GEOMORPHIC EVIDENCE FOR ANCIENT SEAS IN WEST DEUTERONILUS MENSAE, MARS - II: FROM VERY HIGH RESOLUTION VIKING ORBITER IMAGES

by
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Very high resolution (10m/pixel or better) Viking Orbiter images of the martian surface, though rare, make it possible to examine specific areas at image scales approaching those of high altitude terrestrial aerial photographs. Of the approximately 1300 total Viking images in this range, probably less than 500 of them are clear enough to be very useful for studies of the martian surface. Twenty three clear very high resolution images (458B41-51, 61-72; at 9m/pixel) lie within west Deuteronilus Mensae (see 1 figure 1, for location). This discussion will deal with the northernmost images (458B61-72) which constitute an almost unbroken mosaic of the west wall of a long finger-like fret canyon (figure 1).

In the very high resolution images, morphological details on the plateau surface within zone "B" (1), not detectable at low resolution, make it possible to divide the zone into two distinct subzones separated by an east-west escarpment (at D, figure 1). South of this escarpment, the plateau surface is characterized by its smooth texture at small scales and relatively uniform albedo. The plateau surface north of this escarpment has a more mottled appearance. The most notable characteristic of this subzone is the presence of well defined polygons several tens of meters to as much as 200m to 300m across (2). These are best expressed on the plateau surface from about 2km north of the escarpment at D to within 20km of the top of figure 1. Individual polygons are separated by well-defined cracks that are typically a few tens of meters or less wide and appear filled with relatively bright material. The canyon floor south of the contact between zones "B" and "C" is characterized by the presence of polygons similar to but somewhat larger than those on the plateau surface.

The canyon floor north of the contact between zones "B" and "C" consists of two principal morphologic styles. Much of it consists of a relatively uniform albedo, smooth plains surface, broken by a system of narrow, sharp wrinkle ridges. The remainder of the canyon floor consists of a system of bright, low relief mounds. Their contacts with the surrounding plains are usually quite sharp. Individual mounds are typically ovate to elongate with a rounded, irregular outline. The ovate mounds are up to 300m across. The elongate mounds may be 300m wide by as much as 3km long and occur as disconnected, subparallel arcs concave northward. It is this system of subparallel arcs which gives the southernmost portion of zone "C" its "striped" appearance in lower resolution images (1, figure 1).

One of the more interesting aspects of this set of images is the presence of at least three, and possibly four parallel, and apparently topographically conformal benches on the canyon wall. These benches become progressively less sharply defined from lowest to highest (numbered 1 through 4), and are traceable for many tens of kilometers along the canyon wall. Only the lowest of these, bench 1, can be seen in the lower resolution images as the contact between zones "B" and "C". Each bench occurs progressively higher up the wall when traced from south to north. Benches 2, 3, and 4 each in turn disappear at the top of the escarpment. Bench 2 intersects the top of the escarpment in the vicinity of the fresh 800m crater near the top of figure 1. Bench 3 intersects the cliff top just south of the 10km degraded crater in figure 1. Bench 4, less readily traceable than the other three benches, appears to coincide with the base of the east-west escarpment on the plateau surface. Bench 1, though it cannot be seen intersecting the cliff top, is the only one of the four that intersects the canyon floor in the very high resolution images.

The contact between zones "B" and "C" on the canyon floor and along part of the canyon wall is well represented in the very high resolution images. On the canyon floor, it consists of a parallel system of alternating low ridges and swales about 1km wide (E, figure 1) crossing the canyon floor. These describe smooth parallel arcs, concave northward. At its west end, the southernmost of the arcs, a low positive relief feature, grades into bench 1 at the base of the canyon wall. From here northward, it occurs at successively higher positions on the canyon wall until, at the top of figure 1, it appears to be about midway up the wall.

Shading across the benches suggests that the steepest slope elements occur immediately above the benches, with the profile between benches being convex upward. This is opposite what might be expected of most stratigraphic benches. The most common profile for a cliff comprised of layers of varying resistance to erosion is concave upward for the slope profile between benches. In such an example, the steepest slope element lies immediately below the bench (since the more resistant layers tend to be cliff formers). Sapping interfaces within a cliff might produce profiles similar to those in west Deuteronilus Mensae. In this case, sapping above a permeability boundary results in more rapid erosion immediately above the boundary than below. Sapping, however, does not adequately explain the change in the contact between zones "B" and "C" from a bench to a series

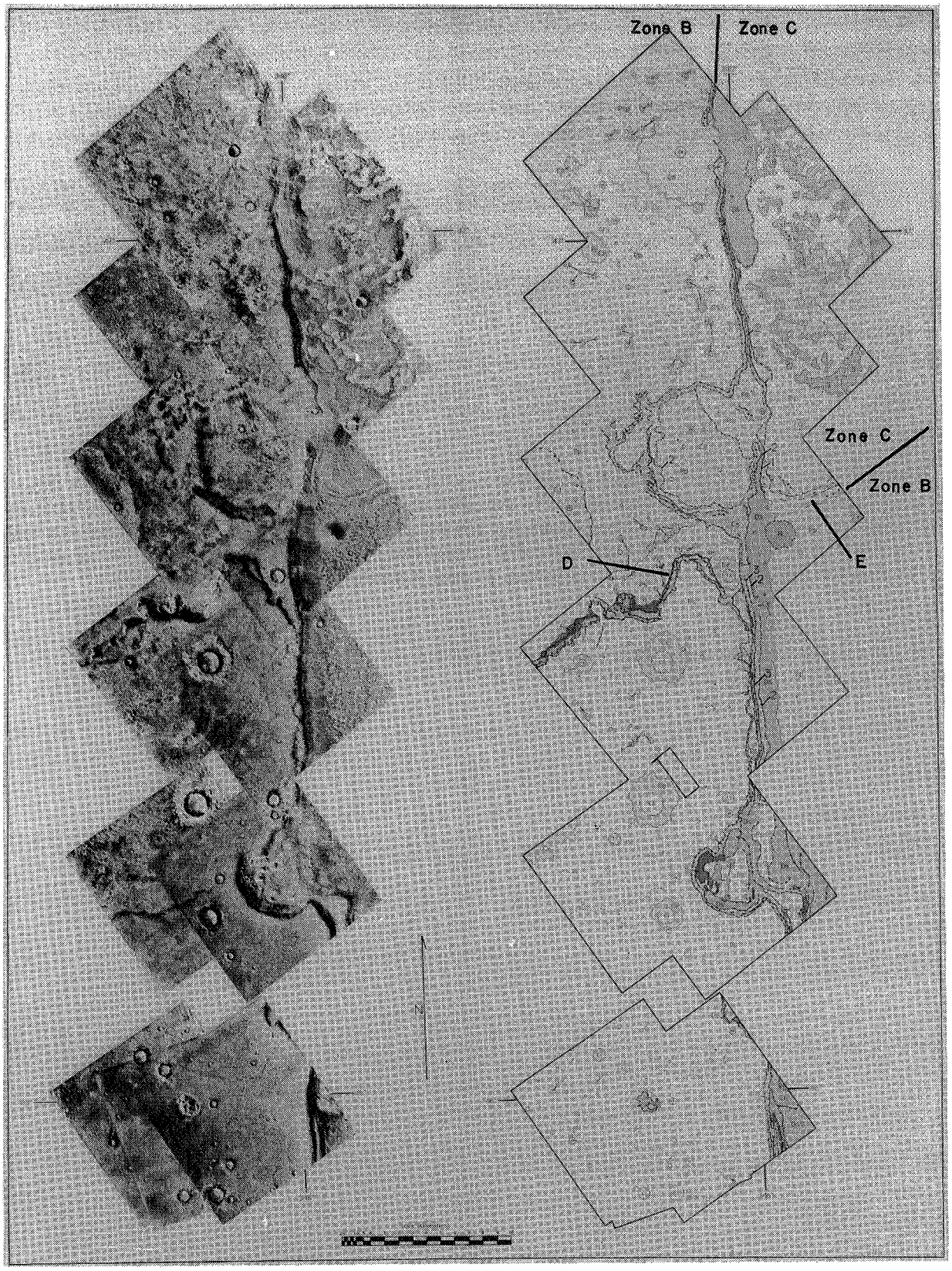
of arcuate ridges and swales across the canyon floor.

A series of strandlines, each lower and younger than the previous one could explain all the above aspects. Wave action against a sloped surface (in this case the canyon wall) could produce the observed profiles. Wave energy is focused on the slope at the shorezone, producing a cliff on the slope immediately above. If successively lower "high stands" are separated by enough time, the lowest, youngest strandline should be the best preserved and the highest the least preserved. The series of ridges and swales at the contact between zones "B" and "C" are similar in scale and plan to terrestrial beach ridges on a very gentle slope.

REFERENCES:

(1) Parker, T. J., Schneeberger, D. M., Pieri, D. C., and Saunders, R. S., Geomorphic evidence for ancient seas in west Deuteronilus Mensae, Mars - I: Regional Geomorphology: This volume.
(2) Lucchita, B. K., 1984, Small-scale polygons on Mars: Reports of the Planetary Geology Program - 1983, NASA TM 86246, p. 205-207.

Figure 1: Very high resolution photomosaic of part of west Deuteronilus Mensae, Mars. Viking Orbiter images: 458861-72. Regional slope is downward to the north. Brief unit descriptions: (Pp), Polygonally patterned plains; (Ps), Smooth Plains; (Psp), "Splotchy" smooth plains; (S), Bright, low mounds (splotches); (B), Blocky material; (Cs), Canyon wall and/or cliff slopes; (Ds), "Debris" slopes; (Ce), Crater ejecta blankets; (H), Hilly material; (C), Craters - C4 freshest, C1 most degraded.


Zone B
Zone C
Zone C
Zone B
D
E