INITIAL HiRISE OBSERVATIONS OF CRATERED CONE GROUPS ON MARS. C. M. Dundas[1], L. P. Keszthelyi[2], A. S. McEwen[1], and the HiRISE team. [1]University of Arizona, Department of Planetary Sciences, Tucson, AZ 85721 (email: colind@lpl.arizona.edu), [2]U. S. Geological Survey, Astrogeology Team, 2255 N. Gemini Dr., Flagstaff, AZ 86001.

Introduction: The High Resolution Imaging Science Experiment (HiRISE) camera [1] is producing the highest resolution images of the Martian surface ever obtained from orbit. Early images include views of cratered cones several hundred meters in diameter from cone groups in widely spaced regions of the Martian surface. A variety of formation mechanisms have been proposed for these cones, with varied implications for the role and state of water or ice in the Martian subsurface.

HiRISE observations provide additional information about the origins of cones in two groups. The two appear to have formed by different mechanisms, as they show different fine-scale features.

Observations of Cones:

Acidalia Planitia: Cratered cones in Acidalia Planitia have been the subject of much speculation since they were initially observed. A variety of origins have been proposed, including cinder cones, rootless cones, pingos, mud volcanoes and spring mounds [2-6]. Recent work has supported a mud volcano or spring mound origin [7].

HiRISE image PSP-001810-2175 is centered near 37.2°N, 348°E and shows several cones in an area of eroded knobs and mesas. Some are irregular, elongate, or have multiple craters. The cones do not seem to contain boulders, in contrast to the surrounding plains; the only boulders present on the cones are associated with nearby impact craters. The cones are superimposed over parts of the surrounding plains, but apparently embayed by a flow covering much of the southern portion of the image.

In two instances, fracture patterns are observed just inside the rim of the summit crater. Some fractures are roughly concentric with the crater, indicating that the topography has influenced their formation. Figure 1 shows an example from a cone near the center of the image. These fractures may be due to desiccation of the cone material, consistent with wet emplacement as in a mud volcanic origin or possibly volatile-rich pyroclastics. Although pingos (ice-cored mounds) have radial cracks, concentric cracks as observed here are rare [8] and dense polygonal cracks are not expected. Additionally, the radial cracks form by extension during pingo growth, and should intersect at the summit rather than forming on the rim of a preexisting crater.

Hephaestus Fossae: Small (~few hundred meter) scale cratered cones were noted in Viking images of the Hephaestus Fossae region [9]. These were suggested to be cinder cones or rootless cones, and have been little studied since then. MOC NA coverage in this area is relatively sparse. HiRISE image PSP-001462-2015 (21.3°N, 123.3°E) covers several cones at high resolution.

The cones are positive-relief, with the floors of the summit craters above the surrounding terrain where preserved. Most are degraded, but the largest appears relatively fresh and distinct (Fig. 2). The cone material is different than that of the the plains; impact craters on the plains have many boulders visible at the rim, while the cones appear smooth. Light-toned material occurs near the rim of the cone.

The high crater/cone diameter ratio (~0.65) of the largest cone suggests a highly explosive origin, inconsistent with mud volcanism or spring deposits. Nearby cones form a kinked linear ridge (Fig. 3), an unlikely configuration for pedestal craters. This supports a volcanic origin (cinder cone or tuff cone); the cones are larger than rootless cones elsewhere on Mars [10] and the surface on which they sit is not fresh lava. The absence of boulders indicates a lack of bombs or large clasts, and suggests that the cone material is not strongly consolidated. Unlike terrestrial cinder cones, the cones are not associated with coeval lava flows.

Future Work: Additional HiRISE observations of these and other cratered cone groups will be made in order to look for additional fine-scale details. This can provide useful information about formation mechanisms as in the examples discussed here, in order to better constrain cone origin. Analysis of the cone heights and slopes from the stereopair already obtained over Hephaestus Fossae and additional stereo coverage elsewhere will also provide useful information about formation processes.

References: [1] McEwen A. S. et al. (2007) *JGR*, in press. [2] Wood C. A. (1979) *Proc. LPS 10*, 2815-2840. [3] Frey H. et al. (1979) *JGR 84*, 8075-8086. [4] Judson S. and Rossbacher L. (1979) *NASA Tech. Memo 80339*, 229-231 [5] Tanaka K. L. (1997) *JGR 102*, 4131-4149. [6] Crumpler L. S. (2003) *Sixth Int. Mars Conf.*, Abstract #3228. [7] Farrand W. H. et al. (2005) *JGR 110*. [8] Mackay J. R. (1998) *Geogr. Phys. Quat.* 52, 271-323. [9] Hodges C. A. and Moore H. J. (1994) *U. S. Geological Survey Prof. Paper 1534*. [10] Lanagan P. D. et al. (2001) *GRL 28*, 2365-2367.

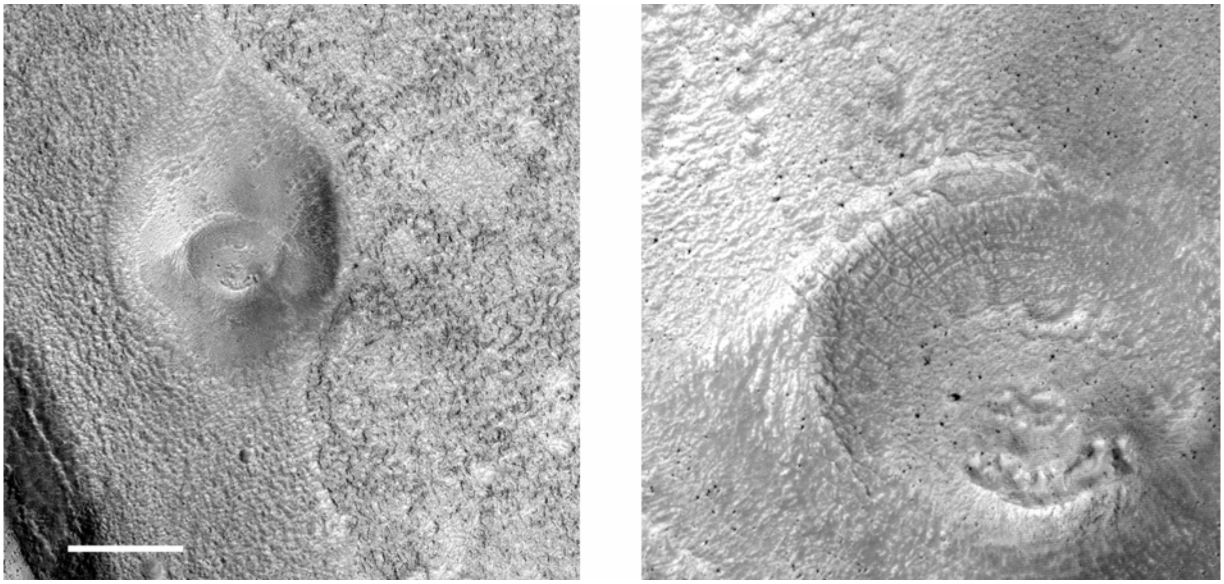

Figure 1: Cratered cone from PSP-001810-2175. Full-resolution subsection (right) shows cracks near cone rim. Scale bar 200 m, illumination from the left; the full-resolution portion is 25 cm/pixel.

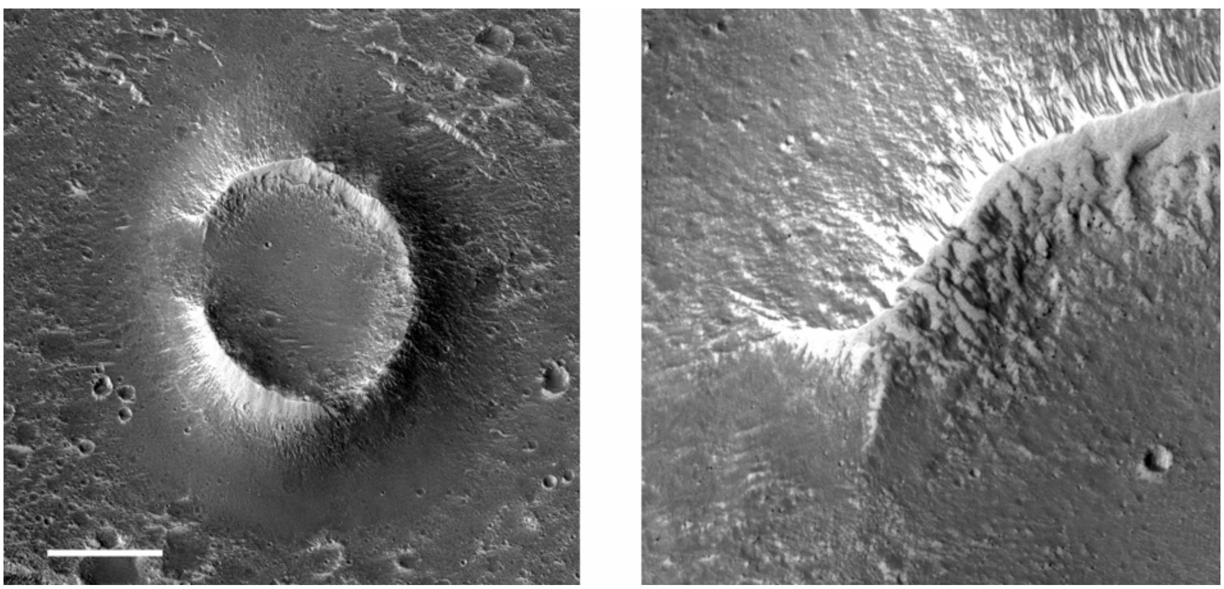

Figure 2: Cratered cone from PSP-001462-2015 at reduced resolution (left) and full resolution showing part of the rim. Scale bar 200 m, illumination from the left; the full-resolution portion is 25 cm/pixel.

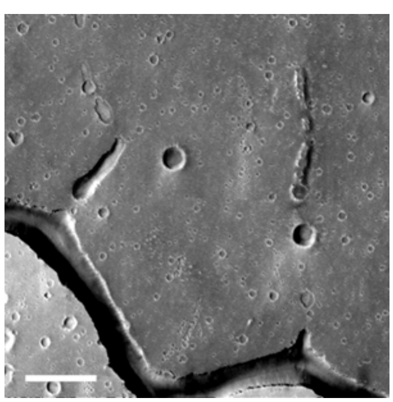

Figure 3: Section of THEMIS image V01968003 showing a kinked chain of cratered cones. This may be explained by volcanic eruption along a fissure, but is an unlikely configuration for pedestal craters. Scale bar is 2 km, illumination from the left.