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Searching for a linkage between volcanic gas flux and geophysical phenomena

January, 30 - 2018.

Aula Riunioni, Area della Ricerca CNR-INGV, Via Ugo La Malfa 153, Palermo

Abstract

Volcanic gases can provide significant information on the state of magma, which is important for interpreting and predicting volcanic activity. In the talk, I would make a brief review of my recent works to bridge volcanic gas and geophysical observations at volcanoes in Japan.

The first topic is a relationship between volcanic gas emission and very-long-period (VLP) seismicity (Kazahaya et al. 2011; GRL). The gas bursts following the VLP seismic signals were observed at Asama volcano, Japan. The high temporal sulfur dioxide (SO₂) emission rate measurements complementing with the dense seismometer network revealed that the seismic moments of the VLP events are proportional to the SO₂ emissions of the gas bursts, suggesting these seismic events are excited by gas movements within the volcano. The VLP seismic events are likely to be caused by sudden outgassing at a shallow depth that is induced by the propagation of gas phase expansion and rupture (Kazahaya et al. 2015; EPSL).

The second topic is a link between ground deformation and gas emission. Multiple cycles of the intensive volcanic gas emission and ground deformation were observed at Asama volcano, Japan. We estimated volume decrease of magma in a reservoir using dense volcanic gas observation data so as to compare with ground deformation (Kazahaya et al. 2015; JGR). As a result, the volume decrease of the magma caused by the gas discharge was larger than the deformation observed by geodesy. This strongly suggests that volcanic gas discharge can be one of the main mechanism to cause deflation of the volcano.

We also made the measurements at Sakurajima volcano, Japan to quantify the relationship between SO₂ emission rate and inflation prior to Vulcanian explosions (Kazahaya et al. 2016; GRL). The explosions associated with precursory inflation events were preceded by decrease in SO₂ emission rates. The amounts of accumulated SO₂ and increase in strain records before the explosions showed a positive correlation. The results indicate that the inflation before the explosions were caused by the gas accumulation in the conduit.

