THE PLAINS UNITS OF SOUTHWESTERN UTOPIA PLANITIA, MARS: CONSTRAINTS ON AN ANCIENT MARTIAN OCEAN; **Steven H. Williams**, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, Texas 77058 and **Paraluman P. Stice**, University of Hawaii at Manoa, Honolulu, Hawaii 96822

That Mars is now believed to have been substantially wetter in the geologic past than had been previously thought is one of the principal conclusions of the *Mars: Evolution of its Climate and Atmosphere* project (1). Water as subsurface ice has long been suspected (see 2 for review), and several investigators cite evidence for the presence of standing water in the canyon systems (2, 3, 4), in saline lakes (5), and even as a large-scale ocean (6, 7, 8). The issue of water standing on the martian surface for long periods of time is extremely important in assessing the possibility of the development of life on Mars (8, 9).

There is no disputing that large quantities of water once flowed over the martian surface (see 10 for review). However, there is not yet a consensus on the fate of the water or on the total amount available for an ocean in the martian past (1); estimates of potential depths range from a minimum of 46 m based on volcanological considerations (11) to >100 m based on Earth-based observations of isotopic hydrogen ratios (12), to >500 m based on geologic constraints (10). Features interpreted as strandlines and tombolos provide additional support for the standing water view (7). Other investigators maintain that a large-scale standing body of water is not needed to produce the observed features of the lowland plains. The plains have been interpreted as being sedimentary deposits of materials delivered to the lowlands via the outflow and other channels (13-17). In that scenario, the polygonal fracturing that characterizes much of the northern plains is due to differential compaction (18) of the sediments as they dry (13, 17).

A detailed examination of the plains units in southwestern Utopia Planitia helps address the issue of the existence of a martian ocean in the geologic past. The study area in question is located near the global dichotomy boundary east of Nilosyrtis Mensae. It is an interesting region (Figure 1); there are ridges that have been compared to those that form at the mouths of Antarctic ice streams (16), "thumbprint" terrain similar to that which has been interpreted as karst topography (19), and what appears to be deposits of material that do not completely cover the lowlands. Immediately east of the "thumbprint" terrain is a faint, lobate margin (Figure 1). The material to the east of the margin appears to be both at a higher elevation and younger than that to the west. Crater statistics from higher resolution images of the area show a small, but statistically significant difference in ages (20), however, when larger areas are examined at lower resolution, the error bars on the crater plots overlap.

A very strong case can be made for the presence of standing water in selected areas in the distant martian past. However, that does not necessarily mean that a large-scale ocean once existed in the northern lowlands. Some of the evidence cited for ocean shorelines requires careful scrutiny before acceptance. For example, strandlines, especially those caused by deposition, not erosion, probably have a very low preservation potential because of aeolian obliteration. The highest resolution Viking photographs almost invariably show that the upper few meters of the martian surface bears evidence of relatively recent aeolian erosion and/or deposition. Availability of higher resolution images has necessitated a change in geologic interpretation of some features once thought to be due to processes other than aeolian (21). Care should also be taken with the interpretation of linear features as tombolos. At least one example can be found where the positive relief "tombolo" on the lowland continues as a negative relief fracture when it encounters a mesa (Figure 2); perhaps they are related to sand wedge casts or some other type of feature rather than those formed in large bodies of water. The presence of a younger and probably higher deposit that has a lobate margin supports the idea that the plains are mudflow-type sedimentary deposits rather than those formed on an ocean bottom.

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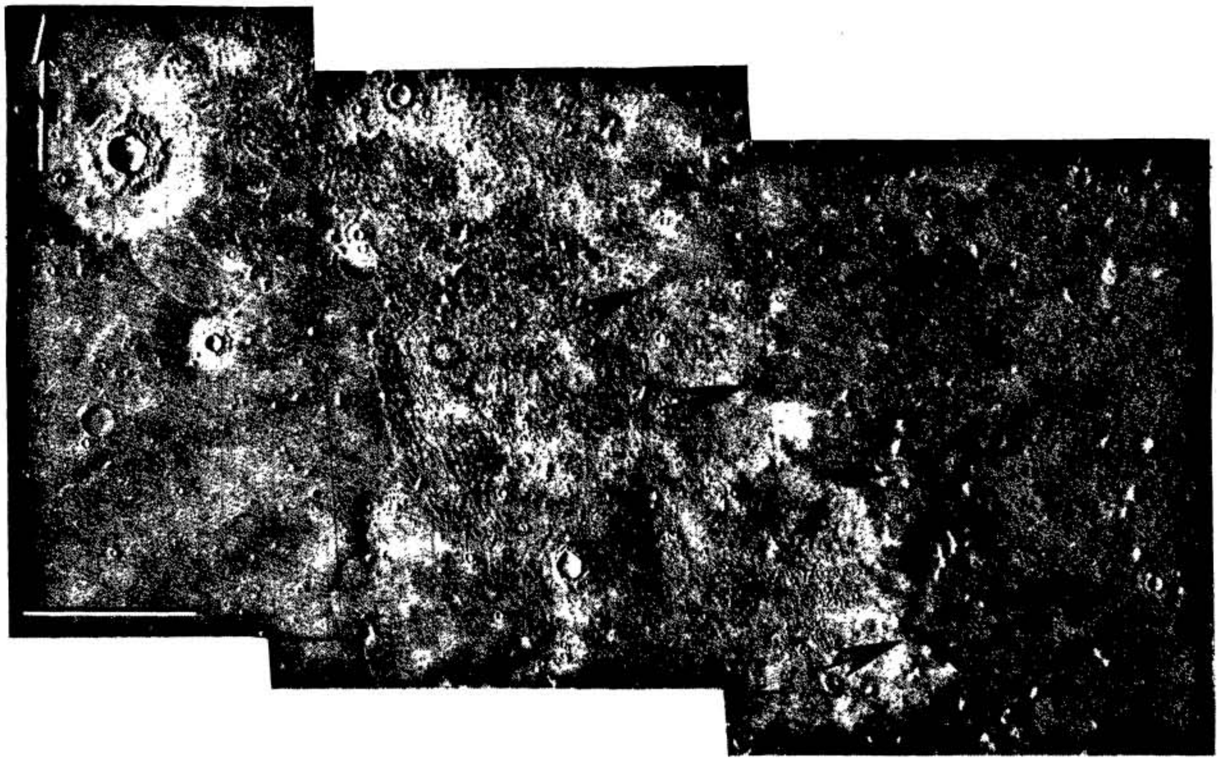

Figure 1. The surface to the east of the "thumbprint" terrain appears to be both younger and at a higher elevation than that to the west. The faint, lobate boundary of the younger deposit is marked by arrows. Portions of Viking orbiter photographs 572A04, 06, and 08, NGF version; the scale bar is 50 km long.

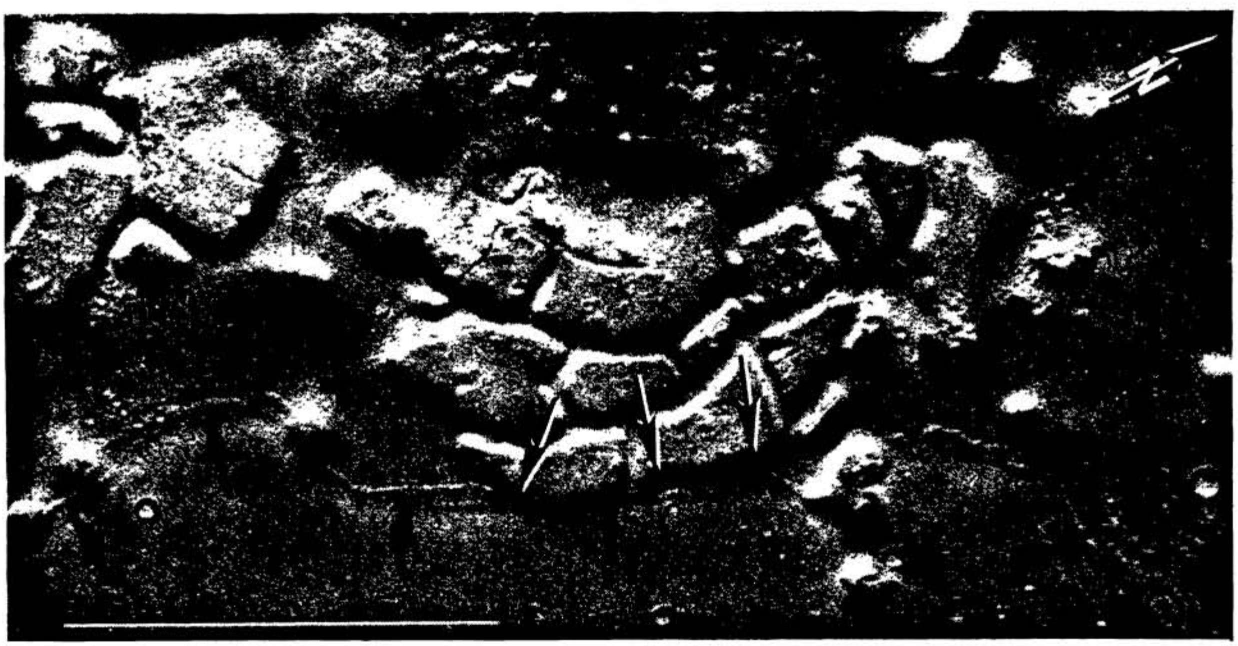

Figure 2. Not all "tombolo"-type linear features that connect positive relief features are due to deposition in a standing body of water. In this example, the ridge on the lowlands (black arrows) becomes a fracture when it encounters a mesa (mixed arrows). The illumination direction is from the upper left. Viking orbiter photograph 86A09, NGF orthographic version; the scale bar is 10 km long.

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