PRESERVATION OF THERMOPHYSICAL EJECTA FACIES IN MARTIAN CRATERS NEAR THE TRANSITION DIAMETER.

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Introduction: A detailed understanding of the morphologic and thermophysical expression of Martian crater ejecta deposits represents an important baseline for impact process modeling as well as identification of past and present modification processes. The results presented here build on previous work that characterized some of the least-modified ejecta deposits of craters with diameters between 1 and 10 km [1,2]. These initial studies focused on craters that fit typically-used criteria for “fresh” craters (sharp morphology, large depth/diameter ratio, presence of pitted material and/or crater rays). The ongoing mapping presented here has examined craters of similar sizes that appear to have undergone more modification, with the goal of determining what, if any, unique changes in thermophysical expression characterize changes in these deposits due to erosional and depositional processes that postdate crater formation.

Method: Generation of thermal inertia mosaics for mapping were completed using similar methods to earlier studies [described in more detail by 1]. Mapping is completed in ArcGIS v10 relying solely on thermal thermal inertia mosaics whenever possible. When data gaps are present in the mosaics, contacts are identified in orthorectified THEMIS daytime infrared images or are inferred. The criteria used to define thermophysical units are the same for each mosaic, to allow for direct comparison of quantitative measurements even if different mappers generated those results. Units are defined using ArcGIS polygon feature classes and are modified using the application’s editing functions (e.g. clip) so that each mapped pixel belongs to a single map unit. Final map units are used to “extract” portions of the thermal inertia mosaic so statistics can be generated using only the pixels in each unit and to generate final map products that use different image stretches for each map unit. Previous work [3] noted that crater floor units have similar ranges of thermal inertia to ejecta deposits, but may appear to have a lower thermal inertia in images due to the proximity to higher thermal inertia crater walls that effectively “wash out” the contrast between pixels on the crater floors. Using separate stretches for each unit helps to mitigate this effect.

Preliminary Results: Comparison of the least-modified craters mapped by [1,2] to more modified deposits shows some expected changes to thermophysical units. The relative spatial extents of the thermophysical ejecta facies are shown in Figure 1 and discussed below.

Thermally discontinuous units: These units are defined by their radial pattern in thermal data, and are found outside continuous ejecta deposits that lack the radial quality. Thees discontinuous units exhibit the most obvious effects of modification. Examining the most well-preserved deposits illustrates some of the effects of underlying topography. When a large nearby topographic obstacle is present (typically another larger crater), the thermally discontinuous ejecta has a significantly different thermophysical expression. When obstacles are present, the thermally discontinuous unit often has an interfingered (“mixed”) appearance, containing both thermally-bright and thermally-dark materials. When obstacles with significant topographic relief are present, this discontinuous deposit may be markedly asymmetric. In craters with little/no local topographic relief, the thermally discontinuous ejecta typically consists of a thermally bright inner facies with a more distant outer facies that is thermally dark. The outer discontinuous unit can extend beyond 10 crater radii from from the rim, even in craters that are not considered “rayed” (e.g. Istok, Noord). The extent of the mappable outer discontinuous deposits decreases with increasing modification, which is to be expected as finer grained material is most easily removed by ongoing aeolian processes. The more resistant inner discontinuous deposits appear to persist longer, as craters with some modification will have thermally bright discontinuous ejecta but no mappable dark discontinuous facies.

Thermally continuous units: The units, which lack the radial signature of discontinuous units but typically have a thermally-distinct outer marge, also exhibit clear asymmetries when topographic obstacles are present. These continuous units are more resistant to modification than the discontinuous facies, and are present even when discontinuous units cannot be mapped in thermal inertia mosaics. An interesting case is the crater Bam, which contains two mappable continuous ejecta facies in thermal inferred data: this crater is clearly somewhat modified as the ejecta is overlain by multiple wind streaks. A nearby crater of similar size that is likely less modified, however (crater Resen), has only one mappable continuous facies.

Morphologic mapping and further examination of inferred images will be used to examine if the outer continuous deposit at Bam is a product of modification or a feature unique to the impact that formed this crater (no other mapped craters have two distinct continuous ejecta facies).

Crater floors and walls: Thermophysical characteristics of crater floors and walls are fairly consistent through the craters mapped here, regardless of amount of modification. Floor units typically have thermal inertia values similar to those in ejecta deposits, with higher values often correlating to observed wall slumps and talus deposits. Crater walls have typically high thermal inertia values consistent with more coherent deposits. It seems likely that the well-preserved craters mapped in this study have not yet experienced enough modification to significantly alter the thermal characteristics of wall and floor deposits.

Conclusions: Although preliminary, the results presented here suggest that there are identifiable thermophysical changes present in ejecta deposits that have been modified since emplacement. Ongoing work will further characterize these changes with the goal of identifying the primary characteristics of Martian crater ejecta and the chronology of changes likely to occur in these deposits due to ongoing modification processes.

References: [1] Piatek, J.L. et al., 2018. *LPSC* 49, #2691. [2] Tornabene, L.L.. et al., 2018. *LPSC* 49, #2431. [3] Piatek, J.L.. et al., 2017. *LPSC* 48**,** #2752.

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Figure 1: Graph of relative thermophysical ejecta facies extent for each mapped crater. The dark circle at the center of each represents the mapped crater floor and wall units. All distances are in units of crater radii, so the extents of mapped ejecta facies can be more easily compared from crater to crater. “Mixed” discontinuous ejecta units have both thermally bright and dark radial features, while the “inner” discontinuous units are typically thermally bright while “outer” units are typically thermally dark. Craters are labelled below the associated graph, and are roughly grouped based on extent of discontinuous ejecta. The bottom row represents craters with more modification, as demonstrated by the smaller extent of discontinuous ejecta (or absence of same, for crater Kontum).