Seismic Attenuation Structure around Unzen Volcano

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Unzen Volcano is an active volcano grown in the Unzen graben, and erupted in 1990-95 forming a lava dome. Since the attenuation Q is one of the most essential properties of the medium and provides us the information about the existence of fluid, the investigation of the seismic attenuation at active volcanoes is important to reveal the magma supplying system and to evaluate the volcanic activity. We estimated the seismic attenuation structure of Unzen Volcano by using the first pulse width of P-waves.

In case the magnitude is small, the seismic wave radiated from the hypocenter can be approximated an impulse. A linear relationship between pulse width broadening and travel time is upheld from observation and theory. The proportion coefficient of pulse width is C/Q for travel time. And the constant C is approximately 0.5 from past experiments. We examined the magnitude dependence of pulse width and confirmed that the method is applicable for the earthquakes of M0.5-2.5. We divided the analysis area into blocks and estimated Q of each block by inverse method. The data used in the analysis are the earthquakes(M0.5-2.5) which occurred in and around the Shimabara peninsula from 1991 to 2003.

First we divided the upper crust of the Shimabara peninsula into 108 blocks and carried out the inversion in order to estimate the attenuation structure of the Unzen volcanic area. The block size is 4km in horizontal and 3-4km in vertical. The low Q was obtained inside the Unzen graben shallower than 3km, which is consistent with the geological structure. In a depth of 6-10km, a strong attenuation area was found at the west side of the peninsula. As the area almost agrees with the location of the pressure source inferred from the crustal deformation, the low Q area probably corresponds to a magma chamber.

Next we divided the shallow part (depth 2km) of the summit caldera into four blocks(600m square) and carried out the inversion for three periods to examine the condition change in the volcanic edifice associated with the eruption activity. The result shows that the Q in the eruption period was extremely low in the whole area of the summit caldera. Moreover we found that the Q of the volcanic edifice increased after the eruption except beneath the lava dome.