

Ground deformation associated with the 2014-2015 and the 2018-2019 volcanic activities at Azumayama

*Jun Okada¹, Shigeo Matsuura², Katsuya Ohmi², Takuya Yamamura², Yu Nihara³, Susumu Seki³

1. Volcanology Research Department (Sendai Office), Meteorological Research Institute, JMA, 2. Seismology and Volcanology Division, Sendai Regional Headquarters, JMA, 3. Regional Volcanic Observation and Warning Center, Sendai Regional Headquarters, JMA

Azumayama is a basaltic to andesitic active volcano located in the volcanic front on the Tohoku (NE Japan) Arc. Historical eruptions occurred mainly in and around O-ana crater in the south flank of Issaikyosan. No eruption occurred for more than 40 years after the last one on December 1977. However, various volcanic phenomena have been observed in recent years. Repeated GPS surveys revealed local inflation-deflation around O-ana crater which plays in a cycle of 2-3-year and corresponds to the increase-decrease of seismicity during 2003-2009. Yoshida *et al.* (2012) estimated the pressure source 200 to 600 meters beneath the O-ana crater. This shows a good agreement with the thermal demagnetization source studied by Yamazaki *et al.* (2010). Monochromatic earthquakes were observed when fumarolic activity of O-ana crater was high during 2008-2011 (e.g. Ueki *et al.*, 2010). By analyzing the frequencies of these earthquakes Torimoto (2016) is beginning to understand the characteristics of shallow hydrothermal systems, a potential hotbed for phreatic eruptions. In more recent years, there are two volcanic unrests such as the 2014-2015 and the 2018-2019 activities. JMA released “Near-crater Warning” and raised Volcanic Alert Level from 1 to 2 on December 2014 and September 2018, respectively.

The start of the 2014-2015 activity can be marked by the slight tilt change at Jododaira station, 750m ESE from O-ana Crater. It showed East-downward ground deformation since late July 2014. Continuous GNSS measurements also captured local inflation around Issaikyosan since September 2014. Seismic activity started on middle October and culminated from December 2014 to middle January 2015. Similarly, the 2018-2019 activity can be recognized by the tilt data of Jododaira. A slow East-downward ground deformation started since May 2018. The tilting rate was significantly increased after the occurrence of the volcanic tremor on 22 July 2018 and remained almost constant (at least at the time of writing). Continuous GNSS data suggested also an inflation of the volcanic edifice since May 2018. The shallow seismicity started since middle August 2018 and remained active (at least at the time of writing).

Strong similarity exists in deformation characteristics between the 2014-2015 and the 2018-2019 activities, that is the dilatational ground deformation, both preceded to the activation of shallow seismicity. Except for the beginning of the activities tilting is maintained with almost the same rate and direction for more than several months. However, several discrepancies should be remarked: (1) Volcanic tremors are more frequent in the 2018-2019 than the 2014-2015. (2) The 2018-2019 activity may be triggered by a remarkable coincidental tilt change (about 1 micro radian at Jododaira station) and the associated volcanic tremor on 22 July 2018. (3) Slight tilt changes which may suggest a deep deflation of Azumayama were clearly observed at distant stations on the foot of Adatarayama, a neighboring volcano in the 2018-2019. These observational evidences may indicate the different volcanic processes in both activities. Regarding (3), other field observation results such as both the increase of SO₂/H₂S since late July 2018 and the enlargement of geothermal areas around O-ana crater can be triggered by the intermittent injection of volcanic fluids (e.g. hot volcanic gasses) from the depth of Azumayama. Results of both tilt and continuous GNSS observations will be presented in the session.

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