

MESSENGER at Mercury: A Mid-Term Report

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After almost five years in development and more than six and a half years in cruise toward its destination, NASA's MERcury Surface, Space ENvironment, GEOchemistry, and Ranging (MESSENGER) spacecraft finally entered orbit about Mercury on 18 March 2011, initiating a one-year, focused investigation of the innermost planet. Operating from a highly elliptical orbit designed to keep the spacecraft safe and to facilitate the required observations, MESSENGER is using its payload of seven instruments and the spacecraft's radio-frequency telecommunications system to characterize the planet's interior, surface, atmosphere, and magnetosphere. The demands of the many measurements needed to meet the program objectives, coupled with the constraints associated with spacecraft safety and the orbital geometry, led to the adoption of an automated science-planning tool to optimize science data collection. The tool was used to design the entire year of observations prior to orbit insertion and has the capability of re-generating the plan quickly in response to anomalies in flight (e.g., spacecraft safe-mode demotions) or on the ground (e.g., missed Deep Space Network tracks). Because one Earth year spans two Mercury solar days, in the course of MESSENGER's science data-collection campaign there are two opportunities to observe any specific location on the planet with a given viewing geometry. To take advantage of this schedule, the science plan was divided into two parts. During the first solar day, priority was given to producing global map products. The second day will be used to focus on specific targets and to recover observations missed during the first half of the year. Also, complementary observations can be made in the second day that, when paired with results from the first day, form a stereo map. Although only midway through the orbital operations phase of the mission, at the end of the first Mercury solar day MESSENGER has viewed the entire surface of the planet once and produced global monochrome and multispectral maps. The spacecraft's orbit has completed two local-time rotations and three rotations in longitude, allowing spatial characterization of the planet's magnetic field, development of an elevation model from northern hemisphere altimetry, and global abundance estimates for major elements. After more than 350 orbits, over 80 gigabits of compressed data have been collected, including more than 50,000 images. Calibrated data from the first two months in orbit have been delivered to NASA's Planetary Data System for dissemination to the science community.