GEOLOGIC MAP OF THE CALORIS BASIN, MERCURY. E. Goosmann[1], D.L. Buczkowski[2], C.M. Ernst[2], B.W. Denevi[2], M.J. Kinczyk[2]. [1]Colorado College 902 N. Cascade Ave. Worner Box 445, Colorado Springs, CO 80946, Erik.Goosmann@ColoradoCollege.edu; [2]The Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723

Introduction: The largest impact basin on Mercury, the 1,550 km diameter Caloris basin, is a highly complex geologic landform. The basin is floored by a spectrally distinct, high-reflectance volcanic plains unit emplaced post-impact, that covers a low-reflectance impact melt unit at least 7.5-8.5km thick [1]. In addition, several spectrally distinct pyroclastic vents have been identified within and around the basin [2]. Surrounding the basin are various ejecta units, which include the Odin Formation, a knobby plains unit that is stratigraphically and morphologically consistent as being Caloris ejecta but has the lowest crater size-frequency of any of the units associated with Caloris emplacement [3]. While the knobs are thought to be Caloris ejecta blocks, the dark, smooth volcanic plains interfingering them have been interpreted to be younger than those flooring Caloris, implying a second plains emplacement event possibly involving lower albedo volcanic material. In addition, the Odin Formation shows two distinct sub-units. The bright sub-unit, which contains fewer and fresher craters, might represent a younger volcanic flow while the dark sub-unit, which has a higher concentration of knobs, might represent Caloris ejecta. Geologic maps are useful tools in compiling geologic data into a single, accessible data source. Previous work by Mariner 10 geologic mappers covered roughly 1/3 of the basin, leaving 2/3 of the basin unmapped. We present a high-resolution geologic map of the Caloris basin based on recently acquired MESSENGER data, with the goal of synthesizing the results of these previous studies into a contextual framework for ease of access. We have integrated our detailed Caloris map into the Mercury global geologic map currently under construction [4].

Caloris basin map: Within the mapping scheme that was developed by Mariner 10 mappers, Caloris is covered by four quadrangles: H-3 Shakespeare (21º-66°N, 90º-180°W), H-4 Raditladi (21º-66°N, 180º-270°W), H-8 Tolstoj (21ºS -21°N, 144º-216°W) and H-9 Eminescu (21ºS-21°N, 216°-288º W). We mapped a Caloris-centric area that ranges from 5º-60°N, 125º-195°E, which includes both the entire basin as well as most of the surrounding dark annulus. After completing the proposed map area, we discovered that extending the map area 5^{o} to the east would better encompass the full extent of the Odin Formation. For this reason, we are actively working on mapping this additional area, as we believe including the full extent of the Odin is crucial for answering questions about its origin.

Geologic Units and Features: Map unit descriptions were based on definitions used by Schaber and McCauley [5] and Guest and Greeley [5] (Tolstoj and Shakespeare quadrangles respectively), combined with new MESSENGER data, and adjusted accordingly.

The most prominent feature rimming Caloris is comprised of smooth-surfaced, discrete, blocky massifs 1-2 km high and 100-150 km wide. First referred to as “mountain terrain” [7], the unit officially named the Caloris Montes Formation (**cm**) is interpreted to be uplifted and fractured pre-basin bedrock.

Existing in-between the Caloris Montes is an undulating to smooth unit, first referred to as “intermontaine plains” [7] and officially named the Nervo Formation (**cn**). Undulating regions appear to drape over the Caloris Montes, causing the massifs to lose their sharp relief and look muted. The unit is interpreted to be to be fallback ejecta and impact melt ejected from the excavation cavity of the basin [8].

Located mostly on the southwestern end of the basin is easily recognizable Caloris rim material that does not fall under the categories of cm or cn. We named this unit Caloris Rim Material (**crm**) and interpreted it to be uplifted pre-basin bedrock that has not fractured like the Caloris Montes. In addition, it appears to be dissected by secondary volcanic events.

Within the map are two plains units. The Smooth Plains (**ps**) unit is a relatively sparsely cratered, essentially level terrain that typically has distinct boundaries with adjacent terrain and a general lack of knobs [3]. The Caloris Floor Plains (**cfp**) is an extensive plains unit similar to ps that covers the floor of Caloris. As compared to ps, cfp shows more intense secondary deformation and is spectrally distinct due to its high-reflectance. Both units are interpreted to be volcanic in origin [1,3], however it is thought that cfp predates ps [1].

There are two geologic units considered to be facies of Caloris ejecta: the Van Eyck Formation and the Odin Formation. The Van Eyck Formation (**cvl**) consists of lineated radial ridges and grooves extending 1,000 km from the outer edge of the basin. While not ridges, radial deposits of knobs extending out from Caloris were also included as Van Eyck, as they are most likely ejecta as well. The Odin Formation (**co**) consists of hummocky plains of low, km-scale hills and embayed knobs that ring the basin in a broad annulus that extends many hundreds of km. It is proposed that the low crater-size frequency of the Odin as compared to the other Caloris units is a result of non-uniform self-secondary cratering [3], meaning that crater counts are not an accurate determinant of age, allowing for the emplacement of the Odin Formation as a Caloris ejecta unit.

Originally mapped as part of the Van Eyck by Schaber and McCauley [5], we mapped the inter-ridge plains around the curved, non-linear ridges, as Inter-crater Plains (**pi**). In addition, the curved ridges themselves were mapped as C_2 and C_1 craters as opposed to Van Eyck.

In addition to geologic units, the map includes the locations of pyroclastic deposits [2] that formed during explosive volcanic processes. The deposits were identified by their high-reflectance, red terrain and proximity to irregularly shaped, rimless pits. The presence of pyroclastic materials is important and provides insight into the distribution, abundance, and composition of volatiles in Mercury's crust. In addition, the presence of these deposits offers a key constraint on early inner-solar system formation models, as it shows that Mercury's crust is not as volatile-depleted as originally thought by previous models [2].

Crater Classification: Despite the fact that various Mercury quadrangle geologic maps have been published, none of them used the same crater classification scheme. In the original map proposal, we proposed to use our own nine part crater classification scheme based on degradation state and crater infilling. After further analysis, we determined that infilling did not vary as originally thought, in addition, for most craters it was impossible to determine whether the floor was covered by impact melt or volcanic material. As a result, all craters >20km diameter within and surrounding Caloris were classified based on the crater classification scheme being used by the Mercury global geologic mapping team to better allow the integration of the Caloris map into the global map. This classification scheme has five categories with C_1 as the most degraded and C_5 being the freshest, rayed craters. It takes into account many aspects of craters, including: rays, rim and terrace degradation, floor-wall boundary sharpness, and ejecta.

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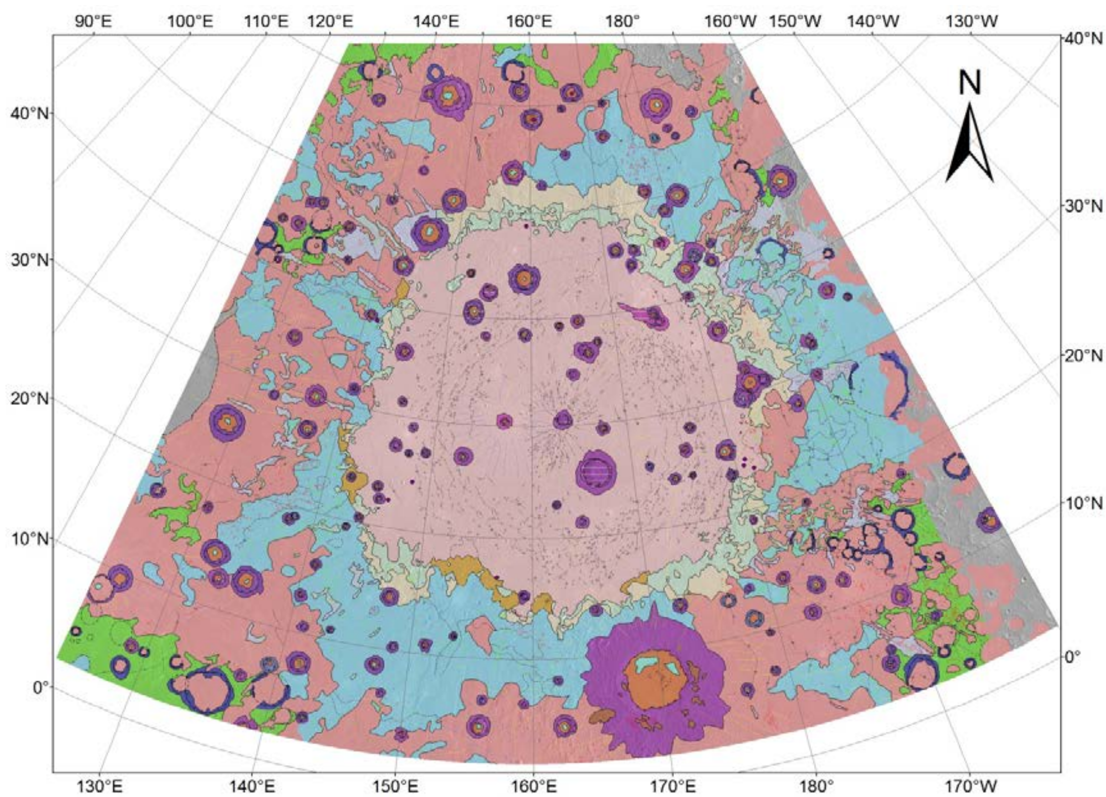

Figure 1. Geologic map of the Caloris basin, from 5º-60°N, 125º-200°E.