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LAWSONITE EQUILIBRIA

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ABSTRACT. The equilibrium conditions of the reaction lawsonite = anorthite + vapor have been determined betwen 370°C and 500°C at pressures in the range [illegible] to 8 kilobars. The boundary slope in this region is expressed by the relation $T_{eqm} = 250 + \frac{P}{41}$ where P is in bars. These data confirm the predictions of Newton and Kennedy.

Lawsonite is one of the critical minerals of rocks belonging to the glaucophane schist facies. The equilibrium decomposition of lawsonite thus sets some restrictions on physico-chemical variables operating in this metamorphic facies. Newton and Kennedy (1963) determined the conditions of the breakdown of lawsonite to silimanite-zoisite-quartz and vapor and the conditions of breakdown of the latter assemblage to anorthite and vapor. From these data and a knowledge of the entropies of the phases, the position of the boundary curve for the lawsonite = anorthite + vapor reaction was estimated. The data presented here confirm the accuracy of their prediction.

All experiments were conducted in cold seal rod bombs. Mixtures of natural materials were held at constant pressure and temperature in sealed silver tubes containing water. X-ray and optical methods were used to detect major changes in the proportions of phases present. Table 1 gives data on these materials. In some cases calcium chloride solution was added, but it had no pronounced catalytic action. All materials were ground to pass a 325 mesh screen. The experimental data are presented in table 2, and the phase relations deduced [illegible] data in figure 1. In four experiments very minor amounts of fine [illegible] properties suggestive of zoisite were found, but the identification is uncertain. These four runs are all in the field of the zoisite assemblage found by Newton and Kennedy. Thus it appears that in much of the region studied, we may be dealing with the metastable lawsonite = anorthite + vapor equilibrium.

Newton and Kennedy extrapolated the existing entropy data for lawsonite and estimated a boundary slope of 45.7 bars $degree^{-1}$. Our experimental slope of 41 bars $degree^{-1}$ agrees within the limits of both methods. King and Weller (1961b) provided data on the heat of this reaction at 25°C. From this and the entropy data the equilibrium conditions of the reaction can be estimated. The main uncertainty in these estimates involves extrapolation of the entropy of lawsonite above 25°C, an extrapolation that may involve very considerable error. Our estimates indicate that lawsonite would be in equilibrium with anorthite and liquid water near 250° ± 25°C at one atmosphere, in satisfactory agreement with the present data.

Whereas the data in figure 1 outlines the relative stability of anorthite and lawsonite, it gives only the most extensive possible field of stability for lawsonite. At low temperatures and pressures zeolites and other minerals, such as prehnite, may replace lawsonite. With present data it is possible to make some reasonable estimate of the magnitude of these effects.