

## ORGANIC GEOCHEMISTRY OF THE COAL-BEARING STRATA OF THE USHUMUNSKOYE FIELD (KHABAROVSK TERRITORY)

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### Introduction

The brown coal Ushumunskoe field is located in the southwestern part of the Middle Amur sedimentary basin. The coal-bearing deposits are confined to the terrigenous Chernaya Rechka Formation (Palaeocene) and Ushumun Formation (Miocene). In these pioneer geochemical study of the Ushumun field, concentration and pyrolytic characteristics of the organic matter (OM) in the occurring sequentially from section bottom to top Chernaya Rechka (P<sub>3</sub><sup>1-2</sup>čr), Birofeld (P<sub>3</sub><sup>2</sup>bf), and Ushumun (N<sub>1</sub><sup>1</sup>uš) formations have been studied (Table) using conventional techniques [1, 2]. Conditions of formation, type, and catagenesis level of OM in the clays, siltstones, and coals of the Ushumunskoye 1180, 1157, and 1138 wells have been investigated for the first time.

### Results

TOC enrichment of the Chernaya Rechka Formation in the 1180 well accounts to 2.8-13.5 % (8.2 % on average) in clays, and to 0.8 % in the lower part of the section and about 7 % at its top in siltstones. Two samples of ash coal, one at the bottom of the Chernaya Rechka Formation and the other at the top, have almost the same TOC concentrations – 51.9 and 56.1 %, respectively. The Birofeld Formation clays, which have been studied in three wells, are enriched in OM from 1.5-2.4 % in the 1157 well (middle part of the formation) to 5.1-6.5 % in the 1180 (lower part of the formation) and 1138 (upper part of the formation) wells. The Ushumun Formation carbonaceous clays in the 1138 well contain 11.7-23.0 % TOC. Vitrinite reflectance indicates immature OM (protocatagenesis) in all three formations ( $R_{\text{vt}}^{\circ} = 0.41-0.44$  %). Pyrolysis studies give the same result for the whole collection –  $T_{\text{max}}$  does not exceed 442°C. The Chernaya Rechka Formation section in the 1180 well contains several levels enriched in type II kerogen in clays (HI = 207-259 mg HC / g TOC), interbedded with layers of type III kerogen in clays and siltstones (HI = 52-119 mg HC / g TOC). Coals have high HI values (181 and 279 mg HC / g TOC) and belong to type II kerogen. The Birofeld Formation contains type II kerogen in the 1180 well and type III kerogen in the 1138 and 1157 wells. Based on pyrolysis data, OM of the Ushumun Formation in the 1138 well can be attributed to type II kerogen. Therefore, during the accumulation of these deposits, sedimentation regime changed repeatedly from marine to terrestrial and vice versa. Direct positive correlation between HI and TOC in the studied collection is typical to the autochthonous OM, related to types III and II kerogens, with preserved generation potential and containing no bitumen. Two coal samples of the Chernaya Rechka Formation deviate from general trends, as there high organic carbon content is not accompanied by a corresponding increase of generating properties. It seems these coals consist of types II and III kerogens. Direct positive correlation between S1 («bitumoid" component) and S2 («kerogen" component) peaks, which is characteristic for the autochthonous chloroform-extractable bitumens, is important for further research, since geochemical conclusions on the basis of the composition of autochthonous chloroform-extractable bitumens can be extrapolated to the enclosing strata.

Table. Concentrations, pyrolysis, and vitrinite reflectance of the Paleogene and Neogene organic matter in the Ushumun brown coal field (in the numerator – spread of values, in the denominator – the average value, and in the parentheses – the number of the samples)

Characteristics	Ushumun Formation (N <sub>1</sub> <sup>1</sup> ), clays, well 1138	Birofeld Formation (P <sub>3</sub> <sup>2</sup> bf), clays			Chernaya Rechka Formation (P <sub>3</sub> <sup>1-2</sup> čr), well 1180		
		well 1138	well 1157	well 1180	clays	coals	siltstones
TOC, %	<u>11.7-23.0</u> 17.3 (3)	<u>5.1-6.5</u> 5.8 (2)	<u>1.5-2.4</u> 2.0 (2)	5.6 (1)	<u>1.8-13.5</u> 8.2 (6)	<u>51.9-56.1</u> 54 (2)	<u>0.8-7.1</u> 4.8 (3)
S <sub>1</sub> , mg HC / g rock	<u>1.4-2.8</u> 2.1 (3)	<u>0.19-0.24</u> 0.22 (2)	<u>0.03-0.05</u> 0.04 (2)	0.23 (1)	<u>0.1-1.3</u> 0.7 (6)	<u>3.8-4.7</u> 4.2 (2)	<u>0.02-0.5</u> 0.3 (3)
S <sub>2</sub> , mg HC / g rock	<u>21.8-51.0</u> 33.9 (3)	<u>3.7-5.8</u> 4.7 (2)	<u>1.0-2.2</u> 1.6 (2)	9.1 (1)	<u>2.7-32.9</u> 15.1 (6)	<u>77.3-116</u> 96.6 (2)	<u>0.7-8.1</u> 4.8 (3)
HI, mg HC / g TOC	<u>198-298</u> 242 (3)	<u>75-97</u> 86 (2)	<u>46-76</u> 61 (2)	160 (1)	<u>84-257</u> 167 (6)	<u>181-279</u> 239 (2)	<u>52-114</u> 85 (3)
T <sub>max</sub> , °C	<u>373-416</u> 399 (3)	<u>408-431</u> 420 (2)	<u>425-429</u> 427 (2)	432 (1)	<u>417-428</u> 423 (6)	<u>401-404</u> 402 (2)	<u>423-425</u> 424 (3)
R <sup>o</sup> <sub>vt</sub> , %	<u>0.41-0.43</u> 0.42 (3)	–	–	–	–	<u>0.42-0.44</u> 0.43 (9)	–

## Conclusions

Thus, all studied strata are enriched in organic matter; depositional environments were changed repeatedly from marine to terrestrial and vice versa. About half of the samples, including coal, have the high hydrocarbon generation potential, which inherent to sapropelic marine organic matter. The organic matter is immature in all samples. "Bitumoid» (S<sub>1</sub>) – "kerogen» (S<sub>2</sub>) direct positive correlation in organic matter suggests an enrichment in autochthonous chloroform-extractable bitumens. Therefore, planned further geochemical study of the chloroform-extractable bitumen composition is perspective for better understanding of organic matter genesis, diagenesis and catagenesis.

## References

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