HIGH RESOLUTION THERMAL INFRARED MAPPING OF MARTIAN CHANNELS

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Morphologic studies [e.g., 1,2] have not yielded a unique interpretation for channel formation [3-7] because of the ambiguity between geomorphologic features and their similarities of one mode of formation with another. For example, teardrop shaped islands, or streamlined hills, have been used in support for all of the channel formation hypotheses and could easily be explained by any of them. Viking Infrared thermal mapper (IRTM) high resolution (2 to 5-km) data have been compiled and compared to Viking Visual imaging subsystem (VIS) data and available 1:5M geologic maps for several martian channels including Dao, Harmakhis, Mangala, Shalbatana, and Simud Valles in an effort to determine the surface characteristics and the processes active during and after the formation of these channels.

Mangala Valles is an approximately 850-km long channel located in the Memnonia quadrangle that cuts through the southern cratered plains from 18.5°S, 149.5°W to Amazonis Planitia at 4.0°S, 150.0°W. Its complicated pattern has been suggested as being the result of several channeling episodes [8]. Channel deposits have been mapped as being approximately 10 to 20-km in width to over 100-km towards the distal portion of the channel [9]. Shalbatana and Simud Valles debouch into Chryse Planitia in the Oxia Palus quadrangle at approximately 10°N, 40°W. Shalbatana Vallis is a sinuous channel with one large tributary and originates in chaotic terrain at 1.0°S, 45.5°W extending NNE for approximately 650-km. Its mapped channel deposits are between 10 to 25-km in width [10]. Simud Vallis originates in Hydroates Chaos at 2.0°N, 36.0°W and may have deposits extending from 20 to over 250-km in width [10] while reaching over 400-km in length. Both Dao and Harmakhis Valles debouch into Hellas Planitia in the Hellas quadrangle. Dao Vallis is a sinuous channel originating in chaotic terrain 33.0°S, 266.0°W and extends for over 500-km to approximately 40.0°S, 275.0°W. Its mapped channel deposits extend from approximately 5 to 50-km in width [11]. Harmakhis Vallis is also sinuous and originates in chaotic terrain closely associated to Reull Vallis at 39.0°S, 265.0°W. Harmakhis Vallis extends for over 450-km and has channel deposits mapped as being 5 to over 40-km wide [11].

This study has involved the use of the highest resolution IRTM data tracks available occurring at ideal conditions (range, 0 to 8,000-km; emission angle, 0° to 60°; time of day, 22 to 2 H; L_s, 0° to 200°). Typically at least two high resolution data tracks occurring at different intervals across the channels' distal extent were examined for each of the above channels; this was needed in an effort to understand the distribution and possibly the mechanism(s) for deposition of material within the channels. Channels such as Huo Hsing, Reull, Samara, and Tiu Valles, among others, have been excluded from this study due to a lack of this optimum data.

Our results show a dominance of aeolian processes active in and around the channels. These processes have left materials thick enough (10's of cm) to mask any genuine channel deposits. High resolution thermal inertia observations taken across the channels' distal extent in various locations compare well with moderate resolution values determined for the corresponding local surrounding regions [12]. A few of the channels (Dao, Harmakhis, and Mangala Valles) showed an increase in thermal inertia with increasing distal extent as observed at Kasei Vallis [13], but these increases were not unique to the area within the channel itself and could be explained as a result of regional trends in grain-size distribution.

Moreover, none of the channels included in this study showed a higher thermal inertia than their surroundings as observed at Ares [13], Ma'adim, and Al-qahira Valles [14]. Results from [13,14] indicate that certain martian channels act as topographic barriers trapping high thermal inertia materials, but instead, our results indicate that very comparable martian channels and their surrounding terrain are blanketed by deposits which are homogeneous in their thermal inertia values. However, optimum IRTM data does not cover the entire martian surface and because local deposits of high thermal inertia material may not be large enough in areal extent or may be in an unfavorable location on the planet, a high resolution data track may not always occur over these deposits. Therefore, aeolian processes may be even more active than the IRTM data tracks can always show. Observations of Ma'adim and Shalbatana Valles illustrate this point.

Ma'adim and Shalbatana Valles are comparable in length (over 900-km versus over 650-km respectively), width (10 to 25-km for both), slope (1/2° to 1° for both), and elevation (from 0 at the distal portion to over 4-km up-channel). They differ in terms of latitude, geologic units, local wind streak patterns, and slightly in the surrounding albedo. Ma'adim Vallis is in the southern hemisphere beginning at 28.0°S, 183.0°W and extending north to 16.0°S, and Shalbatana Vallis is in the northern hemisphere (see above). Ma'adim Vallis is located in hilly and cratered material, which is interpreted as being heavily impacted ancient terrain [15], and Shalbatana is in cratered plateau material, which is interpreted as being heavily impacted lava flows [10]. Local wind streak patterns for Ma'adim Vallis/Aeolis quadrangle are towards the ESE; Shalbatana Vallis/Oxia Palus quadrangle are towards the SSE. Ma'adim is located in a large low albedo region that extends from the Aeolis quadrangle west into Hesperia Planum and further [16,17]. Corresponding wind streak patterns indicate that this low albedo material could move into Ma'adim Vallis and surrounding local craters as suggested in [14,18].

Shalbatana Vallis is approximately 800-km south of a low albedo region situated in northern Chryse and Acidalia Planitias [16, 17]. Based on observed wind streak patterns, we suggest that this low albedo material could move south and remain trapped in Shalbatana Vallis and surrounding large craters. The Oxia Palus quadrangle has dark material centered at 8.0°N, 42.5°W in the junction between Shalbatana Vallis and its tributary, as well as dark material in the south sides of large local craters [19]. However, whether this material is similiar to that observed in Ma'adim and Al-qahira Valles is difficult to determine because the highest resoultion IRTM data tracks do not cover these deposits. The high thermal inertia area reported in nearby Ares Vallis [13] corresponds well to a dark deposit centered a 8.5°N, 22.0°W [20]. This supports the possibility of unobserved high thermal inertia deposits due to the position of the high resolution IRTM data tracks. Our study has also shown that with optimum available data, the mechanism(s) for channel formation will continue to remain ambiguous due to aeolian deposits masking the surface. Future studies should concentrate on the other (i.e., less than optimum) high and additional moderate (30 to 35-km) resolution IRTM data so that the remaining channels may be investigated.

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