The viscoelastic responsive interpretation by ground deformation observations of magma intrusion event into Sakurajima volcano on August, 2015 that contained pre- and after- activities.

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Introduction

Failed eruption, Magma intrusion event into Sakurajima volcano, occurred in August, 2015. From about 7:05 of 15th, VT earthquake was observed, and ground deformation was observed by tiltmeter and extensometer from about 8:00. Following, VT-seismicity became active, and the ground deformation rates increased from 10:27. Low frequency earthquake, large amplitude, was observed on 11:32 and 11:43. Subsequent VT-seismicity and ground deformation gradually became low-active. Ground deformation, like a after slip deformation, continued until about 17th(named intrusion process). By multi parameter ground deformation obsevation (tiltmeter,extensometer,GNSS,InSAR), the intrusion process is interpreted as WNW-ESE tensile crack, tips at 1km b.s.l, and volume change is about $10^6 m^3$ (e.g. Hotta et al., 2016 and Morishita et al., 2016). In followed period (named relaxation process), deformation polarity turned over. At the observation point near intrusion source (e.g. arimura), the deformation was exponentially, as viscoelastic stress relaxation process. On the other hand, at remote point, it seems to be also affected by other factor. In this study, We investigated the spacial-temporal pattern of intrusion process and relaxation process in detail.

Data and Methods

We analyzed tilt and strain data observed at the sites on Sakurajima, operated by SVO and JMA. We divided a intrusion process into 4 stages and defined 5 stage (4stage and relaxation process). (A: 08:00-10:27 B: 10:27-11:15 C: 11:15-11:45 D: 11:45, 15th-18:00, 17th E: 18:00, 17th-)

For each stage, We estimated source by dislocation model (Okada, 1992). Observation data at each sites are coordinate conversion to the directions of calculation value by best fit model. We analyzed the normalized conversion data, temporal response series.

Results

For the tilt data at Arimura, We assumed delay time. Delay time is response factor, assumed Kelvin-Voight medium, when it give step function at the beginning of each stage. The delay time is approximately 50 minutes in stage A - C, but is approximately 360 minutes in stage D. In stage E, relaxation time is approximately 90days (1.3×10^5min) and approximately 40% returned.

It was accepted that delay time is correlation with the distance from the source by relative impulse response (other site to Arimura). In addition, the response at sites in the tensile direction are more rapid than that in the strike direction. At the tensile direction, relative delay time increased from 8:00 to 11:45 on 15th, in following Stage D, it gradually decrease. For Stage E, relative relaxation time have the same correlation. This means inverse correlation with the ratio of deformation in StageE to in StageA-D.

Discussions in meeting

The decrease delay in stage D is interpret as stress relaxation of local stress concentration, diffusion from the source neighborhood to the around. Thus, it will discuss in the details by comparison with VT-seismic activity.

The deformation at Arimura in Stage E is interpreted as delay response by decline of the magma or strain relaxation by stress (pressure) relaxation of intrusion magma. But, These at other sites don't do an exponential change until about October, 2015. We will estimate stress field to make a comparison

between the overlaps and after-VT seismicity, became active a little at slightly remote resion from source in September to October, 2015.
The density of fluid in the crack just after the intrusion is estimated at 0.98±0.37g/cm^3 (Kazama et al., 2016). It seems to be very foaming advanced magma. Therefore, we will consider whether it can interpret above characters by upward or lateral gas diffusion.

Keywords: Sakurajima volcano, magma intrusion, viscoelastic response

