

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Timur Bulatov

PhD Program: Petroleum Engineering

Title of Thesis: Lithological and geochemical study of type I kerogen in the Bazhenov Formation in application to exploration and production of hydrocarbons

Supervisor: Professor Mikhail Spasennykh

Name of the Reviewer: Sergey Stanchits

I confirm the absence of any conflict of interest

Date: 30-09-2022

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

In his Ph.D. thesis, Timur Bulatov presented a detailed lithological and geochemical study of type I kerogen in the Bazhenov Formation, which is a promising unconventional reservoir for Western Siberia. There are three types of kerogen known, and I believe that the study of type I kerogen is especially important, because it has the best potential for the formation of hydrocarbons due to the most hydrogen-rich organic matter. The novelty of the Ph.D. study is related to the fact that a detailed characterization of type I kerogen in the Bazhenov Formation has not previously been presented. The author used a wide combination of different lithological and geochemical techniques, such as thin section/organic petrography, Rock-Eval pyrolysis, kinetics, elemental/isotope analysis, and other methods. He applied these techniques to study core samples obtained from several wells drilled in West Siberian Petroleum Basin. He identified the presence of luminescent layers containing a significant amount of alginite, and assessed the influence of these layers on the overall potential of hydrocarbon generation of the Bazhenov Formation. I think that results of Timur's Ph.D. study can be applied to determine the quality of the source rock and provide important information related to predicting properties of the expelled fluid, therefore I consider the obtained results to be significant.

The thesis is well-written, 95 pages long, contains six chapters, including a literature review, a detailed classification of kerogen types, description of different lithological and geochemical techniques applied to characterize alginite-rich layers, conclusions and recommendations.

I have a few of comments/questions to Timur Bulatov related to the text of the thesis.

- The literature review part of thesis shows that type I kerogen has been found in the deposits related to various ages - from Paleozoic to the Cenozoic - in the USA, Canada, China, Spain, Australia and other countries. Are the findings, obtained on the basis of detailed analysis of Bazhenov Formation, applicable to other sedimentary basins of the globe?
- In the "Conclusion" section, the author writes that the analysis of the proportion of type I kerogen may provide valuable information related to the prediction of expelled fluid properties. I assume that the readers of the thesis would be glad to know in a bit more details: what particular kind of important information can be obtained from the analysis of type I kerogen that can be applied to predict the properties of expelled fluid?
- The author also writes that the analysis of type I kerogen may determine the source rock quality. Do the results of the presented study have any broader potential application? Is it possible to give at least some recommendations to improve the efficiency of the exploration and production of hydrocarbons?

The results of Timur's Ph.D. study have been presented at fourteen International conferences and published in five papers, three of which are in the Q1/Q2 ranking journals. To summarize the above, I believe Timur Bulatov is definitely qualified for a PhD degree.

Provisional Recommendation

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