**GEOLOGY OF URANIUS THOLUS, MARS.** J. B. Plescia, U. S. Geological Survey, 2255 N. Gemini Drive, Flagstaff, AZ 86001.

The Uranius group of volcanoes in the northeast part of Tharsis includes Uranius Patera, Uranius Tholus, and Ceraunius Tholus; these are among the smaller and older tholi and paterae. Analysis of these constructs is important for understanding the nature and style of early volcanism in Tharsis. Previous studies have considered these volcanoes only in a general manner **(1, 2)**. Here the geology of Uranius Tholus is presented; Ceraunius Tholus and Uranius Patera are described elsewhere **(3)**.

Uranius Tholus (Table 1) is the smallest and most poorly imaged construct of the Uranius group, making geologic analysis difficult. The flanks are characterized by troughs and several large craters; the summit region by a caldera complex.

**Table 1. Morphometric Parameters**

| | |
|---|---|
| Location | 26.37° N 97.25° W |
| Construct Dimensions | 60 x 56 km |
| Construct Relief [a] | 4 km |
| Flank Slope | 6 - 12° |
| Construct Volume | 3 x $10^3$ $km^3$ |
| Caldera Diameter | 22 x 19 km |
| Construction Time [b] | 27,000 yr. |

[a] Relative to surrounding plains.
[b] Assumes effusion rate of 0.11 $km^3$ $yr^{-1}$.

The flanks are characterized by a hummocky texture, a subtle radial pattern and a series of radial troughs extending down the slope. Well-defined troughs are concentrated on the north slope with others on the southwest and northeast slopes. Several rimless depressions occur on the flanks, some of which are associated with the troughs. Distinct lava flows and circumferential faults are not observed. However, in several locations linear ridges are observed, suggesting unresolved flows. The morphology of the southern flank suggests it is covered with flows extending from the caldera to the base of the construct. The construct appears embayed by surrounding younger plains.

A considerable fraction of the western and eastern flanks are buried by ejecta from two large (13 and 9.6 km) craters. An 8 km crater on the northern flank does not have ejecta, indicating that it is older than the present flank surface. A 13.4 km crater along the northern margin of the construct is clearly buried by younger plains and flank units, although some ejecta can be traced a short distance onto the northern flank.

Numerous closed depressions occur on the flank; they appear rimless and are interpreted to be collapse features. In several cases troughs occur down slope from the depressions, but the troughs are not physically connected to the depressions at the surface.

Several troughs are clearly observed on the flank and additional unresolved troughs are suggested by the flank texture. Most troughs begin just below the caldera rim; none breach the rim. The heads of some troughs are marked by a wider, shallow depression; others by simple theater-headed end. Troughs are 600 - 1200 m wide. The southern side of the flank lacks obvious troughs and has a texture suggesting the flank is covered with lava flows.

The summit region is defined by a large caldera that forms a level plateau and a smaller inset caldera offset to the east from the center. The larger caldera is marked along its northern and northeastern margin by a scarp, by a narrow ridge on the northwest margin, and only by a change in slope along the southern margin. It appears that lavas filled the caldera and overtopped the southern edge and flowed down the flanks. The smaller, younger caldera is inset into the summit plateau and exhibits scalloped margins.

The origin of the troughs on Uranius Tholus is unclear. They may have a fluvial origin as interpreted for Ceraunius Tholus **(3, 4)**. However, troughs on Uranius Tholus have morphologic differences; they are associated with collapse pits and several begin lower on the flanks. It is possible that sapping played a larger role in their development and that sapping produced the collapse areas. Alternatively, the troughs and pits may be entirely volcanic in origin: the pits being typical volcanic collapse pits and the troughs lava channels or collapsed tubes.

Crater counts for the flank (Table 2) have considerable statistical uncertainty due to limited area (2350 $km^2$) and low number of craters ($n$ = 17). Table 2 lists entries for the flank counts in two columns: “Total” includes all craters and the total counting area; “Edited” eliminates the large craters on the west and north flank and uses a correspondingly smaller area. The rationale for excluding the western crater is that its center and excavated volume actually lie off the construct and if not for the ejecta blanket extending onto the flank would not be considered associated with the construct. The northern crater is clearly not superposed on the flank sur-

face and its stratigraphic position is unclear.

Both sets of counts indicate a high crater frequency and, at face value, indicate a Noachian age (assuming the chronology of **(5)**). However, the two largest craters clearly post-date the surrounding plains (N(1) 1800 ± 130), which are Late Hesperian in age; further the preservation state of these large craters is not consistent with a Noachian age (vis-à-vis the cratered highlands). This suggests that Uranius Tholus is not Noachian in age and that counting statistics are a significant factor. On the basis of the counts for the other constructs and thermal arguments, the age is interpreted to be Late Hesperian.

A Late Hesperian age for Uranius Tholus differs from the interpretation of **(6)**, who suggests that Uranius Tholus is the oldest martian volcano dating to the period of heavy bombardment and formation of the intercrater plains. The Late Hesperian age of the surrounding plains differs from that of **(1)**, who suggests an Amazonian age.

**Table 2. Flank Crater Counts**

| Diameter | Total | Edited |
|---|---|---|
| N (1) | 5107 ± 1474 | 4705 ± 1488 |
| N (2) | 2128 ± 952 | 1412 ± 815 |
| N (5) | 1915 ± 902 | 1176 ± 740 |
| N (10) | 1227 ± 721 | |

where N (d) is the number of craters $\geq$ d / $10^6$ $km^2$.

The geologic history of Uranius Tholus is interpreted to be a central vent volcano built by numerous lava flows largely erupted from the summit region. The presence of troughs across much of the flank suggest that the uppermost surface is mantled and easily eroded, similar to Ceraunius Tholus **(3)** and Hecates Tholus **(7)**. Presumably the mantling material is composed of basaltic pyroclastic material that originally blanketed the entire construct.

The earliest phases of volcanism in Tharsis appear to be characterized by the development of small volcanic constructs having basaltic shield characteristics and minor pyroclastic volcanism. These constructs were active for only short periods of time and may represent areas of higher effusion or higher viscosity eruptions within a broader volcanic province largely characterized by fissure-fed plains-forming eruptions. This style of early constructional volcanism was then followed by the major shield building volcanism in central Tharsis. The change in style may reflect a change in the stress system or source depths. Early volcanism may have been areally extensive because the stress system permitted long regional fractures capable of producing fissure eruptions; younger stresses may not have been conducive to such eruptions. The difference in volume between the smaller constructs in northeast and western Tharsis compared with the Tharsis Montes shields may reflect either a larger, longer lived source region or one of deeper depth allowing for greater pressure to build the taller Tharsis Montes constructs.

References: **(1)** Carr, M. 1975. U. S. G. S. Map I-893. Hodges, C., and H. Moore 1994. U. S. G. S. Professional Paper 1534, 194 pp. Scott, D., *et al*., 1981. U. S. G. S. Map I-1266. **(2)** Scott, D., and K. Tanaka 1986. U. S. G. S. Map I-1802A. **(3)** Plescia, J. 1998, Geology of Ceraunius Tholus, This Volume. Plescia, J. 1998, Geology of Uranius Patera, This Volume. **(4)** Gulick, V. C., and V. R. Baker 1990. *JGR* **95**, 14,325-14,344. **(5)** Tanaka K., *et al*. 1992, Global Stratigraphy, *in* Mars, p. 345-382. **(6)** Barlow, N. 1988. *Icarus* **75**, 285-305; Landheim, R. and N. Barlow 1991. Abstracts Lunar Planet. Sci. Conf. 22, 775-776. **(7)** Mouginis-Mark, P., *et al*. 1982. *JGR* **87**, 9890-9904.