IDENTIFICATION AND MORPHOLOGIC CHARACTERIZATION OF SMALL AND MEDIUM ALLUVIAL FANS ON MARS USING THE CTX GLOBAL MOSAIC. C. A. Mondro[1] , C. M. Fedo[1], and J. E. Moersch[1]. [1]Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, Tennessee 37996-1526, USA (cmondro@vols.utk.edu).

Introduction: Large alluvial fans on Mars have been identified in global surveys but analysis of fan morphology and sedimentology has only been applied to subsets of the largest fans [1–7]. In building upon previously published catalogs of Mars fans [1–3,5], we have expanded the current database of alluvial fans in both regional extent and fan size and analyzed the morphology of fans in the context of terrestrial alluvial fans. In prior work [8], the identification of potential alluvial fans on Mars has primarily used 100m/pixel THEMIS IR images, which limits the resolvability of key morphologic features within the fan. A new CTX Global Mosaic [9] with spatial resolution as low as 5m/pixel provided an opportunity to identify smaller fans with confidence, interpret small-scale morphologic components of individual fans, and investigate a larger population of alluvial fans across the surface of Mars. A global investigation into the scope of alluvial fans and their morphology provides an opportunity to analyze the variability of sediment-transport processes and water-rock interactions during a part of Mars' geologic history when liquid water was active at the surface. The number and regional extent of these newly identified alluvial fans indicates water-sediment transport processes were common on a global scale during the time of alluvial fan formation.

Background: Alluvial fans are subaerial depositional features that occur at topographic breaks where a confined, sediment-heavy fluid flow becomes unconfined as it moves into an open valley or basin. They are defined as semi-conical features with straight or slightly concave-up radial profiles, convex-up cross-fan profiles, and radial slopes > 1.0°. The distinctive profile and slope distinguishes alluvial fans from other, similar looking features [10]. On earth, alluvial fans are found in semi-arid to hyper-arid piedmont settings where ephemeral, high-discharge flow events transport sediment from high-relief, laterally confined catchments to a dry basin or valley [10]. Terrestrial alluvial fans are almost exclusively formed during sporadic discharge events and often experience long dry periods between depositional events, during which the alluvial fan surfaces can be reworked by aeolian and minor fluvial action [11,12].

On Mars, alluvial fans were first confidently identified in MOLA elevation data [13] and fan-like features have since been found all around the planet between 35°N and 60°S along the walls of medium and large craters [1–3,5] (Figure 1). Assuming that sediment transport processes and controls on Mars are similar to those on Earth, the geologic history of alluvial fans can provide insight into the availability of liquid water and

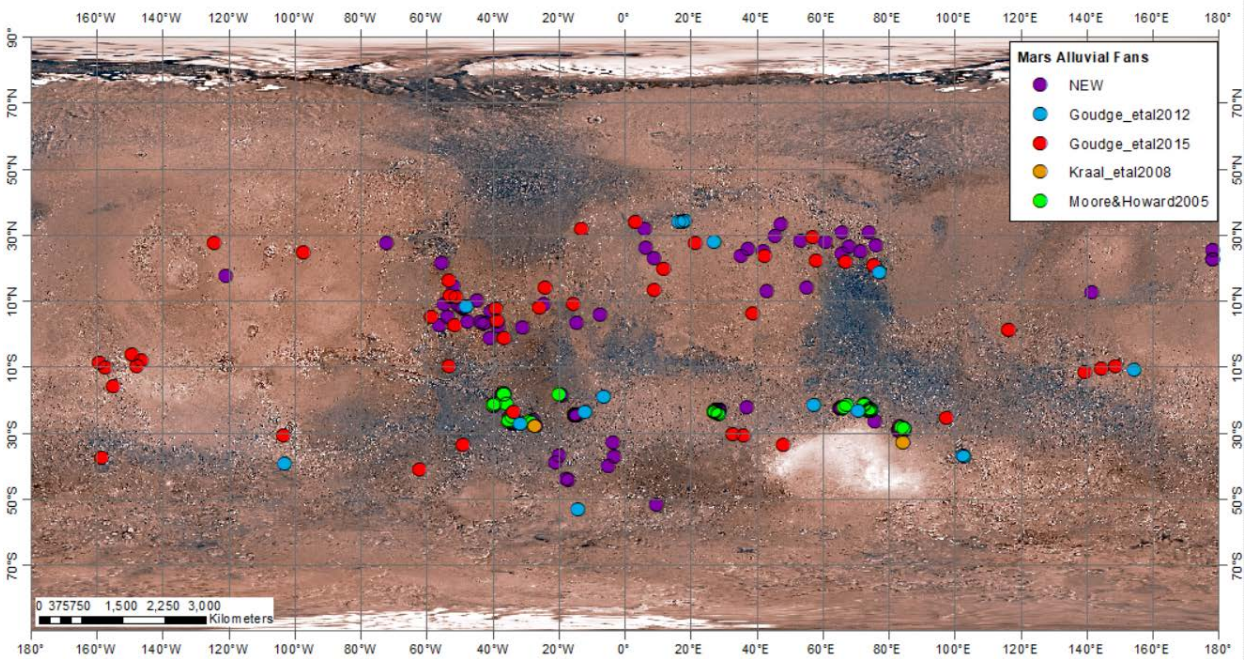

Figure 1. Map of potential alluvial fan locations on Mars, color-coded by source.

variability of runoff on Mars' surface during the time of alluvial fan formation. Martian alluvial fans were originally assumed to be Noachian , but more recent work has dated individual fans in the late Hesperian [14,15], which is also the time of catastrophic outflow channels and may represent a period of more episodic water activity on Mars' surface [16].

Identification of Alluvial Fans: We started by compiling previously published catalogs of fan-like features [1–3,5], which total 87 fan-like features. To expand this current database we used the CTX Global Mosaic [9] to scan high-relief topographic features where alluvial fans could have formed. We surveyed all craters >15km in diameter and sharp-sided valleys and canyons >3km wide, between 60°N and 60°S. Craters smaller than 15km are typically too shallow to provide the high-relief topographic break necessary for alluvial fan formation. We marked 117 semi-conical, fan-like features with radial lengths greater than 2 km as potential alluvial fans (Figure 1). We identified one alluvial fan in a steep-sided channel, the first known example of an alluvial fan on Mars that is not in a crater.

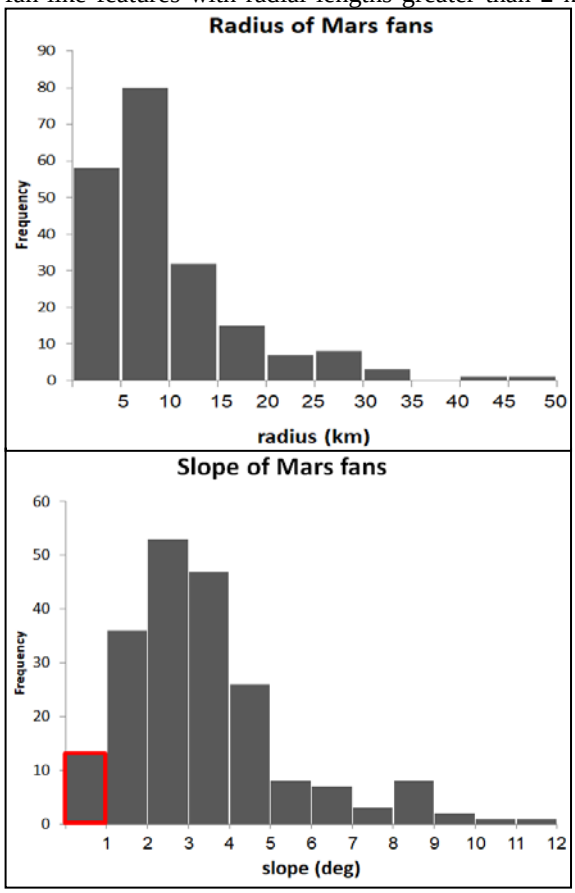

Figure 2. Histograms of radius and slope of all potential alluvial fans on Mars. Slope values represent average slope along a straight radial profile, extracted from HRSC-MOLA DEM. We classified fan-like features with a slope < 1.0° as "not" alluvial fans.

Morphologic Analysis: To distinguish true alluvial fans from deltas, distributive fluvial systems, and other fan-shaped features that can look similar we first used the radial slope of each feature to classify them as confirmed, possible, or not alluvial fans. Using the 200m/pixel Mars HRSC MOLA Blended DEM [17] we extracted the average radial slope of each fan surface along a line from the apex to a toe point at the center of the fan arc and classified the 13 fan-like features that have an average radial slope < 1.0° as 'not' alluvial fans (Figure 2).

We extracted radial profiles and cross-fan profiles for all fan-like features and compared them to a typical terrestrial alluvial fan profile [10]. Fan with radial profiles which showed sharp slope breaks or were strongly concave-up or cross-fan profiles which were concave-up were classified as 'not' alluvial fans. Sharp breaks in middle of the radial profile could be indicative of wave-cut benches along crater lakes, coarse-grained delta deposits, or other depositional features that may be worth further study on their own [10].

Discussion: The formation of alluvial fans of any style is dependent on the occurrence of high-discharge events separated by dry periods of very little runoff [11,12]. This work shows that alluvial fans are found in all regions in mid- to central-latitudes on Mars, between 35°N and 60°S. This indicates that semi-arid conditions and sporadic heavy water runoff events were found on a global scale during the time of alluvial fan formation.

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