Long-period seismic signal activity, seismicity, crustal deformation, SO_2 emission, and total magnetic force at Asama volcano from Oct. 2007 to Jan. 2018

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Vulcanian eruptions had started on September 1st 2004, lasting until December 2004 at Asama volcano. After that, several small eruptions occurred in August 2008, from February to May 2009, and in June 2015. We compile long-period seismic signals, seismicity of volcanic earthquake and N-type earthquake, crustal deformation at the western flank, SO_2 emission data, and a total magnetic force at the summit area from October 2007 to January 2018. We categorize long-period seismic signals into three group; the first category is a very long-period pulse (VLP) excited by a sudden gas emission [Maeda et al., 2011]. The second category is a long-period rebound waveform (LP earthquake), and the third category is long-period tremor characterized by nonlinear waveform (Nonlinear tremor). A short-period earthquake characterized by gradually attenuating long-tail oscillation containing a harmonic spectrum structure are called N-type event naming after non-dumping oscillation. Corresponding to the small eruption in August 2008, the baseline length across the western flank of Asama volcano expanded due to magma intrusion. Followed by small eruptions from February to May 2009, the VLP activity, seismicity, and SO_2 emission had been kept in high level until the end of 2009. However, N-type events had rarely occurred during this period, except at an intensively occurrence of N-type events one day before the small eruption on February 2, 2009; LP earthquake and nonlinear tremor rarely occurred too. The baseline length had turned to contraction from April 2010, lasting until in spring 2015. In spite of the fact that VLP activity and SO_2 emission had been kept in low level in this contraction period, the frequencies of N-type events, LP earthquakes, and nonlinear tremors had increased. We installed a Proton magnetic sensor at the south side of the summit crater in autumn 2009; the total magnetic force exhibits a linear secular trend. If this trend was caused as the result of magnetized state in the conduit, it corresponded to magnetization below the summit crater. From middle of 2013 to July 2015, the total magnetic force had departed from the secular trend and the amount of magnetic force change had reached to -10nT by July 2015. The total magnetic force again has been exhibiting the linear secular trend since July 2015, just after the small eruption in June 16. The start of misalignment from the linear secular trend coincided with the increment of N-type event, and the end of this divergence got together with the end of N-type event activity. A candidate of a plausible excitation model of N-type event is a channel wave along a fluid-filled closed crack surface [Chouet, 1986]. This model suggests that a frequent occurrence of N-type event indicates a clogged state in the shallow part of conduit. The hypocenters of N-type events lie in the summit crater with the depth of 300m to 800m below the crater bottom. The total magnetic force decline of -10nT can be explained by demagnetization of 200m (length) x 200m (width) x 500m (300m to 800m below the crater bottom) area, which roughly correspond with the N-type source area. These results suggest that the state of the shallow part of conduit had changed to occluded state from middle of 2013 and retaining volcanic gas prevented temperature reduction beneath the summit crater causing the change of total magnetic force of -10nT. The occluded state was released by the small eruption on June 16, 2015, and the SO_2 emission and VLP activity were reactivated and the total magnetic force retuned back to the linear secular trend after that.

Keywords: long-period seismic signal, volcanic gas, total magnetic force