MESSENGER provides first optical images of ice near Mercury's north pole

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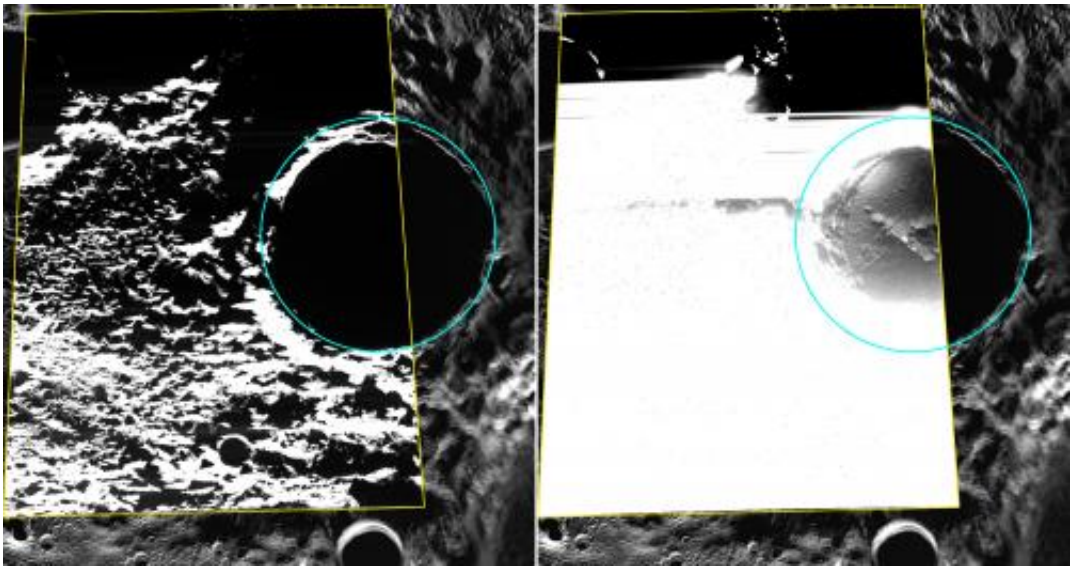

Polar stereographic about the north pole, with 180° E to the top. Kandinsky crater is located near Mercury's north pole and shows evidence for hosting water ice. The floor of Kandinsky is in permanent shadow and never receives direct sunlight, keeping it very cold. However, by using sunlight scattered off the crater's walls and the WAC broadband clear filter, MDIS was able to capture this image that reveals the details of the shadowed surface! The WAC broadband image is shown on the left, outlined in yellow and overlain on an MDIS polar mosaic. The view on the right shows the same image but with the brightness and contrast stretched to show the details of the crater's shadowed floor. Read more about the recently published study using this image and others in this news story. Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

NASA's MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft has provided the first optical images of ice and other frozen volatile materials within permanently shadowed craters near Mercury's north pole. The images not only reveal the morphology of the frozen volatiles, but they also provide insight into when the ices were trapped and how they've evolved, according to an article published today in the journal, Geology.

Two decades ago, Earth-based radar images of Mercury revealed the polar deposits, postulated to consist of water ice. That hypothesis was later confirmed by MESSENGER through a combination of neutron spectrometry, thermal modeling, and infrared reflectometry. "But along with confirming the earlier idea, there is a lot new to be learned by seeing the deposits," said lead author Nancy Chabot, the Instrument Scientist for MESSENGER's Mercury Dual Imaging System (MDIS) and a planetary scientist at the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland.

Beginning with MESSENGER's first extended mission in 2012, scientists launched an imaging campaign with the broadband clear filter of MDIS's wide-angle camera (WAC). Although the polar deposits are in permanent shadow, through many refinements in the imaging, the WAC was able to obtain images of the surfaces of the deposits by leveraging very low levels of light scattered from illuminated crater walls. "It worked in spectacular fashion," said Chabot.

The team zeroed in on Prokofiev, the largest crater in Mercury's north polar region found to host radar-bright material. "Those images show extensive regions with distinctive reflectance properties," Chabot said. "A location interpreted as hosting widespread surface water ice exhibits a cratered texture indicating that the ice was emplaced more recently than any of the underlying craters."

In other areas, water ice is present, she said, "but it is covered by a thin layer of dark material inferred to consist of frozen organic-rich compounds." In the images of those areas, the dark deposits display sharp boundaries. "This result was a little surprising, because sharp boundaries indicate that the volatile deposits at Mercury's poles are geologically young, relative to the time scale for lateral mixing by impacts," said Chabot.

"One of the big questions we've been grappling with is 'When did Mercury's water ice deposits show up?' Are they billions of years old, or were they emplaced only recently?" Chabot said. "Understanding the age of these deposits has implications for understanding the delivery of water to all the terrestrial planets, including Earth."

Overall, the images indicate that Mercury's polar deposits either were delivered to the planet recently or are regularly restored at the surface through an ongoing process.

The images also reveal a noteworthy distinction between the Moon and Mercury, one that may shed additional light on the age of the frozen deposits. "The polar regions of Mercury show extensive areas that host water ice, but the Moon's polar regions—which also have areas of permanent shadows and are actually colder—look different," Chabot said.

"One explanation for differences between the Moon and Mercury could be that the volatile polar deposits on Mercury were recently emplaced," according to the paper. "If Mercury's currently substantial polar volatile inventory is the product of the most recent portion of a longer process, then a considerable mass of volatiles may have been delivered to the inner Solar System throughout its history."

"That's a key question," Chabot said. "Because if you can understand

why one body looks one way and another looks different, you gain insight into the process that's behind it, which in turn is tied to the age and distribution of water ice in the Solar System. This will be a very interesting line of inquiry going forward."

More information: The complete report is available online: geology.geoscienceworld.org/co … ref&siteid=gsgeology

Provided by Johns Hopkins University