



Fractured Reservoirs and Crustal Fluids in the Precambrian Basement of the Volga-Ural Region

I. Plotnikova

Kazan State University, Geological, Kazan, Russian Federation (irena-2005@rambler.ru, +7 843 2315384)

The study area for research is territory of Tatarstan and the South Tatarstan Arch located in the Volgo-Ural Region, which is an enigmatic crustal segment that occupies the eastern third of the East European Craton. Two ultra-deep wells have been drilled in Volga-Ural region: Minnibaev-20000, with a bottom hole depth of 5099 m and the penetrated basement interval of 3215 m, and Novo-Elkhovo-20009 with a bottom hole depth of 5881 m and the penetrated basement interval of 4077 m. Furthermore than 25 wells penetrating the basement down to 2432 m have been drilled. The extensive basement drilling has permitted the discovery of numerous fractured zones with different volume capacity and fluid content. The basement reservoirs vary in thickness up to several hundreds of metres. They have been found both in the uppermost part of the basement and at a depth of more than 5 km. The basement reservoirs have been identified by various geophysical techniques. More than 130 loosely aggregated and fractured intervals of the basement have been tested using the drill stem tester, compressor and deep-well pumps. The distribution of reservoir zones has been studied most thoroughly in the well 20009 (Plotnikova, 2004). More than 63 reservoir zones, with a thickness varying from 1 m to 76 m, have been identified in the well column in the interval of 1804 m to 5881 m.

The study of crystalline basement waters confirmed the presence of high capacity reservoirs in the Precambrian crystalline complex characterised by a water flow rate of 0.17-125 m³/day with the maximum flow rate recorded in the deepest interval studied (4703-5099 m in well Minnibaev-20000). In chemical composition, the waters from the fractured zones of the basement are calcium chloride brines with a density of 1.185 g/cm³ to 1.2 g/cm³ and a total salinity of 245 g/l to 267 g/l. The deep crystalline basement intervals of 4703 m to 5099 m and 4446 m to 4493 m in the well 20000 have produced pure calcium chloride brines that are substantially different in concentration from those from the uppermost portion of the basement. Their total salinity is 289 g/l. The water-dissolved gas of the upper portion of the basement contains methane and nitrogen. The waters of the crystalline basement are characterised by significant concentrations (by carbon) of the water-dissolved organic matter including phenols, nitric components, etc. Bitumen of the fractured zones of the crystalline basement mainly contains hydrocarbons with C14 to C33, occasionally - with C9. A range of hydrocarbons becomes wider in the zones of cataclasm and mylonization. Geophysical and geological investigations have indicated numerous reservoir zones in crystalline basement bearing the traces of bitumen and fluids enriched with the dissolved hydrocarbon gases.

The crystalline rocks studies mainly consisted of the analyses of deep fluids containing the dissolved gases and a monitoring of their composition conducted over several years. As a result, spatial distribution of reservoirs has been determined. The crystalline basement of the South Tatarstan Arch and Melekes trough have been found to contain bitumen with a high uranium content in microfractures (Muslimov & Lapinskaya, 1996). Gas chromatography and polished sections studies have shown that the rocks affected by reducing fluids have a maximum hydrocarbon content. Gas components are mainly represented by methane, its homologs and minor amounts of unsaturated compounds.