Roy which states that their 1961 data were obtained by releasing the pressure before lowering the temperature. On the other hand, Cohen and Roy [1965, p. 150] state that the data shown in their Figure 1 were obtained by pressure release after temperature quenching. R. Roy (personal communication) states that 'every combination of heating, pressing, and cooling de-pressurizing cycles possible' was used throughout their work. Although it is not possible to match the plotted points with one or the other quenching techniques because of lack of information and the scatter of the data, according to the present interpretation samples quenched under pressure should follow the 25°C isotherm; samples that were temperature-

quenched *after* release of pressure should plot along the high-temperature isotherm, and thus the total array of data should scatter between the two calculated curves. These relationships are demonstrated in the following section.

DISCUSSION

Figure 4 summarizes the trajectories of the glasses in a density-pressure or refractive-index-pressure plot, as interpreted in the previous sections. Asterisks refer to equilibrium phases, and we first consider a liquid at A^* on or above the liquidus at pressure P. $A^*-B^*-C^*$ is the equi-



Fig. 4. Density and refractive index of a glass as a function of pressure and temperature. Equilibrium phases indicated by asterisks; SCL is supercooled liquid.

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librium trajectory to room temperature and atmospheric pressure via the equilibrium supercooled liquid phase, and A^* can be returned to by this route or by heating the liquid via D^* at 1 bar and then compressing it. The density variations with pressure and temperature are proportional to the equilibrium-phase κ and α values at 25°C and T, and at 1 bar and P. $A^*-B-C-D^*-A^*$ is a reversible cycle involving formation of a glass instead of the supercooled liquid (the points B and C will scatter somewhat on the ordinate during a number of cycles because of variations in rates of cooling or heating). This cycle is drawn for a 'normal' silicate glass (diopside-albite).

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We first consider the diopside-albite experiments, in which temperature is quenched at pressure. The liquid is at A^* (T, P) and is quenched to point B (25°, P) with ΔV proportional to α_P the thermal expansion coefficient at P. The temperature drops through the glass point and the volume (density, refractive index) corresponding to 25°C and pressure P is attained at point B, via the reversible thermal contraction. The potential energy barrier is now too high for pressure relaxation at low temperature, so that pressure release is irreversible and the properties at point B are locked in to the glass. Thus, any point on any trajectory D^*-A^* , for any T and P, will, in this process, move vertically to the 25° trajectory C-B and plot along C-B at the pressure at which temperature was quenched. As discussed in the section on the diopside-albite results, this follows from the equality $(\partial \alpha / \partial P) = -(\partial \kappa / \partial T)$. (The loop .1*-B-C-D*-A* is drawn for normal silicate glasses in which $\alpha_P < \alpha_0$ and $\kappa_T > \kappa_{25}$.)

Pressure release from above the glass point would simply result in an equilibrium trajectory such as A^*-D^* down the isotherm, with subsequent thermal relaxation to point C, the original uncompressed glass. If the pressure is released at a high temperature below the glass point, the pressure effect may be locked in with subsequent thermal contraction at 1 bar. This sequence is shown in Figure 4 by the area C-D-E-F for SiO₂ glass, in which C-B is now assumed to be the 25°C compression slope for the glass. The compressed glass sample at 600°C is at point E, below the glass point T_{σ} (as, for example, reached by cooling at pressure from the liquidus). When the pressure is released,

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