Source estimate of tilt signals associated with very-long-period pulses at Asama Volcano

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Since the installation of a broadband velocity seismometer in the summit area of Asama Volcano in the fall of 2003, singular very-long-period seismic events swinging one-side with 3-10 seconds duration (later refered as VLP pulses) have been frequently observed. Their particle motions imply a compressional source near the bottom of the crater. We can now have a possibility to get clearer images of these VLP pulses using 4 permanent broadband seismometers and 10 additional temporary broadband seismometers installed in the summit area in September 2008.

Horizontal seismographs of these VLP pulses are followed by another pulsive signals of opposite sign whose durations extend a few tens of seconds. They seems to result from horizontal shifts of seismometer's pendulum caused by tilts, and contamination by these tilt signals on translational motions makes it difficult to perform analyses such as waveform inversion. In order to discriminate these tilt signals from translational motions, we are trying the following two methods; (1)a method proposed by Zaharadnik and Plesinger(2005,BSSA), which assumed that a time-function of tilt is a step function; and (2)one proposed by Wielandt and Forbriger(1999,Annali di Geofisica), which assumed that a translational motion and a tilt have the same time-function each other. From our analysis performed so far, the method (2) seems to be more hopeful.

We also performed particle-motion analysis of these tilt signals themselves using dense seismic network mentioned above in order to obtain some important clue about the source mechanism of VLP pulses. The resultant perticle motions point to mismatched epicenter locations each other, although they all point within the crater direction. The cause of this mismatch would be (1)misorientation of seismometer, (2)topographic effect, and (3)effect of finite non-isotropic source; however, the error of seismometer's direction (possibility (1)) is estimated within a few degrees based on particle-motions of surface wave seismographs, which seems to be too small to explain the mismatch. In order to estimate the effect of topography (possibility (2)) easily, we derived an equation representing azimuth direction of tilt on uniformly sloped free surface by rotating the coordinate of Mogi model. Then we found that, when a slope of original free surface is 30 degrees, tilt azimuth may differ by about 20-30 degrees from the flat case where tilt point to the radial direction. This angle difference depends on location of observation point and its sense is that azimuth tends to become more perpendicular to the contour line when observation point locates above the source. The degree and sense of this result seems to be consistent with observed tilt. On the basis of this preliminary result, we now have a plan to estimate the topographic effect using real 3D topography at Asama Volcano by finite difference method of Ohminato and Chouet(1997,BSSA). As to the effect of finite non-isotropic source (possibility (3)), we are now making crustal-deformation calculation using program of Okada(1992,BSSA) to estimate tilt caused by finite rectangular fault. From results obtained so fer, this effect might explain the observed tilt pattarn qualitatively. In this presentation, we represent these and sequel results.