Danger in Paradise
The lesser-known hazards of volcano geotourism

Sara E. Pratt

In November 2000, rangers at Hawaii Volcanoes National Park made a gruesome discovery. The bodies of a man and a woman, in an advanced state of decomposition, were found near the site where lava from the Kilauea eruption flows into the sea, sending up plumes of scalding white steam. The area, aptly named the Eruption Site, is littered with chunks of tephra, a glassy volcanic rock, which are formed and ejected violently into the air when the 2,000-degree-Celsius lava is quenched by seawater.

The two bodies were 100 meters inland from the Eruption Site and they displayed no visible signs of trauma, so rangers knew that the victims had not been hit and killed by flying tephra. “That one was a bit of a mystery,” says Travis Heggie, an eruption duty officer at the time, who was part of the team tasked with recovering the bodies and investigating the incident. The bodies were placed in slings and airlifted off the lava bench by helicopter. An autopsy report two days later revealed the cause of death: pulmonary edema, or swelling of the lungs, due to the inhalation of hydrochloric acid. The autopsy also noted that the advanced decomposition occurred where skin was exposed to the air, or covered by only a single layer of clothing. The tissue had been decomposed, not by natural postmortem decay, but by acid rain.

Lava itself releases toxic gases, including carbon dioxide, sulfur dioxide, hydrogen sulfide and hydrofluoric acid. When lava interacts with seawater a variety of other toxic gases are produced, including hydrochloric acid, which is highly corrosive. The lava haze, or laze, as it is called, can be deceptively deadly.

“It looks like a pretty white steam cloud, but it’s not. It’s acid,” Heggie says, adding that the accident was all the more tragic because the woman worked at the park and likely knew about the risks of the plume, which can quickly change course with the winds.

Kilauea flowing into the ocean.
Between 1992 and 2002, there were 40 fatalities, 45 serious injuries and 53 minor injuries reported within Hawaii Volcanoes National Park. Each year, tourists are injured, not just by volcanic laze, but by a variety of hazards — some mundane and predictable, others bizarre and unexpected. Overall, incidents in Hawaii have decreased since 2004, Heggie says, when stricter safety guidelines were implemented and tourist safety education efforts were ramped up.

However, the hazards facing tourists at volcanoes are not unique to Hawaii. Globally, tourist injuries and deaths at volcanoes are on the increase, driven by the rise in popularity of volcano geotourism.

“When we look at the tourist numbers, we are talking about mass tourism in potentially dangerous areas,” says Patricia Erfurt-Cooper, a lecturer in tourism planning at Ritsumeikan Asia-Pacific University in Japan, and co-author of the 2010 book “Volcano and Geothermal Tourism.”

Volcano Geotourism on the Rise

More than 100 million people visit volcanic sites around the world every year. In the United States, Hawaii Volcanoes National Park, where Kilauea has been erupting almost continuously since 1983, attracts 2 million visitors; the geothermal features at Yellowstone National Park attract roughly 3 million visitors a year. More than 1 million people visit dormant Mount Rainier in Washington, which is one of 16 “Decade Volcanoes” identified by volcanologists as part of the UN International Decade for Natural Disaster Reduction as being worthy of study due to their histories of large, destructive eruptions and their proximity to large population centers.

Decade Volcanoes also happen to be some of the most popular tourist destinations, Erfurt-Cooper says, part of the trend of volcano tourism, a subtype of geotourism, which is an offshoot of the ecotourism that has become popular over the last few decades. Many governments are promoting volcano tourism to bring in money, and many volcanoes are being designated as World Heritage sites and Geoparks, which makes them more attractive destinations for tourists, says Erfurt-Cooper, whose next book, “Volcanic Tourist Destinations: Geoparks of the World,” is due to be published this month.

In addition, there is also a growing trend toward adventure tourism, in which people are pushing the envelope further and further, she says. Climbing an active volcano is just one such extreme attraction that appeals to millions of people every year. That is due, in part, to a rise in reality adventure- and travel-based TV shows focused on exotic locales, including volcanoes.

Health Risks of Vog

In addition to the hydrochloric acid in volcanic laze that killed a couple at Kilauea’s Eruption Site in November 2000, Hawaiian tourists and locals alike have to contend with the pollutants found in volcanic smog, or vog.

During active eruptions, Kilauea can emit up to 30,000 tons of sulfur dioxide per day. The particulates and sulfurous acid aerosols are then carried on prevailing winds over towns on the island. Vog has been found to cause lung irritation and exacerbate other respiratory ailments such as asthma, lung cancer and chronic obstructive pulmonary disease.
“To view an active volcano erupting is a once-in-a-lifetime experience for most people,” says Tobias Schorr, a photographer and tour guide with Volcano Discovery based in Troisdorf, Germany. The company, founded by volcanologist Tom Pfeiffer, leads adventure and educational travel tours, including tours to active volcanoes in Italy, Greece, Iceland, Hawaii, Indonesia, Vanuatu and Guatemala.

Safety Risks of Volcano Geotourism

The level of risk posed by any individual volcano varies widely based on a number of factors, including the type of volcano, whether it is active or dormant, the weather conditions, and the physical condition of the tourist.

“Any mountain can pose a danger to inexperienced tourists,” Erfurt-Cooper says. Because volcano tourism usually involves travel to remote mountain destinations and activities like skiing, hiking and mountain climbing, many of the accidents and injuries sustained on volcanoes — from mild cuts and abrasions to broken bones to life-threatening conditions like hypothermia and altitude sickness — occur on dormant volcanoes.

At active volcanoes, the risks are compounded. Among active volcanoes, Kilauea is probably the safest for two reasons: it is an effusive-type eruption, and the National Park Service provides tourists with enough information on “how to stay safe in an unsafe environment,” Erfurt-Cooper says. “Hawaiian eruptions, for example, have lava gently oozing out in certain areas and this can be watched from close-up,” she says, “preferably under supervision of park rangers or trained tour guides. Yet people still are injured and some die there.” Flying rocks, killer gas clouds and scalding hot ocean waves are not on the minds of most vacationers who want to relax and enjoy the beautiful scenery. This leads to a lackadaisical attitude about safety that is not only a barrier that park rangers and tour guides must overcome in order to educate tourists about safety risks, Heggie says, but also a serious risk factor in itself.

In 2004, Heggie published the first comprehensive study of the health and safety issues facing lava hikers in Hawaii. “A lot of the injuries we saw were hiking-related,” he says. “Silica will just cut you to shreds.” But the study also showed just how unprepared tourists can be. In a survey of more than 800 hikers leaving the lava fields he found that many had pre-existing health issues,
including heart problems and asthma, which can be exacerbated by gaseous fumes and particulates emanating from lava vents. He also found that more than half were novice hikers, unprepared for the rigors of an up-to-10-kilometer hike across the lava fields. Most of the hikers were ill-prepared, lacking flashlights, sufficient water, first aid kits and sunscreen. Seven percent were wearing dress shoes or high heels. Five percent admitted they were intoxicated. In addition, 93 percent admitted hiking beyond the warning signs posted 500 meters from the Eruption Site where lava enters the ocean.

The concerns are obvious. Tourists unprepared for a basic hike would be even more ill-equipped to face volcanic and geothermal risks such as unexpected eruptions, toxic gas emissions or scalding water. The most apparent hazard at an active volcano is exposure to lava, which can reach 2,000 degrees Celsius. Yet tourists are often intent on getting as close to it as they can. “I think it’s the fascination of seeing creation and destruction at the same time,” says Heggie, who is now a professor of Sport Management, Recreation & Tourism at Bowling Green State University in Bowling Green, Ohio.

The cooler products of lava also cause many injuries — for example, when tourists venture out onto the surface of thin, unsupported lava benches or tubes. In April 1993, two tourists died at Kilauea’s Eruption Site when a lava bench — which looked solid from above but was unstable below — collapsed.

Heggie recalls one incident in which a woman walking over a lava tube broke through the thin crust and fell nine meters to the floor of the tube breaking both of her legs. That incident happened during one of the park’s rare closures and the

Common Sense Is Not Enough

At Hawaii Volcanoes National Park, the National Park Service provides safety information to visitors who attempt to cross the lava flows to the bench where the lava flow meets the sea. Still, nearly a half dozen people have died at the coastal entry in the past 10 years and dozens more have been injured.

The fact-sheet, titled “Viewing Lava Safely: Common Sense is Not Enough,” warns tourists that although Kilauea is known for its approachable lava flows, the volcano is unpredictable and life threatening. Across the top of the flyer, in capital letters, is written: “PLEASE READ CAREFULLY — YOUR LIFE MAY DEPEND ON IT.” In mid-December 2011, lava from Kilauea’s Pu’u ‘Ō’ō vent once again reached the ocean within Hawaii Volcanoes National Park boundaries, at the newly named West Ka’ili’ili ocean entry. A release dated Dec. 14 reveals the dichotomous role of the park: both inviting tourists to visit the volcanic natural wonders and, at the same time, warning them to stay away.

Currently, several streams of lava are pouring into the ocean, providing dramatic views. Visitors who stay after dark can also see channels of lava flowing down the pali and across the flow field, but conditions can change at any time. Hikers need to heed all warning signs and ranger advisories, and be aware of cracks and crevices, sharp terrain and rain-slick pahoehoe lava and other hazards. Steam plumes produced by lava entering the sea contain fine lava fragments and acid droplets that can be harmful. Lava deltas can collapse with little warning, produce hot rock falls inland, and generate large local waves.
woman entered the park illegally, Heggie says, via a backcountry trail with a local she had paid to get her into the park. “Even when we tell people they can’t go out there, they go out and do it anyway,” he says.

In addition to the hazards of the volcanic landscape are the unseen perils of the volcanic atmosphere. Volcanic gases are hot, toxic and undetectable, and large volumes can be emitted and carried by winds to areas that may have had breathable air just moments before. Gases can also be trapped in underground pockets or lava tubes, and emitted suddenly when a lava bench collapses or a skylight opens.

“An often forgotten danger is volcanic gas in fumaroles,” Schorr says. There have been casualties in Italy and in Greece, where two people were killed by gas at the Pausanias baths in Methana, a volcanic peninsula about 50 kilometers southeast of Athens.

At Mammoth Ski Area in California, three ski guides were killed in 2006 as they were fencing off a known fumarole, which had been covered by a deep snowfall, in order to prevent skiers from falling into it. The first victim broke through the snow and fell seven meters into the fumarole, and the second and third victims attempted to save him. All three were asphyxiated. Readings taken by the fire department a few hours after the accident showed the carbon dioxide level inside the fumarole was more than 100,000 parts per million (ppm) with a carbon monoxide concentration above 40,000 ppm.

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— Patricia Erfurt-Cooper, Ritsumeikan Asia-Pacific University

Volcano Geotourism around the World

Accurate statistics on fatalities and injuries due to volcano geotourism worldwide are hard to come by. No international organization tracks such incidents and each country handles tourism safety differently.

When a vent a few kilometers from Eyjafjallajökull started erupting in Iceland a month before the main volcano blew in April 2010, tourists flocked to see the show, enjoying helicopter tours and catered dinners. Heggie, who was also the Public Risk Management Specialist and Tort Claims Officer for the National Park Service until 2007, says that in countries like Iceland where there is no tort culture, tourists are largely responsible for their own safety.

Schorr says that of all the countries in which he guides, “only Hawaii in the U.S. is strict about
guidelines.” The U.S. national parks generally have the best safety strategies for visitors, Erfurt-Cooper agrees, “although not necessarily in enough languages to get the message across.” However, she adds, “many people don’t listen to advice and will attempt to explore active volcanic environments on their own, which is asking for trouble.”

Heggie credits the more extensive safety guidelines in the U.S. to both a tort culture and the flawed assumption that the national parks are inherently safe, which leads many tourists to flaunt the safety guidelines. “The attitude in the U.S. is: ‘This is a national park; our government wouldn’t let us do anything that wasn’t safe,’” he says.

In Japan, warning signs and safety information at active volcanoes such as Mount Unzen and Mount Aso is usually provided in four languages (English, Korean, Chinese and Japanese), which covers the majority of people visiting Japanese volcanoes, Erfurt-Cooper says. But even Mount Aso has claimed a few victims who suffered respiratory problems due to the toxic fumes from the crater.

“There is a lot of room for improvement regarding safety information for international tourists elsewhere,” Erfurt-Cooper says. In developing nations, however, many governments are reluctant to establish guidelines or to publicize safety issues or incidents for fear of diminishing the flow of tourist dollars, Heggie notes, and tour guides are largely unregulated or monitored for safety.

In Central America, dozens of people die on volcanoes each year. Between 2007 and 2011, 29 tourists died on Arenal in Costa Rica, mainly from exposure to volcanic gases but also falls from the crater rim and even heart failure. In Nicaragua, at least 72 tourists have died on the slopes of Cerro Negro over the last five years. Although it hasn’t erupted since 1999, the volcano has recently become
**Cruisin’ for a Bruisin’**

From 1986 when they first started until 2007 when they were banned, commercial bike tours were one of the most popular activities in Haleakala National Park in Hawaii. Each year, about 100,000 people signed up with one of the five commercial bike tour companies, which ran 40 tours per day. Participants were driven to the summit of the dormant volcano, at an elevation of 3,050 meters, often at sunrise. Bikers would then don helmets, straddle unfamiliar bikes and push off from the summit. Riders coasted 50 kilometers down the volcano (only a third of the distance inside the park) on a paved, steeply graded two-lane road with a double-yellow line, no shoulder, and traffic.

In 1998, a fatality prompted a safety review of commercial bike tours. In March 2007, a 44-year-old woman was killed when she went off the side of the road and crashed into rocks. Then in September 2007, a 65-year-old woman lost control of her bicycle on the downhill run from the crater parking lot, crossed the double-yellow line and was struck and killed by the oncoming van of another commercial bike tour company. It was the second bike tour fatality in the park that year. There were also three other serious accidents in the same period, including the near-fatal crash of a tourist, and one in which an experienced guide wrecked, sustaining serious injuries. In October 2007, the National Park Service suspended tours within the boundaries of the park indefinitely pending a safety review.

A March 2008 safety review compared the Haleakala bike tours to a variety of commercial recreational activities at other national parks, including mule riding, horseback riding and whitewater rafting and found the injury rates for all activities were lower than those for commercial bicycle tours on Haleakala. The single exception was a higher fatality rate for whitewater rafting on the Arkansas River.

The National Park Service decided to continue the ban on commercial bike tours within the park. However, tours from lower elevations, outside of the park boundaries, are still operation.

**Safety Guidelines for a Growing Industry**

There currently are no international safety guidelines for volcano tourists. Challenges to implementing them include the wide range of volcano types, local environments and language barriers.

**In 2007, a tourist from Hong Kong fell to her death while taking a photo on the rim of Mount Nyiragongo in the Democratic Republic of Congo.**

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**Biking down Maui’s Haleakala is no longer allowed inside the park.**

**Sandboarding is a popular tourist activity on Cerro Negro in Nicaragua.**
But some people are working to change that. For the first time, a session on Volcano Tourism was convened at the 6th International Cities on Volcanoes conference held in Tenerife, Spain, in 2010. Erfurt-Cooper moderated the session, which addressed safety concerns and practices and risk management.

Schorr warns that the burgeoning popularity of volcano geotourism may prove dangerous to itself, as small, educational tours led by experienced guides familiar with volcanology give way to large bus tours that disgorge hundreds of tourists at volcanic destinations that are treated as mere sightseeing stops. “Mass tourism is the biggest danger at volcanoes anywhere on the planet,” Schorr says. “We can handle a group up to 20 persons, but not hundreds of tourists.”

If people are going to go out exploring volcanoes, they need to choose knowledgeable guides who have previous experience with a particular volcano and who respect the possible dangers, Schorr says. “The most casualties take place in nonguided tours,” he says. Volcano Discovery uses safety equipment, including good footwear, gas masks and helmets, but the most important safety precaution the guides employ, he says, is first conducting “a strict study of local seismic stations in cooperation with local scientists.”

Second, people need to be aware of the hazards, especially when visiting volcanoes that can form lava domes and erupt catastrophically, such as Mount Merapi in Indonesia, Soufrière Hills in Montserrat, and Mount Rainier and Mount Shasta in the Cascades. “All volcanoes that can erupt violently are dangerous, especially where tourists may not have any prior warning,” Erfurt-Cooper says.

However, volcanoes can be monitored and the risk of an eruption can be assessed by geoscientists — so for the most part, tourists can be kept away. What worries Schorr are the other less predictable hazards of adventure travel.

“The highest risks are terrorist attacks, like in Ethiopia, Congo or Guatemala; unsafe airports, like in Africa or Indonesia; or traffic and diseases,” Schorr says. “The volcanoes themselves are not the biggest danger.”

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