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Fine Structure Description of 3D Seismic Data in Huangjindai Oil Field

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Abstract: In this paper, the 3D seismic data and logging data of the gold belt are used to carry out the horizon calibration and wave group characteristics analysis. And then I carry on the whole region of the stratigraphic correlation tracking. In the process of 3D seismic data interpretation, the coherent body technique is used to determine the macroscopic features of the fault, and the Express Landmark velocity model of DepthTeam is used to integrate various geological and seismic data. In the control of seismic interpretation horizon, the time depth relationship of the 26 wells is interpolated, and the 3D velocity model is established. The depth value of each interface is obtained by using the depth of the conversion of variable speed. Through the fine interpretation of 3D seismic data, it has been carried out the Jiazhangsi fault(F1)in the eastern part of the Huangjindai oil field, the Erjiegou boundary fault (F2), and the broken groove main fault –Huangdong fault(F3).

Keywords: *Huangjindai Oil Field,Fine structure description,3D seismic data, horizon calibration*

I. INTRODUCTION

Huangjindai oil field is located in Dawa County of Liaoning Province.There are a large field, ditch multi interlaced, convenient transportation there. The structure of huangjindai oil field is located in the southern part of east sag of Liaohe basin, west near new oilfield, and its northeast is bordered by the yulou oilfield, and its south next to Jiazhangsi sag.There are dongying formation (d), sand section one(S1), sand section three (S3) three sets of oil bearing gas bearing formation in the huangjindai oil field. Dongying group, including dong one ,dong two and dong three sub sections. Dong two and dong three are divided into 4 sand groups. Focus on the layer section of sand one, including the upper, middle and lower three sub section, divided into 15 sand groupa, 33 small layers. The sand three section includes three sub sections, which are divided into 3 reservoirs and 19 small reservoirs. The sand two section in the study area is missing.

The area overall has run through the arch of the Liaohe rift basin Paleocene arch, from the middle Eocene to late Oligocene rifting and late Tertiary to today's depression stage, which reflect the development and changes of the Liaohe basin is universal, and it also reflects its particularity. Through the fine interpretation of 3D seismic data, this paper has carried out the Jiazhangsi fault(F1)in the eastern part of the Huangjindai oil field, the Erjiegou boundary fault (F2), and the broken groove main fault –Huangdong fault(F3).

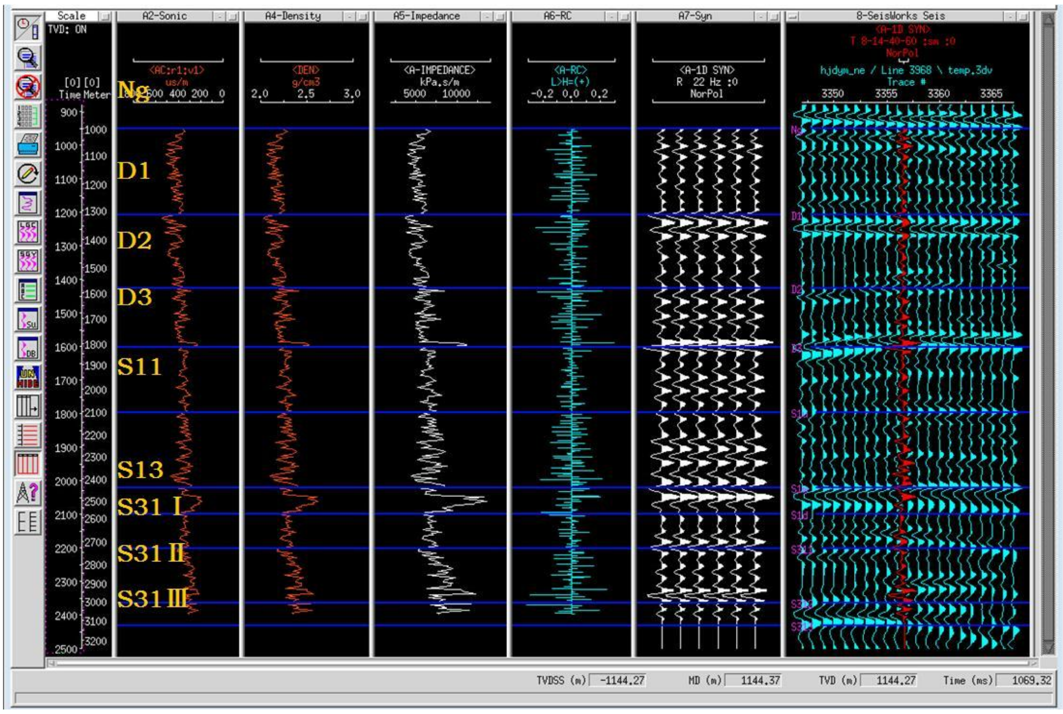
II. HORIZON CALIBRATION AND WAVE GROUP CHARACTERISTICS

2.1 Horizon calibration

Seismic data in the study area is a 3D data body.The area is more than 150 square kilometers.The main frequency is about 20Hz.The noise-signal ratio is relatively high, and the profile quality is good. But the structure of this research area is very complex, and the lithology is more complex, so that the synthetic record can be produced by several wells in each block to achieve the accuracy of the horizon calibration, and also greatly improve the reliability of the stratigraphic correlation tracking.

Accurate horizon calibration is the precondition and foundation of seismic data interpretation and lateral prediction of reservoir, and is the bridge between the drilling and seismic . I use log data, combined with the artificial synthetic seismic record to carry out the speed precise analysis, fitting the method of the comparison of the average speed and the empirical speed and other methods. Due to the influence of instrument measurement and other factors, the logging data is complex. For the situation such as time difference curve not good, segmentation measurement,and the length of the wells section very limited, so I have to deal with the time difference of collection and density curve, including the removal of singular values, baseline drift, curve connection, environmental correction and so on to complete partial correction. In the production of synthetic seismic records, this paper adopts the method of four square method to correct the time difference:(1) Phase rotation;(2) Tension and compression;(3) Determine marker horizon,scanning correction of the time difference between layers in a small range;(4) Matched filtering for synthetic seismic record through seismic wavelet from the well side seismic channel. In the wavelet extraction process, we performed scanning by time window of near wells, in order to obtain the best wavelet. By these means, we have made the synthetic seismic records of 100 wells in the Huangjindai oil field. These records can be well similar to the reflection characteristics of the seismic traces in the wave group and the seismic sequence.

Using well data as a bridge, the corresponding time of the reflection layer is used to calibrate the region well.We use the time of reflection marker and well bypass with synthetic seismogram similarity whose characteristics in the well and seismic profiles are obvious to judge the reliability of the results of calibration(Pic1). Finally, the horizon is calibrated.



Pic 1 Synthetic record

2.2 wave group characteristics

Bottom interface of Guantao Group of up Tertiary：It is equivalent to the bottom boundary of massive sand conglomerate in bottom of Guantao group. Its seismic reflection characteristics are 2 to 3 strong phases. The internal reflection structure is parallel, the region can be continuously tracked, and the lower layer is not integrated into the angle of the formation of the contact.

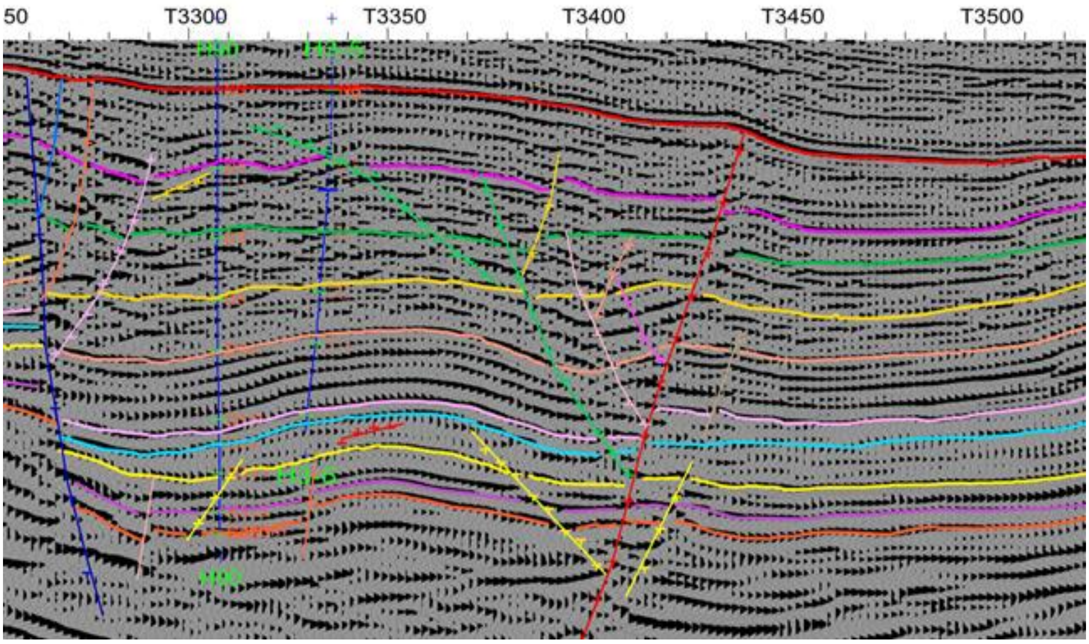
Table1 Seismic reflection wave group feature of Huangjindai Oil Field

hori	Bottom boundary reflection	Top bottom contact	Internal reflection
Ng	2 ~ 3 strong phases	Bottom:conformity	Parallel
Ed_1	2 strong phases	Top: conformity bottom:	Parallel
Ed_2	2 ~ 3 weak-medium phase	Top: conformity bottom:	Parallel or
Ed_3	1 ~ 2 medium-strong phases	Top: conformity bottom:	Progradational-subp
ES_1^1	1 ~ 2 medium-strong phases	Top: unconformity	Parallel
ES_1^2	2 ~ 3 strong phases	Top: conformity bottom:	Parallel
ES_1^3	2 ~ 3 strong phases	Top: conformity bottom:	Parallel
ES_3^1	2 ~ 3 weak-medium phase	Top: unconformity	Subparallel
ES_3^1	2 ~ 3 strong phases	Top: conformity bottom:	Parallel
ES_3^1	2 ~ 3 strong phases	Top: conformity bottom:	Parallel

Bottom interface of Dongying Group of down Tertiary：Corresponding to S1 top boundary whose reflection is continuous-- the first set of sandstone above the oil shale or comparable volcanic rock bottom, seismic reflection characteristics is on the 1 ~ 2 weak phase, and the internal reflection structure is progradational--subparallel, the region can be traced continuously. It is a false integrated contact with the underlying strata.

Bottom interface of S1 Section of down Tertiary：Seismic reflection characteristics are 1 ~ 2 medium-strong phases.The internal reflection structure is a parallel continuous reflection, and the region can be continuously contrast tracked.It is not integrated with the underlying strata, is a regional unconformity.

Bottom interface of S31 Section I reservoir of down Tertiary：The seismic reflection wave group showed that the upper part is weak and the lower part is continuous. The internal reflection structure is a subparallel continuous reflection. It is integrated with the lower strata into the contact. (Table1,Pic2)

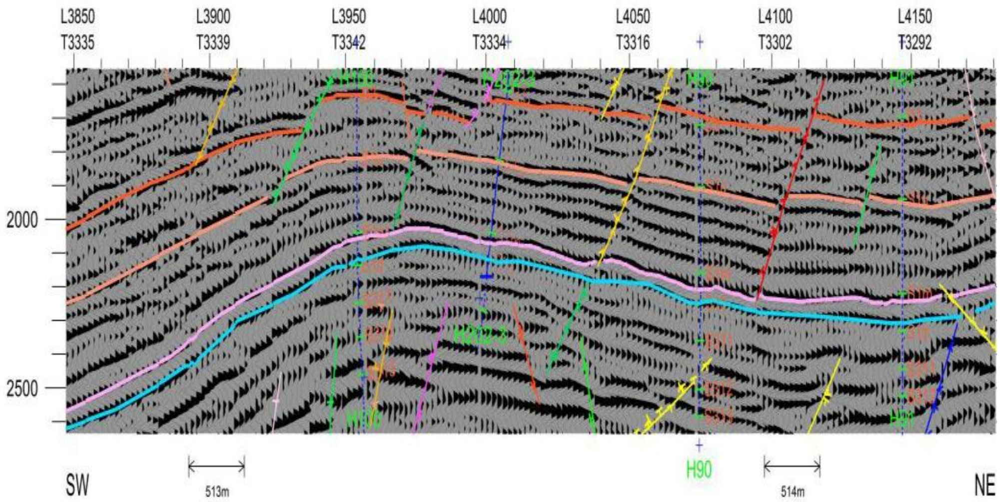


Pic2 Main line interpretation scheme

2.3 The whole region stratigraphic correlation tracking

Firstly, the well seismic interpretation is carried out by using the reflection wave of each target. Based on the well calibration and tracking layer closure of the whole region, the interpretation scheme is determined.

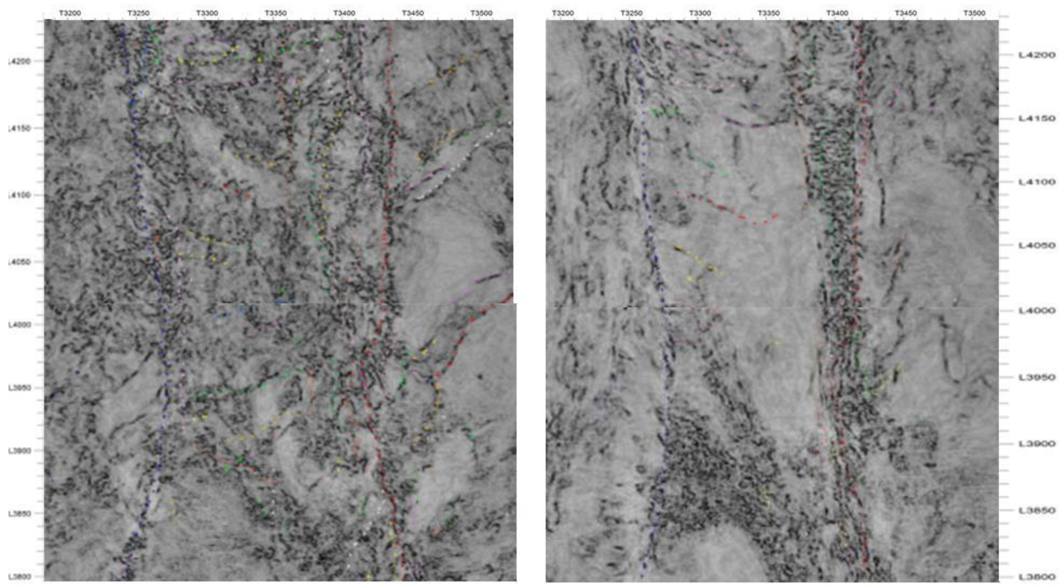
We make the comparison tracking from coarse to fine mesh. In order to ensure that the stratigraphic correlation is correct and reliable, the time profiles in different directions are repeatedly closed, and the interpretation results are verified by 3D visualization technique, horizontal slice and bedding slice. We repeatedly modify the interpretation scheme to achieve the purpose of precise and accurate interpretation.



Pic3 Well seismic combined layer tracing

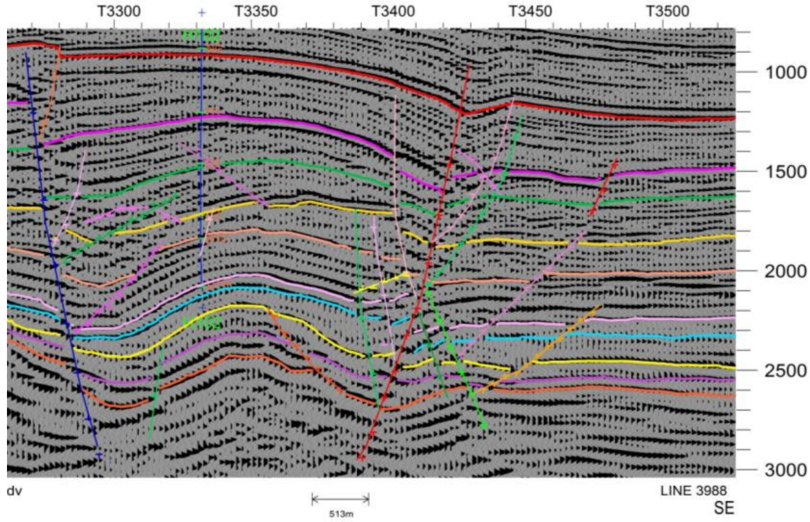
III. FAULT COMBINATION

In the area of 3D seismic data fault interpretation, the coherent body technique is used to determine the macroscopic features of the fault. The characteristics of this technology are: the interpretation of the fault and the geological anomaly body is not affected by human factors, and the actual situations are reflected by the objective and real situations to reduce the multi solution.



Pic4 Coherent body slice interpretation fault

The fault combination is is a combination of the characteristics of the same nature, the same gap between adjacent sections on the same point in a certain distribution, and the trend of the fault after combination should be in accordance with the law of regional geological structure. In interpretation system, in which profile the interpretation of faults are automatically projected onto the intersection line and time slices,so we need to check the rationality of fault strike on the profile of parallel faults: We examine its fall, cross section shape and vertical fracture in the vertical section of the fault strike;and we check whether the plane distribution is in accordance with the geological law in the horizontal slices(Pic5). We combine the three dimensional visualization display function, verify each other, continue to modify, improve the reliability of the fault combination.



Pic5 Fault section combination

IV. VELOCITY STUDY AND TIME DEPTH CONVERSION

In this study, we use the DepthTeam Express Landmark speed model tool to synthesize geological stratification, seismic interpretation, time depth relationship, stacking velocity and other geological and seismic information.Under the control of seismic horizon interpretation, the time depth relationship of the 26 wells is interpolated, and the 3D velocity model is established.

The structure and thickness of each layer in Huangjindai oil field varies greatly, so the layer in the space velocity field varies greatly. If the whole region is used a time depth relationship to make the transformation of time and depth,it will have a greater error. But the error between depth of variable speed conversion and actual drilling depth is small.The depth of variable speed conversion can effectively avoid the local distortion caused by the velocity error, and improve the accuracy of the structure chart. By the time depth conversion, we can get the corresponding depth value of each interface.

V. CONCLUSION

Through the fine interpretation of 3D seismic data, it has been carried out the Jiazhangsi fault(F1)in the eastern part of the Huangjindai oil field, the Erjiegou boundary fault (F2), and the broken groove main fault –Huangdong fault(F3). Through the map of the large area system, this paper has confirmed the pattern of the fault system in this area, and made clear the structural transition relationship among the main fault blocks.

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