

External examiner's report

on Ph. D. thesis by Stephen Collett

Metamorphism and geodynamics of the Proterozoic Kabul Block: Preservation and modification of crustal fragments within an orogenic zone

The thesis consists of an introduction to the topic along with research objectives, followed by four papers published in international journals with impact factor, and conclusions that should – as given in the beginning of the thesis – also assess how the objectives were fulfilled. In addition, there is a bibliography and an Appendix with a list of sampled localities, sample description and analytical data, and a summary of analytical techniques.

The work brings new information on P-T-t evolution of the basement of the Kabul Block in Afghanistan, located in a badly accessible area, using a multidisciplinary approach combining petrology, thermobarometry, thermodynamic modelling, geochemistry and geochronology. Results and their interpretations have been presented in the publications, of which the PhD student is twice the first and twice the second author (once of a paper with unrelated topic). As stated, he was responsible for petrography, geochemistry, thermobarometry and thermodynamic modelling. The papers were reviewed by Peter Tropper, F. Rolfo, G. Hoinkes, Oliver Jagoutz, R. Ge and anonymous reviewers. The other parts of the thesis representing purely work of the PhD student are the extensive Introduction and Conclusions (4 pages incl. one page figure).

The **Introduction** encompasses geology of the whole area of Afghanistan, before it focuses specifically on the Kabul Block. Although it is relatively well written, I have several problems to point out. One is that the information in the text is hardly ever documented in the figures, and vice versa, the figures are not treated in the text. Examples of this are as follows: (i) no link between the text describing geography and the geomorphological map presented, without any geography at all (the Kabul block, the target of studies, needs to be searched for); (ii) Herat-Panjshir Suture Zone is not shown on any of the maps, although there is a paragraph dedicated to it; (iii) information on tectonic limits of the Kabul block without a map is incomplete (at least a reference to Fig. 2 in the first paper should be given, when not the map itself); (iv) the map on Fig. 7 is not related to the text (describing formations); (v) structures described in the text are not documented by any figure. Actually, this chapter contains variable information on metamorphism and absolute age determination, thus its heading is inappropriate; (vi) Fig. 1 in the Conclusions stands alone without any explanation in the text.

It would be also good to learn in the Introduction, which parts of the area were geologically mapped, on which scale, by whom and where these maps are available: there are only some mentions on the mapping under the individual geological missions.

What I am really missing is the link between the Introduction and own work, its target, open questions to be solved, and own results. It appears that the information above the Objective is that pre-dating own work, however, in my opinion this should be stated clearly in the beginning of the Introduction. Alternatively, the objectives could be actually presented in the very beginning. As for the objectives on page 14: what are “microstructural trends” and how they constrain the metamorphic character of the basement rocks? Do you mean crystallization-metamorphism relationships? Term “deciphering relative absolute time scales” is unfortunate, I think. What are “residence times for protolith emplacement and metamorphism”? What is “historical origin of the Kabul Block”?

In the **Conclusions**, the newly constrained geological evolution of the Kabul Block basement is summarized. The contents of the publications clearly show that the objectives presented in the Introduction have been fulfilled: however, this could be presented clearer in the Conclusions. In fact, the assessment of how the objectives were met, which the reader was promised in the beginning of the thesis, has not been made. The summary focuses first on the protolith and metamorphic ages of the studied rocks. May this be a major issue in the area, the accessory and other phases used for dating make part of the rocks with specific composition, mineral assemblages and metamorphic history, which should be introduced first – also because this was student’s part of the team work. The P-T conditions are calculated based on mineral equilibria, thus definition of the coexisting phases is essential prior to presenting the result. As for geochronology, internal zircon and monazite structure, and textural position of the dated micas, represent clues to interpretation of the ages, and should be presented in the summary. And finally, I am lacking any structural data in the results – be it just simple measurements of the main foliation trends at the outcrops. Relevant author’s publications should be also cited in the summarizing text.

As I mentioned above, my opinion is that the objectives of the work have been fulfilled in form of the publications which make integral part of the thesis. Therefore I recommend the submitted thesis to be accepted as a basis for awarding the PhD degree.

Questions to be posed at the defense:

Why the second garnet generation, overgrowing the large biotite I in granulites, is interpreted as representing amphibolite-facies overprint?

What is the evidence for the dome structure of the Kabul Block?

Of which affinity are the rocks within the so-called peridotitic nappes and what is their geotectonic significance?

Formal comments

The way how the abstract is written does not allow to judge what has been newly done by the author – it is rather a summary of what is known.

The structure of the thesis would have been clearer if the chapters corresponding to the publications would have a comment in the title (e.g. “Research paper”). At the same time, the title of the journal, issue and pages/doi should be presented in the heading. I also find confusing when individual chapters of the papers are presented in the Contents as equal to the other chapters of the thesis.

Introduction

- geographical landscape – rather geomorphology?
- neighbouring countries, Hindu Kush Mts. and other units, rivers are not shown in Fig. 1, although mentioned in the text and the figure caption, which makes the text badly comprehensible
- why to make individual chapter in the Contents of different geological missions treated on several lines only?
- in Fig. 3, scale is missing, and showing the position of the area zoomed-in in Fig. 4 is needed: Afghan Central Blocks is presented only in the text, should be at least in the caption of Fig. 4
- how can a formation consist of xenoliths? (p. 8) It can be represented by these.
- What reference is “Russians” (in Structure of the Kabul Block?)

Bibliography

I am not sure if this is a list of references the publications or including the text of the thesis: I could not find some of the references used in the Introduction (e.g. Eppinger et al. 2008).

Although not a native English-speaking person, I would like to point out some, commonly scientific, terms which are in my opinion not correctly used. These are e.g.:

junction – this should be rather junction

either-or used twice on p. 7 – shouldn't it be both-and?

suturing of the Kabul block to the Eurasian continent??

the presence of ophiolitic materialis suggested to have been dragged????

timing of the collision....considered to have occurred: timing is, or collision occurred

(I finish commenting here on p. 7)

the text would profit from more commas separating logical units in sentences