PETROGENESIS OF CENTRAL PEAK FORMATION ON MARS. K. A. Milam, Department of Geological Sciences, Ohio University, Athens, OH 45701 (milamk@ohio.edu).

Introduction: Little attention has been paid to the small-scale details recorded in the target rocks within central uplifts of terrestrial impact craters. So it is no wonder that central peaks on other bodies of the inner solar system have been studied even less. Images from the Moon and Venus suggest central uplifts there consist of multiple peaks or discrete blocks concentrated near the crater center. The visible and radar imagery used to study these central uplifts however, suffer from spatial resolutions that are too low to discern the finer-scale fabrics, textures, and structural geology that are being used in the study of terrestrial impacts [1-4].

High-resolution orbital visible imaging instruments that have been flown to Mars however, do provide a means of observing martian central peaks at finer scales and of making comparisons to their terrestrial counterparts. What is emerging is a story very similar to that of central uplifts studied on Earth.

Methods: This study has involved the examination of hundreds of central peaks/uplifts in complex craters across Mars ranging from 15-120 km in diameter using high-resolution imagery from the Mars Orbiter Camera (MOC) on board Mars Global Surveyor (MGS) and the High Resolution Imaging Science Experiment (HiRISE) on board the Mars Reconnaissance Orbiter (MRO). Spatial resolutions of MOC and HiRISE are as low as 1.5 m and 25 cm/pixel respectively. For more information on these instruments see [5-6].

Fifty of these complex craters were selected for detailed study. The majority of studied uplifts are positive topographic features, i.e. actual central peaks. Most of these (80%) however, were poorly exposed due to dust cover, with Dust Cover Index (DCI) values [7] <0.94. A significant portion (36%) of exposed bedrock consists of either low or high albedo material and is massive, limiting observations of textural and structural features. Many (18%) exposed central peaks consist of blocky material that is likely uplifted regolith.

Four (8%) of the studied craters have central uplifts with well-exposed, layered bedrock that displays textures suitable for discerning petrogenetic relationships that have resulted from central peak formation. Observations of actual bedrock and other coarse-grained material is confirmed by high thermal inertia values (313-376 $J\ m^{-2}K^{-1}s^{-1/2}$) [using 8] and DCI values between 0.96-0.99 [7]. All four craters have been imaged by the HiRISE instrument. Two of these also have coverage by MOC narrow angle (MOC-NA) images.

Observations: The exposed layered bedrock reveals that the uplifted crater floors have been extensively faulted, fractured, and folded (Fig. 1). Movement along major faults has resulted in the separation of target rock material into discrete megablocks. Areal exposures of megablocks in the largest crater, Oudemanns (268.2˚E, 9.8˚S), range from 0.02 to 3.92 km^2. Where measurable, displacements along major faults range from a few meters to > 67 m. Fault breccias (Fig. 2) have been observed along major fault boundaries, similar to terrestrial complex craters. Large displacements suggest that megablock transport during central uplift formation was accomplished along major faults as in terrestrial central peaks [4].

Many megablocks show minimal or no signs of internal deformation at the spatial resolution of the HiRISE or MOC instruments. Some megablocks however, display parallel and sympathetic sets of fractures (Fig. 3) and faults that superficially resemble microfractures and microfaults at the scale of hand specimen viewing. In terrestrial impacts, such fractures and faults have been interpreted to represent rock failure during shock wave passage [4] and initial, minor displacements movement during ascent of crater floor strata. Megablocks are also commonly internally folded. Both fractures and folds truncate along major faults (i.e. megablock boundaries).

Cross-Cutting Relationships: The two best exposed central uplifts (in Martins and Oudemanns craters) show deformation whose cross-cutting relationships are consistent with those in their terrestrial counterparts [4] and the various stages of impact cratering. Fractures and folds are cut and displaced by major faults. Fractures within folded rock show signs of dilation during folding. These observations support initial failure of rock during shock wave passage followed by folding as target rock experienced compression and decompression during uplift. Final movements occurred along major faults and most likely account for the total stratigraphic uplift during central peak formation.

References: [1] Milam et al. (2004) *LPSC XXXV*, Abs. #2073. [2] Milam K. A. and Deane B. (2005) *LPSC XXXVI*, Abs. #2161. [3] Milam K. A. (2006) *LPSC XXXVII*, Abs. #1211. [4] Milam K. A. (2007) *Bridging the Gap II*, Abs. #8053. [5] Malin M.C. and Edgett K. S. (2001) *JGR-Planets, 106*, 23429-23570. [6] McEwen A. S. et al. (2007) *JGR, 112*, doi:10.1029/2005JE002605. [7] Ruff S.W. and Christensen P. R. (2002) *JGR 107*, doi:10.1029/2001JE001580. [8] Putzig N. E. et al (2005), *Icarus, 173*, 325-341.

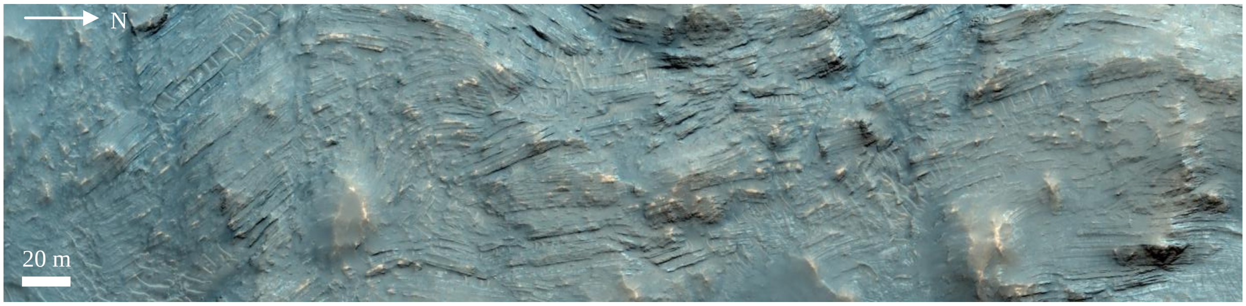

Figure 1. HiRISE false-color image of a portion of the central peak of Martin Crater (centered at 290.72˚E, 21.39˚S and 62 km diameter). Note the sub-vertically oriented layers, folds, and faults. (NASA/JPL/University of Arizona)

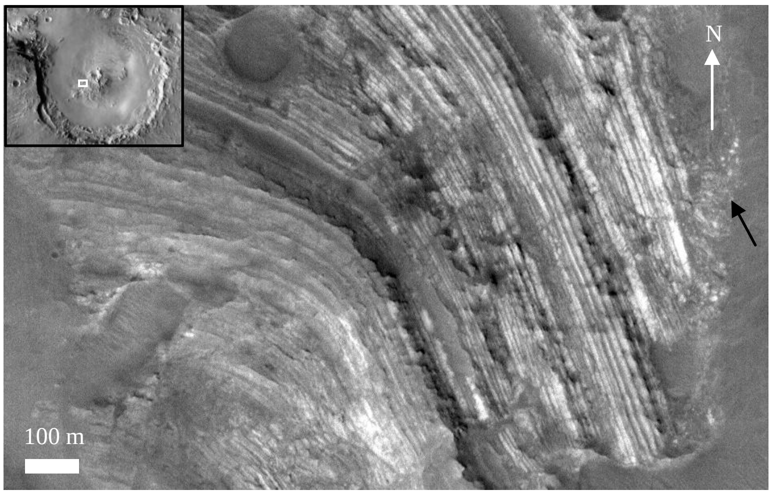

Figure 2. MOC-NA visible image of a single folded megablock along the western flank of the central peak of Oudemanns Crater (centered at 268.2˚E, 9.8˚S and 120 km diameter). Inset box is a THEMIS daytime surface brightness image mosaic showing the location of MOC-NA image. Black arrow highlights apparent fault breccia along mega-block boundary. (NASA/JPL/University of Arizona)

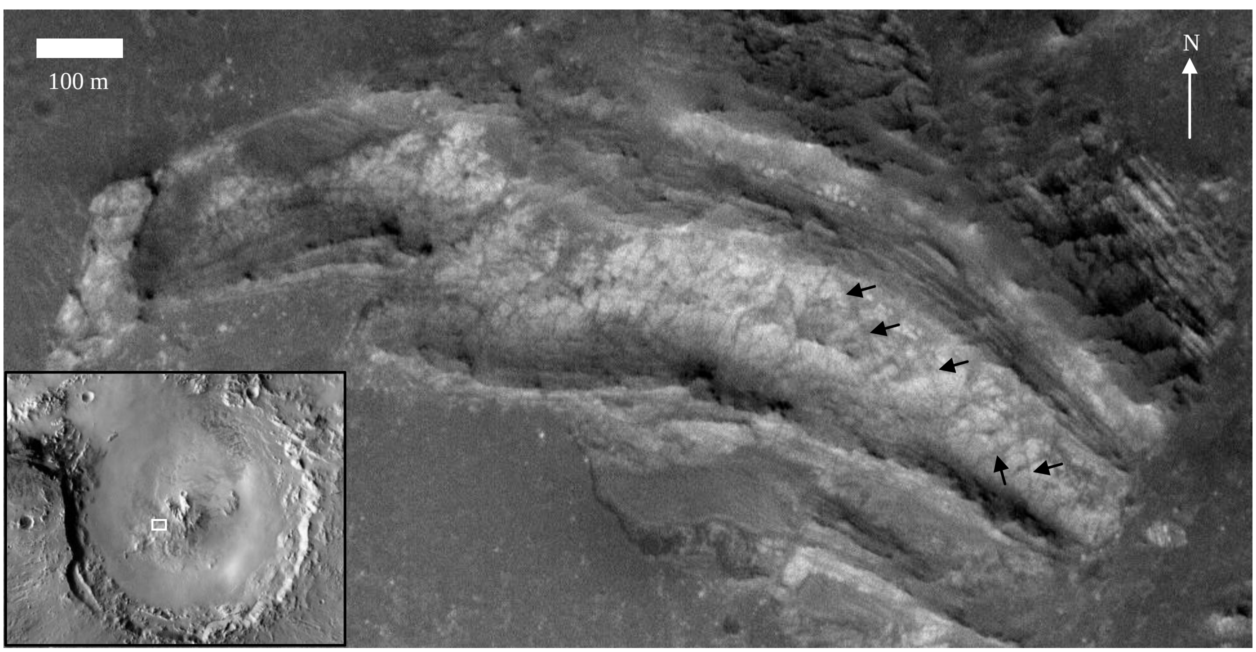

Figure 3. MOC-NA visible image of a single folded megablock within the central peak of Oudemanns Crater (centered at 268.2˚E, 9.8˚S and 120 km diameter). Inset box is a THEMIS daytime surface brightness image mosaic showing the location of MOC-NA image. Sub-vertically oriented layers are folded and extensively fractured (representative fractures are indicated with arrows). Note that some fractures (example highlighted with double arrows) seem wider to the north, suggesting extension during folding. (NASA/JPL/University of Arizona)