$MgO-Al_2O_3-SiO_2$ indicate that the effect of pressure on the minimum melting point is less than 6°C/kilobar, a figure that is considerably smaller than those for the pure phases.

REFERENCES

1. R. Roy and O.F. Tuttle, "Investigations under Hydrothermal Conditions," in Physics and Chemistry of the Earth, ed. L.H. Ahrens, K. Rankama, and S.K. Runcorn, McGraw-Hill Book Co. (1956), 317 pp.

2. D.S. Hughes and J.H. Cross, "Elastic Wave Velocities at High Pressures and Temperatures," Geophysics, 16, 577-593 (1951).

3. D.S. Hughes and C. Maurette, "Elastic Wave Velocities in Granites," Geophysics, 21, 277-284 (1956).

4. D.S. Hughes and C. Maurette, "Variation of Elastic Wave Velocities in Basic Igneous Rocks with Pressure and Temperature," Geophysics, 22, 23-31 (1957).

5. F. Birch, "The Velocity of Compressional Waves in Rocks to 10 Kilobars," J. Geophys. Research., 65, 1083-1102 (1960).

6. F. Birch, "Elasticity and Constitution of the Earth's Interior," J. Geophys. Research., 57, 227-286 (1952).

7. H.S. Yoder, Jr., "High-Low Quartz Inversion up to 10,000 Bars," Trans. Am. Geophys. Un., 31, 827-835 (1950).

8. F. Birch and E.C. Robertson, "Properties of Materials at High Pressures and Temperatures," ONR Report, Contract N5ori-07644, 34 pp. (1957).

9. F. Birch, E.C. Robertson, and S.P. Clark, Jr., "Apparatus for Pressures of 27,000 Bars and Temperatures of 1400°C," Ind. Eng. Chem., 49, 1965-1966(1957).

10. S.P. Clark, Jr., E.C. Robertson, and F. Birch, "Experimental Determination of Kyanite-Sillimanite Equilibrium Relations at High Temperatures and Pressures," Am. J. Sci., 255, 628-640 (1957).

11. D.T. Griggs and G.C. Kennedy, "A Simple Apparatus for High Pressures and Temperatures," Am. J. Sci., 254, 722-735 (1956).

12. F.R. Boyd and J.L. England, "Apparatus for Phase-Equilibrium Measurements at Pressures up to 50 Kilobars and Temperatures up to 1750°C," J. Geophys. Research., 65, 741-748 (1960).

13. H.T. Hall, "Some High-Pressure, High-Temperature Apparatus Design Considerations: Equipment for Use at 100,000 Atm. and 3000°C, Rev. Sci. Instr., 29, 267-275 (1958).

14. S.P. Clark, Jr., (unpublished); a preliminary account of this work will be found in Carnegie Institution of Washington Year Book 59.

15. F.R. Boyd and J.L. England, "The Quartz-Coesite Transition," J. Geophys. Research., 65, 749-756 (1960).

16. E.C. Robertson, F. Birch, and G.J.F. MacDonald, "Experimental Determination of Jadeite Stability Relations to 25,000 Bars," Am. J. Sci., 255, 115-137 (1957).

17. F.R. Boyd, and J.L. England (unpublished); preliminary accounts of this work will be found in Carnegie Institution of Washington Year Books 58 and 59.

18. F. Birch, "Interpretation of the Seismic Structure of the Crust in the Light of Experimental Studies of Wave Velocities in Rocks," in Contributions in Geophysics in Honor of Beno Gutenberg, ed. H. Benioff, M. Ewing, B.F. Howell, and F. Press, Pergamon Press, London (1958), 244 pp.

19. J.D. Bernal, Observatory, 59, 268 (1936).

20. A.E. Ringwood, "The Constitution of the Mantle--I. Thermodynamics of the Olivine-Spinel Transition," Geochim. et cosmochim. Acta, 13, 303-321 (1958).

21. A.E. Ringwood, "The Constitution of the Mantle--II. Further Data on the Olivine-Spinel Transition," Geochim. et cosmochim. Acta, 15, 18-29 (1958).

22. F. Dachille and R. Roy, "System Mg_2SiO_4-Mg_2GeO_4 at 10,000, 60,000, and about 300,000 p.s.i.," Bull. Geol. Soc. Amer., 67, 1682 (1956).

23. H.S. Yoder, Jr., "Change of Melting Point of Diopside with Pressure," J. Geol., 60, 364-374 (1952).

24. F. Birch and P. Lecomte, "Temperature-Pressure Plane for Albite Composition," Am. J. Sci., 258, 209-217 (1960).

DISCUSSION

by F. Dachille

It is of interest to observe that although the existence of an olivine-spinel polymorphic pair of Mg_2GeO_4 was reported by V.M. Goldschmidt[1] in 1931 the spinel form could not be verified and hence was doubted more or less completely by a number of workers until clearly demonstrated by Roy and Roy.[2] With this beginning, and interested in the geophysical importance of a transition of the olivine-spinel type by the suggestion of Bernal and the more elaborated one of Mason,[3] work was started in 1955 in this laboratory to study this transition by well established methods of phase equilibria in the system Mg_2GeO_4. The necessary pressure variable in the study of the solid solution fields soon went beyond the 80,000 psi working limits of the cold seal hydrothermal apparatus[4] but consistent results were obtained in the pressure-temperature region of the uniaxial apparatus. Thus it was possible to present to the 1956 Geological Society of America Meeting the p-t-x relations of the system summarizing the first high pressure work done on an olivine-spinel transition and illustrating the geologically important finding that the substitution of Fe^{2+} for Mg^{2+} broadened the spinel phase field in any isobaric section. Work continued for two more years and was reported in 1958, and later published.[5-6] Some of the findings will be of interest here. An isothermal section in this system at 550°C, the temperature selected in order to avoid the interference of hydrous phases and to stay within reasonable limits of the strength of the tool steel pistons (of the Speed Star or HS66 type), gave the positions of the spinel and olivine solid solution field boundaries (and the separating 2 phase field) to about 60 kb. At the highest experimental pressure the spinel composition contained