

VOLCANOTECTONIC PATTERNS ON THE SOUTHEAST FLANK OF ALBA PATERA
 C.D. Condit, U. Mass., Dept. Geology/Geography, Amherst, MA 01003

Alba Patera is the northernmost, and one of the oldest major volcanic centers associated with the Tharsis volcanic region [1-4], and is associated with a large array of grabens [5]. Understanding the volcanotectonic history of this feature offers the possibility to gain insights into both the early volcanic processes of Mars, and the complex tectonic history of the Tharsis region. This study focuses on these problems, examining the area within the 1:500,000 scale quadrangle MTM 35102, located on the southwest flank of Alba Patera.

Found in the southern part of the quadrangle, the Ceraunius Fossae Formation [4], is the oldest unit mapped (crater densities ≥ 2 km dia., $666/10^6$ km²), and is composed of lava plains, as expressed by diffuse, usually indistinct flow scarps.

The middle member of the Alba Patera Formation [4] dominates the northern two-thirds of the quadrangle, overlies the Ceraunius Fossae Formation, and has crater densities of $313/10^6$ km². Three types of materials have been recognized within this unit. The oldest material is interpreted as pyroclastic flow deposits and dominates the central and northwestern part of MTM 35102. The material has a grainy, mottled appearance with gently undulating topography, broken by indistinct flow boundaries with frayed or feather edges, and numerous digitate to dendritic channels. Recognition of this unit confirms the findings of Mouginis-Mark et al. [6], strengthening their suggestion that Alba Patera should be reinterpreted as a transitional volcano between the older pyroclastic dominated highland paterae and the more recent central vent volcanoes of the Tharsis Montes.

Interspersed with this pyroclastic flow material, and in some cases overlying it, the next younger unit occurs as smooth, broad oblate to slightly sinuous hills with moderate relief, a grainy texture and incipient linear patterns just at the limit of resolution. It is interpreted as pahoehoe flows. These pahoehoe flows overlie the lava flows of the Ceraunius Fossae Formation and are most common along the contact between the middle member of Alba Patera Formation the Ceraunius Fossae Formation in central and southwestern MTM 35102.

Lava flows overlie these pyroclastic and pahoehoe flows in many areas within the middle member of the Alba Patera Formation, and are most commonly found in the northeastern part of the quadrangle where, in some cases, they directly overlie the Ceraunius Fossae Formation. The flows occur as long (>170 km), narrow (10-20 km wide) tongues; most display flow scarps along their edges and distal ends. At their distal ends, near the contact of the middle member of the Alba Patera Formation and the Ceraunius Fossae Formation many flows appear to have ponded, with widths increasing to as much as 30 km. Photoclinometric measurements suggest individual flow thicknesses of about 50 m along narrow tongues, and as much as 100 m where ponding has occurred, with edge (flow scarp) slopes generally $<10^\circ$, averaging about 5° (P. A. Davis, pers. commun., 1987). Where stratigraphic

relations between individual flow lobes are most complete, as many as 10 overlapping lobes can be documented.

Grabens are the dominate tectonic feature of MTM 35102. Three graben sets have been distinguished based on strike, maximum width, associated features and relative age, the latter derived from intersection relations and offset patterns. Each set appears to have overlapping ranges of depth, to several hundred m, fault slopes of about 65° (P.A. Davis, pers. commun., 1987) and lengths exceeding quadrangle boundaries (>300 km). The oldest set is dominated by three large grabens, spaced about 120 km apart and striking about $N 30^{\circ} E$, with the middle of the three located in the center of the quadrangle. The floors share a unique feature to the graben sets: ubiquitous pit craters or pit-crater chains (catena). Six smaller grabens with the same trend, spaced from 10 to 50 km apart also share these pit crater features. The walls of these pit craters have slopes of about 30° (P. A. Davis, pers. commun., 1987), maximum widths of 10 km, and depths of about 2 km. This graben set has the maximum width (to 11 km) observed of the three sets. To the northeast, outside MTM 35012, these grabens display a continuing trend of about $N 30^{\circ} E$ which differs from the next two sets discussed. The last sets were separated based on differing trends (and age relations); the average trend of the intermediate age set is $N 28^{\circ} E$; that of third (youngest) set, which are concentrated in the western part of the area, is $N 08^{\circ} E$. No clear distinction in length, depth or width could be found between the second and third graben sets. Because all flows in the area are cut by grabens, no crater density data to constrain relative timing of faulting could be obtained.

The relationship of grabens to a regional tectonic picture suggests that catena-bearing grabens may be related to the Pavonis I faulting of Plescia and Saunders [7], and, given the distinctive pit-bearing feature may have deeper seated fractures. The relative youth of the $N 08^{\circ} E$ set argue they may be related to Pavonis II faulting, perhaps a reactivation of the Syria faulting [7] expressed in the Ceraunius Fossae directly south of Alba Patera. It appears likely the intermediate age ($N 28^{\circ} E$) set, which curve to a more northerly trend, cutting the catena-bearing grabens 200 km east of the summit calderas of Alba Patera, are of local origin, probably caused by stretching effects of a thin brittle skin as proposed by Wise [5].

References

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