The states P_k, V_k, ($k \neq 0$) represent the series of shock pressures and specific volumes achieved along the infinite series of Hugoniots centered at states P_{k-1}, V_{k-1} that are achieved via wave reverberation in the sample. The total shock energy for case 1 is less than the shock energy for case 2. Assuming that the fused quartz-stishovite phase change occurs reversibly (as is certainly closely valid in the present experiments), the net thermal postshock energy is given by

$$E_{1 \text{ or } 2} = \int_{298^\circ\text{K}}^{T^\circ\text{K}} C_p dT = E_s - E_R \qquad (6)$$

where E_s is given by equations 5 and 3 for cases 1 and 2. The energy term corresponding to the work done against ambient pressure on expansion from 298°K to T is negligible. Numerical integration of equation 6 for postshock energies yields the values given in Table 5. The empirical formula for the molal heat-capacity equation of fused silica

$$C_p \text{ (cal/mole °K)} = 13.38 + 3.68 \times 10^{-3}T - 3.45 \times 10^{5}T^{-2} \qquad (7)$$

given by *Kelley* [1960] is used in equation 6 to yield the postshock temperature given in Table 5. Uncertainties in E_R reflecting the uncertainties in the release adiabats give rise to errors in the calculated postshock temperatures of ~10% at low pressures, ranging to ~20% at ~500 kb.

The postshock temperatures calculated by *Wackerle* [1962] for single-shock experiments are much lower than those we have calculated for pressures up to 300 kb but are comparable to our single-shock temperatures at higher pressures. The differences in the calculated results arise to a minor degree from *Wackerle*'s [1962] assumption of a constant specific heat C_v and constant $(\partial P/\partial E)v$; in addition, Wackerle ignored the elastic compressions and performed numerical integration along extrapolated 'equilibrium' curves. However, the major factor producing the differences in postshock temperature is our use of the new release adiabat data in Figure 7. Since below 300 kb the actual release curves lie below the Hugoniot rather than above, as is implicit in Wackerle's formulation, the differences in T are great at the lower pressures. At much higher pressures the assumptions in Wackerle's calculation should, within the present state of our knowledge, be approximately valid.

On the basis of annealing studies on fused silica, *Arndt et al.* [1971] have found that temperatures of 300°C have a significant effect on the relaxation of densified fused silica. Therefore, in view of our calculated temperatures, annealing could play a major role in causing the drop in refractive index of fused silica shocked to 300 kb and higher pressures.

CONCLUSIONS

1. Variation in the percentage of network-forming polyhedra of silica and alumina affects the threshold of densification and the maximum permanent compression that may result from shock loading. The Hugoniot elastic limit is compatible with the threshold of permanent densification.

2. Postshock annealing may be a mechanism for the relaxation of high-density glasses to low-density glasses for material shocked to below 150 kb. It is certainly active for shock strengths above this level.

3. Transformation of the low-pressure phase to a high-pressure stishovitelike phase followed by adiabatic release to a low-density glass probably occurs for shock compressions up to ~300 kb. Above this pressure, postshock annealing at temperatures in excess of 1000°C would account for the low-density glass that is recovered.

4. Despite the double-valued nature of the fused silica and soda-lime index versus shock pressure relations (Figures 4 and 5), if the pressure regime of naturally shocked glasses can be determined by other means, our data should be useful in obtaining pressure and temperature histories of those glasses.

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