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Surface changes observed by the Mars Exploration Rovers

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1. Abstract

The Mars Exploration Rovers Spirit and Opportunity observed changes in the surface soils and dusts as a result of local wind activity. The dustier Spirit landing site documented a series of dust deposition and cleaning events on the rover and surrounding terrain, redistribution of fines excavated by the rover wheels, small ripple migrations, disappearance of rover wheel tracks, and albedo changes. Opportunity also observed rover tracks fade, redistribution of sands associated with a streak exterior to Victoria crater, and small changes at Santa Maria crater. All such events emphasize the active nature of Mars at both landing sites.

1. Introduction

Throughout the Spirit and Opportunity missions, changes in albedo occurred often as atmospheric dust either settled onto or was eroded from the surrounding terrains or the rovers themselves. Dust cleaning events on the rovers resulted in significant improvements in solar array-generated power. Rover tracks were observed to fade as seasonal wind events allowed sand transport. Disturbed soils were also observed to change as winds redistributed sand grains. We describe here some of the surface changes observed by the rovers as examples of wind-related processes active on Mars today.

1.1 Spirit observations

While investigating the Paso Robles soil on Husband Hill in 2005, the rover experienced a dust cleaning event associated with the onset of wind gusts and dust devils. The solar arrays were substantially cleaned of dust (Figure 1), and the nearby rocks and soils exhibited significant changes in single scattering albedo [3]. The El Dorado ripple field south of Husband Hill showed a series of albedo variations throughout the Spirit mission, and smaller ripples of basaltic sand nearby were observed to migrate [5]. Sulfate-rich soils excavated by the rover wheels also showed changes (Figure 3) resulting from wind events and/or chemical changes after exposure to the martian atmosphere [4,6]. Rover tracks were removed by high winds associated with 2007 regional dust storms (Figure 3)

1.1 Opportunity observations

Prominent low-albedo wind streaks extending from north end of Victoria crater were investigated in 2007, and subtle changes in the sands were observed [2], as well as modification of the rover's tracks (Figures 4-5) [1]. Pancam images acquired before and after the 2011 solar conjunction revealed subtle changes near Santa Maria crater (Figures 6-7) such as the formation of slope streaks, and minor apparent changes to ripples interior and exterior to the crater.

2. Figures

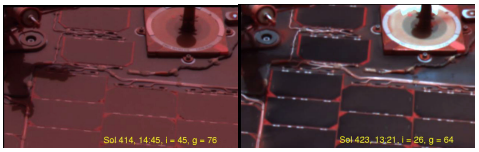

Figure 1: Dust cleaning event on Spirit rover on Sol 420 resulted in noticeable improvement in available solar array power, as evidenced by these images of the rover deck solar panels and Pancam calibration target acquired on Sols 414 (*left*) and 423 (*right*).

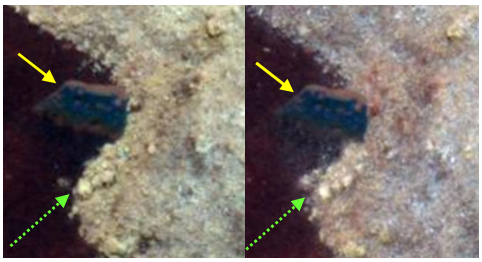
Figure 2. Spirit Pancam false-color views (independently color stretched) of disturbed sulfate-rich soils in the J.W. Powell area, showing changes

between Sols 1864 (left) and 1866 (right). Below the rock fragment (~3 cm across; yellow arrow), changes in the soil textures (dashed green arrow) may result from wind and/or chemical disaggregation [4,6].

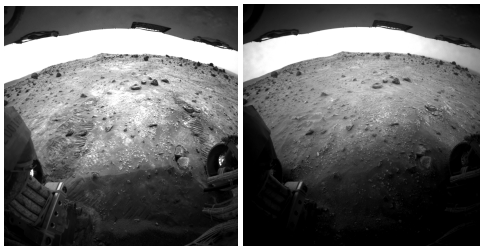

Figure 3. Rear hazard avoidance cameras showing disappearance of Spirit rover tracks between Sols 1250 and 1272.

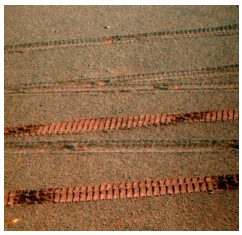

Figure 4. Opportunity Sol 1657 Pancam false-color comparison of two sets of tracks near Victoria crater. Younger tracks (foreground) were made on sol 1289; more eroded tracks were made on sols 951 and 955.

Figure 5. Opportunity Pancam images of Alicante area near Victoria crater on Sols 1143 (left), 1150 (right) [2].

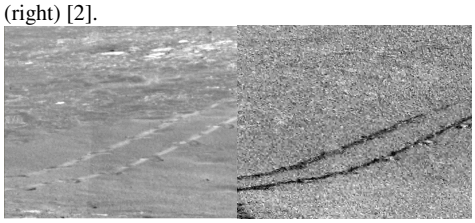

Figure 6. Opportunity rover tracks on Sol 2510 (*left*) and ratio of Sol 2492/2510 images (*right*) near Santa Maria crater (taken at same time of sol), demonstrating brightening of tracks from dust deposition during solar conjunction.

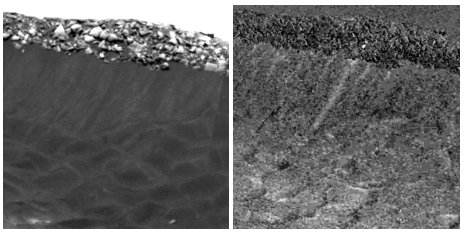

Figure 7. New slope streaks in the interior wall of Santa Maria crater (*left*, Sol 2510) are emphasized in the Sol 2492/2510 image ratio (*right*) in which bright areas represent regions where dust was removed.

3. Summary and Conclusions

The MER rovers observed many wind-related changes to surface features at both landing sites, revealing a Mars more dynamic at small scales than previously appreciated. Many changes involved redistribution of dust on the rover and nearby terrain. Dust is mobilized more easily because it occurs as low-density, sand-sized aggregates [5]. Elevated wind speeds also redistributed sand grains, erasing rover tracks and causing migration of small ripples on the surface [2]. Although Spirit's mission has ended, Opportunity will continue to monitor the surface for changes, particularly when poised on the rim of Endeavour Crater.

Acknowledgements

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References

[1] Geissler, P.E., et al. JGR, 113, E12S31, 2008JE003102, 2008.
[2] Geissler, P. E., et al., JGR,115, E00F11, 2010JE003674, 2010; Geissler, P.E. et al, Eolian Activity in the Martian Tropics , this volume.
[3] Johnson, J.R., et al., JGR, 111, E02S14, 2005JE002494, 2006.
[4] Rice, M. S., et al., JGR, 2010JE003683, 2010.
[5] Sullivan, R., et al., JGR, 113, E06S07, 2008JE003101, 2008.
[6] Wang, A., Z. Ling, JGR, 116, E00F17, 2010JE003665, 2011.