Study on the Identification of Composite Sand Body Single Channel by Well Seismic Combination

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Abstract. The single channel sand body is a relatively independent unit in the reservoir. The accurate identification of the single channel sand body in the composite channel sand body is an important work for the exploitation of the reservoir in the high water saturation late stage, and is also a difficult point in the study of the reservoir. This paper discusses the basic research and identification methods for identifying the single channel sand body in the delta distributary plain composite sand body in the oilfield. The understanding of composite sand bodies is deepened, and the operability of single channel sand body identification is also improved, which has achieved certain results in oilfield development and application.

1. Introduction
The main development layer of the oilfield is a large river delta deposit in the Lake Basin, which mainly develops channel sandstone, and the identification of single channel sand in the composite sand body is an important content to identify the heterogeneity of the channel sandstone. The detailed reservoir description technology of high density well pattern is used to identify single channel sand body, which has a certain guiding significance for excavating potential of the remaining oil in the oilfield.

2. Idea of single channel sand body identification

2.1. Vertical subdivision time unit
The division of the sedimentary units is the basis of reservoir description. In the closed section of the skeleton, the phase control cycle isochronous oil layer comparison method is adopted, and the time unit is subdivided vertically by the method of "sedimentary cycle contrast, stratification control, different phase band difference treatment". According to the degree of undercutting of the early stage channel sand bodies, the vertical cut types of channel sand bodies can be classified into four types.

Type I: the later period of the river only undercut the early distributary channel's upper mudstone, and the uncut sand bodies are completely distinguished.

Type II: the later period of the river undercut the mud siltstone, which is on the top of the previous river, and it can be obviously distinguished.

Type III: the later period river channel undercut down to the early channel sand bodies, and it can be barely distinguished.

Type IV: the later period river channel deeply undercut down to the sand body, and it is completely indistinguishable.
The time unit division is the basis for the identification of the single sand body of the large composite sand body. In order to identify the single sand body in space, first of all, the single sand body level should be delimited in the vertical space, secondly, the wells with the characteristics of type I tangent are selected in vertical direction, and the time units are identified and divided by the space (vertical and plane), which are divided from the time unit to the undivided place. The boundary line is determined first, then the boundary is determined according to the characteristics of the single well cutting surface, the vertical cutting degree and the vertical mode of the genetic element. Finally, the interface of the "large side cutting channel composite sand body" is determined.

2.2. Accurate description of prediction in plane
In a single time unit, the distribution of large and medium channel sand bodies can be traced on the plane according to the well logging data. These channels are often the lateral complexes of several single channel sand bodies in the same period.

In the distribution range of the lateral complexes, according to a series of experiences and methods summed up by the detailed reservoir description technique of high density wellnet, the precise and predictable description of the boundary position, geometry, distribution and combination of the single channel sand body can be described, and its genetic type is determined, and the specific results of identification are also determined.

The composite channel sand body of different causes and different combination patterns, the complexity of the internal single sand body is obviously different, and the differences of the development degree of the single sand body in different sedimentary facies positions are also different. Therefore, not all the single channel sand bodies in composite sand bodies can be fully identified. This is the difficulty of identifying single sand body.

3. Identification methods of single channel sand body
The accurate identification of the river boundary is the key to identifying the single channel. On the basis of identifying the types of the genetic sand body and the spatial structure of the anatomic single sand body, the identification marks of the single channel boundary in the study area are summarized.

3.1. Discontinuity of inter river sand bodies
The channel sand body width of the distributary plain is more than 150 meters, and the river sand body with large area distribution is the result of multi channels lateral integration, but there is always a bifurcation between the two rivers, and the trace of the sediment in the river is left. The discontinuous distribution of the sand body (the river mud or thin sand) along the longitudinal direction of the river is the symbol of the dividing line between the two rivers.

3.2. Abandoned river sedimentation
Under the action of hydrodynamic force, the erosion of the concave bank and the convex bank deposit occurred in the bended part of the river. The lateral accumulation of the river formed a side accumulating body each time. The side accumulation was carried out continuously. The river bend gradually increased. When the river broke through the river bend, the original river was filled with mud and formed an abandoned river. According to its causes, the last period of abandoned river development represents a changement of river. For general distributary channel sand bodies, we can distinguish different channel sand bodies from abandoned river area based on the size of sand bodies. Usually, the well point of abandoned river should be attributed to the channel sand body with its bottom boundary. Abandonment channel deposition is an important sign of single channel sand body boundary.

3.3. Layer difference of river channel
Although the different channel sand bodies belong to a genetic unit, they are affected by the influence of the sedimentary energy and the difference of channel changes or discarded time influenced by the
sedimentary topography, and there are differences in the top and bottom layers. If the difference occurs near the river boundary, it can be regarded as the mark of the boundary of two channel sand bodies. The boundary difference between adjacent wells is 1/3 larger than that of thickness. There may be a single river boundary.

3.4. Thickness difference of sand body at the edge of river
Because of the undercutting of rivers, the thickness of river sand is thinning from the center of the river to the thickness of the edge, and the physical properties of the rock gradually become worse. Although the channel sand bodies are widely distributed in a large area on the plane, the middle thickness of the river and the thin on both sides of the river are similar to the lens, which can be used to distinguish two rivers and identify the two river boundaries.

4. Well seismic combination and its application
The advantage of seismic data in plane is applied to guide the continuity between sand bodies and identify the single river boundary by the use of well seismic and detailed anatomic reservoir technology combination. On the basis of the identification of a single channel by the sedimentary facies diagram, the direction, continuity and boundary of the river courses on the seismic slice figure are corrected by the direction, continuity and boundary of the channel. The development of the sand body between wells and the width, connectivity and direction of the channel sand body are further implemented.

In the B sedimentary unit in the oilfield A, the original sedimentary facies diagram of well A and well B is considered to be in the same channel, and after the combination with the seismic slice figure, it is believed that the two wells are in different channels. The method of pulse well testing is used to judge the connection between well A and well B, and further verify and improve the accuracy of well seismic combination technology.

![Figure 1. Compared identification of old and new sedimentary facies diagram.](image)

From the pulse curves of well B, well A, well C and well D, it is found that the flow curve of the well C of the reaction well varies with the well B pulse cycle of the excited well, and the time lag is 6.396039h, indicating the connection between two wells, and the well A, well D and the excited well B flow curve of the reaction well does not change with the pulse period, so the two well and the excitation are excited. The wells are not connected with the well B.
5. Residual oil distribution

The residual oil can be found in the abandoned river channel. The lithology and physical properties of the abandoned channel become worse, which plays a role of shielding the channel sand, and most of abandoned river channels can form residual oil.

The residual oil can also be found at the edge of the single channel. In the process of laterally changing channel sand into inter channel mudstone, the edge of the river extends to tens of meters or even hundreds of meters, which can form abundant residual oil.

The occlusion type residual oil can be formed between narrow strip channels. This type is the same as the imperfect injection-production residual oil at the edge side of the river. There are narrow strip channels in the large composite sand, and it is not easy to identify when the well density is not intensive enough. It is mistaken for two channels to connect, but in the fact, there is abundant block remaining oil in narrow strip channel.

6. Conclusions

(1) The basis for identifying single channel sand bodies in large composite sand bodies is accurately divided into time units vertically. On the plane, the identification of single sand body must be analyzed synthetically according to the discontinuity of the sand body, the distribution of abandoned river channel, the differences of the two river sand bodies and the thickness differences of the river side.

(2) The method of using well seismic data combination to guide identification of single channel, which can be effectively improve the accuracy of reservoir dissection.

(3) There types of residual oil are identified, which are generally distributed in the abandoned river channel, the single river edge side and between the narrow strip channels.

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