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About relationship between "total content of metals" indicator and the concentration of paraffins, resins and asphaltenes in oils from the deposits of the Eastern oil and gas-bearing region of Ukraine

Scientific interest in the question of the accumulation and migration of metals in oil is connected with the possibility of their industrial extraction in the process of oil refining and the purpose of further realization as a concomitant raw material, actual scientific and technical questions of the genesis of hydrocarbons, as well as the possibility of determining the environmental risks of using this oil as raw materials for the production of oil products and, first of all, gasoline and diesel fuel.

A high total metal content is also a serious problem during the processing of petroleum raw materials, because it leads to irreversible deactivation of catalysts as a result of the deposition of metals on the active surface, blocking of the pore space and destruction of the catalyst structure. Previously, in a series of scientific works [1-5], some features of geochemistry and distribution of metals in caustobiolites have already been considered.

The purpose of this work is to establish and investigate the relationship of the "total metal content" indicator (calculated as the sum of the contents Hg, Zn, Fe, Mn, Ni, Al, Cr, V, Co,) with the concentrations of paraffin, resins and asphaltenes in base oils 36 active deposits of the Eastern oil and gas region of Ukraine.

The Eastern oil and gas-bearing region is currently the largest and most promising in Ukraine. Geologically, it is located within the Dnipro-Donetsk depression. The factual basis of the work was the results of analyzes of the content of metals in oils from 36 fields: Bakhmachskyi, Prylutskyi, Krasnozayarskyi, Kachalivskyi, Kremenivskyi, Karaikozovskyi, Korobochkinskyi, Kulychikhinskyi, Lipovodolinskyi, Monastirishchenskyi, Matlakhovskyi, Malosorochynskyi, Novo-Mykolaivskyi, Perekopivskyi, Prokopenkivskyi, Radchenkivskyi, Rozpashnivskyi, Sofiyivskyi, Sukhodolivskyi, Solontsivskyi, Solokhivskyi, Talalaivskyi, Trostyanetskyi, Turutynskyi, Kharkivskyi, Shchurynskyi, Yuryivskyi, Yaroshivskyi, Khukhryanskyi, Sagaidatskyi No. 1, Sagaidatskyi No. 13, Kybytsivskyi No. 5, Kybytsivskyi No. 51, Kybytsivskyi No. 52, Kybytsivskyi No. 56, Kybytsivskyi No. 1. These deposits were chosen based on the principles of maximum completeness of geochemical information, their location in different oil and gas-bearing areas, different composition of the oil system, different geological types of traps, different structure of deposits and different ages of oil reservoir rocks. Thus, in our opinion, these deposits are sufficiently representative for the Eastern oil and gas-bearing region of Ukraine.

No less than 30 oil samples from each deposit were tested for metal content using X-ray fluorescence analysis on an energy-dispersive spectrometer "Sprut" SEF 01. Spectrum accumulation time is 600 sec.

Thus, from each of the 36 deposits, at least 30 oil samples taken from the wells within the five years of their operation were analyzed. Then the values of the total content of metals and all other geological and technological indicators were normalized. Normalized values of indicators of oil samples from each deposit were processed using the STATISTICA 11.6 program, which performed the calculation of descriptive statistics, correlation, regression analyzes and graphical visualization of the results of the performed studies.

According to the results of the correlation and regression analysis and taking into account the Chedok scale in the oil samples from the considered deposits, it was established the presence of a very weak inverse correlation of "total metal content" and resin (correlation coefficient -0.05, regression equation $Me_{total} = 0.2175 - 0.0517 \cdot Re_{oil}$), a very weak direct relationship between "total metal content" and asphaltenes (correlation coefficient 0.06, regression equation $Me_{total} = 0.1968 + 0.518 \cdot A$), a very weak direct relationship between the indicator "total metal content" and paraffins (correlation coefficient 0.02, regression equation $Me_{total} = 0.2012 + 0.0205 \cdot C$), graphs of regression equations are shown in fig. 1-3).

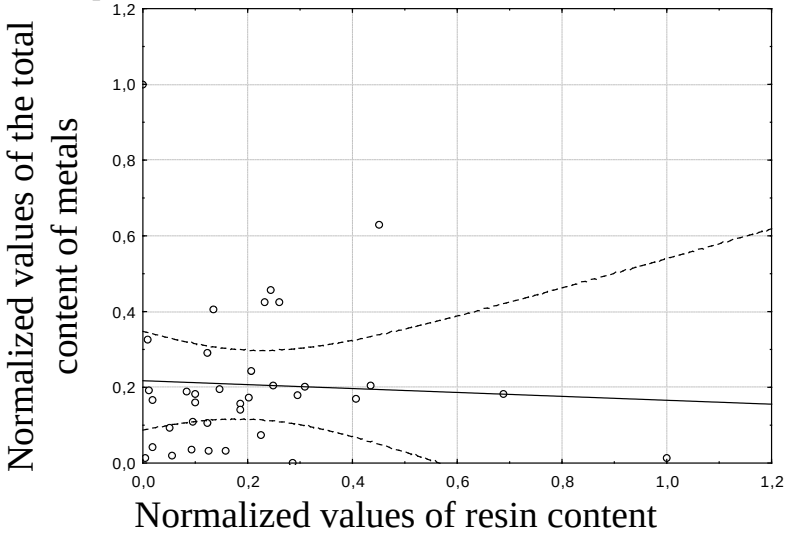

Fig. 1. Graph of regression equations between "total metal content" and resin in oil deposits of the Eastern oil and gas region of Ukraine

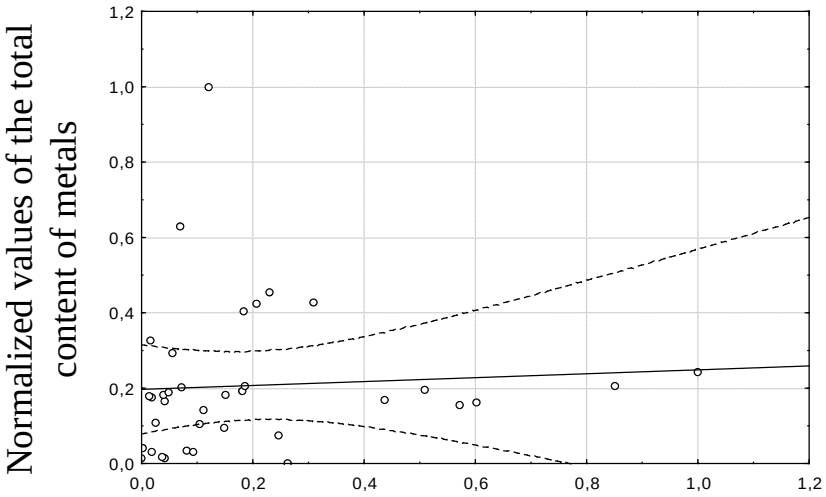

Fig. 2. Graph of regression equations between "total metal content" and asphaltenes in oil deposits of the Eastern oil and gas region of Ukraine

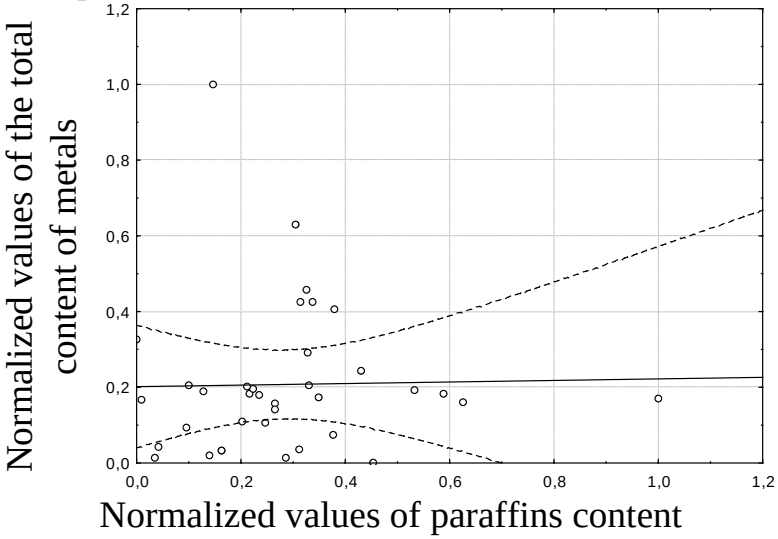

Fig. 3. Graph of regression equations between "total metal content" and paraffins in oil deposits of the Eastern oil and gas region of Ukraine

Main conclusions:

- The indicator "total metal content" has a very weak correlation with the contents of paraffins, resins and asphaltenes. In this regard, established relationships can only be used as indicators of a general trend.

- Considering the integral nature of this indicator, in further studies it makes sense to consider the relationship between each of the elements included in its structure and the contents of paraffins, resins and asphaltenes separately, as well as to evaluate the contribution of each of the metals to the overall indicator.

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