Ventifact Education: Bridging Science and Public Awareness of Wind-Sculpted Landscapes

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Introduction

Ventifacts are rock formations sculpted by the abrasive action of wind-driven sand in arid environments. Ventifacts offer insight into historical and prehistorical wind patterns, past climate conditions, and wind erosion processes. They also function as analogs for studying planetary geology, thereby contributing to our broader understanding of landscape evolution and environmental change.

Ventifacts represent one of the many diverse geological formations across Earth. Engaging students with ventifacts can foster an enthusiasm for science and spark curiosity about our planet's history and processes. They provide tangible examples of landform evolution and offer opportunities for hands-on learning experiences. This is why they are exceptional educational tools for teaching about geology, climate, and environmental science.

PhD student Diana Valenzuela Davila holds reflectors to improve brightness in shadowed regions of Silver Lake, CA, ventifact. 12-bit circular targets surround ventifact to asses scale errors.

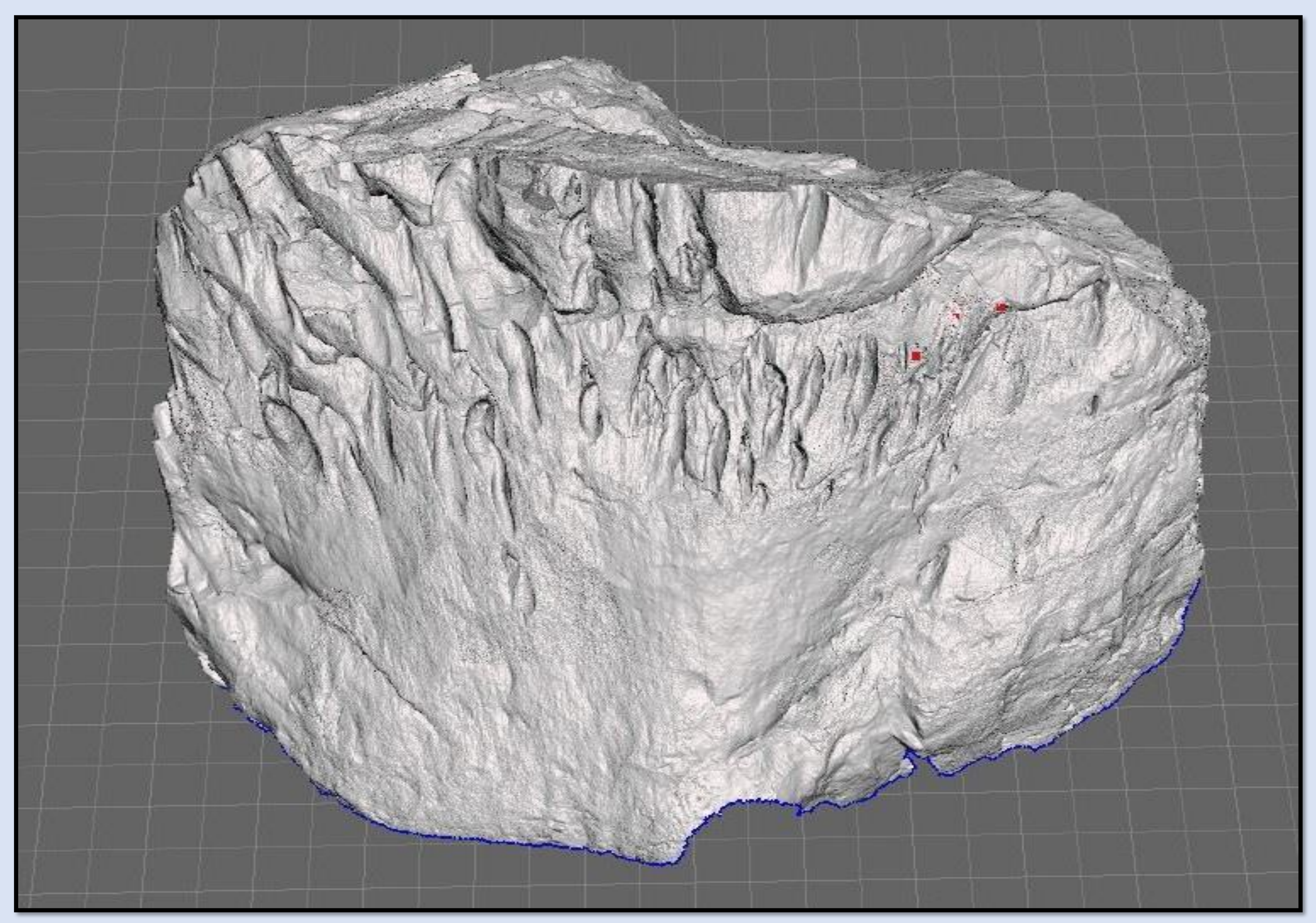
Silver Lake, CA, is an arid desert environment characterized by strong, consistent winds, exposed rock surfaces, minimal vegetation, and a dry climate - typical of where ventifacts are found.

Methods

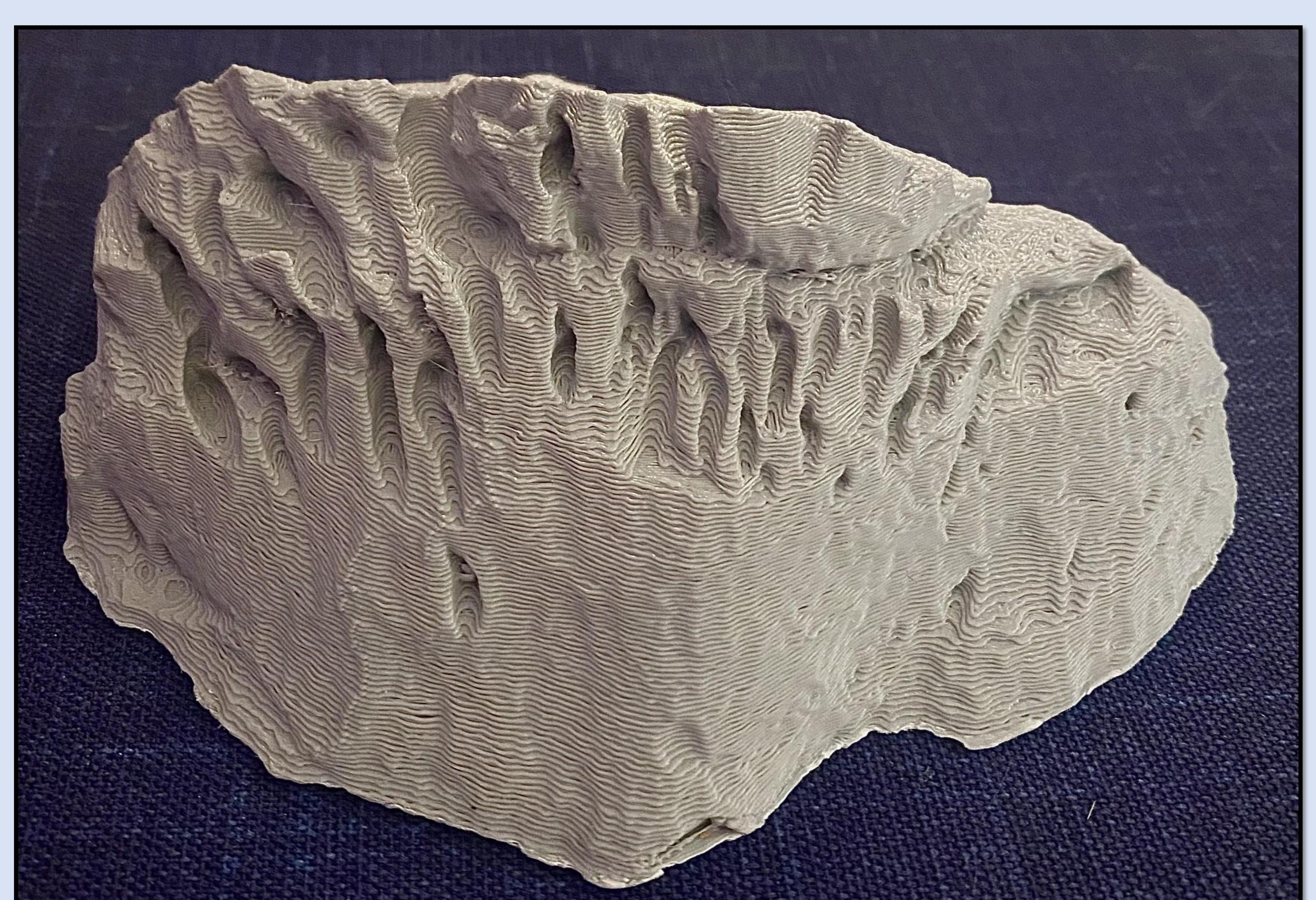
In this study, ventifact samples were collected from two desert locations in southern California: Garnet Hill, nestled in the Coachella Valley north of Palm Springs, and Silver Lake, north of Baker. The collection is comprised of 10 samples, five obtained from each site.

To generate accurate models with sub-millimeter resolution, Agisoft Metashape software was used to spatially locate common pixels between images and generate a dense 3-D point cloud. These 10 digital models were then refined using MeshMixer and Blender 4.0 software before being converted into a suitable format for 3-D printing at the UTA FabLab.

The image above captures Ventifact 7 at Garnet Hill, CA, in its natural field setting



Shown above is the visual structure-from-motion, photorealistic digital model of ventifact 7



Displayed above is a handheld 3D-printed sample representing Ventifact 7 from Garnet Hill site

Discussion

In addition to making the STL files easily accessible to the public, these educational resources will be submitted to the Science Education Resource Center (SERC) for inclusion on the Teaching with Augmented and Virtual Reality (TAVR) website. Furthermore, as many as 50 ventifact models will be 3-D printed for distribution to classrooms lacking access to such resources.

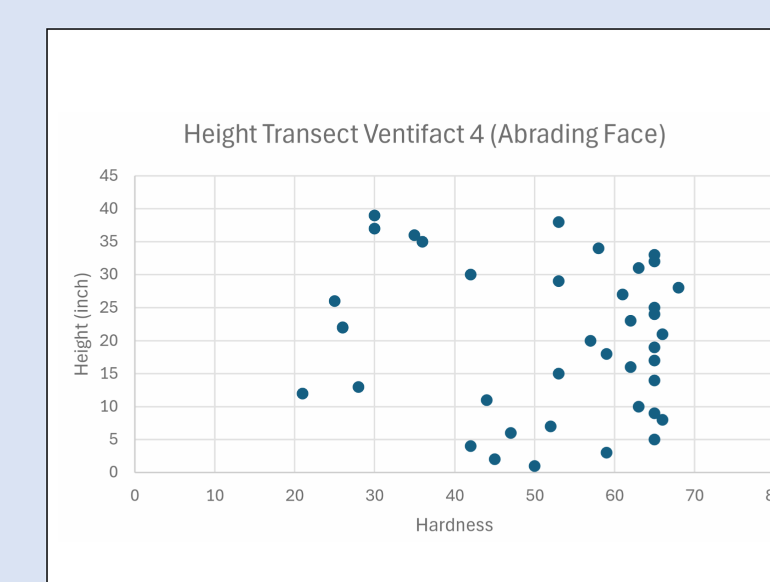
These educational materials will then receive additional promotion at the 2024 Geological Society of America (GSA) Annual Meeting.

Educating about ventifacts contributes to a broader understanding of geological processes, particularly those related to wind erosion. This understanding helps people comprehend how landscapes are shaped over time. Changes in ventifact morphology, distribution, or abundance can serve as indicators of environmental change, such as shifts in wind patterns or climate variability. Understanding ventifacts can raise awareness about environmental issues such as desertification and land degradation, which are pertinent in regions with arid climates.

Future Work

This study will complement another investigation employing geochemistry methods to estimate long-term erosion rates on ventifacts. By analyzing the erosional features of ventifacts, researchers involved aim to utilize optically stimulated luminescence and cosmogenic radionuclide dating techniques to gain insights into the erosion rates that have shaped these geological formations over time.

Undergraduate student Julia Alvarez testing the hardness of ventifact 2 using an 'N'-type Schmidt hammer



The graph above illustrates the hardness of Ventifact 7 acquired from a lateral transect using the 'N'-type Schmidt hammer

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