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By Bob Grant

Socompa towers in the background of this photo taken on a National Geographic Society-funded expedition to the volcano in 2009.
Courtesy of Preston Sowell

The windswept peak of Socompa Volcano, on the border of Argentina and Chile, is not a nice place to visit. Parching winds scour the mountain's gravelly slopes, temperatures can swing from below freezing at night to more than 38 degrees Celsius during the day, and the scarcity of oxygen atop the more than 6,000-meter peak fends off all but the hardiest of mountaineers. You certainly wouldn't want to live there. That is, unless you happened to be a microbial community inhabiting the thin crust of soil covering loosely-packed gravel, and imbibing your nutriment from gases seeping up from the heart of the dormant lava cone.

"It just looks like the surface of Mars," says University of Colorado at Boulder microbial ecologist Steve Schmidt, of Socompa's lofty peak. "Up to about 5,000 meters, you'll see an occasional lizard maybe, but above that there's really nothing." But that didn't stop Schmidt, with the help of scientists and skilled mountain climbers, from discovering complex microbial communities thriving very near the desolate summit of Socompa—the highest microbial communities found anywhere on Earth (*Appl Environ Microbiol* 75:735-47, 2009).

In 1984, scientist Stephan Halley stumbled across

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In 1984, scientist Stephan Halloy stumbled across six large mats of vegetation—clumped communities of autotrophs including mosses, liverworts and algae—clustered around fumaroles very near Socompa's top. "That just sort of blew my mind because the summit is 6,060 meters," Halloy, now the Nature Conservancy's Southern Andes science coordinator, remembers (*Arc. Alp. Res.* 23:247-62, 1991). These organisms could shed new light on autotroph physiology, from how plants survive such harsh conditions to how they propagate and establish what Schmidt calls "islands in a vast sea of dryness." In the years following Halloy's observation, however, no scientists had returned to the inhospitable summit. Schmidt and his team wanted to confirm the existence of Halley's mats, and look for associated microbial communities.

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Scientists find life teeming in a place that "looks like the surface of Mars."

Schmidt had to return to Colorado to teach as the expedition, which began in 2005, got rolling, so didn't make the two-day journey from Salta, Argentina, by four-wheel drive vehicle to the base of Socompa. But his graduate student at the time, Elizabeth Costello, made it to base camp. However, Costello had trouble acclimating to the elevation and the extreme conditions at Socompa, and couldn't reach the top. "We were being very careful not to kill anyone," Schmidt recalls.

Preston Sowell, a Colorado-based environmental consultant and avid mountain climber, and a photographer from *National Geographic* were the only two team members who could fulfill the mission's goals. The two picked along the mountainside, following in the footsteps of Halloy's 1984 expedition. They braved the high winds, traversed a snowfield, used a jagged rock to cut steps into an icy slough, and eventually found Halloy's vegetation mats. "I was crawling at times in order to work," says Sowell, who was listed as a coauthor on the paper describing the discovery. "I was able to grab a few [soil] samples and a few photos." Sowell, who has climbed Himalayan peaks and collected data in steamy South American jungles, says that Socompa is the most difficult—and intriguing—field site he's ever visited.

Schmidt probed the soil samples using PCR and DNA sequencing, and identified microbes—including several bacteria and fungal species—thriving in, under, and around the mats. Schmidt has even found an undiscovered species of mite (likely the highest living of its kind) that still awaits identification and taxonomic description.

Finding flourishing biological communities in such inhospitable environments lends hope to the search for life on distant planets or moons. "It's amazing that they were able to find these little oases of such high diversity," says Anna-Louise Reysenbach, a microbial ecologist at Portland State University.

But the clock is ticking for Socompa. Temperatures have been increasing there, rainfall levels have dropped, and ice fields and lakes are disappearing, according to Halloy. Climbers have already damaged one of the delicate plant mats that dot the summit. Schmidt and his team returned to Socompa earlier this year to try to devise a way to probe the landscape via satellite, and Schmidt made it to the top. "There's so much we don't know about these communities," says Sowell. "If we can find a way to make this remote sensing project work, then we can potentially find other sites to investigate."

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