

GENERAL FEATURES OF HYDROCARBON DISTRIBUTION AND PROSPECT OF OIL/GAS EXPLORATION IN SOUTH CASPIAN BASIN

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Geologically the South Caspian Basin is one of the major modern depressions of the Alpine fold area formed as a result of the closure of the Tethys paleocean during the Mesozoic-Cenozoic. The basin is characterized by an impressively thick sedimentary cover (over 20 km in the most deeply sunk zones), the suboceanic crust, wide –spread diapirism and mud volcanism confined to the periphery of the basin and deep faults in its central part; it was shaped by an abruptly intensifying subsidence during the Pliocene-Quaternary simultaneously with the acceleration of the growth of folded structures at the basin fringes.

Two tectonic-structural stages are distinguished within the basin sedimentary sequence: pre-Pliocene and Pliocene-Quaternary. The thickness of the latter in some areas reaches as much as 10-11 km, 5-6 km of which falls on Middle Pliocene deposits.

The following major geostructural elements can be discerned in the offshore part of the South Caspian Basin: Apsheron-Balkhan Zone of Uplifts, South Apsheron Trough, Lower Kura-Enzeli Depression, Central Zone of South Caspian Folds, Turkmen Structural Terrace, Elbruz Foredeep.

The main petroliferous complex of the South Caspian Basin is Associated with Middle Pliocene deposits characterized by the lithofacial parameters that are most favorable for the formation of oil and gas accumulations, as well as by the proliferation of anticlinal traps. The latest studies evidence that the deposits of the Maykop Formation represent the most likely source rocks for oil and gas pools found within the South Caspian Basin. The highest concentration of the proved oil and gas reserves is confined to the northwestern part of the South Caspian Basin encompassing the northern part of the Baku Archipelago, Apsheron Peninsula with the South Apsheron Trough adjoining it from the south, as well as the western part of the Apsheron-Balkhan Zone of Uplifts. It is this zone that contains all the known oil fields with the proved reserves over 100 MMt. Oil and gas pools found in the northern part of the Baku Archipelago are associated with the northeastern slopes of the Sangachaly-Deniz, Duvanny-Deniz, Bulla-adays uplifts, and with the Bulla-Deniz Uplift. South of this zone commercial oil inflows were registered in only one well on the Garasu Uplift. All the known large within the western part of the Apsheron-Balkhan Zone of Uplifts are confined to the southern anticlinal line where the bulk of the reserves is associated with the “Pereryva” Formation and the upper part of the Productive Series (PS). At the northern anticlinal lines hydrocarbon accumulations are associated with the formations in the lower part of the PS.

Regional distribution of the specific gravities of oils from the PS within the Apsheron region and adjacent areas were studied with the aim to determine in the distribution patterns of the hydrocarbon accumulations. These studies were complemented by the investigation of the specific features of the growth of local uplifts at the northern and southern anticlinal lines of the Apsheron-Balkhan Zone of Uplifts. The studies have established that the changes in the specific gravities of oil within the Apsheron Petroliferous Region, including the western part of the Apsheron-Balkhan Zone of Uplifts, are fairly regular, from the high-gravity oils in the area southeast of the Apsheron Peninsula to the most low-gravity oils at the far periphery of the zone,

including fields on the Apsheron Peninsula, in Apsheron Archipelago, and onshore south of the Apsheron Peninsula. The epicenter of this zone coincides with the area of the maximum sedimentary thickness according to DSS, located south of the Apsheron Peninsula, named by some researches the South Zhiloy Depression. A zone of the Maykop Formation containing the most organic-rich clayey lithofacies roughly matches this depression. It is perfectly evident that here we speak of a kitchen zone that produced hydrocarbons forming the fields of the Apsheron Peninsula, northern part of the Baku Archipelago, and western part of the Apsheron-Balkhan Zone of Uplifts, including the Apsheron Archipelago. Taking this notion as a basis provides an explanation for the distribution of hydrocarbon pools within the Baku Archipelago. The bulk of the hydrocarbons is captured by the traps on the anticlinal line nearest to the kitchen zone. A fault zone, forming a practically impassable barrier, prevents further migration of hydrocarbon fluids southward. Therefore some traps overflow and in some cases even synclinal flanks are filled.

A similar, though somewhat more complex situation can be observed within the Apsheron-Balkhan Zone of Uplifts. Analysis of the growth rate of the uplifts in the northern and southern anticlinal zones has demonstrated that the said zones differ in their development patterns. In the northern zone the growth rate of uplifts attenuated with time, i.e., in the second half of the PS age the growth rate of uplifts slowed down. The situation in the southern zone was the opposite. The growth rate of uplifts accelerated with time, peaking since the second half of the PS age. In our view this finely correlates with the observed distribution of the hydrocarbon pools. In the beginning of the PS age, when folds of the southern zone were still but slightly defined hydrocarbon pools were formed within the northern anticlinal line. In the second half of the PS age the folds of the southern zone created a barrier on the way of hydrocarbon migration, the said folds accumulating all the hydrocarbons arriving here from the kitchen zone. Thus the kitchen zone under consideration provides hydrocarbons for the pools found on the Apsheron Peninsula, in the western part of the Apsheron-Balkhan Zone of Uplifts, northern part of the Baku Archipelago, as well as in the fold zone at the offshore extension of the Fat'mai-Zykh anticlinal line (Bakhar, Shakh-Deniz, Vezirov uplifts).

The Lower Kura kitchen zone, located at the offshore extension of the Lower Kura Trough, apparently possesses a much more modest generating potential. The said zone is presumably the source of hydrocarbon pools found on the Churdasi, Araz-Deniz, Inam and some other uplifts. Maykop deposits within this zone are characterized by a sandy-clayey composition and, accordingly, a lower content of organic matter. Reservoir properties of the PS deposits within the above uplifts are evidently inferior to those found in the areas of the South Caspian Basin located further to the north. These factors accordingly reduced the petroleum potential of the offshore extension of the Lower Kura Trough.

A large trough at the bottom of the Middle Pliocene strata, where the top of the pre-Pliocene deposits sinks down to 9-10 km, is distinguished in the eastern part of the South Caspian Basin. Maykop strata within this trough thins down as compared with the western regions of the South Caspian Basin, which affects the generating potential of the trough. The eastern kitchen zone provided hydrocarbons for the pools found in the eastern part of the Apsheron-Balkhan Zone of Uplifts and Turkmen Structural Terrace. On the basis of the available data commercial pools, containing mostly gaseous hydrocarbons, within the latter structure may be expected at a depth over 6.0 km.

The kitchen zone in the southern part of the South Caspian Basin is confined to the Elburz Foredeep, at the northern flank of which commercial hydrocarbon accumulations may be expected (within the South Turkmen Fold Zone, southern part of the Central Zone of south Caspian Folds). Paleofacial analysis indicates that the Maykop strata within the Elburz kitchen zone thins down, and its composition becomes more coarse as compared to the northern part of the South Caspian Basin, and there by the content of the dispersed organic matter within these deposits is relatively low, which factor reduces the generating potential of this zone.

The foregoing allows totarget the areas within the South Caspian Basin where oil and gas exploration is most likely to produce valid results.