Learning From the Shadows: Exploring North Polar Impact Craters in Mercury's Permanently Shadowed Regions

Palma, Jasmine (School: Townsend Harris High School)
Wu, Michelle (School: Townsend Harris High School)

In the formation of the solar system, frequent collisions on terrestrial bodies left behind populations of impact craters scattered on planetary and satellite surfaces. This study focuses on Mercury, the innermost planet, and north polar impact craters in its permanently shadowed regions (PSRs). The crater diameter and depth of 482 craters were measured to find diameter-depth relationships. Three additional variables of crater information were collected: (1) simplicity vs complexity (2) magnesium abundances and (3) presence of radar bright deposits indicative of volatile materials or water ice. A latitudinal comparison of the north pole was evaluated with the collected data, separated into five regions from lowest to highest, A-E. Scatter plots with a linear regression analysis were created for the diameter-depth relationships, bar charts depicting the percentage of measured craters that had Arecibo radar-bright deposits (1) per region and (2) each magnesium abundance level. Region E, the north polar geographic center, revealed the greatest concentration of cold-trapped volatile materials and water-ice than other lower latitudinal regions, possibly being in the approximate area of the north polar magnetic cap. It was additionally found that Region E had the shallowest craters, suggesting that it experiences more landform degradation than lower latitudinal regions. Radar bright patches were most common in low magnesium abundance levels, meaning ice harbored within the low magnesium abundances craters must have deposited themselves recently. There are two possible explanations: (a) recent comet fragments deposited water and volatile materials and/or (b) solar wind particle bombardments are consistently generating water-ice.

Awards Won:
Fourth Award of $500