EPSC Abstracts
Vol. 11, EPSC2017-1005, 2017
European Planetary Science Congress 2017
© Author(s) 2017

# Building up the 1:3M geological map of Mercury

**V. Galluzzi** (1), L. Guzzetta (1), P. Mancinelli (2), L. Giacomini (1), C. Malliband (3), A. Mosca (4), J. Wright (3), L. Ferranti (4), M. Massironi (5), C. Pauselli (2), D. A. Rothery (3), and P. Palumbo (6,1)
(1) INAF, Istituto di Astrofisica e Planetologia spaziali (IAPS), Rome, Italy (valentina.galluzzi@iaps.inaf.it); (2) Dipartimento di Fisica e Geologia, Università degli Studi di Perugia, Perugia, Italy; (3) School of Physical Sciences, The Open University, Milton Keynes, UK; (4) DiSTAR, Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università "Federico II", Naples, Italy; (5) Dipartimento di Geoscienze, Università degli Studi di Padova, Padua, Italy; (6) Dipartimento di Scienze & Tecnologie, Università degli Studi di Napoli 'Parthenope', Naples, Italy.

## Abstract

The 1:3M-scale geological map series of Mercury was born from individual quadrangle mapping products and has proceeded toward a global mapping project that will be released as a digital global output. The MESSENGER data and reference systems used for this project underwent several changes over the past years. Here we report how we dealt with these updates and the status of our work.

## 1. Introduction

By the end of the NASA Mariner 10 mission (1973-1979), 45% of Mercury's surface had been imaged by the M10 Television Experiment and over 2000 useful pictures were available at a resolution better than 2 km, up to 100 m. These results led to the production of 1:5M geologic maps of seven of the fifteen quadrangles of Mercury [1]. The NASA MESSENGER (MErcury Surface, Space ENvironment, GEochemistry and Ranging; 2004-2015) mission filled the gap by imaging 100% of the planet with a frame resolution up to 8 m/pixel at the north pole, and a global average resolution of 200 m/pixel, enabling preparation of a new global 1:15M geologic map [2]. Today, a complete global series of 1:3M-scale global maps of Mercury is being prepared in support to the BepiColombo joint mission of the European Space Agency (ESA) and the Japan Aerospace Agency (JAXA) [3]. Born from individual geologic quadrangle maps [4, 5, 6], it has evolved into a coordinated global mapping plan, and carried on with the aim of exploiting MESSENGER images at the best resolution available (i.e., global average resolution) in order to set up the context for BepiColombo operations and help re-define mission goals as appropriate. In the early part of the project, the data coming from the still ongoing MESSENGER mission were constantly changed and updated. This required a careful check of our products, and eventually will require a transformation of the linework in the light of the newly released MESSENGER end-of-mission datasets.

## 2. Available Datasets

### 2.1. Past datasets

When this project started, the MESSENGER mission was still releasing datasets, and this caused basemap coverage and resolution to change frequently. Since most basemaps were initially released as 250 m/pixel mosaics, the best dataset that could be used as a reference basemap was the 166 m/pixel map-projected Basemap reduce Data Record (BDR). These resolutions permit us mapping at scales of ~1:300,000 to ~1:600,000. The Mercury Laser Altimeter (MLA) provided also a 500 m grid Digital Elevation Model (DEM) for the North Pole and a 665 m grid DEM for the Northern hemisphere [7]. This was the main reason why the mapping project started from the Northern hemisphere.

### 2.2. End-of-Mission Datasets

By the end of the MESSENGER mission several new global basemaps at 166 m/pixel were released: a new BDR, two high incidence angle basemaps with illumination from East and West (HIE and HIW), and a low incidence angle basemap (LOI). Moreover, the United States Geological Survey (USGS) has made available a 665 m global coverage DEM derived from stereo-imaging [8], providing a better understanding also of the Southern hemisphere.

### 2.3. Reference system issues

The MESSENGER team approximated Mercury's radius to 2440.0 km during the operational phase of the mission, thus our first map products followed the same datum. With the end-of-mission datasets release, this datum was updated to 2439.4 km. Moreover, the prime meridian definition slightly changed, causing a latitudinal shift of the basemaps of almost 0.1°

westward. This shift is not constant however, since the new basemaps are now controlled and projected onto the new USGS DEM. Since we are going to use the end-of-mission basemaps for the new products, the already produced maps will require a careful transformation in order to avoid a mismatch. The transformation will take into account the new sphere radius, the new prime meridian shift, and possibly, the USGS shape-model.

## 3. Current results

Currently, H02 Victoria [4], H03 Shakespeare [6] and H04 Raditladi [5] have been completed; H05 Hokusai [9], H06 Kuiper [10], H07 Beethoven and H10 Derain [11] are being mapped (Fig. 1). The produced geologic maps were merged adjusting mismatches along the quadrangle boundaries. Contact discrepancies were reviewed and discussed among the mappers of adjoining quadrangles in order to match the geological interpretation and provide a unique consistent stratigraphy.

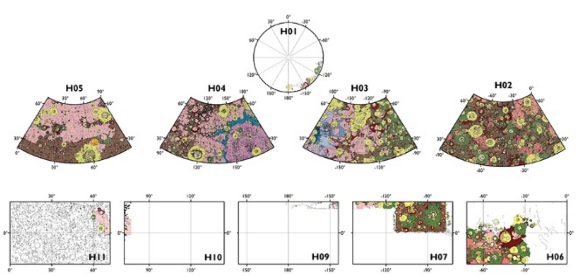


Figure 1: Current status of the 1:3M-scale geological map series of Mercury for the Northern hemisphere quadrangles. The used projections are centered on each quadrangle: H01 Polar Stereographic; H02 to H05 Lambert Conformal Conic with standard parallels at 30°N and 58°N; H06 to H10 Equidistant Cylindrical.

At the current stage, about 30% of Mercury has now a complete 1:3M-scale map and more than 40% of the planet will be covered soon by the maps that are being prepared. This series of 1:3M-scale quadrangle maps cannot be merged into a single physical 1:3M-scale global map. However, the global merged output will be used as a digital full-scale product, which will permit detailed global or regional analyses of Mercury’s surface. This project will lead to a fuller grasp of the planet’s stratigraphy and surface history and is an important goal in preparation for the forthcoming ESA/JAXA BepiColombo mission to aid selection of scientific targets and to provide context for interpretation of new data.

## Acknowledgements

This research was supported by the Agenzia Spaziale Italiana (ASI) within the SIMBIOSYS project (ASI-INAF agreement n. I/022/10/0).

## References

[1] Spudis, P. D. & Guest, J. E., In: Vilas, F., et al. (eds), Mercury, 118–164, University of Arizona Press, 1988.

[2] Prockter L. M., et al., XLVII LPSC, Abs. #1245, 2016.

[3] Benkhoff, J. et al., Planetary and Space Science, 58, 2–20, 2010.

[4] Galluzzi, V. et al., Journal of Maps, 12, 227–238, 2016.

[5] Mancinelli, P. et al., Journal of Maps, 12, 190–202, 2016.

[6] Guzzetta, L. et al., Journal of Maps, 13, 227–238, 2017.

[7] Zuber, M. T. et al., Science, 336, 217–2202011.

[8] Becker, K. J. et al., XLVII LPSC, Abs. #2959, 2016.

[9] Rothery, D. A. et al., XLVIII LPSC, Abs. #1406, 2017.

[10] Giacomini, L. et al., Geophysical Research Abstracts, 19, EGU2017-14574-1, 2017.

[11] Malliband, C. C. et al., XLVIII LPSC Abs., #1476, 2017.