MARTIAN CHANNEL MATERIALS AND THE FORMATION OF CHANNEL WINDS; *Robert A. Craddock[1], Ronald Greeley[1], Philip R. Christensen[1], and Frank T. Aldrich[2], [1]Department of Geology, [2]Department of Geography, Arizona State University, Tempe, Arizona 85287*

High resolution (~3 km) thermal infrared mapping using the Viking IRTM has been completed for several of the larger martian outflow and fretted channels including Dao, Harmakis, Ma'adim, Mangala, and Shalbatana Valles [1]. Previous results [2,3] have been based on thermal inertia data (I, expressed in units of 10^{-3} cal cm^{-2} sec$^{-1/2}$ K^{-1}) only. Calculation of the relative rock abundances (described by [4]) in association with the thermal inertia measurements allow several observations and interpretations to be made:

(1) Wider portions of of the channels exhibit higher overall thermal inertias than the surrounding terrains or the narrower portions of the channels. Typically these values are between 7.0 and 9.0 (effective grain-size of between 0.25 to 0.5 mm; [5]) and correspond to dark materials within the channels. Low rock abundances (<5%) were observed, suggesting that these dark materials are composed primarily of a fine-grained component close to the diameter of their effective grain-sizes. These observations help to confirm previous interpretations of dark materials being aeolian in origin [6,7].

(2) Although 10 to over 100 km across in places, Mangala Valles does not exhibit any concentration of dark materials as observed in the other channels. The low thermal inertia (4.0) corresponds to material that can be related to the large dust sink in Amazonis Planitia identified by [8,9]. Perhaps due to a lack of relief or the low settling rates for fine-grained particles after the martian dust storms, this material seems to "drape" the area and local features--including Mangala Valles.

(3) Narrow portions of the channels exhibit thermal inertias and rock abundances identical to the values observed outside of the channels. This suggests that the processes that formed the channels and the processes that formed the surrounding terrains may have both resulted in deposits that have the same effective grain-sizes and rock abundances. More likely, however, processes that have occurred after the formation of these features have worked to modify and homogenize the upper surface, or the thermal skin depth, of the regions studied. Aeolian activity is well known to be one of most active geologic process occurring on Mars at the present time, and it probably acts as the homogenizing agent by depositing similar size materials uniformially over broad areas.

(4) A notable exception to an area with high thermal inertias (I = 9.0 to 12.0; effective grain-sizes = 0.55 to 1.5 mm) that does not correspond to any dark materials is within Shalbatana Vallis. [10] have made similar observations in Ares Vallis, which is also located in the Oxia Palus quadrangle ~2,000 km to the east. Rock abundances within Shalbatana Vallis are as high as 14%; observations made by *Henry and Zimbelman* [11] show that rock abundances within Ares Vallis are ≥14%. These areas may represent channel deposits that have not been substanially modified since their emplacement; this seems unlikely however, considering that Shalbatana Vallis has obvious aeolian materials deposited within it at other locations (e.g., the large dark streak originating from the chaotic terrain/source area). A mechanism is needed whereby certain areas within the channels are kept free from debris brought in from outside aeolian processes.

These results indicate a dominance of aeolian activity in and around the channels that produces a geologic cover possibly 10's of centimeters deep. This cover does not permit an evaluation of deposits related to the channel forming events to be made by currently available thermal infrared (IRTM) data. Observations made by the IRTM do, however, allow ongoing aeolian processes within the channels to be assessed, and it is probable that the channels behave as topographic sources of local winds that have produced the observations made in this study. These "channel winds" are created and driven through a process of differential heating which occurs throughout a martian day. Differential heating is probably enhanced by the morphology of the channel, namely depth, orientation, and slope, but these variables become difficult to apply directly to the channels because their topography is extremely complex [e.g., 12,13] and because the topographic information for these features is generally poor [14]. Assuming that the channels are

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simple valleys, then diurnal variations in wind speed and direction as a function of differential heating are probably similar to those established by [15,16,17] for terrestrial valleys.

IRTM data confirm that the channels do receive different amounts of insolation due to their morphology. Sequences taken over Shalbatana Vallis during the northern hemisphere spring indicate that the sunlit channel wall can be ~42.0°K warmer in the late evening than the channel floor contained in the shadows 2.5 km below. Temperature differences of only 5.0°K in the 1 km deep Dischma Valley, West Germany created winds of ~5.0 m/sec [18]. Based on wind tunnel simulations [19], winds speeds of more than 35 m/sec need to be generated in the martian channels in order to remove dark materials with effective grain-sizes of between 0.5 to 1.5 mm (I= 8.0 to 12.0). Whether of not wind speeds this great could be produced in the channels is subject to future work, however, the assumption is that they are produced and that they can explain some of the IRTM observations made in this study:

(1) Channel winds may decrease when the channel widens or reduces slope, perhaps explaining the occurence of dark materials (I = 8.0 to 12.0) within the wider portions of the channels. These dark materials may thus be eroded channel deposits, materials that were deposited in the narrower portions of the channels after the martian dust storms, or materials that have fallen into the channels from above; all of which were subsequentially removed and re-deposited by the channel winds.

(2) Portions of Shalbatana and Ares Valles that have high thermal inertia values ($I \cong 11.0$) not corresponding to any dark materials may have lag deposits created by very strong channel winds induced by locally high topographic relief.

(3) Channel portions that have thermal inertia comparable to the surrounding terrain may have data that was gathered after the martian dust storms. This suggests that the climatic conditions necessary to produce the channel winds take time to adjust, and newly deposited materials are left on the surface. It may also be that the channel winds in those particular portions are not strong enough to remove materials.

(4) Channel winds do not seem to be produced in Mangala Valles, possibly because it is a broad low-relief channel that undergoes very little differential heating. Materials deposited on the surface after the dust storms and other processes are never removed.

(5) The dark streaks originating from and extending beyond Ma'adim and Shalbatana Valles are probably materials eroded from the channel. Future simulations of the Ma'adim channel streak may help quantify some of the physical variables of the channel winds.

Further qualitative and quantitative studies of the channel winds and future data from the Mars Observer thermal emission spectrometer (TES) may help verify the possibilites of some of the above arguments.

References

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