HOLLOWS ON MERCURY: A GLOBAL PERSPECTIVE B. De Toffoli[1]; V. Galluzzi[1]; G.W.Schmidt[1]; S. Buoninfante[1]; P. Palumbo[1]; [1] National Institute for Astrophysics - INAF-IAPS, Rome, Italy (Barbara.detoffoli@inaf.it).

Introduction: Mercury's hollows are small, localized, shallow depressions found on the surface of the planet. They are characterized by their distinctive appearance as irregular and bright spots that usually are found grouped in fields. The origin of Mercury's hollows is still not fully understood, but they are believed to be related to sublimation processes. Volatile materials close to the surface go through direct transition from solid to gas due to exposure to high temperatures caused by, e.g., intense sunlight or effusive activity.

We renewed the previous dataset provided by Thomas et al., (2014) [1] by updating the database and its degree of detail. We base our observations on the latest MESSENGER images-based global mosaics and provide GIS-ready polygonal features to encompass areas where fields of hollows are present on the surface. We provide descriptive details and classifications based on appearance, location, and relation with characterizing environmental features for each one of the c. 480 hollow fields identified both from literature and new observations. We aim at analyzing their stratigraphical occurrence on a global scale.

The large majority of hollows lie within crater, therefore this new analysis refines measurements of diameter and Δ elevations (Δ between present-day measurable crater rim and floor) of craters where hollows were mapped.

As far as the correlation of these locations and other factors of potential interest (e.g., hot poles, LRM,...) is concerned, no substantial differences are observed compared to the previous analysis [1]. The investigation of the distribution of diameters and topographic depression extrapolated from DEM 665m and comparison with the global population of craters showed intriguing outcomes.

Preliminary results: Therefore, it becomes relevant to understand whether there are differences between the global crater population and the subpopulation of craters where hollows were observed to understand whether it is a random subset of the global population, and thus replicates its main characteristics, or not. Indeed, it appears that the frequency of diameters and the relationship between diameters and present crater depths are significantly different from that of the global population. Specifically, the craters where hollows are found appear to comprise a subgroup where for each diameter range we measure higher Δ elevations (Fig.1).

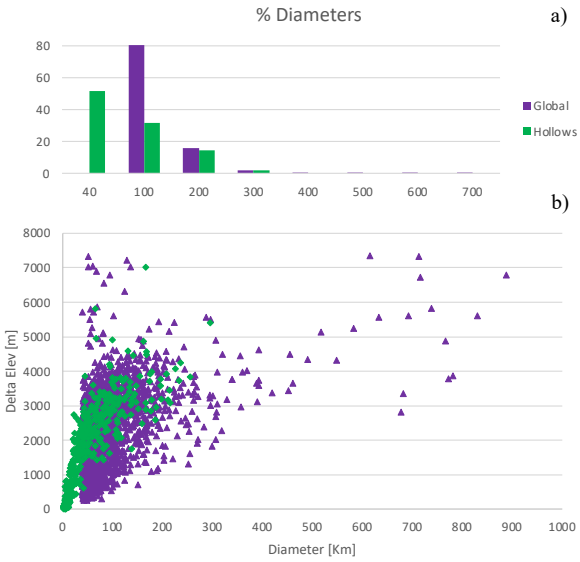

Figure 1. Diameter (a) and diameter against Δ elevations (b) distributions of both the global population (purple trinagles) and the subpopulaion of craters where hollows have been observed (green diamonds). While our mapping includes craters containing hollows of all dimensions, the global database does not investigate craters below 40 km in diameter.

Additionally, due to the fact that about half of the craters containing hollows are part of a global study evaluating morphological crater degradation on Mercury [2], it is possible to make a comparison regarding the state of preservation of the hollow bearing craters. It is clear that once again the subset of craters containing hollows does not reflect the main trends in the global population, but rather shows a clear counter-trend. Although globally we have an abundance of very degraded large craters that gradually decreases, along with diameters, for fresher craters, in the subpopulation we see the exact opposite trend (Fig.2).

Discussions: The intriguing presence of hollows on Mercury's surface offers insight into the dynamic processes shaping the planet's geological evolution. Hollows are thought to be a Kuiperian phenomenon [3] which is supported by our observation as these features appear preferentially within fresher craters, irrespective of their diameters. Nonetheless, hollows are observed also in older craters, so hollows are not necessarily formed shortly after crater formation, possibly due to post-impact alterations or volatile material redistribution. However, a delayed onset of hollow formation,

triggered by subsequent environmental changes over time, cannot be discounted. Identifying the precise triggers for hollow formation remains a key question, warranting further investigation into the specific mechanisms initiating their development.

Moreover, the preferential occurrence of hollows within deeper craters introduces further complexities. The hypothesis that deeper craters excavate layers enriched with materials conducive to hollow formation offers a plausible explanation. However, the presence of hollows across a spectrum of depths implies a nuanced relationship between crater depth and hollow formation. Another hypothesis considers the influence of infilling processes and uprising material (such as melt and fluids) as pivotal factors contributing to the formation of these distinctive surface features. Understanding the role of infill dynamics in hollow formation remains an area warranting detailed investigation to elucidate the interplay between crater morphology, material redistribution, and the genesis of hollows on Mercury.

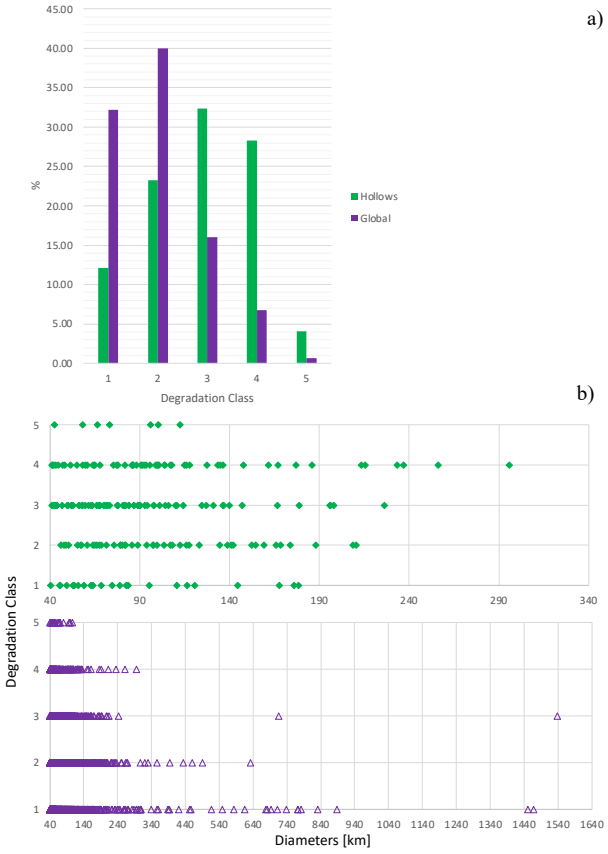

Figure 2. Aboundance of craters (in percentage) for each degradation class (a). Comparison between the degree of crater degradation (class 1 = very degraded; class 5 = fresh) of the two examined populations (b). Counter-trend is visible both in the abundance and diameter distribution.

References: [1] Thomas et al., Hollows on Mercury: Materials and mechanisms involved in their formation, Icarus 2014; [2] Kinczyk et al., A morphological evaluation of crater degradation on Mercury: Revisiting crater classification with MESSENGER data, Icarus, 2020; [3] Blewett et al., Hollows on Mercury: MESSENGER Evidence for Geologically Recent Volatile-Related Activity, Science, 2011.

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