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Solid Earth Discussions

Interactive comment on "Analytical solution for residual stress and strain preserved in anisotropic inclusion entrapped in isotropic host" *by* Xin Zhong et al.

Anonymous Referee #1

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Dear editor, I read the manuscript from Zhong and co-authors with great interest. Their manuscript deals with several open questions in the field of elastic thermobarometry and the results provided by the authors can be very useful to the community. Apart from the lengthy, but necessary, theoretical derivations provided by the authors, this manuscript has significant results when it comes to the application of Raman elastic thermobarometry. In addition, I find their new results on the application of the "volumetrically averaged stress" and the "irregularly faceted inclusions" very interesting and of exceptional quality. Finally, it is very rare to find such studies where the authors have tested their analytical work so extensively.

General Comments My major point of criticism concerns the detailed and clear description of the steps involved in the procedure for the calculation of the eigenstrain. I have written in detail my main points below but they concern the clarity of the presentation and not the actual methodology (which is actually based on well established theories). I believe that this part may be difficult to the petrological community and some things which are considered basic in other fields need to be explained in more detail here.

Specific Comments l. 27-28: Please be more specific that you refer to cases with garnet hosts.

l. 36-37: Somewhere here is implied that you need an elastic model to recover the entrapment conditions. The reason I make this distinction is because one may confuse the elastic model that can be done to convert strains (from vibrational mode shifts) to pressure, with the elastic model that is performed to calculate entrapment conditions from residual P. Please be more specific.

l. 40: Zhang's model allows non-infinite host, it is more general.

l. 50: "no numerical software or programming is required", Theoretically, one could do things by hand (even FEM), in addition, plotting the analytical solution may be more efficient by a software such as Matlab. I would rephrase as "..is that the solution is exact and can be obtained rapidly. . ."

l. 51-52 Please add a relevant reference that relates MC with Uncertainty propagation.

l. 69: "The MATLAB code", which MATLAB code, of the analytical solution, of the FE? Please be more specific.

l. 118-120: I do not quite follow what you mean here ("The thermal effects..."). Could you please develop a bit more?

l. 121: I think that this way of formulating may be confusing. My point is that the eigenstress is what it is (as defined in Eq. 2) and any mineral can have it no matter how stiff or soft. However, if I understood your argument correctly, for a very soft

inclusion in an infinitely rigid host, its eigenstress will be equal to its actual stress. The reason why I would be so specific is because the way its currently expressed it looks that eigenstresses can be defined only for soft minerals in rigid inclusions.

l. 136, what is the “equivalent eigenstrain”? How it is different from the previous one. Could you be more specific? Please also add that the equivalent eigenstrain is yet unknown and needs to be solved for. I think this part deserves a bit more development so clarify some details that may not be obvious to the reader who is not familiar to the Eshelby solution. In that case I would highlight if the stress balance solved for or if it is satisfied by the solution (i.e. is given). In addition, I would highlight that eigenstrain is needed in order to have “equivalent” loading conditions.

l. 143, as before: please mention how the Eshelby tensor is obtained in general, i.e. it is solved for, is it known a-priori (e.g. from Mura, 1987)

l. 171, please add “phonon-mode” in the Gruneisen tensor so that this is not confused with the macroscopic definition.

l. 173, please add “(pressure)” after stress, since you are using it later.

l. 238, 256, like in l. 171

l. 283, which “size” you are referring to? The largest? A mean size?

l. 370, thus the results using rutile should be viewed with caution since they potentially have large errors.

Minor things l. 45: “long time” is relative in geology. I would be more specific, i.e. for more than 50 years

l. 139-141, I would break this sentence in smaller parts.

l. 150, I would suggested reformatting, “equals” -> “.. to be equal to..”

l. 155, I suppose that this is actually a system of equations that gives you all the

eigenstrain components. I would add some brackets here to emphasize this point.

l. 204, I would rather replace “space” with “medium”

l. 290, Please give the formula of Root Mean Square in the text or in Appendix

l. 560, “is aligned” -> “are aligned”

l. 567, please add in brackets the garnet composition (e.g. alm)

l. 570 as in l. 171

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