Petroleum potential of the southern and eastern margins of the Siberian Platform, Russia

AN EVALUATION OF PROVEN HYDROCARBON SYSTEMS AND DIRECTIONS FOR FUTURE EXPLORATION
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Petroleum potential of the southern and eastern Siberian Platform, Russia: An evaluation of proven hydrocarbon systems and directions for future exploration.


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Front cover image by Benedikt Steiner.
Executive Summary

With hydrocarbon resources in over-explored areas of Europe, the Middle East and North Africa becoming ever more depleted, the focus of hydrocarbon exploration is increasingly turning to frontier and remote areas in the Arctic and sub-Arctic regions, such as the vast territories of eastern Siberia. The Siberian Platform, an underexplored area in eastern Siberia stretching from the Yenisey River to the Verkhoyansk Mountains, is thought to host significant undiscovered reserves of oil and gas. The stratigraphic and palaeogeographic development of the Siberian Platform is reviewed from the Riphean-late Mesozoic and put into context with known petroleum systems encountered in key basins of the Platform. This review is supported by the addition of source rock distribution maps, chronostratigraphic and petroleum systems charts. It is envisaged that this timely work will contribute to the exploration and discovery of new hydrocarbon resources in this remote region.

Oil and gas accumulations in the Baykit and Nepa-Botuoba High provinces were sourced from middle-late Proterozoic (Riphean) source rocks, which were deposited in intracratonic depressions and clastic shelf settings. Migration of hydrocarbons occurred presumably in Early Palaeozoic times, when reservoirs and regional evaporitic top seals had already been formed. In the Nepa-Botuoba High province, hydrocarbons are likely to have migrated upslope (in a north-westerly direction in present co-ordinates) from fore-troughs in the Baikal-Patom Region into Vendian and Cambrian clastic and carbonate reservoirs, situated at the crest of large anticlinal structures. Restricted pods of organic-rich shales, e.g. the Iremeken unit in the Madra Graben, may source the giant hydrocarbon accumulations that are found in Riphean and Vendian clastic/ carbonate reservoirs of the Baykit High province. Structural and stratigraphic traps within shallow-marine sandstones of the Vanavara Formation, along with faulted Riphean stromatolitic limestones and vuggy dolomites which were karstified and leached during the late Riphean along the margins of large Precambrian uplifts, represent the most promising targets for future exploration along the southern margins of the Siberian Platform.

By contrast, in the Lena-Vilyuy Basin along the eastern margin of the Siberian Platform, petroleum exploration has been focused within the Permian-Jurassic post-rift clastic succession deposited along the passive margin of the Oymyakon Ocean, and only commercial gas accumulations have been discovered to date. Here, Late Permian coals and coaly shales have sourced large gas accumulations within Late Permian-Cretaceous continental-marine sandstones at the crests of broad anticlinal structures. These are largely concentrated on the Khapchagay and Loglor arches, along with frontal thrusts in the Cis-Verkhoyansk Foreddeep, formed during inversion
of pre-existing rift structures during the Jurassic-Early Cretaceous. Pinch-out traps along the western margin of the basin are perhaps the most prospective for future exploration, along with the chance of finding oil, as migration pathways may exist for marine oil-prone Cambrian and Mesozoic (especially Early Jurassic) source rocks which sit within the oil window. The thick sequence of Late Devonian-Early Carboniferous syn-rift rocks, which were deposited in the centre of the restricted Ygyatta and Kempendiay rift basins, may also have the potential to host source rocks, reservoirs and cap rocks and could be considered as another potential target.

15 February 2017

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# Table of Contents

Copyright Details ......................................................................................................... ii

Executive Summary .................................................................................................... iii

Table of Contents ........................................................................................................ v

Table of Figures.......................................................................................................... vi

1. Introduction: Aims, Objectives and Methodology ................................................. 1

2. Socio-Economic Setting ....................................................................................... 2

2.1 Geography ............................................................................................................ 2

2.2 Climate ................................................................................................................. 3

2.3 Demographics of the Siberian Platform ............................................................ 4

2.4 Culture .................................................................................................................. 5

2.5 Political ............................................................................................................... 6

2.6 Environment ....................................................................................................... 7

2.7 Health & Safety ................................................................................................. 9

2.8 Operations & logistics ....................................................................................... 9

2.9 Business climate ............................................................................................. 10


4. Regional Overview and Structural Setting ......................................................... 14

4.1. Mesoproterozoic-Early Palaeozoic .............................................................. 14

4.2. Late Palaeozoic-Mesozoic ............................................................................. 14

4.2.1 Tectonic history of the eastern margin of Siberia ....................................... 14

4.2.2. Tectonic history of the southern margin of Siberia ................................... 16

4.2.3. Tectonic history of the central part and northern margin of Siberia ....... 17

5. Petroleum Systems of the Siberian Platform .................................................... 20

5.1 The Riphean-Cambrian petroleum system .................................................... 20

5.1.1 Palaeogeographic context ................................................................. 21
Table of Figures

Figure 1. The Yenisei River, Lake Baikal and the Verkhoyansk Mountains delimiting the Siberian Platform within the three Federal Subjects: Krasnoyarsk Krai, the Sakha Republic, and Irkutsk Oblast, with their capital cities shown. Surrounding provinces also belonging to the Russian Federation are shaded in grey. Map is shown at ~1:13,500,000 scale after Esri et al., 2016. ................................................................. 2

Figure 2. Annual mean temperature (left) and precipitation (right) in Krasnoyarsk, Krasnoyarsk Krai, based on meteorological records from 1961-1990 (Hydrometeorological Centre of Russia, 1990a). ................................................................. 3

Figure 3. Annual mean temperature (left) and precipitation (right) in Yakutsk, Sakha Republic, based on meteorological records from 1961-1990 (Hydrometeorological Centre of Russia, 1990c). ................................................................. 3

Figure 4. Annual mean temperature (left) and precipitation (right) in Irkutsk, Irkutsk Oblast, based on meteorological records from 1961-1990 (Hydrometeorological Centre of Russia, 1990b). ................................................................. 4
Figure 5. The population distribution between the three Federal Subjects of the Siberian Platform (central donut) and their respective ethnic compositions (peripheral pie charts) after Rosstat, 2010. .......................................................... 5

Figure 6. Overview map illustrating the subdivision of the Siberian Platform into basins and highs. Note that the Russian terminology for ‘highs’ is ‘arch’ or ‘anteclise’. Red line illustrating location of chronostratigraphic charts within the Lena-Vilyuy section of the report. ..............13

Figure 7. Petroleum Systems Chart for the Baykit High Region, also illustrating proven and potential source rocks, reservoirs and seals. ..................................................32

Figure 8. Petroleum Systems Chart for the Nepa-Botuoba High Region, also illustrating proven and potential source rocks, reservoirs and seals. .............................................33

Figure 9. Vendian- Carboniferous chronostratigraphic chart illustrating the early Palaeozoic pre-rift and Devonian-early Carboniferous syn-rift sedimentation. Location of chronostrat line shown in Figure 6. ..........................................................36

Figure 10. Chronostratigraphic chart illustrating deposition of the Permian-Middle Triassic post-rift passive margin sequence. Location of chronostrat line shown in Figure 6. ............39

Figure 11. Chronostratigraphic chart of the late Triassic to early Jurassic post-rift passive margin sequence. Location of chronostrat line shown in Figure 6..................41

Figure 12. Chronostratigraphic chart of the middle Jurassic to early Cretaceous sequence showing the termination of the Mesozoic passive margin sequence and development of the Cis-Verkhoyansk Foredeep. Location of chronostrat line shown in Figure 6..................43

Figure 13. Chronostratigraphic chart of the middle Cretaceous to Cenozoic sequence illustrating westward propagation of the Verkhoyansk Foldbelt and Foredeep. Location of chronostrat line shown in Figure 6..................44

Figure 14. Petroleum Systems Chart for the Lena-Vilyuy Basin, also illustrating proven and potential source rocks, reservoirs and seals. ..........................................................53