HIGH RESOLUTION MORPHOMETRY OF MERCURY'S CANDIDATE VOLCANIC VENTS USING MERCURY DUAL IMAGING SYSTEM (MDIS)-DERIVED STEREO TOPOGRAPHY. G. Di Achille[1], M. Zusi[1], E. Mazzotta Epifani[1], C. Popa[1], V. Galluzzi[2,3], P. Palumbo[2], [1]Istituto Nazionale di Astrofisica (INAF), Astronomical Observatory of Capodimonte, Napoli, Italy (diachille@na.astro.it), [2]Dipartimento di Scienze Applicate, Università Parthenope, Napoli, Italy. [3]Dipartimento di Scienze della Terra, Università "Federico II", Napoli, Italy.

Introduction: The occurrence of possible pyroclastic deposits on Mercury was suggested from Mariner 10 data [e.g. 1, 2] and substantiated from the first MESSENGER flybys' images [3], which also enabled the identification of candidate volcanic vents on the planet [e.g. 4, 5, 6, 7]. Using orbital MESSENGER data, additional possible volcanic vents have been identified and studied at greater detail [e.g. 8, 9]. However, several aspects about the origin and evolution of possible Mercury's volcanic vents are still uncertain and require further analyses.

Here, we use MDIS narrow angle [10] orbital images to derive high resolution topography of candidate volcanic vents. The obtained digital terrain models (DTMs) allow us to investigate the morphometry of the possible vents at unprecedented detail and to gain a better understanding to characterize them. First of all, our preliminary results are compatible with a volcanic origin for the proposed vents; moreover, the putative volcanic features present a rather significant morphological variety likely reflecting the occurrence of diverse geological and magmatic conditions.

Data and methods: We are surveying the global map of pyroclastic deposits by [7], focusing on possible volcanic vents covered by multiple released orbital MDIS NAC images. Particularly, we use MDIS NAC stereo pairs suitable for the topographic analysis and process the images through the USGS ISIS and NASA AMES Stereo Pipeline [11] softwares. Thus far we analized 22 deposits and we were able to derive the topography for 14 of them based on the available data. Finally, depending on the resolution of the used images we are obtaining DTMs with resolution down to 100 meters per pixel.

Validation of dataset. To assess the quality and reliability of the derived topography we performed a comparative analysis between the obtained DTMs and overlapping MLA shots (Fig. 1). We produced test stereo-derived DTMs for four distinct regions covered by released MLA tracks, comparing the results for a total of more than 240 altimeter shots. Interestingly, the stereo-derived topography matches very well that from MLA except for the elevation absolute values (see example in Fig. 1). The latter discrepancy was expected since we do not use ground control points (GCPs) during the processing. However, the obtained DTMs, even if affected by the above mentioned elevation offset, could be used to make any relative morphometric measurements, like for example measuring depth, slope, volume of studied vents. Moreover, for all the four test regions we found that, although different for each of the four DTMs, the vertical offset between stereo-derived topography and MLA shots is rather costant within each DTM (see Fig. 1). In fact, once the average vertical offset with respect to MLA is determined for the DTM and added to each pixel of the stereo-derived topography, the corrected values would be closely matching those obtained from MLA within the whole DTM (see green dots in Fig. 1). Particularly, we obtained a root mean square error (RMSE) for the absolute elevation of the four test stereo-derived DTMs

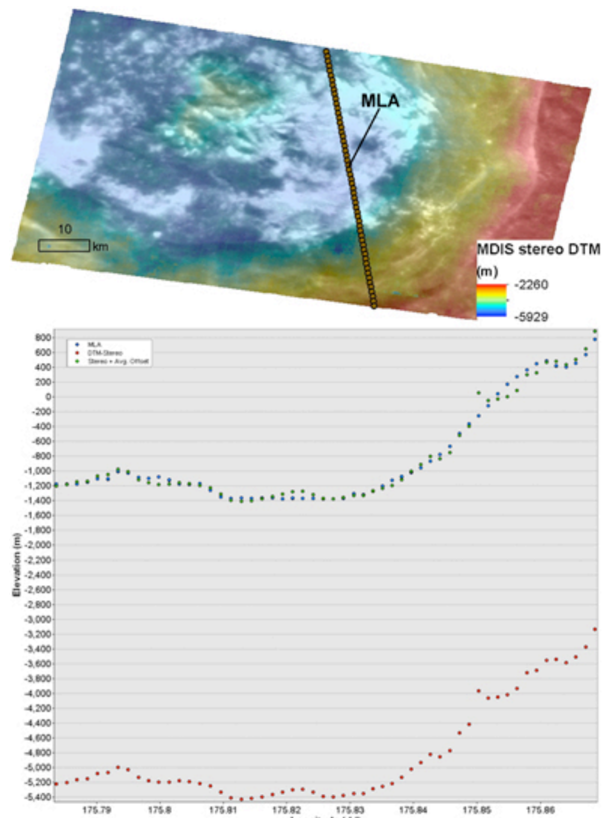

Figure 1 – Example of DTM derived from MDIS NAC stereo pairs showing the central peak and eastern rim of a complex crater with hollows on its floor (top). Comparison with the MLA shots shows that the stereo topography (red dots) matches very well that from laser altimeter (blue dots), except for a rather costant vertical offset within the DTM (see text for details)

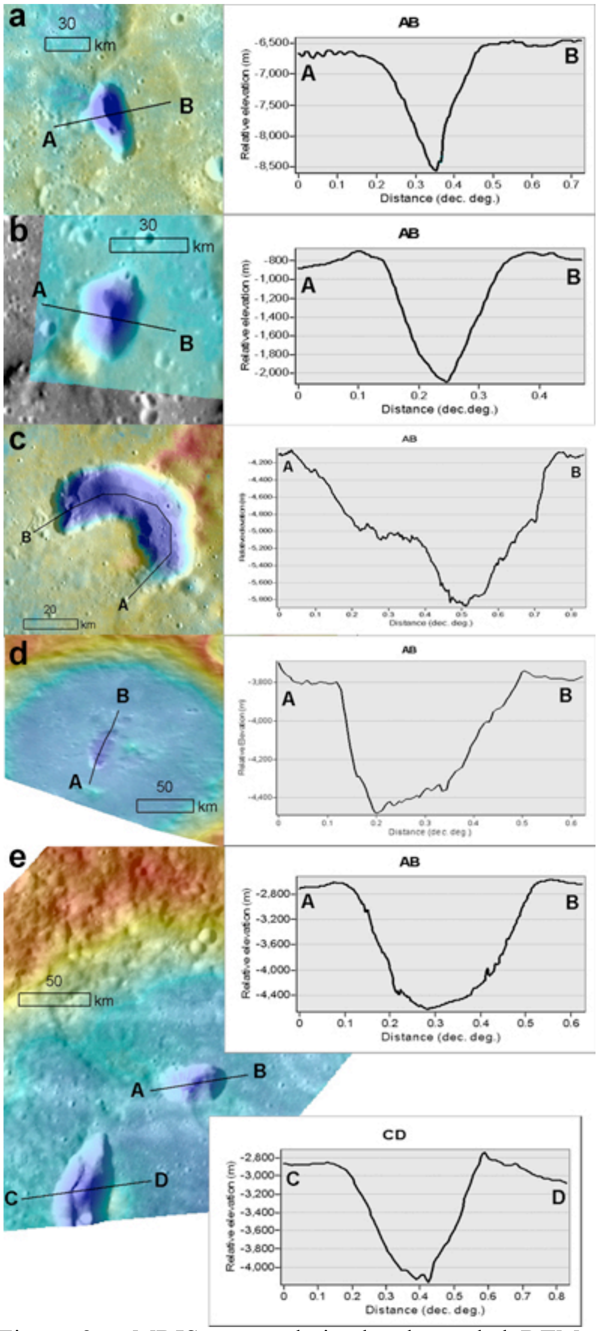

Figure 2 – MDIS stereo derived color-coded DTMs (red for the highest and blue for the lowest regions) and topographic profiles of some of the studied possible volcanic vents.

of 64, 77, 130, and 146 meters, respectively, with respect to MLA elevation values. Overall, our assessment shows that MDIS stereo derived topography through NASA AMES Stereo Pipeline is reliable and accurate when compared to MLA tracks and thus a valid tool for morphometric studies of Mercury's surface even if not corrected for the vertical offset. In fact, all the morphometric measurements are based on relative elevation differences.

Preliminary results: The morphometry of putative volcanic vents is key to characterize the type of volcanic activity (and thus the relative role of volatiles) that formed them and to understand their evolution. We are investigating isolated vents (e.g. a and b in Fig. 2), those typically associated with the floors, central peaks, peak rings, or rims of impact craters [7] (d and e in Fig. 2), as well as those possibly related to tectonic activity [12] (e.g. c in fig. 2). Our preliminary results based on 14 possible vents show overall morphometric characteristics broadly compatible with a volcanic origin of these features if compared with terrestrial or martian and lunar volcanic vents. Seven features (half of the currently investigated vents) show a relatively simple morphology in plan view and an rather axi-symmetric V-shaped cross section (a, b, and e, profile CD, in Fig. 2) likely suggesting these are monogenetic (and thus possibly short-lived) explosive volcanoes resulting in collapse into voids left by magma subsurface retreat. Whereas, 4 vents have more complex outlines showing relatively flat floors likely as a result of caldera floor collapses and presence of lava bottom caps (d and e, profile AB, in Fig. 2). Finally, 3 features present intermediate characteristics with respect to the above described features showing both flat hanging portions and V-shaped deepenings of vent floors likely suggesting these are polygenetic (and thus likely with prolonged activity) volcanoes alternating effusive and explosive eruptions (see c in Fig. 2). However, since this latter morphology is preferentially shown by the studied vents associated with wrinkle ridges and lobate scarps, a tectonic control on these features can not be uniquely excluded. Particularly, c in Fig. 2 shows that the realtively flat portion of the floor is found in corrispondence of the hanging wall of the associated thrust fault while the deepening is on the footwall of the fault thus strongly suggesting a tectonic control on the vent's morphology and related volcanic activity.

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