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Amazonian volcanic activity at the Syrtis volcanic province, Mars

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The Syrtis Major volcanic province, including the entire Syrtis Major Planum, is located near the Martian highland/lowland transitional zone west of Isidis Planitia. It covers ≈7.4×105 km2 and contains two low-shield volcanic edifices with N-S elongated calderas named Nili and Meroe Paterae. The estimated thickness of erupted material in the province ranges from approximately 0.5 km to 1.0 km with a total volume of about 1.6-3.2×105 km3 [1].

The timing of volcanic activity in the Syrtis Major volcanic province has been suggested to be restricted to the Hesperian Period [1-4]. In the geological map of Greeley and Guest [2], volcanic material of Syrtis Major was assigned an Hesperian age based on the density of observed craters larger than 5 km in diameter. Using the same crater density range, recent studies of Hiesinger et al. [1] and Tanaka et al. [3] and Tanaka et al. [4] assigned an Early Hesperian and Early to Late Hesperian age, respectively, for the entire province. In this study we mapped lava flows, lava channels, and major lava-flow margins and report model ages for lava-flow formation and caldera segments of Nili and Meroe Paterae. The objective of this ongoing survey is to better understand the eruption frequency of this volcanic province.

In total, we mapped 67 lava flows, caldera segments, and intra-crater fillings of which 55 were dated. Crater size-frequency distributions (CSFD) were mapped on HRSC and CTX imagery using CraterTools [5]. CSFDs were analyzed and model ages determined in Craterstats [6] using the production and chronology functions of Ivanov [7] and Hartmann and Neukum [8], respectively. A detailed description of the utilization of the crater-counting technique and its limitations with respect to small-scale mapping is given in Platz et al. [9]. Model ages range between 838 Ma (Middle Amazonian) to 3.6 Ga (Late Hesperian). In our survey, a broad age peak occurs between 2 to 2.6 Ga, continuously declining thereafter. We note that three caldera units show Middle Amazonian and later Early Amazonian best-fit ages. A light-toned deposit within Nili Patera was dated at 0.96 Ga. In Meroe Patera, the outer and central caldera floors were chosen for crater counting returning 1.42 Ga and 1.85 Ga, respectively.

The spectrum of model ages derived for lava flows, intra-crater fillings, and caldera segments range from Late Hesperian to Middle Amazonian. It clearly points to a long-lasting volcanic activity in this province, although the majority of erupted material was formed during the Early Hesperian Epoch or earlier, decreasing thereafter. Because most studied lava flows experienced post-emplacement contractional deformation, the tectonic history also extended into the Amazonian Period.

References:

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