A TWO-DIMENSIONAL COMPUTER SIMULATION OF HYPERVELOCITY IMPACT CRATERING: SOME PRELIMINARY RESULTS FOR METEOR CRATER, ARIZONA. J. B. Bryan, D. E. Burton, M. E. Cunningham, and L. A. Lettis, Jr., Earth Sciences Division, Lawrence Livermore Laboratory, Livermore, CA. 94550.

Preliminary results from an initial impact cratering simulation are in good agreement with measured crater cross sections reported by Shoemaker (1963) and Roddy et. al. (1975) for Meteor Crater, Arizona. Some of the preliminary values are compared with the actual crater dimensions in the following table.

	THIS CALCULATION	ACTUAL RODDY ET. AL. (1975)	PERCENT DIFFERENCE
Apparent Crater Radius (m)	485	518	- 6%
Apparent Crater Depth (m)	194	150	+29%
Apparent Crater Volume (m^3)	6.35×10^7	7.60×10^7	-16%
Apparent Lip Crater Radius (m)	606	593	+ 2%
Apparent Lip Crater Height (m)	78.0	47.0	+66%
Apparent Lip Crater Volume (m^3)	1.35×10^8	1.25×10^8	+ 8%

This configuration is based on parameters used in earlier underground explosion cratering calculations (Burton and Snell, 1974) including a slope stability angle of 35 degrees, an ejecta bulking factor of 1.2, and gravitational acceleration of 9.80 m/s^2. The similar crater configuration for lunar gravity of 1.62 m/s^2 shows about fifty percent increase in radius and a threefold increase in crater volume.

The dynamic phase of this meteorite impact was treated with an Eulerian finite difference code called SOIL, written by Johnson (1977) and is a derivative of the RADOIL code (Johnson, 1971). This treatment is similar to an earlier effort by Bjork (1961), but was extended to 0.5 seconds or nearly an order of magnitude later in time. Recently O'Keefe and Ahrens (1976, 1977) have reported similar calculations. At this late time the velocity in the mound region is established so that an extrapolation to the final crater is possible. This was done by computing an ejecta distribution based on ballistic trajectories followed by a slope stability adjustment. This is an extension of an approach used successfully for buried explosion cratering simulations in previous studies (Terhune, et. al., 1970; Bryan et. al., 1974; Burton, et. al., 1975; and Glenn and Thomsen, 1976). A color movie based on this calculation is being produced using computer graphics.

Several simplifying assumptions were made to expedite this calculation of projectile-target interaction. The meteorite projectile was modeled as an iron cylinder of density 7860 kg/m^3, with an equal length and diameter of 30 m. The impact trajectory was chosen to be normal to the target interface

to introduce axial symmetry needed for a two-dimensional simulation. The mass and impact velocity of the impacting meteorite were 1.67×10^8 kg and 1.50×10^4 m/s yielding a kinetic energy of 1.88×10^{16} J (4.5 megatons). The ground target was treated as the single material limestone having a density of 2700 kg/m^3. The computational mesh extended about 3,000 m in both the radial and axial directions. The iron and limestone materials were represented by a Tillotson equation of state with no shear strength using published coefficients by Tillotson (1962) and Allen (1967).

Initial results obtained by extending our computational approach from subsurface explosion cratering to impact cratering is very encouraging. In the future we plan to treat Meteor Crater as well as other lunar and planetary impact cratering sites using material properties based on field data and more complex constitutive models with material strength included.

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COMPUTER SIMULATION OF HYPERVELOCITY IMPACT

Bryan, J. B., et al.

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