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Interactive comment on "Modelling stress field conditions of the Colima Volcanic Complex (Mexico) integrating FEM simulations and geological data" *by* Silvia Massaro et al.

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Review of the paper: "Modelling stress field conditions of the Colima Volcanic Complex (Mexico) integrating FEM simulations and geological data" by S. Massaro and co-authors. The main objective of the present manuscript is to assess the influence of geological data on numerical simulations. As a case study, they investigate the stress field conditions occurring around the Colima Volcanic Complex (Mexico) using Finite Elements. In general, I find this paper very interesting, however I consider that some important points need to be addressed before publication.

General comments:

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Discussion paper

* When citing previous published works use “e.g.” because the lists are not exhaustive and the cited articles are just a small example of the existing references.

* The introduction is a bit confusing to me because the title (and objectives) of the manuscript are focused on stress field and the first paragraph of the introduction is about volcano deformation. I would recommend the authors to rethink the introduction pointing out the importance of calculating the stress field in volcanic areas, which are the components of the stress field (i.e. those processes affecting/modifying it, etc). Then, they can connect all this with the FEM as a “numerical tool” to quantify/predict the stress field in a volcanic area.

* The objectives of the work are presented in two different parts of the introduction (L68-74 and 83-86). I suggest merging them at the end of the introduction.

* To better evaluate the influence of the diverse geological details on the results obtained, it would be more appropriate to carry out first a parametric study on the studied parameters (e.g., Young’s modulus, Poisson ratio, magma chamber geometry). Keeping all parameters constant and changing one parameter at a time in a systematic way, is what really allows estimating (and quantifying) the influence of the individual parameters on the numerical results obtained (see, for example, Kinvig et al. 2009; Geyer & Gottsmann 2010). Once the parametric study has been done, results obtained can be applied to the case studies.

* The authors should be sure that all names mentioned in the text are included in the figures. For example, Figure 1 showing the geological setting of the CVC does not show the location of the Michoacan Block, the Chapala-Tula rift, etc.

* It would really help to include a sketch of the CVC plumbing system.

* The authors should show the mesh and also provide details about the size of the elements, not only the number.

*The authors should better describe how gravity is implemented and how is the resul-

tant stress field derived from it considering the selected mechanical properties of the computational domain. Also, since there is topography, I do not understand what the authors mean with “Gravity in the host rock (z <= 0)” . Is gravity not assigned for z values > 0? This part should be clearly explained because the “background stress field” generated by the gravitational loading may have a strong influence on the results obtained.

* Considering the size and depth of the deep magma chamber, I think that the domain boundaries are far too close to the area of study, specially to the W. This is also acknowledged by the authors (L382-389). Considering that the models are 2D (i.e. computational time is not too high compared to 3D models), it would have been safer to expand the limits of the computational domain further away from the magma reservoirs. The “displacement = 0 m” boundary condition has strong effects on the results obtained if the boundary is too close to the pressure source.

L49-51: I do not understand this sentence. What do the authors mean by “boundary representation”? Please, we sure that you are not confusing the Boundary Element Method (BEM) with the Finite Element Method (FEM).

L55-58: I would mention also the use of FEM for fluid dynamics or thermal problems to illustrate their application to solve other type of physical equations, not only those related to rock mechanics (e.g., Bea 2010; Gutiérrez & Parada 2010; Gelman et al. 2013; Douglas et al. 2016).

L59-60: Use “e.g.”

L60-62: Add references and indicate in GPa what is meant by “stiff” and “low”.

L67-69: Include some references to illustrate what kind of publications already exist.

L74: I think something is missing in this sentence.

L81-83: Please, revise this sentence. I think that something is not correct in the English, a native English speaker should verify it.

L87-92: What overpressure? This sentence is confusing. All this paragraph should come much earlier in the introduction, when presenting the problematic the authors want to solve. If the idea is to highlight the limitations of the elastic approach used in the models, this section should be move to the “Methodology” section.

L95: The CVC acronym has been already explained.

L112: Where is all this information shown in Figure 1?

L130: “a.s.l.”

L186-188: What do the authors mean with “complex” structure?

L193: Extension or extent?

L198: Indicate the website and what INEGI means.

L215: Which geological units? The magma chamber? The rock layers? This sentence is confusing.

L222-224: Since the authors have already extensively described it in the previous section maybe they should refer to their own text (and figure) here.

L224-227: Not sure which is the objective of this sentence, as the authors do not explain the overpressure assigned to their models in this paragraph. Is something missing?

L228: Commas are missing after between and with, otherwise the sentence is difficult to understand.

L258: Please, add references.

L260-261: Please, add references.

Figures:

Figure 1: Indicate the north arrow in (a)

Figure 4: The color different between Unit VD and GF is practically undistinguishable. It seems that the top-left image has a different orientation than the others. The selected color scale is strongly conditioned by the boundary effects at the right and left corners at the free surface. The authors should recalibrate the color scale so that the gravity stress field is visible also at shallower depths. Now is all in green.

Figure 5: It is really confusing to have to color scales for (a) and (b). It is difficult to compare the results between both models and the effect of the shallow reservoir. Has model b the gravitational loading implemented? It is strange to me to see that model provides negative sigma 1 values at such depths (i.e. 15 km).

Figure 6: I strongly recommend using another color scale, similar to the one in Figure 5 going from red to blue colors. In the sigma 1 picture many details are lost because of it.

Figure 7: Same comment as in Figure 5. Is in the model in the middle gravity implemented? To facilitate the comparison among all pictures, the same color scale for all sigma 1 and for all sigma 3 should be assigned. Otherwise is very confusing because the same colors are sometimes <0 and other times >0.

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