Introduction

This paper gives new information about depositional model of Upper Jurassic formation in the central part of the West Siberian Basin. Upper Jurassic formation of West Siberian basin is composed of clastic sedimentary rocks that accumulated in the shallow marine zone in the central part according to published data (Kontorovich, et. al., 2013). Oxfordian regression resulted in deposition of large sand bodies that form oil and gas reservoirs. These sand bodies was formed by fluvial and wave processes in the shorezone (longshore bars, mouth bars), but laterally variable sand and shale units show a great structural complexity. Also new seismic data show a more complicated structure of Upper Jurassic formation. Revision and updating deposition model of this formation provide a foundation for quantitative resource assessments of petroleum areas.

An area of 323 km$^2$ was investigated in this work. It is located within one of the large arches in the central part of the West Siberian Plate. There are 3d seismic data, 58 vertical wells with logging, 3 wells with core and 8 wells with petrophythical measurements by core. This material is base of subsequent complex analysis.

Well data analysis

There are two spectral frequency decomposition slices (0 mc (a) and -6 mc (b)) with RGB blending on the Fig. 1. Elements similar to channels are distinguishable on RGB maps, but the composing sediments are unknown. Logging data analysis showed a special shape of the SP curves in wells located in the channel area (Fig. 2a). There is cylindrical block with sharp top and base (Emery D., Myers K.J., 1996). This shape of curves allows us to suppose thick and vertically homogenous sand bodies in the channel areas. Thus, sediments in these channels were accumulated at high flow energy and these bodies have high sandiness.

There is not description of core samples from sandstone of channels, but core samples from surrounding area have been studied. Rocks of Upper Jurassic formation from surrounding area are dominated by fine-grained sandstones with mudstone and siltstone layers. Siltstones compose the whole section in the northeastern of the territory. The grain size of sandstones increases from the bottom to the top of the layer. Sandstones are intensely burrowed with relict hummocky cross-stratifications and coal beds a few centimeters thick are common at the top of the section. These sediment characteristics indicate the distal mouth-bar of river-dominated delta (Numair, et. al., 2017). Facial analysis results suggest that channel sediments were accumulated later than sediments of mouth-bar. The formation of channels occurred under the erosion of the mouth-bar sediments during the regression and subsequent filling of the erosion areas with new sand.

Analysis of petrophysical relations showed significant influence of the formation conditions on the distribution characteristics of petrophysical parameters in the reservoir (Fig. 2b). It became possible to see that the sandstones composing the meandering channels and the sandstones of mouth-bar significantly differ in the nature of the core-core relations (porosity / permeability).

Seismic data analysis

Seismic-amplitude map was used for contouring of channels (Fig. 3a), but high elevations with steep slopes in the structural plan of the surface contribute to the appearance of increased amplitudes on the map in places where there are no channels. The axial parts of the elevations could be interpreted as the axial parts of the channels and this could lead to errors in the forecasts of the effective thickness the reservoir. The axial parts of the elevations were highlighted on the variance map (Fig. 3b). Contouring of channels was made taking into account the axial parts of the elevations.

Method of predicting well thickness from seismic-amplitude is showed on the cross-plot (Fig. 2c). The relationship of well thickness with seismic amplitude values is characterized by two point clouds. The upper cloud includes points of well thickness from channel area with increased thickness volume. The lower cloud includes points of well thickness from channel area with reduced thicknesses.
Figure 1 Spectral frequency decomposition slices (0 mc (a) and -6 mc (b) with RGB blending)

Figure 2 Well data analysis: a - a special shape of the SP curves in wells in the channel area (red curve) and in the mouth-bars area (blue curves); b - difference in the nature of the core-core relations (porosity / permeability) for channel sandstones (red points) and sandstones of mouth-bars (blue points); c - the relationship of well thickness with seismic amplitude values for channel sandstones (red points) and sandstones of mouth-bars (blue points).
So, the prediction of the thickness of the reservoir was made according to two equations. The final map of the thickness depends on contouring of the channels when using this method. Facial analysis and channel contouring is the most important part of predicting reservoir properties.

The final reservoir thickness map (Fig. 4a) shows reservoir heterogeneity (Fig. 4b) and is consistent with seismic and well data. The channel cut is clearly visible in the section (Fig. 4b).

**Conclusions**

Deposition model of Upper Jurassic formation in the central part of the West Siberian Basin was improved using new 3D seismic data. The facial classification of well data made it possible to substantially refine the prediction of reservoir properties on the investigation area. Delta channels with increased collector thicknesses and high permeability values were outlined. These areas are the most promising reservoirs.

The discovery of delta channels in the central part of the West Siberian basin is an important fact for regional geology and stratigraphy. Transgressive and regressive sea level fluctuations had large amplitude and had a great influence on the structure of the reservoir. This requires the introduction of different indexation for these formations.

Facies analysis and depositional sequence stratigraphy offers real potential to optimize exploitation. The high permeability of the delta channels can contribute to a lower level of water-oil contact and this greatly affects the process of modeling oil deposits.

Tectonic processes also strongly influence the formation of the reservoir and its transformation.
Figure 4 The final reservoir thickness map (a) and section of channel (b).

References

