Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)


SVC45-P37 Room:Convention Hall Time:May 27 18:15-19:30

# A subsurface structure change associated with the eruptive activity at Sakurajima volcano, Japan, inferred from ACROSS

MAEDA, Yuta[1*] ; YAMAOKA, Koshun[1] ; MIYAMACHI, Hiroki[2] ; WATANABE, Toshiki[3] ; KUNITOMO, Takahiro[1] ; IKUTA, Ryoya[4] ; IGUCHI, Masato[5]

[1]Nagoya University, [2]Kagoshima University, [3]The University of Tokyo, [4]Shizuoka University, [5]Kyoto University

1. Introduction

At Sakurajima volcano, where up to 1000 vulcanian explosions are occurring a year, an active seismic source called ACROSS has continuously emitted a regular frequency-modulation signal into the ground since 2012 (Yamaoka et al., 2014 EPS). Deconvolving the signal at a nearby seismic station by the known source time function yields the Green function between the source and the receiver. Monitoring a temporal variation of the Green function would lead to the detection of a subsurface structure change associated with the volcanic activity.

As the first ACROSS-based survey of the Green function change at this volcano, we had stacked the Green functions at different times based on the time relative to eruptions and had found that the correlation coefficients between these stacked Green functions and the all-span average of the Green function had decreased around the times of the eruptions (Maeda et al., 2014 VSJ). However, it had not been certain if this correlation coefficient decrease had been due to a true subsurface structure change or an apparent Green function change caused by volcanic earthquakes and tremors.

In this presentation, we analyzed the Green function energies instead of the correlation coefficients, which enabled us to discriminate actual structure changes and the apparent Green function changes caused by the seismicity.

2. Analysis

We computed the Green functions every 400 s from 19 Sep 2012 to 21 July 2014 at Harutayama, the station closest to the source (distance : 615 m), using the ACROSS signal in a 12.505±2.5 Hz band. We stacked these 400 s Green functions based on the time relative to eruptions. We then computed the kinetic energy waveforms by taking the square summations of the three components of the stacked Green functions. We found an energy decrease in the later phase of the Green functions around the times of the eruptions.

To see this energy decrease more systematically, we averaged the energy in every 2 s window and plotted against the time relative to eruptions. This plot showed a clear energy decrease toward eruptions and a recovery of the energy after eruptions in 2-4 s window. At another station (distance : 1200 m), the energy decrease was visible in 2-4 s and 4-6 s windows.

3. Discussion

The seismogram at a station consists of not only the ACROSS signal but also volcanic earthquakes and tremors. Since the Green functions are estimated from the superposition of these signals, an apparent Green function change under a constant subsurface structure may appear due to an increased seismicity. To evaluate this effect, we formally applied the procedure to estimate the Green functions to 400 s waveforms including explosion earthquakes in early August 2013 when the ACROSS source was not operating. The outputs of this procedure were the errors of the Green function caused by the explosion earthquakes. In most cases, the errors distributed over the entire time window of the Green function. Depending on the timings of the eruptions, the errors concentrated on an earlier part of the Green function window for some eruptions, but for some other eruptions the errors concentrated on a later part, suggesting that averaging the errors for many eruptions would flatten the error distribution. Therefore the energy decrease localized to the 2-4 s window is difficult to explain by contaminations of volcanic earthquakes but is more likely a true temporal variation of the subsurface structure.

As a candidate explanation for this temporal variation, we may consider dynamic effects of volcanic earthquakes before and after eruptions on a medium beneath Showa crater, affecting the reflection amplitude of the Green function in that region. We would evaluate this and other candidate models in the future.

Keywords: ACROSS, Subsurface structure, Active seismic source, Sakurajima volcano, Volcano seismology, Volcano monitoring