UPDATE ON THE GEOLOGIC MAP OF THE BOREALIS QUADRANGLE (H-1) ON MERCURY.
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Introduction: With MESSENGER observations of the Borealis Quadrangle (H-1), we are drafting a new geologic map at 1:5M map scale for the northern pole of Mercury. Mapping at this scale allows for direct comparisons with the original Mariner 10-based USGS geologic maps for Mercury [1], enabling assessment of similarities and differences between the mapped geologic unit boundaries, unit descriptions and observations, and the derived regional chronostratigraphy. Furthermore, our mapping is leveraging the 1:15M-scale global geologic map [2-4]. The global map provides context for mapping in the H-1 quadrangle, and also serves as one of several bases for geologic unit and feature definition. Importantly, the new H-1 map will be among the first USGS Scientific Investigations Map (SIM) series map published for a geologic quadrangle prepared with MESSENGER data–and so provides an opportunity to establish basic standards and practices for quadrangle mapping of Mercury in conjunction with the global map and other quadrangle efforts now being prepared for USGS publication.

Mapping Effort: Three general tasks were defined, informed by past experience both producing and publishing geologic maps with the USGS and by mapping other regions of Mercury's surface and conducting crater analyses. *Map production (Task 1)* will result in a geologic map of H-1 from MESSENGER datasets compiled in GIS format. *Age determination (Task 2)* will assign relative ages to mapped units from observed stratigraphic relationships and measures of areal crater density, so as to place the mapped units in the new chronostratigraphic system for Mercury [e.g., 5, 6] and develop a geologic history for H-1. When possible, absolute model ages will be derived from those crater measurements. *Map publication (Task 3)* encompasses map submission, revision, and publication.

Mapping Data: The MESSENGER Mercury Dual Imaging System (MDIS) monochrome mosaic serves as our basemap and is comprised of Narrow Angle Camera (NAC) and Wide Angle Camera (WAC) images at ~166 meters per pixel (m/px). This mosaic includes images with low emission angles and moderate- to high-incidence angles favorable for emphasizing morphology and topography, which are beneficial for mapping.

We use both the MESSENGER Mercury Laser Altimeter (MLA) digital elevation model (DEM) (covering 55°N–90°N at 500 m/px) and the MDIS DEM [7] (with global coverage at 665 meters per pixel) will be used as needed to aid in identification and mapping of physiographic landforms and geologic units.

Mapping Progress: In 2018 (Project Year 2), we are focused on determining relative ages for units and features through the use of stratigraphic relationships and crater analyses. Our strategy relies on a combination of measured crater densities and crater size–frequency distributions for those geologic units with sufficient spatial extent, coupled with evaluation of stratigraphic relationships for features (and feature classes) and spatially limited geologic units. We are classifying impact structures ≥20 km in diameter and their related materials according to degradational state, applying the methods used in the new global geologic map [e.g., 8]. We are revising the geologic map draft as needed as the project progresses. We continue to refine geologic unit definitions to best represent our mapping, considering at the same time the units identified and described by previous and ongoing mapping efforts, such as those from the original H-1 quadrangle map [9], the current global map [2-4], recently NASA-funded quadrangles [e.g., Whitten et al., DDAP16], and other quadrangles mapped as part of planning activities for the upcoming ESA Bepi-Colombo mission [e.g., 10, 11].

A representative mapping area containing many of the observed geologic units and features is shown in **Figure 1** and geologic unit definitions currently in use are contained in **Table 1**. At present, we have identified two intercrater plains units, Intercrater Plains (Younger) and Intercrater Plains (Older), distinguished primarily on the basis of superposed crater density.

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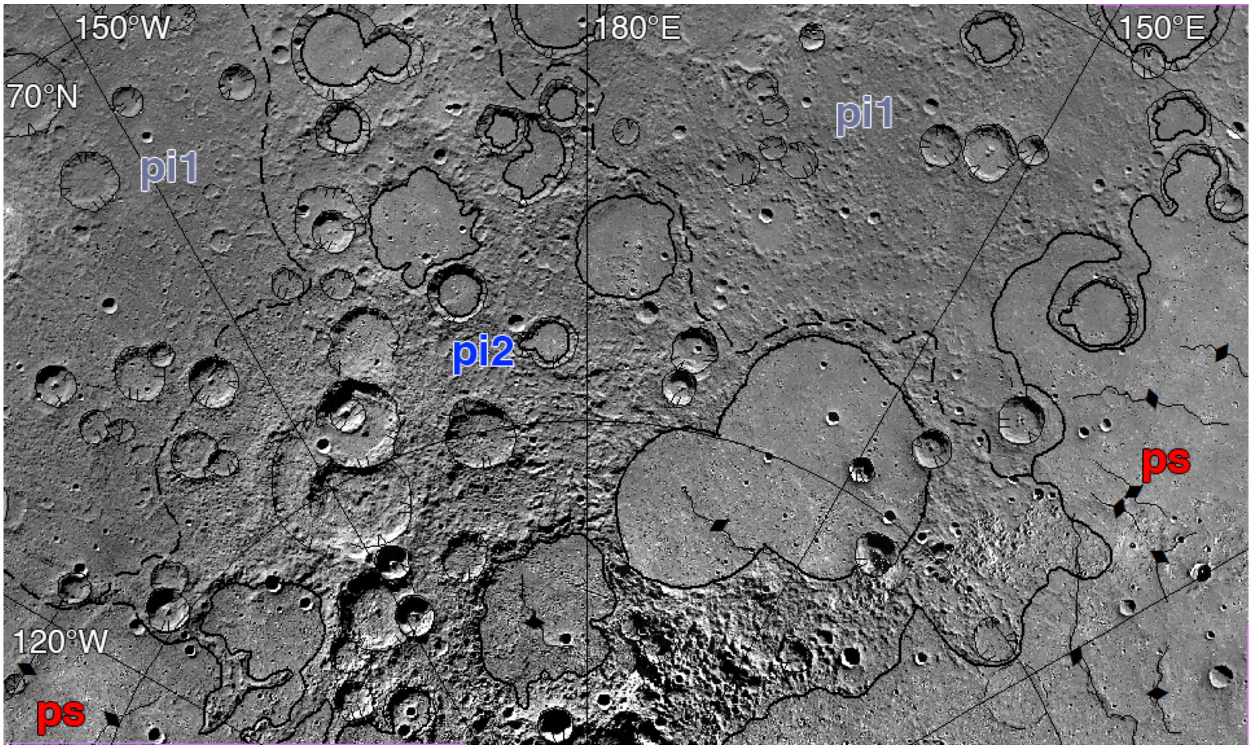

Figure 1. A mapped portion of the H-1 quadrangle selected here as a representative area, where many of the identified geologic units and features that characterize the quadrangle are observed. The north pole is toward the bottom of the figure, beyond the figure extent. In lieu of colored map units, the linework is overlaid on the MDIS monochrome basemap and geologic units are identified by colored symbols [Table 1]. Neither the degradation state of impact craters nor the extent of crater materials is shown.

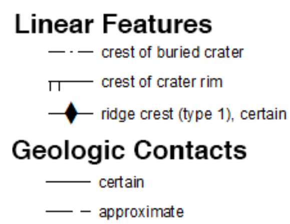

Table 1. Geologic units and their definitions currently in use.

Plains Materials		
ps	Smooth Plains	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).
pi1	Intercrater Plains (Younger)	Lie between large craters and basins, contains fewer superposed craters (~5–15 km diameter) than Intercrater Plains (Older) and more than the Smooth Plains, appear to have lower albedo than the Smooth Plains and Intercrater Plains (Older). Texturally intermediate between the Smooth Plains and Intercrater Plains; rougher than Smooth Plains and smoother than Intercrater Plains (Older). Embayment relations with Smooth Plains gradual without a distinct contact. Boundaries with Intercrater Plains (Older) uncertain; approximate contact
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 Intercrater Plains (Younger) indistinct and uncertain. Some contacts with Smooth Plains are distinct, whereas others are gradational.