



Fracturing regimes as indicators of the creation of new magmatic pathways

R. Smith, C. R. J. Kilburn, P. R. Sammonds

Benfield UCL Hazard Research Centre, Department of Earth Sciences, UCL, UK
(rosanna.smith@ucl.ac.uk)

Andesitic to dacitic volcanoes commonly erupt after intervals of several centuries. After such long intervals, the country rock must fracture in order to create a new pathway for the magma to reach the surface. This fracturing, recorded as Volcano-Tectonic (VT) seismic events, may provide a warning that the volcano is about to reawaken.

Hyperbolic accelerations in fracturing rates occurred in the final 5 to 10 days before eruptions at Mount Pinatubo, Philippines in June 1991 and at Soufriere Hills, Montserrat in November 1995, which both erupted after several hundred years of repose. This pattern of fracturing indicates that the final approach to an eruption may be controlled by the creation of a new magmatic pathway through the growth and coalescence of fractures and could provide an eruption warning several days in advance. However, at other andesitic-dacitic volcanoes erupting after more than 100 years of repose the precursory VT seismicity did not accelerate in this manner. In the final weeks before the 18th May 1980 eruption of Mount St Helens, the VT seismicity was already at high level, but did not accelerate. The recent discovery that there was juvenile magma in the eruptions previously defined as phreatic that began on 27th March indicates that the magmatic pathway was in fact formed at this earlier date. VT seismicity accelerated before these eruptions began and could have provided an eruption warning one to two days before the eruption. However, the form of this acceleration differed from that observed at Mount Pinatubo and Soufriere Hills. A new model is proposed to explain fracturing rates expected before phreatomagmatic eruptions from a shallow magma body such as that at Mount St Helens in March 1980.