**VARIATIONS IN TARGET POROSITY AFFECT EJECTA MORPHOLOGY OF A MARTIAN CENTRAL-PIT IMPACT CRATER.** Paul J. Moretti and Tracy K.P. Gregg, Dept. of Geology, 126 Cooke Hall, University at Buffalo, Buffalo NY 14260 (paulmore@buffalo.edu).

**Introduction:** The formation of Martian central-pit impact craters (CPICs) have been associated with water in the target material [1 - 4]. Here, we define "flat CPICs" as those having little or no positive relief around the rim of their floor pit.

Ejecta ramparts and lobes are Martian flat CPIC features hypothesized to indicate the presence of sub-surface target water [2,5,6]. A homogeneous target would be expected to generate uniform distribution of ramparts and lobes around the crater. Geographically segregated ejecta features might be explained by local variations in the pre-impact target porosity (and therefore water content).

**Approach**: Here, ejecta ramparts are defined as sinuous ridges at or near the terminus of the continuous ejecta blanket (Fig. 1). Ramparts may also exhibit asymmetrical slopes.

Ejecta lobes display primary characteristics that include: 1) positive topography above the surrounding ejecta blanket; 2) steeply-sloped sides, and; 3) a flat to undulatory surface. Ejecta lobes also possess one or more of the following secondary characteristics: 1) surface grooves or furrows parallel or subparallel to the lobe perimeter; 2) cracks on the lobe's undulating surface; 3) a long axis radial to the crater rim, and; 4) a large size compared to other ejecta features.

First, CPICs were identified from a pre-existing, Martian impact crater database (http://webgis.wr.usgs.gov/pigwad/down/mars_crater_consortium.htm#Historical) [7,8]. Second, flat CPICs were extracted from the CPIC data subset and plotted onto a water-mass fraction map [9,10]. Then, from the flat CPIC subset, one impact crater, exhibiting both ejecta ramparts and lobes, was selected for detailed study (29.08° S, 98.29° E): ID #244 [7, 8]. Last, a detailed examination of: 1) the target's geologic history and; 2) the distribution of its rampart and lobe ejecta features around the crater was made.

**Results**: Ten flat CPICs were identified within the impact crater CPIC data-subset extracted from the larger Barlow impact crater dataset [7, 8]. Figure 2 shows that the identified flat CPICs exist within the same diameter range as do other small-diameter (<25 km) CPICs, suggesting that flat CPIC morphology is affected by more variables than those critical to CPIC formation.

The ten flat CPICs are all located on terrain that currently contains 4 – 6 wt.% $H_2O$ (Fig. 3).

Ejecta ramparts are observed in the northwestern quadrant of #224's continuous ejecta blanket and ejecta lobes are found in its southwestern quadrant (Fig. 1).

Figure 4 presents the inferred geologic history of the Martian surface now occupied by crater #244. The southwest rim of #244 overlaps the northeast portion of the rim of an older impact crater (Crater "A" in fig. 4). The sub-surface modifications caused by crater A could have disrupted the substrate sufficiently to modify the target porosity and, therefore, its potential water content.

**Discussion and Conclusions**: Ejecta ramparts and lobes are observed in the continuous ejecta blanket of crater #244, and the geographic segregation of these two ejecta features is consistent with spatial variations in the target substrate at the time of impact.

It has been proposed that the Martian atmosphere is responsible for ejecta ramparts [11]. However, atmospheric interaction should yield a symmetrical distribution around the crater rather than the observed asymmetrical distribution. Therefore, pre-impact target properties, such as localized porosity variations, could account for the location of specific ejecta features in crater #244. However, further research is necessary to quantify the effects of target porosity on impact crater ejecta.

**References**: [1] Smith, E.I., (1976), *Icarus, 28(4)* 543-550. [2] Carr, M.H., et al. (1977) *JGR, 82(28),* 4055-4065. [3] Bramson, A.M., et al. (2015) *GRL 42*, doi:10,1002/2015GL064844. [4] Williams, N.R., et al. (2015) *Icarus 252*, 175-185. [5] Gault, D.E. and Greeley, R. (1978), *Icarus 34(3)*, 486-495. [6] Barlow, N.G. (1994), *JGR 99(E5),* 927-10,935. [7] Barlow, N. G., et al. (2000), *JGR 105*, 26,733-26,738. [8] Barlow, N.G., et al. (2003) *Mars Crater Consortium*. [9] Boynton, W.V., et al. (2002) *Space Sci. Rev*. *110*, 37-83.; [10] Tanaka K.L., et al. (2014), USGS Map I-3292, 1:20M. [11] Schultz, P.H. and Gault, D.E. (1979) *JGR 84(B13),* 1669-7687.

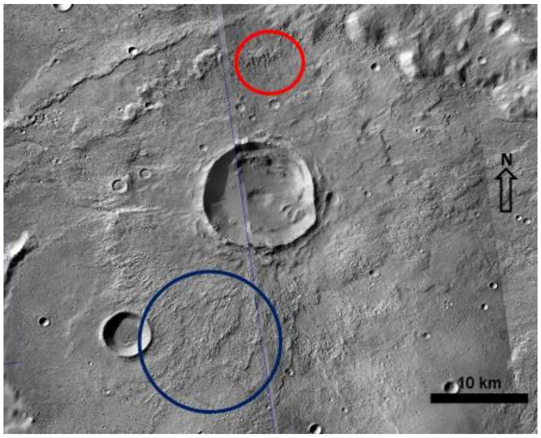


Figure 1. ConTeXt Camera (CTX) images B02_010390_1500_XI_30S261W and B18_007_964_XN_ 29S62W over THEMIS daytime IR image identifying a portion of the ejecta rampart (red circle) and the region of ejecta lobes (blue circle) of impact crater #244 (center) as viewed using JMars. CTX images courtesy of NASA/JPL/MSSS.

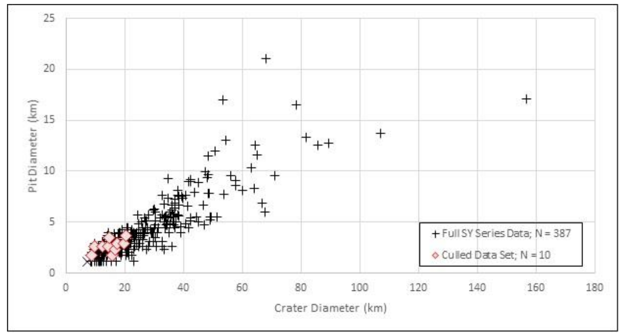


Figure 2. The 10 selected flat central-pit impact craters (CPICs) and 387 remaining symmetrical CPICs in the data set (excluding 19 CPICs with no crater diameter data). Note that the flat CPICs all have diameters within 5-25 km.

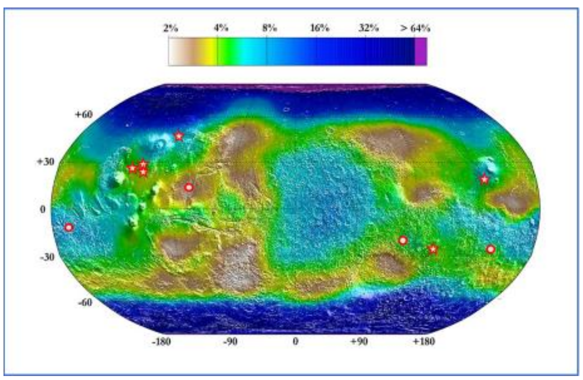


Figure 3. Note that the 10 flat central-pit impact craters plotted on a water mass fraction map are located on terrain that contains 4 – 6 wt.% water. From http://mars.nasa.gov/ odyssey/mission/ instruments/grs/ [9].

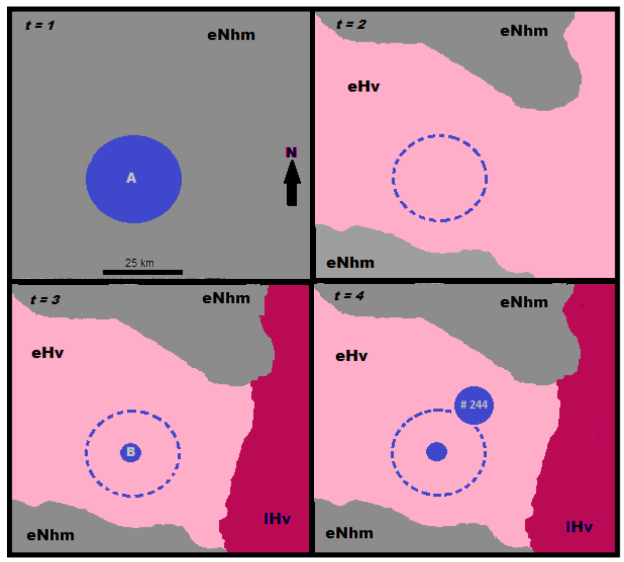


Figure 4. Target history of impact crater #244 (29.08° S, 98.29° E) from [10]. At time (t) = 1, an early Noachian-aged highland massif (eNhm) unit (grey) has been modified by impact crater A (blue). At t = 2, an early Hesperian volcanic (eHv) unit (pink) blankets the region, filling in impact crater A. By t = 3, a late Hesperian volcanic (lHv) unit (magenta) covers the eastern edge of the region and a second projectile creates simple impact crater B in unit eHv. Finally (t = 4), impact crater #244 forms.