Geochemical Characteristics of Upper Cretaceous Oils of the Eastern Cis-Caucasus

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Commercial accumulations of oil in the limestone unit of the Upper Cretaceous have been established in the Eastern Cis-Caucasus in six fields, four of which (Karabulak-Achaluki, Zamankul, Malgobek-Voznesen–Ali-Yurt, Khayan-Kort) are located in Checheno-Ingushetia and two (Selli, Gasha) in the territory of South Dagestan.

Considerable analytical material has now been collected on the physical-chemical properties of the Upper Cretaceous oils of the Eastern Cis-Caucasus, the results of synthesis of which are presented in Table 1.

The Upper Cretaceous pools have been established in a great depth range–on an average from 1450 m (Selli) to 3550 m (Khayan-Kort). Their geothermal level is high: the average formation temperature ranges from 87 to 145°C. Consequently, in these fields the Upper Cretaceous oils occur in the zone of catagenesis. Hypergene processes of alteration of oils are obviously not manifest because the optimum temperature for the growth of bacteria is generally less than 75°C (11).

At the same time the data presented in Table 1 indicate that the factor of depth of occurrence (temperature) is not decisive in altering the physical-chemical characteristics of the oils. In this connection it is better to examine the physical-chemical properties of oils within the limits of individual tectonic zones.

The most interesting in this respect are the Upper Cretaceous oils of the adjacent Karabulak-Achaluki and Zamankul fields, which are located within the Sunzhen and Malo-Karbardin Ranges. In spite of identical geothermal conditions and nearness of the fields to one another (5-7 km), their oils differ sharply from one another in almost every respect.

For example, the oil of the Karabulak-Achaluki area is considerably lighter (sp. gr. 0.822) than that of Zamankul (sp. gr. 0.844); it contains 1.5 times less silica gel tars, 8.3 times less asphaltenes, 1.4 times less sulfur; and has a larger amount of paraffin and aromatic hydrocarbons in the fractions from the beginning of boiling to 200°C. This can be explained by the specific environment of formation of the pools.

The Karabulak-Achaluki structure is better expressed on the top of the Upper Cretaceous than is the Zamankul. For example, the angles of dip of the rocks on the first are almost two times greater. The more intensive tectonic activity of this sector was governed by the presence of disjunctive faulting, which has been not only established but also traced out. Fractures cutting the Cretaceous sediments are present throughout the region; the largest of these occur in the north part of the Achaluki area where displacement is as much as 900 m.

Disjunctive dislocations have not as yet been observed in the Zamankul area. The absence of faulting ties in well with the hydrochemical characteristics of the lower Maykop sediments in this region.

It should be noted that waters of the calcium chloride type are found only in the crest part of the Karabulak-Achaluki field. The appearance of waters of this character is explained by M. P. Lysenko and A. V. Merkulov by encroachment of Upper Cretaceous waters into sediments of the lower Maykop along faults and fractures. These Upper Cretaceous waters somewhat increased the salinity of the lower Maykop waters and altered their genetic type. Consequently, if a similar picture is not observed in the Zamankul area, then this only confirms the idea of the absence here of through-going ruptures that could serve as paths for the movement of liquids.

Thus, the tectonic features of these fields created the most favorable conditions for the vertical migration of oil within the Karabulak-Achaluki area.

The extra-reservoir migration took place in our opinion from Lower Cretaceous sediments along faults into the Upper Cretaceous. Indicative of this is that the Aptian oil is similar qualitatively to the Upper Cretaceous oil. See Table 2.

The data presented show that the Lower Cretaceous oil is somewhat heavier than the Upper Cretaceous, i. e., in the interval of occurrence of the Cretaceous sediments there is a positive vertical density gradient. This is quite normal because as a result of vertical migration within this system a gravity differentiation of the oils is observed. The amount of gas dissolved in 1 cm$^3$ of oil also corresponds with this. For example, the oil of the Upper Cretaceous has an average gas-oil ratio of 280 m$^3$/m$^3$, whereas the content of dissolved gas in the Aptian oil is somewhat lower at 245 m$^3$/m$^3$. 