



Magma accumulation or second boiling - Investigating the ongoing deformation field at Montserrat, West Indies

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For over 20 years, Soufriere Hills Volcano, Montserrat has been in a state of volcanic unrest. Intermittent periods of dome building have been punctuated by explosive eruptions and dome collapse events, endangering the lives of the inhabitants of the island. The last episode of active magma extrusion was in February 2010, and the last explosive event (ash venting) in March 2012. Despite a lack of eruptive activity recently, the volcano continues to emit significant volumes of SO_2 and shows an ongoing trend of island inflation.

Through the aid of three-dimensional numerical modelling, using a finite element method, we explore the potential sources of the ongoing island inflation. We consider both magmatic (dykes and chamber) and tectonic sources. Whilst a magmatic source suggests the possibility for further eruption, a tectonic source may indicate cessation of volcanic activity.

We show that a magmatic source is the most likely scenario, and illustrate the effect of different sources (shapes, characters and depths) on the surface displacement. Furthermore, through the inclusion of topographic data, we investigate how the topography may affect the displacement pattern at the surface.

We investigate the conflicting scenarios of magma chamber resupply versus second boiling - crystallisation-induced degassing. Based on numerical modelling results, we suggest the required pressurisation is too high for crystallisation-induced degassing to be the dominant process - thereby suggesting magma accumulation may be ongoing. However, we show that second boiling may be a contributing factor, particularly when taking into account the local tectonics and regional stretching.