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The Part Factors Influencing the Seismic Reflection Characteristics

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Abstract: Fased the circumstances of less influence factors analysis on the seismic reflection characteristics, this article obtains from the angle of forward, forward model is established for the analysis of reservoir thickness, sandstone superimposed relationship, sandstone thickness and interlayer thickness on the influence of seismic reflection characteristics. The reservoir thickness and thin-sandstone have little influence on the characteristic of seismic reflection, thick sandstone in seismic wave energy is strong, with thick sand wave up degree is more obvious. Interlayer thickness and positively correlated to the influence degree of the seismic reflection characteristics, when the insulation layer thickness more than 30 meters, no longer have an impact. After the conclusion is that analysis of seismic reflection characteristics and the relationship between the underground sand bodies, providing certain guidance to predict channel sand body.
Keywords: seismic reflection feature; forward model; reservoir thickness; Sandstone superimposed relationship; sandstone thickness；interlayer thickness.

INTRODUCTION

Seismic reflection waveform characteristics is the area directly or indirectly reflects the characteristic of structure and lithology. Technology forward modeling is used to simulate structure, lithology and other factors and the relationship between the seismic response characteristics to improve the reliability of lithological seismic data interpretation is of great significance. Based on the gu one block of daqing oil field's putaohua reservoir data as the foundation, using the method of wave equation analysis response on seismic profile and the relationship between the underground sand body, space for further accurate characterization of sand body characteristics to provide the reference [1-4].

The general situation in the study area

Gu 1 block is a nose structure distorted by complicated fault, located in the northern songliao basin in the central depression area, southern qijia-gulong depression, the east of daqing changyuan putaohua structure, and its west to cologne syncline [5].

Ancient buried depth of about 1500-1800 meters, lithology is grey, sage green mudstone and grey silty mudstone, argillaceous siltstone, siltstone and brown grey staining argillaceous siltstone, siltstone and brown in oil, oil powder sandstone interbed in different thickness. It belongs to delta front deposition and contacts with the next layer in the false integration and huge thick mudstone reservoir up and down. Due to the far distance to northern source, sedimentary sand body is not stable, inside the reservoir sand mud mixed, sandstone and mudstone in many inclusions accumulated sandstone thickness generally in 5 ~ 30 m, single sand layer thickness in 1 ~ 6 m.

Principle of ray tracing method

Wave equation method is one of the forward modeling mathematical simulation method. On the basis of physical seismology wave equation, there are mainly G west hoff of self-excited since records simulation and finite difference of 2 d elastic wave equation simulation.

Two dimension and hoff self-excited since receiving record forward modeling formula:

$$u(t,G)=\sum_{\Delta l}\frac{\Delta l(\cos\theta_1+\cos\theta_2)}{(r_1r_2)^{1/2}(r_1+r_2)^{1/2}}\cos\gamma g(t-\frac{r_1+r_2}{\upsilon}) \qquad (1)$$

Finite difference elastic wave two-dimensional simulation equation:

$$\rho\frac{\partial^2 u}{\partial t^2}=(\lambda+2\mu)(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 w}{\partial x\partial z})+\mu(\frac{\partial^2 u}{\partial z^2}-\frac{\partial^2 w}{\partial x\partial z})$$
$$\rho\frac{\partial^2 w}{\partial t^2}=(\lambda+2\mu)(\frac{\partial^2 u}{\partial x\partial z}+\frac{\partial^2 w}{\partial z^2})+\mu(\frac{\partial^2 w}{\partial x^2}-\frac{\partial^2 u}{\partial x\partial z}) \qquad (2)$$

At the same time can make use of the actual speed, density parameters of underground geological structure to obtain information, all kinds of geological model is established, through convolution processing simulate the corresponding seismic section. S(t)=R(t)*b(t), S(t): seismic trace, R(t): reflection coefficient, b(t): seismic wavelet.

CHOOSING MODEL PARAMETERS

The forward model parameters including the speed of formation, formation density, thickness of strata, the seismic wavelet type, seismic wavelet dominant frequency. Spectrum analysis of seismic data in the study area, which indicates that the main frequency of seismic data of 44hz-48hz (figure 1), so the selection of 46 hz ricker wavelet as the seismic wavelet. Statistics of all Wells in the study area stratum thickness, it is concluded that the upper thickness of 20 m, reservoir thickness is 55 m, lower thickness of 25 m.

The density and velocity data of the actual formation in the study area are analyzed in this paper and then the corresponding parameters are given [6].

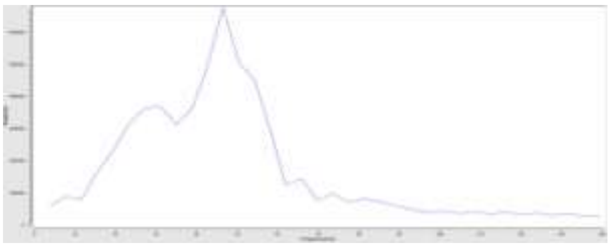


Fig. 1: The frequency and amplitude of the seismic data

The part of factors influencing the seismic reflection characteristics

1. The influence of reservoir thickness on seismic reflection characteristics

Reservoir thickness on the space is not uniform, usually in order to study the effect of reservoir thickness changes of seismic reflection, respectively designed 40 m, 55 m and 60 m thickness of three kinds of forward model (figure 2). Analysis can be concluded that different strata thickness of seismic waveform (energy, amplitude, phase) impact is not big, just in the thin reservoir thickness of local seismic wave development position relative to depend on.

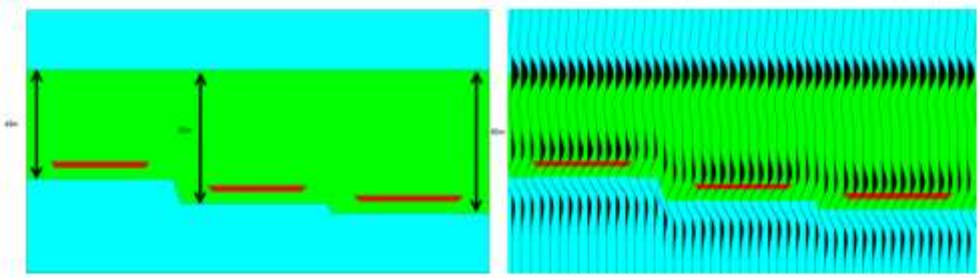
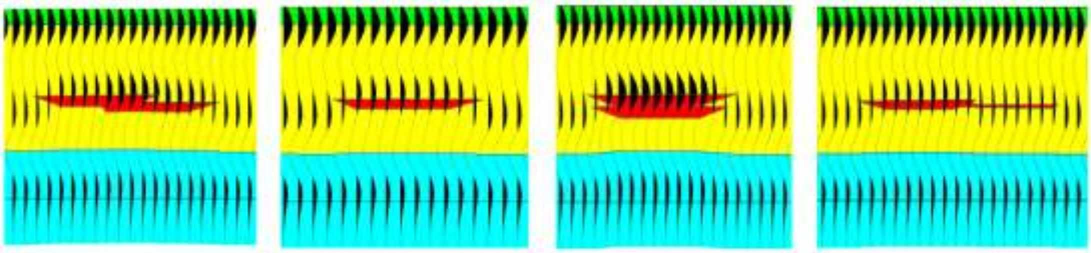


Fig. 2: Different thickness of strata and forward forward modeling section

2. The relationship of sand bodies superimposed influences on the seismic reflection characteristics

Divided into wash cutting type superimposed sand bodies, isolated sand body, the scour contact type superimposed sand bodies in space. According to the west to puxi oil field putaohua reservoir of river channel sandstone thickness analysis, a single channel sandstone thickness for 5m in model. Figure 3a to flush cutting type superimposed sand bodies of the simulation results; the figure 3b to the simulation results of isolated sand body, figure 3c to scour contact type superimposed sand bodies of the simulation results. Contraposed to different sand body, will find that the contribution rate of sandstone of waveform are mainly concentrated in the overlying strata, which will make sandstone in seismic wave move up, move up and sandstone thickness are positively correlated. The sandstone superimposed at the ridge of superposed energy more energy than the thickness of the sandstone; the seismic wave energy is strong.



a. Wash cutting type superimposed sand bodies

b. Isolated sand body

c. The scour contact type superimposed sand bodies

d. Lateral pinch out sand body

Fig. 3: Sand distribution pattern and forward modeling results

3. The influence of the sandstone thickness on seismic reflection characteristics

The area of delta front underwater sedimentary environment, Sedimentary facies consists of underwater distributary channel, sand sheet, sheet sand, argillaceous siltstone evolution process， sandstone content is lower. Through the analysis of puxi oil field putaohua reservoir channel sand and sheet sand combination mode, it is concluded that in the model, a single channel sandstone thickness from 5 m, the outside of the river sand sheet sandstone thickness of 1.2 m.

Figure 3d simulation of river to right in turn into sand sheet, seismic reflection characteristics of argillaceous siltstone, transition to the river sedimentary sand sheet, sandstone sedimentary thickness thinning, sandstone to lower the influence degree of the waveform. Characterized by thick sand place strong seismic wave energy, and thick sand wave up degree is more obvious, the thin sand seismic wave energy is weak.

4. The influence of interlayer on the seismic reflection characteristics

Interlayer is the impermeable rock formations which between two adjacent reservoirs for blocking the complicity. In order to study the influence of different interlayer thickness of seismic waveform. Design is as follows, forward modeling in the same vertical development two 5m single sand body, the model design of insulation layer thickness for the interval of 2m, widening (figure 4). Extraction RMS properties from medium yellow at the figure, Analysis along with the increase of thickness of insulation layer of the seismic reflection characteristics of the yellow line in effect.

In number as the abscissa, rms properties as the ordinate of data points in the line chart, can see every layer thickness is small, the root-mean-square amplitude attribute changes greatly, along with the increase of thickness of insulation layer, the lower level of this influence, when the insulation layer thickness of more than 30 meters (number is 126, has been marked on abscissa) will no longer have an impact.

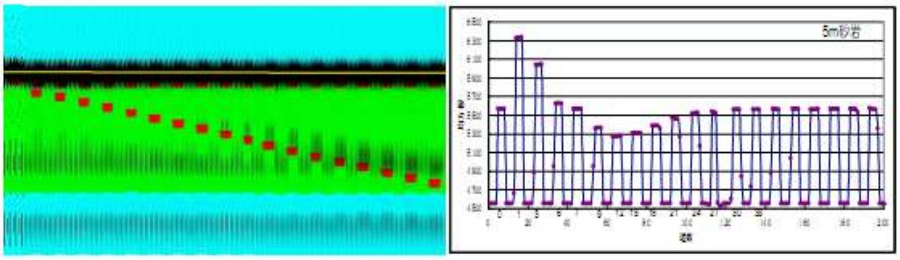


Fig. 4: Insulation layer thickness of 5 m sandstone seismic reflection effect

CONCLUSION

①Different reservoir thickness has little influence on the seismic reflection characteristics, when thin sandstone thickness on seismic reflection effect is low

②Thick sandstone in seismic wave energy is strong, and thick sand wave up degree is more obvious, so the sandstone thickness is one of the important factors affecting seismic reflection.

③Interlayer thickness has certain influence on the seismic reflection, the greater the isolation layer thickness the effect degree is lower, when the insulation layer thickness more than 30 meters, no longer has an impact.

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