

Repeated microgravity, GPS survey and continuous tilt measurement in Kuju volcano

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Kuju volcano, central Kyushu, began to erupt on 11 October 1995. And the second eruptions occurred in December 1995. After that, no eruptions occurred, but crater activities still continue. Precisely repeated gravity survey began from 14 October 1995, to clarify gravity changes caused by eruption. Repeat gravity measurements were made at intervals of a few weeks to several months. And we have been conducted the observation of ground deformation with the single frequency GPS receivers and high precision tiltmeter to detect the three dimensional ground deformations caused by the 1995 eruption.

Repeated microgravity survey

We used Scintrex CG-3 and CG-3M gravimeters to measure precise gravity change. The two-way measurement method was used to evaluate the instrumental drift and precision; we estimated the errors of observation as 10 micro gal.

Gravity decreases up to 90 micro gal, were detected in the gravity stations around the new craters in the period from 19 October 1995 to 13 January 1996. After that, the rate of gravity decrease became smaller. But the rapid gravity increases were detected in some stations (IW5 and IW6) near the new crater.

The contours of gravity changes are limited by lack of the observation stations, however it seems that a center of the gravity decrease exist in the area of the fumaroles and the new craters. Thus it is able to be thought that steam discharge from the new craters and the fumaroles causes the long-term trend of gravity decrease.

The rapid gravity decreases may be attributed to changes of the shallow ground water level by the vaporization of ground water heated by the magmatic fluid. Recent gravity changes about five years after the eruption may be attributed to seasonal variation of ground water level.

Estimation of underground mass balance that is mainly water, based on Gauss's theorem shows that the ground water recharge from the region around new craters is increasing after the eruption and about three months after, the underground water flow is gradually reaching to the equilibrium state.

Repeated GPS survey

GPS survey began from April 1999 at 5 observation points, to clarify ground deformation caused by the 1995 eruption. We have conducted the GPS observation 5 times up to the present. We used the single frequency GPS receivers (TOPCON GP-SX1). The session length is 1 hour and the sampling interval is 10 seconds, and GPS Software Win S/D Ver.1.31 is used for the baseline analysis. We repeated the session any number of times (10-20 times) every observation point.

Contractions of baseline up to 15mm, were detected from April 1999 to July 2000. Horizontal displacement vector is toward westerly direction in some stations (HOKORA, IW3) near the pre-existing fumarolic fields. Applying a point source model on the change in length of baselines, the location of a pressure source is estimated to be A region (one of the pre-existing fumarolic fields) and approximately 700m in depth.

Continuous tilt measurement

We used Pinnacle Technologies high precision borehole tiltmeter (5500 series). The tiltmeter site is located north mountainside of Mt. Hossyo and drilled 12m in depth.

We eliminated the effect of earth tide using BAYTAP-G (Ishigro et al, 1984). The observed tilt was 6 micro radian down in southeasterly direction from 9 October 2000 to 4 November 2000. This direction is toward the pre-existing fumarolic fields and a pressure source estimated from repeated GPS measurements. But the direction has changed toward northeastern down from December 2000.