Mapping Mercury: Global Imaging Strategy and Products from the MESSENGER Mission

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The MESSENGER Team
What is the geologic history of Mercury?

MESSENGER provided the exciting opportunity to undertake the first global imaging campaigns of Mercury.
MESSENGER’s Mercury Dual Imaging System (MDIS)

- Narrow Angle Camera (NAC)
- Wide Angle Camera (WAC) with 11 narrow-band filters

MESSENGER’s Primary Mission

- One Earth year
- Total # of images: 88,746
  - A key constraint: the data volume allocation

MDIS Primary Mission Priorities

- Image the surface completely, at moderate incidence angles to gain both morphology and reflectance information
- Stereo imaging, for a global digital elevation model (DEM)
- Acquire a global multispectral dataset in 8 MDIS filters

MESSENGER

MERCURY Surface, Space Environment, GEochemistry, and Ranging
MESSENGER’s Extended Missions

• 3+ years, for a total of just over 4 years in Mercury orbit
• A key constraint for MDIS was always the data volume

MDIS Extended Mission Campaigns

• Imaging under a range of illumination conditions
  • High and low incidence angles
  • East and west directions
• Higher spatial resolution multispectral datasets
April 30, 2015: “set to end with dramatic crash”, “smashing into planet”, “crash course with history”, “explosive demise”, “destroys itself”, “death plunge”, “fatal dive”, “NASA is going to purposely crash a $446 million spacecraft into Mercury at breakneck speeds”, “doomed NASA spacecraft”...

In total: 277,928 orbital images

MESSENGER
MErcury Surface, Space ENvironment, GEochemistry, and Ranging
Key to the generation of mosaic products:
- Calibration procedure [Hawkins et al., 2007]
- Photometric correction [Domingue et al., 2016]
- Global DEM & control network [Becker et al., 2016]
For the final mosaic products, all orbital images were considered for inclusion, regardless of the original imaging campaign of each.
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Additionally, key to the generation of color mosaic products:

- Multispectral calibration

[Denevi et al., 2016]

8-color global mosaic

665 m/pixel

Filter centers in nm:
430, 480, 560, 630,
750, 830, 900, 1000

(R: PC2, G: PC1, B: 430/1000)
Generation of a global DEM and control network for Mercury improved registration and the final mosaic products

[The largest control network ever processed in ISIS3. Becker et al., 2016]

Rachmaninoff (306-km diameter, 27.7°N, 57.4°E)
(R: PC2, G: PC1, B: 430/1000)
The higher spatial resolution 3-color mosaic complements the global 8-color product. All images in this product are in the global control network.
5-color mosaic
Minimizes the phase angle

332 m/pixel
Filter centers in nm: 430, 560, 750, 830, 1000
Together, these seven mosaics form a complementary set of products that enable Mercury’s surface to be robustly investigated from a diverse set of viewing, imaging, and multispectral conditions.