

## ***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.***

### **Anonymous Referee #4**

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The paper "The permeability and elastic moduli of tuff from Campi Flegrei, Italy: implications for ground deformation modelling" concerns estimation of parameters which are critical in the evaluation of the Campi Flegrei caldera deformation due to injection of both magma or magmatic fluids. The argument is of great interest, as acquisition of data on deformation of the caldera is in progress as number and quality, and it would deserves the publication.

Some critical question arise:

1) the samples used by author, if I understood, seams (line 7, section material investigated) relative to one block of material for type (NYT and WGI) and collected in

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open quarries, and the estimated porosity is 44 and 49 vol.% respectively. The Phlegrean Field show a very high variability in porosity and permeability (see for examples [http://www.fedoa.unina.it/398/1/Campi\\_Flegrei.pdf](http://www.fedoa.unina.it/398/1/Campi_Flegrei.pdf) where core samples by AGIP oil company are analyzed) even at the same sampling depth (different wells) showing that not only temperature and pressure act on these parameters but evidently these depend on lithotypes and alteration degree; moreover if we consider even the dependence on depth, values of porosity range from some % to about 60 % while permeability change up to 3 magnitude order and more. This mean, in general, extrapolation of the analysis performed in the paper are difficult to sustain and extend to the whole caldera sediments, and it as it stand seems applicable only to that open quarry samples.

2) A second question arise relative to the usefulness of the relation found by authors about permeability and porosity and showed in the figure 3 and 4. The sample analyzed by authors has been subject to a different history from the NYT and WGI sediments which fill the caldera at different depth and different time; pressure, time and temperature contribute heavily to the alteration of the materials. It should be performed analysis, by the authors, to some sample collected at different depths to contribute in a substantial improving of our knowledge on the caldera. Papers relative to the physical parameters of the caldera use widely measurements on cored samples. These are, for example, analysis of permeability and porosity on cored samples for which suddenly decrease both pressure and temperature as they are extracted from the wells. The question touched by the authors is critical and it would be very interesting if they could measure hysteresis curves; the curves in fig 4 beyond the  $P^*$  point clearly shows irreversible processes, as stated in the paper. If authors could show some curves with hysteresis cycles it could contribute to the extrapolation of the measured parameters to the original state before the extraction of the sample from the wells.

3) page 1092 row 1-5. Authors stated that they estimate the values of the young modulus in the linear zone at effective pressure of 5 Mbar, but in order to render usefulness the static modules, to apply static elasticity modelisation at episodes of deformation,

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they would estimate the static moduli at different pressure and temperature or show that they do not depend on these variables or in negligible way.

Minor comments

In all the relations showed in figures and in tables it lack the error bars, making it difficult to evaluate the grapes.

page 1101 row 11-12. I would not say that data analyzed emphasized the heterogeneous nature of the tuffs of the caldera, they are only 2 types of tuffs

page 1102 row 5-6. Hold the same comment as the previous.

page 1117 figure 5 B. There is a strange intersection of the permeability/pressure curves at different temperature around 12-30 MPa, it deserve probably some explanation, or error bars could include it?

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Interactive comment on Solid Earth Discuss., 5, 1081, 2013.