



Habilitation thesis reviewer's report

Masaryk University	Faculty of Science
Faculty	Geological sciences
Field of study	<i>Mgr. Jan Cempírek, PhD</i>
Applicant	Department of Geological Sciences
Unit	<i>Natural Al-rich borosilicates – petrology, mineralogy, and crystal chemistry</i>
Habilitation thesis (title)	Professor Adam Pieczka
Reviewer	AGH University of Science and Technology, 30-059 Kraków
Unit	

Reviewer's report (extent of text up to the reviewer)

Review

of the scientific performances and habilitation thesis of Ph.D. Jan Cempírek (Masaryk University in Brno)

Ph.D. Jan Cempírek (born: 1979.01.18) is a graduate of the Masaryk University, Faculty of Sciences (M.Sc. degree; specialization in hydrogeology and geochemistry). In 2010, at the same Faculty, he defended successfully a doctoral dissertation on crystalchemistry of Fe,Mg,Mn,Al-bearing minerals in granitic systems. In 1999–2015, he was a curator of the Moravian Museum – Natural History Museum in Brno; from 2012 to 2015 a post-doctoral fellow in the Department of Earth and Ocean Sciences, University of British Columbia in Vancouver, Canada; since 2015 he works in his parent University, currently as an assistant professor at the Department of Geological Sciences. From the personal questionnaire of the applicant, we learn that he specializes in mineralogical and petrological studies of Al-bearing associations, structural studies of selected minerals, granite-related raw material deposits, and deposits of precious stones and rare elements mainly related to pegmatites.

Evaluation of the scientific performances of the applicant

Ph.D. Jan Cempírek is a co-author of 49 papers, including 27 papers in high-impact WoS journals, such as *Acta Crystallographica*, *American Mineralogist*, *Canadian Mineralogist*, *Geology*, *Journal of Geochemical Exploration*, *Journal of Geosciences*, *Lithos*, *Mineralogical Magazine*, *Mineralogy and*

Petrology and Ore Geology Reviews. He is also a co-author of 1 reviewed paper in *Journal of the Czech Geological Society*, 9 reviewed papers in other, not-impacted Czech journals, 12 papers in other Czech periodical magazines, 22 conference abstracts presented mainly during international conferences, 10 publications in field trip guidebooks published in English, and additionally he was a co-editor of 2 books of abstracts of the IMA 2010 and PEG 2015 international conferences. Those totally 83 scientific contributions include 43 papers, abstracts and other materials prepared with participation of the applicant after 2010, i.e., after obtaining the Ph.D. degree, and include, among others, 20 papers in the mentioned high-impact WoS journals. The papers were cited 109 times (without the self-citations) in journals listed in the *Web of Science* citation data base, which resulted in H-index = 9. **Ph.D. Jan Cempírek** was the main participant in one 3-years research project (2010–2013) of the GAČR agency managed by Prof. Milan Novák, and in 2016 was a manager of an 1-year FR MU project. Up to date, the applicant participated in 4 international conferences (LERM 2003, IMA 2010, CEMC 2014 and PEG 2015), and additionally at all these conferences he took part in organizing conference field trips. He is an author of numerous reviews for high-impact international journals, such as *American Mineralogist*, *The Canadian Mineralogist*, *European Journal of Mineralogy*, *Journal of Geosciences*, *Mineralogical Magazine* and *Mineralogy and Petrology*, and others; totally 26 reviews during the last 5 years.

In his scientific carrier, especially after receiving the Ph.D. degree, **Ph.D. Jan Cempírek** collaborated with many scientists, who play leading roles in the mineralogical community, e.g., (apart from Czech researchers) with Andreas Ertl (Austria), Pavel Uher (Slovakia), Migual A. Galliski and M.F. Márquez-Zavalía (both Argentina), Lee A. Groat (Canada), Gaston Giuliani (France), Federico Pezzotta (Italy), Edward S. Grew (USA), Anthony R. Kampf (USA), Chi Ma (USA), Ferdinando Bosi (Italy), and others, who represent various academic and scientific institutions.

Three main areas of scientific interest of the applicant are:

- (1) broadly understood mineralogy of granitic pegmatites, especially in the field of accessory rock-forming phases and rare-metals carriers, e.g., tourmaline-supergroup minerals and other rare borosilicates, Nb-Ta-Sn-Ti oxides, REE-bearing minerals, mineral stabilities, petrogeneses, etc., including also descriptions of newly recognized mineral phases [e.g., allanite-(Nd), oxy-schorl, vránaite, lucchesiite] (these papers give ~2/3 of total amount of citations),
- (2) studies on geochemical behavior of selected elements in natural environments (e.g., P, Y, F, studies of Li isotope fractionation) as well as As mobility in waste rocks, and the geochemical behavior of S, F and Cl in burned spoil heaps (these papers give ~1/3 of total amount of citations),
- (3) structural and spectroscopic studies of selected minerals, leading to more detailed descriptions of minerals, including new mineral species, e.g., Fe-bearing olenite, allanite-(Nd), oxy-schorl, V-rich oxy-dravite, feruvite, lucchesiite, vránaite), and also synthetic diphosphates, e.g., the

paper published in *Acta Crystallographica* (2009) [citations, being the result of this research subject are included in point (1)].

Additionally, **Ph.D. Jan Cempírek** was a supervisor of 5 completed Master Theses, and currently he is a supervisor 3 Ph.D. students; he is an author of a few learning and scientific materials for general public, generally referring to pegmatites as sources of precious stones and various rare metals utilized by modern industry. Since 2015 he is the Associate Editor of *The Canadian Mineralogist* journal.

Summarizing, **Ph.D. Jan Cempírek**, in spite of a relatively young age, mastered a complex set of modern research methods, which are applicable in modern studies of solids, including minerals, and employs them with success for his scientific profit as well as for the profit of his University, the Czech mineralogy and geology in general. He is an acknowledged researcher, invited by the international mineralogical community as a collaborator and co-author in addressing advanced mineralogical and geological problems, especially in the field of rare elements. It is worth to notice that the issues related to rare elements as raw materials for modern industry are hot topics for the mineralogical and geochemical sciences at the beginning of the 21st century. His achievements, briefly mentioned above, are a good prognostic for his future works in this field. Therefore, I can ascertain that the scientific performance of **Ph.D. Jan Cempírek** is significant, as evidenced by publications in high-impact international journals; he is a talented young researcher, already fully self-dependent, constantly increasing his input into the mineralogical and geological sciences. He completely fulfils all requirements referring imposed on candidates to the habilitation scientific degree.

Evaluation of the habilitation thesis

Ph.D. Jan Cempírek presented for the review as his habilitation thesis a series of nine topical publications with his contribution as one (often the leading) of their co-authors, under the common title *Natural Al-rich borosilicates – petrology, mineralogy and crystal chemistry*. The series is divided by him into three parts dedicated to problems of the tourmaline supergroup, borosilicates with the mullite-type structure and minerals of the dumortierite supergroup, and includes the following papers:

Cempírek, J., Novák, M., Ertl, A., Hughes, J.M., Rossman, G.R., Dyar, M.D. (2006): Fe-bearing olenite with tetrahedrally coordinated Al from an abyssal pegmatite at Kutná Hora, Czech Republic: structure, crystal chemistry, optical and XANES spectra. *The Canadian Mineralogist* **44**, 1, 23–30,

Bačík, P., **Cempírek, J.**, Uher, P., Novák, M., Ozdín, D., Filip, J., Škoda, R. (2013): Oxy-schorl, $\text{Na}(\text{Fe}_2^{2+}\text{Al})\text{Al}_6\text{Si}_6\text{O}_{18}(\text{BO}_3)_3(\text{OH})_3\text{O}$, a new mineral from Zlatá Idka, Slovak Republic and Příbyslavice, Czech Republic. *American Mineralogist* **98**, 485–492,

Bačík, P., Uher, P., **Cempírek, J.**, Vaculovič, T. (2012): Magnesian tourmalines from plagioclase–muscovite–scapolite metaevaporite layers in dolomite marble near Prosetín (Olešnice Unit, Moravicum, Czech Republic). *Journal of Geosciences* **57**, 143–153,

Cempírek, J., Houzar, S., Novák, M., Groat, L.A., Selway, J.B., Šrein, V. (2013): Crystal structure and compositional evolution of vanadium-rich oxy-dravite from graphite quartzite at Bítovánky, Czech Republic. *Journal of Geosciences* **58**, 149–162,

Gadas, P., Novák, M., **Cempírek, J.**, Filip, J., Vašínová-Galiová, M., Groat, L.A., Všíanský, D. (2014): Mineral assemblages, compositional variation, and crystal structure of feruvitic tourmaline from a contaminated anatectic pegmatite at Mirošov near Strážek, Moldanubian Zone, Czech Republic. *The Canadian Mineralogist* **52**, 285–301,

Cempírek, J., Novák, M., Dolníček, Z., Kotková, J., Škoda, R. (2010): Crystal chemistry and origin of grandidierite, ominelite, boralsilite and werdingite from the Bory Granulite Massif, Czech Republic. *American Mineralogist* **95**, 1533–1547,

Novák, M., **Cempírek, J.**, Gadas, P., Škoda, R., Vašínová-Galiová, M., Pezzotta, F., Groat, L.A. (2015): Boralsilite and Li,Be-bearing “boron mullite” $\text{Al}_8\text{B}_2\text{Si}_2\text{O}_{19}$, breakdown products of spodumene from the Manjaka pegmatite, Sahatany Valley, Madagascar. *The Canadian Mineralogist* **53**, 357–374,

Cempírek, J., Grew, E.S., Kampf, A.R., Ma, C., Novák, M., Gadas, P., Škoda, R., Vašínová-Galiová, M., Pezzotta, F., Groat, L.A., Krivovichev, S.V. (2016) Vránaite, ideally $\text{Al}_{16}\text{B}_4\text{Si}_4\text{O}_{38}$, a new mineral related to boralsilite, $\text{Al}_{16}\text{B}_6\text{Si}_2\text{O}_{37}$, from the Manjaka pegmatite, Sahatany Valley, Madagascar. *American Mineralogist* **101**, 2108–2117,

Galliski, M.Á., Márquez-Zavalía, M.F., Lira, R., **Cempírek, J.**, Škoda, R. (2012): Mineralogy and origin of the dumortierite-bearing pegmatites of Virorco, San Luis, Argentina. *The Canadian Mineralogist* **50**, 873–894.

Two of the papers were published in *Journal of Geosciences* (IF 1.33), four in *The Canadian Mineralogist* journal (IF 0.86–1.18), and three in *American Mineralogist* (IF 1.92–2.06). All the papers submitted to the first-rank mineralogical journals were reviewed at least by two reviewers of the international class. To date, these papers were cited 10 / 6 / 1 / 7 / 0 / 8 / 0 / 0 / 7 times, respectively, in journals listed in the WoS database, thus H-index on the basis of citations of the components of the thesis is 5. The applicant evaluated his contributions to the publications at ~40 / 40 / 25 / 80 / 25 / 60 / 40 / 20 and 30 %, respectively, and for each of the publications clearly explained his contribution. A detailed analysis of the explanations suggests that the applicant in many of the publications acquired compositional and structural data from the studied material and actively participated both in the interpretation of the data and in writing the papers. At least in a few cases, he also was the main author of the research projects and secured them with his own material collected, as it can be thought, during field works. As all the papers were reviewed before their publication by international specialists, therefore, in my discussion, I will only concentrate on scientific importance of the papers.

The new nomenclature of **tourmaline-supergroup minerals** (Henry et al., 2011) approved by the IMA-CNMNC, is based on more precise understanding the compositional relationships controlling the crystal chemistry within this structurally complex supergroup, and resulted in the definition of many

new minerals. Five of the papers enclosed into the habilitation thesis of the applicant are dedicated to such precise characteristics of tourmalines with atypical, sometimes rare compositions, often not-fully characterized, and generally corresponding to oxy-tourmaline species (Fe-bearing olenite, Mg-bearing dravitic- to oxy-dravitic tourmaline, V-bearing oxy-dravite, a feruvitic tourmaline named later lucchesiite, and the holotype oxy-schorl). In each of the papers, the authors used microprobe analyses \pm single crystal X-ray structure refinements \pm spectroscopic studies to determine precisely the cation and anion site-occupancies that allow proper classification of the analyzed tourmalines. They also, usually briefly, discuss the associated hosts, parageneses, etc., leading finally to valuable comparisons with other world occurrences of compositionally similar crystals and, finally, to generalized petrological conclusions. I would like to emphasize that two of the papers, dedicated oxy-schorl and a feruvitic tourmaline named recently by Bossi et al. (2016) as lucchesiite and approved by the IMA-CNMNC as valid minerals in the tourmaline supergroup, are descriptions made on the basis of the holotype and co-type samples coming from Slovakia and Czech Republic. In four of the papers **Ph.D. Jan Cempírek** is one of the main authors, appearing in the co-authors teams on the first or second position, and, taking into account declaration on his contributions to the publications, at least partly provided necessary compositional and structural data.

In the second part of the habilitation thesis, dedicated **borosilicates with the mullite structure**, the applicant presents three co-authored papers describing a unique HT-MP paragenesis of Al-rich borosilicates of granditierite, ominelite, boralsilite and werdingite found in the Bory Granulite Massif, Czech Republic, and two minerals structurally related to the group: boralsilite and a boron mullite (accepted later by the IMA-CNMNC as a new mineral vránaite) found in the Manjaka pegmatite in Sahatany valley, Madagascar. The applicant is the first author of two of these papers, that are in my opinion the most important and interesting of this series, and in the third one he is the second author. Two of the papers from this series are prepared in collaboration with American, Italian, Canadian and Russian mineralogists, what additionally emphasizes the interest of foreign mineralogists in this mineral group. Each of the papers practically completely characterizes the mineral occurrences not only in terms of interesting parageneses and stability of the featured mineral, but also gives an exhaustive mineralogical and petrological background. These contributions employ advanced methods of mineralogical and geochemical investigations like electron microprobe analysis, single-crystal structure refinement, Raman spectroscopy, LA-ICP-MS, fluid inclusion studies, etc.

The last of the papers presented for the thesis is dedicated to **dumortierite-bearing pegmatites** of Viroroko, San Luis, Argentina. This is also a co-authored paper published together with recognized Argentinean mineralogists, and results from the applicant's interest in dumortierite-bearing mineralization occurring in those pegmatites, texturally similar to the mineralization known to the applicant from the Kutná Hora region. Re-visiting of this locality resulted in a collection of research material for detailed mineralogical and petrological studies. The results allowed to conclude on the

pegmatitic melt origin and to compare the described localities with other known occurrences of (As,Sb)-bearing dumortierites and holtite.

Final conclusion

Summarizing, I would like to ascertain that **Ph.D. Jan Cempírek** presented the habilitation thesis that is a significant contribution in the development of mineralogical and petrological sciences in general and of the knowledge on rare borosilicates in particular. His scientific performance is original, published in international journals with high impact factors and cited by various researchers. I regard all the presented contributions as complete research works, which, in each case, solve exhaustively scientific problems put forward in the papers titles. They are very well written and the overall style corresponds to concise scientific works much appreciated by editors of first-rank international journals. Of course, I am aware that other co-authors also contributed to these works. However, after careful reading of the papers, I consider **Ph.D. Jan Cempírek** as a person, who had a significant control on their final result. The candidate for the habilitation degree, probably owing to his broad mineralogical and geological knowledge, relatively easily comes into contact with other, even outstanding foreign researchers and is invited to collaborative projects. He took part in discovering four new minerals accepted by the IMA-CNMNC [allanite-(Nd), oxy-schorl, lucchesiite and vránaite]. His present achievements certainly increased splendor of his parent Department, Faculty and University and I am convinced that after the habilitation degree his scientific activity will be equally or maybe even more intense.

Having considered the scientific performances of the applicant in general as well as very high quality of the habilitation thesis that complies with usual standards required for habilitation theses in the field of geological sciences, I strongly recommend the Faculty of Science of the Masaryk University in Brno the acceptance of the habilitation thesis of Ph.D. Jan Cempírek.

Reviewer's questions for the habilitation thesis defence (number of questions up to the reviewer) ...

I have no questions.

Conclusion

The habilitation thesis submitted by Ph.D. Jan Cempírek entitled *Natural Al-rich borosilicates – petrology, mineralogy and crystal chemistry* *meets* the requirements applicable to habilitation theses in the field of Geological Sciences.



In Cracow on 11 January 2017

Adam Pieczka



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