Modeling of a non-eruptive volcanic deflation with strong earthquake swarm by integrated observation data in Meakan-dake, Hokkaido, Japan

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Strong volcanic earthquake swarms were frequent observed in not only eruptive stage but also non-eruptive era. Increasing of seismic activity might be precursor of eruption but not all time. Total understanding of origin source of swarm triggering and individual earthquake/tremor will give clues for activity forecasting.

We have installed integrated volcano monitoring system on active Meakan-dake volcano in Hokkaido of southwestern Kuril subduction zone. This volcano is characterized as one of high seismicity volcano in Japan. No magmatic eruptions were recorded at least in recent two centuries but several phreatic eruptions were observed. Alert to public associated with frequent earthquake swarm based on quantitative understanding is requested from resident.

Broad time constants of volcanic phenomena require proper observation equipments which can capture full range of signals. Short-period and broadband seismographs, bubble-type tiltmeter, GPS, and volumetric strain meter by water level sensor, and ground temperature sensor on active crater have been in operation. This network successfully recorded a successive earthquake swarm event on end of September 2008. Firstly, regional volcano deflation was detected by strain sensors and it had been continued during two days. Earthquake swarm also started almost same moment of strain signal. No GPS signal was recorded. Two days after, a shallowest volcanic tremor with 1-min ramp-function signals in strain, tilt and broadband seismograph were observed. This rapid inflation signal might indicate phase change from liquid to gas beneath active crater. Increased ground temperature on active vent was recorded after a few hours of tremor but no explosive events were recognized by visual observation. Swarm activity was rapidly calmed down after the tremor.

These multidisciplinary signals suggested successive activity was triggered by volatile migration from deeper to shallower. Instability of system due to volatile injection might induce seismicity and drive migration of liquid packet to surface. Deflation volume of deeper source, which is countable from regional strain changes, might indicate heat flux to shallower, and be quantitative indicator of forecasting phreatic eruption.