

Remodelling Mount St Helens

Many different circumstances could have triggered the famous eruption. Rhian Burrell says we need to model them all if we're to predict volcanic collapses.



Tim Bart, Department of Geography, University of Durham

For three months, magma had been intruding into the northern side of Mount St Helens, inflating it. Just after 8:30 on Sunday 18th May 1980, the volcano collapsed catastrophically. The eruption lasted nine hours, killed 57 people, and destroyed vast swathes of forest. Since September 2004, Mount St Helens has been active again, and in mid-October, a new lava dome was seen, growing in the crater. Understanding the 1980 eruption better could help us predict similar events on other volcanoes in the Cascade Range or elsewhere.

Photographs taken on 18th May show that the eruption was triggered by a landslide that exposed magma high up in the volcano. Such massive slope failures are now recognised as crucial to the development of many volcanoes. To improve our understanding of this process we needed to examine in detail the events that led to the May 1980 collapse.

We wanted to know whether a unique combination of conditions led to the eruption. Previous models of the Mount St Helens landslide often used average values for the strength of the volcanic rock and magma, and/or the location of the water table. This last factor is important because it affects the overall rock strength. If the volcano is saturated, the water pressures will push the rock apart and reduce the strength, whereas dry rock is stronger. Through modelling techniques, we have found that using average values leads to large errors that allow the stability of the volcano to be overestimated.

To address the problem, we used a Monte Carlo approach.

We ran our model tens of thousands of times, varying the volcanic rock and magma strengths and water table location each time. Each model was examined to see if it was unstable and whether it reproduced the failure location observed in a classic set of photographs taken during the eruption. We concluded that the magma intruding into the upper part of the volcano triggered the slope failure. This is in contrast with other workers

who assume that the slope failure was triggered by an earthquake. Two sections of the volcano failed at the same

time. Both failure planes passed through the hot interior of the intruded magma. This suggests that there was more magma close to the surface than previously estimated, which made the eruption more explosive.

We also found that the northern flank of Mount St Helens could have failed under a wide range of rock strengths and water table locations, and our method lets us identify the complete range of these conditions. We suggest that similar methods should always be used when trying to calculate the stability of a volcanic slope, especially when the volcanic rock and magma strengths and water table are not known precisely. Otherwise, researchers risk missing a set of conditions that could lead to a catastrophic slope failure.

The northern flank could have failed under a wide range of conditions.

Rhian Burrell is working with Harry Pinkerton at the Department of Environmental Science, Lancaster University, Lancaster, LA1 4YQ. tel: 01524 593975, email: r.burrell@lancaster.ac.uk