CERBERUS FOSSAE AND ELYSIUM PLANITIA LAVAS, MARS: SOURCE VENTS, FLOW RATES, EDIFICE STYLES AND WATER INTERACTIONS.S. E. H. Sakimoto[1] , T. K. P. Gregg[2], [1]GEST at the Geodynamics Branch, Code 921, NASA Goddard Space Flight Center, Greenbelt, MD 20771, sakimoto@geodynamics.gsfc.nasa.gov, [2]Department of Geological Sciences, The University at Buffalo, State University of New York, 876 Natural Sciences Complex, Buffalo, NY 14260, tgregg@nsm.buffalo.edu

Introduction: The Cerberus Fossae and Elysium Planitia regions have been suggested as some of the youngest martian surfaces since the Viking mission (e.g. [1, 2]), although there was doubt whether the origins were predominantly volcanic or fluvial. The Mars Global Surveyor and Mars Odyssey Missions have shown that the region is certainly young in terms of the topographic preservation and the youthful crater counts (e.g. in the tens to a few hundred million yrs. [3]). Numerous authors have shown that fluvial and volcanic features share common flow paths and vent systems [4-7 and others], and that there is evidence for some interaction between the lava flows and underlying volatiles (e.g. [8]) as well as the use by lavas and water of the same vent system. Given the youthful age and possible water-volcanism interaction environment, we'd like constraints on water and volcanic flux rates and interactions. Here, we model ranges of volcanic flow rates where we can well-constrain them, and consider the modest flow rate results results in context with local eruption styles, and track vent locations, edifice volumes, and flow sources and data.

Approach: Figure 1 and 1A-1F show several different examples of channelized flows (some of many). Since the regional preservation of small scale topographic features is excellent—allowing the detection of 1 m high lava levees over hundreds of kilometers—we have very good contraints on lava channel (sizes and slopes), enough MOC and THEMIS coverage to ensure accurate flow and levee boundary identification checks, and high resolution Mars Orbiter Laser Altimeter (MOLA) coverage regridded (using [9]) at 128 pixels per deg. by 256 pixels per deg. as well as the original MOLA profiles. We then use a three-dimensional newtonian channel flow calculation

$$Q = \frac{4ba^3\rho g'\sin\theta}{6\mu}\left[1 - \frac{192a}{\pi^3 b}\sum_{i=1,3,5\ldots}^{\infty}\frac{\tanh(i\pi b/2a)}{i^5}\right]$$

where b is depth, a is half-width, ρ is density, g' is martian gravitational accelleration, μ is viscosity, and θ is slope, and a, b, and θ are constrained by the topographic measurements. (see [10] for details). Table 1 has model flow rates and assumed viscosities. The figures illustrate example locations of rootless cones, fluvial/volcanic vents and lava channel locations.

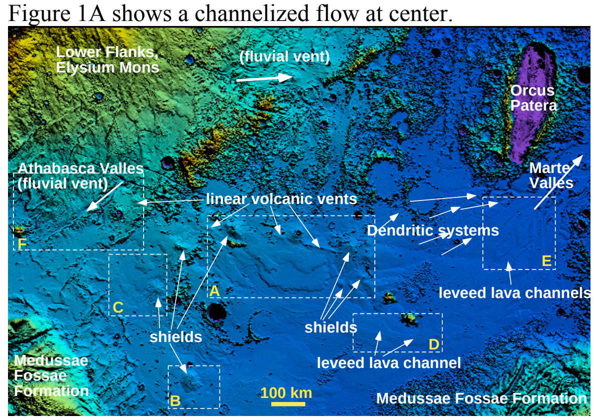
Discussion and Conclusions: The flow rates range for half a m^3/s to thousands of m^3/s and are within the range of Hawaiian eruption rates (typical Pu'u O'o is a few m^3/s), with the maximums 10-1000 less than other large systems on Mars. We find topographic agreement with suggestions that flows occupy fluvial channels and overlie sources of fluvial channels, and that source vents are contiguous, and that rootless cones do occupy flow segments at valley low spots. We expect ongoing missions to show additional evidence of volcano-ice or volcano-water interactions and landform co-existence.

TABLE 1. Lava Channel Data

Fig	Width	Depth	Slope (deg)	Flow Rate m^3/s
A	5-8 km	2-4 m	0.02	50-4000
B	4	6 m	0.02	70-7500
C	3.5 km	2 m	0.1	10-1000
D	5-10 km	3 m	0.01	5-1000
E	7-30km	2-12 m	0.003	0.5-700
F	300m	2 m	0.05	0.5-50

Assumed viscosity range 100-10000 Pa s, densities of 2000kg/m3.

Fig. 1. Shaded relief MOLA topography for the study region. T he Cerberus Fossae cross the image from middle left to middle right. Numerous volcanic flows, edifices, and linear vent structures are readily apparent North is towards the top. Figure 1A shows a channelized flow at center.



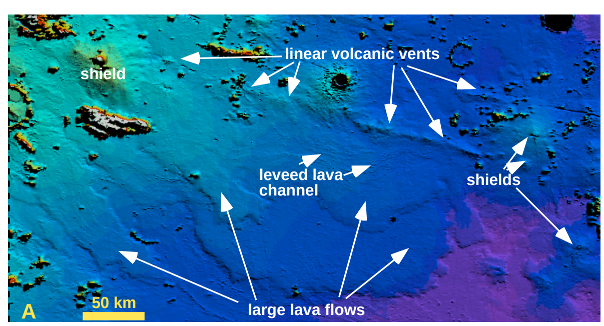


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Fig. 1B shows a 70 km shield 70 m high, embayed by up-slope flows, with a lava channel to the NE of the shield, Fig.1C shows two leveed lava flows. The East flow in Table 1. Fig. 1D shows a portion of a 650 km long channelized flow on a 0.01 deg. Slope m w/ flow thickness of 10 m.

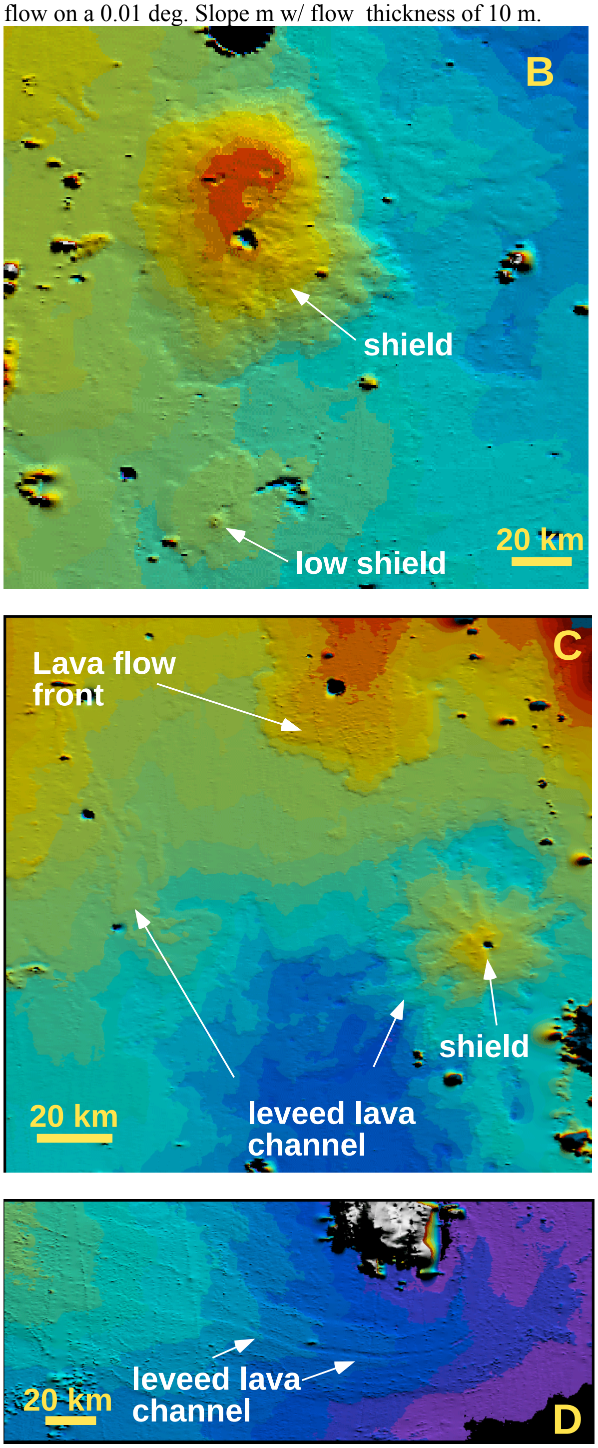

Fig. 1E shows multiple lava channels and MOLA profiles of them with levees marked, and several V-shaped fluvial valleys. Fig. 1F shows the location and portions of MOC 1501822 w/ rootless cone locations on the MOLA profile.