MARTIAN ALLUVIAL FANS: PRELIMARY RESULTS FROM SOUTHERN HEMISPHERE SURVEY.

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Overview: Here we present the results of an on-going global survey for Martian alluvial fans. Preliminary results confirm that there is a distinctive grouping of three alluvial fan clusters (as found by [1]) originating from the rims of large impact craters. In addition, we have detected more fans within the clusters of Moore and Howard [1]. We have also found several 'outlier' fans including geographically isolated fans and an alluvial fan originating from the walls of Capris Chasm.

Survey: An alluvial fan is a low gradient, cone shaped deposit of sediment formed where a stream undergoes an abrupt reduction of slope from steep highlands into a shallow basin. Stream power is reduced over the drop in slope and this reduction causes the stream to deposit its sediment load. It may be possible, through careful surveying and modeling, to use these features as climate proxies to estimate the amount and delivery style of the precipitation used to drive the system. For example, alluvial fans can range from fluvial to debris flow, which indicates a range in the sediment to water ratio of the flow of the system. Moore and Howard [1] used morphological characteristics to hypothesize that the Martian fans they describe are comparable to large, fluvial terrestrial fans, rather than smaller, terrestrial debris flow fans.

Important Preliminary Findings:

- *Fans have been found outside the three regional areas* identified by Moore and Howard [1], figure 1. The majority of fans, 21 out of 24, have been found in clustered in the regions of southern Margaritifer Terra, southwestern Terra Sabaea, and southwestern Tyrrhena Terra. Our complete survey of THEMIS images have found additional fans within these clusters, usually located in craters smaller than the 70 km cut-off of Moore and Howard [1]. In addition, there are three geographically isolated areas containing fan(s). One is located in the walls of Capris Chasm (13.62° S/51.7° W) (see section below). There is also a large fan system in Porter Crater (51° S, 114° W). There are also two small fans located in a ~45 km diameter crater just northwest of Schroeter Crater (1.59° S/301.81° W)

- *One fan has been found in the walls of Valles Marineris*. It is the only fan not found originating in a crater rim. This is surprising because Valles Marineris provides an excellent topographic setting for the formation of alluvial fans (i. e. an abrupt topographic dictomy), so it might be expected that many more fans should be present. Future modeling and analysis will focus on why there are so few fans and why they form in specific locations along the canyon walls.

- *Fans have been found in increasingly small impact craters*. We have found fans in small craters (~ 30 km) as we have extended our search to include all crater sizes. However, as we begin to examine smaller craters, we enter into resolution issues. For example, fans may be located within craters smaller than our resolution limit. One excellent example is Mojave Crater, where small alluvial or debris fans have been located in MOC images [2]. Our survey was conducted using THEMIS IR images, therefore, such fans would not be detected. Several other potential alluvial fans have been identified within smaller (~10 km diameter) craters. We await higher resolution imagery to confirm these possible fans. Size distribution of craters that contain alluvial fans indicates that alluvial fans tend to form in craters of a certain size. But age, bedrock geology, and topographic profile may also play a role. Additional survey work will refine these theories and advance new ones.

Connection to Climate and Cratering

Alluvial fans indicate the presence of precipitation and flowing surface fluids, and, as such, are valuable climate proxies for use in understanding the history and character of climate on Mars. In order to understand alluvial fans as a climate signature, we must determine the global distribution and general morphology of all alluvial fans on Mars and relate the distribution of alluvial fans within craters to impact crater geology. Finally, we must evaluate the morphology of fan alcoves and depositional aprons in order to establish the candidate formation mechanisms (e. g. debris flow vs. fluvial). Ultimately, we hope to place well-defined ranges upon the gross amount of water and the delivery hydrograph correlate alluvial fan survey and analysis with predictions of martian climate derived from general circulation models.

References: [1] Moore, J. M. and Howard, A. H. (2005) JGR, V 110, DOI: 10.1029/2004JE002352. [2] Williams, R. M. E., Edgett, M. C., and Malin, M. C., LPSC XXXV, abstract #1415.

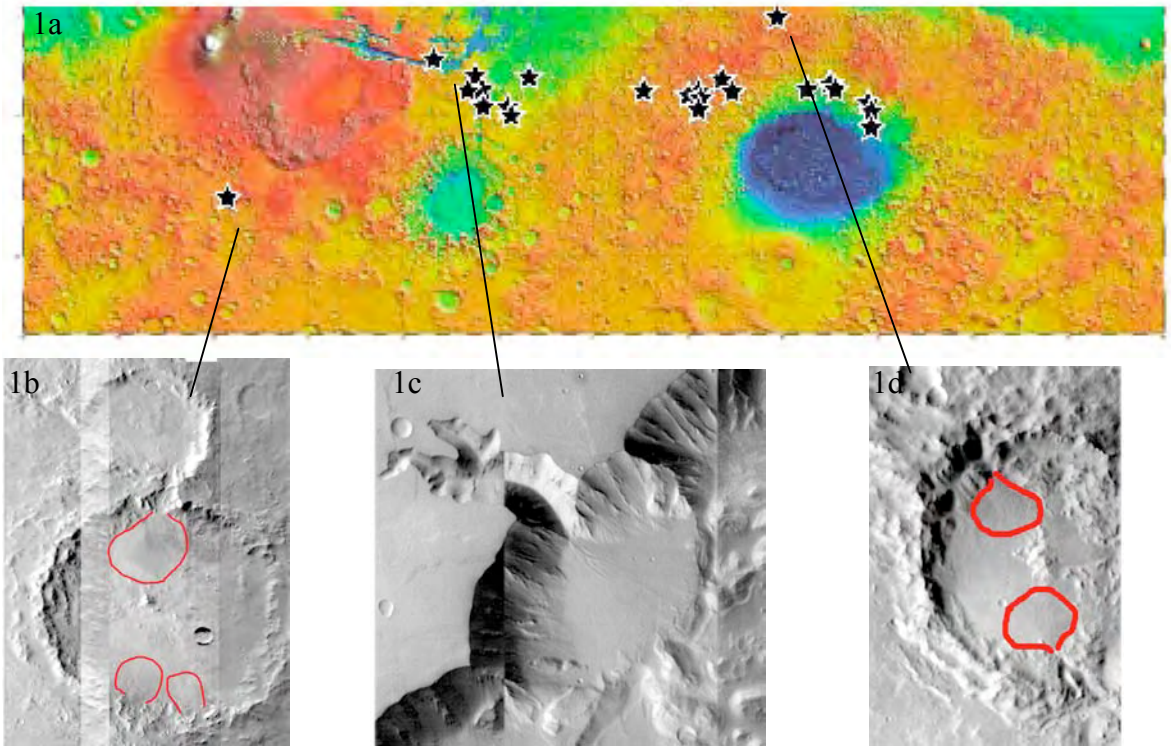

Figure 1: Figure 1a shows the MOLA topography for 0S – 180S. Base image MOLA Science team. Fans are identified with a star symbol. 1b is Porter Crater, 50.7° S/113.71° W (100 km across) with fans outlined in red. The fan (13.6° S/51.7° W) in Capris Chasm (1c) is the only fan not originating from a crater rim. Fans have been found in small crater as well; 1d shows two fans in a 37 km diameter crater at 1.59° S/301.8° W.

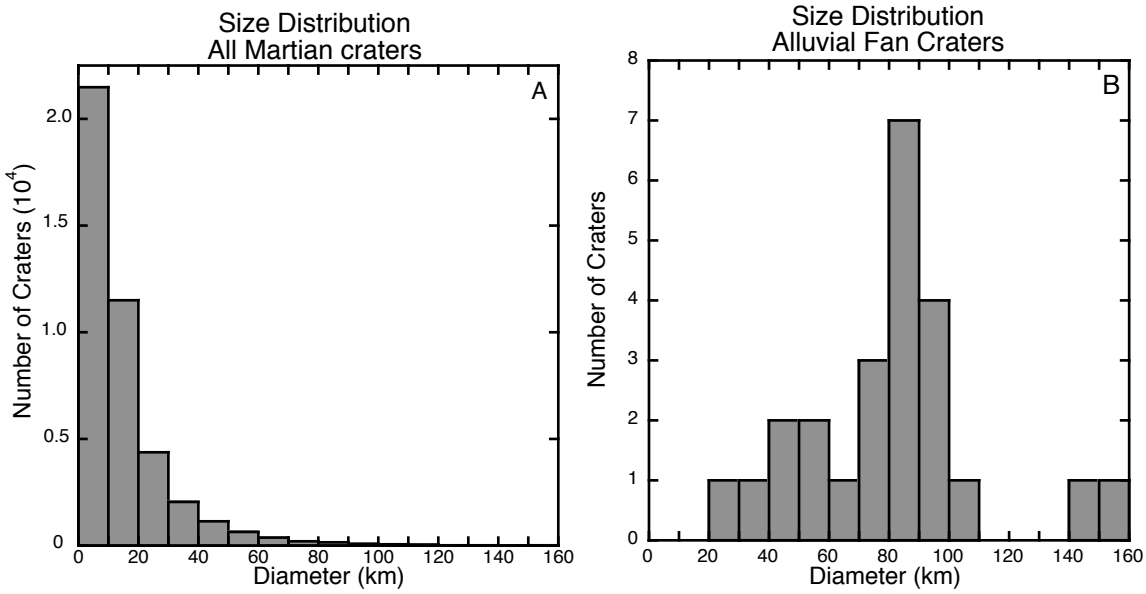

Figure 2: Size distribution of craters that contain alluvial fans (2a) with all of the craters on Mars (2b) from N. Barlow's data base. A total of 24 craters are included. Several other potential alluvial fans have been identified within smaller (~10 km diameter) craters, not plotted here, due to resolution identification problems. On the basis of this histogram it would appear that alluvial fans tend to form in craters of a certain size.