

Dr. Simone Cesca
**Section 2.1 „Physics of Earthquakes
and Volcanoes“**
Helmholtzstr. 7, 14467 Potsdam
torsten.dahm@gfz-potsdam.de
Telephone: +49 (0)331 288-28794
Telefax: +49 (0)331 288-1200

Potsdam, 27. March 2018

**Report on the Doctoral thesis „The structure of the West Bohemian Earthquake
Swarm Source Zone“ by Mr. Martin Bachura**
Charles University of Prague, Faculty of Science
Study program: Applied Geology

Dear Sir, Madame,

it is my pleasure to write a report on the doctoral thesis of Mr. Martin Bachura.

The thesis of Martin Bachura deals with different, advanced seismological analysis performed on recent seismic activity at the West Bohemia swarm source region. In particular the doctoral thesis develops and applies technique devoted to the accurate location of earthquake foci and the determination of crustal properties, such as seismic waves velocity ratios and attenuation factors. Results interpretation helps to better understand the nature and small-scale properties of seismic swarm episodes repeatedly affecting this region.

The thesis is articulated in chapters. It starts with brief introduction and motivation chapters (chapter 1, 2), following with an overview on West Bohemia geological setting, seismicity and seismic monitoring (chapter 3). Chapter 4, 5 and 6 are dedicated to the main analysis performed: seismic relocation, coda attenuation analysis and inference of v_P/v_S ratios. Chapter 7 collects three significant ISI journal manuscript, with major contributions by the candidate, reflecting the scientific impact of the research work.

Chapter 1, 2 and 3 are extremely compact, too much in my opinion, as they miss to introduce the research work in its proper context: the West Bohemia region, which experienced over many decades outstanding seismic swarm episodes, has been target by even more scientific studies and publications, aiming to discuss geological, geophysical and seismological aspects of this peculiar region and unravel the physical processes driving seismicity and surface observations. This lack of a broader introduction does not help to set out the motivation for this study: these appear rather technical, focusing to the development, testing, comparison and application of different advanced methods, but missing their importance in advancing our knowledge on swarms seismogenic processes.

In change, I found chapter 4, 5, and 6, well organize, informative and exhaustive. This is of major importance, since these chapters represent the core of the scientific work. Chapter 4 is dedicated to double difference seismicity relocation. While adopting known techniques, results are important, especially towards the application of v_P/v_S imaging techniques in Chapter 6, which rely on accurate location. Since previous, similar studies focused on the relocation of West Bohemian swarms, I could not clearly judge the extent of the author contribution to this task. Chapter 4 and 5 involve more novel contributions, both in terms of methods development, testing and comparison, as well with respect to the results. Chapter 5, in particular, is very interesting and I particularly enjoyed the reading. The author present here different coda analysis techniques to resolve crustal attenuation properties, nicely discussing in a comparative study advantages, uncertainties and estimations. Chapter 6

uses a recently developed technique to resolve ratios of seismic velocities at the swarm region. Whereas such analysis was previously performed on older swarm, the thesis complement previous results focusing on more recent datasets and discussing spatial and temporal variations of vP/vS .

Results are of major importance, and supported by three relevant ISI publications, basically dedicated to the three topics discussed in the thesis. Each chapter include elaborated discussions and nice, concise conclusions. However, there is not a final conclusion chapter, which could have allowed to jointly interpret and discuss the results of the three analysis, eventually with a better link to the current state of the art and broad literature on the region. Consequently, the three main research lines in the thesis appear loosely linked.

The formal presentation of the thesis is correct. The thesis is compact, readable, complete in its main sections. The manuscript is supported by high quality, informative figures. Most relevant references are given. The English text is not always optimal, and I could find some typos and unclear sentences in different part of the thesis.

I list below a number of questions and comments, which can help as trigger for the PhD discussion:

- What is the main scientific motivation for this study, beside developing specific techniques? Why these specific techniques were chosen? And what are the main findings that we can draw from the joint interpretation of the results (e.g. vP/vS and attenuation)?
- The relocation technique involves some discussion and development, linked to the choice of events pairs with constraints on their differential magnitude (i.e. using events couples with similar magnitude only). While I underst the idea, I wonder how large is the benefit in comparison to a standard approach, with a strict control to use only highly correlating waveforms.
- Concerning Q estimated, there is a broad comparison of different techniques, however they are often applied to specific subset datasets. Why is this choice done? To which extent can we compare results of different methods, when they are applied to independent datasets?
- How do estimated Q values relate to estimate by other authors in this region, but also elsewhere? To which extent should Q values in West Bohemia be considered anomalous?
- Concerning vP/vS results, the method is not new, but results are new and resulting discussion interesting. Should we interpret apparent vP/vS variation as an effect due to spatial variation of this ratio, or to temporal changes (as suggested by previous works)?
- The flat geometry of the seismogenic region poses some challenges to vP/vS imaging methods, and therefore only selected event couples are used. Which uncertainties can we expect to be introduced by such geometry?

In conclusion, I find that the thesis provides interesting and original findings, and significant scientific results. Considering the formal quality of the dissertation, the capacity of the candidate to deal with different seismological problems, including metodological development, data processing, results analysis and interpretation, I believe that the PhD thesis of Mr. Martin Bachura fulfills the requisites to receive a positive evaluation and warmly recommend to accept it.

Your sincerely,

Dr. Simone Cesca



HELMHOLTZ-ZENTRUM POTSDAM
DEUTSCHES
GEOFORSCHUNGSZENTRUM
Sektion 2.1
Telegrafenberg
14473 Potsdam