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The application of seismic reservoir prediction technology research

Liu Jiyu[1]，Shi Dan[1]，Ren Jieping[2]，Xing Tianhui[3]，Li Yang[4]

[1]（*College of earth science of Northeast Petroleum University, Daqing, Hei Longjiang,China*）

[2]（*Southwest Petroleum Engineering Branch Company Linpan drilling, Linyi, Shandong, China*）

[3]（*Liao Xing Oil and Gas Development Company of PetroChina Liaohe Oilfield Company, Panjin, Liaoning, China*）

[4]（*Logging branch of Sinopec Huabei Petroleum Engineering Co., LTD., Zhengzhou, Henan, China*）

Abstract: While using drilling, logging data and geological data with high resolution, can accurately obtain the hole and a small range around the interval of lithology and oil and gas information, but it is hard to describe between shaft and hole around the reservoir, reservoir conditions, due to the seismic data contain abundant information, reservoir property and incomparable with drilling data on lateral continuity, so seismic exploration technique is still in the reservoir prediction and reservoir horizontal asked one of the most effective means. Application of seismic attribute information to qualitative predicting sandstone is the main purpose of the seismic data, from the Angle of geological requirements, the application of seismic data to maximize the prediction of thin sandstone distribution. At home in the earth physics common practice is to use conventional seismic attribute points large section of the qualitative prediction of sandstone distribution and lateral prediction more accurate, is advantageous to the well placement.

Keywords: *Seismic attributes; Lateral prediction; Sandstone prediction; Sandstone distribution*

I. THEORETICAL BASIS

Seismic attribute refers to pre-stack and post-stack seismic data, through mathematical transformation and the export of the seismic wave characters of geometry, kinematics, dynamics and statistical characteristics of special measurements [1]. They are underground lithology, physical property, oiliness and characterization of related physical properties, so the use of these properties can be for reservoir prediction.

Seismic attribute analysis is on the carrier of seismic attributes from seismic data to extract the hidden information, and the information into related to lithology, physical property or reservoir parameters, for geological interpretation and reservoir engineering a direct service information technology [2]. Seismic attribute prediction can be either, lithology and lithofacies prediction oiliness, also can be reservoir parameter prediction, the former emphasizes the function of the clustering and classification of seismic attributes, mainly through the pattern recognition and neural network to realize, the latter emphasizes the estimation function of seismic attributes, approximation methods are mainly function and neural network. The basis of seismic attribute optimization is to improve the prediction results, is the key to attribute analysis. Each attribute from different angles reflects the characteristics of reservoir, but with the lithology, physical property, the relationship between the pore fluid property is very complex, the same properties in different work area, reservoir sensitivity to the predicted object is not exactly the same, but due to the correlation between different properties, several optimal combination is not necessarily a single attribute of the optimization of, does not necessarily get optimal effect (only in various seismic attributes are independent of each other to achieve the optimal effect. Therefore, seismic attribute optimization is to use the person's experience, or mathematics method, optimized the most sensitive to predicted target the most effective, most representative (or), the number of seismic attributes, or

attribute combination, at least to improve the precision of seismic prediction [3].

Seismic reflection event, is the reflection of sandstone sedimentary rhythm, the reflected wave amplitude, frequency, phase characteristic is the result of superposition of each single mutual interference, therefore, sandstone thickness change can be reflected indirectly by seismic waveform, such as seismic reflection wave contains all kinds of lithologic information such as the thickness, velocity and wave impedance, waveform change reflects the changes of the information, and the change of the waveform, can be detected using various seismic attributes [4].

According to each group reservoir sand body development situation of the geological model is set up, develop forward modeling, optimization and sensitive attribute parameter distribution characteristics of sand body prediction, reservoir lateral variation and distribution regularity of macroscopic qualitative analysis. Explain plan forward in front can be concluded that wave amplitude enhanced energy increased with the increase of thickness of sandstone, when single sandstone development, amplitude and energy are positively correlated sandstone thickness, to extract the maximum wave attributes can predict sandstone development, when the period sandstone development more seismic amplitude is affected by the interference of the thin sand-shale interbed, amplitude does not reflect the development degree of sandstone, for each reservoir group to carry out the attribute selection, so you need to select each best sensitive properties of reservoir group [5]. In some interval, the relative sand body development, only a handful of well developed sandstone, sandstone and is a single layer, for this type of sand body, the application of maximum wave properties can predict sandstone distribution, so in the design of the model, the layer of sandstone.

II. THE ACTUAL APPLICATION

2.1 Work area

The 46-116 block is located in the northeast side of Chaoyanggou anticline structure to Sanzhao source sag on the slopes of the pitching, layer is given priority to with Fuyu oil layer development purpose, well spacing will not be divided into two toward 46-116 and towards 39 a well area. 46-116 towards the well region where three wells statistics, the average single well development of effective thickness of 6.5m, horizon developmental instability. At the same time the district longitudinal oil-water layer appear, oil complex relationship. In order to guide the cloth well area not open publishing wells programming, conduct seismic attributes to predict reservoir toward the 46-116 block.

2.2 The forward model design

Due to the limitation of the resolution of seismic data, seismic attributes can't put all the small layers of sandstone prediction accuracy. From the seismic analysis it can be roughly divided into seven layer group unit property prediction. 7 units respectively: F11 F12, F13 F14, F15, F16 - f-17 thunder, F21 - making, moviemaker - F24 - F25 and F31 - F32. Due to the consistent principle, this paper tells two units.

1. The F11 - F12 unit

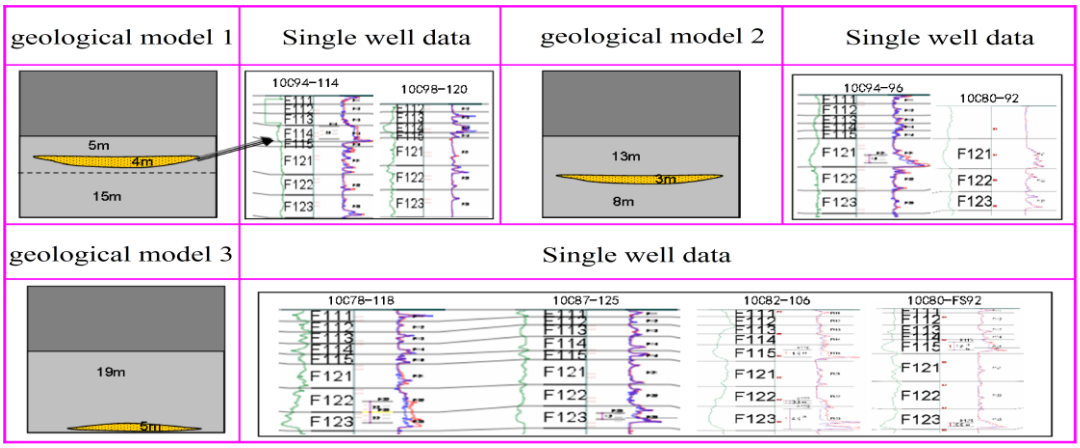
According to the F11 - F12 vertical distribution characteristics of sandstone, can will tumble three geological model (table 1) :

Model 1:1 set of sandstone, the longitudinal development of Fuyu oil layer at the top of the 5 m or so, sandstone thickness of 4 m respectively;

Model 2:1 set of sandstone, the longitudinal development of Fuyu oil layer at the top of the 13 m, sandstone thickness of 3 m respectively;

Model 3:1 set of longitudinal development of sandstone, is located in the F12 at the bottom of the reservoir, the sandstone thickness is 5 m respectively.

Table 1： F11 - F12 geological model divided according to the table



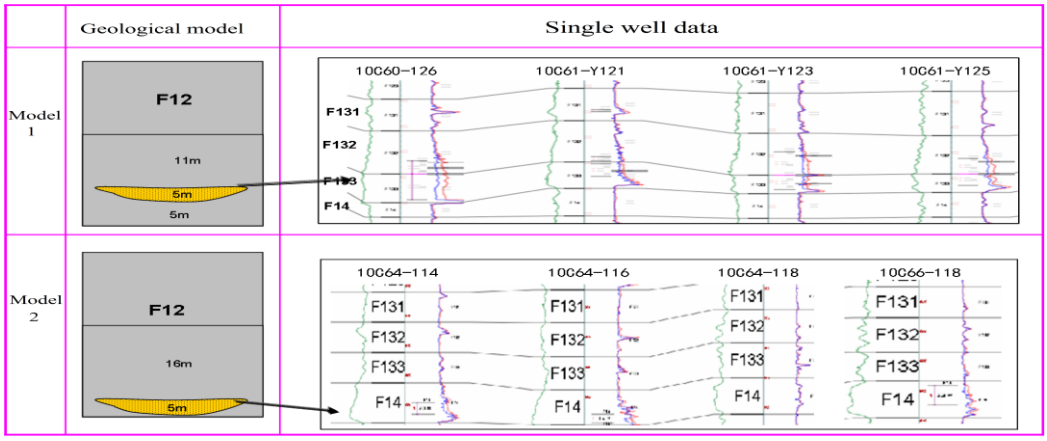
2. F13 - F14 unit

According to F13 inoue - F12 vertical distribution characteristics of sandstone, can will tumble two geological model (table 2) :

Model 1:1 set of longitudinal development of sandstone, development at the bottom of the F13 sandstone thickness 5 m;

Model 2:1 set of longitudinal development of sandstone, development at the bottom of the F14 sandstone thickness is 5 m.

Table 2： F13 - F14 geological model according to the table



According to the thickness of sand body and vertically superimposed relationship, according to the well seismic calibration results, according to the interval of sandstone thickness and layer from the top of the distance, to effectively integrate the layers of sandstone model, will eventually each layer geological model integrated into a comprehensive geological model to carry out the forward modeling (figure 1). Figure in yellow for the geological model of channel sandstone, waveform was right in the performance of seismic trace. Figure in the gray on behalf of qingshankou formation mudstone, the rate of 2800 m/s; Yellow sandstone, the rate of 4200 m/s, blue represents Yang reservoir mudstone background, the rate of 3500 m/s. In practical exploration and development, the single layer thin sand body deposition conditions are rare, most of the alternate deposition is thin sand-shale interbed. So the seismic reflection amplitude under the condition of thin interbed and the

relationship between the thickness of sand bodies accumulated for geological interpretation of seismic data and reservoir prediction has more practical meaning [6]. The geological model of the study design sandstone with total thickness.

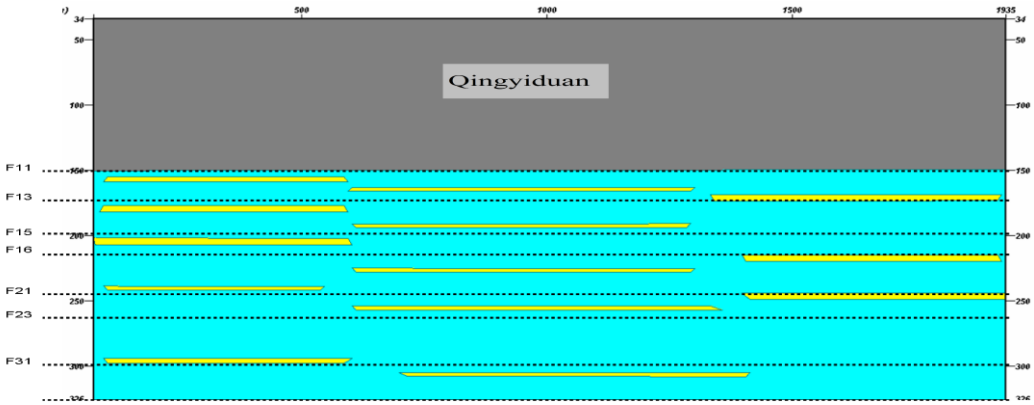


Fig.1： The Fu Yang reservoir in 46-116 block geological model

The forward modeling is done in the middle of the Discovery software, for the vertical incidence, self-excited gathered from the convolution model, choice of wavelet for ricker wavelet, the frequency of 40 Hz, not mixed with noise, the word spacing for lm. Can be seen from the forward modeling results some regularity, get some understanding have corresponding standard (section) : (1) the Fuyu reservoir internal reflection event basically for lithologic interface, rapid change lead to reflection characteristics of different lithology combination is messy; (2) under the condition of the current seismic resolution and the thickness of sandstone, the seismic amplitude attribute is applied after stack data identification of river sand body are relatively effective attribute [7]. Seismic amplitude is affected by the thin sand-shale mutual interference between layers, the maximum amplitude of the size doesn't really reflect the development degree of sandstone, for each reservoir group to carry out the attribute selection, so you need to select best sensitive attributes of each reservoir group.

To design a single sandstone development, the most thin 3 m and 9 m thick single sand body model (figure 2), the forward model, the seismic amplitude is not affected by interference thin interbed, amplitude increase with the increase of thickness of sandstone, the maximum amplitude can reflect the development degree of sandstone.

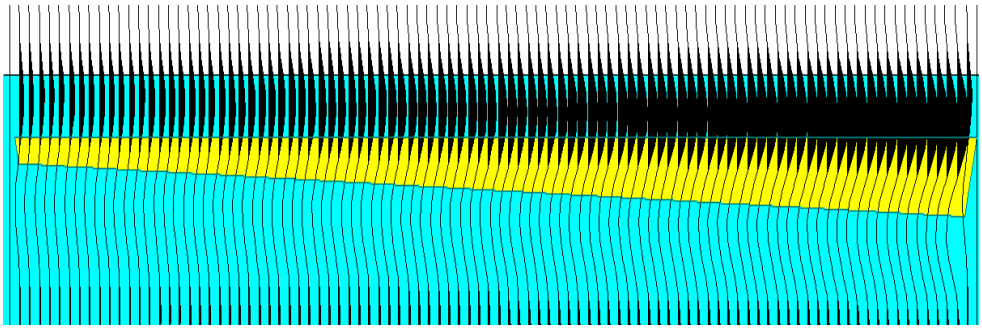


Fig.2： Single sand body forward model

Look from the layers of sandstone prediction results, Fuyu reservoir is better than that of Yang DaChengZi reservoir sand body development. This and inoue statistics of sandstone layers and thickness is the same.

2.3 Attributes optimization and sandstone qualitative prediction

Imply abundant geological information in seismic data, and the information is through seismic attributes. Seismic attribute can be extracted according to section, and body, depending on the research needs. On the basis of forward modeling and conduct the sensitivity of each layer attribute optimization, according to the result of optimization, extract amplitude properties of each layer corresponding to predict sandstone distribution [8]. Limited by the seismic resolution, seismic attributes can't predict the planar distribution of single sand layer.

Seismic amplitude is affected by the thin sand-shale mutual interference among layers, amplitude and can't reflect the development degree of sandstone, for each reservoir group to carry out the attribute selection, so you need to select best sensitive attributes of each reservoir group.

First, considering the characteristics of seismic data, the selection of 60 Hz frequency ricker wavelet is the forward simulation (figure 3), then the vertical unit for each attribute extraction, optimization and sandstone thickness is of the highest correlation attributes as the best sensitive layer properties.

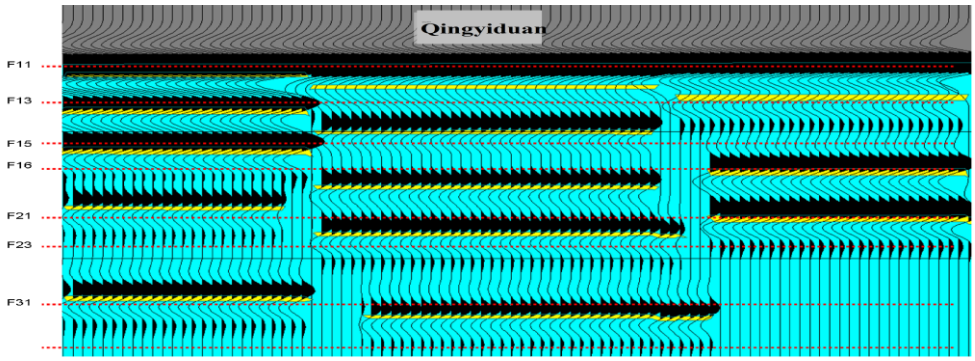


Fig.3： Fuyang reservoir in 46-116 block geological model of the forward section

1. The F11 - F12 unit

F11 F12 attribute (figure 4), compared to the average amplitude attributes and the change of the thickness of sandstone is most sensitive, most can reflect the change of F11 - F12 reservoir sandstone thickness, thus optimizing the average amplitude F11 - F12 reservoir optimal attribute.

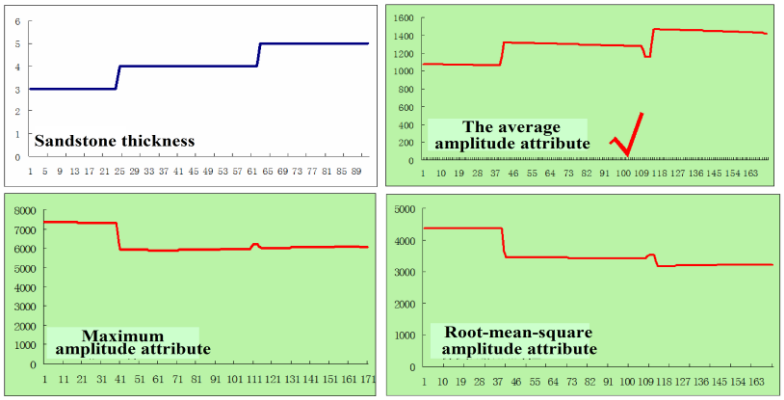


Fig. 4： F11-F12 unit sandstone thickness and seismic attribute contrast

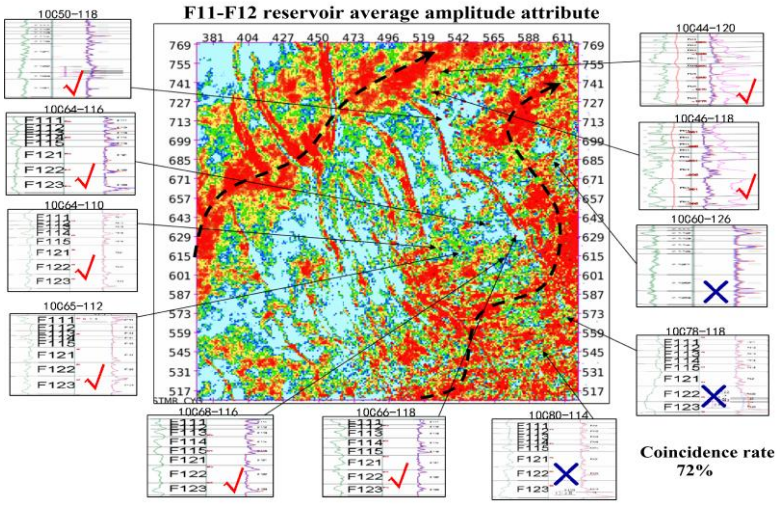


Fig. 5： F11-F12 unit average amplitude attribute sandstone forecast

Attribute (figure 5) on the map, and F11 - F12 unit sandstone prediction coincidence rate was 72%, mainly in the north east to sand body distribution, overall development with wider and major development in the study area in the northwest and southeast.

2. F13 - F14 unit

F13 - F14 properties compared to the sandstone thickness (figure 6), root-mean-square amplitude attribute and the change of the thickness of sandstone is most sensitive, can reflect the change of F13 - F14 reservoir sandstone thickness, thus optimizing the root-mean-square amplitude attribute as F13 - F14 best attribute of the reservoir.

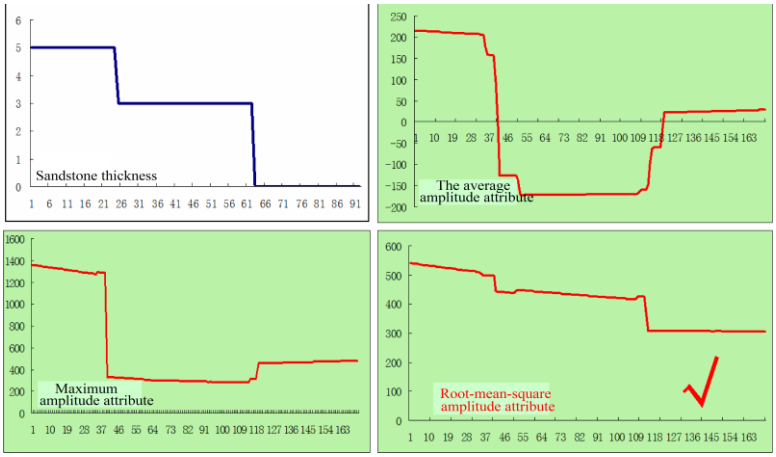


Fig. 6： F13-F14 unit sandstone thickness and seismic attribute contrast

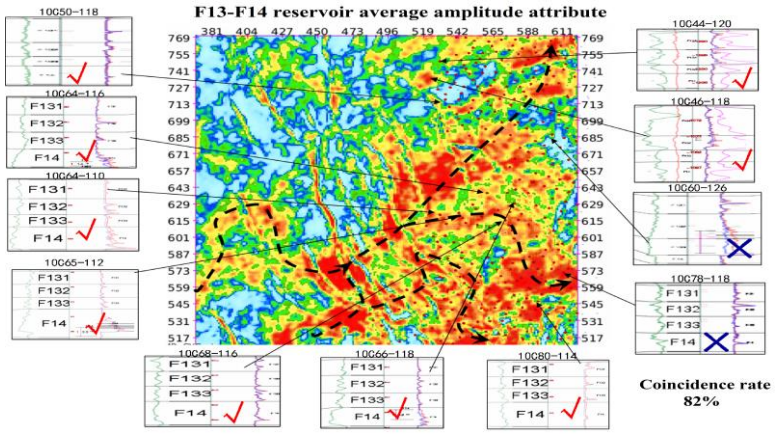


Fig. 7： F13-F14 unit root-mean-square amplitude attribute sandstone forecast

Look attribute graph (figure 7), F13 - F14 unit sandstone prediction coincidence rate was 82%, mainly in the north east to sand body distribution, channel overall development with wider, southeast of major development in the study area.

III. THE CONCLUSION

1. The research of Fuyu oil layer group of modeling. To establish a suitable geological model, the seismic attributes was established based on seismic forward modeling analysis technology classification analysis method and standard, the seismic attribute optimization.

2. Fuyu reservoir sandstone prediction research group of seismic attribute analysis. Well combined, using seismic attribute analysis technology grading fine forecast sand body distribution, direction and distribution form.

3. According to the Fuyu reservoir sand mudstone longitudinal configuration relations, geological forward model design, research on forward modeling, Fuyu reservoir seismic attribute optimization, complete Fuyu reservoir sandstone reservoir group forecast each, each layer comprehensive coincidence rate was 78.5%.

REFERENCES

[1] Chen Jun, Chen Yan. *The application of seismic attribute analysis in reservoir prediction* [J]. Journal of petroleum exploration, 2001, 40 (3): 94-99.

[2] Yu Jianguo, Jiang Xiuqing. *The application of seismic attribute optimization in reservoir prediction* [J]. Journal of oil and gas geology, 2003, 24 (3): 291-294.

[3] Chen Zunde. *Reservoir seismic attribute optimization method* [M]. Beijing: petroleum industry press, 1998. 93 - 100.

[4] Liu Wenling etc. *More information reservoir prediction effectiveness seismic attribute extraction and analysis method*[J]. Journal of petroleum exploration, 2002, 9 (1): 100-106.

[5] NiYi etc. *Reservoir prediction of seismic attribute optimization problem study* [J]. Journal of petroleum geophysical prospecting, 1999, (6): 614-625.

[6] Niu Yan-liang etc. *The statistical analysis method and application of seismic characteristic parameter*[J]. Journal of Daqing petroleum geology and development, 1993, 12 (3): 1-4.

[7] Chen Zunde, Zhu Guangsheng. *Seismic reservoir prediction method research* [J]. Progress in geophysics, 1997, 12 (4): 76-80.

[8] Liu Qiying. *Oil and gas prediction using seismic information* [M]. Beijing: petroleum industry press. 1994:79-114.