ESTIMATING FLOW RATES IN OUTFLOW CHANNELS ON MARS FROM SEDIMENT GRAIN SIZE.

B.Smith[1] and B.Horgan[2], [1]Independent, Lafayette, IN (besmith_16@yahoo.com, smit2262@purdue.edu), [2]Purdue University, West Lafayette, IN

Introduction: Outflow channels are large geologic features located on the Martian surface, caused by the movement of fluids moving down a slope [1]. On Earth, one observation of fluid movement is the erosion and thereby changing of the size of sediment within the fluid as the fluid itself changes velocity as it moves downslope. For outflow channels, is it possible for us to constrain flow rates using grain size of the sediments that fill them? In this study, we conduct a survey of several of the known outflow channels on the Martian surface using datasets available in the *JMARS* software in order to show sediment change along the surveyed outflow channels.

Methods: This survey uses several datasets found in the *JMARS* software. The primary dataset used is thermal inertia derived from the Thermal Emission Imaging System (THEMIS) onboard the Mar Odyssey satellite [2]. The colorized elevation map produced using data from the Mars Orbiter Laser Altimeter (MOLA) onboard the Mars Global Surveyor (MGS) spacecraft was used to help identify the outflow channels, as well as produce an elevation profile of the surveyed channels. The Context Camera (CTX) onboard of MGS was used to obtain higher resolution images of the outflow channels and determine the type of geologic units present.

Once the outflow channel was identified, the data was obtained by using the "Custom Shape" layer found within *JMARS* and a 1 km^2 square area was selected within the channel. An average thermal inertia value for that area was determined using the THEMIS Quantitative Thermal Inertia 100m Global Mosaic. This process was repeated nine other times along the fan, at different points equal to 1/10 the total length of the channel away from each other, thus giving us 10 average thermal inertia values for that outflow channel.

Once the average thermal inertia values were obtained, an averaged particle size could be calculated and obtained for each location within the channel. This calculation was done using the equation found in Presley 2002 [2].

This process was repeated for each outflow channel that was identified in this study.

Results: In total, nine different outflow channels were observed in this study using the aforementioned datasets. Of the nine, three are located on the Eastern edge of Hellas basin, five are in the Circum-Chryse Region, and one in the Amazonis and Elysium planitiae (**Figure 1**).

Sand particles are the most common sediment classification across the study, making up 54 of the 90 total areas studied across the nine outflow channels. Using a Hjulstrom diagram, it can be determined that these sand particles must have been deposited by a fluid flowing anywhere from approx. 1 cm/s to approx. 25 to 30 cm/s.

From CTX imaging of the areas surveyed, the surface appears to be bedrock with a layer of sand across them. The profiles themselves are rather chaotic, unlike those found on the Earth that generally have a steady, positive relationship with the velocity of the fluid.

Discussion: Even though each of these outflows channels are independent of each other, several share similar sediment profiles, possibly indicating similar post-outflow erosion. An example of this can be seen in the profiles of Maja Valles and Kasei Valles, in which there is one large "Spike" in the sediment size profile, indicating a possible anomaly due to erosion after the flow of water in these outflow channels stopped (**Figure 2**) (**Figure 3**).

On Earth, we expect to see a gradual change between the size of sediments within water flows, with the largest observed sediments in any particular water outflow to be at the source, while the smallest sediments are at the mouth. Of the nine observed outflow channels, only one, Ma'Adim Vallis, had a sediment size profile that closely resembled that of what we see here on Earth (**Figure 4**).

A possible explanation of this is the age of the outflow channels themselves. Most outflow channels were formed during the early Hesperian [3], approx. 3.7 GYA. As such, the water that formed these channels would eventually stop flowing, leaving the channels themselves to be eroded by the other forces present on the Martian surface, such as Aeolian processes.

References: [1] Carr, M.H (2006) *The Surface of Mars, 113-148.* [2] Presley, M.A. (2002) *LPSC XXXIII, 2* [3] Hartmann, W.K., and Neukum, G. (2001) *Chronolgy and Evolution or Mars,* 165-94.

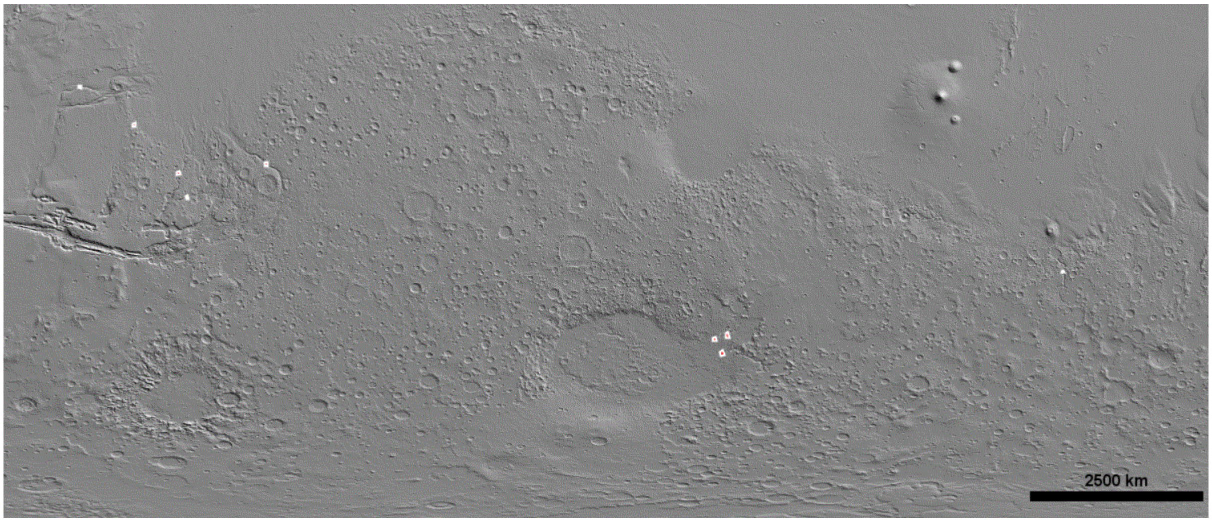

Figure 1: Overview of the Outflow Channels included in the study. Each is marked with a red square.

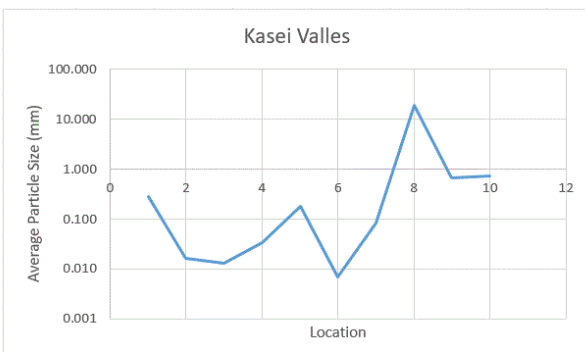

Figure 2: Kasei Valles sediment profile.

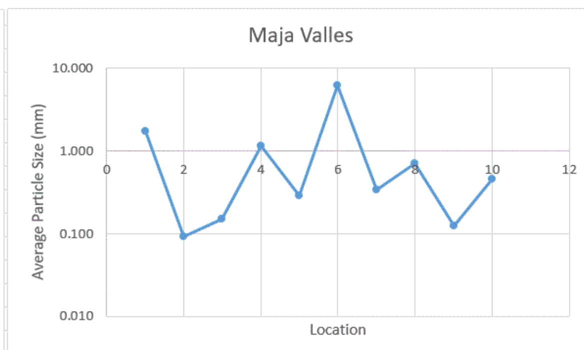

Figure 3: Maja Valles sediment profile.

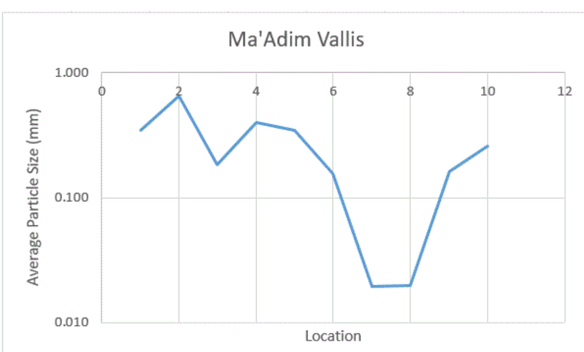

Figure 4: Ma'Adim Vallis sediment profile.