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Shallow inflation of Tokachi-dake Volcano detected by GNSS observation

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1. Introduction.

Since 2001, Sapporo Regional Headquarters, Japan Meteorological Agency (JMA) have been operated GNSS continuous observation network in Tokachidake Volcano, located in central Hokkaido. At first, for topography restrictions, 3 GNSS stations had been biased to the western foot of the volcano. Since 2010, this problem has been settled gradually by adding and relocating the GNSS stations effectively. Furthermore in 2014, new 2 stations were installed around the active crater to detect the ground deformation in shallow region. JMA also have been conducted semi-annual campaign GNSS observation from around the active crater to northwestern flank since 2003. On the other hand, Geological Survey of Hokkaido (HRO) and Institute of Seismology and Volcanology (ISV), Hokkaido University have installed 2 GNSS continuous stations around the active crater in 2003. As a result of the observation, the volume inflation in shallow region beneath 62-2 crater (altitude1725m) was detected from 2006 to 2008 (JMA, 2010). In this study, we reinvestigate the ground deformation of Tokachidake Volcano more in detail with continuous and campaign GNSS observation data from 2003 to 2014.

2. Result

As a summary of the ground deformation after 2006, the distribution of horizontal displacements indicates two characters. One is a radially spreading pattern around active craters and another is the distance decay of amount of displacement from active craters, they suggest the shallow inflation beneath active crater. This inflation is also detected with Interferometric analysis of SAR (MRI, 2010 ; GSI, 2010). In order to analyze GNSS data in detail, we divide the sequence of displacement data into several periods. (Stage Ⅰ to Ⅴ) based on observation data in flank sites.

We estimate the location and the rate of the shallow inflation source by horizontal displacement in each stage, assuming spherical source (Mogi's model) added altitude correction (MRI, 2008). To estimate them, we use a software package named MaGCAP-V (MRI, 2008). As a result, the location of the source is at over 1000m above sea level beneath active craters, the rate is about $10^4 m^3$ per a year, in all stages. It was estimated that the location of the source in Stage Ⅲ and Ⅴ were shallower than that in Stage Ⅱ and Ⅳ. Therefore, it suggests the possibility that the inflation source migrates to shallower region, repeatedly, after 2006.

3. Discussion

Because of the other volume inflation in deeper region has never been detected since starting GNSS observation, we consider the shallow inflation is not directly related with magmatic activity.

According to the classification by MRI (2013), the shallower inflation is classified in inflation process related with volcanic hydrothermal activity. And MRI (2013) also suggests the possibility of small-scale eruption and growing hydrothermal activity after the classified inflation. We investigate correspondence with the shallow inflation and other volcanic activity in shallow region. (e.g.: plume, ground temperature, volcanic seismicity). As the result, it is found that plume height in 62-2 crater has decreased rapidly since Stage Ⅱ defined as a start of volume inflation in shallow region (JMA, 2006). In Stage Ⅲ, the period defined as the migration of the inflation source, it was increasing volcanic plume flux in Taisho crater and activation of B-type seismicity.

In Tokachidake, increasing amplitude level of volcanic micro-tremor was observed near active craters before small-scale eruption in 1985. (Katsui et al.1987) The similar increasing amplitude was observed in Stage Ⅴ, so we will need to investigate about the process of volcanic micro-tremor in detail, and will report the relation with the inflation and them on that day.

Keywords: Tokachidake, ground deformation, volcanic activity