INVERSION OF TOPOGRAPHY IN MARTIAN HIGHLANDS TERRAINS

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Mars displays a diverse physiography which reflects a complex history of surficial processes. Layered deposits and erosional landforms attest to a more varied set of geologic agents than the impact and volcanic processes that dominate other planetary bodies without atmospheres. One unique feature on Mars is the presence of "ring furrows" which are apparently produced by inversion of topography at the rims of partially buried craters.

Ring furrows are flat-floored trenches, circular in plan view, forming rings 7 to 50 km in diameter. The furrow is on the order of 0.5 km deep and 2 to 10 km wide, and it surrounds a flat topped circular mesa or plateau that is 5 to 50 km across. The central plateau is at the same elevation or lower than the surrounding plain outside the ring. A typical example of a ring furrow is found in the Syrtis Major Quadrangle (MC-13SW, Viking Orbiter frame 373S72) at 3-5°N; 308-310°W (Fig. 1-1).

Ring furrows typically occur in the highlands associated with cratered plateau materials. The cratered plateau materials are interpreted as ancient lava flows (1) overlying older cratered terrains. The thickness of the flows is quite variable but averages 800 m (2). Most of the rings are in or near regions of younger surface modification by channel dissection or on the edge of chaotic terrain (Fig. 1-2). The outer wall of many of the rings is breached by valley drainage (Fig. 1-3) or open to lower surfaces (Fig. 1-1).

The occurrence of several variations of seemingly similar landforms suggests that ring furrows are simply one form in a progression of forms. In some regions, circular segments of channels and arcuate channel patterns delineate incompletely isolated circular plateaus (Fig. 1-4 and Ref. 3). In other areas, isolated, smooth topped plateaus surrounded by degraded plains (Fig. 1-5) appear to represent an advanced stage of development.

The circular nature and size range of ring furrows tend to suggest that these features are related to craters partially buried by younger lava flows. The rings have been formed by preferential removal of the exposed crater rims. Ground ice decay, sapping, or fluvial erosion removed the less resistant, porous material of crater rims while leaving the more resistant volcanic flow material. Differential erosion has thus led to a reversal of topography in which the original positive relief of the rim is reduced to a negative relief feature.
References

Figure 1. Inversion of topography at crater rims.