Time change of p-value by Schuster method using earthquakes around Izu-Ohsima summit

*Hiroyuki Takayama[1]

1. Volcanological Division 1st labolatory, Meteorological Research Institute

Morita et al.(2016) and Morita et al.(2017) consider relation between volcanic earthquakes in Izu-Ohsima island and earth tide. Takayama et al.(2018) divide Izu-Oshima into 5 area and calculate p-value and consider relation between earthquakes and earth tide.

We use Schuster method (Schuster (1897)) whether occurrence of earthquake relate earth tide or not. This method is check null hypothesis of no correlation between earthquake occurrence and earth tide. Specifically, we set tide phase angle of earthquake occurrence as Di,

$$R=(\sum \cos Di)^2+(\sum \sin Di)^2$$

$$p=\exp(-R/N)$$

we test relation between earthquake occurrence and earth tide by this p-value. P-value falls in 0 to 1. If p-value is nearly 0, we reject null hypothesis. We calculate tide phase angle to each tidal component. In this research, we use principal lunar semi-diurnal tide (after this, we abbreviate M2).

In principal, if earthquake catalogue contain swarm, we can’ t calculate precise p-value. So, we avoid this problem to decluster catalogue.

In this study, we investigate time change of p-value in summit earthquakes. Detection capability of JMA catalogue in summit area is magnitude 0.0. After we decluster this catalogue, p-value is 0.011. So, we divide summit earthquake by time and calculate p-value of M2 in each group.

Specifically, we use JMA catalogue from April 2002 to January 2017. We pick up earthquakes of Izu-Ohsima summit. The number of earthquakes larger than magnitude 0.0 is 1084. After declusterd, the number of earthquakes is 901. We pick up 100 earthquakes from declusterd catalogue. We calculate p-value by M2 in 801 earthquake lists.
As a result, p-value increase and decrease periodically in time. Maximum is 0.98, minimum is 0.0030. If we select standard of rejection of null hypothesis as 0.05, periods of p-value less than this standard are around 2006, around 2010 and around 2014. Morita et al.(2017) suggest that release of volatile component from magma increase when earthquakes correlate earth tide. In the above three periods, release of volatile component increase possible. Also, Morita et al.(2017) suggest that release of volatile component from magma increase from 2013. This coincide with 2014 period.

Keywords: volcanic earthquake, earth tide, p-value

