

Oil and gas potential of the Paleozoic strata of the Caspian and Volga-Don regions

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The southern part of the Pre-Caspian Depression with unique oil and gas discoveries (Astrakhan, Tengiz, Kashagan, etc.) was for a long time considered to be the most promising area for the Paleozoic deposits in the south of European Russia. For around 40 years, the Paleozoic deposits of the Karpinsky Ridge, Donbass and Precaucasus did not attract any serious attention because of the prevailing assumption that they constitute a highly metamorphosed and dislocated core (basement). It is possible to say that regional stage of seismic acquisition for deep horizons and Paleozoic deposits studying in the Caspian and Volga-Don regions was not organized and conducted.

Modern CDP seismic acquisitions in some large areas of the Southern Russia and in the Caspian Sea made it possible to identify and interpret a number of deep (to 4-15 km) seismic horizons in the Paleozoic strata in several large areas. On a bases of new seismic more than fifty promising leads were found in the Rostov Region, Kalmykia, and adjacent areas of the Caspian Sea at depths down to 4–6 km. Some of these leads are quite large (up to 15×20 km with amplitude bout of 1–1.5 km) and look in seismic sections as carbonate banks or reefs, other ones are interpreted as swells 100-150 km length (V.I.Bogoyavlensky, 2005-2009). The key question remains: “Could rocks of these swells and leads be reservoirs and contain hydrocarbons?”

The deep Western Siberian wells En-Yakhinskaya-7 (TD 8,250 m) and Tyumenskaya-6 (TD 7,502 m) and many other wells Worldwide (fields Shearwater, Elgin, Franklin, Knotty Head, etc.) proved that good reservoirs (with porosities up to 15–35%) can be preserved at depths greater than 6-10 km in conditions of abnormally high formation pressure. In many fields with HPHT considerable saturations of gas and liquid hydrocarbons were detected.

In the Southern Slope of the Voronezh Antecline all Carboniferous oil and gas bearing deposits, including limestones, are lying immediately on the crystalline basement. The limestones have thickness 850 m in the Patronovskaya area and 400-1,300 m in Matveev Kurgan (northern slope of the Rostov Arch). Numerous facts show oil flows into the coal mines of the Donbass (Chaikino, Komsomolets, Lidievka etc.) from the underlying fractured and cavernous rocks. There are many more examples pointing to the regional oil and gas occurrence in the Paleozoic deposits of the Southern Russia.

A data review from modern CDP seismic and wells penetrating Paleozoic deposits in some areas of Southern Russia show weakly dislocated (sub-horizontal) and slightly metamorphosed sedimentary deposits (Ozek-Suat, Krasny Khuduk and Elista).

Our analysis shows that Paleozoic deposits of the Caspian and Volga-Don regions may contain hydrocarbon pools and, in certain areas, generate at least methane gas. The metamorphism factor is not the main factor limiting forecasts of oil and gas occurrence in these deposits. Presence of oil and gas source rocks, reservoirs and seals are more important factors. Leads with abnormally high formation pressure (closed systems) are particularly promising. Paleozoic deposits of the Caspian and Volga-Don regions could well have a huge hydrocarbon potential, and valid swells and leads should be considered as potentially promising targets for future exploration.