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Interactive comment on "Short-lived tectonic switch mechanism for long-term pulses of volcanic activity after mega-thrust earthquakes" *by* M. Lupi and S. A. Miller

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GENERAL COMMENTS This is a very nice paper that addresses the links between large-earthquakes and the rates of volcanic eruptions. A convincing point is made that much magmatic activity follow strike slip shallow smaller events that occur close to the volcanic arcs. The paper is well-written and certainly deserves to be published in SE. I have a few more specific comments below, which I believe could help to further strengthen the paper if discussed/implemented.

SPECIFIC COMMENTS - From the GPS data of the Tohoku EQ, we have a quite good estimate of the finite (non-elastic) deformation associated with a Mega-EQ, which you

could use to estimate strains (Grapenthin and Freymueller, 2011). Would be great if you can add this.

- You discuss some examples of eruptions following major EQs with some that occurred several years after the EQ and others that occur within days. Is there any correlation with the depth of the magma chamber that fed the eruption? Are there any petrological or geochemical constraints on the speed of rising magma?

- It would be nice if you can give some quantitative estimates of how far field changes in strain caused by an earthquake induce stress variations in the vicinity of a magmatic system. To first order, you can model the magma chamber as an elliptical weak inclusion in an elastic matrix in which case you can use the Eshelby analytical solution to estimate stresses and stress concentrations around the magmatic system and estimate whether new dikes are expected to form (Eshelby, 1959; 1957). This is likely to yield significantly larger stress variations than those caused by Coulomb stress transfer alone, so it would be good if you can include this.

- An example of a magmatic province that was likely formed during a period of extension or strike-slip faulting are the Sierra Nevada Batholiths, California which are thought to have formed as soon as compression ceased.

- Arguably, a large part of California is moving under strike-slip conditions (see e.g. (Platt and Becker, 2010)). An active volcanic system underlies the Mammoth mountain/Mono lake area. What about links between earthquakes and volcanic activity in this area?

- On page 824/figure 8, you discuss shearing of the magmatic reservoir, together with reduction in magma viscosity as an important mechanism to start volcanic eruptions, and in various places throughout the manuscript you underline the importance of having a nonlinear magma viscosity. I two problems with this. First, magma only has a nonlinear viscosity under very particular conditions, for example when it has lots of crystals or is sheared incredibly fast (when viscoelastic effects start to kick in). A pure basaltic magma, or most purely molten magmas, have a perfect newtonian viscosity. The reasons for the non-linear viscosity are heavily discussed in literature with some claiming that shear heating plays a role (for which the mechanical evidence is low in my opinion, but see (Mader et al., 2013)), some that realignment of crystals is important (Caricchi et al., 2007) and some suggesting that the breaking of crystals causes the nonlinearity (Deubelbeiss et al., 2011). If this latter mechanism is true, it implies that lab. experiments are not necessarily applicable to natural systems as they tend to have too large stresses compared with nature (which would favor fracturing). The bottom-line is that whether magma is newtonian or non-newtonian is far from clear. Second, I agree that magma viscosity plays a role if you have a well-developed system with dikes that go from the magma chamber to the surface (as the velocity of the magma within those dikes is inverse proportional to the effective viscosity). Yet, the main issue that you are discussing are hose systems but the formation of new dikes. The initiation of such dikes does not depend so much on the magma viscosity, but rather on the state of stress and the fluid (or magma) pressure and whether or not a new dike can form. This is discussed to some extend in (rozhko et al., 2007) and in more detail ina recent paper by ourselves were we model a fully coupled viscoelastoplastic two phase system (Keller et al., 2013). Results from those models indeed show that the key factor to initiate dikes is the stress state around the magma chamber (shear stresses should reach the tensile yield stress plus fluid pressures), and not so much the viscosity of that magma.

In short, I would remove the emphasis on the nonlinear magma viscosity and put more emphasis in stress concentrations and enhanced fluid pressures that are induced by large earthquakes.

- Mazzini et al. discusses mud volcanoes, and not non-Newtonian melt rheologies - see above for some references w.r.t. nonlinear magma viscosities.

TECHNICAL CORRECTIONS

The other reviewer has done a good job in finding typos.

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