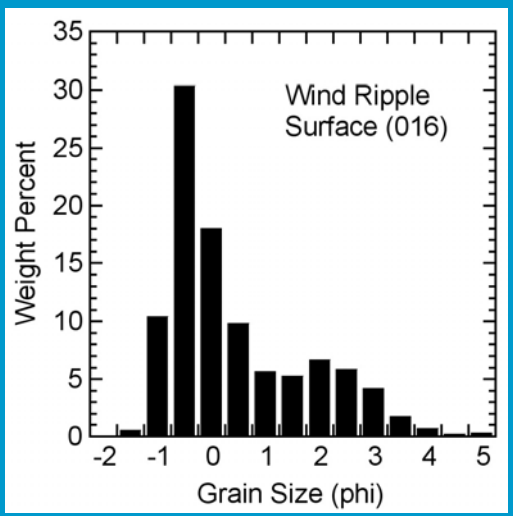
Volcaniclastic Aeolian Dunes at Sunset Crater Volcano: Applications for Martian Dune Morphology and Dynamics

Snow covers Sunset Crater volcano, December 2009

Large coppice or hummock dune near Sunset Crater, AZ



Histogram of a wind ripple surface sample showing a bimodal grain-size distribution

For more information contact:
Donald M. Hooper, Ph.D.
DHooper@swri.org
(210) 522-6649

Southwest Research Institute®

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Principal Investigator(s):	Donald Hooper Ronald McGinnis Marius Necsoiu Cynthia Dinwiddie Debashis Basu
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Project Brief

Statement of Problem: **Most dune systems formed from wind or aeolian activity on Earth are dominated by quartz grains; however, the current understanding is that many dunes on Mars are composed of a different mineralogy derived from basalt and andesite. Terrestrial examples of these basaltic-type aeolian dunes—such as at Sunset Crater volcano—serve as analogs. Sunset Crater in north-central Arizona (USA) is a 900-year-old scoria-cone volcano in which widespread deposits of coarse to fine basaltic ash (tephra) have been redistributed into dune forms by wind action.**

Approach and Accomplishments: **Field work collected essential geomorphological and sedimentological data to establish a baseline for the type and morphometry of dunes, physical properties (e.g., grain size and composition), saltation pathways, and interactions with topography. Coppice dunes, wind ripples, sand streaks, and falling dunes were investigated. Most analyses focused on coppice dunes, which form when saltating particles are trapped by clumps of vegetation and create sand hummocks. They are related to shadow dunes on Mars in which sand accumulates in the lee of boulders or breaks in slope. In the laboratory, sieving of collected volcaniclastic sands was used to determine sorting and grain-size distributions. Granulometric analysis is a fundamentally descriptive measure of surface and sedimentary processes. It is important for understanding the mechanisms operating during sediment transport and deposition, as well as the distance transported. Field work at Sunset Crater has mapped the distribution and defined the dimensions of coppice dunes and laboratory analysis has identified possible controls that grain size has on dune morphology.**

Client Benefits: **There are numerous questions regarding dunes on Mars that could be answered by thoroughly studying analogous dune environments like the Sunset Crater area. SwRI scientists established a baseline for the type and morphometry of dunes, physical properties, sediment transport, and topographic interactions. This baseline information is helping to focus Mars analog studies as well as increase the understanding of sand/saltation transport and sediment history in the Sunset Crater region.**