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Application of fine interpretation technique of 3D seismic structure in Shen 150 block

The basic task of the development of seismic fine tectonic interpretation is the interaction analysis of three-dimensional seismic data interpretation and real drill results, timely guide the well position adjustment and improve the success rate of drilling the reservoir. Aiming at the requirements of the development of the seismic geology task in the north Shen 150 area of the Rongshengbao sag, the technical combination suitable for the characteristics of this area has been worked out, and good geological effect has been achieved. First, the seismic data were evaluated. Second, the fine calibration was carried out. Third, the microstructure was studied. Finally, the concrete application of Shen 150 was studied. The results of 3D seismic fine structure interpretation is more truly reflect the shen 150 block of the underground structure in the study area of fault and the shape of the distribution situation, in order to improve the high steep complicated structure area drilling success ratio provides the reliable data.

Keywords: *Three-dimensional seismic structure, microstructure, horizon calibration.*

Block characteristics

Located in the northern part of the Rongshengbao depression in damintun sag, Shen 150 is a high-steep and complex structure covered by faults. The purpose of sandstone is three, for a set of fan delta front facies deposition, the reservoir to fine sandstone-based, the average pore is 12.9%, the average permeability is $9.9 \times 10^{-3} \mu m^2$. The reservoir depth is -2100 ~ -3200m, and the reservoir type is lithologic structural reservoir. The proved oil-bearing area is 10km^2, and the geological reserves are 1152* 104t. Crude oil belongs to thin oil, the original formation pressure is 30.0MPa, and the formation temperature is 96ºC. The present formation pressure is 23.8MPa, and the pressure coefficient is 0.81.

3D seismic data quality

The seismic interpretation uses the newly processed prestack 3D seismic data completed by the end of 2005, with a network

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density of 25 * 25m. The seismic data of this area is poor, and the seismic frequency of 1.9 ~ 2.5ms is 3 ~ 60 Hz and the main frequency is about 20Hz (Fig.1). The results show that the tectonic seismic data above the Ng group are high in resolution, the signal-to-noise ratio is high and the vertical resolution ability is strong[1]. The second is the seismic performance which is characterized by relatively weak reflection energy, low signal-to-noise ratio and poor continuity. The main reason is that the sandy sedimentary strata belongs to the delta front sedimentary system, sandstone development, sand body is thin and many, While the mudstone overestimate, did not form a better reflective interface[2].
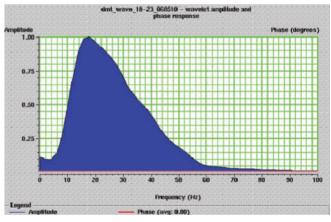

Fig.1 Earthquake spectrum of Shahejie formation (1.8-2.4s)

Horizon calibration

The seismic geologic stratigraphic calibration is a bridge between earthquakes, geology and logging data. It is the basis of tectonic interpretation and reservoir analysis using seismic data. The calibration results directly affect the subsequent structural interpretation accuracy, The accuracy of the interpretation directly affects the comprehensive geological evaluation, we can see that the accuracy of the calibration of seismic geologic stratigraphy is essential[3]. According to the result of the horizon calibration, the well is explained first on the interpretation workstation, and then the interpretation function of the workstation is used to do the automatic tracking of the horizons[4]. The interpretation of

the three-dimensional seismic data is completed accurately and efficiently. Due to the lack of VSP seismic logging data in the area, the area in the production of synthetic seismic records, based on drilling geologic correlation of strata on the application from seismic data well in seismic wavelet made of synthetic seismogram and well seismic wave group has a good corresponding relationship, in the course of the study, through the corresponding relationship of the drilling depth of well logging, and seismic wave impedance characteristics, calibration results relatively uniform distribution of 24 wells preferred plane of the horizon, as a basis for the study of fine structure interpretation, the synthetic seismogram calibration results shown in Fig.2 and Fig.3. It can be seen from the synthetic record calibration that the Es32 and Es32 are the same as those of the first-order seismic marker, and the bottom of each oil group is also strong amplitude reflection, but the continuity is not Es32, Es32 The boundary of the two seismic landmarks, the determination of the two signs of the seismic interpretation of the earthquake played a very good control[5].

Microstructure study

In the process of microstructure research, based on the three-dimensional seismic interpretation structure, the logging data are used to calculate the coordinates of the ground and the target layer respectively. Combined with the actual production situation and consistent with the oil field structure, The microstructures are made of microstructures, including micro-

anticlines, micro-diagonal and micro-nose-like structures, and the types of microstructures between adjacent layers in the oil group are also inherited[6].

Interpretation of faults

Precise tectonic form is the basis of fine fault interpretation, especially for the interpretation of small faults is more important. In order to improve the success rate of drilling, to ensure that the development wells continue to lose oil, in addition to the conventional structural interpretation, but also the focus of structural research on the identification of small faults. Using the coherent data body technology not only can automatically identify the fault, but also solve the plane plane combination problem[7]. The advantage is that it is easy to find faults that are not easily found on the hard surfaces of parallel faults, and can be directly found in the seismic data body without interference from human factors.

Fault characteristics

The Shen 150 block is mainly controlled by three large faults, the northern Shen 172 fault, the middle sink 162 ~ Shen 133 fault, the southern Shen 139 fault belongs to the third fault, which is the boundary fault of this area, which is characterized by long development time and long extension, Big gap. The fault direction is near east-west and southward, and the maximum distance is 165 ~ 350m, which controls the oil and gas distribution in this area. The northeast boundary fault is the western boundary fault of the sand reservoir, and
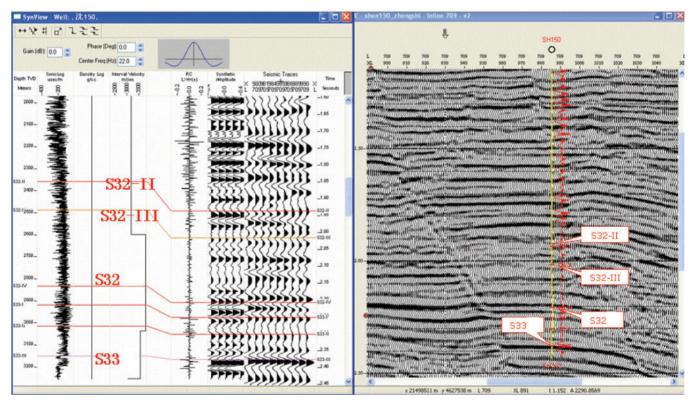

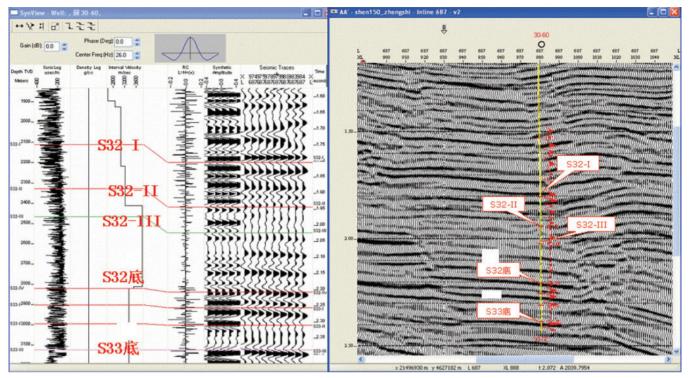Fig.2 Shen 150 well synthetic seismic recording calibration

Fig.3 Pre-30-60 well synthetic seismic recording calibration

the formation of the reservoir has a certain control effect. From the two structural sections (Figs.4 and 5), it can be seen that the results of the stratigraphic comparison of the area are reliable under the principle of combined wellbore.

Application effect analysis

In the 3D seismic block Shen 150 complex structure area of fine structure interpretation, application of calibration, through geological horizon fine micro structure research of key technologies, improve the structural interpretation of the scheme, to further rationalize the extension direction of intersection between tectonic contact relationship and faults,

and provides a reliable basis for the region the implementation and deployment of the next location and reservoir evaluation. It is worth pointing out that the seismic interpretation results need to be comprehensively analyzed by drilling, logging and other data, so as to gradually revise the geological structure model, and then gradually approaching the real underground geological structure.

In this paper, the fine explanation of the structure is carried out on the basis of the fine stratification of the system, the fine comparison of the oil group and the fine calibration of the horizon. First, the seismic data are evaluated and the fine calibration of the horizon is carried out to determine the
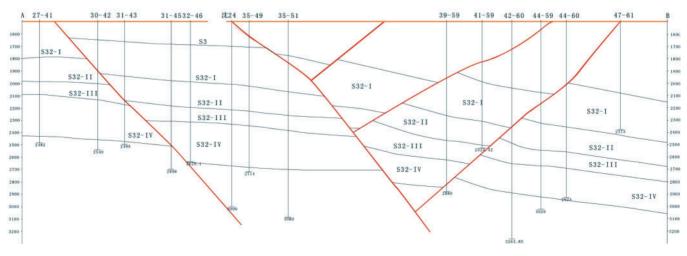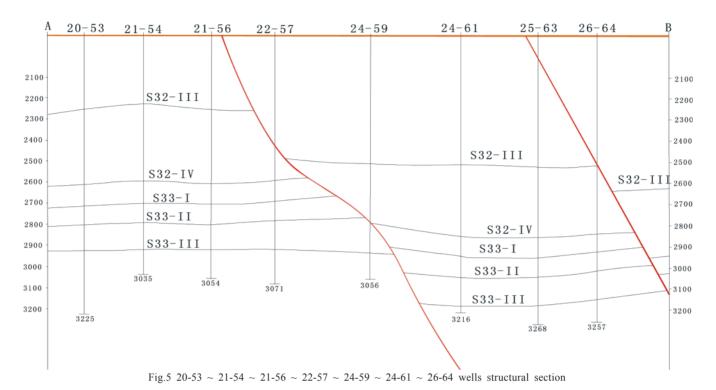

Fig.4 27-41 ~ 31-43 ~ 24 ~ 39-59 ~ 42-60 ~ 44-60 ~ 47-61 well structural section of Shen

Fig.5 20-53 ~ 21-54 ~ 21-56 ~ 22-57 ~ 24-59 ~ 24-61 ~ 26-64 wells structural section

reflection characteristics of the target layer on the earthquake. Through the application of three-dimensional seismic fine structure interpretation technology to the study area of high-steep complex structure geological interpretation, so that the construction results have made a great breakthrough, based on the results of the three-dimensional seismic interpretation of the deployment of drilling, drilling results confirmed that the current three-dimensional seismic fine structure interpretation of the results Which reflects the distribution of underground structures and faults in the study area, and provides reliable information for improving the success rate of drilling in high and steep complex tectonic zones[8].

Conclusions

(1) The relationship of the drilling depth of well logging, and seismic wave impedance characteristics, calibration results relatively uniform distribution of 24 wells preferred plane of the horizon, calibration of the two marker horizons, to determine the two mark layers to a good control effect on the seismic explanation.

(2) The micro structure in the course of the study, the 3D seismic interpretation based on the structure, make full use of logging data and destination coordinates, combined with the actual production situation, according to the micro structure map that micro structure type between the oil group also has inherited the adjacent layer.

(3) The fine structure interpretation of 3D seismic results to reflect the distribution of underground structure of Shen 150 block study area and morphology of the fault, in order to improve the steep and complex structure zone drilling success rate provides reliable information.

References

1. Martinez, J. F., Cartwright, J. and Hall, B. (2005): "3D seismic interpretation of slump complexes: examples from the continental margin of Israel [J]." *Basin Research*, 2005, 17(1): 83-108.

2. Gent, H. V., Back, S. and Urai, J. L., et al. (2010): "Small-scale faulting in the Upper Cretaceous of the Groningen block (The Netherlands): 3D seismic interpretation, fault plane analysis and regional paleostress [J]." *Journal of Structural Geology*, 2010, 32(4): 537-553.

3. Burg, J. P., Sokoutis, D. and Bonini, M. (2002): "Model-inspired Interpretation of Seismic Structures In The Collisional Central Alps [J]." *Geology*, 2002, v. 30(no. 7): 643-646.

4. Hustoft, S., Mienert, J. and Bünz, S., et al. (2007): "High-resolution 3D-seismic data indicate focused fluid migration pathways above polygonal fault systems of the mid-Norwegian margin [J]." *Marine Geology*, 2007, 245(1): 89-106.

5. Hartzell, S., Harmsen, S. and Williams, R. A., et al. (2006): "Modeling and Validation of a 3D Velocity Structure for the Santa Clara Valley, California, for Seismic-Wave Simulations [J]." *Bulletin of the Seismological Society of America*, 2006, 96(5): 1851-1881.

6. Young, M. K., Rawlinson, N. and Bodin, T. (2013): "Transdimensional inversion of ambient seismic noise for 3D shear velocity structure of the Tasmanian crust [J]." *Geophysics*, 2013, 78(3):WB49-WB62.

7. Gilzepeda, S. A. (2002): "3D Seismic Response of the Deep Basement Structure of the Granada Basin (Southern Spain) [J]." *Bulletin of the Seismological Society of America*, 2002, 96(6): 2163-2176.

8. Gafeira, J., Long, D. and Scrutton, R., et al. (2010): "3D seismic evidence of internal structure within Tampen Slide deposits on the North Sea Fan: Are chaotic deposits that chaotic?[J]." *Journal of the Geological Society*, 2010, 167(3):605-616.