**LIGHT LAYER AND SINUOUS RIDGES ON PLATEAU NEAR JUVENTAE CHASMA, MARS.**
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**Introduction:** A light-colored discontinuous layer tops the plateaus surrounding the Valles Marineris. Treiman et al. [1] suggested an origin as diagenetic material, Chapman and Tanaka [2] and Hynek et al. [3] as ash-flow/fall tuffs, and Malin and Edgett [4] as possible lake beds. Edgett and Malin [5] also showed that such layers occur interbedded with lavas in the Valles Marineris walls, brought to the surface in the central peak of a crater. Beyer and McEwen [6] suggested that less competent layers are interbedded with competent basalts [7] in Coprates Chasma walls. Lucchitta [8] inferred that a small lobate outcrop of this layer elsewhere, associated with fault scarps, may be ash-flow tuff. The layer is similar in appearance to the lacustrine siliciclastic and evaporate deposits discovered by the MER rover in Meridiani Planum [9]. Does this layer have the same origin, or could it be the source of the material deposited there?

**Description:** A good exposure of the layer occurs west of Juventae Chasma, where it is well covered by MOC and THEMIS images. It is composed of flat-lying alternating lighter and darker beds, even though some of the darker beds may merely be benches on which dark, windblown material aggregated (Fig. 1). The benches suggest that the layer has beds of varying competence. The layer is deeply dissected by circular, oval, and linear depressions trending north-northeast. The latter vaguely resemble ancient fluvial valleys. The layer is eroded back from the Ius Chasma rim. It is associated with light-colored transverse dunes, suggesting inclusion of sand-sized grains, easily transported by the wind [10]. To the west, a conspicuous pit in the plateau surface shows the layer on its floor.

The light colored layer is associated with sinuous channels on top of ridges (Fig. 2). Where ridges are wide and high, they are underlain by evenly layered light material that crops out in the ridge flanks. Apparently, the ridges are topped by material more resistant to erosion than the underlying beds, protecting them from erosion and forming inverted relief. The layer also occurs in the outward slopes of pedestal crater ejecta. Clearly the ejecta also protected the layer, which is apparently composed of easily eroded material that is now removed from much of the plateau. The sinuous channel/ridges are discontinuous and trend north-northeast. They are dendritic in places, indicating flow in a northerly direction. Many emerge just north of east-west trending wrinkle ridges (Fig.2). Some sinuous ridges cross each other. One ridge originates at a crater and fans out into a broad flow lobe. The sinuous ridges predate emplacement of the pedestal craters, as they disappear and reemerge from underneath their ejecta. The ridges are narrower and less rounded than presumed eskers in Argyre Basin [11].

The wrinkle ridges appear to be fissure vents. Dark lobes emerge from one of the ridges and flow to the south, covering the dissected light-colored layer (Fig. 3). Flow lobes to the north embay and locally overtop sinuous ridges, implying that the flows post-date emplacement and removal of the light layer. The burial of the light layer by dark lava shows that light layers are indeed interbedded with dark flows, as inferred for the Valles Marineris walls by Edgett and Malin [5] and Beyer and McEwen [6].

**Discussion:** The crossing channel/ridges imply that materials were building up. Was this material lacustrine, volcanic, or a combination of eolian and glacial? A lacustrine origin is suggested by the dendritic arrangement and cross-over ridges with inverted relief, as observed in deltas [12]. Similarly flat-lying, light colored layers in Meridiani Planum were apparently emplaced in lakes [9]. However, the plateau on which the ridges occur slopes gently to the north and does not appear to be an enclosed basin that could have harbored a lake. The ubiquitous dunes associated with the light layer and channel/ridges imply inclusion of well-sorted sand-sized material, which is less prevalent in fluvial deposits.

A volcanic origin as ash flows or falls is suggested by the light color, apparent fine grain size, friability, extent, and flat-lying shape. The layer resembles the nearby interior layered deposits inside the Valles Marineris, which have been interpreted as volcanic edifices by many researchers [13,14]. The layer displays a lobate form in one place, similar to a light-colored lobe elsewhere on the plateau, interpreted to be an ash flow [8]. Interbedding with dark, apparently basaltic flows from the wrinkle ridge also makes volcanic origin likely, as does the association of the channel/ridges with the apparent wrinkle-ridge fissure vents. Dendritic lava channels have been observed on the Moon [14]. However, if volcanic, the channels would be feeders to ashflow tuffs. Such feeders are not common on earth; ashflow tuffs are generally emplaced as sheets. If the layer is from airfall tuff, the channels have to be of unrelated origin. Also, the layered deposits inside the Valles Marineris are not flat-lying in most places, but form high mounds with inclined beds, and thus only superficially resemble the light layer on the plateau.

An eolian/glacial origin is suggested because the flat-lying, even layering vaguely resembles that of polar deposits. The layers were perhaps formed during past cycles of high obliquity, when ice could have been laid down in equatorial regions, possibly nucleated on airfall dust or eolian sands. The friability of the unit, the ready formation of dunes, and the preservation only through protection of overlying units are in favor of an eolian/glacial origin. In this scenario, the channels are unrelated to the emplacement of the layer. They could be from mud slurries forced to the surface by pressures from wrinkle-ridge thrusting, then flowing over the glacial deposits and armoring the channels. Further buildup of glacial layers and additional channel formation at higher levels caused the cross-over ridges. Or the channels could have carried mineralized water that formed well-cemented deposits that protected the underlying dust, sand, and ice deposits from erosion, thus forming the inverted relief.

**Conclusion:** The plateau in the vicinity of the Valles Marineris was topped by a light-colored layer that was readily eroded. It may be similar to other layered material on plains or may have served as a source for layered material deposited in sinks elsewhere on Mars. The interbedding of this layer with dark volcanic flows confirms that the Valles Marineris walls contain both basaltic flows and less competent light material. Wrinkle ridges in places appear to serve as fissure vents. Fluids emerged from near the wrinkle ridges and flowed northward down channels, whose deposits were more competent than the underlying light layer and thus protected it from erosion. The origin of the layer on the Valles Marineris plateau, however, remains elusive. Further information is needed to determine whether it is of lacustrine, volcanic, or a combination of eolian and glacial origin.

**References:** [1] Treiman A.H. et al. (1995) *J. Geophys. Res. 100*, 26339-26344. [2] Chapman M.G. and Tanaka, K.L. (2002) *Icarus 155,* 324-339. [3] Hynek B.M. et al. (2002) *JGR 107(E10)* 5088 18-1 to 8-14, [4] Malin M.C. and Edgett, K.S. (2000) *Scienc, 290*, 1927-1937. [5] Edgett K.S. and Malin M.C. *LPS XXXV*, CD, abs. #1188, [6] Beyer R.A. and McEwen A.S. *LPS XXXV,* CD, abs. #1430 [7] McEwen, A.S. et al. (1999) *Nature 397,* 584-586. [8] Lucchitta B.K. and Chapman M.G. (2002) *LPS XXXIII*, CD, abs. #1689 [9] Squyres S.W. et al. (2004) *Science 306*, 1709-1714. [10] Greeley et al. (1980) *GRL 7*, 121-124. [11] Kargel G.S.and Strom R.G. (1992) *Geology 20,* 3-7. [12] Malin M.S., and Edgett, K.S. (2003) *Science 302,* 1931-1934. [13] Chapman M.G. and Tanaka K.L. (2001) *JGR 106(E5)*, 10,087-10,100 [14] Lucchitta B.K. (2004) *LPS XXXV*, CD, abs. #1881. [15] Schaber, G.G. (1973) *Proc. Lunar Sci. Conf. , 4th*, 73-92.

Figure 1. Dissected light layer. Illumination from lower left. Excerpt MOC R0903652.

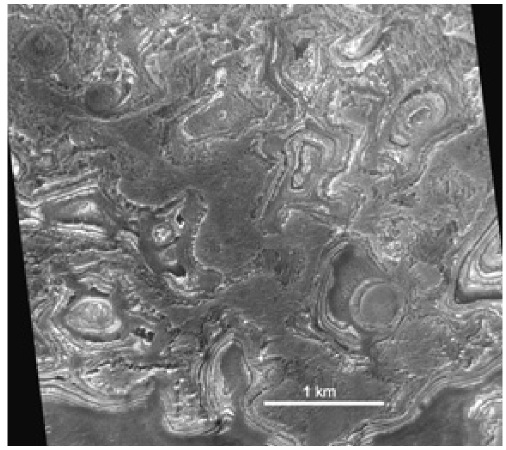


Figure 2. Sinuous channels on top of ridges, originating north of wrinkle ridge. Illumination from lower left. Excerpt MOC R1103343.

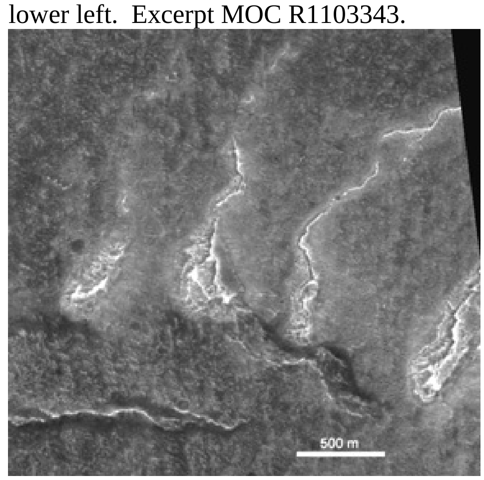


Figure 3. Flow lobe (dark arrow) from apparent wrinkle-ridge fissure (light arrow), covering light layer. Illumination from lower left. Excerpt MOC R0903652.