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Jury Member Report – Doctor of Philosophy thesis.

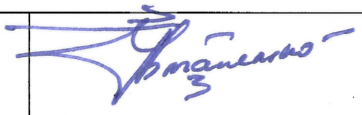
Name of Candidate: Georgy Peshkov

PhD Program: Petroleum Engineering

Title of Thesis: Improving the accuracy of thermal history in basin modelling: reduction of uncertainties in petroleum system analysis

Supervisor: Professor Dimitri Pissarenko
Co-supervisor: Dr. Evgeny Chekhonin

Name of the Reviewer: Dmitriy Potapenko

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	 **Date: 19-11-2021**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

The work of Georgiy Peshkov is focused on improving the reliability of the basin's history reconstruction - one of the modern problems of basin modeling. Specific problems covered in Mr. Peshkov's Ph.D. thesis include studying the impact of the basement's heterogeneity on the basin evolution including the temperature regime history and the rock maturity evolution in the rift structures, understanding the impact of incorporating advanced measurements of thermal properties into basin modeling workflow, considering the role of gravity in basin history reconstruction, and improving overall thermal history reconstruction in 3D basin modeling.

In the current work, Mr. Peshkov proposes and validates the new basin history reconstruction methodology that integrates coupled and decoupled thermal/structural modeling approaches. The proposed methodology was applied to the evaluation of several basins such as South-Western Barent's Sea Basin, West Siberian Basin with a special focus on the Bazhenov formation member and Okhotsk Sea Basin. Obtained results demonstrate that application of this methodology enables significant improvement in understanding the structural dynamic of the studied basins as well as rock properties evolution. The particular attention in these studies is paid to the utilization of the proposed approach for correct reconstruction of the basin' structure and understanding the impact of uncertainties in the model input data on results of the basin's properties modeling. In addition to theoretical evaluations, the thesis describes the application of the proposed approach to the evaluation of the Kara Sea Basin within the framework of a commercial project. In this study, the proposed method was applied for reconstructing the thermal history of this basin. Obtained results can further be used for defining the production potential of this challenging area and making informative decision about its development.

The candidate meets all formal criteria for the Ph.D. work. He has two paper publications in high-ranked international scientific journals (Q1 category), with one more paper accepted for publication in a journal with Q2 category rating. The results of the performed work have been reported at three international conferences with the publication of the corresponding theses. In addition to that, two more papers of Mr. Peshkov have been submitted for publication and are currently under review.

Some of my minor comments to the thesis of Georgiy Peshkov are

- Page 15, 7th row from the bottom "All other material properties (density, specific heat, radio-genic heat and initial porosity) are taken from the simulator database being equal in all dataset by the method presented in Figure 1." Recommending to rephrase it as following to avoid misinterpretation "All other material properties (density, specific heat, radio-genic heat and initial porosity) were taken from the simulator database and were the same in all computations described in Figure 1".
- Page 21, 6th row from the bottom. "Dashed curves on the right panel are the results of modelling without the thermal event (see text for details) (Chekhonin et al., 2020)". Recommending to provide the description of the thermal event in the text and to make the corresponding reference to it.
- Page 52. 19th row from the top. "The gravity anomaly (Figure 22, red line) was not fitted since the modelled σm = 10.5 mGal was greater than the desired accuracy of σ = 6.5 mGal". Recommending to explain how the desired accuracy level was defined.
- Page 53, Figure captions for Figure 22 and Figure 23. Recommending to explain the origin of the used accuracy margins of ±1.5 mGal for the gravity anomaly data, ±7% for temperature, and ±0.05% for vitrinite reflectance.

- Page 67, Figure 30. Does this figure provide any additional information compared to Figure 29? If yes, it would be good to emphasize it in the text.

In addition to the mentioned above, I also recommend that the candidate reviews the document's stylistics and does the grammar corrections.

All of these mentioned points should be considered solely as recommendations, not as a criticism. Provided comments do not reduce the scientific value of the present work, which Mr. Peshkov undoubtfully demonstrated.

Overall, the topic of the dissertation is relevant to its content. The methods employed are relevant to the dissertation subject. Obtained results are novel and have significant value. The thesis's results have been published in high-ranked peer-reviewed journals.

To conclude, Mr. Peshkov definitely demonstrated his ability to perform research work and to apply the results of his research in practice. With minor edits, Mr. Peshkov's thesis certainly satisfies the requirements of the Ph.D program.

Provisional Recommendation

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*