An Analysis of Potential Fluvial Patterns on Mars' Surface Utilizing THEMIS. E. C. Bodager[1], J. W. Sweitzer-Lamme[2], and M. J. Tobias[2], [1]Durham Academy, Durham, NC 27705, [2] North Carolina School of Science and Math, Durham NC 27715.

Introduction: We have selected THEMIS image I27360032 in order to further our research that we first experienced in year one of the Mars Outreach for North Carolina Students (MONS) program. The focus of our projects thus far has been to examine fluvial sediments on Earth's surface and to apply this data and our knowledge to THEMIS images from Mars' surface. The areas we find significant for our purpose are those that have the same sediment make up via grain size as exist in Earth's fluvial systems. This not only furthers expands our research in year two of our MONS program, but also will lead to the exploration of possible water on Mars. With today's examination of global warming on Earth, there are many lessons that can be taken from conditions on Mars particularly if we discover evidence of water.

Analysis: This image may be broken up into three distinct segments, divided by riverbeds, from north to south.

The first segment of the image consists of what appears to be a dried up flood plane. Ripples are inconsistent with other more fluvial looking areas in the image. This area is dimpled with craters, signaling its age. At the very top of the image, a large crater is covering the rippled area; this crater is more richly defined and much crisper along its edges than the ripples are in their own formation. Perhaps this space was a flooded area and the newer river system seen below formed from it. There is one overwhelming trench that is observed to drive through the middle of this dried flood plane. It looks as if what once was a river flowed and cut through this area. There are more craters in the rippled flood plane area than in the river area, showing the progression of events through relative age. From this point begins a flat, washed out looking section. The surface is relatively smooth, and is freckled with only a few small craters. There are waves of different colors of surface, dark waves weaving in and out through lighter ones. At the same time, small meandering paths that greatly coincide with the same grain size pattern as riverbeds on Earth spread like veins through the surface. These smaller fluvial veins are even newer as there are even fewer craters and the ridges formed are much more defined and crisp. With the line of greatest contrast in the entire image below, the second segment begins.

The second segment into which we separated the image was the part that showed the most direct evidence of past water and fluvial systems. While the landforms and features pointed to this history, our main study of the area involved using night-time infrared images of the area to determine grain sizes and match them with commonly known grain size patterns of fluvial systems. At the top of this section of the image runs what appears to be a channel. See figure 1. Around this are several small dendritic channels that flow into and out of the main canyon. While the only part of the daytime image that suggests water flow is the visibility of fluvial-similar systems, the night time IR reveals more information about the rock itself.

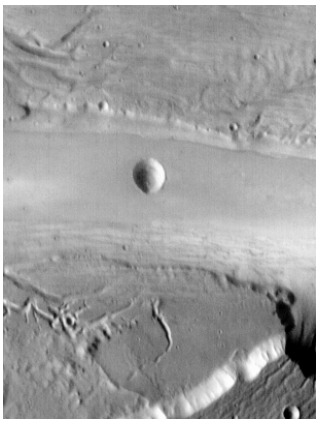

Figure 1

In the image, many of the same formations and indentations in the rock can be seen, but because of thermal properties of rocks, the different grain sizes can easily be seen. Because of their high thermal inertia, large rocks both heat up and cool down quickly-staying cooler during the day and warmer at night. Smaller grain sizes, which have low thermal inertia, behave in the opposite manner. These properties show up in the images, as the imaging system is based on heat radiation. Within the canyon formation, the night time image shows a pattern of extremely light (warmer) rocks moving out to darker (cooler) rocks on both sides, laterally along the channel. On earth, this pattern of large rocks in the center moving to smaller sediments on the sides is shared by any body of flowing water, based on flooding patterns. The combined thermal properties of the rock and landforms in the area suggest strongly that water once flowed through these barren veins.

As we examine further down the length of the image, the terrain becomes very distinct and unique from the rest of the image. Instead of a stream system, there appear many connected linear cracks that form

geometric patterns in the surface. Because of the close proximity to assumed areas of past high water concentration, this area could once have been entirely underwater, and its drying caused what we see in small ponds on Earth on a much larger scale: mud cracks. See figure 2. These cracks showed no distinct thermal properties, although most of them were fairly small grain sized, which could show the layer of dust that generally covers Mars.

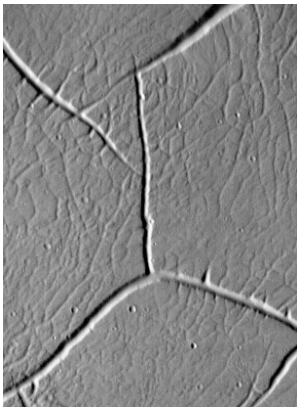

Figure 2

Following that portion of the terrain, a similar channel again cuts through the image just as the previous one did. See figure 3. In this one as well, the thermal properties show a decrease in grain size radiating out from both sides of the channel, showing the possibility of an ancient river. Another significant feature about the picture is the lack of numerous large craters. Usually in images showing fluvial systems, the ground is covered with craters, both large and small, dating the area as relatively older. This region, however, only has some small craters pockmarking the area which suggests that the land is relatively young, and the fluvial system is geologically recent.

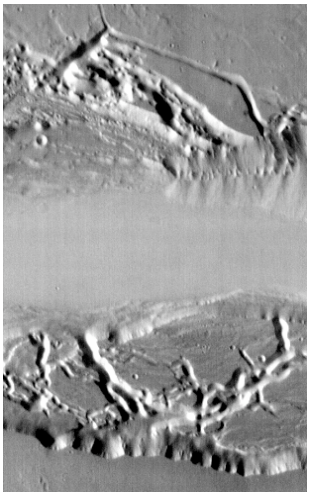

Figure 3

In the most southerly third of the image, there is little to no evidence of any fluvial activity. Small craters dot the surface. There is little variation in thermal properties other than within these craters, which vary dependent upon shadows. See figure 4. The area as a whole is 'bright' when analyzed thermally in daytime, implying a layer of dust.

This surface is the oldest in the image. Viewed more widely, this appears to be a continuation of the older surface through which many channels in this area have cut. Due to the proximity of this image's region to areas of high volcanic activity, namely Ascraeus Mons and the Tharsis Complex to the west and south, we attribute this surface to ancient eruptions by Ascraeus Mons.

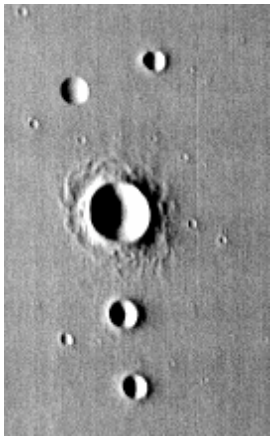

Figure 4

Results: This area of Mars merits further study, as it contains a vast array of terrains, particularly in this small area, that are of the most interest to the scientific community. To the north, an intricate fluvial system allows study of types of water flow. Further south, an area that appears to be an ancient lakebed is prime potential habitat for ancient Martian microorganisms. In the far south, volcanic flows exist, excellent for understanding the interior of Mars as it relates to volcanic eruptions, as well as craters. These are excellent for removing the layers of dust currently making it nearly impossible to comprehend the actual surface of Mars.

References: Images used: THEMIS image I27360032 and its night time and day time context images.

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