Characteristics of multi-component strainmeter in Izu-Oshima for medium to long term variation -- strain data comparison with GNSS observation --

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In order to study about volcanic deformation in Izu-Oshima, we installed a multi-component strainmeter in a borehole at SNB station located in the southwest part of the island in 2013. The depth of strain sensors is about 75m from the ground level, or 25m below the sea level. The instrument has four strain sensors oriented 45 degrees apart and measures horizontal linear strains in N34.2E, N10.8W, N55.8W and N100.8W as CH0 to CH3 respectively. Accumulated data of SNB strainmeter make it possible to research about characteristics for medium to long term strain variation. In this study, we compared the data with two kinds of reference strain field, one is estimated from GNSS observation and the other from a spherical pressure source model. For observation by a borehole strainmeter, it is important to know the instrument' s response to the surrounding crustal strain variation. Comparison with the reference field is an effective tool for that.
For the data of the strainmeter at SNB, abnormal steps are corrected, as well as tidal strain and the effect of atmospheric pressure change. The first reference stain is estimated from GNSS positioning data of three stations within about 4 km from SNB. Average strain field near SNB is derived from the relative displacement of those GNSS stations as strain components e_{xx},e_{xy} and e_{yy} for each day, and linear strains corresponding to CH0 to CH3 of the strainmeter are calculated by coordinate transformation. The other reference stain is estimated from a spherical pressure source model. In Izu-Oshima, volcanic deformation in medium to long interval is approximated to the deformation caused by a spherical pressure source located underground. The accompanied strain at an arbitrary point can be calculated from the source parameters, the position and the volume change. From GNSS observation all around the island, MRI (2017) estimated the position of the pressure source, and also its volume change as time series, from which we calculated the strain fields at SNB. Comparing those two reference strains, CH1 components of both strain were very similar as well as CH2 in long term trend and variations of the period about a year for the interval from 2012 to 2016. It seems the strain estimation is good for these components.
Strain fields of CH1 and CH2 observed by the SNB strainmeter were inspected using the referenced strains. In CH2 data of SNB, we found a continuous long term extension and repeated contraction and extension of the period 1 to 1.5 years. They were very similar to those of the references, the maximum and minimum of the strain data occurred almost in the same days respectively. Their variation from 2014 to 2015 were about 6 micro-strain in amplitude for the strainmeter, about 4 for the estimation from GNSS and about 8 for the estimation from the pressure source. The similarity means that each strain data or estimation is roughly reliable. Contrary in CH1, we could not find the similarity in the variation of the period from 1 to 2 years. The comparison with the reference strain estimated from the GNSS observation nearby and the spherical pressure source model made it clear that CH2 of the strainmeter could be acceptable in monitoring of the medium to long term volcanic deformation of Izu-Oshima.

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