Decompression wave caused eruption chain reaction

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The 2010 eruption of Iceland's Eyjafjallajökull proceeded through fits and starts. A new analysis by Tarasewicz et al.suggests that a downward propagating decompression wave triggered a cascade of explosive eruptions from sequentially deeper magma reservoirs. Drawing on detailed seismic measurements, the authors find that earthquake activity under the volcano propagated deeper into the subsurface as the eruption progressed.

They find that at the onset of the explosive phase of the eruption on April 14, magma was ejected from a chamber located 5 kilometers (3.1 miles) below the summit. Over the subsequent weeks, the eruption calmed and the surface deflated as the subsurface magma chamber emptied. The authors suggest that the decreasing mass of the summit caused the pressure in a subsurface pipeline that fed the main magma chamber to drop.

On May 2, a cluster of earthquakes took place at 10-to-13 kilometers (6-to-8 miles) depth. This seismicity was followed a few days later by a sharp increase in explosive eruption rate. Parallel sequences took place on May 10 and May 15, with earthquake swarms located at 19-to-24 kilometers (12-to-15) being followed by increased explosive activity days later.

The authors suggest that the initial drop in pipeline pressure caused a magma-filled sill, located at 10-to-13 kilometers (6-to-8 miles) depth, to become overpressured relative to the pipeline. The pressure gradient caused the rock separating the sill and the pipeline to fracture, leading to the observed seismicity. This fracturing liberated the magma stored within the sill, driving the surge in explosive eruption rate. The authors suggest that this process then cascaded deeper into the subsurface. The emptying sill led the pressure in the pipeline to be reduced even further, causing a second sill at 19 kilometers (12 miles) deep (and, in turn, a third sill at 24 kilometers (15 miles)) to become similarly overpressured, leading to fracturing and eruption.

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