Extremely Long Period Oscillations Observed by Tiltmeters at Miyakejima Volcano

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Extremely long period (ELP) oscillation had been observed during 2002 - 2005 by borehole tiltmeters at Miyakejima Island, which has been continuously emitting a large amount of volcanic gas from the summit crater since 2000. The oscillation exhibits a sinusoidal wave train with an extremely long period of 20-60 minutes and was observed at all five stations and fully synchronized each other. The amplitude of the oscillation (less than 5 nrad) is very stable, sustaining for several days. Their polarization directions and amplitudes variation indicate a periodic expansion and contraction of the island caused by a periodic pressure change of a magma chamber at the western part of the island 5-10 km deep, which was modeled from crustal deformation data by Ueda et al.(2004, AGU fall meeting). The commencements of ELP oscillation in the many cases had been coincident with the high activity of the shallow seismicity (shallower than 3km) inside of the summit caldera until an active period of July and August 2005. However, although no significant changes was observed in the earthquake activities, crustal deformation and the gas emission in Miyakejima since September 2005, the ELP oscillation weakened in September and quieted down after November 2005.

The oscillation that has an extremely long period and a single peak spectrum without overtones is reasonably explained by Helmholtz resonance of a magma system proposed by Ueda et al. (2005, the Meeting of Volcanological Society of Japan). The magma system is composed of the magma chamber and a conduit that connects the summit caldera to the magma chamber, causing a sinusoidal wave train with a single predominant period as observed. The load of magma in the conduit and the repulsion of magma oscillate the magma head and the pressure of the magma chamber, being similar to a simple mass-spring system. Since the ELP oscillation is very stable, a continuous bubble formation in the conduit probably continuously stimulates the oscillation of the magma head.