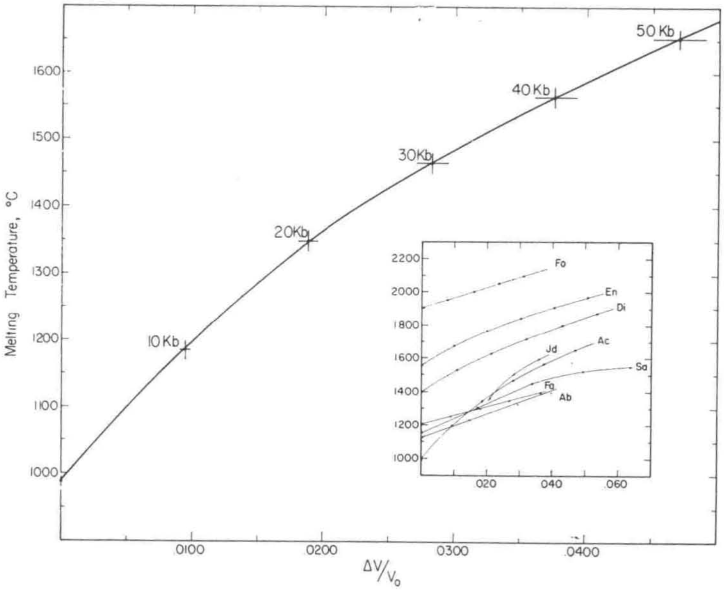

Fig. 4. Melting temperature of acmite versus compression at room temperature. Inset shows similar plots for other silicates. Compression data summarized in Birch (1966, table 7-10). Melting curves are Fo, forsterite, Mg_2SiO_4 (Davis and England, 1964); En, enstatite, $MgSiO_3$ (Boyd, England, and Davis, 1964); Di, diopside, $CaMgSi_2O_6$, and Ab, albite, $NaAlSi_3O_8$ (Boyd and England, 1963); Jd, jadeite, $NaAlSi_2O_6$ (Bell, 1964); Ac, acmite; Sa, sanidine, $KAlSi_3O_8$ (Lindsley, 1966); Fa, fayalite, Fe_2SiO_4 (Hsu, 1967).

linearity might be due to incongruent melting. For comparison, plots of melting temperature versus compressibility for other silicates are shown in the inset of figure 4. Fayalite (Fe_2SiO_4), which melts incongruently up to 40 kb (Hsu, 1967), and sanidine ($KAlSi_3O_8$), which melts incongruently up to 20 kb (Lindsley, 1966), show linear relationships over that region; thus, incongruent behavior cannot be used to explain curvature. In contrast, diopside, which melts congruently (Boyd and England, 1963), and sanidine, which melts congruently above 20 kb (Lindsley, 1966), do not show linear relations. On the whole, the relationships for silicates shown in figure 4 reflect the form of the fusion curves: linear fusion curves result in linear T_M versus $\Delta V/V_o$ curves; fusions with marked curvature result in curved T_M versus $\Delta V/V_o$ relations, with the exception of albite.

A pressure effect on the emf of thermocouples cannot be used to account for the nonlinear T_M–$\Delta V/V_o$ curves presented here, because all curves shown are plotted without this correction so that differences between curves are real. Nothing in the experimental techniques used to determine the melting curves can be appealed to since all these curves were determined with the same type of apparatus and technique. It is possible that the compressibility measurements at lower pressures for silicates may have larger uncertainties than expected and that extrapolation to higher pressure of low-pressure measurements is unwarranted. As previously noted, difficulties in the simple temperature-compression relation are not limited to silicates. Whatever the reasons, the "new law of melting" does not seem to be substantiated by silicates over the pressure range thus far investigated.

In summary, the more significant features of the work are: (1) incongruent melting of acmite persists to 45 kb; (2) oxygen fugacity has a strong influence on acmite melting; (3) incongruency is maintained from high to low oxygen fugacity; (4) the initial slope of the incongruent melting curve is surprisingly steep—about 20°C/kb, one of the steepest of any silicate yet investigated. These observations clearly support the key role of acmite in the genesis of alkaline rocks.

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REFERENCES

Alexandrov, K. S., and Ryzhova, T. V., 1961, The elastic properties of rockforming minerals: Acad. Sci. USSR Izv., Geophys. Ser. (English translation), v. 9, p. 871-875.

Bailey, D. K., 1969, The stability of acmite in the presence of H_2O: Am. Jour. Sci., v. 267-A, Schairer v., p. 1-16.

Bailey, D. K., and Schairer, J. F., 1966, The system Na_2O-Al_2O_3-Fe_2O_3-SiO_2 at 1 atmosphere and the petrogenesis of alkaline rocks: Jour. Petrology, v. 7, p. 114-170.

Bell, P. M., 1964, High-pressure melting relations for jadeite composition: Carnegie Inst. Washington Year Book 63, p. 171-174.

Bell, P. M., and England, J. L., 1967, High-pressure experimental techniques, *in* Abelson, P. H., ed., Researches in geochemistry v. 2: New York, John Wiley & Sons, Inc., p. 619-638.

Birch, F., 1966, Compressibility: Elastic constants, *in* Clark, S. P., Jr., ed., Handbook of physical constants, rev. ed.: Geol. Soc. America Mem. 97, p. 97-173.

Bowen, N. L., and Schairer, J. F., 1929, The fusion relations of acmite: Am. Jour. Sci., 5th ser., v. 18, p. 365-374.

Bowen, N. L., Schairer, J. F., and Willems, H. W. V., 1930, The ternary system: Na_2SiO_3-Fe_2O_3-SiO_2: Am. Jour. Sci., 5th ser., v. 20, p. 405-455.

Boyd, F. R., Bell, P. M., England, J. L., and Gilbert, M. C., 1967, Pressure measurement in single-stage apparatus: Carnegie Inst. Washington Year Book 65, p. 410-414.

Boyd, F. R., and England, J. L., 1960, Apparatus for phase-equilibrium measurements at pressures up to 50 kilobars and temperatures up to 1750°C: Jour. Geophys. Research, 65, p. 741-748.

——— 1963, Effect of pressure on the melting of diopside, $CaMgSi_2O_6$, and albite, $NaAlSi_3O_8$, in the range up to 50 kilobars: Jour. Geophys. Research, v. 68, p. 311 323.

Boyd, F. R., England, J. L., and Davis, B. T. C., 1964, Effects of pressure on the melting and polymorphism of enstatite, $MgSiO_3$: Jour. Geophys. Research, v. 69, p. 2101-2109.

Burnham, C. W., 1962, Lattice constant refinement: Carnegie Inst. Washington Year Book 61, p. 132-135.

——— 1965, Ferrosilite: Carnegie Inst. Washington Year Book 64, p. 202-204.