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Array Analyses of Tremor and Explosion Earthquakes Recorded at Suwanosejima Volcano, Southwest Japan

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Suwanosejima volcano in the southwestern part of Japan is an andesitic volcano currently characterized by explosive eruptions at intervals of 2-4 weeks since 1957. Recently, small ash eruptions called strombolian or vulcanian eruptions have occurred over periods of a few days to months at the central crater. Explosive eruptions were followed by continuous lava effusion and degassing. Explosive earthquakes were followed by continuous tremors with the period from several minutes to hours. Continuous tremors became suddenly weak and were unclear and associated with weak tilt detected inflation of the volcano edifice a few minutes before explosive eruptions. We analyze data from a seismic array deployed 0.7 km south-southwest of the active vents of the volcano during October-November 2010. The seismic array had stations spaced 30 m apart and a total aperture of approximately 250 m. Most seismic signals recorded by the array were continuous tremor and explosion earthquakes. We applied the zero-lag cross-correlation (ZLCC) method to estimate the propagation parameters (back-azimuth and apparent velocities) of the recorded signals. We estimated the parameters for explosion earthquakes and continuous tremors. The back-azimuths for explosion earthquakes and continuous tremors are around N30degE, which is in the direction of the vent. The apparent velocities for explosion earthquakes are around or above 2.0 km/s for portions of their onsets, suggesting P-waves from the vent. The apparent velocities for later phases of explosion earthquakes are around 0.8 km/s, suggesting surface waves from the vent. The apparent velocities for continuous tremors during continuous lava effusion and degassing after explosions are distributed at about 0.8 km/s, suggesting surface waves from a source near active vents. The array analysis detected weak continuous tremors associated with dilatation tilt changes before explosive eruptions. The apparent velocities for the weak continuous tremors are between 1.5 and 2.5 km/s, suggesting mixed waves of body and surface waves came from a deeper portion of the conduit below the vent. Weak continuous tremors before explosions suggest ascent of magma and accumulation of volcanic gas in the conduit below a confining cap of the vent.