OBSERVATIONS OF IONIAN MOUNTAINS. E.P. Turtle[1], L.P. Keszthelyi[1], A.S. McEwen[1], M. Milazzo[1], D.P. Simonelli[2], and the Galileo SSI Team, [1]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721-0092; turtle@lpl.arizona.edu, [2]Cornell University, Ithaca, NY 14853.

Introduction: Of major interest during Galileo's series of close encounters with Io are the curious Ionian mountains. Carr *et al.* [1] have tabulated ~100 mountains and plateaus on Io, many of which have been determined from shadow measurements or stereo photogrammetry to be several kilometers high. The highest mountain measured to date is Boosaule Montes, which is 16 ± 2 km tall [2]. Although Io is the most volcanically active body in the solar system, its mountains do not appear to be volcanoes. Instead, they often resemble tilted blocks bounded by steep scarps, prompting Schenk and Bulmer [2] to suggest that the mountains are formed by thrust faulting due to the subsidence caused by Io's high global resurfacing rate. In many cases mountains appear to be fractured. Despite their likely tectonic origins there is no obvious global tectonic pattern in their distribution. To first order, mountains appear to be evenly distributed over Io, although there may be some variation with longitude [3].

Observations: On both 11 October and 26 November 1999 (orbits I24 and I25, respectively) the Galileo spacecraft passed within several hundred kilometers of Io's surface and acquired images of Ionian mountains at a resolutions ranging from 9 m/pixel to 1.5 km/pixel. These images were expected to help answer the question of how Ionian mountains are formed; however, more evident in the images are the processes by which the mountains deteriorate.

Figure 1 shows images of four Ionian mountains taken during orbit I24 at resolutions of about 500 m/pixel. The images appear to illustrate the deterioration of Ionian mountains from angular peaks and scarps on the left to broad plateaus surrounded by debris aprons on the right. From shadow measurements the mountain in the upper left image is ~9.8 km high. The one in the middle (4.6 km high [1]) appears to be in the process of collapsing outwards in large landslides.

The heights of the steep scarps require that these mountains be composed of a material stronger than sulfur [4]. Thick, extensive layers of sulfurous material, presumably pyroclastic in origin, may provide zones of weakness during landslides [2]. However, kilometer-scale layering is not evident in these mountains. Indeed, the highest resolution image (9 m/pixel) hints at layering only at the scale of ~10 m.

Most of Io's mountains exhibit ridges parallel to their margins, indicative of material moving downslope due to gravity (see Moore *et al.*, 2000 [5] for a more detailed discussion). However, there are some mountains and plateaus that have smooth tops and which are bounded by steep, arcuate scarps. For example, Figure 2 shows an image of a very smooth plateau ~1 km high, taken during orbit I25 at a resolution of ~200 m/pixel. At this time it is not clear whether these morphologic differences are due to local variations in material properties, thermal environment, or simply age. The low height of the plateau in Figure 2 does not rule out the possibility that it is dominantly composed of sulfurous material. One explanation for the morphology of its scarps is that they are formed by sapping as liquified SO_2 seeps out at the base. The SO_2 might be able to carry fine-grained sulfur and silicate particles away as it vaporizes into the Ionian "atmosphere". This is discussed in more detail in [5].

In many cases calderas abut mountains (this is the case for three of the four mountains shown in Figure 1) suggesting a possible relationship between them [6]. In these cases, despite pervasive collapse features along the margins of mountains, the caldera walls and floors show little or no evidence of mountain material collapsing into them, indicating that they are younger than the mountains.

Future Plans: Another close flyby of Io is planned for 22 February 2000 (I27). During this encounter Galileo will acquire images of a number of mountains along the terminator at resolutions of ~350 m/pixel. In addition, an observation of Tohil Mons at 165 m/pixel is planned which, when combined with an observation made during I24, will provide stereo coverage of the mountain complex. Lower resolution (1.5 km/pixel) stereo of much of the anti-Jupiter hemisphere of Io will also be possible by combining images taken of Io in July and October 1999 (orbits C21 and I24, respectively).

References: [1] Carr M.H. *et al.* (1998) *Icarus 135*, 146 - 165. [2] Schenk P.M. and Bulmer M.H. (1998) *Science 279* 1514-1517. [3] Schenk P.M. and Hargitai H. (1998) *BAAS 30*, 1121. [4] Clow G.D. and Carr M.H. (1980) *Icarus 44*, 268-279. [5] Moore J.M. *et al.* (2000) *LPSC XXXI*. [6] Turtle E.P. *et al.* (2000) *LPSC XXXI*.

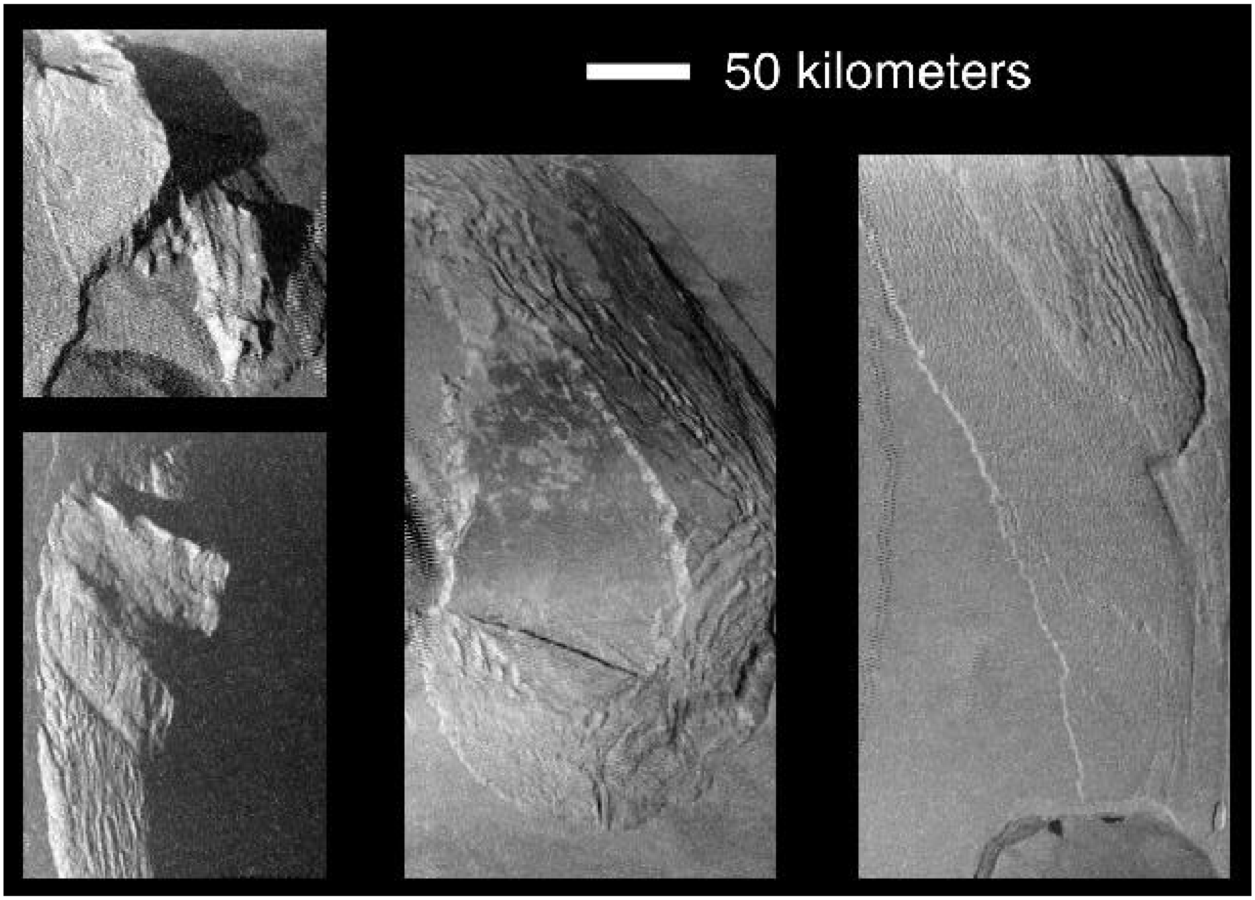

Figure 1: Four examples of Ionian mountains from Galileo images taken on 11 October 1999 during orbit I24. Each image has a resolution of about 500 m/pixel and the sun illuminates the surface from the left in all four images.

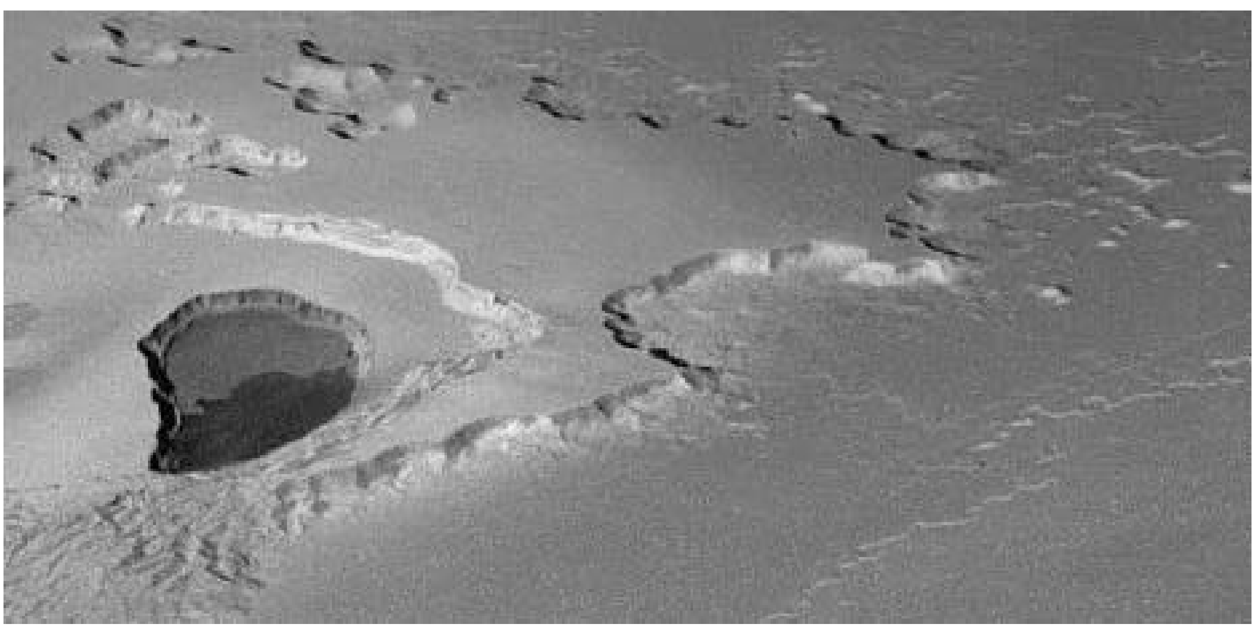

Figure 2: Galileo image of an extensive plateau taken on 26 November 1999 during orbit I25. This image has a resolution of ~200 m/pixel and the sun is illuminating the surface from the lower left. The image is ~150 km across.