

Spatio-temporal changes of magma pressure in the conduit at Stromboli as inferred from analyses of tilt records

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Recent geodetic observations at active volcanoes succeeded in detecting volcano deformations prior to a small volcanic explosion. These could be used for quantitatively understanding the magma ascent processes before eruptions. We installed three tilt meters and one broadband seismometer within a distance of 500 m from the active craters at Stromboli volcano, Italy, in the end of May 2014, and recorded large number of tilt data associated with explosions until September. In this study, we estimate the spatio-temporal changes of magma pressure in the conduit by using these tilt data.

We analyze tilts of 26 events recorded with high S/N ratio. These tilts at the three stations show uplifts toward craters from about 200 s before each explosion that is detected as an onset of seismic signal. By examining tilt vectors, we found that the tilt vectors roughly point to the direction of NE crater, and the direction of tilt vectors rotate about 5 seconds before the start of seismic signal. These characteristics are observed in the 22 events among 26 explosions.

To estimate the location of the source of tilt motions, we calculate the tilt motions due to pressure changes in an open conduit located at NE crater taking into account the topography of Stromboli volcano. The calculation results show that the directions of tilt vectors are changed by the difference in the depth of pressure source. We interpret that from few minutes to 5 seconds before an eruption magma pressure increases at the depth of about 50-100m below the crater. Then just before the eruption, the pressure source becomes deeper, down to about 150 m below the crater.

Keywords: Tilt motion, Strombolian eruption, Pressure source