

A CLOSER LOOK AT SOME OF MERCURY'S NORTH POLAR DEPOSITS: THREE CRATERS THAT COULD HAVE EXTENSIVE SURFACE ICE BUT DON'T? Nancy L. Chabot¹, Gregory A. Neumann², Carolyn M. Ernst¹, Erwan M. Mazarico², and Evangela E. Shread¹ ¹Johns Hopkins Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD 20723, USA (Nancy.Chabot@jhuapl.edu), ²NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA.

Introduction: Earth-based radar observations [e.g., 1] and MESSENGER measurements [e.g., 2–7] have provided multiple lines of evidence that Mercury's polar deposits are dominantly composed of water ice. As MESSENGER was the first spacecraft to fully map the planet, the majority of the first studies using the mission results were appropriately focused on large-scale analyses of the full polar regions rather than specific polar craters. The next logical step for investigations of Mercury's polar deposits using currently available data is to examine specific craters of interest in more detail, to follow up on questions raised by the global studies. In this work, we focus on three craters predicted from their thermal conditions to be conducive to the presence of extensive water ice at the surface but may lack such ice.

Craters Studied: An overview of the three craters that are the focus of this work is shown in **Fig. 1**. The craters are located between 81°–85°N, 210°–230°E and are of particular interest because the thermal modeling results [5, 8] show sizable regions within their permanently shadowed interiors that are conducive to hosting water ice exposed at the surface for a billion years. However, unlike other craters closer to the north pole that are believed to host surface water ice [4, 6, 9], large high-reflectance areas for these three craters have not been observed [4, 9]. The radar-bright regions [1] associated with these three craters are also considerably smaller than the permanently shadowed areas [7]. Does

this mean that these craters lack water ice deposits, providing more evidence for the uneven distribution of water ice between Mercury's polar cold traps [7,10]? Or is there evidence in MESSENGER measurements for surface water ice in these craters or viewing limitations that impeded the radar observations of these craters?

We are investigating the Mercury Laser Altimeter (MLA) and Mercury Dual Imaging System (MDIS) datasets for these craters. We have identified MDIS images that reveal the surfaces within these craters and are registering those images to MLA surface reflectance measurements, as well as to the radar observations, permanently shadowed regions, radar visibility, and thermal models, and we will present our latest results.

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Acknowledgements: NASA DDAP grant NNX15AK89G to N.L.C.; APL ASPIRE and NASA/APL intern programs for E.E.S.

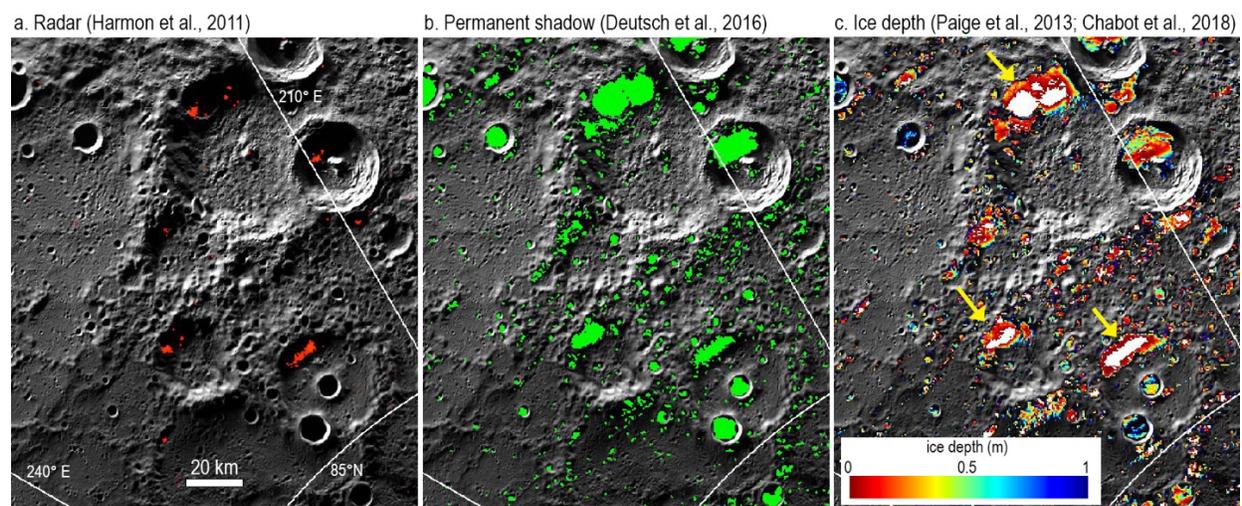


Figure 1. MESSENGER mosaic of a region near Mercury's north pole showing: **a.** locations of radar-bright features in red, **b.** permanently shadowed regions in green, and **c.** modeled depth at which long-term water ice is stable within 1 m of the surface. Yellow arrows identify three craters where sizable surface water ice could be stable (white regions).