SINUOUS RIDGES OF THE SOUTH POLAR REGION, MARS: POSSIBLE ORIGINS; *S.W. Ruff and Ronald Greeley, Department of Geology, Arizona State University.*

Ridges with sinuous, dendritic, and braided morphologies have been identified in the Dorsa Argentea region near the martian south pole and in the Argyre Planitia (Figure 1). They are < 1 km wide, 100-200 m high, and lengths can exceed 200 km. In planform they vary from relatively straight, solitary features to complex, dendritic and braided patterns. In the Dorsa Argentea region, bifurcating and intersecting relationships of ridges give rise to the dendritic patterns. Some ridges are observed to cross medium-sized, partly buried craters while others cross over each other. Their origin remains enigmatic and only two brief interpretations have been proposed. They include: a) eskers (1), b) unusual lava-flow features (2), c) linear dunes, d) inverted topography, and e) clastic dikes.

Howard (1) proposed a fluvial origin by basal melting of ground ice to account for the dendritic and braided characteristics of the ridges. This model suggests that the ridges are eskers, the depositional product of meltwater channels within ice. Terrestrial eskers have similar morphological characteristics which compare favorably to those of the martian ridges. In planform eskers are often braided as well as dendritic features which are a few to 100 m high, up to 6 km wide, and several meters to 400 km long (with breaks) (3). The difficulty with this interpretation is that it requires the presence of large quantities of ice which, on Earth, produce a host of associated glacial landforms. These are not readily apparent in the region where ridges occur.

Tanaka and Scott (2) offered a brief interpretation of the ridges as part of their mapping of the polar regions. They suggested that the ridges could be an unusual lava-flow feature. Known ridge forming features associated with lava flows include, among others, basaltic pressure ridges (e.g., 4), wrinkle ridges (e.g., 5), and flow lobes. However, none of these have morphologies which can explain the forms seen in the martian sinuous ridges. An as yet unexplained and unobserved style of lava flow must be proposed then to account for the ridges.

Another possibility, suggested by Malin (personal communication), proposes that the ridges are dunes. Some linear dunes in Australia bare a striking resemblance to the martian ridges. Australian dunes can be sinuous, bifurcating, and irregular in their occurrence (6). Some parts of these dunes have a braided appearance. They are several meters to 1 km wide and up to 190 km long (7). A dune interpretation for the martian ridges is supported by the fact that aeolian processes on Mars are well documented (e.g.,8) and the adjacent polar layered deposits could represent a ready supply of sediment which could be reworked into dunes. The difficulty with this interpretation is that linear dunes on Earth do not have such complex intersecting and bifurcating patterns as the martian ridges.

An alternative suggestion by Howard (1) includes the possibility of inverted topography to explain the ridges. He discarded this idea due to a lack of favorable morphological comparison to known inverted topography at other martian locales as well as on Earth. But, the preservation of channel deposits produced during fluvial or volcanic activity could, following differential erosion, produce ridge forms. This idea is weakened in the case of the martian ridges by the presence of geometries that are not indicative of flow channels. Namely , many of the ridges have V's which open in opposing directions rather than a single upstream direction.

A final hypothesis that was examined came from Malin (personal communication). He suggested clastic dikes as a possible ridge former. Clastic dikes occur where extraneous material invades a crack within a host rock (9). These features are from 2 cm to 10 m thick and a meter to 15 km long. Perhaps differential erosion could result in a ridge form, but this is not a common attribute of clastic dikes. The relatively small size and lack of topographic relief of terrestrial clastic dikes does not favor them as an analog of the martian ridges.

Additional study is required before making final conclusions. Many of the ridges mapped by Tanaka and Scott (2) have not been inspected in detail, nor has a planetwide inventory of similar appearing features been made. Finally, a complete study of morphometric features associated with the martian ridges and terrestrial analogs must be undertaken. If thermal inertia and/or spectral data with fine enough resolution are available in ridge areas, information concerning the composition of the ridges could be elucidated and could help to constrain certain hypotheses.

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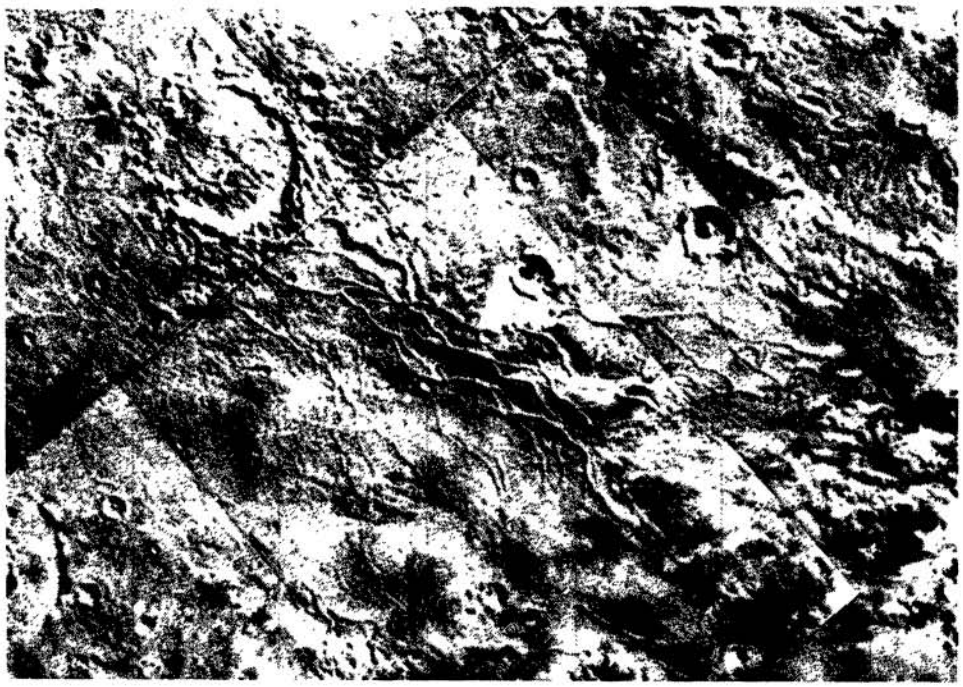

Figure 1. *Viking photomosaic showing sinuous ridges in Dorsa Argentea.*

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