PRELIMINARY ERUPTION HISTORY OF THE SYRTIS MAJOR VOLCANIC PROVINCE, MARS.

P. Jodlowski, T. Platz and G. G. Michael, Freie Universiät Berlin, Institute of Geological Sciences, Planetary Sciences and Remote Sensing, Malteserstr. 74-100, 12249 Berlin, Germany (thomas.platz@fu-berlin.de).

Introduction: Volcanism is one of the most significant processes shaping the surface of Mars. Volatiles released during volcanic eruptions have a significant impact on the composition and density of an atmosphere, which is crucial to understand the planetary evolution.

Syrtis Major is one of the most prominent Hesperian-aged volcanic provinces on Mars, located near the dichotomy boundary, west of Isidis Planitia. It extends over ca. 7.4×10^5 km^2 and has an N-S elongated central depression containing the calderas Meroe Patera and Nili Patera. Lava thicknesses range from approx. 0.5 km to 1.0 km and total volume of erupted material has been estimated at about $1.6\text{-}3.2\times10^5$ km^3 [1].

This province is another target area of our ongoing study to quantify the global volatile release during volcanic eruptions on Mars. Estimates of eruption frequency, associated volume of erupted material, and gas release to the atmosphere are the key parameters of this research. Reconstruction of the eruption history of volcanic provinces is one of the steps to be taken in order to constrain these parameters.

Approach and Methods: In order to achieve representative statistical data, mapping and crater size-frequency determinations should cover proximal, medial and distal reaches of the study area. This approach is restricted by available high-resolution image data and their quality.

Lava flow mapping and crater measurements were conducted in a GIS environment. The global THEMIS IR day time mosaic (100 m/px resolution) was used as the basis for lava flow identification and mapping. Crater size-frequency determinations were carried out on CTX and HRSC data exclusively. A comparative study conducted on a training area (Fig. 1) proved both instrument data, with similar illumination angle and solar longitude parameters, as equivalent. Crater size measurements were performed using *Cratertools* [2] and were analyzed with *Craterstats* [3]. Crater model ages were determined by using the Hartmann and Neukum chronology function [4] and the Ivanov production function [5].

Lava Flow Morphology: Most of the mapped lava flows are located in the northern part of the province, within proximal to medial reaches from the volcanic center. Lava flows are predominantly long and narrow with flow widths of 6 to 32 km and runout distances of 28 to 90 km. The average length-to-width ratio is about 4.4. There were no main channels

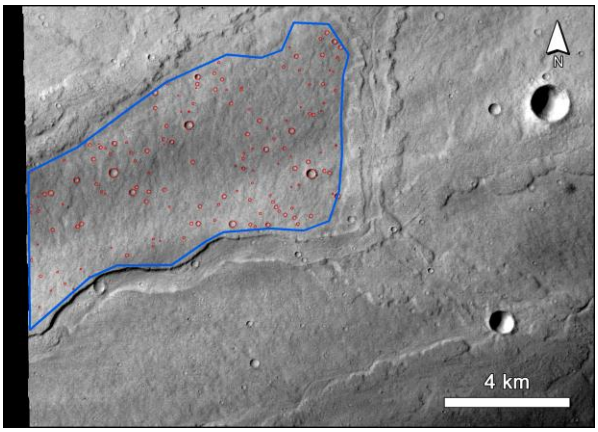

Figure 1: This portion of a lava flow was chosen to determine model ages on HRSC and CTX imagery. Blue outline marks the counting area with measured craters in red. HRSC image 3003_0000.

observed. The flow surfaces appear smooth and there are virtually no well-preserved ejecta blankets of impact craters. Most of the crater rims are blurred and their interiors flat, which indicates later modification through lava flooding and/or dust mantling. Some lava flows exhibit post-emplacement deformation, associated with concentric wrinkle ridges formation.

Crater Model Ages: In total, 56 lava flows were mapped of which 17 model ages have been determined so far. Additionally, the caldera of Meroe Patera was also dated using crater statistics. Model ages range between 0.91 Ga and 3.63 Ga (Fig. 2). There are two peaks in the model age spectrum, one at about 2.2 Ga and a smaller at approx. 3.1 Ga. At this stage of our study there was no apparent time-space correlation found.

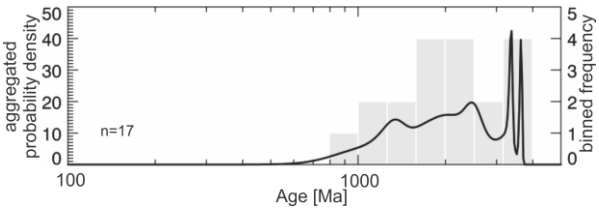

Figure 2: Aggregated age measurements of lava flows and the Meroe caldera. See [6] for more detail on producing this plot.

Discussion: The broad spectrum of model ages, ranging from Early Hesperian to Middle Amazonian (with two distinctive peaks in the Early Amazonian period), points to long-lasting volcanic activity of the studied province. This fact together with post-

emplacement deformation of lava flows indicates a much longer eruption and volcano-tectonic history of Syrtis Major than previously thought, extending it to Middle Amazonian period.

One of the next steps in our ongoing study is to widen the statistical data for model age estimates of currently mapped lava flows. This will provide a more comprehensive understanding of the eruption record and perhaps will reveal a possible time-space correlation.

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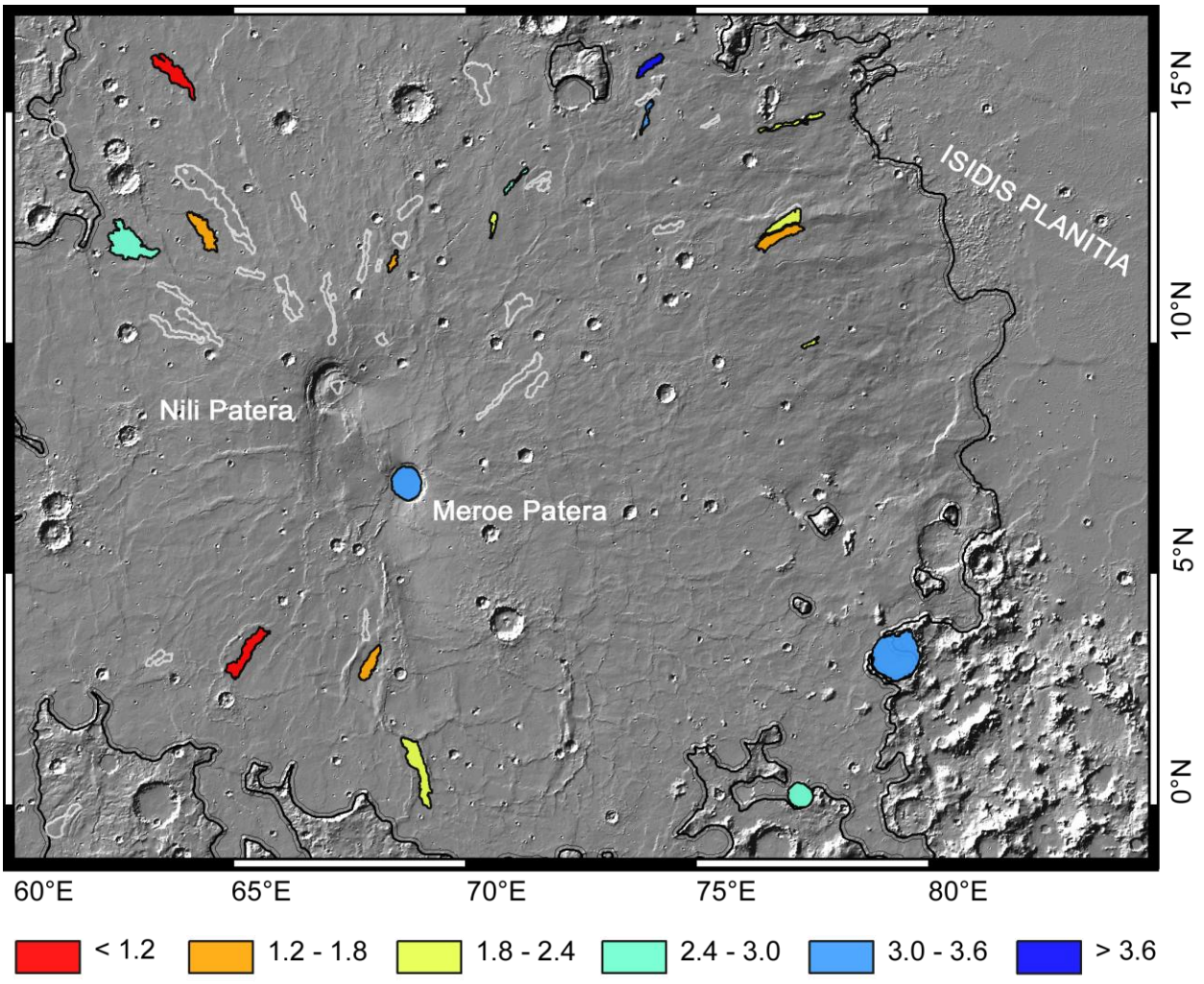

Figure 2: Map of the Syrtis Major Volcanic Province. Formation ages of single lava flows are shown in a color-coded scheme. White outlines depict lava flows which were mapped and where crater counts still need to be performed. Black outline depicts the latest outline of Syrtis Major province, which is based on [7]. Background: MOLA hillshade.