Study On Prediction Technology Of Residual Oil In Prestack Seismic Inversion

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Abstract. The development adjustment of oil field, has entered a stage of determining drilling, and reservoir research focuses on the border of interwell narrow channel sand body position and the connecting relation between sand body. Based pre-stack inversion technique research, based on the seismic and geological results, combining with the construction, prestack inversion results, on the rock physical model test and choose suitable for the interpretation of the cutoff value of parameters, fine distribution of favorable reservoir characterization, analysis of oil gas reservoir, and then, the distribution of remaining oil prediction results, for the deployment of subsequent development Suggestions.

1. Introduction
Seismic inversion is an important method for reservoir prediction using earthquake. Seismic inversion is the use of surface seismic data with known geological regularity and drilling and logging data as constraints, the spatial structure and physical properties of underground rock stratum imaging (solving), the process of seismic inversion points and post-stack inversion and prestack inversion. Seismic transverse wave information is retained by pre-stack inversion, so many kinds of elastic parameters can be obtained by the inversion. The transverse wave has the characteristics that cannot be transmitted in the fluid and can predict the reservoir and fluid. This article is based on prestack CRP gathers the prestack AVO/AVA inversion study, improve the reservoir prediction and reservoir recognition accuracy, and improve the accuracy of remaining oil prediction, optimization in the design of large displacement directional well and old measures.

2. Seismic data volume processing
2.1 Pre-stack CRP channel set optimization
CRP gathers in the study area there are three main problems: the problems existing in the signal-to-noise ratio, the residual dynamic school and energy compensation, to solve these problems not meet the requirements of the prestack inversion set to optimize the processing, the main processing include: to suppress noise, improve the resolution, to deal with the multiple wave, etc, for prestack inversion Angle gathers provides a data basis, so as to meet the needs of prestack inversion. There are the following characteristics: the channel set treated byrna-3d is more effective than the original channel set, the signal-to-noise ratio of the channel concentration is significantly increased, and the effective frequency of the target layer is increased by about 5Hz. By means of radon transform, the multiple waves in CRP channel are suppressed effectively. Through the CRP channel set before and
after offset energy compensation, the near-offset amplitude of the same phase axis with a zero offset distance of 0.98 seconds is effectively compensated.

The quality of synthetic seismic records has been greatly improved after optimization of channel set. The synthetic seismic records before the optimization of the channel set are generally of low correlation, and the correlation coefficient is lower than 75% or so. The correlation of synthetic seismic records after optimized treatment of channel sets is enhanced, which is more consistent with the reflection law of underground media. The correlation coefficient of synthetic seismic records is generally over 85%.

2.2 Through the analysis of the incident Angle of the channel set, the partial superposition scheme of the CRP channel set was formulated

![Fig.1. division offset superposition scheme](image1)

![Fig.2. formwork of rock physical](image2)

On the basis of the optimal set processing, according to the buried depth characteristics of objective layer sarthou, putaohua and high platform, estimates the incident Angle of seismic ray for 35 °, completed five parts to offset the superposition, and on the basis of ray theory, estimates the incident Angle of the superposition of different body, for prestack inversion of seismic data volume(figure 1).

3. Pre-stack inversion rock physical template construction

Well logging, seismic and geophysical prospecting of quantities and the corresponding relation of reservoir parameter are often very complex, the determination of the relationship between the degree of influence of geophysical detection results of reservoir interpretation ability and effect. For logging of physical quantities, tend to be direct, visual, and can with reservoir lithology, physical property, oil content, such as direct explanation of relationship, and for seismic exploration, determine the characteristics of seismic wave factors in addition to the excitation, accept, underground rock elastic modulus, density and attenuation reflects the rock composition, physical properties, buried depth, pore, stress, fluid properties and its content in geological features, such as heterogeneity. Studying the relationship between geophysical characteristics of rocks and seismic parameters can help us to better understand the properties of reservoirs (lithology, physical properties, gas content, etc.).

3.1 Well curve data processing and correction

Because geophysical well logging and seismic reservoir prediction differ in terms of objects of interest, processing methods, data requirements, geological targets and so on, the work done is also different. Such as hole collapse, mud invasion, different s/measuring instrument and so on the various factors affect the quality of well logging, before using these data, we must carry out a variety of processing and correcting, made synthetic records processed well, guarantee the quality of synthetic seismogram. The missing shear wave curve in the study area was studied. The Greenberg-Castagna mathematical model was used to predict the shear wave, which was compared with the existing shear wave curve. After careful parameter adjustment, the prediction accuracy of shear wave was ensured to reach more than 95%. In view of the study area, shale content, porosity, saturation curve only explains the objective interval, is not the problem of continuous curve data, the lack of shale content with gamma curve fitting curve, the water saturation curve by archie formula fitting, porosity density curve is
adopted to improve the fitting, from the point of the effect of fitting accuracy is higher, can meet the needs of the late inversion.

3.2 Rock physical template construction
Given the post-stack inversion of p-wave impedance parameters, can't distinguish good reservoir and the reservoir characteristics, so the prestack inversion, by getting more elastic parameters to divide the reservoir and the reservoir. By analyzing the elastic parameters of intersection, think that the intersection of vertical and horizontal wave velocity ratio of p-wave impedance and can be divided into the vast majority of reservoir characteristics, according to the geological characteristics of the work area and sandstone and mudstone, the elastic parameters and log curve data, the establishment of a longitudinal wave impedance and wave velocity ratio rock physics quantitative interpretation template, provides the technical support for subsequent prestack inversion analysis (figure 2).

4. Prestack inversion

4.1 AVO simultaneous inversion before stack
AVO pre-stack inversion at the same time is more reasonable to extract the hidden lithological parameters of the seismic information of a kind of important way, the expression of approximate Zoeppritze equation, according to the relationship between amplitude changes with incident Angle, using a set of AWA seismic data, AWA wavelet, AWA elastic impedance data of Wells in the horizon, the well data and geological data model constraints, by the real seismic trace set records estimate the shear wave and density, longitudinal wave speed of rock, And then according to the longitudinal and transverse wave velocity and density (Den) and rock poisson's ratio of the theoretical relation between elastic parameters (sigma), shear modulus (mu), lame constant (lambda) and so on the many kinds of elastic parameter data. Basic process is as follows: first, to automatically generate a geological model, then USES the specific algorithm to generate synthetic records, and the synthetic records by iteration, so within a certain range of error fitting with real seismic record.

Because of prestack inversion attribute deterministic inversion method is still at the same time, based on the method of elastic parameters, the longitudinal resolution seismic longitudinal resolution and its hard to depict the thin reservoir fluid. Based on prestack inversion at the same time, in ensuring that the elastic parameters and on the space distribution of the consistency of the premise, to carry out the well point in prestack geostatistical inversion at the same time, in order to achieve fine characterization of thin reservoir fluid.

4.2 Geostatistical inversion
The purpose of this pre-stack simultaneous geostatistical inversion is to obtain the density elastic parameters that are sensitive to the reservoir. In the algorithm, the large incident Angle of seismic data is taken into account, so knott-zoppritz algorithm is adopted. Finally, longitudinal impedance, transverse impedance and density are obtained. Is a blend of prior geological information of prestack inversion and prestack joint inversion of geostatistics in transverse trend has a good consistency, the inversion results conform to the sedimentary rules on macro, well point respect the actual drilling data, the more objective real reflects the reservoir sedimentary characteristics.

![Fig.3. An analysis of water saturation and density](image3)
![Fig.4. oil saturation prediction profile](image4)
Through statistical analysis of density and water saturation intersection and correlation analysis, the correlation was determined as 76% in FIG. 7. Using water saturation as the first variable and density data volume as the second variable, the configuration co-simulation of water saturation was carried out. Well used in the data are from 2005 to 2012, in order to (2008) and seismic data is relatively effective matching, it also can reduce the inversion and subsequent effective reservoir prediction error, followed by well test data is also at the same time interval, which is 2005-2012. The water saturation profile of the well is shown in figure 4. The curve is deep laterally, and the right side of the curve is high value. The average oil saturation of each oil formation was extracted and used as a quantitative basis for predicting the distribution of effective sandstone and residual oil.

5. Verification and application of inversion results
In order to verify the inversion effect, selecting two does not attend the inversion of the Wells for inversion effect validation, two Wells in the main purpose of group drilling in high oil saturation sandstone, the oil saturation values were above 45%. The two Wells drilled in effective sandstone is 108.1 m and 56.5 m respectively, from 8 Wells in study area, 48 sample analysis, well point of each small layer remaining oil thickness error analysis and prediction of remaining oil thickness, average absolute error is less than 15%, the prediction precision is higher. It is further shown that the oil saturation data obtained by statistical inversion has high computational accuracy and can be effectively applied to the subsequent development scheme design.

The inversion results has been used in the design of new Wells and old Wells measures optimization, according to the result of prestack inversion of remaining oil research and provide 2 mouth deployment scheme of high Angle deviated holes, is expected to average single well early 54.4 t is induced on daily fluid production output, daily oil production of 8.9 t, composite water cut 83.7%. The density inversion profile position of a well is given by using the inversion results to guide the hole filling. Fill hole well layer for the purpose of S2 - S3 segment, the shaft in the S2 - S3 section of oil saturation is more than 50%, the thickness of 28.9 m, according to the production data analysis, the well's oil production increased from the original 0.8 t to 4.1 t, 3.3 t to increase production. The method of pre-stack inversion prediction of residual oil can be applied to other blocks, which provides a more reliable geological basis for residual oil exploration.

6. Conclusions
(1) The optimization processing of seismic data is divided into five parts stacked data volume, not only ensure the stability of the inversion solution, and can make each partial stack body has certain resolution, can provide the data for study just prestack inversion calculation basis.

(2) Through the study of the elastic and physical parameters of intersection analysis, determine the vertical and horizontal wave velocity ratio of p-wave impedance and intersection analysis can effectively predict the reservoir, to establish the vertical and horizontal wave velocity ratio of p-wave impedance and two parameters of rock physics templates, for subsequent reservoir and remaining oil analysis provides a standard.

(3) Through the pre-stack inversion and prestack geostatistical inversion at the same time, the longitudinal wave impedance, the density of shear wave impedance, and vertical and horizontal wave velocity ratio and the parameters such as the inversion data volume, guide the reservoir prediction and the analysis of residual oil.

(4) Based on the inversion results and the rock physical template, the oil saturation distribution prediction of 7 oil formations in the study area was completed. The mean absolute error is less than 15% and the prediction precision is high.

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