DISTINGUISHING GEOLOGICAL UNITS IN MERCURY'S INTERCRATER PLAINS IN THE CONTEXT OF THE GLOBAL GEOLOGICAL MAP. Mallory J. Kinczyk[1], Brett W. Denevi[2], Debra L. Buczkowski[2], Louise M. Prockter[3], Paul K. Byrne[1], Lillian R. Ostrach[4], Evan Miller.[1] [1]North Carolina State University, Raleigh, NC 27695. [2]The Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723. [3]The Lunar and Planetary Institute, Houston, TX 77058. [4]U.S. Geological Survey, Astrogeology Science Center, Flagstaff, AZ 86001.

Introduction: Scientific analysis and geological mapping of Mercury have greatly increased in the last decade. Even after the conclusion of the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) orbital mission in 2015, the wealth of data it returned has led to many important insights into the formation and evolution of the innermost planet. The first spacecraft to observe the surface of Mercury was Mariner 10, launched in 1973, which conducted 3 flybys and imaged ~45% of the surface. From these data were produced nine geological quadrangle maps of the surface [1] that aided in piecing together the first picture of Mercury's geological history.

The production of global data products such as image mosaics at multiple viewing geometries [2], geochemical datasets [3–5], and geophysical products (e.g., crustal thickess and gravity) [6] from the MESSENGER mission facilitated the identification and cataloging numerous geological features. Global catalogs were developed for crater and basin rims [7], ghost craters [8], smooth plains [9], tectonic structures [10], pyroclastic vents [11] and hollows [12]. These databases have been synthesized into the geological map, creating the first global view of Mercury's geological setting [13]. However, there is still much to learn about Mercury's geology, one aspect of which is gaining a better understanding of Mercury's intercrater plains.

Background: The Mariner 10 quadrangle maps distinguished several plains materials on the basis of morphology that included "smooth plains," "intercrater plains," and "intermediate plains." Mercury's smooth plains are gently rolling plains materials with a low abundance of superposed craters and typically sharp contacts with surrounding terrain [14]. The intercrater plains consist of materials that lie in between large impact craters and basins >30–50 km in diameter with a high abundance of small craters 5–15 km in diameter [15] (**Figure 1**–pale blue). Intermediate plains were purported to be a less heavily cratered intercrater-like plains unit. However, analysis with MESSENGER data showed that the intercrater and intermediate plains are statistically indistinguishable with regards to crater populations, a finding that opened new questions about the nature and formation of the intercrater plains themselves [15].

While it is widely accepted that intercrater plains units comprise the largest portion of Mercury's surface at a third of the global coverage, there are substainal variations in color, texture, and crater density that warrant further study and suggest a grouping of geological units with separate origins [16]. The global mapping process has provided an opportunity to study the intercrater plains in the context of other global geological units in a manner that has not previously been done.

Methods: Here, we use the global color and monochrome data products [2] produced by the MESSENGER science team to gain a better understanding of how the intercrater plains differ across the entirety of Mercury's surface. Because the intercrater plains have many diverse characteristics, it is critical to use multiple criteria to define geologically distinct regions. The primary criteria used in this study are:

Morphology: Terrain morphology is the primary method by which geological units are distinguished on planetary bodies [17]. However, determining distinct geological contacts for subunits within the intercrater plains has proved challenging due to the apparent gradational morphologies present. The global geological map therefore incorporates a combination of approximate and gradational unit boundaries in this region.

Supervised classification: The production of the global color mosaics [2], as well as the enhanced color mosaic [2], has provided a new means by which geological materials can be distinguished. The enhanced color mosaic is a derived product that uses a principal component (PC) analysis to accentuate Mercury's compositional variations (430, 750, and 1000 nm bands with PC2, PC1, and 430/1000 ratio in the red, green, and blue channels respectively).

We conducted a supervised maximum likelihood classification [18] of the enhanced color product. Based on the previous identification of light intercrater plains and several areas of expansive low-reflectance material, we identified six regions with distinct signatures. Crater statistics will further distinguish the timing of emplacement of these materials.

Albedo: Notwithstanding Mercury's small range of reflectance variations [16], there are regions of the intercrater plains that have distinct albedo signatures relative to the overall albedo of the intercrater plains. While this is not a primary characteristic used for identifying units, there are regional variations in albedo that correlate well with our defined areas of interest, providing an additional method by which unit boundaries may be defined.

Outlook: We defined six areas of intercrater plains that are distinct based on one or more of the critera above (**Figure 1**). In general, there are three types of intercrater plains: light, dark, and intermediate (not to be confused with intermediate plains). There are two additional regions within the intercrater plains that have a similar reflectance to the northern smooth plains. However, this signature is not as distinct in the supervised classification method as it is by visual inspection.

Progress is being made to publish the global map as a USGS SIM series map. The release of the global product to the scientific community will be a valuable tool to aid in future Mercury science investigations, ongoing mission concept studies, and the current BepiColombo mission.

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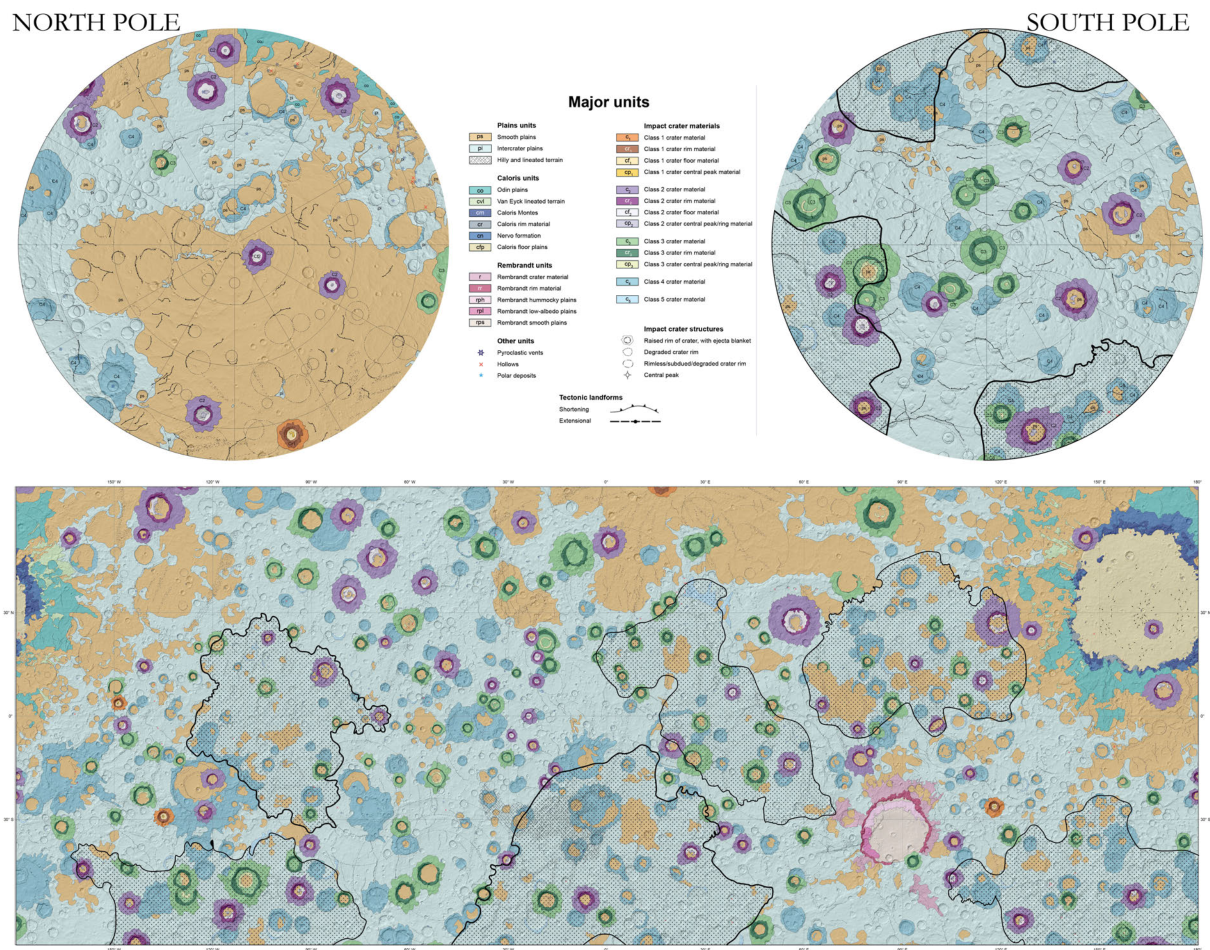

Figure 1. Draft version of the global geological map of Mercury at 1:15M scale, showing major plains units and classified craters ≥90 km in diameter. Overlain in black stipple are the six regions of interest within the intercrater plains (pale blue).