Geophysical Research Abstracts
Vol. 18, EGU2016-16421, 2016
EGU General Assembly 2016

Constraining the thermal structure beneath Lusi: insights from temperature record in erupted clasts

Benjamin Malvoisin (1), Adriano Mazzini (2), and Stephen Miller (1)

(1) UNINE Neuchâtel, CHYN, Neuchatel, Switzerland (benjamin.malvoisin@gmail.com), (2) The Centre for Earth Evolution and Dynamics, University of Oslo, Sem Saelandsvei 24, Blindern 0316 – Oslo, Norway.

Sedimentary units beneath Lusi from surface to depth are the Pucangan formation, the Upper Kalibeng formation where shales and then volcanoclastic clasts are found, the Kujung-Propuh-Tuban formation composed of carbonates and the Ngimbang formation composed of shales. Water and gas geochemistry as well as surface deformation indicate that Lusi is a hydrothermal system rooted at >4 km depth. However, the thermal structure beneath Lusi is still poorly constrained whereas it has first-order impacts on the physical and chemical processes observed during the eruption. In the framework of the Lusi Lab project (ERC grant n° 308126) and of a project of the Swiss National Science Foundation (n°160050) we studied erupted clasts collected at the crater site to determine their source and temperature record. Three types of clasts were studied based on morphological and mineralogical basis. The first type is limestones mainly composed of Ca- and Fe-bearing carbonates. The clasts of the second type are light grey shales (LGS) containing carbonaceous matter, illite/smectite mixture, plagioclase and quartz. The third type is also a shale with a black colour containing hydrocarbons (black shales, BS) and with the additional presence of Na-rich plagioclase, biotite and chlorite. The presence of these latter minerals indicates hydrothermal activity at relatively high temperature. Better constraints on temperature were obtained by using both Raman spectroscopic carbonaceous material thermometry (RSCM) and chlorite geothermometry. Temperatures below 200°C were determined for the LGS with RSCM. BS recorded two temperatures. The first one, around 170°C, is rather consistent with an extrapolation of the geothermal gradient measured before the eruption up to 4,000 m depth. Combined with mineralogical observations, this suggests that BS originate from the Ngimbang formation. The second recorded higher temperature around 250°C indicates heating, probably through interaction with high temperature hydrothermal fluids. Calculations performed for such a heating indicate that associated clay dehydration is sufficient to provide the water released during the eruption and that heating-induced overpressure could favor fluid ascent. These results confirm the hydrothermal scenario in which Lusi eruption is fed by high temperature fluid circulation from the neighboring Arjuno-Welirang volcanic complex.