HIGH-RESOLUTION IMAGING OF CERAUNIUS THOLUS, MARS. M.A. Caplinger, Malin Space Science Systems, P.O. Box 910148, San Diego, CA 92191.

Introduction: High spatial resolution images from the Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) of the fresh channels of the small Tharsis volcano Ceraunius Tholus strongly support a collapse rather than fluvial origin for these features. The summit caldera appears to be unique among martian volcanoes, with a large areal density of pit-like features. The flanks, base, and surrounding plains of the construct are heavily mantled, with a distinct rough-to-smooth textural change from summit to base. The mantle retains large numbers of small, fresh craters, only some of which are unambiguously secondaries. As is common in MOC meter-scale images, the mantle obscures both age relationships and processes.

Background: Since it was first imaged by Mariner 9, Ceraunius Tholus has been a subject of study, in part because of its straightforward yet intriguing sequence of formation: the construct itself, the elliptical impact crater Rahe, and a large channel connecting the summit and Rahe. Most researchers have focused on the mechanism that formed the channel, which has been suggested to be fluvial [1], lava tube collapse [2], volcanic density flows [3], or some combination of these [4, 5]. These investigations were hampered, however, by the poor resolution of most of the available Mariner 9 and Viking images. For this reason, an extensive imaging effort was carried out by the MOC team. During the first 18 months of the MGS mapping mission, 23 Narrow Angle images were acquired, covering about 12% of Ceraunius Tholus. Image resolution ranges from 1.4 to 12 meters/pixel. Most of the features of the construct were imaged, including the summit caldera, the major channel on the north flank of the construct (including the collapse zone at its head), the major channel on the west flank, portions of the floor of Rahe, and the channel-Rahe contact. In addition, two south-north traverses of the entire construct have been acquired (Fig. 1).

Observations: The northern half of the floor of the caldera contains several hundred circular features ranging from ~50 to ~350 meters in diameter (Fig. 2). Their state of degradation is variable, but the freshest appear to have conical cross-sections, and the majority show no evidence of raised rims. While they may be impact craters, a non-impact mechanism, such as the evolution of volatiles from fluid lava, may be involved. The caldera floor is globally flat and "grainy" in texture, but there are extensive raised areas, ~5 km in smaller dimension, and showing about 40 meters of relief in MOLA data, on which are superposed a lower density of pits. The morphology of the caldera floor appears to be unique among the martian volcanoes.

The majority of medium-sized (100-500 meter) impact craters seen on the flanks are almost completely buried by a rough-textured mantle. The mantling changes about two-thirds down the northern flank from rough and highly textured to very smooth, and continues in this form into the deposits in Rahe and beyond onto its ejecta. The smooth mantling retains large numbers of small, fresh-appearing craters, while infilling larger ones. The change in textural character with elevation is less pronounced on the south flank.

The majority of the visible channel morphology supports collapse rather than fluid flow as the mechanism of formation. The arcuate and in many cases interdigitate bends (Fig. 3), with no evidence of a central channel, essentially precludes formation by fluid flow. The only feature suggestive of channelized flow is a bank at the edge of the large channel near its base (Fig. 4). Collapse is further evident in the chaotic region just north of the caldera, where one channel is theater-headed, and no channel cuts through the caldera wall to the caldera itself.

In and near the lower portion of the channel, impact craters with equant streamlined "tails" are observed (Fig. 5). Similar though less distinct forms are seen elsewhere on the flanks (pointing generally downslope), as is yardang-like surface texturing. These features are similar to those described in [6] and are suggestive of aeolian stripping of the surface mantle.

The deposit within Rahe at the base of the large channel is flat and retains an approximately 14-degree slope at its northern edge; the edge's height is about 300 meters, or roughly one-third the depth of Rahe (Fig. 6). The eastern floor of Rahe is less smoothly mantled and exhibits relief suggestive of lava flows. The fluidized ejecta from Rahe on the volcano's flanks, while indistinct, can be seen to have partially filled preexisting craters and flowed around others. A highly-degraded channel can be seen to terminate in the ejecta.

Dark streaks, interpreted as dust avalanches [7] are seen on the northern rim wall of the caldera, on slopes within the fresher channels, and on the slopes within Rahe. Similar streaking is seen on flat regions on the Rahe ejecta to the north of the crater.

References: [1] Sharp R. and Malin M. (1975) *GSA Bull*, **86**, 593-609. [2] Carr M. (1974) *Icarus* **22**, 32-43. [3] Reimers C. and Komar P. (1979) *Icarus* **39**, 88-110. [4] Baker V. and Gulick V. (1990) *JGR*

95, 14325-14344. [5] Plescia J. (2000) *Icarus* **143**, 376-396. [6] Malin M. and Edgett K. (2000) *LPSC XXXI*, 1072. [7] Sullivan R. et al (1999) *LPSC XXX*, 1809.

Figure 1: Mosaic of MOC images FHA-01281, M03-04194, M04-01565, M07-04049, M08-06047, M09-05076, M13-00910, M15-00350, M16-00055, M18-00034, and M19-00701, overlain on Viking image 516A24.
Figure 2: Subframe of M16-00055, 4.2 m/pxl.
Figure 3: Subframe of M07-04049, 4.2 m/pxl.
Figures 4,5,6: Subframes of M04-01565, 4.2 m/pxl.