Summary of Mount St. Helens Seismic Activity, January through September 1995

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Mount St. Helens was quiet between January 1 and September 30 of this year. No explosion or emission of gas and ash occurred from the lava dome. Seismic activity is still low, but the number of small magnitude (less than magnitude 1) earthquakes beneath the crater has increased slowly but steadily from less than 10 events per month in January to about 100 events in September (Fig. 1).

This increase in seismic activity is very small compared to the activity that preceded each of the explosive and dome-building eruptions between 1980 and 1986. During these eruptions, earthquake activity was clearly associated with the rise of molten rock, or magma, into the volcano and its eruption at the surface. The dome-building eruptions were preceded and accompanied by intense shallow earthquake activity, located less than 2 miles beneath the crater. In contrast, recent earthquakes were smaller and originated at depths between about 1 and 6 miles. There is no evidence to suggest that they indicate an upward rise of magma.

The current seismic activity closely resembles seismicity that began in late 1987 and occurred before and during a series of small gas explosions from the dome in 1989–1991. These explosions, though relative small, were large enough to hurl dome rocks as large as 1 foot in diameter at least 0.5 mile from the dome and produce ash plumes as high as about 20,000 feet above sea level. Because the 1989–1991 steam explosions were not preceded by any specific short-term warning, the similarity of the current seismicity to that of the earlier episode raises our concern that small explosions from the dome could again occur without additional warning.

Our experience with the 1989–1991 series of gas explosions from the dome, as well as explosions during the years of dome growth, suggests that they would produce hazards primarily within the crater, to a lesser degree in the stream channels leading from the crater, and to an even smaller degree on the upper flanks of the volcano. These hazards could include the impact of dome rocks ejected from the dome and rapidly moving hot-rock avalanches (pyroclastic flows) sweeping the crater floor. During the explosion on February 5, 1991, a small pyroclastic flow reached the north edge of the crater. Heat from a rock avalanche or pyroclastic flow could also generate a lahar, a mixture of rock, mud, and water, in the crater and channels leading from the crater. Also, gas explosions could generate dilute but visible ash plumes perhaps as high as 20,000 feet above the volcano and light ashfall as far as 100 miles downwind from the volcano.

Likely Explanation of Recent Earthquake Activity

The recent earthquakes originate at depth about 1 to 6 miles below the crater (Fig. 2). This same zone of seismic activity

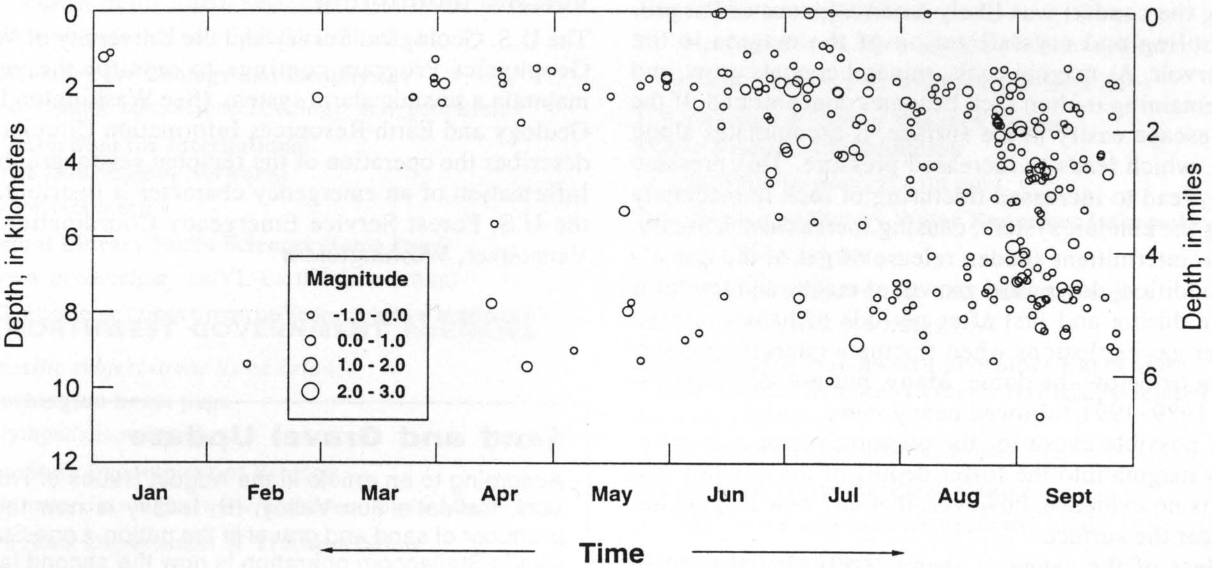
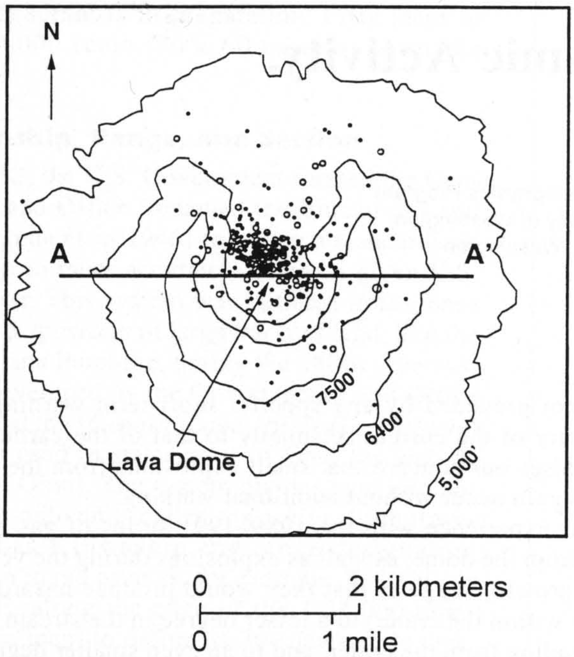


Figure 1. This graph shows the increase in seismic activity at Mount St Helens during the first nine months of 1995. Many of these earthquakes are less than magnitude 1. The largest earthquake (magnitude 2.3) occurred on July 4.



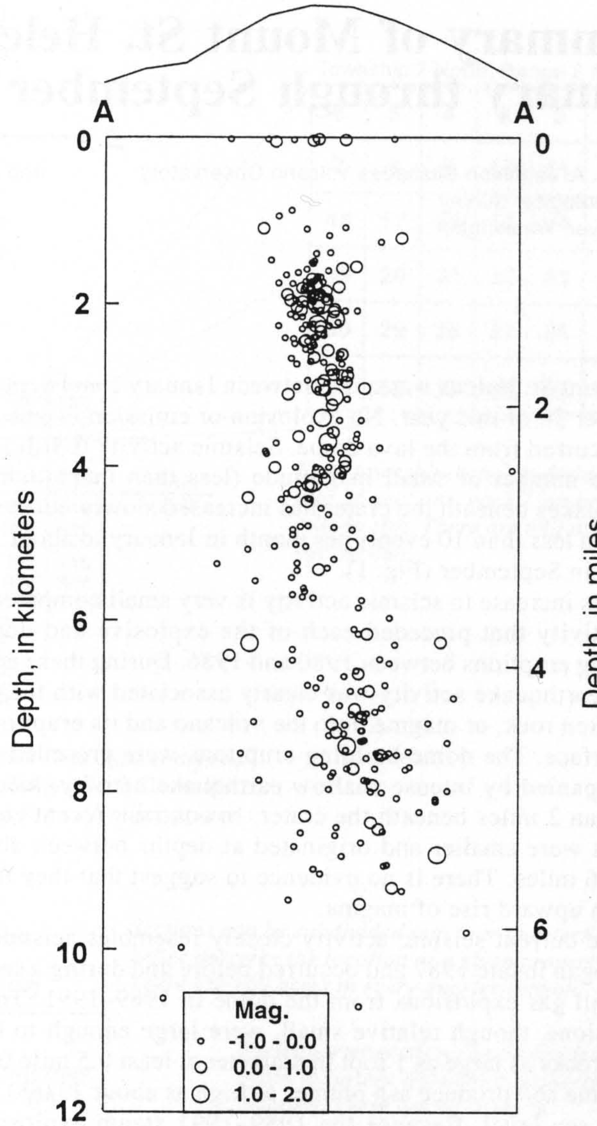


Figure 2. Map and cross section of Mount St. Helens showing epicentral location and depth of earthquakes that occurred from January through September 1995. The 0 depth is referenced to 1.5 km (about 1 mi) below the current summit of the volcano (8,363 ft). The distance A–A′ is the same in both illustrations. Note the small magnitude of the earthquakes, which are located in and around the magma conduit that leads from the magma reservoir to the lava dome.

became active in late 1987, about 2 years before the 1989–1991 steam explosions began, and it marks the approximate location of the magma conduit system leading from the magma reservoir to the lava dome. Detailed study of the 1987–1991 seismicity and the 1989–1991 steam explosions suggests that the two phenomena occurred in response to an increase in pressure in the conduit system.

One possible cause for the pressure increase is that volcanic gas (primarily water in gaseous form) became concentrated along the volcano's conduit system. The concentration of gas along the conduit was likely a consequence of the progressive cooling and crystallization of the magma in the magma reservoir. As magma cools, mineral crystals grow, and gas in the remaining molten rock becomes concentrated. If the gas cannot escape easily to the surface, it accumulates along the conduit, which leads to increased pressure. This pressure would likely lead to increased fracturing of rock immediately surrounding the conduit system, causing increased seismicity, as well as to intermittent sudden release of gas at the dome's surface. In addition, downward growth of cracks and fractures in the dome during and just after periods of heavy rainfall could trigger gas explosions when fractures intersect pressurized areas in or below the dome. Many, but not all of the explosions in 1989–1991 followed heavy rains.

Another possible cause for the pressure increase is intrusion of new magma into the lower depths of the conduit system. There is no evidence, however, that any new magma has moved to near the surface.

Regardless of the cause, it seems likely that the recent small change in seismicity reflects a renewed increase in pressure along the conduit system.

Volcano Monitoring

The U.S. Geological Survey and the University of Washington Geophysics Program continue to monitor the volcano and maintain a seismic alarm system. (See Washington Division of Geology and Earth Resources Information Circular 89; Part 2 describes the operation of the regional seismograph network.) Information of an emergency character is distributed through the U.S. Forest Service Emergency Coordination Center in Vancouver, Washington. ■

(This article is slightly modified from a report received in October.)

Sand and Gravel Update

According to an article in the August issues of *Rock Products*, CalMat's Sun Valley, ID, facility is now the largest producer of sand and gravel in the nation. Lone Star Northwest's Steilacoom operation is now the second largest.