View from the top of Vulcan at the Albuquerque volcanic field. *Photo courtesy of Linda Brown.*

Lite Geology

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This edition of Lite Geology highlights several places described in the New Mexico Bureau of Geology publication: *The Geology of Northern New Mexico's Parks, Monuments, and Public Lands*. L. Greer Price, featured "Through the Hand Lens" geoscientist, edited *The Geology of Northern New Mexico's Parks, Monuments, and Public Lands* book. This issue of *Lite Geology* also details research, hikes, historical geology, and even a movie, framed by these settings. By spotlighting "The *Northern Parks Book*" we hope to inform our readers of the many beautiful landscapes and natural resources in our state that have shaped our history and culture. We also seek to get readers excited about the upcoming New Mexico Bureau of Geology publication: *The Geology of Southern New Mexico's Parks, Monuments, and Public Lands*, scheduled to be released in 2019.

Earth Briefs: The Valles Caldera National Preserve

The Valles Caldera National Preserve, which became a part of the National Park System in 2015, features a 13 mile wide caldera that formed during the eruption of a supervolcano 1.25 million years ago, and a world-class, post-eruption resurgent dome. The Preserve is located in north-central New Mexico about 18 miles west of Los Alamos in the middle of the Jemez Mountains. Visitors flock to the Preserve to see the exceptional volcanic landscapes, enjoy the beautiful vistas across grassy meadows, and view the abundant wildlife that includes large elk herds. Scientists from a wide variety of technical fields (aside from the geological sciences) are also drawn to the Preserve because of its unique ecology, hydrology, and upland setting. One group of scientists from the University of Arizona

has created a collaborative network called the Jemez River Basin Critical Zone Observatory in order to study "the thin veneer of Earth that extends from the top of the forest canopy to the base of weathered bedrock." This area was chosen as an observatory because Redondo Peak, the resurgent dome in the center of the caldera, creates a "unique situation where headwater streams of the Jemez River originate on different aspects [hillslope orientations] of the same mountain, providing the opportunity to probe contrasting microclimates on a uniform parent material with a common precipitation regime." Study of the Jemez River watershed in the Rio Grande basin is paired with study of a second watershed in the Santa Catalina Mountains northeast of Tucson, Arizona, in the Colorado River basin. The National Science Foundation provides funding for these investigations.

Most of the geoscience-related critical zone research in the Valles caldera focuses on determining the thickness of soil and weathered rock (regolith) on volcanic features in the Jemez Mountains using reflection seismology, calculation of rates of regolith production and erosion in this mountainous setting, and measurements of the rate of erosion of regolith after wildfires. These studies have documented that soil and regolith in watersheds on Redondo Peak are generally thicker on ridgelines and slopes and are thinner beneath the valley bottoms; this pattern mimics the depth to the groundwater table observed beneath the topography of mountain ranges. Furthermore, soil and regolith are thicker on north-facing slopes.

Measurements of the thickness of regolith deposits on hillslopes have at least two practical applications. First, this information can be used to properly design the capacity of manmade dams and retention ponds that mitigate the effects of debris flows that form in the aftermath of devastating forest fires, such as the 2000 Cerro Grande and 2011 Las Conchas fires that scorched large parts of the Jemez Mountains. Second, thick regolith deposits profoundly influence groundwater/surface water interactions in high-elevation settings by storing snow-melt water that later provides summer base-flow to mountain streams. Isotopic studies of groundwater show that the water residence times in mountain watersheds that face north are longer than those that face south.

View of the Valle Grande from Los Griegos on the southern rim of the Valles Caldera. The dead trees in the foreground were burned in the 2011 Las Conchas fire. This area is near the origin of that fire. *Photo by Shari Kelley.*

For more information about this project, go to criticalzone.org/catalina-jemez/about/

View from Los Griegos on the south side of Redondo Peak, a resurgent dome that formed when the floor of the Valles Caldera was pushed upward by rising magma after the caldera-forming eruption 1.25 million years ago. The Jemez River Basin Critical Zone Observatory focuses its investigations on this mountain. *Photo by Shari Kelley.*