NASA completes MESSENGER mission with expected impact on Mercury's surface

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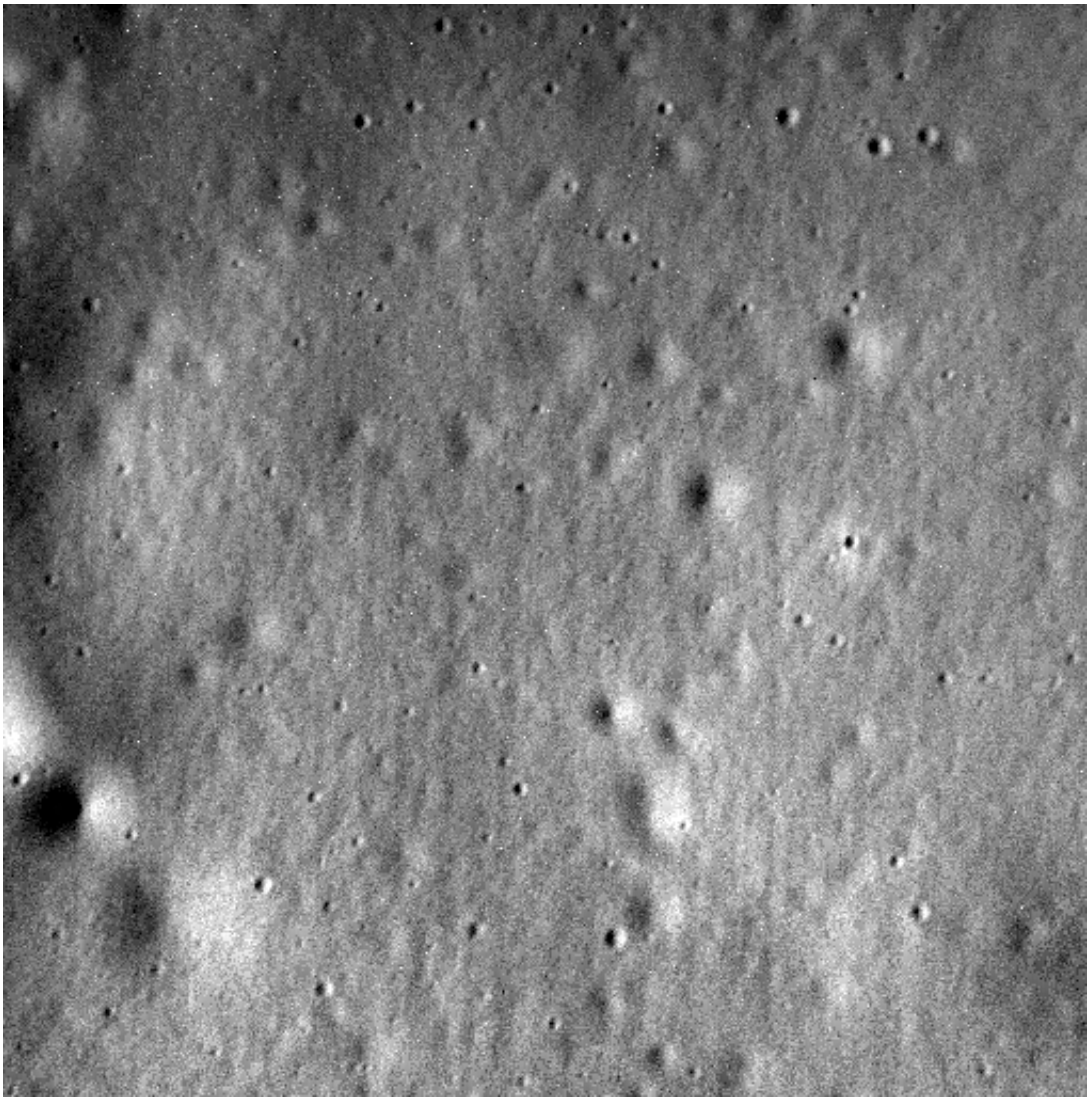

On April 30, 2015, the MESSENGER spacecraft sent its final image. Originally planned to orbit Mercury for one year, the mission exceeded all expectations, lasting for over four years and acquiring extensive datasets with its seven

scientific instruments and radio science investigation. This afternoon, the spacecraft succumbed to the pull of solar gravity and impacted Mercury's surface. The image shown here is the last one acquired and transmitted back to Earth by the mission. The image is located within the floor of the 93-kilometer-diameter crater Jokai. The spacecraft struck the planet just north of Shakespeare basin. As the first spacecraft ever to orbit Mercury, MESSENGER revolutionized our understanding of the Solar System's innermost planet, as well as accomplished technological firsts that made the mission possible. Check out these movies of the Top 10 Science Results and the Top 10 Technology Innovations from the mission. Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

Mission controllers at the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Md., confirmed today that NASA's MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft impacted the surface of Mercury, as predicted, at 3:26 p.m. EDT this afternoon (3:34 p.m. ground time).

Mission controllers were able to confirm the end of operations just a few minutes later at 3:40 p.m., when no signal was detected by the Deep Space Network (DSN) station in Goldstone, California, at the time the spacecraft would have emerged from behind the planet had MESSENGER not impacted the surface. This conclusion was independently confirmed by the DSN's Radio Science team, who were simultaneously looking for the signal from MESSENGER from their posts in California.

MESSENGER was launched on August 3, 2004, and it began orbiting Mercury on March 18, 2011. The spacecraft completed its primary science objectives by March 2012. Because MESSENGER's initial discoveries raised important new questions and the payload remained healthy, the mission was extended twice, allowing the spacecraft to make

observations from extraordinarily low altitudes and capture images and information about the planet in unprecedented detail.

Last month—during a final short extension of the mission referred to as XM2'— the team embarked on a hover campaign that allowed the spacecraft at its closest approach to operate within a narrow band of altitudes, 5 to 35 kilometers above the planet's surface. On April 28, the team successfully executed the last of seven orbit-correction maneuvers (the last four of which were conducted entirely with helium pressurant after the remaining liquid hydrazine had been depleted), which kept MESSENGER aloft for the additional month, sufficiently long for the spacecraft's instruments to collect critical information that could shed light on Mercury's crustal magnetic anomalies and ice-filled polar craters, among other features.

With no way to increase its altitude, MESSENGER was finally unable to resist the perturbations to its orbit by the Sun's gravitational pull, and it slammed into Mercury's surface at around 8,750 miles per hour, creating a new crater up to 52 feet wide.

"Today we bid a fond farewell to one of the most resilient and accomplished spacecraft ever to have explored our neighboring planets," said Sean Solomon, MESSENGER's Principal Investigator and Director of Columbia University's Lamont-Doherty Earth Observatory. "Our craft set a record for planetary flybys, spent more than four years in orbit about the planet closest to the Sun, and survived both punishing heat and extreme doses of radiation. Among its other achievements, MESSENGER determined Mercury's surface composition, revealed its geological history, discovered that its internal magnetic field is offset from the planet's center, taught us about Mercury's unusual internal structure, followed the chemical inventory of its exosphere with season and time of day, discovered novel aspects of its extraordinarily active magnetosphere, and verified that its polar deposits are dominantly water

ice. A resourceful and committed team of engineers, mission operators, scientists, and managers can be extremely proud that the MESSENGER mission has surpassed all expectations and delivered a stunningly long list of discoveries that have changed our views not only of one of Earth's sibling planets but of the entire inner solar system."

MESSENGER's final hours

MESSENGER's last orbit with real-time flight operations began at 11:15 a.m. EDT, with initiation of the final delivery of data and images from Mercury via the DSN 70-m antenna in Madrid, Spain. See the last image delivered above.

After a planned transition to the 34-m DSS-15 antenna at Goldstone, California, at 2:40 p.m. EDT, mission operators later confirmed the switch to a beacon-only communication signal at 3:04 p.m. The mood in the Mission Operations Center at APL was both celebratory and somber, as team members watched MESSENGER's telemetry drop out for the last time after more than four years and 4,105 orbits at Mercury.

"We then monitored MESSENGER's beacon signal for about 25 additional minutes," said Mission Operations Manager Andy Calloway of APL. "It was strange to think that for those last three minutes MESSENGER had already impacted onto Mercury, but we could not confirm that fact yet because of the vast distance across space between Mercury and Earth. MESSENGER passed behind Mercury (as viewed from Earth) at 3:29 p.m., however the signal from our intrepid spacecraft started fading prior to that and dropped out for the last time at 3:25 p.m."

At 3:38 p.m. EDT, at the time the spacecraft would have emerged from behind the planet as viewed from the Goldstone station had MESSENGER not impacted, mission operators began monitoring for a

signal, but as expected they were unable to establish communications between MESSENGER and the DSN. This radio silence was the confirmation of the end of the MESSENGER mission.

Before impact, MESSENGER's mission design team predicted that the spacecraft would pass several miles over the lava-filled Shakespeare impact basin before striking an unnamed ridge near 54.5 degrees North latitude and 210.1 degrees East longitude. Because the probe hit on the far side of the planet, no Earth-based telescope was able to observe the impact. Moreover, space-based telescopes are precluded from observing Mercury because of the planet's proximity to the Sun, exposure to which would damage sensitive optics and instruments.

A future Mercury mission, such as the BepiColombo mission now in development by the European Space Agency and Japan Aerospace Exploration Agency, might be able to identify the impact crater left behind by MESSENGER. The MESSENGER team has acquired images of the entire planet, so a future mission will have MESSENGER's observations of the region before the impact to use as a baseline for comparison with subsequent imaging data sets to help pinpoint MESSENGER's impact site. The impact crater should be one of the youngest on Mercury and should have exposed fresh material from Mercury's subsurface that will have been exposed to the effects of space weathering for only a limited and precisely known time, so multispectral observations of MESSENGER's crater will provide an important constraint on rates of optical maturation of Mercury's surface material.

"Going out with a bang as it impacts the surface of Mercury, we are celebrating MESSENGER as more than a successful mission," said John Grunsfeld, associate administrator for NASA's Science Mission Directorate in Washington. "The MESSENGER mission will continue to provide scientists with a bonanza of new results as we begin the next phase of this mission—analyzing the exciting data already in the

archives, and unraveling the mysteries of Mercury."

MESSENGER's Education and Public Outreach team included the public in the final chapter of the MESSENGER story by sponsoring a "Name that Crater," competition, providing an opportunity for the public to name five impact craters. Thousands of submissions were received, and the winners were announced on April 29.

Although the MESSENGER flight mission has now officially ended, the science data collected by MESSENGER are archived in NASA's Planetary Data System, where they are preserved and remain accessible for future use by the scientific community for years and even decades to come. The Science Team will continue to use these data to pose and answer questions about Mercury's formation and evolution and the planet's place in our Solar System through the end of the MESSENGER project in May 2016.

Provided by Johns Hopkins University