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A Synchronised Deep Source and Repetitive triggering of Long-Period Tremors in Aso volcano, Japan

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In the southwest Japan, long-period tremors (LPTs) in Aso volcano have been observed since the pioneering work by Sassa (1935). Similar to VLPs discovered in other volcanoes, LPTs typically have a resonance period of $\sim$15 seconds and they are repetitive and time-invariant in their location and mechanism. It is considered that LPTs represent the resonance of a crack-like volcanic conduit located close to the active first crater, with a source depth near the sea level. While surface degassing/eruption and magmatic heating (or hot gas) are often invoked to trigger LPTs, seismic observation indicative of direct triggering remain elusive.

We previously constructed LPT catalog between 2011 and 2016 and identified diverse LPT families . After removing the background trend, we align and stack broadband displacement and horizontal tilt borehole recordings with respect to the arrival of LPTs. LPT stacked waveforms are accompanied by a very weak (e.g,. vertical displacement of $\sim$ 1 μm and horizontal tilt of $<$ 1 nrad) static offset with a rise time of 50-100 seconds. To obtain robust estimate of waveform polarisation over time, waveform data in the passed band of 100-200 sec period are used as a proxy of static offset. Interestingly, these waveform polarisations show no appreciable change over the 6-year period, but they are distinct from those of LPTs, suggesting another repetitive, but non-destructive source located away from the LPT source. Moment tensor inversion locates a deep source at about 3.2 km depth, just between the LPT source and the inferred magma chamber at $\sim$ 5-6 km depth. The source mechanism of the deep source is best represented by the combination of an isotropic source and a vertical crack orienting approximately east-west.

These observations not only provide causal evidence of direct and repetitive triggering of LPT from a deep triggering source, such a triggering source potentially serves as a buffer between the LPT source and the magma chamber beneath a well developed caldera. We will discuss the triggering threshold of LPT, possible triggering mechanism and the role of the deep triggering source in intra-crustal magma transport over the 2011-2016 eruption cycle.