LAVA FLOW FIELDS OF SOUTHERN THARSIS, MARS: MAPPING, MORPHOLOGIC, AND CHRONOLOGIC STUDIES. David A. Crown[1], Michael S. Ramsey[2], and Daniel C. Berman[1], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719, [2]Department of Geology and Planetary Science, University of Pittsburgh, Pittsburgh, PA 15260; crown@psi.edu.

Introduction: The recent acquisition of high-resolution datasets with significant areal coverage provides an opportunity to explore in detail the styles, magnitudes, and chronology of Martian volcanism. The current investigation uses imaging, topographic, and compositional datasets to characterize lava flow fields of southern Tharis, including those on the southern flanks of Arsia Mons and further to the south in Daedalia Planum. We are producing detailed flow field maps (Figs. 1-2) in order to assess flow field development and stratigraphy [1-2], to examine flow morphology in order to interpret emplacement processes [1-2], to evaluate thermophysical signature as an indicator of composition and degradational history [3], and to use populations of small, superposed impact craters to derive relative and absolute age constraints for individual flows and flow sequences.

Study Area: Arsia Mons, southernmost of the Tharsis shield volcanoes, is 461 x 326 km across and 17.7 km high, with exposed relief of 11+ km and flank slopes averaging ~5° [4]. Arsia Mons has a well-developed summit caldera [5-9] and exhibits two large aprons of flows that extend from alcoves on the NE and SW flanks of the volcano and postdate its main shield [4, 10]. Daedalia Planum is an elevated plains region at the southern margin of the Tharsis region, where lava flows and plains embay remnants of high-land terrain [e.g., 11-12]. Using Viking Orbiter images, a series of sixteen 1:2M scale lava flow maps were previously completed for the Tharsis region [e.g., 13-15]. Recent studies of the Tharsis region have utilized Mars Express High Resolution Stereo Camera (HRSC) images to identify different flow morphologies (e.g., channel-fed and tube-fed flow units) and to examine evolutionary stages in effusive volcanism [16]. Comparisons have also been made between the spectral signatures of relatively dust-free lava flows in Daedalia Planum and those of SNC meteorites [17].

Flowfield Mapping: The southern Arsia flow fields consist of numerous prominent, long, narrow, sinuous flows. With the transition to the plains of Daedalia Planum, individual flow lobes are observed to widen and merge together (Fig. 3). Daedalia Planum is characterized by wider, less well-defined flow units along with a series of presumed volanic plains. Mars Reconnaissance Orbiter Context Camera (CTX; ~5 m/pixel) images imported into ArcGIS are the primary image base used to map parts of the southern Arsia flow field at 1:50,000-scale. In order to fully characterize volcanic features in southern Tharsis, we also use the Mars Odyssey Thermal Emission Imaging System (THEMIS) global mosaic (230 m/pixel) and infrared multi-band images (~100 m/pixel), High Resolution Imaging Science Experiment (HiRISE; ~1 m/pixel) images, and Mars Orbiter Laser Altimeter (MOLA; 128 pixel/deg) DEMs.

Summary: Flow field mapping using CTX images provides important insights into physical volcanic processes and allows reconstruction of complex volcanic surfaces (Figs. 1-2). CTX images reveal a host of small-scale volcanic features and allow for the recognition of two main flow types. Although in the study region darker, tube/channel fed flows are generally younger than thicker, rugged leveed flows, the observed diversity and complexity of interactions suggests that lava sources with different eruptive styles and magnitudes were distributed throughout the region and active contemporaneously. The characteristics of the different flow types, their surface morphologies, and interactions with local topography (embayment of other flows, deflection by obstacles, and capture by topographic lows) provide critical clues to understanding flow rheology and emplacement styles. General analogies to terrestrial basaltic volcanoes appear to be valid, with comparable suites and diversity of volcanic features and similarities in flow morphology [e.g., 9-10].

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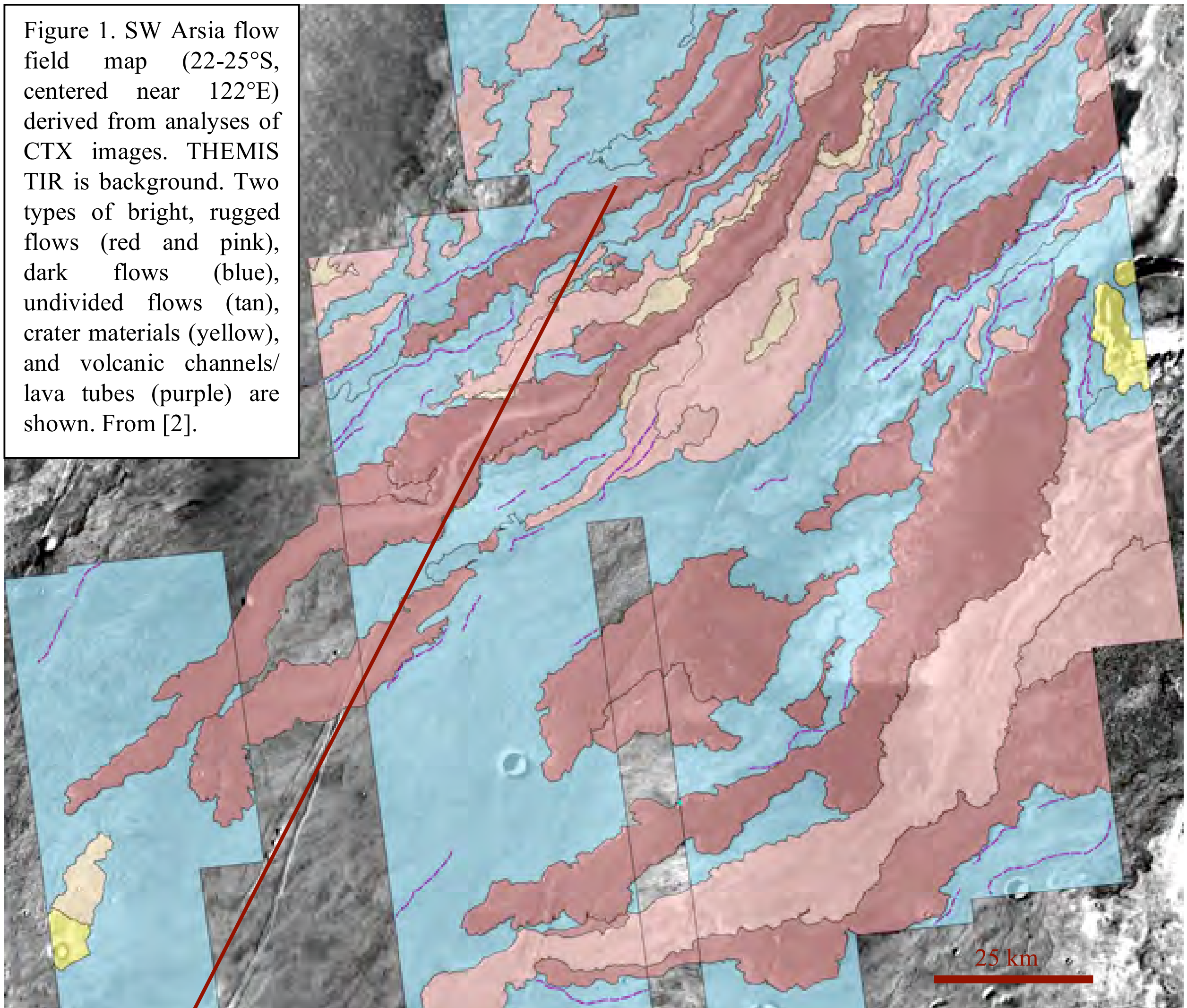

Figure 1. SW Arsia flow field map (22-25°S, centered near 122°E) derived from analyses of CTX images. THEMIS TIR is background. Two types of bright, rugged flows (red and pink), dark flows (blue), undivided flows (tan), crater materials (yellow), and volcanic channels/ lava tubes (purple) are shown. From [2].

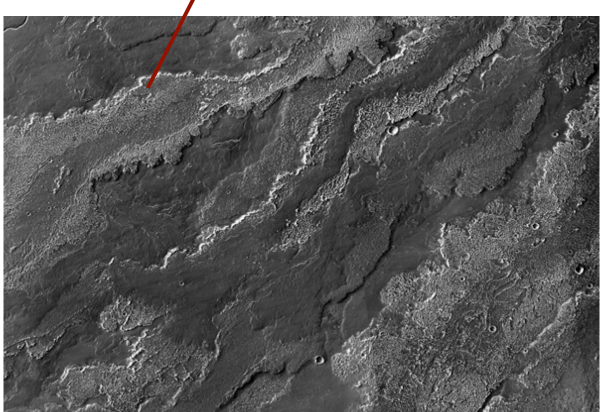

Figure 2. CTX image extracted from GIS coverage of SW Arsia Mons showing flow field stratigraphy. Note younger dark flows (at center) are captured by and cover the central channels of older rugged flows. Scene width is ~30 km.

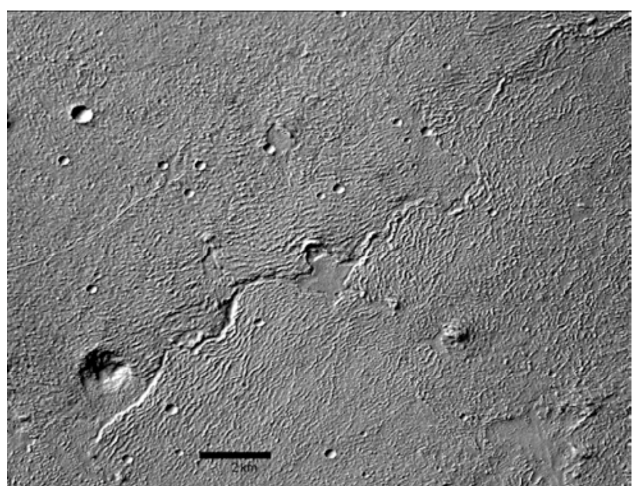

Figure 3. CTX image extracted from GIS coverage of Daedalia Planum showing coalescence of broad lobes to form volcanic plain that is indicated by sinuous flow margin contact. Scale bar is 2 km.