DISTRIBUTION AND EVOLUTION OF LACUSTRINE AND FLUVIAL FEATURES IN HELLAS PLANITIA, MARS, BASED ON PRELIMINARY RESULTS OF GRID-MAPPING. M. Voelker, E. Hauber, R. Jaumann, German Aerospace Center, Institute of Planetary Research, Rutherfordstr. 2, 12489 Berlin, Germany (martin.voelker@dlr.de).

Introduction: Hellas Planitia, the second-largest impact basin on Mars (2.300 km), is located in the Martian mid-latitudes at the ultra-low elevation points of the planet. Several authors have proclaimed that the basin was once filled by an extended body of water [e. g. 1, 2, 3]. This work will support this hypothesis by creating a geospatial inventory of both large and small-scale landforms of fluvial and lacustrine origin, based on high-resolution observation. Moreover, the results will implicate further information about the history of water and climate in Hellas Planitia, and hence, about possible habitable environments.

Methods: We have applied the newly developed grid-mapping method according to [4] in a GIS-environment. This allowed us to quantify the presence of selected landforms geographically. We separated Hellas into 20,000 grids; each 20×20km. Every grid has been mapped on a scale of 1:30,000 on basis of CTX images (Context Camera onboard Mars Reconnaissance Orbiter). Because of the high amount of grids, we just mapped every second grid (10,000 grids). At the time of writing, ~6,500 grids have been mapped. Mapped fluvial and lacustrine landforms are; channels, chaos', fans, gullies, sheet deposits, light-toned deposits, and possible shorelines. Future work will comprise statistical analyses of parameters like elevation, aspect and slope of each mapped landform.

Results: In this abstract we are focusing on channels, chaos', sheet deposits, light-toned deposits (LTD) and possible shorelines. All other landforms mentioned before do not show a significant distribution yet. Channels are mainly observed along the rim of Hellas; especially on its eastern portion. On the basins floor they show a low density despite a relatively rough topography. Most of them terminate at an elevation of around 6,300m below the Martian datum. Only the big eastern inflow valleys (Dao and Harmakhis Vallis) reach deeper (up to -6,800m). And in contrast to all other parts on the planet, chaotic terrains appear at the lower end of both valleys and not at their heads. Along these big valleys so-called sheet deposits cover their adjacent plains. If they are of fluvial or volcanic origin is still a matter of discussion [5, 6]. LTD's (as already described by [1, 2] in adjacent Terby crater) occur mainly along the inner rim between an elevation of -6,000 to -4,500 m and in some scattered places on the basins floor (Fig. 1). Along the slopes of Hellas' NE rim there is an arcuate sedimentary bank measuring almost 1,000 km in length. CRISM analyses have shown that these deposits mainly consist of Mg/Fe phyllosilicates, fitting to the results of Terby [1, 2]. Shorelines are hard to distinguish. By now, we could not identify any extensive and long shorelines. They are either located in small depressions on the basins floor or at very scattered places along the rim where also LTD's occur.

Discussion: Our analyses determined that LTD's, as described by [1, 2] in Terby crater, extend far more than expected along an arcuate bank at the NE Hellas rim. We cannot exclude an even wider extent as we just can observe open outcrops of these layers. So it is possible that this sedimentary arc could be just an outcrop of a sedimentary ring encircling Hellas'. This might support theories of a former sea within Hellas, although the insufficient abundance of shorelines is still a problem. The body of water might not have endured long enough to form distinct coastal morphologies or they have been eroded over the last ~3 Ga as they were too weak. In some small closed depressions on the floor of Hellas we could find possible shorelines together with LTDs'. So an alternative hypothesis is that Hellas contained at least some smaller lakes, persisting longer times because of the high air pressure in these lowest parts of the basin. The observed phyllosilicates along the rim are evidence for water activity in Hellas during the Noachian. In some places (like Hellas Chasma) CRISM shows clays that are not arranged as typical layered deposits. So we cannot exclude that these deposits are even more extensive than in our maps, that are based on photogeologic decisions.

Channels occur predominantly at the rim where topography shows high relief energy. Despite there are even hills, mountains, and tall slopes on the basins floor as well as high air pressure values, it is almost free of significant fluvial landforms. The question is, why channels did not develop there? There are several possible scenarios. A deep body of water, an ice-shield, or a combination of both prevented erosion of channels. Remarkably, the termination level of the channels is lower than the hypothesized sea level that is necessary to develop the adjacent layered deposits. So we suggest two Hellenic lake stages; a high levelled Noachian one forming bright layered deposits, and a later (Hesperian?) lower-levelled one, forming small ponds (see Fig. 2). According to our scenario, Hellas contained a sea level with an elevation of up to-3,500m in the Noachian/Phyllosian period ([1] even suggested an elevation of -2,000m for the adjacent Terby crater linked to Hellas). At this time, the extensive phyllosicates deposited along the rim of Hellas caused by the inflow of several small channels (e.g. Navua Valles). However, we cannot state a source that is big enough to fill Hellas with a sea having a depth of several thousand meters. During the Hesperian volcanic activities east of Hellas awoke and caused the formation of Dao and Harmakhis Vallis [7] as a consequence. Their release of water caused the formation of sheet deposits along their banks and possibly smaller lakes formed at the bottom of the Hellas basin. Within these lakes further LTDs developed. Finally, in the Amazonian all liquid water vanished and left the mentioned deposits and landforms behind.

Another enigmatic observation are several chaotic terrains SW of Talas crater. They are located at the far end of the big eastern valleys draining into Hellas. Usually, chaotic areas are considered to be a source for channels, but in this area the situation is inverted. So we cannot exclude that these chaotic terrains have a different genesis than other chaos' on Mars; they merely share the same appearance (equifinality?).

Conclusion: The grid-mapping method has been proved helpful in analyzing Hellas, although this method is very time consuming. By using the results, we could determine a high elevated extensive arcuate sedimentary bank along Hellas' NE rim as well as some local and low levelled bright deposits on the basins floor. This lead us to the assumption of two different lake levels that once filled Hellas Planitia.

References: [1] Ansan et al. (2011) Icarus, 211, 273-304. [2] Wilson et al. (2007) JGR, 112, E08009. [3] Crown et al. (2005) JGR, 110, E12S22. [4] Ramsdale J.D. et al. (2015) LPSC 46, #1339. [5] Voelker M. et al. (2012) LPSC 44, #2886. [6] Leverington D.W. (2011) Geomorphology, 132, 51-75. [7] Leonard G.J. and Tanaka K.L. (2001) USGS, map I-2694.

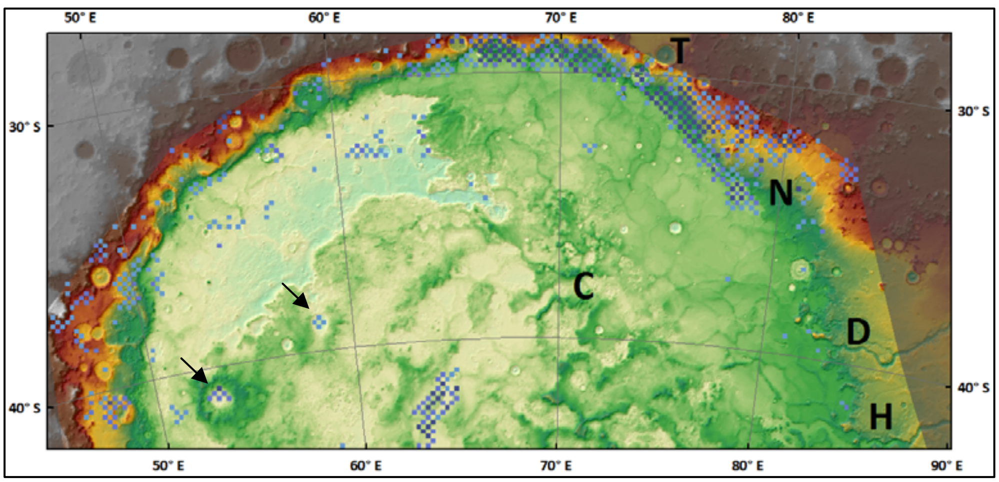

Figure 1. Grid-map showing the distribution of LTD's. The darker the grid the more prominent the deposits. Terby crater (T), Navua Valles (N), Chaos' (C), Dao (D) and Harmakhis Vallis (H). Black arrows indicate enclosed depressions showing both LTD's and shorelines (Basemap MOLA).

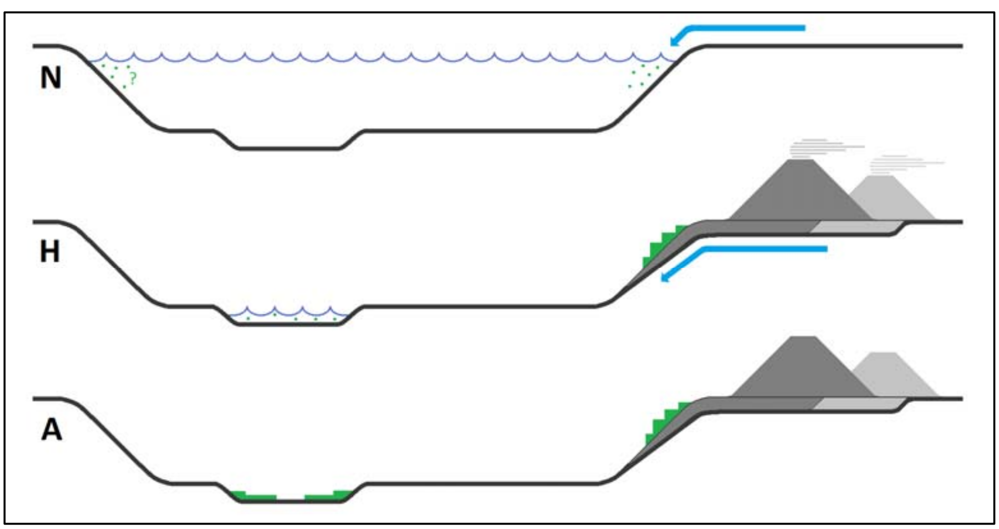

Figure 2. Cross-cut profile of Hellas (W-E) showing the evolution of light-toned deposits (green) during the the three Martian epochs. Blue arrows indicate the influx of water. For detailed description see discussion.