

Interactive comment on “Thermal conditions during deformation of partially molten crust from TitaniQ geothermometry: rheological implications for the anatectic domain of the Araçuaí belt, Eastern Brazil” by G. C. G. Cavalcante et al.

Anonymous Referee #1

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General Comments 1. The authors state the viscosity of 10^{-19} Pa s as the one required for a channel flow to operate citing Beaumont et al. (2004). However, it should be noted that there are several parameters that determine the conditions for the channel flow (Beaumont et al., 2004; Grujic, 2006; Mancktelow, 1995; Turcotte and Schubert, 2002). In the simplest fluid-dynamics form, these are the viscosity of the channel material, width of the channel, the pressure difference along the channel and the relative velocity of bounding plates. For example, for the present pressure difference between the Himalaya plateau and the Indian foreland, and assuming a channel only

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one kilometre thick, Grujic et al. (1996) have estimated that the threshold viscosity to start the back flow is about 10^{-17} Pa s. These relationships should be clearly stated and put into the tectonic context of the study area. 2. Considering the potential geometry of the studied orogen was there a potential plateau area or thickened crust area and where was the respective foreland with the normal crustal thickness towards which would mid crustal flow be directed? Is this consistent with the observations of the kinematics? 3. Only one calibration of the Ti-in-quartz geothermometer has been used, the original one. Although there is not yet an agreement on the exact calibration there is solid evidence for the pressure sensitivity of the Ti concentration in quartz (Huang and Audétat, 2012; Thomas et al., 2010), making therefore this technique a geothermobarometer. Therefore another two calibrations should be applied as well. As the authors state the pressure at the peak temperature has been estimated to 600-800 MPa while the used calibration of the Ti-in-quartz thermometer has been calibrated at 1 GPa. Accordingly, the calibrations using pressure sensitivity would yield about 80-100 °C lower temperatures. Taking this in account might make the Ti-in-quartz temperatures more consistent with the biotite-garnet geothermometry, which yields lower temperatures for the mineral rims.

Specific Comments: 1. The authors mention in the geological setting that the magmatic flow direction progressively changes within the study area, but there is no clear evidence if this flow pattern was achieved during the magmatic flow or was the initial flow direction deformed in a successive (or progressive) deformation. How is this pattern of flow related to the tectonic setting as shown in figure 1 where the Neoproterozoic belts wrap around cratons. Related to this the authors briefly describe and show in the figure 2c the magnetic (AMS) lineation. However, it is crucial to have information on kinematics (top-to-the-direction of the flow). How is this flow pattern related to the tectonic model? 2. In the large-hot orogens the mid and lower crustal channel flow occurs along a horizontal crustal layer, resulting in a subhorizontal foliation. However in the study area the foliation is moderately to steeply dipping while the lineation is more gently plunging suggesting a strike rather than dip directed flow. How is this

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reconciled with the Himalayan-type channel flow models? 3. Please explain what is the relationship between the field foliation and the magnetic foliation (Figure 2 b)? Are there different types and generations of the foliation and is there any deformation foliation, e.g. mylonitic foliation? 4. In the model and field examples of a mid crustal channel flow the weak crustal layer flowing laterally is bounded by two coeval, sub parallel, opposite-sense shear zones. Are such shear zones observed in the study area? 5. With such high temperatures and so slow cooling rates as reported in the manuscript and combined with the long geological time-scale, some sort of solid-state Ti diffusion should be expected (Cherniak and Watson, 2007). Are any such features observed? These could be measured and quantified (e.g. Nachlas et al., 2014).

Formatting (a) Please explain all the acronyms in the figure 1. (b) There is no lithological legend for the subfigure 2b and c. In general the caption of the figure 2 is inconsistent with the subfigures b and c. (c) What are the thick red and black lines in figure 2b? These obscure the structural measurements. (d) Instead of figure 8 it is suggested to construct frequency plots of the measured temperatures. The data shown in the figure 8 (measurement number/temperature) can be read from the corresponding table. (e) Manuscript is well written but there are scattered minor typos and grammar errors. It is suggested to revise the final version of the manuscript by a professional language and style editor. There are several affordable services.

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