Geology and Oil-Gas Prospects of the Riphean Sedimentary Basins of the Siberian Craton

K. A. Savinskiy, G. P. Filippova, V. V. Zabaluyev, K. Ye. Veselov, V. S. Volkhonin

(Geologiya Nefti i Gaza, no. 10, p. 5–10, 1992)

Successes in oil-gas exploration in the Precambrian Riphean sediments in the west of the Siberian craton (Yurubchen-Tokhom zone, Kuyumba and Kardin areas of Krasnoyarsk Territory) has focused attention on this part of the section.

The Riphean sedimentary basins are localized only in large, ancient downwarps of the Archean-Lower Proterozoic basement. Uplifted parts of the basement clearly divide the areas of Riphean rocks into west and east parts. See figure 1. The west part contains by far the largest Riphean basin.

Some idea as to the volume of Riphean sediments in these basins has been gained from deep seismic sounding profiles. See figure 2. Six separate Riphean basins are recognized here: 1) Yenisey, 2) Tunguska, 3) Angara, 4) Anabar-Olenek, 5) Vilyuy, and 6) Yudomo-Haysk. See figure 3.

The Yenisey basin extends along the northwest margin of the craton and includes several depressions. The Riphean rocks occur at depths of -4 to -6 km, rising to -2 km on highs. The lower and middle Riphean consists of sandy rocks in which reservoirs are present. The upper Riphean is shale-carbonate and carbonate rock, which may act as a seal.

The content of organic matter in these rocks and the degree of its maturation do not exclude the possibilities for hydrocarbon accumulations here. Prospects, however, are low.

The Tunguska basin is very favorable for oil and gas. The lower Riphean is at a depth of 4-7 km and consists of two parts: lower redbeds and upper massive dolomite. In between the two is a 40-80 m siltstone, which carries up to 6.5 percent organic matter and is regarded as a source bed. The upper Riphean is dolomite, which contains beds of clay and siltstone. The central parts of the basin are prime targets for exploration.

The Angara basin in the south part of Siberian craton is characterized by east-west trends of the structures, which on the east change to northeast paralleling the trend of the Baykalian fold belt.

The most complete section of Riphean rocks in this basin is in the Yenisey Range, where the lower Riphean is a shale-carbonate unit, which is overlain by shale, sandstone, and siltstone of the middle Riphean. The upper Riphean is a thick succession of alternating carbonates and clastics. Carbonaceous shale and bituminous limestone with a high hydrocarbon generating potential are present here. The commercial flows of oil and gas in the Yurubchen and Kuyumba areas attest to the prospects of this basin. There is also the possibility that the oil and gas migrated stratigraphically downward from Vendian sources.

The Anabar-Olenek basin is characterized by narrow rift-like downwarps separated by broad uplifts. The middle and upper Riphean are represented by carbonates. The east part of this basin is assessed as the most favorable.

In the Yudomo-Maysk basin the lower part of the Riphean consists of redbed conglomerates and sandstones. These pass upward into interbedded clastics and carbonates. Low content of organic matter and high catagenic maturity of these rocks indicate little chance for oil and gas here.

The structure, geochemistry, and lithology of the Riphean rocks on the Siberian craton are favorable for hydrocarbons to have been generated. Conditions under which they may have been preserved are more restricted, however. Pools are more likely to be present in zones of intense fracturing in carbonate rocks, where karsting may have taken place. Such zones are present at the top of the Riphean where there was a 500-600 million year erosional break, and depth of leaching is 200-300 m.

Effective reservoirs are predicted in the interfluve of the Podkamen Tunguska and Nizhnyaya Tunguska Rivers and in the south part of the Turukhan-Noril’sk Ridge. These areas have the advantage of being beneath the Cambrian salt seal of the region. However, there are probably sufficient seals in the carbonates below the salt. On figure 3 are delineated the regions that are favorable for Riphean exploration.

Copyright © 2014 Petroleum Geology: A digest of Russian literature on Petroleum Geology