## Ground deformation source model at Kuchinoerabu-jima volcano during 1995–2014 as revealed by repeated GPS observation

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We analyzed repeated GPS observation data in Kuchinoerabu-jima during August 1995-April 2014. Most stations located around the Shin-dake crater showed crater-centered radial horizontal displacements. There was a tendency that observed horizontal displacements at western rim of the Shin-dake crater were larger (16.6–20.6 cm) compared to those at eastern rim (7.8–11.6 cm). In addition, station KUC14 which locates approximately 500 m south of the Shin-dake crater showed westward horizontal displacement rather than crater-centered radial (southward) one. On the other hand, small displacements (less than 2 cm) were detected at the stations located at the foot of Kuchinoerabu-jima. We modeled the observed displacements. In order to take topographic effects into account, we applied a finite element method (FEM) using the software Flex PDE Professional version 6.40. We set entire FE domain as 100×100×50 cubic kilometers (129.7011-130.7351°E, 29.9911-30.8994°N, 0-50 km bsl). We set top of the domain as a free surface, and sides and bottom of the domain as fixed boundaries. Since we used stations inside Kuchinoerabu-jima in the present study, topography was introduced in the area within Kuchinoerabu-jima using DEM data provided by Kagoshima prefecture, and elevation of the outside area was assumed to be sea level (zero). We assumed a homogeneous elastic rheology with a shear modulus of 30 GPa and Poisson's ratio of 0.25. We applied a vertical spheroid source model and searched optimal values of horizontal location, depth, equatorial and polar radiuses, and internal pressure change of the source which minimize the RMS between observed and calculated displacements using the forward modeling method. A spherical source with 100 m radius (i.e., both equatorial and polar radiuses are 100 m) was obtained beneath the Shin-dake crater (130.2157°E, 30.4462°N) at a depth of 310 m asl (i.e., the uppermost part of the spherical source is approximately 100 m below the crater bottom). The pressure increase of 831 MPa yields volume increase of 90 thousand cubic meters. Taking topographic effects into account allowed the reproduction of large horizontal displacements at western rim of the Shin-dake crater and westward horizontal displacement at KUC14. The location of the obtained spherical source coincide with the demagnetized ellipsoid estimated by Kanda et al. (2010, JVGR). They interpreted that piezomagnetic variation was produced by the pressurized rocks around the aquifer due to the continuous supply of high-temperature volcanic gases in addition to the thermal effect. The obtained spherical source may be corresponding to the pressurized aquifer.

Keywords: Kuchinoerabu-jima volcano, ground deformation, GPS, finite element method