Geophysical Research Abstracts
Vol. 13, EGU2011-7048, 2011
EGU General Assembly 2011

Analysis of the Reull Vallis Upper Reaches and the Morpheos Basin in the Eastern Hellas Rim Region, Mars.

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Reull Vallis, one of the large canyons of the eastern Hellas rim region has been studied in detail in earlier studies [i.e. 1, 2]. The new data from Mars Express and MRO adds more detail to the general view of the fluvial system and gives a possibility to determine more exact age constraints through crater size-frequency counting using the available images of CTX, HiRISE and HRSC.
Between the Reull Vallis segments 1 and 2 locates a closed flat-floored topographic depression, the Morpheos basin [2,3,4]. The deepest parts of this basin are at ∼450 m, about 50 m deeper than the level of the floor at the beginning of the Segment 2 of Reull Vallis [2]. A hypothesis of a transient reservoir of water that existed in the western portion of the Morpheos basin has been suggested [2,3,4]. According to the hypothesis, the reservoir was filled by the effluents of Segment 1 and served as the source of water that later carved Segment 2 [2]. A volumetric re-analysis of the Reull Vallis system by Capitoli [5] determined that more likely level of filling would be around the levels of 450-500 m.
In our earlier study [2] the MDIM derived crater retention age of the Morpheos basin floor was indistinguishable from the age of the Hesperia Planum. This result was now tested with the availability of much more detailed images of both Morpheos and Hesperia surface. Three areas were used for countings within the Morpheos basin, and three within Hesperia Planum in order to get comparative results. Calculations within area 1 (A1_MB) of Morpheos basin (HiRISE, SP_016719_1425_RED, resolution of 50cm/pix) resulted in the surface age of ∼3.69 Ga, which was comparable to the results from areas 1-3 of Hesperia Planum (A1_HP: CTX, B16_015928_1501_XN_29S254W, 5.13m/pix; A2_HP: CTX, P19_008280_1519_XN_28S251W, 5.1m/pix; A3_HP: HRSC, H1876_0000_ND3, 23.5m/pix) with the ages of ∼3.66 Ga, ∼3.84 Ga and ∼3.68 Ga, respectively. However, the counts in the two other areas of interest within Morpheos basin (A2_MB: CTX, P04_02531_1438_XN_36S246W, 5.08m/pix; A3_MB: CTX, P20_008794_1430_XI_37S245W, 5.16m/ pix) resulted in ages of ∼3.55 Ga and ∼3.54 Ga, respectively. The analyzed three Morpheos basin areas differ by their altimetric locations: the areas 2 and 3 are located within the surface area confined by the contour level of 500 m and area 1 of Morpheos basin is located next to the Segment 2 channel head at ∼550 m.
Conclusions: The crater size-frequency distribution calculations with the high resolution images show the difference in the previously indistinguishable [2] Hesperia Planum and Morpheos basin surface ages. The deepest parts of the basin show younger surface age. Also, our new crater size-frequency distribution calculations of the Morpheos basin surface support the proposition by Capitoli [5]. It seems that the limit of the basin filling is at around the 500 m contour level, as the only area of calculation (A1_MB) outside this contour level of the basin gives the same age results as the Hesperia Planum areas. This result implies that around 3.55 Gyr ago the surface of the basin below the contour level of 500 m was modified along with the cratering record by a significant resurfacing event, such as by filling with water released from the Segment 1.
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