Prospects for Further Exploration for Oil and Gas in the Volga-Ural Oil-Gas Province

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In spite of a very mature level of exploration the Volga-Ural oil-gas province remains a leading oil producer of Russia. The history of study of the oil geology goes back to the Eighteenth Century when oil seeps and asphalt at the surface at many places in, the Middle Volga region were described. Systematic oil exploration began in the Thirties with discovery in 1929 of oil at Verkhnechusov Gorodkov. Exploration shifted to the platform part of the province in the Forties, and several large fields were discovered during World War II. A number of super-giants were discovered in the following years - Bavly in 1946, Romashkino in 1948, Serafimovka in 1949, Zhirnov in 1950.

Large new fields were discovered in the next decades, all on large highs or reefs.

Discovery of oil fields continued in the Eighties; however, most were on drapes over reef buildups of late Frasnian-Famennian age in downwarps of the Kama-Kinel system. Buried Devonian graben-like downwarps in Bashkortostan were studied during this time. These features have not been investigated sufficiently in other regions.

Seven main structural-lithologic complexes are now recognized in the sedimentary section. Spatial distribution of the main fields is shown on figure 1.

Forty commercial oil-bearing horizons are recognized in the Paleozoic section, and about 1500 fields with more than 4200 pools of oil, gas, and condensate have been discovered. Yields of wells range from 0.2-1.5 tons per day to several hundred tons per day.

Most of the reserves are in the 1000-3000 m depth interval. Density of the oil is in the 0.8-0.9 range, and gas/oil ratio is 10-500 m$^3$/ton. In many cases the density of the oil decreases with depth parallel with an increase in gas saturation. Stratigraphic distribution of oil production is (in percent): Devonian clastics - 55, Lower Carboniferous clastics - 30, Oka-Bashkirian carbonates - 7, the other four complexes - 8.

Assessments place the discovered oil in the Volga-Ural province at 76 percent of the ultimate resources. Discoveries in the coming years will probably be small. Since the Upper Devonian-Tournaisian carbonates and the Lower Carboniferous clastics are well explored, attention should be turned to detailed study of small oil accumulations in Eifelian-lower Frasnian clastics of the Devonian, and clastic-carbonates of the Middle and Upper Carboniferous and Permian.

Six productive horizons are recognized in the Eifelian-lower Frasnian of the Volga-Ural province: D-0, D-I, D-II, D-III, D-IV, and D-V. (These are listed here in descending stratigraphic order.) These are well sorted sandstones with beds of clay and limestone separated by clay members 5-20 m thick. Regionally oil-productive horizons D-0 (Kynov), D-I (Pashiy), and part of D-II (Mullin) have long been the main objects of investigation. As far horizons D-III (Ardatov), D-IV (Vorob’yev), and D-V (Afonin), as a consequence of their local distribution largely in the most subsided structural features and their generally limited oil saturation, they have been neglected.

Large and medium size pools in D-0, D-I, and D-II have already been found and depleted. Further exploration must be directed toward stratigraphically lower parts of the section, where pools will be more sporadic in their occurrence. They will be found on small, local highs associated with Devonian graben-like downwarps and in zones of pinch out against buried basement hills. The graben-like downwarps have a largely northeast and north-south trend, cutting across the main structural features of the east part of the Russian platform.

This “clastic Devonian” is favorable in all parts of the Volga-Ural province, particularly on the large structural features where large oil pools have already been found. For example, the crest and flanks of the South Tatar arch (Romashkino field) are favorable. At Romashkino, horizons D-I and D-0 were the objects of the most attention. The prospects of the lower, little studied horizons (D-III, D-IV, and D-V) have been confirmed by discovery of individual oil pools in several areas of the field. For example, in horizon V (Biy Horizon) an oil pool was found in sandstones as well as in fractured basement gneisses. In the central part of the field in the Pavlov, Abrahmanov, and other areas, pools have been found in horizons D-IV and D-III. The oil pools occur here in lenses of sandstone and are controlled by small, low amplitude highs. Pavlov well 3425 tested oil at 23 tons per day from horizon D-III.