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Application of the Combination of Well and Earthquake in Reservoir Prediction of AoNan Area

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Abstract: - *The study is carried under the prestack time migration processing technology in order to deal with the old data, obtain high signal-to-noise ratio and high resolution seismic processing results, and on this basis to carry out fine structure interpretation, reservoir prediction and reservoir comprehensive evaluation study, then further define the structure and fracture distribution characteristics, the distribution rule of reservoir and oil/water distribution characteristics, and at last determine the accumulation mode and rule and the plane distribution of sand body in each layer.*

Keywords: - *sand body; seismic; reservoir prediction;*

I. OVERVIEW

The target layer of the study is the Heidimiao reservoir, the anomaly shows of oil and gas wells of Heidimiao reservoir in this area is more, showing that the region has plenty of oil and gas resources, but it shows that oil and gas water relations of the area is complex through the test of oil testing results, and it does not have unified water interface of oil and gas, it is multiple controlled by structure, fault, sand body. To better reveal the structural characteristics, reservoir characteristics, distribution regularity of oil and water in Heidimiao layer. We adopt the integrated train of thought of integration of interpretation and processing, apply well logging constrained inversion technique, definite reservoir physical property of known location through logging data, and obtain plane distribution characteristics of reservoir from seismic data, the combination of both can obtain high precision quantitative reservoir prediction results.

II. THE RESERVOIR PREDICTION BASED ON SEISMIC INVERSION

Seismic inversion technology occupies a very important position in oil field exploration and development, it is an important basis of looking for lithologic reservoir, making the deoxidization body distribution rule, delineating favorable oil and gas accumulation zone. Based on the test of inversion method and curve optimization, we carry the experiment of well constrained sparse pulse inversion and geostatistical inversion method, and finish reservoir inversion of Heiyi reservoir group.

2.1 Logging data analysis

2.1.1 Sensitivity logging parameter analysis of reservoir

An important work is the statistical analysis of logging data to research zone before the inversion work. It is to determine the correlation of different lithology and logging curve in this area. Sensitivity logging parameter analysis of reservoir is the basis of reservoir prediction, through comparing analysis of multiwell, the SP and R250 curve is the main log indicating curve of sand shale identification division, the lithologic interface is clear, the response is accurate, so it is suitable for use of the curve to distinguish the sand shale.

At the same time, through a variety of logging attributes intersection analysis, both the SP and R250 and SP and P_sonic curves have good correlation (Fig1), it is can be seen from the chart, the correlation of SP and P_sonic is better than R250 and P_sonic, which leads to the stochastic inversion results, the resolution of SP inversion results is better than R250 inversion results.

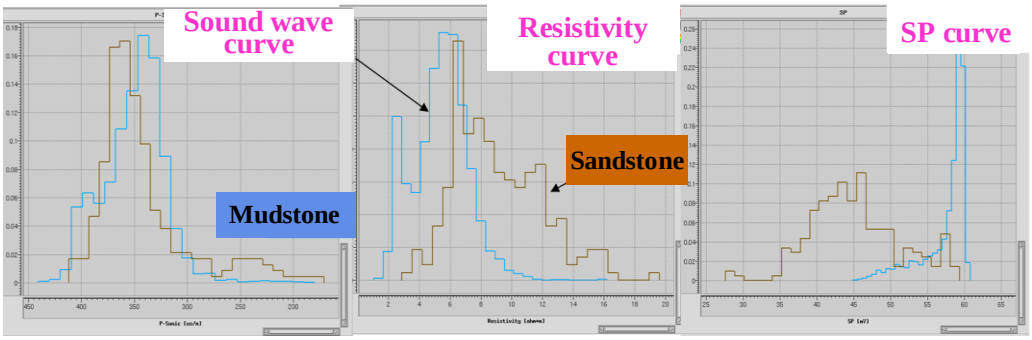


Fig1 Sensitivity analysis of the single curve

2.1.2 Standardization and normalization of well logging curve

The logging data of high quality is the basis of the quantitative reservoir description research. Logging data are used to calibrate seismic data volume for first, however, the measured logging curve often has the problem of the loss of part of the collected data, poor quality, lack of consistency between multiple well. Therefore, the log data must be in quality control before a combined application with seismic data in order to provide a relatively complete set of logging data.

1) Standardization and normalization of logging curve

The histogram method is mainly adopted for standardization of acoustic logging curve processing, taking the histogram of key standard as calibration model of standardization of well logging data, and then by analyzing the frequency distribution of the same type of standard layer and comparing with the standard model to determine the calibration offset needed. We carried standardized processing of 42 wells with acoustic curve. The sound wave curve is relatively consistent after standardization, the comparability between wells is stronger, it also can be seen from the histogram, score of sandstone and mudstone and distribution range in distribution histogram is consistent (Fig2).

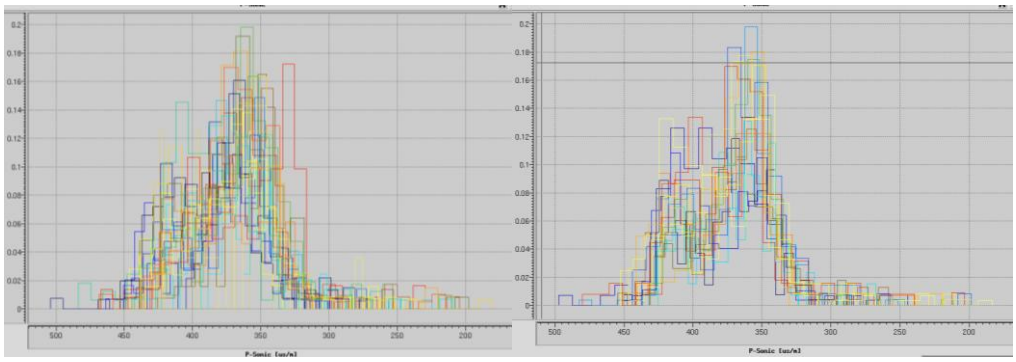


Fig2 Normalization of sound wave curve

We adopt the method of calculating the relative magnitude of the sp in this study, as the following formula 1, thus all the wells in the plane have a uniform scale, so as to realize the normalization of sp.

In formular 1:

$$SH = \frac{SP - SP_{min}}{SP_{max} - SP_{min}}$$

SH- Shale content，decimals；

SP_{min} - Natural potential value corresponding to pure sandstone，mv；

SP_{max} - Natural potential value corresponding to pure shale，mv；

SP- Meatured natural potential value，mv。

We made normalization processing of sp curve of the work area using the above method. Figure 3 is the contrast section of natural potential curve before and after the normalization, it can be known from the figure, the SP curve after normalization processing has good comparability, achieving the expected purpose of normalization (Fig3).

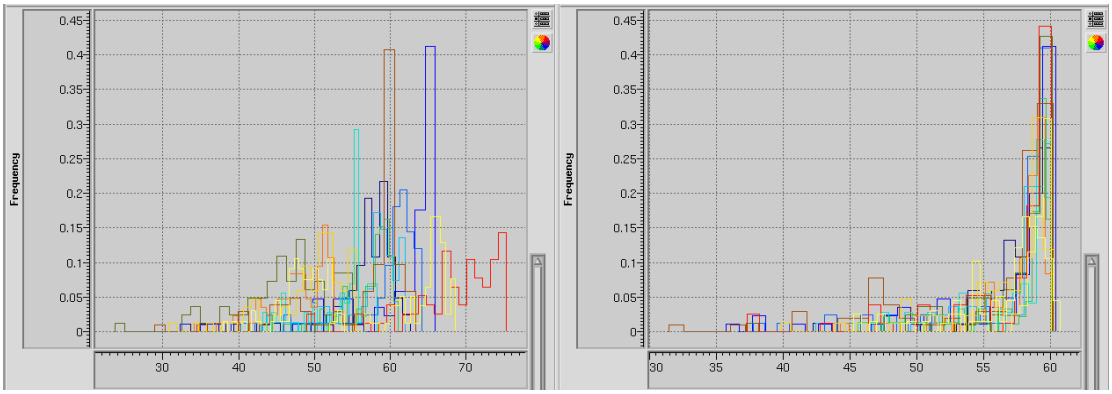


Fig3 The normalization of SP curve

Standardized methods of resistivity curve: the best method to determine the shale line standard is to select the standard well, but there is no standard well in the district, so taking R0, the average of R '0 of all wells as the standard baseline values; Standardizing resistance curves of all well, the standardized formula is as follows:

$$R_{std} = \frac{\log(R_0)}{\log(R'_0)} \times R \qquad (2)$$

Among them: R_{std}, The resistivity of standardization;

R', The original resistivity;

$R'0$, The baseline value;

R_0, The standard baseline value。

We carried out the unified standardization process of R250 curve and the curve of LLD in the work area using the formula (2). Figure 4 is the resistivity even well profiled before and after the standardization.

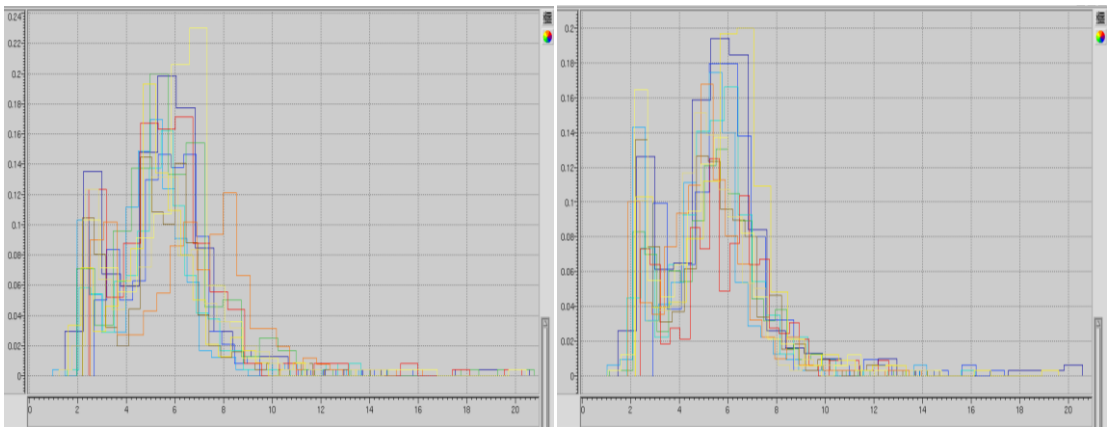


Fig4 The normalization of resistivity curve

2.2 Optimization of the inversion method

The post-stack seismic inversion technology mainly includes three types: band-limited inversion, sparse pulse method, and the based on the model inversion. Through the experiments, the longitudinal resolution of sparse pulse inversion (Fig5) is too low, it cannot satisfy the accuracy requirement of reservoir exploration and evaluation phase, and can't meet the requirement of reservoir prediction and fluid identification on the condition that the well pattern is dense in old development area. So we consider adopting the based on model inversion technology. On the basis of many simulation experiments, we select the variation function of the Gaussian model. Integrating the requirement of regional geology and reservoir prediction accuracy of this work area, vertically into the selection of 0.002 ms, level into (400m, 400m).

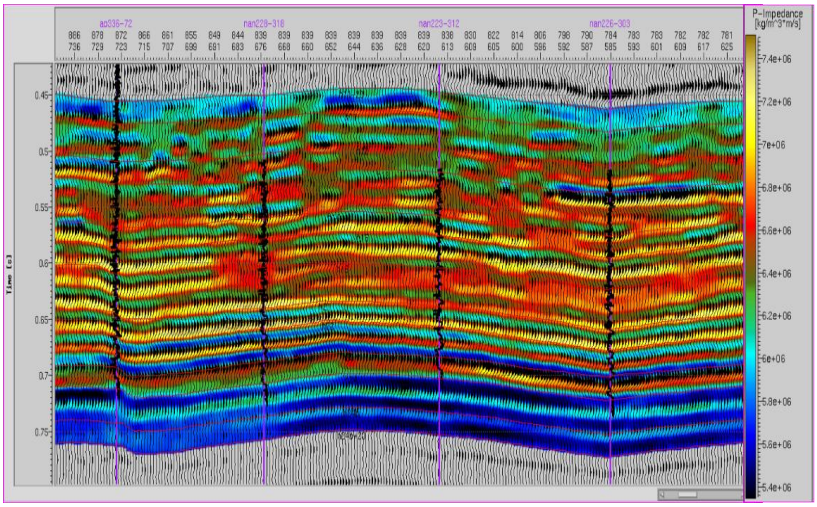


Fig5 Inversion profile of sparse pulse wave impedance

Development degree of Heidimiao is higher in this inversion, the drilling quantity is large, the well data are rich. And the wells have high intensity and reasonable spacing, though it increases the workload of several times, but this can be a very good inversion of the actual change of interwell reservoir properties (Fig6).

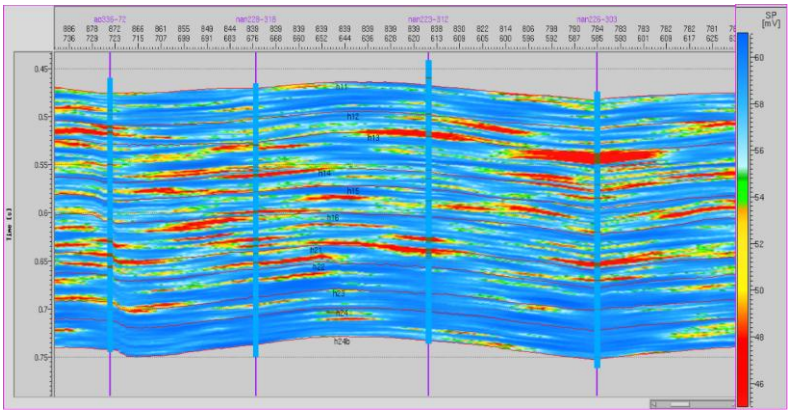
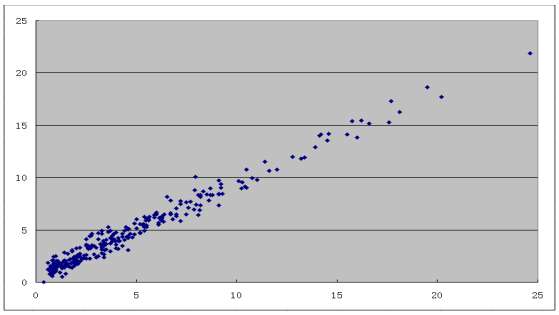


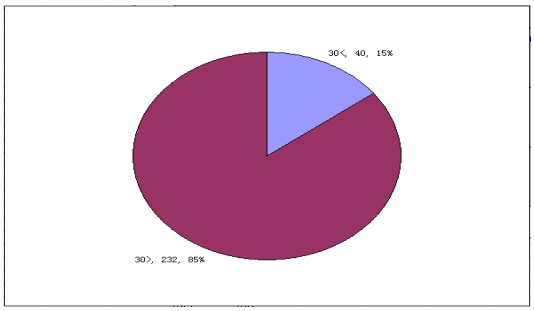
Fig6 inversion results of SP

2.3 Accuracy analyses of the inversion results

Using double fox to formate a figure making use of the reservoir thickness data of each set. Through the analysis and comparison of thickness of the well point and the predict thickness, we find that the prediction accuracy of inversion results is higher, also in accordance with the standards that the thickness error is around 20%, the forecasting precision are more than 85%. Take the sandstone prediction results of Heidimiao I group of Aonan for example, as shown in figure 7 (a, b), it can be seen from the intersection map that the coincidence rate of predict thickness and the thickness of well point is very high , compared with the intersection of properties prediction, its precision is higher. Through statistical analysis pie chart, it can be seen in 272 Wells, there are 232 Wells whose thickness relative error is under 30%, accounted for 85%.



(a) intersection figure of well point thickness and predict thickness



(b) The pie chart of coincidence rate

Fig7

It can be seen from the precision analysis of prediction results. The results of the inversion accuracy are up to 85% or greater.

2.4 Reservoir prediction results

Given the results of seismic inversion accuracy is higher than that of properties prediction accuracy, the forecast results optimize reservoir prediction results of inversion, and take the properties prediction results as the important reference, the plane distribution of sand body in each layer are as follows:

1) Sandstone forecast result of layer 1 of Heiyi group

The sandstone thickness is between 0 and 11m, generally in 1-7m. The sandstone development in southern work area is significantly better than the other part, it shows the shape of continuous sheet, the development sandstone is better in the area of Nan252 - Xie304 -Nan255-Xie306 well,Nan248-Xie328,the developed sandstone thickness is more than 8m; The shape of belt develops in the north of the work area, sandstone thickness is about 5m around the well of Nan216-322, in other parts of the north, its sandstone development thickness is in 3m or so; There is little or no development of sandstone in the area of Nan 266 - Xie366 - Nan240-340well.

2) Sandstone forecast result of layer 2 of Heiyi group

The sandstone thickness is in 0 to 18m, the sand body of good development is mainly concentrated in the southwest corner of Nan240-316-Nan240-310-Nan255-Xie306 well area, the sand body thickness is in 15m and the shape of continuous bar strip develops, a north-south extent belt develops in the central of the work area, its thickness is around 10m; The sandstone develops poor in other parts, sandstone development is less than 2m in the north of the work area.

3) Sandstone forecast result of layer 3 of Heiyi group

This sandstone thickness is in 0 to13m, controlled by the source area, the sand body development in the north is better than other parts. The sand body more than 8m is concentrated in the north-central of the work area, it shows the shape of ribbon development on the whole, the sandstone is less than 3m in Nan242-340 well area of less development zone.

4) Sandstone forecast result of layer 4 of Heiyi group

This sandstone thickness is in 0 to 15m. The sandstone development is relatively better in the north of work area, showing a continuous development. The sandstone thickness is more than 10m in Nan249 - 309 well area. The sandstone develops poorest in Nan 314-65 well area, the thickness is generally less than 2m, the sandstone thickness is around 4m in other parts of the work area.

III. CONCLUSION

The sand body distribution characteristics of the target layer are clearly shown through this study, combined with the log constrained inversion method, we improve the vertical resolution of the sand body, clear about the horizontal change of the interwell sand body, determine the accumulation pattern. Through statistics of inversion prediction results of each small layer of 47 wells, we discover that there are 174 small layers of 35 Wells whose relative error is less than 30%. The reservoir prediction coincidence rate reaches 83.2%.

REFERENCES

[1] LU Baokun, SHI Ge. The Research Summary of Logging Data and Seismic Attribute [J]. Journal of Beijing university (natural science edition), 2005, 41(1):154-160.

[2] MA Jinfeng, XU Shenghui, WANG Guishui, GAO Le. The confronting problems and progress of Seismic trace inversion [J]. Oil & Gas Geology, 2002, 23(4):321-325.

[3] CHEN Yaxin, WEI Fenyun, GAO Lifeng. Application of Reservoir prediction technique in pyroclastic rock in Ying 2 Segment, Yingtai fault depression, songliao basin [J].China Petroleum Exploration, 2013, 18(3):50-56.

[4] WANG Xiaoping, SHANG Jianlin, WANG Linsheng. Application of Geostatistical inversion in Mabei oilfield of junggar basin [J]. Xinjiang Petroleum Geology, 2013, 34(3):320-323.

[5] LI Zhanglin, WANG Ping, LI Dongmei. Research and application of the calculation methods of Experimental variation function. [J]. 2008,(2):10-14.