

DEPOSITION OF THE KHATYSPYT FACIES, NORTHEASTERN SIBERIA

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Introduction

The celebrated exceptionally fossiliferous uppermost Ediacaran Khatyspyt Formation of northeastern Siberia is equally famous for having a high content of mature organic matter. It is no surprise that the Khatyspyt Formation has been a subject of numerous studies from the perspective of organic geochemistry [1–4]. We here present results of a new study based a collection of 23 samples that elucidate important aspects of deposition of the Khatyspyt facies.

Results

The studied material is mostly limestones, occasionally silicified limestones and calcareous siliceous rocks. The section in general is characterised by low carbon content (TOC = 0.1–2.0%). Saturated hydrocarbons were analysed by gas–liquid chromatography and gas chromatography mass spectrometry. Pr/Ph ratio values varied in a wide range, from 0.3 to 1.2. The average CPI over the section is 1.1. We here establish two types of sterane distribution in the Khatyspyt Formation, the first dominated by ethylcholestanes and the second showing similar concentrations of cholestanes and ethylcholestanes. Gammacerane has been identified in all of the samples and is a biomarker of water column stratification (commonly, due to hypersaline conditions) [5]. Gammacerane index (GI) [5] calculated for the Khatyspyt Formation varies between 0.4 and 3.9.

When gammacerane index is plotted as a function of Pr/Ph ratio values (fig.1), position of the figurative points on this diagram suggests that the Khatyspyt Formation comprises at least three “geochemical” facies. Facies I corresponds to low concentrations of gammacerane ($GI < 1.5$) and high Pr/Ph ratios (> 0.5). Facies II is distinguished by high concentrations of gammacerane ($GI > 1.5$) and low Pr/Ph ratios (< 0.5). Facies III is transitional between the first two. We establish a positive correlation between GI values and the C_{35}/C_{34} [2] homohopane index ($R^2=0.44$). Facies I and II are characterised by $C_{35}/C_{34} < 1.3$ and $C_{35}/C_{34} > 1.4$, respectively. Importantly, facies II comprises mostly carbonates, with insoluble residue (IR) $< 27\%$, whereas facies I includes both limestones and calcareous siliceous ricks (IR = 4.1–87%).

Conclusions

Three “geochemical” facies have been identified based on indicators such as Pr/Ph ratio, GI, and C_{35}/C_{34} homohopane index. Facies I is thought to represent well aerated depositional environments, as indicated by Pr/Ph > 0.5 , $GI < 1.5$, and $C_{35}/C_{34} < 1.3$. Facies II is most likely to be deposited in an environment with limited aeration of water column and extremely reduced conditions, supposedly related to hypersalinity at certain time intervals as evidenced by Pr/Ph < 0.5 , $GI > 1.5$, and $C_{35}/C_{34} > 1.4$. Both TOC and the type of sterane distribution demonstrate no correlation with the facies. Facies distribution in the Khatyspyt Formation follows a certain pattern. Facies I occur in the lower and upper parts of the section, whereas facies II and III are confined to the middle part of the section. These results are important for reconstruction of the geological history of the Khatyspyt sedimentary basin. In addition, the north of the Siberian

Platform hosts a diversity of bitumen and oil different in composition of hydrocarbons. The observed pattern of biomarker composition, specifically the established three “geochemical facies” suggest that at least three different types of bitumen and/or oil, each characterised by a distinct hydrocarbon composition, may be encountered in the north of the Siberian Platform, and all could be sourced from the Khatyspyt Formation. So far the Khatyspyt Formation is known as a source of bitumen from the Ediacaran/Cambrian boundary strata of the Olenek Uplift [4].

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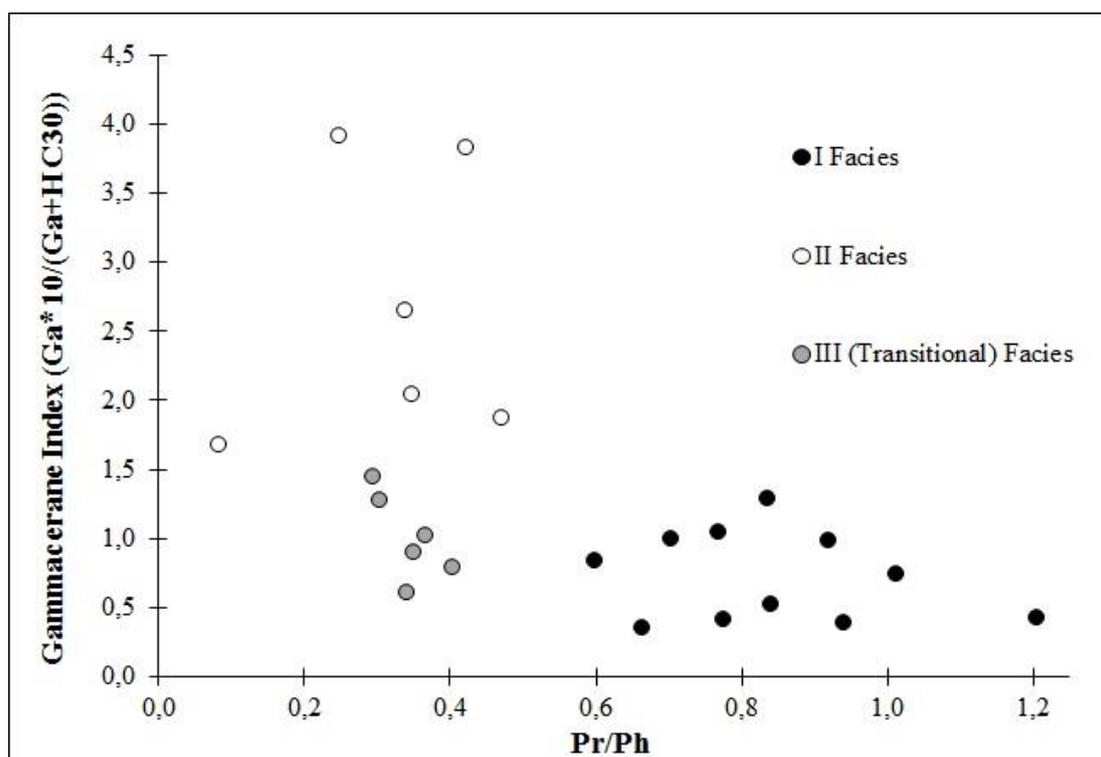


Figure 1 Gammacerane index plotted as a function of Pr/Ph ratio.

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