JUNNER, N. R., 1939. Sekondian System. *Rept. Gold Coast Geol. Surv.*, 1938–39, pp. 13–15.
—— 1940. Geology of the Gold Coast and Western Togoland. *Gold Coast Geol. Surv. Bull.*, No. 11.
KEGEL, W., 1957. Das Paranaiba-Becken. *Geol. Rund.* **45**, 522–540.
KING, L. C., 1958. Basic Palaeogeography of Gondwanaland during the late Palaeozoic and Mesozoic Eras. *Quart. J. geol. Soc. Lond.*, **114**, 47–70.

TEMPERATURE DEPENDENCE OF THE DISTRIBUTION COEFFICIENT

SIR,—The mineral data presented by Frost (1962) form a valuable contribution to the study of mineral assemblages. His analysis of these data is however open to criticism from various directions. The present criticism is confined to his treatment of the temperature dependence of the distribution coefficient.

An exchange equilibrium between garnet of formula (Fe, Mg)$_3$Al$_2$Si$_3$O$_{12}$ and biotite of formula K(Fe, Mg)$_3$AlSi$_3$O$_{10}$(OH)$_2$ may be expressed :—

$$\text{Fe garnet} + \text{Mg biotite} \rightleftharpoons \text{Mg garnet} + \text{Fe biotite} \qquad (1)$$

Provided both phases are ideal mixtures, the distribution coefficient (K_D) takes the form :—

$$K_D = \frac{X_b}{1 - X_b} \cdot \frac{1 - X_a}{X_a} = \exp\left[\frac{\Delta G}{RT}\right] \qquad (2)$$

where $X = \text{Mg}/(\text{Fe} + \text{Mg})$, a and b denote phases garnet and biotite respectively, ΔG is the Gibbs free energy change of reaction (1), R is the gas constant, and T is absolute temperature. The temperature dependence of K_D may be obtained as follows :—

$$\frac{\partial \ln K_D}{\partial T} = \frac{1}{R}\frac{\partial(\Delta G/T)}{\partial T} = -\frac{\Delta H}{RT^2} \qquad (3)$$

where ΔH is the enthalpy change of reaction (1). Note that equation (3) does not express a linear relationship between $\ln K_D$ and T. A linear relationship, if desired, may be obtained as follows :—

$$\frac{\partial \ln K_D}{\partial(1/T)} = \frac{1}{R}\frac{\partial(\Delta G/T)}{\partial(1/T)} = \frac{\Delta H}{R} \qquad (4)$$

Provided ΔH remains independent of T, as it does in some experimental systems, a plot of $\ln K_D$ against the reciprocal of absolute temperature must produce a straight line.

Hence the supposed linear relationship between $\log_{10} K_D$ and T (Frost, 1962, p. 434) finds no support in theory. Provided a displacement of K_D can definitely be attributed to a variation in T (and not to variation in the Mn and Ca content of garnet), an explicit linear relationship can be expected only if the abscissa is the reciprocal of absolute temperature (not temperature or metamorphic grade) and the ordinate is $\ln K_D$ (not $\log_{10} K_D$).

REFERENCE

FROST, M. J., 1962. Metamorphic grade and iron-magnesium distribution between co-existing garnet-biotite and garnet-hornblende. *Geol. Mag.*, **99**, 427–438.

RALPH KRETZ.

DEPARTMENT OF GEOLOGY,
UNIVERSITY OF QUEENSLAND,
BRISBANE, AUSTRALIA.

29th January, 1963.

https://doi.org/10.1017/S0016756800055412 Published online by Cambridge University Press