STAGES OF CREATING A THREE-DIMENSIONAL GEOLOGICAL MODEL

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The creation of three-dimensional geological models at the present stage is a necessary element in the design, analysis and regulation of the development of oil and gas fields. The task of reliable and high-quality three-dimensional modeling is relevant for calculating reserves and drawing up design technological documents. The purpose of this work is to study algorithms for three–dimensional geological modeling. Within the framework of this goal, the key task is to study by students approaches to improving the reliability and quality of three-dimensional models. By the quality of 3D models, we will understand the compliance of the 3D model with formal physical and mathematical requirements, by the reliability of 3D models - the compliance of the 3D model with the real geological environment (oil deposits) [1, p.56-61].

It should be noted that for poorly studied deposits, the solution of the problem of increasing reliability is of extremely important practical importance. Building a reliable geological model is a non-trivial task that requires an engineer to have a good knowledge of the geological structure of the simulated objects and a wide range of methodological modeling techniques. Let's list the main software complexes of three-dimensional geological modeling used today in the world: Stratamodel (Landmark), Petrel (Shlumberger), IRAP RMS (Smedvig Technologist), DV GEO (CGE). On the territory of the Perm Region, 99% of the models are built using IRAP RMS and a small part - with DV GEO. All modern modeling software packages contain the following main stages of three-dimensional geological modeling: - preparatory stage; - structural modeling– - creation of a three-dimensional grid; 5 - averaging of borehole data into cells of a three-dimensional grid; - lithological and facies modeling– - petrophysical modeling; - saturation modeling; - 3D inventory calculation. All stages are interconnected, and the results of each affect both the quality of the subsequent stages and the reliability of the entire model. The training manual provides an overview of the stages of modeling, the ways of their optimization are considered [2, p.15-19].

The first stage of any modeling project is the collection and loading of initial information. Basic data required for the construction of three-dimensional geological models:

1) inclinometry and coordinates of wellheads;
2) geophysical studies of wells and the results of the interpretation of geophysical studies of wells;
3) results of detailed geological correlation;
4) results of structural and dynamic interpretation of seismic exploration;
5) fluid contact levels;
6) inventory counting materials.

A project is created in the three-dimensional modeling software package, and all the source data is loaded into it.

Note that the quality and reliability of the final three-dimensional geological model depend on the quality of the initial data. Further, the developed approaches to finding errors and correcting some types of source data at various stages of model construction will be considered in more detail [3,4].

The result of the stage is the loading of all the collected information into a three-dimensional modeling package. All uploaded data can be visually viewed and evaluated in simulation software packages.

In many ways, the quality of the model depends on the quality of the source data, in particular, on the well inclinometry.

Let's consider the main types of problems encountered related to inclinometry data, which complicate the construction of three-dimensional geological models and the industrial calculation of reserves based on them. Problems can be divided into two types:

1) technical problems related to measuring equipment and subsequent machine processing of the received data;

2) problems of using inclinometry data to build three-dimensional geological models.

The first type includes errors and inaccuracies made directly during measurements (due to the technical capabilities of the devices). Firstly, these are errors in the zenith angle of the borehole. The essence of the error is that the zenith angle of the borehole between two adjacent points of registration of the inclinometer varies within unacceptable limits.

Secondly, the stretching of the logging cable during inclinometry and geophysical studies of wells also introduces an error in measuring the depth of the wellbore [4, p.1-6].

Some of the various errors occur when processing the received data. The reason for these errors is most often the "human factor". In addition, the source information has a different format, low quality of recording and digitization, mainly it refers to inclinometry for old deposits, data on which were obtained several decades ago. All this creates considerable difficulties when processing and loading data.

The second type of problems associated with inclinometry arises

directly during the construction of three-dimensional geological models. Firstly, these are problems that appear at the stage of structural modeling and are associated with the coordinates of the intersections.

According to the coordinates of the intersection of stratigraphic boundaries of layers with the borehole, the structural surfaces of these layers are constructed. Sometimes there are situations when wells with significantly different marks of formation intersections fall near one cell node, which negatively affects structural constructions.

The use of new functionality of software complexes in terms of working with inclinometry in practice makes it possible to correct inclinometry in an environment for creating three-dimensional geological models. The result is three-dimensional geological models in which the influence of errors in the source data is minimized. For poorly studied deposits, it is best to take data for the model from neighboring deposits (analogues) that have been studied as much as possible by drilling and seismic exploration, with a complex of special petrophysical core studies, such as lithological-facies, biostratigraphic analysis.

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