

the various investigators and within data obtained by the same investigator. The pronounced stress relaxation observed behind the elastic wave by all the previous investigators suggests that the yield process is quite complex and, as is evident from the data, sensitive to experimental conditions. With our technique of obtaining the Hugoniot elastic limit all measurements are made in direct compression without unloading from free surfaces, and the region around the Hugoniot elastic limit may be investigated for small increments of stress over the critical value rather than for the large input stresses characteristic of an explosive experiment.

Intermediate pressure region

Our data in the stress region intermediate between the two cusps show the usual linear relation between U_s and u_p . In comparing our data to that of other investigators, it should be observed that interpretation of the data from a free surface velocity experiment for a material with a multiple wave structure and time dependent mechanical properties is sensitive to assumptions concerning the various wave interactions and relaxations. Our experiment characterizes the material for the total particle velocity imparted to the material and gives the wave velocity of all waves without complications resulting from the interaction of the waves. Thus the data relating the total particle velocity to wave velocities is obtained with minimum qualification. However, as was previously stated, to compute the stress in the multiple wave region, it must be assumed that the particle velocity of the leading wave is independent of the total particle velocity. This assumption is open to criticism since WACKERLE⁽¹⁴⁾ has observed that the particle velocity and wave velocity of the Hugoniot elastic wave in crystalline quartz increase with increasing driving pressure. However, our wave velocity measurements provide some indication of the amplitude of the leading wave since a change in wave velocity is expected to result from a change in particle velocity. As can be seen in Table 1 the wave velocity of the leading wave was found to be constant with driving pressure. Thus large changes in the amplitude of the elastic wave are not likely. The stress-volume values which result when a constant amplitude elastic wave is assumed are shown in Table 1. Our previous brief report on

Ge compares our stress-volume data to that obtained from a free surface velocity technique.⁽¹⁵⁾

Characteristics of the transition

The large shear component of the elastic wave in the shock experiment results in a transition characterized by a stress rather than by the pressure of the transition. Therefore, we must consider the effect of the elastic compression on the transition. MINOMURA and DRICKAMER⁽¹⁰⁾ have reported that the static transition is insensitive to shear; thus, if this observation is quantitatively correct, we would expect the transition to occur at the same volume regardless of the stress tensor producing the volume change. Our data show that the specific volume at the transition is between $0.870 V_0$ and $0.880 V_0$ when the very small correction to room temperature is made. Thus the transition does occur at the same volume in the static and shock wave experiment since Jamieson's static value⁽¹⁶⁾ for the volume at the transition is $0.875 V_0$.

In order to compute an equivalent pressure from the observed transition stress, several assumptions must be made. Assuming that all stress increments in excess of the Hugoniot elastic limit are hydrostatic (the elastic-plastic assumption) and that the transition pressure is not changed by the shear component, an equivalent hydrostatic pressure may be computed from the observed transition stress. Since it is the volume which is independent of the stress configuration, the equivalent pressure for the elastic range is computed from the volume at the elastic limit and the compressibility. This yields a value from 114 to 122 kb* for the equivalent pressure compared to MINOMURA and DRICKAMER's⁽¹⁰⁾ value of from 120 to 125 kb. Thus, good agreement is achieved between the static and shock wave compression values for the pressure of the transition.

There has been some question,^(1,13) whether the shock induced transition is an anomalous melting and perhaps not the solid-solid transition identified by JAMIESON⁽¹⁶⁾ as a transition to a metallic

* Cusps in the stress-volume curve are located between particle velocity points below and above the cusp. The values shown indicate the range of values possible within the observed points. Consideration of the $U_s - u_p$ values indicates that the cusp is most likely toward the upper end of the range quoted.

