GEOMORPHIC PROCESSES IN THE ARGYRE-DORSA ARGENTEA REGION OF MARS;
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Introduction. Among many indications of possible ancient Martian glaciation are sinuous eskerlike ridges in southern Argyre Planitia and the Dorsa Argentea region [1, 2]. But, in photogeology, other interpretations are always possible, and what appears eskerlike to one set of eyes may appear quite different to another. Interpretations of these ridges are about as numerous as observers, who collectively have suggested nine distinct hypotheses! Martian sinuous ridges have been interpreted as wrinkle ridges, lava flows, igneous dikes, clastic dikes, linear sand dunes, spits or bars, examples of inverted stream topography, or glacial crevasse fill [3-8]. With Mars Observer en route to Mars the prospects for a narrowing of the debate are bright. The esker hypothesis will gain support if Mars Observer images show that the ridges contain boulders, that the ridges are layered and contain channel structures, that the ridges are modified by thermokarst, or that the ridges occur in close, logical associations with other glacial landforms such as flutes, oriented grooves, and moraines. In the meantime, the evidence presented below bolsters the esker hypothesis, challenges certain alternative ideas, and draws a tentative geomorphic connection between the sinuous ridges of Argyre and those of Dorsa Argentea.

Data. Sinuosity is a key aspect of Martian sinuous ridges. This characteristic of the Martian ridges is compared with sinuosities of suggested terrestrial analogs in Figs. 1-4. These comparisons confirm that, in scale and sinuosity, Martian sinuous ridges resemble many terrestrial river channels and eskers and may be distinguished from terrestrial linear dunes. The data for wrinkle ridges and sinuous ridges overlap considerably, but wrinkle ridges tend to be less sinuous than sinuous ridges; other morphologic aspects of wrinkle ridges clearly distinguish them from sinuous ridges, including the tendency of wrinkle ridges to form en echelon patterns and to have asymmetric cross profiles. One cannot easily rule out the existence of conditions unique to Mars or to these regions of Mars that might have contributed to formation of unusual wrinkle ridges or sand dunes or some other feature. However, a simpler explanation is that the patterns of Martian sinuous ridges resemble terrestrial channels and eskers because all these features were deposited by channelized water flows. This explanation is also consistent with the hypothesis of inverted stream topography, but the occurrence of other possible glacial landforms in the Argyre and Dorsa Argentea regions favors the esker analog.

Figure 5 shows a longitudinal topographic profile from a mountainous region (near 79° S lat, 350° long) to what is believed to be the proximal end of Dorsa Argentea ridges, to the distal end, along a deep channel incised through the Charitum Montes, and into the area of sinuous ridges in Argyre Planitia. Although topographic uncertainties are large, the data are consistent with a continuous down-gradient from the mountainous region (where peaks probably exceed 7000 m in elevation) to the floor of Argyre. If the Mars Observer laser altimeter confirms this gradient, it will be a powerful argument favoring a gravitationally driven fluid-flow origin of the sinuous ridges. Such a gradient also is consistent with an integrated interpretation of sinuous ridges and other landforms of possible glacial origin in the Dorsa Argentea and Argyre regions.

Conclusions. The sinuosities of Martian sinuous ridges are comparable with those of terrestrial rivers and eskers. The esker hypothesis is favored because other plausible glacial landforms occur in the Argyre and Dorsa Argentea regions. Glacial features in these two regions may well have been related to the movement of an ice sheet from the south polar area across Dorsa Argentea and into Argyre Planitia.

References. [1] Kargel, J.S. and R.G. Strom (1992) *Geology*, **20**, 3-8. [2] Kargel, J.S. and R.G. Strom (1991) *Lun. Planet. Sci.*, **XXII**, 683-684. [3] Carr, M.H. and 12 others (1980) *Viking Orbiter Views of Mars*, Washington, D.C., U.S. Government Printing Office, p. 136. [4] Howard, A.D. (1981) *Repts. Planet. Geol. Prog.*, NASA TM-84211, 286-288. [5] Parker, T.J., D.C. Pieri, and R.S. Saunders (1986) *Repts. Planet. Geol. Prog.*, NASA TM-88383, 468-470. [6] Tanaka, K.L. and D.H. Scott (1987) Geologic map of the polar regions of Mars, *U.S. Geol. Surv. Misc. Inv. Ser. Map I-1802-C*. [7] Ruff, S.W. and R. Greeley (1990) *Lun. Planet. Sci.*, **XXI**, 1047-1048. [8] Metzger, S.M. (1991) *Lun. Planet. Sci.*, **XXII**, 891-892.

Figure captions. Figure 1. Sinuosities of Martian sinuous ridges in Argyre region (solid circles) and Dorsa Argentea region (solid squares) and of Canadian eskers (open squares).

Figure 2. Sinuosities of Argyre's ridges (solid squares) and terrestrial eskers (large circles) and rivers (Yangtze, small circles; Niger, triangles; middle Porcupine, diamonds; and lower Porcupine, open squares).

Figure 3. Sinuosities of sinuous ridges in Argyre region (solid diamonds) and Dorsa Argentea region (solid squares), and of terrestrial linear sand dunes (Simpson Desert, Australia, open circles; Namib Desert, southern Africa, open squares; and Erg Chech, North Africa, open diamonds).

ARGYRE - DORSA ARGENTEA REGION OF MARS: Kargel, J.S.

Figure 4. Sinuosities of sinuous ridges in Argyre and Dorsa Argentea regions (solid symbols) and wrinkle ridges in Lunae Planum (open circles).

Figure 5. Longitudinal topographic gradient in Dorsa Argentea and Argyre regions (see text).

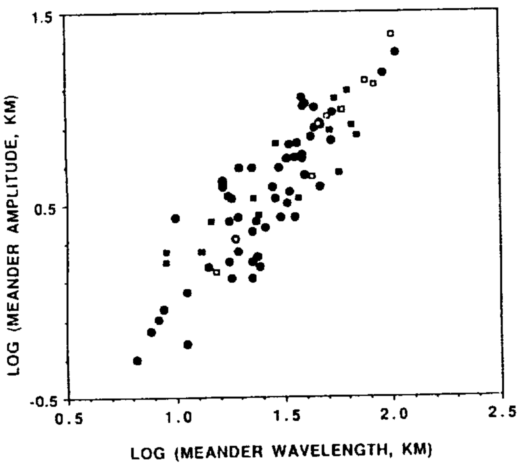
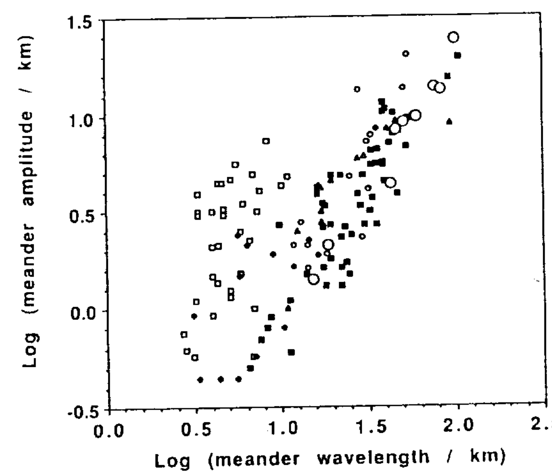


Figure 1.



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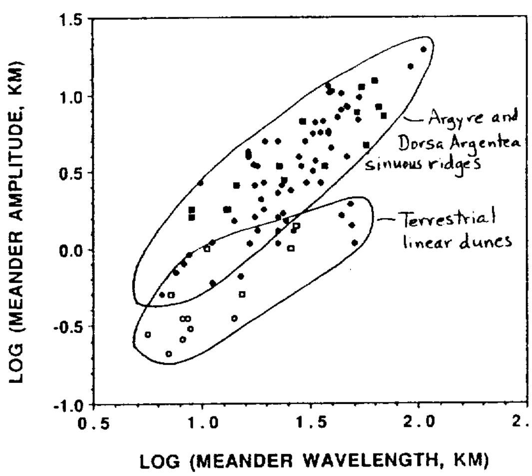

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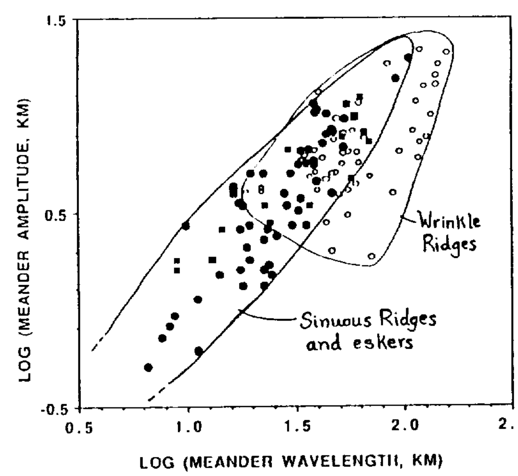

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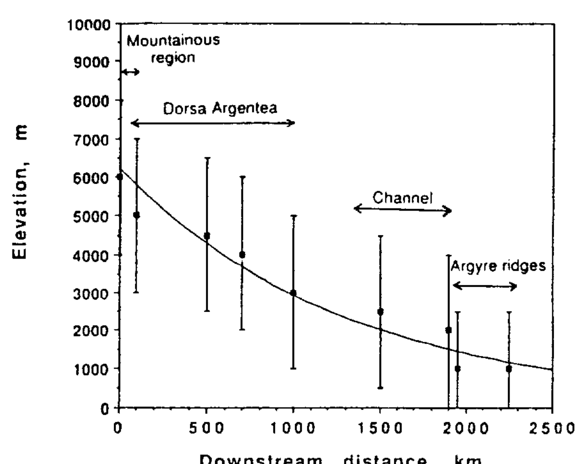

Figure 5.