Introduction: High-resolution imaging and topographic datasets available from recent orbital missions to Mars can facilitate process-oriented studies of Martian volcanoes and provide constraints on the evolution of Martian flow fields. Here we examine select parts of the expansive flow fields that surround the prominent shield volcanoes in the Tharsis Volcanic Province [1]. Our detailed investigation of Martian flow fields is designed to investigate the distribution, types, topographic attributes, and volcanic settings for the pāhoehoe-like flow morphologies that can now be identified and characterized in high-resolution datasets [e.g., 2-11]. This knowledge, combined with that for larger flow features (i.e., ‘a‘ā-like flows with central channels and lateral levees), can be used to document spatial and temporal patterns in Martian volcanism.

Datasets and Methods: We are using GIS software to map and compile catalogs of volcanic features. Primary imaging datasets used include: THEMIS IR daytime (~100 m/pixel), CTX (~5 m/pixel), and the Global CTX Mosaic of Mars (NASA/JPL/MSSS/The Murray Lab). Topographic datasets include: MOLA DEM (128 pixel/deg) and CTX (24 m/pixel) and HiRISE (1 m/pixel) DTMs generated using the Ames Stereo Pipeline [12].

Study Sites: To-date our research has focused on two regions within the peripheral volcanic plains of Tharsis: 1) Southern Tharsis (10-40°S, 115-145°W), including lava flow fields that comprise the SW rift apron of Arsia Mons, form Daedalia Planum, and extend to form the southern distal reaches of Tharsis; and 2) Eastern Tharsis (0-15°N, 85-107°W), where volcanic plains east of Ascraeus and Pavonis Montes include rift apron flows mixed with flows sourced at small local vents that extend to Tharsis’ eastern distal margin.

Flowfield Mapping: In each of our study sites, we are mapping major features of the lava flow fields and compiling a comprehensive database of distinctive pāhoehoe-like flow features. Our initial work has focused on 1) vents, 2) central channels of ‘a‘ā-like flows, 3) distributary features for pāhoehoe, and 4) inflation plateaus. Pāhoehoe distributary pathways have diverse and variable morphologic signatures that include narrow, rill-like channels, perched channels, lava tubes, and sinuous ridges/plateaus. Other features of interest include a) small networks, b) features due to flow inflation, c) smooth textures, d) platy-ridged textures, and e) aligned pits and mounds.

Results: Mapping of the southern and eastern Tharsis study regions has delineated the major volcanic features and allows for preliminary interpretations of flow field development (Figures 1 and 2). Both flow field regions include an abundance of ‘a‘ā-like and pāhoehoe-like flow morphologies occurring in complex flow field surfaces where the different flow types are intermingled. Inflation plateaus are abundant in both regions. Continued mapping will focus on documenting smaller-scale features and surface textures that will help delineate the full spatial extent and volcanic settings of pāhoehoe-like flows.

Mapping of the southern Tharsis region reveals patterns of flow emplacement that radiate from the SW rift at the base of Arsia Mons (Figure 1). An intermingled flow field of ‘a‘ā-like and pāhoehoe-like flows defines the upper part of the SW rift apron flow field and contains elongate channelized flows and pāhoehoe distributary pathways that supply lava downslope for large distances. This proximal zone of the flow field transitions downslope to broad lobes and large sheet flows in the medial and distal zones, where inflation plateaus become abundant. Inflation plateaus are observed along the margins of broad lobes and sheets that may pre-date and/or extend from the extensive distributary systems that originate upslope.

Mapping of the eastern Tharsis region reveals elongate, intermingled ‘a‘ā-like and pāhoehoe-like flows, particularly near Tharsis Tholus and to the south (Figure 2). Pāhoehoe distributary pathways have numerous inflation plateaus along their lengths; several begin as a ridged pāhoehoe-like feature [6] and transition to a flow with inflated margins. As in southern Tharsis, pāhoehoe-like flows are observed to reoccupy the central channels of pre-existing flows and inundate the older and often rugged flow surface [2]. In addition, in many cases pāhoehoe-like flows become confined between the thicker flow margins of ‘a‘ā-like flows. These overlap relationships suggest emplacement of higher effusion rate, ‘a‘ā-like flows was followed by lower effusion rate, pāhoehoe-like flows in many localities.

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Figure 1 (left). Southern Tharsis (10-40°S, 115-145°W) flow field map. Major volcanic features of the Arsia Mons SW rift apron include central channels of ‘a’ā-like flows (red dashed lines), distributary pathways for pāhoehoe-like flows (dark blue lines), and inflation plateaus (red circles). Note the downslope progression from the proximal intermingled flow field with extensive lava transport features and the abundance of inflation plateaus in the medial and distal zones.

Figure 2 (below). Subset of eastern Tharsis flow field map (~7-15°N, 85-95°W). Flow field exhibits numerous ‘a’ā-like flows with central channels (red lines) that wrap around Tharsis Tholus, a pre-existing topographic high. Inflation plateaus (red circles) are located along the distal margins of pāhoehoe-like flows (blue lines).