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High-resolution geological mapping of hollow fields on Mercury

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The Mercury Dual Imaging System (MDIS), on-board the NASA MESSENGER (Mercury Surface, Space, ENvironment, GEochemistry, and Ranging) spacecraft, provided over 250,000 images improving our grasp on Mercury's surface and raising new questions. Despite the wealth of data, the newly discovered features are still of challenging interpretation today, and thus will be a target of the future ESA/JAXA mission BepiColombo. Among these targets, hollows will be a top priority. In fact, they are features peculiar to Mercury, characterized by irregular-shaped, rimless depressions, few kilometers large and tens of meters deep [1]. Although scattered all over the planet, they are mainly concentrated within impact craters [1], and on the low-reflectance material color-unit [2]. Several geological maps were compiled for Mercury after MESSENGER datasets [3, 4], but none of these has a sufficient resolution to study such small features in deeper detail. With this work, we describe the methods used to compile the geological maps of three areas of hollows found within three impact craters: Dominici, Velazquez and an unnamed crater located at 356.25°E, 25.58°N (U01). We used MDIS/Narrow Angle Camera (NAC) images in the range of 20 to 50 m/pixel resolution, and performed the line-drawing at an average mapping scale of 1:100:000. This mapping scale permitted us to distinguish the hollowed areas into three morphological units: isolated hollows (hi), hollow clusters (hc) and hollowed terrain (ht). Isolated hollows are represented by single depressions tens of meters large. Hollow clusters are wider depressions, whose borders are often linked together forming irregular sunken areas hundreds meters large. Both hi and hc are very easy to recognize due to their high-reflectance values, which can be enhanced by applying a gamma correction to the images that helps bringing out details on their borders and floors. Areas marked as ht present a bright appearance due to the halos of hollows encompassed within the terrain; however, they appear darker after applying the gamma correction. Some small dark spots made of low-reflectance material are also present within the ht unit of U01. The correlation of these geological maps based on monochrome MDIS/NAC images, with the spectral clustering analysis performed by [5] will allow a full characterization of the geological framework of these hollow fields. Moreover, these maps will provide a sound basis for the selection of future high-resolution targets of the BepiColombo mission.

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