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Movement of pressure source at Sakurajima volcano after 2006 revealed by continuous GPS observation data

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Ground deformation around Sakurajima has been mainly detected by precise leveling, and has been modeled with 2 spherical pressure sources at the center of the Aira caldera (about 10 km depth) and at beneath the summit crater (about 4 km depth) (Eto, 1989, Annuals of DPRI, Kyoto Univ.). The ground around the Aira caldera turned to uplift since 1993. After continuous GPS observation started at Sakurajima in 1995, explosive activity at summit crater temporally increased at the end of 1999, and Showa crater started eruptive activity at June 2006. Large deformation rate was obtained prior to these eruptive activities, and a pressure source was located at depths 6-8 km near the northern coast of Sakurajima by assuming a spherical source (Hotta et al., 2013, Annual of DPRI, Kyoto Univ.). It is thought that both of pressure sources at the center of the Aira caldera and at beneath the summit crater expanded, and a pressure source apparently moved toward northern coast of Sakurajima. Eruptive activity at Showa crater has increased since 2009. In this study, we analyzed GPS data to make clear process of magma movement accompany with eruptive activity of Showa crater.

GPS data observed by SVO (Sakurajima Volcano Observatory) and GEONET data during 2006-2012 were analyzed by using PPP-AR analysis of GIPSY OASIS II ver. 6.1.2. Although no significant deformations are found during 2006-2009, variable deformation rates are found after around 2009.

Here, we focused on the period of the largest deformation rate after eruptive activity at Showa crater started (from October 2011 to March 2012). At first, we searched average positions of pressure sources whole the period by using GA. Pressure sources located at the center of Aira caldera (8.3 km depth; source A) and beneath Sakurajima (2.9 km depth; source B). Next, fixing the position of source A at the average position (because previous studies also obtained pressure source at the center of Aira caldera around this average position), we set a time window with 4 month period, and shifted it by 10 days. Source B moved from around Kitadake toward the northern part of Sakurajima during 1st time window (October 1, 2011-January 31, 2012) to 6th one (November 21, 2011-March 21, 2012), and then moved toward beneath Minamidake at 7th one (December 1, 2011-March 31, 2012). During the period of November 26, 2011-March 25, 2012, which is middle of 6th and 7th time windows, source B located around Kitadake. Deformation pattern of GPS stations at the northern part of Sakurajima changed around the end of December 2011. Moreover, eruptive activity at Showa crater increased from December 2011. These suggest that magma migrated from Aira caldera toward Sakurajima at around December 2011.

Keywords: Sakurajima volcano, Aira caldera, ground deformation, GPS, Mogi’s model