

RNDr. Marian Janák, DrSc.
Ústav vied o Zemi, Slovenská akadémia vied
Dúbravská cesta 9, P.O.Box 106
840 05 Bratislava 45
Slovenská republika

Review of the Ph.D. thesis

Metamorphism of gabbroic rocks of Teplá-Barrandian Unit

Author: Mgr. Petra Holá

General opinion:

The thesis is written as a monograph. It focuses on petrographic, geochronological and geochemical characterization of gabbroic rocks of the Teplá-Barrandian Unit in Bohemian Massif to provide constrains on the Cambro-Ordovician and Variscan evolution. The case is well documented with explicative illustrations, detailed petrographic descriptions, mineral chemistry, geothermobarometry, EBSD analysis and geochronological and geochemical data. The topic is well-selected since the gabbroic rocks react mostly incompletely during metamorphism, recording evolution from magmatic stage to metamorphic re-equilibration. Gabbroic rocks presented here contain interesting and quite unique features such as decomposition of magmatic plagioclase, corona textures and zircon coronas around ilmenite and baddeleyite.

The thesis is written as a monograph synthetising the works already published (Jašarová et al., 2016) or those in review or preparation. Overall, the topic of the PhD. thesis is of interest for a wide geological audience and in line with modern PhD. work.

Petrological study of metagabbros together with U–Pb dating allowed to characterize three events defined by different textural position of zircon and titanite. The oldest (Cambrian) magmatic event is recorded in isolated metamictized matrix-hosted zircons that yield similar

mean age of c. 500 Ma. The younger Cambro-Ordovician event was connected with formation of tiny zircon grains forming a rim around ilmenite at ~480–490 Ma due to diffusion reaction of ilmenite and surrounding silicates. The youngest (Variscan) event is recorded by formation of zircon corona around baddeleyite at ca. 360–380 Ma and titanite forming corona around ilmenite.

All magmatic and metamorphic events are supported by proper geological background, mineralogical-petrologic, geochemical and geochronological data, and interpreted in terms of tectonic evolution. Petrological aspects are based on microprobe analyses which allowed to determine the compositions of major minerals used to determine the P-T conditions of metamorphism. Several aspects, like the microtextures, corona formation and magmatic plagioclase recrystallization in response to metamorphism are well understood. However, formation of zircon from ilmenite needs more rigorous explanation. Tectonic interpretations are made in a context of the pre-Variscan and Variscan evolution of the Bohemian Massif, which may challenge the traditional models. For example, Cambro-Ordovician rifting and related regional low-pressure metamorphism, or Cadomian vs. Variscan Barrowian metamorphism.

The results suggest that (1) Cambrian metagabbroic rocks originated from two different portions of magma. (2) Cambro-Ordovician event was related to regional, rift-related metamorphism. (3) Variscan metamorphism at 360-380 Ma was dominant, the increasing P-T conditions from east-southeast (~600±50°C; 10±1.5 kbar) to west-northwest (~700±50°C; 13.5±1.5 kbar) corresponds to previously reported Variscan metamorphic field gradient in this area.

Specific comments, questions:

Formation of zircon from ilmenite is rather confusing: “Formation of tiny zircon grains forming rim around ilmenite at ~480–490 Ma due to diffusion reaction of ilmenite and surrounding silicate matrix **was enabled by increase of temperature**”...”Newly obtained results of U-Pb zircon dating (this study) systematically yielded ages c. 480 Ma for tiny zircon grains forming a rim around ilmenite, this age is **consistent with decrease of temperature** which followed after the peak metamorphism in TCC”... Is there any relationship between zirconium content and temperature based on distribution of zirconium between ilmenite and zircon?

The compositions of zircon and baddeleyite is not presented, any microprobe analyses ?

U-Pb zircon dating.

Figures 23, 26: Results of U-Pb zircon dating do not plot on concordia. Please explain.

P-T conditions

Rutile is described as a member of the Variscan metamorphic assemblage. Zirconium content in rutile is commonly used for calculations of temperature, however, Zr-in Rt thermometry is not used here. There are several calibrations of garnet-clinopyroxene thermometer but only one (Ravna 2000) was used.

Please explain.

Cambro-Ordovician event at c. 480 Ma

This age is obtained from a group of zircon grains associated with ilmenite. Is ilmenite magmatic? Is there any other mineral in metagabbros to document Cambro-Ordovician metamorphism? For example, Perřestý et al. (2017) documented relicts of garnet in metapelites.

There are several formal and grammar errors throughout the text which can be corrected, mineral abbreviations should be consistent with recommended mineral symbols, for example Warr (2021), Mineralogical Magazine (2021), 85, 291–320 doi:10.1180/mgm.2021.43

To summarize, there are no fundamental weaknesses in this work and I believe that above stated inconsistencies will be clarified.

Conclusion

I suggest to the scientific committee to accept this thesis work and award the Ph.D. degree to Mgr. Petra Holá.

Bratislava, 12.6. 2024

RNDr. Marian Janák, DrSc.

