2019 UPDATE ON THE GEOLOGIC MAP OF THE BOREALIS QUADRANGLE (H-1) ON MERCURY.

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Introduction: We are completing a geologic map of the northern polar region of Mercury (H-1 Borealis Quadrangle) using MESSENGER orbital observations at 1:5M map scale. Our mapping leverages current and ongoing USGS-supported geologic mapping efforts of the 1:15M-scale Mercury global geologic map [1–4] and the 1:5M-scale H-10 Derain Quadrangle [5] to establish basic standards and practices for quadrangle mapping of Mercury using MESSENGER data.

Mapping Progress: For 2019 (Project Year 3), we are focusing on finalizing the map components and preparing for map submission. This task encompasses finalizing the Description of Map Units (DOMU) and Correlation of Map Units (COMU), along with the text for the map pamphlet, and finalizing the GIS package for map submission. The current map and draft unit definitions for plains materials are shown on the following page [**Fig. 1**]. We are behind schedule for map completion, in part due to the partial government shutdown from December 2018/January 2019, and expect to submit the map at the conclusion of this project year.

Although we planned to determine relative ages for units and features in Year 2, we were unable to complete that task last year. In particular, we have made preliminary progress in completing the impact crater classification and degradation state assessment and expect to make substantial progress by the Annual Planetary Mappers Meeting in June. Impact structures ≥20 km in diameter and their related materials will be classified according to degradational state using the methodology applied in the global geologic mapping effort [e.g., 4,6]. Current definitions and interpretations for four types of crater materials are shown in **Fig. 2**; we have worked closely in conjunction with Kincyzk and Whitten to develop and refine these definitions during mapping.

Consistently mapping the intercrater plains, the most areally extensive geologic unit on Mercury [e.g., 7], remains a challenge in H-1 as it does for other USGS-supported mapping investigations [4, 5]. The intercrater plains is comprised of gently rolling plains materials in between large craters and basins, with a high spatial density of small, superposed craters ~5–15 km in diameter that is indicative of a complex resurfacing history [5, 7]. In H-1 we mapped two intercrater plains units primarily distinguished by textural differences. However, we may revise our unit definitions and mapping dependent on current mapping efforts for the global map and the H-10 quadrangle, both of which are employing multiple techniques in an attempt to consistently and confidently subdivide the intercrater plains.

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References: [1] Prockter, L.M. et al. (2016) LPS 47, Abst. 1245. [2] Kinczyk, M.J. et al. (2016) PGMM, Abst. 7027. [3] Kinczyk, M.J. et al. (2017) 3rd Planetary Data Workshop, Abst. 7116. [4] Kincyzk, M.J. et al. (2018) PGMM, Abst. 7031. [5] Whitten, J.L. et al. (2018) PGMM, Abst. 7027. [6] Kinczyk, M.J. et al. (2017) LPS 48. Abst. 2717. [7] Trask, N.J. & Guest, J.E. (1975) JGR, 80, 2461-2477.

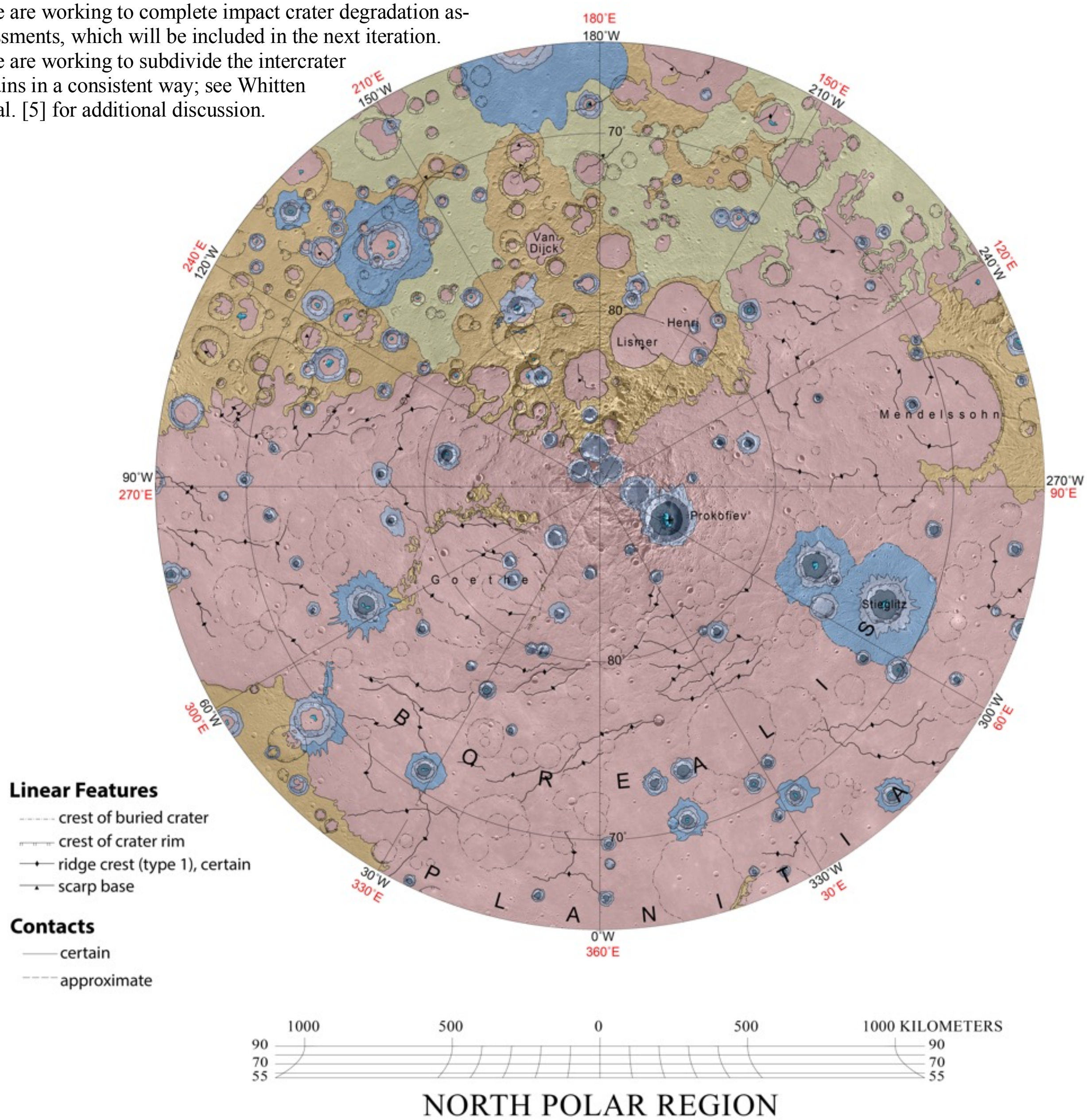
Crater Materials – Impact craters ≥20 km in diameter exhibiting various degrees of degradation and burial.

Here, a single set of crater materials symbols are used until the new degradation sequence for Mercury is applied.

c	Crater material – Material of craters with identified rims, ranging from discontinuous, degraded rims to relatively distinct rims exhibiting little erosion; crater walls terraced in some instances. Inclusive of continuous ejecta deposit if present, which forms a smoothed annulus surrounding the crater rim and may include scalloping at the distal margin. *Interpretation: Crater rim materials consisting of overturned flap and fallback; crater walls include bedrock, may exhibit slumping. Continuous ejecta deposit reflects ballistically emplaced materials mixed with pre-existing materials.*
cf	Crater floor material – Material on crater floors in ps1 and ps2 typically hummocky or hilly, often superposed with larger secondary craters or other ejecta. Material on crater floors in ps typically flat and smooth with distinct contacts at the crater walls and central peak, if present. *Interpretation: Crater floors filled with crater ejecta or ps for craters in ps1 and ps2; may be combination of both ejecta and volcanic material. Smooth crater floors reflect presence of impact melt resurfacing in ps.*
cp	Crater central peak material – When present, generally a single peak, occasionally clusters of multiple small peaks; peaks typically located near crater center. *Interpretation: Formed by upwelling and rebound during the impact process. Crater central peaks in ps1 and p2 frequently degraded and/or partially buried by crater floor material.*
cr	Crater discontinuous ejecta material – When present, moderately to well-developed, radially lineated, distinctive annulus frequently dominated by secondary crater chains and clusters. Adjacent to crater material (specifically the continuous ejecta deposit). *Interpretation: Ballistically emplaced materials mixed with pre-existing materials dominated by secondary impact crater-forming ejecta fragments.*

Fig. 2: Working definitions and interpretations for four different types of crater materials currently mapped in H-1. Degradation assessment in progress.

Fig. 1: Current draft of the H-1 Borealis Quadrangle map. We are working to complete impact crater degradation assessments, which will be included in the next iteration. We are working to subdivide the intercrater plains in a consistent way; see Whitten et al. [5] for additional discussion.



Plains Materials

ps

Smooth Plains Material – Flat to gently rolling plains, sparsely cratered, occurring in topographically low areas (Borealis Planitia) and within some basins. Stratigraphically younger than other plains materials. Contacts with older units are observed to be sharp with distinct boundaries in some locations or exhibiting a gradational contact (where older terrain was embayed). *Interpretation: Volcanic plains emplaced by effusively erupted lavas; no volcanic vents observed. Hosts abundant tectonic deformation, primarily in the form of narrow to broad wrinkle ridges. Pervasive arcuate tectonic deformation forming wrinkle ridge rings interpreted to reflect the rim crests of buried craters.*

pi1

Intercrater plains (Younger) – Lie between large craters and basins, contains fewer superposed craters (~5–15 km diameter) than pi1 and more than ps, appear to have lower albedo than ps and pi2. Texturally intermediate between ps and pi2: rougher than ps and smoother than pi2. Embayment relations with ps gradual without a distinct contact. Boundaries with pi2 uncertain; approximate contact. *Interpretation: Mixture of volcanic deposits and impact materials, including both basin and crater ejecta. Evidence of emplacement by lava or fluidized ejecta abundant.*

pi2

Intercrater plains (Older) – Lie between large craters and basins, contains highest density of superposed craters (~5–15 km diameter) of the plains units, hummocky texture. Contacts with pi1 indistinct and uncertain. Some contacts with ps distinct, whereas others gradational. *Interpretation: Mixture of basin and crater ejecta and associated materials and volcanic plains emplaced nearing the end of the Late Heavy Bombardment.*