CHANNELS ON ALBA PATERA, MARS: EVIDENCE FOR POLYGENIC ERUPTIONS;

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Our analysis of the U.S.G.S 1:500,000 maps and very high resolution (<10 m/pixel) Viking Orbiter images of Alba Patera has identified a large number of channel networks on the northern flanks of the volcano, approximately 600-800 km from the central calderas (Figs. 1, 2). Unlike channels attributed to tube-fed and tabular lava flows (1-3), these examples have morphologic characteristics suggestive of fluvial origin: 1) The channels have a branching, dendritic pattern similar to channel networks in the Southern Highlands (4,5). 2) No obvious vents, lava flow fronts or flow lobes are associated with these channels. Each channel network appears unbroken by subsequent channels. 3) Viking images (Fig.3) indicate that the channels are purely erosional in origin; no constructional features are visible along the sides of the channels (65° solar incidence angle). The inter-channel areas are morphologically bland, possessing a uniform lithology and no identifiable structure. 4) Several of these channels originate from canyons with amphitheater heads (Fig. 3) similar to channels interpreted to form by sapping (6). Inter-channel areas show no signs of erosion, arguing against a pluvial origin.

Thermal inertia data suggest a fine, unconsolidated material may exist on the flanks of Alba. Values for the plains west of the volcano are relatively uniform (1.4-1.5 x 10^{-3} cal cm^{-2} $s^{-1/2}$ K^{-1}), indicative of a particle size <30 micron for an ideal, uniformerly-sized particulate surface. The Alba Fossae fissures and fractures have values of about 1.0. Temperatures decrease almost parabolically toward and away from the Fossae so that the thermal inertia change is most pronounced closest to the fractures. While there is no compelling evidence that the thermal inertia variations are volcanic in origin, the parabolic shape of the variations is consistent with what might be expected as a result of mantling of the volcano flanks by a pyroclastic deposit that thins away from the vent. The most likely non-volcanic explanation would be elevation effects upon what is actually a uniform thermal inertia covering. Using the western plains for reference, the Alba Fossae would need to be about 4 km higher than indicated on the U.S.G.S. topographic map, and would imply a slope away from the Fossae both to the plains and the central caldera (inconsistent with preserved lava flow directions).

Implications for Volcano Evolution: Several intriguing implications are raised for the volcano's history, should the channels be water carved. As with the channels on Hecates Tholus (7), the Alba channels are more likely to be carved in friable ash deposits than in coherent lava flows. Unlike Hecates, however, well preserved lava flows also exist on Alba (8,9), making this the only martian volcano where evidence for both effusive and explosive activity is well preserved. Greeley and Spudis (2) hypothesized that Tyrrehnum Patera experienced considerable phreatomagmatic activity early in its history, but at Alba the volcanism evidently persisted for a sufficient time for deep-regolith or magmatic volatiles to be depleted, causing a transition from ash-producing eruptions (stage 1) to lava-producing (stage 2). Following the emplacement of the pyroclastic material, possibly contemporaneous with the eruption of lava flows or due to igneous intrusions, near-surface volatiles were released and carved the observed channels. Because of the relatively youthful age of the Alba flows (10), the inferred volatile release at this latitude (45 - 48°N) would be a further constraint on models describing regolith/atmosphere volatile exchanges and the relatively recent distribution of ground ice on Mars (11).

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ALBA PATERA ERUPTIONS

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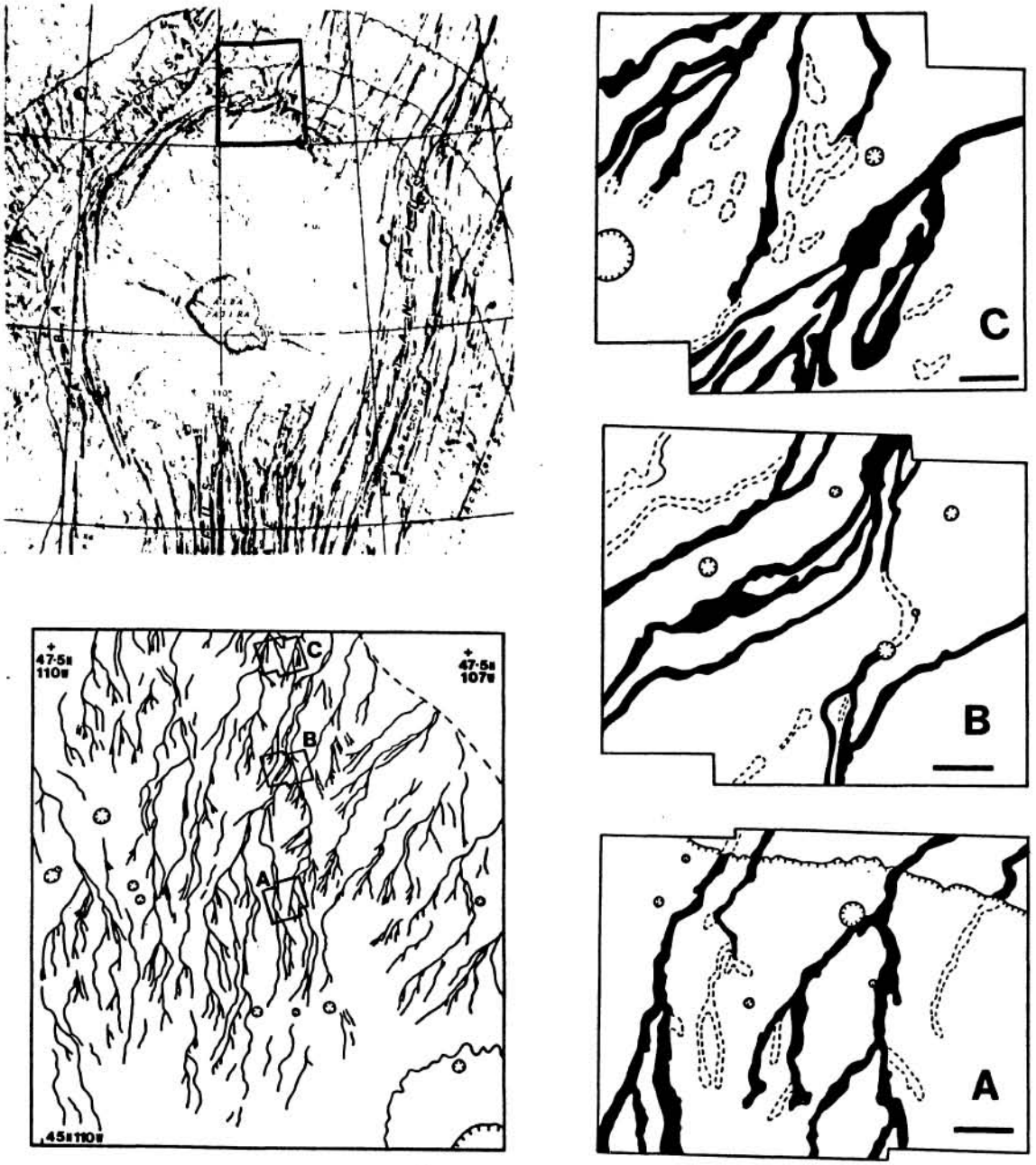

Fig.1 (Top left): Shaded relief map of Alba Patera (MC-3) showing the location of the study area, approximately 600-800 km north of the summit calderas. **Fig.2 (Bottom left):** Sketch map of the channels interpreted here to be of fluvial origin. Direction of flow is toward top of page. Outlined are the three subscenes presented in Fig.3. A 30 km diameter impact crater is at bottom right of this scene, while the dashed line denotes area of poor visibility due to clouds. Mapped from USGS photomosaic MTM 45107. **Fig.3 (Right):** Details of channel segments shown in Fig.2. Prominent channels are shown in solid black, degraded channels are outlined with dashed lines. Note the presence of several "collapse" depressions. In "A" a fault scarp is shown by hatched line (barbs on downthrown side). Scale bars are 2 km. Mapped from Viking frames 445B07/08 ("A"), 445B11/12 ("B") and 445B15/16 ("C").