AGES OF LAVA FLOWS IN THE HESPERIA VOLCANIC PROVINCE, MARS. T. R. Lehmann, T. Platz and G. G. Michael, Freie Universität Berlin, Institute of Geological Sciences, Planetary Sciences and Remote Sensing, Malteserstr. 74-100, 12249 Berlin, Germany (thomas.platz@fu-berlin.de).

Introduction: Hesperia Planum is one of the major volcanic provinces on Mars and is located NE of the Hellas impact basin [1]. The extensive volcanic lava plain was interpreted to have formed during the Hesperian period [2]. The Tyrrhena Patera shield volcano is located in the centre and source of most volcanic flows.

Hesperia Planum is composed of multiple successions of lava flows extending as far as 800 km from Tyrrhena Patera. In this study we investigate the eruption history of the Tyrrhena Volcanic Province by mapping individual lava flows and lava plateaus. Due to the complex setting and morphology of the edifice the focus has been primarily on lava flows outside Tyrrhena Patera.

Method: The identification and mapping of lava flows was done one THEMIS IR daytime and HRSC data. Each single lava flow is mapped in an ArcGIS environment.

The Martian production function [3] and the chronology function [4] are the basis for the age determination of the lava flows. The size frequency distribution of craters on lava flows were measured with the ArcGIS extention *cratertool* [5]. Crater statistics are then analyzed in *craterstats* [6] to determine crater model ages. The aereal extent of counting areas for the age determination using impact craters varies from 100 to 1400 km². Clusters of secondary craters were excluded from the counts.

Lava flow morphologies: The majority of the mapped flows are lobate lava flows with a narrow portion towards their sources and a broad lobate morphology at its end. They extend over 50-150 km. A minority of long meandritic lava channels cut the lobate lava flows over a distance of up to several hundred km (Fig.1a). The thickness of the lava fill is estimated to be on average 300-400 m [7]. Lava flows are often recognized at their distal reaches and cannot be traced back to their source regions due to the burial by younger flows. Extensive wrinkle ridge formation further complicate flow identification [8, 9, 10]. Often lava flow boundaries cannot be traced beyond wrinkle ridges. In addition, flow margins and cross-cutting relations to adjacent/underlying flows are often subdued due to thick mantling deposits of dust or ash.

Various eroded, plateau-like areas are observed, particularly at the base of the edifice. Although those plateaus were likely formed by a succession of lava flows, they form homogeneous surface and therefore can be used for age dating (Fig. 1b). Furthermore, Hesperia Planum has been fluvially modified, especially in marginal areas [7] making it partially difficult to clearly identify volcanic deposits.

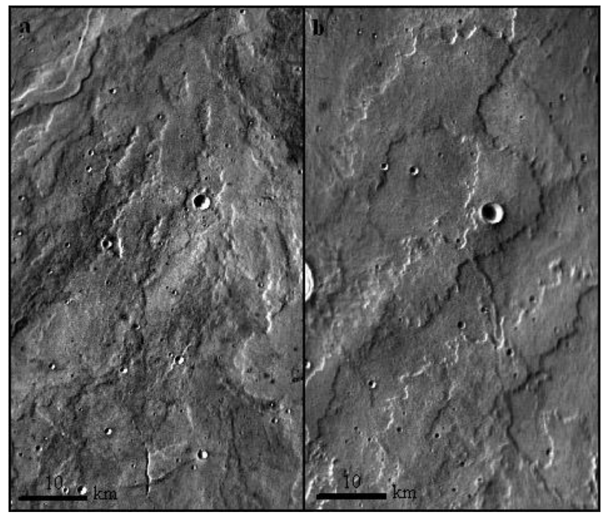

Fig. 1: Lava flows on Themis data Images a) lobate lava flow source in NE propagate to SW in lobate. At the NW edge: a little part of a lava channel. b) plateau like lava strong eroded. For localities see Fig. 2.

Results: Formation ages of 17 lava flows range from 2.2 to 3.5 Ga (Fig. 2). These first results imply eruption events to be constrained to Late Hesperian/Early Amazonian. Nine lava-flow model ages are older than 3 Ga, five range from 2.5 to 3 Ga. Only 2 are younger than 2.5 Ga.

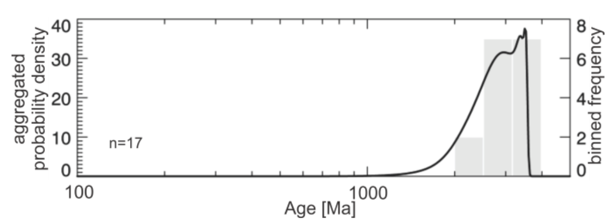

Fig. 2: Aggregated age measurements of lava flows and lava plateaus in the Hesperia Volcanic Province. See [11] for more detail on producing this plot.

Discussion and future work: The current status of our study is shown in Figure 3 where mapped lava deposits are colour-coded by model age. Preliminary results of this study to investigate the eruption history of the Hesperia Volcanic Province suggest that, in contrast to the Elysium and Syrtis Major Volcanic Provinces, volcanic activity appears to be contraint to a rather narrow period of about 1.5 Ga. Further lava flows need to be mapped and dated before this initial conclusion can be supported by a more complete picture of the eruption history.

References: [1] Greeley R. and Guest. J. (1987) *USGS Misc. Series* I-802-B. [2] Gregg T. K. P. et al. (2005) *LPS XXXVI*, Abstract #1962. [3] Ivanov B. A. (2001) *Space Sci. Rev.*, *96*, 87–104. [4] Hartmann W. K. and Neukum G. (2001) *Space Sci. Rev.*, 96, 165-194. [5] Kneissl T. et al. (2011) *Planet. Space Sci*., 59, 1243-1254. [6] Michael G. G. and Neukum G. (2010) *Earth Planet. Sci. Lett.*, 294, 223-229. [7] Ivanov M. A. et al. (2005) *J. Geophys. Res.*, 110. [8] Mest S. C. and Crown D. A. (1996) *LPS XXVII* Abstract #869. [9] Goudy C. L. et al. (2003) *LPS XXXIV*, Abstract #1475. [10] Neel C. R. and Mueller K. (2007) *LPS XXXVIII*, Abstract #2185. [11] Platz T. and Michael G. G. (2011) Earth. Planet. Sci. Lett., 312, 140-151.

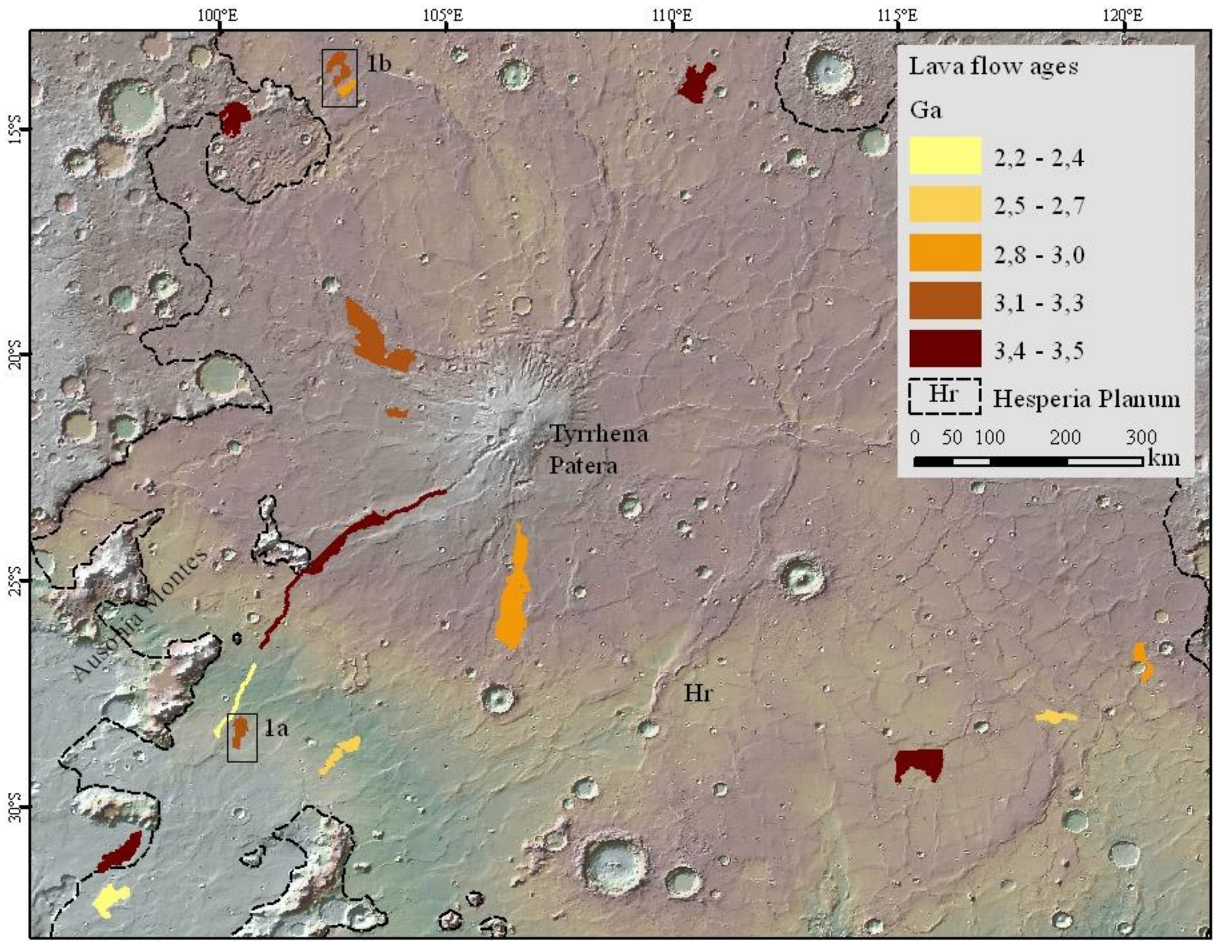

Fig. 3: Lava flows and plateaus mapped in the Hesperia Volcanic Province. Dashed outline marks the extent of Hesperia Planum mapped by Greeley and Guest [1] as ridged plains material (*Hr*). The model ages of counted areas are shown in a colour-code scheme. Background is the elevation-coloured MOLA digital terrain model superimposed on the MOLA hillshade.