

Evidence for an Aeolian Concentration of Crystalline Hematite Deposits Observed within Sinus Meridiani

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Introduction: Results of our previous work indicate that aeolian infilling has strongly affected the area within the hematite signature in Sinus Meridiani (SM) covered by MOC NA image m0704322 (hereafter, Image 1) and that two distinct surface units exist within this image. We expand upon this work by comparing this area with the results of a detailed examination of image m1801300 (hereafter, Image 2) located just outside the hematite region. The objective of this study is to gain a better understanding of the processes that have produced the hematite enrichment and how they differ from other surface processes in the SM region.

Approach: Impact crater size-frequency (D-n) statistics were compiled for small (<1 km diameter) craters in both narrow angle, high resolution MOC images for comparison. These statistics were used in conjunction with other observational evidence in an effort to shed light on the origin of the hematite.

Results: Image 1. In addition to two distinct regional surface units, an additional crater population consisting of buried 'stealth' craters at smaller (>80 m) diameters grading to heavily degraded craters at larger (<150 m) diameters exists. This unit (Unit 0) is an ancient ejecta blanket deposit that has experienced continual but modest resurfacing by aeolian activity over the last few billion years (Unit 1).

More recently, aeolian sediments that have encroached from the W/SW have partially buried Unit 1 forming the youngest unit, Unit 2. These units are not regionally continuous but do form zones where either Unit 1 or Unit 2 is dominant. In the Unit 2-rich area, Unit 1 surfaces have been almost completely covered by younger and darker aeolian deposits of Unit 2. In the area of Unit 1, higher albedo material is only partially covered by Unit 2 material.

Image 2 Results: Crater statistics indicate the action of some extended process, probably aeolian infilling, removing craters of all diameters. This is distinct from the total crater population statistics we derived from Image 1. However, the D-n graphs for Image 2 and Unit 2 of Image 1 are strikingly similar. Furthermore, there is an abundance of very old craters with very degraded rims and infilled cavities, similar to the indications of a Unit 0 in Image 1. Both areas also are very similar in appearance and share similar geomorphic qualities.

Conclusions: Our study indicates that the portion of SM covered by Image 2 contains geological units similar in characteristics to Unit 0 and Unit 2 of Image 1. There is no surface unit in Image 2 that corresponds with Unit 1 of Image 1. As Image 2 is outside the hematite zone, this suggests that Unit 1 is responsible for the hematite signature in Image 1. Morphological constraints and crater statistics indicate that Unit 1 is a relatively old aeolian deposit that has been partially covered by Unit 2, itself a younger aeolian deposit. Consequently, we suggest that the hematite-rich areas within SM may

not be the source areas of crystalline hematite formation at all. Instead, these areas may be regional sinks where hematite-rich sediments collected or were concentrated through density sorting similar to placer formation and then fossilized prior to the emplacement of Unit 2.