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THEORETICAL FOUNDATIONS ON ESTIMATION OF OIL AND GAS POTENTIAL PERSPECTIVES OF PALEOSOIC SEDIMENTARY BASINS OF KAZAKHSTAN

Abstract. According to the results of the paleotectonicregime reconstruction from the position of plate tectonics, seven types of Paleozoic sedimentary basins are distinguished, which are significantly different in the sedimentation conditions, oil and gas generation potential and accumulation. These sedimentary basins are continental; passive continental margin`s basins, back-arc and inter-arc basins. A differentiated approach with accounting of geodynamic evolution in the identification of structural and formation complexes that correspond to the main stages in the basins development history and the reconstruction of the features of oil and gas formation and accumulation conditions at each stage with a change in the development regime allow us to identify the main areas of searching for new oil and gas accumulations in each basin.

Keywords: plate tectonics, geodynamic evolution, basin, spreading, subduction, rift, oil and gas generation.

Introduction. In Kazakhstan, fifteen petroleum-bearing and promising for the exploration of oil and gas sedimentary basins are known:

Most researchers distinguish basins of three types, located on an ancient platform, on young platforms and intermontane.

Known maps of the oil and gas bearing areas of the USSR, edited by A.Sh.Shardanov and L.N.Rozanov (1983), V.V. Semenovich, G.K. Dikenstein (1984), a map of the forecast of oil and gas potential of Kazakhstan, edited by O.A. Akchulakov (2000) and Daukeeva S., Uzhkenova B.S., Abdullina A.A. and others (2002). They were based on the doctrine of platforms and geosynclines and showed the stratigraphic range of the sedimentary cover, the main stages of their deflection, and the structural and morphological features of the structure (uplifts and deflections of different scales). The main factors, such as the formation (genesis) of the basins, their geodynamic conditions of evolution, which predetermined the conditions and the rate of sedimentation, the dynamics of the change in the climatic and thermal regime and their relation and relationship with framings of various nature were not taken into account. Without taking into account these factors, the forecast and assessment of the oil and gas potential of the basins in the current stage of development of geological thought and science in the geology of oil and gas are impossible. These shortcomings are largely taken into account and eliminated in the approach to the study and classification of basins and to oil and gas geological zoning from the standpoint of plate tectonics theory.

Proceeding from the position of plate tectonics, we reconstructed the paleotectonic regime for the development of a vast territory from the Kazakh massif in the east to Voronezh in the west and from the northern borders of Kazakhstan to the Kopetdag dislocation systems in the south. The obtained results indicate that the majority of Paleozoic sedimentary basins were formed as a result of the development of the Ural-Tien-Shan Paleozoic ocean between two lithospheric slabs of the East European and Kazakhstan.

Each pool is different. The degree of prospectivity of each of them depends on the volume and nature of sedimentary filling and the geodynamic development regime. These factors ultimately predetermine the possibilities of generation, accumulation and conservation of hydrocarbons. The lion's share of the explored reserves and the forecast resources of Kazakhstan's oil and gas are confined to the Paleozoic basins.

The pools underwent a complete cycle of geodynamic evolution. In the early divergent period of the cycle, in the situation of prevalence of continental divergences, sedimentation and, consequently, oil and gas formation processes occurred in rifts, sub-rhythmic zones of bending and on passive continental margins.

On the territory of Kazakhstan, basins are developed on the passive continental margin, not transformed by the subsequent collision of two plates that led to the formation of the Ural fold system, both the Eastern Caspian and the basins on the passive continental margin transformed by the collision of slabs like Torgai and Syrdarya, and in Perm, developed in geodynamic conditions of back-arc basins.

The average period of the geodynamic cycle is characterized by the collision of two plates with the predominance of horizontal displacements, the formation of the Ural fold system and the activation of volcanism on the marginal parts of the Kazakhstani approaching plate, as a result of which the Valerian-Beltau-Kuramin volcanic arc was formed. The final period of the geodynamic cycle is characterized by isostatic alignment, which occurs with different intensities on various structural elements of the Eurasian lithospheric plate formed after the closure of the Ural Ocean at the end of the Paleozoic, and this process was accompanied by the formation of new rift structures like the South Torgai and the outflow of trap basaltic volcanism in the early Triassic on the North Torgai trough.

The oil and gas content of the basins is in a functional dependence on sedimentation, i.e. the greater the volume of precipitation, hence the volume of buried organic matter, the rate of their accumulation, the degree of warmth, the greater the probability of oil and gas formation processes. Since the nature and type of sedimentation, in turn, is predetermined by the geodynamic situation, the classification and assessment of the prospects for the oil and gas potential of the basins should be based on the results of the study of the paleogeodynamic evolution.

Taking into account the peculiarities of the geodynamic formation regime, it is necessary to distinguish seven types of Paleozoic basins in Kazakhstan. This is the basin of the passive continental margin of the Eastern Caspian, formed on the passive edge of the Ural Ocean in the Devonian and Carboniferous periods, the inland Central Central Caspian, the Tengiz and Shu-Sarysu basins within the Kazakhstan plate, the subripit South-Caspian, the marginal (southeastern) North Ustyurt, Torghaysky and Sirdarya, which developed in the Devonian and Early Carboniferous in the regime of the passive continental margins of the Kazakhstani plate, and in the late Carboniferous and Permian in the regime S arc basin.

In the Ural-Tien-Shan system, in addition to the main folded arc, as noted above, a volcanic arc that unites the Valerian and Beltau-Kuramin volcanic zones is clearly traced. Between the two arcs in the section of the Ural system turning to the Tien Shan, another type of intercurrent East-Aral basin was formed. This approach to the classification of basins based on the geodynamic conditions of their formation allows one to approach differently to each basin and each complex corresponding to the major stages of basin development in assessing the prospects of their oil and gas potential.

A schematic diagram of the formation of the above-mentioned Polozoo sedimentary basins is presented in the following sequence. The pre-Paleozoic (the first cycle of geodynamic evolution) and the Early Paleozoic (second cycle) history of the territory under consideration can be recovered in general terms, since the deposits of Riphean, Vendian, Cambrian, Ordovician and Silurian have been studied only in outcrops in the Urals and in the Kazakh, Ulytau and Karatau massifs and fragmentarily on Sultanuizdag and Northern Tien Shan. According to these data, it can be concluded that at the end of the Riphean and at the beginning of the Vendian, Eastern European and Kazakh lithospheric plates existed there. In addition to these surviving large slabs, there was the Ural-Tobolskmicroplate, broken off from the main plates by faults and rift zones.

Within the study part, the Eastern European continent consists of two parts. The north-western part of it is a continuation of the Archean-Karelian age of the oldest massifs of the Voronezh and the Volga-Urals. At present, within the Caspian syneclise, the surface of the ancient foundation is submerged to a depth of 18–20 km. The relatively young south-eastern part of the Riphean age formed approximately 1.7–1.0 billion years ago. The zone of articulation of these two uneven-aged parts of the southeast of the East European continent probably corresponds to the Astrakhan-Aktobe system of uplifts.