How Martian winds make rocks walk

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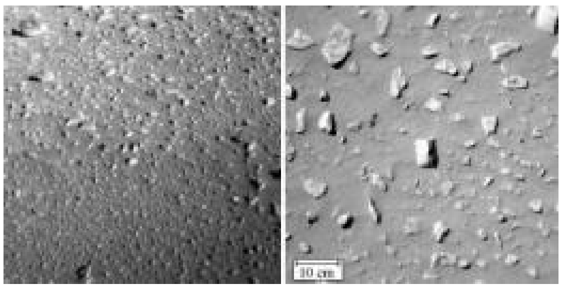


These Spirit Rover camera images of the intercrater plain between Mars' Lahontan Crater show uniformly-spaced small rocks, known as clasts. The image on the left is a portion of NAVCAM image ID 2 N 137561115 EFF 47 00 P1827 L0 M1. The image on the right is a portion of Pancam image 2 P 137636467 EFF 47 DQ P2514 R1 C1. Credit: Geological Society of America.

Rocks on Mars are on the move, rolling into the wind and forming organized patterns, according to new research.

The new finding counters the previous explanation of the evenly spaced arrangement of small rocks on Mars. That explanation suggested the rocks were picked up and carried downwind by extreme high-speed winds thought to occur on Mars in the past.

Images taken by the Mars Exploration Rover Spirit show small rocks regularly spaced about 5 to 7 centimeters apart on the intercrater plains between Lahontan Crater and the Columbia Hills.

Although Mars is a windy planet, it would be difficult for the wind to carry the small rocks, which range in size from a quarter to a softball, said Jon D. Pelletier, associate professor of geosciences at The University of Arizona in Tucson.

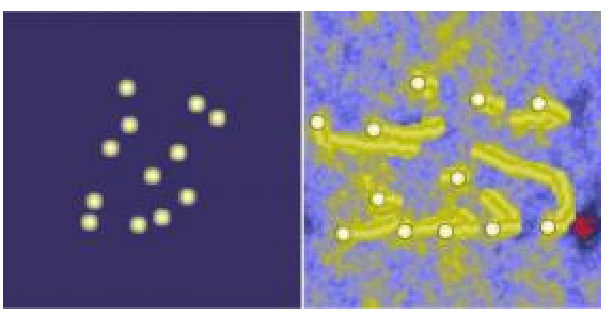
Pelletier and his colleagues suggest that wind blows sand away from the front of the rock, creating a pit, and then deposits that sand behind the rock, creating a hill.

The rock then rolls forward into the pit, moving into the wind, he said.

As long as the wind continues to blow, the process is repeated and the rocks move forward.

This explanation does not require extreme winds, Pelletier said.

"You get this happening five, 10, 20 times then you start to really move these things around," he said. "They can move many times their diameter."



These images show how the simulated rocks ended up being spaced by the computer simulations. The image on the left is the starting position. The image on the right shows the final spacing of the rocks. The yellow streaks behind the rocks represents the sand piled up behind the rocks by the wind. Credit: Jon D. Pelletier, The University of Arizona

The process is nearly the same with a cluster of rocks.

However, with a cluster of rocks, those in the front of the group shield those in the middle or on the edges from the wind, Pelletier said.

Because the middle and outer rocks are not directly hit by the wind, the wind creates pits to the sides of those rocks. Therefore, they roll to the side, not directly into the wind, and the cluster begins to spread out.

Pelletier, Andrew L. Leier of the University of Calgary in Alberta, Canada, and James R. Steidtmann of the University of Wyoming in Laramie report their findings in the paper, "Wind-Driven Reorganization of Coarse Clasts on the Surface of Mars." The paper is in the January issue of the journal *Geology*.

When Leier was a graduate student at the UA, he told Pelletier about an experiment on the upwind migration of rocks that Steidtmann, Leier's thesis advisor, had conducted.

Steidtmann had studied upwind migration about 30 years ago. He used a wind tunnel to see how pebbles on sand moved in the wind. Steidtmann's research showed that the rocks moved upwind and that over time, a regular pattern emerged.

Pelletier wasn't sure how he could use the idea.

Some time later, while attending a lecture that showed pictures of uniformly organized rocks on Mars, Pelletier recalled his conversations with Leier about Steidtmann's experiments -- and it all came together.

To investigate the regular patterns of the rocks on Mars, Pelletier combined three standard numerical computer models. The first modeled air flow, the second modeled erosion and deposition of sand and the third modeled the rocks' movement, he said.

"We can model it on the computer to try to get a better sense of what's actually happening and to provide another sort of documentation or justification for the idea," he said.

Pelletier was the first to combine the three standard models and apply them to this new problem.

He also conducted what is known as a Monte Carlo simulation, which applied his combination numerical model over and over to a random pattern of rocks to see how the rocks ultimately end up.

Pelletier ran the simulation 1,000 times. The rocks ended up into a regular pattern 90 percent of the time, he said.

As an independent verification, he also compared the pattern predicted by the numerical model to the distances between each rock and its nearest neighbor in the Mars images. The patterns of the Martian rocks matched what the model predicted.

Pelletier said upwind migration of rocks also occurs on Earth.

Co-author Leier wrote in an e-mail, "Something as seemingly mundane as the distribution of rocks on a sandy, wind-blown surface can actually be used to tell us a lot about how wind-related processes operate on a place as familiar as the Earth and as alien as Mars."

However, because plants and animals can alter wind patterns and rearrange rocks, it is much more difficult to study this process on Earth, Pelletier said.

Of Mars' mysterious walking rocks, he said, "This is a neat problem, but there are bigger fish to fry."

Pelletier plans to apply the same numerical models to larger features on Mars such as sand dunes and wind-sculpted valleys and ridges called "yardangs."

He said understanding the climate history of other planets and where those climates went awry can help in understanding our own climate system.

Source: University of Arizona

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