THE RELATIONSHIP OF LAYERED (FLUIDIZED) EJECTA RUN-OUT DISTANCE TO RAMPART WIDTH: IMPLICATIONS TO THE PROPERTIES OF EJECTA.

Joseph M. Boyce[1] and Olivier Barnouin-Jha[2], [1]Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI, 96922, [2]Applied Physics Laboratory, The Johns Hopkins University, Laurel, MD 20723. jboyce@higp.hawaii.edu.

Boyce et al., (2009) have identified impact craters on Ganymede and Europa whose ejecta layers terminate in ramparts similar to those of layered ejecta craters on Mars. The morphology of these craters suggests that their ejecta were fluidized during emplacement similar to that of Martian layered ejecta. Lonar, a fairly fresh terrestrial fluidized ejecta crater, also appears to have a single rampart. The geomorphic analysis of the ejecta deposits of these craters can provide useful information about the rheologic properties and mechanics of ejecta flow and on the environmental conditions present that might influence this flow (see Aranson and Tsimring, 2006). However, because of the fairly poor quality of the available images and topography for Ganymede and Europa, only rampart widths, ejecta run-out distances, and ejecta sinuosity can be measured with reasonable accuracy.

Measurement of these parameters have been done for the 26 Ganymede, 6 Europa (only 2 have ramparts), and 97 Martian (20 single layer ejecta or SLE, 41 double-layer ejecta or DLE and 36 multiple-layer ejecta or MLE) layered ejecta craters in this study. The average width of ramparts (Wav)) was determined by averaging ~ 10 measurements in different locations across a rampart at the distal margin of each ejecta layer, and the average run-out distance (EM) by averaging ~ 10 radii measurements at different locations around the crater of the distance from the crater rim to the outer edge of each ejecta layer. These data are plotted in Fig. 1. In addition, these data can also be normalized to crater size (radius) to yield dimensionless numbers; Wav ratio and EM ratio. These are plotted against each other in Fig. 2.

Fig. 1 shows that the width of ramparts of all ejecta layers, independent of crater type or planet, not only increases with run-out distance, but cluster into two major groups of similar characteristics. In the first group (i.e., Group 1) the ejecta layers of Martian SLE, MLE, the outer ejecta layers of Martian DLE and GRLE craters (and Ganymede's Nergal crater), the ejecta layer of Europa craters, and Lonar have relatively narrow ramparts for their ejecta run-out distances. In the second group, (i.e., Group 2), which includes the inner ejecta layers of Martian DLE and GRLE craters the ramparts are comparatively wider relative to ejecta run-out distance.

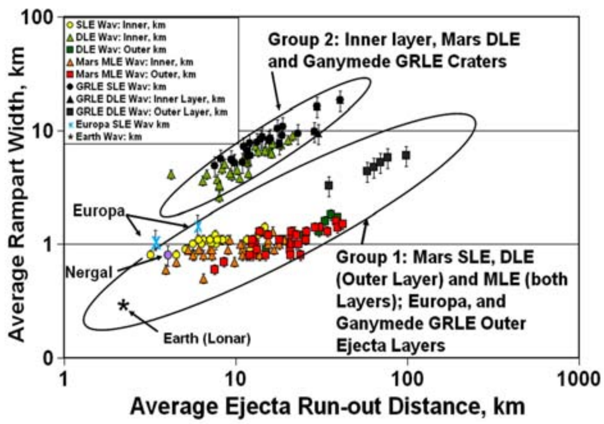

Fig. 1 Scatter diagram of average rampart width in km plotted against average ejecta run-out distance in km. The two major groups have been circled.

Fig. 2 also shows clustering of the data into the same two major groups, but it also shows that with changing crater size there is proportionally little change in rampart width with the run-out of ejecta of SLE and MLE craters, while proportionally, rampart width increase with ejecta run-out distance of the ejecta in both layers. This suggests that either there is a factor within the ejecta scaling equation for fluidized ejecta that is different for DLE than for SLE and MLE ejecta or different ejecta scaling laws operates.

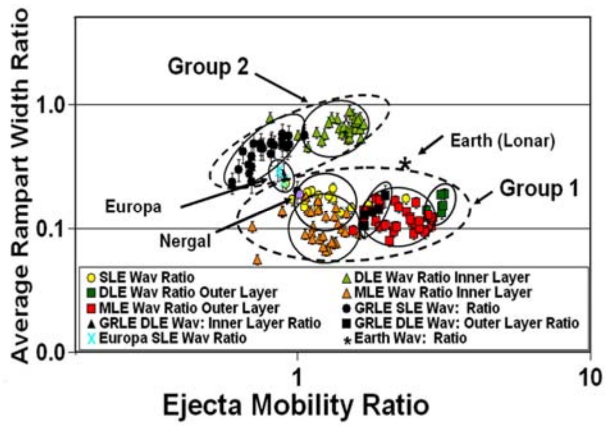

Fig. 2 Scatter diagram of average rampart width ratio plotted against average ejecta mobility ratio.

In addition, by fitting a regression line through the data points of Fig 1, we obtain an exponent that describes the rate at which ramparts widen as function of crater size. The exponents cluster into similar groups (Fig. 3) to what we see in Fig. 1 and as with the other figures suggest that the ejecta of DLE craters behaves differently than the ejecta of MLE and SLE craters independent of planet. This difference in behavior may be due to a rheology effect produced by differences in such factors as the fraction of fines or water in the ejecta of each type crater.

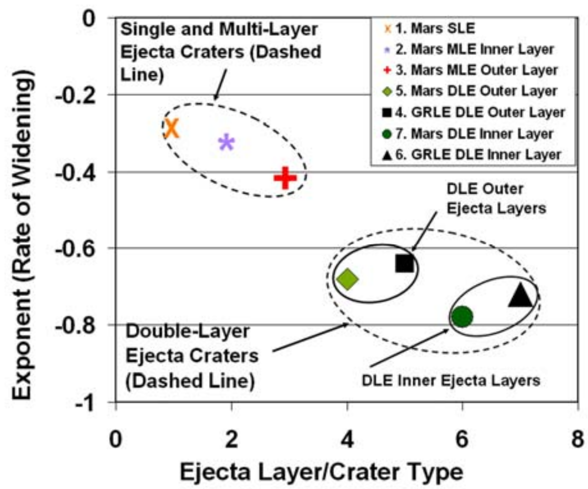

Fig. 3 Rate of widening of ramparts (i.e., the exponent calculated from the regression analysis of the data from each layered ejecta type) plotted against the type of layered ejecta crater.

References: [1] Boyce, J., et al., 2009 MAPS, submitted; [2] Aranson, I., and T. Tsimring, 2006 Rev. Mod. Phys., 78, 641-687.