

EPISODIC CHANNEL ACTIVITY AT MA'ADIM VALLIS, MARS, Dale M. Schneeberger, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, 91109.

Ma'adim Vallis is located at 20°S, 182°W in the Aeolis SE Quadrangle, south of Elysium Planitia and about 325 Km south of Apollinaris Patera. It is a well preserved flat-floored valley, about 700 Km long, that dissects the cratered uplands. Sharp and Malin (1) note the average width of the main channel to be 15 Km widening to about 25 Km at its mouth. It empties onto the smooth floor of crater Gusev less than 150 Km south of the lowland/upland boundary. The valley appears to end where the main channel empties onto the floor of Gusev (figure 1), with no apparent outlet, although there may be an outlet through the crater rim to the northwest.

Ma'adim Vallis has both sinuous and relatively straight channel segments. Craters have been either eroded by the channel forming process or have presented a topographic obstacle sufficient to divert the channel (Figure 1). Some structural control is evident but its influence upon the channel system is not clear. The headward reaches of the main channel, and some of its tributaries, exhibit patterns (1,2) that appear to terminate within the margins of intercrater plains. Carr (3) noted this and suggested a similarity to karst regions on Earth.

Other valley forms like fretted or chaotic terrains (3,4,5) appear to be the result of processes different from those responsible for the development of Ma'adim Vallis. Benches along the walls of the valley resemble terrestrial paired terraces, and medial bar-like features and what may be the remnants of the last active "thalweg" can be seen in places on the valley floor. A relatively thin deposit of smooth material mantles the floor of crater Gusev (Figure 1,A), and breaches the rim of a smaller crater, filling its floor similarly (Figure 1,B). The smooth material has been partly stripped away from where it contacts the remnants of the smaller crater's ejecta blanket (Figure 1,C).

A debris lobe is present at the mouth of Ma'dim Vallis and is moderately degraded into irregular blocks with intervening channels and subsequent small ridges (Figure 1,D). Degradation of this lobe is probably due to a combination of both channel and eolian processes, since fluvial erosion alone cannot adequately explain the morphology. A drop in base level would expose the lobe to degradation by subsequent discharges from the main channel. Evidence for this is seen in Figure 1 at E. Such a change in base level at Ma'adim Vallis may have been a local phenomenon related to the filling and draining of crater Gusev. The lack of debris aprons immediately adjacent to the dissected fan suggests that the debris was redistributed in a shallow body of standing water within Gusev (Figure 1,F). Another possibility is that a reduction in the flow volume and intensity within the valley system caused changes in the flow regime and affected the rate of deposition at its mouth. Changes from aggradation to degradation would depend on whether the flow volume or rate was increasing or decreasing.

Is Ma'adim Vallis similar to the pristine branching valley networks distributed throughout the heavily cratered terrain, as described by Pieri (6,7) and Baker (8), and thus the product of basal sapping by groundwater? Is there evidence to indicate formation by surface runoff? Is it, perhaps, some combination of the two? What are the paleoclimatic implications of surface runoff? And is there a direct relationship between formation of the valley network and that of the lowland/upland boundary?

Preliminary assessment of the geomorphic features of Ma'adim Vallis and the surrounding area suggests that the sources may have been surface runoff (1) from the intercrater plains. This is supported by the presence of small tributary valleys that appear to "drain" these areas. The benches developed along the valley walls may have resulted from multiple episodes of flow at varying intensities and volumes. Similar benches are seen in a smaller unnamed valley 300 Km east, and at Al Qahira Vallis 750 Km east of Ma'adim Vallis. Inspection of the benches at the other two valleys suggests they may have similar separations. If so, perhaps a regional base level change was responsible. Another possibility is that the formation of benches may be due to the differential erosion of vast deposits of ignimbritic material. The bench-like morphology would result from variations in the degree of welding. For this case, any regional similarities in bench elevation would not have to be due to regional base-level changes.

REFERENCES:

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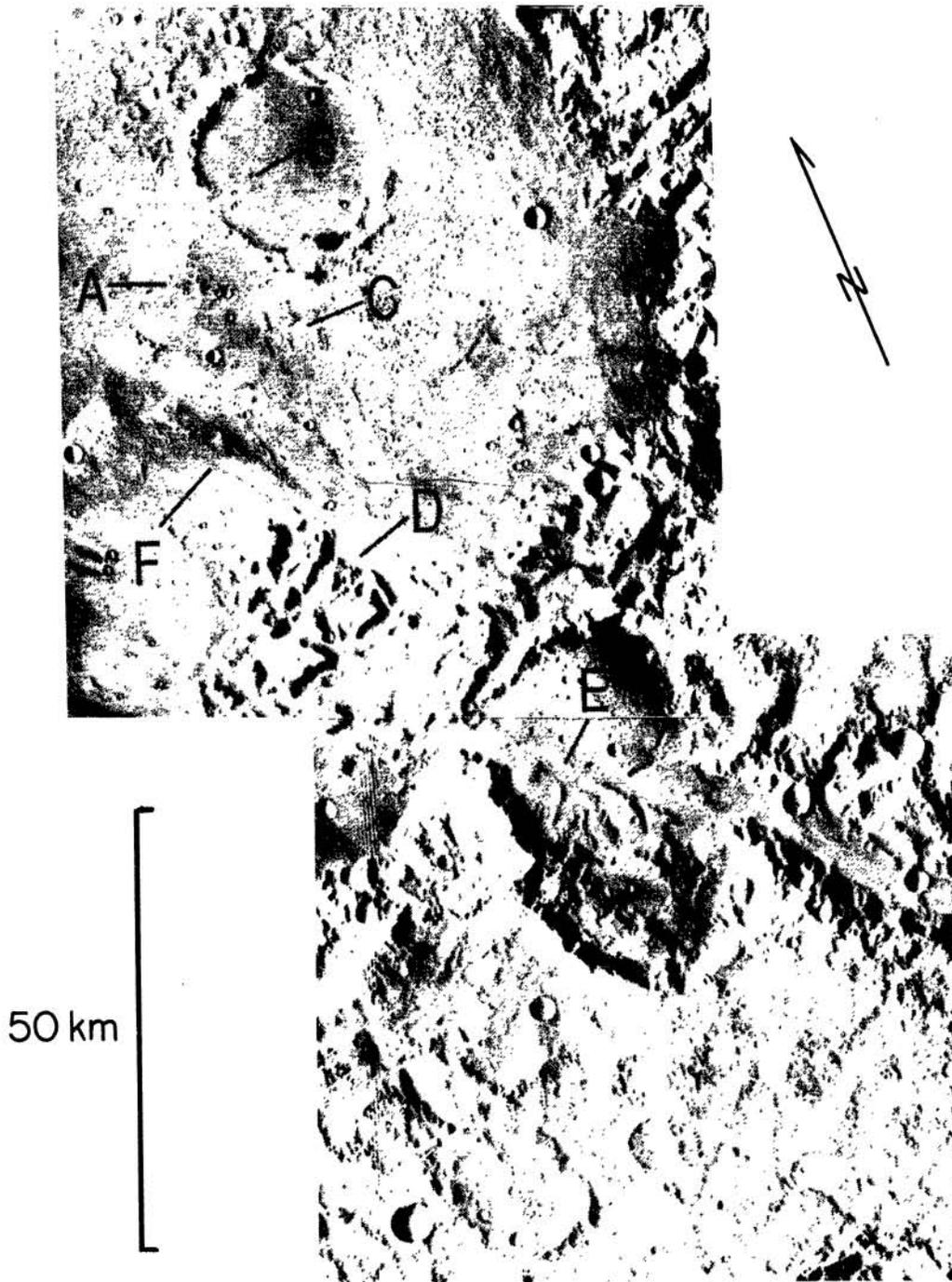


Figure 1. Photomosaic showing where the main channel of Ma'adim Vallis empties onto the floor of crater Gusev, the fan-like debris lobe, and the thin mantle of material on the crater floor. Viking Orbiter images 434S09,434S10.