International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 2017 vol.17 N11, pages 631-636

The influence of hydrothermal processes in the crystalline basement on the oil-bearing capacity of the sedimentary cover of the Volga-Ural region (Russia)

Khasanov R., Mullakaev A., Galiullin B., Khayrtdinova L.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© SGEM2017. All Rights Reserved. The Volga-Ural oil and gas province is one of the oldest oil-producing regions in Russia. The central position in its borders is occupied by Tatarstan, in the territory of which is explored the largest oil deposits of the region. Oil deposits belong to the Devonian sediments, and in a lesser degree to the Carboniferous and Permian deposits. Despite the high degree of research of the region, the origin of oil deposits still one of the most controversial issues. Most researchers consider that the source of oil is the organic-rich strata of the Devonian - domanikites, which mostly fill depressed areas on the surface of the crystalline basement. Their largest capacities are confined to the zone of the Melekess depression, the northern part of which is the most elevated and located on the territory of Tatarstan. However, the thickness of sedimentary rocks here mostly does not exceed 2 km. Based on the geothermal gradient, this depth is not enough to start the processes of oil formation. According to the data from field researches, conducted on oil wells, the maximum temperature difference at the absolute level of -1000 meters in the Volga region reaches 30°C. Temperatures range from 14.25°C to 48.20°C. The structure of the thermal field is closely related to the tectonic structure of the territory and is characterized by relatively low temperatures in the area of the North Tatar arch and their increase in the areas located within the South Tatar arch and the adjacent sections of the Melekess depression. Studies of the catagenetic maturity of organic matter in domanikites and the upper carbonaceous coal, carried out on the reflectivity of vitrinite, have showed that their organic matter is characterized by a greater degree of conversion than can be achieved at modern temperatures. Thus, it can be assumed that the formation of oil deposits in the region occurred as a result of the effect of heat fluxes of deep origin. In favor of this point of view says the result of a study of the crystalline basement of the Volga-Ural region. The crystalline basement on the Volga-Ural segment of the earth's crust is composed by high-metamorphosed rocks of the Archaean-Proterozoic age (up to 2-2.6 billion years) mainly mafic and high alumina composition. Based on the results of deep drilling, there are fixed in some parts of the crystalline basement traces of later hydrothermal activity. Such areas are noted within the Melekess depression, where in sedimentary cover located the thick strata of the domanikites. In the crystalline basement there are rocks broken by a rare net of open cracks with burgundy-red crust of iron oxides on the surface. Some of the cracks are filled with barite, which is a typical hydrothermal mineral. These results may be interesting in the connection with the oil content of the overlying sedimentary strata. Signs of hydrothermal activity may indicate increased heat flux, contributed the formation of oil in organic-rich (domanikoid) sediments and its migration to higher horizons (Carboniferous and Permian).

http://dx.doi.org/10.5593/sgem2017/11/S01.079

Keywords

Catagenetic maturity, Crystalline basement, Hydrothermal processes, Organic matter, Origin of oil deposits

References

[1] Aliev, M.M., Batanova, G.P., Khachatryan R.O. et al. Devonian deposits of the Volga-Ural oil and gas province. M.: Nedra, 1978. 216 p. (in Russian).

[2] Khasanov, R.R., Gafurov, Sh.Z., Mullakaev, A.I. The paragenesis of coal and oil deposits in paleozoic sediments in the east of the Eastern European platform/16th International Multidisciplinary Scientific GeoConference SGEM 2016, SGEM2016 Conference Proceedings, Book 1. Vol.1, 627-631pp. DOI: 10.5593/SGEM2016/B11/S01.079

[3] Yudovich, Ya.E. Geochemistry of black shale/Ya.E. Yudovich, M.P. Cetris. - L.: Science. 1988. 272 p. (in Russian).

[4] Kiryukhina, T.A., Fadeyeva, N.P., Stoupakova, A.V., Poludetkina, E.N. and Sautkin, R.S. Domanik deposits of Timano-Pechora and Volga-Ural basins. Oil and Gas geology. 2013. (3), pp. 76-87 (In Russan).

[5] Bartis, James T.; LaTourrette, Tom; Dixon, Lloyd; Peterson, D.J.; Cecchine, Gary. Oil shale development in the United States: prospects and policy issues. The RAND Corporation. 2005. 68 p.

[6] Sharipova, N.S., Lebedev, N.P., Batyrbaeva R.A. The organic matter of the Devonian carbonate strata of north and west of Tataria. Geology and geochemistry of oils. Kazan: Kazan Publishing House. University, 1985, pp. 47-65. (in Russian).

[7] Gatiyatullin, N.S., Tarasov, E.A., Ananiev, V.V., Shagidullin, F.F. Assessment of oil and gas potential prospects of Paleozoic deposits of the Melekess Basin. Exploration and protection of mineral resources. 2005. (2-3), pp. 39-43. (in Russian).

[8] Vassoevich, N.B. The origin of oil. Bulletin of the Moscow State University. Ser. Geology. 1975. (5), pp. 3-23. (in Russian).

[9] Bertrand, R. Standardization of solid bitumen reflectance to vitrinite in some Paleozoic sequences of Canada. Energy Sources Journal. 1993. V. 15, (2), pp. 269-288.

[10] Khristoforova, N.N., Neprimerov, N.N., Khristoforov, A.V. et al., Thermal conditions and evaluation of oil and gas potential of the Volga region, Georesources, 2004. (1), pp. 24–27. (In Russan).

[11] Khasanov, R.R., Gafurov, Sh.Z., Rakhimzyanov, A.I. The degree of the epigenetic transformation of an organic matter in the Early Carboniferous sediments of the central part of the Volga-Ural oil and gas province. 2016. Neftyanoe Khozyaystvo - Oil Industry. 2016. (10), pp. 29-31. (In Russan).

[12] Geology of Tatarstan: Stratigraphy and tectonic. Moscow, GEOS. 2003. 402 p. (In Russan).