science for a changing world

10 Ways Mount St. Helens Changed Our World

The Enduring Legacy of the 1980 Eruption

The May 18, 1980, catastrophic eruption of Mount St. Helens began with a large, deep-seated landslide (debris avalanche) followed by a near-horizontal blast and pyroclastic flow. The vertical eruption column, shown here, reached a height of 15 miles. U.S. Geological Survey photograph by Austin Post.

Mount St. Helens was once enjoyed for its serene beauty and was considered one of America's most majestic volcanoes because of its perfect cone shape, similar to Japan's beloved Mount Fuji. Nearby residents assumed that the mountain was solid and enduring. That perception changed during the early spring of 1980. Then, on May 18, 1980, following 2 months of earthquakes and small explosions, the volcano's over-steepened north flank collapsed in a colossal landslide and triggered a near-horizontal blast, followed by a powerful vertical eruption. The high-speed, rock-filled, and gas-charged blast quickly evolved into a gravitationally driven pyroclastic flow, which leveled millions of trees, stripped them of their branches and bark, and scoured soil from bedrock. The vertical eruption that followed fed a towering plume of ash for more than 9 hours. Winds carried the ash from the volcano and deposited it hundreds of miles away. Lahars (volcanic mudflows) buried river valleys. These catastrophic events caused the worst volcanic disaster in the recorded history of the conterminous United States. The events violently transformed Mount St. Helens and left a lasting impression on the hearts and minds of people living in the Pacific Northwest and beyond.

Mount St. Helens rises above Spirit Lake in 1979 (top) and 1982 (bottom). Photographs by U.S. Forest Service and U.S. Geological Survey, Lyn Topinka.

The May 18, 1980, eruption of Mount St. Helens was a historic event that fundamentally changed the way we see volcanoes. For some people, the eruption was a singular experience in which they were momentarily involved. For those who lost family and friends, homes, and livelihoods, their lives were profoundly altered. For scientists, the event accelerated efforts to improve our knowledge of explosive eruptions, volcanic hazards, and the long-term disturbances to landscapes, rivers, ecosystems, and population centers. For local governments, it stimulated discussions and preparation for emergency responses.

Between the memorable events of May 18, 1980 and 1986, Mount St. Helens erupted more than 20 times, pumping fresh lava onto the crater floor to create a new lava dome and beginning the process of mountain rebuilding. Between 2004 and 2008, the volcano continuously erupted, oozing near-solid lava that further refilled the crater. This fact sheet returns us to 1980 and highlights some significant facets of the enduring legacy of Mount St. Helens' catastrophic eruption.

U.S. Department of the Interior
U.S. Geological Survey

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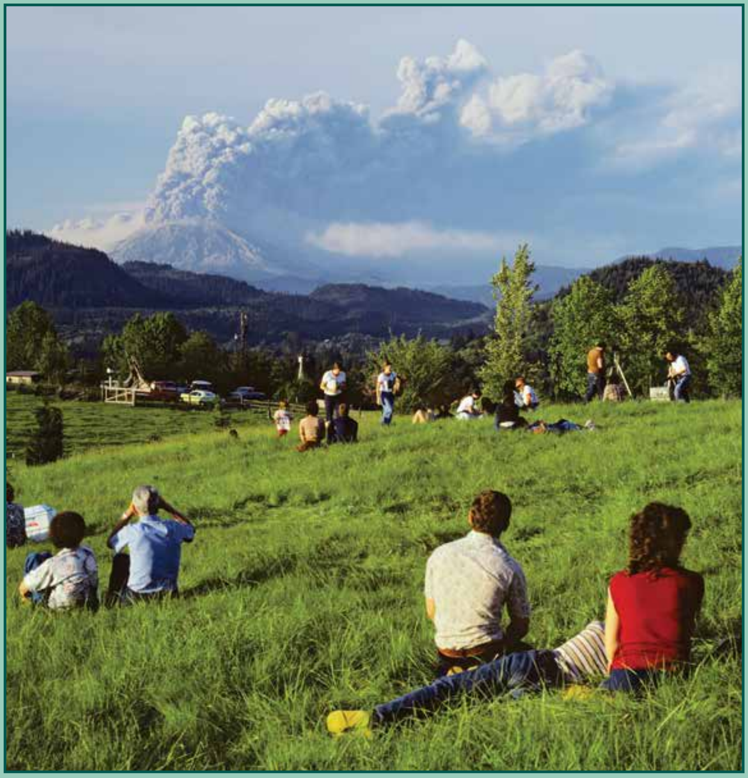
01 Residents and the world gained a profound appreciation for the destructive power of volcanoes.

A series of small earthquakes shook Mount St. Helens from March 16 to 20, 1980. Over the course of the following week, a mile-long crack split the summit and steam explosions opened a small crater. Mount St. Helens had awakened for the first time since 1857. From late March into early May an excited public eagerly listened to news reports of low-level eruptive activity from this formerly quiet volcano. Local residents sat in open fields and perched on rooftops to photograph small explosions of ash and steam. An atmosphere of excitement and anticipation accompanied conversations about potentially larger eruptions. Mount St. Helens took center stage in the theater of geologic change, visible to an audience of millions. Yet this volcanic activity was just the warm-up act.

On May 18, 1980, at 8:32 a.m., three sonic booms and a rapidly spreading cloud of ash were among the first indications of a catastrophic eruption. Hikers at Chinook Pass, 60 miles to the northeast, observed the advancing ash cloud but could not see its full extent. Around 9:00 a.m. clumps of ash began to fall. Surprised, they swept fallen ash into lunch bags, assuming they were collecting rare souvenirs. On their trip home, ash blocked the sun and turned daylight to darkness. Upon arrival home in Yakima, Washington, 85 miles northeast of the volcano, an inch of ash covered everything. West of Mount St. Helens, lahars (volcanic mudflows) swept logs, boulders, trucks, and homes downriver like toys. Fearing collapse into the muddy torrents, officials closed bridges carrying Interstate 5 traffic and the Burlington Northern's West Coast railroad tracks.



During the early evening hours of May 18, 1980, residents watched the waning ash plume of Mount St. Helens from a viewpoint about 25 miles southwest of the volcano near Amboy, Washington. Photograph copyright by Tom Leeson, used with permission.

Poor visibility brought northbound cars to a stop on Interstate 5. Southbound truck drivers (left) coped with reduced visibility by driving their vehicles side-by-side to slow traffic and minimize ash resuspension. U.S. Geological Survey photograph by Carolyn Driedger, May 25, 1980.

02 Officials pioneered new ways to reclaim communities from volcanic ashfall.

During the eruption, ash composed of tiny particles of rock and volcanic glass drifted downwind and filled the sky across eastern Washington, Idaho, and western Montana, reducing visibility and making driving unsafe. Officials closed Interstate 90 from Seattle to Spokane, Washington, for 1 week and airlines cancelled more than 1,000 commercial flights. Once travel resumed, truckers on interstate highways drove slowly and side-by-side to minimize the stirring up of ash and maintain a smooth flow of traffic. Smaller eruptions of ash in late spring and summer prolonged economic losses and inconvenience.

In pre-Internet 1980, City of Yakima authorities searched their local library for information about volcanic ash impacts and cleanup. When they found none, they devised their own ash-cleanup strategy, and worked with others to document their experiences. Residents swept ash off house roofs, sidewalks, and driveways, and pushed it into piles. Officials used more than 120 borrowed trucks, sweepers, and graders to move the piles of ash to dump sites, where they covered it with topsoil. Multiple public spaces now exist atop ash disposal sites.

The Mount St. Helens eruption was the first to bring the health effects of volcanic ash to serious scientific attention. Researchers from around the world studied ash impacts and methods for cleanup in agriculture, transportation, communication, electrical power systems, and water treatment facilities. Their published findings and observations from more recent eruptions (see Additional Resources) are available online to aid anyone in the world coping with volcanic ash.

Lupines were one of the first plant colonizers in the devastated area because of their ability to live in nutrient-poor soil conditions. Photograph by Harriet Kauffman, August 2011, used with permission.

03 Communities downstream learned how a day-long volcanic eruption can continue to disturb river systems decades later.

On May 18, 1980, lahars (volcanic mudflows) raced down river valleys, overtopping banks and flooding low-lying valleys. Sediment clogged channels in the Toutle River, in the Cowlitz River downstream, and eventually in the Columbia River, 75 miles downriver from the volcano. In the Columbia River the accumulation of sediment reduced the water depth from 40 to 14 feet, halting ship traffic, which caused severe economic distress to ports. In the Cowlitz and Toutle Rivers, accumulated channel sediment resulted in raised water levels and reduced the flood protection provided by local levees.

In the years after the eruption, river water flushed record-breaking amounts of sediment downstream. Long-term measurements by U.S. Geological Survey (USGS) scientists show that the rate of sediment transport was among the highest in the world for several years. To minimize accumulation of this sediment downstream, the U.S. Army Corps of Engineers dredged the channels and built a structure on the North Fork Toutle River to trap sediment but let water flow freely. For more than a decade this remarkable structure prevented sediment from flowing downstream and entering the lower Cowlitz River. Sediment has now filled in the reservoir to the level of the spillway; the structure still holds back some sediment but with reduced efficiency.

The U.S. Army Corps of Engineers dredged extensively to restore the channels of the Columbia River for navigation and the Toutle and Cowlitz Rivers for flood control. Piles of dredged debris remain visible along Interstate 5. U.S. Geological Survey photograph by Lyn Topinka, February 5, 1981.

Today, rivers continue to wash enormous loads of sediment downstream at rates a few tens of times greater than before the eruption. These sediment loads continue to pose challenges to authorities responsible for flood protection and fisheries, and they may persist for decades to come. The lesson to authorities is clear: heavy sediment loads in rivers can be a lasting legacy of volcanic eruptions, even decades later.

04 Scientists discovered the barren landscape was quickly transformed into a mosaic of new and thriving habitats.

Prior to 1980, ecologists and biologists had limited experience observing the direct effects of explosive eruptions on plants and animals. Many scientists presumed that all life would perish where the most intense volcanic processes affected the landscape, and that several successive generations of plant, insect, and animal species would be required to rebuild nutrient-rich soils and repopulate the landscape. However, long-term studies revealed that ecosystems were not uniformly devastated, resulting in a complex mosaic of habitats.

Even though the eruption killed most life in the immediate area, many organisms survived. Snow and ice cover protected many plants and animals, as did species behavior (for example, nocturnal animals were in their dens). Near the volcano entire forests were splintered, but trees farther away were only singed or dusted with ash. Water erosion cut gullies on hillsides covered in volcanic sediment and exposed living plants. These gullies became thriving oases of life. Surviving plants also emerged through thin ash layers, and roots of seedings blown in by winds or brought in by animals bored downward into nutrient-rich pre-eruption soils. Plants with nitrogen-fixing bacteria on their roots, such as lupine and alder, flourished in thicker, nutrient-poor volcanic sediment and improved habitat conditions for other species.

Although the eruption killed thousands of large mammals, and millions of fish, birds, and insects, observers found signs of animal life just weeks later. Wintering amphibians and fish emerged from beneath lake ice, and bugs snug in old trees and ground-burrowed animals awakened from hibernation amidst a bleak and barren landscape. Other wildlife pioneered new habitats for many species: pocket gophers mixed soils and brought seeds to the surface, and beavers built dams, creating new ponds and riparian habitats.

The diversity of life at Mount St. Helens today exceeds that of the pre-eruption landscape. Forty years of study have advanced our understanding of how life returns and thrives after large disturbances of all kinds. The same long-term ecological study techniques finely tuned at Mount St. Helens are now used in studies at volcanically disturbed regions elsewhere.

05 Congress preserved a unique volcanic landscape for public use and future study.

People were both awestruck and fascinated by the May 18, 1980, eruption and subsequent smaller explosive eruptions that occurred between 1980 and 1986. Public pressure soon arose to allow greater access, even though the volcano remained restless and some places remained too dangerous for visitors. Other people sought to protect the area from overuse and to study how nature would recover. To accommodate these diverse needs, in 1982 Congress set aside 110,000 acres on and adjacent to the volcano for preservation, recreation, and education. They authorized the Mount St. Helens National Volcanic Monument and directed the U.S. Forest Service to protect the new landscape and its plant, animal, and cultural resources. Now, visitors can view the volcano closeup from trails and climb the volcano, while the study of geologic forces and the evolving ecology proceeds with minimal human interference. Visitors to the Monument, to Washington State Park's Mount St. Helens Visitor Center and Weyerhauser's Forest Learning Center can view the volcano and study the unfolding of the 1980 events.

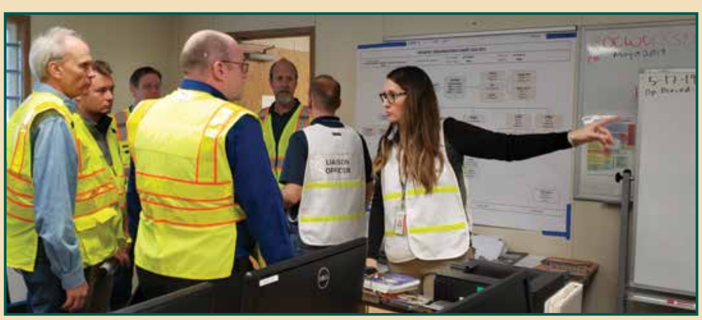
Visitors at Johnston Ridge Observatory view Mount St. Helens. U.S. Geological Survey photograph by Carolyn Driedger, June 2016.

06 Scientists and public officials forged specialized teams to respond to volcanic threats.

A 1975 USGS scientific report and press release identified Mount St. Helens as a young and explosive volcano, and concluded that the volcano could erupt again, possibly before the end of the 20th century. That information was still being grasped by scientists and was mostly unknown by public officials when Mount St. Helens reawakened in 1980. The volcano's sudden onset of eruptive activity caught the public by surprise. Residents of the Pacific Northwest wanted to know what the volcano would do next and which areas were safe.

During the ensuing response, scientists, land managers, and public-safety officials quickly learned that they would need to work in close coordination. Scientists supplied information based upon the best available data, and land managers and public-safety officials provided the governmental structure for a coordinated response. Together, they developed a well-managed system for overseeing hazardous areas and for distributing information to anxious news media and the public. Through their coordinated efforts, a new era of volcano-crisis management was born.

Scientists, public safety officials, and land managers have continued this team approach to risk reduction and communication with the public. Now, officials and scientists meet regularly to assess the hazards and develop and practice emergency response plans for the next volcanic crisis. Today's emergency managers draw a direct line from lessons learned at Mount St. Helens to the current volcanic hazards planning efforts at the other Cascades volcanoes. The Cascade Range (Cascades) extends from British Columbia in Canada to northern California.



Lessons learned from the 1980 eruption of Mount St. Helens prompted action by emergency officials living near other Cascades volcanoes. Here, officials from the City of Puyallup, Washington, more than 40 miles downstream of Mount Rainier, practice the steps required for lahar evacuation of their school district. U.S. Geological Survey photograph by Carolyn Driedger, May 8, 2019.

07 Mount St. Helens inspired a new generation of volcanologists and increased international scientific cooperation.

Prior to 1980, USGS volcano monitoring efforts focused on nonexplosive eruptions in Hawaii. This was accomplished with USGS staff and university partners at the Nation's first and only facility dedicated to study volcanoes—the Hawaiian Volcano Observatory (HVO). Elsewhere at U.S. volcanoes, studies of past eruption histories were in their infancy. A worldwide expansion of interest in volcanism occurred after the 1980–86 eruptions at Mount St. Helens. Scientists and eager students sought to understand volcanoes, to improve monitoring and warning systems, to assess volcanic hazards, and to communicate with at-risk populations.

Clearly, more scientific work was required, and partly to fill this need, in 1982 the USGS dedicated and staffed the David A. Johnston Cascades Volcano Observatory (CVO). Today, CVO staff as well as the staff of HVO and the three other USGS volcano observatories work closely with universities and government agencies to provide timely warnings about future volcanic activity. Similarly, partners at the University of Washington's Pacific Northwest Seismic Network greatly expanded their staffing and earthquake monitoring efforts at many Cascades volcanoes. The lessons learned at Mount St. Helens are the same ones that are essential to addressing every reawakening volcano, both in terms of science and hazard mitigation.

Since 1980, hundreds of volcanologists from around the world have come to study Mount St. Helens. The relationships built with international colleagues, the advances in monitoring, and the accumulation of skills built through cooperative work at Mount St. Helens make it possible for U.S. scientists to aid with eruption responses in other nations. In 1986, in response to the devastating eruption of Nevado del Ruiz volcano in Colombia, the accumulated knowledge and international connections were fundamental in the development of the Volcano Disaster Assistance Program (VDAP). Co-funded by the U.S. Agency for International Development and the U.S. Geological Survey, the VDAP team has responded to more than 70 volcanic crises worldwide and strengthened response capacity in 12 nations.

At the Cascades Volcano Observatory, a U.S. Geological Survey (USGS) scientist and international training participants build volcanic gas monitoring instruments. USGS photograph by Elizabeth Westby, July 2018.

08 Scientists gained important insights about the geologic history of Mount St. Helens.

In 1980, scientists became acquainted with one of nature's most massive and destructive volcanic processes—the debris avalanche. Until then, relatively few people had witnessed one, but on May 18, 1980, startled onlookers saw, and some even photographed, the collapse and debris avalanche that demolished the north slope of Mount St. Helens.

Observations made on May 18, 1980, allowed scientists to link debris avalanches and other eruptive processes with their geologic deposits. While examining the volcano and the surrounding landscape, they found evidence of two similar, but smaller, debris avalanches that happened between 2,500 and 3,000 years ago. Another deposit, approximately the size of the 1980 event, documents the destruction of an earlier version of Mount St. Helens about 20,000 years ago. Scientists have since recognized similar patterns of debris avalanche collapse and subsequent rebuilding at more than 200 volcanoes around the world.

Geologic mapping and improved methods for determining the ages of past eruptions yielded some surprises at Mount St. Helens. It had been thought that Mount St. Helens was a young volcano, but more research found that volcanic eruptions had occurred as long ago as 270,000 years. Although much of the present mountain grew remarkably fast (in only 4,000 years), it sits atop older volcanic deposits. With every eruption, rocks from lava flows, pyroclastic flows (avalanches of hot rock and gas), lahars, and ash-rich deposits accumulated, one upon another, to remake the volcano. Moreover, not only did the volcano grow relatively quickly, but its eruptive style varied widely through time, including violent ash-producing explosions, oozing of near-solid lava, and flank eruptions of fluid, Hawaiian-style lava flows.

Layers of volcanic ash, resembling coarse-grained gray particles of sand, are evidence of episodic, high-powered eruptions at Mount St. Helens around 3,500 years ago. U.S. Geological Survey photograph by Larry Mastin, August 2019.

09 New studies improved our understanding of Cascades volcano hazards and eruption frequency.

The eruptions at Mount St. Helens became the impetus for a new generation of studies at Mount St. Helens and Cascades volcanoes throughout Washington, Oregon, and California. Scientists have documented the explosiveness of past eruptions, identified the areas that were affected, and assessed which areas could be impacted by future eruptions.

Some Cascades volcanos were discovered to have erupted more frequently than previously thought. The likelihood of an eruption at a Cascades volcano during any given year ranges from around 1 in a 100 at Mount St. Helens to much less, as seen at nearby Mount Jefferson in Oregon, which erupted so infrequently in previous millennia that good estimates of frequency cannot be established. By examining eruptive histories, scientists can say there is a 1–2 percent chance that at least one Cascades volcano in Washington, Oregon, or California will erupt in any given year, and that many eruptions continue intermittently for many years.

A U.S. Geological Survey (USGS) intern collects gases at Mount St. Helens. More than 1,000 gas measurements were made in the 1980s at Mount St. Helens, providing scientists with one of the best volcanic gas datasets ever collected. USGS photograph by Jessie Bersson, September 5, 2018.

10 New ideas and technologies sparked a revolution in volcano monitoring and ability to provide hazard warnings.

Before 1980, only one seismometer was deployed within 30 miles of Mount St. Helens, and a few others were scattered on distant Cascades volcanoes. Scientists' ability to detect rising magma and to make eruption forecasts and warnings to the public was limited because they did not have enough information to thoroughly evaluate volcano behavior. The rapid onset of volcanic activity and repeated eruptions during 1980–86 demonstrated the need for early warning and more advanced monitoring technologies. Mount St. Helens and CVO quickly became research laboratories to improve understanding of volcanic hazards, to develop and evaluate monitoring techniques, and to test eruption forecasting methods.

Since 1980, volcano monitoring has evolved from the placement of a few scientific instruments to broad integrated networks of sensors to detect a variety of indications of volcanic activity. Scientists at the USGS, the Pacific Northwest Seismic Network, UNAVCO, and other coalitions work in partnership to measure earthquake activity, ground deformation, temperature variations, and the composition and emission rates of volcanic gases. Scientists detect and track magma movement beneath volcanoes in real time, using a combination of ground-based and remote sensing techniques. They also study the erupted rocks to learn about conditions beneath the volcano, which improves our understanding of how magma moves, how it forms, and the conditions that might trigger an eruption. Having multiple sources of data has helped identify patterns in volcano behavior that improve eruption forecasts.

These advancements allow scientists to provide early warnings that give officials precious additional time to enact evacuations or to advise people to shelter indoors. When Mount St. Helens reawakened in 2004, scientists had data for decision making and long-established pathways for communication with officials and people at risk. The resulting response was effective and demonstrated the societal value of long-term volcano monitoring and continued vigilance.

The 1980 eruptions of Mount St. Helens had profound scientific, technological, and societal impacts. Decades later, we can reflect upon the progress in science and preparedness initiated by the May 18, 1980, eruption, and look forward to new scientific insights that will help us prepare for future volcanic eruptions.

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Edited by Katherine Jacques and designed by Kimber Petersen

Scientists conduct a laser-scanning survey of the upper North Fork Toutle River to measure changes in valley shape. U.S. Geological Survey photograph by Jon J. Major, 2010.

Additional Resources

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International Volcanic Health Hazard Network (IVHHN):
https://www.ivhhn.org/home

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MOUNT ST. HELENS CHANGED OUR WORLD
40TH ANNIVERSARY
1980 - 2020