INFLATED LAVA FLOWS NEAR ELYSIUM MONS, MARS. K. L. Wood[1] and J. R. Zimbelman[2], [1]University of Maryland Department of Geology, College Park, Maryland 20742, kwood@umd.edu, [2]CEPS/NASM MRC 315, Smithsonian Institution, Washington, D.C. 20013-7012, zimbelmanj@si.edu.

Introduction: When a pahoehoe lava flow is traversing a surface with a very shallow gradient, inflation can occur [1, 2]. The exposed surface and sides of the flow begin to cool and solidify, but this growing crust remains ductile for hours to days. The molten center of the flow continues to feed into this flexible outer shell. The resulting features are termed inflated lava flows, and they appear as smooth-surfaced plateaus that can be lobate in form and quite extensive (Fig. 1).

Whether inflated lava flows are commonplace on Mars has been in question for some time. A few groups have searched for examples, primarily in the Tharsis region, and these studies have reported diverse abundances. One study that covered a vast region surrounding the Tharsis Montes and Olympus Mons yielded quite low results, finding inflated flows in only 1.6% of all the Mars Reconnaissance Orbiter Context Camera (CTX) images viewed [3]. Conversely, a study focused in the volcanic plains east of Tharsis Montes and west of Syria Planum found that 12.8% of the Mars Odyssey Thermal Emission Imaging Spectrometer (THEMIS) frames examined contained inflated flows [4]. Perhaps as methods are refined, the conditions suitable for detecting such flows may be better determined, and the inflated flows could be more easily located in spacecraft images.

Focus: For this study, we searched for inflated lava flows in the Elysium region rather than Tharsis. In particular, a large region west of Elysium was targeted, extending into the northern lowlands (Fig. 2). Flows in this area are known to have traveled great distances, extending as far as 1700 km to the northwest of the central Elysium Mons construct [5].

The data examined here included THEMIS visible-wavelength images obtained during Mars Odyssey years 2 through 4. Nearly all of the year 2 THEMIS images for this target region were viewed. Then the areas in which probable inflated flows were found in year 2 images were viewed in images from years 3 and 4. A few flows were also subsequently confirmed using CTX images obtained through Google Mars.

Inflated lava flows were identified based on a number of unique characteristics. First, they must have an upper surface with little to no relief. Flows with irregular surfaces are assumed to be normal pahoehoe or ‘a‘ā flows. Second, they are tabular, meaning that they are wider and longer than they are thick. Third, they have irregular edges, for similar features with uniform edges may be aqueous in origin. Fourth, they must be elevated. Inflated lava flows grow to be many meters in thickness, forming an inflation plateau.

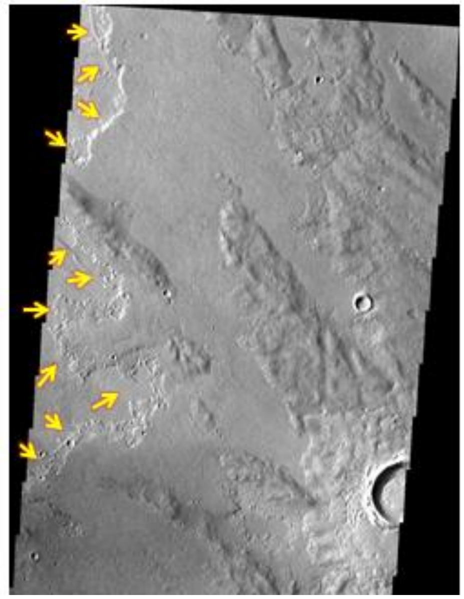

Figure 1. Inflated lava flow near 36.196434° N, 132.6849° W. Subset of THEMIS V21700010. This image was recorded as a “good inflated flow” and was therefore represented in Fig. 2. Image width 19 km.

As images were reviewed, they were declared to contain good inflated flows, possible inflated flows, or no inflated flows. This label, along with the image ID, latitude, longitude, and general description of important features in the image, were entered into an Excel spreadsheet. The good inflated flow candidates were then compiled into a separate Excel spreadsheet, so that those flows could be evaluated separately.

Findings: The existance of abundant inflated lava flows was confirmed in the Elysium study region. Of the 123 images viewed, 38 were classified as containing good inflated flows, resulting in a 30.9% presence rate. Compared to the two studies previously mentioned, this percentage is quite high. Does this mean that this area near Elysium produced more inflated flows, or is it simply a difference in methods?

Through plotting the central latitudes and longitudes of the images that contained good inflated lava flows, an important trend was revealed. Most of the inflated lava flows are to the northwest of Elysium Mons, where the landscape gradually decends to Utopia Planitia.

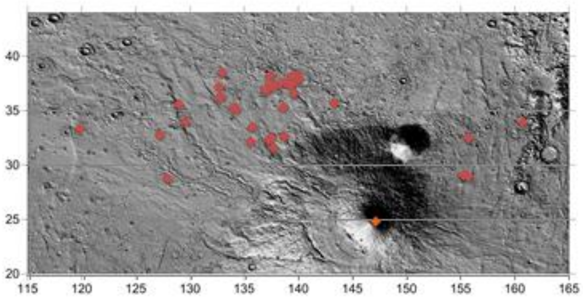

Figure 2. Representation of the relative locations of identified "good" inflated lava flows. The "Center Latitude" and "Center Longitude" of THEMIS images determined to contain "good flows" were plotted on the vertical and horizontal axes, respectively. Each THEMIS image is represented by a red diamond (the orange diamond on the peak of Elysium Mons is not an inflated flow, but a point used for reference). The location information was overlain on a MOLA shaded relief image of the region of interest.

One would suspect such a trend to correspond with a trend of gradient. Gradients were calculated using Mars Global Surveyor Mars Orbiter Laser Altimeter (MOLA) data of elevation (m) and ground distance (m) acquired from Google Mars. Calculations of four representative slopes, as shown in Fig. 3, were made starting with coordinates of a flow nearest Elysium's central construct and ending with coordinates of a flow farthest from the construct.

The gradients calculated along the trendlines were as follows (Table 1). The numbers represent the change in elevation (m) between two points divided by the distance (m) between the two points.

#	gradient
1	0.00089
2	0.00123
3	0.00089
4	0.00323

Table 1. Gradient measurements shown in Fig. 2.

As can be easily seen, all of the sample gradients are quite small, particularly gradients 1, 2, and 3 to the west of Elysium Mons, where a majority of the inflated flows were found. The average of these three gradients is 0.00100, which indicates a very shallow slope. Apparently inflated lava flows on Mars, like those on Earth, occur primarily on surfaces with less than a 1^{o} incline. Future work on inflated lava flows in this region can focus on areas within about 1700 km of the central construct and on gradients of 0.004 or less.

References: [1] Walker G. P. L. (1991) *Bull. Volc.*, *53*, 546–558. [2] Self S. et al. (1996) *Geophys. Res. Lett.*, *23*(19), 2689–2692. [3] Graff M. A. and Zimbelman J. R. (2012) *LPS XLIII*, Abstract #1144. [4] McCarthy M. L. and Zimbelman J. R. (2013) *LPS XLIV*, Abstract #1153. [5] Carr M. H. (2006) *The Surface of Mars*, Cambridge Univ. Press, p. 59.

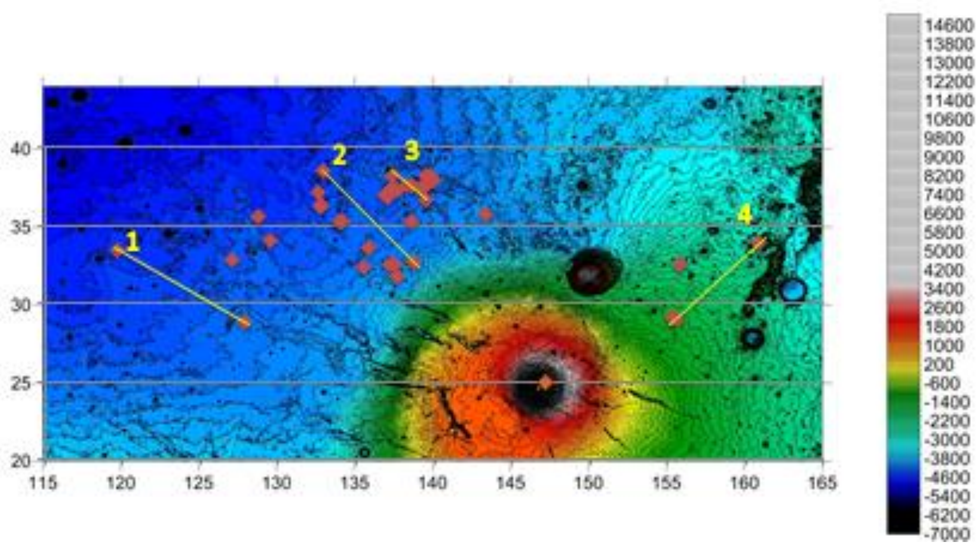

Figure 3. Contoured MOLA elevation map of the region shown in Figure 2. Yellow lines labeled 1, 2, 3, and 4 indicate the paths along which sample gradients were determined (see Table 1).