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The Formation of Martian Dune Gullies by Dry Ice: Field Experiments

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Long, narrow grooves found on the slopes of martian sand dunes were first reported in 2002 by Mangold and are most likely the result of
large blocks of dry ice. Imaging by the Mars Orbiter Camera (MOC) on the Mars Global Surveyor and the High Resolution Imaging Science Experiment (HiRISE) on the Mars Reconnaissance Orbiter has demonstrated that these linear gullies are found within many dune fields and on sandy crater walls within the mid-laj.nield@soton.ac.uktitudes on pole-facing slopes. These slopes typically range from 7 to 12 degrees (well below the angle at which a dry granular material is expected to flow. Over the past six Mars years, HiRISE images show that existing grooves have elongated and new grooves have formed at the start of each spring, demonstrating that these features are active in the present-day Martian climate.

The dry ice block hypothesis is consistent with the observed morphology, location, and current activity: that blocks of carbon dioxide ice break from over-steepened cornices as sublimation processes destabilize the surface in the spring, and these blocks move downslope, carving out leveed grooves of relatively uniform width and forming terminal pits.

To test this hypothesis, we have performed experiments at two dune fields, Grand Falls in Arizona and Coral Pink in Utah. Dry ice blocks were released and on a variety of slopes and their positions tracked in three dimensions using video cameras. In addition Terrestrial laser scanning was used to create digital terrain models and to map the changing morphology of the surface. The data is combined to produce trajectory data for each block measured as arc length down the thalweg as a function of time. The results show that steady movement is possible on slopes of as little as five degrees.