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eEarth Discussions

Interactive comment on "Impact vesiculation – a new trigger for volcanic bubble growth and degassing" *by* D. A. Rothery et al.

Anonymous Referee #1

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The authors present a set of experiments in which they succeeded in triggerring bubble growth by firing pellets at, or dropping weights onto, rhyolitic melts. These experiments were aimed at simulating volcanic bomb impact. Although the process of ''impact vesiculation" is not a major volcanological process, it may have interesting implications for magma degassing and should be taken in consideration in analysis of bubble size distributions. As such, I think that this work remains too much qualitative and that it needs to be revised before publication. My major concern is that, in the present version, the experimental work is not sufficiently well described and exploited, whereas the description of Stromboli 1930 bombs (1 page + 2 figures) is too lengthy insofar as there is no solid evidence that the observed textures are due to impact vesiculation.

General comments.

The lack of precise textural data on the experimental samples. I think that textures in the experimental samples should be characterised more properly. Standard techniques of image analysis applied to SEM micrographs would allow to measure parameters such as the vesicularity after impact vesiculation, bubble size distributions or the number of bubbles per unit volume. A comparison of textures before and after impact vesiculation would allow estimate the amount of gas released following the impact, and whether or not new bubbles nucleate due to the impact (if there is a significant increase of the number of bubbles per unit volume in the impacted samples). Also SEM micrographs would provide much nicer illustrations of the experimental samples than the reflected light micrographs in Figure 3.

Stromboli 1930 bombs. My point of view is that the contrasted textures in the core and in the rind of Stromboli bombs (Figure 3) may be explained in many different ways: impact vesiculation is only a possibility. In addition, the measurements in Figure 4 are of poor quality (again, the authors should use classical techniques of image analysis to measure bubble size distributions as a function of depth) and do not demonstrate the operation of impact vesiculation. Accordingly, I suggest to remove section 4 (and Figure 4) and simply mention in the ‘‘Implications and conclusions” section that impact vesiculation could be responsible for a late stage of bubble growth (and may be nucleation) recorded in the cores of some volcanic bombs, as exemplified in Figure 3. An interesting point that could be discussed by the authors, is the type of textures that would be typical of impact vesiculation and that would allow to discriminate between this mechanism and other mechanims of vesiculation (but I presume this is a difficult issue).

Supersaturation pressures required for bubble nucleation in rhyolitic liquids. The figures quoted p. 3 for supersaturation pressures are underestimated: heterogeneous bubble nucleation on magnetite requires supersaturation pressures of $<$ 5 MPa according to Hurwitz and Navon (1994) or $<$ 20 MPa according to Gardner and Denis (2004) and Gardner (2007); in the case of homogeneous bubble nucleation, the

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supersaturation pressures may even exceed 100 MPa (e.g., 150 MPa in the study of Mourtada-Bonnefoi and Laporte, 2004). Also it is not correct to quote Lensky et al. (2004) which is a paper on bubble growth, not bubble nucleation, and to forget quoting the works of Mourtada-Bonnefoi and Laporte (1999, 2004) and of Gardner and coworkers: Mourtada-Bonnefoi and Laporte, Experimental study of homogeneous bubble nucleation in rhyolitic magmas, Geophys. Res. Lett. 26 (1999) 3505-3508. Mourtada-Bonnefoi and Laporte, 2004. Kinetics of bubble nucleation in a rhyolitic melt: An experimental study of the effect of ascent rate. Earth Planet. Sci. Lett., 218: 521-537 Gardner and Denis, 2004. Heterogeneous bubble nucleation on Fe-Ti oxide crystals in high-silica rhyolitic melts, Geochim. Cosmochim. Acta, v.68, p.3587-3597, DOI 10.1016/j.gca.2004.02.021). Gardner, 2007. Heterogeneous bubble nucleation in highly viscous silicate melts during instantaneous decompression from high pressure, Chem. Geol., v.236, p.1-12.

Experimental details. How long would it take for the samples to expand into a foam (p. 4, second paragraph)? How long does it take to remove the furnace and subject the sample to an impact? Is the time lapse between furnace removal and impact short enough to neglect cooling of the samples?

Figure 2. It is not possible to see the bubbles in c and d because the scale is too small (also improve the polishing in d).

Minor comments.

p. 1, l. 4 of the abstract: delete ‘‘call”. p. 1, last sentence of the abstract: too long, not clear, and not really necessary in the abstract. p. 2, first line of the third paragraph: replace ‘‘bubble nucleation” by vesiculation (or bubble growth). Caption Fig. 1: one word lacking in line no. 4. The article of Rittmann (1931), quoted p. 2, is not in the Reference list.

Interactive comment on eEarth Discuss., 2, 151, 2007.