Two-decades-long broadband seismic observations at Aso volcano, Japan

Mare Yamamoto[1], Takahiro Ohkura[2], Satoshi Kaneshima[3], Hitoshi Kawakatsu[4]

[1]Geophysics, Graduate School of Science, Tohoku University, Japan, [2]Aso Volcanological Laboratory, Kyoto University, Japan, [3]Graduate School of Science, Kyushu University, Japan, [4]Earthquake Research Institute, University of Tokyo, Japan

E-mail: mare@zisin.gp.tohoku.ac.jp

Aso volcano is one of the most active volcanoes in Japan. It has erupted in Strombolian style repeatedly, and recent activities take place at the central cone composed of seven craters aligned NW-SE direction with a length of 1 km. At Aso volcano, various kinds of volcanic signals with broad frequency contents have been observed since the pioneering work by Sassa, who installed Wiechert and Galitzin long-period seismometers in 1930s. Our observations using modern broadband seismometers have revealed the details of conduit system and physical processes generating these seismic signals. In this presentation, we review the results of our 20-year-long broadband observations at Aso volcano, and discuss future direction of our study.

In 1994, we started our broadband seismic observation close to the active crater of Aso volcano. At the first stage of our observation, we revealed that Sassa's "second kind" of tremor has an even longer period component, and those Sassa and others were observing are higher modes of the long period tremors (LPTs). The characteristics of the LPTs are summarized as follows: (1) continually emitted regardless of surface activity; (2) spectra show several common spectral peaks (15, 7.5, 5 s); (3) decay fairly fast and the duration is only a few cycles; and (4) often accompanied with short-period tremors. Analyzing the dense broadband network data, we have revealed that the kinematic source of the LPTs is an oscillation of a crack-like conduit beneath the crater. The strike and width of the crack are almost the same as those of the chain of craters, and it extends nearly vertically from a depth of 300-400m below the surface to a depth of about 2.5 km.

We also studied the physical properties of the crack-like conduit. To qualitatively interpret the nature of the LPT source, we developed an efficient method for modeling fluid-filled crack, and demonstrated that the LPTs can be modeled as an oscillation of a thin crack filled with gas-ash mixture. The existence of such crack-like conduit is also supported by other geophysical studies like seismic reflection and magnetotelluric surveys, and the crack is considered as a subsurface path connecting a postulated magma chamber at a depth of around 5 km and the surface craters.

In addition to obtaining such static image of volcanic system, our continuous broadband observation over years also enabled us to monitor the temporal changes in the system. For example, during our observation, we sometimes observed fluctuations in the dominant periods of LPTs which seem to correlate with changes in SO2 emission rate, and we could estimate the changes in thermal state of the volcanic fluid by seismological means based on our conduit model.

These results suggest the importance of continuous observation, and at the same time, imply that constructing quantitative physical model explaining multi-disciplinary observations is crucial to deepen our understanding of volcanic systems.