New evidence for exposed water ice in micro-cold traps and four large craters at the north polar region of Mercury

Ariel N. Deutsch,1 Gregory A. Neumann,2 James W. Head1

1 Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912, USA
2 NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA
Ariel_Deutsch@brown.edu

Abstract. The Mercury Laser Altimeter (MLA) measured surface reflectance, $r_s$, at 1064 nm at zero phase angle over the northern hemisphere. On Mercury, most water-ice deposits have anomalously low $r_s$ values indicative of an insulating layer of low-reflectance materials beneath which the water ice is buried. Previous detections of surficial water ice were limited to the 112-km Prokofiev crater (85.8°N, 62.9°E). Here we map $r_s$ and density of energy returns in four additional permanently shadowed craters that host extensive radar-bright deposits. Each crater has a mean $r_s$ value > 0.3, suggesting that water ice is exposed at the surface. Thus there is a suite of five large craters that hosts exposed water ice at Mercury’s north pole. Furthermore, we identify micro-cold traps (< 5 km) where $r_s > 0.3$ and permanent shadows have biannual maximum surface temperatures < 100 K (Fig. 1). We suggest that a substantial amount of Mercury’s water ice is not confined to large craters, but exists within micro-cold traps as well, within rough patches and inter-crater terrain.