



An unusual collapse event at the Soufriere Hills volcano, Montserrat, interpreted using broadband seismic and infrasonic signals

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An explosive event on the 3rd March 2003 at Soufriere Hills volcano, Montserrat, occurred without major precursory activity during a period of no magma extrusion. Broadband seismic signals were recorded which ranged from an ultra-long-period signal with a dominant period of 120s to impulsive, short-duration events containing frequencies up to 30Hz. Infrasonic tremor and pulses were also recorded in the 1-20Hz range. Synthetic displacement functions, to which the seismometer response was applied, were fit to the long-period seismic data. These suggest that the upward ground motion is best described by a truncated ramp function lasting approximately 100s. Combining this analysis with a Boundary Element deformation model, including realistic topography, indicates that a shallow collapse of the volcanic edifice occurred, initiated 300m below the surface. The edifice collapse, recorded as the ground displacement, stops coincident with ash venting occurring at the surface, recorded as infrasonic tremor. The high-frequency seismicity and infrasound are consistent with the collapse of a gravitationally unstable buttress of remnant dome material which impacted upon the edifice surface. We interpret the event as being due to the fragmentation, and subsequent collapse, of gas-charged magma, emplaced in the shallow conduit when extrusion stopped six months previously. Diffusion of volatiles and growth of microlites would have occurred in the period when the magma column was stationary. This would have caused the system to become overpressurised, leading to conditions favourable for fragmentation. This unique dataset demonstrates the benefits of deploying multi-parameter stations equipped with broadband instruments.