Some Systematic Variations in Reservoir Properties of Rocks of the Main Oil-Bearing Unit of Northeast Sakhalin (Okobykay Formation)

B. K. Ostistyy

More than 30 oil and gas fields are now known on Sakhalin. Most of them, as well as the exploration areas with proved reserves, are located in the northeast part of North Sakhalin. See Fig. 1. The pools are predominantly the blanket-crest type, rarely tectonically or lithologically shielded, and occur at the base of the sandy-silty formations of the Okobykay formation (upper Miocene). In spite of more than 40 years of exploration and production in these fields, there has not yet been a clear idea of the main pattern of variation of reservoir properties of the pay zone; only fragmentary information is available (1, 2).

The Okobykay productive formation occurs widely along the entire east coast of North Sakhalin and is known in all operating fields and exploration areas. This unit has a generally uniform lithology, being comprised of alternating, predominantly poorly sorted varieties of blue-gray clays, siltstones, and light fine- and medium-grained sandstones. The thickness of the formation ranges from 800 to 1700-1800 m. The composition of the Okobykay formation and the occurrence in it of a large number of representatives of shallow-water marine fauna and plant detritus indicate a shallow water, almost lagoonal character of deposition (1). The author uses the generally accepted three-fold subdivision of the Okobykay formation (3). To the lower sub-stage is referred a member from the top of the Dadin formation to the base of stratum XII; to the middle are referred strata VII-XII; to the upper - from the top of VII to the base of stratum II (according to Gilyako-Abunan nomenclature).

In connection with the great nonhomogeneity of the section and replacement of some varieties by others, a bed-by-bed correlation of sections of individual pools is not possible; therefore, the author has been compelled to give the characteristics of the three members corresponding to the three recognized sub-formations.

Comparing data on thicknesses of sub-formations and their content of sand-silt rock (see Fig. 1), it should be noted that only in the western part of Northeast Sakhalin (Gyrgylan’in, partly the Nekrasov and Sabin zones), some agreement in corresponding maxima is observed. In a large part of the territory, with rare exceptions (Torrakh region for the upper Okobykay), sectors with greater thickness are characterized by low or, more often, background contents in the section of sandy-silty rocks; and on the other hand in sectors of accumulation of low or background thicknesses there is a greater sand content. Upward along the section from the lower to the middle sub-formation there is an increase in the content of sandy-silty rocks (background values are 10-30 and 50-70%, respectively); in the upper sub-formation the sand content drops to average values (background, 20-50%). There is a systematic increase in the content of sand-silt rocks in the sub-formations toward the west and southwest from the Ekhabi, Sabo, and Paromay anticlinal zones.

According to data of mechanical analysis, the reservoirs of the lower sub-formation are largely sandy-clayey siltstones and poorly sorted rocks of the transition type from siltstones to sandstones. Sands and sandstones occur in the south and north parts of the Sabo anticlinal zone and also throughout almost the entire Ekhabi zone. For the middle sub-formation the area of sands and sandstones extends into the north part of the region, including the Shmidt Peninsula and north part of the Nekrasov zone; and on the south, part of the west flank of the Paromay zone. For the upper sub-formation, the field of sandy reservoirs increases, embracing the Nekrasovka and Gyrgylan’in zones. For the entire section, the sands and sandstones contain a large quantity of silty-clayey material, averaging not less than 30-40%. In sectors of higher sand content the reservoirs are predominantly sands and sandstones. The authors have analyzed the results of more than thirty thousand analyses of mechanical properties, carbonate content, porosity, and permeability of rocks of the Okobykay formation, more than a third of which are characterized by capacity and filtration properties of reservoirs. In many cases on a basis of open porosity three groups of reservoirs are distinguished: low capacity (less than 5%), medium capacity (5-15%), and high capacity (greater than 15%).

The map in Fig. 2 confirms a significant worsening of capacity of the reservoirs downward along the section of the Okobykay formation: the upper and middle sub-formations are characterized by reservoirs of predominantly high and medium capacity, whereas those of the lower sub-stage have medium to low capacity. In the upper sub-formation, reservoirs of high capacity occur on all anticlines except the northern structures of the Sabo zone and Nekrasovka. In the middle sub-formation they are distinctive of the Ekhabi, Sabo, Nekrasovka, and particularly the Gyrgylan’in zones; and in the Paromay zone they are known in the region of Paromay and to the south of Severonyy Boatasino.

In the lower sub-formation, reservoirs of high capacity are encountered very rarely (see Fig. 2); it is host to reservoirs of...