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Origin of Bright Dust Devil Track on Mars

K.Hamada (1), S. Nishizawa (2) and **K.Kurita** (1)
(1) ERI,Univ. of Tokyo,Japan USA, (2) Riken Advanced Institute for Computational Science, Japan

Abstract

Bright Dust Devil Tracks(BDDT) on Mars are an enigmatic surface signature on Mars. Although several mechanisms have been proposed why the bright albedo is formed there still exist inconsistent observed features and they are still enigmatic. The biggest enigma would be coexistence of BrightDDT(BDDT) and DarkDDT(DDDT) in regional scale and in some cases they are cross-cutting. This requires an specific explanation for the formation of both BDDT and DDDT during the short life time(several Earth months). In this study we performed detailed investigation on DDT in two regions where BDDT are abundantly observed; in and around Schiaparelli Crater and Amazonis Planitia by using CTX images. We found 1) BDDT are confined to localized regions while DDDT are distributed broadly in these regions, 2) in 10km scale both BDDT and DDDT exhibit dominant orientations, and 3) existence of banded DDT. By using these observed signatures as constraints we propose diurnal variation of local wind system such as wind direction and speed would control the formation of BDDT and DDDT.

1. Introduction

On the martian surface dust devil tracks are globally distributed ubiquitous features and this means the dust devil activity is one of the general atmospheric activity on Mars. The activity can be traced by linear tracks on the surface. The most common type has lower albedo than the surrounding areas, thus called as dark dust devil track. The dark-looking feature is interpreted as exposure of coarse grained substrate by removal of the surface fine-grained dust during dust devil activity.

There exist, however, brighter dust devil tracks though the number is quite few. Several mechanisms for the bright albedo have been proposed such as the existence of highly reflective substrate, rearrangement of the surface grains and compaction ([1],[3],[**?**]). Particularly [5]proposed a physical mechanism of modification of the arrangement of surface grains through field surveys of terrestrial BDDT, But all these mechanisms can not fully explain the coexistence of BDDT and DDDT in the same region.In this study we performed detailed investigation on DDT in two regions where BDDT are abundantly observed.

2. Analysis

We selected two regions for the analysis of BDDT; Region A in and around Schiaparelli Crater and Amazoni Planitia. Both regions are known to have higher density of BDDT([3],[**?**]). Relatively uniform coverage of CTX/MRO in these regions with the average resolution of 5m made homogeneous survey possible. Fine structure of the DDT is analysed in HiRISE/MRO images. We constructed population density map for DDT in the bin size of 0.125°.

3. Results

Here we report selected results in Schiaparelli regions about population density for BDDT and DDDT, orientation distribution of BDDT and DDDT.

3.1. Distribution

Most of BDDT are concentrated in the south regions of the crater while DDDT are distributed homogeneously. The distribution of BDDT corresponds to the dark region in THEMIS Day IR map. This trend is clearly recognized in Figure 1. The upper figure is THEMIS Day IR map and the middle exhibits the population density of BDDT, the lower exhibits that of DDDT. The region designated as A is an island of dark region where localized distribution of BDDT can be seen clearly. This strongly suggests the formation of BDDT is controlled by the surface characteristics but the important feature is not only BDDT but also large numbers of DDDT are observed in this region. Simple exposure mechanism can not explain this coexistence.

3.2. Orientations

Figure 2 shows one of the presentative images in Region A. Both BDDT and DDDT can be seen. The most

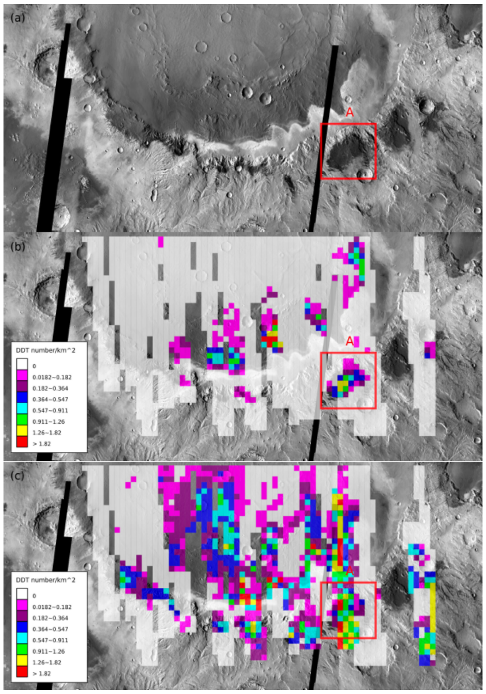

Figure 1: Distributions of BDDT(middle) and DDDT(lower).

remarkable feature is the orientation of DDT; most BDDT are aligned in NW-SE direction while DDDT are in NE-SW. This feature is particularly prominet in Region A.

Figure 3 summarizes the histogram of the orientation for BDDT and DDDT.

4. Probable Formation Mechanism for BDDT

The coexistence of BDDT and DDDT would be constraint for the formation mechanism of BDDT. Several models are proposed such as the existence of bright substrate such as ice and salts just below the surface. But the coexistence requires further explanation. The model of preferred orientation of the disturbed surface grains also requires further explanation. The key would be preferred orientations of BDDT and DDDT. This suggests difference in the formation time in the diurnal wind cycle.

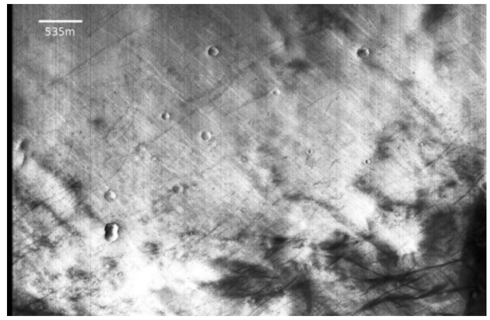

Figure 2: Coexistence of BDDT and DDDT

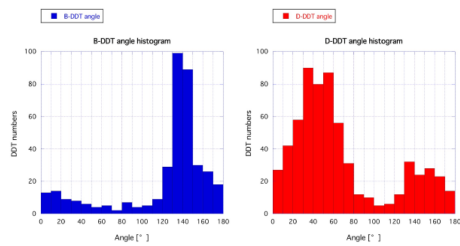

Figure 3: Orientation histograms for BDDT and DDDT in SE of Schiaparelli Crater.

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