CALCULATING IMPACT MELT VOLUMES PRODUCED BY NON-VERTICAL IMPACTS ON THE EARTH, MOON, AND MARS.

D. A. Kring[1], O. Abramov[1], and S. M. Wong[2]. [1]Center for Lunar Science and Exploration, USRA - Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston TX 77058. E-mail: kring@lpi.usra.edu. [2]Lunar and Planetary Laboratory, University of Arizona, Tucson AZ 85721.

Introduction: Previous studies have shown that the volume of impact melt generated and its volume relative to fragmented rock increases with crater diameter [1-3]. In a comparison of the parameters affecting impacts on different planetary surfaces, Grieve and Cintala [4] also suggested the melt volume associated with similar-sized transient craters is nearly 6 times greater on the Earth and Venus than on the Moon. Comparisons of this type were derived from analytical expressions that assume a vertical impact trajectory and, thus, are limited to only a small proportion of the impacts that occur on a planet. The most probable trajectories have impact angles of 45º [5] and impact events with even shallower inclinations are possible. Recently computer codes have been developed that allow three-dimensional simulations of impact events. One numerical study [6] used hydrocode modeling to determine the amount of melt produced by impacts at various impact angles on Earth and showed that it decreases with impact angle. We use that type of result to render an easy-to-use analytical expression for calculating impact melt volumes.

Results: Our analytical expression is derived for melt volumes produced by oblique impacts as a function of gravity, impact velocity, impact angle, and density of impact projectiles and target surfaces on the Earth, Moon, and Mars. The most probable oblique impact (45º) produces ~2 times less melt volume than a vertical impact, and ~2 to 7 times more melt than impacts with 30º and 15º trajectories, respectively. The melt volume for a particular crater diameter increases with gravity and impact velocity, so a crater on Earth will have more melt than similar-size craters on Mars and the Moon. For example, the formation of a transient crater with a particular diameter on Earth generates ~3 times more melt than on Mars and ~5 times more melt than on the Moon. However, the melt volume for a particular projectile diameter does not depend on gravity, but has a strong dependence on impact velocity, so the melt generated by a given projectile on the Moon is ~2 times greater than that on Mars. Collectively, these results imply thinner central melt sheets and smaller proportion of melt particles in impact breccias on the Moon and Mars than on Earth.

References: [1] Ahrens T. J. and O'Keefe J. D. 1977. In *Impact and Explosion Cratering.* pp. 639-656. [2] Grieve R. A. F. and Cintala M. J. 1992. *Meteoritics* 27:526-538. [3] Pierazzo E. et al. 1997. *Journal of Geophysical Research* 103:28607-28625. [4] Grieve R. A. F. and Cintala M. J. 1997. *Advances in Space Research* 20:1551-1560. [5] Shoemaker E. M. 1962. In *Physics and Astronomy of the Moon.* pp. 283-359. [6] Pierazzo E. and Melosh H. J. 2000. *Icarus* 145:252-261.