SPECTRAL CLUSTERING AND GEOMORPHOLOGICAL ANALYSIS ON MERCURY HOLLOWS.

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Introduction: One of the most surprising discoveries revealed by MESSENGER (Mercury Surface, Space, Environment, Geochemistry, and Ranging, [1]) spacecraft was the presence of particular features, called hollows, on the surface of Mercury. These were revealed as shallow irregular and rimless flat-floored depressions with bright interiors and halos, often found on crater walls, rims, floors and central peak [2,3,4] and were named "hollows". These features are located everywhere on the surface of the planet [4] and since they are fresh in appearance, they may be actively forming today via a mechanism that could involve depletion of subsurface volatiles [2,5] whose nature is not known. [6] identified an absorption feature in the photometry of hollows located in center of the Dominici crater (1.38N, 323.5°E) extending from 559 nm to 828 nm and one centered at 629 nm in the south wall/rim hollows of the crater suggesting the presence of MgS or a combination of MgS and CaS. We already applied a spectral clustering technique to characterize in deeper detail the behavior of hollows located in three different craters [7,8]. Our aim is to understand whether there is a similar trend between hollows located in different areas of the planet, and whether a possible correlation exists between spectral behavior of hollows and geomorphological units.

Dataset: We chose three different craters hosting hollows: (i) the **Dominici crater** (1.38N, 323.5°E, Kuiper quadrangle) with a diameter of 20 km, selected due to previous different spectral detection [6]; (ii) an **unnamed crater** (25.62°N, -3.4°W, Victoria quadrangle) with a diameter of 25 km; (iii) the **Velazquez crater** (37.74°N, 304.77°E, Victoria quadrangle) with a diameter of 128 km. For each crater the following WAC dataset was used:

-Dominici crater: dataset with a scale of 935 m/px through eight filter ranging from 0.433 to 0.996 µm;

-Unnamed crater: dataset with a scale of 265 m/px through eleven filter ranging from 0.433 to 1.012µm.

-Velazquez carter: dataset with a scale of 260 m/px through eleven filter ranging from 0.433 to 1.012µm.

Methodology and Results: We applied a spectral clustering technique based on a K-mean algorithm that allow us to separate in clusters our studying area, and characterized each one by an average multi-color spectrum and its associated variability (Fig. 2). We applied radiometric and photometric correction to all images using the ISIS3 image processing package of the USGS. The spectral clustering method has been already reported in [7,8].

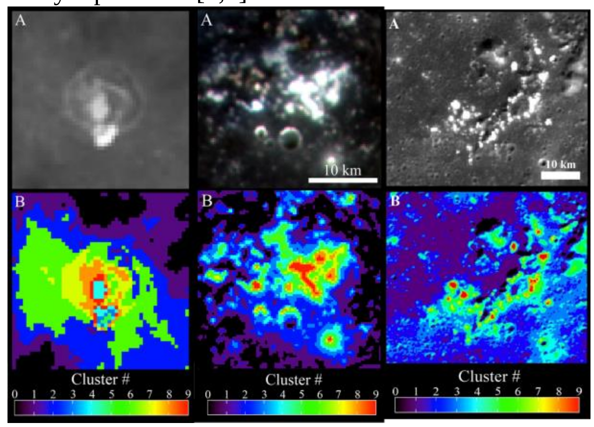
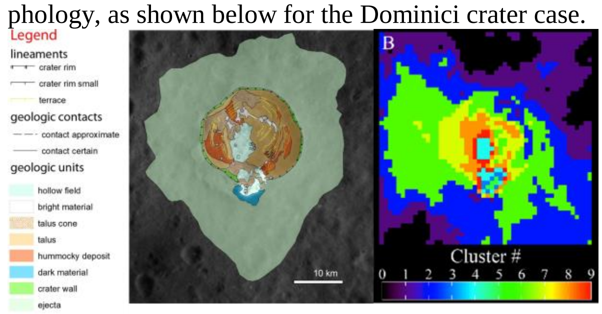


Fig. 2. *A:WAC reference images (EW0210848973D) (EW1017269227D) (EW1020781879D) for Dominici, unnamed and Velazquez crater respectively. B: The relative 10 clusters identified in the MDIS datasets*.

From clusters spectra [7,8] we discriminated areas with a possible diagnostic absorption indicative of sulfides in correspondence of hollows location in all craters (e.g. MgS as suggested by [6]).

In addition, in order to assess the powerful of our clustering method, we performed detailed geomorphological maps of the craters under study to make a comparison with the spectral clustering results. This strengthens the powerful of our method since the application of the clustering technique exhibits a spatially coherent distribution between clusters and the detailed geomorphology, as shown below for the Dominici crater case.



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