EPSC Abstracts
Vol. 10, EPSC2015-183, 2015
European Planetary Science Congress 2015

Grid Mapping of Hellas Planitia – Preliminary Results from the Northern Impact Rim

M. Voelker (1), E. Hauber (1) S. van Gasselt (2) and R. Jaumann (1,2)
(1) German Aerospace Center (DLR), Rutherfordstr. 2, 12489 Berlin, Germany (martin.voelker@dlr.de); (2) Institute for Planetary Sciences, Freie Universität Berlin, Malteserstr. 74 – 100, 12449 Berlin, Germany

1. Introduction

The Hellas impact basin, located in the southern highlands of Mars, is one of the largest basins and the deepest impact structure on the planet. With a diameter of 2,300 km and a depth of more than 8,000 m it is a melting pot of several diverse geomorphic systems. Today, the basin is enriched with volatiles and ice-cemented materials [1], and its central parts show a scarcity of craters, smooth surfaces, and a high albedo, supporting the assertion of a recently modified and/or active surface. It is likely that the low elevation once accommodated more favorable conditions for volatiles and freeze–thaw cycles than most other areas on the planet. Glacial and fluvial landforms, glacier-like features [2, 3], polygons [4] and fluvial channels [5, 6] have been reported throughout the whole basin. All of them require at least temporary water and/or melting conditions.

2. Methods and Data

We examined the geomorphologic setting of northern Hellas using the planetary grid mapping method developed by [7]. The study area encompasses the entire Hellas floor below an approximate elevation of 5,500 m below the Martian datum. As Hellas is a circular formation located in the mid-latitudes we used a stereographic projection centered at λ=69°, φ=-49°. To be able to compare our results with other grid-mapped regions [7] we use the same grid size of 20 × 20 km and a CTX-based (Context camera [8]) dataset. For creating an exact grid the tool *Repeating Shapes* [9] has been applied. Due to the vast size of the study area, however, we will only analyze every second grid cell in a checkered pattern. This sampling density already produces a representative dataset for preliminary results for some of the mapped landforms. Mapping scale is 1:30,000 and is carried out in an *ArcGIS 10.3* environment. The total number of grid cells being mapped is approx. 10,200. Mapped landforms are: latitude-dependent mantle (LDM), concentric crater fills (CCF), layered sediments, glacier-like features, viscous valley flows, banded terrain, honeycomb terrain, polygons, scalloped terrain, texture, chaos', channels, gullies, fans, fluvial sheet deposits, shorelines, bedrock, and dunes. The presented results are based on 1,500 already analyzed grids, located along the northern margin of the Hellas basin floor.

3. Results

The most important results using grid mapping concern the geospatial distribution of each mapped landform. The majority of the mapped landforms are not very prominent at the northern rim; so there are no representative results available for them by now. However, some relevant inferences can be already made for LDM, CCF, and layered sediments (Fig. 1).

LDM is distributed all over the northern rim and the floor of the basin, although in different roughness (i.e. degradation state) and thickness. The LDM is less prominent on the rim than on the basin floor. Moreover, its thickness decreases towards northeast on both the rim and the basin floor. This observation is consistent with the roughness map of [10], as their map postulates a rougher surface in that area, and thus, a possibly thinner LDM layer. LDM is also a little less dominant along the base of Coronae Scopulus (Fig. 1). The spatial distribution of **CCF** is similar to LDM. It is also less prominent in the NE part of Hellas, and disappears completely in small craters there (<3 km). There are also some small areas to the east and west of Coronae Scopulus lacking CCF's. The third type of major landforms in northern Hellas is represented by (often bright or light-toned) **layered sediments**. These are located along the northern rim and display an elevation range of around -6,400 to -4,500 meters. They occur more often along the NE part of the rim, and at some

scattered places on the NW part. There are also a few outcrops on the floor of the basin, albeit less distinctive. Other less prominent features in northern Hellas are channels (which are mainly located on the rim, and only in very few places on the basin floor), a few gullies, and reticulate terrain (in very small and isolated patches). It is also remarkable that despite of the high atmospheric pressure no large dune fields have been observed.

4. Discussion

Based on visual inspection, the preliminary results for the distribution of LDM show a relatively good correlation with both the dust cover index [11] and roughness map [10], as both of them indicate a lower abundance of dust with a relatively rough (possibly degraded) surface in the NE. While the LDM is very dominant in the SW of the mapped area, it is absent or less distinctive in the east. Moreover, our map shows that the LDM extends further north than predicted by [1, 10]. The reason may be found in different generations of LDM. Madeleine et al. [1] find that the mantling unit in Hellas extends from 40°S poleward, and the roughness map shows a more rugged landscape north of 30°S. Our CTX examinations have shown, however, that the mesoscale surface smoothening caused by LDM extends at least up to 27°S to the north outside of the Hellas basin. A comparison to our preliminary low-resolution mapping of the whole Hellas area has shown, that the LDM surface appears to be significantly rougher in the northern part of Hellas. This roughness could be caused by a higher age or a higher rate of degradation of the LDM in this area; as the more southern LDM (south of 30°S) has been covered by more recent LDM layers (within the last 2 Ma [1]), the rougher LDM (north of 30°S) may originate from an atmospheric dust and ice deposition older than 2 Ma, and could thus have been degraded over a longer time period, without having been covered by a younger LDM again. The thinner and missing LDM cover in the NE of Hellas does not show any sharp margins, so we can exclude a superposition of this unit by other materials. Hence we hypothesize that the rougher LDM in that area is possibly caused by the atmospheric circulation pattern within the basin. As wind currents rotate clockwise in the basin [12], the areas in NE Hellas receive the warmest winds coming from the most northern parts of the basin. This may cause a drier atmosphere and/or a faster sublimation of ice on the ground. This could also explain the lack of CCF's in this part of Hellas.

The spatial distribution of layered sediments seems to depend on the topography, as they are located on the inner slopes of the rim. Their similar elevation may indicate that they could have been formed in the same standing body of water. Future work will show how continuous a possible ring of layered sediments around Hellas is. They are best visible in the NE quadrant where the LDM thickness is low or absent. If they originate from the same body of water, Hellas Planitia must have contained a sea with a depth of up to 4,000 m and a diameter of around 2,700 km.

References

[1] Madeleine J.-B. et al. (2014) GRL 41(14), 4873–4879. [2] van Gasselt S. (2007) Cold-Climate Landforms on Mars, 264 p. [3] Hubbard B. et al. (2011) Icarus 211, 330–346. [4] Diot X. (2014) Planetary and Space Science 101, 118–134. [5] Kostama V.-P. et al. (2008) LPSC 39, #2018. [6] Kostama V.-P. et al. (2010) Earth Planet. Sci. Lett. 294, 321–331. [7] Ramsdale J.D. et al. (2015) LPSC 46, #1339. [8] Malin M.C. et al. (2007) JGR 112, E05S04. [9] Jenness J. (2012) Repeating shapes for ArcGIS. Jenness Enterprises. [10] Kreslavsky M.A. & Head J.W. (2002) GRL 29(15), 1719 pp. [11] Ruff S.W. & Christensen P.R. (2002) JGR 107(E12), 5127. [12] Howard A.D. et al. (2012) LPSC 43, #1105.

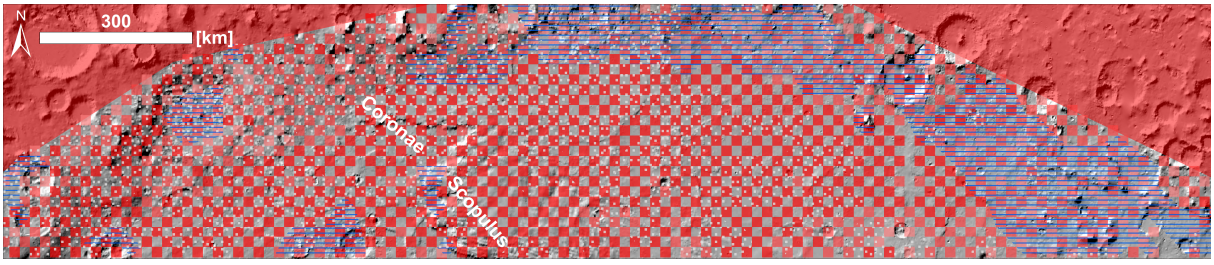

Figure 1: Map showing the northern rim of Hellas. Red squares = LDM (The darker the signature the more distinctive it is); blue crosshatches = layered sediments; grey dots = CCF; solid red areas = not mapped.