

SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration (5)

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THE MESSENGER MISSION CONTINUES: TRANSITION TO THE EXTENDED MISSION

Abstract

The MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft, under NASA's Discovery Program, is the first probe to orbit the planet Mercury. Launched in August 2004, MESSENGER's three flybys of Mercury marked the first spacecraft visits to the innermost planet since those of Mariner 10 in 1974-1975. Following a successful orbit insertion on 18 March 2011, MESSENGER has been gathering data successfully during its primary, yearlong mission. An extended mission, for an additional Earth year of operations from orbit, was approved by NASA and announced on 9 November 2011. Building on the scientific results to date from the primary mission, six new and more focused science questions have been posed for the extended mission: (1) What are the sources of Mercury's surface volatiles? (2) How late into Mercury's history did volcanism persist? (3) How did Mercury's long-wavelength topography change with time? (4) What is the origin of localized regions of enhanced exospheric density on Mercury? (5) How does the solar cycle affect Mercury's exosphere and volatile transport? (6) What is the origin of Mercury's energetic electrons? As with the primary mission, each of these questions is linked to a specific set of measurement objectives designed to yield a corresponding answer. The six measurement objectives are, respectively: (1) determine the morphological and compositional context of "hollows" and their relationship to bright crater-floor deposits and pyroclastic vents; (2) acquire targeted, high-resolution observations of volcanic materials of low impact-crater density identified during the primary mission; (3) document changes in long-wavelength topography versus geological time on Mercury from altimetric and complementary imaging measurements; (4) characterize regions of enhanced exospheric density versus solar distance, proximity to specific geologic units, solar activity, and magnetospheric conditions; (5) measure changes in exospheric neutrals, plasma ions, and magnetospheric dynamics as solar activity increases; and (6) infer the sources and energization mechanism from the location, energy spectra, and temporal profiles of energetic electrons. Overarching themes as embodied in the science questions for the MESSENGER extended mission ensure that the second year of orbital operations will not be a simple continuation of the primary mission. These themes include more comprehensive measurement of the magnetosphere and exosphere during a period of more active Sun,

greater focus on observations at low spacecraft altitudes, and a greater variety of targeted observations. In particular, the extended mission is a critical epoch for the study of Mercury's magnetosphere and exosphere.