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Bright Dust Devil Tracks on Earth: Implications for their Formation on Mars.

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Dust devils are formed from unstable near-surface warm air generated by insolation and are common on Earth and Mars [1]. Tracks left by passages of active dust devils are abundant on Mars, but rarely observed on Earth. On Mars, dust devil tracks are mostly darker than their sur-roundings, although some of them are brighter [2]. Here, we report about the formation of bright dust devil tracks (BDDTs) on Earth based on first observations and in situ analyses [3]. We also discuss possible implications of our results for the formation of BDDTs on Mars. BDDTs were observed in the Turpan depression desert located in northwestern China. In the evening of 17 April 2010 a rainfall of about five minutes occured in the normally very dry region. On 18 April 2010 we observed active dust devils leaving bright tracks instead of dark tracks, observed the days before [4]. The study region is characterized by a ripple-bedform surface and a dune surface with grain sizes ranging from coarse sand to clay. The short duration rainfall changed the upper surface due to raindrop impacts forming aggregates, which is a well known process on Earth [5]. The aggregates are up to $\sim$1 cm in diameter and consist of coarse sand, fine sand, silt and clay grain sizes. The cohesion of the aggregates is very weak, probably because of the dry climate in the study region. We observed that passages of dust devils can easily destroy the aggregates, which results in smooth surface textures within the BDDTs in contrast to the rough surface tex-tures next to the tracks. These differences in surface textures caused albedo differences due to changes of the photometric properties of the surface. The smooth textures within the tracks ap-pear brighter than the rough textures outside of the dust devil track. The formation process of BDDTs on Mars is still unclear. The BDDTs on Mars reported by [6,7,8] appear in regions with a thick dust cover, based on the dust cover index [9]. We conclude that the occurrence of BDDTs seems to be limited to dusty areas on Mars. Rainfall on Mars under current climatic conditions is impossible. However, there might be alternative processes which lead to the formation of dust aggregates on Mars, including dust electrification [10,11]. Weakly-bound dust aggregates held together by van der Waals, electrostatics, or other interparticle forces have been observed in the "soils" at Gusev crater with the Microscopic Imager (MI) onboard the Mars Exploration Rover (MER) Spirit [12,13,14]. The observed surface dust occurs as very fragile, porous, sand-sized aggregates, which can be easily entrained and disaggregated by dust devils [14,15]. Based on our observations of the formation of BDDTs on Earth, the changes in photometric properties between the track (smooth texture) and outside the track (rough texture) might cause the observed albedo differences and lead to the formation of BDDTs on Mars.

[1] Balme, M. and Greeley, R. (2006), Rev. Geophys., 44, doi:10.1029/2005RG000188. [2] Malin, M.C. and Edgett, K.S. (2001) JGR, 106, 23429-23570. [3] Reiss, D. et al. (2010) Icarus, 211, 917-920. [4] Reiss, D. et al. (2010) GRL, 37, L14203, doi:10.1029/2010GL044016. [5] McIntyre, D.S. (1958), Soil Sci., 85, 261-266. [6] Cushing, G.E. et al. (2005) GRL, 32, doi:10.1029/2005GL024478. [7] Cantor, B. A. et al. (2006) JGR, 111, doi:10.1029/2006JE002700. [8] Hoffer, M.P. and Greeley, R. (2010) LPS, 41, Abstract 2713. [9] Ruff, S. W. and Christensen, P.R. (2002) JGR, 107, doi:10.1029/2001JE001580. [10] Greeley, R. (1979) JGR, 84, 6248-6254. [11] Merrison, J. et al (2004) PSS, 52, 279-290. [12] Herkenhoff, K. E. et al. (2004) Science, 305, 824-826. [13] Herkenhoff, K. E. et al. (2006) JGR, 110, doi:10.1029/2005JE002574. [14] Sullivan, R. et al. (2008) JGR, 113, doi:10.1029/2008JE003101. [15] Greeley et al. (2010) JGR, doi:10.1029/2010JE003608.