UNLOCKING MERCURY'S GEOLOGICAL HISTORY WITH DETAILED MAPPING OF REMBRANDT BASIN: YEAR 2. B. M. Hynek[1-2], S. J. Robbins[3], K. Mueller[2], J. Gemperline[1], M. K. Osterloo[1], and R. Thomas[1], [1]Laboratory for Atmospheric and Space Physics & [2] Dept. of Geological Sciences, University of Colorado-Boulder, 3665 Discovery Drive, Boulder, CO 80303, [3]Southwest Research Institute, 1050 Walnut St., Suite 300, Boulder, CO 80302. hynek@lasp.colorado.edu

Introduction: The Rembrandt basin on Mercury was discovered during the second flyby of the MESSENGER spacecraft. At ~715-km-diameter, it is the second largest known well-preserved basin, after the Caloris basin (~1500 km). The large basins on Mercury record a focus of subsequent geological activity, including the interplay between tectonism and volcanism. Rembrandt, in particular, records prolonged compressional and extensional tectonism and multiple volcanic flooding events. The geologic evolution of Rembrandt and surroundings includes late-stage global planetary contraction, as indicated from cross-cutting thrust faults, including the largest identified to date on the planet [1]. Understanding the geological history of Rembrandt basin is thus key to interpreting the geologic evolution of Mercury at regional to global scales. Characterizing the relationships among geological processes, including impact cratering, tectonics, and volcanism within Rembrandt can inform global activity on this poorly-understood terrestrial planet. A primary objective of this work is to produce a geologic map of the Rembrandt basin region (15°S, 65°E to 50°S, 110°E) at the 1:2M-scale that will be submitted for peer-review and publication by the USGS.

Scientific Objectives: Four goals for this project are: (1) Delineate the major geologic units in and around Rembrandt basin to infer the history of activity in a time-stratigraphic context. (2) Assess the tectonism in and around the basin, including spatial and temporal associations among the geologic units and tectonic structures. (3) Develop an understanding of how the rheology and stress fields of the lithosphere in this region affected the formation of the tectonic structures. (4) Chronicle the bombardment history of the Rembrandt region to place constraints on the basin-forming event and its subsequent modification, as well as the formation of tectonic structures both related and unrelated to the impact event.

Datasets: Basemaps provided by the USGS include a Messenger Team Global MDIS grayscale mosaic (250 m/pix) and MDIS color mosaic (665 m/pix) [2]. A 1 km/pix DTM exists over the western half of the map area [3] and custom DTMs have been generated based on stereo pairs of NAC images. Additionally, we have spent significant time making controlled mosaics from ~2600 NAC images available in the PDS, filtered by incidence angle (60°-70°; 70°-80°; 80°-90°) to highlight topographic features.

Preliminary Results: Fig. 1 shows the current complete draft of our geologic map and unit descriptions. We have delineated 11 distinct non-crater-related geologic units based on morphology, topography, texture, color (spectral information), and other primary characteristics. Large craters (>40km) were mapped based on degradation similar to the five-age classification system yielding another three units corresponding to C4, C3, and C2 craters. Additionally, 47,032 craters down to 3-km-diameter have been mapped for unit age determinations. Units related to Rembrandt basin include several classes of interior plains, hummocky material, rim material, and basin-radial lineated terrain inferred to be ejecta. Exterior units include low and high albedo plains, intermediate terrain, and heavily cratered highlands. 820 individual tectonic structures were mapped, with 89% being contractional features.

Geologic History: Highland terrain is the most ancient feature and records early heavy bombardment. The Rembrandt impact occurred around 3.9 Ga [this work; also 4] and was coeval with radial lineated terrain and low albedo exterior plains inferred to be impact melt. Plains units within and outside of the Rembrandt basin, of presumed volcanic origin, formed between 3.6-3.8 Ga. Several classes of plains units were delineated based on setting (intra- vs. inter-crater) and spectral characteristics. A few depressions inferred to be volcanic vents are present; however, most plains units entirely fill low-lying depressions and source vents are not evident.

Tectonic Activity: Within the mapping region, 606 tectonic features have been mapped that extend >10km. These features can be divided into two broad categories based on whether they resulted from global compression of Mercury's crust or post-impact basin related activity within Rembrandt. Tectonic structures related to global contraction include large, lobate scarps that cross-cut the youngest and oldest mapped units and smaller arcuate thrust faults that are predominantly found in smooth plains units exterior to Rembrandt. Basin-related tectonic features include thrust faults, graben, and high-relief ridges [e.g., 5]. These features occur within the basin rim, preferentially deform smooth, high-albedo plains, and exhibit a wheel and spoke pattern. Basin radial features only extend to roughly half the basin radius (~160km) and consist of both extensional and contractional features. Basin concentric structures occur at and beyond half the basin radius and are exclusively contractional. A broad arc of high relief terrain that deforms both hummocky material and smooth plains is observed in the northern half of Rembrandt. This broad arc is inferred to be of tectonic origin since it deforms two morphologically distinct units. It is unclear whether this feature is related Enterprise Rupes, post-impact basin related tectonism, or a combination of the two.

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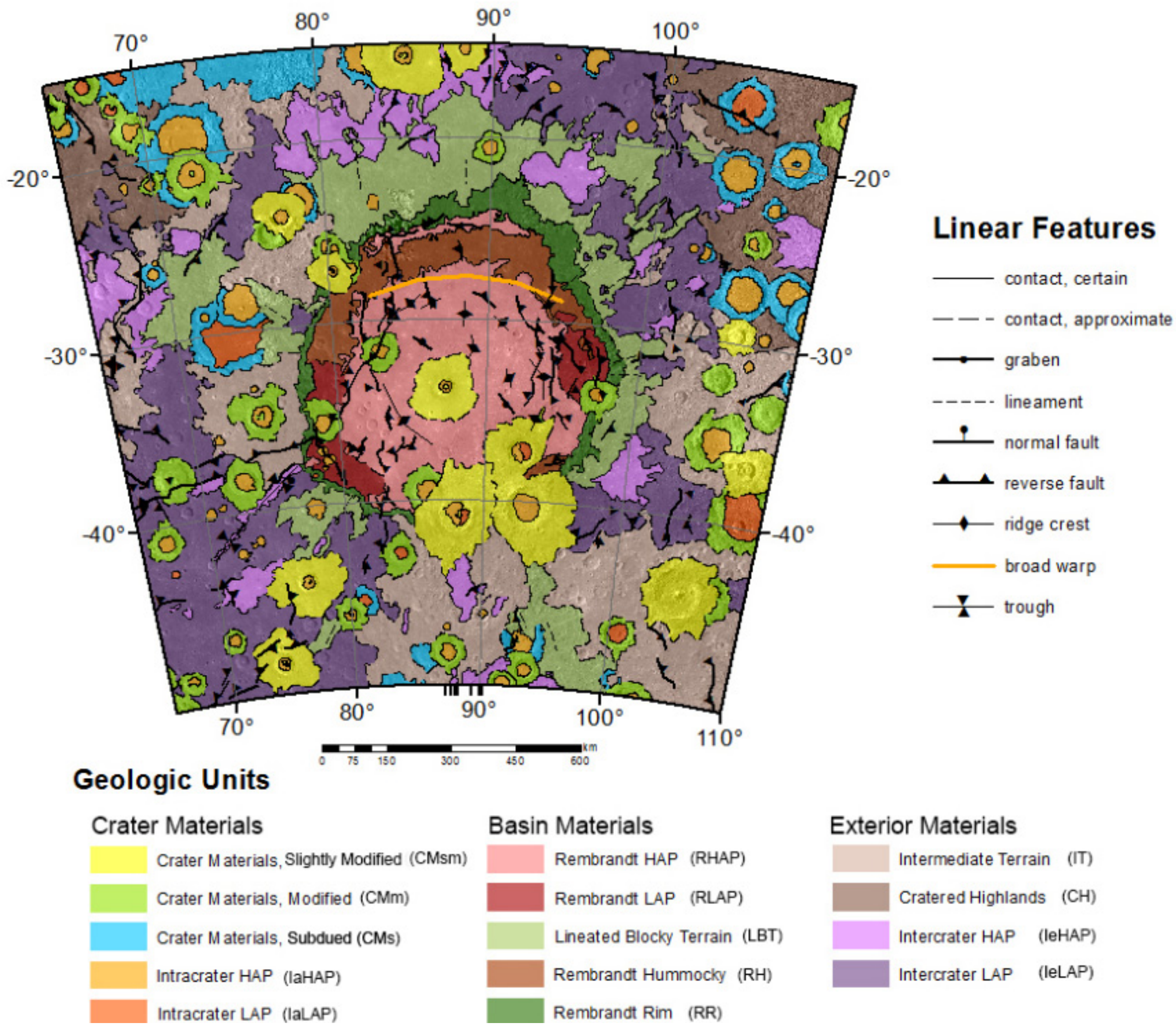

Fig. 1. Geologic units on MDIS 250 m/pix basemap. **Crater Materials** - material of walls, floors, rims, and central peaks of slightly modified craters (*CMsm*), modified craters (*CMm*), and subdued craters (*CMs*). *IaHAP*: high albedo smooth plains that infill craters. *IaLAP*: low albedo smooth plains that infill craters. **Basin Materials** – *RHAP*: high albedo smooth plains that form an annulus around the center of Rembrandt. *RLAP*: low albedo smooth to gently rolling plains along the interior margins of Rembrandt. *LBT*: rugged, blocky mounds surrounding RR exhibiting radially lineated texture. *RH*: hummocky knobs to gently rolling hills with similar albedo to RR. *RR*: rugged, high relief basin-facing scarps surrounding Rembrandt. **Exterior Units** – *IeHAP*: flat to gently rolling high albedo plains that fill areas of lowest relief. *IeLAP*: flat to gently rolling low albedo plains in relatively low-relief areas. *IT*: hilly, moderately cratered terrain between large craters. *CH*: uneven to rugged heavily cratered surface in high-relief regions. Only tectonic features extending >50km are shown for simplicity.