Mechanism of explosive eruptions at Sakurajima volcano

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The source processes of explosion earthquakes that accompany explosive eruptions at an andesitic volcano Sakurajima, were investigated to clarify the mechanics of explosive eruption. Waveforms of explosion earthquakes are composed of a compressional P-wave first motion (P phase), following dilatational motion of larger amplitude (D phase) and the largest amplitude motion, with longer periods of 2s (LP phase), which appears 2 to 3s after the arrival of the P-wave first motion. Considering the particle motion, attenuation with the epicentral and hypocentral distances, and propagation velocity, the P and D phases are composed of P-waves and the LP phase is composed of Rayleigh waves. Moment tensors for the phases were estimated by a waveform inversion method. The waveforms of explosion earthquakes are simulated by two sources at depths of 2km and two sources immediately beneath the crater. The three diagonal components of the moment tensors of the 1st source generating the P phase have similar positive values for all the events. The non-diagonal components are negligibly small compared with the diagonal components. The 2nd source corresponding to the D phase is contraction and larger. The vertical dipoles have negative values and the horizontal dipoles are about twice as large as the vertical dipoles. The results show that the P phase is generated by an isotropic expansion and the source of the D phase is approximated by a contraction of a cylinder at a depth of 2km beneath the crater. The seismic moment of the cylindrical contraction is 5 to 20 times larger than that of the isotropic expansion, and the origin time of cylindrical contraction source was delayed by 0.2 to 0.5s from the onset of the isotropic expansion. The LP phase was excited by an isotropic expansion and a following horizontal contraction source at depths of 0.25-0.5km beneath the crater bottom. The seismic moments of the shallow isotropic expansion and horizontal contraction sources. Origin times of shallow isotropic expansions are delayed by 0.9-1.1s from the occurrence of explosion earthquakes and coincide with the generation time of the air-shock at the crater bottom. Seismic moments of shallow expansion sources are correlated with the amplitudes of the air-shocks. The source depths of the shallow isotropic expansion and horizontal contraction coincide with that of the rapid deflations which are caused by outbreak of gas pockets at the uppermost part of the volcanic conduit. It is inferred that the isotropic expansion is caused by instantaneous volume increase of the gas pocket formed at the uppermost region of the volcanic conduit which generates the air-shock. The horizontal contraction reflects decrease in volume caused by pressure decrease due to collapse of the gas pocket.