Geophysical Research Abstracts
Vol. 18, EGU2016-11473, 2016
EGU General Assembly 2016

Is magma cooling responsible for the periodic activity of Soufrière Hills volcano, Montserrat, West Indies?

Luca Caricchi (1), Guy Simpson (1), Cyril Chelle-Michou (1,2), and Jürgen Neuberg (3)

(1) University of Geneva, Earth Sciences, Geneva, Switzerland (luca.caricchi@unige.ch), (2) Department of Geology LMV-TL, Jean Monnet University, Saint-Etienne, France, (3) School of Earth & Environment, Leeds University, Leeds, United Kingdom

After 400 years of quiescence, Soufrière Hills volcano on Montserrat (SHV) started erupting in 1995. Ongoing deformation and sulphur dioxide emission demonstrate that this volcanic systems is still restless, however, after 5 years of inactivity it remains unclear whether magma extrusion will restart. Also, if such periodically observed activity at SHV will restart, can we use past monitoring data to attempt to forecast the reawakening of this volcano?

Cooling of volatile saturated magma leads to crystallisation, the formation of gas bubbles and expansion. Such volumetric variations are not only potentially responsible for deformation signals observed at the surface (Caricchi et al., 2014), but also lead to pressurisation of the magmatic reservoir and eventually renewed magma extrusion (Tait et al., 1989).

We postulate that volcanic activity observed at SHM over the last 20 years could be essentially the result of the unavoidable progressive cooling of a magmatic body, which was probably assembled over thousands of years and experienced internal segregation of eruptible lenses of magma (Christopher et al., 2015). To test this hypothesis, we performed thermal modelling to test if the cooling of a shallow magma body emplaced since 1990 could account for the monitoring signals observed at SHV. The results show that progressive cooling of a 4km3 volume of melt could explain the deformation rate currently observed. Using the deformation rate obtained from the modelling for the first 15 years of cooling, a reservoir volume of about 13 km3 (Paulatto et al., 2012) and a critical value of overpressure of 10 MPa, it would have taken approximately only 3 years to pressurise the reservoir to the critical pressure and restart magma extrusion. This is in agreement with the time interval between previous pauses at SHV before 2010. Considering the current deformation rates, we speculate that magma extrusion could restart in 6-8 years after the end of the last event in 2010, hence in the period 2016-2018. Because cooling affects mainly the outer portions of the magmatic reservoir, pressurisation by cooling and crystallisation lead to the release of magma from the inner part of the reservoir with essentially constant composition, as observed at SHV over the last 20 years.

REFERENCES

Caricchi, L., Biggs, J., Annen, C., & Ebmeier, S. (2014). Earth and Planetary Science Letters, 388, 166–174. doi.org/10.1016/j.epsl.2013.12.002.

Christopher, T. E., Blundy, J., Cashman, K., Cole, P., Edmonds, M., Smith, P. J., et al. (2015). Geochemistry Geophysics Geosystems, 16(9), 2797–2811. doi.org/10.1002/2015GC005791.

Paulatto, M., Annen, C., Henstock, T. J., Kiddle, E., Minshull, T. A., Sparks, R. S. J., & Voight, B. (2012). Geochemistry Geophysics Geosystems, 13(1), doi.org/10.1029/2011GC003892.

Tait, S., Jaupart, C., & Vergniolle, S. (1989). Earth and Planetary Science Letters, 92(1), 107–123. doi.org/10.1016/0012-821X(89)90025-3