MAPPING MARTIAN LAVA FLOW FIELDS: INVESTIGATIONS OF PAHOEHOE-LIKE FLOW MORPHOLOGIES IN THE THARSIS AND ELYSIUM VOLCANIC PROVINCES. D. A. Crown[1], W. B. Garry[2], D. C. Berman[1], S. W. Anderson[3], S. P. Scheidt[1,2,4], S. M. Baloga[5], and S. A. Miller[3], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719, [2]NASA Goddard Space Flight Center, Greenbelt, MD 20771, [3]University of Northern Colorado, Greeley, CO 80639, [4]University of Maryland, College Park, MD 20742, [5]100 Lands End Blvd., Myrtle Beach, SC 20572.

Introduction: On Earth, basaltic lava flow fields typically consist of diverse lava flow types. Hawaiian and other flow fields exhibit complex assemblages of ʻaʻā and pāhoehoe flow textures. ʻAʻā flows have been widely used as analogs for planetary flows given their simpler shapes, larger dimensions, and well-developed central channels with lateral levees, as well as the resulting visibility in early spacecraft datasets. Such flows usually represent only a small part of the surfaces of flow fields that also can include large expanses characterized by relatively smoother, indistinct, and smaller-scale pāhoehoe features. Recent studies of Martian volcanoes have revealed flow features indicative of processes common to terrestrial pāhoehoe. High-resolution imaging and topographic datasets can now be used to characterize diagnostic details of pāhoehoe-like flow emplacement processes that occur in areas with recent Martian volcanism.

Our investigation of Martian lava flow fields is designed to evaluate the distribution, types, topographic attributes, and spatial and temporal contexts of pāhoehoe flow morphologies in selected parts of the Tharsis and Elysium Volcanic Provinces. This will allow us to explore the full range of lava flow emplacement styles on Mars and evolutionary patterns in Martian flow field development.

Study Sites: We have selected three areas in which to catalog pāhoehoe-like flow morphologies and analyze their spatial distribution and age relationships: 1) southern Tharsis (10-40°S, 115-145°W), including flow fields associated with the SW rift apron of Arsia Mons; 2) eastern Tharsis (0-15°N, 85-107°W), where volcanic plains east of Ascraeus and Pavonis Montes include rift apron flows along with flows sourced at small local vents; and 3) southern Elysium (5°S-10°N, 145-175°E), where flows in the Cerberus plains are considered to be among the youngest on Mars [1].

Catalog of Flow Morphologies: For each study area, we are compiling a comprehensive database of distinctive pāhoehoe-like flow features from analyses of CTX images (~5 m/pixel), including: a) small networks, b) inflation ridges and plateaus, c) steepened flow margins, d) smooth textures, e) platy-ridged textures, and f) aligned pits and mounds. Systematic mapping of these types of flow features will reveal the full suite of morphologies that characterize pāhoehoe-like flow emplacement on Mars.

For a series of representative locations, we will generate CTX DTMs (24 m/pixel) using the Ames Stereo Pipeline to further characterize morphologic attributes and to produce longitudinal and cross-sectional profiles, with a focus on distributary flow patterns and flow margins that show evidence of inflation. High-resolution topography will be used to: a) determine the relief and shapes of inflated flows; b) characterize upper flow surfaces (local relief, slope, and presence of inflation features such as fractures, tumuli, and lava-rise pits, and pit depth); and c) analyze flow margins.

Pāhoehoe-like Flow Morphologies: High-resolution images have allowed identification of morphologies indicative of pāhoehoe-like flow emplacement and associated inflation on Mars. Some lava flow lobes exhibit properties typical of terrestrial pāhoehoe, including small, thin lobes with smooth surfaces, emplacement via narrow channels, small-scale branching into distributary flow "networks", and evidence for lava storage and subsequent breakout [2] (Figure 1). These morphologies define late-stage flows south of Arsia Mons, which were also interpreted to exhibit small tumuli, squeeze-ups, and lava rises [3]. Most commonly described indicators of compound/ pāhoehoe flow behavior on Mars are attributed to flow inflation; these include steep flow margins (sometimes with fractures), pits (i.e., lava-rise pits), and sinuous ridges and plateaus, often observed together [2, 4-8] (Figures 2-4). The geologically young Cerberus flood lavas are attributed to low-viscosity lava flows; these display platy-ridged flow surfaces (attributed to rubbly pāhoehoe analogous to Icelandic basalt flows) that can transition into smooth, flat-topped plateaus with inflated margins and features interpreted to be tumuli and inflation pits [9-11].

Future Work: We will integrate systematic mapping and related analyses of pāhoehoe-like flow morphologies in Tharsis and Elysium with studies of: a) the spatial distribution of the different types of pāhoehoe-like features to provide volcanic context and identify suites of associated features, and b) populations of small impact craters on pāhoehoe-like and adjacent flow surfaces to derive chronologic constraints. The low eruption rates and long durations associated with pāhoehoe have important implications for flow field evolution on Mars.

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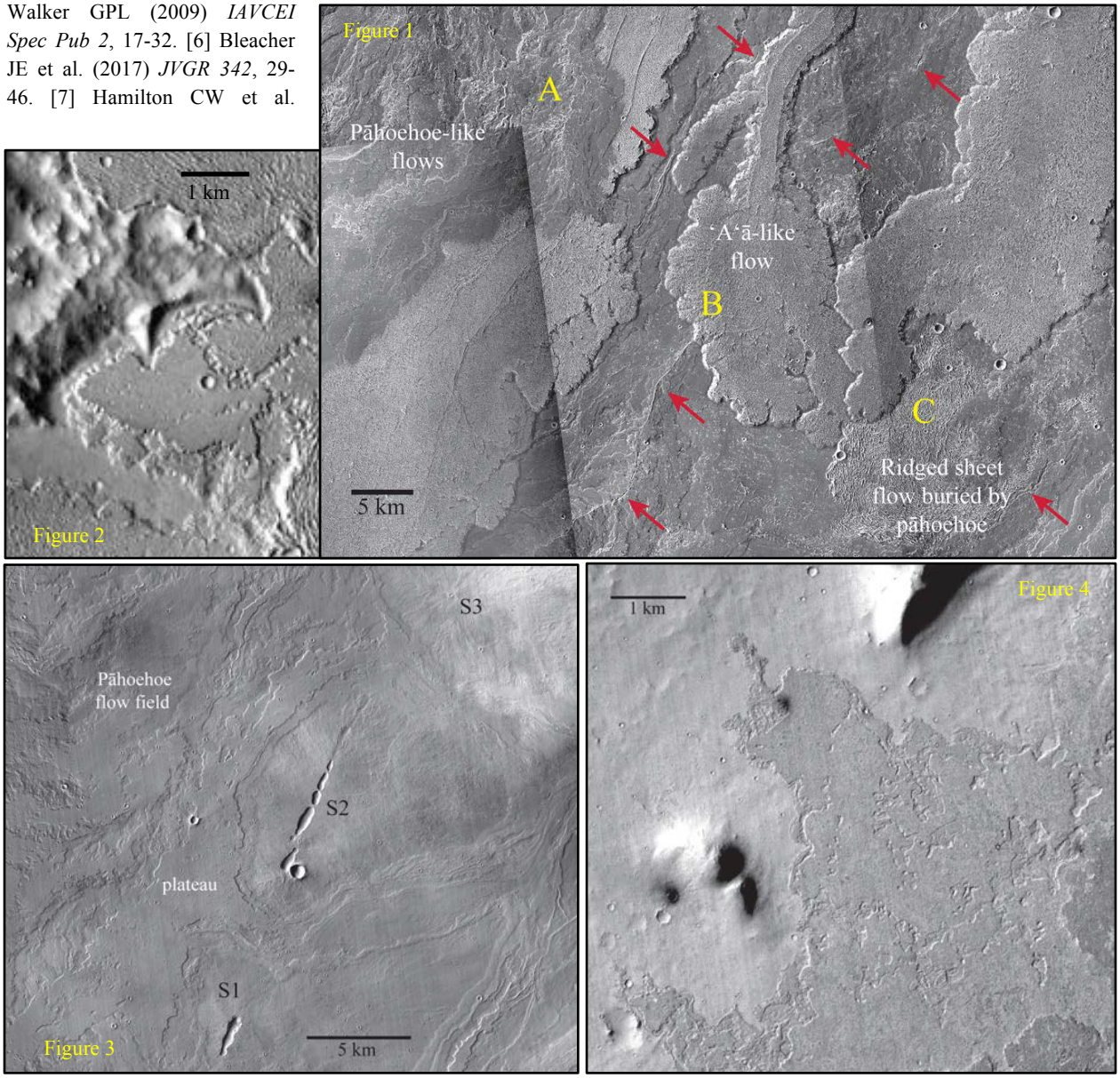

Figure 1. CTX mosaic of southern Tharsis lava flow field with intermingled pāhoehoe-like and ʻaʻā-like flow types. A: small dark, smooth lobes (pāhoehoe), some with steepened margins (suggesting inflation) bury rough, elongate lobe with central channel. B: distal ʻaʻā-like flow extends from central channel and buries arcuate ridge that extends into narrow channel, both of which feed small, dark lobes laterally. C: Remnant of ridged sheet flow embayed by ʻaʻā-like lobes, surrounded by pāhoehoe-like flows to SE and SW, and partly obscured by thin, dark pāhoehoe-like flows. Arrows denote pāhoehoe distributary features. **Figure 2.** Pāhoehoe flow morphology in southern Tharsis, with ridged sheet flow feeding smooth inflation plateau with digitate margin. **Figure 3.** CTX mosaic (Caltech Murray Lab) of eastern Tharsis pāhoehoe-like flows with plateau morphology and steep margins indicating inflation and surrounding three small shields (S1-3). Note smooth flow surfaces with irregular pits. **Figure 4.** CTX mosaic (Caltech Murray Lab) of southern Elysium pāhoehoe-like flows with smooth surfaces and steepened margins. Note sinuous lobe with digitate front at leading NW edge. Irregular depressions may define former boundaries between pāhoehoe lobes that have coalesced during inflation.