COMPOSITION OF CEMENT IN TERRIGENEOUS ROCKS OF VARTOVSKIY ARCH (WEST SIBERIA) AND ITS RELATION TO RESERVOIR PROPERTIES

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Rock reservoir properties are particularly important for estimation of reserves of an oilfield and for designing the optimal strategy of its exploration. Porosity and permeability can be estimated by geophysical well logging, core sample analyses and other methods.

Individual grains form a hard framework of cemented clastic rocks which change very little during catagenesis with almost no effect on pore space. Therefore, reservoir properties of the rocks depend mostly on composition of clay minerals, their origin and structure. Thus, knowledge of clay minerals composition and identification of degree and stages of their alterations are very important for understanding reservoir properties of rocks.

Upper Jurassic and Lower Cretaceous rocks of Vartovskiy Arch are represented by arkosic fine-grained sandstones, siltstones with clay cement and bedded silty-clayey rocks. Clay cement always consists of a mixture of illite, chlorite, kaolinite, smectite and mixed layer illite-smectite and chlorite-smectite. Kaolinite and chlorite have significant variations of content and are in negative correlation with each other. Illite and smectite are allogenic and illite-smectites were formed during post-depositional transformation.

Contents of chlorite and kaolinite varied through geological time. Rocks from Upper Jurassic to upper part of Lower Cretaceous are characterised by continuous increase of chlorite content which abruptly decreases by Cenomanian time and kaolinite becomes a dominant clay mineral in Cenomanian rocks. Authigenic clay minerals were formed in several stages. Initially, during catagenesis, chlorite crust was formed. Later, after oil infiltrated the interval, the crust has undergone dissolution with simultaneous formation of kaolinite cementation. Authigenic chlorite and kaolinite were formed in pores of different size and type. Chlorite was forming crusts around grains of fine-grained sandstones and siltstones with smaller pores. The peak of chlorite formation was in Late Valanginian. Allogenic chlorite is also found in small amounts as clastic grains.

Authigenic kaolinite is represented by two types: large, chaotically arranged flakes, infilling the whole pore space and loose vermicular aggregates of up to silt in size. The former type is fund predominantly in small pores of the Upper Jurassic bedded clayey-silty rocks along with authigenic chlorite. These rocks have the worst reservoir properties among the studied formations. The latter type is found mostly in Cenomanian rocks with the minimal chlorite contents. It is thought that the large pore size facilitated almost complete dissolution of the initial chlorite crust and subsequent formation of the vermicular kaolinite aggregates. A mixture of both types is found in Valanginian rocks with medium-size pores and good reservoir properties.

It is generally believed that formation of authigenic chlorite degrades reservoir properties while formation of kaolinite does the opposite. Our study showed that this may not always be the case. Although formation of chlorite does decrease porosity, the permeability may remain the same or even increase. Formation of kaolinite can have both, positive and negative, effects on reservoir properties. It is found that morphology of the kaolinite crystals depends on pore size.