sure at 25°C is near 3700 atmospheres and the initial boundary slope 9.4 atmospheres/°C. As the temperature [illegible] while ΔV and ΔS will retain negative signs over a considerable [illegible], the data of Sharp (1962) indicates that ΔS will become considerably [illegible] and the slope much flatter. We have made an estimate of the transition pressure at 300°C, and a value near 5000 atmospheres is indicated. The form of the curve is suggested in figure 1.

Little is known about the stability of thomsonite (a calcium zeolite) which may replace lawsonite in silica-poor environments. Synthesis experiments (Coombs and others, 1959) indicate stability up to temperatures of the order of 300°C at moderate pressures. The assemblage thomsonite-analcime, is known to replace plagioclase in zeolite facies alteration (Coombs and others, 1959, p. 63). For the reaction:

$$\text{lawsonite} + 0.4H_2O = \text{thomsonite}$$

$$CaAl_2Si_2O_7(OH)_2 \cdot H_2O + 0.4H_2O = CaAl_2Si_2O_8 \cdot 2.4H_2O$$

$$\Delta V^0 = 27.01 \text{ cm}^3.$$

and it would be remarkable if ΔS^0 is not also positive. Hence as with laumontite, it appears that the lawsonite stability field will be replaced by thomsonite at low pressures and temperatures, and the boundary relations will be of the same form as with laumontite.

Zen (1961) has stressed the importance of consideration of relative partial pressures of water and carbon dioxide in low-grade metamorphism. Lawsonite may be replaced as indicated by the reaction:

$$\text{Calcite} + \text{kaolinite} = \text{lawsonite} + CO_2 \qquad (5)$$

$$CaCO_3 + Al_2Si_2O_5(OH)_4 = CaAl_2Si_2O_7(OH)_2 \cdot 2H_2O + CO_2.$$

For reaction (5) [illegible] is water independent:

$$\Delta G^0 \text{ [illegible]} ; \Delta S^0 = +37.1 \text{ e.u.} ; \Delta V_{solid\ phases} = -34.9 \text{ cm}^3.$$

These figures imply that calcite-kaolin is stable at low temperatures, but lawsonite becomes relatively more stable with increasing temperature. In an environment where $P_{total} = P_{H_2O} + P_{CO_2}$ lawsonite will be favored by high ratios of P_{total}/P_{CO_2} on account of the large ΔV solids term. For example, if P_{total} is 5000 bars, at 25°C, then the reaction (5) will be in equilibrium when P_{CO_2} is approximately 100 bars (ideality assumed). Obviously, in any low-temperature environment where the fluid phase is rich in CO_2, lawsonite will not be favored.

CONCLUSIONS

As lawsonite frequently occurs in vein fillings with quartz or carbonate or is formed by the simple breakdown of plagioclase (McKee, 1962), the data presented have some bearing on the mineralogical processes. It should be stressed, however, that the stability field indicated is maximal for quartz-bearing systems, and other phases such as prehnite, heulandite (more stable than laumontite at low temperature) will lead to some additional restriction on the field.