PHOTOGEOLOGIC MAPPING OF MALEA PLANUM: A NEW VIEW OF THE OLDEST OF MARS' LARGE VOLCANIC PROVINCES H. Bernhardt and D. A. Williams. School of Earth and Space Exploration, Arizona State University, Tempe, USA (h.bernhardt@asu.edu).

Motivation: Late Noachian to early Hesperian-aged Malea Planum has been suggested as the site of large-scale volcano-ice interactions and as a major source for deposits now filling the adjacent Hellas basin to the north [1-4]. Activity on Malea Planum might also have affected the south polar Dorsa Argentea Formation immediately to the south, which has repeatedly been interpreted as a product of widespread wet-based glaciation affected by volcanic heat [e.g., 5,6]. Furthermore, it has been stated that such large-scale volatile mobilization and potential gas release should have affected the early martian climate and regional habitability [e.g., 7,8]. However, despite the potential of new datasets and its significance for volcanic and glacio-fluvial processes on Noachian and early Hesperian Mars, Malea Planum had not undergone a dedicated, detailed mapping effort. Here we present our photogeologic map and preliminary quantitative geologic analyses of that region (Fig. 1).

Data: For a description of our basemap and topographic datasets (THEMIS-IR and MOLA), please see our companion PGM Meeting abstract #7013. In addition, we used mid- to high-resolution visible image data from the High Resolution Imaging Science Experiment (HiRISE; 25-50 cm/px) and the Context Camera (CTX; ~6 m/px) [9-11]; the latter also in the form of the consolidated global mosaic by [12]. We also employed nadir as well as color images by the High Resolution Stereo Camera (HRSC; 12.5-50 m/px) on Mars Express (MEx) [13,14], although most HRSC data are compromised by atmospheric opacity at this latitude.

Technique: The mapping is conducted in ArcMap at 1:1,000,000 for a 1:2,000,000 end product. The mapping area was defined as a quadrangle comprising the entirety of the wrinkle ridged plains constituting Malea Planum (Fig. 1, purple unit). Otherwise the mapping process as well as absolute unit dating via crater size-frequency measurements are conducted in the same manner as already described in our companion PGM Meeting abstract (#7013). While not part of the mapping process, further analyses of the following hyperspectral and RADAR datasets, conducted by us or previous investigations, further complements unit interpretation and correlation: The Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) [19,20], the Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité (OMEGA) [21,22], the Shallow Radar instrument (SHARAD) [23,24], and the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) [2,25].

Select results and preliminary conclusions: Using all state-of-the-art datasets, we identified 25 geomorphologic units assigned to six groups. We compiled a stratigraphy based on superposition relations, with preliminary apparent model ages (AMAs) of the dominant wrinkle-ridged plains, as well as plains- and paterae-AMAs derived by [1,2], as provisional anchor points pending further crater size-frequency measurements on more of our units.

Disregarding crater ejecta and Amazonian veneers, we identified at least six distinct, major depositional units (*Nml*, *HNpr*, *Hst*, *Hs*, *Hpc*, and $AHpc_2$) in our mapping area spanning a time period from ~3.8 Ga to at least 3.5 Ga. While the wrinkle-ridged plains (*HNpr*) still cover the majority of the region, we suggest that only small percentages of the other five deposits remain. Based on our ongoing mapping and morphometric analyses, volumes on the order of 400,000 to 500,000 km^3 of these units might have been removed from Malea Planum. Therefore, while Hesperia Planum likely contributed the majority of the once ~10^6 km^3 of Hellas infill [4], Malea Planum should also have decisively contributed to the basin's infilling. While large-scale volatile mobilization of up to ~10^6 km^3 via volcanic heating has previously been suggested [3] for Malea Planum, our preliminary assessment of the region's geomorphologic record implies not one catastrophic event, but several distinct episodes of erosion that occurred over several 100s of Ma. Furthermore, some (glacio)-fluvial landforms traverse the entirety of Malea Planum from south to north, therefore implying a ~1,600 km long drainage system that also fed the Hellas basin with sediments and volatiles from today's South Pole region.

Lastly, we found that *HNpr* around Malea, Peneus, and Amphitrites Paterae hosts concentric normal faults, i.e., patera-forming collapse likely occurred after the plains were emplaced. Conversely, the lack of normal faults surrounding Pityusa Patera might indicate that it predates, and thus possibly contributed to, *HNpr*'s emplacement.

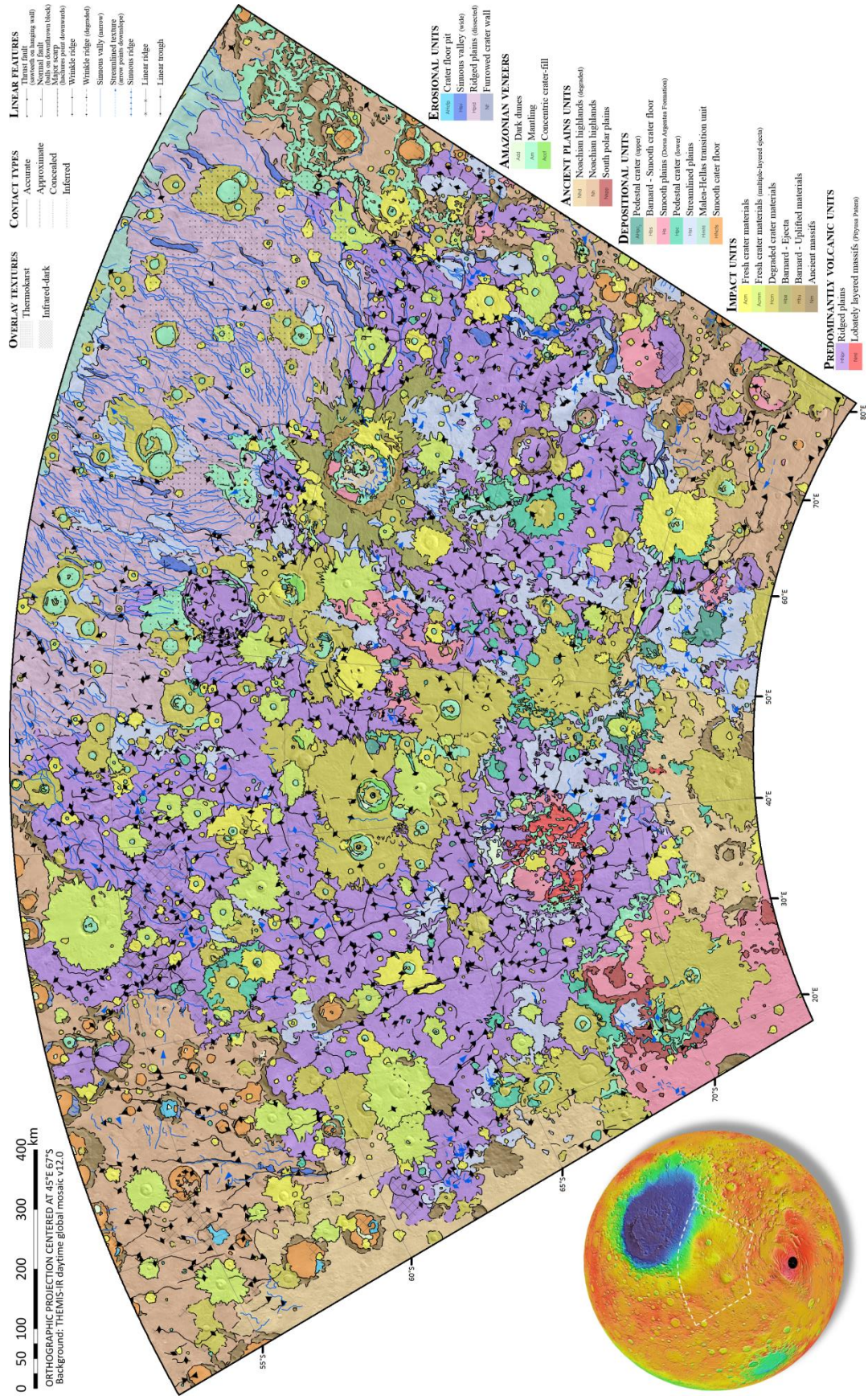

Figure 1: Downscaled version of our photogeologic map of the Malea Planum volcanic province (original map product is 1:2,000,000). Orthographic projection centered at 45°E, 67°S; background is version 12 of the global THEMIS-IR day mosaic.

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