

Source mechanism of a very-long-period seismic event at Mt. Ontake

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On January 25, 2007, 9:00 (JST), very-long-period (VLP) seismic signals that occurred beneath Mt. Ontake were observed by tiltmeters of Hi-net and broadband seismometers of F-net. The VLP signals are characterized by impulsive waveform signatures with the characteristic period of 30 s. We performed waveform inversion of these signals to estimate the source mechanism using an extended method of Nakano and Kumagai [GRL, 32, L12302, 2005]. Lateral dimensions of 20 x 20 km centered at Mt. Ontake and a vertical extent of 20 km with a uniform grid of 5 km were used in a grid search to find the best-fit solution. Isotropic and horizontal and vertical crack point sources were assumed at each node point, where we performed a grid search in the azimuthal angle for a vertical crack. Green's functions were calculated by a discrete-wavenumber method using a horizontally layered structural model. We used three-component broadband seismograms from two stations of F-net, and tiltmeter records from 15 stations of Hi-net within an epicentral distance of 50 km from the volcano. The observed displacement waveforms bandpassed between 20 and 50 s were used in our inversion.

The inversion result indicates that a vertical crack just beneath Mt. Ontake provides the best fits to the observed seismograms among the assumed three sources. We also performed a grid search in the crack orientation (azimuth and plunge angles) at the best-fit location, which show that a vertical crack provides the minimum residual. The source depth is not well constrained in our inversion because the fits become better as the depth decreases, suggesting that the source may be shallower than 5 km below the surface. The crack orientation is estimated as N30W. The estimated moment functions show inflation, followed by small deflation and a recovery phase, with an amplitude of 10^{14} Nm and a total duration of 100 s. The vertical crack may represent an intruded dike beneath Mt. Ontake. The volumetric changes at the VLP source may be originated from vesiculation processes in an intruded magma. The size of the VLP event (10^{14} Nm) is moderate compared to VLP events observed at various active volcanoes such as Aso, Miyake, Hachijo, Usu, Kilauea, and Stromboli.