CHARACTERIZATION OF THERMOPHYSICAL EJECTA FACIES IN WELL-PRESERVED MARTIAN CRATERS . J. L. Piatek[1], L. L. Tornabene[2], R. Capitan[2], I. Murphy[1], N. G. Barlow[3], G. R. Osinski[2,4], and S. J. Robbins[5], [1]Dept. of Geological Sciences, Central Connecticut State University, New Britain, CT (piatekjel@ccsu.edu) [2]Centre for Planetary Science & Exploration (CPSX) and Dept. of Earth Sciences, Western University, London, ON, [3]Dept. of Physics & Astronomy, Northern Arizona University, Flagstaff, AZ, [4]Dept. of Physics & Astronomy, Western University, London, ON, [5]Southwest Research Institute, Boulder, CO.

Introduction: The goal of this ongoing work is to characterize ejecta deposits as a baseline to better understand impact processes, particularly those that involve interactions with subsurface volatiles and/or the atmosphere. Previous work [1,2] focused on detailed examination of craters near the transition diameter (~4–8 km) thought to represent the best-preserved/least modified deposits, due to the presence of features such as pitted material, sharp morphologies, and large depth/diameter ratios. Results from ongoing mapping of high-resolution visible imagery, including description of a newly-characterized continuous ejecta facies (deposited beyond the "rampart" typically considered as the boundary of continuous deposits) is presented at this conference by [3].

Method: Thermophysical maps are based on quantitative thermal inertia (TI) derived from THEMIS images and merged into image mosaics, as described in previous abstracts related to this work [1]. Thermal inertia images are generated in ENVI using lookup tables from the model of [4] via custom IDL routines available at [5]. Values of dust opacity are varied to best match observed thermal inertia values in overlapping images. The resulting mosaic needs minimal color balancing/edge feathering, although inconsistencies in TI value do exist across image edges, likely due to differing image quality and/or edge artifacts not removed during processing. The overall range of TI values in adjacent images are relatively consistent, however, allowing for collection of reasonably reliable statistics across image mosaics.

Mapping and further analyses are completed in ArcGIS v10. Map units are defined based solely on the thermal inertia (TI) mosaics where possible, but informed by THEMIS day infrared images where contacts are unclear or where gaps in mosaics occur. To make sure unit boundaries are consistent in these cases, the TI mosaics are aligned to orthorectified THEMIS day images if available, or to the MOLA gridded dataset if not. Map units are defined using polygon features, allowing for statistical analysis of the points contained within units. Overlapping features are modified using ArcGIS functions (e.g. cut, crop) so each map pixel is part of one, and only one, map unit. Finalized map units can be used to analyze statistics within the unit and to create "extracted" units that contain only the pixels within each unit. The latter allows each unit to have a unique image stretch, so to better enhance variations. It was noted previously [1] that crater floor units often appear to the eye to be darker (lower TI value) even though actual pixel values are similar to those found in ejecta units; this effect is possibly due to the proximity of bright (higher TI) wall units. Using separate stretches for each unit reduces this effect.

Results: Initial statistical results focus on characterization of the best-preserved crater deposits as a baseline for identifying the effects of modification. These will be expanded to include craters in various stages of degradation and to account for variations in ejecta units that are not present in all mapped craters. Thermal inertia ranges and means for each unit are shown in Figure 1.

Crater floors. These units are characterized as lower thermal inertia areas enclosed by higher inertia walls. TI values for these units represent a range of particle sizes and/or porosities, consistent with floor units containing porous fill or talus deposits and slumps from steep walls as well as subsurface features that may represent an incipient central peak uplift (these craters are near the simple/complex transition diameter).

Crater walls. As expected, wall units exhibit both the widest range and highest overall TI values. The high values are likely associated with blocky deposits and potential exposed bedrock while lower values are consistent with finer (gravel/sand/dust) deposits lying on top of wall blocks, such as mass wasting/talus deposits commonly observed in visible images.

Thermally continuous ejecta: The definition of this unit used in mapping includes all ejecta that is adjacent to crater walls extending to a thermophysically distinct margin, likely associated with the "rampart" edge of layered ejecta facies. All mapped craters have a thermally-distinct continuous ejecta margin, although this margin may have been identified using daytime IR images when local topography interferes. Aside from the margin, the thermally continuous ejecta has no additional characteristic thermophysical variations: these do not exhibit radial patterns, nor do deposits appear strongly graded with higher TI values closer to the crater walls. In the initial results, this unit contains a relatively wide range of thermal inertia values at each crater, although the mean for each skews to lower values. One crater (Bam) appears to have two distinct thermophysical margins within the continuous ejecta dividing it into concentric units, but only the outer most margin is distinct in visible images.

Thermally discontinuous ejecta: Thermophysical contrasts in radial discontinuous ejecta are not consistent: some craters have "inter-fingered" values of high and low TI while others have higher TI inner deposits with distinctly lower TI distal deposits. Discontinuous/distal ejecta facies can extend up to 20 crater radii from the rim, although most is located within 5-10 crater radii. In some cases, radial deposits with have high TI values consistent with large blocks of ejecta and/or secondary craters not visible at THEMIS resolution. Discontinuous ejecta units are not always contiguous, and are clearly disrupted by the presence of nearby topographic features. Furthered detailed mapping and statistical analyses will be required to better identify where material has been deposited and where it was removed during impact.

The unique ejecta deposits presented by [3] do not have distinctive thermophysical signatures: without the high-resolution visible images, it would be difficult/impossible to identify this unit in TI mosaics. Further mapping and comparison will be used to determine if this is simply an effect of differing image resolution or if the thermophysical properties of this ejecta facies are truly indistinguishable from what is mapped here as discontinuous ejecta.

Conclusions: Thermophysical mapping of the least-modified Martian craters has identified distinct thermal inertia patterns likely related to impact and ejecta emplacement processes. These initial results will serve as a baseline for further detailed analyses, comparison with morphologies observed in high-resolution visible images, and identification of changes due to modification of ejecta deposits by the Martian environment.

References: [1] Piatek, J.L. et al., 2017. *LPSC* 48, #2752. [2] Bina, A. et al., 2017. *LPSC* 48, #2856. [3] Tornabene, L.L. et al., 2018. *LPSC* 49**, t**his conf. [4] Putzig, N. and M. Mellon, *Icarus* 191, 68-94. [5] http://www.physics.ccsu.edu/piatek/jenvi/.

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Figure 1: *Bar graphs displaying ranges of thermal inertia values for mapped thermophysical units in initial crater maps (names along x axis, in no particular order). Values given in MKS units (J m^{-2} K^{-1} $s^{-0.5}$), with circles marking the mean for each unit. The top two graphs represent the crater floors (left) and walls (right), the bottom are data from ejecta facies: thermally continuous (left) and thermally discontinuous (right).*