

Interactive comment on “Pre-earthquake magnetic pulses” by J. Scoville et al.

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We are disappointed that reviewer #1 did not have time to read and understand the model presented in this paper.

However, we do value the reviewer's comments insofar as they highlight some possible misconceptions that could emerge from a cursory reading. Specifically, we want to emphasize that the paper concerns a phenomenological model rather than a theoretical derivation.

A phenomenological model, as we have presented, is not derived from a set of postulates. It concerns a mathematical relationship in empirically observed data. The validity of a phenomenological model is determined only by its agreement with observed data. Underlying mechanisms, although they may inspire such a model, are not directly rel-

C3302

evant to the mathematical relationship. This can't be emphasized enough. This is the nature of phenomenology, and it is fundamental to the process of science.

It seems that reviewer #1 regards the present study as some sort of conclusion derived from results found in the literature, rather than phenomenology. In reality, most of the references could be omitted entirely without affecting the substance of the paper. The literature is cited mainly to motivate the purpose and context of the model. They are not assumptions of the model and their correctness (or lack thereof) ultimately does not affect the model or the conclusions of the paper in any way.

The model does not "assume" anything other than the drift-diffusion equations and the equations of electromagnetism. The apparent agreement of the model with observations does not contradict the hypothesis that these equations describe the observed data. The particular mechanisms underlying this mathematical relationship are not the topic of the paper, nor of phenomenology in general. Although they provide context for the reader, the discussion of such mechanisms could also be omitted entirely without significantly affecting the substance of the model.

Although it is not relevant to our phenomenological model, one fact of which we can be 100% certain is that the deep crust is not "wet" in any traditional sense of the word. Water cannot exist as a liquid deep in the Earth because 1) at great depth communicating pores are closed by the lithostatic overload, and 2) deep crustal temperatures regularly exceed 374C. At these temperatures, water is a supercritical fluid, not a liquid, and has very different chemical and physical properties. Supercritical water is highly reactive and will be consumed by mineral reactions on geologically short time scales. The often-repeated assertion that liquid water is prevalent deep in the crust is simply false.

On the other hand, the point is well taken that laboratory experiments do not exactly replicate crustal conditions. However, this is phenomenology, and the ability of a drift-diffusion model to describe observed magnetic pulses suggests that the crust may

C3303

exhibit behavior similar to that seen laboratory experiments. Note that the converse argument is not being made - we aren't taking a laboratory results as a set of postulates and concluding from them that magnetic pulses must occur.

Another fact about which we can be 100% certain is that the generation of magnetic fields does not necessitate a "circuit" as reviewer #1 suggests. This is another common misconception. It is well known that magnetic fields can be produced without circulating charges - Bremsstrahlung, for example. More to the point, our model describes the production of magnetic fields without presupposing a circuit, so reviewer #1's objection on these grounds seems puzzling and irrelevant.

We definitely agree that an analysis to demonstrate a correlation between magnetic pulses and earthquakes near Lima, Peru would be valuable. However, this will have to be reserved for a future paper.

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