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HYDROCODE PREDICTIONS OF COLLISIONAL OUTCOMES: EFFECTS OF TARGET SIZE; E.V. Ryan, Planetary Science Institute, Tucson AZ; E. Asphaug, University of Arizona, Tucson; H.J. Melosh, University of Arizona, Tucson.

Traditionally, laboratory impact experiments, designed to simulate asteroid collisions, have attempted to establish a predictive capability for collisional outcomes given a particular set of initial conditions. Thus, after specifying an impact velocity, target/projectile size, material, etc., the objective is to predict the degree of fragmentation of the target, and the size and velocity distributions of the ejected fragments. This understanding of the collisional process could then be applied to interpreting the dynamics of the asteroid belt. Unfortunately, in laboratory experiments we are restricted to using targets considerably smaller (diameters typically ~0.1 m) than the objects we wish to model (asteroids, diameters of the order of 1 km). It is therefore necessary to develop some methodology for extrapolating the extensive experimental results to the size regime of interest. To do this, we must isolate which initial parameters have a dominant influence on the resultant collisional outcome.

We report here on results obtained through the use of a two-dimensional hydrocode based on Los Alamos' 2-D SALE (1) and modified to include strength effects, and the Grady and Kipp (2) fragmentation equations. The hydrocode has been tested by comparing its predictions for post-impact fragment size distributions to those observed in laboratory impact experiments. The series of experiments done by Takagi *et al.* (3) using basalt targets were used for the initial comparisons. Figure 1 is an example of how well the hydrocode can replicate the experimental results given the target and projectile masses, material properties, and the projectile velocity as initial conditions.

It has been suggested in the literature (4) that target size might have a critical influence on collisional outcomes. Since we are unable to vary this parameter to any great extent experimentally, the hydrocode was used to determine what effect if any simply changing the size of the target has on the resultant fragment size distribution in an impact event. The parameters kept constant were the projectile/target mass ratio, the impact velocity, and therefore specific energy Q (projectile kinetic energy/target mass). Target size was varied from 10 cm to 10 km, restricting this study to the strength regime for large bodies (gravitational forces are minor). Figure 2 shows how the mean fragment size (normalized to the target diameter) was found to decrease with increasing target diameter. The implication is that even when the energy per unit mass available to fragment a target is being held fixed, larger and larger bodies will fragment into relatively smaller pieces. A linear fit to the variation of the normalized mean fragment size with target diameter yields a slope of -0.26. The strain-rate exponent in this analysis is ~1/4, possibly implying a connection between strain-rate dependence and the influence of target size.

(1) Amsden, A.A., H.M. Rupple, and C.W. Hirt (1980), Los Alamos Scientific Report LA-8095; (2) Grady, D.E. and M.E. Kipp (1980), *Int. J. Rock Mech. Min. Sci. and Geomech. Abstr.* **17**; (3) Takagi, Y., H. Mizutani, and S. Kawakami (1984), *Icarus* **59**, 462-477; (4) Housen, K. and K. Holsapple (1990), *Icarus* **84**, 226-253;

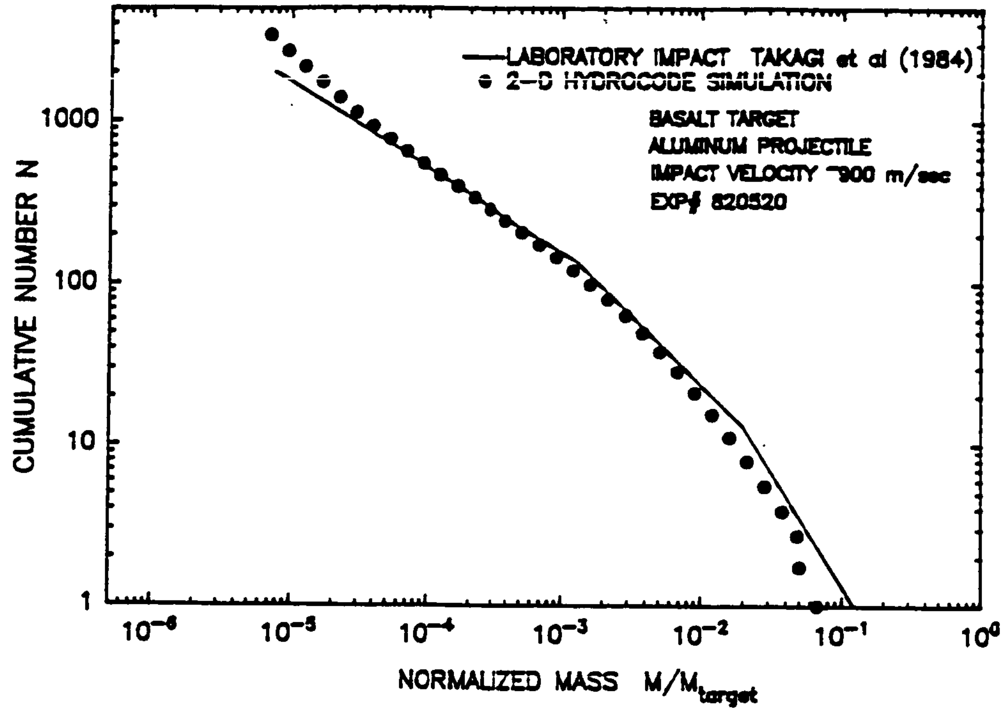

Figure 1. Fragment mass distribution obtained from hydrocode calculations compared to laboratory results of Takagi *et al.* (1984) using basalt targets.

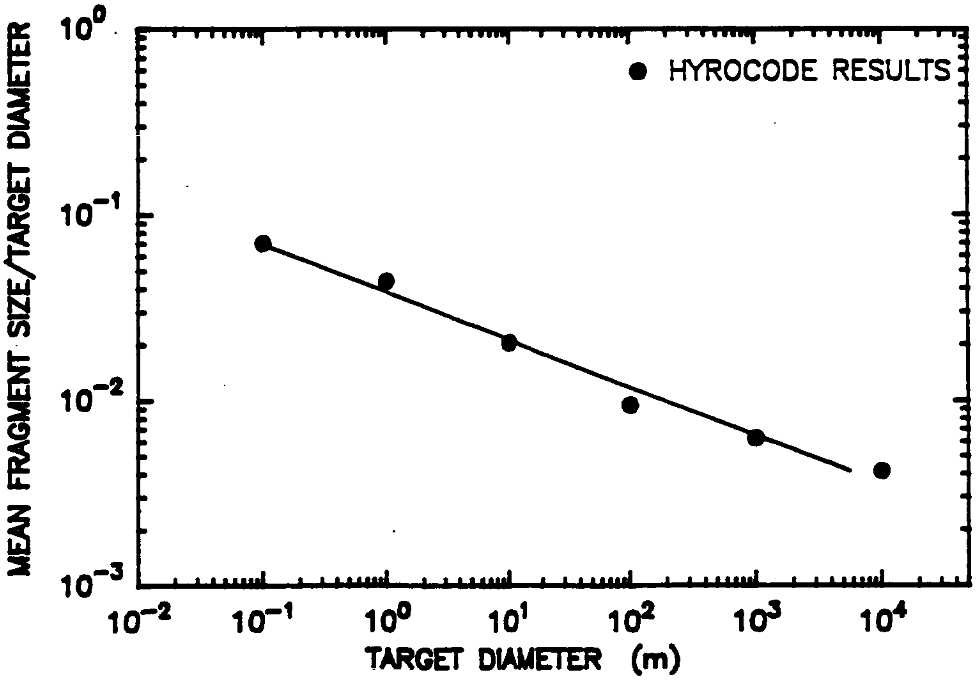

Figure 2. The variation of mean fragment size (normalized to target diameter) with target diameter. The solid line is a linear fit to the theoretical calculations, having a slope of -0.26.