MORPHOMETRIC EVIDENCE FOR TWO TYPES OF DOUBLE LAYER EJECTA (DLE) CRATERS, Joseph M. Boyce[1], Nadine Barlow[2] and Peter Mouginis-Mark[1], [1]Hawaii Institute of Geophysics and Planetology, University of Hawai'i, Honolulu, HI 96822, [2]Department of Physics and Astronomy, Northern Arizona University, Flagstaff, AZ. 86011. (jboyce@higp.hawaii.edu),

Introduction: Boyce et al., (2010) showed that DLE craters are morphometrically different than single layer ejecta (SLE) or multi-layer ejecta (MLE) craters. Recently, Barlow (2015) showed that while DLE craters, like those described by [1, 3], are common (here referred to as DLE type-1), there are other ejecta layer craters that morphologically resemble SLE and MLE craters (here referred to as DLE type-2). In this paper, we provide morphometric evidence (i.e., radial grooves and rampart widths, and cross section characteristics) to support the contention of [2] that two types of DLE craters exist.

Radial Groove: Widths: The average widths of radial grooves on SLE, MLE and DLE-type 2 craters of similar size are similar, but different than those on DLE-type 1 craters. This is plotted in Figure 1 a, that shows that while the average groove width increases with crater diameter on all craters, when compared with crater size it declines, but at rates that are dependent on crater type (Figure 1 b). In addition, the grooves widen markedly outward from 0.5 R (crater radii) on DLE type-1, but widen little on the ejecta of other types of craters similar to grooves on long run-out landslides [5-8].

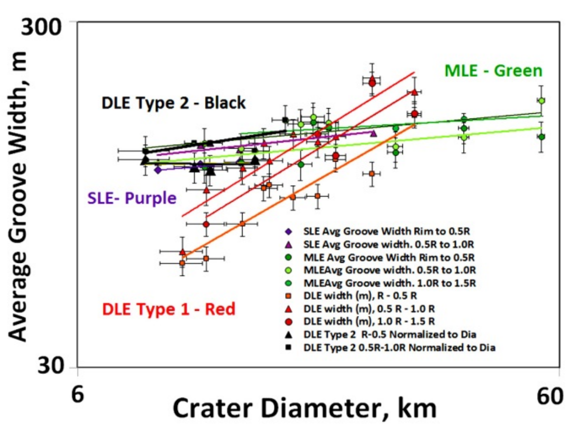

Figure 1 a: Average width of radial grooves in layered ejecta out to 1.5 R in 0.5 R increments.

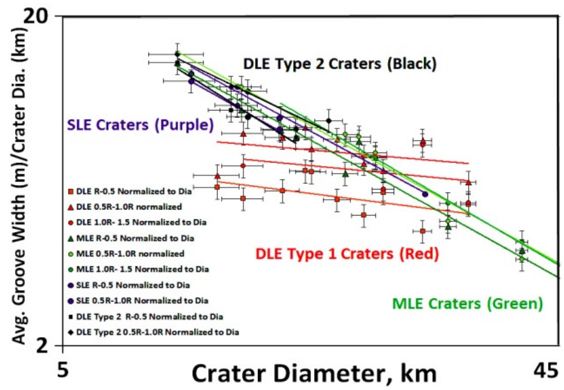

Figure 1 b: Average width of radial grooves normalized to crater dia.

Ramparts: Widths. Rampart ridges typically are found at the outer edge of each ejecta layer [9-11]. Boyce et al., (2010) found that the ramparts of the inner ejecta layer of DLE type-1 craters are systematically wider than those on SLE and MLE crater ejecta. We have measured the average width of ramparts in a sample of fresh DLE-type 2 craters and compared them with previous data [1]. These are plotted in Figure 2 that shows that the average rampart widths of both ejecta layers of DLE-type 2 craters are similar to those of SLE and MLE ramparts, but different than DLE-type 1 ramparts, as well as different than the relatively narrow ramparts of the outer ejecta layer of DLE-type-1 craters (which are systematically slightly wider than ramparts on similar size SLE and MLE craters).

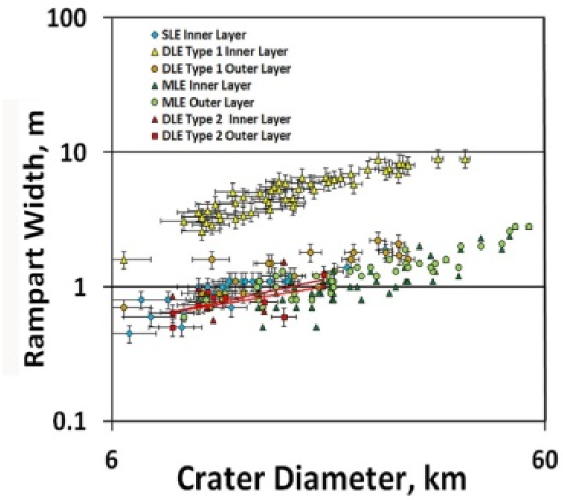

Figure 2: Width of rampart ridges at the terminations of ejecta layers. Red lines are regression lines for ejecta layers of DLE type-2 craters. Error bars indication horizontal measurement errors of ~ 10% in crater dia. and ~ +/- 15% width of rampart.

Ejecta topographic profile: Boyce et al (2010) have shown that the profiles of ejecta deposits are different with crater type. In Figure 3 we have compared the profile of DLE type-2 craters with the profiles from [1] for the other types of craters. This figure shows that DLE type-2 crater ejecta like that of MLE craters, thins rapidly from the rim quickly becoming nearly uniform thickness outward with each layer terminating in a narrow rampart.

Conclusions: Morphometric parameters presented here are consistent with the contention of [2] that there are DLE type-2 craters on Mars and that their ejecta deposits

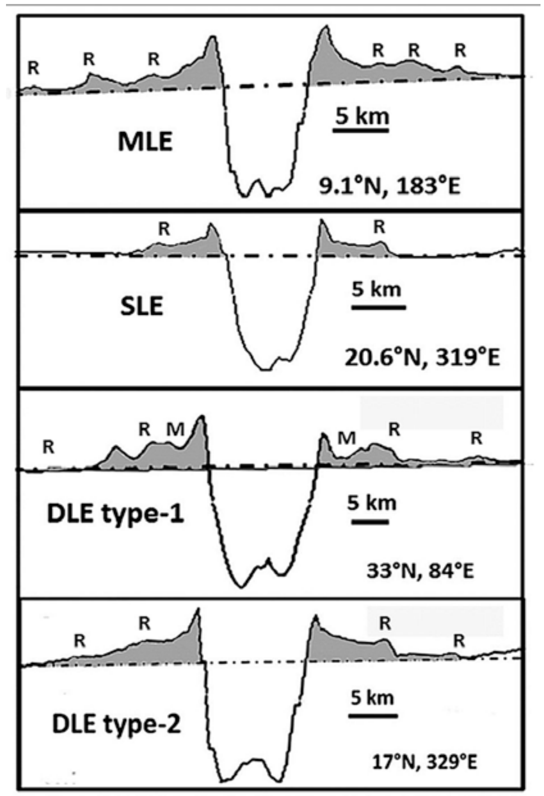

Figure 3: Cross sections of the types of layered ejecta craters based on MOLA 1/°128 DEM data. R indicates rampart location, and M moat location. Horizontal line is approximate location of pre-impact surface. Vertical exaggeration is ~ 10.

morphometrically resemble SLE and MLE ejecta deposits. Based on the shape of DLE type-2 ejecta layers, we suggest that they are merely a natural part of the progression from SLE to MLE type craters. In addition, we suggest that to account for the two types of DLE craters the simple nomenclature recommended by the Mars Crater Consortium [4] may require an additional descriptor in their designation.

References: [1] Boyce, J. M. et al., 2010, MAPS 45; 661; [2] Barlow. N., 2015, LPSC XXXXVI, Abst. 2216; [3] Boyce, J. and Mouginis-Mark, P., 2006, *JGR*, doi:10. 1029/2005JE2638; [4] Barlow, N. *et al*., 2000, *JGR* 105, 26,733 – 26,738; [5] Shreve, R., 1966, Science 154, 1639-1643; [6] Marangunic, C., and Bull, W., 1968, Nat. Acad. Sci., 383-394; [7] Dufresne, A., and Davis, T., 2009, Geomorph., 105, 171-181; [8] DeBlasio, F., 2014, Geomorph., 213, 88-89; [9] Carr et al., 1977 JGR 82:4055–4065; [10] Mouginis-Mark, P.J. (1981), *Icarus* 45, 60-76; [11] Baloga, S. *et al*. 2005, *JGR* 110,doi10.102/ 2004JE00233.