The first possibility seems quite plausible for shallow intrusions that fracture their roofs. The experimental results suggest that solutions that rush off under disequilibrium conditions of this kind will be highly enriched in silica. Conversely the rocks from which the solutions are derived will be desilicated. A probable example of the operation of this process has been discovered in the Belleoram adamellite stock, Newfoundland (Ermanovics, Edgar, and Currie, 1967). The adamellite intrudes impervious, unfractured shales and slates without notable marginal effects. Where it intrudes permeable, fractured conglomerate, a highly desilicated, syenitic phase is developed with an imperceptible gradation from the intrusive into the conglomerate. Solubility experiments on the adamellite showed that under disequilibrium conditions, silica solubility was highly enhanced, just as it is in albite. This suggests that rapid loss of volatiles into the fractured, permeable conglomerate desilicated the solidified borders of the intrusion. At a distance of 2 km from the intrusive, a girdle of quartz veins is found that can be plausibly identified with the silica lost from the intrusive.

Under deeper-seated conditions, a much slower, more uniform motion of solutions may be expected. The arguments advanced above show that at the lower end of the P/T range covered, the solutions will be relatively soda and alumina rich. If the vein component in igneous and metamorphic complexes is identified with material deposited from solutions, this reasoning suggests that veins in low grade rocks should be comparatively Na rich and quartz poor, while at higher grades they should contain free quartz. Conversely the (depleted) host rocks should be relatively rich in silica at low grades and become relatively richer in alkalies at higher grades. To a first approximation this is an accurate description of many metamorphic complexes.

In the absence of data on potash and lime feldspars and on mixtures of feldspars and quartz, these conclusions are highly tentative. However preliminary work on the solubility of natural rocks (Ermanovics, Edgar, and Currie, 1967) and work in progress on the solubility of other feldspars suggest that these conclusions are qualitatively correct.

ACKNOWLEDGMENTS

Chemical analyses of the experimental waters were made by W. L. Traversy and J. J. Lynch. Mr. Lynch developed improved techniques for analysis of $SiO_2$ and $Al_2O_3$ and suggested several improvements in the experimental method. The apparatus was kept in repair by A. G. Meilleur. The paper has been greatly improved by critical reading by Dr. Hugh Webster.

REFERENCES

American Society for Testing Materials, 1959, Manual on industrial water specifications: Philadelphia, Pa., Tech. Pub. 148D.

Ermanovics, I. F., Edgar, A., and Currie, K. L., 1967, Evidence bearing on the origin of the Belleoram stock, Newfoundland: Canadian Jour. Earth Sci., v. 4, no. 3, p. 413-431.

Euler, R., and Hellner, E., 1958, Hydrothermale und röntgenographische Untersuchungen an gesteinbildenden mineralen: Geochim. et Cosmochim. Acta, v. 13, p. 220-231.



Fowler, R. H., and Guggenheim, E. A., 1939, Statistical thermodynamics: Cambridge, England, Cambridge Univ. Press, 490 p.

Franck, E. U., 1956, Zur loslichkeit fester stoffe in verdichten Gasen: Zeitschr. Phys. Chemie, neu folge, v. 6, p. 345-355.

Jasmund, Karl, 1952, Löslichkeit von KCL in der Gasphase von überkritisch erhitztem Wasser: Heidelberger Beitr. Mineralogie Petrographie, v. 3, p. 380-406.

Kennedy, G. C., 1950, Pressure-volume-temperature relations in water at elevated temperatures and pressures: Am. Jour. Sci., v. 248, p. 540-564.

Kolthoff, I. M., and Sandell, E. B., 1952, Textbook of quantitative inorganic analysis, 3d ed.: New York, MacMillan, 759 p.

Morey, G. W., and Hesselgesser, J. M., 1951, The solubility of some minerals in superheated steam: Econ. Geology, v. 46, p. 821-835.

Orville, P. M., 1963, Alkali ion exchange between vapor and feldspar phase: Am. Jour. Sci., v. 261, p. 201-237.

Sharp, W. E., 1962, Thermodynamic functions for water: California Univ., Lawrence Radiation Lab. Pub. UCRL 7118, p. 4-11.

Weill, D. F., and Fyfe, W. S., 1964, The solubility of quartz [in $H_2O$] in the range 1000-4000 bars and 400-500°C: Geochim. et Cosmochim. Acta, v. 28, p. 1243-1256.

Zwikker, C., 1954, Physical properties of solid materials: London, Pergamon Press, 403 p.