FLUVIAL PROCESSES IN EASTERN HELLAS PLANITIA, MARS: RESULTS FROM CRATER COUNTS. W. Zuschneid[1] and S. van Gasselt[1], [1]Freie Universität Berlin, Institute of Geological Sciences, Planetary Sciences and Remote Sensing Group, Malteserstr. 74-100, 12249 Berlin (wilhelm.zuschneid@fu-berlin.de).

Introduction: With a diameter of 2,300 km and a depth of more than 8,000 m, the Hellas basin is one of the major geomorphic and topographic features in the southern martian hemisphere. It has been acting as a depositional sink since its formation 4 Ga ago [1] and has been the location of a wide variety of geologic processes. In this ongoing study, we investigated the stratigraphy of fluvial features in the eastern Hellas region on Mars, focusing on apparently young fluvial depositional areas in the Dao and Harmakhis Valles region and on the eastern plains within the Hellas basin.

The region connecting Hesperia Planum with Hellas Planitia is characterized by a patchwork of remnant massifs protruding through a set of plains units of varying morphology and surface texture, indicating a diverse and eventful geologic history. A variety of geologic processes has been observed, from the basin-forming Hellas impact, widespread plains-forming and central vent volcanism [2,3] to fluvial and cold climate processes [3,4]. In order to analyze the stratigraphy, we performed crater counts for selected areas to obtain absolute ages for young areas formed by fluvial processes. We also obtained a lower limit for the age of major fluvial processes.

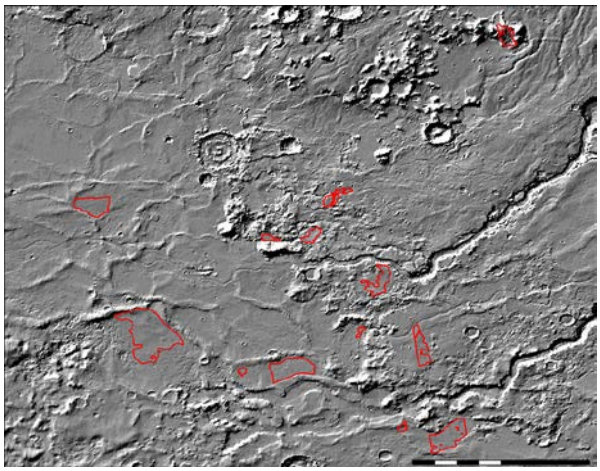

Fig 1.: Eastern Hellas basin: overview of crater counting areas (red outline) on MOLA shaded relief. Scale bar length is 250 km.

Data and Methods: The study is based on the analysis of image data collected by the CTX camera (MRO) and the THEMIS IR instrument (Mars Odyssey). CTX data was processed and map-projected using the ISIS suite, and then integrated into ArcGIS for further analysis and supplemented by the THEMIS IR daytime mosaic produced by ASU. Areas for crater counting and age determination were selected based on the apparent youth of the surface, and their potential association with fluvial landforms. In addition, several additional areas with different origin were selected for comparison and to complement the general picture. Problems arose from a reduced image quality due to atmospheric dust at lower elevations in the Hellas basin.

Using the CraterTools 2.2 extension [5], counting areas were outlined based on the criteria as outlined e.g. in [6], care was taken to exclude obvious clusters and chains of secondary craters. The crater counts obtained were analyzed using the Craterstats 2 software described in [7].

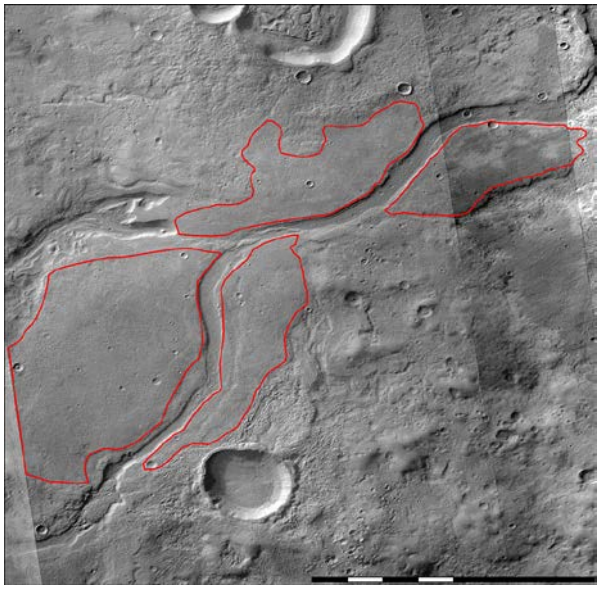

Fig. 2: Counting areas on floodplains along a small fluvial channel north of Dao Vallis. Resurfacing age is 488 Ma, age of the underlying strata is 1.89 Ga. Note the diversity of geologic and morphologic units into which the floodlplains are embedded. Mosaic of CTX images. Scale bar length is 20 km, image center is located at 84.2 E, 37.8 S.

Observations: The eastern region of Hellas Planitia is characterized by abundant fluvial features. The most obvious are Dao and Harmakhis Valles, but plenty of smaller fluvial channels can be observed at lower elevations along the slope into the basin. Associated with these smaller channels are flat, uniform small plains, which are interpreted as floodplains. At the channel

termini on the eastern plains in Hellas basin, associated sedimentary deposits are observed.

We investigated selected areas of this type along a small valley north of Dao Vallis, and along Sungari Vallis, a medium-sized channel located between Dao and Harmakhis Valles; in addition, we investigated the deposits at the termini of the valleys. For these areas, crater counts were performed to obtain crater size-frequency distributions and ages. In addition, craters were counted in several of the shallow basins separated by ridges located on the eastern floor of the Hellas basin [8]. This large spatial spread of counting areas made an evaluation of the spatial extent of resurfacing effects possible. For comparison, an area on mountain remnant containing a valley network was included in the age determinations.

Results: Although the crater count areas are spatially separated, the absolute age determinations yield relatively consistent results, indicating ages for the last fluvial resurfacing between 400 and 600 Ma. Similar resurfacing ages were obtained for the basins on the eastern plains. Pre-resurfacing ages of 3.4 to 3.7 Ga were determined for the basins, establishing a baseline for the oldest events following the formation of Hellas basin. The formation ages of > 3.5 Ga for the plains are in good agreement with results obtained by [2] (for much larger counting areas).

Tab. 1: Generalized formation and resurfacing ages for counting areas

Count area	Age
Floodplains N Dao	1.89 / 0.49 Ga
Sungari Floodplains	3.67 / 0.58 Ga
Basins	3.5 -3.6 / 0.38 -0.74 Ga
Valley network on remnant massif	3.6 Ga

Conclusions: The results of our crater counts indicate an episode of increased fluvial activity from 400 to 600 Ma. This fluvial activity led to the partial resurfacing of areas on the slope as well as on the basin floor. On the slope into the Hellas basin, resurfacing occurred by sedimentary deposition. The extent of the depositional areas indicates a high sediment load associated with the single fluvial events. The water sources associated with fluvial activity are not in the focus of this investigation, but a release from the subsurface (shallow or deep) has been proposed for Sungari Vallis, e.g. by [9, 10] and also seems feasible for the other, smaller valley system north of Dao Vallis.

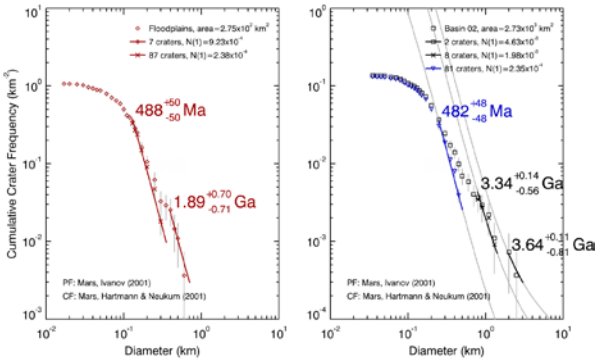

Fig. 3: Crater count results for two counting areas: The floodplains (left plot) display a single resurfacing event at 488 Ma, the underlying unit formed at 1.89 Ga. The right plot shows a count from one of the basins on the eastern Hellas plains, displaying a formation age at 3.64 Ga with subsequent modification at 3.34 Ga. Resurfacing occurred at 482 Ma.

For the basins on the Hellas floor, a resurfacing by sedimentary deposition is not directly observed. Here, better HiRISE coverage may be helpful in the identification of resurfacing mechanisms. The area on the remnant massif does not show resurfacing in the timespan between 400 to 600 Ma, indicating that not all surfaces were affected by the resurfing episode. Older resurfacing events were also identified (e.g. at around 1.9 Ga), but their occurrence is not as widespread as the younger episode.

Outlook: The high degree of contemporaneity merits further investigation of the absolute ages of more areas in the region of eastern Hellas. While the results presented are focused on the youngest major episode of activity, the history of the region extends back to the formation of the Hellas basin at 4 Ga. The ever improving coverage with high resolution image data will help to understand this complex stratigraphic mosaic.

References:

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