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

Anonymous Referee #2

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The contribution by Kendrick et al. “Seismogenic frictional melting in the magmatic column” addresses an increasingly examined phenomenon in physical volcanology, namely the intimate association of shearing and faulting with extrusion of the magma conduit. Synformational deformation of volcanogenic and magmatic materials has been examined by different authors, with much emphasis on the effect of multiple excursions through the glass transition, and thermal mechanical feedback during shear of viscous magma. This paper examines the formation of a distinctive vein comprising zoned cataclastic and very fine-grained crystallized material that is argued to be frictionally induced melt (pseudotachylyte). Characterization of the vein material is undertaken using differential scanning calorimetry, and magnetic techniques. Both of these approaches indicate distinct differences between the vein and host rock that are ascribed to shear melting of the host. Analysis of the repetitive LP seismicity at

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Soufrière hills suggests that individual pulses are sufficient to cause melting, and a final statement is that such “drumbeat” seismicity is “inextricably” linked to formation of pseudotachylyte. Notwithstanding the supporting evidence there remain some inconsistent data. I wish to emphasize that I do think friction melts can develop, but because of their significance to our understanding of extrusion mechanics, it is essential that their occurrence be closely characterized

1-Nature of the Vein/Shear Band - For frictional melts, there are typically generation surfaces and injection veins. Fig. 1 very much resembles an injection vein as opposed to a frictional generation surface. a feature in which flow structure is often most clearly No distinct evidence of shear is presented, and brings into questions whether it is a shear band. As the samples are from a loose block, it is critical to ascertain from other fabric information what the orientation of the conduit was relative to the vein; this should clarify the concern as to the origin of the feature. The text refers to the occurrence of slip parallel to the conduit wall, as observed elsewhere, so slip zones can be expected in this orientation.

2-Relationship to Seismicity – The combination of expected slip along the conduit boundary and the frequency of events would suggest that melt events, if tied to the “drumbeats”, would be much more common than a single vein/block. Without precluding melting, this would argue for the described structure being an injection vein, as opposed to shear surface. By comparison, the Mt. St. Helens (MSH) conduit boundaries are densely sheared. Also, repetitive seismicity at MSH appears linked to post-crystallization (de-gassing) within the conduit, at conditions under which brittle deformation initiates.

3- Nature of the Vein Material – Almost from the beginning of the presentation, there seems to be acceptance that the fine-grained material is friction melt. This should be established more systematically e.g. what says definitely melt, what distinguishes healed cataclasite from melt, etc., especially in the microstructural descriptions. The mixing of cataclasites and other material can occur in injection veins as well as gen-

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eration bands, so indirectly indicates multiple slip episodes. Characterization of fine-grained microstructures by higher resolution techniques (TEM?) could clarify some of the ambiguities.

Document editorial comments p.1661, l.3 – SHV - expand to Soufrière Hills volcanics as this is first occurrence in text p.1661, l.15 -25 References – several of these are listed in mixed or reverse chronological order – re-order? Also occurs throughout the MS. p.1662, l. 6 – see comments about whether this is unambiguously a shear feature p.1663, l.29 – mixed pseudotachylyte and cataclasis – this needs extended description and explanation p.1664, l.1 – surface; hence, ... p.1665, l.24 – include more primary reference e.g. Sibson 1977 or another of his early papers p.1667, l.23 – as noted, I think “inextricably” linking drumbeats and melting is not proven

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

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