

A source mechanism of singular long-period earthquakes observed before the 2004 eruptions at Asama Volcano

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Broadband seismometers just on the edge of summit crater were installed before the 2004 eruption at Asama volcano. These instruments had recorded singular long-period earthquakes whose waveforms are essentially different from ordinary volcanic earthquakes. They had been observed at only a few stations just near the summit crater, and their source locations had been estimated to be remarkably shallow. Yamamoto et al. (2005) had classified them into 3 types, and we are analysing one of them, outward pulsive events, which have relatively simple waveforms. An outward pulsive event begins with its initial phase of about 5 sec whose polarity is outward from the vent, followed by next inward longer and slower phase. They had been always observed since the beginning of observation until about 1 month before the first eruption, reducing after then.

In this study, we made a waveform inversion to estimate a source mechanism of outward pulsive events. The Green's Functions are calculated by a finite difference method including 3-D topography (Ohminato and Chouet, 1997), and the inversions were carried out by a singular value decomposition with sharp cut-off approach for numerical stability. We combined a grid search to derive a best estimate of source location.

At first, an event at 17:38 on June 27, 2004, observed at all three stations, were analyzed using 0.05-0.25Hz band-pass-filtered waveform. Its hypocenter is estimated to be below the center of vent and 2300m above sea level, provided we choose a model with the fewest parameters among the ones which explain data within 15% errors. The solution has its dominant character of EW-directed dipole. Fitting of observed and synthetic waveforms are good, except a bad fitting at the farthest station with small amplitude.

We then analyzed other 11 events in late July and early August, 2004, about 1 month before the first eruption, which have broadband records at two stations, with fixing their hypocenter at the same location as the one obtained from the event on June 27 to cover a lack of data. Analysis results shows that EW-directed dipole is dominant in late July, which becomes inclined in west-up since in August.

Solutions have some under-determined parameters. We assumed them to be within the same scales as over-determined ones and changed them within this range, estimating probable ranges of principal axis and values. Its result implies that the total volumetric change of initial phase is likely to be outward while at least one of the principal stress might be inward, and the direction of dominant dipole ranges in a narrow angle.

References

[1] Yamamoto et al. (2005), A unique earthquake activity preceding the eruption at Asama volcano in 2004, Bull. Vol. Soc. Jpn., 50, 393-400.

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