

Table 17. *Fractionation of olivine basalt at 13.5 kb and 18 kb*

| P, T conditions (kb) | 13.5 | 18 |
|---|--|---------------------------------------|
| (°C) | 1,310 | 1,335 |
| Nature and estimated percentage of minerals | 10% orthopyroxene (as at 1,320°C, 13.5 kb) | 5% orthopyroxene 10% clinopyroxene |

Composition of crystal extract

| | | |
|--------------------------------|------|------|
| SiO ₂ | 53.8 | 51.9 |
| Al ₂ O ₃ | 6.4 | 8.6 |
| FeO | 6.6 | 5.8 |
| MgO | 30.3 | 25.6 |
| CaO | 2.9 | 8.1 |

Composition of residual liquid

| | (Initial liquid) | | |
|--------------------------------|------------------|------|------|
| SiO ₂ | 47.10 | 46.4 | 46.3 |
| TiO ₂ | 2.31 | 2.6 | 2.7 |
| Al ₂ O ₃ | 14.15 | 15.0 | 15.1 |
| Fe ₂ O ₃ | 0.42 | 0.5 | 0.5 |
| FeO | 10.64 | 11.1 | 11.5 |
| MnO | 0.16 | 0.2 | 0.2 |
| MgO | 12.71 | 10.8 | 10.4 |
| CaO | 9.86 | 10.6 | 10.2 |
| Na ₂ O | 2.21 | 2.5 | 2.6 |
| K ₂ O | 0.44 | 0.5 | 0.5 |

CIPW norm of residual liquid

| | | | |
|-----------------------|------|------|------|
| Or | 2.7 | 3.0 | 3.3 |
| Ab | 18.9 | 16.8 | 17.8 |
| Ne | — | 2.4 | 2.3 |
| An | 27.3 | 28.1 | 27.8 |
| Di | 17.6 | 19.9 | 18.6 |
| Hy | 1.3 | — | — |
| Ol | 27.2 | 24.2 | 24.3 |
| Ilm | 4.4 | 5.0 | 5.1 |
| Mt | 0.6 | 0.7 | 0.8 |
| 100 Mg | 68.1 | 63.4 | 61.8 |
| Mg + Fe ⁺⁺ | | | |

with 20% clinopyroxene extracted is almost the same as for 10% (orthopyroxene + clinopyroxene) extraction. Extraction of clinopyroxene alone (if this is similar in composition to that analyzed at 1,335°C, 18 kb) appears likely to yield compositions unlike natural basanites or olivine nephelinites. The possible derivation by fractionation of these more extremely undersaturated liquids is currently being studied and factors such as the appearance of spinel or garnet and the Na₂O content of the liquidus clinopyroxenes are potentially important in this problem.

Without microprobe analyses of the phases crystallizing from the picrite, it is not possible to quantitatively discuss the fractionation of this composition. However the normative composition is such that the picrite is essentially the same as the olivine basalt composition with the addition of about 9% more olivine. The

Table 18. *Fractionation of alkali olivine basalt at 13.5 kb and 18 kb*

| P, T conditions (°C) | 13.5 1,280 | 18 1,310 | |
|--|---|---|------|
| Nature and estimated percentage of minerals | 2.5% ortho- pyroxene + 7.5% clino- pyroxene (as at 13.5 kb, 1,290°C) | 20% clinopyroxene (as at 18 kb, 1,320°C) | |
| <i>Composition of crystal extract</i> | | | |
| SiO ₂ | 49.6 | 49.1 | |
| Al ₂ O ₃ | 11.0 | 11.0 | |
| FeO | 9.2 | 7.6 | |
| MgO | 22.3 | 19.5 | |
| CaO | 7.9 | 12.8 | |
| <i>Composition of residual liquid</i> | | | |
| | (Initial liquid) | | |
| SiO ₂ | 45.39 | 44.9 | 44.5 |
| TiO ₂ | 2.52 | 2.8 | 3.2 |
| Al ₂ O ₃ | 14.69 | 15.1 | 15.6 |
| Fe ₂ O ₃ | 1.87 | 2.1 | 2.3 |
| FeO | 12.42 | 12.8 | 13.6 |
| MnO | 0.18 | 0.2 | 0.2 |
| MgO | 10.37 | 9.1 | 8.1 |
| CaO | 9.14 | 9.3 | 8.2 |
| Na ₂ O | 2.62 | 2.9 | 3.3 |
| K ₂ O | 0.78 | 0.9 | 1.0 |
| P ₂ O ₅ | 0.02 | — | — |
| <i>CIPW norms of residual liquids</i> | | | |
| Or | 4.5 | 5.5 | 6.1 |
| Ab | 18.0 | 15.7 | 17.4 |
| Ne | 2.2 | 4.9 | 5.6 |
| An | 26.2 | 25.3 | 24.8 |
| Di | 15.7 | 17.1 | 13.2 |
| Hy | — | — | — |
| Ol | 25.8 | 23.2 | 23.6 |
| Ilm | 4.8 | 5.3 | 6.1 |
| Mt | 2.9 | 3.0 | 3.3 |
| 100 Mg | 59.8 | 56.1 | 51.5 |
| Mg + Fe ⁺⁺ | | | |

melting runs at 13.5 kb and 18 kb are in excellent agreement with this conclusion as olivine is the liquidus phase at both pressures and following precipitation of a moderate amount of olivine, orthopyroxene followed closely by clinopyroxene separates from the residual liquid. We conclude that initially the picrite would fractionate by separation of olivine to yield a composition with $25 \pm 3\%$ normative olivine, 4% normative hypersthene. Further fractionation by separation of orthopyroxene or of orthopyroxene + clinopyroxene accompanying the olivine would yield nepheline normative liquids closely analogous to those derived from the olivine basalt composition.