

Comments on: Anatomy of the magmatic plumbing system of Los Humeros Caldera (Mexico), implications for geothermal systems

Federico Lucci, et al.,

The authors did a great analytical job and their proposal about the multi-reservoir model is in accordance with recent investigations. However, I think data could be used in more detail to explore other scenarios. The main idea will remain, the polybaric model seems unrefutable, but the processes involved during the evolution of magmas could be an important factor for the geothermal system.

The model proposed by the authors rely in only one differentiation process; crystallization. Whereas mixing, and perhaps assimilation, seems to be important processes.

Something should be explained about the origin of these magmas. Once explained, you can go further and propose how do you think they evolved.

I think mixing is evident, for example:

- 1) TAS diagram looks very linear. Find published liquid lines of descent for basalts evolving to trachytes just by crystallization. I think they do not look like the trend displayed by your samples.
- 2) Plagioclase microlites and phenocryst rims show a very wide compositional range An₂₀₋₆₃. Is evident this are not in equilibrium.
- 3) The presence of Cr-rich titanomagnetites and Cr-poor titanomagnetites in the same sample. In fact, I suggest to remove the ulvospinel data, is of bad quality. Either, the crystals were very small and you excite the surrounding matrix or something failed with the standarization. Although data is not publishable, the relative abundance of Cr is evident and you should explain it.

Thermobarometric results should be used with caution. Its hard to match the results reported on the text with the supplementary data. But for example plagioclase data of almost the same composition found in different WR samples is used to calculate temperature and pressure. These models almost always will yield a number, the idea is to generate a good interpretation for the results, the best possible approximation. Even if is not evident on their tests, the authors should incorporate explanations on how mixing could affect their thermobarometry results.

Protracted heating-mixing could be the driving force for convection-conduction in a geothermal reservoir.

The manuscript is overall well written. Below you will see more detailed comments.

L351-L353. Here you highlight the dissolution on pyroxene. You should do the same for plagioclase.

L368-L374. Aegirine is an index mineral on peralkaline rocks. The same for anorthoclase. You reported non peralkaline rocks occur in the studied area. Mixing processes should be explored. The wide compositional range on "microlites" reported above could suggest the same mixing process.

L389. Fayalite is present, same comment as above. Fayalite occur in peralkaline rhyolites.

L446. It's correct to use the WR; however, you need first to define why this is valid if mixing could modified some magmas. The whole rock would simply be an integrated result of all magmatic processes (mixing+assimilation) that occurred just before the eruption.

L484. This sentence is not clear. A crystal could have a patchy zone at the core and then be in equilibrium with the melt (rim). In your sentence you should clarify or have a reference to one of your figures.

L485-L487. Not necessarily; just changes in temperature would record extreme compositional changes in crystals, without any mixing involved (mass exchange).

L488-489. First you need to clarify and yield some confidence to the reader about the origin of the melts and the magmatic processes that modified each magma. If mixing occurred, then the WR is a mixture of xenocrysts and phenocrysts. How does this affect the equilibrium between the phenocrysts and the WR? You should clarify the phenocrysts you used, is not clear and not proven the criteria to choose them.

"..... pristine liquids in equilibrium with early crystallized phenocrysts and microlites"? This is confusing; What do you mean as microlites??, decompression induced crystals grown during decompression-cooling? Or these are microphenocrysts?? Do you mean all melts where tapped as they were formed?, I mean, how is possible that a liquid is in equilibrium with an early crystallized phenocryst and a microlite??

L502-503. You need to explain why this value was chosen.

L550. You should delete the negative values. Have no petrological meaning, no matter other authors have interpreted them as anhydrous. All models will yield data, the job of the petrologist is to evaluate which are usable.

L551-563. Does these water contents match the pressure calculated with other methods used in this investigation? 1.40 wt.% is very shallow. If these are subduction related magmas how is possible they are anhydrous? I know is dictated by the model, but what do you think, the model approach well the problem?? Moreover, if basalt are required to be anhydrous, then what is the origin of the water required for the evolved LHPCS??

Have you try other hygrometer, different to Lhur and Housh 1991,?

L567-569. You have a great amount of xenocrysts with felsic compositions. Many of the cores where temperature was calculated have the same composition as other cores measured in TA. The

temperature is different because the WR composition in which are supposedly in equilibrium varies. So, which one is the system in equilibrium??

L634-637. Are these megacrysts or resorbed crystals?, fragmented crystals??. Is there any possibility these are intrusive xenocrystals??. Give a reference for subsolidus equilibration of groundmass after eruption or explore an alternate possibility.

L650-653. This is confusing, or at least, with not enough information for the reader in order to understand the author's point of view. Are these basalts the product of differentiation of the former basalts mentioned just before? This evolution is recorded along the crystallization of the Fe-rich olivine, albites and aegirines? Report the texture of the borders, are they in equilibrium. Is this alkaline-low oxygen fugacity mineral assemblage the result of mixing with more alkaline melts? Mixing could occur at depth or at shallow pressures??

L657-658. Then, what happened to the proposal that basalts should be anhydrous?

L670-673. I suggest a brief proposal about the origin of these magmas should be explained. If mafic and intermediate are tapped almost straight from deep reservoirs, then what is the origin for felsic magmas?, do they arrived already evolved to shallow levels? Moreover, the intermediate melts do not have any traces from mixing? Mixing has been reported as one of the mechanisms to produce andesite-dacite melts.

L674-683. I disagree. You need to explain why some TA and AB have a mixture of restitic phases as ulvospinel (titanomagnetite)? What I mean is that some samples contain evolved titanomagnetites and Cr-rich titanomagnetites. This is a strong evidence for mixing.

L682-L683. I do not understand what you try to explain. Rephrase.

L694-695. These are not the only evidence for mixing.

L715. If I remember well this is the first time alkali-basalt is mentioned. Should be pointed before, this would explain the origin of aegirine and fayalite???

L717-718. Harker diagrams are not the best option to explain fractional crystallization. In fact, it seems that the trends are very linear typical of binary mixing-assimilation. Let's think about the mixture of Fe-Ti oxides you have, mixing occurred. At very least you should show trace element evidence;. Trace elements are very sensitive to mixing and assimilation, so you could adjust your model.

L721-724. Then, how does this support crystallization acting alone to form the trachytes??

L750. So what is the origin of these anhydrous basalts? If these evolved to more felsic melts what is the origin of water in those?

L806-813 This paragraph is very confusing. Do you mean this alkaline basalt will arrive almost at its liquidus at shallow pressure, and only then aegirine and fayalite would crystallize?? What is the origin of this alkaline basalt? The basalt has ilmenite-ulvospinel?, calculate the oxygen fugacity and discover if it is enough reduced to crystallize fayalite-aegirine.

Figure 3. There are multiple attempts to recreate liquid line of descents for melts evolving by fractional crystallization from basalts with these compositions. Search and try to fit your data. To me look very linear and probably related to mass-addition processes.

Figure 5. Basalts, trachyandesites and trachytes contain anorthoclase as phenocrysts and in the groundmass. I do not remember an explanation about this in the text. Could be mixing with alkaline melts??