A CATALOG OF ROCK ABRASION FEATURES AT THE MER LANDING SITES: PRELIMINARY RESULTS FROM SPIRIT AND COMPARISONS WITH ORBITAL WIND DIRECTION INDICATORS

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Introduction

Aeolian abrasion is the dominant rock weathering mechanism on Mars. Ventifacts, defined as rocks whose shapes or textures have been modified by windblown particles, are the manifestation of this weathering mechanism and are found on Earth and Mars. Studies of ventifacts and related features at the well-traversed Spirit Mars Exploration Rover (MER) landing site provides insight into rock abrasion rates, the variability of abrasion as a function of location relative to local topography, and comparisons between the mechanisms by which abrasion operates in the Martian versus the terrestrial environment. Herein we provide a record and interpretation of results, so far, of ventifacts and related features at the Spirit landing sites using Pancam data (Figure 1). The use of MOC NA and THEMIS VIS images are also used to observe and interpret relevant wind direction features (Figure 2). Results at this point are qualitative, with quantitative analysis ongoing.

Methods:

Spirit Pancam images showing aeolian geologic textures such as pitting, elongated pitting, flutes and facets were recorded (Figure 1). MOC NA and THEMIS VIS images were used to measure wind direction from the azimuth of wind streaks (light and dark), dunes, and ripples. The relations of these azimuths to surrounding topography were noted. The image data base was larger than that used by [1], thereby increasing areal coverage relative to this earlier study.

Results:

The catalog created from this research provides a thorough database of abraded rocks and local wind patterns at the Spirit landing site. Of the rocks imaged by Spirit through Sol 551, approximately 75% are faceted and 20% contain aeolian textures. These categories overlap, with some rocks being both faceted and pitted. Rocks lacking either attribute are a minority. Groupings of rocks generally have facets of similar trends and plunges and are commonly aligned with the soil wind tails.

Orbital images of dunes and ripples in the vicinity of Spirit site have a WNW-ESE azimuth (Figure 2).

Due to the difficulty of confidently identifying slip faces in some transverse bedforms, bidirectional arrows are indicated. Nearby wind streaks from small crater rims and other topographic highs are, however, trending ESE to SE, indicating that dominant local winds in the current era come from the WNW. By comparison, work of [2] for the first 90 sols indicated most abraded rocks were faceted on their NW sides, consistent with these larger-scale wind indicators.

Interpretations:

Wind has significantly modified most of the rocks at the Gusev landing site, making this environment similar in appearance to many desert ventifact localities on Earth. The fraction of rocks that exhibit abrasion features is much greater than at Viking and Pathfinder. This is in contrast to published work for the first 90 sols of the mission that indicated ventifact abundance was less than at Pathfinder [2]. Comparisons to Opportunity, for which research is ongoing, are more difficult to make because many of the rocks in Meridiani have presumably been completely removed by the wind [3] and, being siliclastic [4], probably have a lower resistance to abrasion compared to the basalt at the other sites.

Figure 1: Pancam images portraying pitting (upper left), elongated pitting (lower left) and faceted features (lower right).
Figure 2: MOC WA image of Gusev crater. The “x” marks the Spirit landing site. Arrows show direction of inferred winds based on feature orientation. Yellow arrows are light wind streaks, blue are dark wind streaks, and red are dunes and ripples. Where arrows are double-sided, only vector orientation, not direction, could be determined definitively.