

negative in so far as the identification of high-quartz is concerned.'

Further investigation may, however, provide inversion criteria [e.g., Barsanov and Gur'yeva, 1963]. Clearly the establishment of such criteria would contribute to the development of petrogenetic grids.

Acknowledgments. Assistance from the Committee on Research, University of California, Berkeley (L.H.C.) and the support of a fellowship from the Miller Institute, University of California, Berkeley (W. K.), are gratefully acknowledged.

REFERENCES

- Babb, S. E., Jr., Some notes concerning Bridgeman's manganin pressure scale, in *High Pressure Measurement*, edited by Giardini and Lloyd, pp. 115-124, Butterworths, Washington, 1963.
- Barsanov, G. P., and E. Ya. Gur'yeva, Differences in natural quartz that underwent α - β transformation, *Dokl. Akad. Nauk SSSR*, 153, 150-153, 1963.
- Bell, P. M., G. Simmons, and J. F. Hays, Shearing squeezer experiments with quartz and coesite, *Carnegie Inst. Wash. Yr. Book*, 64, 141-144, 1965.
- Berger, C., L. Eyraud, M. Richard, and R. Rivière, Étude radiocristallographique de variation de volume pour quelques matériaux subissant des transformations de phase solide-solide, *Bull. Soc. Chim. France*, 1966, 628-633, 1966.
- Berger, C., M. Richard, and L. Eyraud, Application de la microcalorimétrie à la détermination précise des variations d'enthalpie de quelques transformations solide-solide, *Bull. Soc. Chim. France*, 1965, 1491-1495, 1965.
- Boren, M. D., S. E. Babb, Jr., and G. J. Scott, Fixed point calibrations of pressure gauges, *Rev. Sci. Instr.*, 36, 1456-1459, 1965.
- Boyd, F. R., P. M. Bell, J. L. England, and M. C. Gilbert, Pressure measurement in single-stage apparatus, *Carnegie Inst. Wash. Yr. Book*, 65, 410-414, 1966.
- Boyd, F. R., and J. L. England, The quartz-coesite transition, *J. Geophys. Res.*, 65, 749-756, 1960.
- Bridgman, P. W., Thermo-electromotive force, Peltier heat, and Thomson heat under pressure, *Proc. Am. Acad. Arts Sci.*, 53, 269-386, 1918.
- Bridgman, P. W., *The Physics of High Pressure*, 398 pp., Macmillan, New York, 1931.
- Bundy, F. P., Effect of pressure on emf of thermocouples, *J. Appl. Phys.*, 32, 483-488, 1961.
- Clark, S. P., Jr., and A. E. Ringwood, Density distribution and constitution of the mantle, *Rev. Geophys.*, 2, 35-88, 1964.
- Cohen, L. H., W. Klement, Jr., and G. C. Kennedy, Investigation of phase transformations at elevated temperatures and pressures by differential thermal analysis in piston-cylinder apparatus, *J. Phys. Chem. Solids*, 27, 179-186, 1966a.
- Cohen, L. H., W. Klement, Jr., and G. C. Kennedy, Melting of copper, silver, and gold at high pressures, *Phys. Rev.*, 145, 519-525, 1966b.
- Dachille, F., and R. Roy, High pressure relations of the silica isotopes, *Z. Krist.*, 111, 451-464, 1959.
- Dickinson, S. K., Jr., Alpha-beta quartz equilibrium (abstract), *Geol. Soc. Am. Ann. Meeting*, 44, 1964.
- Dickinson, S. K., Jr., Stability relationships of beta-quartz at high pressures and temperatures (abstract), *Abst. Bull. Inst. Metals Div., Am. Inst. Mining Engrs.*, I, 24, 1966.
- Frondel, C., Dana's *System of Mineralogy*, 7th ed., vol. 3, *The Silica Minerals*, 334 pp., John Wiley & Sons, New York, 1962.
- Gibson, R. D., The influence of pressure on the high-low inversion of quartz, *J. Phys. Chem.*, 32, 1197-1205, 1928.
- Griggs, D. T., Hydrolytic weakening of quartz and other silicates, *Geophys. J. Roy. Astron. Soc.*, 13, in press, 1967.
- Griggs, D. T., and J. D. Blacic, Quartz: Anomalous weakness of synthetic crystals, *Science*, 147, 292-295, 1965.
- Griggs, D. T., F. J. Turner, and H. C. Heard, Deformation of rocks at 500° and 800°C, *Rock Deformation*, edited by D. T. Griggs and J. Handin, *Geol. Soc. Am. Mem.*, 79, 39-104, 1960.
- Hanneman, R. E., and H. M. Strong, Pressure dependence of the emf of thermocouples to 1300°C and 50 kbar, *J. Appl. Phys.*, 36, 523-528, 1965.
- Hanneman, R. E., and H. M. Strong, Pressure dependence of the emf of thermocouples, *J. Appl. Phys.*, 37, 612-614, 1966.
- Keith, M. L., and O. F. Tuttle, Significance of variation in the high-low inversion of quartz, *Am. J. Sci., Bowen Vol.*, 203-280, 1952.
- Kelley, K. K., Contributions to the data on theoretical metallurgy, 13, High-temperature heat-content, heat-capacity, and entropy data for the elements and inorganic compounds, *U. S. Bur. Mines Bull.*, 584, 232 pp., 1960.
- Kennedy, G. C., G. J. Wasserburg, H. C. Heard, and R. C. Newton, The upper three-phase region in the system $\text{SiO}_2\text{H}_2\text{O}$, *Am. J. Sci.*, 261, 501-521, 1962.
- Kitahara, S., and G. C. Kennedy, The quartz-coesite transition, *J. Geophys. Res.*, 69, 5385-5400, 1964.
- Kitahara, S., S. Takenouchi, and G. C. Kennedy, Phase relations in the system $\text{MgO-SiO}_2\text{H}_2\text{O}$ at high temperatures and pressures, *Am. J. Sci.*, 264, 223-233, 1966.
- Klement, W., Jr., L. H. Cohen, and G. C. Kennedy, Melting and freezing of selenium and tellurium at high pressures, *J. Phys. Chem. Solids*, 27, 171-177, 1966.
- MacDonald, G. J., Relations at high pressure, *Am. J. Sci.*, 254, 71, 1962.
- Majumdar, A. J., II, Thermodynamic properties and α - β cristobalite relations in the system $\text{SiO}_2\text{H}_2\text{O}$, *Solids*, 25, 1487-1494, 1966.
- Ostrovsky, I. A., $\text{P}_2\text{O}_5-\text{H}_2\text{O}$, *Geol. J.*, 5, 1941.
- Rosenholtz, J. L., Thermal expansion of rock crystals, *Am. J. Sci.*, 254, 1941.
- Schreyer, W., and J. Seifert, Solutions with one or more solid phases in the system $\text{SiO}_2\text{MgO}\text{Al}_2\text{O}_5$, *Geochim. et Cosmochim. Acta*, 29, 1965.
- Sosman, R. B., *The Chemical Catalog*, 1966.
- Strelkov, P. G., G. V. Kostylev, and V. V. Kostylev, *Phase Transformations in the System $\text{SiO}_2\text{MgO}\text{Al}_2\text{O}_5$* , Naukova Dumka, Kiev, 1970.