Analysis of Reservoir Prediction Method in Outspread no-well Area

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Abstract: # oilfield has entered the late development stage of super high water cut, the comprehensive water cut of the oilfield has exceeded 96.7%, the production decline leads to the difficulty of maintaining stable production, it is imperative to increase the recoverable reserves. According to the oil test data of 6 outspread evaluation Wells deployed in the east outspread area of # Oilfield from 2008 to 2010, it is proved that this block has certain productivity. In this study, based on the sand-body characteristics of three and four belts based on the well logging data sedimentary facies map, combined with the seismic attribute interpretation results, the five belt sand-body was predicted. The development characteristics and distribution of the reservoir were clarified, which provided a reliable basis for the formulation of reservoir engineering plan and the realization of efficient development of the five strip extension block.

1. Introduction.
Due to the lack of well logging data in the study area, in order to make clear the geological characteristics of the study area, the scope is extended to three zones. Based on the latest logging data and well seismic reservoir prediction method, the sedimentary unit facies belt map of SI oil-bearing unit in the study area is drawn. It provides an important basis for this study.

2. General situation and existing problems of the study area
The oil-water transition zone of SI unit in the east wing of # oilfield is located outside the oil-water transition zone of SII unit. The block is monoclinic structure, with undeveloped faults and stratum dip angle of 3-5 °.

However, most of the research results have not been completed in the Eastern oil zone based on the well logging data. There is no well area in the eastern extended area of the oilfield, and there are only 6 evaluation wells data. The conventional pattern mapping method can not meet the requirements of facies belt map accuracy. It is the only way to carry out the sand body distribution characteristics in the extended area by combining the seismic attribute slice data with well seismic prediction method.

3. Well seismic attribute fusion technology in Eastern transition zone

3.1 seismic attribute extraction and optimization
Seismic waveform attribute extraction technology is a new technology that uses various seismic inunit to divide sedimentary facies zone. Seismic trace waveform can truly reflect the geological characteristics of underground, and is a simple method for geologists to quickly obtain seismic inunit.
It has been proved that the application of this technology makes full use of abundant seismic inunit to reflect the lateral variation of seismic signal, and has a remarkable effect in sedimentary facies research and reservoir prediction. In this study, attribute slices of 6 sedimentary units of SI unit in the extended area were extracted (Fig.1). Each sedimentary unit extracted 15 kinds of seismic attributes and instantaneous attributes of 10s open time window, a total of 150 slices. The most sensitive attributes to geological conditions are selected, and the sedimentary units which are most suitable for attribute prediction by attribute slice are selected.

![Seismic attribute slice of Eastern transitional zone](image)

**Fig. 1** Seismic attribute slice of Eastern transitional zone

### 3.2. seismic attribute fusion reservoir prediction

Because the reservoir parameter prediction of neural network model is based on well point data, it can well predict the connectivity of channel sand body in the area with wells, but it can not be predicted in the area without wells. Therefore, the reservoir prediction in the five belt extended area should be combined with single attribute slice to realize the preliminary implementation of sand body distribution characteristics in the well free area.

### 4. Study on reservoir prediction method of well seismic combination

#### 4.1 drawing principle of sedimentary facies zone map

According to the above seismic research results, the drawing principle of sedimentary facies belt map in the study area is determined comprehensively: the well pattern control degree in the four zones is high, the well point facies characteristics are mainly in the area, and the attribute fusion slice is used for prediction and description between wells; the single seismic attribute slice and pattern mapping method are comprehensively used to draw the sedimentary facies belt map in the extended no well area.

#### 4.2 drawing method of well seismic sedimentary facies zone

##### 4.2.1 drawing method of facies zone diagram in well area.

Adjustment of well seismic combination phase: taking A and B wells as examples (Fig.2), SI3 unit is developed with independent effective thickness of 1.3m and 1.5m, permeability of $0.621 \mu m^2$ and $1.117 \mu m^2$. Referring to seismic multi-attribute slice, seismic reflection attribute is consistent with that of adjacent wells. Therefore, the main sheet sand identified by computer is changed into channel sand, and the channel sandbodies originally considered to be intermittently developed are connected into narrow strip continuous distribution channel sandbodies.
Intermittent continuous adjustment: when the model drawing method is used to draw the sedimentary facies belt map, there is no prediction for well points separated by more than 150m between channel sands. For example, for the two wells *10-1110 and *10-121, channel sand is developed in SI5 unit. Although the river channel has obvious directionality, it is conservatively considered that the channel is intermittently developed due to the well row barrier. Referring to the seismic attribute slice, it shows that the seismic reflection attributes between the two well points are consistent, so it is comprehensively judged that the channel sand in SI5 unit of the two wells is connected.

Well seismic adjustment combined with continuous intermittent adjustment of sand body between well points: when drawing phase zone diagram with pattern drawing method, a kind of connection processing is made for the same phase of adjacent well points. For example, well *10-1030 and well *10-114 are adjacent, and SI11 unit belongs to fluvial facies. The sand body connection processing of the same river channel is conducted. Referring to the seismic attribute slice, it shows that the seismic attributes of the two wells are inconsistent. After comprehensively considering the sand body direction, the river continuity is adjusted.

Drawing method of facies belt map in well area: the sedimentary facies belt map is drawn according to the mode drawing method in the area with well point data. For reservoir prediction between well points, the reservoir development directionality is mainly considered, and the reservoir continuity is comprehensively predicted by combining with seismic multi-attribute fusion slice; for individual main sheet sand, the logging curve shape is positive rhythm, the permeability is greater than 0.400 μm², and it follows the river course trend and geological conditions The seismic attributes show that the sand body has good connectivity, and the facies is adjusted to channel sand.

4.2.2 drawing method of facies zone diagram in no well area.
Under the condition that the single attribute slice is consistent with the reservoir development trend: firstly, the directivity, continuity and scale of the five belt sandbodies in the wellless area are predicted according to the model drawing method, and then the single attribute slice is referred to. The consistent range of seismic attributes in *12-1600 well block is larger than that predicted by model mapping method. According to the trend of river channel and from the genetic analysis, it is concluded that the burst impact fan is more reasonable, and the development area of sheet sand is enlarged during mapping (Fig.3).
In the case that the single attribute slice is inconsistent with the development trend of reservoir: firstly, the sand body in the external expansion area is predicted according to the model drawing method. Considering that the SI12 unit belongs to delta sedimentary environment, the channel sand is less developed, and the sheet sand body is developed in a large area. According to the development scale and direction of sand body at adjacent well points, the sand body in the external expansion area is predicted.

Drawing method of facies belt map in no well area: for units whose seismic attribute slice is in accordance with the trend of facies belt diagram, the single seismic attribute slice is mainly used to display the results, and the facies, directivity, continuity and scale of the sand body in the well free area are comprehensively predicted by referring to the development direction of sand body in the well area; for the unit whose seismic attribute slice is not in good agreement with the phase belt diagram, the sand body prediction in the well free area is in the trend According to the conservative principle of "low, not high", extrapolation prediction is carried out according to the development direction of sand body in surrounding well area.

4.3 sedimentary characteristics of SI unit sandbodies in extended area

According to the above mapping methods and principles, six sedimentary facies maps of the study area have been completed (Fig. 4)

The sedimentary reservoir of the fifth zone in the eastern transition zone of # oilfield is SI unit, belonging to the outer front sedimentary environment. The sand body characteristics are mainly thin sheet sand, and the upper three units are worse, mainly non main sheet sand and surface sand, less main sheet sand, and sandstone pinch out area is relatively developed; the lower three units are mainly composed of main sheet sand, with non main body and scattered small lump water locally. The sand
body of lower channel is rare in the pinch out area of sandstone. Generally speaking, the reservoir development characteristics of the study area have little change after the combination of well and seismic, and the facies changes in some areas after combining with seismic attribute slicing, and the prediction of inter well sand body and non well area sand body prediction change, so that the continuity, direction and development scale of river channel are partially modified.

5. conclusions and suggestions
5.1 the mapping principle of well point facies characteristics in well area is established, and seismic attribute slice is used to predict and depict between wells; seismic single attribute slice and pattern drawing method are comprehensively used to draw sedimentary facies zone map in extended area without well.

5.2 the prediction of cross well sand body in well area is mainly combined with attribute fusion slice, and the well seismic combined with sand body phase judgment method under the control of well point facies is established.

5.3 innovatively combined with seismic single attribute slice, the sand body prediction in no well area is completed, and the sand body distribution characteristics are clarified.

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