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In order to address the questions of whether the cratering scaling which has been developed by Holsapple and Schmidt (1980,1982) and Housen et al. (1983) can be extrapolated to low velocity encounters, of planetesimals appropriate for the conditions appropriate during accretion of the planets and the impact mechanics of encounters of both asteroids and the solid objects which comprise the rings of the outer major planets, a series of experiments at low g and at high vacuum are proposed. Specific issues which could be addressed include

1. What is the effect of very low g on cratering efficiency and final crater shape in unconsolidated media at low g? At what g and vacuum levels do scaling laws become affected by surface and/or electrostatic forces? Are ejecta curtains different at very low g? Could these possibly give rise to the striae seen on the surfaces of Phobos and Deimos? Is a regime achieved such that <u>all</u> impact ejecta escape and the projectile erodes the target and falls aways from the target?

2. What are the dynamics of impact into a strengthless spherical and ellipsoidal "liquid" targets? Is impact into a liquid sphere a viable fragmented asteroid model? What controls spall, ejecta size, mass and velocity in such a situation?

As a precursor to experiments on a space station, impact experiments employing drop towers on earth could play a useful role. Experimental facilities at NASA/Lewis and Marshall Space Centers can be employed in both developing instrumentation and obtaining preliminary impact data on geologic materials at low and very controlled g levels in hard vacuum.

Constraining likely experiments are both the size of chambers available in drop towers and their drop time. The Lewis Research Center has the world's largest such facility. It has the capability of launching a 1 meter diameter x 3.4 meter long hollow container, in which the proposed impact experiment is placed, into a vertical ballistic trajectory and thus obtain virtually zero g for ten seconds. If the container is just dropped from the top of the 145 m high tower, 5 seconds of test-time is available at various low g levels. Another facility which is a simple (100 m) drop tower is available at Marshall Center. This has a 0.9 m diameter test container. Using the formulas in Holsapple and Schmidt (1980, 1982), expected crater sizes and crater formation times were calculated for impact into Ottawa sand. Useful bounds on the crater sizes (Fig. 1) and crater formation times (Fig. 2) can be obtained by assuming the lowest and highest energy impactor which could conceivably be launched are a 0.01 g, 10 m/sec and a 1 gm, 10 km/sec plastic and iron projectile, respectively. As can be seen from Fig. 1, the 145 m tower will just barely contain the 100 cm diameter crater expected at 10^{-5} g for the 1 g - 10 km/sec projectile. Fig. 2 demonstrates that the 12 to 200 second crater formation times are much too long for the 3 to 10 second test times available from drop towers. Ejecta absorbing or catching internal walls would be required for drop tower experiments to be conducted to final crater dimensions. Moreover, although both facilities have apparatuses for decelerating payloads, because craters in unconsolidated media in vacuum are fragile, it is unlikely that good recoveries will always be obtained. Both onboard video recording and acceleration versus time recording appear to be important ingredients in obtaining high quality data in this environment.

References:

K. A. Holsapple, R. M. Schmidt, On the scaling of crater dimensions, 1. Explosive Processes, J. Geophys. Res. 85, 1980.

K. A. Holsapple, R. M. Schmidt, On the scaling of crater dimensions, 2. Impact Processes, J. Geophys. Res. 87, 1982.

K. R. Housen, R. M. Schmidt, and K. A. Holsapple, Crater ejecta scaling laws: Fundamental forms based on dimensional analysis, J. Geophys. Res. 88, 1983.

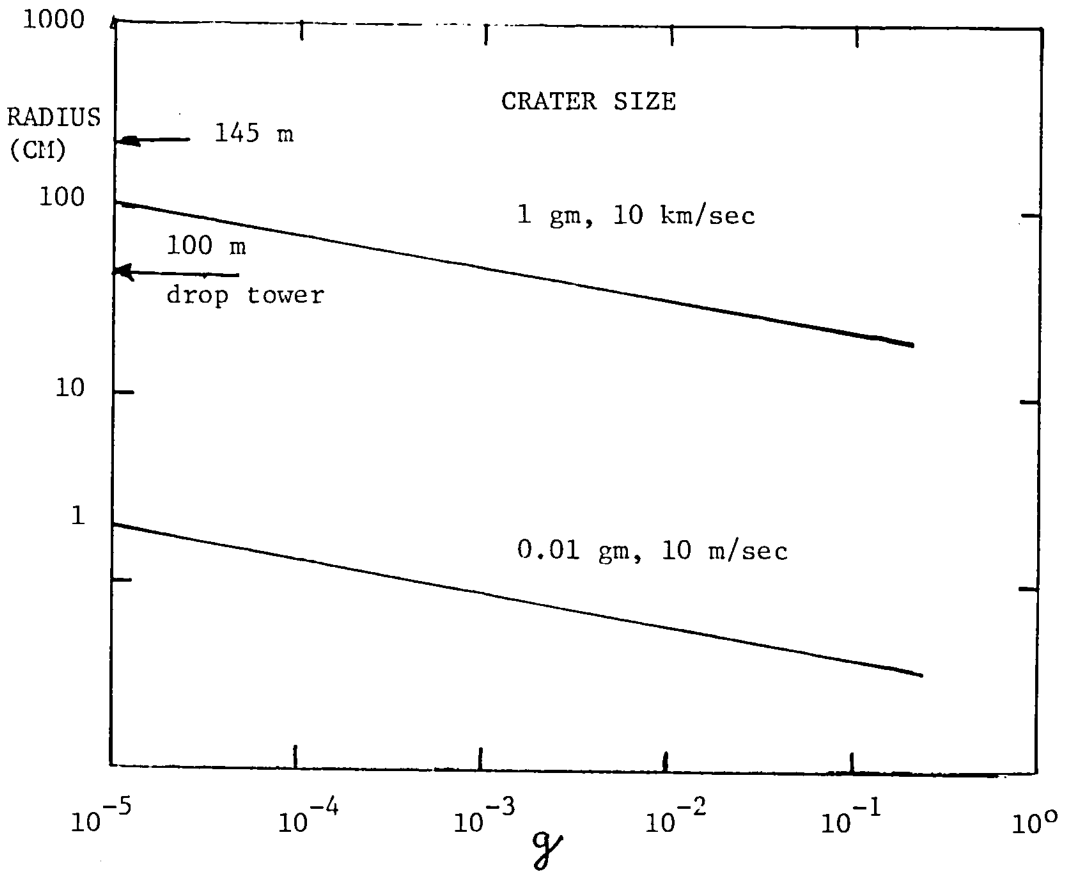

Figure 1. Calculated Ottawa sand crater diameter at different g levels for a 1 gm iron projectile impacting at 10km/sec and a 0.01 gm plastic projectile impacting at 10 m/sec. Available drop tower dimensions are indicated.

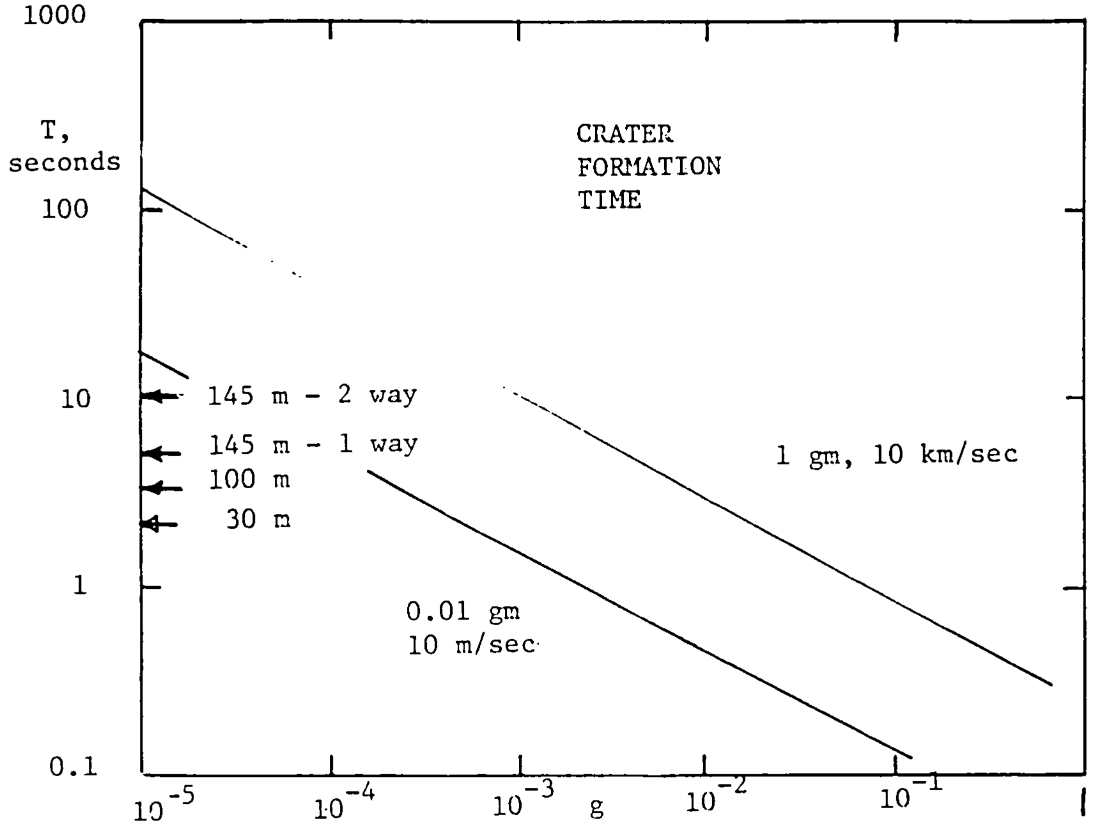

Figure 2. Calculated Ottawa sand crater formation times at different g levels for the two projectiles of Fig. 1. Drop tower test times are indicated.