Geophysical Research Abstracts
Vol. 19, EGU2017-16046, 2017
EGU General Assembly 2017
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The Lusi mud eruption dynamics: constraints from field data.

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The Indonesian Lusi eruption has been spewing boiling water, gas, and sediments since the 29th of May 2006. Initially, numerous aligned eruptions sites appeared along the Watukosek fault system that was reactivated after the Yogyakarta earthquake occurring the 27th of May in the Java Island. Since its birth Lusi erupted with a pulsating behavior showing intermittent periods of stronger activity resulting in higher fluids and solid emissions intervals. Since 2010 two active vents are constantly active.

We conducted detailed monitoring of such clastic geysering activity and this allowed us to distinguish four distinct phases that follow each other and that reoccur every ~30 minutes: (1) regular bubbling activity (constant emission of water, mud breccia, and gas); (2) clastic geysering phase with intense bubbling (consisting in reduced vapor emission and more powerful diffused mud bursting); (3) clastic geysering with mud bursts and intense vapour discharge (typically dense plume that propagates up to 100 m in height); (4) quiescent phase marking the end of the geysering activity (basically no gas emissions or bursts observed).

In order to better understand this pulsating behavior and to constrain the mechanisms controlling its activity, we designed a multidisciplinary monitoring of the eruption site combining the deployment of numerous instruments around the crater site. Processing of the collected data reveals the dynamic activity of Lusi's craters. Satellite images show that the location of these vents migrated along a NE-SW direction. This is subparallel to the direction of the Watukosek fault system that is the zone of (left) lateral deformation upon which Lusi developed in 2006. Coupling HR camera images with broadband and short period seismic stations allowed us to describe the seismic signal generated by clastic geysering and to constrain the depth of the source generating the signal. We measure a delay between the seismic (harmonic) record and the associated clastic geyser explosion of approximately 3 s. This, in agreement with previous studies, corresponds to a source located some tens of meters depth inside the conduits. We ascribe the harmonic seismic signal to rise of batches of H_2O-CO_2-CH4 fluids inside the conduit. Once they approach the water-vapour region the sudden pressure drop triggers flashing and the exsolution of the dissolved CO_2 and CH4.
In the last part of our study we verified whether the powerful clastic geysering (emitting jets up to 20 m high) may induce local deformation of the mud edifice. During the stronger geysering events we measure an increase and drop of gravity overtime that are related to change of mud density within the feeder conduit. We process continuous camera recordings with a video magnifying tool capable of enhancing small variations in the recorded images. Results highlight that major eruptive events are preceded by a deformation of the mud edifice surrounding the vents. Ongoing studies aim to verify if these events are also captured by the tiltmeter measurements.

This study represents a step forward to better understand the activity that characterizes Lusi. Further studies will help to better constrain the reactions and dynamics ongoing inside the conduit.