**Introduction:** The first reconnaissance of Mercury was carried out by the Mariner 10 spacecraft in the 1970s. Three flybys of the planet yielded images of just under half of the globe that were used as the basis for a U.S. Geological Survey (USGS) series of Mercury quadrangle maps [1]. However, the map authors did not follow a uniform set of mapping conventions or units, resulting in inconsistencies across map boundaries and hampering efforts to compare geologic units across multiple regions of the mapped hemisphere.

The MERCURY Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft orbited Mercury from 2011 to 2015 and imaged the planet in its entirety. A global monochrome image mosaic was released to the Planetary Data System (PDS) in May 2016 at largely uniform viewing geometry and a resolution of ~250 m/pixel [2], providing a comprehensive dataset for geological mapping. This vastly improved data product forms the basis for the first global geological map of Mercury (Fig. 1) [3]. The geological map will facilitate the comparison of units distributed discontinuously across Mercury’s surface, thereby enabling a global understanding of the planet’s stratigraphy, and providing a guiding basis for future mappers.

**Map Status:** The map has been prepared for publication at 1:15M scale and will be submitted to a peer-reviewed journal for publication. However, the standards for maps published following USGS guidelines afford detailed community feedback and result in a product that will provide a robust basis for future mappers and missions. The project team is currently in year one of funding through the PDART program to publish the map as a USGS Scientific Investigations Map (SIM) series product.

Geomorphological units for the current map are being delineated on the basis of texture, color, and topographical relief. These units include impact craters, intercrater plains [4], smooth plains [5], and ejecta facies of several large impact basins [6–8], as well as linear/point features such as tectonic landforms [9], hollows [10], and pyroclastic vents [11]. Efforts going forward for the SIM will be focused on improving the state of mapped unit boundaries based on final data products that are publicly available in the final MESSENGER PDS data release [2]. These data will also be used to enhance the map with additional delineated units as warranted.

**Mercury’s Intercrater Plains:** At present, the intercrater plains unit is the most extensive mapped unit on Mercury’s surface. It comprises plains materials that lie between large craters and basins and that contain a high spatial density of small superposed craters 5–15 km in diameter [4]. The origin of intercrater plains has been disputed, with proposed mechanisms including effusive volcanism and impact melt pools originating from ancient large impact events [12,13]. Assessing spatial color variation within the intercrater plains could further our understanding of the spatial and temporal differences within this large region on Mercury’s surface. Previously, artifacts from temporal variation in responsivity of the MESSENGER Mercury Dual Imaging System (MDIS) Wide-Angle Camera were as large as or larger than Mercury’s true color variations, preventing reliable comparisons of regional color properties. However, recalibrated data now accurately resolve regional color variations within the intercrater plains [13].

Denevi et al. [13] identified an isolated area of intercrater plains with different color properties than the surrounding regions, centered at ~10° N, 270° E. Throughout this region, the intercrater plains have moderate reflectance, and most impact craters with distinct ejecta deposits here expose high-reflectance red material (HRM), defined by a steeper spectral slope and elevated reflectance relative to Mercury’s mean. HRM is spectrally equivalent to smooth plains deposits [14], and examples of such material exposed by impact craters [15] were thought to represent older generations of buried volcanic plains. The margins of this area mark a transition to more frequent exposures of low-reflectance material (LRM) within craters and lower overall surface reflectance. This is one of several regions of observed color variations within the intercrater plains.

As part of our work to prepare the Mercury global SIM, we will seek to characterize regional changes in color, topographic, and compositional differences, as well as variations in crater degradation and crater size–frequency distributions, to identify and distinguish subunits within the intercrater plains. The presently available enhanced color mosaic shows evidence that the intercrater plains are not a morphologically or temporally homogeneous unit. Therefore, identifying, resolving, and including these subunits in the Mercury global SIM will provide information critical to future studies of the planet’s stratigraphy and early geological history.
Age Estimates for Major Surface Units: Relative and absolute model ages will be determined by evaluating stratigraphic relationships and crater areal densities and size–frequency distributions (SFDs) for units delineated during this work; we will also reevaluate published crater SFDs for previously delineated units. Impact craters ≥8 km in diameter will be measured for representative regions of each major mapped surface unit, including possible intercrater plains units, major impact basin-related units (such as the Caloris and Rembrandt units), and select smooth plains units.

By deriving their crater SFDs, we will place each unit into the current chronostratigraphic system for Mercury (i.e., Pre-Tolstoian, Tolstoian, Calorian, Mansonian, and Kuiperian [16]). Representative sections of each unit will be selected on the basis of a spatial randomness analysis [17,18]. Absolute model ages for mapped units will be derived with two modern chronologies for Mercury [19–21].

These tasks will improve the state of the current geological map and will lead to a product that will be consistent in scientific utility with other USGS SIM products.