修士論文

Moment tensor inversion for very-long-period seismic events observed during the 2000-2002 volcanic activity at Mt. Bandai

(２０００－２００２年磐梯山火山活動で観測された超長周期地震のモーメントテンソルインバージョン)

東北大学大学院理学研究科
地球物理学専攻

Jose Jesus Karim Pacheco Vivero

論文審査委員
西村　太志　准教授（指導教員・主査）
佐藤　春夫　教授
松澤　暢　　教授
植木　貞人　准教授

平成２３年

Abstract:

Very-long-period (VLP) seismic events have been investigated at many active volcanoes in the world especially since the development of portable broad-band seismometers. VLP seismic events are characterized by long period waves of more than about 5 seconds that are insensitive to heterogeneous structures of volcanoes. Analyses of their source mechanism enable us to infer mass transports and oscillations of fluids in magmatic and hydrothermal systems beneath active volcanoes.

During the 2000-2002 volcanic activity of Mt. Bandai, Japan, VLP seismic events occurred together with volcano-tectonic earthquakes and tremor. The activity of the VLP events was not high, as only one event occurred every a few months during the observation period of two years.

The VLP events are characterized by short-period waves (SP phase) at the beginning of the seismogram, and long-period phase (LP phase) of about a few seconds followed by very-long-period oscillations (VLP phase) of approximately 10 seconds. The waveforms at 10 seconds are quite similar to each other, suggesting a persistent system beneath the volcano.

The seismograms are band-pass filtered at 0.06-0.12 Hz and 0.24-0.48 Hz, which correspond to VLP and LP phases respectively, and the moment tensor inversions are applied for each frequency band to determine the source locations and mechanisms of the VLP and LP phases. Seismic data of the event with the largest amplitudes during the observation, corresponding to the event recorded on August 23rd, 2001 is analyzed in the present study.

The source of the VLP phase is determined to lie at a depth of 4.5 km beneath the horseshoe-shaped crater on the north flank of the volcano that was formed in the 1888 eruption. The calculated source time functions of the moment tensor show volumetric oscillations of a vertical crack with a strike of about 12 degrees, which is consistent with the direction of the

distribution of the fumaroles observed in the crater just after the 1888 eruption. The variance reduction values obtained by means of the moment tensor inversion analyses show two possible source locations for the LP phase: one is located at a depth of 3-4 km beneath the north-eastern flank and the other is at a depth of 2 km depth beneath the north of the summit. Considering the hypocenters of SP phases and the source location of VLP phase, we conclude that the latter source located at a depth of 2 km is more plausible. The obtained source time functions of the moment tensor suggest oscillations of a sub-horizontal crack dipping approximately to the north direction at a depth of 2 km.

Our inversion results indicate that VLP events at Mt. Bandai consist of SP phase generated close to the low-resistivity zone where volcanic fluid is expected to exist, LP phase generated at 2 km depth beneath the summit, and the VLP phase originating from the oscillations of a vertical crack at a depth of 4.5 km beneath the horse-shoe shaped crater. The VLP activity for two years with very low frequency suggests a stable conduit system that consists of plural cracks where volcanic fluid can move and/or transfer the pressure beneath the volcano.

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