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Cyclic fracturing during spine extrusion at Unzen, Japan

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The 1990-1995 eruption at Unzen, Japan, was characterised by the continuous formation of a dacitic dome from May 1991 to February 1995. The period was punctuated by two phases of lava spine extrusion: at the onset of dome formation (20-21 May 1991) and near the eruption's end (October 1994 to February 1995). Using continuous seismic data collected during the latter period, this investigation seeks to identify and characterise seismicity associated with the spine extrusion.

Seismic events were automatically detected and characterized using a STA/LTA algorithm on continuous data. The data was recorded on a single short-period seismometer located roughly 600 m from the eruption vent. After filtering for false triggers, a total of 12,208 seismic events were detected between 1st October 1994 and 28th February 1995. Statistical analysis of hourly event counts was done using a combination of Multi-taper Method and Short-term Fourier transform. A strong ~41 hour cycle is detected during the first few weeks of spine extrusion, consistent with previous seismic and tilt observations. Temporal patterns in frequency and amplitude suggest that the fracturing processes associated with the spine dominate the record during the first few weeks of extrusion. Using waveform correlation, intense and long-lived clusters were identified during this period of extrusion and appear to form the basis of the strong cyclicity described previously. Source mechanisms will be inverted to obtain information on the state of stress and how it varies as the extrusion of the spine continued.

This investigation forms part of a broader project looking at seismogenic processes during the formation of lava domes. It is complemented by investigations of similar datasets from other volcanoes, including Mt St Helens (USA) and Volcán de Colima (Mexico). In addition, data are compared to acoustic emissions recorded during high-temperature magma deformation experiments.