Structure and Evolution of the Kama-Kinel Downwarps in Bashkiria and Main Directions of Geological Exploration


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An extensive belt of uncompensated downwarps is present on the east border of the East European craton and west flank of the Urals for a distance of more than 2000 km from the Gulf of Pechora on the north to the Caspian Sea on the south. The best studied of these is the Kama-Kinel system of downwarps, which has been investigated since the Fifties.

The Kama-Kinel system of downwarps is a series of interconnected accumulational-topographic depressions, which lay between regions of paleo-arches and large highs in Late Devonian-Early Carboniferous time. Within Bashkiria this system is represented by the Aktanysh-Chishmin, Inzero-Usol, and south part of the Shalym downwarps.

The Aktanysh-Chishmin downwarp extends northwest-southeast between the broad regions of the Bashkir and South Tatar paleo-arches. See figure 1. It is about 250 km long and 80-100 km wide. On the northwest it merges with the Lower Kama downwarp in Tataria and the south end of the Shalym downwarp of the Perm Region. On the southeast it passes into the Inzero-Usol downwarp.

Formation of the Kama-Kinel downwarps began in middle and late Frasnian time when the entire region of the Russian platform experienced steady subsidence, and near-shore continental conditions in its eastern regions were replaced by near-shore marine and marine conditions. Different rates of subsidence in various parts of this marine basin led to differentiation of the territory into highs and depressions.

The South Tatar and Bashkir arches were areas of shallow-water (20-30 m) deposition of shelf carbonates. Water depth in the intervening downwarps was 100-200 m. Conditions were optimum along the shelf margins for the growth of massive barrier reefs. Solitary reefs and bioherms formed on high places in the depressions as well as in the back-reef areas.

The shallow-water shelf carbonates pass into deep-water bituminous and siliceous clastic carbonate deposits in the axial areas of the depressions. These uncompensated sediments are similar to the underlying Domanik facies.

The outer border zones (III and V of figure 1) include the margins of the Tatar and Bashkir arches of Late Devonian time. Here the upper Frasnian-Famennian carbonates are thicker due to the reef buildups. They offer a steep flank toward the depressions, where they pass into the depression facies of the inner border zones (II and IV of figure 1).

The Kama-Kinel depressions became exploration targets after it had been determined that they were central to the formation and distribution of most of the oil fields of the republic. This role had two aspects to it. First, structural conditions were favorable. The border zones with barrier and solitary reefs and numerous shelf bioherms contributed to development of drape and compaction structures, which contain most of the oil and gas of the Carboniferous and carbonate Devonian. There is this combination of land, shelf, slope, and depression, or in the terms of Rich, the undaform, clinoform, and fondoform.

Second, conditions were favorable for formation and migration of hydrocarbons. The depression facies had a large stratigraphic interval from the Domanik to the lower Visean, and these were source beds. Hydrocarbons migrated from the depression areas up the dip into reservoirs in the border areas. All this contributes to the high favorability of the margins of the Tatar and Bashkir arches.

Exploration during the recent 11th Five Year Plan in the Kama-Kinel depressions of Bashkiria was carried out on 296 highs, and 24 fields were discovered, including 190 pools. These discoveries accounted for two-thirds the growth of reserves for Bashkiria as a whole. Most of this growth was in the outer zone of the Shalym downwarp and the inner zone of the Aktanysh-Chishmin downwarp.

As of now more than 90 oil fields have been discovered in the Kama-Kinel downwarps of Bashkiria. They occur in a wide stratigraphic range from the Eifelian of the Middle Devonian to the Artinskian of the Lower Permian. These fields are grouped into 22 zones of oil accumulation.

In spite of a high maturity of exploration at more than 80 percent, the Kama-Kinel downwarps still have good potential for further finds. The most favorable targets are the Upper Devonian-Tournaisian carbonates and the Lower Carboniferous clastics. The most promising areas are inner zone IV and outer zone V of the Shalym downwarp and southwest zone III and northeast zone V of the