STRUCTURAL DEFORMATION AND SURFACE PROPERTIES OF A MARTIAN CRATER – INSIGHTS FROM THEMIS INFRARED IMAGES. Matthew J. Petrowsky, Ry Jones, and Neil M. Coleman, University of Pittsburgh at Johnstown (Department of Earth & Planetary Science, Johnstown, PA 15904; mjp85@pitt.edu, rej10@pitt.edu, nmcoleman@comcast.net).

Introduction: We use THEMIS infrared (IR) images to analyze the history and surface properties of a large crater on Mars. We take advantage of a special condition – that the crater floor was offset by faulting, revealing a cross-section of strata beneath the floor.

Crater Morphology: The unnamed crater is located ~50 km south of the southern rim of Coprates Chasma (Figure 1). The crater is ~45 km wide and exists in Noachian terrain mapped as Npl_2 (Subdued crater unit) [1]. The crater displays no ejecta and the rim is highly eroded and topographically subdued. The crater is likely Noachian in age, which is further supported by the presence of numerous smaller craters on its' floor. The crater is >1000 m deep with a relatively flat floor that is crosscut by a graben 500 m deep (Figures 2 & 3). This structure crosses the entire crater and offsets the rim in two places. The graben parallels the same trend as Coprates Catena and several unnamed pit chains, located 400 km to the west. This E-SE trend also parallels the bounding faults on the north and south flanks of Coprates Chasma. Our continuing research is examining the association of the extensional fault structure in the unnamed crater with the crustal stress patterns that produced the Valles Marineris and associated features.

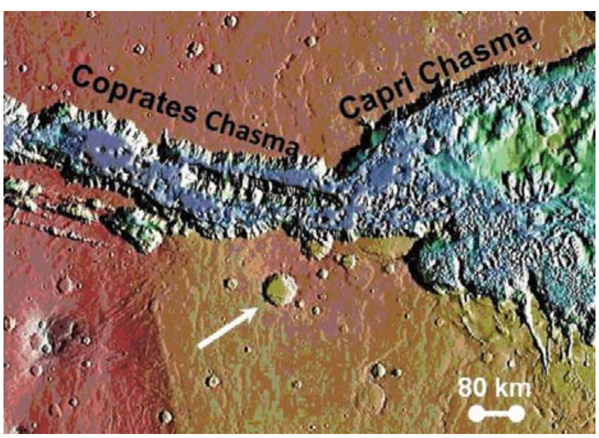

Figure 1. Context image of unnamed crater (white arrow), located south of juncture between Coprates Chasma and Capri Chasma. Crater center is at MOLA coordinates 17.00°S, 54.07°W. North is up. Credit [2].

Discussion: The thermal properties of the Martian surface are strongly controlled by the thickness of dust layers and the abundance of surface rocks and outcrops. Dust has very low thermal inertia compared to rock. This means the dust heats up and cools off quickly, while rocks very slowly gain and lose heat. Dust deposition rates of 20-45 μm per Earth year were previously measured at the Pathfinder landing site, near the mouth of Ares Vallis [3]. There had been concern that dust accumulation on solar cells would adversely affect the Opportunity and Spirit Rovers over time, but the "cleaning" effects of numerous dust devils minimized the problem. Topography and the prevalence of dust devils together help determine which areas permit accumulation and which areas remain relatively dust free. Flat-lying areas will retain more dust, while dust will less likely accumulate on rocky, angular surfaces, given the action of dust devils.

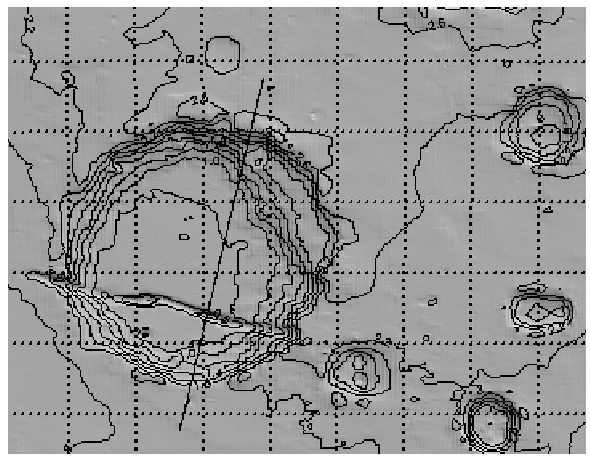

Figure 2. Contour map of unnamed crater. C.I. = 200 m. Grid lines are 0.2 degrees apart. Profile line shows location of cross-section in Figure 3. Figure created with GRIDVIEW [4].

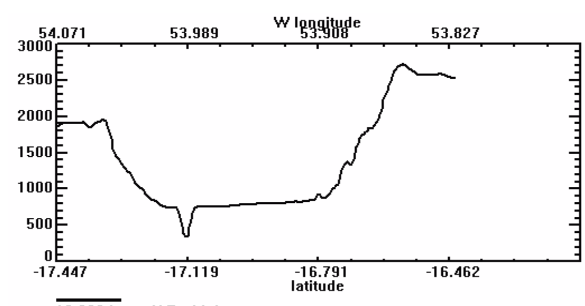

Figure 3. MOLA profile across unnamed crater revealing the depths of the crater floor and the graben that crosscuts it. Vertical axis in meters. Note subdued crater rim and greater elevation of terrain on northern flank of crater. Cross-section created with GRIDVIEW [4].

Interpretation of IR Images: The thermally brightest areas on Mars are rock outcropping areas on the sides of canyons, cavi, crater rims, and channels and rocky terrain associated with paleofloods. The brightness in nighttime IR of much of the unnamed crater floor (Figure 4) confirms that any dust layer present is thin, and that bedrock or boulder fields dominate. The smaller craters on the floor of the crater are thickly dust covered, based on their dark appearance in the nighttime IR image (Figure 4). Thermal inertia values [5] for the region outside the unnamed crater range from ~200 to 300 J/m^2 K s$^{0.5}$. The crater interior has values from ~400 to 550 J/m^2 K s$^{0.5}$, consistent with a rock-rich terrain. In fact, the floor of the unnamed crater has the highest thermal inertias found over a large region south of Coprates Chasma.

The upper margin of the graben is also very bright in nighttime IR (Figure 4, right panel). The structural valley serves as a "window" through which we can study the stratigraphy beneath the crater floor. Close examination of a MOC image that crosses the graben (Figure 5) reveals a resistant, cliff-forming layer at the surface that is ~100 m thick. We interpret this resistant layer of high thermal inertia as a sequence of basalt flows that covered the interior of the crater prior to graben formation. The fact that dust has not thickly covered the crater floor over geologic time suggests it consists of rocky terrain with highly angular surfaces that do not readily collect dust.

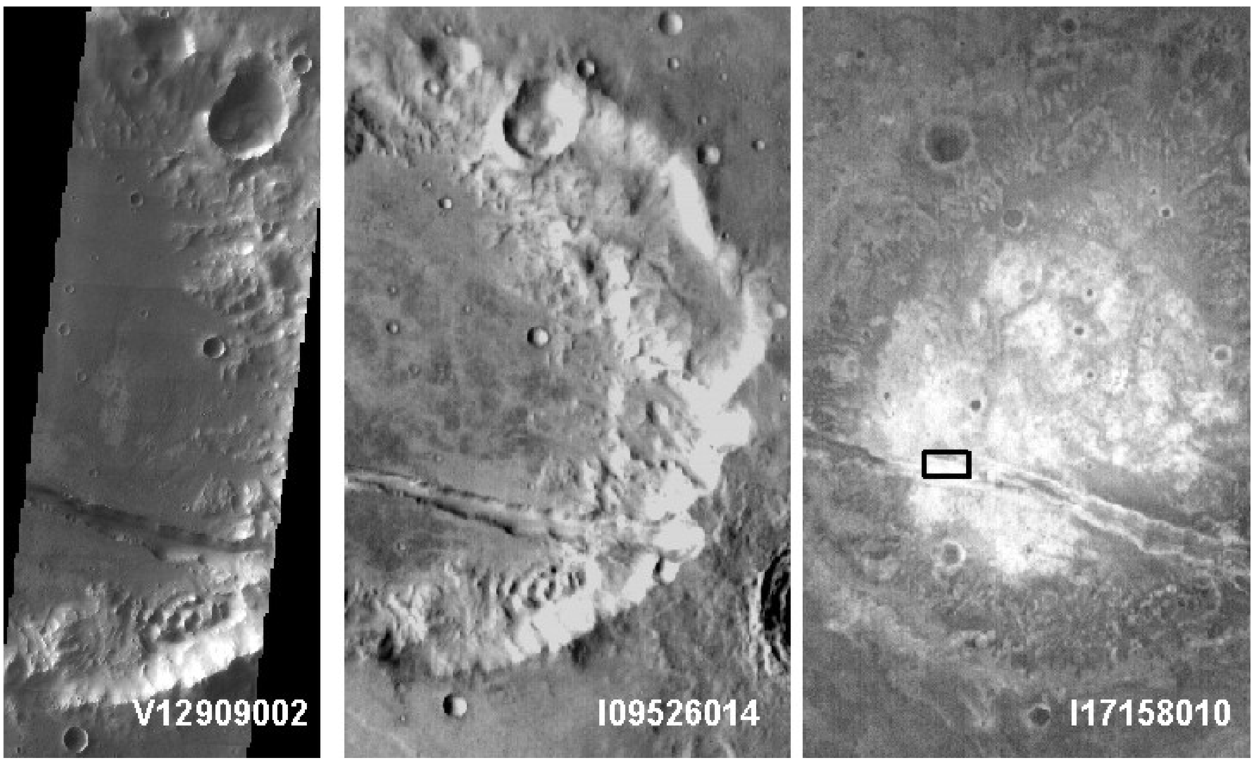

Figure 4. Unnamed crater at 17.00°S / 54.07°W, deformed by post-impact faulting. THEMIS images [6] from left to right: visible light, daytime IR, and nighttime IR (local time 4.30 hr). Black box shows location of Figure 5. Most of graben floor is dust covered (dark), but graben margins are bright in nighttime IR. Crater floor is rock covered, as indicated by dark mottling in daytime IR and large bright areas in nighttime IR.

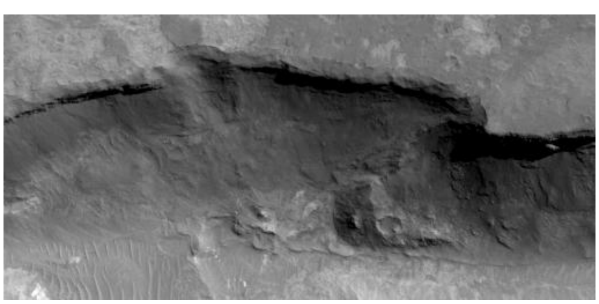

Figure 5. Portion of MOC image R18-01350 [7]. Note cliff-forming, resistant strata along northern margin of graben. Frame is 3.04 km wide.

References: [1] Witbeck, N. et al., USGS Map I-2010, 1991. [2] Derived from map MC-18 at http://planetarynames.wr.usgs.gov/. [3] Johnson, J. R., et al., *Icarus*, v. 163, p. 330-346. [4] GRIDVIEW program available from Goddard Space Flight Center at http://core2.gsfc.nasa.gov/gridview/. [5] Thermal inertia data available from Ames Research Center at http://marsoweb.nas.nasa.gov/dataViz/. [6] Christensen et al., THEMIS public releases, http://themis-data.asu.edu/. [7] Malin Space Science systems; http://www.msss.com/moc_gallery/.