Prediction of Large Non-Anticlinal Oil and Gas Traps in West Yakutia


Exploration in Yakutia has been directed almost entirely toward anticlinal traps that had been mapped by seismic surveying. There is good geological reasoning, however, to expect pools in large non-anticlinal traps to be discovered. Most of these are associated with up-dip pinchouts or facies change. Faults may also be an important factor here.

Zones of large non-anticlinal traps are possible in the north part of the Nepa-Botuobinsk anteklize, the east of the Syugdzher saddle, the region of junction of the latter with the Nepa-Botuobinsk anteklize, and the south border of Lena-Anabar downwarp. Particular attention has been given to correlation within the Cambrian-Vendian section.

TRAPS OF THE NEPA-PELEDUY ARCH

The main factors in the possible formation of non-anticlinal traps in this region are the presence of thick Cambrian salt as the seal, pinchout of prospective carbonate-clastic units of the upper Precambrian, belt-like distribution of sandstone productive horizons, monoclinal rise of the lower part of the sedimentary section toward the west and northwest, that is, the direction of their pinchout.

Thickness of the sedimentary cover in this region is 1500–2000 m. The section is largely Vendian and Cambrian.

The most favorable part of the section is the clastic Vendian, which is 50 to 200 m thick. Several largely sandstone horizons are recognized, separated by clay-carbonate members. From the bottom upward they are the Vilyuchan, Talakh, Khamakin, and Botuobinsk. The latter is regarded as a basal unit for the overlying Vendian carbonates, the Itkekh Series.

Reservoir properties of the Vendian sandstones were determined largely by conditions of deposition, which was on a shallow-water shelf of a broad epi-continental sea. The relationship of horizons in the section indicates successive marine transgression onto a differentially downwarping of the sea floor. Deposition of the Botuobinsk sandstones was accompanied by some erosion and redeposition of earlier sediments. These deposits appear to be a micro-facies of near-shore bars. This deposition of the Botuobinsk preceded a somewhat stable tectonic regime. Please see p. 43 this issue for stratigraphic position of the Botuobinsk.

Thickness and composition of the Early Vendian clastics indicate their deposition in a relatively calm peri-cratonal downwarp. During the Late Vendian and Cambrian a typical cratonic regime of sedimentation prevailed. The main structure-forming movements took place in the Middle Paleozoic. They were governed in great degree by inversion and uplift of the Patom mountains. There were subsequent times of greater activation. The most important of these was the neotectonic stage with formation of the very large Patom uplift.

Coinciding with these periodic tectonic movements were processes of migration of hydrocarbons and their accumulation in pools as well as destruction of pools. For example, in the Late Precambrian and Early Paleozoic there were successive migrations of hydrocarbons toward the craton from the Riphean and Vendian-Cambrian multi-kilometer sedimentary fill of the Patom basin as it passed through depth intervals in which oil and gas were generated. These processes were strongly intensified in the Middle Paleozoic. Large accumulations of oil and gas formed in the region of the Nepa-Botuobinsk anteklize, mostly in non-anticlinal traps. These accumulations experienced slow destruction over subsequent time up into the Neogene.

The neotectonic stage with its high uplift of the Patom Highlands led to a regional drop in formation pressure in the study area, de-gassing of the formation waters, and intensive migration of hydrocarbon gases toward the craton. In many cases rejuvenation of faults and block movements resulted in modification of structural traps. These events led to partial reformation of the oil-gas zones and to introduction of newly generated gas. These processes were further complicated by extreme cooling at the surface and formation of permafrost, and with its subsequent reduction in the present stage.

Large oil and gas pools that formed in the Middle Paleozoic in non-anticlinal traps were naturally also affected; however, they appear on the whole to have survived.

In the Nepa-Botuobinsk oil-gas region shows of various intensity have been found through a great depth range from a few hundred