OBSERVATIONS OF APRONS IN MARTIAN FRETTED TERRAIN. M. C. Malin and K. S. Edgett, Malin Space Science Systems, P. O. Box 910148, San Diego, CA 92191-0148, USA.

Introduction: Martian fretted terrains together constitute one of several erosional landscapes initially recognized in Mariner 9 images [1]. Believed to date from a time associated with the formation of the planetary topographic and physiographic north-south dichotomy, fretted terrains are characterized by landforms that transition from narrow rectilinear valleys on the uplands side of the dichotomy boundary to isolated mesas on the lowlands side of the boundary. Two geomorphic attributes of fretted terrain were especially notable in distinguishing them from other martian landforms: *lineated valley fill* (longitudinal striations down the medial axes of the rectilinear valleys) and *circum-mesa aprons*. Lineated valley fill is not the subject of this abstract. Rather, here we discuss the other major character of fretted terrain—namely, the aprons that surround isolated mesas and ridges. These aprons appear in Viking images to have relatively smooth surfaces (occasionally displaying lineations "radial" from the central mesa) and apparently convex topographic profiles [2–4]. Often termed "debris aprons" or "rock glaciers" after their superficial resemblance to similar terrestrial landforms, most pre-MGS interpretations argued for formation by surficial flow (debris flows) or near-surface deformation creep (rock glaciers).

MGS Observations: MOC image SP1-20504, acquired 29 March 1998 at 0147 UTC, shows a particularly instructive example of a fretted terrain apron in the Deuteronilus Mensae region (40.2°N, 337.6°W). This image, acquired during the first science phasing orbit period, has a crosstrack resolution of 2.05 m/pxl, an aspect ratio of 2:1, and covers an area 1.5 km east/west by 45 km north/south. The Mars Orbiter Laser Altimeter (MOLA) groundtrack for this image occurs along the extreme eastern edge of the frame. Figure 1 shows the MOC and MOLA data at the same spatial scale, with the MOLA data vertically exaggerated by 4X. Although MOLA does not resolve many of the small scale features seen in the MOC data, it shows four attributes of interest: 1) the steep slope near the top of the mesa, which averages about 15° but may be as steep as 30° at its steepest; 2) a relatively horizontal section of the apron (extending 11 km at an average slope of substantially less than 1°); 3) a distinct break in slope wherein the slope increases for about 3 km by almost an order of magnitude, after which the apron continues to descend at a low slope (~1°); and 4) a terminal toe at the base of the apron. Total relief down the apron is about 600 m over about 30 km.

Description of MOC Data: Figure 2 shows representative samples along the length of SP1-20504. Each image is 1.5 km square. The upland surface (A) displays the roughened surface typical of the martian mid-latitudes. This morphology is characterized by closely spaced knobs replacing the upland surface; crater ejecta and rims are almost non-existent. The headslope from the upland to the apron (B) shows azimuthal variations, with ridge/groove forms suggesting down-dip material transport or shear. Small ridges parallel to the base of the cliff suggest material has been shed; a difference in albedo and texture along the lower 10% of the cliff may indicate an area of recent slope movement or rejuvenation. The upper slope of the apron (C, D) is characterized by closely spaced, non-aligned pits/troughs and knobs/ridges separated by zones of smooth (unpitted) surface whose margins are defined by lineaments, and occasional low amplitude, long-wavelength ridges transverse to the lineaments and zones. At only one location do ridges suggest diversion of material around an obstacle (E). No distinctive morphology characterizes the break in topographic slope, but the morphology below the break is different from that above. Below the break, the pits/troughs are aligned downslope, and the surface transitions gradually from one consisting almost entirely of equidimensional pits/troughs and knobs/ridges to one with a smooth, occasionally pitted surface (F, G). The toe of the apron has small ridges conforming to the perimeter of the apron (H), and a steep slope meeting the basal plains. These plains are somewhat topographically rough and large boulders appear to be liberally scattered across the surface (I).

What does this all mean: There is only minor evidence that material is flowing from the head to the toe of the fretted terrain aprons. Certainly, there is no surficial flow as might be expected for materials emplaced by debris flow. Creep of ice-rich material, in the form of a rock glacier, may be consistent with some of the features seen, but it is not clear that this creep would extend to any great depth. The pervasive pitting, its spatially distinct relationships (higher on the apron is more pitted than lower), and the terminal ridges suggest that either the upper slopes are in extension and the lower slopes compression, or that the upper slopes are experiencing greater erosion than the lower slopes. The topographic and morphologic relationships may indicate that fretted terrain aprons most resemble terrestrial pediments; that is, that they are "bedrock" layers whose slopes and erosional forms reflect bedrock layers with different material properties rather than transport mechanisms.

References: [1] Sharp R. P. (1973) *JGR, 78*, 4073-4083. [2] Eppler D. B. and Malin M. C. (1981) *LPSC XII*, 260-261. [3] Eppler D. B. and Malin M. C. (1982) *NASA TM-85127*, 237-238. [4] Malin M. C. and Eppler D. B. (1983) Proc. 4th Int'l Permafrost Conf., Fairbanks, AK (National Academy of Science Press, Washington, D. C.), 787-791.

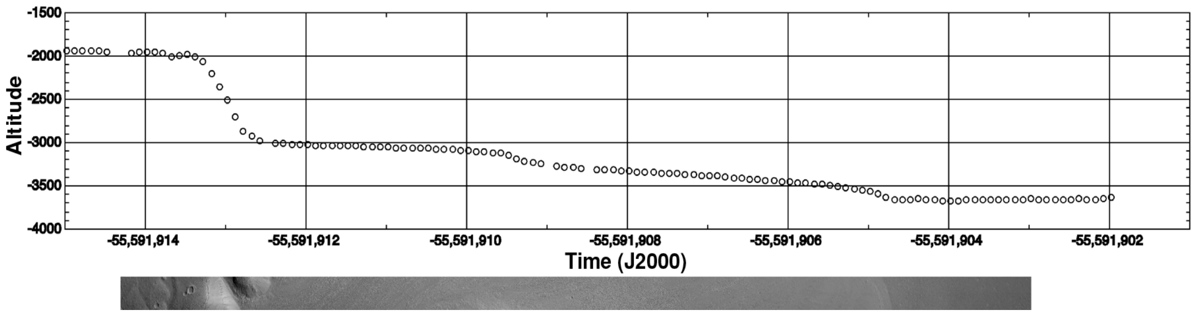

Figure 1: 4X vertically exaggerated Mars Orbiter Laser Altimeter profile matched to MOC SP1-20504 (bottom).

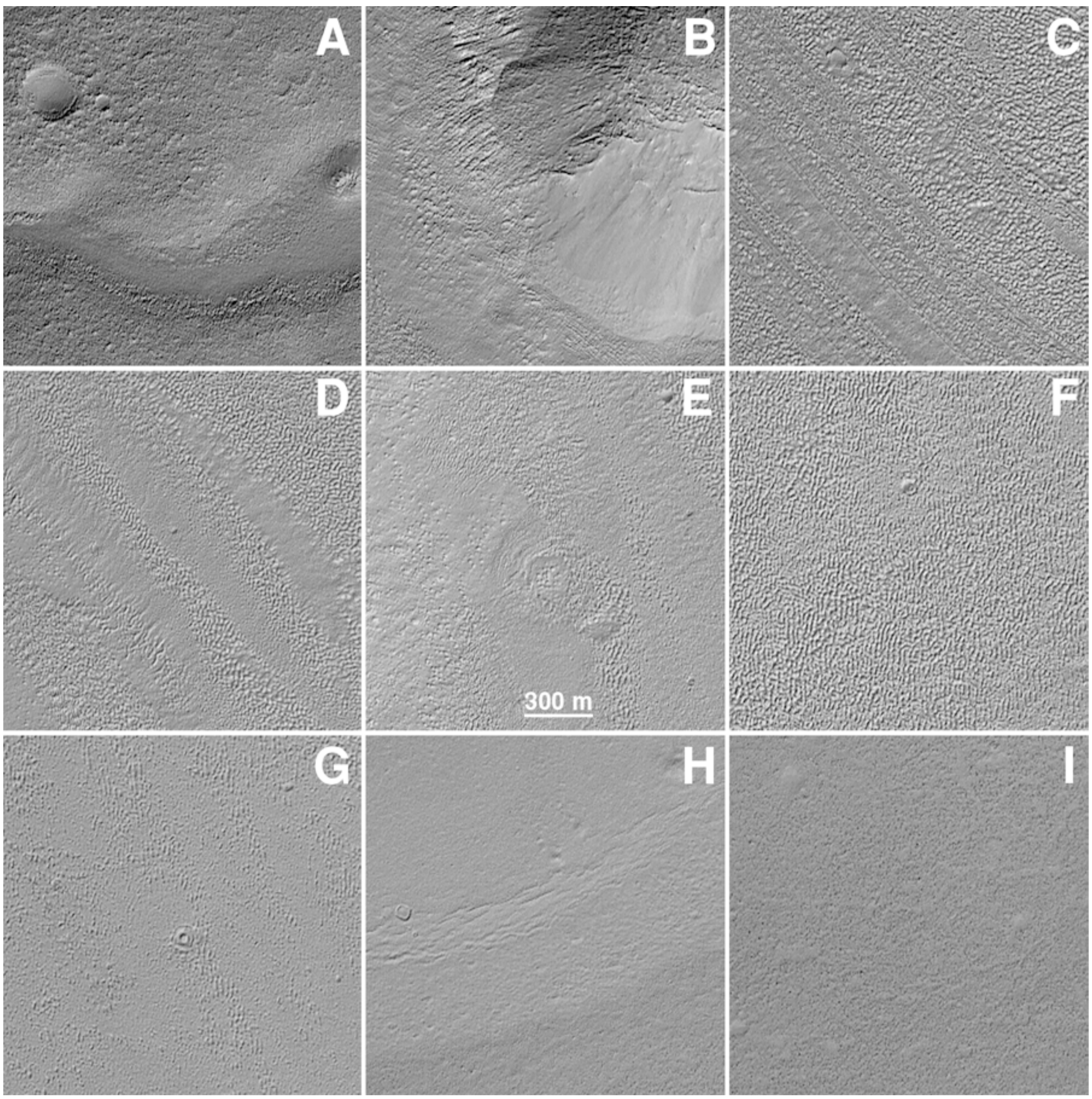

Figure 2: Sections of MOC SP1-20504, showing the range in textures from the head of the fretted terrain apron (A) to the toe of the apron (H) and the rough, bouldery surface subjacent to the apron (I). See text for descriptions.