GEOLOGIC MAPS OF THE OLYMPUS MONS REGION OF MARS

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INTRODUCTION

Olympus Mons is one of the broadest volcanoes and certainly the tallest in the Solar System. It has been extensively described and analyzed in scientific publications and frequently noted in the popular and nontechnical literature of Mars. However, the first name given to the feature—Nix Olympica (Schiaparelli, 1879)—was based on its albedo, not its size, because early telescopic observations of Mars revealed only albedo features and not topography (Inge and others, 1971). After Mariner 9 images acquired in 1971 showed that this albedo feature coincides with a giant shield volcano (McCauley and others, 1972), the name Olympus Mons was adopted for the shield to distinguish it from the albedo feature.

Olympus Mons is one of the most photographed features on the planet. The Mariner 9 spacecraft obtained 126 images of Olympus Mons with resolutions of 60 m/pixel to 2.5 km/pixel. Later, the two Viking orbiters greatly enlarged this dataset, acquiring more than 2,150 images of the Olympus Mons region at various resolutions and altitudes; 925 images have resolutions of better than 50 m/pixel. More than 150 of the Viking images provide stereoscopic coverage of the shield region (Blasius and others, 1982).

The Mariner 9 images formed the basis for the first formal geologic mapping of Olympus Mons at 1:5,000,000 scale (as part of a series of 30 quadrangles that cover the planet). Olympus Mons is included on two maps in this series (Carr, 1975; Morris and Dwornik, 1978) because of the locations of quadrangle boundaries. Viking-based 1:2,000,000-scale maps of the Tharsis region (Scott and others, 1981) that highlight lava-flow fronts also include Olympus Mons; important features of the Tharsis region are shown in figure 1 (sheet 2). More recently, the Olympus Rupes and vicinity in the southeastern part of the map area were mapped by Morris and others (1991); their map differs in detail from the current maps because of differences in interpretation. Global maps of Mars (Scott and Carr, 1978; Scott and Tanaka, 1986) place the volcano within a broader context. Finally, a special Transverse Mercator photomosaic base (fig. 2) was prepared by the U.S. Geological Survey (1981) for geologic mapping of Olympus Mons at 1:2,000,000 scale. A reduced, 1:3,000,000-scale version of this photomosaic served as the base for an informal geologic map produced as part of a thesis dissertation (Tanaka, 1983).

Our map (sheet 1) is the first formal geologic map focused on the Olympus Mons region. After compilation of this map was well underway, a 1:1,000,000-scale special topographic map of the shield area of the volcano (unpublished) was constructed from stereoscopic image pairs by using conventional photogrammetric techniques and analytical stereoplotters (see Wu and others, 1981). We were able to use this base for detailed mapping of the shield (sheet 2). The topographic map permits measurements of relief valuable in determining such factors as volcano volume, structural offsets, and lava-flow rheology. Except for the difference in extent of the areas mapped, the topographic information, the cartographic control (latitudes and longitudes of features may differ by as much as a few tenths of a degree), and the greater detail permitted by the larger scale base, the two maps are virtually the same. A comparison of our map units with those of other Viking-based maps is given in table 1.

Unraveling the geology of the Olympus Mons region is not limited to a simple exercise in stratigraphy. Complex and difficult problems arise from the unresolved origin of major geologic features that include the aureoles, the basal scarp, and the annular depression on the south and east flanks. However, our mapping does provide stratigraphic and structural evidence that assists in solving these geologic problems.

Table 1. *Comparison of map units of this and previous maps of Olympus Mons region*

This map	Scott and Tanaka (1986)	Tanaka (1983)	Scott and others (1981)
Aar, Aah, Aab, Aas	As	As	As
Amr	Ae, Amm, Amu	Aal, Aeu	Aeu
Ams	Ae, Amm, Amu	Aal, Aeu	Aeu
Amp	Ae, Amu	Aeu	Aeu
Aa_3	Aa_3	Aap_2, Apu	Aps
Aa_1	Aa_1	Aap_1	$AHoa_1$
Aoc_{1-4}	Aos	Aom_2	Aom_2
Aop	Aop	Aop, Avop	Aop
Aos_{1-4}	Aos	Aom_2	Aom_2
Aoau	Aoa_4	$AHoa_4$	Aau_4
$Aoam_a$	$Aoa_{3,4}$	$AHoa_{3,4}$	$AHoa_{3,5}$
$Aoam_b$	$Aoa_{1,3}$	$AHoa_{1,2c}$	$AHoa_{2,3}$
$Aoam_c$	Aoa_3	$AHoa_{2c}$	$AHoa_3$
$Aoam_d$	Aoa_2	$AHoa_{2b}$	$AHoa_2$
$Aoam_e$	Aoa_2	$AHoa_{2a}$	$AHoa_2$
Aoal	$Aoa_{1,2}$	$AHoa_{1,2d}$	$AHoa_2$
AHosc, HNosc	Hf	Aom_1	Aom_1, HNht
Atm, AHtm	At_4, AHt_3	Atm	Atm, Aam_3
Acf	AHcf	AHac	Acf
Aam	Aam	AHac	Aap_3
Hal	Hal	AHac	$AHap_2$
Hhf, Hhp, Hhh	v	HNvu	$AHap_1$
Hf	Hf	HNpf	HNht
Nap	Npl_2	HNpr	$AHap_1$
Nam	v	HNvu	HNht
Naf	Nf	Naf	HNht