**DISTINGUISHING VOLCANIC AND FLUVIAL ACTIVITY IN MANGALA VALLES, MARS VIA GEOMORPHIC MAPPING.** A. L. Keske[1,2], A. S. McEwen[2], I. J. Daubar[2], [1]Department of Geosciences, University of Arizona, Tucson AZ, 85721 (keskea@email.arizona.edu), [2]Lunar and Planetary Laboratory, University of Arizona, Tucson AZ, 85721.

**Introduction:** Mangala Valles is a 900 km-long outflow system extending from the Martian southern highlands toward the northern lowlands just west of the Tharsis bulge. It originates at Mangala Fossa, part of the Memnonia Fossae graben system. Until recently, it was widely accepted that the flow features observed in Mangala Valles are the result of one or more catastrophic flooding events, likely by igneous disturbance of massive aquifer sources [1,2,4]. Such ideas have been supported by the presence of obvious streamlined features that can be easily identified using relatively low-resolution images such as those returned by Viking [1]. Subsequent studies focused on the number of flooding events, the amount of time separating each event, and whether they shared a common source [e.g. 3,4]. However, Leverington [5,6] introduced the idea that the system could have been carved by thermomechanical erosion by voluminous lava flows, or a hybrid hypothesis where the valley was initially carved by aqueous processes and later modified by volcanic erosion and deposition.

McEwen et al. [10] also suggested that rather than being a strictly fluvial or strictly volcanic system, Mangala was formed by fluvial incision followed by large-scale volcanic activity, perhaps similar to Athabasca Vallis [7] and Kasei Vallis [8]. To investigate this hypothesis, we are mapping geomorphic units using primarily MRO Context Camera (CTX) images [9]. Previous workers [1-4] used lower-resolution images. CTX images provide excellent (~3 PM) illumination conditions and resolution (~6 m/pixel) to perform such an evaluation. HiRISE images [15], covering a small fraction of the region, are also helpful in some ways. They show where impacts do or do not produce boulders, for example, though the dust mantle obscures most meter-scale volcanic and fluvial geomorphologies.

**Methods:** The mapping area extends from roughly 7.5°S to 20°S and 145°W to 153°W. Data from the Mars Orbiter Laser Altimeter (MOLA) [11], the Thermal Emission Imaging System (THEMIS) instrument [12], and the Context Camera (CTX) were used in mapping and analysis. A THEMIS daytime IR mosaic was used as the base map, which has a resolution of ~100 m/pixel [13]. CTX images and MOLA shaded relief/colored elevation maps [11] were used for detailed mapping and analysis. Maps from [1], [3] and [4] were used as reference. JMars [14] was used as the mapping tool and the primary source of geographic information.

**Preliminary Results:** Although many connecting units have been mapped, correlation between units is incomplete, and much of the northern portion of the mapping area remains to be mapped at the time of writing (January 2013). Our goal is to interpret each mapped unit as having a fluvial, volcanic, or other origin. Fluvial units might be distinguished by boulder deposits, but are extremely rare on Mars as the channels are often covered by lava flows [10]. Lava flows tend to form smooth plains with lobate boundaries, and contain features suggestive of lava inflation (see fig. 2a and 2b). Despite the fact that small-scale features are muted by the dust cover, we interpret many plains units in Mangala Valles as lava flows.

An overlay of the age map from Fig. 30 of [2] reveals that several of the units we have thus far interpreted as lava flows are relatively young (~1 Ga), and that there are also much older units (~3.5 Ga) that were cut by the channels. This is consistent with one or more aqueous outburst events early in Mangala's history followed much later by a phase of extensive plains volcanism, which partially or completely filled its channels. Previous interpretations of relatively young fluvial activity [3] may instead be explained by relatively young lava flows.

**Future Work:** In order to perform a full analysis, our mapping area must be completed, which requires mapping the northern portion as well as adding more detail in the southern geological units. Current units will be examined more closely so that more age/facies correlations can be made and the units clearly interpreted. Localized crater counts may be performed where ages from [2] are unclear.

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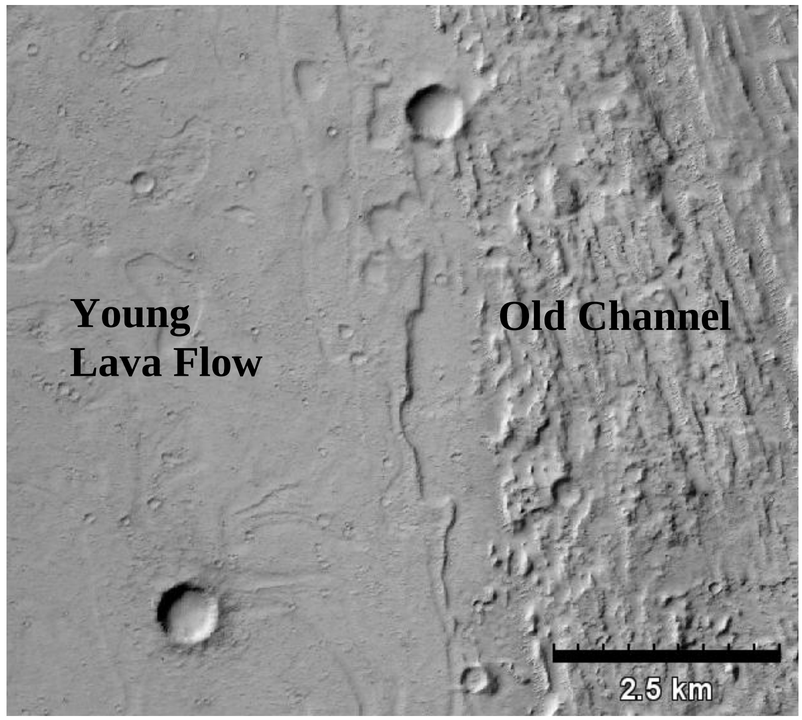


**Figure 1.** A contact between what we've identified as a younger lava flow with a smooth, plains-like appearance and a lobate flow front embaying an older channel showing prominent flow features,. Center coordinates 210°E, 13.5°S, CTX image P19_008474_1688_XN_11S150W.

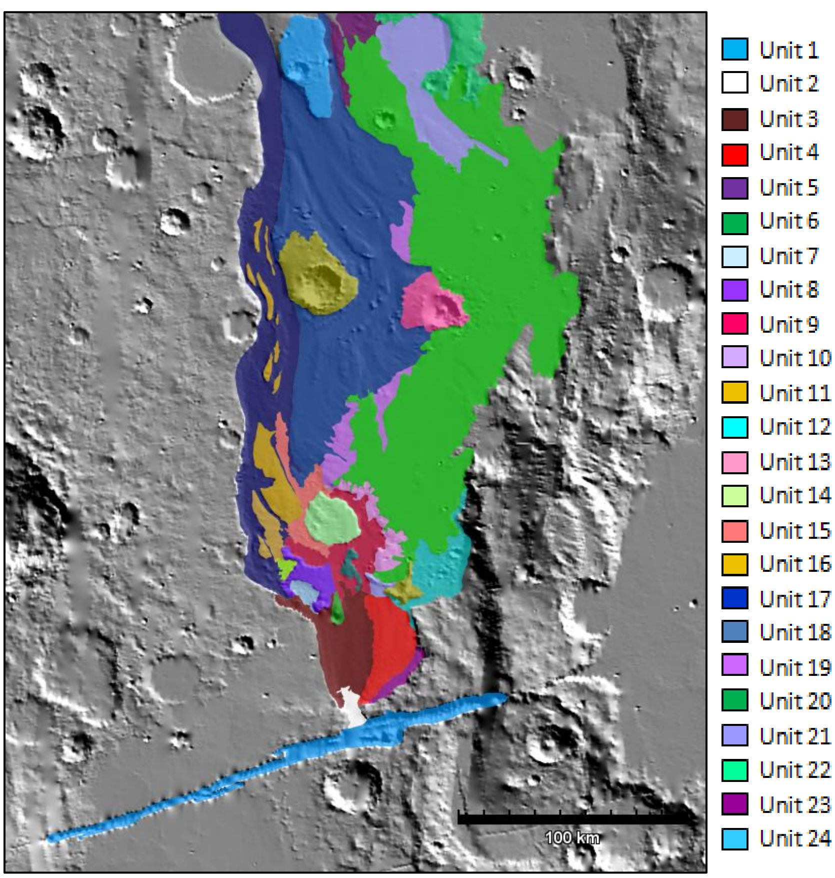


**Figure 2.** Our preliminary map of the southern portion of Mangala Valles, with center coordinates (211°E, 16°S) over a MOLA shaded relief mosaic base map [11].