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State of the art and future direction of ACROSS at Volcanoes

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Introduction Temporal variation of seismic propagation property in volcanoes has important information to monitor the subsurface volcanic activity, such as magma intrusion, pressure change or vesicular state in magma chamber, hydrothermal or gas activity and stress change. Though seismic interferometry and seismic anisotropy with natural seismic vibration are often used to detect temporal variation, little effort has been made on the usage of artificial sources, which has an advantage in the resolution of temporal change.

Seismic source Rotation sources that have been used for seismic ACROSS have some serious disadvantage for practical use. They use relatively large bearing, which requires high cost in case of trouble and produces large heat. Yamaoka et al. (2014) designed a new-type across to overcome such shortcomings with a combination of small unit sources. Yamaoka et al. (2011) tested a linear-motion type seismic source, which is commercially available, for the operation in lower frequency range as the rotation source can produce only small force in lower frequency. It can produce a sinusoidal wave with overtone distortion of 5%.

The borehole seismic source will be also useful for monitoring the deep part of volcanoes apart from meteorological effects. Linear motion source along the axis of borehole is useful for low-frequency operation, whereas rotation source is useful for high-frequency operation. Yokoi et al. (2014) designed a prototype of borehole type linear moving source that can drive small electric power.

Sakurajima We have started an experiment of seismic ACROSS at Sakurajima volcano in 2012 (Yamaoka et al. 2014). We deployed rotary-type ACROSS sources with vertical axis, which are reliable after long-term test for practical use in Toyohashi, Japan. Deploying ACROSS source at a volcano is our first challenge that we may face some difficulty. Actually unstable electric power condition in summer season often stop the ACROSS source, which have been overcome in the collaboration with local university of Kagoshima. A careful analysis on the data to correlate with the activity of Sakurajima revealed the temporal change associated with the explosions (Maeda et al., 2014).

Keywords: Volcano, Monitoring, subsurface structure, temporal variation, magma, hydrothermal system