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Solid Earth
Discussions

Interactive comment on "Magma mixing enhanced by bubble segregation" *by* S. Wiesmaier et al.

Anonymous Referee #1

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This manuscript presents new experimental data relevant to magma mixing processes operating in magmatic systems. Specifically, the authors have set out to explore efficacy of magma mixing when it is driven by bubble transport and these experiments are a complement to previous studies which have been numerical in nature or based on analogous fluids.

The high-temperature experiments involve a lower cylinder of basalt overlain by a cylinder of basalt. The properties of the two melts are fully characterized prior to the experiments. The experiments are isothermal and the temperatures have been chosen carefully on the basis of the rheology of the two melt and in order to ensure no crystallization. The bubbles are a partly serendipitous in that they derive from the air trapped at the melt interface.

The experiments involve holding the two layered melts (plus air bubbles) at fixed temperature for prescribed amounts of time. During this time, bubbles form, coalesce and rise; bubbles originating within the basalt or at the basalt-rhyolite interface rise and pull up tendrils or filaments of lower viscosity basaltic melt. The filaments rising into the rhyolite comprise a magma mixing mechanism involving advective transport of basalt (mingling) and chemical diffusion (mixing). Run products are sectioned perpendicular to the vertical axis to allow chemical and physical study of the filaments in cross-section.

The manuscript provides full qualitative and quantitive description (physical and chemical) of the filaments. Their analysis includes petrographic analysis, micro-computed tomographic imaging and electron microprobe analysis. These data are then used to compare the experimental results to the literature - especially the numerical modelling of bubble ascent (e.g. Manga & Stone). They also use these observations to establish the complex dynamic processes involved in the bubble rise and basalt melt infiltration of filaments into the rhyolite.

The manuscript concludes with a full discussion of the applicability of these processes to nature - to what extent can bubble migration contribute to magma mixing in natural systems.

Overall the manuscript is well organized, well-written and illustrated. The arguments are by and large convincing.

There are however a number of areas where I suggest the manuscript and arguments could be clarified. My suggestions are listed below. ——————————-

0) the manuscript could be improved overall with another editing.

1) Introduction: The introduction should be rewritten. Currently, the introduction is not really a an introduction to the paper. It is actually more a review of magma mixing ideas. I recommend a short introduction to this paper - the question, the data, the goal. This can then be followed by a new section that summarizes all these ideas.

2) Vocabulary: I found that I had to read some of the text several times to find out what you actually meant with some terms. I think you need to revise text to define terms better and perhaps add a sketch figure to existing figures to make sure the reader is able to keep up. Bubbles rise / they entrain melt to create vertical filaments / the run products are sectioned horizontally to interest filaments / EMP analyses transect the filament cross-sections.

3) Experimental st -up and other places I think it is worth defining the dimensionless numbers Re, Bo, Mo so that the reader is reminded which physical properties are involved.

4) Section 2.4 The first few sentences are complex and unclear. I think you are saying: "After each experiment, the glass cylinders are sectioned at 3 locations parallel to the basalt-rhyolite interface".

5) Section 2.7 The thickness is defined by the inflection points in the SiO2 vs. distance curves.

6) Section 3.1 Line 23: for visibility »» or »» for illustrative purposes

7) Section 3.2 line 10-12. This is repeat - so you could simply state this only once (say it here and not in section 2.4)

8) Section 3.2.2 I think you can do a much better job to connect these transects to Figure 4 - see my comments on the figure. It took me a long time to even see the transects in figure 4. I didn't know to look.

9) section 4.2 Lineline 25 "Stokes law correlates linearly with viscosity" I think this should be " Stokes Law velocities are proportional to 1/viscosity"

10) Section 4.3.1 Here is another idea on interpreting the compositional profiles. As the plumes rise they are creating a longer and longer interface against the enclosing rhyolite melt. The extent of diffusion during the rise will increase as the tendril gets longer. This is the same as during heat flow that the longer magma transits a dyke

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system the more heat is conducted into he wall rocks. You might consider this effect in terms of interpreting the compositional profiles.

11) Section 4.3.2 Line 10-15. When you are describing Figure 8 you should refer to the previous figure which shows the concave down model curves. Also I notice the scales are very different - any explanation for this discrepancy. Would your observed curves ultimately become concave down?

Table 1: These compositions are normalized. How were they measured? I realize that you are citing another paper but it is easy enough to indicate how they were measured (EMP I guess).

Figures - see my uploaded PDF file of scanned figs with comments

Please also note the supplement to this comment:
http://www.solid-earth-discuss.net/7/C627/2015/sed-7-C627-2015-supplement.pdf

Interactive comment on Solid Earth Discuss., 7, 1469, 2015.

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