	21.2	20.0	19.6
38.4	39.1	44.6	36.4	43.2	41.6	40.9	39.8	42.8	15.7	26.1	29.6	33.6
41.1	38.0	33.5	40.1	33.4	38.1	37.9	39.2	36.7	52.4	45.8	44.7	41.9
0.9	0.6	0.6	0.6	0.6	0.9	0.9	0.9	0.9	0.6	0.6	0.6	0.6

WOOD, in press). The $\frac{Mg}{Mg + Fe}$ ratio for the garnets is invariably lower than this ratio in co-existing clinopyroxenes. In any particular composition the lime content of the garnet increases with increasing pressure, for similar degrees of crystallization at the various pressures under comparison.

c) Plagioclase (Table 12)

Only a few plagioclase analyses are listed in Table 12 since more detailed work involving plagioclase is dealt with elsewhere (T. H. GREEN, 1967a, b and in preparation). The most noteworthy feature of the analyses given in Table 12 is the increase in albite content of the plagioclase crystallizing from the basaltic andesite under dry conditions, as the pressure is increased from 9—18 kb.

Summary of the Most Significant Results

1. The near-liquidus phases in the basalt to dacite compositions change from plagioclase-pyroxene dominated at 0—18 kb to pyroxene-garnet dominated at 27—36 kb.
2. The pyroxene crystallizing at high pressure contains more alumina and less silica than the low pressure pyroxene. This contributes to the subsilicic character of the near-liquidus phases crystallizing at high pressures.
3. The proportion of garnet relative to pyroxene increases as the pressure is increased from 27—36 kb.
4. The proportion of garnet relative to pyroxene as a near-liquidus phase increases as the bulk composition becomes more acidic.
5. The almandine content of the garnet increases as the bulk composition changes from basalt to rhyodacite.

Table 12. *Electron microprobe analyses of plagioclases from selected runs on the high-alumina olivine tholeiite, high-alumina quartz tholeiite and basaltic andesite compositions*

Composition	High-alumina olivine tholeiite	High-alumina quartz tholeiite	Basaltic andesite	
Conditions of Run	18 kb 1,230°C 2 hrs Wet[c]	18 kb 1,300°C 55 mins	9 kb 1,200°C 60 mins	18 kb 1,250°C 60 mins
Co-existing phases	cpx[b], ga[b]	cpx[b], ga[b]	cpx	cpx[b], ga[b]
SiO_2	57.5[a] (56.0)	56.6	55.9	58.0
Al_2O_3	26.3	26.8	27.5	26.6
CaO	9.0	9.5	10.7	8.5
Na_2O	6.5[a] (6.1)	6.0[a] (5.8)	5.3[a] (5.2)	6.5[a] (5.9)
K_2O	0.08	0.3	0.3	0.5
	99.4	99.2	99.7	100.1
Mol. Prop.				
Or	0.5	1.7	1.8	2.9
Ab	56.3	52.4	46.6	56.3
An	43.2	46.9	51.6	40.8

[a] Denotes calculated content; bracketed values following calculated contents are the measured contents.
[b] Denotes co-existing phase analyzed.
[c] Water not added to sample.

6. Andesite rather than more acidic dacite or rhyodacite has the lowest liquidus temperature at 27—36 kb. This is best illustrated in Figs. 7 and 8.
7. The liquidus phase changes from garnet to quartz as the bulk composition changes from andesite to dacite (Fig. 8).

Interpretation of Results

In Fig. 7 the liquidi have been extrapolated at their 18—36 kb gradients to a pressure of 50 kb corresponding to a depth of about 160 kms. The andesite liquidus falls below the dacite and rhyodacite liquidi and above the tholeiite solidus at high pressures. The higher liquidi of the dacite and rhyodacite and the presence of quartz on the liquidus of these two compositions at high pressure under dry conditions indicate that at depth andesite is a lower melting fraction than the more acid compositions. Thus at depths of 100—150 kms fractional crystallization of basalt and basaltic andesite by separation of garnet and pyroxene will cause the composition of the liquid fractionate to move towards that of an andesite. This conclusion is emphasized in Fig. 8 where the extrapolated liquidi and sequence of crystallization of phases under dry conditions at 30 kb are plotted. This shows clearly that the andesite composition lies in a marked thermal valley, and that there is a change in liquidus phase from garnet to quartz between the andesite and dacite compositions.

The importance of garnet and clinopyroxene as the co-crystallizing phases in the basaltic compositions is that because of their sub-silicic character, they provide a highly efficient means of enriching the fractionating liquid in silica and alkalies. A sharp rise in Fe/Mg ratio due to crystallization of low Fe/Mg clinopyroxene is precluded by the simultaneous crystallization of almandine-rich garnet. Thus