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Stratal Slicing and Coherence Technique for Describing Sand Body

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Abstract: In the middle-late stage of reservoir development, in order to sovle the problem of describing sand body boundary between wells, river channel's combination is diversity, difficult to describe the variation sand body's distribution, and so on. We elaborate geological interpretation and level calibration Sartu oil-bearing layer, under seismic sedimentology's guidance, we use strata slice technology to extract seismic attribute, after that we choose seismic attribute slice of every sedimentation unit quantitative and qualitative, use coherence technique as an auxiliary method to describe sand body boundary, at last we make amplitude-coherence fusion slice, and combined with log information, the study of describing sand body of thirty-three sedimentation unit Sartu oil-bearing layer has been carried out. The study shows that amplitude-coherence fusion slices have a great effect on the problem of describing sand body boundary between wells, river channel's combination is diversity and describe the variation sand body's distribution, and we continue forecasting the sand body's distribution at the lower sedimentation unit which has no log information in the north of the study area, and solve the problem of only use log information to describe sand body before.
Keywords: strata slice technology; attribute optimization; amplitude-coherence fusion; describing sand body.

INTRODUCTION

Seismic sedimentology is a subject, through which we can use seismic data to study sedimentology and its effect, its theoretical basic is based on sequence stratigraphy, sedimentology, seismic stratigraphy, geophysics and others. Strata slice technology is one of the three main technologies of seismic sedimentology, its basic and core theory is to redefine the geological significance of seismic synthetic shaft, to solve the isochronous problem of seismic stratigraphic [1-3]. However, only on the basis of strata slice technology to extract amplitude attribute has some problems such like the attribute values of boundary is not clear, men's intervention color modulation, etc.. Coherent technology has a good effect in the analysis of discontinuous seismic data (fault, sand body boundary). In this paper, we base on the research of two kinds of technology, give full play to the advantages of these two, using coherence technology to solve the problem of seismic attribute slice boundaries are not clear, made amplitude-coherent slice fusion, study the characterization of the sand body with it, the application has gained a good effect.

SURVEY OF RESEARCH AREA

Sabei development area North Ecotone is located on Northeast of Saertu Oilfield, Daqing Placanticline. The study area is located in the central section of the north transition zone, the area is about 11.68km^2, including 484 different batches' wells. The purpose layer is the Saertu reservoir group(Sa I, Sa II, SaIII), the average thickness is 107.56m, seismic response time is about 70ms, belongs to the Fluvial-Delta sedimentary system, the sand and mud interbed distribution. Because in the mid and later stages of development, interwell sand body description difficulties, well distance of the study area north south sparse dense, the lower section of the northern part of the target layer of logging data deletion and other issues, only by logging data it is difficult to grasp the fine sand body characterization. The 3D seismic data are of high quality in researching area, frequency is about 44Hz. Structure is relatively simple, only developed a small scale fault providing good conditions for the region using the method of combining logging and seismic fine description of sand body.

THE ANALYSIS OF SEISMIC RESPONSE FOR THE SAND BODY

Using seismic attribute as a basis, which is extracted from seismic data, to describe planar sand body, first we must determine the corresponding sedimentary units of the seismic response time; it is an important basis for combination of well and seismic reservoir sand body characterization[4-6].

The establishment of seismic stratigraphic framework

Establish stratigraphic frame for carrying out seismic sedimentology study of seismic and geological framework, in the study of seismic sedimentology is indispensable. First of all, the layer should be fine for the purposes of the division and correlation of sedimentary units, based on the implementation of log

data delineating. Then pick the wells, which have a similar drilling time with the seismic acquisition time, used to demarcate seismic horizons, making the whole area under control. At last we choose the strong seismic events, developing all over this area and near by the target layer, to establish the seismic stratigraphic framework.

Follow these principles had carefully horizon calibration. The Sa I top, Sa II top and bottom Sa III in the seismic are strong axis seismic reflection, T_1 corresponds to the top of the Sa II, T_{1-1} corresponds to the end of the Sa III. (Figure 1).

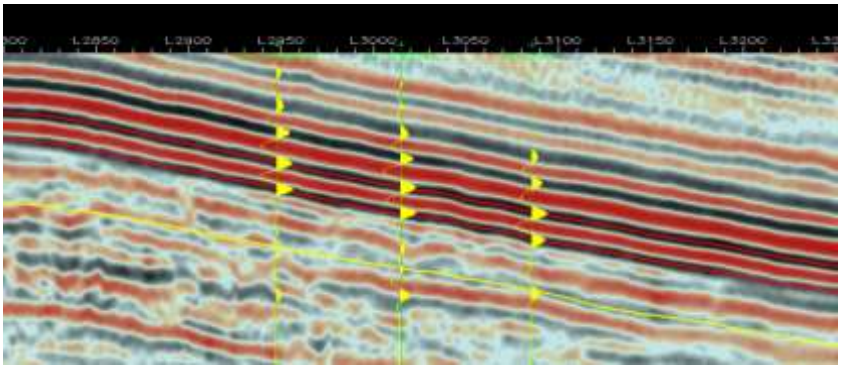

Fig. 1: Demarcate seismic horizons in Sabei Development Area Saertu oil layers group

Optimization of seismic slice

Determination of seismic attributes

Each attribute has its different meanings, used to reflect the physical characteristics of underground rocks, having very complex relationship with lithology, physical properties, oil, gas and water, and the presence of repetitive and multi solution. So the researchers must have clear purpose and fully understand the physical meaning of each attribute and its geological significance of the representative cases, qualitative and quantitative optimization of choosing seismic attributes [8, 9]. According to the interpretation experience of adjacent blocks and predecessors, the distribution law of sand body in the study area is better correlated with the instantaneous amplitude attribute, so it can be used to determine the distribution of sand bodies according to the variation of the instantaneous amplitude along the layer.

Strata slice technology

Strata slice technology is a method which based on two seismic interpretation events as top and bottom, linear insertion function in accordance with equal proportion of thickness in two seismic events, re extracted seismic horizon, and extracting seismic attributes by using these extracted horizons [10-16]. Compared with the time slice and single layer under the drift section, strata slice has more deposition on such characteristics, and can accurately locate the seismic response time of sedimentary, so as to avoid the leakage and wear layer. And the application of stratigraphic section method can effectively improve the seismic vertical resolution; break through the traditional resolution limit 1/4λ, according to the actual situation of this research area, the seismic longitudinal resolution is 1/6λ.

In this paper, the linear interpolation 100 cases between the SaII top and the bottom of the SaIII oil layer in the study area, and the instantaneous amplitude properties are extracted from the top down. In these sections, we can clearly observe the distribution of plane sand bodies and the trend of sand bodies in the vertical direction. On the basis of the sedimentary units of sand isopach map, taking SaII1+2b sedimentary unit as an example. First we find some slices for sand body distribution similar to a plurality of sections in the 100 attribute slices. Secondly were extracted from these attribute slice borehole side seismic attribute values, values of these attributes and sandstone data correlation analysis. Finally, select highest correlation of seismic attribute sections described as the sedimentary units of sand body seismic bases (Figure 2).

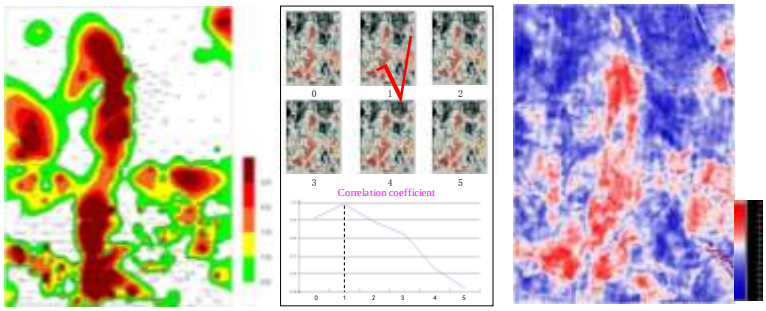

Fig. 2: Qualitative and quantitative optimization of small layer attribute slice

Coherence analysis

Coherent data reflects the relative change in seismic reflection intensity of the adjacent seismic traces, its physical meaning that reflect the discontinuity of the three-dimensional seismic data, and the geology of this change is reflected as faults and reservoir lithology changes. Therefore, coherence technology can help geologists to effectively understand the rule of sand body plane distribution, and identify the sand body's boundary, so as to achieve the purpose of fine characterization of sand body.

Adjacent seismic traces coherent distribution range is between 0 and 1. In order to improve the precision of the range of linear proportion to expand and full coherence of the data points to maximize value for subsequent processing. Coherent slices were extracted from the sedimentary units by stratigraphic section method to ensure the consistency of seismic data (Figure 3).

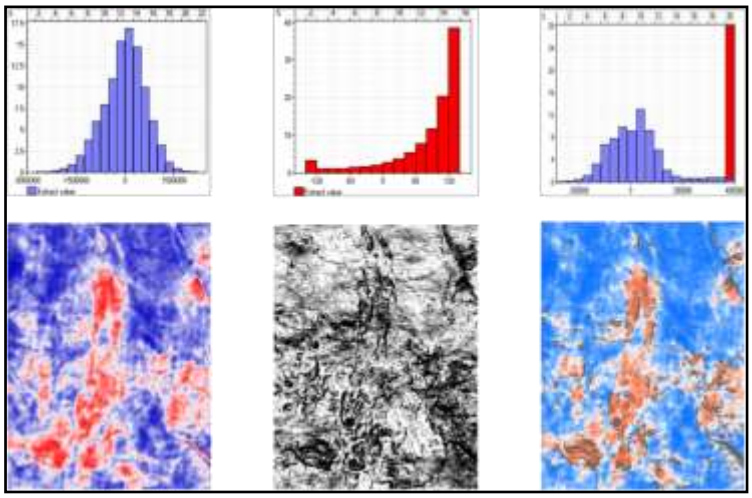

Fig. 3: Amplitude coherent fusion technique

Amplitude-coherence fusion technology

According to the conventional amplitude slices on local channel sand body boundary prediction is not clear, make full use of coherent technology boundary recognition ability strong and instantaneous amplitude attribute to reflect the characteristics of lateral lithology variation trend, processing and merging the two seismic data, so it can reflect the information of instantaneous amplitude attribute, and it also includes the characteristics of the sand body boundary ability of the coherent technology in one seismic slice. The advantages of the utility model are also included in the determination of the sand body boundary prediction of the river channel. The problem of increasing the workload of the sand bodies in the multi section prediction is reduced, and the errors in the prediction of the well seismic binding sand bodies can also be reduced.

The fusion process specific, taking SaII1+2b as an example: first, determine the amplitude attribute distribution, and according to reservoir sandstone thickness distribution characteristics determine the boundary of the sand body of coherent threshold value. Secondly to is greater than the threshold value of coherent data unified as a single value, and removed from the amplitude attribute range distribution range. Finally according to the three-dimensional coordinates of the seismic, the last coherent boundary value replace all to seismic attributes, to become on the range of the distribution range of modulation code, you can get the amplitude coherent fusion slices (Figure 3).

APPLICATION EFFECT

In order to ensure the accuracy of the sand body characterization, the data processing and extraction process must strictly obey the order, and finally produce the amplitude coherent fusion section, which is used to describe the sand body. The application effect of the fine description of the sand body of well seismic collection is described with the example of the two sedimentary units of SaII1+2b and SaII13+14a:

In the problem of sand body boundary is not clear, channel combination of diversification, according to information fusion slices, clear channel combinations. Northern study area under the log records are missing parts, according to the seismic response of information, the general prediction of sand body distribution and river go to (Figure 4). Fusion combines the characteristics of the section intensity amplitude boundary, initially identified channel internal variation of the distribution of sand body (abandoned channel), and based on boundary information is roughly delineate the abandoned channel trend. Combined with logging data, implement sand body worse situation, the final repair decoration abandoned channel of plane distribution characteristics (Figure 5).

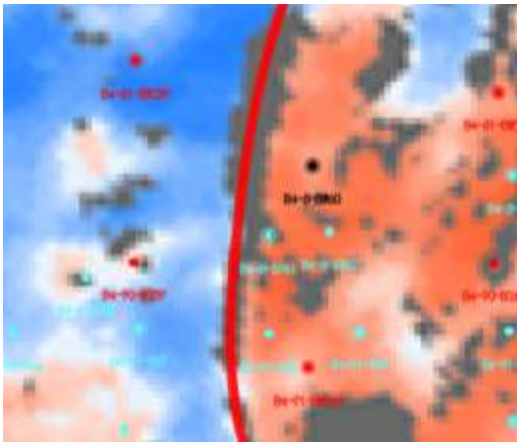

Fig. 4: Description sand bodies between well

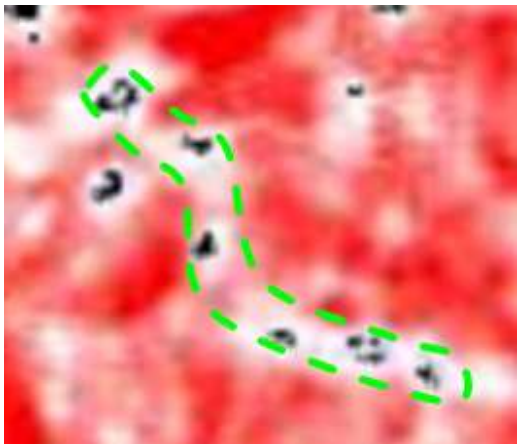

Fig. 5: Description abandoned channel

CONCLUSIONS

To fine deposition unit division and correlation of the identified divided according to the well logging data, combined with the implementation of the seismic on the deposition of stratal slicing method when division, and in the vertical through the first qualitative quantitative analysis method to determine the relationship between the two. Combined with the coherent technology making the amplitude coherent fusion slices, meticulous depiction of sand body, the implementation of sand body boundary, channel combinations and the identification of abandoned channel, the well seismic combination of sand body description is more consistent with the interpretation of seismic sedimentology theory, makes full use of the seismic data. Using the technology of Sabei development area in northern transitional zone of Saertu oil layer group a total of 33 sedimentary units of the fine sand body description of and resolved only in the past to logging data as depicting some of the drawbacks of the sand bodies according to, and has a very important significance of sand body of reservoir description.

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