GEOLOGY OF URANIUS PATERA, 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 to understand the nature and style of early volcanism in Tharsis. These constructs also exhibit evidence for pyroclastic volcanism, hence they illuminate the extent to which pyroclastic volcanism occurs in the northern hemisphere and in Tharsis in particular. Previous studies have considered these volcanoes only in a general manner **(1, 2)**. Here the geology of Uranius Patera is presented; Ceraunius Tholus and Uranius Tholus are described elsewhere **(3)**.

Uranius Patera (Table 1) is characterized by a flank composed of radial lava flows with several low shields and impact craters, a large caldera elongate to the northeast with scalloped margins, and minor caldera concentric faults. The surrounding smooth plains are part of the Amazonian Tharsis Montes Formation. Faulted plains and fractured terrane of Hesperian and Noachian age occur on the east flank of the volcano **(2)**.

Table 1. Morphometric Parameters

Location	27° N 93°W
Construct Dimensions	275 x 240 km
Relief [a]	2 km
Flank Slope	<1 - 7°
Volume	4.5×10^4 km^3
Caldera Dimensions	57 x 43 km
Caldera Depth [b]	0.5 - 2.0 km
Construction Time [c]	410,000 yr.

[a] Relative to surrounding plains.
[b] Depth relative to adjacent flank.
[c] Assumes effusion rate 0.11 km^3 yr^{-1}.

The flank is characterized by radial texture; impact craters, some of which have well-defined ejecta deposits; low shields; and several faults and lineaments. A few poorly resolved troughs and pits also occur. Overall the morphology of the construct is similar to the other shield volcanoes in Tharsis, particularly Biblis Patera **(4)**. The radial texture of the flank, with respect to the caldera location, is observed in most locations to be the result of linear lava flows. Flows are tabular and lack observable channels or collapsed tube systems. In four locations on the flank along caldera-concentric faults, circular, relatively smooth surfaces, 6-10 km across, containing a central pit occur; these features are interpreted to be low shields, similar to Mauna Ulu in Hawaii **(5)**, localized by the faults.

The caldera of Uranius Patera is divided into four units: caldera wall, smooth caldera floor, ridged caldera floor, and slump material. Overall, the caldera is ~90 by 65 km with the long axis oriented northeast; it is a complex structure having a scalloped margin and several wrinkle ridges. The dimensions are similar to those of the Biblis Patera caldera and some of the larger individual calderas on Olympus Mons. The caldera floor is smoother than the flank, indicating that pieces of the flank down-dropped into the caldera have been resurfaced. At least nine major arcuate sections of the wall are observed, with a few additional minor sections either perched along the margins or occurring as tilted blocks on the caldera floor. The scalloped margin and various radii of curvature suggest multiple episodes of caldera formation and coalescence with individual caldera being smaller and of various shapes.

Faults, fractures and lineaments on the flank have two trends; circumferential about the caldera and northeast-trending. Caldera-concentric fractures, as on Uranius Patera, have been suggested to be the result of extensional stresses due to loading by the volcanic pile and associated lithospheric flexure **(6)**; the northeast-trending faults are associated with the regional tectonic pattern of northeast Tharsis. Concentric fractures -- narrow graben or unresolved lineaments -- occur from just beyond the caldera rim to the lower northwest and eastern flanks. Those near the summit are 20 - 45 km long; those on the northern flank are 10 - 25 km long. A few subtle features also having an approximately concentric trend occur at about 60 km from the caldera edge. Widths, where resolved, are 500 - 750 m (2-3 pixels). Lengths are probably lower limits as many appear to be locally buried by younger flows. Faulting on the flanks is minor, particularly in respect to the level observed on some of large Tharsis shields (e.g., Arsia Mons) **(7)** or on Biblis Patera **(4)**. The minimal faulting suggests that the strength of the lithosphere was only marginally exceeded by the load of Uranius Patera.

Crater counts for the flank and caldera floor of Uranius Patera (Table 2) indicate an Hesperian age, assuming the chronology of **(8)**. Counts suggest that the caldera is older than the flank, but statistically, the two ages are not distinguishable.

Table 2. Crater Frequencies

Diameter	Flank	Caldera
N (1)	3275±328	2538±655
N (2)	740±155	1156±441
N (5)	212±83	247±198
N (10)	74±49	

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

All of the Uranius group constructs are interpreted to date to the Late Hesperian and define the earliest phase of basaltic shield constructional volcanism on Mars. All three were built largely by effusive eruptions of low viscosity lavas, presumably basaltic. Uranius Patera either did not experience pyroclastic volcanism as occurred on Ceraunius Tholus and Uranius Tholus **(3)** or it was buried by later effusive eruptions. Plausible eruption rates suggest that Uranius Patera could have been built in a relatively short period of time, of the order 10^5 years. Volcanic activity at Uranius Patera was contemporaneous with that of small volcanoes in western Tharsis and coeval with plains volcanism in southern Tharsis, Syria and Sinai.

The earliest phases of volcanism in the Tharsis region appear to be characterized by the development of small volcanic constructs having basaltic shield characteristics and minor pyroclastic volcanism. The Uranius Group constructs were active for only short periods of time (individual constructs could be built over periods of only 10^4 - 10^5 years) and may represent areas of higher effusion or higher viscosity eruptions within a broader volcanic province largely characterized by high effusion, fissure-fed, plains-forming eruptions. This style of early constructional volcanism was then followed by the major shield building volcanism in central and northern 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. Prof. Paper 1534, 194 pp. Reimers, C., and P. Komar 1979. *Icarus* **39**, 88-110. 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, Mars. This Volume. Plescia, J., 1998, Geology of Uranius Tholus, Mars. This Volume. **(4)** Plescia, J. 1994. *Icarus* **111**, 246-269. **(5)** Tilling, R., *et al.* U. S. G. S. Prof. Paper 1350, p. 405-469. **(6)** Comer, R., et al. 1985. *Rev. Geophys*. **23**, 61-92. **(7)** Crumpler, L., and J. Aubele 1978. *Icarus* **34**, 496-511. **(8)** Tanaka, K. 1992, Global Stratigraphy, *in* Mars, p. 345-382.