**Solid Earth
Discussions**

*Interactive comment on* "**Metamorphic history and geodynamic significance of the Early Cretaceous Sabzevar granulites (Sabzevar structural zone, NE Iran)**" *by* **M. Nasrabady et al.**

**Anonymous Referee #2**

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The key aim of this ms is to demonstrate an anticlockwise PTt path for metabasites from the Sabzevar suture zone in Iran and to integrate this result into a tectonic model for their evolution. I will concentrate on the petrographic details and the geothermobarometry in order not to repeat the comments of the existing review.

The key to understanding pressure-temperature paths in a single rock is to carefully decipher the information available - mineral compositions, zoning, inclusion relationships etc from an obviously disequilibrium situation. From this initial information one can then start to speculate as to how much information remains unmodified by recrystallisation or diffusive resetting (especially in rocks that reached high grade conditions), which

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phases persisted metastably from older stages, which mineral compositions pertain to possible former equilibrium assemblages and, in the case of pseudosection analysis, what is the effective reactive bulk composition for any particular metamophic stage of an obvious complex multistage evolution.

In this example we are dealing with metabasic rocks at high pressure amphibolite to high pressure granulite facies conditions. The prograde evolution is represented by inclusions in garnet. Unfortunately, the figures documenting this stage show large quartz+plagioclase inclusions with some local amphibole and titanite. Such a coarse poikilitic microtexture makes it really difficult to decide if the inclusions really are inclusions as it is possible that the garnet is rather porous in three dimensions. A hint of this possibility comes from the fact that plagioclase, regardless of textural position (matrix or inclusion) has the same composition. Even in the case where the inclusions really were trapped as multiphase inclusions as garnet grew, it is still possible that they reacted with the matrix and thus lost information regarding an early pre-garnet evolutionary stage. I would be very cautious here.

For a reliable determination of pressure-temperature conditions in such rocks it is imperative that the compositional zoning in garnet is properly understood and also the exact nature of inclusion suites with regard to a specific garnet composition or compositional zone. The compositional maps and profiles should be much better integrated into the story as they are critical for the reliable PT determination regardless of whether conventional or pseudosection methods are used. The text (section 5.1) also misinterprets the zoning patterns with regard to the models of Spear (1993) which were not applicable to metabasites however. The pattern is of Ca increase linked to Mg decrease from core to rim but the actual near-rim trends are different in all three cases. Part of this is probably due to resorption (the amphibole+plagioclase coronas) but superimposed on this is a growth zoning and a probable diffusion-modified zoning. A quick look at the different XFe trends shows that there is no way to explain all of these profiles by the same process. Each of them must be deciphered individually with spe-

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cial care being taken to understand the growth versus diffusion trends and also properly integrating the resorption history. I get the impression that the profiles were measured before the compositional maps were made as there is a lot of critical zoning information missed by the presented profiles. Only when the garnet history is correctly determined can any attempt be made to use specific compositions for PT-ometry.

Coming to the pseudosection it is obvious from the diagram presented in fig 11 that something does not tie in properly to what was stated in the text about granulite facies metabasites. If the presented assemblage of gt+cpx+fsp+qz is really so diagnostic, how is it possible that the pseudosection shows this HP granulite facies assemblage even at 3kbar 500C?

The isopleths for the garnet composition have been utilised to determine that peak pressures were followed by initial cooling whilst remaining at high pressures. In order to realistically use this type of information from this pseudosection it is imperative that the same bulk system pertains: clearly not the case!!! To convince the reader that this cooling at high pressure really is the case you would need to modify the bulk composition to extract the already formed garnet. This is a major weakness with the ms that has major implications for the interpretation and is thus central to the credibility of the presented model.

As a final point it is necessary to present the subduction / dynamothermal sole model in a simple cartoon to explain the location of the heat sources at the given pressure (i.e. depth) stages of the presented model. Also, the cooling trend at high pressure has to be properly incorporated. Where does the starting point for M1 at 500 C and 6kbar lie in respect to the rest of the rifted crust or ophiolite and how do you envisage that a hot ophiolitic slice came into contact with this unit (providing a pressure increase and heating in the described dynamothermal sole)? Such a simple schematic representation of the proposed evolution, with the metamorphic stages indicated, will help enormously in the understanding of the proposed model for the general audience.

Interactive comment on Solid Earth Discuss., 3, 477, 2011.