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Solid Earth
Discussions

Interactive comment on "Dynamic magma mixing revealed by the 2010 Eyjafjallajökull eruption" *by* O. Sigmarsson et al.

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We are grateful for this thorough review produced by anonymous referee #1, which is very helpful for improving the manuscript. Our replies to the reviewer's comment are given below along with appropriate explanations.

Answers to General Comments.

Unfortunately some of the citations got misplaced in the original manuscript. This mistake has now been corrected and appropriate citations are included in the Introduction. The reviewer finds that our manuscript lacks "clarity in the use of analytical data". This lack of clarity stems from additional values that were only included in the text but not in the corresponding Table 1. We have corrected and added this information into Table 1

for clarity.

Answers to Specific Comments.

1 – One main criticism is of taxonomic nature, namely the use of the words mixing and mingling. We agree that a clear distinction should be made between the two, especially when referring to a specific magmatic process. However, the term magma mixing is also used in a general sense when two or more magma have been either mingled or completely mixed together. We have made strong effort to keep the use of these terms in according to definition, although some overlap in usage is unavoidable, in particular when discussing mechanically mixed magma that are equivalent to mingled magma.

2 – We shall move the listed references, which inadvertently fell out, from the abstract and discussion sections to the Introduction chapter. We will add to the Introduction the following phrase "Such mechanical magma mixing triggering an eruption has been frequently inferred from mingled magma deposits (e.g. Sparks et al., 1977; Eichelberger, 1980; Nakamura, 1995; Clynne, 1999; Suzuki and Nakada, 2007; Pallister et al., 2008; Tonarini et al., 2009)".

3 – We have modified the text in line 21 as follows: "The eruption produced a lava field of olivine- and plagioclase-phyric primitive basalt". This will illustrate the effusive character of the flank eruption. To better describe sample preparation we have added the following paragraph to the section 3: "The freshly collected samples were reduced to a powder in an agate ring-mill in preparation for whole rock analysis. Tephra samples were mounted in epoxy, whereas the 1821 tephra was washed and sieved several times until all soil fragments were eliminated. Two size fractions were mounted in epoxy and polished before in-situ analysis. No alteration of the glass fragments was observed." The glass analyses of the 1821 tephra are indicated in all diagrams and in Table 2.

4 – Oxygen isotope ratios, which were erroneously reported in Table 1, have been corrected as well as the errors associated with the delta 18O- values in the text. These typographic mistakes do not alter the discussion or the conclusions presented in the

paper.

We have synchronized the analytical information of Sr and Nd isotope measurements. Primitive-mantle normalized spider-diagram of trace element concentrations in the melt inclusion is not critical for the discussion in this manuscript. These results are specifically addressed in a separate manuscript by Moune et al. submitted to JGR. Thus, we prefer not to draw such diagram in order to minimize duplication.

The two missing whole-rock sample values have been included in Fig. 4.

We disagree with the notion that a chemostratigraphical log is a better way to illustrate the time progression in magma mingling than our Fig. 5, which has the time on abscissa. We, therefore, prefer to keep Figure 5 to illustrate diminishing proportions of the mafic end-member in the magma mixing (as a general term) and changing composition of the mafic end member with time.

Answers to Minor Comments.

Although a largely crystallized groundmass can, in principle, be caused by appropriate cooling rates, the fast cooling of the tephra would produce glass rather than crystallized groundmass. Therefore, degassing and consequent increase in solidus temperature is a better explanation for the Eyjafjallajökull tephra. We have added a short discussion on this matter into the manuscript.

Figure 2a and 2c show normally zoned olivine (ol), which is not in contradiction to plagioclase (plag) and clinopyroxene (cpx) showing reverse zoning. As discussed in the manuscript, plag and cpx are frequently inherited from the silicic mixing end-member whereas the ol is injected by the basic end-member. The mixed or mingled magma will thus show normally zoned ol but reversely zoned plag and cpx.

Adding MgO and CaO after the descriptive SiO2 concentration in the text for the different components of the composite sample EJ-2 is rather redundant because these values can be read of the diagram in Fig. 3 and obtained from Table 2 as cited in the

text.

Writing "...mechanical mixing or mingling" does not mean either mechanical mixing or mingling. It is an abbreviation for "mechanical mixing or in other words mingling". We shall add the word "probable" in front of the sentence "older silicic melt". We think that the silicic mixing end-member is older because its composition is identical to that of the 1821 glass. However, we have no firm age for the silicic melt.

Answers to Technical Comments. We agree with all the detailed suggestions from the reviewer and we will change the manuscript accordingly.

Interactive comment on Solid Earth Discuss., 3, 591, 2011.