Paleo-Geomorphological Conditions of Deposition of Clastic Sediments of Devonian of Tatarstan

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Using drilling data from more than 200 wells and seismic survey data, a detailed study was made during 1990–1993 of the clastic sediments of the Devonian of the west and north flanks of the South Tatar arch. These investigations on the whole confirmed concepts developed during recent years as to the geomorphological environment of sedimentation in Middle and Late Devonian time. At the same time they led to revision of the model for the geological development of the Tatar region during Kynov time.

The Bii-Vorob’ev shale-sandstone complex of the clastic Devonian at the base of the sedimentary cover occurs sporadically in the region. It is present in irregularly shaped structural lows (south part of the Altunino-Shunak graben, Kazan-Kirov graben) and in small swales in the relief of the crystalline basement. See figures 1 and 2. Thickness of these rocks ranges from 80 m in the Shugurovo area to 1 m on the North Tatar arch. A large number of wells were drilled in West Tataristan in 1969–1971, disclosing the wide distribution of Vorob’ev sediments (Stratum D-IV) in the Kazan-Kirov aulacogen.

Ardatov Beds of the Starooskol Horizon of the Givetian Stage rest transgressively on the surface of the crystalline basement. At their base are sandstones and siltstones of Stratum D-III, and at their top is the “middle limestone” and its overlying shale and siltstone. Commonly present in Stratum D-III is coarser, even gravelly sandstone. Where the latter occurs on an erosion surface on Devonian clastics it is interpreted as near-shore facies of the Ardatov sea. Thickness of the Ardatov Beds ranges from 60 m in the south of Tatarstan and in the Kazan-Kirov aulacogen to 25 m in the Tanay-Bekhterev, Privyat, Uarat’min, and Menzelino-Aktanysh areas.

Stratum D-III exhibits no significant lithologic variation. Above the basal beds are fine-, in places medium-grained sorted sandstone with admixed silt and clay sizes and siltstone with admixed sand sizes. Everywhere in Tatarstan Stratum D-III has a similar lithology.

Two members are recognized in the Mullin Beds of the Starooskol Horizon. See figure 4. These are a lower, sandstone-siltstone member (Stratum D-II) and an upper, siltstone-shale member with a “black Limestone” marker bed. Thickness ranges from 50 to 10 m. Devonian clastic sediments more than 60 m thick have been penetrated by the drill in the Vetrov graben on the west flank of the North Tatar arch (figure 1). They consist of Ardatov Beds and overlying sandstone-clay deposits of the Mullin.

Up to five sandstone beds are present in the Pashiy Horizon (Stratum D-I) of the Frasnian Stage in Romashkino oil field. The sandstones are fine- and medium-grained and commonly very porous. This is the main pay. Thickness is 20–40 m, attaining 60 m and more in the Kuzaykin and Baganin grabens. See figures 1, 2, and 4.

Lower, middle, and upper Kynov Beds are recognized. The lower consists of shale with the “upper limestone” marker at its base. The latter is present only in east Tatarstan. See figure 1, profile A-A.

To the middle Kynov are referred Stratum D-0 and an overlying shale member (analog of Archedin Member) some 20 m thick. The shales are greenish gray, chocolate brown, and thin bedded. The greatest thicknesses are found in Romashkino field and southeast Tatarstan.

In southeast Tatarstan above Stratum D-0 is generally a carbonate rock (Middle Kynov Marker) up to 1.5 m thick. On the west and north flanks of the South Tatar arch between the base of the “Ayaksy” marker and the top of the Archedin shales is a thin (1–5 m) shale-siltstone member with a carbonate bed at its base. The latter carries a normal marine fauna. Thickness increases to 25 m in the Altunino-Shunak graben. Sandstones in this unit on the southeast flank of the North Tatar arch are host to all the known oil pools here.

In the Kazan-Kirov aulacogen the Kynov Horizon consists of the Archedin Member, upper Kynov limestone, and overlying sandstone and siltstone (figure 1, profile B-B). All these thin toward the border of the aulacogen. Thickness in the axial part of the