[JJ] Evening Poster | S (Solid Earth Sciences) | S-VC Volcanology

[S-VC41]Active Volcanism

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This session discusses various aspects of active volcanisms including, but not limited to, recent and historical eruptions, various phenomena associated with the volcanic activities, underground structures of the volcanoes, and developments of new instruments based on geophysical, geochemical, geological, and multidiscipline approaches. We also welcome studies on understanding and predicting the transitions of the eruptive activities from observational, theoretical, and experimental approaches.

[SVC41-P03]Magma migration model to explain temporal pattern of volcanic surface deformation -Application to the inflation and deflation sequence observed from 1997 to 2017 around Meakandake volcano, Japan-

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1. Introduction

The Meakandake Volcano is an active volcano nested in the eastern part of Hokkaido, Japan. An ongoing surface deformation on its north eastern flank is detected by both GNSS and space-borne InSAR. The distance between the 2 GEONET stations; 960513(Akan 2) near the Akan Lake and 950122 (Tsurui) to the south east of Akan Lake, shows a repetition of episodic transient events that begin with rapid expansion and end with slow shrink superimposed on a constant shrinking trend. The overall shrinking trend can be attributed to the tectonic contraction of the eastern Hokkaido due to the subduction of the Pacific plate. After the removal of this linear trend, the remaining component show more clearly the repetition of transient events, which are characterized by a repetition of rapid, short-term stretching and slower shortening, continued for more than 20 years. Its repetition rate is about a few years. From the satellite SAR interferometry, we have already know that the inflation in the depth at the north eastern part of the volcano during the GNSS expansion period. Thus, the expansion/shrinking of the above mentioned GNSS stations is likely to correspond to inflation/deflation of the subsurface magma chamber.

2. Magma model of Meakandake volcano

In this study, we try to explain the mechanism of the observed surface deformation. We follow the methods by Mével et al. (2016) which discussed the surface deformation observed around the Laguna del Maule volcanic area (LdM), Chile with a relatively simple mechanism. They assumed a magma chamber in an elastic medium and a volumetric change is caused by an inflow of magma from the further depth. Although their model is a rather simplified magma system, it seems to explain the basic characteristics of the observed deformations of LdM. Thus we try to modify their model as a starting point for understanding the basic characteristics of Meakandake Volcano.

Mével et al. (2016) deal only with the expansion phase. However, since the Meakandake volcano shows both inflation and deflation of the magmatic source, it is necessary to divide the whole process into 2 parts; one for the inflow and the other for outflow of magma. Hence, we derive two analytical solutions for the surface displacements corresponding to the two-stage deformations corresponding to the expansion and contraction. Hence, the surface displacements are expressed by two different exponential decay functions with different time constants.

This set of analytical solutions was applied to GEONET surface displacement data to determine the associated parameters. Here, we focus on a total of 6 events, each of which consists of expansion and contraction phases. We find that the time constants for expansion phase lie in the range of 70 - 220 days and those for shrinking phase range from 470 to 2300 days. For all 6 events the expansion phase was shorter than shrinking phase. Their ration ranges about 2 to 30.

If the volcanic parameters such as the shape of the magma and the elastic properties of the crust stay constant over a period of about 20 years, the difference between these time constants can be attributed to the difference in viscosity of the incoming and outgoing magma The difference in the time constant can be explained by the hypothesis that the viscosity of the magma increases from 2 to 30 times when the flow of the magma changes from the inflow to the outflow. This result may be explained the increase of viscosity is caused by the cooling of the magma

3. Future work

At the present stage, the discussion is based on an extremely simplified model. However it explains the basic characteristics of expansion and contraction phases observed around the Meakandake Volcano. A detailed analysis of crustal deformation based on multiple station GNSS data and InSAR suggests that the structure of magmatic system beneath this volcano is more complex, As a future work, it is necessary to improve the model to reflect such a complexity.

4. Acknowledgments

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