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**ВЫЯВЛЕНИЕ ВОЗМОЖНЫХ ГЕОХИМИЧЕСКИХ ПОКАЗАТЕЛЕЙ  
НЕФТЕНОСНОСТИ НА ПЛОЩАДЯХ ВОСТОЧНОЙ СИБИРИ**

**DETECTION OF PROBABLE GEOCHEMICAL MARKS OF OIL-BEARING  
AREAS IN EASTERN SIBERIA**

*АННОТАЦИЯ. На примере площадей в Восточной Сибири демонстрируется взаимосвязь содержания легких нафтенно-ароматических углеводородов в приповерхностных отложениях с нефтеносностью. Описываемые УВ могут быть использованы в качестве геохимических*

*показателей при поиске и разведке залежей нефти наряду с традиционно применяемыми гомологами метана C<sub>2</sub>-C<sub>6</sub>.*

*ABSTRACT. Correlation of the light naphthenic and aromatic hydrocarbons content in the subsurface sediments with oil-bearing is demonstrated in terms of the Eastern Siberian area. These hydrocarbons, along with traditional methane homologues (C<sub>2</sub>-C<sub>6</sub>), can be used as geochemical marks for search and exploration of Oil deposits.*

*КЛЮЧЕВЫЕ СЛОВА: геохимические методы поиска, нефтеносность, миграция углеводородов, приповерхностные отложения.*

*KEY WORDS: geochemical methods search, oil-bearing, hydrocarbons migration, subsoils deposits.*

Nowadays the geochemical methods of search and exploration of oil deposits convince their efficiency proof. Keeping this trend up can be possible only with continuous improvements while geological conditions of oil-search objects become to be increasingly complicated. One of the actual problems of oil-search geochemistry is feasibility of oil-search marks.

Last century researches carried out in 1970-80th show that high content of hydrocarbons gases (HCG), used as the deferment marks during geochemical search doesn't always indicate the oil-bearing properties of tested structures [1-2]. For the determination of epigenetic properties of HCG additional criteria are required. Isotopic method is the most reliable for the determination of HCG genesis. The fact of hydrocarbons generation in the present sediments can be determined according to the correlation of the HCG and organic carbon content. One of the marks of their epigenetic properties is also the ratio of saturated and unsaturated HCG in a sample. However, these methods of the hydrocarbons genesis determination have some disadvantages. High cost of isotopic method doesn't give an opportunity to use it overall. Correlation of organic carbon and HCG content can indicate that HCG is of sediment genesis, but it can't estimate the quantity of HCG which was generated by organic matter of low sediments. The informative value of the ratio of saturated and

non-saturated HCG as epigenetic mark is a debating point. In this view the actual direction in solution of the oil-search problems is expansion of the assessed hydrocarbons range and interpretation of their allocation based on the processes migration study for oil-bearing forecast.

One of the reliable oil-search marks is toluene and benzene concentration. The informative value of these marks was noted in the process of the experimental research performed by RSRINGG [2]. L. Tzorkin, E. Stadnik, I. Starobinets, V. Vishemirskiy and others investigated the problems about informative value of aromatic hydrocarbons. These hydrocarbons contain appreciable amounts in oils and in brine water of oilfield and it has high migration ability due to well solubility in water and increased volatility and they are resistant to biochemical oxidation and practically don't generate in present sediment. Geochemical criterion of migration condition hydrocarbons was offered due to concentration ratio of benzene and toluene B/T [3].

The aim of this research is to find out which hydrocarbons can be used for oil-search forecast. For this purposes statistical investigation of results of analysis ground samples for the content of hydrocarbons of gasoline fraction which consists in comparing of ratio benzene and toluene with others hydrocarbons. Samples were taken from Yakutia, the area of Mirniy City during geochemical shooting which was carried out by scientific team of WSD IOGG SD RAS under the direction of A. Belonosov (executive in charge of works – S. Sheshukov). The selection of samples was implemented in one or more meters deep by grid along seismic profile and winter road.

Analysis of the gasoline fraction content in hydrocarbons was executed with gases chromatograph analyzer Crystal 5000.2 equipped with 100-meters column CR-1 PONA with inner diameter 0.25 mm and phase 0.5 mcM. After passage through the column hydrocarbons were registered both in flame-ionization detector (FID) and photo-ionization detector (PID) simultaneously. Determination of heights of the chromatograph peaks and content of hydrocarbons was executed in FID. Selectivity

of PID to unsaturated HC was used for increase reliability identification of peaks. Two hundred samples were analyzed for research.

On the territory of researches three general types of landscape was identified: pine forest, mixed forest and swamp. The average concentration of saturated hydrocarbons represented for different types of landscape in Fig. 1. The highest concentration of HC was determined in sands of pine forest and silt marshes. The loam of mixed forest can be characterized by the lowest concentration of alkane. The different of average content of HC decreases accordingly with the increase of molecular weight. It assumed that increase of the alkanes concentration in swamp due to the present generation of alkanes in wet environment of sediments which rich in organic matter. The increase HC content in sands with low content of organic matter is due to their high porosity and permeability. Consequently, the migrating HC easily penetrate through the thick sand and concentrate in subsoil. Accumulation of HC in loam renders difficult because of low porosity and permeability. High sorption capacity of loam (compared to sand and sandy loam) doesn't play an important part at consideration level of HC content, i.e. permeability of ground is the most significant here.

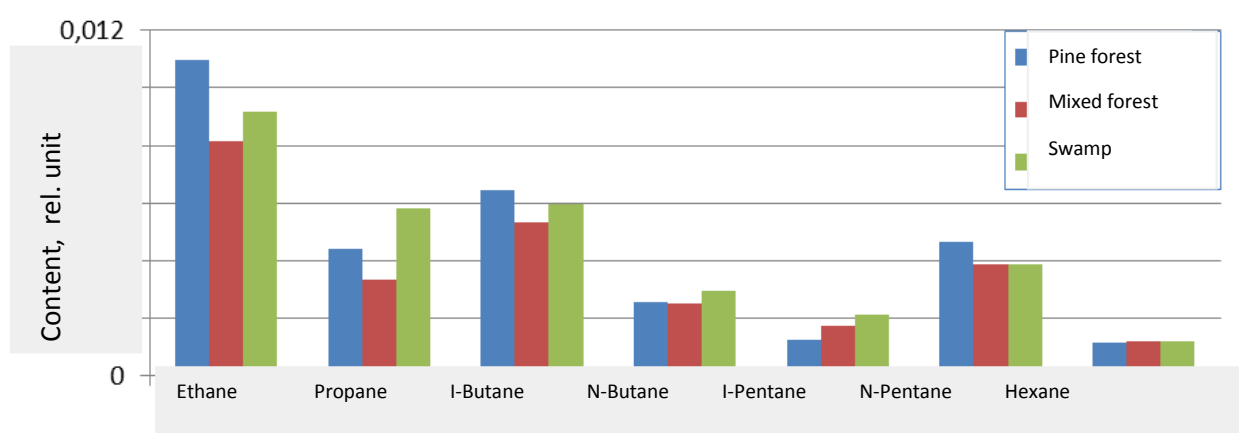


Fig. 1. The average content HC in different landscape conditions

Generation of methane in present sediments is the proved fact and it doesn't permit to use this alkane as reliable oil-search mark. However, the opportunity of companion production in large quantity methane homologues is impugned by many

scientists. Some sand samples with low content organic matter (pine forest) and high content (swamp) was chosen for decision this question. Samples were opened and blown to delete HC in gases phase and covered up again. The repeated measurement was carried out in one and two months. The increase of HC content in gases phase was recorded while in sandy loam of pine forest the concentration HC doesn't increase (Table 1). Consequently, in facies condition of swamp generation not only of methane but also its nearest homologues take place.

Table 1. The Change of HC Concentrations in Prolonged Storage.

Landscape	No change	Methane, rel. un.	Ethane, rel. un.	Propane, rel. un.	Butane, rel. un.	Pentane, rel. un.	Hexane, rel. un.
Pine forest	Change 1	0.033	0.031	0.018	0.005	0.025	0.002
	Change 2	0.035	0.030	0.016	0.007	0.023	0.002
	Change 3	0.022	0.023	0.013	0.005	0.017	0.002
Swamp	Change 1	4.770	0.015	0.007	0.001	0.002	0.001
	Change 2	1.811	0.018	0.009	0.000	0.006	0.000
	Change 3	3.699	0.039	0.016	0.001	0.009	0.002

The content of toluene in subsurface sediments is determined its migration from oil-saturated reservoirs. It is indirectly confirmed by distribution of toluene concentrations in sands, sandy loam and loam of forest's landscape (Fig. 2). The content of toluene increases with the increase of ground's porosity. Hydrocarbons which have distribution like toluene are identified due to methods of statistic analysis. Figure 2 shows that aromatic and naphthenic hydrocarbons (1,2,4-trimethylbenzene, 1-methyl-2-ethylbenzene, methylcyclopentane, butylcyclopentane and i.e.) as well as n-alkane  $C_6-C_{10}$  refer to those compounds. The distribution of HCG in forest's grounds is also similar the toluene distribution. Arene hydrocarbons, naphthenes, alkanes and some olefines with the similar molecular weight ( $C_6-C_8$ ) have higher correlation coefficients ( $>0,4$ ).

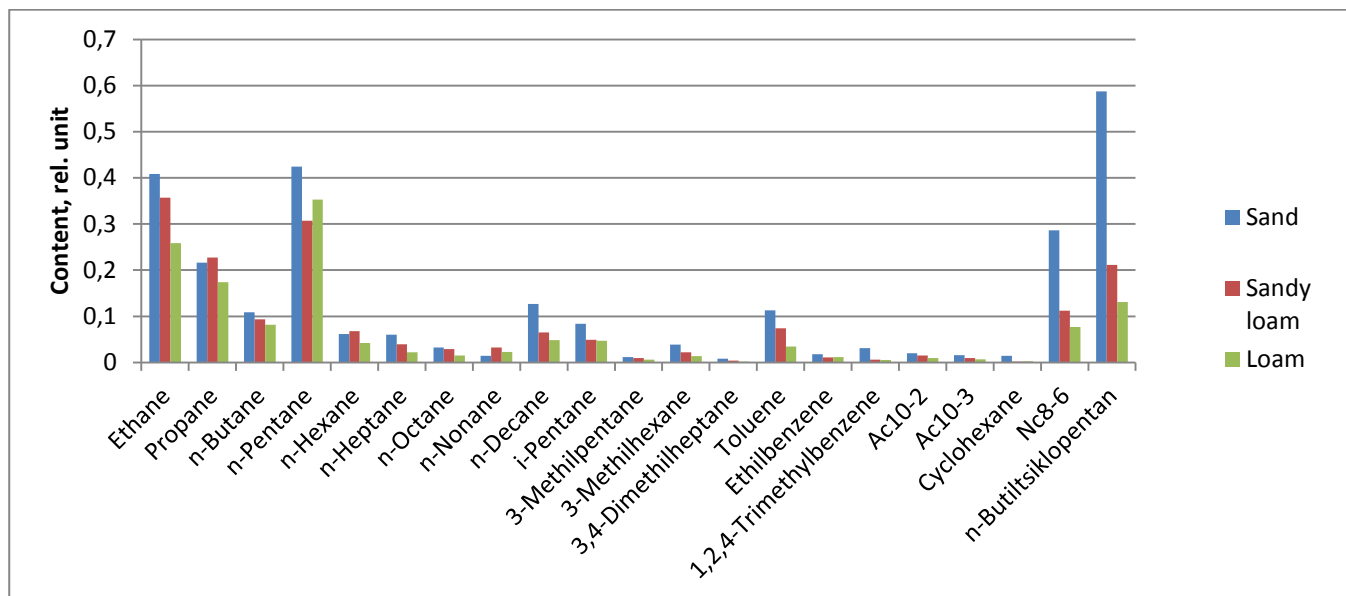


Fig. 2. The average content HC in different types of forests subsoil's deposits.

In conclusion, the HCG content in subsurface sediments is determined by their migration from oil-saturated sediments and generation in present sediments in the presence of favorable conditions.

The content of the arene HC, in particular benzene and toluene, is caused by their migration from oil-saturated reservoirs. The arene and naphthenic HC of gasoil fraction as well as n-alkanes  $C_6-C_{10}$  have similar character of distribution. It can be supposed that the above HC also there is deep genesis and transport in subsurface sediments from oil deposits. In this case, the highest correlation coefficient values with the distribution of toluene have distribution of hydrocarbons which are close to molecular weight that can be explained by analogous character of migration of HC to be similar in weight.

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