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# LUSI LAB: a multidisciplinary project in a natural active laboratory

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The 29th of May 2006 several gas and mud eruption sites suddenly appeared along a strike-slip fault (Watukosek fault system) in the NE of Java, Indonesia. The eruption occurred almost two days after a 6.3 M earthquake striking the island of Java. Within weeks several villages were submerged by boiling mud. The most prominent eruption site was named Lusi. To date Lusi is still active. This disaster has forced 50.000 people to be evacuated and an area of ∼7 km2 is covered by mud. The social impact of the eruption and its spectacular dimensions still attract the attention of international media reporting on the "largest mud eruption site on Earth".
LUSI LAB (ERC grant n° 308126) focuses on five main aspects in order to complete a comprehensive regional investigation of this impressive event: 1) sampling and monitoring the active Lusi eruption site; 2) monitoring and sampling the neighbouring volcanic arc; 3) monitoring the local micro-seismicity and its relationship with regional seismicity; 4) monitoring the fault system originating from the volcanic arc, crossing Lusi and extending to the NE of Java island; 5) numerical modelling of Lusi activity and the strike-slip/magmatic complex system.
We completed several field expeditions. Our studies investigated the mechanisms of reactivation of the Watukosek fault system that crosses Lusi locality and continues to the NE of Java. Results show that after the 27-05-2009 earthquake it was activated the lateral movement of this strike-slip system resulting in these several aligned eruptions sites including Lusi. Further, our geochemical studies of the erupted fluids reveal a mantle signature and point to a connection with the neighboring Arjuno-Welirang volcanic complex indicating that Lusi is a sedimentary hosted geothermal system.
We have designed, developed and constructed the Lusi drone. This is a remote controlled hexacopter developed and assembled in order to complete multidisciplinary studies in extreme and inaccessible environments. The Lusi drone allowed us to successfully complete video/photo surveys as well as fluids/mud sampling from the crater including spot measurements.
In order to estimate the amount of gas that is being released around the Lusi crater area (∼7 km2), we conducted two surveys including over 350 stations ($CO_2$ and CH4 flux measurements) using a closed-chamber flux-meter system, measured radon emissions, and collected more than 60 gas samples to analyze the composition of the seeps and the crater plume.
We also investigated microbial processes and thriving communities conducting several sampling campaigns to collect samples of fresh mud from the erupting crater using the remote controlled drone. In addition we completed a transect in the mud flood zone to sample older, weathered flows for comparison. The results of the microbial colonies incubation reveal the widespread presence of active microbial colonies, even at high temperatures, opening new questions regarding life in the deep biosphere.
Since more than a year we have operating a network of 31 seismic stations distributed around the Arjuno-Welirang volcanic arc, along the Waukosek fault and around Lusi. The purpose of this long term monitoring is to observe how local seismicity and/or the frequent seismic activity ongoing in the subduction zone in southern Java affects the activity of the magma chamber, the Watukosek fault system and the Lusi activity. In addition we also deployed temporary stations inside the embankment area to observe the activity of the pulsating behavior of Lusi and its geysering bursts. This study is coupled with video observations.
A comprehensive combined electrical resistivity and self-potential (SP) survey was performed in the 7 km2 area inside the Lusi embankment. The goal of the geophysical survey was to map the near-surface occurrence of the Watukosek fault system, and provide useful data for numerical modelling.
The large amount of data collected allows us to test several approaches to model numerically some of the dynamics ongoing in the Lusi conduit and, on a larger basinal scale, to construct a 3D geological model of the region around Lusi.