

Seismic Velocity Imaging below Aira Caldera

*Takeshi Tameguri¹, Hiroshi Yakiwara², Tomoki Tsutsui¹, Masato Iguchi¹

1. Sakurajima Volcano Research Center, Disaster Prevention Research Institute, Kyoto University, 2. Graduate School of Science and Engineering, Kagoshima University

Aira Caldera with a diameter of about 20 km is situated at Kagoshima bay in southern Kyushu. The Sakurajima volcano was formed on the southern rim of the Aira caldera, and is the most active volcano in Japan. Since 1992, the ground around the Aira caldera has continued to inflate, based on GNSS observations and leveling surveys, the inflation source is estimated to be approximately 10 km deep below the center of the Aira caldera. In the ground deformation analysis, point sources are assumed and the volume change of the inflation source can be estimated, but the absolute amount of the inflation source considered with magma is unknown. We estimated total magma accumulation and clarified magma supply system beneath the Aira caldera from seismic anomaly of 3D seismic velocity tomography analysis. We use P- and S-waves of natural earthquakes and P-waves of controlled source in order to clarify three-dimensional seismic velocity structure at deeper part of the Aira caldera. There are 47 seismic stations in southern Kyushu, and 431 natural earthquake events around the Aira caldera with the arrival times of 16,110 P waves and 11,838 S waves and 3,121 P waves of the seismic experiment in 2008 were used for the analysis.

At a depth of 1 km, the S-wave velocity is low under the Wakamiko caldera in the northeastern part of the Aira caldera. On the other hand, the high-speed of P-wave can be seen at the northern edge of the caldera. At a depth of 5 km, the P- and S-wave velocities in the Aira caldera from 4.5 km/s to 5.8 km/s and from 2.6 km/s to 3.7 km/s, respectively, and no significant velocity anomaly is observed. At a depth of 10 km, the P-wave and S-wave velocities range from 5.2 km/s to 6.1 km/s and from 3.4 km/s to 3.8 km/s, respectively, and also no significant velocity anomaly is observed. At a depth of 15 km, the P- and S-wave velocities range from 5.4 km/s to 6.8 km/s and from 1.1 km/s to 4.4 km/s, respectively. There is a region where the S wave velocity is rather low (LS region). At a depth of 20 km, the P-wave velocity is high from the south to the east of the Aira caldera, and the P-wave velocity is relatively low at 5 km/s near the center to the north. In the vertical section, the LS region can be seen at depths around 12 km to 22 km. At a depth of 35 km, the P-wave velocity anomaly is not observed, but the velocity around the Aira caldera is relatively fast. As for the S-wave, there is a region where the velocity is slow in the southwestern part of the Sakurajima volcano, and the V_p/V_s ratio is as high as 3.2. Many deep low-frequency earthquakes occur at depths of 25 km to 30 km, and high V_p/V_s regions are located below their events. The generation mechanism of deep low-frequency earthquakes under volcanoes is related to movement of fluid, and this high V_p/V_s region at 35 km depth may suggest the fluid.

Keywords: Aira caldera, seismic velocity structure, magma chamber