ESTUDOS EXPERIMENTAIS DO MECANISMO DE CRAQUEAMENTO DE FRAÇÕES DE ÓLEO PESADAS DA FORMAÇÃO ROCHOSA BAZHENOVSKAYA

EXPERIMENTAL STUDIES OF MECHANISM FOR OIL HEAVY FRACTIONS CRACKING FROM THE BAZHENOV SUITE

ЭКСПЕРИМЕНТАЛЬНЫЕ ИССЛЕДОВАНИЯ МЕХАНИЗМА КРЕКИНГА ТЯЖЕЛЫХ ФРАКЦИЙ НЕФТИ БАЖЕНОВСКОЙ СВИТЫ

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RESUMO

Atualmente, estamos à beira da era do desenvolvimento de depósitos de petróleo com as chamadas reservas de recuperação difícil. Especialmente relevantes e importantes neste momento são as questões fundamentais da formação de depósitos de hidrocarbonetos. Para entender, que é a maneira mais econômica de extrair petróleo pesado de depósitos argilosos e betuminosos, é necessário conhecer a natureza do processo de formação de hidrocarbonetos. Este artigo discute os estudos experimentais que confirmam o efeito de campos eletromagnéticos nas mudanças na composição fracional do petróleo e no craqueamento de frações de hidrocarbonetos naftênicos pesados, bem como exemplos de fenômenos naturais que podem afetar a formação rápida e abrupta de depósitos de petróleo leve alterando nosso campo eletromagnético do nosso planeta. O objeto de pesquisa é a mudança na composição fracional do óleo sob a influência de um campo eletromagnético com uma frequência de 50 Hz e indução magnética de cerca de 0,81 T. O tema da pesquisa é o óleo do horizonte Bazhenovskiy, que, segundo muitos cientistas, é fonte de petróleo na Sibéria Ocidental. O objetivo do estudo é avaliar a mudança nas frações pesadas do petróleo sob a influência de um campo eletromagnético.

Palavras-chave: *formação de campos de petróleo e gás; reservas de óleo de recuperação difícil; craqueamento de compostos de hidrocarbonetos; rochas de baixa permeabilidade e fontes de óleo.*

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ABSTRACT

Nowadays, the time is coming for development of oil deposits with the so-called hard-to-recover reserves (HRR). Particularly relevant and important at this time are the fundamental issues of the formation of hydrocarbon deposits. To understand how the most cost-effective way to extract heavy oil from clay-bituminous sediments, it is necessary to know the nature of the process of the formation of hydrocarbons. In the present work, experimental studies confirming the influence of electromagnetic fields on the change in the fractional composition of oil and fraction of heavy naphthenic hydrocarbon fractions are considered, as well as examples of natural phenomena that could affect the rapid, jumping formation of light oil deposits by changing the electromagnetic field of our planet. The object of research is the change in the fractional composition of oil under the influence of an electromagnetic field of frequency 50 Hz and magnetic induction of about 0, 81 T, as the subject of research is oil Bazhenov horizon, which according to many scientists is oil generating in Western Siberia. The purpose of the study was to evaluate the change in heavy oil fractions under the influence of an electromagnetic field.

Keywords: *formation of oil and gas fields; hard-to-recover oil reserves; cracking of hydrocarbon compounds; low-permeability and petroleum-bearing rocks.*

АННОТАЦИЯ

В настоящее время наступает эпоха разработки залежей нефти с так называемыми трудно извлекаемыми запасами (ТРИЗ). Особенно актуальными и важными в это время становятся фундаментальные вопросы образования залежей углеводородов. Чтобы понять, как наиболее экономически выгодным путем добывать тяжелую нефть из глинисто-битуминозных отложений, необходимо знать природу процесса образования углеводородов. В настоящей работе рассматриваются экспериментальные исследования, подтверждающие влияние электромагнитных полей на изменение фракционного состава нефти и крекинг тяжелых нафтеновых углеводородных фракций, а так же приводятся примеры природных явлений, которые могли повлиять на резкое, быстрое, скачкообразное формирование залежей легкой нефти за счет изменения электромагнитного поля нашей планеты. В качестве объекта исследований выступает изменение фракционного состава нефти под воздействием электромагнитного поля частотой 50 Гц и магнитной индукцией около 0,81 Тл, в качестве предмета исследований выступает нефть баженовского горизонта, который по мнению многих ученых является нефтематеринским в Западной Сибири. Цель исследования – оценить изменение тяжелых фракций нефти под воздействием электромагнитного поля.

Ключевые слова: *формирование нефтегазовых месторождений; трудноизвлекаемые запасы нефти; крекинг углеводородных соединений; низкопроницаемые и нефтематеринские горные породы.*

INTRODUCTION

Nowadays, the time is coming for development of oil deposits with the so-called hard-to-recover reserves (HRR). Particularly relevant and important at this time are the fundamental issues of the formation of hydrocarbon deposits (Zhang *et al.*, 2018; Wang *et al.*, 2018). In order to identify the most economically advantageous way to extract heavy oil from clay-bituminous deposits, it is necessary to know the nature of the process of the formation of hydrocarbons. In the present work, experimental studies confirming the influence of electromagnetic fields on the change in the fractional composition of oil and fraction of heavy naphthenic hydrocarbon fractions are considered, as well as examples of natural phenomena that could affect the rapid, jumping formation of light oil deposits by changing the electromagnetic field of our planet.

Most of the petroleum-bearing rocks of the West Siberian mega basin are concentrated in the deposits of the Bazhenov suite, which is represented by bituminous siliceous-argillaceous and carbonate-argillaceous deposits. In 2010, the world energy agency WEO-2010 geological reserves of oil in the Bazhenov suite were estimated at 140 billion tons, but recoverable ones amounted to only about 20 billion tons, which means that presently existing technologies do not allow extracting about 85% of reserves and making full use of energy potential. The remaining 15% of the reserves are concentrated in the fissured-siliceous varieties, cavernous-

fractured carbonate rocks and sand lenses, which are noted in the so-called "anomalous sections", the search technologies of which – also require further development. The ambiguity of the standard methods for assessing the filtration-capacitive properties of low-permeability oil-bearing rocks and the lack of efficient technologies for the production of hydrocarbons from such deposits necessitates the development of new and more precise approaches to the development of such deposits (Syzrantsev *et al*., 2018; Khakimova *et al*., 2019).

The object of research is the change in the fractional composition of oil under the influence of an electromagnetic field of frequency 50 Hz and magnetic induction of about 0, 81 T, as the subject of research is oil Bazhenov horizon, which according to many scientists is oil generating in Western Siberia (Braduchan *et al*., 1986; Balushkina *et al*., 2013; Nesterov, 1979; Nesterov, 1994; Nesterov, 1997; Nesterov, 2004; Nesterov *et al*., 1987; Buchachenko, 1984; Buchachenko, 2007; Buchachenko, 2014). The purpose of the study was to evaluate the change in heavy oil fractions under the influence of an electromagnetic field.

MATERIALS AND METHODS

To create an electromagnetic field, a source of variable sinusoidal voltage and an electromagnet were used, near which flasks with oil were installed. A collection was created consisting of 7 samples of oil, each of the samples was in an electromagnetic field in a step interval of 10 minutes – see Table 1.

To assess the change in heavy oil fractions, a gas chromatographic method was used using a "Kristall-5000" chromatograph with the following configuration: a capillary column 30 m; phase – polydimethylsiloxane 100%; The temperature of the column is programmable linear heating from 30 to 300 °C. The evaporator temperature is 310 °C. The calculation of the fractional composition was carried out using the simulated distillation method. In this case, special interest was focused on heavy oil fractions that could be registered by this method: fuel oil from C-28 to C-35 and tar from C-36 to C-38.

RESULTS AND DISCUSSION:

As a result of the carried out experiments and the analysis of the component composition, oil chromatograms were obtained, see Fig. 1. From the visual analysis of the chromatograms, one can immediately note the practical unchanged condition of the heavy hydrocarbon fractions (starting from C-28), however, a sharp decrease in heavy fractions and an increase in light fractions of oil are observed at the 40th minute of the electromagnetic action. In the period from 50 to 60 minutes the amount of heavy fractions increases. The author believes that this is due to the accumulation of intramolecular energy and the subsequent abrupt, discontinuous disruption of the -C-C- and -C-H- bonds due to nuclear-electron interactions. In the period from 40 to 50 minutes, the stored energy is sufficient to break the bonds in the naphthene compounds, and from 50 to 60 minutes – the accumulated intramolecular energy is sufficient for cracking the asphaltenes. It should be noted that during the experiment the frequency, the intensity of the electromagnetic field and the most important oil temperature were unchanged. The temperature of the oil was about 22-36 degrees Celsius.

An amazing phenomenon is a change in the component composition of oil as a result of electromagnetic interference (Fabini *et al*., 2017; Fang *et al*., 2017). It would seem that oil does not have any magnetic properties and should not interact with the electromagnetic field, but according to leading Russian scientists (Nesterov, 2009; Buchachenko, 1984; Buchachenko, 2007; Buchachenko, 2014), each element has magnetic effects to some extent, this is due in particular to the angular magnetic moment of the electrons revolving around the nucleus of the atom. According to I.I. Nesterov, any rotating object or the smallest particle has an angular magnetic moment. In addition, scientists assert that an atom or molecule has an energy memory. By the way, about the magnetic effects of the molecule A.L. Buchachenko in his book “From Quantum Strings to the Mysteries of Thinking ... An Excursus on the Most Enchanting Problems of Physics, Chemistry, Biology, and Mathematics” (2017) writes: "A single molecule that carries dozens, often hundreds of magnetic electrons, is a single molecular magnet and reveals all its properties: spontaneous magnetization, anisotropy, and magnetization hysteresis, domain organization, dynamic hysteresis. Electron-magnets usually "sit" on the atoms of metals, concentrated in the center of the molecule. They make up its magnetic core, surrounded by a nonmagnetic shell – a "clothing" of organic molecules that make the core

magnetically isolated. ... Inside the molecules, electron-magnets form into groups and form domains. Unlike classical ferromagnets in magnet molecules, domains change the direction of magnetization by the quantum mechanics, so a quantum loop of hysteresis appears in these molecules; its characteristic feature is the "step" of magnetization".

Apparently, the obtained experimental results will be difficult to explain by the standard laws of classical physics and chemistry; it becomes necessary to go deeper into the study of the processes of nuclear-electron interaction from the point of view of quantum mechanics.

Returning to the mechanisms of formation of hydrocarbon deposits, it is necessary to focus attention on the fact that at present in Russia the most popular is the "sedimentary-migration theory of the origin of oil", the sense of the theory is that the scattered organic matter was accumulated, then, as a result of sedimentation, thermobaric conditions, petroleum was formed from kerogen, followed by migration into traps (Danilin *et al*., 2015; Kakhramanov *et al*., 2017). There are numerous experimental confirmations that when oil is exposed to the core of rocks rich in organic matter at temperatures from 300 degrees Celsius and higher, oil can be obtained. In addition, there is a method of pyrolysis Rock-Eval, which allows determining the degree of maturity of organic matter in rocks by heating to a temperature of about 650 degrees Celsius with the fixation of released hydrocarbon fractions. It should be noted that there are no such temperatures in oil deposits and never were (Ostryy, 1971).

As for the theory of the inorganic origin of oil, with the statement about the migration of inorganic hydrogen from the mantle and the flow of reactions with free radicals of organic matter – the authors of this article have serious doubts about this theory. Since the reactive unpaired hydrogen atom can be in the free state for 10^{-13} seconds, it is then combined with another unpaired atom or reacts with the nearest chemical elements.

CONCLUSIONS:

In the course of the conducted research to study the change in the chemical composition of the oil in the Bazhenov suite as a result of electromagnetic, wave action at a frequency of 50 Hz, it was established that under these conditions radical reactions occur with the transition of heavy oil fractions to lighter ones, including the transition of solid compounds (asphaltenes) in the liquid – naphthenic. The authors believe that these changes occur as a result of excitation of hydrogen and carbon atoms as a result of electromagnetic, wave action. Analysis of the literature indicates that this phenomenon occurs due to the presence of magnetic effects in protons, neutrons, and electrons.

As is known, all rotating objects have an angular magnetic moment, including our planet Earth revolving around the Sun, as well as the Solar system, in addition to circular motion in orbit, makes vertical oscillations with respect to the galactic plane, crossing it every 30-35 million years and it appears in the northern, then in the southern galactic hemisphere. It is likely that periodically, every 30-35 million years, there are powerful electromagnetic fluctuations (bursts), which contribute to the accumulation of intramolecular energy of organic matter in petroleum reservoirs of rocks, followed by cracking, (in terms of geological time it is about 2000 years) and proton-oil formation.

To continue research on this issue, the authors see it appropriate to make additional experiments to establish the patterns of change in the fractional composition of oil, when it is processed by electromagnetic, wave fields of diverse frequencies and intensity. For a more accurate theoretical rationale of the processes of cracking of heavy oil fractions, it is necessary to understand the nature of electromagnetic fields, as well as nuclear-electronic interactions in carbon and hydrogen compounds. This study can form the basis for the creation of innovative technologies for the development of oil deposits with low permeable, oil-bearing rocks, such as the Bazhenov suite (Russia); Irati (Brazil); Taratu Formation in the Great South Basin (New Zealand) and others.

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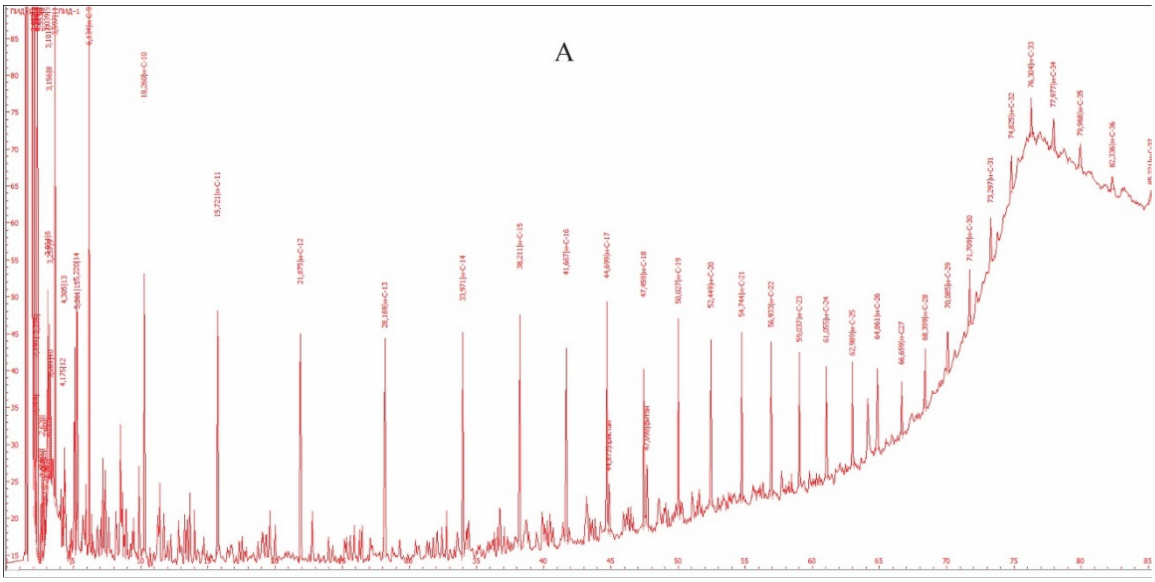

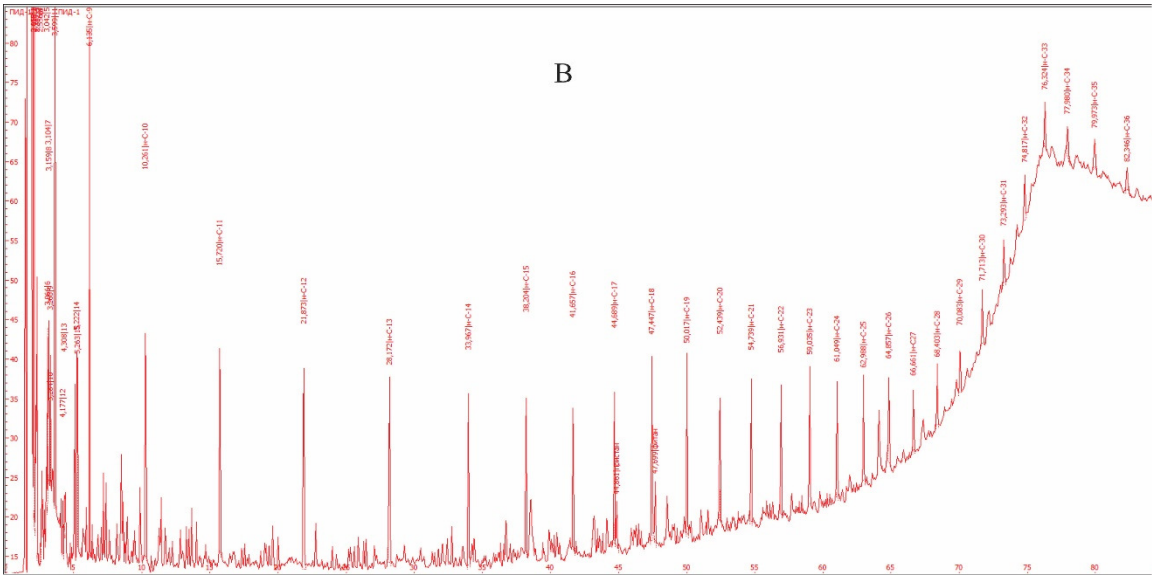

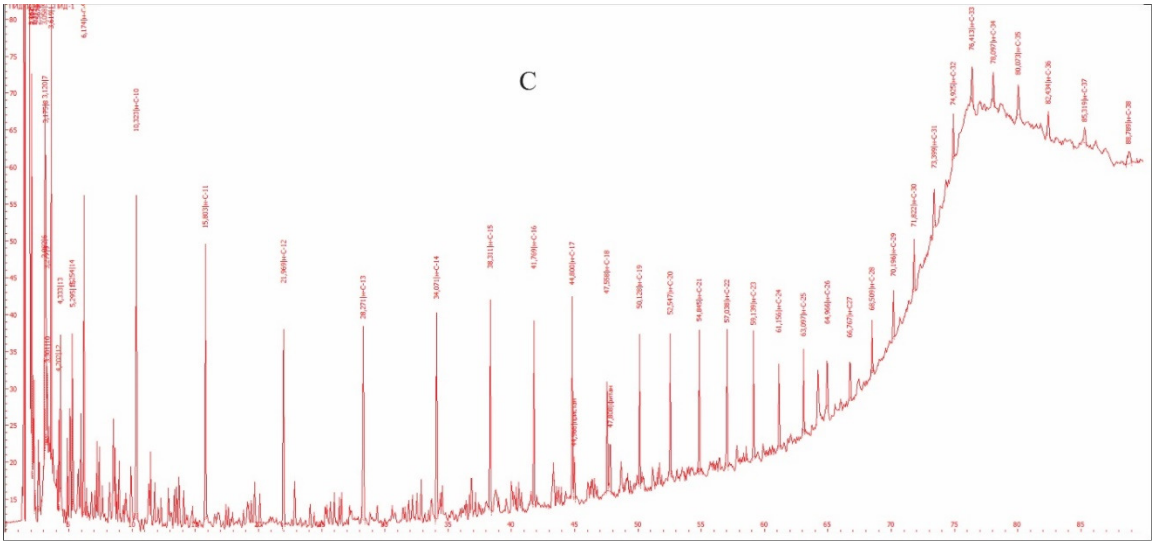

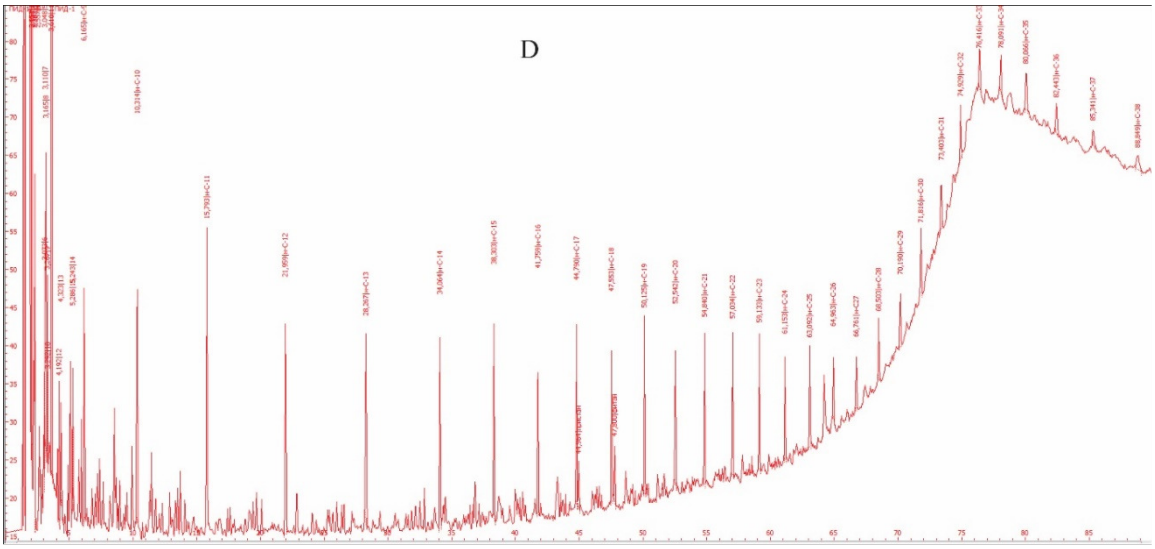

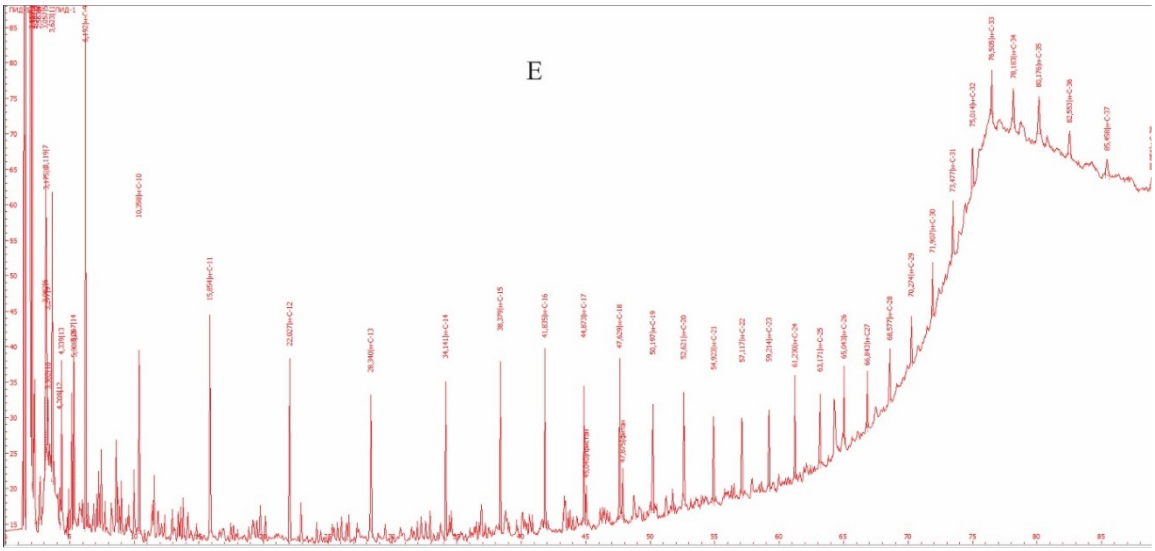

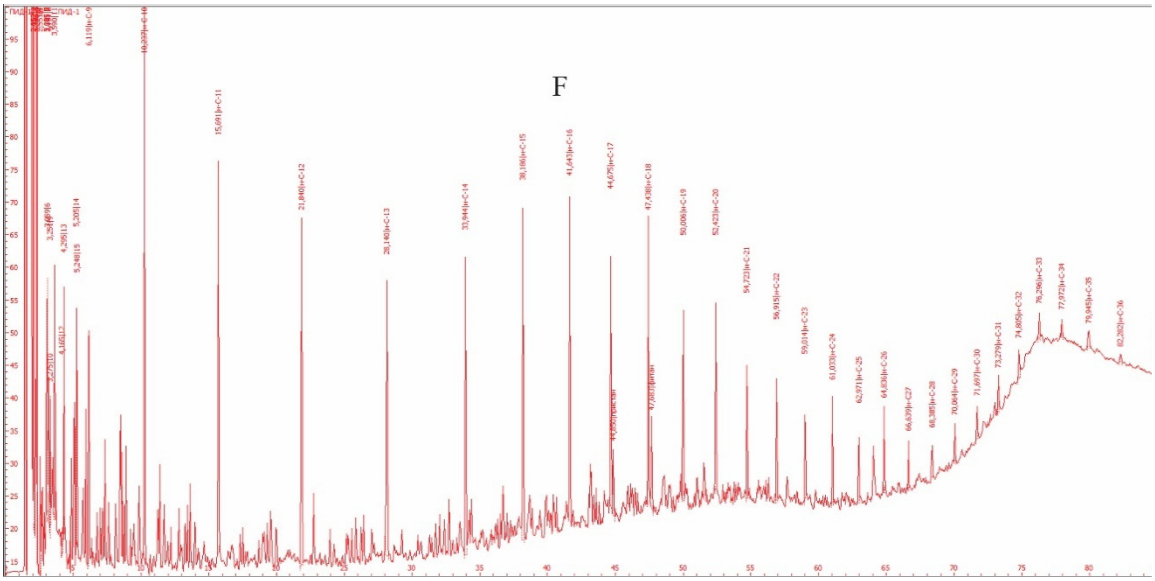

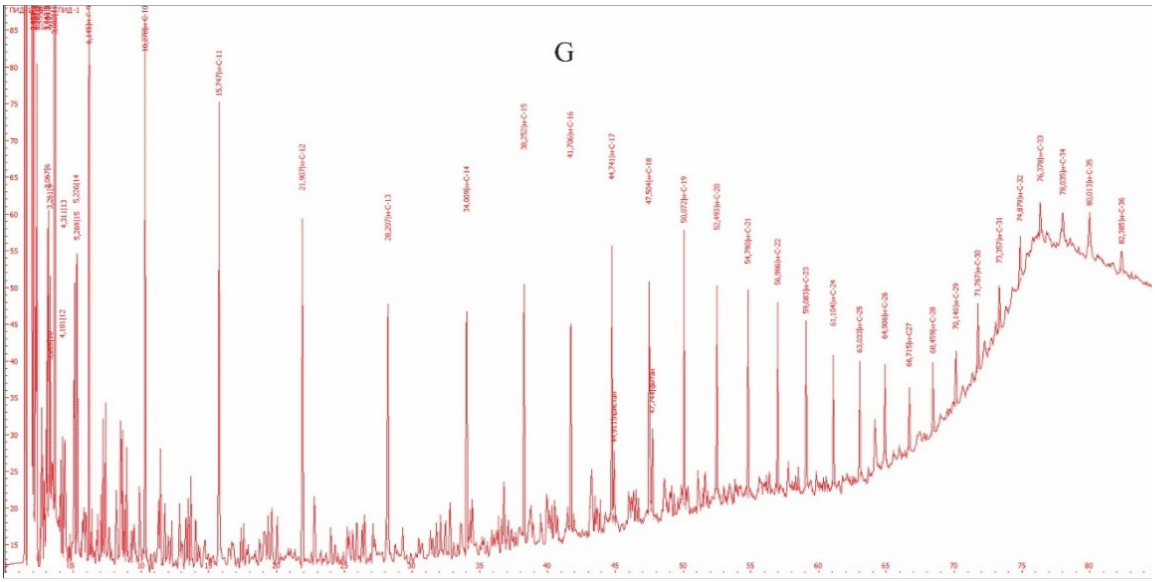

Figure 1. *The results of chromatographic analysis of a collection of oil samples: A – initial oil without treatment in an electromagnetic field; B – oil after 10 minutes of treatment in an electromagnetic field; C – oil after 20 minutes of treatment in an electromagnetic field; D – oil after 30 minutes of treatment in an electromagnetic field; E – oil after 40 minutes of treatment in an electromagnetic field; F – oil after 50 minutes of treatment in an electromagnetic field; G – oil after 60 minutes of treatment in an electromagnetic field*

Table 1. *Collection of samples of oil Bazhenov horizon and the time of electromagnetic impact on each sample*

Symbol	Field	Well No.	Selection interval, m	Time of electromagnetic radiation, min.	Frequency Hz
A	Salym	308-P	2873-2940	0	50
B	Salym	308-P	2873-2940	10	50
C	Salym	308-P	2873-2940	20	50
D	Salym	308-P	2873-2940	30	50
E	Salym	308-P	2873-2940	40	50
F	Salym	308-P	2873-2940	50	50
G	Salym	308-P	2873-2940	60	50