Review report on the Ph.D. thesis of Kuznetsov Maksim Viktorovich, entitled "Intraplate volcanism evolution of Eastern Mongolia volcanic area in the Late Mesozoic – Early Cenozoic"

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The result of the Ph.D. thesis of Mr. Kuznetsov Maksim Viktorovich is very interesting. Several studies have been published on the petrology of Late Mesozoic-Early Cenozoic volcanic rocks in Eastern Mongolia, but the origin and geodynamic setting are still under debate. The author aimed to determine the source and petrogenesis of the Late Mesozoic-Early Cenozoic volcanic rocks in the Eastern Mongolian volcanic area (EMVA) based on complex methods combining field study, petrography, major and trace element geochemistry, K-Ar dating, Sr, Nd, and Pb isotopic analysis and thermodynamic and trace element modeling by alphaMELTS software package.

The thesis is a cumulative dissertation consisting of four main chapters, an introduction, a conclusion, references, and appendixes. The thesis (Russian version) covers 246 pages entirely and includes 43 figures, 4 tables, 3 appendices, and 169 references and it is well-structured and well-described in a clear concise manner. The author quoted an appropriate number of bibliography sources. The figures, diagrams, and tables are properly shown.

The Ph.D. thesis begins with an Introduction to the subject matter. The main part of the dissertation consists of four chapters (Chapters 1 -4).

Chapter 1 summarized the geological setting of the EMVA and a review of hypotheses about the formation of the EMVA briefly based on previous researchers' publications (4 pages).

Chapter 2 describes research methods clearly (3 pages). The candidate used appropriate complex methods for petrological study.

Chapter 3 presents all the results of the research (14 pages) starting with Sub-chapter 3.1 which describes the field study. A total of six volcanic fields of the eastern part (Uldza gol, Norovlin soum, Northern Onon, Batnorov, Bayan-Adarga) and southwestern part (Central Gobi) of the EMVA were studied. Based on field observation, they observed three successive evolutionary stages of volcanic activity in the EMVA (Cover Volcanic Complex-CVC; Early Cretaceous Extrusion Complex-ECEC; Late Cretaceous Extrusion Complex-LCEC). Sub-chapter 3.2 (1 page) illustrates age data for volcanic rocks in the EMVA. There are 8 new age dates of basic and acidic rocks from CVC and ECEC by the K-Ar method obtained at the Laboratory of Isotope Geochemistry and Geochronology of IGEM, RAS. A short petrographical description for representative samples from the CVC, ECEC, and LCEC comprises sub-chapter 3.3. (2 pages). In sub-chapter 3.4. shows the geochemistry of the volcanic rocks. Major element chemistry is described briefly based on TAS and K2O vs SiO2 classification and Harker variation diagrams, as well as major element contents and Mg#. Characteristics of trace element composition of volcanic rocks are explained and spider diagrams, REE patterns, and Harker variation diagrams based on newly obtained and previously published data are illustrated. According to Sr, Nd, and Pb isotopic signatures of volcanic rocks of EMVA indicate a DM source. But, samples of CVC volcanic rocks are plotted closer to the EMII composition and formed weakly pronounced trends from the EMII area to the EMI area.

Chapter 4 focused on the Origin of the volcanism of the EMVA (50 pages). This chapter contains 5 sub-chapters explaining the sources of basaltoid formation and the origin of intermediate and felsic volcanic rocks of the CVC, the source of early and Late Cretaceous volcanic complexes, and the geodynamic model of the development of the EMVA. This chapter is the most important and the main discussion part of the thesis and shows the role of crustal contamination, crystallization differentiation,

the role of continental metasomatized lithospheric mantle and lower continental crust rock in the magma generation process, various melting modeling of continental metasomatized lithospheric mantle and lower continental crust rock, modeling of fractional crystallization and assimilation-fractional crystallization processes, then sources of the CVC, ECEC and LCEC and possible geodynamic model.

Based on the above-mentioned original research results in combination with previously published data, the author explained the evolution of the mantle sources of intraplate volcanism during the Early Cretaceous-Early Cenozoic time in the Eastern Mongolian volcanic area. This research work has fully achieved its objectives.

There are a few remarks, questions, and comments related to the thesis that should be cleared.

- In the Introduction, the author did not mention published original papers in the part "Testing of the results and publications". (Maybe I have an earlier version of the thesis before the publication of the papers.)
- There is no sample or section locality map. If the location of the studied samples is shown on the map, it would be fine.
- There are few descriptions of petrography in the thesis, I think you have a lot of thin-section descriptions. How correlated are petrography and geochemistry?
- In the major element chemistry description, normative minerals such as nepheline are mentioned. But CIPW normative minerals are not shown in the table as in Appendixes.
- If each chapter had a summary or conclusion, it would be clearer for readers.
- Factual material and research methods part mentioned that the original material was collected during the Russian-Mongolian expeditions in 2015, 2016, and 2017. What was the role of the Mongolian side in the joint expedition?

Above mentioned remarks, questions, and comments would not affect the evaluation of the entire dissertation. The author has published two original papers (one of them is the first author) related to the subject in the international journal Petrology. I think that it indicates the high impact and quality of the entire research result. New data on geochemistry, especially K-Ar age, and Sr, Nd, and Pb isotopic data is valuable information for Mongolian geological study.

In my opinion, the reviewed thesis fulfills all requirements set in theses aimed at obtaining a Ph.D. degree.

Reviewer:

Doctor (PhD, Eng), Prof. Baatar Munkhtsengel
Department of Geology and Hydrogeology,
School of Geology and Mining Engineering,
Mongolian University of Science and Technology
Ulaanbaatar 14191