

Ph.D. Thesis Review

Author: RNDr. Kateřina Diáková

Title: Vulnerability of organic matter in permafrost-affected soils and potential greenhouse gas emissions

Reviewer: Ing. Jan Kopecký, PhD.

The thesis presents studies on degradability of organic matter in arctic permafrost soils from two specific habitats, cryoturbated soils and permafrost peatlands. Effects of temperature, availability of oxygen, and input of exogenous plant-derived compounds were assessed in laboratory incubation experiments; to assess the influence of nitrogen availability both laboratory and in situ experiments were included.

The thesis is based on a set of four thematically coherent original articles in recognized peer-reviewed journals. Since their publication in 2015-2016, the articles have already received significant numbers of citations (5-14). The candidate is the first author of two of the enclosed articles, and her contribution to all published works is clearly defined.

The texts of the four articles are supplemented with a brief and informative introduction summarizing the present state of knowledge, clearly formulated aims of the work, a synthesis of results with discussion/conclusions, and a chapter describing future prospects for continuation of the work on this topic. The discussion interconnects results from the published works and unifies them in a consistent story. Individual findings and drawn conclusions are critically evaluated from different perspectives assessing their relevance. The resulting text offers a balanced, realistic view of the findings obtained in this work in the context of available knowledge in the field.

Questions and comments

1. Soil microbial community was considered only in terms of total microbial biomass. This approach seems to limit interpretation of the results, the communities inhabiting different soil horizons will be different due to long-term adaptation (It is mentioned only when discussing the effects of oxygen availability). In course of a laboratory incubation, even otherwise untreated, the community composition will change. Knowledge of the community composition in situ, at the beginning and at the end of a laboratory experiment would help to understand the underlying processes.
2. A traditional fumigation method was used to quantify the microbial biomass. Value of biomass determination is clear, however, what are potential biases when comparing soils with very different organic matter quality and content, and also different community size and composition?
3. Estimations of organic C amounts stored in the arctic soils are given as accurate numbers, not ranges or confidence intervals, and with surprising number of (significant?) figures. What analytical data are they based on, and how reliable they are? Please explain the data mentioned in the Introduction: 1307 Pg C in arctic region, out of that 800 Pg in permafrost – does the amount in permafrost include both cryoturbated soils (454 Pg) and permafrost peatlands (300 Pg)?

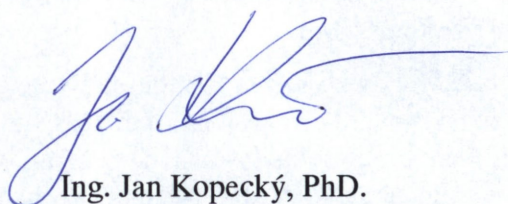
4. Are there in situ data from sites, where increasing temperatures have already caused thawing of the permafrost? If so, how such sites develop? Do the C losses support the estimated rates?

Conclusions

The candidate has clearly proved her ability to design and perform scientific experiments, achieve original results, analyze and adequately interpret them in the context of present state of knowledge in the field.

The thesis meets the required standards in terms of the nature and quality of work undertaken, and the degree 'Doctor of Philosophy' can be awarded upon successful defense.

Praha, Dec 12, 2018



Ing. Jan Kopecký, PhD.



Helsinki 10.12.2018

To Prof. Hana Santrucková
Head of the Committee for PhD studies
in Biology of Ecosystems

Subject:

Review of the PhD thesis "Vulnerability of organic matter in permafrost-affected soils and potential greenhouse gas emissions" by Katerina Diáková

This thesis consists of four published articles (papers I – IV) and introduction. The topic of the thesis - vulnerability of organic matter in permafrost-affected soils is important, since the tundra soil carbon stocks are large and the controls of decomposition of organic matter in tundra soil are not yet fully understood. Also the potential greenhouse gas emissions with climate warming from tundra soils can have a significant impact on the climate system, and need to be better understood. This thesis provides an important scientific contribution, providing new information about the biological, chemical and physical controls of organic matter decomposition, and CH₄ and N₂O emissions in tundra soils. The introduction is well written, of sufficient length and well referenced. The introduction gives a thorough explanation of the background (of different theories, hypothesis and previous research results), describes the motivation of the research and discusses the results and conclusions using up-to-date literature citations placing the new results in the context of what is already known. The figures included in the introduction part were also clear and informative.

The aims and objectives of the thesis are clearly described, covering a wide range of different processes from organic carbon decomposition to priming and N₂ fixation that are nicely bound together in the introduction. The questions asked and answered are relevant for advancing science, but they are also important questions in the context of climate change, and understanding climate change feedbacks from tundra ecosystems. The thesis consists of different approaches from field measurements to laboratory incubations and different techniques from greenhouse gas measurements, ¹³C isotopes and ¹⁵N fixation assays. The use of these multiple approaches is a clear strength of the thesis, and they are selected so that they are suitable for testing the hypothesis. The methods used are described clearly in the publications.

The published articles are impressive, for example presenting the first mechanistic insights on the vulnerability of a wide range of arctic soils for C losses through priming effects. The doctoral candidate is the first author in two papers, second author in one paper, and fourth author in one paper, which clearly demonstrates sufficient independent contribution of the doctoral candidate, and the contribution to each paper is also clearly described in the introduction part.

According to my evaluation, the doctoral candidate can be granted the permission to defend the dissertation.

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