

MESSENGER IMAGING OF REGIONS OF MERCURY NOT SEEN BY MARINER 10.

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On January 14, 2008, the MESSENGER spacecraft will make a close flyby of the planet Mercury and acquire 1213 images of the surface. The majority of these are of the hemisphere that was not imaged by the Mariner 10 spacecraft during its three flybys of Mercury in 1974 and 1975 (Fig. 1). Although Mariner 10 flew by the planet three times, its trajectory was such that the same hemisphere was visible on each occasion. Overall, less than 50% of the planet was imaged, yielding about 2000 useful images at a resolution of ~1 to 1.5 km/pixel (comparable to Earth-based telescopic observations of the Moon), and only a small sampling of the surface at about 100 m/pixel [1]. Mariner 10 had the capability to image Mercury at three wavelengths, ultraviolet (355 nm), blue (475 nm), and orange (575 nm), enabling color ratio maps to be made at moderate resolution (2-10 km/pixel).

The MESSENGER spacecraft acquires its images using the Mercury Dual Imaging System (MDIS) [2]. MDIS consists of a Wide Angle Camera (WAC), with a 10.5° field of view, and a Narrow Angle Camera (NAC), with a 1.5° field of view. The WAC contains 11 filters over the range 430 nm to 1010 nm, as well as a broadband filter centered at 700 nm, used for optical navigation and calibration. Both cameras are mounted onto a pivot with a 90° range of rotation. The pivot allows flexibility in imaging the surface of Mercury, because MDIS can point independently of the other instruments on the spacecraft or can coordinate with them as needed.

During its first Mercury encounter, MESSENGER will pass only 200 km from the surface on the night side and will cross the terminator shortly thereafter. For the three Mariner 10 flybys, Mercury was illuminated from 350°E to 170°E. During the MESSENGER flyby, Mercury will be illuminated from 96°E to 276°E, allowing somewhat less than half of the previously unseen hemisphere to be imaged. The illuminated region includes the western half of the ~1300-km-diameter Caloris basin (Fig. 1). Also of great value is the fact that MESSENGER will re-image portions of Mercury at

very different Sun angles than those obtained by Mariner 10 thus enabling improved morphologic, albedo, and color analysis.

MDIS will acquire a number of imaging sequences during the flyby (Table 1). These include inbound and outbound movies, a color mosaic of part of the previously unimaged hemisphere (Fig. 1), several large monochrome mosaics at resolutions ranging from better than 200 m/pixel to ~1 km/pixel, and a series of color frames from 600 m/pixel to 5 km/pixel, designed for photometric analyses. Several of the monochrome mosaics acquired during departure will provide opportunities for stereo analysis. The MDIS observations are generally of higher resolution than the Mariner 10 data, and most of the color observations are in eleven filters, rather than three.

The new MDIS images allow several key scientific questions to be addressed [e.g., 3- 4 and references therein]. Here we discuss the general characteristics of the regions not previously seen by Mariner 10 and compare them to surface features and processes inferred from the Mariner 10 data. We focus on the overall style of geomorphic and tectonic processes that can be documented in the newly imaged hemisphere and compare them to those that shaped the hemisphere viewed by Mariner 10.

MESSENGER will fly by Mercury two more times, in October 2008 and September 2009, before the probe is inserted into Mercury orbit in March 2011. During these subsequent flybys, the remainder of the hemisphere not seen by Mariner 10 will be observed while in sunlight. After these flybys, most of the planet will have been imaged at synoptic resolutions, and any remaining gaps will be filled after MESSENGER enters its orbital phase.

References. [1] Murray, B. C., et al., *Science*, 185, 169, 1974. [2] Hawkins, S. E., III, et al., *Space Sci. Rev.*, 131, 247, 2007. [3] Solomon, S. C., et al., *Planet. Space Sci.*, 49, 1445, 2001. [4] Head, J. W., et al., *Space Sci. Rev.*, 131, 41, 2007.

Sequence number	Flyby observations	Start time	Camera	Approx. resolution km/pxl	Mosaic rows	Mosaic columns	Filters	# of frames	Repetitions	Total # of frames
1	Approach movie	E -30h	WAC	-	1	1	3	3	86	258
2	Approach color image	E -1h 20 mins	WAC	5.2	1	1	11	11	1	11
3	Approach NAC mosaic	E -55 mins	NAC	0.5	11	5	1	55	1	55
4	Color photometry 1	E + 8 mins	WAC	0.6	1	1	11	11	1	11
5	Color photometry 2	E + 9 mins	WAC	0.7	1	1	11	11	1	11
6	Color photometry 3	E + 11 mins	WAC	0.9	1	1	11	11	1	11
7	Color photometry 4	E + 12 mins	WAC	1	1	1	11	11	1	11
8	High-res. NAC mosaic part 1	E + 15 mins	NAC	0.1-0.2	4	17	1	68	1	68
9	Color photometry 5	E + 24 mins	WAC	1.25	1	1	11	11	1	11
10	High-res. NAC mosaic part 2	E + 27 mins	NAC	0.4-0.5	9	11	1	99	1	99
11	Departure color mosaic	E + 40 mins	WAC	2.5	3	3	11	99	1	99
12	Departure NAC mosaic 1	E + 50 mins	NAC	0.5	11	9	1	99	1	99
13	Departure NAC mosaic 2	E + 1 hr	NAC	0.6	10	8	1	80	1	80
14	Departure color image	E + 1hr 20mins	WAC	4.8	1	1	11	11	1	11
15	Departure NAC mosaic 3	E + 1hr 27mins	NAC	0.75	8	6	1	48	1	48
16	Departure NAC mosaic 4	E + 1hr 33mins	NAC	0.8	7	6	1	42	1	42
17	Departure movie	E + 1hr 48 mins	NAC	1.6-2.2	1	1	1	1	288	288
									TOTAL	1213

E = Encounter (closest approach to Mercury).

Table 1. Imaging sequences planned during MESSENGER's first flyby of Mercury.

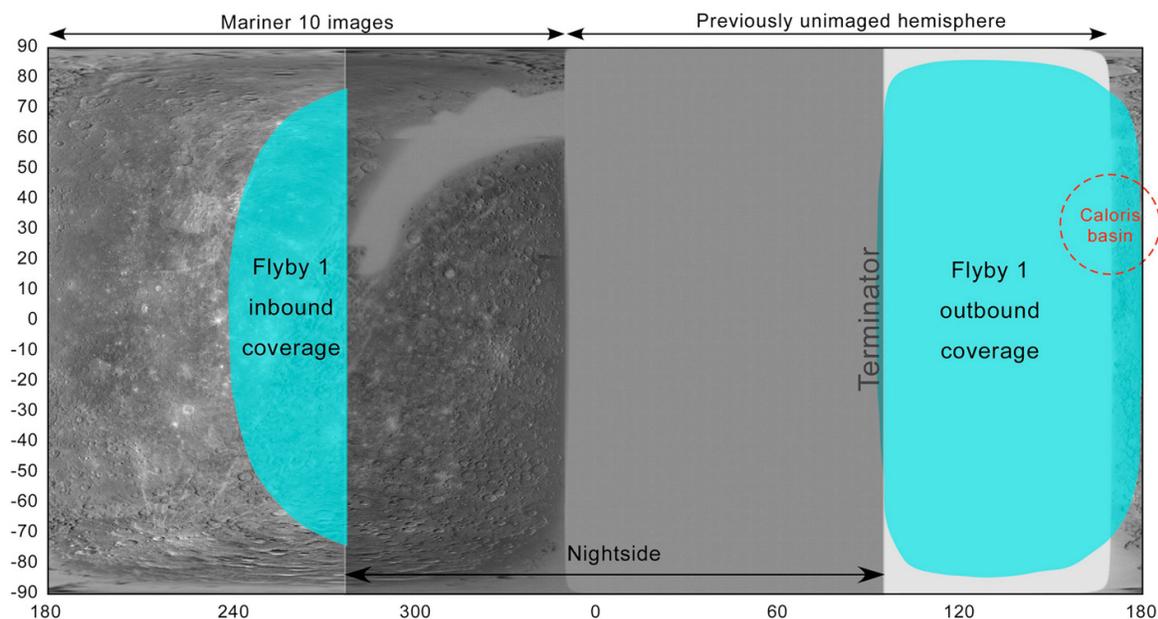


Figure 1. Approximate area imaged by MDIS during MESSENGER's first flyby of Mercury on January 14, 2008.