Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SVC45-02 会場:304 時間:5 月 27 日 16:30-16:45

ストロンボリ火山の繰り返し噴火から溶岩流出噴火への移行期における地震動の時間変化
Seismic signal variation during the transitional phase from repetitive explosion to effusive eruption at Stromboli

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Stromboli volcano, which is famous for Strombolian basaltic explosions, has changed the eruption style from repetitive explosion to effusive eruption in early August 2014. Our research group began temporary seismic and tilt observations at Stromboli volcano in late May and successfully obtained the continuous data throughout the transitional phase of volcanic activity. In this study, we investigate temporal changes in RMS amplitude and in polarization of seismic waves during 4 months of observation as preliminary analyses to understand the transition phases of the volcanic activity. Changes in intensity of volcanic activity will be reflected in RMS amplitude. Polarization of seismic signals will bring us information about source location and excitation mechanism.

Here we calculated RMS amplitudes of velocity seismogram in 8 frequency bands between 0.02 Hz and 5.12 Hz. The broadband seismic data at Stromboli mainly consist of two kinds of signals: very-long-period pulse (VLP pulse) and short-period volcanic tremor (SP tremor). The signals of higher frequencies over 1 Hz correspond to SP tremor. RMS amplitude of SP tremor gradually increased from early June to the evening of August 6, and then it suddenly decreased within two days. The rapid change in RMS amplitude of SP tremor is quite consistent with the beginning of lateral effusive eruption. Therefore, SP tremor amplitude may represent the change in altitude of magma head in the conduit and intensity of gas emission at a shallow depth. On the other hand, VLP pulse has a dominant period at around 10 s as reported in the previous studies (e.g., Chouet et al., 2003). Amplitude change in the lower frequency bands below 0.16 Hz mainly correspond to VLP activity. Contrary to SP tremor, long-term gradual increase in RMS amplitude towards August 6 was not clearly recognized. Instead, VLP activity in June seemed slightly higher than that in July. However, from the end of July, RMS amplitude of low frequency signals rapidly increased until August 6. VLP pulse observed at Stromboli is a kind of explosion earthquake that coincides with the vigorous gas ejection from the active vent. Change in seismic amplitude in low frequency signals may reflect the size of gas slug ruptured at the top of magma column.

Next, we made a list of occurrence time of Strombolian explosions from band-passed seismic data and estimated polarization azimuth and inclination of each VLP pulse. More than 45,000 explosions were identified during about 4 months of observation. Before the effusive eruption on August 6, two azimuthal peaks at around N37W and N32W were recognized. When we visited the volcano for the installation work in middle May, NE and SW crater have been repeating vigorous gas ejection. Therefore, these two azimuthal peaks may reflect the difference of location of explosion. After the beginning of the effusive eruption, it converged at around N32W. Inclination also increased coincident with the change in azimuthal direction, which strongly suggests the subsidence of VLP source. Giudicepietro et al. (2009) performed similar polarization analysis for the 2007 effusive eruption and found the temporal change in polarization of seismic waves after the beginning of effusive eruption in February 2007. Quantitative comparison between our data with their result will be a future study.

From this study, we confirmed the gradual increase in intensity of magmatic activity toward the beginning of effusive eruption in early August. However, there was no distinctive change in the polarization of VLP pulses before the transition from repetitive explosion to effusive eruption. This means that the location of magma in the conduit before the transition was almost stationary. The rapid increase in amplitude of low frequency signals a few days before the effusive eruption suggests the significant changes in the size of gas slug, magma pressure etc. towards the transition.

キーワード: ストロンボリ火山, 噴火遷移過程, ストロンボリ式噴火, 溶岩流出噴火, 超長周期振動
Keywords: Stromboli volcano, transition process of volcanic eruption, Strombolian explosion, effusion eruption, very-long-period signal