Figure 4. A. Cumulative number fraction for low-mass fragments as a function of the specific energy, Q, and impact angle. Cumulative number fraction is the cumulative number of fragments larger than a given mass relative to the total number of fragments larger than 0.0013 projectile masses. Solid symbols indicate a nearly constant Q with varying impact angle from 7.5° to 30°. Crosses indicate a constant impact angle (15°) with velocities from 1.9 km/s to 6.3 km/s. Impactors are 0.635 cm aluminum spheres; target is No. 24 sand. Matching distributions indicate that the vertical component of impact velocity controls catastrophic failure from subsonic to hypervelocities. B. Largest ricochet mass, \( m_L \), relative to original impactor mass, \( m_p \), as a function of the specific energy, Q, and impact angle. Data for aluminum spheres impacting No. 24 sand and basalt spheres impacting No. 140-200 sand are shown.

Figure 5. Self-luminous vapor cloud created by a 5.18-km/s impact at 15° into dry-ice block. Spectra indicate that luminosity is due to aluminum oxide. Accompanying diagram illustrates important features. A two-component vapor cloud can be seen in this image about 57 μs after impact. One component expands above the impact point with the center of mass moving downrange with time. The other component accompanies ricochet fragments downrange with velocities at the leading edge approaching the initial impact velocity. Entrained projectile fragments in the downrange cloud created hypervelocity pits in the wall of the well surrounding the target. Measurements of the growth of the hemispherical cloud in the presence of a tenuous atmosphere permit estimating its energy.