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Interactive comment on "Seismogenic frictional melting in the magmatic column" *by* J. E. Kendrick et al.

Anonymous Referee #3

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Comments on the manuscript Âń seismogenetic frictional melting in the magmatic column by J.E. Kendrick, Y. Lavallée, K.-U. Hess, S. De Angelis, A. Ferk, H.E. Gaunt, D.B. Dingwell, and R. Leonhardt.

General Comments

In this manuscript the authors describes a layered structure developed in a andesitic lava block sampled in a block and ash flow deposit from the 2010 eruption of the Soufriere Hills volcano (SHV), Montserrat island. Petrography and petrology of this layered microstructure is analyzed while magnetic and calorimetric measurements are performed to characterize the pseudotachylyte nature of the main band. Although the presence of pseudotachylytes in the volcanic products issued from extrusion and/or explosion of andesitic events is recognized from a long time - as illustrated by the number

of references cited in this manuscript – this paper is novel as it includes an experimental approach in deformation to link the frictional melting produced in the discrete structure to the periodic seismogenic rupture in the ascending magma. I really appreciate this approach. From the general point of view, the spelling is correct and the figures are well designed.

The main results of this considerable work in terms of volume of datas and analytical techniques involved are: the pseudachylytic nature of a part of the layered structure is evidenced; this structure is a shear band along which crystal cataclase (cataclasite s.s) taken place; the pseudotachylyte is linked to the seismogenic rupture in the ascending magma and finally the pseudotachylyte is an impermeable barriers as demonstrated by the simulation realized on medium resolution tomographic 3D images. From this last conclusion, the authors discuss the potential influence of the pseudotachylyte on degassing capabilities of the magmatic column during ascent of the magma followed by an eventual explosive activity and/or dome formation. Finally, I particularly appreciate the experimental approach to link the repetitive seismicity frequently recorded during magma ascent and the development of pseudotachylyte along conduit walls. The authors conclude that the presence of pseudotachylyte documents the evidence of frictional melting along conduit walls of an ascending viscous magma.

1- The main major comment comes from the general organization in the manuscript between the different investigations (petrography/petrologic descriptions, geophysical characterization, magnetism, Permeability determination from tomographic imaging, experimental test to characterize the mechanism of slip. . .), the description of the used methodologies and the interpretations. In that sense I follow the suggestions proposed by the first referee: I would prefer to see a rigorous separation between the analytical techniques, the results and the interpretations, and finally the conclusion. On the whole this manuscript need a moderate revision.

2- From this point a view an example is given by the term of “pseudotachylyte” that is used as early as in the petrographic investigation. I am not convinces that the authors

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can characterize strictly the pseudotachylitic nature of a part of the structure only from the observations made in the field or even in thin section. At this scale of observation this part of the shear band may be confused with an ultracataclastic vein . . .? 3 -There is also sometime a lake in the description of the different parts of the shear band. In particular, a quantitative analysis of the textural characteristics in the pseudotachylyte, the cataclase and the host rock is required.

This work is based on one example found in the field and the authors conclude about the importance of this type of structure (i)- because first, is an impermeable barrier that possibly act on (limit?) the degassing process of the magmatic column and second (ii) express a melting linked to the repetitive seismicity that taken place in the magma along the conduit wall. I agree with these conclusions (already evoked and described in previous publications). Therefore such structures should be very common in the blocks issued from the magmatic column/dome and sampled in the block and ash flow. Is there any systematic field observations and calculations made by the authors about the volume of materials affected by theses shear bands ?. It is clear that these structures are discrete and initially located only along the conduits walls or along shear zones, if present, in the magmatic column. The volume of magma affected by the frictional melting is therefore not necessarily very large but the number of shear bands should be significant to express the large number of earthquakes recorded during the eruption.

Others minors comments or questions

What was the influence of the porous fraction probably present during formation and development of this shear band along the conduit wall? this point remains strongly speculative but could be potentially evoked.

The pseudotachylytes are often characterized by injection veins along which secondary brittle injections often take place in the host rock or in the cataclase zone. Is these structures have been observed ?

This sample was not in place. Is there any information from the relationships between

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the orientation of the shear band and the other structures such as the mineral fabric in the host rock that constrain the original orientation of this band with respect to the conduit wall (and therefore the flow) geometry ? this point is relatively important to support the control on the bulk permeability of the magma by the pseudotachylyte (see fig.9).

Interactive comment on Solid Earth Discuss., 5, 1659, 2013.