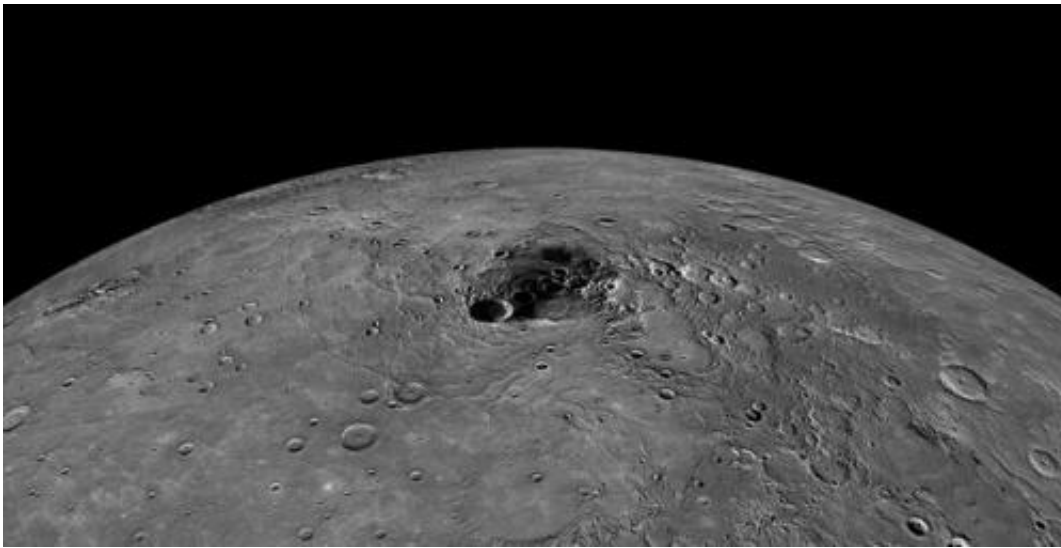


Scientists discuss new results from MESSENGER's low-altitude campaign

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Credit: NASA

NASA's MErcury Surface, Space ENvironment, GEOchemistry, and Ranging (MESSENGER) mission, now nearing the end of its fourth and final year of orbital operations at Mercury, is well into a low-altitude campaign that is returning images and measurements of the planet's surface and interior that are unprecedented in their resolution. MESSENGER scientists will discuss new findings from the low-altitude campaign and their implications for Mercury's geological evolution and the planet's geophysical and geochemical characteristics at a press briefing today at the 46th Lunar and Planetary Science Conference.

Illuminating Hollows

Early in its primary orbital mission, MESSENGER discovered thousands of peculiar depressions at a variety of longitudes and latitudes, ranging in size from tens of meters to several kilometers across and tens of meters deep.

"These features, given the name 'hollows,' were a major surprise, because while we had been thinking of Mercury as a relic—a planet that wasn't really changing anymore—hollows appear to be younger than the planet's freshest impact craters. This finding suggests that Mercury is a planet whose surface is still evolving," says MESSENGER Participating Scientist David Blewett, a geologist at The Johns Hopkins University Applied Physics Laboratory (APL).

The team has since deduced that the hollows form through loss of a component in the rocks that is susceptible to sublimation (or a similar process) when exposed to the harsh environment of the planet's surface. "High-resolution images obtained by the spacecraft at low altitudes are revealing striking details about these hollows, including their young ages, their depths, and the diversity of locations in which they are found."

Mercury's Surface Composition

Since MESSENGER entered orbit about Mercury in March 2011, the spacecraft's X-Ray Spectrometer (XRS) has measured solar-induced X-ray fluorescence from the top ~100 micrometers of the planet's surface and determined the abundances of key rock-forming elements, including magnesium, aluminum, silicon, sulfur, calcium, titanium, and iron. MESSENGER observations at low altitudes have enabled the surface elemental composition of Mercury to be determined with unprecedented spatial resolution and reveal compositional heterogeneities at a scale of a

few to a few tens of kilometers.

"At this scale, elemental data can be correlated to other properties, color and reflectance, for example, to improve our understanding of the detailed geological history of Mercury's crust," says Larry Nittler, MESSENGER Deputy Principal Investigator and a cosmochemist in the Department of Terrestrial Magnetism at the Carnegie Institution of Washington, Washington, D.C. "Moreover, recent measurements by both the XRS and MESSENGER's Neutron Spectrometer have also shown that the highest iron abundances on Mercury are associated with a large region containing the highest magnesium, calcium, and sulfur contents on the surface, possibly the remains of an ancient impact basin."

"As MESSENGER's periapsis altitude continues to decline before the end of the mission in April 2015, we anticipate XRS observations with even better spatial resolution," he adds. The results from the new XRS data will be integrated with complementary datasets to generate increasingly detailed maps of Mercury's geologically and geochemically heterogeneous surface.

Small Scarps Revealed

MESSENGER instruments have confirmed that the tectonic history of Mercury since the late heavy bombardment is dominated by contraction, and the most broadly distributed contractional tectonic landforms on Mercury are lobate scarps, the surface manifestation of thrust faults. These scarps are often hundreds of kilometers long and display hundreds to thousands of meters of relief. High-resolution images obtained during MESSENGER's low-altitude campaign have revealed a population of small fault scarps that can be more than an order of magnitude smaller in size than their larger counterparts and are comparable in scale to similar small scarps on the Moon.

"Small lunar scarps are likely less than 50 million years old on the basis of the rate of degradation of small landforms by continuous meteoroid bombardment, and because the cratering rate on Mercury is as much as a factor of ~3 greater than on the Moon, small scarps on Mercury may be substantially younger," says Thomas Watters, a MESSENGER Participating Scientist and senior scientist in the Center for Earth and Planetary Studies at the National Air and Space Museum, Smithsonian Institution. "Mercury's small scarps provide evidence that young faults are forming to accommodate the most recent phases of interior cooling and global contraction, raising the possibility that some of these small, young faults are active today."

Close up of Polar Deposits

Multiple datasets have provided evidence that water ice is present in permanently shadowed regions near Mercury's poles: Earth-based radar imaged radar-bright deposits, imaging and neutron spectrometry by MESSENGER instruments showed regions of permanent shadow and enhanced hydrogen in Mercury's north polar region, respectively, and thermal models indicated that temperatures could sustain surface and near-surface water ice in the permanently shadowed regions. Additionally, visible and near-infrared measurements have revealed that polar deposits display both high- and low-reflectance surfaces.

MESSENGER's low-altitude campaign has enabled imaging of the polar deposits in the permanently shadowed floors of Mercury's near-polar craters at higher resolutions than ever previously obtained, says Nancy Chabot, the Instrument Scientist for MESSENGER's Mercury Dual Imaging System (MDIS) and a planetary scientist with APL.

"Acquired with the broadband filter of MDIS, low-altitude images show that the deposits have sharp, well-defined boundaries and are not disrupted by small, young impact craters," says Chabot. "These

characteristics indicate that the deposits are geologically young. This inference points either to delivery of volatiles to Mercury in the geologically recent past or to an ongoing process that restores the deposits and maintains the sharp boundaries."

"Despite several years of orbital observations of Mercury from higher altitudes, MESSENGER's low-altitude campaign has shown us many details of the planet's geological and geophysical processes for the first time," adds MESSENGER Principal Investigator Sean Solomon, Director of the Lamont-Doherty Earth Observatory at Columbia University. "Over the next six weeks, as observations are made at still lower altitudes, we expect that Mercury will give up a few more of its secrets before the books finally close on a mission that has exceeded all expectations."

More information: Presentation materials and presenter biographies are available [online](#).

Provided by NASA

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