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The Importance of Dunes on a Variety of Planetary Surfaces

The Fourth International Planetary Dunes Workshop: Integrating Models, Remote Sensing, and Field Data
Boise, Idaho, 19–22 May 2015

Dark dunes within Mars's Herschel Crater, most likely composed of basaltic sand. The dunes are barchans; steep faces on the bottom edges of these features show the dominant direction of prevailing winds. Pits and smaller ripples on the dunes point to complex interactions between multiple aeolian and other geological processes.

Scientists observe aeolian bed forms, or dune-like structures, throughout the solar system in a range of locations, from bodies with only transient atmospheres, such as comets, to places with thick atmospheres, such as Venus and the Earth's ocean floor. Determining the source of sand and the different dune formations that result is thus important to understanding solar system and planetary evolution.

Curiously, aeolian bed forms appear to maintain similar morphologies over a large range in size, from centimeter-scale sand ripples to kilometer-scale megadunes. Their occurrence across environments and their diversity in size suggest that a variety of processes all produce similar landforms. This phenomenon, called equifinality, requires an interdisciplinary approach to research.

To advance understanding of aeolian bed forms and processes, 60 scientists and students representing eight countries (from four continents) gathered in May 2015 in Boise, Idaho, to discuss remote sensing observations, in situ studies, and computer models of aeolian activity.

The workshop, the fourth in a series focusing on planetary dunes, brought together terrestrial and planetary researchers from diverse backgrounds with the goal of fostering collaborative interdisciplinary research. The small-group setting facilitated intensive discussions of many aspects of aeolian processes on Earth, Mars, Venus, Titan, and even comets.

Transverse Aeolian Ridges

Especially noteworthy discussions were related to features called transverse aeolian ridges (TARs), aeolian bed forms on Mars that may have formed either as large ripples or small dunes. The research on TARs is ongoing, including the recent hypothesis that TARs may have formed through deposition of dust carried by wind, in a manner comparable to antidunes in a fluvial setting on Earth.

> The presence of vast sand seas of large, linear dunes on Titan highlights the importance of understanding megadunes in the solar system.

A field trip on 20 May to the Bruneau Dunes allowed workshop attendees to observe reversing dunes, another possible Earth analogue for TARs.

Importance of Megadunes

The presence of vast sand seas of large, linear dunes on Titan has highlighted the importance of understanding megadunes in the solar system, attendees noted. These landforms, reaching more than 1 kilometer in width, may be long-lived, yet currently active, and thus can dominate many locations on planetary surfaces.


Jani Radebaugh

Workshop attendee Devon Burr, walking in the saltation cloud on the summit of a dune during the workshop's field trip to Idaho's Bruneau dune field.

Speakers highlighted how conditions required for megadune growth are not fully understood, although the importance of winds that elongate the dune through down-axis sand transport is becoming clearer. New studies using fieldwork as well as physical and mathematical modeling are quickly improving understanding of linear dune initiation and propagation.

The Search for Sand Sources

Sand sources for dunes remain an important topic for dune research, as these vary widely. Several talks focused on these diverse sources.

On Earth, most dunes are made from the slow, steady process of the creation of quartz grains through plate tectonics–related uplift and volcanism followed by erosion. On Mars, the sand is basaltic and likely from explosive volcanism, impact cratering, and the action of wind. On Venus there appear to be few dunes, perhaps because atmospheric constraints limit the volume of sand created by explosive volcanism and impact cratering. On Titan, sand production continues to be a question, but ultimately, these materials are thought to be derived from the photodissociation of methane in the upper atmosphere.

For more details, visit http://bit.ly/dunes_workshop.

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