GEOLOGY OF THE OLYMPUS MONS REGION OF MARS, E.C. Morris, U.S. Geological Survey, Flagstaff, AZ 86001

The Olympus Mons region encompasses an area on Mars of more than 3 million square kilometers between lat 5° and 40° N. and long 125° and 150°. The region lies on the northwest flank of the Tharsis-Syria upland. The huge shield volcano Olympus Mons is the largest volcanic structure on Mars; it and its extensive aureole deposits cover over three fourths of the map area. West of Olympus Mons are the low, featureless plains of Amazonis Planitia, which descend northward into the circumpolar lowlands (Arcadia Planitia, Vastitas Borealis). Northeastward, the terrain rises toward the old shield volcano, Alba Patera. Surrounding Olympus Mons is a ring of plains 100 to 200 km wide that appear almost featureless in low to moderate resolution pictures. Beyond the plains is an aureole of grooved terrain that is asymmetric to Olympus Mons, extending more than 700 km northwest of the volcano but only 300 km southeast. Southwestward, of Olympus Mons and its aureole are the rolling plains of the Memnonia area that lap upon densely cratered terrain. Southeast the terrain rises towards the three large shield volcanos of the Tharsis Montes.

The geologic events recorded in the rocks exposed in the region represent a major portion of Martian time--over 3.5 billion years. The earliest history is recorded in the basement rocks, which form densely cratered, highly fractured terrains. These rocks underlie voluminous outpourings of lava that originated from Olympus Mons, the three large Tharsis shield volcanos, and Alba Patera. Nine periods of volcanic activity in the Tharsis-Olympus Mons region have been recognized [1]; Olympus Mons grew during the late stages. The youngest sequence of lava flows was emplaced a few hundred million years ago in the circumferential basin around Olympus Mons [2].

Most volcanism was effusive: broad flat sheet flows covered the plains and lower slopes of the volcanos, and channel and tube-fed flows formed on the steeper slopes [3]. Pyroclastic or explosive volcanism may have occurred early and late in the volcanic sequences. The aureole deposits may be the result of pyroclastic eruptions [4] early in the volcanic activity of the region, whereas the smooth, flat to gently rolling plains south of Olympus Mons, interpreted as ash-flow tuffs [5], were formed late in the dying phase of volcanic activity.

Several episodes of tectonism have occurred in the region. These episodes, expressed by fracturing and faulting, culminated before the bulk of the volcanic activity. Major faulting probably occurred during updoming of the Tharsis area 1.5 to 2.0 billion years ago [6]. This fracturing dominates most of the western hemisphere of Mars, and is seen in the Olympus Mons region as a system of fractures radial to the Tharsis area, in the densely faulted and fractured plains unit (Hpf) and to a lesser extent in the older Alba Patera flows. An earlier episode of fracturing, unrelated to the Tharsis activity, is evidenced in the ancient rocks of Acheron Fossae. Most craters are superimposed on the fractures indicating a very old (>3.5 billion years) episode of faulting.

The latest tectonic activity of the region formed the imposing scarp surrounding Olympus Mons 0.5 to 1.06 billion years ago. Many aspects of the scarp indicate a tectonic origin, possibly related to the adjustments of the Martian crust to the great mass of Olympus Mons.

REFERENCES

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