INFLATED LAVA FLOWS EAST OF MARS' THARSIS MONTES. M. L. McCarthy[1] and J. R. Zimbelman[2], [1]Harvard University Earth and Planetary Science Department, 266 Dunster Mail Center, Cambridge, MA 02138-7523, meghanmccarthy@college.harvard.edu; [2] CEPS/NASM MRC 315, Smithsonian Institution, Washington, D.C. 20013-7012, zimbelmanj@si.edu.

Introduction: Inflated lava flows are elevated sheets of pahoehoe lava that result from fluid lava being injected into a flow's interior and inflating its rigid outer skin [1]. Previous searches for inflated lava flows on Mars have yielded low percentage results, casting doubt on the prevalence of inflated lava plateaus on the Red Planet. One such study covered a broad region in the Tharsis region and found that only 1.6% of the satellite images observed featured portions of inflated lava flows [2]. Recent discoveries of vast inflated plateaus in specific volcanic plain regions [3] have contested the idea that Martian inflated flows are rariities. Inflated lava flows can readily be found on Mars when searching in an appropriate region using suitable satellite images.

Process: The area of interest for this inflated flow search was the volcanic plain region east and parallel to the Tharsis Montes and west of the Syria Planum region (14.2 N-19.4 S, 238.9-272.5 E).

Identifying inflated flows via satellite images: To be considered a candidate inflated lava flow, a satellite image must illustrate a feature that meets certain requirements. First, the potential candidate feature must show evidence of an elevated surface. Grayscale aerial views oftentimes cause surface depressions to ressemble surface uplifts. Therefore, an elevated geological feature is detected by comparing the candidate uplift's lighting to that of a nearby crater. A crater's depth is indicated by its shadowed portion and its outer rim is indicated by the lighted portion. From this, the location of the Sun can be determined and a similar shadow-light analysis can be carried out to locate an elevated feature. Second, the elevated geological feature must span a broad region, as lava flows that are longer than they are wide are oftentimes normal pahoehoe finger-deposits [4]. Third, the feature should maintain a uniformly smooth surface, for rough texture is indicative of an a'a flow. Fourth, the lava flow should have an irregular margin, so as to distinguish it from a water-carved feature with a smooth margin. Adjacent volcanoes are also good indicators of candidate inflated regions.

Instruments: The search was primarily conducted using images from the Thermal Emission Imaging System (THEMIS) aboard the eleven-year running Mars Odyssey spacecraft [5]. The images used in the study were taken in the visible spectrum from 2002-present and were shot during both the daytime and nighttime. THEMIS VIS images have a resolution of ~18 meters/pixel. Probable and possible inflated lava regions were then viewed in images from a camera aboard the Mars Reconaissance Orbiter, Context Imager (CTX), which provided a resolution of 6 meters/pixel [5]. CTX images helped to verify the probable regions and to eliminate 5 contenders previously classified as "possible candidates"; the CTX frames of the "possible candidates" provided a zoomed-in view that revealed a coarse, shell-like surface not found in inflated lava flows.

Classificaiton System: THEMIS frames were classified as either "good candidates," "possible candidates," or "not candidates" based on their adherence to the previously-stated requirements. "Good candidates" presumably showed inflated lava flows, which were then verified by their corresponding CTX frames. "Possible candidate" images might have shown inflated lava flows, meaning they fulfilled 3/4 candidate requirements. The most common reason for a "possible candidate" labeling was a smooth, elevated flow that ran long and thin instead of wide and thick. Faulty THEMIS frames oftentimes blurred the texture of geological features, so broad plateaus were dubbed "possible candidates" until CTX illustrated a smooth surface. Frames that were "not candidates" lacked elevated lava flows completely, though many did show other notable geographical features, like craters, channels, and grabens.

Results: Of the 673 THEMIS images examined in this study, 86 frames were labeled as "good candidates." Therefore, 12.8% of the THEMIS frames observed in this study contained inflated lava flows. Of these 86 strong candidates, 24 of these frames were labeled as "best candidates" because they imaged exemplary inflated lava flows that strictly cohered to the four requirements. Figures 1-2 provide examples of such frames. Though the "best candidates" were dispersed throughout a broad region (9.5 N-11S), 45.9% of these top candidate frames were concentrated in the region north and east of Arsia Mons, (2-11 S). Figure 3 provides a quantitative break-down of the inflated lava flow study and reveals that just under half of the frames (41.3%) could include inflated lava flows. Frames from another orbiter camera, like the Mars Orbiter Camera (MOC), might show the "possible candidates" in a different light, and thereby reclassify them as "good candidates."

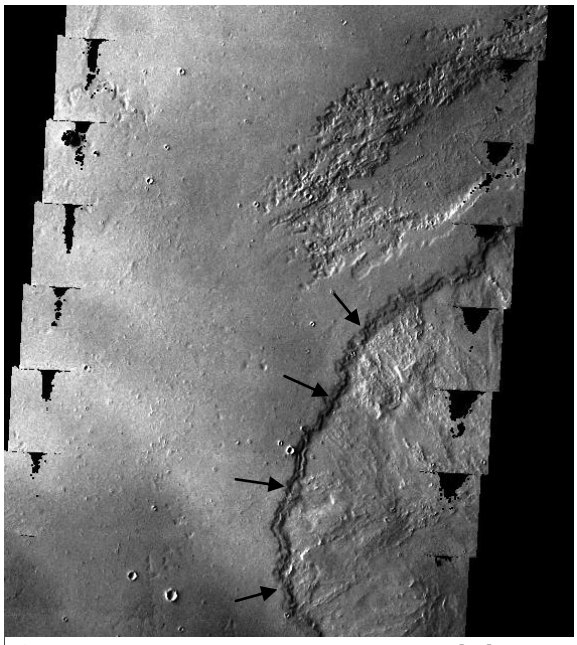

Figure 1: THEMIS image V05209011 includes good candidate inflated lava plateau found near (0.4 N, 253.4 E). Surface visisbly smooth and lacking much texture. Arrows indicate neighboring volcanoes' border and also point to lava flow's shadowed edge to indicate the elevation.

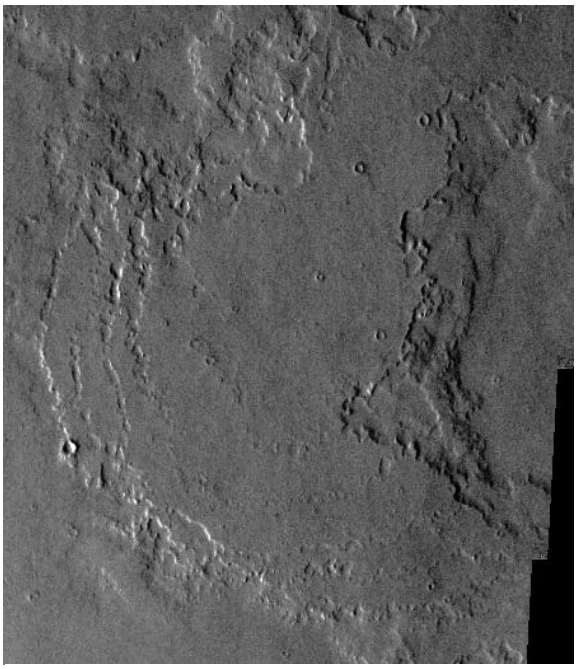

Figure 2: THEMIS image V23731002 features good candidate inflated plateau found near (10.0 S, 245.5 E). Contorted shape and irregular margin verify that it is a lava flow. Also an example of a terraced flow.

Inflated Flow Status	*Amount*	*Percentages*
Good Candidate	86	12.8%
Possible Candidate	192	28.5%
Not Candidate	395	58.7%
Total	**673**	**100%**

Figure 3: Inflated lava flow study in numbers. Inflated lava flows were suspected in almost 50% of the THEMIS frames.

Discussion: Though 673 THEMIS images were studied in the plain region east of the Tharsis Montes, it is possible that a candidate frame could have been overlooked and went unexamined. Even so, we believe that a 12.8% "good candidate" rate in this specific Tharsis region demonstrates that inflated lava flows are not uncommon on Mars; prevalence of inflated lava flows simply depend on the regions being investigated and the tools which carry out the investigation. We conducted this search in an attempt to test and improve on a 2011 study [2] that examined a random Tharsis location and found very few inflated lava flows. By comparing the 2011 study to this study, we are reassured that inflated lava flows are not rare on Mars and can be detected aerially; the key to locating inflated lava flows on Mars is searching in a more lava-concentrated area. Selecting the right camera-equipped satellite to conduct the investigation is also vital to the study. We found over 673 lava-related THEMIS frames in the eastern Tharsis region, but we could not find many HiRISE frames that were relevant to our study area.

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