



ABOUT THE POSSIBILITY OF INCREASE IN RELIABILITY OF FORECASTS OF OIL AND GAS FIELDS AT THE GEOCHEMICAL METHOD OF SEARCHING

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ABSTRACT

Methodical basics of geochemical methods of search of oil and gas fields are covered in the article. It is shown that hydrocarbonic gases (HCG) interacting with breeds and waters at vertical migration, not only form the specific geochemical field, but also changes structure of breeds, and concentrates noticeable quantity of HCG and minerals. Researches of element and gas structure of breeds at various depths of the section, earlier drilled wells, showed that this information can be used for increase in reliability of forecasts at search drillings. The algorithm is developed for calculation of the relations of concentration of separate elements.

Getter properties of breeds depending on a specific surface area (aggregate size) also were investigated. The value of an absorption coefficient increases with increase in a molecular mass of hydrocarbon (HC), clay breeds are capable to concentrate the significant amount of HCG.

KEY WORDS: hydrocarbonic gases, breed minerals, oil and gas field, wells, forecast, reliability of the forecast.

1. INTRODUCTION:

It is known that exploration works on the oil and gas not always guarantee the wished success. Process of search of deposits of hydrocarbons (HC) can be considered as very risky game interfaced to possible financial losses. Therefore it is not casual that increase in reliability of the forecast of discovery of the fields is attached the special priority significance, and developments on improvement of methods of prediction promising actual economic effect is very relevant.

So-called "direct" methods of search and investigation of oil and gas fields' already long time are used for the purpose of positioning of fields of oil and gas and increase in reliability of the forecast of oil-and-gas content within a search object. These methods of the local forecast of oil-and-gas content are subdivided into three basic groups: geological, geochemical and geophysical. All of them were widely adopted and brought the encouraging results therefore their application is relevant in the modern economic conditions.

Geochemical indicators are based on the phenomena of interaction of hydrocarbonic components (methane, ethane, propane, butane, etc.) with a surrounding medium at their subvertical migration from fields of naphtha and gas. In the theoretical plan it is necessary to believe that penetration of noticeable amounts of migration gases into the covering deposits has to lead to violation of primary natural ratios in system syngenetic gases of breeds (organic matter – a mineral part of breeds). Studying the nature of these violations allows approaching in essence important question of diagnostics of genetic types of dispelled hydrocarbonic gases (HCG) and other components.

Thus listed (and a number of not listed) geochemical indexes could be used rather widely and successfully during the searching and investigation of oil and gas fields. The lack of highly sensitive methods and gages and also methods of processing of primary information led long time to the fact that from 10 drilled exploratory wells productive were at best 3 wells.

The present article is devoted to a way of receiving and processing of geochemical information for increase in effectiveness of prospecting works and as a result, improvements of their technical and economic indexes.

The objective is solved by processing of the geochemical information obtained at a stage of search prospecting works with use of the Gas chromatography–mass spectrometry (GC-MS), the chromatograph having high resolving power and the high identifying property of a mass spectrometer [1,2].

The processes proceeding in breeds under the influence of erratic hydrocarbons:

The hydrocarbons of deposits getting into the top horizons owing to a diffusion and filtrational mass transfer enter interaction with breeds and waters (physical and chemical, chemical and biochemical processes). At the same time the phenomena of a sorption and dissolution are great importance. A part of HC are dissolved in a water component of breeds, occluded by mineral components and the organic matters (OM), gets into subcapillaries and microcracks. Possibilities of their chemical change are almost excluded in the lower geochemical zone where usually there is no microflora. A part of HC in the top-most horizons as a result of chemical processes is exposed to destruction and change that leads to the abnormal accumulation of products of their transformation.

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According to various researchers [3-5] sedimentary breeds have the getter properties in relation to HC depending by nature HC, temperatures, pressure of structure of breeds and humidity.

We conducted the pilot studies of getter properties of breeds of various lithologic structures in relation to alkanes. For this purpose a column with the studied breed joined a chromatograph. Test of gas of the famous structure was moved in a column by means of a batcher. The column with the studied breed joined a chromatograph. Experiences on model exemplars showed that at low humidity getter properties of breeds depend on lithologic and mineral structure of breeds (tab.1). Respectively change and also adsorptive – chromatographic effects when passing mixes of gases through the specified breeds. So, when passing through the breed containing clay fractions quite sharp separation of almost all hydrocarbonic components of gas mixture is observed.

Experiments showed that absorption – the chromatographic effect depends on aggregate size of rocks (in inverse proportion to a ratio of a methane and nitrogen in erratic mix) the higher this ratio, the more legible differentiation is noted for gaseous homologues.

In relation to problems of geochemical search getter properties of breeds (in relation to individual hydrocarbonic gases and their mixes) influence of a specific surface area (aggregate size) of breeds, their structure and humidity was considered, the ratio of processes and adsorption was considered. Influence of structure and specific surface area of breeds on their getter properties (in relation to individual hydrocarbons gas by means of chromatographic shootings was studied (tab. 1).

Table 1: Influence of structure and a specific surface area of breeds on their getter properties after the relation to hydrocarbons gas.

Aggregate size of breeds, mm	The sorbing capacity, in cm^3/g				
	CH_4	C_2H_6	C_3H_8	C_4H_{10}	C_5H_{12}
Clay, 0,25-0,5	23,0	32,5	43,0	68,7	50,4
0,5-1,0	17,4	21,8	35,0	51,0	61,0
2,0-3,0	11,0	21,0	35,0	41,0	59,0
3,0-5,0	9,8	21,0	33,0	34,0	51,0
Limestone, 0,25-0,5	8,6	32,7	42,4	26,0	35,0
0,5-1,0	11,1	20,1	30,6	15,5	42,0
2,0-3,0	10,3	12,5	33,0	13,2	33,4
3,0-5,0	9,8	12,5	33,0	13,7	23
Sandstone, 0,25-0,5	-	10,6	18,3	19,2	30,0
2,0-3,0	-	7,8	19,8	23,0	25,8
3,0-50	-	7,6	9,8	13,1	16,7

As one would expect with body height of a specific surface area (with decrease of aggregate size) the quantity of the occluded HC usually increases with increase in a molecular mass of HC the tendency of body height of quantity of the component withheld by breed however remains, it is characteristic that the growth rate of getter ability of breeds with increase in mass of a molecule depends its structure (for clay this speed is noticeable, than for limestone).

The question of the nature of change residual is in essence important (the absorptive gas after decontamination of breeds by a thermal vacuum method (TVM). In this residual gas in a larger degree the share of high molecular weight hydrocarbons increases. In general (and it is very important) residual gas, both in the quantitative, and in qualitative the relations bears information. Therefore, at the movement HC through sedimentary breeds are fixed and are not taken by the method applied by TVD, i.e. breeds are capable to accumulate information from erratic HC [6,7].

Thus, sedimentary breeds for rather short term are capable to concentrate noticeable quantities of HC of gases and diluted not hydrocarbonic with components of mixes. At the same time concentration level considerably depends on lithologic structure of breeds and level of a dilution of mix, and rate of delivery of HC decreases with body height of a molecular mass and increase in shaliness of breeds.

Trace elements:

Diffusion – a filtration stream from an oil and gas breakthroughs can influence rocks of a section differently depending on their lithologic structure and remoteness from a breakthroughs. The larger role in change of structure and properties of rocks is played by a carbon dioxide. Its concentration is considerably regulated by reaction of carbonaceous equilibrium:



The ion of Mg gets into a crystal lattice of lime carbonate (breed of cement) owing to exchange reactions between ions of Ca and Mg, i.e. there is a partial secondary dolomitization (the natural phenomenon of transformation $CaCO_3$ in $CaMg(CO_3)_2$). In particular conditions change of properties of rocks under the influence of erratic HC is possible as a result of radiation chemical reactions (a radiolysis of water and organic matters). There are in one form or other, change concentration of such important rock-forming elements as Ca, Si, Mg, Na, K, Fe, etc.

Thus, changes of element and mineral structure of rocks and also change of their physical properties will be fixed [8,9] in all geochemical zones. On the basis of the theoretical and actual materials given in these works by us the main directions of researches were outlined. They come down to need to consider changes of element structure of rocks under the influence of the flyuoid migrating from oil and gas deposits as the uniform interdependent process of redistribution of element and mineral structure of rocks.

Researches of changes in rocks began with studying of their element structure – the maintenance of Fe, Mn, V, Ni, Cu, Ca, Si, Th, K, Al, Na, Ti of their ratios Fe/Mn, V/Ni, Mn/Cu, Ca/Si, Si/Al. The nature of distribution of elements and change of their ratio is given in figures 1, 2, 3. It allows, will reveal average element structure of rocks of a section in comparison to Clarks of elements of the corresponding types of rocks. Zones of the increased and under maintenance of separate elements on the explored square come to light against the background of set point values of the specified elements. Then ratios of elements pay off and schedules of nature of changes (fig. 2) of these sizes on a section (or the areas) the explored area is under construction. It will allow allocating the specific geochemical zones and sites subject to influence of migrants from oil and gas deposits.

The intensity of analytical lines about 20 solutions with identical concentration of 10 mg/kg was defined for determination of element structure of rocks. Tests were prepared by a mineralization of breeds with use of the microwave Ethos-One by firm Milestone. Autoclaves with exemplars and basic solutions chambered. Heating of tests happened due to individual absorption HF of energy basic solutions. At the same time the Boundary Peak conditions made: $t = 300^\circ C$ and $p \leq 100$ of atm. Cycle time of sample preparation is given in tab. 2. Control of a mineralization was exercised in real time on in advance made program of change of pressure and temperature in autoclaves with a frequency of 10 measurements a second. Power of a high-frequency generator was regulated according to data on temperature throughout all process of a mineralization.

Table 2: Sample preparation cycles at a mineralization of exemplars

Step	Time, min.	$t^\circ C$	Power HF generator, W
1	5	3	50
2	2	5	100
3	7	10	150
4	10	10	250

Reference solutions of Sigma Chemical Company (USA), HNO_3 or HCl acids and also demonized water ($R \geq 17 M\Omega \cdot sm$) were used as basic solution. Measurements were taken on a mass spectrometer by 7700 ICP-MS Agilent Technologies (USA), the mode of measurement of power HF of the W=1400 generator of W; speed of the gas-carrier (argon) of $V=1,2$ l/min.

In a range of masses recorded lines of singly charged ions. Lu chose as the internal standard. The choice of Lu is caused by rationing convenience analytical signals because of the low potential of the first ionization ($\phi_i^+ = 5,4$ eV).

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Table 3: The algorithm of calculation of the relations of concentration for 10 minerals as a part of rock, for one depth ($m h=250$)

	$\frac{M_2}{M_1}$	$\frac{M_3}{M_1}$	$\frac{M_4}{M_1}$	$\frac{M_5}{M_1}$	$\frac{M_6}{M_1}$	$\frac{M_7}{M_1}$	$\frac{M_8}{M_1}$	$\frac{M_9}{M_1}$	$\frac{M_{10}}{M_1}$
$\frac{M_1}{M_1}$	1	$\frac{M_3}{M_1}$	$\frac{M_4}{M_1}$	$\frac{M_5}{M_1}$	$\frac{M_6}{M_1}$	$\frac{M_7}{M_1}$	$\frac{M_8}{M_1}$	$\frac{M_9}{M_1}$	$\frac{M_{10}}{M_1}$
$\frac{M_2}{M_2}$		1	$\frac{M_4}{M_2}$	$\frac{M_5}{M_2}$	$\frac{M_6}{M_2}$	$\frac{M_7}{M_2}$	$\frac{M_8}{M_2}$	$\frac{M_9}{M_2}$	$\frac{M_{10}}{M_2}$
$\frac{M_3}{M_3}$			1	$\frac{M_5}{M_3}$	$\frac{M_6}{M_3}$	$\frac{M_7}{M_3}$	$\frac{M_8}{M_3}$	$\frac{M_9}{M_3}$	$\frac{M_{10}}{M_3}$
$\frac{M_4}{M_4}$				1	$\frac{M_6}{M_4}$	$\frac{M_7}{M_4}$	$\frac{M_8}{M_4}$	$\frac{M_9}{M_4}$	$\frac{M_{10}}{M_4}$
$\frac{M_5}{M_5}$					1	$\frac{M_7}{M_5}$	$\frac{M_8}{M_5}$	$\frac{M_9}{M_5}$	$\frac{M_{10}}{M_5}$
$\frac{M_6}{M_6}$						1	$\frac{M_8}{M_6}$	$\frac{M_9}{M_6}$	$\frac{M_{10}}{M_6}$
$\frac{M_7}{M_7}$							1	$\frac{M_9}{M_7}$	$\frac{M_{10}}{M_7}$
$\frac{M_8}{M_8}$								1	$\frac{M_{10}}{M_8}$
$\frac{M_9}{M_9}$									1
$\frac{M_{10}}{M_{10}}$									

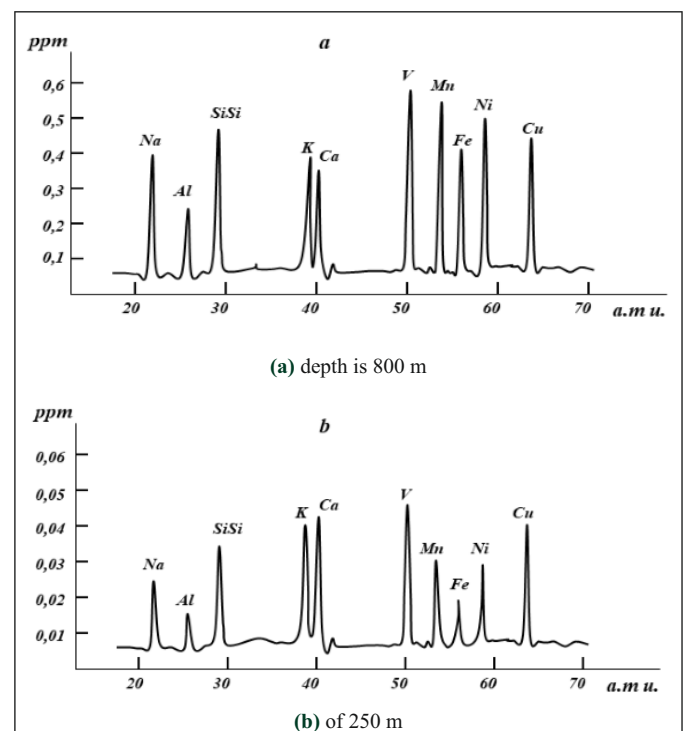


Fig. 1: Concentration of rock-forming minerals

The mass ranges of the elements which are contained in the rocks withdrawn from two different depths (250 and 800 m) are presented in fig. 1. Apparently from the drawing of mass spectrums received by "ICP-MS" of Agilent Technologies (USA) ions of various elements legibly are traced. Distinction of concentration of elements suggests that these changes take place on all depth. The dispersion of the relations of concentration of rock-forming elements in fig. 2 demonstrates it.

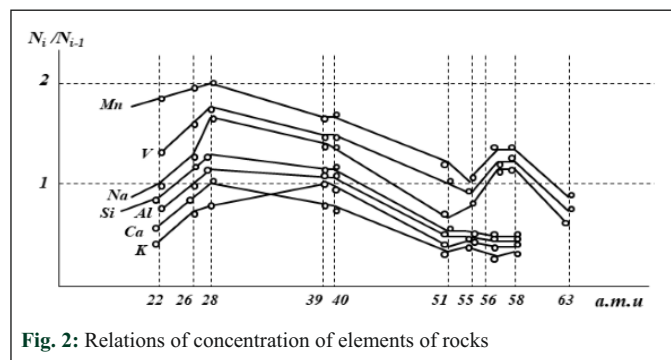


Fig. 2: Relations of concentration of elements of rocks

2. CONCLUSION:

Thus, the received results demonstrate existence of changes of element mineralogical structure of rocks and their physical properties in all geochemical zones.

The informational content of this or that set of indicators is defined by geological and geochemical features of areas of researches, a depth of deposits of naphtha and gas and their phase a state.

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