

Interactive comment on “The permeability and elastic moduli of tuff from Campi Flegrei, Italy: implications for ground deformation modelling” by M. J. Heap et al.

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The manuscript by Heap and coauthors presents an experimental study of the effect that pressure and temperature have on permeability and elastic moduli of CI and NYT at Campi Flegrei, Italy. Their results show that the water permeability of Neapolitan Yellow Tuff (NYT) and a tuff from the Campanian Ignimbrite (WGI) differ by about two orders of magnitude, indicating an heterogeneous nature of Campi Flegrei's tuffs. They also point out how the permeability and the elastic moduli of NYT is affected by thermal stressing increase, while the CI appears not to be affected by such stress.

The manuscript is well written; the methodology and results are well presented and

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discussed in the manuscript. The results are very important for the understanding of how the physical parameters of the rock can affect processes such the bradyseism at Campi Flegrei. The bibliography on the Campi Flegrei is outdated, and therefore the presentation of the geological background lacks the most recent published papers (last 10 years!) on the topic. I would recommend publication of this manuscript, but revision of the introduction is NEEDED in order to have an updated description of the volcanic area and its products.

In specific, here are my comments:

Line 69-70 The Neapolitan area is surrounded by Mt. Somma-Vesuvius to the east and the Campi Flegrei volcanic system to the west. So I will suggest the authors to change Line 69-70 with the following sentence: “The densely populated (about 3 million) Neapolitan area, southern Italy, is in a state of constant threat provided by the proximity of Mt. Somma-Vesuvius and Campi Flegrei (CF) volcanic district.”

Line 72-73 There are several theories around the activity at Campi Flegrei, which are not taken into account by the authors. Also the bibliography they use is very old (almost 10 years old) and lot of new data has been produced since 1999.

As far as the activity in CF, some authors (Rosi and Sbrana, 1987; Orsi et al., 1996) relate the origin of Campi Flegrei either to the eruption of the Campanian Ignimbrite (CI, 39 ka, De Vivo et al., 2001), or to the Neapolitan Yellow Tuff (NYT, 15 ka, Deino et al., 2004). Other authors (De Vivo et al., 2001; Rolandi et al., 2003) interpret the eruption of the CI not as a unique event originating in the Campi Flegrei caldera, but as a sequence of eruptive events occurred from fractures activated along the neotectonic Apennine fault system parallel to the Tyrrhenian coastline. These events, of ignimbritic origin, lasted from >300 ka to 19 ka and are not confined to a unique volcanic center in Campi Flegrei. According to Rolandi et al. (2003), only the NYT erupted within Campi Flegrei, whereas the CI has a much wider source area.

Line 74 It is well established that the Campanian Ignimbrite (CI) is dated at 39ka (De

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Vivo et al., 2001) and the Neapolitan Yellow Tuff (NYT) at 15ka (Deino et al., 2004).

Line 84-98 This is just according with one source!! What about the other proposed models? Why the authors choose Chiodini's model over all the others? Why the authors prefer this model to the others published? It seems that the model from Chiodini et al is the one explaining the bradyseismic events in CF, while the others are only speculations. I would suggest the authors to rephrase the sentences in lines 84- 98 and to list ALL the proposed models for ground deformation at CF.

Line 94 Lima et al. (2009) present a quantitative model for subsidence and uplift, based on the linkage between bradyseism and magma body cooling and concomitant crystallization and fluid phase exsolution, coupling long timescale magma crystallization and volatile exsolution from melt and expulsion from magma to shorter timescale hydrothermal system behavior.

Line 149 CI and NYT are NOT the two major eruption in CF. The authors are speculating that CI has occurred in the CF, while several authors suggested (in several articles, that the authors are ignoring) that it occurred OUTSIDE the CF. Furthermore, the ages attributed to the eruptions are outdated. Again, CI occurred 39 ka (De Vivo et al., 2001) and NYT occurred 15Ka (Deino et al., 2004).

Line 359 Make reference with figure, example Fig. 6A. Apply to all the properties you discuss: S-wave -Figure 6B, Young modulus -figure 6C and so on.

Line 362 Add A-F. General comment: since you have labeled the figure A through F, you should somehow report the same labeling in the text.

Line 364 Add A-F. See comment for figure 6.

Line 366 Make reference to figure, labeling each property with the appropriate letter.

Line 374 Add A-B

Line 432 Figure 10 is composed by 3 SEM photos, which are not explained at all in the

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text. In particular what is figure 10A represent? From the figure caption is clear that C is a zoom of B, but what is A?

Line 452 A-C. Description of figure? Why there are no pictures to compare WGI before and after the heating?

Line 456 Which ones? Reference such studies!

Line 458 "chabazite and phillipsite undergo a partial reversible dehydration at 240 °C". Reference??

Line 506-509 Some parentheses are missing. Please check!

Line 519-520 why do you use ONLY this model??? There are 4-5 other models for the bradyseismic events at CF. Why assuming that this one is the right one?? Explain why this model is better than the others!!

Line 537-539 What will be the difference between samples collected in boreholes from different parts of the caldera and those available from the AGIP survey? Wouldn't the sample be compacted as well? I do not understand the NEED to have more boreholes in the CF caldera, if the samples are going to be affected by the same "problems" of those from AGIP boreholes. Please explain the reasons why there is the need of collecting oth

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