A similar development may be applied to the piezometric data to obtain the expanded form (9):

$$-\ln N_1 = (\Delta V_O/RT)\ (P-P_O)\ \{(1 + 1/2\Delta V_O)\ [\ (dV/dP)_l - (dV/dP)_c]\ (P-P_O)\}, \quad (4)$$

$$= A'\Delta P\,[1 + B'\Delta P], \quad (4a)$$

where

$A' = \Delta V_O/RT$

$B' = (1/2\Delta V_O)\ [(dV/dP)_l - (dV/dP)_c]$

(dV/dP) = molar compressability coefficient of the liquid (l) or solid (c) phase at the pressure P_O and temperature T.

Equation 4 takes into account the change in volumes of the solid and liquid phases during the changing pressure of the fusion. The similarity of the forms of equation 3 and 4 seemed to justify the extrapolation of the time-pressure data by hyperbolic equations similar to those used for the time-temperature data.

The pressure, P, and time, t_a, at which an infinitesimal amount of solid is in equilibrium with liquid were obtained by fitting the values in the liquid-solid region to a curve and extrapolating to the intersection with the time-pressure curve for the liquid. The time, t_b, when the sample would have been completely solid, if pure, was obtained by extrapolating the time-pressure curve for the solid to the pressure, P. The interval $(t_a - t_b)$ was taken as the duration of the transition and was used to calculate ΔV_O (the volume change for the transition).

---

(9) A derivation of this equation follows:
The basic differential equation at constant temperature is:

$$-d\ln N_1 = \left(\frac{V_l - V_c}{RT}\right) dp = (\Delta V/RT)\, dp \quad (a)$$

Let: $\Delta V = \Delta V_O + (k_l - k_c)\ (P - P_O)$, $\quad (b)$

where : P_O is the pressure when $N_1 = 1$; P is the pressure when $N_1 = N_1$; and k is dV/dP for each phase.

Substitute for ΔV into equation (a):

$$-d\ln N_1 = \frac{\Delta V + (k_l - k_c)\ (P - P_O)}{RT}\, dP. \quad (c)$$

$$\text{Integrate: } -\ln N_1 = \frac{\Delta V_O}{RT}\ (P - P_O) + \frac{(k_l - k_c)}{RT}\ \frac{(P - P_O)^2}{2}.$$

Rearrange and substitute for k:

$$-\ln N_1 = (\Delta V_O/RT)\ (P - P_O)\ \{\ 1 + (1/2\Delta V_O)\ [\ (dV/dP)_l - (dV/dP)_c]\ (P - P_O)\}. \quad (d)$$