MARS: FRETTED TERRAIN AS ERODED EJECTA FROM THE BOREALIS MEGA-IMPACT ORIGIN FOR THE CRUSTAL DICHOTOMY

(Letter to the Editor)

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Abstract. The proximity of unconsolidated fretted terrain to the proposed basin result of the mega-impact theory for the crustal dichotomy on Mars implies the possibility this unconsolidated fretted terrain may be eroded deposits of a large ejecta blanket emplaced by the Borealis mega-impact origin for the crustal dichotomy.

Fretted terrain on Mars is considered eroded transitional terrain between the cratered uplands and northern lowlands along the dichotomy boundary (Carr, 1981). The fretted terrain has possibly resulted from a combination of mass wasting, fluvial and aeolian activity (Dimitriou, 1990). Mass wasting is very evident in the fretted terrain and appears to be the dominant process of erosion (e.g., Squyres 1978, 1979). Mass wasting in the fretted terrain appears to be result of debris creep initiated by the mix of sediment with interstitial ice which is seasonally condensed from the atmosphere in mid-latitude regions on Mars during the winter season (Squyres, 1978).

The fretted terrain located between 280 and 350° longitude and centered at 40° N latitude is considered to be the most unconsolidated of the mass wasting material (Squyres, 1979). An explanation for this area of unconsolidated material on the surface of Mars has not yet been offered. It is possible to consider one of the theories for the Martian crustal dichotomy as an emplacement mechanism for this unconsolidated sedimentation.

There are two preferred theories for the origin of the Martian crustal dichotomy (McGill and Squyres, 1991). Those two theories are the endogenic origin and the mega-impact origin proposed by Wilhelms and Squyres (1984). One of the problems with the mega-impact origin theory is that no evidence of an extensive impact debris field on Mars has been found although surficial indications of such a debris field may not be recognizable with current imagery (McGill and Squyres, 1991). The Borealis mega-impact theory has a proposed outer boundary of the original multi-ring basin result of the massive impact which has a position of close proximity to the location of the unconsolidated fretted terrain (Wilhelms and Squyres, 1984; Figure 1). This geographical proximity may indicate a genetic relationship between the Borealis mega-impact theory and the unconsolidated fretted terrain.

The reason for the unconsolidated state of this fretted terrain area may relate

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to particulate size in these sediments. A finer particulate size in these fretted terrain sediments could result in a more fluid mass flow of sediment and interstitial ice than found in other mass flow regions of Mars. The origin of this finer particulate-sized sedimentation may be result of a combination of impact emplacement and subsequent erosion.

As previously stated, a single mega-impact origin for the Martian crustal dichotomy would result in the presence of a large debris field on the planet's surface (McGill and Squyres, 1991). This impact would have taken place early in Martian history, shortly after the origin of the planet at approximately 4.55 b.y. (McGill and Squyres, 1991). Mars may have had a thicker substantial atmosphere than it has today as indicated by the presence of runoff channels on the planet's surface dating back to the period of heavy bombardment (e.g., Carr, 1981). The presence of this thicker atmosphere may have had a significant effect on the distribution of the large debris field since atmospheric drag can effect the ballistic trajectories of impact ejecta (e.g., Melosh, 1989). The close proximity of the unconsolidated fretted terrain to the proposed Borealis mega-impact implies that, if remnants of an impact ejecta blanket, the fretted terrain deposits are part of the thicker ejecta blanket deposits which would be closer to the transient crater than thinner deposits farther away from the transient crater. The impact ejecta pattern of thicker to thinner deposits the farther distance from the transient crater is consistent (e.g., Melosh, 1989).

Erosion of a mega-impact ejecta blanket on Mars is certainly expected to cause considering modification of the Martian surface, since the proposed time of the mega-impact (McGill and Squyres, 1991). Therefore, it would not be unreasonable to consider the unconsolidated fretted terrain as erosional remnants of the thicker part of this ejecta blanket. Impact cratering occurring after the mega-impact may have been the major process in the erosion of the debris field since impact gardening of the Martian regolith would be responsible for a large redistribution of surface material and reduction of a primary high topographic level of the debris field. The finer particulate size of the unconsolidated fretted terrain may have resulted from the breakup of shocked ejecta particulates by subsequent impact and other erosional processes.

Further research on the unconsolidated fretted terrain on Mars will hopefully provide more information on the nature of these deposits and contribute to the knowledge of their origin. The Mars Observer Camera experiment of the Mars Observer mission will provide higher resolution imagery of the unconsolidated fretted terrain. The Thermal Emission Spectrometer experiment of the Mars Observer mission will provide further data on the particulate sizes of the material comprising the unconsolidated fretted terrain.

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